Mr. Michael Squire
Project Manager
New York State Department of Environmental Conservation
Division of Environmental Remediation, Remedial Bureau C
625 Broadway, 12th Floor
Albany, New York 12233

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Date: January 23, 2025
Our Ref: 30251446
Subject: **Monitoring Well Installation Work Plan**
Clyde Former Manufactured Gas Plant Site
16 Sodus Street, Clyde, New York

Dear Mr. Squire,

On behalf of New York State Electric & Gas Company (NYSEG), Arcadis of New York, Inc. (Arcadis) has prepared this Well Installation Work Plan (work plan) for the Clyde Former Manufactured Gas Plant (MGP) site (site) (New York State Department of Environmental Conservation [NYSDEC] Site Number 859019) located at 16 Sodus Street in Clyde, New York (Figure 1). Monitoring well installation activities will be conducted in accordance with the draft Site Management Plan (SMP)[1] prepared by GEI Consultants, Inc. and submitted to the NYSDEC in October 2022. This work plan summarizes proposed well installation field activities to install two monitoring wells as proposed in the draft SMP[1].

Site Description

The site is located in the village of Clyde, Wayne County, New York. The approximately 1.12-acre site is bounded by a Veterans of Foreign Wars building and a vacant lumberyard to the north, a CSX railroad corridor to the south, adjacent commercial properties (including the Village of Clyde Museum and a former bottle and can redemption center) and Sodus Street to the east, and a vacant parcel to the west (owned by the Village of Clyde) (Figure 1).

The site consists of two parcels of land (western and eastern) that are owned by NYSEG. The NYSEG Clyde Electrical Substation is located on the western parcel. Most MGP-related activity took place in and around the Electrical Substation in the western parcel. NYSEG purchased the mostly vacant eastern parcel in 2006. A former gas holder foundation was located on this parcel. A gravel access driveway to the substation passes through the northern portion of both parcels.

[1] GEI Consultants, Inc. 2022. *Draft Site Management Plan,* Clyde Former Manufactured Gas Plant Site, Wayne County, Village of Clyde, New York. October.

Geology

Site geology generally consists of shale bedrock overlain by alluvial deposits and unconsolidated fill[2]. A layer of fill containing anthropogenic materials was observed at most of the soil boring locations around the primary area of MGP activities. This layer is thickest in the vicinity of the gas holder foundation toward the southern boundary of the site. Underlying the fill is glaciofluvial alluvium, mostly comprised of silt, sand, and gravel, reworked by stream action following the last glacial period. No potential confining units have been observed. A thin, discontinuous layer of glacial till was observed beneath the alluvium at several boring locations. Shale bedrock was encountered beneath the alluvium/till, at depths ranging from 12 to 25 feet below ground surface (bgs), across the investigation area.

Hydrogeology

Overburden groundwater and the bedrock piezometric surface both flow north to south across the site toward the adjacent railroad corridor. Depth to groundwater in overburden wells ranges from approximately 1 to 7 feet bgs across the site. A potential for vertical downward groundwater flow has been observed between the overburden and the bedrock units.

Proposed Field Activities

Two monitoring wells (MW14 and MW15) will be installed as shown on Figure 1. Field activities will be conducted in accordance with this work plan, the site-specific Health and Safety Plan (Attachment 1), the draft SMP[1], and Arcadis' Technical Guidance Information (TGI) documents for Soil Description (Attachment 2), Monitoring Well Installation (Attachment 3), and Monitoring Well Development (Attachment 4). Considering the limited subsurface disturbance posed by installing the monitoring wells, Arcadis proposes to conduct community air monitoring, in compliance with the draft SMP[1], by using one upwind and one downwind station.

Utility Survey

A subsurface utility survey will be conducted prior to the start of any intrusive field work. The drilling contractor will submit a dig ticket to UDig NY at least 5 full working days, and not more than 10 days, prior to the start of ground intrusive activities. UDig NY will arrange for locating and marking underground utilities entering the site from the public right-of-way. Arcadis will subcontract and oversee a private utility location survey for subsurface utilities at the proposed monitoring well installation locations. If necessary, the monitoring well locations will be modified based on the results of the UDig NY markout and the private utility location survey. Any modifications to sample locations identified in this work plan greater than 5 feet from the proposed location will be approved by the NYSDEC. Soil boring locations will be cleared by hand or vacuum truck down to a depth of 5 feet bgs to avoid potential damage to utilities during intrusive activities.

[2] GEI Consultants, Inc. 2012. *Remedial Investigation Report,* Clyde Former Manufactured Gas Plant Site, Wayne County, Village of Clyde, New York. October.

Monitoring Well Installation and Development

Arcadis will subcontract and oversee a New York State-licensed driller install monitoring wells MW14 and MW15, proposed in the draft SMP[1], at the locations shown on Figure 1. Please note that the proposed location for MW14, shown on Figure 6 of the draft SMP[1], was moved approximately 40 feet north to avoid the gravity wall that remains in place at the site following the completed site remedy. This revised proposed location for MW14 is centrally located in the remediated area between the former MGP structure areas (Gas Holder, Shed, and Purifiers) and will be used to monitor post-remediation groundwater conditions in the former source area. MW15 will be installed hydraulicly downgradient of the site and will be used to monitor offsite migration of potentially impacted groundwater.

Soil will be continuously recovered from each location using Macro-Core® samplers, from ground surface to refusal, the upper 5 feet bgs during utility clearance activities, and the remainder of the location. Recovered soil will be screened with a photoionization detector and characterized using the Unified Soil Classification System for soil type, texture, moisture content, density, plasticity, and the presence/absence of observable potential MGP-related impacts. Boring refusal depth will be assumed to represent the top of weathered bedrock, which will be verified during soil sample characterization. Locations will be drilled to the depth of Macro-Core® refusal using 4.25-inch inside diameter hollow stem augers. Soil description procedures and a boring log template are provided in Arcadis' TGI for Soil Description (Attachment 2).

The monitoring wells will be constructed with an approximate 10-foot-long by 2-inch diameter, 0.010-inch slotted, Schedule 40, polyvinyl chloride well screen. The bottom of the screen will be set at the presumed top of the weathered bedrock, and a 2-inch-diameter, Schedule 40, polyvinyl chloride riser will be installed to just below ground surface. An appropriately sized sand filter pack will be installed 1 to 2 feet above the well screen, a 1- to 3-foot-thick hydrated bentonite seal will be placed above the sand pack, and a cement grout will be placed above the bentonite seal to the surface. Actual well construction details will be determined in the field based on observed stratigraphy. Monitoring wells will be completed at the surface with a flush-mounted curb box set in a concrete apron. Monitoring well installation will be completed in accordance with Arcadis' TGI for Monitoring Well Installation (Attachment 3).

Monitoring wells MW14 and MW15 will be developed no sooner than 24 hours after installation. Well development will be performed to evacuate the accumulated fine-grained sediments from the filter pack and ensure that formation water is present in the screened interval. Monitoring well development will be performed in accordance with Arcadis' TGI for Monitoring Well Development (Attachment 4).

Decontamination

Drilling and hand-clearing equipment, including rods, bits, hand augers, shovels, etc., will be decontaminated between monitoring well locations. A temporary decontamination pad, lined with polyethylene sheeting, will be constructed onsite by the drilling subcontractor. Equipment will be pressure-washed within the decontamination pad, and decontamination water will be pumped from the pad into 55-gallon, Department of Transportation-approved drums. The driller will decontaminate all equipment, tools, and the drill rig at the completion of work each day and prior to leaving the site.

Waste Management

All drill soil cuttings and well development/decontamination water will be contained in 55-gallon, Department of Transportation-approved drums. Drums will be staged onsite in an area designated by NYSEG and subsequently transported offsite for disposal by NYSEG's waste disposal vendor. General refuse (material that has not contacted MGP residuals or other potentially regulated substances) will be bagged and managed as a non-hazardous waste.

Reporting

A summary of the well installation field activities, including well construction logs, will be provided in the subsequent Quarterly Groundwater Sampling Report.

Please contact John Ruspantini (NYSEG) at 607.725.3801 / jjruspantini@nyseg.com or me with any questions or comments.

Sincerely,
Arcadis of New York, Inc.

Nicholas Beyrle
Principal Geologist

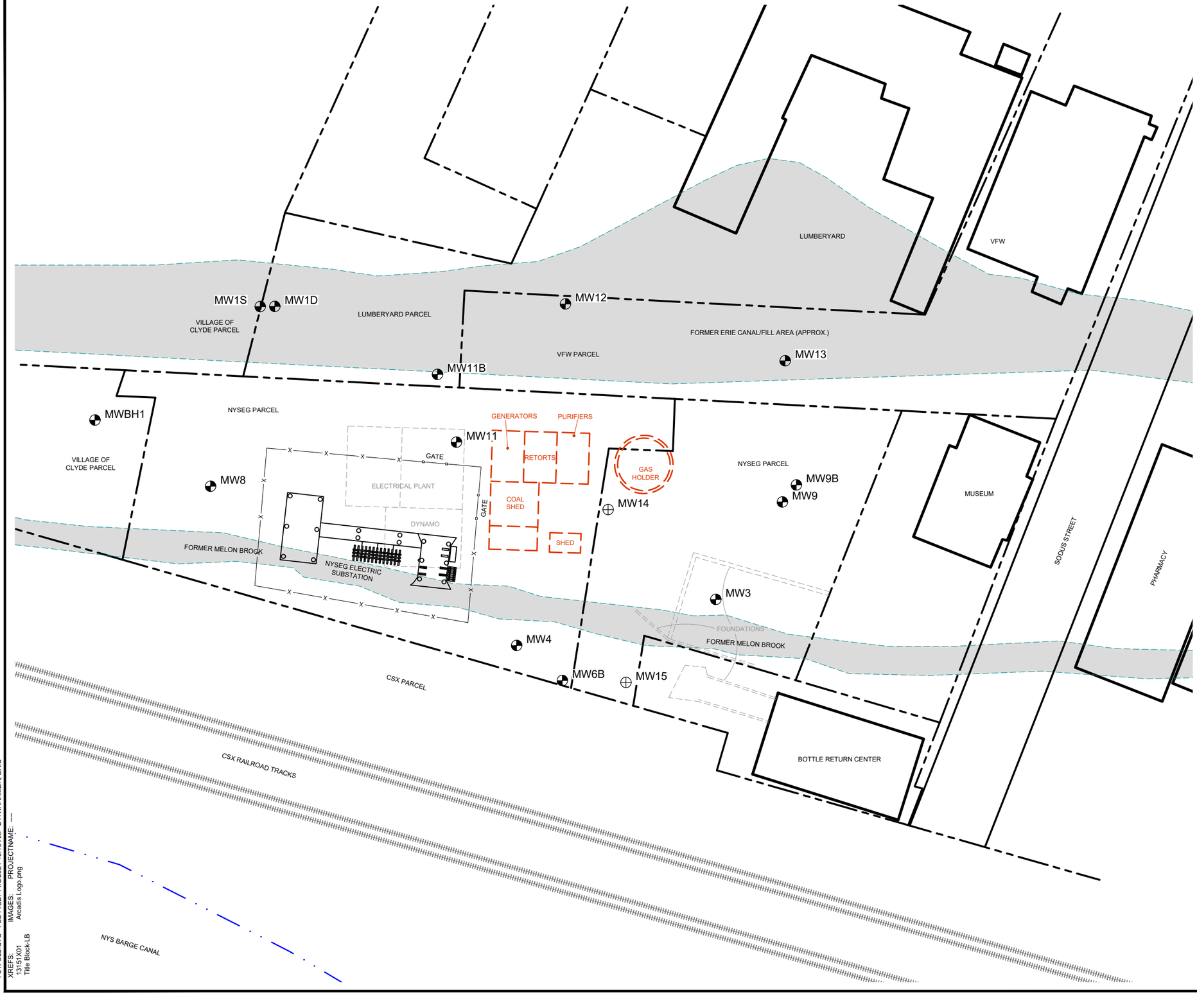
Email: nicholas.beyrle@arcadis.com
Direct Line: 585.662.4044

CC. John Ruspantini, CHMM, NYSEG

Enclosures:

- Figure 1 – Proposed Monitoring Well Locations
- Attachment 1 – Health and Safety Plan
- Attachment 2 – TGI for Soil Description
- Attachment 3 – TGI for Monitoring Well Installation
- Attachment 4 – TGI for Monitoring Well Development

Figure



LEGEND:

- PROPOSED MONITORING WELL
- MONITORING WELL
- PROPERTY LINE
- FORMER MGP STRUCTURES
- APPROXIMATE LOCATION OF FORMER BROOK/CANAL
- FENCE LINE

NOTES:

1. ALL LOCATIONS ARE APPROXIMATE.
2. BASE MAP REFERENCES: MAP SHOWING EXISTING CONDITIONS AT THE NYSEG CLYDE FORMER MANUFACTURED GAS PLANT - DRAWN BY THEW ASSOCIATES LAND SURVEYORS AND DATED SEPTEMBER 7, 2011, REVISED ON APRIL 23, 2012. HORIZONTAL DATUM: NEW YORK STATE PLANE COORDINATE SYSTEM (EAST ZONE, NORTH AMERICAN DATUM (NAD83). VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM (NAVD 88).
3. MONITORING WELLS MW5, MW6, MWBH6, MW7, MW10 AND MW10B HAVE BEEN DECOMMISSIONED AND ARE NOT SHOWN ON THIS FIGURE.

0 50' 100'

GRAPHIC SCALE

NYSEG
CLYDE FORMER MANUFACTURED GAS PLANT SITE
SITE NO. 8-59-019

MONITORING WELL INSTALLATION WORK PLAN

PROPOSED MONITORING WELL LOCATIONS

ARCADIS

FIGURE 1

Attachment 1

Health and Safety Plan

Site Specific Health and Safety Plan

Template Revision: 21 d

Project Name:	Clyde Former MGP Site 16 Sodus Street Clyde, New York 14433
Project Number:	30251446
Client Name:	NYSEG
Date:	1/22/2025
HASP Expires	1/22/2026
Revision:	

Approvals:

HASP Developer: Robbie Sullivan

Project Manager: Nicholas (Klaus) Beyrle

HASP Reviewer: Veronica Bean

HASP Reviewer Name Typed

HASP Reviewer Signature (handwritten or digital signature)

Emergency Information

Site Address: 16 Sodus Street,
Clyde, New York 14433

Emergency Phone Numbers:

Emergency (fire, police, ambulance)		911
Emergency (facility specific, if applicable):		
Clyde Police Department (non-emergency)		315-923-3121
Clyde Fire Deparment (non-emergency)		315-923-7667
Primary Client Contact:	John Ruspantini	607-762-8787
WorkCare (non-life-threatening injury/illness):		1-888-449-7787
Project H&S:	Ryan Clare	585-880-7747
Task Manager:	Ryan Clare	585-880-7747
Project Manager:	Nicholas (Klaus) Beyrle	585-752-8882
H&S Specialist:	Sheldon Neill	214-468-7611
Area H&S Director:	Aaron Svitana	925-360-2313

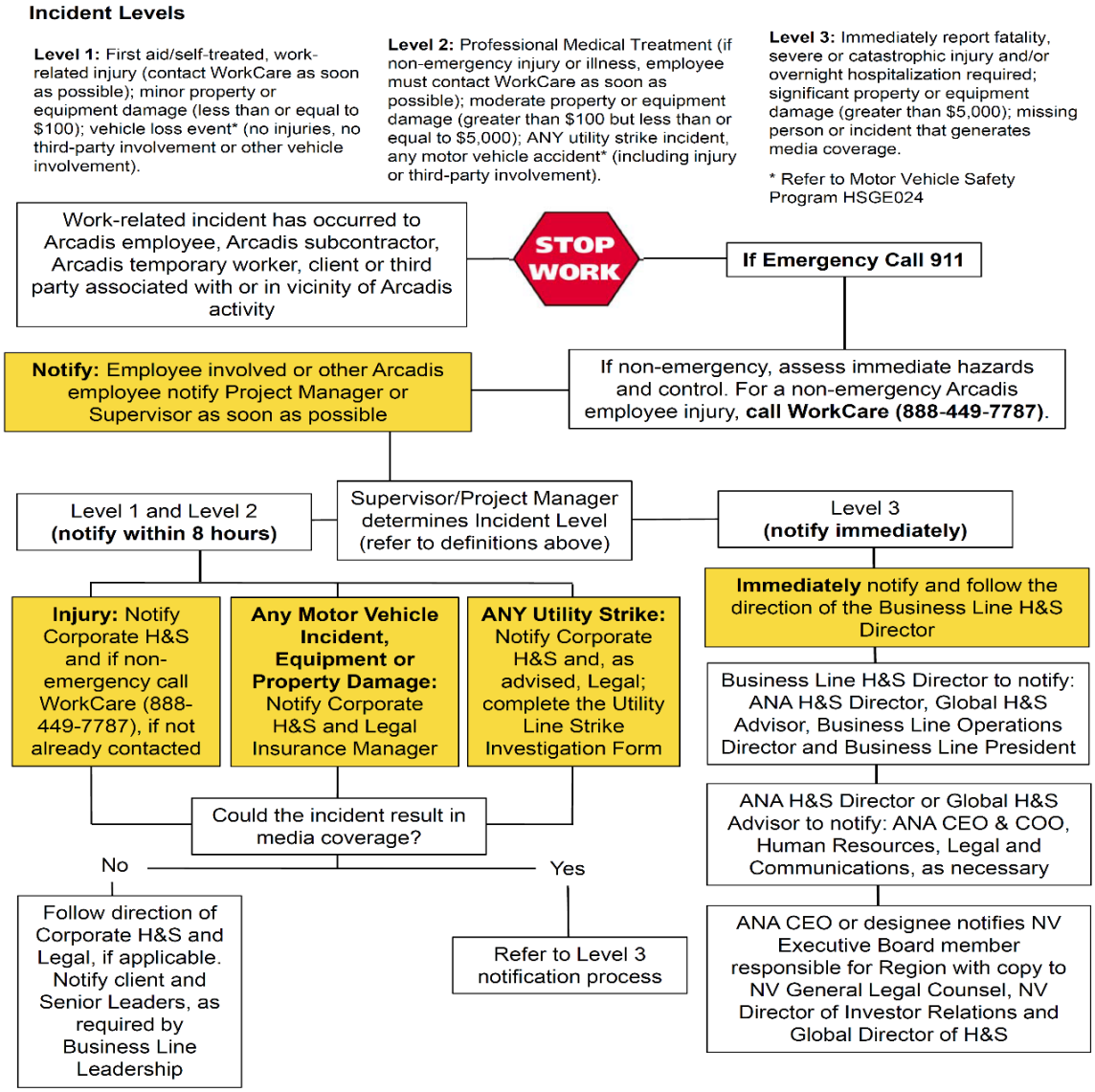
Hospital Name and Address: RRH Newark-Wayne Community Hospital
1200 Driving Park Ave
Newark, New York 14513

Hospital Phone Number: 315-332-2022

Other Important Phone Numbers:

Poison Control Center	1-800-222-1222
Nat. Response Ctr. (spills in reportable quantities)	1-800-424-8802
U.S. Coast Guard (spills to water)	1-800-424-8802

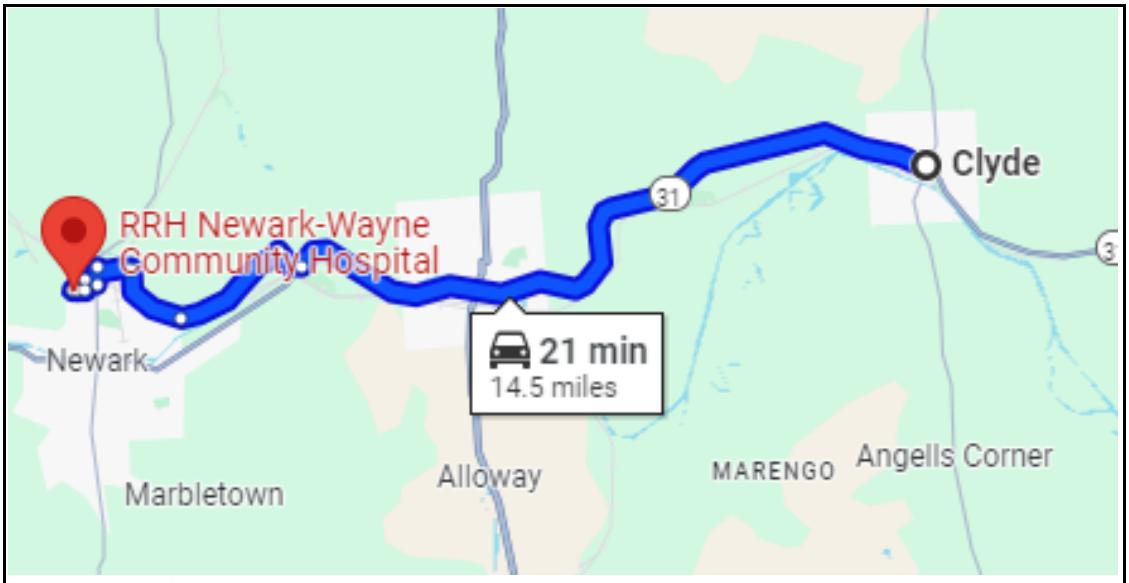
Incident Reporting Protocol Within Arcadis



Client Incident Reporting Protocol

Contact NYSEG environmental project manager John Ruspantini at 585-484-6787.

Route to the Hospital



from Clyde, New York 14433
to RRH Newark-Wayne Community Hospital, 1200...

21 min (14.5 miles)

via NY-31 W

Fastest route, the usual traffic

Clyde
New York 14433

- Head southwest on Glasgow St toward N Park St
  1 sec (23 ft)
- Follow NY-31 W to County House Rd in Arcadia
  14 min (10.1 mi)
- Continue on County House Rd to your destination in Newark
  8 min (4.4 mi)

RRH Newark-Wayne Community Hospital
1200 Driving Park Ave, Newark, NY 14513

Site Type

The project site is an active facility with the following attributes:

Commercial	Active
Utility	

Surrounding Land Use and Topography

The site is bounded by a Veterans of Foreign Wars building and a vacant lumberyard to the north, a CSX railroad corridor to the south, adjacent commercial properties, Sodus Street to the east, and a vacant parcel to the west (owned by the Village of Clyde). A NYSEG Clyde Electrical Substation (client owned) is located on the western and central portion of the site. A gravel access driveway to the substation passes through the northern portion of the site. The site and all adjacent parcels are zoned for Commercial Use (C1 Designation) by the Village of Clyde. The site is generally flat with a slight slope to the south heading toward the CSX Railroad owned property.

Simultaneous Operations (SimOps)

SimOps is expected or will be conducted in proximity to Arcadis work activities on the project site. SimOps creates unique hazards that could affect Arcadis employees and subcontractors and SimOps hazards identified on site will be addressed in the JSA or similar governing document (i.e. permit) for affected Arcadis work tasks. If the SimOps work activities create a high hazard to Arcadis staff or subcontractors, Arcadis will utilize stop work until the SimOps activity is complete or will coordinate work activities with SimOps workers and/or client to ensure SimOps work hazards are mitigated.

Site Background

The Clyde MGP was constructed in 1856 and began to supply gas to the Village of Clyde in 1860, when the connective gas distribution piping into the Village was installed. During most of this period, gas was manufactured using a coal gasification process by the Clyde Gas Light Company. Just before the plant was shut down it was retrofitted as a carbureted water gas plant. Between 1907 and 1916 most of the above-grade MGP structures were removed. MGP structure removal was completed by 1918. Construction of the NYS Barge Canal began, and the old Erie Canal north of the site was abandoned in 1918. Melon Brook to the south of the MGP process area appears to have also been filled-in around this time. The old Erie Canal was filled-in with construction debris during the late 1930's by the Village of Clyde. NYSEG acquired the MGP parcel in 1936. An electric company building at the site was used as a transformer house until the late 1950's and early 1960's; it was demolished in the late 1960's. The current electrical substation was built in the early 1970's.

There were four structures present during the time of gas production. A gas production building was constructed and was utilized as a gas purifying area, a compressor and generator room, and a coal storage area. A gas holder with a below-grade foundation was constructed at a location adjacent to, and to the east of the gas production building. The surface water features adjacent to the site were modified following closure of the MGP. The COCs in soil and groundwater include BTEX, PAHs, and cyanide based on previous site investigations.

Project Tasks

The following tasks are identified for this project:

1	Drilling - Contractor oversight
2	Monitor well - Well sounding, water level or product measurements using probes, tapes or downhole water parameter measurements
3	Sampling - Well sampling using peristaltic pumps
4	Sampling - Soil sampling using split spoons or continuous sampling tool
5	Waste - Containment of IDW in small containment devices greater than 10 gallons but less than or equal to 119 gallons capacity

The following documents/plans/support associated with the above task(s) are attached or to be provided:
- The Arcadis Utilities and Structures Checklist must be used for utility clearance activities.

[X] Required Checklists/Work Forms

- *Tailgate Safety Briefing Form*
- *Vehicle Inspection Checklist*
- *Utility and Structures Checklist*

[ ] Required Permits

- *Not Applicable*

[X] Required H&S Standards

- *Motor Vehicle Safety Program_ARC HSGE024*
- *Stop Work Authority_ARC HSGE009*
- *Utility Location Procedures_ARC HSFS019*
- *Respirable Crystalline Silica_ARC HSIH012*
- *Short Service Employee_ARC HSGE019*

Short Service Employees (SSEs), Part Time As Needed Employees (PTANs) and Temporary Agency Employees

SSEs (employees who are employed with Arcadis for less than 1 year or are Inexperienced Workers) have the potential to work on this project. If SSEs are utilized, the project team working in conjunction with the SSE's administrative supervisor will ensure requirements of ARC HSGE019 "Short Service Employees" are completed. SSE's will be identified on the project Tailgate Safety Meeting Form.

Roles and Responsibilities

	Name	Role	Short Service Employee
1	Nicholas (Klaus) Beyrle	Project Manager (PM)	No
2	Ryan Clare	Associate Project Manager (APM)	No
3	Ryan Clare	Task Manager	No
4	Kaitlyn Fleming	Field Technical Lead	No
5	Kaitlyn Fleming	Site Safety Officer (SSO) (HAZWOPER)	No
6	Robbie Sullivan	Field Staff	Yes
7	Bailey Kudla-Williams	Field Staff	No
8	Adam Svensson	Field Staff	No

☐ The staff listed above are the initial participants on this project phase of work. This phase of work will have rotating staff on a a daily or weekly basis. See Project scheduling tool or equivalent tool for current staff roles and responsiblities.

Training

All Arcadis employees are required to have the following training to be on site:

Arcadis Basic H&S Training Suite(1)
Hazwoper 40-Hour
Hazwoper 8-Hour Annual Refresher
None
Client specific/Other:

Selected Arcadis employees are required to have the following additional training:

	Names or Numbers from above
Hazwoper 8-Hour Supervisor	4
DOT HazMat #1	4,6,7,8
First Aid/CPR	4
BBP (Bloodborne Pathogens)	4
Silica General Awareness	4,6,7,8
None	

(1) The Arcadis Basic H&S Training Suite includes the following non-certificate trainings: H&S Orientation, Hazard Communication (HAZCOM/GHS), Emergency Action Planning (EAP), Personal Protective Equipment, and Hearing Conservation. The Suite also includes the following certificate issued training: Smith System Forward/Backing Training.

Protecting Our People: Our Health, Safety and Wellbeing Principles

As a people first business, our mission is to improve quality of life by promoting that our employees, clients, and wider society are kept both physically and psychologically healthy and safe, through our shared commitment to Health, Safety and Wellbeing, as a core Arcadis value. This reflects our key priority of "Protecting our People" by mitigating risk and preventing harm in everything we do.

Protecting Our People ensures the safeguarding of Arcadians from physical and psychological harm. Through robust health, safety, security, and wellbeing approaches, we identify, control, and manage risks, prevent harm, and create a secure environment where Arcadians can thrive. Protecting Our People ensures the health, safety, security, wellbeing, and happiness of Arcadians whilst delivering sustainable outcomes for our customers.

To achieve our "Protecting Our People" values, Arcadis relies on our Health, Safety and Wellbeing Principles:

TRACK is a basic risk analysis and assessment tool which helps us to: 1) Identify, assess, and control hazards; and 2) maintain safe work behaviors and practices.

Apply TRACK every day when planning tasks and before starting any task and use TRACK again when conditions change

Every employee at Arcadis is empowered and expected to stop what they are doing if they feel that something could happen or if they simply are not sure if it is safe to move forward.

It is your responsibility to stop your own work, the work of other Arcadis staff, or work under Arcadis control, if you believe it to be unsafe.

Be accountable for keeping yourself and others around you safe by acting immediately to prevent harm. If you see something unsafe (or not right), say something!

Undertake Health and Safety Planning.

Prepare and maintain a Health and Safety Plan for all work activities outside of an office environment.

Report all incidents, significant near misses, and unsafe acts and conditions immediately so that they can be investigated, corrected to prevent recurrence, and the lessons learned shared.

Wellbeing is a fundamental element of our health, safety and wellbeing priority, to protect our People by eliminating risk and preventing harm in everything we do.

Harnessing the potential of Arcadians through comprehensive training,, empowering them with invaluable knowledge and transforming experiences, ensuring a workforce ready to champion protection, minimize risk, and safeguard all from harm.

This is the "face" of Health, Safety and Wellbeing and we are all stewards, from the Chief Executive Officer to the newest employee, We must purposely think about how our actions or inaction regarding health and safety impact on others.

General Task Hazard Assessment and Risk Control (HARC)

General:	Site-Wide

The 12 hazard category HARC ratings are not available in this General THA. The mitigated and unmitigated ratings for the hazards presented are based on the Risk Assessment Matrix below. Modify hazards and ratings as necessary to meet project needs.

Risk Assessment Matrix		Likelihood Ratings			
Consequences Ratings		A	B	C	D
People	Property	0 Almost Impossible	1 Possible but Unlikely	2 Likely to Happen	3 Almost Certain to Happen
1-Slight or No Health Effect	Slight or No Damage	0-Low	1-Low	2-Low	3-Low
2-Minor Health Effect	Minor Damage	0-Low	2-Low	4-Medium	6-Medium
3-Major Health Effect	Local Damage	0-Low	3-Low	6-Medium	9-High
4-Fatalities	Major Damage	0-Low	4-Medium	8-High	12-High

Hazard

Driving - On road - Injury or vehicle damage from motor vehicle accident or incident

Suggested FHSHB Ref:	3.4	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	HIGH	Smith System (on line)
Mitigated Risk:	MEDIUM	JSAs
Comments:	Use Smith System "5-Keys" when driving. See Driving JSA for details.	

Hazard

Driving - Driver - Injury, death or property damage due to driver distraction, fatigue, etc.

Suggested FHSHB Ref:	3.4, 3.21	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	HIGH	Smith System (on line)
Mitigated Risk:	LOW	Driver awareness/use of stop work authority
Comments:	Use route planning. Keep eyes moving while driving. See Driving JSA.	

Hazard

Biological - skin/eye irritation or damage from poisonous plants

Suggested FHSHB Ref:	3.17.11	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	See HASP "Tick/Poisonous Plant Hazards" Section
Mitigated Risk:	LOW	Job Briefing/Site Awareness
Comments:	Use skin pre-treatment lotions when available.	

Hazard

Biological - bites or stings from exposure to insects or arachnids

Suggested FHSHB Ref:	3.17: 2,3,7,8,9,10	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	Job Briefing/Site Awareness
Comments:	Do body check daily. For ticks see also HASP Tick/Poisonous Plant section	

Hazard

Biological - cuts, scrapes, skin/eye puncture from exposure to physically damaging plants

Suggested FHSHB Ref:	3.17.11	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Job Briefing/Site Awareness
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Know how to identify poisonous plants. Maintain groundskeeping.	

General Task HARC (continued)

Hazard		
Environmental - Thermal stress - Injury or illness from heat or cold		
Suggested FHSHB Ref:	3.16	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Field H&S Handbook
Mitigated Risk:	LOW	JSAs
Comments:	Use job rotation or rest breaks. Stay hydrated and eat regularly.	
Hazard		
Environmental - Inclement weather -Injury or equipment damage from inclement weather		
Suggested FHSHB Ref:	3.12	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Weather Monitoring
Mitigated Risk:	LOW	Cont./Emerg. Planning
Comments:	Use 10/30 rule for lightning. See FHSHB section 3.12.2 for details.	
Hazard		
Motion - Musculoskeletal - Injury from lifting, twisting , stooping, or awkward body positions		
Suggested FHSHB Ref:	3.29.1	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Engineering Controls (specify in comments)
Mitigated Risk:	LOW	Admin. Controls (specify in comments)
Comments:	Use proper lifting techniques. See FHSHB/HASP Stretching Worksheet. Job rotation.	
Hazard		
Motion - Musculoskeletal - Injury from repeated work activity or body motion		
Suggested FHSHB Ref:	3.29.2	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Field H&S Handbook
Mitigated Risk:	LOW	Admin. Controls (specify in comments)
Comments:	Use job rotation or lifting aids. See FHSHB/HASP Stretching Worksheet.	
Hazard		
Gravity - Falls - Injury due to slips and trips		
Suggested FHSHB Ref:	3.26.4, 4.11	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Site Awareness
Mitigated Risk:	LOW	Housekeeping
Comments:	Use footwear appropriate for site conditions, plan routes and do not hurry while walking.	

Task Specific HARC

Task 1:	Drilling - Contractor oversight						
HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low):					FHSHB Ref:	4.5	
Biological*	L	Chemical	L	Driving*	-	Electrical	L
Environmental*	L	Gravity*	L	Mechanical	M	Motion*	L
Personal Safety	-	Pressure	L	Radiation	-	Sound	M

* *Hazard rating, if present, excludes General THA hazards in this category.*

Hazard #1

Sound - Noise - Injury or illness due to noise exposure

Suggested FHSHB Ref:	3.15	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	Field H&S Handbook
Comments:	Use hearing protection and maintain a safe distance from machinery.	

Hazard #2

Mechanical - Crushing - Injury by crushing body part in mechanical process

Suggested FHSHB Ref:	3.27.4	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Machine Guarding
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Contractor should test any E-Stop switches on equipment. Arcadis to maintain a safe distance from machinery while contractors are performing work.	

Hazard #3

Mechanical - Pinch point - Injury by pinching of body part in mechanical process

Suggested FHSHB Ref:	3.27.4	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Machine Guarding
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Contractor should wear gloves and tear-away safety vests. Arcadis to maintain a safe distance from machinery while contractors are performing work. Arcadis will perform oversight only. Review safety concerns with contractor during tailgate meeting.	

Task 2:	Monitor well - Well sounding, water level or product measurements using probes, tapes or downhole water parameter measurements						
HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low):					FHSHB Ref:	3.9	
Biological*	L	Chemical	M	Driving*	-	Electrical	-
Environmental*	M	Gravity*	L	Mechanical	-	Motion*	M
Personal Safety	-	Pressure	M	Radiation	-	Sound	L

Hazard #1

Chemical- liquids - injury or illness from skin absorption

Suggested FHSHB Ref:	3.9, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	JSAs
Comments:	Use proper PPE when working on a well (safety glasses, nitrile gloves, long sleeves).	

Hazard #2

Environmental - Sun or wind -Skin injury from sun or wind exposure

Suggested FHSHB Ref:	3.12	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	Field H&S Handbook
Comments:	Wear gear that covers exposed skin and use sunscreen as needed.	

Hazard #3

Pressure - Hydraulic - Injury from hydraulic process or device failure

Suggested FHSHB Ref:	2.5, 4.5, 4.6	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	Engineering Controls (specify in comments)
Comments:	Face away from well when removing J-plugs. Wear eye protection.	

Hazard #4

Motion - Cuts and scrapes - Injury from moving object impacting skin or eye

Suggested FHSHB Ref:	2.5, 3.22	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Engineering Controls (specify in comments)
Mitigated Risk:	LOW	Site Awareness
Comments:	Use knee boards/pads when kneeling next to wells.	

Task 3:	Sampling - Well sampling using peristaltic pumps

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: 3.9

Biological*	L	Chemical	M	Driving*	-	Electrical	L
Environmental*	M	Gravity*	L	Mechanical	L	Motion*	M
Personal Safety	L	Pressure	L	Radiation	-	Sound	L

Hazard #1

Chemical- liquids - injury or illness from skin absorption

Suggested FHSHB Ref:	3.9, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	JSAs
Comments:	Use proper PPE when working on a well (safety glasses, nitrile gloves, long sleeves).	

Hazard #2

Environmental - Sun or wind -Skin injury from sun or wind exposure

Suggested FHSHB Ref:	3.12	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	Field H&S Handbook
Comments:	Wear gear that covers exposed skin and use sunscreen as needed.	

Hazard #3

Motion - Cuts and scrapes - Injury from moving object impacting skin or eye

Suggested FHSHB Ref:	2.5, 3.22	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Engineering Controls (specify in comments)
Mitigated Risk:	LOW	JSAs
Comments:	Take care when using tubing cutters. Inspect sample bottles prior to use and avoid overtightening lids.	

Task 4:	Sampling - Soil sampling using split spoons or continuous sampling tool

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: 3.9

Biological*	L	Chemical	M	Driving*	-	Electrical	L
Environmental*	L	Gravity*	L	Mechanical	M	Motion*	L
Personal Safety	L	Pressure	L	Radiation	-	Sound	M

Hazard #1

Chemical- solids/particulates - injury or illness from skin absorption

Suggested FHSHB Ref:	3.9, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	JSAs
Comments:	Use proper PPE when sampling and logging soils (safety glasses, nitrile gloves, long sleeves).	

Hazard #2

Mechanical - Crushing - Injury by crushing body part in mechanical process

Suggested FHSHB Ref:	3.27.4	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Machine Guarding
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Contractor should wear gloves and tear away safety vests. Arcadis to maintain a safe distance from machinery while contractors are performing work. Arcadis to perform oversight only. Review safety concerns with contractor during safety tailgate meetings.	

Hazard #3

Mechanical - Pinch point - Injury by pinching of body part in mechanical process

Suggested FHSHB Ref:	3.27.4	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Machine Guarding
Mitigated Risk:	LOW	Inspections
Comments:	Contractor should test any E-stop switches on equipment. Arcadis to maintain safe distance from machinery while contractors are performing work.	

Hazard #4

Sound - Noise - Injury or illness due to noise exposure

Suggested FHSHB Ref:	3.15	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	Engineering Controls (specify in comments)
Comments:	Use hearing protection and set up sampling station a safe distance from machinery.	

Hazard #5

Chemical - solids/particulates, skin or eye irritation/damage/allergy

Suggested FHSHB Ref:	3.9, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	JSAs
Comments:	Wear safety glasses to mitigate dust from drilling operations entering eyes.	

Task 5:	Waste - Containment of IDW in small containment devices greater than 10 gallons but less than or equal to 119 gallons capacity

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: 3.3

Biological*	L	Chemical	M	Driving*	-	Electrical	-
Environmental*	#N/A	Gravity*	L	Mechanical	M	Motion*	L
Personal Safety	L	Pressure	L	Radiation	-	Sound	L

Hazard #1

Chemical- liquids - injury or illness from skin absorption

Suggested FHSHB Ref:	3.9, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Prevent spash back by containerizing and pouring small amounts of purge water into drums. Wear safety glasses and nitrile gloves.	

Hazard #2

Mechanical - Pinch point - Injury by pinching of body part in mechanical process

Suggested FHSHB Ref:	3.27.4	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Machine Guarding
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Take care when opening and closing 55-gal drums. Wear protective gloves when appropriate.	

Hazard Communication (HAZCOM)/Global Harmonization System (GHS)

- [ ] HAZCOM/GHS for this project is managed by the client or contractor
- [ ] Project will utilize <=3 Chemical(s)/Product(s) subject to HAZCOM/GHS

List the chemicals anticipated to be used by Arcadis on this project per HAZCOM/GHS requirements.
(Modify quantities as needed)

	Preservatives	Qty
	Not applicable	
X	Hydrochloric acid	<500 ml
X	Nitric acid	<500 ml
	Sulfuric acid	<500 ml
X	Sodium hydroxide	<500 ml
	Zinc acetate	<500 ml
	Ascorbic acid	<500 ml
	Acetic acid	<500 ml
	Isopropyl alcohol	< 4 gal.
	Formalin (<10%)	< 4 gal.
	Methanol	<500 ml
	Sodium bisulfate	<500 ml

	Decontamination	Qty
	Not applicable	
X	Alconox	≤ 5 lbs
	Liquinox	≤ 1 gal
	Acetone	≤ 1 gal
	Methanol	≤ 1 gal
	Hexane	≤ 1 gal
	Isopropyl alcohol	≤ 4 gal
	Nitric acid	≤ 1 L
	Other:	

	Calibration	Qty.
	Not applicable	
X	Isobutylene/air	1 cyl
	Methane/air	1 cyl
	Pentane/air	1 cyl
	Hydrogen/air	1 cyl
	Propane/air	1 cyl
	Hydrogen sulfide/air	1 cyl
	Carbon monoxide/air	1 cyl
X	pH standards (4,7,10)	≤ 1 gal
X	Conductivity standards	≤ 1 gal
X	Other:	
	Turbidity, ORP, Auto Cal	

	Fuels	Qty.
X	Not applicable	
	Gasoline	≤ 5 gal
	Diesel	≤ 5 gal
	Kerosene	≤ 5 gal
	Propane	1 cyl
	Other:	

	Kits	
X	Not applicable	
	Hach (specify):	
	DTECH (specify):	
	Other:	

		Qty.
		1 kit
		1 kit
		1 kit

	Remediation	Qty.
X	Not applicable	

	Other:	Qty.
	Not applicable	
X	Spray paint	≤ 6 cans
	WD-40	≤ 1 can
	Pipe cement	≤ 1 can
	Pipe primer	≤ 1 can
	Mineral spirits	≤ 1 gal

	DOT(1):	Qty.
	MOT eligible soils	
	MOT eligible water	
	MOT eligible solids	
	MOT eligible liquids	

(1) Attach applicable Materials of Trade (MOT) Quick Form to shipping determination or this HASP. SDS not generally applicable to this category.

SDSs for this project will be available electronically on a designated project field computer. All project workers will be notified of the SDS location in their initial safety briefing.

Air Monitoring

	There are no atmospheric chemical, radiological, or particulate hazards on this project requiring air monitoring.
	Air monitoring is the responsibility of the client or subcontractor.
X	Air monitoring is required for the following tasks:

Drilling - Contractor oversight

Select

Constituents of Interest:

Time Weighted Averages (TWAs) are ACGIH 8 Hr Threshold Limit Values (TLVs) unless noted.

Benzene			
TWA	0.5 ppm, OSHA Reg.	LEL/UEL (%):	1.2/7.8
STEL	2.5 ppm	RGD (Air = 1):	NA
IDLH	500 ppm, NIOSH	VP (mmHg):	75
Toluene			
TWA	20 ppm	LEL/UEL (%):	1.1/7.1
STEL	150 ppm, NIOSH	RGD (Air = 1):	NA
IDLH	500 ppm, NIOSH	VP (mmHg):	21
Ethylbenzene			
TWA	20 ppm	LEL/UEL (%):	0.8/6.7
STEL	125 ppm, NIOSH	RGD (Air = 1):	NA
IDLH	800 ppm, NIOSH	VP (mmHg):	7
Xylenes			
TWA	20 ppm	LEL/UEL (%):	1.1/7.0
STEL	150 ppm, NIOSH	RGD (Air = 1):	NA
IDLH	900 ppm, NIOSH	VP (mmHg):	9

TWA - Time Weighted Average (ACGIH TLV unless noted)
STEL - Short Term Exposure Limit
IDLH - Immediately Dangerous to Life and Health

LEL/UEL - Lower/Upper Explosive Limit
RGD - Relative Gas Density
VP (mmHg) - Vapor Pressure (millimeters mercury)

Notes:
One or more constituents above is listed with a skin notation. Avoid conditions where dusts, mists, or aerosols are created. Avoid skin contact with impacted media.

As noted, one or more of the above constituents is an OSHA regulated substance. If exposure is expected to be above the TWA, contact a CIH or CSP for assistance unless otherwise permitted by a substance specific plan template identified in this section.

Required Monitoring Instruments, Action Levels and Monitoring Frequency

Photoionization Detector Select Lamp: 10.6 eV

Action levels are in PID units (1):			Computed action levels have been manually adjusted.
<	1.9		Continue working
	1.9 -	3.7	Levels sustained > 5 minutes, monitor continuously and review engineering controls and PPE. Proceed with caution.
>	3.7		Stop work and contact SSO

(1) Computed action levels are for PIDs which have not been programmed to correct TLVs for specific constituents or mixtures.

Particulate/aerosol monitoring is not required. Re-evaluate if visible dusts or aerosols cannot be controlled.

Action levels are in mg/m3			Computed action levels have been manually adjusted.
<	NA		Continue working
	NA		Levels sustained > 5 minutes, monitor continuously and review engineering controls and PPE. Proceed with caution.
>	NA		Stop work and contact SSO

Breathing zone air monitoring using the above instruments will be performed at the following frequency:
Continuously

The monitoring instrument(s) used must be capable of data logging if continuous monitoring is required. Staff using these instruments must be trained in data logging procedures for the actual instrument(s) used. Data logging results must be backed up daily.

Multigas (including LEL/O2 and Hg vapor) monitoring is not required.

LEL/O2 Meter	0-5% LEL	Continue work
LEL/O2 Monitoring Not Required	>5-10% LEL	Continually monitor, review engineering controls, proceed with caution
	>10% LEL	Stop work, evacuate, contact SSO
	19.5%-23.5% O2	Normal, continue work
	<19.5% O2	O2 deficient, stop work, evacuate, contact SSO
	>23.5% O2	O2 enriched, stop work, evacuate, contact SSO

Additional Gas/Vapor Monitoring is Not Required

		1/2 TLV	Stop Work Action Level	Comments
	Ammonia	12.5 ppm	25 ppm	
	Carbon dioxide	2500 ppm	5000 ppm	
	Carbon monoxide	12.5 ppm	25 ppm	
	Chlorine	0.05 ppm	0.1 ppm	
	Hydrogen cyanide	2.35 ppm (skin)	4.7 ppm* (skin)	
	Hydrogen sulfide	0.5 ppm	1 ppm	
	Methane	Simple Asphyxiant		
	Nitrogen dioxide	0.1 ppm	0.2 ppm	
	Phosphine	0.025 ppm	0.05 ppm	
	Sulfur dioxide	0.125 ppm	0.25* ppm	
	Mercury vapor	0.0125 mg/m3	0.025 mg/m3	

* Ceiling or STEL value

All air-monitoring instruments must be calibration checked daily, if used, per manufacturer's instructions. Calibration checks, including calibration gases used, must be documented.

Tick and Poisonous Plant Hazards

For all projects with outdoor work, biological hazards must be addressed in the tailgate safety meeting each day. The following controls must be used to mitigate biological hazards while working and must also be discussed in the tailgate safety meeting.

Controlling Tick Hazards

Risk Guide for Ticks:

Low	Paved areas; parking lots; well manicured lawns and fields; no work taking place within 15 feet of vegetated areas; work in REGIONS with no tick populations; sub-freezing temperatures, snow or ice cover on ground.*
Medium	Brush hogged fields, wetlands, and grasslands; forested areas with little undergrowth; weeds less than knee height; moderately dense foliage; sporadic or moderately vegetated shaded areas; average leaf accumulation and decaying material on the ground; work taking place in fields after application of insecticide; work in REGIONS with a recognized moderate tick populations; outdoor work during spring, summer and fall months.*
High	Uncut fields, wetlands, forested areas, and grasslands; weeds taller than knee height; heavy dense foliage; heavily vegetated shaded areas; excessive accumulations of leaves and decaying material on the ground; work in REGIONS with recognized heavy tick populations; areas with posted tick hazard warnings; outdoor work during spring, summer and fall months.*

*Cold weather does not eliminate risk of exposure to deer ticks as they may be active all year in areas that experience subfreezing temperatures.

Ticks are ranked as a **Medium** risk for this project

Care should be taken to avoid walking through or working in tall grasses, overgrown or bushy vegetation to the extent reasonable and practical. No single control is effective against ticks.

Select required controls below:

Engineering Controls

- [ ] Mowing of work area
- [X] Clearing overgrown vegetation
- [ ] Pesticide application
- [ ] Other: _____

Administrative Controls

- [X] Complete tick check morning/evening
- [ ] Scheduled tick check: _____
- [X] Inspect backpacks, equipment cases, etc. daily
- [X] Vehicle cab - maintain good housekeeping
- [ ] Other: _____

Personal Protective Equipment

- [X] Light colored clothing
- [ ] Light colored hat/hardhat
- [ ] Pants tucked in boots
- [ ] Shirt tucked into pants
- [ ] Long sleeved shirt and long pants
- [ ] White Tyvek pants
- [ ] White coveralls/Tyvek
- [ ] Taped cuffs/pant legs
- [ ] Tick gators
- [ ] Double sided tape/duct tape sticky side out
- [ ] Insect mesh/netting for face/head or whole body suit
- [ ] Other: _____

Repellents

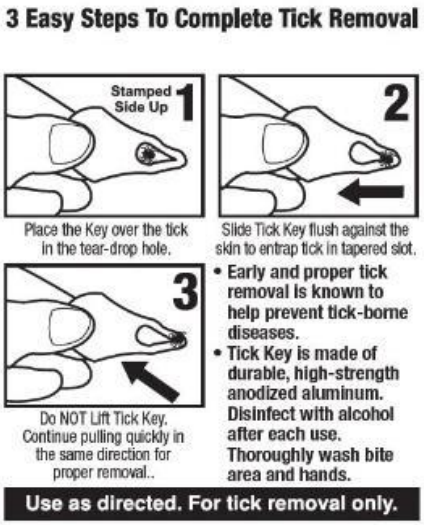
- [ ] Repellents will not be used
- [X] Permethrin impregnated clothing (purchased)
- [X] Permethrin (0.5% self applied/treated to clothing)
- [X] Deet 20-40% applied to skin
- [ ] Other: _____

Permethrin must be applied to clothing within the past 6 weeks or within 6 garment washings. Do not apply permethrin directly to skin. Follow manufacturer's application instructions.

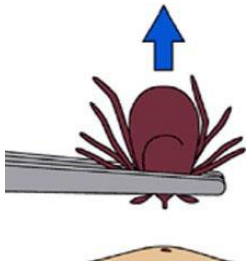
Tick Removal and First Aid

Ticks removed within 24 hours of embedment represent a very low risk for adverse outcomes. Perform tick checks as directed above. To properly remove a tick:

Using a Tick Removal Tool



Using Tweezers



1) Use point tip tweezers, if available, to reduce potential of crushing the ticks body
2) Grasp the tick as close to skin as possible
3) Pull upward with even pressure.

Do not crush tick with fingers

After removal, wash affected area with alcohol or iodine. Wash hands thoroughly after removal.
Document date/time of the removal in field notes, field form or H&S app.
If rash or fever develops, call WorkCare

Poisonous Plants (Poison Ivy, Poison Oak, Poison Sumac)

All work outdoors, regardless of time of year, must address poisonous plant hazards and controls in the tailgate safety meeting.

Controlling Exposure to Poisonous Plants

Poisonous Plants are ranked as a **Medium** risk on this project

Select required controls below:

Engineering Controls

- [X] Not applicable
- [ ] Mowing of work area
- [ ] Clearing overgrown vegetation
- [ ] Herbicide application
- [ ] Other: _____

Administrative Controls

- [X] Identify and avoid (see ID Quick Guide below)
- [X] Watch for signs or symptoms of exposure
- [X] Vehicle cab - maintain good housekeeping
- [ ] Other: _____

Personal Protective Equipment

- [X] Gloves
- [ ] Hat/hardhat/head covering
- [ ] Pants tucked in boots
- [ ] Shirt tucked into pants
- [ ] Long sleeved shirt and long pants
- [ ] White coveralls/Tyvek
- [ ] Taped cuffs/pant legs
- [ ] Dust mask (during burning activities, etc.)
- [ ] Other: _____

Repellents

	Repellents will not be used
X	Barrier creams
	Other: _____

Skin Decontamination

X	Wash with post-exposure soap and water
X	Wash with soap and water (use hot water if available)
X	Hot shower at end of day
	Other: _____

First Aid

If skin irritation or other signs of allergic reaction develops contact WorkCare for assistance.
Document date and time of exposure, if known, in field notes, field form or H&S app.

Identification Quick Guide

Ticks:

American Dog Tick

Blacklegged (Deer) Tick

Brown Dog Tick

Groundhog Tick

Gulf Coast Tick

Lone Star Tick

Rocky Mountain Wood Tick

Soft Tick

Poison Ivy:

Poison Oak:

Poison Sumac:

For other biological hazards, address the hazards and controls in the JSA for the work task.

Personal Protective Equipment (PPE)

See JSA or Permit for the task being performed for required PPE. If work is not conducted under a JSA or Permit, refer to the governing document for PPE requirements. At a minimum, the following checked PPE is required for all tasks during field work (outside of field office trailers and vehicles) not covered by a JSA or Permit on this project:

Minimum PPE required to be worn by all staff on project:

						Specify Type:
X	Hard hat		Snake chaps/guards		Coveralls:	
X	Safety glasses		Briar chaps		Apron:	
	Safety goggles		Chainsaw chaps	X	Chem. resistant gloves:	Nitrile
	Face shield		Sturdy boot	X	Gloves other:	Cut Resistant
	Hearing protection	X	Steel or comp. toe boot		Chemical boot:	
	Rain suit		Metatarsal boot		Boot other:	
	Other:			X	Traffic vest, shirt or coat:	Class II
					Life vest:	

Task specific PPE: See JSAs for additional PPE requirements. Nitrile gloves will be used when sampling soil and/or groundwater. Hearing protection will be used during drilling oversight.

Comments: Hardhat only required while working around heavy equipment (i.e., drilling oversight)
See Tick and Poisonous Plant Hazards section for addtional PPE information.

Medical Surveillance

All Arcadis employees and subcontractors performing field work will be required to be current in HAZWOPER medical surveillance.

Client and DOT mandated drug and alcohol testing is not required for this project and will not be performed.

Hazardous Materials Shipping and Transportation

A shipping determination package has been prepared, reviewed and is attached to this HASP.

Traffic Safety and Traffic Safety Plans (TSPs)

Not Applicable

Arcadis Commercial Motor Vehicles (CMVs)

CMVs operated by Arcadis employees on public roadways will not be utilized on this project. Arcadis defines a CMV as any single vehicle with a gross vehicle weight rating (GVWR) ≥10,001 pounds or a truck and trailer combination with a combined GVWR ≥10,001 pounds (GVWR of truck + GVWR of trailer = ≥10,001 pounds).

Site Control

The scope of work on this project does not require use of site control.

Decontamination

Decontamination protocols are addressed in the applicable task JSA(s) for this project. The applicable JSAs are attached to this HASP.

Sanitation

The project scope is a mobile work operation. The project field team will have reasonable access to restroom facilities within 10 minutes of the work area where the mobile work activity is actively taking place. Potable water will be carried by the field team in the vehicle used for the project. Unless alternate requirements are stipulated in a plan supplement (i.e. Heat Injury and Illness Prevention Plan), permit or JSA, bottled or water coolers with potable water will be provided to project workers at 1 gallon/worker/day.

Safety Briefings

Arcadis will lead all safety briefings on this project and will document the safety briefing on a Tailgate Safety Briefing form or logbook. Safety briefings will be conducted once at the beginning of each work day unless the Site Safety Officer deems more frequent safety briefings will be required based on work being conducted. All project workers, including Arcadis subcontractors, will be required to attend the safety briefing. Site visitors and project workers not on duty during the morning safety briefing will receive the safety briefing upon their arrival onto the project site for the day.

Employee Health and Safety Engagement

The CPM or APM is responsible for reviewing and establishing H&S engagement goals for the project. These goals are summarized below.

Hazard Observations (via H&S App or TIP) required at the following frequency on this project:

1 per field staff per event

Close Call reporting (via H&S app) goals for this project:

As needed or observed

Other (specify):

Safety Equipment and Supplies

Safety equipment/supply requirements are addressed in the JSA or Permit for the task being performed. If work is not performed under a JSA or Permit, the following safety equipment is required to be present on site in good condition unless otherwise noted (Check all that apply):

X	First aid kit	X	Insect repellent:
	Bloodborne pathogens kit	X	Sunscreen
	Fire extinguisher		Air horn
	Eyewash (ANSI compliant)	X	Traffic cones
X	Eyewash (bottle)		2-way radios
X	Drinking water		Heat stress monitor
X	Other:	X	See Tick and Poisonous Plant Hazards section for addtional equipment/supply information.
	Cell Phone and charger		

International Travel

International travel is not required for this project.

Spill Control and Containment

Spill control and containment protocols, including required equipment and supplies, are located in a JSA prepared by Arcadis. Implementation of the JSA requirements are the responsiblity of Arcadis.

Use of Electronic Devices in Areas of Increased Safety Risk

The intent of this section is to ensure use of standard computer tablets, laptops, or cell phones (collectively referred to in this HASP as digital device) is performed in a manner that is effective in preventing or mitigating injury to the user of the digital device.

Use of electronic devices in an active parking lot must be addressed in the Non-ROW TSP. Use of Non-ROW short-term traffic controls in situations where digital data collection or documentation is conducted should be avoided unless spotter options are utilized. When practical, use project vehicle as shield in parking lots.

Electronic device use and distractions to be discussed and documented in the job briefing/safety briefing.

Signatures

I have read, understand and agree to abide by the requirements presented in this health and safety plan. I understand that I have the absolute right to stop work if I recognize an unsafe condition affecting my work until corrected.

Printed Name	Signature	Date

Add additional sheets if necessary

You have an absolute right to STOP WORK if unsafe conditions exist!

Attachment A
Forms

Arcadis Visitor Acknowledgement and Acceptance of HASP Signature Form

By signing below, I waive, release, and discharge the owner of the site and Arcadis and their employees from any future claims for bodily and personal injuries which may result from my presence at, entering, or leaving the site and in any way arising from or related to any and all known and unknown conditions on the site.

Printed Name	Signature	Company	Date/Time On Site	Date/Time Off Site

THIS FORM MUST BE ENTIRELY COMPLETED PRIOR TO BEGINNING ANY INTRUSIVE WORK

Project Name: Clyde Former MGP Site16 Sodus Street(Start Date: _____

Project #: 30251446 End Date: _____

Utility markings valid for 15 days. Initiate clearance renewal 5 days prior to expiration for ongoing work

PRE-FIELD WORK REQUIREMENTS

DigSafe 811 notified 48-72 hrs. in advance of work? ☐ DigSafe Ticket #: _____

Ticket Expiration Date: _____ State Utility Laws: www.commongroundalliance.com/map

Ticket(s) Attached(Y/N)? ☐ List utility owners notified via DigSafe 811 & response status:

List addt'l. utilities requiring notification not included in DigSafe811 Notice:

Review task details w/ private utility location subcontractor. ID work areas, clearance equipment needed, depth of clearance needed, types of features, utilities, anticipated/known/unknown. Verify DigSafe 811 markings to confirm public utility clearance.

Private Utility Locator Name, if used: AUS onsite meeting (Y/N)? ☐

FIELD WORK REQUIREMENTS

This portion of the checklist must be completed on site. AUS staff must have a minimum of one year of field experience in identifying utilities to complete the checklist. Field staff will review the completed checklist with PM or designee prior to beginning intrusive work.

Heavy equipment/mechanized intrusive work w/in the Arcadis Tolerance Zone (utility or structure present within 30-in. of point of work) REQUIRES pre-approval by Corporate H&S prior to working at all such locations. STOP WORK if the Arcadis Tolerance Zone work has not been approved.

List work type & locations for utility location and clearance as applicable to this checklist:

3 Reliable Lines of Evidence are REQUIRED for EACH INTRUSIVE LOCATION prior to starting any subsurface intrusive work. Check corresponding boxes below to document utility clearance efforts.

☐ OneCall/DigSafe 811 Public Utility Locate (required by State law for subsurface work)

811 is only reliable as a Line of Evidence when working in/adjacent to a public ROW or easement.

Marking type: ☐ Paint ☐ Pin Flags/Stakes ☐ Other: _____ ☐ None

☐ Client provided maps/drawings (Y/N)? ☐ Maps/drawings not provided (Y/N)?

☐ Client Clearance (Y/N)? Name(s)/Affiliation(s): _____

☐ Interviews (Y/N)? Name(s)/Affiliation(s): _____

☐ Specific subsurface feature types and depths provided by person interviewed (Y/N)?

Details provided: _____

☐ Site Inspected (Y/N)? (document on Pg. 2.) Photo Document Marked Utilities & Structures

☐ Public records/Client Dwgs/As-Builts (Y/N)? Type:

List private locator tools used: ☐ Radio Freq. Detection ☐ Electromagnetic ☐ GPR

☐ Metal Detector ☐ Acoustic Pipe Locator ☐ Downhole sonde Other:

☐ Soft Dig Methods used (Y/N)? ☐ Hand auger ☐ Probing ☐ Hand tools (shovel/rake)

☐ Air knife ☐ Hydro Knife ☐ Potholing/Vacuum extraction

☐ Other soft dig tools used (Y/N)? If Yes, list here:

ALL BOXES BELOW MUST BE COMPLETED BEFORE PROCEEDING

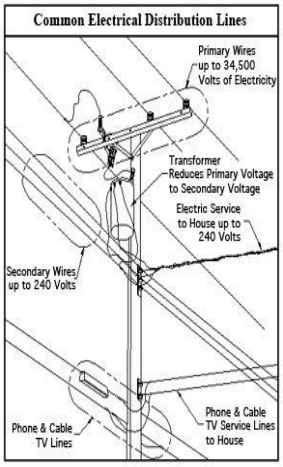
Site inspection also requires investigating vicinity outside of the work area for structures and utilities. Noting "YES" requires addt'l. investigation. Utilities must be field marked prior to intrusive work.

Is the utility present (Y/N)?		Utility Color Code
	Utilities entering/exiting structures?	No Color
	Intrusive work area marked out?	White
	Structural features above or below?	White
	Public natural gas line or meter?	Yellow
	Private natural gas laterals/feeders?	Yellow
	Public electrical service?	Red
	Conduit from meter or on wall?	Red
	Conduit from poles into ground?	Red
	Poles/devices w/ no visible lines?	Red
	Overhead electrical lines?	Red
	Solar arrays or wind turbines?	Red
	Public water line(s)?	Blue
	Private water line(s) or lateral(s)?	Blue
	Water meter onsite?	Blue
	Fire hydrants/post indicator valves?	Blue
	Irrigation system control box/valve?	Blue
	Sprinkler heads, drip lines, vaults?	Blue
	Water dispensers, fill stations?	Blue
	Telecomm. overhead or buried?	Orange
	Telecomm. ground box or relays?	Orange
	Telecomm./security CCTV devices?	Orange
	Public sanitary sewer pipes?	Green
	Combined sanitary/storm pipes?	Green
	Private sanitary laterals/clean outs?	Green
	Restrooms, kitchens, wash bays?	Green

Is the utility present (Y/N)?		Utility Color Code
	Evidence of stormwater network?	Green
	Curb drains/catch basins/manholes?	Green
	Stormwater culverts, outfalls?	Green
ABOVEGROUND Features Present?		
	Transportation tunnels/structures/markers present?	
	Overhead electrical lines?	Red
	< 50 kV w/in 10 ft of work area?	Red
	>50-200 kV w/in 15 ft of work area?	Red
	>200-350 kV w/in 20 ft of work area?	Red
	>350-500 kV w/in 25 ft of work area?	Red
	>500-750 kV w/in 35 ft of work area?	Red
	>750-1000 kV w/in 45 ft of work area?	Red
	Aboveground fire suppression?	Blue
	Aboveground communications?	Orange
	Aboveground chases/racks/trays?	Orange
	Private/Remediation system lines?	Various
	Unclassed utilities/anomalies?	Pink
	Warning signs/stakes/markers present?	
	Heavy Equipment: Mark travel route for overhead, next to route, and/or under route (e.g. crush risk) utilities.	
Signs of other utilities/ground disturbance		
	Signs of asphalt or concrete disturbance/repair?	
	Any ground subsidence or change in vegetation?	
	Unknown manholes or valve covers in work area?	

Tips for Thorough Utility Location (HSS Section 5.6):

1. Don't forget to look up for utilities
2. Be on-site with Private Utility Locators.
3. Ask Private Locators to "confirm" other's markings.
4. Also clear alternate/backup locations
5. Mark all known utilities.
6. No hammering, no pickaxes, no digging bars, no shortcutting.
7. No excessive turning or downward force of hand tools, especially hand augers.
8. Utilities may run in or directly under asphalt/concrete
9. Heavy equipment may damage shallow utilities. Especially during clearing and grubbing.
10. Use spotter for heavy equipment near aboveground utilities?



☐ Utilities & Structures Checklist reviewed by the PM or Designee (Y/N)? *If no, STOP WORK call PM*

PM or Designee Name: _____

Name and Signature of person completing the checklist: _____

Date of checklist review / update: _____

ALL SUSPECT UTILITY STRIKES REQUIRE CORPORATE H&S NOTIFICATION WITHIN 24 hrs. OF KNOWLEDGE OF STRIKE WITH A CONFIRMED RESPONSE FROM CORPORATE H&S.

Task Improvement Process

General

Observed Company:

Observation Type:

TIP Form: H&S Field Multi-Task (General)

Task Observed:

Observee Name:

Observer Name:

Observation Date:

Project Number: 30251446

Project Name: Clyde Former MGP Site16 Sodus StreetClyde, New York 14433

Supervisor:

Equipment On Site:

Pertinent Information:

Observation

Task	Correct	Questionable	Comments
General			
PPE worn according to HASP/JLA specifications and inspected before use?			
STOP work authority used where appropriate?			
Body Use/Positioning			
Proper lifting/pushing/pulling techniques used (no awkward positions/posture; no twisting or excessive reaching; no straining; no excessive weight; load under control/stable; etc.)?			
Body parts away from pinch points (clear or protected from being caught between objects/equipment or from contacting sharp objects/edges, etc.)?			
Body parts not in the Line of Fire (protected from being struck by traffic, equipment, falling/flying objects, etc.)?			

Work Procedures/Environment			
Correct type and number of barricades/warning devices/cones?			
Communication with others when necessary (hand signals, flags, etc.)?			
Right tools and equipment selected for the job and inspected before use?			
Tools and equipment used properly?			
Housekeeping performed (work areas and pathways clear of hazards, uneven surfaces addressed, etc.)?			
Slip/trip/fall hazards addressed (path selected and cleared, eyes on path, speed footing, etc.)?			
Proper energy control (electrical systems grounded, lock out/tag out performed, isolated, cords/fixtures in good condition, GFCI inspected and utilized when appropriate and used properly, etc.)?			
Protected from overhead/underground utilities (proper clearance, properly marked, spotters as necessary, etc.)?			
Safe work on/near water (appropriate flotation device, appropriate boat for body of water and operation of boat, etc.)?			
Chemical/Radiation protection (decontamination zones set up properly, air monitoring, completed, and logged, etc.)?			
Fall from elevated height prevention (maintains 3-points of contact, appropriate ladder, mounting/dismounting vehicle/equipment, fall arrest system, etc.)?			
Any additional safety issues identified:			

Tip Summary **Enter details of the TIP and follow up discussion provide details on how any questionable items were resolved.**

Discussion following the TIP led by: _____

Date of follow-up discussion: _____

Positive Comments:

Discussion Summary Completed:

- ☐ Supervisor Led
- ☐ Peer to Peer
- ☐ Arcadis Employee to Subcontractor

Summary of Questionable Items

Action Items (Optional) Assign appropriate action items based on the observations made. You can add more than one action item if needed.

Item #	Action Item	Responsible Person	Due Date	Comp. Date
1				
2				
3				

Standard Review

Reviews to be performed after entry of this TIP into 4-Sight.

Quality Review

Quality Reviews to be performed after entry of this TIP into 4-Sight.

Field Validation and Verification

Use the 4-Sight generated copy of this TIP to perform field V&V activities.

Control Number: TSM- 30251446

TSM + project number plus date as follows: xxxxxxxx.xxxx.xxxxx - dd/mm/year

TAILGATE HEALTH & SAFETY MEETING FORM

Project Name:			**Project Location:**
Date:	**Time:**	**Conducted by:**	**Signature/Title:**

Issues or concerns from previous day's activities:

Task anticipated to be performed today:

☐ Additional permits/checklists attached

USE TRACK! Evaluate the hazards (h) for the tasks being performed today and rank as Low (L), Medium (M) or High (H). Use relevant JSAs, FHSHB, permit or other work standard to communicate controls (c) to be used to eliminate or mitigate identified hazards.

☐ Gravity (i.e., ladder, trips) (L M H) h: c:	☐ Motion (i.e., traffic, machinery) (L M H) h: c:	☐ Mechanical (i.e., augers, motors) (L M H) h: c:
☐ Electrical (i.e., utilities) (L M H) h: c:	☐ Pressure (i.e., gas cyl., wells) (L M H) h: c:	☐ Environment (i.e., heat, cold) (L M H) h: c:
☐ Chemical (i.e., fuel, acid, paint) (L M H) h: c:	☐ Biological (i.e., ticks, poison ivy) (L M H) h: c:	☐ Radiation (i.e., alpha, sun, laser) (L M H) h: c:
☐ Sound (i.e., machinery) (L M H) h: c:	☐ Personal (i.e. alone, night) (L M H) h: c:	☐ Driving (i.e. car, ATV, boat) (L M H) h: c:

☐ Refer to the attached Hazard Analysis Sheet(s) or JSA

Comments:

Signature and Certification: I have read and understand the project specific HASP for this project.

SSE Employee*

Non-Life Threatening Injury or Illness
Call WorkCare 1-888-449-7787

	Printed Name/Signature/Company	Sign In Time	Sign Out Time

***Short Service Employee (SSE) working for Arcadis <1 year.**

I will STOP the job any time anyone is concerned or uncertain about health & safety or if anyone identifies a hazard or additional mitigation not recorded in the site, project, job or task hazard assessment.

I will be alert to any changes in personnel, conditions at the work site or hazards not covered by the original hazard assessments.

If it is necessary to **STOP THE JOB,** I will perform **TRACK**; and then amend the hazard assessments or the HASP as needed.

I will not assist a subcontractor or other party with their work unless it is absolutely necessary and then only after I have done TRACK and I have thoroughly controlled the hazard.

All site staff should arrive fit for work. If not, they should report to the supervisor any restrictions or concerns.

In the event of an injury, employees will call **WorkCare at 1.888.449-7787** and then notify the field supervisor.

Utility strike, motor vehicle accident or 3rd party property damage - field supervisor will immediately notify the Project or Task Manager

PID Calibration Log

ARCADIS

Zero Gas Source: ____________________ Instrument Type: ____________________ PAGE ____ of ____

Lot Number/Expiration Date: ____________________ Serial Number: ____________________

Calibration Gas Source: ____________________ Instrument Type: ____________________

Lot Number/Expiration Date: ____________________ Serial Number: ____________________

Concentration: ____________________ ____________________

Instrument Number	Date	Time	Zero Cal. OK (Y/N)	Calibration Gas Reading	Comments	Calibration w/in 2% (Y/N)?	Alarms Set (Yes/No)?	User Initials

Attachment A
JSAs

Job Safety Analysis

General

JSA ID	HASP 1	**Status**	Complete
Job Name	General Industry-Driving - passenger vehicles	**Created Date**	1/22/2025
Task Description	Driving a car, van, or truck on public roadways.	**Completed Date**	01/22/2025

Client / Project

Client	NYSEG
Project Number	30251446
Project Name	Clyde Former MGP Site
Project Manager	Nicholas (Klaus) Beyrle

User Roles

Role	Employee	Due Date	Completed Date
Developer	Robbie Sullivan	1/22/2025	1/22/2025
HASP Reviewer	Veronica Bean	1/22/2025	1/22/2025
Quality Reviewer			

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Pre-Trip Inspection	1	Failing to perform pre-trip inspections may cause mechanical failure, accident or injury.	Perform walk around of vehicle with particular attention to tire inflation and condition. Check lights, wipers, seatbelts for proper operating condition. Properly adjust seat and mirrors prior to vehicle operation. Use or review vehicle inspection checklist as required under the MVSP.	ARC HSGE024 Motor Vehicle Safety Standard (MVSP)
		2	Scrapes, cuts, burns to hand if inspecting engine fluids and/or tires. Eye splash hazard if inspecting engine fluids. Pinch or crush hazards when opening or closing hood, trunk, or tailgate.	Wear protective gloves and safety glasses as described below when checking under hood or tires. Use TRACK and keep hands clear when opening/closing hood, trunk, or tailgate to avoid crush or pinch hazard.	
		3	Struck by other vehicles while walking around vehicle performing inspections.	Wear high visibility vest, shirt, or coat while performing inspections in parking lots or other areas with a traffic hazard. Remain vigilant of moving vehicles or equipment in area, face oncoming vehicles to extent practical.	
		4	Improperly secured cargo may dislodge creating injury, property damage, or road hazard.	Ensure all cargo is properly secured to prevent movement while the vehicle is in operation. This includes cargo in the cab of the vehicle.	

2	Driving a motor vehicle on public streets	1	Failing to observe traffic flow ahead increases risk of hard braking resulting in potential impact of vehicle ahead, being struck by another vehicle from behind, and decreases decision making time.	Use Smith System Key #1, "Aim High in Steering". **Look ahead (15 seconds if possible) to observe traffic flow and traffic signals.** Adjust speed accordingly to keep vehicle moving and avoid frequent braking. Select lane of least traffic and adjust speed based on observed signal timing when possible. Avoid following directly behind large vehicles that obscure view ahead.	Smith System "5-Keys" is a registered trademark of Smith System Driver Improvement Institute, Inc.
		2	Failing to observe vehicles, pedestrians, bicyclists, and other relevant objects in vicinity of your vehicle increases risk of side swipes, rear ending, and third party injury.	Use Smith System Key #2, "Get the Big Picture". **Maintain 360 degrees of awareness around vehicle.** Check a mirror every 6-8 seconds, maintain space around the vehicle, choose a lane that avoids being boxed in. Look for pedestrian activity ahead in crosswalks or sidewalks. Watch for construction zone approach signs and act early by executing lane changes and reducing speed.	
		3	Failing to keep your eyes moving increases risk of not seeing relevant vehicles, pedestrians, and objects in your vicinity that may impair your ability to make timely and appropriate driving decisions and also increases risk of accident.	Use Smith System Key #3, "Keep Your Eyes Moving". **Move your eyes every 2 seconds and avoid staring while evaluating relevant objects.** Scan major and minor intersections prior to entering them. Check mirrors.	
		4	Failing to maintain space around and in front of your vehicle increases risk of striking another vehicle or being struck by another vehicle. Insufficient space shortens time for effective driving decision making resulting in increased accident risk.	Use Smith System #4, "Leave Yourself an Out". **Use 4 second rule when following a vehicle.** Avoid driving in vehicle clusters by adjusting speed and using lanes that permit maximum space and visibility. When stopped, keep one car length space in front of vehicle ahead or white line.	
		5	Failing to communicate with other drivers and pedestrians increases risk of striking vehicles, pedestrians, or being struck by other vehicles, especially from the rear.	Use Smith System Key #5, "Make Sure They See You". **Brake early and gradually when stopping to reduce potential of being rear ended.** Keep foot on brake while stopped. Use turn signals and horn effectively. Establish eye contact with other drivers and pedestrians to extent practical. Use vehicle positioning that promotes being seen.	
		6	Distractions within the vehicle takes focus off driving, increases risk of accident decreases time for making effective driving decisions.	**Cell phone use (any type or configuration) is prohibited while the vehicle is in motion.** Familiarize yourself with vehicle layout and controls (radio, temperature controls, etc.) prior to operating unfamiliar vehicles. Set controls prior to operating vehicle. Use GPS in unfamiliar areas to avoid use of paper maps/directions while driving. Set GPS prior to vehicle operation. Pull over and stop to modify GPS functions. Avoid consuming food or drink while driving.	

3	Parking	1	Parking vehicle in areas of clustered parked vehicles or near facility entrance may impair visibility to oncoming traffic in lot and increase exposure to pedestrian traffic.	**Use pull through parking or back into parking space when permitted or practical.** When practical and safe to do so, park away from other vehicles and avoid parking near the facility entrance or loading docks. If available, use a spotter to aid in backing activity. Back no further than necessary and back slowly. Get out and look (GOAL) if uncertain of immediate surroundings. Tap horn prior to backing.	

PPE Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses	While checking engine or tires	Required
Hand Protection	work gloves (specify type)	Leather or equivalent checking engine or	Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
	other	Vehicle kit (applies to company trucks)	Required
Miscellaneous	fire extinguisher	Applies to company trucks	Required
	first aid kit	Applies to company trucks	Required

Job Safety Analysis

General

JSA ID	15016	**Status**	(2) Review
Job Name	Environment-Groundwater Sampling	**Created Date**	4/28/2017
Task Description	Collection of groundwater samples for laboratory analysis.	**Completed Date**	
Template	FALSE	**Auto Closed**	FALSE

Client / Project

Client	NYSEG
Project Number	30251446
Project Name	Clyde Former MGP Site
PIC	Keith White
Project Manager	Nicholas (Klaus) Beyrle

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Kudla-Williams, Bailey	4/25/2023	2/6/2023	Higgins, Michael	☑
HASP Reviewer					☑
Reviewer					☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Stage at pre-determined sampling location and set up work zone and sampling equipment	1	Personnel could be hit by traffic from parking lot and road.	Set up cones and establish work area. Position vehicle so that field crew is protected from site traffic. Unload as close to work area as safely possible.	
		2	Sampling equipment, tools and monitoring well covers can cause tripping hazard	Keep equipment picked up and use TRACK to assess changes.	
2	Open wells to equilibrate and gauge wells	1	When squatting, personnel can be difficult to see by vehicular traffic.	Wear class II traffic vest if wells are located proximal to vehicular traffic. Use tall cones and the buddy system if practicable.	
		2	Pinchpoints on well vault or stick up wells can pinch or lacerate fingers	Use correct tools to open well vault/cap and stick up well caps. Wear ANSI level 2 cut resistant gloves/liners when removing well vault lids, and chemical protective gloves while gauging. Wear proper PPE including safety boots, knee pads and safety glasses.	
		3	Lifting sampling equipment can cause muscle strain	Unload as close to work area as safely possible; use proper lifting and reaching techniques and body positioning; don't carry more than you can handle, and get help moving heavy or awkward objects.	
		4	Pressure can build up inside well causing cap to release under pressure	Keep head away from well cap when removing. If pressure relief valves are on well use prior to opening well. Make sure to wear safety glasses.	
3	Begin Purging Well and Collecting Parameter Measurements	1	Electrical shock can occur when connecting/disconnecting pump from the battery.	Make sure equipment is turned off when connecting/disconnecting. Wear leather gloves. Use GFCIs when using powered tools and pumps. Do not use in the rain or run electrical cords through wet areas.	
		2	Purge water can spill or leak from equipment	Stop purging activities immediately, stop leakage and block any drainage grate with absorbent pads. Call PM to notify them of any reportable spill.	
		3	Water spilling on the ground can cause muddy/slippery conditions	Be careful walking in work area when using plastic around well to protect from spillage	

		4	Lacerations can occur when cutting materials such as plastic tubing	When cutting tubing, use tubing cutter. No open fixed blades should ever be used. Wear ANSI level 2 cut resistant gloves/liners.	
		5	Purge water can splash into eyes	Pour water slowly into buckets/drums to minimize splashing. Wear safety glasses.	
4	Collect GW or Free Product Sample	1	Sample containers could break or leak preservative	Discard any broken sampleware or glass properly. Do not overtighten sample containers. Wear chemical protective gloves.	
5	Staging of Well Purge water and/or Free Product	1	Muscle strains can occur when moving purge water or drums	If using buckets, do not fill buckets up to the top. Always keep lid on buckets when traveling or moving them to another location. Only half fill buckets so when dumping the buckets weigh less. See drum handling JSA for movement of drums.	Drum handling JSA

PPE **Personal Protective Equipment**

Type	Personal Protective Equipment	Description	Required
Dermal Protection	long sleeve shirt/pants		Recommended
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)	Nitrile	Required
	work gloves (specify type)	ANSI level 2 cut resistant gloves/liners	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs		Recommended
Miscellaneous PPE	other	Knee pads	Required
	traffic vest--Class II or III		Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Decontamination	Decon supplies (specify type)	alconox, DI water, spray bottle	Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
Personal	eye wash (specify type)	bottle	Required
	insect repellant		Recommended
	sunscreen		Recommended
	water/fluid replacement		Required
Traffic Control	barricades		Recommended
	traffic cones		Required

Job Safety Analysis

General

JSA ID	44	**Status**	(3) Completed
Job Name	Environment-Drilling, soil sampling, well installation	**Created Date**	2/4/2009
Task Description	Drilling, and well installation	**Completed Date**	12/08/2017
Template	True	**Auto Closed**	False

Client / Project

Client	NYSEG
Project Number	30251446
Project Name	Clyde Former MGP Site
PIC	Keith White
Project Manager	Nicholas (Klaus) Beyrle

User Roles

Role	Employee	Due Date1	Completed Date	Supervisor	Active
Developer	Kudla-Williams, Bailey	4/25/2023	2/06/2023	Higgins, Michael	☑
Developer	Merkle, Kurt J	12/22/2017	12/8/2017	Jones, Alison C.	☑
HASP Reviewer	McDonald, Andrew J		12/8/2017	Tremblay, Tony	☑
Quality Reviewer	Abou Abdallah, Said W	12/11/2017	12/11/2017	Carpenter, Matt	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Set up necessary traffic and public access controls	1	Struck by vehicle due to improper traffic controls	Use a buddy system for placing site control cones and/or signage. Position vehicle so that you are protected from moving traffic. Wear Class II traffic vest	
2	Utility Clearance	1	Potential to encounter underground or above ground utilities while drilling.	Complete utility clearance in accordance with the ARCADIS Utility Clearance H&S Standard.	ARCADIS H&S Standard ARCHSFS019
3	General drill rig operation	1	Excessive noise is generated by rig operation.	When the engine is used at high RPMs or soil samples are being collected, use hearing protection.	
		2	During drill rig operation, surfaces will become hot and cause burns if touched, and COCs in the soils more readily vaporize generating airborne contaminates.	Due to friction and lack of a drilling fluid, heat will be produced during this method. Mainly drill augers. Be careful handling split spoons. Wear proper work gloves. When soils and parts become heated, the COC could volatilize. Air monitoring should always be performed in accordance with the HASP.	
		3	Moving parts of the drilling rig can pull you in causing injury. Pinch points on the rig and auger connections can cause pinching or crushing of body parts.	Stay at least 5 feet away from moving parts of the drill rig. Know where the kill switch is, and have the drillers test it to verify that it is working. Do not wear loose clothing, and tie long hair back. Avoid wearing jewelry while drilling. Cone off the work area to keep general public away from the drilling rig.	
		4	Dust and debris can cause eye injury and soil cuttings and/or water could contain COCs.	Wear safety glasses and stay as far away from actual drilling operation as practicable. Wear appropriate gloves to protect from COCs.	
		5	Drilling equipment laying on the ground (i.e. augers, split spoons, decon equipment, coolers, etc), create a tripping hazard. Water from decon buckets generate mud and cause a slipping hazard.	Keep equipment and trash picked up, and store away from the primary work area.	
		6	The raised derrick can strike overhead utilities, tree limbs or other elevated items	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Clearance H&S Standard for guidance.	

4	Mudd rotary drilling	1	The raised derrick can strike overhead utilities, tree limbs or other elevated items.	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance.	
		2	This technology uses fluid, which collects with sediments in large basin. Fluid can splash out and cause slipping/mud hazard. Liquid mixture can splash into your eyes.	Wear rubber boots if needed, and keep clear of muddy/wet area as much as practicable. If area becomes excessively muddy, consider mud spikes or covering the area with a material that improves traction. Wear safety glasses.	
5	Hollow stem auger drilling	1	All hazards in step 3 apply. Additionally,The raised derrick can strike overhead utilities, tree limbs or other elevated items	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance.	
		2	Hands or fingers can get caught and crushed if trying to clean by hand or with tools while the auger is still turning.	Auger should always be stopped and clutch disengaged prior to cleaning.	
6	Air Rotary Drilling	1	This drilling method works with high air pressure and can generate flying debris that can strike your body or get in your eyes.	When the drill rig is being driven into media, it will produce flying debris. The flaps behind the drill rig should stay closed whenever possible to reduce the risk of flying debris. Safety glasses and hard hat should always be worn when the drill rig is operating. When penetrating asphalt, protect surrounding cars that may be present to avoid damage to pain or windshields.	
		2	The raise derrick can strike overhead utilities, tree limbs or other elevated items.	Never move this rig with the derrick up. Ensure there is proper clearance to raise the derrick and that you are far enough away from overhead power lines. See the Utility clearance H&S Standard for guidance.	
		3	When drilling through bedrock prior to groundwater, dust can be produced from pulverization. Inhalation of dusts/powder can occur.	Supplemental water should be used to manage dust and/or dust masks should be used if necessary.	
7	Reverse rotary drilling	1	This method will use fresh water to pump out drill cuttings through the center of the casing. Water/sediment mixture is generated and could cause contact with impacted soils or groundwater.	Ensure the pit construction can hold the amount of cuttings that are anticipated. Air monitoring should also be used of pit area.	
		2	Fire hydrants are often used for water source. Hydrants deliver water at high pressure. Pressurized water can cause flying parts/debris and excessive slipping hazards.	Water usage from fire hydrants should be cleared with local municipalities prior to use. Only persons that know how to use the hydrant should be performing this task. Ensure all connections are tight, and hose line is not run over to cut by traffic. Any leaks from the hydrant should be reported immediately.	
		3	Settling pit construction can cause tripping hazard from excavated soils, and plastic sheeting can cause slipping.	Cone off the area to keep the general public/visitors away from the settling pit. Ensure proper sloping of excavation.	
		4	The raised derrick can strike overhead utilities, tree limbs or other elevated items.	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance.	

8	Rotosonic drilling	1	Fire hydrants are often used for water source. Hydrants deliver water at high pressure. Pressurized water can cause flying parts/debris and excessive slipping hazards.	Water usage from fire hydrants should be cleared with local muncipalities prior to use. Only persons that know how to use the hydrant should be performing this task. Ensure all connections are tight, and hose line is not run over to cut by traffic. Any leaks from the hydrant should be reported immediately.	
		2	This method requires a lot of clearance. The drill head can turn 90 degrees to attach to the next drill flight or casing. This usually requires a large support truck to park directly behind the rig. As the drill head raises the new casing flight is angled down at the same time until it can be turned completely vertical.	Ensure sufficient overhead clearance.	
		3	Heavy lifting of cores can cause muscle strain.	Always use 2 people to move core containers. Use caution moving core samples to layout area. Plan layout area to ensure adequate aisle space between core runs for logging. Keep back straight and use job rotation.	
		4	The rotosonic drill head can move very quickly up and down while working on a borehole. Moving parts can strike someone or catch body parts.	The operator and helper must communicate and stay clear of the path of the drill head. The drill utilizes two large hydraulic clamps to continuously hold casings while load/unloading previous casings. Do not wear loose clothing.	
9	Direct push drilling	1	The drill rods will be handled by workers most of the time rather than the rig doing it, therefore pinch points can cause lacerations and crushing of fingers/body parts.	Keep a minimum of 5 feet away from drill rig operation and moving parts.	
		2	The direct push rigs are usually meant to fit in spaces where larger rig can't. Tight spaces can pin workers.	Do not put yourself between the rig and a fixed object. Use Spotters or a tape measure to ensure clearances in tight areas. Pre-plan equipment movement from one location to the next.	
		3	Some direct push equipment is controlled by wireless devices. These controls can fail and equipment can strike workers or cause damage to property.	The drill rig should be used in a large open area to test wireless controls prior to moving to boring locations. The operator of the rig will test the kill switch with wireless remote prior to use. Operator will stay in range of rig while moving so that wireless signal will not be too weak and cause errors to the controls.	
		4	Sampling sleeves must be cut to obtain access to soil. Cutting can cause lacerations.	It's preferable to let the driller cut the sleeves open. Many drillers have holders for the sleeve to allow for stability when cutting. If you cut the sleeves, use a hook blade, change blade regularly, and cut away from the body.	
		5	Soil cores may contain contaminated media.	Wear nitrile gloves and saftey glasses for protection from contaminated media when logging soil borings.	
10	Rock coring	1	Flying debris can hit workers or cause debris to get in eyes.	Rock chips or overburden may become airborne from drilling method. Wear safety glasses and hard hat and remain at a safe distance from back of drill rig.	
		2	Heavy lifting of cores can cause muscle strain.	Always use 2 people to move core containers. Use caution moving core samples to layout area. Plan layout area to ensure adequate aisle space between core runs for logging. Keep back straight and use job rotation.	

11	Sample collection and processing	1	Injuries can result from pinch points on sampling equipment, and from breakage of sample containers.	Care should be taken when opening sampling equipment. Look at empty containers before picking them up, and do not over-tighten container caps. Use dividers to store containers in the cooler so they do not break.	Sample Cooler Handling JSA
		2	Lifting heavy coolers can cause back injuries.	Use two people to move heavy coolers. Use proper lifting techniques.	
12	Monitoring well installation	1	Same hazards as in Step 3 with general drill rig operation	See step 3	
		2	Monitoring well construction materials can clutter the work area causing tripping hazards.	Well construction materials should be picked up during the well installation process.	
		3	Heavy lifting can cause muscle strains, and cutting open bags can cause lacerations.	Well construction materials are usually 50 lbs or greater. Team lift or use drill rig to hoist bags. Always use work gloves while cutting open bags.	
		4	Well pack material (i.e. sand, grout, bentonite) can become airborne and get in your eyes.	Wear safety glasses for protection from airborne sand and dust.	
		5	Cutting the top of the well to size can cause jagged/sharp edges on the top of the well casing.	Wear gloves when working with the top of the well casing, and file any sharp jagged edges that resulted from cutting to size.	
13	Soil cutting and purge water management	1	Moving full drums can cause back injury, or pinching/crushing injury.	Preferably have the drilling contractor move full drums with their equipment. If this is not practicable, use lift assist devices such as drum dollies, lift gates, etc. Employ proper lifting techniques, and perfrom TRACK to identify pinch/crush points. Wear leather work gloves, and clear all walking and work areas of debris prior to moving a drum.	Drum Handling JSA

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)	Nitrile	Required
	work gloves (specify type)	leather	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs		Required
Miscellaneous PPE	traffic vest--Class II or III		Required
Respiratory Protection	dust mask		Recommended

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Decontamination	Decon supplies (specify type)	Driller to provide and manage	Recommended
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
Personal	eye wash (specify type)	bottle	Required
	water/fluid replacement		Recommended
Traffic Control	traffic cones		Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	McDonald, Andrew J HASP Reviewer Approve 12/8/2017	
Employee: **Role** **Review Type** **Completed Date**	Abou Abdallah, Said W Quality Reviewer NA 12/11/2017	Useful hints to consider when attending field soil borings for utility type work.

Job Safety Analysis

General

JSA ID	7983	**Status**	(3) Completed
Job Name	Environment-Drum sampling/handling	**Created Date**	7/26/2012
Task Description	Drum Handling, Sampling and Transfer of Drum Contents	**Completed Date**	07/26/2012
Template	True	**Auto Closed**	False

Client / Project

Client	NYSEG
Project Number	30251446
Project Name	Clyde Former MGP Site
PIC	Keith White
Project Manager	Nicholas (Klaus) Beyrle

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Kudla-Williams, Bailey	04/25/2023	02/06/2023	Higgins, Michael	☐
HASP Reviewer	Hubbard, Lauren M	8/9/2012	7/26/2012	Tremblay, Tony	☑
Quality Reviewer	Hubbard, Lauren M	7/27/2012	7/27/2012	Tremblay, Tony	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Inspect Drums for signs of Bulging, Leaking, Crystals, Temperature, and Odor	1	Exposure to chemicals stored in drum or container.	Read drum labels for information about contents. Review all relevant MSDSs about chemical contents. If labels are not attached, call PM or Local H&S Representative.	None
		2	Contents of the drum can cause fire/explosion hazard.	Use air monitoring meters to screen drums. % LEL and VOCs (PPM). If either of the values are above the action levels described in the HASP or MSDS then Stop Work, move away from the area, and reassess the situation. Call PM and H&S staff for support.	
2	Remove lids or bungs from Drums	1	Hand Injuries can occur from sharp edges, pinch points, and from use of hand tools.	Wear appropriate work gloves. When removing ring from drum, fingers can get pinched between ring and drum. Keep fingers clear of this space. Select proper tool for task. If large amount of drums will be encountered, use a speed or drum wrench.	Employee H&S Field book, Section III Subpart II, page 104. Also Section III Subpart L, page 38.
		2	Rapid depressurization from empty or partially full drums can cause flying parts or volatile COCs releasing on staff.	Do not handle or open bulging drums (contact Corp H&S for assistance). Bleed any built up pressure by carefully loosening bung prior to removing ring. Keep face and arms away from bung opening when loosening. Slightly lift lid, insert end of air monitoring device to monitor air inside drum.	
		3	Use of mechanical tools to remove bolts from drum lids causes excessive noise.	Wear hearing protection.	
		4	Splashing can occur if filling drum, or collecting samples.	Wear eye and face protection. Pour liquids into drum slowly to minimize splashing.	
		5	When working with COCs that have fire/explosive properties, sparking or heat could cause fire/explosion.	Use brass or non Spark Hand Tools if such a hazard exists or is suspected.	
3	Sample Contents from Drums	1	Exposure to COCs can occur by contacting impacted contents.	Select proper dermal protection for task, at a minimum nitrile gloves should be worn. Wear appropriate eye face and body protection as outlined in the HASP.	
		2	Staff can be exposed to chemical vapors/fumes when	Conduct air monitoring as outlined in the HASP, and if required, select appropriate	

			sampling.	respiratory protection for the task.	
		3	Sharp edges and broken sample containers can cause lacerations.	Discard any broken sample ware or glass properly. Do not over tighten sample containers.	
		4	Chemical burns or skin irritation can occur from contact with sample preservatives.	Wear chemical protective gloves when collecting samples, or when handling damaged sample containers.	
4	Replace drum lids	1	Hand Injuries can occur from sharp edges, pinch points, and from use of hand tools.	see step 2 above	
5	Moving and Storing Drums	1	Drum storage areas can be accessed by the general public, or may not be secure.	Calculate how many drums will be stored in new location. Ensure that drums are not easily accessed by the general public. Do not store such that drums impede pedestrian or vehicular traffic.	
		2	Muscle strain can occur when lifting/pulling/pushing drums.	Drums that are full can weigh as much as 800 lbs. Use a lift assist device whenever possible, and use a team lift approach. When moving soil drum generated by drilling, have drillers use their equipment to move the drums. Using dolly, slightly lift drum away from dolly to install forks under drum. Slowly let drum come back down and rest on dolly. Using hook on top of dolly, ensure it latches on top of drum bung.	
		3	Body parts can be pinched between lift device, or drum and the ground.	Be aware of hand and foot placement during drum staging. Do not hurry through task.	
		4	When moving, the drum can tip or the dolly could become unstable from uneven ground surface.	Plan travel route with drum prior to moving. With drum secure on dolly, have one employee pull back on dolly, and other employee slowly push back on drum toward dolly. Have second worker act as spotter for traffic, pedestrians, and any trip hazards along the way.	

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	chemical protective suit (specify type)		Required
Eye Protection	faceshield		Required
	safety goggles		Required
Hand Protection	chemical resistant gloves (specify type)	Nitrile	Required
	work gloves (specify type)		Required
Hearing Protection	ear plugs		Required

Supplies

Type	Supply	Description	Required
Miscellaneous	Other	dolly	Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Hubbard, Lauren M HASP Reviewer Approve 7/26/2012	
Employee: **Role** **Review Type** **Completed Date**	Hubbard, Lauren M Quality Reviewer NA 7/27/2012	Reviewed by Corporate H&S Department

Job Safety Analysis

General

JSA ID	166	**Status**	(3) Completed
Job Name	Environmental-Sample cooler handling	**Created Date**	5/1/2009
Task Description	Sample cooler handling	**Completed Date**	05/13/2009
Template	True	**Auto Closed**	False

Client / Project

Client	NYSEG
Project Number	30251446
Project Name	Clyde Former MGP Site
PIC	Keith White
Project Manager	Nicholas (Klaus) Beyrle

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Kudla-Williams, Bailey	04/25/2023	02/06/2023	Higgins, Michael	☑
HASP Reviewer	Moyers, Sam	5/25/2009	5/13/2009	Kundert, Brian	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Transfer field samples to sample packing area	1	Lifting heavy coolers may result in muscle strain especially to lower back.	Use proper lifting techniques and keep back straight. Use buddy system for large coolers, Use mechanical aids like hand trucks if readily available to move coolers. Do not over fill coolers with full sample containers for temporary movement to the sample prep area. Ensure an adequate supply of sample coolers are in field.	
		2	Hazards to hands from broken glass caused by over tightening lids or improper placement in cooler	Inspect all bottles and bottle caps for cracks/leaks before and after filling container. Do not over tighten sample lids. Clean up any broken bottles immediately, avoid contact with sample preservatives. Wear leather gloves when handling broken glass.	
		3	Exposure to chemicals (acid preservatives or site contaminants) on the exterior of sample bottles after filling.	Wear protective gloves for acid preservatives and safety glasses with side shields during all sample container handling activities (before and after filling), Once filled follow project specific HASP PPE requirements for skin and eye protection.	
		4	Samples containing hazardous materials may violate DOT/IATA HazMat shipping regulations	All persons filling a sample bottle or preparing a cooler for shipment must have complete ARCADIS DOT HazMat shipping training. Compare the samples collected to the materials described in the Shipping Determination for the Project and ensure consistent. Re-perform all Shipping determinations if free product is collected and not anticipated during planning.	
2	Sample cooler selection	1	Sample coolers with defective handles, lid hinges, lid hasps cracked or otherwise damaged may result in injury (cuts to hands, crushing of feet if handle breaks etc)	Only use coolers that are new or in like new condition, No rope handled coolers unless part of the manufacturer's handle design.	ARCADIS Shipping Guide US-001
		2	Selection of excessively large coolers introduces lifting hazards once the cooler is filled.	Select coolers and instruct lab to only provide coolers of a size appropriate for the material being shipped. For ordinary sample shipping sample coolers should be 48 quart capacity or smaller to reduce lifting hazards.	
3	Pack Samples	1	Pinch points and abrasions	Beware that lid could slam shut; block/brace	

			to hands from cooler lid closing unexpectedly	if needed; be wary of packing in strong winds. New coolers may be more prone to self closing, tilt cooler back slightly to facilitate keeping lid open.	
		2	Awkward body positions and contact stress to legs and knees when preparing coolers on irregular or hard ground surfaces.	Plan cooler prep activities. Situate cooler where neutral body positions can be maintained if practical, like truck tailgate. Avoid cooler prep on rough gravel surfaces unless knees and legs protected during kneeling.	
		3	Frostbite or potential for oxygen deficiency when packing with dry ice. Contact cold stress to fingers handling blue ice or wet ice	Dry ice temperature is -109.30F. Wear thermal protective gloves. DO NOT TOUCH with bare skin! Dry ice sublimates at room temp and could create oxygen deficiency in closed environment. Maintain adequate ventilation! Do not keep dry ice in cab of truck. Wear gloves when handling blue ice or gaging wet ice. Dry Ice is DOT regulated for air shipping, follow procedures in Shipping Determination.	
4	Sealing, labeling and Marking Cooler	1	Cuts to hands and forearms from strapping tape placement or removing old tape and labels	Do not use a fixed, open-blade knife to remove old tags/labels, USE SCISSORS or other safety style cutting device. Only use devices designed for cutting. Do not hurry through task.	
		2	Lifting and awkward body position hazards from taping heavy coolers, dropping coolers on feet during taping.	Do not hurry through the taping tasks, ensure samples in cooler are evenly distributed in cooler to reduce potential for overhanging cooler falling off edge of tailgate/table when taping.	
		3	Improper labeling and marking may result in violation of DOT/IATA HazMat shipping regulations delaying shipment or resulting in regulatory penalty	Do not deviate from ARCADIS Shipping Guide or Shipping Determination marking or labeling requirements.	
5	Offering sample cooler to a carrier or lab courier for shipment.	1	Lifting heavy coolers may result in muscle strain especially to lower back.	See lifting hazard controls above.	
		2	Carrier refusal to accept cooler may cause shipping delay and/or result in violation of DOT HazMat shipping regulations.	Promptly report all rejected and refused shipments to the ARCADIS DOT Program Manager. Do Not re-offer shipment if carrier requires additional labels markings or paperwork inconsistent with your training or Shipping Determination without contacting the ARCADIS DOT Compliance Manager.	

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Hand Protection	chemical resistant gloves (specify type)	nitrile	Required
	work gloves (specify type)	leather	Required

Supplies

Type	Supply	Description	Required
Miscellaneous	Other	Scissors	Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Moyers, Sam HASP Reviewer Revise 5/11/2009	Kevlar is required? Leather work gloves are listed. i suggest just leather gloves.

Employee:	Moyers, Sam	
Role	HASP Reviewer	
Review Type	Approve	
Completed Date	5/13/2009	

Attachment C
SDSs

Hydrochloric Acid,ACS

SECTION 1 : Identification of the substance/mixture and of the supplier

Product name : **Hydrochloric Acid,ACS**

Manufacturer/Supplier Trade name:

Manufacturer/Supplier Article number: **S25358**

Recommended uses of the product and uses restrictions on use:

Manufacturer Details:

AquaPhoenix Scientific
9 Barnhart Drive, Hanover, PA 17331

Supplier Details:

Fisher Science Education
15 Jet View Drive, Rochester, NY 14624

Emergency telephone number:

Fisher Science Education Emergency Telephone No.: 800-535-5053

SECTION 2 : Hazards identification

Classification of the substance or mixture:

Corrosive
Serious eye damage, category 1
Corrosive to metals, category 1
Skin corrosion, category 1B

Irritant
Specific target organ toxicity following single exposure, category 3

Corr. Metals 1
Corr. Skin 1B
Eye Damage 1
STOT. SE 3

Signal word :Danger

Hazard statements:
May be corrosive to metals
Causes severe skin burns and eye damage
May cause respiratory irritation

Precautionary statements:
If medical advice is needed, have product container or label at hand
Keep out of reach of children
Read label before use
Use only outdoors or in a well-ventilated area
Wear protective gloves/protective clothing/eye protection/face protection
Keep only in original container
Do not get in eyes, on skin, or on clothing
Wash skin thoroughly after handling
IF SWALLOWED: Rinse mouth. Do NOT induce vomiting

IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing
Immediately call a POISON CENTER or doctor/physician
Specific treatment (see supplemental first aid instructions on this label)
Wash contaminated clothing before reuse
Absorb spillage to prevent material damage
Store in a well ventilated place. Keep container tightly closed
Store locked up
Store in corrosive resistant stainless steel container with a resistant inner liner
Dispose of contents and container to an approved waste disposal plant

Other Non-GHS Classification:

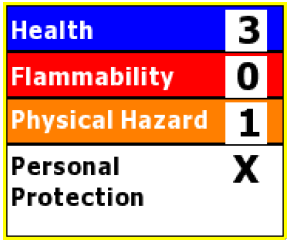
WHMIS

D1A 

E 

NFPA/HMIS

NFPA SCALE (0-4)



HMIS RATINGS (0-4)

SECTION 3 : Composition/information on ingredients

Ingredients:		
CAS 7647-01-0	Hydrochloric Acid, ACS	30-50 %
CAS 7732-18-5	Water	50-70 %
		Percentages are by weight

SECTION 4 : First aid measures

Description of first aid measures

After inhalation: Move exposed individual to fresh air. Loosen clothing as necessary and position individual in a comfortable position.Seek medical attention if irritation or coughing persists.

After skin contact: Wash affected area with soap and water. Immediately remove contaminated clothing and shoes.Rinse thoroughly with plenty of water for at least 15 minutes.Immediately seek medical attention.

After eye contact: Protect unexposed eye. Flush thoroughly with plenty of water for at least 15

minutes.Remove contact lenses while rinsing.Continue rinsing eyes during transport to hospital.

After swallowing: Rinse mouth thoroughly. Do not induce vomiting. Have exposed individual drink sips of water. Immediately seek medical attention.

Most important symptoms and effects, both acute and delayed:

Inhalation may cause irritation to nose and upper respiratory tract, ulceration, coughing, chest tightness and shortness of breath. Higher concentrations cause tachypnoea, pulmonary oedema and suffocation . Ingestion may cause corrosion of lips, mouth, oesophagus and stomach, dysphagia and vomiting.Pain, eye ulceration, conjunctival irritation, cataracts and glaucoma may occur following eye exposure.Erythema and skin irritation, as well as chemical burns to skin and mucous membranes may arise following skin exposure.;Potential sequelae following ingestion of hydrochloric acid include perforation, scarring of the oesophagus or stomach and stricture formation causing dysphagia or gastric outlet obstruction. In some cases, RADS may develop. Respiratory symptoms may take up to 36 hours to develop.Symptoms of burning sensation, cough, wheezing, laryngitis, shortness of breath, spasm, inflammation, edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema. Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin.

Indication of any immediate medical attention and special treatment needed:

Provide SDS to Physician.Physician should treat symptomatically.

SECTION 5 : Firefighting measures

Extinguishing media

Suitable extinguishing agents: Use water, dry chemical, chemical foam, carbon dioxide, or alcohol-resistant foam.

For safety reasons unsuitable extinguishing agents:

Special hazards arising from the substance or mixture:

Combustion products may include carbon oxides or other toxic vapors.If in contact with metals toxic fumes may be released.

Advice for firefighters:

Protective equipment: Wear protective eyeware, gloves, and clothing. Refer to Section 8. Wear respiratory protection.

Additional information (precautions): Thermal decomposition can produce poisoning chlorine. Hydrochloric acid reacts also with many organic materials with liberation of heat.Avoid inhaling gases, fumes, dust, mist, vapor, and aerosols. Avoid contact with skin, eyes, and clothing.

SECTION 6 : Accidental release measures

Personal precautions, protective equipment and emergency procedures:

Ensure adequate ventilation. Ensure that air-handling systems are operational.

Environmental precautions:

Should not be released into environment. Prevent from reaching drains, sewer, or waterway.

Methods and material for containment and cleaning up:

Always obey local regulations. If necessary use trained response staff or contractor. Evacuate personnel to safe areas. Containerize for disposal. Refer to Section 13. Keep in suitable closed containers for disposal. Soak up with inert absorbent material and dispose of as hazardous waste. Cover spill with soda ash or calcium carbonate. Mix and add water to form slurry.Wear protective eyeware, gloves, and clothing. Refer to Section 8.

Reference to other sections:

SECTION 7 : Handling and storage

Precautions for safe handling:

Prevent formation of aerosols. Never use hot water and never add water to the acid.Do not allow contact between hydrochloric acid, metal, and organics.Follow good hygiene procedures when handling chemical materials. Refer to Section 8. Prevent contact with skin, eyes, and clothing. Follow proper disposal methods. Refer to Section 13. Do not eat, drink, smoke, or use personal products when handling chemical substances. Use only in well ventilated areas.Avoid splashes or spray in enclosed areas.

Conditions for safe storage, including any incompatibilities:

Store in a cool location. Keep away from food and beverages. Protect from freezing and physical damage. Store away from incompatible materials. Provide ventilation for containers. Keep container tightly sealed.Containers for hydrochloric acid must be made from corrosion resistant materials: glass, polyethylene, polypropylene, polyvinyl chloride, carbon steel lined with rubber or ebonite.

SECTION 8 : Exposure controls/personal protection




Control Parameters: 7647-01-0, Hydrochloric Acid, ACGIH: 2 ppm Ceiling
7647-01-0, Hydrochloric Acid, NIOSH: 5 ppm Ceiling; 7 mg/m3 Ceiling

Appropriate Engineering controls: Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapor and mists below the applicable workplace exposure limits (Occupational Exposure Limits-OELs) indicated above. Emergency eye wash fountains and safety showers should be available in the immediate vicinity of handling.

Respiratory protection: Not required under normal conditions of use. Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. When necessary use NIOSH approved breathing equipment.

Protection of skin: Select glove material impermeable and resistant to the substance. Select glove material based on rates of diffusion and degradation. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Use proper glove removal technique without touching outer surface. Avoid skin contact with used gloves. Wear protective clothing.

Eye protection: Faceshield (8-inch minimum).Tightly fitting safety goggles.

General hygienic measures: Perform routine housekeeping. Wash hands before breaks and immediately after handling the product. Avoid contact with skin, eyes, and clothing. Before rewearing wash contaminated clothing.

SECTION 9 : Physical and chemical properties

Appearance (physical state,color):	Clear, colorless liquid.	**Explosion limit lower**: **Explosion limit upper**:	Non Explosive Non Explosive
Odor:	Pungent odor	**Vapor pressure**:	5.7mmHg @ 0C
Odor threshold:	0.3 – 14.9 mg/m3	**Vapor density**:	1.27 (Air=1)
pH-value:	< 1	**Relative density**:	1.0 - 1.2

Melting/Freezing point:	- 74 C	**Solubilities**:	Miscible
Boiling point/Boiling range:	81.5 - 110 C	**Partition coefficient (n-octanol/water)**:	Not Determined
Flash point (closed cup):	Not Applicable	**Auto/Self-ignition temperature**:	Not Determined
Evaporation rate:	>1.00	**Decomposition temperature**:	Not Determined
Flammability (solid,gaseous):	non combustible	**Viscosity**:	a. Kinematic:Not Determined b. Dynamic: Not Determined
Density: Not Determined **Hydrochloric Acid:**MW is36.46			

SECTION 10 : Stability and reactivity

Reactivity: Reacts violently with bases and is corrosive.
Chemical stability: No decomposition if used and stored according to specifications.
Possible hazardous reactions: Attacks many metals in the presence of water forming flammable explosive gas (hydrogen).Reacts violently with oxidants forming toxic gas (chlorine).
Conditions to avoid: Incompatible materials.
Incompatible materials: Bases, Amines, Alkali metals, Metals, permanganates (potassium permanganate), Fluorine, Metal acetylides, Hexalithium disilicide.
Hazardous decomposition products: Hydrogen chloride gas.Carbon oxides.

SECTION 11 : Toxicological information

Acute Toxicity:		
Inhalation:	7647-01-0	LD50 Rat 3124 ppm/hour
Oral:	7647-01-0	LD50 Rat 238 - 277 mg/kg
Dermal:	7647-01-0	LD50 Rabbit >5010 mg/kg
Chronic Toxicity: No additional information.		
Corrosion Irritation:		
Dermal:	7647-01-0	Skin - rabbit Result: Causes burns.
Ocular:	7647-01-0	Eyes - rabbit Result: Corrosive to eyes
Sensitization:		No additional information.
Single Target Organ (STOT):		7647-01-0: The substance or mixture is classified as specific target organ toxicant, single exposure, category 3 with respiratory tract irritation.
Numerical Measures:		No additional information.
Carcinogenicity:		No additional information.
Mutagenicity:		No additional information.

Reproductive Toxicity:	No additional information.

SECTION 12 : Ecological information

Ecotoxicity

7647-01-0: Toxicity to fish LC50 - Gambusia affinis (Mosquito fish) - 282 mg/l - 96 h (Hydrochloric acid)

Persistence and degradability:
Bioaccumulative potential:
Mobility in soil:
Other adverse effects:

SECTION 13 : Disposal considerations

Waste disposal recommendations:

Do not allow product to reach sewage system or open water.It is the responsibility of the waste generator to properly characterize all waste materials according to applicable regulatory entities (US 40CFR262.11). Contact a licensed professional waste disposal service to dispose of this material. Dispose of empty containers as unused product. Product or containers must not be disposed together with household garbage. Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations. Ensure complete and accurate classification.

SECTION 14 : Transport information

UN-Number

1789

UN proper shipping name

HYDROCHLORIC ACID

Transport hazard class(es)

Class:
8 Corrosive substances

Packing group:II
Environmental hazard:
Transport in bulk:
Special precautions for user:

SECTION 15 : Regulatory information

United States (USA)

SARA Section 311/312 (Specific toxic chemical listings):

Acute

SARA Section 313 (Specific toxic chemical listings):

7647-01-0 Hydrochloric Acid

RCRA (hazardous waste code):

None of the ingredients is listed

TSCA (Toxic Substances Control Act):

All ingredients are listed.

CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act):

7647-01-0 Hydrochloric Acid 5000 lbs

Proposition 65 (California):

Chemicals known to cause cancer:

None of the ingredients is listed

Chemicals known to cause reproductive toxicity for females:

None of the ingredients is listed

Chemicals known to cause reproductive toxicity for males:

None of the ingredients is listed

Chemicals known to cause developmental toxicity:

None of the ingredients is listed

Canada

Canadian Domestic Substances List (DSL):

All ingredients are listed.

Canadian NPRI Ingredient Disclosure list (limit 0.1%):

None of the ingredients is listed

Canadian NPRI Ingredient Disclosure list (limit 1%):

7647-01-0 Hydrochloric Acid

SECTION 16 : Other information

This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the SDS contains all the information required by the Controlled Products Regulations.Note:. The responsibility to provide a safe workplace remains with the user.The user should consider the health hazards and safety information contained herein as a guide and should take those precautions required in an individual operation to instruct employees and develop work practice procedures for a safe work environment.The information contained herein is, to the best of our knowledge and belief, accurate.However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by the use of this material.It is the responsibility of the user to comply with all applicable laws and regulations applicable to this material.

GHS Full Text Phrases:

Abbreviations and acronyms:

IMDG: International Maritime Code for Dangerous Goods
PNEC: Predicted No-Effect Concentration (REACH)
CFR: Code of Federal Regulations (USA)
SARA: Superfund Amendments and Reauthorization Act (USA)
RCRA: Resource Conservation and Recovery Act (USA)
TSCA: Toxic Substances Control Act (USA)
NPRI: National Pollutant Release Inventory (Canada)
DOT: US Department of Transportation
IATA: International Air Transport Association
GHS: Globally Harmonized System of Classification and Labelling of Chemicals
ACGIH: American Conference of Governmental Industrial Hygienists
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)

HMIS: Hazardous Materials Identification System (USA)
WHMIS: Workplace Hazardous Materials Information System (Canada)
DNEL: Derived No-Effect Level (REACH)

Effective date : 01.08.2015
Last updated : 03.20.2015

SAFETY DATA SHEET

Isobutylene

Section 1. Identification

GHS product identifier : Isobutylene

Chemical name : 2-methylpropene

Other means of identification : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene)

Product use : Synthetic/Analytical chemistry.

Synonym : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene)

SDS # : 001031

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : FLAMMABLE GASES - Category 1
GASES UNDER PRESSURE - Liquefied gas

GHS label elements

Hazard pictograms :

Signal word : Danger

Hazard statements : Extremely flammable gas.
May form explosive mixtures with air.
Contains gas under pressure; may explode if heated.
May cause frostbite.
May displace oxygen and cause rapid suffocation.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Always keep container in upright position. Approach suspected leak area with caution.

Prevention : Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

Response : Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.

Storage : Protect from sunlight when ambient temperature exceeds 52°C/125°F. Store in a well-ventilated place.

Disposal : Not applicable.

Hazards not otherwise classified : In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Chemical name : 2-methylpropene

Other means of identification : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene)

CAS number/other identifiers

CAS number : 115-11-7

Product code : 001031

Ingredient name	%	CAS number
Isobutylene	100	115-11-7

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Section 4. First aid measures

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : Contains gas under pressure. Extremely flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.

Large spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid contact with eyes, skin and clothing. Avoid breathing gas. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Empty containers retain product residue and can be hazardous. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Keep container tightly closed and sealed until ready for use. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Isobutylene	**ACGIH TLV (United States, 3/2015).** TWA: 250 ppm 8 hours.

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Section 8. Exposure controls/personal protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Gas. [Liquefied compressed gas.]

Color : Colorless.

Molecular weight : 56.12 g/mole

Molecular formula : C4-H8

Boiling/condensation point : -6.9°C (19.6°F)

Melting/freezing point : -140.7°C (-221.3°F)

Critical temperature : 144.75°C (292.6°F)

Odor : Characteristic.

Odor threshold : Not available.

pH : Not available.

Flash point : Closed cup: -76.1°C (-105°F)

Burning time : Not applicable.

Burning rate : Not applicable.

Evaporation rate : Not available.

Flammability (solid, gas) : Extremely flammable in the presence of the following materials or conditions: open flames, sparks and static discharge and oxidizing materials.

Lower and upper explosive (flammable) limits : Lower: 1.8%
Upper: 9.6%

Vapor pressure : 24.3 (psig)

Vapor density : 1.94 (Air = 1)

Specific Volume (ft^3/lb) : 6.6845

Gas Density (lb/ft^3) : 0.1496 (25°C / 77 to °F)

Relative density : Not applicable.

Solubility : Not available.

Solubility in water : 0.263 g/l

Partition coefficient: n-octanol/water : 2.34

Auto-ignition temperature : 465°C (869°F)

Decomposition temperature : Not available.

SADT : Not available.

Section 9. Physical and chemical properties

Viscosity : Not applicable.

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.

Incompatible materials : Oxidizers

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Isobutylene	LC50 Inhalation Vapor	Rat	550000 mg/m³	4 hours

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Section 11. Toxicological information

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
Isobutylene	2.34	-	low

Section 12. Ecological information

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1055	UN1055	UN1055	UN1055	UN1055
UN proper shipping name	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE
Transport hazard class(es)	2.1 	2.1 	2.1 	2.1 	2.1 
Packing group	-	-	-	-	-
Environment	No.	No.	No.	No.	No.
Additional information	**Limited quantity** Yes. **Packaging instruction** **Passenger aircraft** Quantity limitation: Forbidden. **Cargo aircraft** Quantity limitation: 150 kg **Special provisions** 19, T50	Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2). **Explosive Limit and Limited Quantity Index** 0.125 **ERAP Index** 3000 **Passenger Carrying Ship Index** Forbidden **Passenger Carrying Road or Rail Index** Forbidden **Special provisions** 29	-	-	**Passenger and Cargo Aircraft**Quantity limitation: 0 Forbidden **Cargo Aircraft Only** Quantity limitation: 150 kg

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Section 14. Transport information

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined

United States inventory (TSCA 8b): This material is listed or exempted.

Clean Air Act (CAA) 112 regulated flammable substances: isobutylene

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Fire hazard
Sudden release of pressure

Composition/information on ingredients

Name	%	Fire hazard	Sudden release of pressure	Reactive	Immediate (acute) health hazard	Delayed (chronic) health hazard
Isobutylene	100	Yes.	Yes.	No.	No.	No.

State regulations

Massachusetts : This material is listed.

New York : This material is not listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

International regulations

International lists

National inventory

Australia : This material is listed or exempted.

Canada : This material is listed or exempted.

China : This material is listed or exempted.

Europe : This material is listed or exempted.

Japan : This material is listed or exempted.

Malaysia : Not determined.

Section 15. Regulatory information

New Zealand : This material is listed or exempted.

Philippines : This material is listed or exempted.

Republic of Korea : This material is listed or exempted.

Taiwan : This material is listed or exempted.

Canada

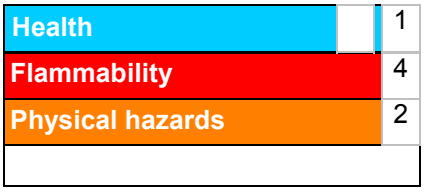
WHMIS (Canada) : Class A: Compressed gas.
Class B-1: Flammable gas.

CEPA Toxic substances: This material is not listed.
Canadian ARET: This material is not listed.
Canadian NPRI: This material is listed.
Alberta Designated Substances: This material is not listed.
Ontario Designated Substances: This material is not listed.
Quebec Designated Substances: This material is not listed.

Section 16. Other information

Canada Label requirements : Class A: Compressed gas.
Class B-1: Flammable gas.

Hazardous Material Information System (U.S.A.)



Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on SDSs under 29 CFR 1910. 1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

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

Reprinted with permission from NFPA 704-2001, Identification of the Hazards of Materials for Emergency Response Copyright ©1997, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the National Fire Protection Association, on the referenced subject which is represented only by the standard in its entirety.

Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
Flam. Gas 1, H220 Press. Gas Liq. Gas, H280	Expert judgment Expert judgment

History

Date of printing : 7/11/2016

Date of issue/Date of revision : 7/11/2016

Date of previous issue : No previous validation

Section 16. Other information

Version : 0.01

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References : Not available.

Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

SAFETY DATA SHEET

51601

Section 1. Identification

Product name : KRYLON® ColorMaster™ with Covermax™ Technology Paint + Primer Gloss Black

Product code : 51601

Other means of identification : Not available.

CAS # : Not applicable.

Product type : Aerosol.

Relevant identified uses of the substance or mixture and uses advised against

Not applicable.

Manufacturer : Krylon Products Group
101 Prospect Avenue NW
Cleveland, OH 44115

Emergency telephone number of the company : US / Canada: (216) 566-2917
Mexico: SETIQ 01-800-00-214-00 / D.F. 5559-1588 24 hours / 365 days a year

Product Information Telephone Number : US / Canada: (800) 457-9566
Mexico: Not Available

Regulatory Information Telephone Number : US / Canada: (216) 566-2902
Mexico: Not Available

Transportation Emergency Telephone Number : US / Canada: (800) 424-9300
Mexico: SETIQ 01-800-00-214-00 / D.F. 5559-1588 24 hours / 365 days a year

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : FLAMMABLE AEROSOLS - Category 1
GASES UNDER PRESSURE - Compressed gas
SKIN CORROSION/IRRITATION - Category 2
SERIOUS EYE DAMAGE/ EYE IRRITATION - Category 2A
CARCINOGENICITY - Category 2
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Narcotic effects) - Category 3
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) - Category 2
ASPIRATION HAZARD - Category 1

Percentage of the mixture consisting of ingredient(s) of unknown acute toxicity: 31.4%

GHS label elements

Hazard pictograms :

Signal word : Danger

Section 2. Hazards identification

Hazard statements : Extremely flammable aerosol.
Contains gas under pressure; may explode if heated.
Causes serious eye irritation.
Causes skin irritation.
Suspected of causing cancer.
May be fatal if swallowed and enters airways.
May cause respiratory irritation.
May cause drowsiness or dizziness.
May cause damage to organs through prolonged or repeated exposure.

Precautionary statements

General : Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand.

Prevention : Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear protective gloves. Wear eye or face protection. Wear protective clothing. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Do not spray on an open flame or other ignition source. Use only outdoors or in a well-ventilated area. Do not breathe dust or mist. Wash hands thoroughly after handling. Pressurized container: Do not pierce or burn, even after use.

Response : Get medical attention if you feel unwell. IF exposed or concerned: Get medical attention. IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or physician if you feel unwell. IF SWALLOWED: Immediately call a POISON CENTER or physician. Do NOT induce vomiting. IF ON SKIN: Wash with plenty of soap and water. Take off contaminated clothing and wash it before reuse. If skin irritation occurs: Get medical attention. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical attention.

Storage : Store locked up. Protect from sunlight. Do not expose to temperatures exceeding 50 °C/122 °F. Store in a well-ventilated place.

Disposal : Dispose of contents and container in accordance with all local, regional, national and international regulations.

Supplemental label elements : DELAYED EFFECTS FROM LONG TERM OVEREXPOSURE. Contains solvents which can cause permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents can be harmful or fatal. WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

Please refer to the SDS for additional information. Keep out of reach of children. Keep upright in a cool, dry place. Do not discard empty can in trash compactor.

Hazards not otherwise classified : DANGER: Rags, steel wool, other waste soaked with this product, and sanding residue may spontaneously catch fire if improperly discarded. Immediately place rags, steel wool, other waste soaked with this product, and sanding residue in a sealed, water-filled, metal container. Dispose of in accordance with local fire regulations.

Section 3. Composition/information on ingredients

Substance/mixture : Mixture

Other means of identification : Not available.

CAS number/other identifiers

Section 3. Composition/information on ingredients

Ingredient name	% by weight	CAS number
Acetone	25.48	67-64-1
Propane	20.4	74-98-6
Lt. Aliphatic Hydrocarbon Solvent	10.98	64742-89-8
n-Butyl Acetate	10.13	123-86-4
Butane	9.6	106-97-8
Ethyl 3-Ethoxypropionate	4	763-69-9
Xylene	1.5	1330-20-7
Carbon Black	1.12	1333-86-4
Ethylbenzene	0.34	100-41-4

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention. If necessary, call a poison center or physician. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Continue to rinse for at least 10 minutes. Get medical attention. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : Get medical attention immediately. Call a poison center or physician. Wash out mouth with water. Remove dentures if any. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Stop if the exposed person feels sick as vomiting may be dangerous. Aspiration hazard if swallowed. Can enter lungs and cause damage. Do not induce vomiting. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : Causes serious eye irritation.

Inhalation : Can cause central nervous system (CNS) depression. May cause drowsiness or dizziness. May cause respiratory irritation.

Skin contact : Causes skin irritation.

Ingestion : Can cause central nervous system (CNS) depression. May be fatal if swallowed and enters airways.

Over-exposure signs/symptoms

Section 4. First aid measures

Eye contact : Adverse symptoms may include the following:
pain or irritation
watering
redness

Inhalation : Adverse symptoms may include the following:
respiratory tract irritation
coughing
nausea or vomiting
headache
drowsiness/fatigue
dizziness/vertigo
unconsciousness

Skin contact : Adverse symptoms may include the following:
irritation
redness

Ingestion : Adverse symptoms may include the following:
nausea or vomiting

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : Extremely flammable aerosol. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. Gas may accumulate in low or confined areas or travel a considerable distance to a source of ignition and flash back, causing fire or explosion. Bursting aerosol containers may be propelled from a fire at high speed. Runoff to sewer may create fire or explosion hazard.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. In the case of aerosols being ruptured, care should be taken due to the rapid escape of the pressurized contents and propellant. If a large number of containers are ruptured, treat as a bulk material spillage according to the instructions in the clean-up section. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Dilute with water and mop up if water-soluble. Alternatively, or if water-insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large spill : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see Section 13). Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Pressurized container: protect from sunlight and do not expose to temperatures exceeding 50°C. Do not pierce or burn, even after use. Avoid exposure - obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not get in eyes or on skin or clothing. Do not breathe vapor or mist. Do not swallow. Avoid breathing gas. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Empty containers retain product residue and can be hazardous.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Protect from sunlight. Store locked up. Eliminate all ignition sources. Use appropriate containment to avoid environmental contamination.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits (OSHA United States)

Ingredient name	Exposure limits
Acetone	**ACGIH TLV (United States, 3/2016).** TWA: 250 ppm 8 hours. STEL: 500 ppm 15 minutes. **NIOSH REL (United States, 10/2013).** TWA: 250 ppm 10 hours. TWA: 590 mg/m³ 10 hours. **OSHA PEL (United States, 6/2016).** TWA: 1000 ppm 8 hours. TWA: 2400 mg/m³ 8 hours.
Propane	**NIOSH REL (United States, 10/2013).** TWA: 1000 ppm 10 hours. TWA: 1800 mg/m³ 10 hours. **OSHA PEL (United States, 6/2016).** TWA: 1000 ppm 8 hours. TWA: 1800 mg/m³ 8 hours.
Lt. Aliphatic Hydrocarbon Solvent	None.
n-Butyl Acetate	**NIOSH REL (United States, 10/2013).** TWA: 150 ppm 10 hours. TWA: 710 mg/m³ 10 hours. STEL: 200 ppm 15 minutes. STEL: 950 mg/m³ 15 minutes. **OSHA PEL (United States, 6/2016).** TWA: 150 ppm 8 hours. TWA: 710 mg/m³ 8 hours. **ACGIH TLV (United States, 3/2016).** STEL: 150 ppm 15 minutes. TWA: 50 ppm 8 hours.
Butane	**NIOSH REL (United States, 10/2013).** TWA: 800 ppm 10 hours. TWA: 1900 mg/m³ 10 hours. **ACGIH TLV (United States, 3/2016).** STEL: 1000 ppm 15 minutes.
Ethyl 3-Ethoxypropionate	None.
Xylene	**ACGIH TLV (United States, 3/2016).** TWA: 100 ppm 8 hours. TWA: 434 mg/m³ 8 hours. STEL: 150 ppm 15 minutes. STEL: 651 mg/m³ 15 minutes. **OSHA PEL (United States, 6/2016).** TWA: 100 ppm 8 hours. TWA: 435 mg/m³ 8 hours.
Carbon Black	**NIOSH REL (United States, 10/2013).** TWA: 3.5 mg/m³ 10 hours. TWA: 0.1 mg of PAHs/cm³ 10 hours. **OSHA PEL (United States, 6/2016).** TWA: 3.5 mg/m³ 8 hours. **ACGIH TLV (United States, 3/2016).** TWA: 3 mg/m³ 8 hours. Form: Inhalable fraction
Ethylbenzene	**ACGIH TLV (United States, 3/2016).** TWA: 20 ppm 8 hours. **NIOSH REL (United States, 10/2013).** TWA: 100 ppm 10 hours. TWA: 435 mg/m³ 10 hours.

	STEL: 125 ppm 15 minutes. STEL: 545 mg/m³ 15 minutes. **OSHA PEL (United States, 6/2016).** TWA: 100 ppm 8 hours. TWA: 435 mg/m³ 8 hours.

Occupational exposure limits (Canada)

Ingredient name	Exposure limits
Acetone	**CA Alberta Provincial (Canada, 4/2009).** 8 hrs OEL: 1200 mg/m³ 8 hours. 15 min OEL: 1800 mg/m³ 15 minutes. 8 hrs OEL: 500 ppm 8 hours. 15 min OEL: 750 ppm 15 minutes. **CA British Columbia Provincial (Canada, 5/2015).** TWA: 250 ppm 8 hours. STEL: 500 ppm 15 minutes. **CA Ontario Provincial (Canada, 7/2015).** TWA: 500 ppm 8 hours. STEL: 750 ppm 15 minutes. **CA Quebec Provincial (Canada, 1/2014).** TWAEV: 500 ppm 8 hours. TWAEV: 1190 mg/m³ 8 hours. STEV: 1000 ppm 15 minutes. STEV: 2380 mg/m³ 15 minutes. **CA Saskatchewan Provincial (Canada, 7/2013).** STEL: 750 ppm 15 minutes. TWA: 500 ppm 8 hours.
Propane	**CA Alberta Provincial (Canada, 4/2009).** 8 hrs OEL: 1000 ppm 8 hours. **CA British Columbia Provincial (Canada, 5/2015).** TWA: 1000 ppm 8 hours. **CA Quebec Provincial (Canada, 1/2014).** TWAEV: 1000 ppm 8 hours. TWAEV: 1800 mg/m³ 8 hours. **CA Ontario Provincial (Canada, 7/2015).** TWA: 1000 ppm 8 hours. **CA Saskatchewan Provincial (Canada, 7/2013).** STEL: 1250 ppm 15 minutes. TWA: 1000 ppm 8 hours.
n-Butyl Acetate	**CA Alberta Provincial (Canada, 4/2009).** 15 min OEL: 200 ppm 15 minutes. 15 min OEL: 950 mg/m³ 15 minutes. 8 hrs OEL: 150 ppm 8 hours. 8 hrs OEL: 713 mg/m³ 8 hours. **CA British Columbia Provincial (Canada, 5/2015).** TWA: 20 ppm 8 hours. **CA Ontario Provincial (Canada, 7/2015).** TWA: 150 ppm 8 hours. STEL: 200 ppm 15 minutes. **CA Quebec Provincial (Canada, 1/2014).** TWAEV: 150 ppm 8 hours. TWAEV: 713 mg/m³ 8 hours. STEV: 200 ppm 15 minutes.

	STEV: 950 mg/m³ 15 minutes. **CA Saskatchewan Provincial (Canada, 7/2013).** STEL: 200 ppm 15 minutes. TWA: 150 ppm 8 hours.

Occupational exposure limits (Mexico)

Ingredient name	Exposure limits
Acetone	**NOM-010-STPS (Mexico, 4/2016).** LMPE-PPT: 500 ppm 8 hours. LMPE-CT: 750 ppm 15 minutes.
Propane	**NOM-010-STPS (Mexico, 4/2016).** LMPE-PPT: 1000 ppm 8 hours.
n-Butyl Acetate	**NOM-010-STPS (Mexico, 4/2016).** LMPE-PPT: 150 ppm 8 hours. LMPE-CT: 200 ppm 15 minutes.
Butane	**NOM-010-STPS (Mexico, 4/2016).** LMPE-PPT: 1000 ppm 8 hours.
Xylene	**NOM-010-STPS (Mexico, 4/2016).** LMPE-CT: 150 ppm 15 minutes. LMPE-PPT: 100 ppm 8 hours.

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: chemical splash goggles.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Section 8. Exposure controls/personal protection

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use.

Section 9. Physical and chemical properties

Appearance

Physical state : Liquid.

Color : Not available.

Odor : Not available.

Odor threshold : Not available.

pH : 7

Melting point : Not available.

Boiling point : Not available.

Flash point : Closed cup: -29°C (-20.2°F) [Pensky-Martens Closed Cup]

Evaporation rate : 5.6 (butyl acetate = 1)

Flammability (solid, gas) : Not available.

Lower and upper explosive (flammable) limits : Lower: 0.9%
Upper: 12.8%

Vapor pressure : 101.3 kPa (760 mm Hg) [at 20°C]

Vapor density : 1.55 [Air = 1]

Relative density : 0.72

Solubility : Not available.

Partition coefficient: n-octanol/water : Not available.

Auto-ignition temperature : Not available.

Decomposition temperature : Not available.

Viscosity : Kinematic (40°C (104°F)): <0.205 cm^2/s (<20.5 cSt)

Molecular weight : Not applicable.

Aerosol product

Type of aerosol : Spray

Heat of combustion : 29.64 kJ/g

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame).

Incompatible materials : No specific data.

Section 10. Stability and reactivity

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Acetone	LD50 Oral	Rat	5800 mg/kg	-
n-Butyl Acetate	LD50 Dermal	Rabbit	>17600 mg/kg	-
	LD50 Oral	Rat	10768 mg/kg	-
Butane	LC50 Inhalation Vapor	Rat	658000 mg/m³	4 hours
Ethyl 3-Ethoxypropionate	LD50 Oral	Rat	3200 mg/kg	-
Xylene	LC50 Inhalation Gas.	Rat	5000 ppm	4 hours
	LD50 Oral	Rat	4300 mg/kg	-
Carbon Black	LD50 Oral	Rat	>15400 mg/kg	-
Ethylbenzene	LD50 Dermal	Rabbit	>5000 mg/kg	-
	LD50 Oral	Rat	3500 mg/kg	-

Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
Acetone	Eyes - Mild irritant	Human	-	186300 parts per million	-
	Eyes - Mild irritant	Rabbit	-	10 microliters	-
	Eyes - Moderate irritant	Rabbit	-	24 hours 20 milligrams	-
	Eyes - Severe irritant	Rabbit	-	20 milligrams	-
	Skin - Mild irritant	Rabbit	-	24 hours 500 milligrams	-
	Skin - Mild irritant	Rabbit	-	395 milligrams	-
n-Butyl Acetate	Eyes - Moderate irritant	Rabbit	-	100 milligrams	-
	Skin - Moderate irritant	Rabbit	-	24 hours 500 milligrams	-
Ethyl 3-Ethoxypropionate	Skin - Mild irritant	Rabbit	-	24 hours 500 milligrams	-
Xylene	Eyes - Mild irritant	Rabbit	-	87 milligrams	-
	Eyes - Severe irritant	Rabbit	-	24 hours 5 milligrams	-
	Skin - Mild irritant	Rat	-	8 hours 60 microliters	-
	Skin - Moderate irritant	Rabbit	-	24 hours 500 milligrams	-
	Skin - Moderate irritant	Rabbit	-	100 Percent	-
Ethylbenzene	Eyes - Severe irritant	Rabbit	-	500 milligrams	-
	Skin - Mild irritant	Rabbit	-	24 hours 15 milligrams	-

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Classification

Section 11. Toxicological information

Product/ingredient name	OSHA	IARC	NTP
Xylene	-	3	-
Carbon Black	-	2B	-
Ethylbenzene	-	2B	-

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Name	Category	Route of exposure	Target organs
Acetone	Category 3	Not applicable.	Respiratory tract irritation and Narcotic effects
Propane	Category 3	Not applicable.	Respiratory tract irritation and Narcotic effects
Lt. Aliphatic Hydrocarbon Solvent	Category 3	Not applicable.	Respiratory tract irritation and Narcotic effects
n-Butyl Acetate	Category 3	Not applicable.	Narcotic effects
Butane	Category 3	Not applicable.	Respiratory tract irritation and Narcotic effects
Xylene	Category 3	Not applicable.	Respiratory tract irritation and Narcotic effects
Ethylbenzene	Category 3	Not applicable.	Respiratory tract irritation and Narcotic effects

Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
Acetone	Category 2	Not determined	Not determined
Propane	Category 2	Not determined	Not determined
Lt. Aliphatic Hydrocarbon Solvent	Category 2	Not determined	Not determined
Butane	Category 2	Not determined	Not determined
Xylene	Category 2	Not determined	Not determined
Ethylbenzene	Category 2	Not determined	Not determined

Aspiration hazard

Name	Result
Propane	ASPIRATION HAZARD - Category 1
Lt. Aliphatic Hydrocarbon Solvent	ASPIRATION HAZARD - Category 1
Butane	ASPIRATION HAZARD - Category 1
Xylene	ASPIRATION HAZARD - Category 1
Ethylbenzene	ASPIRATION HAZARD - Category 1

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : Causes serious eye irritation.

Inhalation : Can cause central nervous system (CNS) depression. May cause drowsiness or dizziness. May cause respiratory irritation.

Skin contact : Causes skin irritation.

Ingestion : Can cause central nervous system (CNS) depression. May be fatal if swallowed and enters airways.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : Adverse symptoms may include the following:
pain or irritation
watering
redness

Inhalation : Adverse symptoms may include the following:
respiratory tract irritation
coughing
nausea or vomiting
headache
drowsiness/fatigue
dizziness/vertigo
unconsciousness

Skin contact : Adverse symptoms may include the following:
irritation
redness

Ingestion : Adverse symptoms may include the following:
nausea or vomiting

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : May cause damage to organs through prolonged or repeated exposure.

Carcinogenicity : Suspected of causing cancer. Risk of cancer depends on duration and level of exposure.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Route	ATE value
Oral Inhalation (gases)	42934.2 mg/kg 229141 ppm

Section 12. Ecological information

Toxicity

Product/ingredient name	Result	Species	Exposure
Acetone	Acute EC50 7200000 µg/l Fresh water	Algae - Selenastrum sp.	96 hours
	Acute LC50 6000000 µg/l Fresh water	Crustaceans - Gammarus pulex	48 hours
	Acute LC50 6900 mg/l Fresh water	Daphnia - Daphnia magna	48 hours
	Acute LC50 5600 ppm Fresh water	Fish - Poecilia reticulata	96 hours
	Chronic NOEC 4.95 mg/l Marine water	Algae - Ulva pertusa	96 hours
	Chronic NOEC 0.016 ml/L Fresh water	Crustaceans - Daphniidae	21 days
	Chronic NOEC 0.1 ml/L Fresh water	Daphnia - Daphnia magna - Neonate	21 days
Lt. Aliphatic Hydrocarbon Solvent	Acute LC50 >100000 ppm Fresh water	Fish - Oncorhynchus mykiss	96 hours
n-Butyl Acetate	Acute LC50 32 mg/l Marine water	Crustaceans - Artemia salina	48 hours
	Acute LC50 18000 µg/l Fresh water	Fish - Pimephales promelas	96 hours
Xylene	Acute LC50 8500 µg/l Marine water	Crustaceans - Palaemonetes pugio	48 hours
	Acute LC50 13400 µg/l Fresh water	Fish - Pimephales promelas	96 hours
Ethylbenzene	Acute EC50 4600 µg/l Fresh water	Algae - Pseudokirchneriella subcapitata	72 hours
	Acute EC50 3600 µg/l Fresh water	Algae - Pseudokirchneriella subcapitata	96 hours
	Acute EC50 6530 µg/l Fresh water	Crustaceans - Artemia sp. - Nauplii	48 hours
	Acute EC50 2930 µg/l Fresh water	Daphnia - Daphnia magna - Neonate	48 hours
	Acute LC50 4200 µg/l Fresh water	Fish - Oncorhynchus mykiss	96 hours

Persistence and degradability

Product/ingredient name	Aquatic half-life	Photolysis	Biodegradability
Acetone	-	-	Readily
n-Butyl Acetate	-	-	Readily
Xylene	-	-	Readily
Ethylbenzene	-	-	Readily

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
Lt. Aliphatic Hydrocarbon Solvent	-	10 to 2500	high
Xylene	-	8.1 to 25.9	low

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT Classification	TDG Classification	Mexico Classification	IATA	IMDG
UN number	UN1950	UN1950	UN1950	UN1950	UN1950
UN proper shipping name	AEROSOLS	AEROSOLS	AEROSOLS	AEROSOLS, flammable	AEROSOLS
Transport hazard class(es)	2.1 	2.1 	2.1 	2.1 	2.1 
Packing group	-	-	-	-	-
Environmental hazards	No.	No.	No.	No.	No.
Additional information	- **ERG No.** 126	Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2. 13-2.17 (Class 2). **ERG No.** 126	- **ERG No.** 126	-	**Emergency schedules (EmS)** F-D, S-U

Special precautions for user : Multi-modal shipping descriptions are provided for informational purposes and do not consider container sizes. The presence of a shipping description for a particular mode of transport (sea, air, etc.), does not indicate that the product is packaged suitably for that mode of transport. All packaging must be reviewed for suitability prior to shipment, and compliance with the applicable regulations is the sole responsibility of the person offering the product for transport. People loading and unloading dangerous goods must be trained on all of the risks deriving from the substances and on all actions in case of emergency situations.

Transport in bulk according to Annex II of MARPOL and the IBC Code : Not available.

Proper shipping name : Not available.

Ship type : Not available.

Pollution category : Not available.

Section 15. Regulatory information

SARA 313

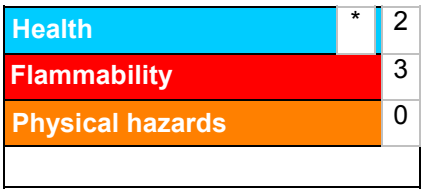
SARA 313 (40 CFR 372.45) supplier notification can be found on the Environmental Data Sheet.

California Prop. 65

WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

Section 16. Other information

Hazardous Material Information System (U.S.A.)



The customer is responsible for determining the PPE code for this material.

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on SDSs under 29 CFR 1910. 1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

Procedure used to derive the classification

Classification	Justification
FLAMMABLE AEROSOLS - Category 1	On basis of test data
GASES UNDER PRESSURE - Compressed gas	Calculation method
SKIN CORROSION/IRRITATION - Category 2	Calculation method
SERIOUS EYE DAMAGE/ EYE IRRITATION - Category 2A	Calculation method
CARCINOGENICITY - Category 2	Calculation method
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3	Calculation method
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Narcotic effects) - Category 3	Calculation method
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) - Category 2	Calculation method
ASPIRATION HAZARD - Category 1	Calculation method

History

Date of printing : 4/19/2017

Date of issue/Date of revision : 4/19/2017

Date of previous issue : 4/12/2017

Version : 7.02

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

Notice to reader

Section 16. Other information

It is recommended that each customer or recipient of this Safety Data Sheet (SDS) study it carefully and consult resources, as necessary or appropriate, to become aware of and understand the data contained in this SDS and any hazards associated with the product. This information is provided in good faith and believed to be accurate as of the effective date herein. However, no warranty, express or implied, is given. The information presented here applies only to the product as shipped. The addition of any material can change the composition, hazards and risks of the product. Products shall not be repackaged, modified, or tinted except as specifically instructed by Sherwin-Williams, including but not limited to the incorporation of non Sherwin-Williams products or the use or addition of products in proportions not specified by Sherwin-Williams. Regulatory requirements are subject to change and may differ between various locations and jurisdictions. The customer/buyer/user is responsible to ensure that his activities comply with all country, federal, state, provincial or local laws. The conditions for use of the product are not under the control of the manufacturer; the customer/buyer/user is responsible to determine the conditions necessary for the safe use of this product. The customer/buyer/user should not use the product for any purpose other than the purpose shown in the applicable section of this SDS without first referring to the supplier and obtaining written handling instructions. Due to the proliferation of sources for information such as manufacturer-specific SDS, the manufacturer cannot be responsible for SDSs obtained from any other source.

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Printing date: 31.12.2013 **Revision:** 31.12.2013

1 Identification of the substance/mixture and of the company/undertaking

· **1.1 Product identifier**

· **Trade name: ALCONOX**

· **1.2 Relevant identified uses of the substance or mixture and uses advised against**
No further relevant information available.

· **Application of the substance / the mixture:** Cleaning material/ Detergent

· **1.3 Details of the supplier of the Safety Data Sheet**

· **Manufacturer/Supplier:**
Alconox, Inc.
30 Glenn St., Suite 309
White Plains, NY 10603
Phone: 914-948-4040

· **Further information obtainable from:** Product Safety Department

· **1.4 Emergency telephone number:**
ChemTel Inc.
(800)255-3924, +1 (813)248-0585

2 Hazards identification

· **2.1 Classification of the substance or mixture**

· **Classification according to Regulation (EC) No 1272/2008**


GHS05 corrosion

Eye Dam. 1; H318: Causes serious eye damage.


GHS07

Skin Irrit. 2; H315: Causes skin irritation.

· **Classification according to Directive 67/548/EEC or Directive 1999/45/EC**


Xi; Irritant

R38-41: Irritating to skin. Risk of serious damage to eyes.

· **Information concerning particular hazards for human and environment:**
The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.

· **Classification system:**
The classification is according to the latest editions of the EU-lists, and extended by company and literature data.
The classification is in accordance with the latest editions of international substances lists, and is supplemented by information from technical literature and by information provided by the company.

· **2.2 Label elements**

· **Labelling according to Regulation (EC) No 1272/2008**
The product is classified and labelled according to the CLP regulation.

(Contd. on page 2)

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Printing date: 31.12.2013 **Revision:** 31.12.2013

Trade name: ALCONOX

(Contd. of page 1)

· **Hazard pictograms**

GHS05

· **Signal word:** Danger

· **Hazard-determining components of labelling:**
sodium dodecylbenzene sulfonate
· **Hazard statements**
H315: Causes skin irritation.
H318: Causes serious eye damage.
· **Precautionary statements**
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P264: Wash thoroughly after handling.
P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310: Immediately call a POISON CENTER or doctor/physician.
P321: Specific treatment (see on this label).
P362: Take off contaminated clothing and wash before reuse.
P332+P313: If skin irritation occurs: Get medical advice/attention.
P302+P352: IF ON SKIN: Wash with plenty of soap and water.
· **Hazard description:**
· **WHMIS-symbols:**
D2B - Toxic material causing other toxic effects

· **NFPA ratings (scale 0 - 4)**

Health = 1
Fire = 0
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**

Health = 1
Fire = 0
Reactivity = 0

· **HMIS Long Term Health Hazard Substances**
None of the ingredients is listed.

· **2.3 Other hazards**
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.

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Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Printing date: 31.12.2013 **Revision:** 31.12.2013

Trade name: ALCONOX

(Contd. of page 2)

3 Composition/information on ingredients

· **3.2 Mixtures**
· **Description:** Mixture of substances listed below with nonhazardous additions.

· **Dangerous components:**		
CAS: 68081-81-2	sodium dodecylbenzene sulfonate Xn R22; Xi R36 Acute Tox. 4, H302; Eye Irrit. 2, H319	10-25%
CAS: 497-19-8 EINECS: 207-838-8 Index number: 011-005-00-2	Sodium Carbonate Xi R36 Eye Irrit. 2, H319	2,5-10%
CAS: 7722-88-5 EINECS: 231-767-1	tetrasodium pyrophosphate substance with a Community workplace exposure limit	2,5-10%
CAS: 151-21-3 EINECS: 205-788-1	sodium dodecyl sulphate Xn R21/22; Xi R36/38 Acute Tox. 4, H302; Acute Tox. 4, H312; Skin Irrit. 2, H315; Eye Irrit. 2, H319	2,5-10%

· **Additional information:** For the wording of the listed risk phrases refer to section 16.

4 First aid measures

· **4.1 Description of first aid measures**
· **After inhalation:** Supply fresh air; consult doctor in case of complaints.
· **After skin contact:**
Immediately wash with water and soap and rinse thoroughly.
If skin irritation continues, consult a doctor.
· **After eye contact:**
Remove contact lenses if worn.
Rinse opened eye for several minutes under running water. If symptoms persist, consult a doctor.
· **After swallowing:**
Rinse out mouth and then drink plenty of water.
Do not induce vomiting; call for medical help immediately.
· **4.2 Most important symptoms and effects, both acute and delayed**
No further relevant information available.
· **4.3 Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

5 Firefighting measures

· **5.1 Extinguishing media**
· **Suitable extinguishing agents:**
CO2, powder or water spray. Fight larger fires with water spray or alcohol resistant foam.

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Safety Data Sheet
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· **5.2 Special hazards arising from the substance or mixture:** No further relevant information available.
· **5.3 Advice for firefighters**
· **Protective equipment:**
Wear self-contained respiratory protective device.
Wear fully protective suit.
· **Additional information:** No further relevant information available.

6 Accidental release measures

· **6.1 Personal precautions, protective equipment and emergency procedures**
Product forms slippery surface when combined with water.
· **6.2 Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
· **6.3 Methods and material for containment and cleaning up:**
Pick up mechanically.
Clean the affected area carefully; suitable cleaners are:
Warm water
· **6.4 Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

7 Handling and storage

· **7.1 Precautions for safe handling**
Prevent formation of dust.
Keep receptacles tightly sealed.
· **Information about fire - and explosion protection:** No special measures required.

· **7.2 Conditions for safe storage, including any incompatibilities**
· **Storage:**
· **Requirements to be met by storerooms and receptacles:** No special requirements.
· **Information about storage in one common storage facility:** Not required.
· **Further information about storage conditions:** Protect from humidity and water.
· **7.3 Specific end use(s):** No further relevant information available.

8 Exposure controls/personal protection

· **Additional information about design of technical facilities:** No further data; see item 7.

· **8.1 Control parameters**

· **Ingredients with limit values that require monitoring at the workplace:**	
7722-88-5 tetrasodium pyrophosphate	
REL (USA)	5 mg/m³
TLV (USA)	TLV withdrawn
EV (Canada)	5 mg/m³

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· **Additional information:** The lists valid during the making were used as basis.

· **8.2 Exposure controls**
· **Personal protective equipment:**
· **General protective and hygienic measures:**
Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing.
Wash hands before breaks and at the end of work.
Avoid contact with the skin.
Avoid contact with the eyes and skin.
· **Respiratory protection:**
Not required under normal conditions of use.
In case of brief exposure or low pollution use respiratory filter device. In case of intensive or longer exposure use self-contained respiratory protective device.
· **Protection of hands:**


Protective gloves

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation.
· **Material of gloves**
Butyl rubber, BR
Nitrile rubber, NBR
Natural rubber, NR
Neoprene gloves
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material cannot be calculated in advance and has therefore to be checked prior to the application.
· **Penetration time of glove material**
The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.
· **Eye protection:**


Safety glasses

· **Body protection:** Protective work clothing

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Safety Data Sheet
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Trade name: ALCONOX

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9 Physical and chemical properties

· **9.1 Information on basic physical and chemical properties**	
· **General Information**	
· **Appearance:**	
Form:	Powder
Colour:	White
· **Odour:**	Odourless
· **Odour threshold:**	Not determined.
· **pH-value (10 g/l) at 20 °C:**	9,5 (- NA for Powder form)
· **Change in condition**	
Melting point/Melting range:	Not Determined.
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Not determined.
· **Ignition temperature:**	
Decomposition temperature:	Not determined.
· **Self-igniting:**	Product is not self-igniting.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapour pressure:**	Not applicable.
· **Density at 20 °C:**	1,1 g/cm³
· **Relative density**	Not determined.
· **Vapour density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with water:**	Soluble.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
· **Solvent content:**	
Organic solvents:	0,0 %
Solids content:	100 %
· **9.2 Other information**	No further relevant information available.

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Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Printing date: 31.12.2013 **Revision:** 31.12.2013

Trade name: ALCONOX

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10 Stability and reactivity

· **10.1 Reactivity**
· **10.2 Chemical stability**
· **Thermal decomposition / conditions to be avoided:**
No decomposition if used according to specifications.
· **10.3 Possibility of hazardous reactions**
Reacts with acids.
Reacts with strong alkali.
Reacts with strong oxidizing agents.
· **10.4 Conditions to avoid:** No further relevant information available.
· **10.5 Incompatible materials:** No further relevant information available.
· **10.6 Hazardous decomposition products:**
Carbon monoxide and carbon dioxide
Phosphorus compounds
Sulphur oxides (SOx)

11 Toxicological information

· **11.1 Information on toxicological effects**
· **Acute toxicity:**
· **Primary irritant effect:**
· **On the skin:** Irritant to skin and mucous membranes.
· **On the eye:** Strong irritant with the danger of severe eye injury.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
The product shows the following dangers according to the calculation method of the General EU Classification Guidelines for Preparations as issued in the latest version:
Irritant
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation of esophagus and stomach.

12 Ecological information

· **12.1 Toxicity**
· **Aquatic toxicity:** No further relevant information available.
· **12.2 Persistence and degradability:** No further relevant information available.
· **12.3 Bioaccumulative potential:** Not worth-mentioning accumulating in organisms
· **12.4 Mobility in soil:** No further relevant information available.
· **Additional ecological information:**
· **General notes:**
Water hazard class 2 (German Regulation) (Self-assessment): hazardous for water.
Do not allow product to reach ground water, water course or sewage system.
Danger to drinking water if even small quantities leak into the ground.
· **12.5 Results of PBT and vPvB assessment**
· **PBT:** Not applicable.

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· **vPvB:** Not applicable.
· **12.6 Other adverse effects:** No further relevant information available.

13 Disposal considerations

· **13.1 Waste treatment methods**
· **Recommendation**
Smaller quantities can be disposed of with household waste.
Small amounts may be diluted with plenty of water and washed away. Dispose of bigger amounts in accordance with Local Authority requirements.
The surfactant used in this product complies with the biodegradability criteria as laid down in Regulation (EC) No. 648/2004 on detergents. Data to support this assertion are held at the disposal of the competent authorities of the Member States and will be made available to them, at their direct request or at the request of a detergent manufacturer.

· **Uncleaned packaging:**
· **Recommendation:** Disposal must be made according to official regulations.
· **Recommended cleansing agents:** Water, if necessary together with cleansing agents.

14 Transport information

· **14.1 UN-Number**	
· **DOT, ADR, IMDG, IATA, ICAO**	Not Regulated
· **14.2 UN proper shipping name**	
· **DOT, ADR, IMDG, IATA, ICAO**	Not Regulated
· **14.3 Transport hazard class(es)**	
· **DOT, ADR, IMDG, IATA, ICAO**	
· **Class**	Not Regulated
· **14.4 Packing group**	
· **DOT, ADR, IMDG, IATA, ICAO**	Not Regulated
· **14.5 Environmental hazards:**	
· **Marine pollutant:**	No
· **14.6 Special precautions for user**	Not applicable.
· **14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	Not Regulated

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Printing date: 31.12.2013 **Revision:** 31.12.2013

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15 Regulatory information

· **15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture**
· **United States (USA)**
· **SARA**

· **Section 355 (extremely hazardous substances):**
None of the ingredients is listed.
· **Section 313 (Specific toxic chemical listings):**
None of the ingredients is listed.
· **TSCA (Toxic Substances Control Act):**
All ingredients are listed.

· **Proposition 65 (California):**

· **Chemicals known to cause cancer:**
None of the ingredients is listed.
· **Chemicals known to cause reproductive toxicity for females:**
None of the ingredients is listed.
· **Chemicals known to cause reproductive toxicity for males:**
None of the ingredients is listed.
· **Chemicals known to cause developmental toxicity:**
None of the ingredients is listed.

· **Carcinogenic Categories**

· **EPA (Environmental Protection Agency)**
None of the ingredients is listed.
· **IARC (International Agency for Research on Cancer)**
None of the ingredients is listed.
· **TLV (Threshold Limit Value established by ACGIH)**
None of the ingredients is listed.
· **NIOSH-Ca (National Institute for Occupational Safety and Health)**
None of the ingredients is listed.
· **OSHA-Ca (Occupational Safety & Health Administration)**
None of the ingredients is listed.

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· **Canada**

· **Canadian Domestic Substances List (DSL)**	
All ingredients are listed.	
· **Canadian Ingredient Disclosure list (limit 0.1%)**	
None of the ingredients is listed.	
· **Canadian Ingredient Disclosure list (limit 1%)**	
497-19-8	Sodium Carbonate
7722-88-5	tetrasodium pyrophosphate
151-21-3	sodium dodecyl sulphate

· **15.2 Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· **Relevant phrases**
H302: Harmful if swallowed.
H312: Harmful in contact with skin.
H315: Causes skin irritation.
H319: Causes serious eye irritation.
R21/22: Harmful in contact with skin and if swallowed.
R22: Harmful if swallowed.
R36: Irritating to eyes.
R36/38: Irritating to eyes and skin.

· **Abbreviations and acronyms:**
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road) IMDG: International Maritime Code for Dangerous Goods DOT: US Department of Transportation
IATA: International Air Transport Association
GHS: Globally Harmonized System of Classification and Labelling of Chemicals
ACGIH: American Conference of Governmental Industrial Hygienists
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
WHMIS: Workplace Hazardous Materials Information System (Canada)

Material Safety Data Sheet

Section 1 – Chemical Product and Company Identification

Catalog Numbers: AC6004-A, AC6004-B, AC6004-C, AC6004-D, AC6004-P, AC6004-Q, AC6004-G, AC6004-T

Product Identity: AutoCal Solution

Chemical Family: Not Applicable
Synonyms: Not Applicable
Recommended Use: Laboratory chemicals

Manufacturer's Name: AquaPhoenix Scientific, Inc., 9 Barnhart Dr., Hanover, PA 17331, (866) 632-1291
Emergency Contact Number (24hr): Chemtel (800) 255-3924

Issue Date: 1/20/11
Revision Date: 02/19/12, 2/12/15

Section 2 – Hazard Identification

Emergency Overview: Non-flammable, non-corrosive, non-toxic. Does not present significant health hazards. Wash areas of contact with water.
Appearance: Clear liquid **Odor:** Odorless
Target Organs: Eyes, skin
Potential Health Effects/ Routes of Exposure:
Eyes: May cause slight irritation.
Skin: May cause slight irritation.
Ingestion: May cause diarrhea, nausea, vomiting, and cramps.
Inhalation: Not likely to be a hazard.
Chronic Effect / Carcinogenicity: None (IARC, NTP, OSHA)
Aggravated Medical Conditions No information available
These chemicals are not considered hazardous by OSHA.
See section 11 for toxicological information. See section 12 for potential environmental effects.

Section 3 – Composition, Information on Ingredients

Potassium Acid Phthalate, CAS# 877-24-7, <1% w/v
Water, purified, CAS# 7732-18-5, >98% w/v

Section 4 – First Aid

Eyes: Immediately flush eyes with water for at least 15 minutes. Immediately get medical assistance.
Skin: Flush with water for 15 minutes. Get medical assistance if irritation develops.
Ingestion: DO NOT induce vomiting. Dilute with water or milk. Get medical assistance.
Inhalation: Remove to fresh air. Give artificial respiration if necessary. If breathing is difficult, give oxygen.
Notes to Physician Treat symptomatically.

Section 5 – Fire Fighting Measures

Flash Point: Not Applicable **Autoignition Temperature** No information available.
Explosion Limits Upper No data available **Lower** No data available
Extinguishing Media: Use means suitable to extinguishing surrounding fire.
Unsuitable Extinguishing Media: No information available
Fire & Explosion Hazards: Not considered to be a fire or explosion hazard.

Fire Fighting Instructions / Equipment: Use normal procedures. Use protective clothing. Use NIOSH-approved breathing equipment.
Hazardous Combustion Products: No information Available
Sensitivity to mechanical impact No information available.
Sensitivity to static discharge No information available.
Specific Hazards Arising from the Chemical: No information available
NFPA Rating: (estimated) Health: 1; Flammable: 0; Reactivity: 0

Section 6 – Accidental Release Measures

Personal Precautions Use personal protective equipment. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing.
Environmental Precautions No information available.
Methods for Containment and Clean Up Absorb with suitable material. Always obey local regulations.

Section 7 – Handling and Storage

Handling: Wash hands after handling. Avoid contact with skin and eyes.
Storage: Protect from freezing and physical damage.

Section 8 – Exposure Controls, Personal Protection

Potassium Acid Phthalate, CAS# 877-24-7, ACGIH TLV: NA, OSHA PEL: NA
Water, purified, CAS# 7732-18-5, ACGIH TLV: NA, OSHA PEL: NA

Engineering Measures/ General Hygiene: Normal ventilation is adequate. Ensure eyewash and safety showers are available.
Personal Protection Equipment: Skin Protection: Chemical resistant gloves.
Eye/Face Protection: Safety Glasses or goggles. **Respiratory Protection:** Normal ventilation is adequate

Section 9 – Physical and Chemical Properties

Appearance/Physical State: Clear liquid
Odor: Odorless
Boiling Point: Approx 100C
Melting Point: Approx 0 C
Vapor Density: No Information Available
Evaporation Rate: No Information Available
pH: 4.0
Flammability: No Information Available
Solubility: Infinite
available
Relative Density: No Information Available

% Volatility: No Information Available
Specific Gravity: Approx 1
Vapor Pressure: No Information Available
Flash Point: Not Applicable
Coefficient of water/oil distribution: Not Available
Odor Threshold: Not Available
Decomposition Temperature: No Information Available
Partition Coefficient n-octanol/water: No data

Molecular Weight: Not available

Section 10 – Stability and Reactivity

Chemical Stability: Stable under normal conditions of use and storage.
Incompatible Materials Nitric Acid.
Conditions to Avoid: No Information Available.
Hazardous Decomposition Products: Oxides of potassium and carbon.
Hazardous Polymerization: Does not occur
Hazardous Reactions: None under normal processing.

Section 11 – Toxicological Information

Routes of Exposure/Symptoms/Corrosiveness – See Section 2
LD50 orl-rat: 3200 mg/kg (Potassium Acid Phthalate) LC50 inhalation-rat: NA
Irritation: No Information Available
Toxicologically Synergistic: No Information Available

Chronic Exposure
Carcinogenicity No Information Available
Sensitization No information available.
Mutagenic Effects No information available.
Reproductive Effects No information available.
Developmental Effects (Immediate/Delayed) No information available.
Teratogenicity No information available.
Other Adverse Effects No Information Available.
Endocrine Disruptor Information No information available

Section 12 – Ecological Information

Ecotoxicity: Not Available.
Persistence and Degradability: No Information Available **Mobility:** No Information Available
Bioaccumulation/ Accumulation: No Information Available

Section 13 – Disposal Considerations

Waste Disposal/Waste Disposal of Packaging: Dilute with water.
All chemical waster generators must determine whether a discarded chemical is classified as hazardous waste. Comply with all local, state, and federal regulations.

Section 14 – Transport Information

DOT - Not Regulated

Section 15 – Regulatory Information (not meant to be all inclusive)

OSHA Status: These chemicals are not considered hazardous by OSHA.
Canada DSL: These chemicals are listed on Canada's DSL list.
TSCA: The components of this solution are listed on the TSCA Inventory
SARA Title III Section 313: Not Applicable
RCRA Status: Not Applicable
CERCLA Reportable Quantity: Not Applicable
WHMIS: Not Applicable.
This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

Section 16 – Additional Information

Disclaimer: The information on this MSDS applies to this specific material as supplied. It may not be valid for this material if it is used in combination with any other materials. It is the user's responsibility to determine the suitability and completeness of this information for his own particular use. No warranty is implied regarding the accuracy of the data or the results to be obtained form the products use.

HI 7021
ORP Solution for Platinum and Gold Electrodes

Safety Data Sheet

According to Regulation (EC) No. 1907/2006
OSHA Regulation 29 CFR 1910.1200
Canadian Regulation SOR/88-66

Revision Date: 2013-06-14
Reason for Revision: Regulation (EC) No. 1272/2008 Compliance

SECTION 1: IDENTIFICATION OF THE PRODUCT AND COMPANY

Product Name: HI 7021 ORP Solution

Application: ORP Solution for Platinum and Gold Electrodes.
240 mV @ 25°C/77°F

Additional Product Codes: HI 7021L
HI 7021M
HI 7021/G

Company Information (USA):
Hanna Instruments, Inc.
584 Park East Dr, Woonsocket, Rhode Island, USA 02895

Technical Service Contact Information:
1-800-426-6287 (8:30AM - 5:00PM ET)
+1-401-766-4260 (8:30AM - 5:00PM ET)

USA Emergency Contact Information: 1-800-424-9300 (Chemtrec 24Hr. Emergency)

International Emergency Contact Information: +1-703-527-3887 (Chemtrec 24Hr. Emergency)

E-mail Address: tech@hannainst.com

SECTION 2: HAZARD IDENTIFICATION

Non-hazardous product as specified in Directives 67/548/EEC and 1999/45/EC.
Non-hazardous product as specified in OSHA Regulation 29 CFR 1910.1200.
Non-hazardous product as specified in Canadian Regulation SOR/88-66.
Non-hazardous product as specified in Regulation (EC) 1272/2008.

SECTION 3: COMPOSITION AND COMPONENT INFORMATION

Aqueous Solution

SECTION 4: FIRST AID MEASURES

After Inhalation: Remove to fresh air.

After Skin Contact: Wash affected area with plenty of water.

After Eye Contact: Rinse out with water.

After Swallowing: Wash out mouth thoroughly with water and give plenty of water to drink. In severe cases obtain medical attention.

General Information: Remove contaminated, soaked clothing immediately and dispose of safely.

SECTION 5: FIRE-FIGHTING MEASURES

Suitable Extinguishing Media:
Water spray, Carbon Dioxide, Dry Chemical Powder, Appropriate Foam.

Special Risks:
Non-combustible.

Special Protective Equipment:
Do not stay in dangerous zone without suitable chemical protection clothing and self-contained breathing apparatus.

Additional Information:
NA

SECTION 6: ACCIDENTAL RELEASE MEASURES

Personal Precautions:

Avoid formation of dusts. Do not inhale dusts. Avoid substance contact.

Environmental Precautions:

Do not discharge into the drains/surface waters/groundwater.

Additional Notes:

Take up with liquid-absorbent material. Clean up affected area and dispose according to local regulation. Avoid generation of dusts.

SECTION 7: HANDLING AND STORAGE

Handling:

Cannot be stored indefinitely.

Storage:

Tightly closed. Store at room temperature (+15 to +25 °C recommended). Protect from light.

SECTION 8: EXPOSURE CONTROL/PERSONAL PROTECTION

Engineering:

Maintain general industrial hygiene practice.

Personal Protective Equipment:

Protective clothing should be selected specifically for the working place, depending on concentration and quantity of the hazardous substances handled.

Respiratory Protection:	***Protective Gloves:***	***Eye Protection:***
Required when vapors/aerosols are generated. Work under hood.	Rubber or plastic	Goggles or face mask

Industrial Hygiene:

Change contaminated clothing. Wash hands after working with substance.

SECTION 9: PHYSICAL/CHEMICAL PROPERTIES

Appearance:	Yellow liquid	***Odor:***	Odorless	***Density at 20°C:***	~ 1 g/cm³
Melting Point:	NA	***Boiling Point:***	ND	***Solubility:***	Soluble
pH at 20°C:	~ 7	***Explosion Limit:***	NA	***Flash Point:***	NA
Thermal Decomp.:	NA				

SECTION 10: STABILITY AND REACTIVITY

Conditions to be Avoided:

Strong Heating

Hazardous Decomposition Products:

None

Hazardous Polymerization:

Will not occur.

Substances to be Avoided:

The generally known reaction partners of water

Further Information:

Not available

SECTION 11: TOXICOLOGICAL INFORMATION

Product Toxicity

No toxic effects are to be expected when the product is handled appropriately.

Component Toxicity

Acute Toxicity:
Not Available

Chronic Toxicity:
Not Available

Additional Data:
Not Available

SECTION 12: ECOLOGICAL INFORMATION

No environmental hazard.

Further Data: Can be safely disposed off as ordinary refuse.

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal:

SECTION 14: TRANSPORTATION INFORMATION

Land:	***Sea:***	***Air:***
Not subject to transport regulations	Not subject to transport regulations	Not subject to transport regulations

SECTION 15: REGULATORY INFORMATION

Complies with European Regulations (EC) No. 1907/2006 and No. 1272/2008.
Complies with European Council Directives 67/548/EEC and 1999/45/EC.
Complies with OSHA Regulation 29 CFR 1910.1200.
Complies with Canadian Regulation SOR/88-66

SECTION 16: OTHER INFORMATION

Text of phrases under Section 3

NA

Revision Information

Revision Date:	2013-06-14
Supersedes edition of:	2012-06-01
Reason for revision:	Regulation (EC) No. 1272/2008 Compliance
Legend	NA: Not Applicable ND: Not Determined

THE INFORMATION CONTAINED HEREIN IS BASED ON THE PRESENT STATE OF OUR KNOWLEDGE. IT CHARACTERIZES THE PRODUCT WITH REGARD TO THE APPROPRIATE SAFETY PRECAUTIONS. IT DOES NOT REPRESENT A GUARANTEE OF THE PROPERTIES OF THE PRODUCT.

HI 7031
Conductivity Calibration Solution, 1413 µS/cm @ 25°C/77°F

Safety Data Sheet

According to Regulation (EC) No. 1907/2006
OSHA Regulation 29 CFR 1910.1200
Canadian Regulation SOR/88-66

Revision Date: 2013-06-14
Reason for Revision: Regulation (EC) No. 1272/2008 Compliance

SECTION 1: IDENTIFICATION OF THE PRODUCT AND COMPANY

Product Name: HI 7031 Conductivity Calibration Solution

Application: For calibrating electrodes. 1413 µS/cm @ 25°C/77°F

Additional Product Codes: HI 7031/1G HI 7031L HI 7031L/C HI 7031M HI 7031/120ML

Company Information (USA):
Hanna Instruments, Inc.
584 Park East Dr, Woonsocket, Rhode Island, USA 02895

Technical Service Contact Information:
1-800-426-6287 (8:30AM - 5:00PM ET)
+1-401-766-4260 (8:30AM - 5:00PM ET)

USA Emergency Contact Information: 1-800-424-9300 (Chemtrec 24Hr. Emergency)

International Emergency Contact Information: +1-703-527-3887 (Chemtrec 24Hr. Emergency)

E-mail Address: tech@hannainst.com

SECTION 2: HAZARD IDENTIFICATION

Non-hazardous product as specified in Directives 67/548/EEC and 1999/45/EC.
Non-hazardous product as specified in OSHA Regulation 29 CFR 1910.1200.
Non-hazardous product as specified in Canadian Regulation SOR/88-66.
Non-hazardous product as specified in Regulation (EC) 1272/2008.

SECTION 3: COMPOSITION AND COMPONENT INFORMATION

Aqueous Solution

SECTION 4: FIRST AID MEASURES

After Inhalation: Remove to fresh air. Call a physician if breathing becomes difficult.

After Skin Contact: Wash affected area with water and soap.

After Eye Contact: Rinse out with plenty of water for at least 15 minutes. If pain persists, summon medical advice.

After Swallowing: Wash out mouth with plenty of water, provided person is conscious. Obtain medical attention if feeling unwell.

General Information: Not available

SECTION 5: FIRE-FIGHTING MEASURES

Suitable Extinguishing Media:
Water Spray, Foam, Dry Powder, Carbon Dioxide

Special Risks:
Non-combustible.

Special Protective Equipment:
Do not stay in dangerous zone without suitable chemical protection clothing and self-contained breathing apparatus.

Additional Information:
Contain escaping vapors with water.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Personal Precautions:

None

Environmental Precautions:

None

Additional Notes:

None

SECTION 7: HANDLING AND STORAGE

Handling:

No restrictions

Storage:

Keep container closed and protected from direct sunlight. Store at room temperature (+15°C to +25°C).

SECTION 8: EXPOSURE CONTROL/PERSONAL PROTECTION

Engineering:

Maintain general industrial hygiene practice.

Personal Protective Equipment:

As appropriate to quantity handled.

Respiratory Protection:	***Protective Gloves:***	***Eye Protection:***
Required when vapors/aerosols are generated.	Rubber or plastic	Goggles or face mask

Industrial Hygiene:

Change contaminated clothing. Wash hands after working with substance.

SECTION 9: PHYSICAL/CHEMICAL PROPERTIES

Appearance:	Colorless liquid	***Odor:***	Odorless	***Density at 20°C:***	~ 1 g/cm³
Melting Point:	NA	***Boiling Point:***	~ 100°C	***Solubility:***	Soluble
pH at 20°C:	~ 7	***Explosion Limit:***	NA	***Flash Point:***	NA
Thermal Decomp.:	NA				

SECTION 10: STABILITY AND REACTIVITY

Conditions to be Avoided:

Strong Heating (above boiling point). Stable in the recommended storage conditions.

Hazardous Decomposition Products:

In the event of fire: See section 5.

Hazardous Polymerization:

Will not occur.

Substances to be Avoided:

The generally known reaction partners of water

Further Information:

Not available

SECTION 11: TOXICOLOGICAL INFORMATION

Product Toxicity

Quantitative data on the toxicity of this product is not available.

Potential Health Effects:

Further Data: Hazardous properties cannot be excluded, but are relatively unlikely because of the low concentration of the dissolved substances, when the product is handled appropriately. The product should be handled with the usual care when dealing with chemicals.

Component Toxicity

Acute Toxicity:

Not Available

Chronic Toxicity:

Not Available

Additional Data:

Not Available

SECTION 12: ECOLOGICAL INFORMATION

Quantitative data on the ecological effect of this product is not available.

Further Data: No ecological problems are to be expected when the product is handled and used with due care and attention.

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal: Can be safely disposed of as ordinary refuse.

SECTION 14: TRANSPORTATION INFORMATION

Land:	***Sea:***	***Air:***
Not subject to transport regulations	Not subject to transport regulations	Not subject to transport regulations

SECTION 15: REGULATORY INFORMATION

Complies with European Regulations (EC) No. 1907/2006 and No. 1272/2008.
Complies with European Council Directives 67/548/EEC and 1999/45/EC.
Complies with OSHA Regulation 29 CFR 1910.1200.
Complies with Canadian Regulation SOR/88-66

SECTION 16: OTHER INFORMATION

Text of phrases under Section 3

NA

Revision Information

Revision Date:	2013-06-14
Supersedes edition of:	2012-06-01
Reason for revision:	Regulation (EC) No. 1272/2008 Compliance
Legend	NA: Not Applicable ND: Not Determined

THE INFORMATION CONTAINED HEREIN IS BASED ON THE PRESENT STATE OF OUR KNOWLEDGE. IT CHARACTERIZES THE PRODUCT WITH REGARD TO THE APPROPRIATE SAFETY PRECAUTIONS. IT DOES NOT REPRESENT A GUARANTEE OF THE PROPERTIES OF THE PRODUCT.

HI 7004
Buffer Solution pH 4.01

Safety Data Sheet

According to Regulation (EC) No. 1907/2006
OSHA Regulation 29 CFR 1910.1200
Canadian Regulation SOR/88-66

Revision Date: 2016-02-17
Reason for Revision: Section 3, 15 updated

SECTION 1: IDENTIFICATION OF THE PRODUCT AND COMPANY

Product Name: HI 7004 Buffer Solution pH 4.01

Application: pH Buffer Solution, ± 0.01 @ 25°C/77°F

Additional Product Codes: HI 7004/1G HI 7004/1L HI 7004L HI 7004L/C HI 7004M HI 7004P/5 HI 7004M/S HI 7004/120ML HI 7004/1LB HI 7004C HI 7004LB HI 7004M-0 HI 7004W

Company Information (USA):
Hanna Instruments, Inc.
584 Park East Dr, Woonsocket, Rhode Island, USA 02895

Technical Service Contact Information:
1-800-426-6287 (8:30AM - 5:00PM ET)
+1-401-766-4260 (8:30AM - 5:00PM ET)

USA Emergency Contact Information: 1-800-424-9300 (Chemtrec 24Hr. Emergency)

International Emergency Contact Information: +1-703-527-3887 (Chemtrec 24Hr. Emergency)

E-mail Address: tech@hannainst.com

SECTION 2: HAZARD IDENTIFICATION

Non-hazardous product as specified in OSHA Regulation 29 CFR 1910.1200.
Non-hazardous product as specified in Canadian Regulation SOR/88-66.
Non-hazardous product as specified in Regulation (EC) 1272/2008.

SECTION 3: COMPOSITION AND COMPONENT INFORMATION

Component:	EC No:	CAS No:	Hazard Class:	Phrases:	Concentration:
Water	231-791-2	7732-18-5	-	-	> 95%
Other components, disclosure not required according to Regulation (EC) No. 1907/2006	-	-	-	-	< 5%

SECTION 4: FIRST AID MEASURES

After Inhalation: Remove to fresh air. Call a physician if breathing becomes difficult.

After Skin Contact: Wash affected area with water and soap.

After Eye Contact: Rinse out with plenty of water for at least 15 minutes. If pain persists, summon medical advice.

After Swallowing: Wash out mouth with plenty of water, provided person is conscious. Obtain medical attention if feeling unwell.

General Information: Not available

SECTION 5: FIRE-FIGHTING MEASURES

Suitable Extinguishing Media:

Water Spray, Foam, Dry Powder, Carbon Dioxide

Special Risks:

Non-combustible. Development of hazardous combustion gases or vapors possible in the event of fire.

Special Protective Equipment:

Do not stay in dangerous zone without suitable chemical protection clothing and self-contained breathing apparatus.

Additional Information:

Contain escaping vapors with water.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Personal Precautions:

None

Environmental Precautions:

None

Additional Notes:

None

SECTION 7: HANDLING AND STORAGE

Handling:

No restrictions

Storage:

Keep container closed and protected from direct sunlight. Store at room temperature (+15°C to +25°C).

SECTION 8: EXPOSURE CONTROL/PERSONAL PROTECTION

Engineering:

Maintain general industrial hygiene practice.

Personal Protective Equipment:

As appropriate to quantity handled.

Respiratory Protection:	***Protective Gloves:***	***Eye Protection:***
Required when vapors/aerosols are generated.	Rubber or plastic	Goggles or face mask

Industrial Hygiene:

Change contaminated clothing. Wash hands after working with substance.

SECTION 9: PHYSICAL/CHEMICAL PROPERTIES

Appearance:	Colorless or red liquid	***Odor:***	Odorless	***Density at 20°C:***	1.0 g/cm³
Melting Point:	NA	***Boiling Point:***	~ 100°C	***Solubility:***	Soluble
pH at 20°C:	4.01 at 25°C	***Explosion Limit:***	NA	***Flash Point:***	NA
Thermal Decomp.:	NA				

SECTION 10: STABILITY AND REACTIVITY

Conditions to be Avoided:

Heating

Hazardous Decomposition Products:

In the event of fire: See section 5.

Hazardous Polymerization:

Will not occur.

Substances to be Avoided:

The generally known reaction partners of water

Further Information:

Not available

SECTION 11: TOXICOLOGICAL INFORMATION

Product Toxicity

Quantitative data on the toxicity of this product is not available.

Potential Health Effects:

Further Data: Hazardous properties cannot be excluded, but are relatively unlikely because of the low concentration of the dissolved substances, when the product is handled appropriately. The product should be handled with the usual care when dealing with chemicals.

Component Toxicity

Acute Toxicity:

Not Available

Chronic Toxicity:

Not Available

Additional Data:

Not Available

SECTION 12: ECOLOGICAL INFORMATION

Quantitative data on the ecological effect of this product is not available.

Further Data: No ecological problems are to be expected when the product is handled and used with due care and attention.

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal: Can be safely disposed of as ordinary refuse.

SECTION 14: TRANSPORTATION INFORMATION

Land:	***Sea:***	***Air:***
Not subject to transport regulations	Not subject to transport regulations	Not subject to transport regulations

SECTION 15: REGULATORY INFORMATION

Complies with European Regulations (EC) No. 1907/2006 and No. 1272/2008.
Complies with OSHA Regulation 29 CFR 1910.1200.
Complies with Canadian Regulation SOR/88-66.
All chemical substances in this product are listed on the TSCA Inventory.

SECTION 16: OTHER INFORMATION

Text of phrases under Section 3

NA

Revision Information

Revision Date:	2016-02-17
Supersedes edition of:	2013-04-01
Reason for revision:	Section 3, 15 updated
Legend	NA: Not Applicable ND: Not Determined

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HI 7007
Buffer Solution pH 7.01

Safety Data Sheet

According to Regulation (EC) No. 1907/2006
OSHA Regulation 29 CFR 1910.1200
Canadian Regulation SOR/88-66

Revision Date: 2016-02-17
Reason for Revision: Section 3, 15 updated

SECTION 1: IDENTIFICATION OF THE PRODUCT AND COMPANY

Product Name: HI 7007 Buffer Solution pH 7.01

Application: pH Buffer Solution. ± 0.01 @ 25°C/77°F

Additional Product Codes: HI 7007/1G HI 7007/1L HI 7007L HI 7007L/C HI 7007M HI 7007P/5 HI 7007/120ML HI 7007AN HI 7007C HI 7007LB HI 7007M/S HI 7007QC

Company Information (USA):
Hanna Instruments, Inc.
584 Park East Dr, Woonsocket, Rhode Island, USA 02895

Technical Service Contact Information:
1-800-426-6287 (8:30AM - 5:00PM ET)
+1-401-766-4260 (8:30AM - 5:00PM ET)

USA Emergency Contact Information: 1-800-424-9300 (Chemtrec 24Hr. Emergency)

International Emergency Contact Information: +1-703-527-3887 (Chemtrec 24Hr. Emergency)

E-mail Address: tech@hannainst.com

SECTION 2: HAZARD IDENTIFICATION

Non-hazardous product as specified in OSHA Regulation 29 CFR 1910.1200.
Non-hazardous product as specified in Canadian Regulation SOR/88-66.
Non-hazardous product as specified in Regulation (EC) 1272/2008.

SECTION 3: COMPOSITION AND COMPONENT INFORMATION

Component:	EC No:	CAS No:	Hazard Class:	Phrases:	Concentration:
Water	231-791-2	7732-18-5	-	-	> 95%
Other components, disclosure not required according to Regulation (EC) No. 1907/2006	-	-	-	-	< 5%

SECTION 4: FIRST AID MEASURES

After Inhalation: Remove to fresh air. Call a physician if breathing becomes difficult.

After Skin Contact: Wash affected area with water and soap.

After Eye Contact: Rinse out with plenty of water for at least 15 minutes. If pain persists, summon medical advice.

After Swallowing: Wash out mouth with plenty of water, provided person is conscious. Obtain medical attention if feeling unwell.

General Information: Not available

SECTION 5: FIRE-FIGHTING MEASURES

Suitable Extinguishing Media:

Water Spray, Foam, Dry Powder, Carbon Dioxide

Special Risks:

Non-combustible. Development of hazardous combustion gases or vapors possible in the event of fire.

Special Protective Equipment:

Do not stay in dangerous zone without suitable chemical protection clothing and self-contained breathing apparatus.

Additional Information:

Contain escaping vapors with water.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Personal Precautions:

None

Environmental Precautions:

None

Additional Notes:

None

SECTION 7: HANDLING AND STORAGE

Handling:

No restrictions

Storage:

Keep container closed and protected from direct sunlight. Store at room temperature (+15°C to +25°C).

SECTION 8: EXPOSURE CONTROL/PERSONAL PROTECTION

Engineering:

Maintain general industrial hygiene practice.

Personal Protective Equipment:

As appropriate to quantity handled.

Respiratory Protection:	***Protective Gloves:***	***Eye Protection:***
Required when vapors/aerosols are generated.	Rubber or plastic	Goggles or face mask

Industrial Hygiene:

Change contaminated clothing. Wash hands after working with substance.

SECTION 9: PHYSICAL/CHEMICAL PROPERTIES

Appearance:	Colorless or green liquid	***Odor:***	Odorless	***Density at 20°C:***	1.0 g/cm³
Melting Point:	NA	***Boiling Point:***	~ 100°C	***Solubility:***	Soluble
pH at 20°C:	7.01 at 25°C	***Explosion Limit:***	NA	***Flash Point:***	NA
Thermal Decomp.:	NA				

SECTION 10: STABILITY AND REACTIVITY

Conditions to be Avoided:

Heating

Hazardous Decomposition Products:

In the event of fire: See section 5.

Hazardous Polymerization:

Will not occur.

Substances to be Avoided:

The generally known reaction partners of water

Further Information:

Not available

SECTION 11: TOXICOLOGICAL INFORMATION

Product Toxicity

Quantitative data on the toxicity of this product is not available.

Potential Health Effects:

Further Data: Hazardous properties cannot be excluded, but are relatively unlikely because of the low concentration of the dissolved substances, when the product is handled appropriately. The product should be handled with the usual care when dealing with chemicals.

Component Toxicity

Acute Toxicity:

Not Available

Chronic Toxicity:

Not Available

Additional Data:

Not Available

SECTION 12: ECOLOGICAL INFORMATION

Quantitative data on the ecological effect of this product is not available.

Further Data: No ecological problems are to be expected when the product is handled and used with due care and attention.

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal: Can be safely disposed of as ordinary refuse.

SECTION 14: TRANSPORTATION INFORMATION

Land:	***Sea:***	***Air:***
Not subject to transport regulations	Not subject to transport regulations	Not subject to transport regulations

SECTION 15: REGULATORY INFORMATION

Complies with European Regulations (EC) No. 1907/2006 and No. 1272/2008.
Complies with OSHA Regulation 29 CFR 1910.1200.
Complies with Canadian Regulation SOR/88-66.
All chemical substances in this product are listed on the TSCA Inventory.

SECTION 16: OTHER INFORMATION

Text of phrases under Section 3

NA

Revision Information

Revision Date:	2016-02-17
Supersedes edition of:	2013-04-01
Reason for revision:	Section 3, 15 updated
Legend	NA: Not Applicable ND: Not Determined

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HI 7010
Buffer Solution pH 10.01

Safety Data Sheet

According to Regulation (EC) No. 1907/2006
OSHA Regulation 29 CFR 1910.1200
Canadian Regulation SOR/88-66

Revision Date: 2016-02-17
Reason for Revision: Section 3, 15 updated

SECTION 1: IDENTIFICATION OF THE PRODUCT AND COMPANY

Product Name: HI 7010 Buffer Solution pH 10.01

Application: pH Buffer Solution. ± 0.01 @ 25°C/77°F

Additional Product Codes: HI 7010/1G HI 7010/1L HI 7010L HI 7010L/C HI 7010M HI 7010/1LB HI 7010C HI 7010LB HI 7010M-0 HI 7010W HI 7010QC

Company Information (USA):
Hanna Instruments, Inc.
584 Park East Dr, Woonsocket, Rhode Island, USA 02895

Technical Service Contact Information:
1-800-426-6287 (8:30AM - 5:00PM ET)
+1-401-766-4260 (8:30AM - 5:00PM ET)

USA Emergency Contact Information: 1-800-424-9300 (Chemtrec 24Hr. Emergency)

International Emergency Contact Information: +1-703-527-3887 (Chemtrec 24Hr. Emergency)

E-mail Address: tech@hannainst.com

SECTION 2: HAZARD IDENTIFICATION

Non-hazardous product as specified in OSHA Regulation 29 CFR 1910.1200.
Non-hazardous product as specified in Canadian Regulation SOR/88-66.
Non-hazardous product as specified in Regulation (EC) 1272/2008.

SECTION 3: COMPOSITION AND COMPONENT INFORMATION

Component:	EC No:	CAS No:	Hazard Class:	Phrases:	Concentration:
Water	231-791-2	7732-18-5	-	-	> 95%
Other components, disclosure not required according to Regulation (EC) No. 1907/2006	-	-	-	-	< 5%

SECTION 4: FIRST AID MEASURES

After Inhalation: Remove to fresh air. Call a physician if breathing becomes difficult.

After Skin Contact: Wash affected area with water and soap.

After Eye Contact: Rinse out with plenty of water for at least 15 minutes. If pain persists, summon medical advice.

After Swallowing: Wash out mouth with plenty of water, provided person is conscious. Obtain medical attention if feeling unwell.

General Information: Not available

SECTION 5: FIRE-FIGHTING MEASURES

Suitable Extinguishing Media:
Water Spray, Foam, Dry Powder, Carbon Dioxide

Special Risks:
Non-combustible. Development of hazardous combustion gases or vapors possible in the event of fire.

Special Protective Equipment:
Do not stay in dangerous zone without suitable chemical protection clothing and self-contained breathing apparatus.

Additional Information:
Contain escaping vapors with water.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Personal Precautions:

None

Environmental Precautions:

None

Additional Notes:

None

SECTION 7: HANDLING AND STORAGE

Handling:

No restrictions

Storage:

Keep container closed and protected from direct sunlight. Store at room temperature (+15°C to +25°C).

SECTION 8: EXPOSURE CONTROL/PERSONAL PROTECTION

Engineering:

Maintain general industrial hygiene practice.

Personal Protective Equipment:

As appropriate to quantity handled.

Respiratory Protection:	*Protective Gloves:*	*Eye Protection:*
Required when vapors/aerosols are generated.	Rubber or plastic	Goggles or face mask

Industrial Hygiene:

Change contaminated clothing. Wash hands after working with substance.

SECTION 9: PHYSICAL/CHEMICAL PROPERTIES

Appearance:	Colorless or violet liquid	***Odor:***	Odorless	***Density at 20°C:***	1.0 g/cm³
Melting Point:	NA	***Boiling Point:***	~ 100°C	***Solubility:***	Soluble
pH at 20°C:	10.01 at 25°C	***Explosion Limit:***	NA	***Flash Point:***	NA
Thermal Decomp.:	NA				

SECTION 10: STABILITY AND REACTIVITY

Conditions to be Avoided:

Heating

Hazardous Decomposition Products:

In the event of fire: See section 5.

Hazardous Polymerization:

Will not occur.

Substances to be Avoided:

The generally known reaction partners of water

Further Information:

Not available

SECTION 11: TOXICOLOGICAL INFORMATION

Product Toxicity

Quantitative data on the toxicity of this product is not available.

Potential Health Effects:

Further Data: Hazardous properties cannot be excluded, but are relatively unlikely because of the low concentration of the dissolved substances, when the product is handled appropriately. The product should be handled with the usual care when dealing with chemicals.

Component Toxicity

Acute Toxicity:

Not Available

Chronic Toxicity:

Not Available

Additional Data:

Not Available

SECTION 12: ECOLOGICAL INFORMATION

Quantitative data on the ecological effect of this product is not available.

Further Data: No ecological problems are to be expected when the product is handled and used with due care and attention.

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal: Can be safely disposed of as ordinary refuse.

SECTION 14: TRANSPORTATION INFORMATION

Land:	***Sea:***	***Air:***
Not subject to transport regulations	Not subject to transport regulations	Not subject to transport regulations

SECTION 15: REGULATORY INFORMATION

Complies with European Regulations (EC) No. 1907/2006 and No. 1272/2008.
Complies with OSHA Regulation 29 CFR 1910.1200.
Complies with Canadian Regulation SOR/88-66.
All chemical substances in this product are listed on the TSCA Inventory.

SECTION 16: OTHER INFORMATION

Text of phrases under Section 3

NA

Revision Information

Revision Date:	2016-02-17
Supersedes edition of:	2013-04-01
Reason for revision:	Section 3, 15 updated
Legend	NA: Not Applicable ND: Not Determined

THE INFORMATION CONTAINED HEREIN IS BASED ON THE PRESENT STATE OF OUR KNOWLEDGE. IT CHARACTERIZES THE PRODUCT WITH REGARD TO THE APPROPRIATE SAFETY PRECAUTIONS. IT DOES NOT REPRESENT A GUARANTEE OF THE PROPERTIES OF THE PRODUCT.

Fisher Scientific

Part of Thermo Fisher Scientific

SAFETY DATA SHEET

Creation Date 12-Mar-2009 **Revision Date** 15-Dec-2015 **Revision Number** 4

1. Identification

Product Name **Nitric acid, Trace Metal Grade**

Cat No. : **A509-212; A509-500; A509P212; A509P500; A509SK212**

Synonyms Azotic acid; Engraver's acid; Aqua fortis

Recommended Use Laboratory chemicals.

Uses advised against No Information available

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Oxidizing liquids	Category 2
Corrosive to metals	Category 1
Skin Corrosion/irritation	Category 1 A
Serious Eye Damage/Eye Irritation	Category 1
Specific target organ toxicity (single exposure) Target Organs - Respiratory system.	Category 3
Specific target organ toxicity - (repeated exposure) Target Organs - Kidney.	Category 2

Label Elements

Signal Word
Danger

Hazard Statements
May cause fire or explosion; strong oxidizer
May be corrosive to metals
Causes severe skin burns and eye damage
May cause respiratory irritation
May cause damage to organs through prolonged or repeated exposure

Precautionary Statements
Prevention
Do not breathe dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Use only outdoors or in a well-ventilated area
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep/Store away from clothing/ other combustible materials
Take any precaution to avoid mixing with combustibles
Keep only in original container
Response
Immediately call a POISON CENTER or doctor/physician
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Ingestion
IF SWALLOWED: Rinse mouth. DO NOT induce vomiting
Fire
In case of fire: Use CO2, dry chemical, or foam for extinction
Spills
Absorb spillage to prevent material damage
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Store in corrosive resistant polypropylene container with a resistant inliner
Store in a dry place
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
None identified

Unknown Acute Toxicity
.? percent of the mixture consists of ingredient(s) of unknown acute toxicity

3. Composition / information on ingredients

Component	CAS-No	Weight %
Nitric acid	7697-37-2	65 - 70
Water	7732-18-5	30 - 35

4. First-aid measures

General Advice Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.

Immediate medical attention is required.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Remove and wash contaminated clothing before re-use. Call a physician immediately.

Inhalation If breathing is difficult, give oxygen. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Remove from exposure, lie down. Call a physician immediately.

Ingestion Do not induce vomiting. Never give anything by mouth to an unconscious person. Clean mouth with water. Call a physician immediately.

Most important symptoms/effects Causes burns by all exposure routes. . Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation: Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media CO_2, dry chemical, dry sand, alcohol-resistant foam.

Unsuitable Extinguishing Media No information available

Flash Point Not applicable
Method - No information available

Autoignition Temperature No information available

Explosion Limits
Upper No data available
Lower No data available

Oxidizing Properties Oxidizer

Sensitivity to Mechanical Impact No information available
Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors. The product causes burns of eyes, skin and mucous membranes. Oxidizer: Contact with combustible/organic material may cause fire. May ignite combustibles (wood paper, oil, clothing, etc.).

Hazardous Combustion Products
Nitrogen oxides (NOx) Thermal decomposition can lead to release of irritating gases and vapors
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

NFPA

Health	Flammability	Instability	Physical hazards
4	0	0	OX

6. Accidental release measures

Personal Precautions Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Ensure adequate ventilation. Use personal protective equipment.

Environmental Precautions Should not be released into the environment. Do not flush into surface water or sanitary sewer system. See Section 12 for additional ecological information.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Sweep up and shovel into suitable containers for disposal.

7. Handling and storage

Handling

Use only under a chemical fume hood. Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Do not ingest. Do not breathe vapors or spray mist. Keep away from clothing and other combustible materials.

Storage

Keep containers tightly closed in a dry, cool and well-ventilated place. Do not store near combustible materials.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Nitric acid	TWA: 2 ppm STEL: 4 ppm	(Vacated) TWA: 2 ppm (Vacated) TWA: 5 mg/m³ (Vacated) STEL: 4 ppm (Vacated) STEL: 10 mg/m³ TWA: 2 ppm TWA: 5 mg/m³	IDLH: 25 ppm TWA: 2 ppm TWA: 5 mg/m³ STEL: 4 ppm STEL: 10 mg/m³

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Nitric acid	TWA: 2 ppm TWA: 5.2 mg/m³ STEL: 4 ppm STEL: 10 mg/m³	TWA: 2 ppm TWA: 5 mg/m³ STEL: 4 ppm STEL: 10 mg/m³	TWA: 2 ppm STEL: 4 ppm

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures

Use only under a chemical fume hood. Ensure that eyewash stations and safety showers are close to the workstation location. Ensure adequate ventilation, especially in confined areas.

Personal Protective Equipment

Eye/face Protection

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166. Tightly fitting safety goggles. Face-shield.

Skin and body protection

Long sleeved clothing.

Respiratory Protection

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures

Keep away from food, drink and animal feeding stuffs. When using, do not eat, drink or smoke. Contaminated work clothing should not be allowed out of the workplace. Provide regular cleaning of equipment, work area and clothing. Avoid contact with skin, eyes and clothing. For environmental protection remove and wash all contaminated protective equipment before re-use. Wear suitable gloves and eye/face protection.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Clear Colorless, Light yellow
Odor	Strong Acrid
Odor Threshold	No information available
pH	< 1.0 (0.1M)

Melting Point/Range	-41 °C / -41.8 °F
Boiling Point/Range	Not applicable °C / °F
Flash Point	Not applicable
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	0.94 kPa (20°C)
Vapor Density	No information available
Specific Gravity	1.40
Solubility	miscible
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	HNO3
Molecular Weight	63.02

10. Stability and reactivity

Reactive Hazard Yes

Stability Oxidizer: Contact with combustible/organic material may cause fire.

Conditions to Avoid Incompatible products. Combustible material. Excess heat. Exposure to air or moisture over prolonged periods.

Incompatible Materials Combustible material, Strong bases, Reducing agents, Metals, Powdered metals, Organic materials, Aldehydes, Alcohols, Cyanides, Ammonia, Strong reducing agents

Hazardous Decomposition Products Nitrogen oxides (NOx), Thermal decomposition can lead to release of irritating gases and vapors

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Oral LD50 Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.

Dermal LD50 Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.

Vapor LC50 Based on ATE data, the classification criteria are not met. ATE > 20 mg/l.

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Nitric acid	Not listed	Not listed	LC50 = 2500 ppm. (Rat) 1h
Water	-	Not listed	Not listed

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Causes severe burns by all exposure routes

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico

Nitric acid	7697-37-2	Not listed	Not listed	Not listed	Not listed	Not listed
Water	7732-18-5	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Respiratory system
STOT - repeated exposure Kidney

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation: Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Do not empty into drains. Large amounts will affect pH and harm aquatic organisms. Contains a substance which is:. Harmful to aquatic organisms. The product contains following substances which are hazardous for the environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Nitric acid	Not listed	LC50: = 72 mg/L, 96h (Gambusia affinis)	Not listed	Not listed

Persistence and Degradability Miscible with water Persistence is unlikely based on information available.
Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its water solubility.

Component	log Pow
Nitric acid	-2.3

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT

UN-No UN2031
Proper Shipping Name NITRIC ACID
Hazard Class 8
Subsidiary Hazard Class 5.1
Packing Group I

TDG

UN-No UN2031
Proper Shipping Name NITRIC ACID
Hazard Class 8
Subsidiary Hazard Class 5.1
Packing Group I

IATA

UN-No UN2031

Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	I

IMDG/IMO

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	I

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Nitric acid	X	X	-	231-714-2	-		X	X	X	X	X
Water	X	X	-	231-791-2	-		X	-	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Nitric acid	7697-37-2	65 - 70	1.0

SARA 311/312 Hazard Categories

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	Yes

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Nitric acid	X	1000 lb	-	-

Clean Air Act Not applicable

OSHA Occupational Safety and Health Administration

Component	Specifically Regulated Chemicals	Highly Hazardous Chemicals
Nitric acid	-	TQ: 500 lb

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Nitric acid	1000 lb	1000 lb

California Proposition 65 This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Nitric acid	X	X	X	X	X
Water	-	-	X	-	-

U.S. Department of Transportation

Reportable Quantity (RQ): Y
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security
This product contains the following DHS chemicals:

Component	DHS Chemical Facility Anti-Terrorism Standard
Nitric acid	2000 lb STQ

Other International Regulations

Mexico - Grade No information available

Canada
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

WHMIS Hazard Class
C Oxidizing materials
E Corrosive material
D2B Toxic materials

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

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Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the

date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

Safety Data Sheet

1. IDENTIFICATION:

Product Name: ProCal Turbidity Calibration Standards
CAS Number: Mixture
Catalog Numbers: 39071 39820 39825 39828 39830 39845 39855 39887 39927 39928 39938 39939 39950 39953 39957 52070 52080 52090 52100 52110 52120 52180 52190 52200 52210 52220 52230 52240 52250 52300 52310 52320 52330 52340 52350 52360 52370 52380 52382 52384 52386 52430 52440 52450 52460 52470 52480 52530 52540 52550 52560 52570 52580 53000 53040 53050 53060 53070 53080 53090 53100 53110 53120 53130 53140 53160 53170 53180 53200 53210 53220 53230 53250 53260 53270 53280 53340 53350 53370 32483S 34381S 70853 30860 52000 52010 52090 52170 52290 52520 53380 52590
Product Use: Analytical \ Laboratory Reagent
Manufacturer: HF Scientific, Inc
Address: 3170 Metro Parkway Fort Myers, Fl 33916

General Information: 888-203-7248
Transportation Emergency Number: CHEMTREC® 24 hr US 800-424-9300
CHEMTREC® 24 hr International 703-527-3887

2. HAZARDS IDENTIFICATION

GHS Classification

Health	Environmental	Physical
Acute Toxicity: None Eye Corrosion: Category 2B Skin Corrosion: Category 3	Aquatic Toxicity: None	Flammable Liquid: No

GHS Label

Pictogram: None	Signal Word: WARNING
Hazard Statements Causes mild skin irritation Causes eye irritation	**Precautionary Statements** If skin irritation occurs, get medical advice/attention. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists, get medical advice/attention. Wash hands after handling

3. COMPOSITION / INFORMATION ON INGREDIENTS

Component	Cas Number	Weight %
Deionized Water	7732-18-5	99.0
Styrene Divinylbenzene Co-Polymer Beads	9003-70-7	0.97
Antimicrobial	Mixture	0.02
Octylphenoxypolyethoxyethanol nonionic surfactant	Mixture	0.01

4. FIRST AID MEASURES

Eye Contact: Immediately Flush with Excess Water for 15 Minutes
Skin Contact: Immediately Flush with Excess Water for 15 Minutes. Remove Contaminated Clothing.
Inhalation: Remove to Fresh Air
Ingestion: Give Large Quantities of Water. Call Physician.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media: Foam or Dry Chemical
Fire Fighting Procedures: Wear self contained breathing apparatus for fire fighting if necessary.
Unusual Fire and Exposure Hazards: None
Combustion Products: None
NFPA Classification HEALTH: 0 FLAMMABLE: 0 REACTIVITY:0

6. ACCIDENTAL RELEASE MEASURES

Wear Proper Personal Protective Equipment. See Section 8 for Additional Information. Remove Liquid with Absorbent Material and Seal in a Bag or Container for Disposal. Wash Spill Area Once Pickup is Complete.

7. HANDLING AND STORAGE

Handling: Wear Safety Glasses, Latex or Nitrile Gloves, and Lab Coat or Apron. Avoid Contact with Skin and Eyes. Do Not Ingest.
Storage: Store at Room Temperature. **Do not Freeze**.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Limits: N/A
Engineering Controls: N/A
Personal Protective Equipment:
Eyes: Safety Glasses
Skin: Latex or Nitrile Gloves and Lab Coat or Apron

9. PHYSICAL AND CHEMICAL PROPERTIES

Flashpoint: N/A
Autoignition Temperature: N/A
Boiliong Point: 100ºC, 212ºC
Melting Point: N/A
Vapor Pressure: 760 mm Hg

Vapor Density: N/A
% Solubility in Water: 100%

Pour Point: N/A
Molecular Formula: Mixture
Odor / Appearance: Odorless, clear to white liquid (depending on standard value)

Lower Flammability Limit: N/A
Upper Flammability Limit: N/A
Specific Gravity: 1.0
% Volatile: N/A
Evaporation Rate (Water=1): N/A
Viscosity: N/A
Octanol / Water Partition Coefficient: N/A
pH: Neutral (6.5-7.5)
Molecular Weight: Mixture

10. STABILITY AND REACTIVITY

Stability / Incompatibility: Product Stable Under General Use and Storage Conditions.
Hazardous Reactions / Decomposition Products: Hazardous polymerization will not occur

11. TOXICOLOGICAL INFORMATION

Symptoms of Overexposure: Irritation of the skin and eyes
Acute Effects: May cause skin, eye irritation
Eye Contact: May cause eye irritation
Skin Conatct: May cause skin irritation
Inhalation: N/A
Ingestion: N/A
Target Organs Effects: Skin and Eyes
Chronic Effects: N/A
Medical Conditions Aggravated by Exposure: Pre-existing skin and
Acute Toxicity Values: N/A

12. ECOLOGICAL INFORMATION

No Ecological Data Available

13. DISPOSAL CONSIDERATIONS

Dispose of in a manner consistent with Federal, State and Local Regulations.

14. TRANSPORT INFORMATION

US DOT (United States Department of Transportation): Not Regulated
IATA (International Air Transport Association): Not Regulated
IMO (International Maritime Organization): Not Regulated

15. REGULATORY INFORMATION

CERCLA: No
SARA/Title III: No
TSCA Inventory: Yes
Cal. Proposition 65: No
WHMIS: No
DSL: No
NDSL: No

16. OTHER INFORMATION

THE ABOVE INFORMATION IS BELIEVED TO BE ACCURATE AND REPRESENTS THE BEST INFORMATION CURRENTLY AVAILABLE TO US. ALL PRODUCTS ARE OFFERED IN ACCORDANCE WITH THE MANUFACTURER'S CURRENT PRODUCTION SPECIFICATIONS AND ARE INTENDED SOLELY FOR USE IN ANALYTICAL TESTING. THE MANUFACTURER SHALL IN NO EVENT BE LIABLE FOR ANY INJURY, LOSS OR DAMAGE RESULTING FROM THE HANDLING, USE OR MISUSE OF THESE PRODUCTS.

Attachment D
HS Standards

Table of Contents

1. POLICY

It is Arcadis US policy to be proactive in the identification, assessment and control of health and safety hazards and associated risks. To those means, any work involving trenching and excavation that is under the control or direction of Arcadis or an Arcadis subcontractor will be accomplished following, at a minimum, this Standard.

It is Arcadis' policy that Arcadis staff will not enter excavations and trenches unless it is necessary. It is also the policy of Arcadis to ensure an OSHA-defined Excavation Competent Person is on-site for all excavation work under Arcadis contractual control. The competent person will be provided by the entity on site responsible for performing the excavation work unless otherwise required by the client. Thus, if an Arcadis subcontractor is conducting the excavation work, that subcontractor will provide the competent person. If Arcadis is self-performing the excavation services, then Arcadis will provide a competent person whether a specialized subcontractor or authorized employee.

2. PURPOSE AND SCOPE

2.1 Purpose

This Health & Safety Standard (HSS) sets forth the requirements to effectively control or eliminate the hazards presented by working near or entry into excavations or trenches, this Standard sets forth the accepted practice for and establishes the requirements for workplace safety near excavations and trenches and employee and subcontractor entry into such.

2.2 Scope

This HSS with associated checklists and the Utility Location Standard ARC HSFS019. apply to all employees of Arcadis U.S. Inc. Only trained and authorized personnel are permitted to work near or enter excavations and trenches, perform rescue services, or act as the excavation competent person.

3. DEFINITIONS

Definitions related to Excavation and Trenching can be found in Exhibit 1. Acronyms and Abbreviations are found in Exhibit 2.

4. RESPONSIBILITIES

4.1 Project Management

The Project Manager is responsible for:

- Verify that excavation and trench protocols are properly identified and addressed within the project work plan, project health & safety plan, and/or other project-related documents.
- Verify that their divisional or project team employees have received the proper training provided by Corporate Health & Safety or qualified training source prior to conducting excavation/trenching entry activities.
- Verify that any Arcadis employee acting as the Excavation Competent person has been designated and authorized to do so per the requirements specified in section 4.4 of this standard.
- Verify that the proper entry equipment, including personal protective equipment (PPE), atmospheric testing equipment and safety equipment, is available for use by their divisional employees.
- Verify that copies of the completed checklists are available for Corporate Health and Safety review and retained with the project files.
- Request that Corporate Health and Safety review cancelled checklists as necessary and appropriate

4.2 Arcadis Sponsors

Arcadis Heavy Equipment Operator Sponsors are recognized by The Company as:

- Subject matter experts regarding projects that require heavy equipment operation.
- Someone in a leadership role within Arcadis that is tasked with identifying operators and Supervisors for Arcadis projects.
- Recognized as a Sponsor by the Arcadis Corporate Health and Safety or Business Line President.

4.3 Corporate H&S Staff

The Corporate H&S Staff is responsible for:

- On a routine basis, review, and update, as necessary, this standard.
- As requested by Operations Leadership, review cancelled checklists periodically to ensure conformance to this standard.

- Coordinate with the Training Group to ensure that the excavation competent person qualifications and training/retraining requirements are met.
- Conduct excavation competent person evaluations for nominated individuals as necessary, in order to approve and designate them as competent.
- Recommend qualified training provider for excavation awareness training for employees working in or around excavation/trenching operations.
- Provide technical assistance regarding excavation and trench protocol, atmospheric testing equipment, PPE, hazard assessment and research information on unusual hazards.
- Audit project-specific excavation sites for compliance with this standard.

4.4 Competent Person

Competent Person responsibilities include:

- Anticipation, identification, and control of excavation and trenching hazards, as well as the signs and symptoms of exposure to the hazard(s), and the Authority to implement all corrective actions including Stopping Work.

Note: An excavation Competent Person must be involved in the excavation/trenching hazard assessment process. This will assist in determining the need for an engineering opinion when excavating near or adjacent to structures and determining the need and timing of inspections.

- Review existing soil sampling data (if any) or other pertinent hazard characterization information recorded by the client.
- Investigate the client's excavation/trenching protocol, to verify that any identified hazards and previous experience with earthwork at the site is properly communicated.
- Coordinate entry operations with the client's employees when both client and Arcadis employees will be working in or near an excavation/trench.
- Offer all entrants an opportunity to review the applicable control measures and testing results and an opportunity to request a reevaluation as necessary.
- Design of structural ramps that are used solely by employees as a means of access or egress from excavations.
- Monitoring of water removal equipment and operations, if water is controlled or prevented from accumulating using water removal equipment,
- Inspection of excavations subject to runoff from heavy rains.
- Daily inspections of excavations, the adjacent areas, and protective systems when required.
- If evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions are present, the Competent Person is responsible for ensuring that exposed employees are removed

from the hazardous area until the necessary precautions have been taken to ensure their safety.

- Examining material or equipment used for protective systems that is damaged to evaluate its suitability for continued use. If the competent person cannot assure the material or equipment is able to support the intended loads or is otherwise suitable for safe use, then such material or equipment shall be removed from service and shall be evaluated and approved by a registered professional engineer before being returned to service.

- For excavations less than 5 feet (1.52 m) in depth, in which employees will be entering, a Competent Person must examine the ground to determine if there are indications of a potential cave-in hazard. If there are potential indicators of a cave-in hazard, the Competent Person will require some form of cave-in protection be implemented before employees can enter.

- Classifying soil and rock deposits based on site and environmental conditions, and on the structure and composition of the earth deposits.

- Soil and rock deposits shall be classified by a Competent Person as Stable Rock, Type A, Type B, or Type C based on the results of at least one visual and at least one manual analysis.

- If, after classifying a deposit, the properties, factors, or conditions affecting its classification change in any way, the changes shall be evaluated by a Competent Person. The deposit shall be reclassified as necessary to reflect the changed circumstances.

- When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person shall determine the degree to which the actual slope must be reduced below the maximum allowable slope and shall assure that such reduction is achieved.

- Order evacuation of the excavation/trench if an uncontrolled hazard develops, either within or outside the space, or upon observing a behavioral effect of hazard exposure among excavation/trench entrants.

- Verify that all tests and precautionary measures identified on the Daily/Periodic Inspection Checklist located in Exhibit 3 and the Arcadis Utility Location Policy and Standard ARC HSFS019 has been performed prior to authorizing subsurface work or entry into an excavation or trench.

Arcadis employees must meet the following requirements to be a designated and approved Competent Person:

- Attend an Excavation Competent Person training course approved by Corporate Health and Safety or have equivalent training; and
- Approval by Corporate Health and Safety through demonstration of practical field experience and/or knowledge of the subject matter.
    - Documentation of the evaluation and approval of each excavation competent person will be completed using the form provided in Exhibit 4.
    - This documentation and a listing of the approved ARCADIS excavation competent person will be maintained by the Training Group; and
- If on an Environmental project where HAZWOPER training is required by ARCADIS, the Competent Person must also have completed the 40 Hour HAZWOPER training, be current on their annual 8 Hour HAZWOPER refresher and it is recommended, but not required, that the Competent Person completed the HAZWOPER Supervisor training course.

4.5 All Employees

All employees are responsible for:

- Notify the PM or SSO if they have not received appropriate training.
- Review the site-specific HASP, task specific JSAs, and other written plans that are associated with their work.
- Use the TRACK process regularly and frequently to recognize the hazards which may be faced during work around or in excavation/trenches, as well as to understand the signs and symptoms of exposure to airborne hazard(s).
- Never enter an excavation/trench without verifying that the required Utility Location Procedure, Daily/Periodic Inspection Checklist and required air monitoring is conducted.
- Use Stop Work Authority if excavation/trenching hazard(s) have not been appropriately addressed. Immediately consult with SSO, Competent Person and Arcadis Project/Task Manager.

- Use the PPE, air monitoring and testing equipment that has been provided or have access to the information documenting those results are within the defined Action Levels established within the HASP.
- Maintain an awareness of all required hazard controls and consult with the Competent Person as necessary.
- If unexpected conditions arise during entry, immediately notify other entrants, evacuate the space and inform the designated Competent Person
- Obey evacuation orders given by the Competent Person, SSO, automatic alarm activation, or when self-perceived.
- At least one person on site must maintain current certification in basic first aid and cardiopulmonary resuscitation (CPR)

4.6 Health and Safety Plan Writers and Reviewers

Use this standard as guidance to ensure the appropriate identification, assessment and control of excavation and trenching hazards for documentation in project HASPs and development of task specific Job Safety Analysis (JSA).

4.7 Site Safety Officer (SSO)

When Arcadis and/or our subcontractor is in control of an excavation project, the SSO will be responsible for the following:

- Interface with the client representative and Competent Person to identify and understand hazards associated with the client's excavation and trenching and/or work permit programs.
- Implement the Arcadis Utility Clearance Policy and Procedure and complete the Daily/Periodic Excavation Inspection Checklist when the excavation project is under the control of Arcadis.
- Verify adequate training and experience of those Arcadis employees working in and around excavations.
- Verify that the safety procedures identified in this Standard, the site-specific HASP, and applicable regulatory requirements are used when required to protect employees during excavation activities.

- Verify that the client takes the necessary precautions in notifying their employees that our employees will be installing an excavation or trench.
- Review the lockout/tagout and isolation measures implemented by Arcadis, our subcontractor and/or the client as necessary based on proximity of utilities or other energy sources in the excavation/trench.
- Immediately report any unusual or unplanned excavation or trenching hazards to both the Competent Person and the Project Manager or Task Manager.
- Keep unauthorized persons away from the excavation area.
- Confirm that the Arcadis Utility Location Policy and Standard ARC HSFS019 has been performed prior to authorizing subsurface work or entry into an excavation or trench.
- Issue, authorize, and have the Utility Clearance and Daily/Periodic Inspection forms readily available for review
- Verify that copies of the completed clearance forms and checklists are properly disseminated to Corporate Health and Safety and retained with the project files, as specified in Section 8.0 – Records.

5. PROCEDURE

5.1 Operator Approval

Prior to operating excavation and/ or trenching equipment, including but not limited to:

- Standard and compact excavators
- Trenching equipment (Ditch Witch)

All operators must be approved by a Sponsor before being allowed to operate the above-referenced heavy equipment, in accordance with Heavy Equipment H&S Standard (ARC HSCS006).

All operators must be evaluated by a Site Supervisor and be observed on the specific equipment that will be in use. The Site Supervisor will complete the Site-Specific Operator Approval Form (Task Specific Hazard Review, Operator Evaluation and Operator Authorization for Heavy Equipment Operators) to deem the operator as an Authorized Operator. The form must be completed in full to demonstrate employees have been evaluated, deemed qualified, and have been “Authorized” by Arcadis as Heavy Equipment operators.

This form must be maintained on site and in the project files (unless maintained digitally) and is only valid for the project, operational task, and piece of heavy or mechanized equipment listed on the form. It should be noted that in some cases, state specific licensing or registration may be required for heavy equipment operators.

5.2 General Safety Requirements for all Excavations

- If excavation work encounters unanticipated groundwater contamination, soil contamination or other unanticipated contaminants, Arcadis staff will Stop Work and notify the Project Manager. An appropriate work plan to sample the suspected contaminants shall be developed, samples collected by HAZWOPER trained personnel, the HASP modified, and a contaminant management plan developed, as necessary.

- All surface obstructions must be moved or supported to protect employees and equipment.

- Prior to excavation, all underground installations (water, electric, telephone, gas, etc.) must be located and documented in accordance with Arcadis Utility Clearance Policy and Standard ARC HSFS019.

- When excavating in areas near underground installations, proper precautions must be taken to determine the exact location of the installations and to adequately protect and support them. While an excavation is open, underground installations shall be protected, supported, or removed as necessary to protect employees.

- Structural ramps that are used solely by employees as a means of access or egress from excavations shall be designed by a competent person.

- Structural ramps used for access or egress of equipment shall be designed by a competent person qualified in structural design and shall be constructed in accordance with the design.

- Ladders must extend at least 36” (3 feet) above the landing surface.

- All excavations over four feet in depth shall be provided with a stairway, ladder, ramp, or other safe means of egress to require no more than 25 feet of lateral travel. As deemed necessary by the competent person, excavations less than 4 feet in depth will be provided with a stairway, ladder, ramp, or other safe means of egress to require no more than 25 feet of lateral travel.

- If personnel are working in a location exposed to vehicular traffic they must be provided with and be required to wear reflective safety vests. Adequate, signs, barriers or other equivalent traffic controls must be used to protect employees.

- Personnel are not permitted to be beneath elevated loads handled by equipment or be in excavations when heavy equipment is digging in or near the excavation.

- Mobile equipment located near open excavations must be adequately protected from falling or rolling into excavations using barricades or warning devices.

- Employees entering bell-bottom pier holes, or other similar deep and confined footing excavations, shall wear a harness with a lifeline securely attached to it. The lifeline shall be separate from any line used to handle materials and shall be individually always attended while the employee wearing the lifeline is in the excavation.

- Water must not be allowed to accumulate in open excavations where employees are working. When necessary, means such as diverting natural drainage around the excavation or actively pumping water must be used to prevent or control water accumulation.

- Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning shall be provided to ensure the stability of such structures for the protection of employees.

- All structures adjacent to an open excavation must be supported, or a registered professional engineer (PE) must determine that the structure will not be affected by the excavation activities.

- Excavated materials (spoil) must be placed no closer than 2 feet from the edge of an open excavation, and otherwise retained to prevent loose material from falling into the excavation.

- Each employee at the edge of an excavation 6 feet (1.8 m) or more in depth shall be protected from falling by guardrail systems, fences, or barricades when the excavations are not readily seen because of plant growth or other visual barrier.

- Employees at the edge of a well, pit, shaft, and similar excavation 6 feet (1.8m) or more in depth shall be protected from falling by guardrail systems, fences, barricades, or covers.

- Work tasks will be designed to limit the number of personnel required to enter any excavation. All tasks that can be completed remotely from outside the excavation (such as soil sampling) will be conducted in such a manner.

- Personnel will not be allowed to enter any excavation unless required protective systems and procedures are used to prevent accidents and injury.

Best Management Practice: In some instances, an excavation will not have any protective systems in place when employees will not be entering into the excavation. Even if employees are not entering into this type of excavation, a competent person should be consulted to establish a safe zone distance away from the edge of any open excavation to minimize the hazard of falling into this type of excavation. Standing at the edge of an excavation places an employee at risk of falling into the excavation, thereby subjecting themselves to the hazard of excavation/trench collapse, which then triggers the requirement for protective system use as defined in this standard. General guidance would be for employees to remain 6 feet or more away from the edge of any excavation.

- Dust control measures will be implemented during excavation and soil-moving activities as required by the Health and Safety Plan (HASP). As necessary, dust control measures will also be used to manage soil located in temporary storage areas or stockpile areas. Specific dust control measures will be detailed in the HASP. The Competent Person must be consulted prior to initiating “wet” dust control measures to discuss limits/impact to protective systems.

- Excavations cut through a firewall or containment berm/bund shall provide alternate means of containment while the job is progressing. A specific containment procedure or diversion procedure will be included as a supplement to the HASP or defined in the Remedial Work Plan.

- Excavating in archeological sites requires special consideration and compliance with local legal requirements and shall be avoided wherever possible. Archaeological investigations on federal and state lands have additional requirements. For example, permit provisions are established in federal (specifically the federal Archaeological Resources Protection Act) and some state statutes. If an artifact or archeological feature is unearthed during

excavation, Arcadis shall stop work and consult with client, regulatory agencies and professional archaeologist, as necessary.

5.3 Excavations Requiring Protective Systems

This section defines excavations that require protective systems.

- All excavations into which employees will enter, regardless of depth, where the potential for cave-in exists.
- Any excavation over 5 feet in depth into which employees will enter that is not entirely in stable rock as defined in this Standard.
- Any excavation near a structure, (e.g., foundations, piers, footers, walls, sidewalks, tanks, roadways, etc.), as required by the registered professional engineer reviewing the stability of the excavation and the structure.
- All excavations over 20 feet in depth must be designed by a registered professional engineer regardless of whether personnel will enter it or not.
- All excavations that could potentially impact adjacent structures shall be reviewed by a registered professional engineer to determine if the stability of the structure will be affected by the excavation.
- Support systems for an adjacent structure must be designed by a registered professional engineer.

5.4 Selection and Use of Protective Systems

5.4.1 Shoring or Shielding

If shoring or shielding is selected as the protective system for an excavation, soil classification in accordance with 1926 Subpart P Appendix A is required.

One of the following options must be used for excavations which will be shored or shielded.

- Timber shoring as specified in 1926 Subpart P Appendix C must be utilized
- Hydraulic shoring, trench jacks, air shores, or shields as required in 1926.652 (c)(2) must be utilized following the system manufacturer's data

- A system which follows other tabulated data (approved by a registered professional engineer) must be utilized
- The excavation must be designed by a registered professional engineer

5.4.2 Sloping

If sloping is selected as the protective system for an excavation, the excavation sides must be sloped at a maximum of 34 degrees (1.5 Horizontal: 1 Vertical), unless the procedure listed above is followed.

Soil classification is required for all excavations with sides which will be sloped greater than 34° (1.5 Horizontal: 1 Vertical). If it will be sloped greater than 34°, the one of the following options must be utilized:

- Option 1 - assume Type C and slope 1.5/1 - default sloping classification
- Option 2 - classify soil according to the standard and use Type A/B sloping requirements
- Option 3 – use other tabulated data with PE approval
- Option 4 – PE approval of sloping/benching design

5.5 Atmospheric Testing for Entry

All excavations over 4 feet in depth must be tested for hazardous atmospheres whenever personnel are required to enter, and a potential exists for the existence of hazardous contaminants or oxygen deficiency. Excavations less than 4 feet in depth must be evaluated by the competent person and at the competent person's discretion be tested for hazardous atmospheres whenever personnel are required to enter, and a potential exists for the existence of hazardous contaminants or oxygen deficiency.

Emergency rescue equipment, such as breathing apparatus, a safety harness and line, or a basket stretcher, shall be readily available where hazardous atmospheric conditions exist or may reasonably be expected to develop during work in an excavation. This equipment shall be attended when in use.

The site designated "Competent Person" and/or SSO will document initial and periodic air monitoring results for all activities requiring entry into the excavation. All atmospheric testing of

excavations must be conducted in the following sequence and meet the following air quality criteria.

- Oxygen content must be between 19.5% to 23.5%
- Combustible gas or vapor less than (<) or equal to 5% of its lower explosive limit (LEL): Level D. Continue to monitor atmospheric conditions as detailed in project specific Health and Safety Plan.
- Combustible gas or vapor levels greater than (>) 5%, but < 10% of its LEL: Continuous atmospheric monitoring required; review use/implementation of engineering controls (ventilation, etc.) and PPE; evaluate potential source(s) of ignition and where feasible, remove from the area; fire extinguisher must be available; and use TRACK to assess condition/controls and proceed with caution.
- Combustible gas or vapor levels > or equal to 10% of its LEL: Stop Work; evacuate the excavation/trench; contact the Competent Person and SSO; and re-evaluate source/controls of combustible gas,
- Carbon monoxide levels must not exceed 25 ppm as an 8-hour Time Weighted Average (TWA).
- Hydrogen sulfide must not exceed 5 ppm as a Short-Term Exposure Limit (STEL) value or 1 ppm as an 8-hour TWA.
- Toxic air contaminant levels must not exceed 50% of the PEL or the TLV for the specific contaminant (whichever is lower).

5.6 Location of Underground/Overhead Utilities

- The competent person and the project manager shall both verify that local underground facilities location/protection agencies are notified within the required time frame prior to the initiation of excavation activities and meet all requirements in the Arcadis Utility Location Policy and Standard ARC HSFS019.
- Prior to initiation of excavation or trenching operations the competent person shall verify that all utilities have been located.

5.7 Daily/Periodic Inspections

- Prior to initiation of daily excavation or trenching operations the competent person shall complete a daily inspection of the excavation.

- During excavation or trenching operations, the competent person shall complete a periodic inspection after any event (e.g., thunderstorm, vibration, excessive drying) that may affect excavation stability.

Note: In order to correctly ascertain the soil types, the competent person must identify the locations and the limits of each type of soil and must conduct visual and all appropriate manual tests to classify the initial (opening) soil types observed.

Note: These inspections are only required when employee exposure can be reasonably anticipated. Not just in-trench exposure, but also ANY hazardous condition in the area that an employee could be exposed to.

The competent person shall complete the daily/periodic inspection checklist (A copy of the checklist is attached to this Policy as Exhibit 3) – Subcontractors must complete the Arcadis checklist or an equivalent inspection form for each inspection of excavation and trenching activities.

5.8 Soil Classification for Selection of Protective Systems

5.8.1 Soil Classification

This section describes a method of classifying soil and rock deposits based on site and environmental conditions, and on the structure and composition of the earth deposits. This section contains definitions, sets forth requirements, and describes acceptable visual and manual tests for use in classifying soils.

This section applies when a sloping, benching or shoring system is utilized as a method of protection for employees from cave-ins.

5.8.2 Soil Classification Definitions

5.8.2.1 Types/Classes of Soil

5.8.2.1.1 Type Class A Soils

Type/Class A Soils are cohesive soils with an unconfined, compressive strength of 1.5 ton per square foot (tsf) (144kPa) or greater. Examples of cohesive soils are Clay, silty clay, sandy clay, clay loam and in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil is Type A if the following apply.

- The soil is fissured
- The soil is subject to vibration from heavy traffic, pile driving, or similar effects
- The soil has been previously disturbed
- The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4 Horizontal:1 Vertical) or greater
- The material is subject to other factors that would require it to be classified as a less stable material

5.8.2.1.2 Type Class B Soils

Type/Class B Soils are:

- Cohesive soils with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa)
- Granular cohesion-less soils including angular gravel (like crushed rock), silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam
- Previously disturbed soils except those which would otherwise be classed as Type C soil
- Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration
- Dry rock that is not stable
- Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontals to one vertical (4 Horizontal:1 Vertical), but only if the material would otherwise be classified as Type B

5.8.2.1.3 Type/Class C Soils

Type/Class C Soils are:

- Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less
- Granular soils including gravel, sand, and loamy sand
- Submerged soil or soil from which water is freely seeping
- Submerged rock that is not stable
- Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4 Horizontal:1 Vertical) or steeper

5.8.2.2 Methods for Classifying Soils

Each soil and rock deposit shall be classified by a competent person as Stable Rock, Type A, Type B, or Type C in accordance with the definitions set forth in this section. The classification of the deposits shall be made based on the results of at least one visual and at least one manual analysis conducted by a competent person using tests described below, or in other recognized methods of soil classification and testing such as those adopted by the American Society for Testing Materials, or the U.S. Department of Agriculture textural classification system.

The visual and manual analyses, such as those noted as being acceptable in this section, shall be designed and conducted to provide sufficient quantitative and qualitative information as may be necessary to identify properly the properties, factors, and conditions affecting the classification of the deposits. Visual analysis is conducted to determine qualitative information regarding the excavation site in general, the soil adjacent to the excavation, the soil forming the sides of the open excavation, and the soil taken as samples from excavated material.

Observe the following:

- Samples of soil that are excavated and soil in the sides of the excavation. Estimate the range of particle sizes and the relative amounts of the particle sizes. Soil that is primarily composed of fine-grained material is cohesive material. Soil composed primarily of coarse-grained sand or gravel is granular material.

- Soil as it is excavated. Soil that remains in clumps when excavated is cohesive. Soil that breaks up easily and does not stay in clumps is granular.

- The side of the open excavation and the surface area adjacent to the excavation. Crack like openings such as tension cracks could indicate fissured material. If chunks of soil spall off a vertical side, the soil could be fissured. Small spalls are evidence of moving ground and are indications of potentially hazardous situations.

- The area adjacent to the excavation and the excavation itself for evidence of existing utility and other underground structures, and to identify previously disturbed soil.

- The open side of the excavation to identify layered systems. Examine layered systems to identify if the layers slope toward the excavation. Estimate the degree of slope of the layers.

- The area adjacent to the excavation and the sides of the opened excavation for evidence of surface water, water seeping from the sides of the excavation, or the location of the level of the water table.

- The area adjacent to the excavation and the area within the excavation for sources of vibration that may affect the stability of the excavation face.

Manual analysis of soil samples is conducted to determine quantitative as well as qualitative properties of soil and to provide more information to classify soil properly.

5.8.2.3 Classifications

- *Plasticity*. Mold a moist or wet sample of soil into a ball and attempt to roll it into threads as thin as 1/8 inch in diameter. Cohesive material can be successfully rolled into threads without crumbling. For example, if at least a two-inch (50 mm) length of 1/8 inch thread can be held on one end without tearing, the soil is cohesive.

- *Dry strength*. If the soil is dry and crumbles on its own or with moderate pressure into individual grains or fine powder, it is granular (any combination of gravel, sand, or silt). If the soil is dry and falls into clumps which break up into smaller clumps, but the smaller clumps can only be broken up with difficulty, it may be clay in any combination with gravel, sand or silt. If the dry soil breaks into clumps which do not break up into small clumps and which can only be broken with difficulty, and there is no visual indication the soil is fissured, the soil may be considered unfissured.

- *Thumb penetration*. The thumb penetration test can be used to estimate the unconfined compressive strength of cohesive soils. Type A soils with an unconfined compressive strength of 1.5 tsf can be readily indented by the thumb; however, they can be penetrated by the thumb only with very great effort. Type C soils with an unconfined compressive strength of 0.5 tsf can be easily penetrated several inches by the thumb and can be molded by light finger pressure. This test should be conducted on an undisturbed soil sample, such as a large clump of spoil, as soon as practicable after excavation to keep to a minimum the effects of exposure to drying influences. If the excavation is later exposed to wetting influences (rain, flooding), the classification of the soil must be changed accordingly.

- *Other strength tests*. Estimates of unconfined compressive strength of soils can also be obtained by use of a pocket penetrometer or by using a hand operated shear vane.

- *Drying test*. The basic purpose of the drying test is to differentiate between cohesive material with fissures, unfissured cohesive material, and granular material. The procedure for the drying test involves drying a sample of soil that is approximately one inch thick (2.54 cm) and six inches (15.24 cm) in diameter until it is thoroughly dry:

    1. If the sample develops cracks as it dries, significant fissures are indicated.

    2. Samples that dry without cracking are to be broken by hand. If considerable force is necessary to break a sample, the soil has significant cohesive material content. The soil can be classified as an unfissured cohesive material, and the unconfined compressive strength should be determined by using the thumb penetration or other test.

5.8.2.4 Cohesive with Fissures vs Granular

If a sample breaks easily by hand, it is either a fissured cohesive material or a granular material. To distinguish between the two, pulverize the dried clumps of the sample by hand or by stepping on them. If the clumps do not pulverize easily, the material is cohesive with fissures. If they pulverize easily into very small fragments, the material is granular.

5.8.2.5 Layered system

A layered system shall be classified in accordance with its weakest layer. Each layer may be classified individually where a more stable layer lies under a less stable layer.

5.8.2.6 Reclassifying Soils

A layered system shall be classified in accordance with its weakest layer. Each layer may be classified individually where a more stable layer lies under a less stable layer.

5.8.2.7 Excavation Construction Based on Soil Type

The maximum allowable slope means the steepest incline of an excavation face that is acceptable for the most favorable site conditions as protection against cave-ins and is expressed as the ratio of horizontal distance to vertical rise (H:V). Short-term exposure means a period less than or equal to 24 hours that an excavation is open. Soil and rock deposits must be classified in accordance with Appendix A to Subpart P of Part 1926. The maximum allowable slope for a soil or rock deposit must be determined from the table provided below. The actual slope must not be steeper than the maximum allowable slope. The actual slope must be less steep than the maximum allowable slope when there are signs of distress. If that situation occurs, the slope must be cut back to an actual slope which is at least horizontal to one vertical (1/2H:1V) less steep than the maximum allowable slope. When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person must determine the degree to which the actual slope must be reduced below the maximum allowable slope and must assure that such reduction is achieved. Surcharge loads from adjacent structures must be evaluated in accordance with 1926.651(I). Configurations of sloping and benching systems must be in accordance with 29 CFR 1926 Subpart P, Appendix B.

EXCAVATION SLOPE INFORMATION FROM 29 CFR 1926 SUBPART P APPENDIX B MAXIMUM ALLOWABLE SLOPES	
Soil or Rock Type	**Maximum Allowable Slopes (H:V) (1) for Excavations Less Than 20 Feet Deep[2]**
Stable Rock	Vertical (90 degrees)
Type A (2)	¾:1 (53 degrees)
Type B	1:1 (45 degrees)
Type C	1½:1 (34 degrees)

1. Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal (H). Angles have been rounded off.
2. Sloping or benching for excavations greater than 20 feet deep must be designed by a registered professional engineer.
3. A short-term maximum allowable slope of 1/2H:1V (63 degrees) is allowed in excavations in Type A soil that are 12 feet (3.67 m) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 m) in depth must be 3/4H:1V (53 degrees).

6. TRAINING

6.1 Project - Specific Orientation

All staff working on a site where trenching and excavation activities are being conducted by Arcadis or its subcontractors will be provided with site orientation on excavation projects and participate in daily safety meetings that include a discussion of the following:

- Site excavation hazards and procedures
- Requirements for conducting activities remotely whenever possible
- Client requirements and procedures for excavation activities
- Review of applicable federal, state and/or local excavation requirements; and
- This Excavation and Trenching Standard, as appropriate

6.2 Employee Training

Besides site orientation training, additional training will be provided as follows based on the employee's activities:

- All employees who work in potential excavation/trenching sites will receive awareness level training as provided and/or approved by Arcadis Corporate H&S in order to recognize and to understand the hazards associated with trenching/excavation work.
- On an as needed basis, employees will receive site specific instruction regarding the excavation/trenching operation from the Competent Person and/or the SSO.

6.3 Competent Person Training

Competent Persons will be provided training as follows:

For Arcadis employees to be assigned duties as a competent person, with respect to excavation and trenching, in addition to the criteria noted in section 4.0, personnel must attend an Excavation Competent Person training course approved by Corporate Health and Safety or have equivalent training. The course shall include, but is not limited to the following:

- Introduction to and definition of trenches and excavations.
- General requirements of OSHA 29 CFR 1926 Subpart P.
- Responsibilities and requirements of a competent person.
- Hazards associated with trenches/excavations and Identification and Assessment of these hazards.
- Hazard controls
    - Soil analysis and testing (visual and manual)
    - Protective systems
    - Personal protective equipment
    - Utility location
    - Atmospheric testing
    - Water drainage and pumping
    - Site housekeeping and management
    - Communications
    - Access and egress
- Emergency Procedures.
- Inspections.

All training provided must be reviewed and approved by Corporate Health & Safety and will be managed through the Training Team.

Documentation of training certification received by attendance at any training course including externally provided training courses will be kept by the employee with copies provided to the Training Team.

7. REFERENCES

The following H&S standards can be found on the Policies and Integrity Site:

- Arcadis Health and Safety Standard ARC HSFS010– Health and Safety Plan
- Arcadis Health and Safety Standard ARC HSFS004- Control of Hazardous Energy (Lockout/ Tag-out)
- Arcadis Health and Safety Standard ARC HSFS019- Utility Clearance

Additional resources regarding excavation and trenching include but are not limited to:

- OSHA 29 CFR Part 1926 Subpart P – Excavations
- Competent Person Evaluation Form For Excavation and Trenching

8. RECORDS

- Training records will be kept by the individual employee with copies of such certificates kept by the Training Team. Training dates and times will be kept by the Training Team.
- Completed clearance forms and checklists will be kept in the project files with copies available for Corporate H&S review.
- Copies of all HASPs that document excavation trenching procedures will be kept in the project files.

Training records will be stored in Arcadis' Learning Management System so they may be provided, if requested by Arcadis, clients or a regulatory agency. Employees must send copies of their training records from external vendors to the Arcadis Corporate Training Team (PeopleServices@arcadis.com).

9. APPROVALS AND HISTORY OF CHANGE

Miriam Buehrer, CSP – Corporate H&S Manager of Technical Programs

Miriam R. Buehrer

History of Change

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
12 May 2008	01	Greg Ertel	Original document
13 June 2008	02		Modified Section 5.1 – 4th bullet related to structural ramps. Modified Section 5.2 to designate a 6x factor for structural integrity of structures near the excavation. Revised Exhibit 1 to modify the definition of a Competent person
9 January 2009	03		Cleaned up definitions, deleted training requirements from Section 5.0 and moved them to Section 6.0, modified purpose statement
31 March 2011	04		Updated Competent Person training and qualification requirements in section 4.6, section 6.2 and definition in Exhibit 1.
27 March 2012	05	Tremblay	Section 4 competent person, SSO and employee responsibilities revised; Confined Space references eliminated; Training requirements clarified; use of ladders detailed; Fall prevention requirements clarified in section 5.1; depth of protective system requirement corrected to 5 feet; spoils pile must be minimum 2 feet from edge of excavation; Atmospheric Monitoring Action Levels revised; Employee Awareness Training and Competent Person Training requirements clarified
4 June 2012	06	Tremblay	Section 4.4 typo corrected; 8-hour HAZWOPER Supervisor course for competent person was made a recommended practice instead of a requirement; Section 4.5 SSO responsibilities revised to eliminate those responsibilities that belong with the Competent Person; Section 5 Best Management Guidance to maintain safe distance from the edge of excavation; checklists hyperlinked

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
18 September 2013	07	Tremblay	Tracking table format updated; Section 5.1 revised to include information about encountering unanticipated contaminants, implementing dust control measures, instituting containment measures when breeching a containment berm and avoiding excavating in archeological sites
26 September 2013	08	Tremblay	Section 5.7.2.7 Maximum Allowable Slope Table had a typo in Type C soil line H:V ratio (corrected the ratio to read 1 ½ : 1). The value of 34 degrees is correct; Header format update and pages renumbered
23 February 2015	09	Tremblay	Page numbering correction; Exhibit 2 checklist and Exhibit 3 Competent Person Checklist inserted to supplement the existing hyperlink to documents
16 February 2023	10	Eve Crudup	Updated branding and to include new links to forms/exhibits

Exhibit 1 - Definitions

Attendant is a trained qualified individual stationed outside the excavation whose duty is to monitor authorized entrants inside the excavation or trench and have a means of communication with the designated rescue services.

Benching/Benching system means a method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

Cave-in means the separation of a mass of soil or rock material from the side of an excavation, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person.

Cemented soil means a soil in which the particles are held together by a chemical agent, such as calcium carbonate, such that a hand size sample cannot be crushed into powder or individual soil particles by finger pressure.

Cohesive soil means clay (fine grained soil), or soil with a high clay content, which has cohesive strength. Cohesive soil does not crumble, can be excavated with vertical sides, and is plastic when moist. Cohesive soil is hard to break up when dry and exhibits significant cohesion when submerged. Cohesive soils include clayey silt, sandy clay, silty clay, clay, and organic clay.

Competent person means one who, through education, training, and/or experience, can identify existing and predictable hazards or working conditions which are unsanitary, hazardous, or dangerous to employees and who has authorization to take prompt corrective measures to eliminate them.

Dry soil means soil that does not exhibit visible signs of moisture content.

Excavation means any man-made cut, cavity, trench, or depression in an earth surface formed by earth removal into which a person can bodily enter.

Entry constitutes the act by which an employee proceeds into an excavation or trench. Consideration of hazards, especially cave-ins and fall protection must still be considered and accounted for when equipment or personnel are near an excavation or trench, even if personnel will not be entering.

Entrants are employees who are trained and authorized to enter a trench or excavation. Entrants must have attended a Qualified Excavation Training course offered or approved by Corporate Health and Safety.

Failure means the breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities.

Fissured means a soil material that tends to break along definite planes of fracture with little resistance, or a material that exhibits open cracks, such as tension cracks, in an exposed surface.

Granular soil means gravel, sand, or silt (coarse grained soil) with little or no clay content. Granular soil has no cohesive strength. Some moist granular soils exhibit apparent cohesion. Granular soil cannot be molded when moist and crumbles easily when dry.

Hazardous Atmosphere is an atmosphere which exposes employees to a risk of death, incapacitation, injury, or acute illness from one or more of the following:

- An atmospheric concentration of any substance more than 50% of its established permissible exposure limit (PEL); or its assigned threshold limit value (TLV) or other value listed on the Material Safety Data Sheet (MSDS) for the chemical constituent, whichever is lower.
- A flammable gas, vapor, or mist more than 10% of its lower explosive limit (LEL).
- An airborne combustible dust at a concentration that obscures vision at 5 feet or less.
- An atmospheric oxygen concentration below 19.5% (oxygen-deficient atmosphere) or above 23.5% (oxygen-enriched atmosphere).
- An atmosphere which is immediately dangerous to life and health.

Immediately Danger to Life and Health (IDLH) means any condition which poses an immediate threat to loss of life; may result in irreversible or immediate-severe health effects; may result in eye damage, irritation, or other conditions which could impair escape from the space.

Layered system means two or more distinctly different soil or rock types arranged in layers. Micaceous seams or weakened planes in rock or shale are considered layered.

Moist soil means a condition in which a soil looks and feels damp. Moist cohesive soil can easily be shaped into a ball and rolled into small diameter threads before crumbling. Moist granular soil that contains some cohesive material will exhibit signs of cohesion between particles.

Plastic means a property of a soil which allows the soil to be deformed or molded without cracking, or appreciable volume change.

Protective system means a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems and other systems that provide protection.

Ramp means an inclined walking or working surface that is used to gain access to one point from another and is constructed from earth or from structural materials such as steel or wood.

Registered Professional Engineer means a person who is registered as a professional engineer in the state where the work is to be performed. However, a professional engineer, registered in any state is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for "manufactured protective systems" or "tabulated data" to be used in interstate commerce. To oversee an excavation/trench activity the PE must have experience with and expertise in excavation, soil and stability considerations.

Saturated soil means a soil in which the voids are filled with water. Saturation does not require flow. Saturation, or near saturation, is necessary for the proper use of instruments such as a pocket penetrometer or sheer vane.

Sheeting means the members of a shoring system that retain the earth in position and in turn are supported by other members of the shoring system.

Shield (Shield system) means a structure that can withstand the forces imposed on it by a cave-in and thereby protect employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shield can be either pre-manufactured or job-built in accordance with 1926.652 (c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields".

Shoring (Shoring system) means a structure such as a metal hydraulic, mechanical, or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.

Sloping (Sloping system) means a method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

Soil classification system means, for the purpose of this procedure, a method of categorizing soil and rock deposits in a hierarchy of Stable Rock, Type A, Type B and Type C, in decreasing order of stability. The categories are determined based on an analysis of the properties and performance characteristics of the deposits and the characteristics of the deposits and the environmental conditions of exposure.

Stable rock means natural solid mineral material that can be excavated with vertical sides and will remain intact while exposed. Unstable rock is stable when the rock material on the side or sides of the excavation is secured against caving-in or movement by rock bolts or by another protective system that has been designed by a registered professional engineer.

Submerged soil means soil which is underwater or is free seeping.

Support system means a structure such as underpinning, bracing, or shoring, which provides support to an adjacent structure, underground installation, or the sides of an excavation.

Trench means a narrow excavation (in relation to its length) made below the surface of the ground to which a person can bodily enter. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet (4.6 meters). If forms or other structures are installed or constructed in an excavation to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet (4.6 meters) or less (measured at the bottom of the excavation), the excavation is a trench.

Unconfined compressive strength means the load per unit area at which a soil will fail in compression. It can be determined by laboratory testing, or estimated in the field using a pocket penetrometer, by thumb penetration tests, and other methods.

Wet soil means soil that contains significantly more moisture than moist soil, but in such a range of values that cohesive material will slump or begin to flow when vibrated. Granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.

Exhibit 2 – Abbreviations and Acronyms

ANA	Arcadis North America
Arcadis	Arcadis U.S. Inc.
HS	Health and Safety
H&S	Health and Safety
HSS	Health and Safety Standard
IDLH	Immediately Danger to Life & Health
CPR	Cardiopulmonary Resuscitation
STEL	Short Time Exposure Limit
PEL	Permissible Exposure Limit
LEL	Lower Exposure Limit
TLV	Threshold Limit Value
MSDS	Material Safety Data Sheet
CPR	Cardiopulmonary Resuscitation

Exhibit 3 – Daily / Periodic Excavation Inspection Checklist

(Link to form)

ARCADIS

Daily / Periodic Excavation Inspection Checklist

Project Name:	**Date / Time:**
Project Number:	**Location:**
Prepared By:	**Project Manager:**

This checklist or similar must be completed for all excavations. It documents that daily and post-event / periodic inspections are conducted.

Soil Classified As:	☐ Stable Rock	☐ Type A	☐ Type B	☐ Type C
Soil Classified On:	By:			
Type of Protective System in Use	☐ Sloping	☐ Shoring	☐ Shielding	☐ Benching ☐ Other
Description:				

Inspection Item	YES	NO	N/A	Comments
Has the Arcadis Utility Clearance Procedure been completed?	☐	☐	☐	
Are underground installations protected from damage?	☐	☐	☐	
Has a Competent Person been identified?	☐	☐	☐	
Are adequate means of entry / exit available in the excavation – at least every 25 feet?	☐	☐	☐	
If exposed to traffic, are personnel wearing reflective vests and adequate barriers/traffic controls installed?	☐	☐	☐	
Do barriers exist to prevent equipment from rolling into the excavation?	☐	☐	☐	
Was air monitoring conducted prior to and during excavation entry?	☐	☐	☐	
Was the stability of adjacent structures reviewed by a registered P.E.?	☐	☐	☐	
Are spoil piles at least 2 feet from the excavation edge?	☐	☐	☐	
Are employees protected from falling into excavations by guardrail systems, fences, or barricades *if the excavation is not readily seen because of plant growth or other natural barriers*? Best Management Practice Note: When employees are required entering into an excavation, competent person should be consulted to establish a safe zone distance away from the edge of any open excavation. General guidance would be for employees remain 6 feet or more away from the edge of any excavation	☐	☐	☐	
If the well, pit, shaft, or similar excavation is 6 feet (1.8m) or more in depth are employees protected from falling by guardrail systems, fences, or barricades?	☐	☐	☐	
Are work tasks completed remotely if feasible?	☐	☐	☐	
Is a protective system in place and in good repair?	☐	☐	☐	
Is excavation isolated from the effects of vibration?	☐	☐	☐	
Are employees protected from falling / elevated material?	☐	☐	☐	
Is soil classification adequate for current environmental / weather conditions?	☐	☐	☐	
Do portable ladders extend at least 3feet above the excavation?	☐	☐	☐	
Are portable ladders or ramps secured in place?	☐	☐	☐	
Have all personnel attended safety meeting on excavation hazards?	☐	☐	☐	
Are support systems for adjacent structures in place?	☐	☐	☐	
Is the excavation free from standing water?	☐	☐	☐	
Is water control and diversion of surface runoff adequate?	☐	☐	☐	
Are employees wearing required protective equipment?	☐	☐	☐	
Excavation Competent Person:				**Date/Time:**

Daily-Periodic Excavation Inspection Checklist_ARCHSCS005_US_Rev10_Exhibit 3_16 February 2023

Exhibit 4 – Competent Person Evaluation Form for Excavation / Trenching

(Link to form)

Competent Person Evaluation Form For Excavation and Trenching

1. Provide previous experience related to excavation and trenching including excavation types, protection methods used. *

Enter your answer

2. Which of the following training courses have you completed

- [ ] Excavation General Awareness
- [ ] 10-hr Construction Training
- [ ] 30-hr Construction Training
- [ ] Other

3. Upload certificates for trainings identified above

Upload file

File number limit: 9 Single file size limit: 10MB Allowed file types: PDF, Image

4. List other relevant qualifications including but not limited to CSP, ASP, CHST, CIH, CHMM, CIH.

Enter your answer

+ Add new

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Exhibit 2 – Abbreviations and Acronyms **E2**

1. POLICY

This Health & Safety Standard (HSS) applies to all Arcadis U.S. (Arcadis) employees with less than one (1) year of employment at Arcadis and existing Arcadis employees inexperienced in a task being completed outside of any office setting, and client teams in which a short service employee (SSE) program is required.

2. PURPOSE AND SCOPE

2.1 Purpose

Employees who are new to Arcadis and employees inexperienced in a task being completed outside of any office setting are potentially at a greater risk for incidents. SSEs will be appropriately Mentored, coached, accompanied, and/or managed to ensure their health, safety, and security until they can safely work on their own.

2.2 Scope

This HSS supplements the requirements in the current version of the Arcadis Field Health and Safety Handbook. Additional client-specific requirements may apply requiring further program development. The Client Services Director must determine what additional client requirements apply and create a client-specific program.

3. DEFINITIONS

Definitions related to Short Service Employee can be found in Exhibit 1. Acronyms and Abbreviations are found in Exhibit 2.

4. RESPONSIBILITIES

4.1 Project Management

The Project Manager is responsible for:

- Identification of each SSE and Inexperienced Worker assigned to the project and for verification that the SSE or Inexperienced Worker has the appropriate training prior to beginning any work performed outside of any office setting.
- Assigning a Mentor to the SSE or Inexperienced Worker and verify an on-site safety/task orientation is provided by a knowledgeable, experienced employee prior to initial work assignment.

- Ensuring that an SSE or Inexperienced Worker will not complete a new or unfamiliar task without being coached, Mentored, and/or provided hands on training by an Assigned Mentor with relevant task experience.

- Completing the Culture of Caring form in the HASP.

4.2 All Employees

All employees are responsible for:

Use the TRACK process described below regularly and frequently. In addition, employees read and understand all documented hazard identification and risk assessments conducted using the HARC process. ARCADIS employees will:

- Participate in entry operations only if trained and authorized to do so.
- Never enter an active work area without first getting acknowledgment and approval of the operator and Designated Signal Person, as applicable.
- Use STOP WORK Authority if unsafe or unexpected conditions arise during operation and immediately notify other personnel in the area.

4.3 Client Services Director

Client Services Director is responsible for:

- Determining whether a client team requires a client-specific SSE program, obtain the client requirements for the client-specific SSE program, and oversee development of the client-specific SSE program within the client team. These client-specific SSE program requirements must be incorporated into each project Health & Safety Plan (HASP).

4.4 SSE & Inexperienced Worker Supervisor

Supervisors are responsible for:

- Ensuring an SSE or Inexperienced Worker will be appropriately Mentored, coached, accompanied, and/or managed to ensure their health, safety, and security until they can work independently.

- Contacting Frontline Project Management to ensure the SEE or Inexperienced Worker has been assigned a Mentor. Supervisors must ensure all applicable training is completed and the SSE or Inexperienced Worker is assigned a Mentor prior to completing a new or unfamiliar task outside of an office setting.

4.5 Assigned Mentors

The Assigned Mentor (Mentor) is a designated person who is responsible and accountable for guiding and monitoring the H&S performance of the new/inexperienced employee. The Mentor has demonstrated knowledge and skills regarding H&S matters in the office and/or in the field and task-related hazards, hazard management, and safe working practices to be communicated to the SSE/inexperienced employee. The Mentor should have a positive safety attitude and be an experienced Arcadis employee with the proper operations knowledge and applicable task skillset who will display the appropriate safety leadership and work ethic. Mentors are responsible for teaching and coaching the SSE or Inexperienced Worker on the roles, responsibilities, and safe work practices for all assigned tasks. The Mentor is expected to either be on site with the new employee, assign another safety mature employee to be on site with the SSE or be available to the SSE for consultation until they have fully demonstrated health and safety maturity.

4.6 SSE Employees

SSE will complete all appropriate training prior to beginning work at the site and will participate in an on-site orientation upon arrival. The SSE will follow the instruction of and seek guidance from the assigned Mentor. The SSE will initiate Stop Work Authority if he or she feels unsafe or does not understand the task, or when task conditions change.

4.7 Inexperienced Worker

The Inexperienced Worker will communicate to Frontline Project Management when a assigned task is new or unfamiliar. The Inexperienced Worker will complete all appropriate training prior to beginning work at the site and will participate in an on-site orientation upon arrival. The Inexperienced Worker will follow the instruction of and seek guidance from the assigned Mentor. The Inexperienced Worker will initiate Stop Work Authority if he or she feels unsafe or does not understand the task, or when task conditions change.

4.8 Arcadis Client Health & Safety Team

The Arcadis Client Health & Safety (H&S) Team is responsible for:

- Reviewing the client's SSE program and develop a plan that meets both Arcadis and client requirements. The team will then communicate the plan to Project Management for implementation.

4.9 Corporate H&S Staff

Corporate Health & Safety is responsible for:

- Communicating the requirements of this HSS with Arcadis U.S.
- Verifying this standard is being implemented, maintained, and reviewed effectively.
- Providing guidance and technical support to those assessors conducting defined assessments in accordance with this standard and in assisting those assigned to identify, develop, and implement solutions to address non-conformances from any assessments conducted.
- Performing conformance assessments.
- Developing or overseeing the development of the various assessment protocol, checklists, etc. for use by assessors throughout the organization

5. PROCEDURE

5.1 Arcadis SSE Program Minimum Requirements

5.1.1 Employees with Less Than One (1) Year of Employment at Arcadis

The minimum requirements below apply to all employees with less than 1 year of employment at Arcadis:

- **New Hire Orientation Call** - Completed by SSE within 7 days of hire.
- **New Hire Health & Safety Program Orientation** – Completed by SSE in the Learning Center within 14 days of hire.
- **New Hire Health & Safety Checklist Task Improvement Process (TIP)** – New Hire H&S Checklist TIP must be completed with the SSE by the SSE Supervisor (or designee) within 60 days of hire.
- **New Hire Health & Safety Culture Assessment** – Assigned in the Learning Center to SSE 60 days after hire. The New Hire Health & Safety Culture Assessment must be completed by SSE in the Learning Center within 90 days of hire.
- **Culture of Caring Review**– For tasks completed outside of any office setting, Front Line Project Management will provide coaching and mentoring on Arcadis H&S expectations for associated project work. This will include a review of task specific hazards and controls and assignment of a Mentor with relevant task experience that can be contacted if SSE has questions regarding planned or unplanned work tasks.

- **SSE mentoring** – SSEs will not perform a new or unfamiliar task outside of any office setting without being provided coaching, mentoring, and/or hands on training by a Mentor with relevant task experience. This can be documented by completion of a Tailgate Safety Meeting form, signoff of relevant JSA, or relevant TIP on the SSE.

  Note: The SSE mentoring requirement does not apply if the SSE can demonstrate in review with Project Management, firsthand experience, task proficiency, or demonstrable knowledge of the task execution, task specific hazards, and controls.

  Note: It is recommended a TIP be completed at the end of the SSE Period to confirm the SSE Program requirements have been met. If the new employee cannot graduate in a reasonable amount of time or if they are not making progress and demonstrate a poor safety attitude, a corrective action plan will need to be set up for that new employee.

5.2 SSE Identification

Frontline Project Management will complete the Culture of Caring form in the HASP.

SSEs participate in all Tailgate Safety Meetings and their status documented on the Tailgate Safety Meeting Form.

New employees should be identified on projects by using a different color hardhat, colored hardhat band, or different colored / landed safety vest. This is intended to allow other people to visually recognize new employees, monitor their performance, and aid when needed.

5.3 Arcadis Client Specific SSE Program

Arcadis Client Teams will meet the Arcadis SSE Program minimum requirements listed in Section 5.1 in addition to following client-specific guidelines. The client-specific SSE program will be provided to the Arcadis Client Team and subcontractors, if applicable. Client requirements may include but are not limited to notification of client/host facility when an SSE will be at the site or not allowing the SSE to work alone.

5.4 Existing Arcadis Employees with Inexperience

For Arcadis employees who are inexperienced in the task being completed outside of any office setting (Inexperienced Worker), Frontline Project Management will provide coaching and mentoring on Arcadis H&S expectations for associated project work. This will include a review of task specific hazards and controls and assignment of a Mentor with relevant task experience. The Mentor will provide coaching, mentoring, and/or hands on training until the employee can perform the task independently and will be available if the Inexperienced

Worker has questions regarding planned or unplanned work tasks. This can be documented by completion of a Tailgate Safety Meeting form, signoff of relevant JSA, or relevant TIP on the SSE.

6. TRAINING

All Arcadis staff will be assigned the New Hire H&S Orientation training upon hire and are required to complete this training within 14 days of hire. The New Hire Health & Safety Culture Assessment will be assigned after the first 60 days of hire and must be completed by SSE in the Learning Center within 90 days of hire.

Other applicable training will be determined based on the job and responsibilities of the SSE (refer to the H&S Training Matrix on the Learning Center Resources page).

7. REFERENCES

Arcadis Field Health and Safety Handbook, current version.

8. RECORDS

SSE progress will be documented in the Arcadis Learning Center, 4-Sight and/or applicable project files. Records will also be kept in accordance with the client requirements.

Training records will be stored in Arcadis' Learning Management System so they may be provided, if requested by Arcadis, clients, or a regulatory agency. Employees must send copies of their training records from external vendors to the Arcadis Corporate Training Team (PeopleServices@arcadis.com).

9. APPROVALS AND HISTORY OF CHANGE

Julie Santaniello, CSP – Corporate H&S Director of Technical Programs

History of Change

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
10 January 2017	01	Sharon Lingle/Tony Tremblay/Julie Santaniello	Original document
30 October 2017	02	Alec MacAdam/Denis Balcer/ Lauren Hubbard/Tony Tremblay/Andrew McDonald/Julie Santaniello	Implementation of Arcadis U.S. wide SSE program for all employees with less than 1 year of employment at Arcadis.
13 February 2019	03	Andrew McDonald/Pat Vollertsen/ Denis Balcer/ Lauren Hubbard/ Julie Santaniello	Updated SSE definition to include employees not experienced in the task being completed outside of any office setting. Update H&S Standard template.
03 May 2019	04	Andrew McDonald / Julie Santaniello	Clarified the Client Services Director (CSD) role and updated grammatical errors.
06 July 2020	05	Sharon Lingle / Julie Santaniello	Updated Section 5.3 with client-specific examples.
27 December 2021	06	Julie Santaniello	Updated entire document to new template. Hyperlinks updated
11 August 2023	07	Greg Mason, Zach Mongan, Brittney Jones, Eve Crudup, Julie Santaniello	Removed Quick Reference Sheet; added clarified Mentor responsibilities, updated email addresses.

Exhibit 1 - Definitions

Short Service Employee (SSE): An employee with less than one (1) year of employment at Arcadis.

Exemption: Employees who have been rehired by Arcadis, including Part Time as Needed (PTAN) employees, who had previously completed the SSE program requirements and can demonstrate firsthand experience or knowledge of the task execution, specific hazards, and controls are not required to be designated as SSEs. If the above applies to a re-hire employee, the Supervisor must send an email to ANACorpHS@arcadis.com which:

1. Indicates the employee is a re-hire.
2. States that the employee had successfully completed all required new hire training during the prior employment period with Arcadis.

As part of on-going stewardship of safety and responsible Mentorship, Supervisors, and Frontline Project Management must ensure re-hires who are assigned new/unfamiliar tasks are provided proper mentoring in accordance with Section 5.2

Inexperienced worker: An existing Arcadis employee who is inexperienced in a task being completed outside of any office setting.

Exhibit 2 – Abbreviations and Acronyms

ANA	Arcadis North America
Arcadis	Arcadis U.S. Inc.
CSD	Client Services Director
HS	Health and Safety
H&S	Health and Safety
HSS	Health and Safety Standard
JSA	Job Safety Analysis
PTAN	Part Time as Needed
SSE	Short Service Employee
TIP	Task Improvement Process

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1. POLICY

It is Arcadis policy that employees who are required to work in cold environments or in other areas where the environmental risk factors for cold illness are present, be protected from related hazards. Cold-related illness and injury may be prevented by using safe work practices including administrative controls, engineering controls, and/or PPE.

2. PURPOSE AND SCOPE

2.1 Purpose

The purpose of this Health & Safety Standard (HSS) is to provide employee awareness regarding cold stress symptoms, direction on the controls and prevention of cold-related illnesses, and guidance on appropriate response actions if symptoms do occur.

2.2 Scope

This standard applies to Arcadis employees and Arcadis subcontractors who work on projects and operations where cold stress may be encountered.

3. DEFINITIONS

Definitions relating to Cold Stress can be found in Exhibit 1**.** A list of acronyms and abbreviations used in this HSS is provided in Exhibit 2**.**

4. RESPONSIBILITIES

4.1 Project Management

The Project Managers (PMs), Associate Project Managers (APMs) and Task Managers (TMs) will:

- Consider cold-related injury and address in project task hazard analysis, risk assessment and project planning.
    - Evaluate the activities, workload, personal protective equipment (PPE) and clothing worn to determine if cold-related injury may be of concern.
- Confirm that Arcadis employees that may be exposed to cold-related illnesses read, understand and follow this HSS.
- Confirm that a plan is in place and communicated to site staff to control and mitigate cold-related issues at the site.

4.2 All Employees

Arcadis employees are responsible for:

- Understanding the signs and symptoms that can lead to cold stress and adhere to the prescribed control and mitigation processes and methods.
- Reviewing and understanding this Cold Stress Prevention HSS.
- Reporting any signs and symptoms of cold stress exhibited by themselves or by other personnel on the project site.

4.3 Corporate H&S Staff

Corporate Health & Safety is responsible for:

- Communicating the requirements of this HSS with Arcadis U.S.
- Provide guidance on implementation of this HSS.
- Verifying this standard is being implemented effectively.
- Periodically review and update this HSS.

5. PROCEDURE

The hazard and risk assessments should identify the conditions and activities that can result in cold-related injury and identify ways to mitigate them. The H&S plan (HASP) and/or Job Safety Analysis (JSA) or other risk assessment will also document the hazards and controls for the project.

The wind chill temperature (ambient temperature and the velocity of the wind) should be used when estimating the effect of cold on exposed skin and when determining clothing insulation requirements. Exhibit 3 presents the adjusted wind chill index temperature for a range of temperatures and wind speeds.

5.1 Safe Work Practices

Arcadis staff shall follow these general safe work practices when working in the cold:

- Check temperature and wind speed throughout the day when air temperatures are below 45ºF.

- Hydrate appropriately. Dehydration may increase the susceptibility of cold injury due to a change in blood flow to the extremities.
- When possible, periods of acclimatization are made available allowing for adjustment to the cold before beginning a full work schedule.
- Whenever possible, select the warmest hours of the day to do work outside.
- Develop and implement work/warm-up schedules when wind chill temperatures reach approximately -15ºF or lower, regardless of how employees are dressed.
- Confirm that a means of communication is available when working in a wind chill below -22°F, so that a rescue can be conducted in case of an accident.
- When applicable, provide thermal insulation on tool handles.
- Wear adequate insulating clothing, as outlined in the HASP or JSA. Dress in layers, shedding layers as the body creates heat from physical exertion.

5.1.1 Personal Risk Factors

- Wearing inadequate, inappropriate (i.e., thin cotton) or wet clothing increases the effects of cold on the body.
- Lack of hydration to replace metabolized electrolytes.
- Inadequate acclimatization to cold weather-related stresses.
- Consumption of certain drugs or medications such as alcohol, nicotine, caffeine, and medication which inhibits the body's response to the cold or impairs judgment.
- Existing illness such as common virus, diabetes, heart, vascular and thyroid problems - may make a person more susceptible to hazards of the cold.
- Becoming exhausted or immobilized, especially due to injury or entrapment may speed up the adverse effects of cold weather.

5.1.2 Environmental Risk Factors

- Performing work in environmental conditions such as low temperatures, high velocity air movement, dampness, and potential for cold water emersion.

- Wind chill is a critical factor when evaluating work conditions.
- Continuous contact with a cold and/or highly thermo-conductive surface such as stone, ice, concrete or metal.
- Working in facilities where refrigerated processes are in operation or where no mechanized heat is provided.

5.2 Assessing the Work Environment

During project planning and project execution, identify and assess potential cold-stress risk factors in the work environment and implement appropriate controls (e.g., apply TRACK). For example, each employee will need to:

- Understand the weather condition(s) that may exist throughout the workday (air temperature, humidity, water temperature, and wind speed for example).
- Determine how much physical activity is anticipated.
- Determine length of the work shift/potential exposure time to evaluate planned work/rest schedule.
- Evaluate the type of clothing/PPE being worn; and
- Consider personal medical conditions that may be aggravated by working in the cold.

Based on this assessment, Arcadis employees will need to consider the risk and implement appropriate controls before proceeding with work.

5.3 Preventative Measures and Controls

5.3.1 Engineering Controls

Engineering controls to consider implementing:

- Use of an on-site source of heat, for example, air jets, radiant heaters or contact warm plates.
- Shield work areas from drafty or windy conditions.
- Provide a heated shelter (e.g., vehicle, building, tent) for employees who experience prolonged exposure to equivalent wind-chill temperatures of 30°F /-1°C or less. Do

not use a heat source that generates toxic gases from combustion without adequate ventilation.

- When taking breaks in the shelter ensure that snow and ice are removed from clothing prior to entry to minimize water generation.
- Use thermal insulating material on equipment handles when temperatures drop below 30°F / -1°C.

5.3.2 Administrative Controls

Administrative controls to consider implementing include:

- Develop and implement work/warm-up schedules when wind chill temperatures reach approximately -15ºF or lower.
- Complete training when wind chill temperatures reach approximately -15ºF or lower.
- Planning work so that a heated location, such as a vehicle, is available and in reasonable distance from the work area for warm-up if needed whenever possible.
- When multiple staff are on site, monitor each other for signs of cold stress.

5.3.3 Protective Clothing Guidance

Protective clothing is generally needed for work at or below 39°F. Cold stress is still possible at higher temperatures when coupled with wind and rain so 39°F is a guideline temperature. Clothing should be selected to suit the temperature, weather conditions (e.g., wind speed, rain), the level and duration of activity, and job design. These factors are important to consider so that employees can regulate the amount of heat and perspiration generated while working. If the work pace is too fast or if the type and amount of clothing are not properly selected, excessive sweating may occur. The clothing next to body will become wet and the insulation value of the clothing will decrease dramatically. This increases the risk for cold injuries, therefore, consider the following guidance:

- Clothing should be worn in multiple layers which provide better protection than a single thick garment. The air between layers of clothing provides better insulation than the clothing itself. Having several layers also gives employees the option to open or remove a layer before you get too warm and start sweating or to add a layer when you take a break. It also allows you to accommodate changing temperatures and weather conditions. Successive outer layers should be larger than the inner layer, otherwise

the outermost layer will compress the inner layers and will decrease the insulation properties of the clothing.

- The inner layer should provide insulation and be able to "wick" moisture away from the skin to help keep it dry. Base layers should be made of hydrophobic synthetic material, such as polypropylene or natural fibers constructed of wool or similar material. These materials will reduce the amount of perspiration that remains on the skin surface. Thermal base layers made from polyesters or polypropylene is suitable for this purpose.

    - Cotton clothing should be avoided as a base layer touching the skin due to its hydrophilic moisture retention properties.

- Additional layers of clothing should provide adequate insulation for the weather conditions under which the work is being done. These additional layers should also be easy to open or remove before an employee gets too warm to prevent excessive sweating during strenuous activity. Employees should consider a middle layer of hydrophobic synthetic fabric to transfer moisture and retain insulation in a damp environment.

- For work in wet conditions, the outer layer of clothing should be waterproof. Consider an outer layer provided with a waterproof breathable membrane to break the wind (e.g., Gore-Tex® or other proprietary fabric). The outer layer should have the means for closing off and opening the waist, neck and wrists to help control how much heat is retained or given off. Some jackets have netted pockets and vents around the trunk and under the arm pits (with zippers or Velcro fasteners) for added ventilation possibilities.

- Clothing should be kept clean since dirt fills air cells in fibers of clothing and destroys its insulating ability.

- Consider keeping a change of clothing available in case work clothing becomes damp or wet.

- Excessive heat loss can occur through the head. When appropriate, additional insulation when wearing a hard hat, may include an insulated hard hat liner, skull cap, scarf and/or ear warmers.

- In extreme temperatures, hands should be always covered to reduce potential for cold burns as well as frostbite. Ill-fitting gloves can impair circulation and increase susceptibility to frostbite/frostnip. Be aware of tight-fitting gloves and consider mittens for the added benefit that portable hot pockets can be carried inside mittens. For work below 1.4°F, mittens should be used. Cotton is not recommended. It tends to get damp or wet quickly and loses its insulating properties. Wool and synthetic fibers, on the other hand, do retain heat when wet.

- Protective eyewear should be treated with anti-fog spray prior to wearing in cold conditions.

5.3.4 Protective Footwear Guidance

The feet are particularly vulnerable in cold conditions because of direct contact with the ground or working environment, perspiration, and circulation:

- Consider using felt-lined, rubber bottomed, leather-topped boots with removable felt insoles for heavy work in cold weather conditions. Leather products are naturally porous and breathable, which will allow some perspiration (water vapor) to escape, however, leather is a poor insulator. It is important to create a layer of thin warm air between the skin and the interior of the boot. This can be achieved by wearing socks constructed of wool, alpaca or similar natural yarns, which are hydrophobic and very insulating. A dual layer sock system consisting of a thin liner sock inside an insulating outer sock is recommended. Avoid cotton socks. Overly snug footwear allows for body heat loss due to conductive heat transfer. The insulating materials and socks may become wet more quickly than when wearing leather boots and increase the risk for frostbite.

- If work involves standing in water or slush, waterproof boots should be worn. While these waterproof boots protect the feet from getting wet from cold water in the work environment, they also prevent the perspiration to escape. When working in wet or damp conditions, the application of water-proofing materials on leather footwear will reduce the potential for water to permeate the leather, which is generally beneficial for wet, cold conditions. However, use of these products will also reduce the amount of perspiration that normally is allowed to escape in the form of water vapor. Trapped perspiration can be problematic unless the boot is very insulated. Footwear that is constructed with a waterproof membrane, such as Gore-Tex™, is

preferred as it prevents water molecules from reaching the foot but allows water vapor from perspiration to escape.

- Neoprene and neoprene-lined boots, such as Muck™, are very insulating but will not allow perspiration to escape. Neoprene products are available in varying thickness and are preferred in extreme cold conditions, particularly when working around water. Other insulating footwear options are available, such as Thinsulate™ and similar insulating liners. However, the use of thick wool socks in a looser fitting boot (allowing air space) will have a similar, if not preferred, effect.

- Avoid steel shank and/or steel toe boots where an appropriate composite material substitute (e.g., carbon-fiber, ceramic and/or Kevlar toe/insert) is available.

5.4 Types of Cold Stress - Signs and Symptoms

5.4.1 Frostnip

Frostnip occurs when the tissue is cooling because of the constriction of blood vessels and the resulting inadequate blood supply to the area. The skin may get pale or turn red and feel extremely cold or numb. Most victims of frostnip will fully recover if removed from the cold environment. However, if untreated, frostnip may progress to frostbite.

5.4.2 Frostbite

Skin exposed to temperatures a little below the freezing mark can take hours to freeze, but very cold skin can freeze in minutes or seconds. Air temperature, wind speed, and moisture all affect how cold the skin becomes. A strong wind can lower skin temperature considerably by dispersing the thin protective layer of warm air that surrounds our bodies. Wet clothing readily draws heat away from the skin because water is a potent conductor of heat. The evaporation of moisture on the skin also produces cooling. For these reasons, wet skin or clothing on a windy day can lead to frostbite even if the air temperature is above the freezing mark. The extent of permanent injury, however, is determined not by how cold the skin and the underlying tissues become but by how long they remain frozen.

Frostbite is an injury to the body that is caused by freezing. Frostbite causes a loss of feeling and color in the affected areas. It most often affects the nose, ears, cheeks, chin, fingers, or toes. Frostbite can permanently damage body tissues, and severe cases can lead to amputation. In extremely cold temperatures, the risk of frostbite is increased in workers with reduced blood circulation and among workers who are not dressed properly.

Three nearly simultaneous physiological processes underlie frostbite injury: tissue freezing, tissue hypoxia, and the release of inflammatory mediators.

Symptoms of Frostbite:

- Reduced blood flow to hands and feet (fingers or toes can freeze)
- Sharp pain progressing to numbness with red skin at first, then turning cold and white
- Tingling or stinging
- Aching
- Bluish or pail, waxy skin
- Skin becomes hard and numb. Blisters may form following thawing.
- Usually affects the fingers, hands, toes, feet, ears and nose first.

Frostbite is classified by degree of injury (first, second, third, or fourth), or simply divided into two types, superficial (corresponding to first- or second-degree injury) and deep (corresponding to third- or fourth-degree injury). Most frostbite injuries affect the feet or hands. The remaining 10% of cases typically involve other exposed body parts (e.g., nose, ears, cheeks, etc.). Once frostbite sets in, the affected part begins to feel cold and, usually, numb; this is followed by a feeling of clumsiness. The skin turns white or yellowish. Many victims experience severe pain in the affected part during rewarming treatment and an intense throbbing pain that arises two or three days later and can last days or weeks. As the skin begins to thaw during treatment, edema (excess tissue fluid) often accumulates, causing swelling. In second- and higher-degree frostbite, blisters appear. Third-degree cases produce deep, blood-filled blisters and, during the second week, a hard black eschar (scab). Fourth-degree frostbite penetrates below the skin to the muscles, tendons, nerves, and bones.

5.4.3 Hypothermia

When exposed to cold temperatures, your body begins to lose heat faster than it can be produced. Prolonged exposure to cold will eventually use up your body's stored energy. The result is hypothermia, or abnormally low body temperature. A body temperature that is too low affects the brain, making the victim unable to think clearly or move well. This makes

hypothermia particularly dangerous because a person may not know it is happening and will not be able to do anything about it.

Symptoms of hypothermia:

- Body temperature drops below 95°F / 35°C
- Fatigue or drowsiness
- Uncontrolled shivering
- Cool, bluish skin
- Slurred speech
- Clumsy movements
- Irritable, irrational, or confused behavior

5.4.4 Other Cold-Related Conditions

Trench foot, also known as immersion foot, is an injury of the feet resulting from prolonged exposure to wet and cold conditions. Trench foot can occur at temperatures as high as 60°F if the feet are constantly wet. Injury occurs because wet feet lose heat 25-times faster than dry feet. Therefore, to prevent heat loss, the body constricts blood vessels to shut down circulation in the feet. Skin tissue begins to die because of lack of oxygen and nutrients and due to the buildup of toxic products.

Symptoms of trench foot include:

- Reddening of the skin
- Numbness
- Leg cramps
- Swelling
- Tingling pain
- Blisters or ulcers
- Bleeding under the skin
- Gangrene (the foot may turn dark purple, blue, or gray)

Chilblains are caused by the repeated exposure of skin to temperatures just above freezing to as high as 60°F. The cold exposure causes damage to the capillary beds (groups of small blood vessels) in the skin. This damage is permanent, and the redness and itching will return with additional exposure. The redness and itching typically occurs on cheeks, ears, fingers, and toes.

Symptoms of chilblains include:

- Redness
- Itching
- Possible blistering
- Inflammation
- Possible ulceration in severe cases

5.4.5 Cold Water Immersion

Cold water immersion creates a specific condition known as immersion hypothermia. It develops much more quickly than standard hypothermia because water conducts heat away from the body 25 times faster than air. Typically people in temperate climates don't consider themselves at risk from hypothermia in the water, but hypothermia can occur in any water temperature below 70°F. Survival times can be lengthened by wearing proper clothing (wool and synthetics and not cotton), using a personal flotation device (PFD, life vest, immersion suit, dry suit), and having a means of both signaling rescuers (strobe lights, personal locator beacon, whistles, flares, waterproof radio) and having a means of being retrieved from the water.

Details relating to cold water immersion and PFD requirements are detailed in Arcadis Health and Safety Procedure ARC HSFS002 – Water Operations Safety.

5.5 First Aid and Emergency Procedures

Cold stress that leads to hypothermia or destructive damage to tissue warrants contacting Emergency Medical Services. For lesser injuries, call WorkCare (1 888 449 7787) for self-care measures.

5.5.1 Frostnip

Frostnip occurs when the tissue is cooling because of the constriction of blood vessels and the resulting inadequate blood supply to the area. Your skin may get pale or turn red and feel extremely cold or numb. In a controlled environment, frostnip victims should fully recover. Contact WorkCare is frostnip is suspected.

5.5.2 Frostbite

Superficial (mild) frostbite is when true frostbite starts to take hold. The reddened skin may become pale or white, and some ice crystals start to form within the skin. The skin may actually feel warm, which often indicates tissue damage has occurred. Upon warming, skin may look mottled or purple and fluid-filled blisters may appear up to 36 hours after rewarming. Severe frostbite occurs when the frostbite has gone beyond the outer layers of the skin and affected the deep tissues underneath. The victim may notice complete numbness, pain, or discomfort. Surrounding muscles may not function normally and the victim may experience blisters, often filled with blood, a day or two after rewarming. There can be permanent tissue death at this stage, where the affected areas become hard and black.

Emergency medical help should always be summoned whenever frostbite is suspected. The following information is provided when professional medical assistance is unavailable or delayed.

- Move the person to a warm dry area. Do not leave the person alone.
- Remove any wet or tight clothing that may cut off blood flow to the affected area.
- Do not rub the affected area. Rubbing causes damage to the skin and tissue.
- It should be noted that experts advise rewarming in the field only when emergency help will take more than two hours to arrive, and refreezing can be prevented.
- First line of rewarming should include bundling the affected area in warm dry clothing and blankets to utilize body heat to treat the affected area.
- Should the affected area not respond to body heat only, gently place the affected area into a lukewarm water bath and slowly and gradually increase temperature, but do not exceed 105°F. Monitor the water temperature to slowly warm the tissue. Do

not pour warm water directly on the affected area because it will warm the tissue too fast causing tissue damage. Warming takes about 25-40 minutes.

- After the affected area has been warmed, it may become puffy and blister. The affected area may have a burning feeling or numbness. When normal feeling, movement, and skin color have returned, the affected area should be dried and wrapped to keep it warm.

- The key to prehospital treatment is to avoid partial thawing and refreezing, which releases more inflammatory mediators and makes the injury substantially worse. If there is a chance the affected area may get cold again, do not warm the skin. If the skin is warmed and then becomes cold again, it will cause severe tissue damage.

5.5.3 Hypothermia

- Call for emergency help.

- Move the person to a warm, dry area. Do not leave the person alone.

- Remove any wet clothing and replace with warm, dry clothing or wrap the person in blankets.

- Have the person drink warm, sweet drinks (sugar water or sports-type drinks) if they are alert. Avoid drinks with caffeine (coffee, tea, or hot chocolate) or alcohol. Handle hypothermia victims gently and do not give anything by mouth if they are unconscious.

- Have the person move their arms and legs to create muscle heat. If they are unable to do this, place warm bottles or hot packs in the arm pits, groin, neck and head areas. Do not rub the person's body or place them in warm water bath, as this may stop their heart.

5.5.4 Trench Foot

Workers suffering from trench foot should:

- Remove shoes/boots and wet socks.

- Dry their feet.

- Avoid walking on feet, as this may cause tissue damage.

5.5.5 Chilblains

Workers suffering from chilblains should:

- Avoid scratching.
- Slowly warm the skin.
- Use corticosteroid creams to relieve itching and swelling.
- Keep blisters and ulcers clean and covered.

6. TRAINING

Arcadis employees completing activities that can result in cold-related injury will read and review this HSS annually. Arcadis employees working in wind chill temperatures of approximately -15ºF or lower will complete Cold Stress Prevention training upon initial assignment and annually, as applicable.

Working in the Arctic involves project-specific requirements and specialized training, including but not limited to Working on the North Slope (Alaska) and Learn to Return – Survival Training (Canada and Alaska) or similar. Arcadis staff must also comply with client-specific requirements when it comes to selecting survival school training.

7. REFERENCES

The following H&S standards can be found on the Policies and Integrity Site:

- Arcadis Health and Safety Standard ARC HSFS010– Health and Safety Plan
- Arcadis Health and Safety Standard ARC HSGE015- Personal Protective Equipment Program
- Arcadis Health and Safety Standard ARC HSFS002 – Water Operations Standard

Additional resources regarding cold-related illnesses and prevention include but are not limited the following:

- NIOSH – Hazards and Exposures www.cdc.gov/niosh/topics/coldstress
- Fact Sheet No. OSHA 98-55 ProtectingWorkersinColdEnvironments.pdf
- OSHA – The Cold Stress Equation 1998 OSHA Coldcard.html
- OSHA – Cold Stress Guide, Workplace Safety & Health Topics – Cold Stress
- OSHA – Tips to Protect Workers in Cold Environments

8. RECORDS

Training records will be stored in Arcadis' Oracle Learning Cloud (OLC) so they may be provided, if requested by Arcadis, clients or a regulatory agency. Employees must upload copies of their training records from external vendors to the Arcadis OLC.

9. APPROVALS AND HISTORY OF CHANGE

Julie Santaniello, CSP – Enabling Function H&S Director of Technical Programs

History of Change

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
31 May 2013	01	Keith Antell/Tony Tremblay	Original document
3 February 2015	02	Tony Tremblay	Section 7 links updated
9 October 2018	03	Julie Santaniello	Updated template; added Table of Contents, added Section 4.1 and 4.2 regarding responsibilities at the site and added Acronyms and abbreviations as Exhibit 2. Removed Exhibit 5 work/warm-up schedule for Canada work (refer to Canada-specific HSS).
22 November 2022	04	Miriam Buehrer	Updated template; included additional definitions regarding cold weather events; updated References section.

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
28 September 2023	05	Julie Santaniello	Updated template; included temperature at which to implement action in Section 5.1; switched engineering and PPE in Section 5.3; added Section 5.2; updated training requirements in Section 6; updated Section 8; pulled in Exhibit 3 from the Field H&S Handbook.
11 October 2023	06	Greg Mason	Modified first aid section; modified protective clothing and protective footwear sections.

Exhibit 1 - Definitions

Blizzard Warning – Issued for sustained or gusty winds of 35 miles per hour (mph) or more and falling or blowing snow creating visibilities at or below ¼ mile these conditions should persist for at least three hours.

Cold Burn – instant superficial freezing of tissue when touching a very cold object, tool or specific types of liquids or gases.

Cold Stress – Injuries or health effects that come from working under cold conditions. Four factors contribute to cold stress: cold air temperature, high velocity air movement, dampness of the air and contact with cold water or surfaces.

Cold Water - Water where the monthly mean low water temperature is normally 59 degrees F (15 degrees C) or less, as defined by the US Coast Guard.

Fingertip Fissures – Deep, intractable, and very painful fissuring that may occur on the fingertips when exposed to prolonged or repeated cold conditions.

Frostbite – Exposed skin is susceptible to frostbite when the air temperature is below 0°F or when there are high winds combined with cold temperatures. Symptoms may include loss of sensation, cold, pale and waxy skin. Frostbite can lead to tissue damage, scarring and possible amputation.

Frost Nip – the freezing of the skin and superficial tissue. The skin turns white after exposure to cold wind. Frost nip is a similar mechanism of injury as frost bite but less severe.

Hydrophilic Material – Materials that exhibit a strong affinity for water, e.g., cotton.

Hydrophobic material – Materials that exhibit a lack of affinity for water. Typically, a polyester fabric (polypropylene, polar fleece or a number of other proprietary names) that does not absorb water/perspiration. Additionally, body heat will cause a capillary effect moving moisture away from the skin to the out surface of the fabric. This capillary action will keep the wearer warmer over a longer period than a hydrophilic fabric.

Hypothermia – The chilling of the body's core temperature below 95°F (35°C). Hypothermia usually happens at very cold temperatures, but can also occur in cooler temperatures, for example, if an individual is submersed in water or becomes chilled from rain. Symptoms may include shivering (uncontrolled), slurred speech, memory loss, erratic behavior, clumsy movements, and bluish/purple colored skin.

Trench Foot – caused by continuous exposure to the cold without freezing, combined with constant dampness or immersion in water. Water temperatures do not have to be below freezing. Symptoms of trench foot include a tingling and/or itching sensation, pain, swelling, cold and blotchy skin, numbness and a prickly or heavy feeling in the foot.

Wind Chill Advisory- Issued when wind chill temperatures are expected to be a significant inconvenience to life with prolonged exposure, and, if caution is not exercised, could lead to hazardous exposure.

Wind Chill Temperature - How cold people and animals feel when outside. Windchill is based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature. Therefore, the wind makes it feel much colder. If the temperature is 0 degrees Fahrenheit and the

wind is blowing at 15 mph, the wind chill is -19 degrees Fahrenheit. At this wind chill temperature, exposed skin can freeze in 30 minutes.

Wind Chill Warning- Issued when wind chill temperatures are expected to be hazardous to life within several minutes of exposure

Winter Storm Warning- Issued when hazardous winter weather in the form of heavy snow, blizzard conditions, heavy freezing rain, or heavy sleet is imminent or occurring; are usually issued 12 to 24 hours before the event is expected to begin.

Winter Storm Watch- Alerts the public to the possibility of a blizzard, heavy snow, heavy freezing rain, or heavy sleet; are usually issued 12 to 48 hours before the beginning of a Winter Storm.

Exhibit 2 – Abbreviations and Acronyms

ANA	Arcadis North America
Arcadis	Arcadis U.S. Inc.
HASP	Health and Safety Plan
HS	Health and Safety
H&S	Health and Safety
HSS	Health and Safety Standard
JSA	Job Safety Analysis
PPE	Personal Protective Equipment
OSHA	Occupational Safety and Health Administration
MPH	Miles per hour
NOAA	National Oceanic and Atmospheric Administration

EXHIBIT 3 - ACGIH Wind Chill Temperature Index

Wind Speed (in mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperatures (°F)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70		
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67				
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63					
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69					
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER Maximum danger of false sense of security.				INCREASING DANGER Danger from freezing of exposed flesh within 1 minute.			GREAT DANGER Flesh may freeze within 30 seconds.				

***Note**: Trench foot and immersion foot may occur at any point on this chart.*

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Exhibit 4 – Personal Noise Monitoring Field Form **E5**

1. POLICY

It is the policy of Arcadis to assess noise hazards resulting from or encountered by our staff during job activities and to control such noise hazards to minimize and eliminate hearing loss among our staff, subcontractors, clients, and the public. Arcadis will make hearing protection devices available to staff to wear when exposed to noise that exceeds an 8-hour time-weighted average (TWA) of 80 decibels in the A scale (dBA) or a peak sound pressure level of 140 dB C-weighted (dBC) for any amount of time. Where noise exposure cannot be eliminated or minimized by engineering and administrative controls and an Arcadis employee will be exposed to noise at or over an 8-hour TWA of 85 dBA, employees will be required to wear appropriate hearing protection. When in doubt, Arcadis will provide hearing protection.

2. PURPOSE AND SCOPE

2.1 Purpose

This Health & Safety Standard (HSS) sets forth the requirements for providing a standard policy on the health and safety requirements and processes for employees with potential exposure to excessive noise (levels in excess of 80 dBA) and to comply with occupational exposure limits established by the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV), detailed in Exhibit 3 and the Occupational Safety and Health Administration (OSHA) Occupational Noise Exposure Standard (29 CFR 1910.95 and 29 CFR 1926.52).

2.2 Scope

This HSS applies to every project and all operations conducted by Arcadis. Hearing Protection Devices (HPDs) will be supplied and/or approved by Arcadis for use by employees in carrying out their assignments. All employees conducting work where the potential for noise exposure exceeds 85 dBA as an 8-hour TWA are required to have their assigned HPDs available and used as required by the project Health & Safety Plan (HASP), Job Safety Analysis (JSA) and/or client requirements.

3. DEFINITIONS

Definitions related to Hearing Conservation Health & Safety Standard can be found in Exhibit 1. Acronyms and Abbreviations are found in Exhibit 2.

4. RESPONSIBILITIES

4.1 Project Management

Project Managers (PMs) have the responsibility to know and follow applicable Arcadis and client H&S requirements for ensuring work is conducted in accordance with this HSS, and for implementing the requirements in this HSS at any project site and/or office that pose hazards to Arcadis employees or employees of its subcontractors, clients, and other organizations present in the vicinity of work controlled by Arcadis.

For project related work, PMs responsibilities also include determining and communicating any specific client requirements that are applicable, including:

- Taking appropriate steps to minimize the risk of noise-induced hearing loss that may include implementing noise control measures, as well as the provision of hearing protection devices to employees, as required.
- Communicating with and appropriately managing subcontractors, ensuring that employees have appropriate training and qualifications, and for ensuring all client HS requirements are met.
- Involving the appropriate Arcadis H&S staff and project client staff, as necessary.
- Ensuring that all subcontractors have been communicated with concerning the minimum H&S requirements for the project.
- Providing adequate resources and budget for personal protective equipment (PPE), including HPDs, at no cost to the employee.
- Ensure that Arcadis employees working on their projects are properly using and caring for their HPDs.

In addition, as project and client agents and on behalf of Arcadis, the Project Managers for client-related work shall be responsible for:

- Stewarding H&S and setting expectations that all Arcadis employees working on their projects must comply with H&S rules and requirements.
- Guaranteeing each employee, the absolute right to exercise “Stop Work Authority” in good faith without fear of retribution or disciplinary action; and

- Using the Arcadis Incident Investigation process for formally resolving a “Stop Work” condition.

Using this “Stop Work Authority” process, the Project Manager and the employee will:

- Discuss and document the condition.
- Identify and document the root cause for the condition.
- Determine and document the solutions.
- Implement the solutions; and
- Confirm and acknowledge the solutions in place are to the satisfaction of the employee(s) involved in the stop work incident.

4.2 All Employees

Employees are required to wear prescribed HPDs during activities where noise levels will exceed 85 dBA as an 8-hour TWA. The requirements for availability, selection, and use of HPDs shall be defined by project HASPs, JSAs and/or client requirements.

In addition, employees have the responsibilities to adhere to this HSS and to communicate H&S concerns, issues and questions to their supervisor or their respective H&S resource. In addition, all employees have the responsibility to:

- Maintain hearing protectors in sanitary condition and proper working order.
- Use the **TRACK** process prior to any activity.
- Follow all Arcadis and client requirements.
- Participate in the medical surveillance program, including annual audiograms and hearing conservation training, as applicable based on their job duties.
- Notify both their Supervisor and Enabling Function Health and Safety if they were exposed to high noise levels and required to wear hearing protection during the previous year and are not already in the medical surveillance program; and
- Understand and appropriately use the “Stop Work Authority” concept as described in the Arcadis Stop Work Authority HSS (ARC HSGE009).

4.3 Supervisors and Operations Managers

Supervisors and Operations Managers are responsible for:

- Stewarding the H&S program to ensure that staff in their practice are appropriately equipped with the necessary hearing protection and have been provided the appropriate training.
- Knowing and understanding our H&S program, policy, vision, and this HSS in detail enough to be prepared to explain it to a client when required.
- Providing oversight management for the H&S of employees in their respective operations. Each will assure that appropriate time and resources are provided to facilitate the implementation of this HSS.
- Involving themselves in any “Stop Work” issued by an employee, as requested by an Arcadis employee, project manager, or Operations Managers. Supervisors will assist in resolving the issue associated with the “Stop Work Authority” issued by an employee.

4.4 Health & Safety Managers, Specialists and Site Safety Officers

Health and Safety Managers and Specialists and Site Safety Officers (SSOs) are responsible for facilitating the policy and standard requirements in this HSS in their area of responsibility and for providing “hands-on” assistance to Arcadis staff to ensure this standard is appropriately implemented.

4.5 Enabling Function H&S Staff

Enabling Function Health & Safety is responsible for:

- Communicating the requirements of this HSS with Arcadis U.S. project teams and employees.
- Verifying this standard is being implemented effectively via staff feedback, conducting reviews of project site audits, and through participation in incident investigations.
- Ensuring that Operations Management, Supervisors, Project/Task Managers, and staff affected by excessive noise are aware of this HSS.
- Provide technical services and advice regarding control measures, assist employees in the selection of appropriate hearing protective devices and provide instruction on their use, maintenance, and care, as requested.

- Collaborating with the Arcadis medical surveillance program administrator and Arcadis employees who require audiogram re-testing when a standard threshold shift (STS) in their audiogram results has been detected.
- Provide required training or guidance on approved training options; and
- Review, evaluate and maintain this HSS on a routine basis.

5. PROCEDURE

5.1 Noise Monitoring and Exposure Assessments

When information indicates that an employee's exposure may equal or exceed an 8-hour TWA of 80 dBA, Arcadis shall conduct a noise exposure evaluation (e.g., review of historical exposure monitoring data and/or published sound levels for anticipated activities) and as warranted, develop and implement a monitoring program. The objective assessing whether an excessive noise may be present is to assist project teams in evaluating potential engineering and/or administrative controls and to assist in identifying the necessity for HPDs for the affected staff.

Noise monitoring will be prescribed by H&S professionals during the development of the HASP and/or JSAs in accordance with the Industrial Hygiene HSS (ARC HSIH009). Noise monitoring may also be conducted at the discretion of the SSO or any staff members that have questions or concerns about potential noise exposure that could result in employee exposure above 85 dBA as an 8-hour TWA. If noise monitoring is not feasible, Arcadis staff will assume that noise levels that require elevated speech beyond standard conversation level for staff to be heard are exceeding 85 dbA and will use appropriate hearing protection. Noise monitoring results will be collected in accordance with the OSHA Occupational Noise Exposure Standard (29 CFR 1910.95). Monitoring results will be communicated to staff and used to determine adequate types and effectiveness of hearing protection device.

The measurement of the A-weighted sound pressure level in a workplace shall be performed instantaneously, during normal working conditions, using the slow response setting of a sound level meter. Noise exposure level is determined through the integration of all continuous, intermittent, and impulsive (e.g., a noise event characterized by very short rise time and duration.) sounds between 80 dB and 140 dB.

During this noise hazard investigation, the Personal Noise Monitoring Field Form (Exhibit 4) will be completed. The following matters shall be considered:

- The sources of sound in the workplace.

- The A-weighted sound pressure levels to which the employee is likely to be exposed and the duration of such exposure.
- The methods being used to reduce this exposure.
- Whether the exposure of the employee is likely to exceed the 85 dBA as an 8-hour TWA or other limits defined in the Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices, and
- Whether the employee is likely to be exposed to a noise exposure level equal to or greater than 85 dBA as an 8-hour TLV-TWA.

On completion of the noise hazard assessment or monitoring, the person appointed to carry out the assessment or monitoring shall document:

- Observations with regards to potential noise exposure.
- Recommendations respecting the measures that should be taken to limit employee exposure to noise.
- Requirements that HPDs will be made available to staff to wear when exposed to noise that exceeds an 8-hour TWA of 80 dBA or a peak sound pressure level of 130 dBC for any amount of time.
- Requirements for use of hearing protection by employees who are exposed to a noise exposure level equal to or greater than 85 dBA as an 8-hour TWA.

5.2 Reduction / Control of Noise Exposure

Insofar as is reasonably practicable, Arcadis shall, by engineering controls or physical means other than hearing protectors, reduce the employee's exposure to sound to a level that does not exceed an 8-hour TWA noise exposure level of 85 dBA or other limits defined in the ACGIH TLV – refer to Exhibit 3

The hierarchy of hazard controls that must be followed:

1. *Eliminating the Noise Source* - The elimination of a source of noise is the most effective way to prevent risks to employees and should always be considered when new work equipment or workplaces are planned.

2. *Substitution of Noise Source* – In certain scenarios the device or equipment producing the noise may be able to be substituted for an alternative piece of equipment which, because of new technology, new design, or necessary maintenance, can complete the work while producing less noise.

3. *Engineering Controls* – Another method of dealing with noise in the workplace is to reduce the noise at the source using engineering controls. Engineering controls can eliminate the need for hearing protection, audiometric testing, and other elements of a hearing conservation program. Even if noise cannot be reduced to safe levels at the source, reducing noise increases the likelihood that hearing protection will be even more effective in reducing noise exposures below the 85 dBA exposure limit. Some possible options include reduction of noise at source, enclosure of noise source, enclosure of employees, acoustical treatment of room, separating workers from the noise source and a combination of these controls. In addition, substitution controls may be employed, as part of the engineering control measures.

4. *Administrative Controls* - Education and training are the primary administrative controls for hearing protection. Administrative controls also include measures such as work-rest cycles and infrequent work tasks. These controls are aimed at reducing the time a worker is potentially exposed to noise.

5. *Use of Personal Protective Equipment (PPE)* - When engineering controls cannot eliminate the noise hazard, HPDs will be used to lower noise exposures to acceptable levels. Hearing protection in the form of ear plugs and/or earmuffs are examples of hearing protection devices that can help serve to minimize noise exposures.

5.3 Warning Signs

Workplaces in which the noise level exceeds 85 dBA TWA, and where it is feasible to do so, will have signs posted. Signs shall read "**Caution - Hearing Protection Required**." In extreme noise areas with measured noise levels greater than 105 dBA for any length of time, signs shall read "**Danger – Hearing Protection Required**." In some cases, the responsibility will fall upon the client and/or contractor to post these warning signs. For temporary work locations, Arcadis will coordinate/discuss required warning sign requirements with the controlling contractor.

5.4 Audiometric Testing

Arcadis has established and maintains an audiometric testing program by making audiometric testing available to all employees whose exposures equal or exceed an 8-hour TWA of 85 decibels.

Within 6 months of an employee's first exposure meeting or exceeding the action level, Arcadis shall establish a valid baseline audiogram against which subsequent audiograms can be compared.

At least annually after obtaining the baseline audiogram, Arcadis shall obtain a new audiogram for each employee exposed at or above an 8-hour TWA of 85 decibels.

Audiometric tests will be scheduled in conjunction with pre-placement, periodic, and termination medical examinations as required by the Arcadis Medical Surveillance Program (ARC HSGE010). All employees that are not already part of the medical surveillance program must inform their supervisor and Enabling Function Health and Safety if they were exposed to high noise levels as part of their job duties. Employees that were exposed to high noise levels must receive an audiogram as specified by the Medical Surveillance Program. Employees will be informed of the requirement that they avoid both non-occupational and occupational noise exposure for 14 hours prior to audiometric testing.

Audiograms will be compared to baseline and prior tests to determine if a standard threshold shift (STS) has occurred. The TPA for the Arcadis Medical Surveillance Program (currently WorkCare) will directly notify an employee and the Arcadis Enabling Function Health and Safety Medical Surveillance Program Administrator in writing of an STS within 21 days of determination. If an STS is detected, retesting may be done within 30 days of the initial test to determine whether the STS is occupationally related. If an occupational STS is confirmed, the employee will be informed in writing and may need to be refitted and retrained in hearing protection use. If subsequent testing shows that an STS is not determined to be occupational, yet an STS is confirmed to be present, the employee will be informed of the updated determination. Additional audiometric testing may be conducted at the discretion of Arcadis Enabling Function Health and Safety.

The TPA physician or audiologist will determine if further evaluation is needed and, if so, will provide to the specialist all the information that is required. If the physician determines that the medical pathology is unrelated to work exposure or wearing hearing protectors (e.g., “non-occupational”), the employee will be informed by the physician.

The Audiometric Testing program will be managed by the Arcadis TPA for the medical surveillance program.

5.5 Hearing Protection Devices

HPDs will be available to all workers exposed to noise levels that exceed 80 dBA as an 8-hour TWA and will be required when workers are exposed to noise levels that exceed 85 dBA as an 8-hour TWA, in accordance with the Personal Protective Equipment (PPE) HSS (ARC HSGE015). HPDs will be provided at no cost to the employee. Some types of hearing protection include:

- Earmuffs – fit over the whole ear and seal the ear from noise. The efficiency of the muff type may decrease if the muff is not fitted properly or if glasses are worn with them.
- Ear Plugs – which are worn in the internal part of the ear, and they are made of a variety of materials (rubber, plastic, or other material) that will fit tightly in the ear.

Arcadis shall supply a hearing protector that:

- Has appropriate Environmental Protection Agency (EPA) labeling for hearing protectors (40 CFR 211), which requires manufacturers to identify the noise reduction capability of all hearing protectors on the hearing protector package. This measure is referred to as the noise reduction rating (NRR); and
- Prevents the employee using the hearing protector from being exposed to a level of sound that exceeds the limits detailed in Exhibit 3

  Note: The actual effectiveness of any individual hearing protector cannot be determined under workplace conditions. However, OSHA's noise standards 29 CFR 1910.95(j)(2) and 29 CFR 1926.52(b) require that personal hearing protection be worn to attenuate the occupational noise exposure of employees. Arcadis chooses to implement the ACGIH-TLV for noise exposure. OSHA Occupational Noise Exposure Standard, Appendix B: Methods for Estimating the Adequacy of Hearing Protector Attenuation provides information on how to determine the adequacy of hearing protector attenuation using the NRR of a given hearing protector.

Certain workplace scenarios may involve the exposure to noise sources considered to be “extreme”. An extreme level of noise is defined as “Areas with measured noise levels greater than 105 dBA for any amount of time.” As a Best Management Practice, Arcadis employees working in **extreme** noise areas are directed to wear “dual” hearing protection, consisting of

earplugs along with earmuffs. Additional engineering and/or administrative controls limiting the exposure time to keep the sound from reaching the worker's ear drum below 85 dBA TWA must also be initiated. Based on current OSHA policy, the wearing of earmuffs over ear plugs will boost the overall attenuation of the earplugs by 5 dB. Employees will be given the opportunity to select their HPDs from a suitable variety. Arcadis shall provide training in the use and care of all HPDs provided to employees.

5.6 Preventing Hearing Loss Caused by Chemical (Ototoxicity) Exposure

The Centers for Disease Control (CDC) in collaboration with OSHA prepared the "Preventing Hearing Loss Caused by Chemical (Ototoxicity) and Noise Exposure" safety and health bulletin. The OSHA bulletin provides details on how worker exposure to certain types of chemicals, ototoxics, may affect how the ear functions including causing hearing loss and/or balance problems, regardless of noise exposure. The group of ototoxic chemicals includes certain pesticides, solvents, and pharmaceuticals. Ototoxic chemicals are classified as neurotoxicants, cochleotoxicants, or vestibulotoxicants based on the part of the ear that is damaged. Ototoxic chemicals can reach the inner ear through the blood stream and cause injury to inner parts of the ear and connected neural pathways. The first step in preventing exposure to ototoxicants is to know if they are present at the worksite. One way to identify if an ototoxic chemical is present is by reviewing the Safety Data Sheet (SDS) Section 11 "Toxicological Information" for ototoxic substances and/or chemicals, and ototoxic health hazards associated with ingredients in the product. Some ototoxic chemicals which may be encountered by Arcadis staff include, but are not limited to, solvents such as carbon disulfide, n-hexane, toluene, p-xylene, ethylbenzene, n-propylbenzene, styrene, methylstyrene, trichloroethylene, carbon monoxide, hydrogen cyanide and related salts, mercury compounds, and lead. Since ototoxic substances can be absorbed through the skin, the effective use of PPE like nitrile gloves, chemical protective aprons, or chemical protective coveralls to prevent dermal contact with such substances.

6. TRAINING

Employees who have potential or actual noise exposure work scenarios which exceed 80 dBA as an 8-hour TWA value, will be required to receive training on noise hazards, the selection, use and care of HPDs. Training can be arranged through the Arcadis Learning Management Platform (LXP) or by contacting People Services (peopleservices@arcadis.com) for support.

Employees required to wear hearing protection will receive training as provided by Enabling Function H&S. The training will be provided at least annually with refresher training as necessary and will include:

- Information regarding effects of noise on hearing.
- Purpose of hearing protectors.
- Advantages, disadvantages, and attenuation of various types of hearing protectors.
- Selection, fitting, use, and care of hearing protectors; and
- Purpose of audiometric testing and an explanation of the test procedures.

7. REFERENCES

The following H&S standards can be found on the Policies and Integrity Site:

  - Arcadis Health and Safety Standard ARC HSFS010– Health and Safety Plan
  - Arcadis Health and Safety Standard ARC HSIH009– Industrial Hygiene
  - Arcadis Health and Safety Standard ARC HSGE010– Medical Surveillance Program
  - Arcadis Health and Safety Standard ARC HSGE015- Personal Protective Equipment Program
  - Arcadis Health and Safety Standard ARC HSGE009- Stop Work Authority

- OSHA Occupational Noise Exposure Standard 29 CFR 1910.95 (General Industry) and 29 CFR 1926.52 (Construction Industry)
- ACGIH Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices
- Environmental Protection Agency labeling for hearing protectors 40 CFR 211
- Noise Navigator™ Sound Level Database with over 1700 Sound Level Measurement Values; E-A-R 88-34/HP; 3M Occupational Health & Environmental Safety Division; July 6, 2010; Version 1.5
- OSHA Occupational Noise Exposure Standard, Appendix B: Methods For Estimating the Adequacy of Hearing Protector Attenuation
- "Preventing Hearing Loss Caused by Chemical (Ototoxicity) and Noise Exposure"; US Occupational safety and Health Administration and Centers for Diseases Control Safety and Health Bulletin, SHIB 03-08-2018 DHHS (NIOSH) Publication No. 2018-124.

8. RECORDKEEPING

All records regarding noise exposure measurements will be maintained by the offices for two years. All audiometric test records will be maintained by the TPA for the Arcadis Medical Surveillance Program for the duration of the affected employee's employment.

Training records will be stored in the LXP so they may be provided, if requested by Arcadis, clients or a regulatory agency. Employees must upload copies of certificates following the instructions for Entering External Training in LXP in the LXP Guidance.

9. APPROVALS AND HISTORY OF CHANGE

Julie Santaniello, CSP – Enabling Function H&S Manager of Technical Programs

History of Change

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
1 December 2007	01	Mike Thomas/Tony Tremblay	Original document
30 January 2008	02		Change to new template
5 October 2010	03		Change name from Procedure to Standard; revision of section 5.3

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
12 December 2012	04		Executive Summary Added; HSP changed to HSS; Definitions relocated to Exhibit 1 and added Representative Exposure definition; Added BMP regarding use of both ear plugs and ear muffs when noise level exceeds 105 dBA; Requirement for use of HPD aligned with ACGIH Noise TLV; Training Section updated; References hyperlinked; Section 7 Hyperlinks added, including link to Common Noise Level Reference table; NRR to assess hearing protector adequacy calculation added to Exhibit 1 NRR definition
10 June 2013	05	Tony Tremblay	Noise Exposure values clarified in Executive Summary; Section 5 reformatted to include noise monitoring exposure and assessment, reduction/control of noise exposure, warning signs, audiometric testing and HPDs; Section 6 determining when noise exposure Training clarified
01 October 2013	06	Lauren Edwards	Changed the requirement for an audiometric exam within 6 months if an employee is exposed to noise at 85 dBA or higher for an 8-hr TWA. Section 5.4
6 October 2014	07	Amanda Tine/Tony Tremblay	Clarified employee audiometric testing requirements in Section 5.4 based on OSHA 29 CFR 1910.95

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
20 April 2017	08	Sharon Lingle, Tony Tremblay/Julie Santaniello	New format. Added TPA will notify the Arcadis employee within 21 days of a threshold shift. Updated requirements include making hearing protection devices available to staff to wear when exposed to noise that exceeds an 8-hour TWA of 80 dBA or a peak sound pressure level of 130 dBC for any amount of time; and staff are required to wear prescribed HPDs during activities where noise levels will exceed 85 dBA as an 8-hr TWA. Excessive noise definition modified.
8 June 2022	09	Alec MacAdam	Formatting updates. Section 4.5 Corporate H&S staff to assist in STS tracking. Section 5.2 added substitution hazard control examples. Section 5.4 clarification of STS determination. Add section 5.6 detailing ototoxic chemicals. Add STS definition to Exhibit 1. Update Exhibit 2. Update Exhibit 3.
22 Nov 2024	10	Brian Dean Keh	Formatting updates and updated table. Updated values in ACGIH TLV chart. Removed quick sheet. Updated information in section 6 for training. Added personal noise monitoring field form (Exhibit 4).

Exhibit 1 – Definitions

Decibels – A Weighted – the unit of measure to be used when measuring noise levels on Arcadis work sites and when comparing to occupational exposure standards and limits.

Excessive Noise – noise levels in excess of 80 dBA for any amount of time (noise environment that requires speech levels above those used for normal conversation).

Extreme Noise Areas are defined as areas with measured noise levels greater than 105 dBA for any amount of time.

HSS – Health and Safety Standard

NRR – Noise Reduction Rating is the measure, in decibels, of how well a hearing protector reduces noise, as specified by the Environmental Protection Agency. The higher the number, the greater the noise reduction. When dual protectors are used, the combined NRR provides approximately 5 decibels more than the higher rated of the two products. For example, using ear plugs (NRR of 29 decibels) with earmuffs (NRR 27) would provide a Noise Reduction Rating of 34 decibels. For practical purposes, users should assume they will receive protection that is 5 decibels less than the published value.

When using the NRR to assess hearing protector adequacy and the sound level measurement reported is in the "A" scale, the following method is used to evaluate the adequacy of the hearing protector attenuation:

Step 1: Convert the A-weighted dose to TWA (dBA)

Step 2: Subtract 7 dB from the NRR

Step 3: Subtract the remainder of Step 2 from the A-weighted TWA (Step 1 value) to obtain the estimated A-weighted TWA under the ear protector.

Representative Exposure – Measurements of an employee's noise dose or 8-hour time-weighted average sound level that the employers deem to be representative of the exposures of other employees in the workplace.

Standard Threshold Shift – OSHA defines a standard threshold shift as a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear.

Sound Level Meter – means a device for measuring sound pressure level that meets the performance requirements for a Type 2 instrument as specified in the International Electrotechnical Commission Standard 651 (1979).

Sound Pressure Level – means 20 times the logarithm to the base 10 of the ratio of the root mean square pressure of a sound to the reference sound pressure of 20 µPa, expressed in decibels.

Summary of Noise Trigger Levels:

- 80 dBA – Noise exposure assessment will be conducted if worker is or is likely to be exposed to noise at a workplace in excess of 80 dBA.
- 80 dBA – HPDs will be made available to staff to wear when exposed to noise that exceeds an 8-hour TWA of 80 dBA or a peak sound pressure level of 130 dBC for any amount of time. This will also trigger training on the selection, use and care of HPDs.
- 85 dBA – AUS staff will be **required** to use HPDs for noise levels at or exceeding 85 dBA as an 8-hour TWA.
- 85 dBA as 8-hour TWA – If employee exposed at 85 dBA or higher for an 8-hr TWA, then they are required to have audiometric testing included as part of their workplace medical surveillance.
- 85 dBA or higher – noise hazard signs posted.
- 105 dBA or higher – Employee must use both ear plugs and earmuffs together for exposure to noise for any amount of time that exceeds 105 dBA.

TWA – Time Weighted Average; The average exposure to a contaminant or condition (such as noise) to which workers may be exposed without adverse effect over a period of 8 hours a day or a 40-hour work week.

Exhibit 2 – Abbreviations and Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
Arcadis	Arcadis U.S. Inc.
ARC	Arcadis
HPD	Hearing Protection Devices
HS	Health and Safety
H&S	Health and Safety
HSS	Health and Safety Standard
IH	Industrial Hygiene
JSA	Job Safety Analysis
NRR	Noise Reduction Rating
OSHA	Occupational Safety and Health Administration
TLV	Threshold Limit Value
TWA	Time Weighted Average
STS	Standard Threshold Shift
TPA	Third Party Administrator

Exhibit 3 – ACGIH TLV FOR NOISE

	Duration per Day	Sound Level dBA (slow response)
Hours	24	80
	16	82
	8	85
	4	88
	2	91
	1	94
Minutes	30	97
	15	100
	7.5	103
	3.75	106[1]
	1.99	109
	0.94	112
Seconds	28.12	115
	14.06	118
	7.03	121
	3.52	124
	1.76	127
	0.88	130
	0.44	133
	0.22	136
	0.11	139
	0.08	140[2]

Notes:

1. An extreme level of noise is defined as “Extreme noise areas are defined as areas with measured noise levels greater than 105 dBA for any amount of time.
2. No exposure to continuous, intermittent, or impact noise in excess of a peak C-weighted level of 140 dB. Exhibit 4 – Personal Noise Monitoring Field Form

Exhibit 4 – Personal Noise Monitoring Field Form

(Link to the Personal Noise Monitoring Field Form)

ARCADIS

PERSONAL NOISE MONITORING FIELD FORM

Company:	**Location:**
Sample No.:	**Sample Date:**
Noise Type: (circle: Steady, Intermittent, Impact)	**Sampled By:**
Operation Status: (circle: Routine, Non-Routine)	**Sampling Strategy:** (circle: Typical, Worst Case, Random)
Employee Name: (F.L)	**Employee Identification No.:**
Employee Job Function:	
Shift Start: **Shift Stop:**	**Shift Length (minutes):** (circle: 480, 540, 600, 660, 720)
Work Area(s):	
Job Duties Performed:	
PPE In Use: (circle: No Hearing Protectors Used, Ear Muffs (Supplier & Model:), Ear Plugs (Supplier & Model:)	
Sampling Instrument Used: (s/n)	
Calibrator No.: (s/n)	
Is Employee exposed during any non-sampled period? (circle: Yes No)	
Additional Comments:	

EXAMPLE

Hearing Conservation_ARCHSIH008_US_Rev10_Exhibit 4_13 January 2025 1 of 1

Implementation Date	ARCADIS HS Standard Name	ARCADIS Design & Consultancy for natural and built assets
31 August 2011	Heat Stress Prevention	
Revision Date	ARCADIS HS Standard No.	Revision Number
17 February 2020	ARC HSIH013	09

Table of Contents

QUICK SHEET

Applicability

Heat related illnesses (also referred to as “Heat Stress”) are caused by working in hot environments. The hazards associated with working in hot environments can be controlled and minimized by using safe work practices such as applying administrative controls, engineering controls, and providing the appropriate personal protective equipment (PPE).

Need To Know

Project personnel are responsible for understanding the conditions, signs, and symptoms that can lead to heat illness and adhering to the prescribed control and mitigation and methods.

Personal risk factors for heat illness include poor health, age, excessive weight, and pre-existing medical conditions; inadequate acclimation to working in the heat; and a previous episode of heat illness. Environmental risk factors include workload severity and duration, high temperature and humidity, direct sun exposure, and insufficient air movement. If left unchecked, heat illness will progress to the heat stroke stage, which is a life-threatening condition, and emergency personnel should be contacted immediately.

Preventive safe work practices involve avoidance of working in the heat when possible; taking regularly scheduled shade breaks; acclimatization; rotating personnel; avoiding beverages containing caffeine or sugar; staying appropriately nourished; maintaining hydration; and providing readily available fresh, pure, and suitably cool potable water access at all times.

Engineering controls that should be implemented include monitoring and measuring temperature and heat index factors, designing appropriate work/rest cycles, and choosing clothing that allows for wicking of perspiration.

Personnel will report any signs and symptoms of heat illness exhibited by themselves or by other personnel.

Training

Training for heat illness prevention will be provided to all supervisory employees before project assignment. Topics will include the importance of acclimatizing, risk factors, signs and symptoms of various heat illnesses, and procedures to follow in the event of an emergency. Staff working in California, Washington, or other states with specific heat illness standards must receive documented training before assignment. Other affected employees not working in these states must be familiar with this HSS and the information detailed in the Field Health & Safety Handbook. Corporate H&S recommends that all staff that might reasonably be anticipated to be exposed to the risk of heat illness complete the online heat illness training course.

Equipment

Equipment required for work in hot environments may include but is not limited to cooling devices, shade structures and weather monitoring devices. Refer to the Heat Plan H&S Plan Supplement for project or task specific equipment required.

Permits or Forms Required

The Heat Plan H&S Plan Supplement will be prepared during project planning to document and communicate the site-specific heat illness prevention provisions for projects in California and Washington State (best management practice [BMP] for other states).

1. POLICY

It is Arcadis policy that the project team and field staff will work together to protect on-site personnel from the hazards of heat illness when employees are required to work in hot, outdoor places of employment or in other areas where the environmental risk factors for heat illness are present.

Heat-related illnesses may be prevented by using safe work practices including administrative controls, engineering controls, and/or appropriate personal protective equipment (PPE).

2. PURPOSE AND SCOPE

2.1 Purpose

The purpose of this Health & Safety Standard (HSS) is to promote employee awareness regarding heat illness symptoms, direction on the controls and prevention of heat-related illnesses, and guidance on appropriate response actions if symptoms do occur.

2.2 Scope

This HSS applies to Arcadis projects that include, but are not limited to: indoor operations in hot environments or outdoor operations conducted in hot weather such as construction, refining, oil and gas extraction, asbestos removal, and hazardous waste site activities, especially those that require employees to wear semipermeable or impermeable chemical protective clothing (CPC) that are likely to cause heat illness among the exposed. California and Washington State enforce specific occupational heat illness prevention requirements, which are addressed in this HSS. Project teams are advised that, for all other states and U.S. territories, the information provided in this HSS will be used as best management practices (BMPs) for addressing heat-related illness prevention.

Project sites located in California and Washington State must comply with the requirements set forth in this HSS, which has been developed to comply with the California Occupational Safety and Health Administration (Cal/OSHA) Title 8 California Code of Regulations (CCR) 3395 Heat Illness Prevention Standard and the Washington State Outdoor Heat Exposure Regulations 296-62-09510 thru 09560. Project sites in California and Washington State must complete the HASP Supplement and include this HSS as an attachment to the field copy of the HASP, along with the completed HASP Supplement.

3. DEFINITIONS

There are a number of definitions associated with this standard. These definitions are presented in Exhibit 1 of this document. A list of acronyms and abbreviations used in this HSS is provided in Exhibit 2.

4. RESPONSIBILITIES

4.1 Project Managers, Associate Project Managers, and Task Managers

Project Managers (PMs), Associate Project Managers (APMs) and Task Managers (TMs) are responsible for ensuring that heat illness is considered and addressed in project task hazard analysis, risk assessment, and project planning.

Ensure that the project Health & Safety Plan (HASP) addresses the need for adequate water, provisions for shade are available at a job site, and that time is available for staff to eat when the environmental risk factors for heat illness are present.

Ensure that the HASP addresses the need for affected employees to receive applicable training on heat illness prevention and that staff are provided time to complete the training before starting work.

4.2 Supervisory Personnel

Supervisory personnel (e.g., Site Safety Officers [SSOs], PMs, APMs, and/or TMs who are supervising employees working on site and in the heat) must review this HSS and complete training in the prevention of heat related illnesses before supervising employees that work in the heat (risk of heat illness). Supervisory personnel will be trained in heat illness prevention methods and provided procedures in this HSS to follow when an employee exhibits symptoms consistent with possible heat illness including emergency response procedures. Supervisory personnel must ensure that personal risk factors that contribute to heat-related illness are considered before assigning a task where there is the possibility of a heat-related illness occurring (See Section 5.2 for risk factors) and plan for and implement preventive measures and controls when heat advisories are issued for those areas in which staff will be working.

Ensure that effective communication by voice, observation, or electronic means is maintained so that site employees can contact a supervisor, WorkCare, or emergency medical services when necessary. Devices, such as radios or mobile phones or satellite phones, may be used for this purpose only if reception in the area is reliable. If an electronic device does not provide reliable communication in the work area, the project team must ensure that a suitable means of summoning emergency medical services is available.

Ensure that affected employees working on site have received proper training on heat illness prevention.

Ensure that the requirements in this HSS are documented and followed.

Ensure that staff working in the heat have constant access to suitably cool, fresh, pure potable water; are provided routine breaks; and have access to shade.

4.3 Affected Employees

Employees are responsible for understanding the conditions, signs, and symptoms that can lead to heat illness and for using and adhering to the prescribed control and mitigation and methods. Personnel will report to the SSO and/or PM any signs and symptoms of heat illness exhibited by themselves or by other personnel on the project site.

If site personnel have not received heat illness training before conducting work, then site personnel will be educated on heat illness prevention by reviewing this HSS, reading the site HASP (including the site-specific Heat Illness Prevention Plan [HIPP] HASP Supplement as required for California and Washington States), and by attending the daily tailgate meeting.

Employees must review and comply with the provisions of this HSS.

Employees must ensure that they have suitably cool, fresh, pure (potable) water available at all times and that they eat before starting work and during the day when the environmental risk factors for heat illness are present.

Employees will ensure that they have constant access to a shaded area to prevent or recover from heat-related symptoms.

4.4 Corporate Health & Safety

Corporate H&S is responsible for keeping this HSS up to date with regulatory requirements and best work practices.

As requested, provide training to potentially impacted employees and their supervisors on the risks and prevention of heat illness, including how to recognize symptoms and how to respond when they appear.

5. PROCEDURE

5.1 Safe Work Practices

Arcadis staff will follow these general safe work practices when working in hot environments:

- Where determined by regulation, the project site will implement heat illness prevention measures when temperatures in the work area exceed an equivalent heat index temperature of 80 degrees (°) Fahrenheit (F) or 26.6° Celsius (C), accounting for ambient air temperature, humidity, use of semi-permeable and impermeable PPE, and the degree of exertion by the workers.
- Staff will avoid working during periods of high heat ($\geq$ 95°F / 35°C) when possible. This can be accomplished by avoiding scheduling work during the hottest parts of the day, working in cooled enclosures, or providing cooling units in the work area. Severe heat conditions can be cause for stopping or not starting work.
- Allow personnel to acclimatize and adapt to the heat; specifically, those employees new to the project, wearing semi-permeable/impermeable PPE, conducting strenuous tasks, or working in high heat areas.
- The SSO will be particularly watchful of the condition of new employees and stay alert to the onset of heat-related symptoms. New employees will be assigned a “buddy” or experienced co-worker for monitoring each other closely for symptoms of heat illness.
- Whenever possible, rotate personnel in/out of working conditions where heat is a hazard.
- Personnel will have constant access to suitably cool, fresh, pure (“fresh and pure” is defined as being free of odors) water. Where the supply of water is not plumbed or otherwise continuously supplied, water will be provided at no cost to the employee(s) (or employee will be reimbursed) in sufficient quantity at the beginning of the work shift and for the shift duration.

Note: *Thirst cannot be relied on as a guide for hydration. Employees need to drink cool, fresh water throughout the day (four 8 oz cups per hour) during hot weather. Electrolyte replacement drinks or "Sports Drinks" can be used to replace essential minerals lost during sweating. Generally, such drinks should supplement water intake such as one "sports drink" to every three bottles of water. One teaspoon of salt added to every gallon of water could also be used.*

Electrolyte replacement and "Sport Drinks" should not be used as the primary source of hydration or as a substitute for food or water.

- Employees will be notified of the location(s) of the closest drinking water supplies.
- Employees should be advised to choose non-carbonated water over sodas and other beverages containing caffeine or sugar.
- Employees should eat before work and then during the work rotation.
- Employees and the SSO must understand the individual, pre-disposing susceptibilities to heat illness (e.g., previous exposure to heat illness or when taking certain medications).
- Employees must understand the signs and symptoms of heat illness including discomfort, excessive sweating, headache, poor concentration, muscle pain, cramping, dizziness, fatigue, irritability, loss of coordination, vomiting, blurry vision, confusion, lack of sweating, fainting, and seizures.
- Employees must understand first aid and emergency response procedures associated with heat illness.
- If an emergency arises, it is critical that employees understand the process and contact information for requesting emergency medical support. The reception coverage for the site must be evaluated to ensure that adequate communication is in place across the project site and for contacting emergency responders.
- See Exhibit 3 for more safe work practices information.
- See Exhibit 4 for a link to the HASP Supplement, contained in the Standard Excel® HASP template.

5.2 Risk Factors for Heat-Related Illnesses

The personal and environmental risk factors for heat-related illnesses must be evaluated as part of the TRACK process before performing a task.

5.2.1 Personal Risk Factors

Risk factors applicable to the individual employee must be considered when evaluating a working environment for potential exposure to heat illness. The following risk factors should be considered for each individual employee, as these may vary among individuals.

- No recent exposure to high heat work areas is a risk factor because the individual's body is not acclimatized to working in the heat.
- Individual susceptibilities, such as age, weight, degree of physical fitness, use of medications, and certain medical conditions (such as hypertension and diabetes), all affect the potential to experience a heat-related illness.
- A person is at greater risk for heat illness when they are in poor health, are dehydrated, have not eaten, have not been acclimated to working in the heat, or have experienced previous heat illness.

- Working in a hot environment tends to lower the mental alertness and physical performance of an individual. Increased body temperature and physical discomfort promote irritability, anger, and other emotional states that have the potential to cause personnel to overlook safety procedures or to divert attention from hazardous tasks.
- Wearing PPE that increases the potential for the onset of heat illness symptoms is also considered a risk factor for the onset of heat illness.

5.2.2 Environmental Risk Factors

Some risk factors are considered environmental, and therefore apply to all individuals working in a specific area. These are additional to any personal risk factors identified for individual employees. The following risk factors should also be considered when determining the potential for the occurrence of heat illness.

- High temperature and humidity
- Working in direct sun
- No breeze or wind
- Radiant heat or heated air movement
- Conducting strenuous tasks and long duration work.

Working in the heat tends to increase the likelihood of accidents due to the slipperiness of sweaty palms, dizziness, or the fogging of safety glasses. The frequency of accidents, in general, appears to be higher in hot work environments (> 80°F/26.6°C) than in environments involving moderate temperatures.

5.3 Administrative and Engineering Controls

When feasible, Arcadis staff will implement the following administrative and engineering controls:

- Avoid scheduling work during the hottest parts of the day when possible. Alternatively, schedule more strenuous tasks or tasks that require use of semi-permeable or impermeable (e.g. non-breathable, non-venting) PPE early in the morning when conditions are typically cooler than midday or afternoon conditions.
- Monitor the temperature and humidity at the site. These comprise the heat index factors, which convey the magnitude of the heat hazard. Discussion during the daily safety briefings is critical to ensure that this hazard is understood by on-site personnel. Monitoring can be accomplished with on-site instrumentation, especially when working indoors or in enclosed spaces, or by monitoring outdoor weather conditions through the internet, radio, or local weather bureaus. See Section 5.3.4.
- Encourage personnel to wear appropriate clothing that allows for the wicking away of perspiration as a form of evaporative cooling to help cool the wearer.
- Develop and implement appropriate work/rest cycles to allow for adequate cool-down periods.
- Employees suffering from heat illness related symptoms must be allowed, and will be encouraged, to take a preventive cool-down rest in an area with shade that is either open to the air or provided with ventilation or cooling (e.g., cooling stations, misters, air-conditioned spaces). While taking a preventive rest, the employee will be monitored for heat illness symptoms by the SSO and encouraged to remain in the shade and not allowed to return to work until the symptoms are gone. Access to shade will always be permitted.

5.3.1 Procedure for Acclimatization

Supervisors, SSOs, and employees will be trained on the importance of acclimatization, how it is developed, and how to implement an acclimatization process consistent with applicable regulations and the guidelines set forth in this HSS. An employee is at risk of heat illness during a sudden increase in the ambient temperatures of the work environment if not given time to adjust to the changing conditions. Acclimatization (the physiological process of becoming accustomed to changing conditions) is necessary especially in conditions of high heat and for tasks requiring strenuous physical exertion. In addition to acclimatization, other factors can affect employees working at sites where high temperatures are anticipated, such as: poor general health, age, weight, pre-existing medical conditions, and having previously experienced heat illness. Employees are not required to share personal health information such as pre-existing medical conditions. However, including a discussion of how these factors can contribute to the onset of heat illness in the Tailgate Safety Meeting discussion raises individual awareness of the risks involved with heat illness.

A gradual acclimatization period will be implemented for new employees that have not been exposed to a work environment where high temperatures are present (e.g., employees not accustomed to the conditions of the work site will be given slower paced, less physically strenuous tasks during the hot parts of the day and given the more physically strenuous tasks during cooler parts of the day). New employees will be closely monitored during their acclimatization period, which can last up to 2 weeks. The steps taken to reduce the workload intensity for employees not yet acclimated to working in high heat conditions will be documented in the field copy of the HASP Supplement.

The SSO or designee is responsible for implementing the following procedures for acclimatization. These procedures include, but are not limited to, the following:

- Observing employees closely for signs of heat illness. Specific site conditions warranting close observation include, but are not limited to, any day when the temperature is 80°F/26.6°C or greater and is at least 10°F (6°C) higher than the average daily temperature for the preceding 5 days.
- Providing effective acclimatization procedures for employees during exposure to a sudden increase in temperature. The SSO will be aware of those employees who are not yet acclimatized to sudden changes in temperature and will attend to those employees to prevent heat illness.
- Monitoring weather daily. The SSO will be on the lookout for sudden heat wave(s) or increases in temperatures that employees haven't been exposed to for several weeks or longer per Section 5.3.4 Weather Monitoring Procedures, detailed in this HSS.
- Implementing specific Work/Rest Cycles based on monitoring vital signs of on-site personnel, see Section 5.4.3.

5.3.2 Provisions for Water at the Site

At the start of work, the importance of drinking water, the signs and symptoms of heat illness, the location(s) of the water/water coolers, and the schedule of water/rest breaks will be communicated to all staff during each Tailgate Safety Meeting. The SSO or the designated alternate will provide for distribution of suitably cool, fresh, clean potable (drinking) water at the project site. An adequate supply of suitably cool, fresh, clean potable water will always be maintained on site to allow each employee to consume 1 quart (1 liter [1 L]) of water per hour (i.e., 2 gallons [8 L] per employee for an 8-hour shift).

Where unlimited drinking water is not immediately available from a plumbed system or otherwise continuously supplied, water will be provided to staff via coolers containing bottled water or insulated drinking water dispensers (verify that coolers/dispensers are of a sufficient capacity to support the amount of field staff present) accompanied with disposable cups to maintain sanitary conditions for potable water consumption. When conditions are anticipated to exceed 80°F/26.6°C, SSOs and/or supervisors will encourage employees to drink water before they "feel" thirsty. Ideally, drinking 8 ounces of water every 15 minutes will allow the body to remain properly hydrated while working in high temperature conditions.

If the decision is made not to provide all site employees the full-shift quantity of drinking water at the start of a work shift (i.e., 2 gallons [8 L] per employee for an 8-hour shift), then effective procedure(s) must be documented and implemented to ensure drinking water replenishment to allow each employee to drink 1 quart (1 L) per hour. This means that a sufficient quantity of water must always be present and readily accessible to allow every employee to consume at least 1 quart of water per hour until the water supply has been replenished.

- Coolers containing bottled water or drinking water coolers should be maintained to provide for a minimum of 3 hours of water per employee (at least 1 quart [1 L] of water will be made available per employee per hour) to account for a sufficient quantity of water to always be present.
- Water supplies will be positioned as close as reasonably possible to site workers. Ideally, water supplies will be positioned within 50 feet of employee activity or in vehicles used by employees to gain access to individual work areas; however, coolers will be stationary when employees are essentially stationary. Placing water only in shaded areas or by toilet facilities is not sufficient, particularly at large work sites or at multi-story construction sites. Drinking water sources need to be close enough to workers to allow for routine consumption.
- Coolers will be inspected and replenished with water and ice for cooling periodically (e.g., every 30 minutes, or based on site temperature and number of employees present) by the SSO or designee.
- Ice will be added to the coolers, as necessary, during the required inspections.

  ***Note**: When the temperature exceeds 90°F (32°C), inspections will be increased in frequency and ice will be added as needed to keep water cool*.

- Ice will be distributed from a separate cooler or service and added to coolers to ensure that the drinking water remains potable and appropriately cool for employee consumption. Ice used to chill the water will be stored separately to remain sanitary. Sanitary ice storage can include storage of ice in bags when bottled water is used or use of separate storage coolers when using drinking water dispensers.
- Coolers will be inspected and cleaned after each work shift or before starting work each shift. The SSO will oversee cooler maintenance and provide appropriate cleaning supplies.
- The SSO or designee will document the weekly review of the HASP Supplement and make the necessary adjustments each week for weather changes or when new employees are introduced to the project. The reminder may include water ordering information if purchased in bulk from an appropriate supplier.

5.3.3 Access to Shade

The project team is responsible for making sure that the necessary equipment to provide shade is available at the project site. The temperature threshold for shade to be in place is when site temperatures exceed 80°F/26.6°C. The SSO or designee is responsible for directing how shade will be coordinated and placed. The term "shade," for the purposes of complying with applicable regulations, will be defined as "The blockage of sunlight to the extent that no shadow is cast while sitting in the designated area." Flecks of sunlight are acceptable as long as, overall, the shade provides substantially complete blockage of sunlight. Where trees or other vegetation are used to provide shade, the thickness and shape of the canopy must cast sufficient shadow, given the changing angles of the sun, to protect employees from the sun during the entire shift.

At the start of each shift, the importance of taking shade breaks, recognizing the signs and symptoms of heat illness, the duration of shade breaks (> 5 minutes per break), and the shade location will be addressed during each Tailgate Safety Meeting. Access to shade must be allowed at all times.

> ***Note**: Where required by regulation, shade breaks will be taken at a minimum rate of 15 minutes of shade for every 2-hour work period. As temperature increases shade breaks will increase in frequency. See the Heat Index table in Section 5.4 for Heat Index specific Action Levels defining shade break frequency and duration.*

Establishing adequate shaded areas for employees involves:

- If the temperature at the site exceeds 80°F, shade structures will be opened and made available to employees.
- Shaded areas must be able to accommodate all employees taking a recovery or rest break including those employees who are on meal breaks. This does not mean that the shaded area(s) must provide shade to accommodate all employees on a site or working a shift *at the same time.* An example includes rotating routine breaks among employees. Also, additional portable shade structures can be erected as needed.
- Employees must have enough shaded space to sit comfortably while fully shaded and to allow for sitting without being in physical contact with each other.

  > ***Note**: When establishing shade, it is important to ensure that employees who desire access to shade will not be deprived of it due to lack of space. One such procedure to address this point would be to rotate employees in and out of shaded areas to ensure that all have sufficient access for the 15-minute interval required. Another option would be to have additional shade structures on hand to deploy as needed.*

- Shade structures will be relocated to follow the crew for moving tasks.
- Shade structures will be placed within 50 feet of the work area if practical. A key consideration when placing a shade structure is that it is a short walk away (e.g., 2 to 3 minutes) from the work area. This consideration becomes critical as the temperature rises above 80°F/26.6°C.
- Where it is not safe or feasible to provide shade, notes will be made to the HASP Supplement of the unsafe or unfeasible conditions. The SSO will also document the steps taken to provide alternative cooling measures equivalent to providing shade, such as vehicles equipped with air conditioning or air-conditioned office trailers.
- An employee who takes a preventive cool-down rest:

- Will be monitored by the SSO and asked if they are experiencing symptoms of heat illness.
- Will be encouraged to remain in the shade.
- Will not be ordered back to work until any signs or symptoms of heat illness have abated.
- If an employee exhibits signs or symptoms of heat illness while taking a preventive cool-down rest, the SSO will provide appropriate first aid or emergency response.

5.3.4 Monitoring of Weather and Procedures for Heat Waves

The SSO or designee will be trained in consulting weather forecasting resources and is responsible for checking the extended weather forecast before work. Work schedules will be adjusted in advance, considering whether high temperatures or a heat wave is expected. The SSO will be responsible for obtaining thermometers before the start of the project and ensuring that they are readily accessible or posted on site for ease of monitoring throughout the workday. The following web pages are considered accurate and reliable sources for checking weather forecasts:

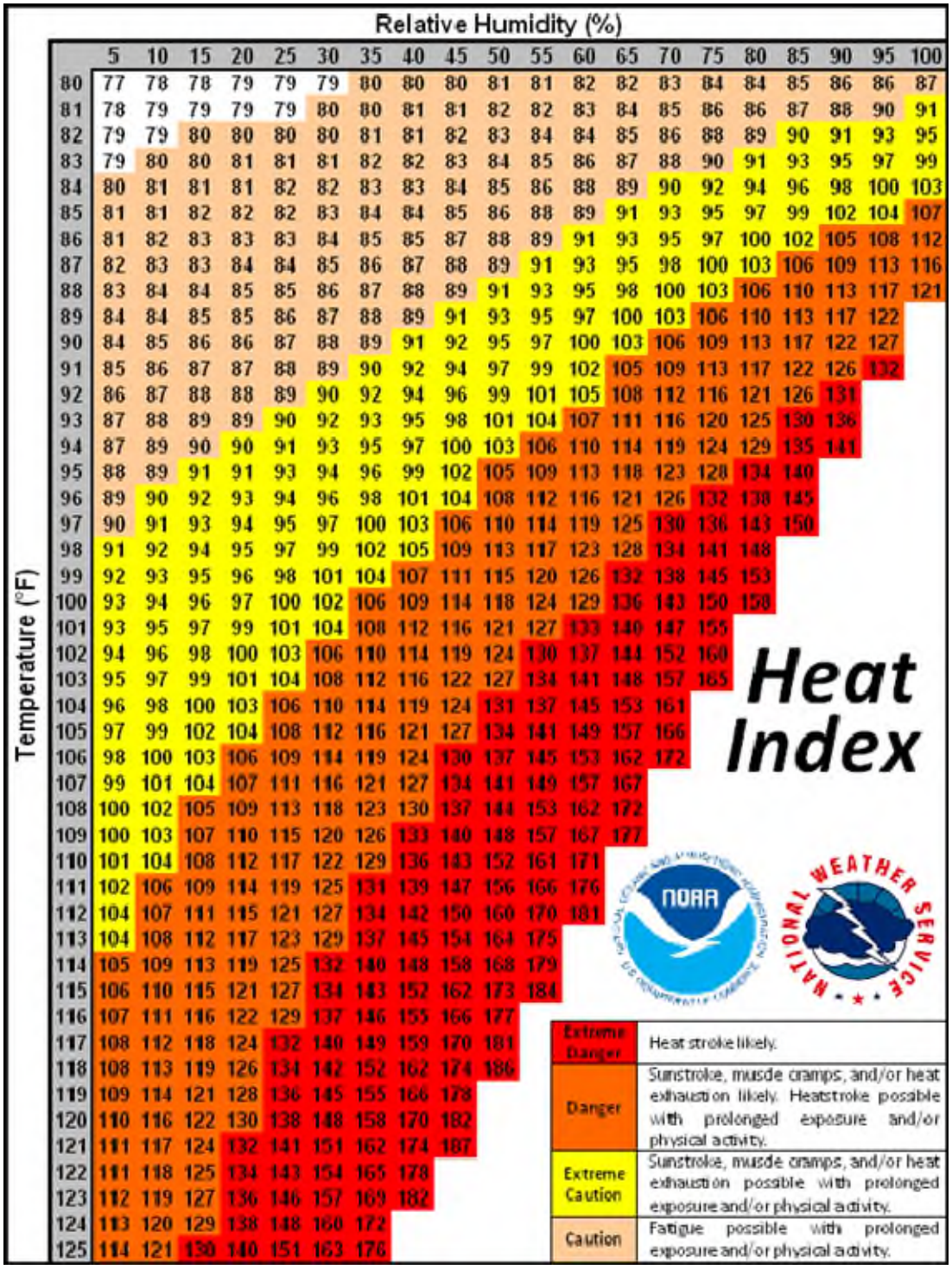
- http://www.noaa.gov/
- https://www.weather.gov/

Before starting each shift, the SSO or designee will review the forecasted temperature and humidity for the work site and compare conditions against the National Weather Service Heat Index (See Table 1) to evaluate the risk level for heat illness. A “heat wave,” as defined by the National Oceanic and Atmospheric Administration (NOAA), is a period of abnormally and uncomfortably hot and unusually humid weather.” Typically, a heat wave lasts 2 or more days.

5.4 Heat Index Table, Heat Index Action Levels, and Recommended Hazard Controls

The following action levels and controls information are intended to be used as recommended guidance by project teams for work conducted in all states except where heat-related illness hazard controls are required by regulation.

Table 1 – Heat Index Table



During the planning stages for future field work, develop a communications plan where field staff will contact the project team when conditions are expected that will trigger Heat Index Action Levels.

Use the information in Table 1 to determine if employees will be exposed to a combination of temperature and humidity that pose a risk for heat illness. If the site conditions are characterized as falling inside the ranges for “Extreme Caution,” "Danger," or “Extreme Danger” for heat illness, additional steps must be taken. It is important to note that the NOAA Heat Index was developed with an understanding that partial shade and light wind conditions are present. Work conducted in direct/full sunlight without light wind conditions (e.g., no partial shade or no breeze) adds up to 15°F (8°C) to the Heat Index value.

Each Heat Index level detailed below is additive.

- If the Heat Index indicates "CAUTION" 80° to 90°F (26° to 32°C), implement one or more of the following:
  - Provide and direct hydration, schedule rest breaks, ensure lightweight clothing is worn, provide break areas with shade / ventilation / air conditioning.
- If the Heat Index indicates "EXTREME CAUTION" 90° to 105°F (32° to 40.5°C), implement all the above and add one or more of the following:
  - Provide light-duty PPE, cooled break areas, and shaded work areas.

    Note: *“Light-duty PPE” includes items such as hard hat sunshades, sun hats, dry or wet evaporative cooling vests, microfiber cooling towels, scarves, headbands, hard hat neck shades, hard hat suspension inserts, and sweatbands.*

- If the Heat Index indicates "DANGER" 105° to 130°F (40.5° to 54.4°C.), implement all the above and add one or more of the following:
  - Provide cooled work areas, modify work schedule, provide heavy-duty PPE,and personnel physiological monitoring.

    Note: *“Heavy-duty PPE” includes phase-change cooling vests, and gel pack and ice pack equipped cooling vests. Ice pack vests generally offer the coldest option and should not be worn directly against the skin. Consider engineering controls such as forced ventilation.*

- If the Heat Index indicates "EXTREME DANGER" +130°F (+54.4°C) or greater, Stop Work until conditions change or hazards are effectively controlled using items listed above. At this range of temperatures it is critical to implement personnel vital sign monitoring for determining the appropriate frequency and duration of Work / Rest cycles.

5.4.1 Procedures for High Heat

High heat procedures will be implemented when the temperature rises above 95°/35°C. High heat procedures include:

- Hold a Tailgate Safety Meeting to review the high heat procedures, encourage employees to drink plenty of water, and remind employees of the importance of taking a preventive or recovery cool-down rest when necessary.
- Arcadis will ensure that effective employee observation and monitoring procedures are put in place including:

  - SSO or designee will supervise 20 or fewer employees.
  - The “Buddy System” is mandatory.
  - Regular communication with SSO or designee will be implemented via mobile phone or radio.
  - One or more employees will be designated as authorized to contact emergency medical services and communicating that, if no designate is identified and the SSO is unavailable, any employee can call for emergency medical assistance.
- Employees will be reminded throughout the shift to drink plenty of water.
- The “Buddy System” must be implemented for worker monitoring. Particular attention will be paid to new employees or employees who have yet to acclimate to high heat conditions. Additionally, frequent communication will be maintained with employees working by themselves (via cell phone or two-way radio), to be on the lookout for possible symptoms of heat illness.
- During high heat conditions, employees will be provided with a minimum 10-minute cool-down period every 2 hours.
- Employees will be regularly observed for alertness and signs and symptoms of heat illness to be documented in the field book or field log.
- When the SSO is not available, an alternate responsible person must be assigned to look for signs and symptoms of heat illness. Such a designated observer will be trained to know what steps to take if heat illness occurs.

5.4.2 Procedures for Heat Waves

A “heat wave,” as defined by NOAA, is a period of abnormally and uncomfortably hot and unusually humid weather. Typically, a heat wave lasts 2 or more days. A "heat wave," as defined for the purposes of this HSS, is when temperatures are sustained above 80°F (26°C), or if site conditions indicate the potential for “Extreme Caution,” "Danger," or “Extreme Danger” per Table 1, the following steps will be taken:

- The SSO or designee, in coordination with the project team, will use their Stop Work Authority; evaluate the following actions; and document the action in the daily field log:
  - Modify the work shift or cut the work day short (e.g., 12:00 pm).
  - Reschedule the work (e.g., conduct the remaining work during cooler times of the day) or suspend strenuous tasks.
  - Use Stop Work Authority to cease work for the day.
- If schedule modifications are not possible, the Heat Illness HASP Supplement will be reviewed before work resumes. At a minimum, procedures for heat illness prevention, the provisions for high heat procedures, the weather forecast, and emergency response protocols will be reviewed.
- Employees will be provided with additional water and rest breaks and will be observed more frequently. They will also be reminded throughout the shift to drink plenty of water.
- During work activities and rest breaks, employees will be observed for signs and symptoms of heat illness.
- All employees will maintain frequent communication with the SSO or designee, who will be monitoring employees for possible symptoms of heat illness.

***Note**: At large project sites where the SSO is unable to be near the employees (to directly observe or communicate with them), communication via a cell phone or radio may be used for this purpose if reception in the area is reliable.*

5.4.3 Work/Rest Cycle Duration and Frequency Procedures

The occurrence of heat illness depends on a variety of factors. All workers, regardless if they are wearing permeable or semi-permeable clothing, should be monitored when conditions warrant monitoring (e.g., when temperatures exceed 80°F/26.6°C). If semi-permeable clothing is worn (e.g., not standard cotton or synthetic work clothing), it is recommended to begin monitoring those workers when temperatures exceed 70°F in the work area and prioritize workers completing strenuous tasks. Personnel monitoring becomes particularly important when work is conducted indoors, includes strenuous tasks, and additional PPE is worn (such as Level C respiratory protection or CPC). If semi-permeable clothing, Level C PPE, or CPC is not worn, follow the Heat Index table instructions and prepare to implement monitoring as part of the high heat measures discussed in Section 5.4.1. Table 2 below details procedures to be followed to determine an appropriate work/rest cycle with the default rest cycle duration beginning with a 15-minute period every hour when working in temperatures exceeding 90°F.

***Note:** Warning signs include: When a person's sustained (e.g., several minutes) heart rate exceeds 180 beats per minute (bpm) minus their age (e.g., 180 - age = X) for individuals with normal cardiac performance per their physician; or a body core temperature exceeds 101.3°F/38.5°C for acclimatized workers or 100°F/38°C for unacclimated workers; a recovery heart rate at 1 minute after a peak work effort is greater than 120 bpm; or there are symptoms of sudden and severe fatigue, nausea, dizziness, or lightheadedness.*

Table 2 - Suggested Frequency and Duration of Work/Rest Cycles Applying Physiological Monitoring of Acclimatized Personnel

Adjusted Air Temp. [1]	Wearing Permeable PPE [2]	Wearing Impermeable PPE [3]
> 90°F/32°C	After ea. 45 mins. of work	After ea. 15 mins. working
87.5 to 90°F/30.8 to 32.2°C	After ea. 60 mins. of work	After ea. 30 mins. working
82.5 to 87.5°F/28.1 to 30.8°C	After ea. 90 mins. of work	After ea. 60 mins. working
77.5 to 82.5°F/25.3 to 28.1°C	After ea.120 mins. of work	After ea. 90 mins. working
72.5 to 77.5°F/22.5 to 25.3°C	After ea.150 mins. of work	After ea. 120 mins. working

Notes:

[1] - Adjusted air temp (ta adj) calculation: ta adj F = ta F + (13 x % sunshine). Measure the air temperature (ta) with a thermometer (shielded from radiant heat). Estimate the percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)

[2] - Permeable PPE consists of cotton clothing with long sleeves and pants or breathable coveralls.

[3] - Add 1.8 °F for Tyvek coveralls; add 5.4 °F for heavy clothing; add 19.8 °F for impermeable/semi-impermeable PPE - Level A/B suits)

5.4.4 Monitoring Personnel Vital Signs for Determining Work/Rest Cycles

To conduct heart rate monitoring, first collect and record a resting heart rate to establish the baseline value for each individual to be monitored. Count the heartbeats at the radial pulse (located on the inside of the wrist below the base of the thumb) during a 30-second interval. During rest cycles, count and record the heart rate as early as possible at the beginning of the rest cycle and again 3-5 minutes later. The pulse rate should fall rapidly and soon approach the individuals baseline heart rate level. The heart rate will remain elevated for a worker experiencing onset of heat illness.

- If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one third and keep the rest period the same.
- If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one third.

Body temperature monitoring is used in conjunction with heart rate monitoring to evaluate an individual's condition and ability to sufficiently cool down during breaks when working in hot environments. Monitor and record body temperature orally using a clinical thermometer (3 minutes under the tongue and before drinking liquids) or using an infrared forehead swipe thermometer per manufacturer's directions. Take temperatures at the end of the work period before the rest cycle.

- If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one third without changing the rest period.
- If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one third.
- Do not permit a worker to wear a semi-permeable or impermeable garment when the oral temperature exceeds 100.6°F (38.1°C).

5.5 Heat Exhaustion and Heat Stroke Symptoms, First Aid and Emergency Procedures

Emergency procedures include recognizing the more serious symptoms associated with the third and fourth stages of heat-related illness: heat exhaustion and heat stroke. A critical step to having effective emergency procedures involves ensuring that effective communication has been established and maintained to contact emergency responders.

5.5.1 Heat Exhaustion and Heat Stroke Symptoms

Signs of heat exhaustion include:

- Cool, moist, pale, or flushed skin
- Heavy sweating
- Headache
- Nausea, dizziness, and exhaustion
- Normal or below normal body temperature.

Signs of heat stroke include:

- Hot, red skin, which can be dry or moist from exercise
- Changes in consciousness
- Rapid, weak pulse

- Rapid, shallow breathing, vomiting
- A person experiencing heat stroke can have a very high body temperature—sometimes as high as 106°F (41°C).

5.5.2 First Aid Procedures for Heat Exhaustion

If an employee is determined to be suffering from heat exhaustion, perform the following steps:

1. Move the person to a cooler place.
2. Remove or loosen tight clothing and apply cool, wet cloths, such as towels or sheets soaked in water.
3. If the person is conscious, give him or her cool water to drink. Make sure the person drinks slowly. Give a half glass of cool water every 15 minutes.
4. Contact the employees' supervisor, the project manager, and Work Care 1-888-449-7787 (US & Canada).
5. Let the person rest in a comfortable position.
6. Watch carefully for changes in his or her condition.

Do not give liquids that contain alcohol or caffeine because they can cause further dehydration, making conditions worse.

5.5.3 First Aid and Emergency Procedures for Heat Stroke

Heat stroke is a life-threatening situation. If you suspect that someone is suffering from heat stroke, call 9-1-1 or the local emergency number immediately.

1. Move the person to a cool place.
2. Loosen tight clothing.
3. Remove perspiration-soaked clothing.
4. Apply cool, wet cloths to the skin.
5. Fan the person.
6. If conscious, give small amounts of cool water to drink.
7. Place the person on his or her side.
8. Contact the employees' supervisor, the project manager, and Work Care 1-888-449-7787 (US & Canada).
9. Continue to cool the person using ice or cold packs on the wrists, ankles, groin, and neck and in the armpits.
10. Continue to check breathing and circulation.

Do not give liquids that contain alcohol or caffeine because they can cause further dehydration, making conditions worse. Ensure that 911 or the local emergency number is called if the person refuses water, vomits, or starts to lose consciousness.

Emergency contact telephone numbers and hospital directions/map must be included in each site-specific HASP for employee reference.

6. TRAINING

The Arcadis Heat Illness Prevention online training offered through the Arcadis Learning Center is required to be completed before Supervisory Personnel and Affected Employees working in California or Washington States will be permitted to begin work. Project teams conducting work in

locations other than California or Washington States are expected to complete the training before conducting work as defined in the H&S training matrices specific to each Business Line. Completion of the training once is generally considered sufficient to satisfy the training requirement; however, the training may be required to be completed again as determined by Arcadis policy or management, or by client or specific state requirements. Refresher training is encouraged for all staff that infrequently conducts or supervises work where heat illness is a hazard.

6.1 Supervisory Personnel

Personnel supervising staff on a California or Washington State site who might reasonably be anticipated to be exposed to the risk of heat illness will be provided training in the following topics before assignment:

- The environmental and personal risk factors for heat illness
- The importance of frequent consumption of small quantities of water; consuming 8 fl. oz. every 15 minutes or 32 fl. oz. per hour, when the work environment temperature exceeds 80°F/26.6°C because employees are more likely to be sweating more than usual in the performance of their duties.
- The importance of staying appropriately nourished and hydrated
- The importance of acclimatizing before work
- The different types of heat illness and the common signs and symptoms
- The importance for employees to immediately report to the employer, directly or through the employee's supervisor, symptoms or signs of heat illness in themselves or in co-workers
- The procedures to follow for responding to symptoms of possible heat illness, including how emergency medical services will be provided should they become necessary
- The procedures for contacting emergency medical services, and if necessary, for transporting employees to a point where they can be reached by an emergency medical service provider
- The procedures for ensuring that, in the event of emergency, clear and precise directions to the work site can and will be provided as needed to emergency responders.

In addition, these supervisory personnel must review and understand:

- This Heat Illness Prevention HSS and the associated HASP Supplement
- How to implement the emergency response procedures detailed in the site-specific HASP when an employee exhibits symptoms consistent with possible heat illness
- Weather monitoring reports as detailed in the field Health & Safety Handbook
- How to monitor weather reports and how to plan for and respond to hot weather advisories.

This training will be documented within the Learning Center database along with details on the subject matter covered and date of training recorded.

6.2 Affected Employees

For those employees who work in California or Washington State, or when using this HSS as a BMP in any other state and might reasonably be anticipated to be exposed to the risk of heat illness, training in the following topics is required before assignment:

- The environmental and personal risk factors for heat illness
- The importance of frequent consumption of small quantities of water; 8 fl. oz. every 15 minutes or 32 fl. oz. per hour when the work environment temperature exceeds 80°F/26.6°C and employees are more likely to be sweating more than usual in the performance of their duties
- The importance of acclimatizing
- The different types of heat illness and the common signs and symptoms
- The importance for employees to immediately report to the employer, directly or through the employee's supervisor, symptoms or signs of heat illness in themselves or in co-workers
- The procedures for responding to symptoms of possible heat illness, including how emergency medical services will be provided should they become necessary
- The procedures for contacting emergency medical services, and if necessary, for transporting employees to a point where they can be reached by an emergency medical service provider
- The procedures for ensuring that, in the event of emergency, clear and precise directions to the work site can and will be provided as needed to emergency responders.

This training will be documented within the Learning Center database along with details on the subject matter covered and date of training recorded.

Note: *For those staff who are not working in California, Washington State, or other states that have specified heat illness training requirements, staff that might reasonably be anticipated to be exposed to the risk of heat illness will (at a minimum) review the information detailed in the Field Health & Safety Handbook and this HSS. Corporate H&S recommends that all staff that might be reasonably be anticipated to be exposed to the risk of heat illness complete the online heat illness training course through the Learning Center.*

7. REFERENCES

- Occupational Safety and Health Administration (OSHA) Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities Section 8 "Heat Stress and Other Physiological Factors" OSHA, National Institute for Occupational Safety and Health (NIOSH), United States Environmental Protection Agency (USEPA), U.S. Coast Guard (USCG). Chapter 8. 1985.
- OSHA Technical Manual – Section III Chapter 4
- National Institute of Occupational Safety and Health (NIOSH) Publication Number 86-112
- American Conference of Governmental Industrial Hygienists (ACGIH) "Guidelines for Limiting Heat Strain" 2018
- American Red Cross 2007
- Cal/OSHA Title 8 CCR 3395 Heat Illness Prevention Standard and Title 8 CCR 3202 Injury and Illness Prevention Program
- Washington State Outdoor Heat Exposure Regulations 296-62-09510 thru 09560
- See Exhibit 3 for links to additional regulatory resources.

8. RECORDS

Heat illness training records will be maintained by the Arcadis Training Team.

Heat Plan H&S Plan Supplement will be maintained with project files.

9. APPROVALS AND HISTORY OF CHANGE

Approved by: Julie Santaniello, CSP – Corporate H&S Manager of Technical Programs

History of Change

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
31 August 2011	01	Tony Tremblay & Mija Coppola	Original document
13 March 2012	02	Tony Tremblay	Detailed Supervisory Personnel requirement to plan/detail preventive measures/controls when heat advisories are issued; clarified training requirements for staff and supervisory personnel; inserted heat advisory and excessive heat warning definitions
19 June 2012	03	Pat Vollertsen	Information added about nourishment
16 June 2014	04	Pat Vollertsen & Alec MacAdam/Tony Tremblay	Revised standard format and History of Change Section. Updated to include specific prescriptive language to address Cal OSHA and Washington State requirements. Inclusion of HASP supplement and preparation guidance. Clarification of the use of sports/electrolyte drinks
7 August 2014	05	Alec MacAdam	Update guidance for use of “Sports Drinks”

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
6 April 2015	06	Alec MacAdam	Revise temperature threshold from 85° to 80°F, provisions for shade, guidance for preventative rest breaks, revised high heat procedures and clarification of acclimatization procedures
15 March 2017	07	Alec MacAdam & Denis Balcer/ Tony Tremblay & Julie Santaniello	Updated brand. Updated links to Exhibits 2 & 3, Revised Admin. Controls in Section 5.3, Additional regulatory detail in Sections 5.3.2 and 5.3.3. Added Section 5.4 Heat Index Action Levels and Recommended Hazard Controls. Revised the HIPP HASP Supplement to reflect changes in the HSS.
2 January 2020	08	Alec MacAdam	Updated format. Clarifications in Roles & Responsibilities § 4; Updated Safe Work Practices in § 5.1; Updated Administrative and Engineering Controls in § 5.3; Updated Heat Index Table 1 § 5.4; Added Work/Rest Cycle Guidance § 5.4.3; and Personnel Vital Signs Monitoring § 5.4.4; Revised Heat Exhaustion and Heat Stroke Emergency Procedures; Updated References; Updated HASP Supplement with above noted revisions on 6 May 2019.
17 February 2020	09	Julie Santaniello	Updated Heat Index ranges in Section 5.4 so text matches Table 1.

EXHIBIT 1 - DEFINITIONS

Acclimation – A process by which the body adjusts to increased heat exposure. The body needs time to adapt when working in hotter environments. Employees working in a hot environment are more likely to develop heat illness if not allowed or encouraged to allow their body to acclimate when a heat wave strikes or when starting a job that newly exposes them to heat. Acclimatization is fully achieved in most people within 4 to 14 days of regular work involving at least 2 hours per day in the heat.

Excessive Heat Warning - Extreme Heat Index making it feel very hot, typically above 110°F (43°C) for 3 hours or more during the day for two consecutive days or above 110°F (43°C) at any time. Specific criteria vary over different county warning areas.

Heat Advisory - Issued when the Heat Index is expected to exceed 105°F (40°C) during the day and 80°F (27°C) during the night for at least two consecutive days.

Heat Cramps – Normally caused by performing hard physical labor in a hot environment. These cramps have been attributed to an electrolyte imbalance caused by sweating. Salt tablets should not be taken.

Heat Collapse – Commonly known as “Heat Stress,” technically referred to as heat syncope. Heat collapse or syncope (fainting) is the condition where the brain does not receive enough oxygen because blood pools in the extremities. To prevent heat collapse, the employee should gradually acclimatize to the hot environment.

Heat Exhaustion – Less severe than heat stroke, but the victim must be treated as soon as possible. Symptoms include clammy and moist skin; pale or flushed complexion; sweating along with extreme weakness or fatigue, giddiness, nausea, or headache; and (in more serious cases) vomiting or loss of consciousness.

Heat Fatigue – The signs and symptoms of heat fatigue include impaired performance of skilled sensorimotor, mental, or vigilance jobs. There is no treatment for heat fatigue except to remove the person from the heat before a more serious heat-related condition develops.

Heat Index – an “apparent temperature” that is a measure of how hot it feels when relative humidity is added to the actual air temperature.

Heat Rashes – Also referred to as prickly heat, is the most common problem in hot work environments. Prickly heat is manifested as red papules and usually appears in areas where the clothing is restrictive.

Heat Stress – A physiological condition induced when high temperatures and humidity compromise the body’s ability to cool itself, resulting in heat-related illness.

Heat Stroke – The body's system of temperature regulation fails, and body temperature rises to critical levels. This condition is caused by a combination of highly variable factors, and its occurrence is difficult to predict. **Heat stroke is a medical emergency.** The primary signs and symptoms of heat stroke include confusion; irrational behavior; loss of consciousness; convulsions; a lack of sweating (usually); hot, dry skin; and an abnormally high body temperature.

Heat Wave - A “heat wave,” as defined by NOAA, is a period of abnormally and uncomfortably hot and unusually humid weather. Typically, a heat wave lasts 2 or more days. A "heat wave," as defined for the purposes of this HSS, is when temperatures are sustained above 80°F.

Provision of Water - Employees will have access to potable drinking water meeting the requirements of Section 5.3.2 of this HSS including but not limited to the requirements that it be fresh, pure (water must be potable and free of odors), suitably cool (the water must be cooler than the ambient temperature but not so cool as to cause discomfort), and provided to employees free of charge. The water will be located as close as practicable to the areas where employees are working. Where drinking water is not plumbed or otherwise continuously supplied, it will be provided in sufficient quantity at the beginning of the work shift to provide 1 quart per employee per hour for drinking for the entire shift. Employers may begin the shift with smaller quantities of water if they have effective procedures for replenishment during the shift as needed to allow employees to drink 1 quart or more per hour. The frequent drinking of water will be encouraged. The purpose of requiring that water is “fresh, pure, suitably cool, and provided to employees free of charge” and “located as close as practicable to the areas where employees are working” is to encourage workers to drink water often and avoid making the workers interrupt their work in order to do so. To ensure that water is fresh, pure, and suitably cool, Cal/OSHA advises that employers or supervisors visually examine the water and pour some on their skin.

Shade - The blockage of direct sunlight. Canopies, umbrellas, and other temporary structures or devices may be used to provide shade. One indicator that blockage is sufficient is when objects do not cast a shadow in the area of blocked sunlight. Shade is not adequate when heat in the area of shade defeats the purpose of shade, which is to allow the body to cool. For example, a car sitting in direct sunlight does not provide acceptable shade to a person inside it unless the car engine is operating with air conditioning on. Shade may be provided by any natural or artificial means that does not expose employees to unsafe or unhealthy conditions and that does not deter or discourage access or use.

Transient Heat Fatigue – The temporary state of discomfort and mental or psychological strain arising from prolonged heat exposure. Employees unaccustomed to the heat are particularly susceptible and can suffer, to varying degrees, a decline in task performance, coordination, alertness, and vigilance.

EXHIBIT 2 - ACRONYMS AND ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
ANA	Arcadis North America
APM	Assistant Project Manager
Arcadis	Arcadis U.S. Inc.
BMP	Best Management Practice
BPM	Beats Per Minute
°C	Degrees Celsius
Cal/OSHA	California Occupational Safety and Health Administration
CCR	California Code of Regulations
CPC	Chemical Protective Clothing
°F	Degrees Fahrenheit
HASP	Health & Safety Plan
HIPP	Heat Illness Prevention Plan
HS	Health and Safety
H&S	Health and Safety
HSS	Health and Safety Standard
L	Liter
NIOSH	National Institute of Occupational Safety and Health
NOAA	National Oceanic and Atmospheric Administration
OSHA	Occupational Safety and Health Administration
Oz	Ounce
PM	Project Manager
PPE	Personal Protective Equipment
SSO	Site Safety Officer
TM	Task Manager

EXHIBIT 3 – Heat Illness Links

CDC / NIOSH Occupational Exposure to Heat and Hot Environments - 2016

Heat Illness Symptoms

Heat Illness Thermometer and PPE

OSHA Working Outdoors Fact Sheet

OSHA Worker Protection from Heat Stress

California Heat Illness Prevention Enforcement Q&A

Washington State Outdoor Heat Exposure Enforcement Procedures

EXHIBIT 4 – Heat Illness Prevention Plan HASP Supplement Template

The Heat Plan HASP Supplement is contained in the Standard Excel® HASP template. The most current version of the HASP template is located on the ANA H&S Intranet site on the "Forms and Templates" page.

Link to the H&S "Forms and Templates" page:
https://arcadiso365.sharepoint.com/sites/naintranet/en-us/HealthandSafety/FormsTemplates

The Heat Plan supplement can be accessed by right clicking on the lower toolbar of the excel HASP template and selecting "Unhide" and selecting the "Heat Illness Prevention Plan."

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QUICK SHEET

Applicability

The Heavy Equipment H&S Standard (HSS) applies to employees of Arcadis that operate heavy equipment. Only trained and authorized personnel are permitted to operate heavy equipment. For work with Powered Industrial Trucks (Forklifts) refer to Arcadis Standard Powered Industrial Trucks for details.

Need to Know

Arcadis employs a wide range of heavy equipment in various operations. Arcadis staff operating heavy equipment requires, at minimum, compliance with the policies set forth in this Health and Safety Standard (HSS). In addition to federally mandated requirements, each state may enforce more stringent standards related to training, licensure, inspection and documentation.

The requirements set forth in this policy provide direction in heavy equipment operations:

- Specific training for Powered Industrial Trucks (forklifts) will follow OSHA 29 CFR 1910.178. Refer to Arcadis Standard Powered Industrial Trucks for additional details and requirements.
- All employees involved in Heavy Equipment Operations shall read and understand documented hazard identification and risk assessments conducted using the Hazard Assessment and Risk Control (HARC) Process. Understand and actively use TRACK and Stop Work Authority during heavy equipment operations.
- Arcadis Utility Location Standard shall be followed prior to beginning subsurface intrusive work which involves heavy or mechanized equipment.
- Preventative maintenance and pre-operation checks shall be conducted in accordance with the manufacturer’s requirements and documented daily prior to equipment usage.
- All prospective Arcadis Heavy Equipment Operators and Heavy Equipment Site Supervisors (Site Supervisors) must complete Online Heavy Equipment General Awareness Training, and review & understand this HSS. Prospective Arcadis Heavy Equipment Operators and Site Supervisors will be evaluated by an Arcadis Sponsor and designated as Heavy Equipment Operator Awareness Trained or designate as Heavy Equipment Site Supervisor.

- Only authorized personnel will operate heavy equipment. General authorization to operate heavy equipment is provided by the Sponsor and documented on the Arcadis General Heavy Equipment Operator Approval Form (Exhibit 3).

- Site Supervisors will complete the Site-Specific Arcadis Heavy Equipment Operator Approval Form (Exhibit 4), prior to authorizing any Arcadis employee to operate heavy equipment. Digital files are preferred. When the form has been completed on paper, a copy of it must be maintained onsite and kept in project files for review. Authorization is only valid for the project, operational task, and piece of heavy or mechanized equipment listed on the Arcadis Heavy Equipment Operator Approval Form.

- Authorized Operators must maintain all current & applicable licensing, Arcadis Heavy Equipment Operator Authorization Form (Task Specific Hazard Review, Operator Evaluation and Operator Authorization for Heavy Equipment Operators), and project documentation as required by federal and state regulations.

- Heavy Equipment must be inspected prior to use every day. Heavy Equipment Inspection Checklist is Exhibit 5.

Training

All affected employees must complete online Heavy Equipment General Awareness Training. Additionally, all prospective Arcadis Heavy Equipment Operators and Site Supervisors must complete Online Heavy Equipment General Awareness training.

Equipment

List of equipment that can be operated is mentioned in **Section 5**.

Permits or Forms Required

- General Heavy Equipment Operator Approval
- Site Specific Heavy Equipment Operator Approval
- Heavy Equipment Inspection Checklist

1. POLICY

It is Arcadis-US policy to be proactive in the identification, assessment and control of health and safety hazards and associated risks. To those means, it is Arcadis' policy that Arcadis staff will be adequately trained and experienced before authorized to operate heavy equipment.

2. PURPOSE AND SCOPE

2.1 Purpose

Arcadis developed this HSS to mitigate or eliminate the hazards presented by working with or around heavy or mechanized equipment (i.e., back-hoes, track-hoes, bobcats, concrete crushers, etc.) by ensuring operators are experienced and understand the risk associated with operating heavy equipment.

2.1 Scope

This HSS includes an Equipment Inspection Checklist (Exhibit 5) and an Arcadis General Heavy Equipment Operator Approval Form (Exhibit 3) and Site-Specific Arcadis Heavy Equipment Operator Approval Form (Exhibit 4), that apply to employees of Arcadis that operate or supervise others who operate heavy equipment. Only trained and authorized personnel are permitted to operate heavy or mechanized equipment. For work with Powered Industrial Trucks (Forklifts) refer to Arcadis Standard ARC HSSP006 for details.

3. DEFINITIONS

Definitions related to Heavy Equipment can be found in Exhibit 1. Acronyms and Abbreviations are found in Exhibit 2.

4. RESPONSIBILITIES

4.1 Project Management

The Project Manager is responsible for:

- Verifying that all activities that require use of heavy or mechanized equipment are properly identified and addressed within the project work plan, project health & safety plan, and/or other project-related documents.

- Investigating the State and Local licensure and/or certification requirements for mechanized equipment operation and verify Arcadis operators or subcontractors have required licenses and certifications.

- Verifying that their divisional or project team employees have received the proper training and have the required experience and skills to operate heavy or mechanized equipment.

- Verifying those copies of the completed Arcadis Heavy Equipment Operator Authorization Form (Task Specific Hazard Review, Operator Evaluation and Operator Authorization for Heavy Equipment Operators) are maintained on site and in project files.

- Verifying those copies of the completed Heavy Equipment Inspection Checklists are maintained on site and in project files

4.2 Arcadis Sponsors

Arcadis Heavy Equipment Operator Sponsors are recognized by The Company as:

- Subject matter experts regarding projects that require heavy equipment operation.

- Someone in a leadership role within Arcadis that is tasked with identifying operators and Supervisors for Arcadis projects.

- Recognized as a Sponsor by the Arcadis Corporate Health and Safety or Business Line President.

4.3 Heavy Equipment Site Supervisors

Heavy Equipment Site Supervisors (Site Supervisors) must complete the Online Heavy Equipment General Awareness Training and have been designated by the Arcadis Sponsor as a Site Supervisor. Site Supervisors are responsible for evaluating, authorizing, monitoring, and coaching/mentoring of heavy equipment operators.

Site Supervisors will have a minimum of 5 years construction management and/or hands-on operating experience and demonstrated proficiency with the skills required for heavy equipment. Site Supervisors will have completed the 10-hour or 30-hour OSHA Construction Training. If working on an environmental project where HAZWOPER training is required by Arcadis, the Site Supervisor must also have completed the 40-hour HAZWOPER training, be current on their annual 8-hour HAZWOPER refresher and complete the 8-hour HAZWOPER Supervisor Training. A list of qualified Site Supervisors will be maintained by the Corporate Training Team.

Specific job responsibilities include:

- Interface with the client representative to identify hazards associated with the client's project site.

- Review the client's equipment operating procedures and permit requirements, as applicable.
- Arcadis Utility Location Standard shall be followed prior to beginning subsurface intrusive work which involves heavy or mechanized equipment.
- Above grade utilities in proximity to a heavy equipment work area must be marked with warning signs, shields or other protective measures, if the minimum required clearance distances cannot be maintained.
- Ensure Authorized Operators have completed the Online Heavy Equipment General Awareness Training and have been designated as heavy equipment operator general awareness trained.
- Ensure Authorized Operators are certified or licensed if required by state/local regulations.
- Evaluate prospective Authorized Operators using the attached Arcadis Heavy Equipment Operator Authorization Form (Task Specific Hazard Review, Operator Evaluation and Operator Authorization for Heavy Equipment Operators) and determine if an adequate level of hands-on skill has been demonstrated to safely operate the equipment.
- Upon completing the Arcadis General Heavy Equipment Operator Approval Form (Exhibit 3), Task Specific Hazard Review, and Site-Specific Arcadis Heavy Equipment Operator Approval Form (Exhibit 4), the Site Supervisors will either authorize the Operator to operate the equipment or require additional training prior to authorizing the Operator to operate the equipment. Operator Authorization will be documented on the General Heavy Equipment Operator Approval Form (Exhibit 3), and must be available on the project site for review and retained in project files.
- Ensure Daily Equipment Inspection Checklist (Exhibit 5) or an equivalent inspection form provided by the manufacturer or vendor is completed and maintained at the project site and retained with the project files.
- Conduct Task Improvement Process (TIP's) Observations on Authorized Operators and provide coaching and feedback as necessary. All TIP's will be recorded in the 4-Sight Database.

- Revoke operating privileges as necessary, if required skill level is not maintained. Outline a specific Corrective Action Plan and discuss with employee and supervisor.

4.4 Authorized Operators

Authorized Operators must complete the Online Heavy Equipment General Awareness Training and have been designated by the Arcadis Sponsor as Heavy Equipment Operator Awareness Trained. Additionally Authorized Operators must have adequate training and instruction in their duties and responsibilities regarding equipment operation, as documented in the Arcadis Heavy Equipment Operator Authorization Form (Task Specific Hazard Review, Operator Evaluation and Operator Authorization for Heavy Equipment Operators).

Responsibilities include:

- Complete required daily preventive maintenance and pre-operation checks in accordance with the manufacturer's requirements and the attached Equipment Inspection Checklist (Equipment/Manufacturer Specific Checklists may be used in lieu of this form where appropriate to cover all required items).
- Operate heavy equipment within design specifications and limitations, which includes operating in a safe and controlled manner.
- Conduct TRACK Assessment to identify, assess and control the hazards which may be faced during equipment operation as well as the signs and symptoms of exposure to the hazard(s) of the work environment.
- Above grade utilities in proximity to a heavy equipment work area must be marked with warning signs, shields or other protective measures, if the minimum required clearance distances cannot be maintained.
- Arcadis Utility Location Standard shall be followed prior to beginning subsurface intrusive work which involves heavy or mechanized equipment.
- Always maintain visual contact and/or verbal communications with the spotters and other personnel in the area.
- Use the PPE, air monitoring and testing equipment as specified in the HASP.

- Maintain an awareness of all barriers, operating limits and other warning devices required to protect from external hazards (e.g., traffic, pedestrians) and the proper use of those barriers.
- Obey “Stop Work” orders given by personnel in the area automatic alarm activation, or when self-perceived.

4.5 Affected Employees

- Complete online Heavy Equipment General Awareness Training.
- Conduct TRACK Assessment and monitor activities near areas where heavy equipment is in operation.
- Maintain visual contact or verbal communication with all Authorized Operators and Designated Signal Person prior to approaching or when within the operating range of the equipment.
- Order evacuation of the area if a hazard develops, either within or outside the operating area.
- Warn unauthorized persons away from the operating area.
- Summon rescue and other emergency services as necessary.
- Minimum Class II High visibility vest/clothing shall be worn by Affected Employees.

4.6 Corporate H&S Staff

Corporate Health & Safety is responsible for:

- Verifying this standard is being implemented effectively.
- Review and update, as necessary, this standard, associated attachments, and training requirements.
- Audit Project, Business Line, and Training Team documentation files of Authorized Operators and Site Supervisors.
- Provide technical assistance regarding proper heavy equipment for excavations, trenching, grading, PPE, hazard assessment and research information on unusual hazards.

5. PROCEDURE

Heavy equipment operation can present a unique set of hazards. Only trained, qualified and authorized employees will be allowed to operate heavy or mechanized equipment in accordance with this standard (Authorized Operator). Prior to starting work with heavy or mechanized equipment all the required permits, clearance and required project documentation will be in place. Arcadis Utility Location Standard (ARCHSFS019) shall be followed prior to beginning subsurface intrusive work which involves heavy or mechanized equipment. Operators must be familiar with state and local regulations that govern the use of heavy equipment in the applicable location.

For work with Powered Industrial Trucks (Forklifts) refer to Arcadis Powered Industrial Trucks Standard for details.

5.1 Operator Approval

Prior to operating any heavy or mechanized equipment including but not limited to:

- Standard and compact excavators
- Back-hoes
- Skid steer
- Agricultural tractors
- Rubber tired articulating Loaders
- Walk behind track Loaders
- Straight Frame and Articulating Dump Trucks
- Water Truck
- Auger and Hammer Probe Drill Rigs
- Rollers (non-remote operated)
- Trenching Equipment (Ditch Witch)
- Other Heavy Equipment

All operators must be generally approved by a Sponsor before being allowed to operate the above-referenced heavy equipment.

All operators must be evaluated by a Site Supervisor and be observed on the specific equipment that will be in use. The Site Supervisor will complete the Site-Specific Operator Approval Form (Task Specific Hazard Review, Operator Evaluation and Operator Authorization for Heavy Equipment Operators) to deem the operator as an Authorized Operator. The form must be completed in full to demonstrate employees have been evaluated, deemed qualified, and have been "Authorized" by Arcadis as Heavy Equipment operators. This form must be maintained on site and in the project files (unless maintained digitally) and is only valid for the project, operational task, and piece of heavy or mechanized equipment listed on the form. It should be noted that in some cases, state specific licensing or registration may be required for heavy equipment operators.

All heavy equipment will be inspected daily prior to use, using the attached Equipment Inspection Checklist (Exhibit 5) or an equivalent inspection form provided by the manufacturer or vendor to address equipment specific items.

Note: Forklifts, Gantry & Bridge Cranes and other equipment that require more formal certification or licensure are not covered by this procedure. Project Managers are required to verify that selected contractors have the required training, certification, and equipment maintenance programs in place.

5.2 Heavy Equipment Requirements

All vehicles used in construction must have:

- Brake lights;
- Appropriate lights or reflectors, or barricades equipped with appropriate lights or reflectors, to identify the location of the equipment;
- Service, parking, and emergency brakes;
- Fenders on vehicles with rubber tires made after 1972;
- Mud flaps on vehicles with rubber tires made before 1972;
- Seats and compliant seat belts for the intended number of passengers;
- An audible warning system;
- An audible reverse alarm if the vehicle travels in reverse with an obstructed view;

- Lights, if the vehicle operates in dimness or darkness;
- A defroster if windshields fog;
- A windshield and wipers on vehicles with cabs;
- Rollover protective structure (ROPS); and
- Properly secured fire extinguisher with a minimum rating of 10-B:C.

5.3 General Requirements

The following Work Practices must be followed for heavy equipment operations:

- Must be equipped with appropriate lights or reflectors.
- Controls must be in a neutral position, with the motors stopped and brakes set, unless work being performed requires otherwise.
- Whenever the equipment is parked, the parking brake shall be set. Wheeled equipment parked on inclines shall have the wheels chocked and the parking brake set.
- All cab glass shall be safety glass, or equivalent, that introduces no visible distortion affecting the safe operation of equipment.
- Do not move heavy or mechanized equipment or vehicles upon any access roadway or grade unless the access roadway or grade is constructed and maintained to accommodate the safe movement of the equipment and vehicles involved.
- Maintain 3-points of contact with the steps and handrails while getting on/into the equipment. Do not use the controls or steering wheel as a handhold.
- Operate equipment only in well ventilated areas.
- Select a gear that will prevent excessive speed when going downhill – Do not coast downhill.
- Lower all the hydraulic equipment before shutting down or getting off the machine.
- Adequate illumination in accordance with OSHA standards and work activities must be provided for all work areas. An approved type (explosion-proof as necessary) lighting device must be used.

- Cellphones and other handheld electronic devices are prohibited from being used while equipping is in operation.

- Rigging and lifts will only be made when the operator judges it a safe operation.

    - Hoist hooks will have safety latches.

    - Equipment will only be used within the maximum rated capacity.

    - Personnel will remain at a distance from overhead loads.

    - Test directional and speed controls prior to operation.

    - Do not move a load over people.

    - Do not exceed the rated capacity of the equipment or rigging.

- When Heavy or Mechanized equipment is in transit with no load and boom is lowered, the equipment clearance shall be a minimum of 4 feet for voltage less than 50kV, and 10feet for voltages over 50kV, or twice the length of the line insulator, but never less than two feet.

5.3.1 Motor Vehicle Specific Requirements

- Must be inspected at the beginning of each shift to ensure that the equipment and safety controls are in safe operating condition.

- Must have a service brake system, an emergency brake system, and a parking brake system.

- When working in areas of low visibility, motor vehicles must be equipped with at least two headlights and two taillights, which are operable.

- If motor vehicle has an obstructed rear view, it must be equipped with reverse signal alarm that must be audible above the surrounding noise level or the vehicle is backed up only when an observer signals that it is safe to do so.

- Dumping, lifting, and hauling vehicles must have overhead protection for the operator.

- Operating levers controlling hoisting or dumping devices on haulage bodies must be equipped with a latch or other device which will prevent accidental starting or tripping of the mechanism.
- Trip handles for tailgates of dump trucks shall be so arranged that, in dumping, the operator will be in the clear.
- Never exceed load capacities for the vehicle.
- Use seat belts and do not carry passengers were not intended on the vehicle.
- Use the parking brake when parking and chock the wheels when needed to prevent rolling.
- Secure loose tools in the cab with workers.
- Dumping and lifting mechanisms must be secured when not in use.
- Verify that areas are clear before lifting, loading, and unloading.
- All controls shall be in a neutral position, with the motors stopped and brakes set, unless work being performed requires otherwise

5.3.2 Earthmoving Equipment

- Use seat belts and do not carry passengers where not intended on the vehicle. Seat belts need not be provided for equipment which is designed only for standup operation.
- All bidirectional machines, such as rollers, compacters, front-end loaders, bulldozers, and similar equipment, shall be equipped with a horn, distinguishable from the surrounding noise level, which shall be operated as needed when the machine is moving in either direction.
- Use the audible reverse alarm or signals from another worker when driving in reverse with an obstructed view.

5.3.3 Working in the Vicinity of Overhead Power Lines

Unless the overhead power lines are deenergized and visibly grounded at the worksite, with confirmation from utility owner, encroachment prevention measures must be implemented to prevent the heavy equipment from breaching a minimum clearance

distance. For heavy equipment work near energized electrical lines up to 350kV, the minimum clearance distance options would be:

1. Maintain 20 feet clearance distance from electrical line by maintaining encroachment prevention measures (refer to section 5.3.4); or
2. Determine the actual electric line voltage and implement encroachment prevention measures (refer to section 5.3.4) to maintain minimum clearance distance specified in Table 1 below.

Table 1: Minimum Clearance Distance

Voltage (nominal, kV, alternating current)	Minimum Clearance (feet)
Up to 50	**10**
>50 to 200	**15**
>200 to 350	**20**
>350 to 500	**25***
>500 to 750	**35***
>750 to 1,000	**45***
> 1,000	**Determined by utility/owner**

***** According to OSHA 29 CFR 1926.1409, for power lines over 350 to 1,000 kV, the minimum distance is presumed to be 50 feet. Over 1,000 kV, the utility/owner, or a registered engineer, who is a qualified person with respect to electrical power transmission and distribution, must establish the minimum distance.

If any vehicle or mechanical equipment (e.g., crane or drilling rig) capable of having parts of its structure elevated near energized overhead power lines is operated in California, a durable warning sign legible at 12 feet reading: "Unlawful to Operate This Equipment Within 10 Feet of High-Voltage Lines of 50,000 Volts or Less" shall be posted and maintained in plain view of the operator and driver. In addition to the above wording, the

following statement in small lettering shall be provided on the warning sign: "For Minimum Clearances of High-Voltage Lines in Excess of 50,000 Volts, See California Code of Regulations, Title 8, Article 37, High-Voltage Electrical Safety Orders."

5.3.4 Preventing Encroachment/Electrocution

Where encroachment precautions are required under Option (1) or Option (2) of section 5.3.3, all the following requirements must be met:

1. Conduct a planning meeting with the operator and the other workers who will be in the equipment or load to review the location of the power line(s), and the steps that will be implemented to prevent encroachment/electrocution.

2. If tag lines are used, they must be non-conductive.

3. Erect and maintain an elevated warning line, barricade, or line of signs, in view of the operator, equipped with flags or similar high-visibility markings, at 20 feet from the power line (if using Option 1 of this section) or for Option 2, at the minimum approach distance listed under Table 1. If the operator is unable to see the elevated warning line, a dedicated spotter must be used.in addition to implementing one of the following measures:

    i) A proximity alarm set to give the operator sufficient warning to prevent encroachment

    ii) A device that automatically warns the operator when to stop movement, such as a range control warning device. Such a device must be set to give the operator sufficient warning to prevent encroachment

    iii) A device that automatically limits range of movement, set to prevent encroachment; or

    iv) An insulating link/device installed at a point between the end of the load line (or below) and the load; and

4. Implement at least one of the following measures:

    i. A proximity alarm set to give the operator sufficient warning to prevent encroachment

    ii. A dedicated spotter who is in continuous contact with the operator. Where this measure is selected, the dedicated spotter must:

- Be equipped with a visual aid to assist in identifying the minimum clearance distance. Examples of a visual aid include but are not limited to: A clearly visible line painted on the ground; a clearly visible line of stanchions; a set of clearly visible line-of-sight landmarks (such as a fence post behind the dedicated spotter and a building corner ahead of the dedicated spotter).
- Be positioned to effectively gauge the clearance distance.
- Where necessary, use equipment that enables the dedicated spotter to communicate directly with the operator.
- Give timely information to the operator so that the required clearance distance can be maintained.

iii. A device that automatically warns the operator when to stop movement, such as a range control warning device. Such a device must be set to give the operator sufficient warning to prevent encroachment

iv. A device that automatically limits range of movement, set to prevent encroachment; or

v. An insulating link/device installed at a point between the end of the load line (or below) and the load; and

5.3.5 Designated Signal Person

Some project activities may require a Designated Signal Person(s) to direct heavy equipment operators.

Only persons who are competent and qualified by experience and/or training with the operations being directed shall be used as signal persons.

Where manual (hand) signals are used, only one person shall be designated to give signals to the operator. This signal person shall be located to see the load and be always clearly visible to the operator.

Manual (hand) signals may be used when the distance between the operator and signal person is not more than 100 ft. (30.4 m). Radio, telephone, or a visual and audible electrically operated system shall be used when the distance between operator and signal person is more than 100 ft. (30.4 m) or when they cannot see each other.

Standard hand signals shall be posted onsite and/or in a job trailer, signal control points, and other points as necessary to inform those concerned.

Signal persons shall back one vehicle at a time. While under control of a signal person, the heavy equipment driver shall not back or maneuver until directed, and the driver shall stop when visual contact with the signal person is lost.

The signal person shall have a warning device, clear range of vision and a penetrating sound to warn persons when the load is coming in, so they have time to get in the clear.

Minimum Class II High visibility vests shall be worn by flag and signal persons.

5.3.6 Refueling

- If refueling on site, the fueling area must be clearly marked (NO SMOKING), and ignition sources eliminated.
- Turn off the engine before refueling.
- If refueling could result in gasoline/diesel meeting hot engine parts, shut off and cool the engine and any electrical equipment before refueling.
- Ensure the fueling area is well ventilated.
- Do not smoke while refueling. Keep open flames and sparks away from area.
- Ground the funnel or fuel nozzle against the filler neck to avoid sparks when refueling.
- Do not use gasoline or diesel fuel for cleaning parts.
- A dry chemical or carbon dioxide fire extinguisher (rated 10:BC or larger) is in a location accessible to the fueling area.
- A 5-gallon or larger spill kit is in a location accessible to the fueling area.
- Diesel cold start systems containing ether, which is explosive, are prohibited from being used.

6. TRAINING

All affected employees must complete online Heavy Equipment General Awareness Training.

All prospective Arcadis Heavy Equipment Operators and Site Supervisors must complete the following.

- Online Heavy Equipment General Awareness training.
- Review and understand this HSS prior to participating in the competency review.
- Be evaluated by the Arcadis Sponsor and designated as Heavy Equipment Operator Awareness Trained and/or Site Supervisors.

Additionally, Site Supervisors will have a minimum of 5 years construction management and/or hands-on operating experience and demonstrated proficiency with the skills required for heavy equipment. Site Supervisors will have completed the 10-hour or 30-hour OSHA Construction Training. If working on an environmental project where HAZWOPER training is required by Arcadis, the Site Supervisor must also have completed the 40-hour HAZWOPER training, be current on their annual 8-hour HAZWOPER refresher and complete the 8-hour HAZWOPER Supervisor Training. A list of qualified Site Supervisors will be maintained by the Corporate Training Team.

Hands on training, including on-the-job training, when required, will be provided by a qualified vendor or through supervised operation by a Site Supervisor under controlled conditions and must be document on the Arcadis General Heavy Equipment Operator Approval Form (Exhibit 3). A copy of this form must be maintained onsite and keep in project files for review.

7. REFERENCES

- The current versions of the following referenced Arcadis H&S Standards are located on the ANA-Policies & Integrity intranet page:
    - Arcadis Health and Safety Procedure ARC HSCS003 – Hoisting and Rigging (Cranes, Mobile Cranes, Pile Drivers, Derricks, and variations of such equipment)
    - Arcadis Health and Safety Procedure ARC HSSP006 – Powered Industrial Trucks (Forklifts)
    - Arcadis Health and Safety Procedure ARCHSFS019 – Utility Location and Clearance
    - Arcadis Employee Field Health & Safety Handbook
- US Army Corps of Engineers EM 385-1-1. 15 Sep 08 18.G Machinery Equipment

- OSHA 29 CFR 1926 Subpart O - Motor Vehicles, Mechanized Equipment and Marine Operations

8. RECORDS

Certification and Training records will be kept by the individual employee with copies of such certificates kept by Corporate Training Team. Training dates and times will be kept by Corporate Training Team. Online Heavy Equipment General Awareness training and designated as heavy equipment operator general awareness training will be maintained by the Corporate Training Team.
A list of qualified Site Supervisors will be maintained by the Corporate Training Team.

Arcadis Heavy Equipment Operator Authorization Form (Task Specific Hazard Review, Operator Evaluation and Operator Authorization for Heavy Equipment Operators) documentation will be maintained at the project site and retained with the project files.

All daily Equipment Inspection Form or an equivalent inspection form provided by the manufacturer or vendor documentation will be maintained at the project site and retained with the project files.

Training records will be stored in Arcadis' Learning Management System so they may be provided, if requested by Arcadis, clients or a regulatory agency. Employees must send copies of their training records from external vendors to the Arcadis Corporate Training Team (HROperations.ANA@arcadis.com).

9. APPROVALS AND HISTORY OF CHANGE

Julie Santaniello, CSP – Corporate H&S Manager of Technical Programs

History of Change

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
22 November 2011	01	Greg Ertel	Original document
22 November 2013	02	Tony Tremblay	Section 5.3 added that it's encouraged that hearing protection be worn. Formatted History of Change table, Updated Header, and fixed links.
10 March 2015	03	Andrew McDonald/Tony Tremblay	Removal of Heavy Equipment Operator Permit and adjusted text within standard to accommodate the establishing of a single Arcadis Heavy Equipment Operator Authorization Form (Task Specific Hazard Review, Operator Evaluation and Operator Authorization for Heavy Equipment Operators) to evaluate equipment operators and authorize equipment operators; Header and Footer format update; History of Change Format update
2 March 2018	04	David Kobe/Julie Santaniello	Added CA-specific signage text in Section 5.3.3. Updated approver to Julie Santaniello.
02 September 2021	05	Julie Santaniello	Updated entire document to new template; Hyperlinks updated.
02 September 2022	06	Greg Mason	New process, including digital application of forms and approvals. Extensive edits clarifying procedures from the perspective of Arcadis employees visually observing activities performed by heavy equipment referenced through out this Standard, as opposed from perspective of Operator of said equipment.

EXHIBIT 1 - Definitions

Affected Employees – Employees who are trained and authorized to work on projects where heavy or mechanized equipment is in use by either Arcadis employees or subcontractors.

Authorized Operator – A trained, authorized individual with the experience, training, license (as applicable) and demonstrated skills to safely operate heavy or mechanized equipment in accordance with this procedure and applicable regulatory requirements.

Backhoe-Loader – As the name implies, it has a loader assembly on the front and a backhoe on the back.

Bulldozer – A powerful crawler (caterpillar tracked tractor) equipped with a blade.

Crane – A machine for hoisting and moving heavy objects by means of cables attached to a movable boom. Cranes can include the following types: overhead, gantry, locomotive, and truck. Cranes are not usually operated by Arcadis employees; the PM is responsible for verifying proper qualifications and licensure for crane operation by subcontractors.

Earthmoving Equipment – Scrapers, loaders, crawler or wheel tractors, bulldozers, off-highway trucks, graders, agricultural and industrial tractors, and similar equipment.

Excavator – An engineering vehicle consisting of a backhoe and cab mounted on a pivot (turntable is a more apt description) atop an undercarriage with tracks or wheels.

Heavy Equipment – includes excavators/track-hoes, back-hoes, bucket loaders, bulldozers, articulating all terrain trucks, graders, agricultural and industrial tractors, sweepers, and other powered mechanical equipment.

Manlifts – includes boom lifts, scissor lifts and other powered equipment designed to provide an elevated work surface. Manlifts require training by an authorized vendor or provider that includes a hands-on demonstration of competency that meets regulatory requirements and meets fall protection requirements. Refer to the Arcadis Aerial Lifts Standard ARC HSFS017 for details.

Motor Vehicles (as referenced in this standard) – Vehicles that operate within an off-highway jobsite, not open to public traffic. The definition of Motor Vehicles does not include earthmoving equipment.

Powered Industrial Truck (Forklift) – includes fork trucks, tractors, platform lift trucks, motorized hand trucks and other specialized industrial trucks powered by electric motors or internal combustion engines. Forklifts require training by an authorized vendor or provider that includes a

hands-on demonstration of competency and meets the regulatory requirements. Refer to the Arcadis Powered Industrial Truck (Forklift) Standard ARC HSSP006 for details.

Heavy Equipment Site Supervisor – The employee responsible for reviewing the project scope and determining if an acceptable skill level has been achieved and demonstrated by an employee, prior to being considered an Authorized Operator.

Skid Loader – Also called a skid steer, is a compact, low-capacity machine used for pushing or lifting material and for digging. It is typically used for earth moving during construction and landscaping in limited spaces but is also used to move loose materials in farming and industry.

Skidder – A type of vehicle used in forestry for pulling cut down trees (timber) out of a forest (logging).

EXHIBIT 2 – Abbreviations and Acronyms

ANA	Arcadis North America
Arcadis	Arcadis U.S. Inc.
HS	Health and Safety
H&S	Health and Safety
HSS	Health and Safety Standard
TIP	Task Improvement Process
ROPS	Rollover Protective Structure

EXHIBIT 3 – General Heavy Equipment Operator Approval

(Link to Form)

ARCADIS

General Heavy Equipment Operator Approval

Operator's Name:	**Date:**		
Sponsor's Name:			
Employee's Designation: Operator ☐ Supervisor* ☐ Both* ☐			
Training and Experience			
Has completed Heavy Equipment Awareness Training	☐ Yes	☐ No	
Has at least 4 years of Construction/Heavy Equipment Experience (Required for Site Supervisors overseeing Heavy Equipment Operations)	☐ Yes	☐ No	☐ NA
OSHA Construction Training (Required for Site Supervisors overseeing Heavy Equipment Operations)	☐ OSHA 10	☐ OSHA 30	☐ NA
General Equipment Approval			
1. Standard Excavator (steel track)	☐ Yes	☐ No	
2. Compact-excavator (rubber track)	☐ Yes	☐ No	
3. Backhoe (rubber tired)	☐ Yes	☐ No	
4. Agricultural Tractor (Bush Hog)	☐ Yes	☐ No	
5. Rubber tired Articulating Loader	☐ Yes		
6. Walk behind Loader	☐ Yes	☐ No	
7. Straight Frame D p Truck	☐ Yes	☐ No	
8. Articul Dum Truck (off d)	☐ Yes	☐ No	
9. Water Truck	☐ Yes	☐ No	
10. er Drill R	☐ Yes	☐ No	
11. Hammer Pro Drill Ri	☐ Yes	☐ No	
Roller (hor emote operated)	☐ Yes	☐ No	
13. Trenching Equipment (Ditch Witch)	☐ Yes	☐ No	
14. Other	☐ Yes	☐ No	
15. Other	☐ Yes	☐ No	

Authorized Operator (Print):_____ Signature:_____

Sponsored by (Print):_____ Signature:_____

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EXHIBIT 4 – Site Specific Heavy Equipment Operator Approval

ARCADIS

Site Specific Heavy Equipment Operator Approval

Operator's Name:	**Date:**
Evaluator's Name:	**Project:**
Equipment Type:	**Model:**
Manufacturer:	**Year:**

Performance Criteria and Demonstrated Skills	Yes	No	N/A
1. Has reviewed the manufacturers' manual and operating instructions for the machine/equipment and Arcadis operating procedures.	☐	☐	☐
2. Has received hands-on training by an experienced and qualified operator.	☐	☐	☐
3. Can communicate terrain and/or movement limitations of the equipment.	☐	☐	☐
4. Demonstrated/communicated use of safety equipment and procedures that are specific to preventing bystanders and other worker injury (swing radius, blind spot, etc.)	☐	☐	☐
5. Demonstrated the ability to perform daily, pre-operational inspections and maintenance (locations for grease, etc.) on the equipment.	☐	☐	☐
6. Demonstrated the ability to check operating gauges and where location would indicate out of range.	☐	☐	☐
7. Demonstrated use of equipment movement controls. Movement observed was in a safe and controlled manner.	☐	☐	☐
8. Demonstrated use of equipment controls not related to movement, such as outriggers.	☐	☐	☐
9. Demonstrated ability to move equipment safely from location to location.	☐	☐	☐
10. Demonstrated the ability to stabilize the machine on various terrain, if equipped.	☐	☐	☐
11. Demonstrated the ability to safety load or unload equipment on trailer, if equipped.	☐	☐	☐
12. Other/ Project Specific Issues. Evaluator to add as necessary.	☐	☐	☐

☐ ***This Operator is authorized to operate the equipment indcated above.***

☐ ***This Operator is NOT authorized to operate the following piece of equipment: Document below***

Heavy Equipment Type	Manufacturer	Model	Year

Authorized Operator (Print):_____Signature:_____

Authorized by (Print):_____Signature:_____
(Site Supervisor)

Note: Only one piece of Heavy Equipment may be authorized per form. This form is only good for the project, task and piece of Heavy Equipment listed. A copy of this form must be maintained on site and in project files. Task Description must be completed prior to authorization.

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EXHIBIT 5 – Heavy Equipment Inspection Checklist

ARCADIS

Heavy Equipment Inspection Checklist

Operator's Name:	**Date:**
Inspector's Name:	**Project:**
Client Name:	**Task:**
Vehicle/Equipment No:	**Manufacturer:**
Type of Equipment:	**Owner:**
Hour Meter Reading:	

Visual Checks	Ok	Deficiency	N/A
1. Engine oil level	☐	☐	☐
2. Radiator water level	☐	☐	☐
3. Belts and Hoses	☐	☐	☐
4. Battery: check for corrosion, loose terminal, hold downs	☐	☐	☐
5. Obvious Damage and Leaks (fuel/oil/hydraulic fluid/coolant/transmission/differential oil)	☐	☐	☐
6. Tire or Track (loose rollers, broken flanges, condition)	☐	☐	☐
7. Body/Cab/Covers	☐	☐	☐
8. Grab Bars/Steps	☐	☐	☐
9. Rock and radiator guards securely mounted	☐	☐	☐
10. Headlights and taillights	☐	☐	☐
11. Warning lights	☐	☐	☐
12. Hour meter	☐	☐	☐
13. Other gauges and instruments (oil pressure/temperature)	☐	☐	☐
14. Roll-over protection system (ROPS): properly secured to main frame/Seat belts	☐	☐	☐
15. Windshield	☐	☐	☐
Operational Checks	**Ok**	**Deficiency**	**N/A**
16. Fire extinguisher present (monthly inspection current)	☐	☐	☐
17. Mirror(s)	☐	☐	☐
18. Horn	☐	☐	☐
19. Steering	☐	☐	☐
20. Service brakes	☐	☐	☐
21. Parking brake	☐	☐	☐
22. Check blade, ripper, winch (operates smoothly and will hold at any point)	☐	☐	☐
23. Warning lights (strobe)	☐	☐	☐
24. Warning Alarm (reverse travel)	☐	☐	☐

Inspector's Name (Print):_____Signature:_____

Date of Inspection: _____

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Table of Contents

1. POLICY

It is the policy of Arcadis to implement sound defensive driving training and education to employees and provide administrative management that ensures vehicles are well maintained and driven by qualified employees. This Health and Safety Standard (HSS) (referred to as "MVSP") provides requirements that ensure compliance with this of this policy. Employees who fail to follow these MVSP requirements will result in an employee being prohibited from driving on behalf of Arcadis and/or may face additional disciplinary action.

2. PURPOSE AND SCOPE

2.1 Purpose

The MVSP sets forth the requirements for providing a healthy and safe work environment for our employees, subcontractors, clients, and visitors. To this end, Arcadis embraces this MVSP.

This HSS and accompanying requirements provides consistent practices with regards to defensive driving and vehicle administration for Arcadis vehicles.

2.2 Scope

This MVSP applies to Arcadis U.S. employees operating motor vehicles for company business in any country in which Arcadis employees, or temporary agency employees, are working. It applies to every Arcadis driver operating an Arcadis rental, leased (fleet), or personal vehicle used for company business. Employees operating Arcadis owned, leased, or rented vehicles for non-business use must have written supervisor's approval (see Section 5.4 for additional information).

Additional requirements apply to the operation of a commercial motor vehicle (CMV). Refer to the Arcadis Transportation Safety Program for Commercial Motor Vehicles (CMV Program) for additional information.

When client requirements are more restrictive than this MVSP, the more restrictive requirement will apply for all work activities involving driving for that client.

3. DEFINITIONS

Definitions related to MVSP can be found in Exhibit 1. Acronyms and Abbreviations are found in Exhibit 2.

4. ROLES & RESPONSIBILITIES

4.1 Drivers

Drivers are any Arcadis employee or temporary agency employee who drives an Arcadis vehicle, leased vehicle, rental vehicle, or personal vehicle for business reasons whether the use of the vehicle includes operation from the local office or for travel while away from the local office. Drivers will:

- Adhere to this MVSP.
- Communicate health and safety (H&S) concerns, issues, and questions to their Line Manger or to H&S staff.
- Complete a hazard assessment (TRACK) prior to any driving activity.
- Follow all applicable Arcadis, federal, state, provincial, and local jurisdiction regulatory requirements.
- Follow client driving requirements when driving an Arcadis owned, leased, or rented vehicle for the project.

4.1.1 Drivers without an Assigned Driving Function for Arcadis

Drivers without an assigned driving function for Arcadis are still subject to the requirements of Section 5.1, Section 5.2 and Section 5.4 of this HSS.

4.1.2 Joint Venture and Temporary Agency Employees

Use of joint venture and temporary agency employees working with or for Arcadis to operate Arcadis vehicles requires pre- approval of the Business Area (BA) Director, EF Legal, and must also satisfy training requirements set by Enabling Function (EF) Health and Safety. If authorized to drive an Arcadis vehicle, in addition to Section 5.1:

- The employee's MVR must be clear of any violation for the prior three (3) years and list no prior critical violations. Critical violations include:
    - Alcohol-related offenses.
    - Driving while impaired or under the influence of alcohol or drugs.
    - Homicide, negligent homicide, or manslaughter by vehicle.
    - Fleeing or attempting to elude police officer.

- Hit and run.

- If the employee receives a ticket for a violation, is convicted of a violation, or has an accident while driving on Arcadis business, they are immediately prohibited from driving Arcadis vehicles, rental vehicles, or a personal vehicle for Arcadis business unless otherwise permitted by the applicable Arcadis BA Director in consultation with the applicable EF Health and Safety Director, regardless of fault or preventability.

4.2 Project Management

Project Management is responsible for:

- Providing stewardship concerning the requirements of this HSS to lower tier managers and employees.
- Assuring that appropriate time is provided to ensure implementation of MVSP requirements and facilitate maintenance request approvals.

4.3 Line Managers

Line Managers are responsible for:

- Providing stewardship concerning the requirements of this HSS to their direct reports.
- Assuring that appropriate time is provided to ensure implementation of MVSP requirements by their direct reports.
- Tracking and ensuring their direct reports complete any assigned defensive driving training or completing any other corrective actions prescribed by this standard.

4.4 Health and Safety MVSP Specialist (MVSP Specialist)

The MVSP Specialist is the primary contact for all issues related to implementation of this MVSP, including reporting of all accidents and incidents involving a motor vehicle. The MVSP Specialist will coordinate with other EF departments, as required, related to MVSP implementation requirements.

4.5 Enabling Function People Department

EF People has the responsibility to review applicable portions of this HSS for the purposes of ensuring consistency with EF People's communication policies and procedures regarding motor vehicle operation. EF People have a primary focus of ensuring administrative procedures concerning vehicle use are followed by employees. EF People has the authority to request and evaluate MVRs on Arcadis drivers at any time.

4.6 Enabling Function Legal Department

EF Legal has the responsibility to provide oversight of the requirements stipulated in this HSS to ensure Arcadis risks are properly managed. Legal has the authority to request and evaluate MVRs on Arcadis drivers at any time.

4.7 Enabling Function Procurement

EF Procurement has the responsibility to oversee leasing and maintenance management vendors and facilitate maintenance issues associated with Arcadis owned or leased vehicles. Procurement will also work with EF H&S on safety equipment upfitting for owned or leased vehicles.

4.8 Enabling Function and Operations Health and Safety Staff

EF H&S and staff Operations Health and Safety staff are responsible for:

- Communicating the requirements of this HSS with Arcadis.
- Verifying this HSS is being implemented effectively.
- Ensuring this MVSP is being implemented effectively. EF H&S has a primary focus of identifying defensive driving education and training resources.
- Identifying defensive driving education and training resources.
- Requesting and evaluating MVRs on Arcadis drivers at any time.
- Stewarding programs involving vehicle inspections and maintenance requirements.

5. PROCEDURE

5.1 General Driver Requirements

Only Arcadis Drivers, as defined in Section 4.1 and Exhibit 1, are permitted to drive Arcadis vehicles. Exceptions to this policy are limited only to individuals authorized by the Arcadis Driver or fleet administrator to perform short-term driving and parking activities involving Arcadis vehicles such as maintenance employees and valets. Use of joint venture and temporary agency employees working with or for Arcadis to operate Arcadis vehicles requires pre- approval of the BA Director, EF Legal, and must also satisfy training requirements set by EF H&S.

Arcadis Drivers who drive Arcadis vehicles or personal vehicles used for Arcadis business will maintain a valid driver's license, appropriate for the vehicle they are operating, that is free from any driving restrictions or suspension (with the exception of corrective lenses). All Arcadis drivers with an assigned driving function for Arcadis may have their Motor Vehicle Record (MVR) reviewed by approved representatives of EF People, EF Health and Safety and/or EF Legal Departments (Exhibit 3). An Arcadis Driver who is asked to drive for business purposes in any type of vehicle, shall notify their supervisor or designated Arcadis contact and the MVSP Specialist in writing by the next business day if:

- Their license is suspended, revoked, or restricted in any state.
- They receive a moving violation while driving for Arcadis-related business.
- Receive a moving violation or conviction related to non-business driving in any type of motor vehicle that might affect their driving status with Arcadis.

The MVSP Specialist (or designate), in cooperation with EF People and EF Legal, as deemed necessary, will evaluate the employee's driving status (especially in instances of license suspension, revocation or restriction) and, as appropriate, corrective action and/or restriction recommendations will be made. Evaluations will consider the date of any citations and any corrective action and/or restriction recommendations will remain in effect until adjudicated by a court.

Employees who fail to report a driving violation to their supervisor that might affect their driving status for Arcadis purposes (a restricted driver) will face disciplinary action which may include termination if the conviction is discovered through routine MVR pulls (Exhibit 3), criminal background checks or other official documentation transmitted or made available to Arcadis. Arcadis will work to the extent practical with employees who report driving violations that might affect their driving status for Arcadis purposes if Arcadis operations management can accommodate a driving restriction for the driver or other suitable arrangement is made consistent with EF People and Legal policies.

All Arcadis Drivers driving an Arcadis motor vehicle or personal vehicle for Arcadis business will:

- Always wear seat belts in any vehicle with seat belts (this includes taxis and shuttle buses equipped with seat belts).

- Have a valid unrestricted operator's license appropriate for the vehicle being driven.
- Wear corrective lenses if required by the driver's license.
- Operate and license the vehicle in accordance with applicable laws.
- Operate the vehicle consistent with client driving rules, and speed limits when operating the vehicle on project sites.
- Drive defensively as learned through training, education, and experience.
- Ensure that the start of each shift begins with a thorough pre-trip inspection to evaluate the health of the vehicle.
- Exercise caution when taking any prescription or over-the-counter medication that may cause drowsiness or an altered mental state.
- Not use controlled substances, illegal drugs, or be under the influence of alcohol or marijuana (where legal) while driving on Arcadis business.
- Not drive in a manner that could be deemed reckless or aggressive by other drivers.
- Not use radar/laser-type detectors.
- Not pick up hitchhikers.
- Not smoke in company vehicles.
- For drivers with an assigned driving function for Arcadis, if permanently assigned an Arcadis motor vehicle will ensure the vehicle is maintained as directed by the Arcadis maintenance vendor.

Use of headlights, even during daylight hours, is recommended. Additionally, Arcadis expects all drivers to use pull through parking or back into parking places consistent with their defensive driving training specified in this HSS and as permitted by local laws.

5.2 General Driving Safety

5.2.1 Driving Distractions and Electronic Device Use While Operating a Motor Vehicle

Arcadis strictly prohibits employee use of personal or company-provided electronic devices (as defined in Exhibit 1) while the vehicle is in motion or stopped in traffic. This includes use

of these devices in hands-on mode or hands-free mode while the employee is operating any motor vehicle for Arcadis purposes.

Electronic devices used for navigation must be secured in the vehicle with a mount designed for such purpose.

Guidance for vehicle controls and settings: If the driver needs to do more than push a button or flip a switch one time to complete the desired action, then the driver should not be performing the function while the vehicle is in operation or stopped in traffic. For example, the driver should not be repeatedly pushing the "seek" button on the radio to find a radio station they like or adjust the seat while simultaneously driving the vehicle. Vehicles mirrors should also be adjusted during pre-trip inspections to avoid adjusting while driving. This includes both side mirrors, and rear-view mirror.

To avoid distractions that could result in an accident, reading, grooming, eating, and drinking should be avoided while operating a motor vehicle.

5.2.2 Additional Defensive Driving Procedures

Arcadis promotes additional defensive driving techniques to assist in the elimination or minimization of MVAs and VLEs. These techniques include:

- When a second Arcadis employee is available, and where it is safe to do so, all vehicle backing operations should use a spotter to assist with the backing operation.
- When an employee is not available to assist, we should preform G.O.A.L. (Get Out And Look). Before backing without a spotter, we will get out of our cars, and do a full lap around the vehicle to help us get the big picture and scan our environment.
- G.O.A.L. should also be used anytime that we have left our vehicle for an extended amount of time, our environment is always changing, and there could be new hazards that were not in front of or behind us previously.
    - As a best practice in conjunction with GOAL or as required by a client, use the Cone Program (or similar program) to promote awareness of hazards around parked vehicles.
- To assist drivers in their potential lack of familiarity with the location in which they are driving, one of the following should be utilized by drivers traveling to unfamiliar locations:

- The use of Global Positioning Systems (GPS) systems programmed prior to operating the vehicle, and/or
- Pre-Trip Route Planning using software such as Google® Maps or MapQuest®, and/or
- Preparation of a Journey Management Plan (JMP) using the template provided in the Excel Standard Health and Safety Plan (HASP) Template

When the driver is the only occupant of the vehicle, use of a GPS device is preferred. Drivers are prohibited from using hard copy versions of maps and JMPs while the vehicle is in motion or stopped in traffic. These navigational aids should be used by passengers in the vehicle to assist the driver in navigating to the desired destination.

5.2.3 Special Considerations for Rental Vehicles

Rental vehicles will be treated and driven in a manner equivalent to an Arcadis owned or leased vehicle. Additionally, Arcadis employees renting vehicles will plan and select a vehicle appropriate for the conditions anticipated when driving. Careful planning is required to preferentially use Arcadis owned or leased vehicles for off road use instead of using rental vehicles when reasonable, practical, and permitted under contract (client or rental company) terms. Due to operating unfamiliarity typically encountered when renting vehicles, use of TRACK to identify and mitigate atypical or unfamiliar vehicle functionality or performance is required.

Guidance: Avoid free upgrades to larger vehicles if you are not familiar with driving the larger vehicle being offered.

Preforming proper pre-trip inspections when driving a rental vehicle is especially important. This will help the driver to become familiar with the layout of the vehicle and spot any potential hazards. In addition to Section 5.3.1 inspection criteria, some additional things to look for prior to leaving the rental car facility:

- Ice scaper/brush during wintertime.
- Check under seats and in glove boxes/console compartments for possible presence of weapons/drugs left behind from a previous renter.

5.2.4 Special Considerations for Ridesharing Services

Arcadis prohibits the use of "Uber POOL" and "Lyft Shared" services, or other vendor equivalent offering pool rideshare services. Arcadis also prohibits sharing taxis with other passengers not known to the employee using the taxi.

Guidance: Use of standard Uber or Lyft services not listed above is not prohibited. Use of shuttle services to and from the airport (such as Super Shuttle, rental car shuttles or hotel shuttles) is not prohibited. Use of bike share services is not prohibited if a hazard assessment (TRACK) is performed prior to use of the bike and appropriate personal protective equipment is used. Use of carshare services such as Zip Car is not prohibited.

5.2.5 Special Considerations for Atypical Methods of Transportation

Arcadis prohibits using Segway's, kick scooters (provided by scooter share services), hoverboards, ridable luggage, and similar means of battery powered personal transport as a means of business travel or business commute.

Guidance: Use of Segway's for recreational networking or team building activities related to Arcadis work is not prohibited if a hazard assessment (TRACK) is performed prior to use of the Segway.

Section 5.2.5 prohibitions do not apply to battery powered bicycles; battery powered scooters equipped with a seat nor does it apply to electric golf carts used on golf courses. However, use of "kick scooters" such as those offered by Bird, Bolt, Lyme, Scoot Networks, etc. is prohibited in all instances affiliated with Arcadis.

Gasoline powered bikes, scooters equipped with a seat, mopeds, and motorcycles are not prohibited if a hazard assessment (TRACK) is performed and proper personal protective equipment is used.

5.2.6 Insurance

Arcadis has vehicle insurance coverage for Arcadis Vehicles and Rental Vehicles. If an accident occurs or damage is sustained, there is a $2,000 deductible for damage to the Arcadis Vehicle ("collision") and a $10,000 deductible for damage to another vehicle, property damage or injury to another party ("liability"). These deductibles are paid by the relevant Arcadis employee overhead.

If an accident should occur during non-business hours while an employee is driving an Arcadis Vehicle or Rental Vehicle, in accordance with state law, the Arcadis employee could be personally liable for injuries and damages associated with such an accident.

5.2.6.1 *Vehicle Rental in the United States*

As stated above, Arcadis has insurance for all Arcadis Vehicles. When renting for business in the United States, the rental must be arranged through the Arcadis approved travel agency, and there is no need to accept the insurance coverage offered by Arcadis preferred rental car vendors.

5.2.6.2 *Vehicle Rental Outside of the United States*

If renting a vehicle for business purposes **outside of the United States or Canada, the employee must accept the insurance offered by the local rental car company in order to be fully covered under the company's Foreign Package policy.** In addition, check with EF Legal about any additional coverage that may be needed for the country in which you are renting.

5.2.6.3 *Personal Vehicles*

Employees who drive their own vehicle for company business, as a condition for performance of their duties, shall comply with all minimum state requirements for auto insurance as required by their state. This requirement includes auto liability insurance with the minimum amounts of coverage meeting or exceeding that state's requirements. If requested, employees shall provide a current insurance card which indicates the amount of coverage as adequate proof of insurance coverage.

If a personal vehicle is damaged or involved in an accident while being driven for company business, the insurance covering that personal vehicle is primary. Arcadis does not reimburse employees for personal auto insurance deductibles.

5.3 Vehicle Safety

5.3.1 Vehicle Inspections and Maintenance

All company owned or leased vehicles will be maintained in safe operating condition. To ensure vehicles are properly maintained, a daily pre-trip visual inspection must be informed prior to operating the vehicle. The pre-trip inspection should include, but is not limited to:

- Seat belts
- Doors and door locks
- Lights
- Mirrors
- Horn
- Back up alarms, if equipped
- Back up cameras, if equipped
- Parking brake
- Instrument panel
- Steering
- Windows
- Windshield wipers
- Tires; and
- Emergency equipment.

A more comprehensive weekly documented inspection (daily if required by the client, manager, or supervisor or if vehicle is operated in harsh environments) is also required.

Rental vehicles operated by Arcadis for more than one week also must also use the documented weekly inspection process. Inspections are required to be documented on the Weekly Vehicle Inspection Checklist, in Arcadis approved software, or client approved equivalent form or software.

Note: Staff working on project sites subject to Mine Safety and Health Administration (MSHA) regulations must use a vehicle inspection checklist designed for mining projects. Contact EF Health and Safety for assistance.

Deficiencies identified in inspections or at any other time will be managed through the Arcadis vehicle leasing company vendor or maintenance provider specified by EF Procurement.

Routine maintenance (gasoline, oil, car washes, etc.) will also be managed through these vendor(s) using approved fuel cards. Use of assigned fuel cards is critical to help ensure maintenance schedules are maintained for the vehicle. Records of vehicle inspections should be maintained at the office or project location where the vehicle is assigned.

Guidance: Fuel cards are assigned to the vehicle (not drivers) and must remain with their assigned vehicle

Employees operating company owned or leased vehicles (including qualifying rental vehicles) required to be maintained under the commercial motor vehicle (CMV) program will follow inspection and maintenance requirements specified in the CMV Program. Use of Weekly Vehicle Inspection checklist (hardcopy or non-CMV Program approved software) for CMV operation is not permitted.

5.3.2 Safety Equipment for Arcadis Vehicles

All Arcadis owned or leased vehicles are expected to have, at a minimum, a 2.5 lb. A, B, C fire extinguisher (permanently mounted), a flashlight, first aid kit and an orange strobe or oscillating light. The amber warning light may be permanently affixed or removable. Rental vehicles will be subject to equivalent requirements, if used for field work unless otherwise excepted from a specific safety equipment requirement by the project specific HASP or Job Safety Analysis. Rental vehicles are not required to have fire extinguishers and amber warning light permanently mounted.

All Arcadis owned or leased vehicles obtained after June 1, 2012, are equipped with back up alarms. All Arcadis owned or leased pickup trucks with an open bed obtained after April 4, 2016, are equipped with a rear window protector.

Refer to MVSP Guide-010 for additional recommendations for safety and emergency equipment that may be required for specific project needs.

All Arcadis vehicles managed under the Arcadis approved vendor maintenance program have Emergency Roadside Assistance. Documentation, including the phone number for the vendor providing assistance must be maintained in the glove box of the vehicle.

5.3.3 Securing Loads in Vehicles

All luggage, equipment and supplies loaded into a vehicle operated by Arcadis will be stowed in a manner that will prevent appreciable movement. Luggage, equipment, and supplies placed in the passenger compartment of vehicles will be placed in a manner that will prevent rapid forward movement in the event of a hard stop or frontal collision. Objects will not be placed on the dashboard of vehicles unless they are secured in place by friction mats, suction cups, or similar securing device.

Securing straps, tiedowns (all types) and securing nets used to secure loads on trucks must be inspected prior to each use. Damaged, worn or frayed securing straps or tiedowns must not be used.

Chemicals transported in Arcadis vehicles must conform to the requirements of the Arcadis Transportation Safety Program for Hazardous Material Shipping and Transportation. Compressed gas cylinders not enclosed in a case or similar packaging should be transported in a vertical secured position.

Arcadis CMVs are subject to additional load securement requirements specified by the Arcadis CMV Program.

5.3.4 Vehicle Modification

Arcadis employees are prohibited from modifying Arcadis owned or leased vehicles unless the modification is approved in writing by EF Health and Safety and/or EF Procurement.

5.3.5 Electronic Logging Devices

Some Arcadis vehicles designated by EF Health and Safety are equipped with an Electronic Logging Device (ELD). Arcadis employees are prohibited from tampering with any of these devices or rendering these devices inoperable. ELD use is currently restricted to specific Arcadis CMV drivers.

5.3.6 Telematics and Vehicle Cameras

Arcadis may apply telematics equipment to any leased, owned or rented vehicle. Arcadis vehicles equipped with telematics capable of generating driving behavior data (including camera observations) will be reviewed against established Arcadis criteria presented in MVSP Guide-001. Drivers operating telematic equipped vehicles are required to assign themselves to the vehicle prior to driving. Drivers identified as not meeting established criteria may be subject additional training to improve driving skills. In the case of low telematic scores or

defined speed violations prescribed in MVSP Guide-001, Driver Improvement Plan prescribed by MVSP Guide-001 will be implemented. Arcadis reserves the right to restrict any vehicle, asset, or driver during the telematics data review process.

Arcadis owned or leased vehicles may have a forward / road facing and driver facing camera(s) installed. Additionally, vehicles only equipped with forward facing cameras may be upgraded with a driver facing camera as part of a driver improvement plan for drivers with a low driver score (a defined in MVSP Guide-001) or in the event of a preventable MVA or VLE. When a forward and/or driver facing camera is installed as a result of a listed event above, the driver will be only be permitted to operate a vehicle that is camera equipped and will not be permitted to drive any other vehicle on behalf of Arcadis. After 180-days, for upgraded cameras installed as part of a Driver Improvement Plan or a corrective action, the driver may file an appeal in accordance with MVSP Guide-008 to have the forward and/or driver facing camera removed. For vehicles equipped with cameras, placing objects that obstruct the cameras field of view is prohibited.

Supervisors and Project Managers may request in writing access to telematics data to review for their direct reports and projects.

5.4 Non-Business, Business Development and Marketing Use of Company Vehicles

Personal use of an Arcadis Vehicle or Rental Vehicle during business hours and/or having non-business-related passengers in an Arcadis Vehicle or Rental Vehicle during such business use is restricted and requires supervisor or project manager approval. Utilizing an Arcadis owned or leased vehicle for non-business-related Goodwill functions will require written supervisor approval.

If an accident should occur while driving in a non-business related activity, the employee is personally liable for injuries and damages associated with such an accident and the employee, not Arcadis, will be responsible for all rental charges. Operating an Arcadis Vehicle or Rental Vehicle for strictly personal use on weekends, evenings and holidays is prohibited, unless prior approval by the employee's supervisor or project manager is given, the vehicle possession is necessary due to remote location and assignment, and the employee has all required personal automobile liability insurance. Supervisors and project managers should assess the requirement and may place any other appropriate limitations on such use (see MVSP Guide-009).

Use of an Arcadis Vehicle or Rental Vehicle to commute to and from work is also considered personal use and should be limited to those situations where there is a sound business reason to do so and must be authorized by the employee's supervisor.

Cost allocation associated with an Arcadis Vehicle or Rental Vehicle that relates to the authorized personal use of the vehicle by employees (including transportation to and from work) as described in this section is not permitted to be billed to projects. Personal use mileage and other vehicle charges related to personal use must be logged separately from business use charges during vehicle billing to clearly identify personal use charges.

Use of an Arcadis Vehicle for business development, marketing, or non-billable purposes (except when used in an approved personal use situation described above) is prohibited unless approval is granted by the BA Director.

6. TRAINING

6.1 Defensive Driving Training, Evaluation, and Education Requirements

6.1.1 New Hire Defensive Driving Training

All new hires (regardless of driving assignment) with an active driver's license will complete on-line defensive driving training prescribed by Health and Safety and assigned by EF Human Resources within 30 days of employment.

New hires with conditional driving status may be required to complete additional on-line defensive driving training prior to operating a vehicle for Arcadis as directed by EF Health and Safety.

6.1.2 Existing Employee Defensive Driving Training

On a frequency defined by EF Health and Safety, in cooperation with operations senior management, employees who have an assigned driving function for Arcadis shall complete an on-line defensive driving training course designated by EF Health and Safety or an equivalent course approved by EF Health and Safety.

In furtherance of Arcadis' goal of promoting safe driving, employees who do not have an assigned driving function for Arcadis are also eligible to voluntarily participate in the same on-line defensive driving training concurrent with prescribed timeframes for any assigned Arcadis driver training.

If a client requires classroom or hands-on defensive driver's training, EF People will arrange for the required classroom training. The Arcadis required on-line training will not be required for those driving employees who attend classroom training (hands-on or subject matter training) consistent with a EF Health and Safety recognized defensive driving system during the same calendar year.

All Arcadis drivers are expected to review and be familiar with the contents of the Operator's Manual(s) for the vehicles they will be operating. Additional training may be provided or required at the request of an employee's supervisor, EF Health and Safety, or as required by a client.

6.1.3 Inexperienced Drivers

New hires or existing employees having an assigned driving function for Arcadis and known to have only possessed a valid driver's license for less one year, possesses a driver's license issued outside of the United States or Canada and/or experienced drivers that are unfamiliar with driving large vehicles may warrant additional evaluation and training in the operation of the vehicle(s) they are expected to drive while working for Arcadis. Supervisors are encouraged to review with their direct reports their license and driving history to ensure the driver is comfortable and knowledgeable of expected vehicle operation. If determined by the supervisor that additional evaluation is warranted, a Commentary Drive (see Section 6.3) should be considered. The supervisor may schedule an additional TIP later to ensure safe driving of larger vehicles is being performed.

Supervisors may opt to enroll drivers in additional defensive driving on-line training or hands-on defensive driver training if the driver expresses concerns about their ability to safely drive a vehicle.

New employees or transferring employees possessing a driver's license issued by a country outside of the United States or Canada must obtain a driver's license within the United States or Canada prior to operating a motor vehicle for Arcadis. Use of an International Driving Permit in conjunction with a valid Non-United States or Canadian driver's license is only permitted when approved by the Country or BA Director when driving a motor vehicle for Arcadis.

6.1.4 Drivers Requiring Training or Evaluation due to Corrective Action from MVR Review

Any driver subject to Corrective Action arising from an MVR review will be trained or evaluated as prescribed in the MVR evaluation process (MVSP Guide-005).

6.1.5 Additional Defensive Driving Training and Education Requirements for Employees Involved in a Vehicle Loss Event

Corrective actions associated with an employee involved in a preventable or non-preventable VLE will be determined by the supervisor based on the severity and circumstances of the incident as determined by the Incident Reporting and Investigation HSS (ARC HSMS010).

6.2 Sources for On-Line and Video Based Defensive Driving Training

The on-line defensive driving training or equivalent training will be provided by, or based on, a nationally recognized defensive driving training company such as Smith System or other recognized provider as approved by EF Health and Safety, assigned by EF People and arranged through the Arcadis Learning Management System (Arcadis LMS). Video based defensive driving training modules, when assigned, will be arranged through the Arcadis LMS or as available on the ANA Health and Safety SharePoint site.

6.3 Commentary Drive Program

The Commentary Drive evaluates driver understanding of safe driving behaviors by having the driver verbalize their observations to the Commentary Drive observer when operating the vehicle. The observer will use a standard Driving Task Improvement Process (TIP) form or Commentary Drive form to document driver understanding of safe driving principles such as the Smith System “5 Keys”. The observer will also provide real time feedback on questionable driving behaviors. Commentary Drives are expected to last a minimum of 1 hour behind the wheel driving time.

Employees performing observer functions for Commentary Drives must be current on Health and Safety defensive driving on-line training obligations as described in Section 6.1.1 and meet additional criteria in MVSP-Guide 002. Instructions for properly conducting Commentary Drives are provided in MVSP Guide-002.

6.4 The Driving Task Improvement Process

The driving TIP may be used to evaluate driver performance and provide solutions related to questionable driving behaviors for routine driving evaluations under the Arcadis Behavior Based Safety (BBS) Program. Solutions generated using the TIP process will be consistent with the expectations of the Arcadis BBS Program.

6.5 Sources of Hands-On Defensive Driving Training

When used, hands-on defensive driving training will be provided by, or based on, a nationally recognized defensive driving training course such as Smith System or other provider approved by EF Health and Safety. The trainer must be certified in the program upon which they are instructing and can be either internal or external to Arcadis. Arrangements for hands-on defensive driving courses are handled by the Arcadis LMS.

6.6 Additional Training and Education for Other Driving Conditions

Working together, supervisors, managers, and EF Health and Safety have the responsibility of determining additional training for employees driving under special conditions such as CMVs, towing trailers, riding in or driving all-terrain vehicles or other non-routine driving conditions. Training approved by EF Health and Safety will be arranged through the Arcadis LMS.

7. REFERENCES

- Arcadis Transportation Safety Program for Commercial Motor Vehicles
- The following MVSP Guides:
    - MVSP Guide-001, Telematics
    - MVSP Guide-002, Guidelines for Conducting Commentary Drives
    - MVSP Guide-003, Automated Enforcement Conviction Evaluation Criteria
    - MVSP Guide-004, Criteria for Defining a Motor Vehicle Accident
    - MVSP Guide-005, Guide for MVR Corrective Actions
    - MVSP Guide-006, Rental Vehicle Safety Requirements and Best Practices
    - MVSP Guide-007, Spotter and Cone Program Best Practices

- MVSP Guide-008, MVSP Restricted Driving Appeal Process
- MVSP Guide-009, *Reserved*
- MVSP Guide-010, Safety Requirements for Arcadis Vehicles
- MVSP Guide-011, Reporting Requirements for all Vehicle Damage

The following H&S standards can be found on the Policies and Integrity Site:

- Incident Reporting and Investigation HSS (ARC HSMS010)
- Specialty Vehicle HSS (ARC HSFS001)

8. RECORDS

Records will be maintained as follows:

- MVRs pulled as required under this MVSP and associated notifications, approvals, releases, and findings information will be maintained by EF People.
- TIP results and near miss reports related to MVSP activities will be maintained in the 4-Sight database.
- Motor vehicle incident reports will be maintained in the Cority.
- When performed, Commentary Drive documentation will be provided to the employee unless otherwise specified by the MVSP Specialist or project management. Commentary Drive findings may be entered into 4-Sight as a Driving TIP for employees wishing to receive a driving TIP credit.
- Any training certificates or documentation arranged through the Arcadis LMS (hands-on defensive driving, defensive driving on-line, defensive driving videos, etc.) will be maintained by the Arcadis LMS.

Training records will be stored in Arcadis' LMS so they may be provided, if requested by Arcadis, clients or a regulatory agency. Employees must upload copies of their training records from external vendors the Arcadis LMS.

9. APPROVALS AND HISTORY OF CHANGE

Julie Santaniello, CSP – Corporate H&S Manager of Technical Programs

History of Change

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
26 March 2007	01		Original document
18 August 2007	02		Change in required on-line defensive drivers training
22 October 2007	03		Changing over to new template format and addition of the "Comments on My Driving?" program
21 January 2008	04		Change to new template; change to 2008 organization job titles; change to prohibit texting/emailing while driving
13 June 2008	05		Addition of Sections 5.10 and 5.11 on other defensive driving techniques and cone placement.
6 October 2008	06		Clarified who is required to complete online training in Section 5.3 and modified section on when hands-on defensive driving is required after an accident.
8 April 2009	07		Incorporated references to the CMV program and vehicle inspection requirements. Incorporated Vehicle Use Policy. Added fatigue management requirements. Deleted references to the Commentary Drive which is obsolete.

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
3 November 2009	08		Incorporated Smith System videos as a corrective action, Commentary Drive Program and revised Exhibit 2 and added new Exhibit 4.
1 November 2010	09		Deleted Comments on my driving section as program was discontinued.
25 May 2011	10		Revised content and restructured selected exhibits and standard sections. Most content duplicated in the Vehicle Use policy removed. Vehicle Use policy incorporated by reference
August 16, 2011	11		Replaced section 5.7, added new definitions and guide references, clarified fatigue management recommendations, modified terminology for BBS program, provided MVR report clarifications.
May 2, 2012	12		Comprehensive restructuring, Revisions to training and MVR processes, expanded rental vehicle safety, inclusion of additional MVSP guidance documents, roles and responsibilities clarification. Inclusion of vehicle safety equipment information. Formalization of the ARC process.
14 March 2013	13		Clarified MVR review and training for new hires. Clarified standard conflict with other corporate department policies. Restructuring of section 5.2. Removal of assigned driving function. Revision to headlight use. Section 4.2 MVSP Specialist e-mail link address updated

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
8 December 2013	14		Added definition for assigned driving function, Restructured MVR review requirements, newly licensed driver requirements, and add references to new MVSP Guides. Title changes and minor editing throughout.
29 January 2014	15	Sam Moyers	Addition of new section 5.13 addressing load securement to harmonize with other H&S standards and guidance. Addition of pre trip visual inspection information to harmonize with other H&S standards and guidance. Clarification of expectations in the cone and spotter program. Revised header and footer to current standard and modified revision history table.
4 February 2014	16	Sam Moyers	Section 5.1 was modified to clarify Arcadis parking expectations
22 September 2015	17	Sam Moyers	Revised appeal process and relinked revised MVSP Guide-005. Rebranding. Revised signature block
6 May 2016	18	Sam Moyers	Revised with new section 6 dealing with insurance issues. New section 5.3.6 dealing with temporary agency employees. Both were included from integrated **Human Resources** Vehicle Use Policy. Revised sections 5.3.5, 5.9 and 5.12 to clarify current policy. Added a definition for field work in Exhibit 1. Added additional references concerning cell phone prohibition.

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
27 March 2018	19	Sam Moyers/Julie Santaniello	Revised Executive Summary and Exhibit 1 concerning electronic devices, Revised sections 5.9, 5.10, and 5.13 to reflect current policies. New section 5.15 for ELDs and telematics. Added definition of “electronic device” in Exhibit 1. Minor editorial corrections throughout. Fixed broken links. Combined MVSP guides into one document.
4 October 2018	20	Sam Moyers	New section 2.2.2 concerning non-business driving. New section 5.3 addressing telematic data review. Revised sections 5.4.1 and 5.4.3 for protocols associated with employees with foreign driver’s licensing. Section 5.10 revised to clarify use of maps and JMPs. Section 5.11 modified to permit use of software to record vehicle inspections. Minor editorial corrections throughout. Updated all hyperlinks.
30 May 2019	21	Sam Moyers	Insertion of MVSP Guide-001 reference in section 5.3. New sections 5.18 and 5.19
15 August 2019	22	Sam Moyers	Revision to section 6.1 dealing with personal use vehicle charges and harmonization of terminology used in section 6.1 and use of vehicle for marketing, and business development prohibited. Updated Executive Summary to reflect revisions in section 6.1.

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
12 October 2020	23	Sam Moyers / Andrew McDonald	Revised MVSP Guide-001, 005, and 008. Revised section 5.1 to require drivers to notify a supervisor and the MVSP Specialist in writing. Revised section 5.1 to require drivers of telematic vehicles to assign themselves to the vehicle. Revised section 5.2.5 and 5.4.6 replacing BL President with COO. Minor editorial corrections throughout.
15 October 2020	24	Sam Moyers	Revised Table and FAQ 2 in Guide 001.
7 February 2023	25	Julie Santaniello/Zach Mongan/Sam Moyers	Updated standard to new standard template, reorganized Sections 5 and 6, update hyperlinks, harmonize language, add telematics data review information, conviction language, camera language, corrective actions, and goodwill functions
2 July 2024	26	Jacob MacDuffie/ Sam Moyers	Revised sections 5.1, 5.2.1-5.2.3,, 5.3.2, numerous editorial corrections and terminology updates, Additional guidance notes added in sections 5.2.3 and 5.3.1

Exhibit 1 - Definitions

Arcadis vehicle or Arcadis motor vehicle: Any motor vehicle owned or leased by Arcadis employee.

Note: ATV/UTV/Snowmobile operation is addressed in Arcadis Specialty Vehicle HSS ARC HSFS001

Arcadis driver or driver: Any Arcadis employee or temporary agency employee who drives an Arcadis vehicle, leased vehicle, rental vehicle, or personal vehicle for business reasons whether the use of the vehicle includes operation from the local office or for travel while away from the local office.

Arcadis employee: Any full-time, part-time, temporary, as needed employee, and interns employed by Arcadis.

Assigned Driving Function for Arcadis: Any Arcadis driver who drives on average 5 or more days per month in the interest of Arcadis.

Business use of Arcadis owned, leased, rented, or personal motor vehicle: For the purposes of this HSS, business use of an Arcadis, rental, leased or personal vehicle including but not limited to attending meetings; driving to and from a client location; driving to dinner while out of town on business; and driving to an office supply store to pick up office supplies. Use of the vehicle for business would not include personal use as described below.

Electronic Device: Any portable electronic device not required for safe operation of a motor vehicle including, but not limited to, cell phones, computer tablets, laptops, watches (iWatch, etc.) and GPS.

Enabling Function: As used in this HSS and materials incorporated by reference, the term “Enabling Function” means EF Health and Safety, EF People, EF Procurement, and/or EF Legal departments unless otherwise specified.

Field Work: As used in this HSS means any Arcadis work activity outside of an office environment.

Goodwill Function: A non-business-related action that is performed by a representative of the company to benefit the community (i.e., community flood cleanup response).

Manager: The employee’s administrative supervisor, Line Manager, or an Operations Manager.

Motor vehicle accident: Any incident on a reasonably work-related anticipated route where an Arcadis owned, leased, or rented motor vehicle is:

- On a public or established private roadway or parking area involving a third-party motor vehicle, excluding load securement failures by a third-party motor vehicle.
- On a public roadway involving damage to public or private property, excluding road debris damage.
- Involved in any type of pedestrian impact resulting in injury or property damage.
- Involved in an Arcadis load securement failure or mechanical component failure on a public or established private roadway involving a third-party motor vehicle or public property damage.
- On a public roadway involving damage or injury associated with another Arcadis operated vehicle, including load securement failures.

Personal use of Arcadis vehicle, leased vehicle or rented motor vehicle: For the purposes of this HSS, personal use of an Arcadis vehicle, leased vehicle or rental vehicle include but are not limited to supervisor approved: driving to dinner with a non-business-related person(s) in the vehicle; driving for the purposes of personal entertainment or personal business; using an Arcadis vehicle or rental vehicle for staying over period of time not required for business (e.g., staying over a weekend to visit friends, etc.).

Potential New Hire or Candidate: To this HSS, means an individual who has had a written offer made and accepted for employment with Arcadis.

Preventable MVA: A MVA where the Arcadis driver was as fault or was determined through the Arcadis Investigation process failed to exercise reasonable care while driving an Arcadis vehicle. The classification of Preventable MVA is assigned by EF Health and Safety.

Rental vehicle: For the purposes of this policy, any motor vehicle rented from an established rental car company for Arcadis business whether the use of the vehicle is operated from the local office or for travel while away from the local office.

Supervisor: The employee's administrative supervisor (project supervisor if approved by the administrative supervisor).

Temporary agency employee: A temporary agency employee utilized by Arcadis for temporary work. Temporary Employee Agency agreements shall provide for standard automobile insurance and other terms consistent with this policy.

Vehicle loss event: Any incident involving a motor vehicle that does not meet the definition of a MVA. A VLE may be preventable or non-preventable based on findings of the Arcadis Investigation process and is assigned by EF Health and Safety.

Exhibit 2 – Abbreviations and Acronyms

Arcadis	Arcadis North America
ARC	Accident Review Committee
BA	Business Area
BBS	Behavior Based Safety
CMV	Commercial Motor Vehicle
EF	Enabling Function
ELD	Electronic Logging Device
GPS	Global Positioning Systems
HASP	Health and Safety Plan
HR	Human Resources
HSS	Health and Safety Standard
JMP	Journey Management Plan
MVA	Motor Vehicle Accident
MVSP	Motor Vehicle Safety Program
MVR	Motor Vehicle Report
MSHA	Mine Safety and Health Administration
OLC	Oracle Learning Cloud
TIP	Task Improvement Process
TRACK	Hazard Assessment Tool – Think, Recognize, Assess, Control, Keep H&S First
VLE	Vehicle Loss Event

Exhibit 3 – Motor Vehicle Records

New Hire MVR Review

EF People will perform an MVR review on potential new hires of positions that have an assigned driving function for Arcadis. The MVR review process for potential new hires follows an established review process that will result in a Pass, Conditional, or Restricted status. EF People will communicate the MVR review results for Pass or Conditional status to the employee and their supervisor and will notify the employee and their supervisor for need to complete prescribed corrective actions in the case of Conditional status. An MVR review resulting in Restricted status will prevent hiring of the candidate unless excepted as specified in the Appeals section of Exhibit 3. EF People will communicate the MVR review results to the new hire candidate and hiring manager prior to finalizing the new hire process.

Existing Employee MVR Review

Health and Safety or EF People may perform a MVR review on existing employees with an assigned driving function for Arcadis at a frequency stipulated by EF Health and Safety. The MVR review process for existing employees follows an established review process that will either result in a Pass, Conditional, or Restricted status. EF Health and Safety or EF People will communicate the MVR review results for Pass or Conditional status to the employee and their supervisor and will notify the employee and their supervisor for need to complete prescribed corrective actions in the case of Conditional status. Health and Safety will coordinate with EF People in instances where a MVR review for an existing employee results in Restricted status. EF People will communicate the MVR review results to the employee and their administrative supervisor when a Restricted status is identified from the MVR review.

Post-Accident MVR Review

Any vehicle related accident classed as a preventable Motor Vehicle Accident (MVA) will require a MVR review for the employee involved in the MVA. A Preventable Vehicle Loss Event (VLE) is not generally subject to the MVR review process; however, EF Health and Safety reserves the right to perform a MVR review on any employee involved in a vehicle related accident regardless of accident classification. The MVSP Specialist will report the need to run a MVR to EF People upon determination of a preventable MVA. Health and Safety working with EF People will communicate the MVR results to the employee and their supervisor using the process described the Existing Employee MVR Review section of Exhibit 3.

Commercial Motor Vehicle MVR Reviews

Detailed requirements concerning MVR review and evaluation for drivers participating in the Arcadis CMV Program are not addressed in this HSS. MVR reviews related to CMV drivers are performed by Arcadis Director of Transportation Safety or approved designate. MVRs with corrective actions identified during the MVR process will follow the process described in the Existing Employee MVR Review section of Exhibit 3.

Appeals

MVR reviews that result in Restricted driving status for a potential new hire or existing employee may be appealed to the potential new hire's or employee's applicable BA Health and Safety Director, BA Operations Director, BA Director, and may include the Accident Review Committee (ARC) consisting of members from EF Health and Safety, People and Legal in accordance with MVSP Guide-008. The BA Director may elect to maintain the restriction or overturn the restriction. An overturned restriction may be referred by the BA Director to the Accident Review Committee (ARC) for additional corrective action based on the circumstances of the restriction.

Table of Contents

1. POLICY

Arcadis understands the hazards of personal exposure to respirable crystalline silica (silica-containing dust) and will implement the appropriate controls to minimize or eliminate the hazards associated with silica-containing dust. These controls will focus first on engineering controls to mitigate silica-containing dust hazards where appropriate and practical. In most circumstances, dust suppression (wetting cutting surface) is effective in managing silica-containing dust. Work practices (administrative controls) may also be implemented as appropriate and practical. Wherever engineering and administrative controls are not sufficient to reduce employee exposure to or below the OSHA Permissible Exposure Limit (PEL), Arcadis will nonetheless use the controls to reduce employee exposure to the lowest feasible level and will supplement them with the use of respiratory protection that complies with the requirements of Section 5.5.

2. PURPOSE AND SCOPE

2.1 Purpose

This Health & Safety Standard (HSS) meets the Title 29 Code of Federal Regulations (CFR) Part 1926.1153 (Construction) requirements of the U.S. Occupational Safety and Health Administration (OSHA) regulation.

2.1.1 Exposure to Silica-Containing Dust

This HSS and associated standards provides information to protect Arcadis employees, subcontractors, and other affected personnel from exposures to silica-containing dust while conducting work on Arcadis projects.

The following personal exposure limits are established for silica-containing dust by inhalation:

- OSHA ACTION LEVEL
  - Time Weighted Average (TWA) – 25 micrograms per cubic meter of air (µg/m^3) silica in air averaged over an 8-hour period
- OSHA PERMISSIBLE EXPOSURE LEVELS (PELs)
  - TWA – 50 µg/m^3 silica in air averaged over an 8-hour period.
- ACGIH THRESHOLD LIMIT VALUES (TLVs)

- TWA – 0.025 mg/m^3 silica-in-air averaged over an 8-hour period for the respirable crystalline silica fraction which are those particles that enter deep into the lung where gas exchange takes place.

The Action Level, PEL, and TLV apply to three forms of silica-containing dust: Quartz, Cristobalite, and Tridymite. Quartz is by far the most common form of silica-containing dust found at construction workplaces.

2.2 Scope

This HSS and the associated standards apply to all projects where silica-containing dust is generated in a way Arcadis employees, subcontractors and other affected personnel are or could be exposed to silica-containing dust above the Action Level.

3. DEFINITIONS

Definitions related to Respirable Crystalline Silica can be found in Exhibit 1. Acronyms and Abbreviations are found in Exhibit 2.

4. RESPONSIBILITIES

4.1 Project Management

The Project Manager is responsible for:

- As part of the project hazard assessment, for determining if silica-containing dust may be generated at the project site
- Determining client requirements with respect to the control of silica-containing dust hazards.
- Ensuring that project staff have the appropriate and applicable training for silica-containing dust prior beginning work.
- Maintaining exposure monitoring records, if required, for a minimum of 30 years and submitting copies to Corporate Health and Safety, as required by the Industrial Hygiene H&S Standard (ARC HSIH009).

4.2 All Employees

All employees are responsible for:

Use the TRACK process described below regularly and frequently. In addition, employees read and understand all documented hazard identification and risk assessments conducted using the HARC process. ARCADIS employees will:

- Participate in entry operations only if trained and authorized to do so.
- Never enter an active work area without first getting acknowledgment and approval of the operator and Designated Signal Person, as applicable.
- Use STOP WORK Authority if unsafe or unexpected conditions arise during operation and immediately notify other personnel in the area.

4.3 Project Personnel

Project Personnel are responsible for:

- Reading and following all hazard control processes, as required by the project Health & Safety Plan (HASP)
- To stop work and notify the Site Safety Officer and the Project Manager immediately, and not proceed with the associated task until authorized.

4.4 Competent Person

The Competent Person is an individual who can identify existing and foreseeable silica-containing dust hazards in the workplace and who has authorization to take prompt corrective measures to eliminate or minimize them. The competent person must have the knowledge and ability necessary to fulfill the responsibilities set forth in the Exposure Control Plan. The Competent Person is expected to make frequent and regular inspections of job sites, materials, and equipment to implement the written exposure control plan.

4.5 Corporate H&S Staff

Corporate Health & Safety is responsible for:

- Communicating the requirements of this HSS with Arcadis U.S.
- Verifying this standard is being implemented effectively.
- Overseeing the medical surveillance program for silica-containing dust, as applicable and provides a silica training program for presentation to appropriate staff.

5. PROCEDURE

5.1 Respirable Crystalline Silica

Exposure to silica-containing dust occurs when the following tools are used on concrete, brick, block, stone, mortar, and other materials that contain silica:

- Stationary masonry saws
- Handheld power saws
- Walk-behind saws
- Drivable saws
- Rig-mounted core saws or drills
- Handheld and stand-mounted drills (including impact and rotary hammer drills);
- Dowel drilling rigs
- Vehicle-mounted drilling rigs
- Jackhammers and handheld powered chipping tools
- Handheld grinders
- Walk-behind milling machines and floor grinders
- Drivable milling machines
- Crushing machines; and
- Heavy equipment and utility vehicles when used to abrade or fracture silica-containing materials (such as hoe-ramming or rock ripping) or during demolition activities, and for tasks such as grading and excavating.

Exposures to silica-containing dust also occurs during tunneling operations and during abrasive blasting when sand or other blasting agents containing silica are used, or when abrasive blasting is performed on substrates that contain silica, such as concrete.

The health effects of silica-containing dust are based on the type of exposure encountered. Silicosis is a progressive lung disease resulting from prolonged and repeated exposure to

silica-containing dusts. When inhaled, silica-containing dust passes into the lungs, and scavenger cells such as macrophages engulf it. Enzymes released by the scavenger cells cause the lung tissue to scar. The onset and degree of scarring is often dependent upon the duration and frequency of exposure.

- Chronic silicosis usually occurs after 10 or more years of exposure to silica-containing dust at relatively low concentrations and is often first realized due to breathing difficulty during exercise. Sometimes the breathing difficulty progresses to shortness of breath even during rest. Some people have a cough that may produce sputum. Breathing may worsen for years after the person stops working with silica-containing dust. The lung damage can lead to lower levels of oxygen in the blood and can also strain the right side of the heart. This strain can lead to a type of heart failure called cor pulmonale (also known as Pulmonary Hypertension), which can be fatal.

- Accelerated silicosis results from exposure to high concentrations of silica-containing dust and develops 5 to 10 years after the initial exposure.

- Acute silicosis occurs where exposure concentrations are the highest and can cause symptoms to develop within a few weeks to 4 or 5 years after the initial exposure

5.2 Standard Applicability

This HSS applies to all occupational exposures to silica-containing dust, except where employee exposure will remain below 25 µg/m^3 as an 8-hour TWA under any foreseeable conditions.

Some tasks, identified by OSHA, can reasonably be anticipated to remain below 25 µg/m^3 as an 8-hour TWA that involved only minimal exposure to silica-containing dust. Such tasks include:

- Mixing concrete for post holes

- Pouring concrete footers, slab foundation, and foundation walls; and

- Removing concrete formwork.

When tasks are performed in which exposure is anticipated to remain under 25 µg/m^3 as an 8-hour TWA, and isolated from tasks that generate significant exposures to silica-containing dust, this HSS does not apply. Some employees may perform construction-related tasks

involving occasional, brief exposures (below 25 µg/m^3 as an 8-hour TWA) to silica-containing dust that are incidental to their primary work.

Example: For employees using a hand-held drill to install a singular sub slab vapor point, if the duration of exposure is 15 minutes or less, the 8-hour TWA exposure can reasonably be anticipated to remain under the 25 µg/m^3 threshold (assuming no exposure for the remainder of the shift), and this HSS would not apply. If the duration of the exposure is greater than 15 minutes, active real-time air monitoring equipment must be utilized to determine applicability of this HSS.

5.3 Exposure Controls

Project Teams have two options to comply with this HSS when employee exposure is anticipated to be at or above 25 µg/m^3 as an 8-hour TWA under any foreseeable conditions:

1. Specified exposure control methods; or
2. Alternative exposure control methods.

5.3.1 Specified Exposure Control Methods

The specified exposure control option requires full compliance with OSHA's Table 1-Specified Exposure Control Method When Working with Materials Containing Crystalline Silica (Exhibit 3). When controls in Exhibit 3 are fully and properly implemented, Project Teams are not required to assess employees' exposure levels or keep employee exposure at or below the PELs.

When implementing the control measures specified in Exhibit 3, Project Teams shall ensure the following:

- For tasks performed indoors or in enclosed areas, provide a means of exhaust, as needed, to minimize the accumulation of visible airborne dust
- For tasks performed using wet methods, apply water at flow rates sufficient to minimize release of visible dust
- For measures implemented that include an enclosed cab or booth, ensure that the enclosed cab or booth:
    - Is maintained as free as practicable from settled dust
    - Has door seals and closing mechanisms that work properly

- Has gaskets and seals that are in good condition and working properly
- Is under positive pressure maintained through continuous delivery of fresh air
- Has intake air that is filtered through a filter that is 95% efficient in the 0.3-10.0 µm range (e.g., MERV 16 or HEPA [MERV 17-20]); and
- Has heating and cooling capabilities.

- Where an employee performs more than one task in Exhibit 3 during a shift, and the total duration of all tasks combined is more than four hours, the required respiratory protection for each task is the respiratory protection specified for more than four hours per shift. If the total duration of all tasks in Exhibit 3 combined is less than four hours, the required respiratory protection for each task is the respiratory protection specified for less than four hours per shift.

5.3.2 Alternative Exposure Control Methods

For tasks not listed in Exhibit 3, or where engineering controls, administrative controls, and respiratory protection described in Exhibit 3 are not fully and properly implemented, alternative exposure control methods shall be implemented.

No employee will be exposed to an airborne concentration of silica-containing dust in excess of 50 µg/m^3, calculated as an 8-hour TWA. This is determined by assessing the exposure of each employee who is or may reasonably be expected to be exposed to silica-containing dust at or above the Action Level (25 µg/m^3 as an 8-hour TWA) in accordance with either the performance option or the scheduled monitoring option (Section 5.4).

Project Teams who follow alternative exposure control methods must:

1. Determine the levels of silica-containing dust that employees are exposed to over an 8hr TWA in accordance with Section 5.4;
2. Limit employee exposures to a PEL of 50 µg/m^3 as an 8-hour TWA
3. Use engineering and administrative controls, to the extent feasible, to limit employee exposures to the PEL, and supplement the controls with respiratory protection when necessary. If exposure controls are not sufficient in reducing worker exposure to at or below the PEL, the controls must still be implemented

and supplemented with respiratory protection (Approved Protection Factor [APF] of 10 or greater).

4. Keep records of employee exposure to silica-containing dust in accordance with the Arcadis Industrial Hygiene HSS (ARC HSIH009).

5.4 Exposure Assessment

Project Teams following alternative exposure control methods must assess the 8-hour TWA exposure for each employee who is or may reasonably be expected to be exposed to silica-containing dust at or above the Action Level.

Personal exposure monitoring shall utilize standard industrial hygiene sampling techniques and recordkeeping as required in Arcadis Industrial Hygiene HSS (ARC HSIH009). Exposure assessments will be completed either using:

- Performance Option; or
- Scheduled Monitoring Option

5.4.1 Performance Option

The Project Team shall assess the 8-hour TWA exposure for each employee based on any combination of air monitoring data or objective data sufficient to accurately characterize employee exposures to silica-containing dust.

Example: Objective data includes:

- Air monitoring data from industry-wide surveys, which includes well-documented procedures for measuring exposures and methods for controlling dust, could be used by Project Team to characterize employee exposures where employees perform tasks consistent with those described in the survey
- Calculations based on the composition of a substance, area sampling results and exposure mapping profile approaches. Project Teams can use direct-reading instruments to measure real-time levels of respirable dust in the air. Only if Arcadis has information on the percentage of silica-containing dust in that respirable dust (for example, from the analysis of a bulk sample or information from a safety data sheet), Project Teams can then calculate the level of silica-containing dust in air; and

- Historic air monitoring data collected by Arcadis. Historic air monitoring data collected by the Arcadis could be used to assess employee exposures if the Project Team can show that the data was collected during work operations and conditions that are consistent with the processes, types of material, control methods, work practices, and environmental conditions in the Project Team's current operations.

Project teams choosing the performance options must:

- Conduct the exposure assessments before work begins
- Reassess exposures, whenever a change in production, process, control equipment, personnel, or work practices may reasonably be expected to result in new or higher exposures at or above the Action Level, or when the Project Team has any reason to believe that new or additional exposures at or above the Action Level have occurred
- Be able to demonstrate that employee exposures have been accurately characterized; and
- Make sure that the exposure assessment reflects the exposures of employees on each shift, for each job classification, in each work area.

The Performance Option may be especially useful when measuring employee exposures is challenging, such as when tasks are conducted for short durations of time or performed under different weather conditions. Under the Performance Option, Project Teams can characterize employee exposure within a range to account for exposure variability. Project Teams can also use that this option to show that exposures exceed the PEL by a certain level, such as less than 10 times the PEL, after using all feasible controls. Project Teams would then provide respiratory protection (APF of 10 or greater) and medical surveillance for employees required to wear a respirator under this HSS for 30 or more days per year.

5.4.2 Scheduled Monitoring Option

The Project Team shall perform initial personal exposure monitoring with laboratory analysis to assess the 8-hour TWA exposure for each employee based on one or more personal breathing zone air samples that reflect the exposures of employees on each shift, for each job classification, in each work area. Where several employees perform the

same tasks on the same shift and in the same work area, the employer may sample a representative fraction of these employees to meet this requirement. In representative sampling, the employer shall sample the employee(s) who are expected to have the highest exposure to silica-containing dust.

If initial monitoring indicates that employee exposures are below the Action Level, the Project Team may discontinue monitoring for those employees whose exposures are represented by such monitoring.

When the most recent exposure monitoring indicates that employee exposures are at or above the Action Level but at or below the PEL, the project team shall repeat such monitoring within six months of the most recent monitoring.

Where the most recent exposure monitoring indicates that employee exposures are above the PEL, the Project Team shall repeat such monitoring within three months of the most recent monitoring.

Where the most recent (non-initial) exposure monitoring indicates that employee exposures are below the Action Level, the Project Team shall repeat such monitoring within 6 months of the most recent monitoring until two consecutive measurements, taken seven or more days apart, are below the Action Level, at which time the project team may discontinue monitoring for those employees whose exposures are represented by such monitoring.

The Project Team shall reassess exposures whenever a change in the production, process, control equipment, personnel, or work practices may reasonably be expected to result in new or additional exposures at or above the Action Level, or when the Project Team has any reason to believe that new or additional exposures at or above the Action Level have occurred.

Personal exposure monitoring data will be collected using the Scheduled Monitoring Sampling Form for Silica (Exhibit 4). Completed Scheduled Monitoring Sampling Forms for Silica should be submitted along with a copy of the sample chain of custody (COC), photos and analytical data to ANACorpHS@arcadis.com. Additional information on Scheduled Monitoring sampling protocol can be found in Exhibit 5.

5.4.3 Exposure Air Monitoring Notification

Project Teams must notify each affected employee of the results of the exposure assessment within 5 working days of completing it, in accordance with the Arcadis Industrial Hygiene HSS (ARC HSIH009). The 5-day period for notification starts when:

- The Project Team following the Performance Option finishes the exposure assessment; or
- The Project Team following the Scheduled Monitoring Approach receives the laboratory results.

Exposures can be characterized and reported as a range (for example, between the Action Level and the PEL), but must reflect exposures that would occur if the employee were not using a respirator.

When an exposure assessment reveals exposure above the PEL, the written notification must also describe the corrective action the Project Team is taking to reduce employee exposures to or below the PEL. Corrective actions must include engineering controls. However, if engineering controls are not feasible or the project team needs more than 5 days to identify the right engineering controls, respiratory protection is the corrective action that would be described in the written notification.

5.5 Respiratory Protection

Project Teams will provide employees with appropriate respirators where required by this HSS. Respirators will be used in accordance with the Arcadis Respiratory Protection HSS (ARC HSGE017). Project Teams who follow the specified exposure control methods listed in Exhibit 3 must provide respiratory protection where required. Project Teams who follow alternative exposure control methods must provide respiratory protection:

- Where exposures exceed the PEL during periods necessary to install or implement feasible engineering and work practice controls
- Where exposures exceed the PEL during tasks, such as some maintenance and repair tasks, for which engineering, and work practice controls are not feasible
- During tasks in which the employer has implemented all feasible engineering and work practice controls, but exposures remain above the PEL.

5.6 Abrasive Blasting

Provision 29 CFR 1910.94(a)(5)(ii)(b) of the General Industry Ventilation Standard requires that "abrasive-blasting respirators" shall be worn by all abrasive-blasting operators when using silica sand in manual blasting operations where the nozzle and blast are not physically separated from the operator in an exhaust ventilated enclosure.

The ventilation standard for Construction, 29 CFR 1926.57, also contains requirements for ventilation and PPE, including respirators when using silica-based abrasive blasting media.

5.7 Housekeeping

Cleaning methods such as dry sweeping, dry brushing, and use of compressed air can cause silica-containing dust to get into the air and be inhaled by employees. Therefore, the use of these cleaning methods is prohibited to prevent unnecessary exposures to employees. Other cleaning methods such as wet sweeping and HEPA filtered vacuums shall be used because such methods reduce employee exposures by preventing silica-containing dust from getting into the air. Compressed air maybe used as a cleaning method, if used in conjunction with a ventilation system that effectively captures the silica-containing dust created by compressed air.

Project Teams are not required to follow these housekeeping requirements when cleaning ordinary soil, large debris, and non-silica-containing materials, such as sawdust.

5.8 Written Exposure Control Plan

A written Exposure Control Plan (written plan), Exhibit 6 is required when exposure to silica-containing dust is or can reasonably be expected to exceed 25 µg/m^3 of silica-containing dust in air averaged over an 8-hour period. The written plan will be included in the site-specific HASP, which will be reviewed at least annually to evaluate the effectiveness of the written plan in accordance with the Arcadis Health and Safety Plan HSS (ARC HSFS010). The written plan shall be made readily available to each employee covered by this HSS.

The written exposure plan must include:

- A description of the tasks in the workplace that involve exposure to silica-containing dust
- A description of the engineering controls, administrative controls, and respiratory protection used to limit employee exposure to silica-containing dust for each task

- A description of the housekeeping measures used to limit employee exposure to silica-containing dust

- A description of the procedures used to restrict access to work areas, when necessary, to minimize the number of employees exposed to silica-containing dust and their level of exposure, including exposures generated by other employers or sole proprietors

- Designation of the Competent Person who is responsible for implementing the written plan and making frequent and regular inspection of job sites, material, and equipment; and

- A copy of or location of the safety data sheet (SDS) for crystalline silica products in accordance with the Arcadis Hazard Communication HSS (ARC HSGE007).

5.9 Medical Surveillance Program

Arcadis employees will complete an initial (baseline) medical examination for silica within 30 days after initial assignment (the day the employee starts working in a job/task in which he or she will be required by this HSS to wear a respirator for 30 or more days per year). Respirator use with past employers does not count toward the 30-day threshold. Periodic exams will be completed every three years from the employee's last examination or more frequently as determined by the Arcadis a third-party administrator (TPA) for the Arcadis medical surveillance program (currently Work Care (1-800-455-6155)) occupational health physician.

Refer to the Arcadis Medical Surveillance Program HSS (ARC HSGE010) for additional information on the administration of the Medical Surveillance Program and instructions on requesting an exam.

The medical surveillance program for silica is intended to:

- Identify respirable crystalline silica-related diseases so that employees with those diseases can take actions to protect their health

- Determine if an employee has any condition, such as a lung disease, that might make him or her more sensitive to silica exposure; and

- Determine the employee's fitness to use respirators.

6. TRAINING

Silica awareness training is required for all employees who must comply with this HSS and/or are assigned to a work area suspected or known to contain silica-containing dust. Awareness training is available in the Arcadis Learning Center and will consist of:

- Operations that involve silica-containing dust exposure
- Methods/observations that can be used to detect the presence or release of silica-containing dust
- Physical and health hazards of silica-containing dust
- Methods used to protect against the hazards of silica-containing dust including PPE and respiratory protection
- A review of the applicable standard and where copies can be found; and
- An explanation of the medical surveillance program and an employee's right to access medical and exposure records.

6.1 Competent Person Training

The Silica Competent Person training covers all points described previously with the addition of a competency exam following the successful completion of the training. Retraining may be required as determined by Arcadis policy or management or by client or state-specific requirements.

7. REFERENCES

- OSHA Silica Page

The following H&S standards can be found on the Policies and Integrity Site:

- Arcadis Medical Surveillance H&S Standard – ARC HSGE010
- Arcadis Respiratory Protection H&S Standard – ARC HSGE017
- Arcadis Industrial Hygiene H&S Standard – ARC HSIH009
- Arcadis Health and Safety Plan H&S Standard - ARC HSFS010

8. RECORDS

Medical records will be maintained by Arcadis' medical surveillance TPA (WorkCare). Employees may obtain a copy of their complete medical record by contacting the medical surveillance TPA directly and a copy will be provided at no cost to the employee.

All records regarding occupational exposure measurements will be provided to employees by the project manager, Site H&S Officer or the Competent Person responsible for administering the exposure monitoring program, maintained in the applicable project team file and copies of such exposure monitoring records provided to both Corporate H&S (ANACorpHS@arcadis.com) and People Services (peopleservices@arcadis.com) for file retention. See the Arcadis Industrial Hygiene HSS (ARC HSIH009) for additional information.

Training records will be stored in Arcadis' Learning Management System so they may be provided, if requested by Arcadis, clients or a regulatory agency. Employees must upload certificates to the Oracle Learning Cloud.

9. APPROVALS AND HISTORY OF CHANGE

Julie Santaniello, CSP – Corporate H&S Manager of Technical Programs

History of Change

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
22 September 2017	01	Greg Mason / Andrew McDonald/ Julie Santaniello	Original document
13 November 2017	02	Greg Mason / Andrew McDonald/ Julie Santaniello	Clarified when Engineering and Administrative controls are to be used in Section 1. Updated example in Section 5.2. Clarified using compressed air during housekeeping in Section 5.7.

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
23 September 2021	03	Greg Mason / Julie Santaniello	Update to new template and fixed hyperlinks.

Exhibit 1 - Definitions

Action Level is the airborne concentration established by OSHA that triggers certain regulatory requirements (25 µg/m3 silica in air 8-hour time weighted average).

Affected Employee means all employees whose exposures were assessed, including employees whose exposures were represented by other employees' exposure measurements, and those whose exposure assessments were based on objective data.

Air Monitoring Data are any results of air monitoring (analyzed according to the procedures and requirements in 29 CFR 1926.1153 Appendix A methods of sample analysis) that the employer has done to meet the requirements of this HSS.

Crystalline Silica is a common mineral found in many naturally occurring and man-made materials used at construction sites. Materials like sand, concrete, brick, block, stone, and mortar contain crystalline silica. Amorphous silica, such as silica gel, is not crystalline silica.

Competent person is an individual who can identify existing and foreseeable respirable crystalline silica hazards in the workplace and who has authorization to take prompt corrective measures to eliminate or minimize them.

Fully and properly implemented means that controls are in place, are properly operated and maintained, and employees understand how to use them. Several factors required for full and proper implementation of controls are listed in the discussion for each Exhibit 3 entry. The presence of large amounts of visible dust generally indicates that controls are not fully and properly implemented. A small amount of dust can be expected from equipment that is operating as intended by the manufacturer; however, a noticeable increase in dust generation during the task is a sign that the dust controls are not operating correctly. The difference between the small amounts of dust generated when control measures are working properly, and the large amount of dust generated during tasks when control measures are not used or not operated effectively is easily observed. When this happens, prompt corrective actions are required.

High-Efficiency Particulate Air (HEPA) filter means a filter capable of trapping and retaining at least 99.97 percent of mono-dispersed particles of 0.3 micrometers in diameter.

Objective Data is information demonstrating that a particular product or material containing silica or a specific process, operation, or activity involving silica cannot release dust or fumes in concentrations at or above the Action Level even under the worst-case release conditions. Objective data can be obtained from an industry-wide study or from laboratory product test results

from manufacturers of silica-containing products or materials. The data the used from an industry-wide survey must be obtained under workplace conditions closely resembling the processes, types of material, control methods, work practices and environmental conditions in the employer's current operations.

Permissible Exposure Limit (PEL) is an average airborne concentration regulatory limit established by OSHA above which requires control to protect people from adverse health effects (50 µg/m3 silica in air averaged over an 8-hour period).

Respirable Crystalline Silica means quartz, cristobalite, and/or tridymite contained in airborne particles that are determined to be respirable by a sampling device designed to meet the characteristics for respirable-particle-size-selective samplers specified in the International Organization for Standardization (ISO) 7708:1995: Air Quality – Particle Size Fraction Definitions for Health-Related Sampling https://www.iso.org/standard/14534.html.

Threshold Limit Value is a recommended average airborne concentration limit established by ACGIH. The TLVs are reviewed and updated as appropriate annually.

Time Weighted Average (TWA) is the average exposure to a contaminant or condition (such as silica) to which workers may be exposed without adverse effect over a period of 8 hours a day or a 40-hour work week.

Exhibit 2 – Abbreviations and Acronyms

ANA	Arcadis North America
Arcadis	Arcadis U.S. Inc.
HS	Health and Safety
H&S	Health and Safety
HSS	Health and Safety Standard
PPE	Personal Protective Equipment
TWA	Time Weighted Average
PEL	Permissible Exposure Level
TLV	Threshold Limit Values
CFR	Code of Federal Regulations

Exhibit 3 – OSHA's Table 1- Specified Exposure Control Method When Working with Materials Containing Crystalline Silica

Construction Task or Equipment Operation		Engineering and Work Practice Control Methods	Required Respiratory Protection	
			≤ 4 hours/shift	>4 hours/shift
1	Stationary masonry saws	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
2a	Handheld power saws (any blade diameter) when used outdoors	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask
2b	Handheld power saws (any blade diameter) when used indoors or in an enclosed area	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask
3	Handheld power saws for cutting fiber-cement board (with blade diameter of 8 inches or less) for tasks performed outdoors only	• Use saw equipped with commercially available dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency.	None	None
4a	Walk-behind saws when used outdoors	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
4b	Walk-behind saws when used indoors or in an enclosed area	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask
5	Drivable saws for tasks performed outdoors only	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
6	Rig-mounted core saws or drills	• Use tool equipped with integrated water delivery system that supplies water to cutting surface. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
7	Handheld and stand-mounted drills (including impact and rotary hammer drills)	• Use drill equipped with commercially available shroud or cowling with dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None

Construction Task or Equipment Operation		Engineering and Work Practice Control Methods	Required Respiratory Protection	
			≤ 4 hours/shift	>4 hours/shift
		• Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism. • Use a HEPA-filtered vacuum when cleaning holes.		
8	Dowel drilling rigs for concrete for tasks performed outdoors only	• Use shroud around drill bit with a dust collection system. • Dust collector must have a filter with 99% or greater efficiency and a filter cleaning mechanism. • Use a HEPA-filtered vacuum when cleaning holes.	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask
9a	Vehicle-mounted drilling rigs for rock and concrete	• Use either a dust collection system with close capture hood or a shroud around drill bit; both must be paired with a low-flow water spray to wet the dust at the discharge point from the dust collector.	None	None
9b	Vehicle-mounted drilling rigs for rock and concrete	• Operate from within an enclosed cab and use water for dust suppression on drill bit.	None	None
10a	Jackhammers and handheld powered chipping tools when used outdoors	• Use tool with water delivery system that supplies a continuous stream or spray of water at the point of impact.	None	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask
10b	Jackhammers and handheld powered chipping tools when used indoors or in an enclosed area	• Use tool with water delivery system that supplies a continuous stream or spray of water at the point of impact.	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask
10c	Jackhammers and handheld powered chipping tools when used outdoors	• Use tool equipped with commercially available shroud and dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism.	None	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask
10d	Jackhammers and handheld powered chipping tools when used indoors or in an enclosed area	• Use tool equipped with commercially available shroud and dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism.	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask
11 **11 cont.**	Handheld grinders for mortar removal (i.e., tuckpointing) Handheld grinders for mortar removal (i.e., tuckpointing)	• Use grinder equipped with commercially available shroud and dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism.	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask	Powered Air-Purifying Respirator (PAPR) with P100 Filters

Construction Task or Equipment Operation		Engineering and Work Practice Control Methods	Required Respiratory Protection	
			≤ 4 hours/shift	>4 hours/shift
12a	Handheld grinders for uses other than mortar removal for tasks performed outdoors only	• Use grinder equipped with integrated water delivery system that continuously feeds water to the grinding surface. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
12b	Handheld grinders for uses other than mortar removal when used outdoors	• Use grinder equipped with commercially available shroud and dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism.	None	None
12c	Handheld grinders for uses other than mortar removal when used indoors or in an enclosed area	• Use grinder equipped with commercially available shroud and dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism.	None	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask
13a	Walk-behind milling machines and floor grinders	• Use machine equipped with integrated water delivery system that continuously feeds water to the cutting surface. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
13b	Walk-behind milling machines and floor grinders	• Use machine equipped with dust collection system recommended by the manufacturer. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide the air flow recommended by the manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism. • When used indoors or in an enclosed area, use a HEPA-filtered vacuum to remove loose dust in between passes.	None	None
14	Small drivable milling machines (less than half-lane)	• Use a machine equipped with supplemental water sprays designed to suppress dust. • Water must be combined with a surfactant. • Operate and maintain machine to minimize dust emissions.	None	None
15a	Large drivable milling machines (half-lane and larger) for cuts of any depth on asphalt only	• Use machine equipped with exhaust ventilation on drum enclosure and supplemental water sprays designed to suppress dust. • Operate and maintain machine to minimize dust emissions.	None	None
15b	Large drivable milling machines (half-lane and larger) for cuts of four	• Use machine equipped with exhaust ventilation on drum enclosure and supplemental water sprays designed to suppress dust.	None	None

Construction Task or Equipment Operation		Engineering and Work Practice Control Methods	Required Respiratory Protection	
			≤ 4 hours/shift	>4 hours/shift
	inches in depth or less on any substrate	• Operate and maintain machine to minimize dust emissions.		
15c	Large drivable milling machines (half-lane and larger) for cuts of four inches in depth or less on any substrate	• Use a machine equipped with supplemental water spray designed to suppress dust. • Water must be combined with a surfactant. • Operate and maintain machine to minimize dust emissions.	None	None
16	Crushing machines	• Use equipment designed to deliver water spray or mist for dust suppression at crusher and other points where dust is generated (e.g., hoppers, conveyers, sieves/sizing or vibrating components, and discharge points). • Operate and maintain machine in accordance with manufacturer's instructions to minimize dust emissions. • Use a ventilated booth that provides fresh, climate-controlled air to the operator, or a remote-control station.	None	None
17a	Heavy equipment and utility vehicles used to abrade or fracture silica-containing materials (e.g., hoe-ramming, rock ripping) or used during demolition activities involving silica-containing materials	• Operate equipment from within an enclosed cab.	None	None
17b	Heavy equipment and utility vehicles used to abrade or fracture silica-containing materials (e.g., hoe-ramming, rock ripping) or used during demolition activities involving silica-containing materials	• When employees outside of the cab are engaged in the task, apply water and/or dust suppressants as necessary to minimize dust emissions.	None	None
18a	Heavy equipment and utility vehicles for tasks such as grading and excavating but not including demolishing, abrading, or fracturing silica-containing materials	• Apply water and/or dust suppressants as necessary to minimize dust emissions.	None	None
18b	Heavy equipment and utility vehicles for tasks such as grading and excavating but not including demolishing, abrading, or fracturing silica-containing materials	• When the equipment operator is the only employee engaged in the task, operate equipment from within an enclosed cab.	None	None

Exhibit 4 – Scheduled Monitoring Sampling Form for Silica

(Link to Scheduled Monitoring Sampling Form for Silica)

ARCADIS

Scheduled Monitoring Sampling Form for Silica

Filter/Cassette #: _____

Page 1 of 2

Project Number	Date	Project Name
Employee Name		**Project Description**

Type of Work Being Performed

Task	% Time Performing	Task	% Time Performing
☐ Abrasive Blasting	☐ <25% ☐ 25-50% ☐ 50-75% ☐ >75%	☐ Mixing Concrete	☐ <25% ☐ 25-50% ☐ 50-75% ☐ >75%
☐ Cutting	☐ <25% ☐ 25-50% ☐ 50-75% ☐ >75%	☐ Mixing Mortar	☐ <25% ☐ 25-50% ☐ 50-75% ☐ >75%
☐ Chipping	☐ <25% ☐ 25-50% ☐ 50-75% ☐ >75%	☐ Patching	☐ <25% ☐ 25-50% ☐ 50-75% ☐ >75%
☐ Drilling	☐ <25% ☐ 25-50% ☐ 50-75% ☐ >75%	☐ Polishing	☐ <25% ☐ 25-50% ☐ 50-75% ☐ >75%
☐ Excavating	☐ <25% ☐ 25-50% ☐ 50-75% ☐ >75%	☐ Scabbing/ Scapping	☐ <25% ☐ 25-50% ☐ [illegible] ☐ >75%
☐ Formwork Cleaning	☐ <25% ☐ 25-50% ☐ 50-75% ☐ >75%	☐ Scarifying	☐ <[illegible] ☐ 25-50% ☐ 50-[illegible] ☐ >75%
☐ Grading	☐ <25% ☐ 25-50% ☐ 50-75% ☐ >75%	☐ Scraping	☐ <25% ☐ 25-50% ☐ 50-7[illegible] ☐ >75%
☐ Grinding	☐ <25% ☐ 25-50% ☐ 50-75% ☐ [illegible]	☐ [illegible]zo W[illegible]	☐ <25% ☐ 25-50% ☐ 50-75% ☐ >75%
☐ Hand Sweeping	☐ <25% ☐ [illegible] ☐ 50-7[illegible] ☐ >[illegible]	☐ [illegible]	☐ [illegible]% ☐ 25-50% ☐ 50-75% ☐ >75%
☐ Milling	☐ <25% ☐ 25-[illegible] ☐ 50-7[illegible] ☐ >75	☐ Other	☐ <25% ☐ 25-50% ☐ 50-75% ☐ >75%
☐ Other	☐ <25% ☐ 25-5[illegible] ☐ 50-7[illegible] ☐ [illegible]75%	☐ Other	☐ <25% ☐ 25-50% ☐ 50-75% ☐ >75%

Base Mate[illegible]ecificat[illegible]	Silica Contained in Base Material
☐ Asphalt ☐ Block ☐ Brick ☐ Concrete ☐ Cement ☐ Grout ☐ Gu[illegible] ☐ Jortar ☐ Soil ☐ Terrazo ☐ Tile ☐ Other Material: _____	☐ From Bulk Sample ☐ From Estimate (SDS or list)

Tool Being Used Attach Photo	PPE Utilized
Make: _____ Model: _____	☐ Dust Mask (DM) ☐ Half Face (HF) ☐ Full Face (FF) ☐ Protective Clothing (PC) ☐ Gloves (G)

Control Methods

- ☐ None (N)
- ☐ Dry (D)
- ☐ Natural Ventilation (NV)
  - ☐ Employee Downwind
  - ☐ Employee Upwind
  - ☐ Employee Crosswind
- ☐ General Mechanical (GM)
- ☐ Local Exhaust Ventilation - with HEPA vacuum (LE-HEPA)
- ☐ Local Exhaust Ventilation - with shop vac or other vacuum (LE-OTHER)
- ☐ Wet Method – Continuous Drip (WM-CD)
- ☐ Wet Method – Continuous Spray (WM-CS)
- ☐ Wet Method - Non-continuous Drip (WM-NCD) Frequency: _____
- ☐ Wet Method - Non-continuous Spray (WM-NCS) Frequency: _____

Rev 3_14 February 2023

ARCADIS

Scheduled Monitoring Sampling Form for Silica

Filter/Cassette #: _____

Page 2 of 2

Project Number	Date	Project Name

Employee Name		Project Description

Silica controls maintenance plan in effect?	☐ Yes	☐ No
Controls checked during sampling period?	☐ Yes	☐ No
Employee trained and familiar with operation of controls?	☐ Yes	☐ No

Weather Conditions

☐ Sunny ☐ Overcast ☐ Rain ☐ Snow

Environment	Air/Wind Currents	Temperature
☐ Outdoors	☐ None	☐ < 40 °F
☐ Open Sided (Free Flow)	☐ < 5 mph	☐ 40 °F - <90 °F
☐ Enclosed 1Side (Limited Flow)	☐ 5-10 mph	☐ > 90 °F
☐ Enclosed All Sides (No Flow)	☐ >10 mph	

Nearby Visible Dust Sources	Humidity
☐ None	☐ < [illegible]
☐ Other workers doing same task	☐ 20[illegible] <40%
☐ Partial from Other tasks and sources	☐ 40[illegible] <60%
☐ Continuous from Other tasks and sources	☐ 60[illegible]
	☐ >80%

Sa[illegible]ing [illegible]ent

☐ [illegible]spira[illegible] C[illegible]talline [illegible]ica

Sample[illegible]ype

☐ [illegible]sonal (P) ☐ Area (+/- Distance to Activity) ☐ Bulk (B)

Pump [illegible]ification	Analytical Method
Make / Model:	NIOSH 7500; OSHA ID-142

Filter [illegible]assette #	Pre-Calibration	Post Calibration	Flow Rates
	Date	Date	Pre-Rate
Cyclo[illegible]t Type			
	Sampling Times		Post Rate
Agent	Start / Stop	Time	
Respirable Crystalline Silica			
	Start / Stop	Time	Average Flow Rate

Average Flow Rate	Total Sampling Time	Total Volume

Laboratory Results (µg/m³)			
Quartz	Cristobalite	Trydymite	RCS

Notations

_____ Sampler's Name

_____ Sampler's Signature

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Exhibit 5 – Scheduled Monitoring Sampling Guidelines

Project Teams using the Scheduled Monitoring Option should collect and analyze samples using the procedures specified in one of the following analytical methods: OSHA ID-142 and/or NIOSH 7500. It is recommended that Project Teams use SKC PPI samplers in place of cyclone samplers. When collecting samples Project Teams should collect 1 field blank per 20 samples. For personal exposure monitoring sampling, devices should be placed in the breathing zone of the employee, often on the employee's lapel. Area samples should also be collected to help determine required exclusion zones, distance from the silica-containing dust source should be recorded on the Scheduled Monitoring Data Sampling Form for Silica (Exhibit 4).

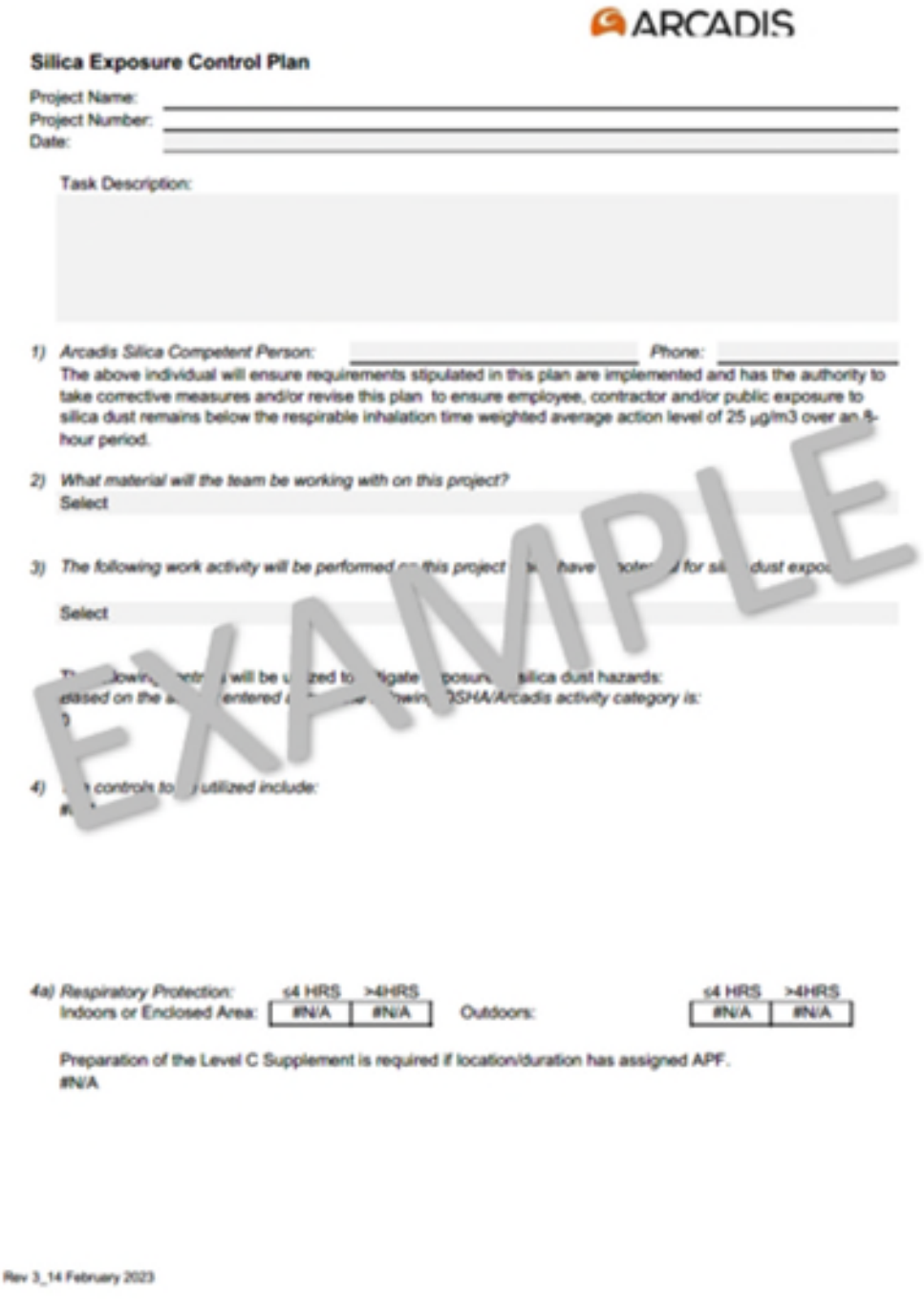
Silica sampling kits can be rented from SGS Galson, which includes all the required equipment to complete the sampling:

- Gil-Air Pump with Charger
- Tubing and Clip
- Media for sample collection
    - Field blank – One field blank per 20 samples will be collected the Field blank will be carried to the sampling site, exposed to the sampling conditions during pump calibration, returned to the laboratory, treated as a sample, and carried through all steps of the analysis to evaluate possible effects attributable to shipping and field handling procedures.
- Instructions
- Calibrator (Rotameter)
- Packing Materials
- Test Report – Silica-containing dust (quartz, cristobalite & tridymite) with respirable dust

Personal exposure monitoring data will be collected using the Scheduled Monitoring Data Sampling Form for Silica (Exhibit 4). Completed Scheduled Monitoring Data Sampling Forms for Silica should be submitted along with a copy of the sample chain of custody (COC), photos and analytical data to ANACorpHS@arcadis.com.

Exhibit 6 – Silica Exposure Control Plan

(Link to Silica Exposure Control Plan)



ARCADIS

Silica Exposure Control Plan

Project Name: _____
Project Number: _____
Date: _____

Task Description:

1) *Arcadis Silica Competent Person:* _____ *Phone:* _____
The above individual will ensure requirements stipulated in this plan are implemented and has the authority to take corrective measures and/or revise this plan to ensure employee, contractor and/or public exposure to silica dust remains below the respirable inhalation time weighted average action level of 25 µg/m3 over an 8-hour period.

2) *What material will the team be working with on this project?*
Select

3) *The following work activity will be performed on this project [illegible] have [illegible] for silica dust expo[illegible]*

Select

The following [illegible] will be utilized to mitigate exposure to silica dust hazards:
Based on the [illegible] entered [illegible] following OSHA/Arcadis activity category is:
0

4) *[illegible] controls to be utilized include:*
#N/A

4a) *Respiratory Protection:*

Indoors or Enclosed Area:	≤4 HRS	>4HRS
	#N/A	#N/A

Outdoors:	≤4 HRS	>4HRS
	#N/A	#N/A

Preparation of the Level C Supplement is required if location/duration has assigned APF.
#N/A

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EXAMPLE

Additional Housekeeping Requirements:
Arcadis prohibits dry sweeping or dry brushing where such activity could contribute to employee exposure to respirable crystalline silica unless wet sweeping, HEPA-filtered vacuuming or other methods that minimize the likelihood of exposure are not feasible.

Arcadis prohibits use of compressed air to clean clothing or surfaces where such activity could contribute to employee exposure to respirable crystalline silica unless:
The compressed air is used in conjunction with a ventilation system that effectively captures the dust cloud created by the compressed air; or
No alternative method is feasible (requires concurrence with a CIH).

5) Air Monitoring Requirements for Activities with an Assigned Respirator APF Listed in Section 4a.

☐ Real-time air monitoring for silica is not required for this project.
☐ Real-time air monitoring will be conducted during work activities where employees or contractors are exposed to or have the reasonable probability to be exposed to silica dust hazards. Silica air monitoring will include use of an aerosol monitor equipped with a Dorr-Oliver cyclone kit for respirable dust evaluation. Although not permitted to be the sole method of determining employee exposure, real-time air monitoring for silica will be performed in the employee breathing zone (personal air monitoring) and will be performed at the perimeter of the work area (exclusion zone boundary). The results will be documented and submitted to Corporate H&S upon completion of the project. Air samples for laboratory analysis will also be required unless excepted from collection by a CIH.

Aerosol monitor selected for use on this project: _____
Frequency of air sample collection for laboratory analysis: _____
Air samples will be submitted to the following laboratory: _____

6) Medical Surveillance

Employees performing work activities where exposure to silica dust is known to be or has a reasonable probability to be above the OSHA 8-Hr TWA action level of 25 µg/m3 will participate in silica medical surveillance in conjunction with their annual HAZWOPER physical. New entrants into the silica medical surveillance program at times when the HAZWOPER physical is not due will coordinate the required surveillance with WorkCare and then maintain the surveillance with their HAZWOPER physical going forward.

7) Additional Instructions

Signatures:

_____ _____
Preparer Name Printed Date

_____
Preparer Signature

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1. POLICY

It is Arcadis policy that during the conduct of their work, Arcadis and subcontractor employees have the authority and responsibility to Stop Work immediately in any situation when the Health, Safety, Security and Environment hazards and associated risks associated with work being performed is not clearly understood, established or controlled. This standard presents the requirements to be observed if and when this situation occurs.

2. PURPOSE AND SCOPE

2.1 Purpose

This standard describes the authority, obligation and responsibility to stop potentially unsafe work at the earliest stage possible. Every Arcadis and subcontractor employee is responsible for prevention of unsafe acts, behaviors or conditions, consequently preventing harm to people, the environment or property.

Every Arcadis and subcontractor employee has the authority and obligation to stop work that he or she considers to be unsafe. The Arcadis leadership team is committed to support anyone who exercises his or her 'Stop Work' authority. There will be no negative consequences as a result of 'Stop Work' actions.

2.2 Scope

This standard applies to all activities performed by Arcadis or on behalf of Arcadis. A stop work process will include the participation of all Arcadis, Arcadis subcontractors and other involved personnel as appropriate.

3. DEFINITIONS

Definitions related to Stop Work Authority can be found in Exhibit 1. Acronyms and Abbreviations are found in Exhibit 2.

4. RESPONSIBILITIES

4.1 Project Management

The Project Manager is responsible for:

- Confirming that 'Stop Work' requirements and obligations are understood thoroughly by Arcadis and subcontractor employees.
- Creating a culture where 'Stop Work' is exercised freely, honoring and responding promptly to requests to stop work and working to resolve issues to the satisfaction of all involved parties before operations resume.
- Recognizing proactive participation and verifying that all 'Stop Work' actions are properly reported with required follow-up, as necessary.

4.2 All Employees

All employees are responsible for:

- Understanding their authority and obligations under 'Stop Work,' initiating a 'Stop Work' intervention when warranted, supporting the intervention of others and properly reporting all 'Stop Work' actions as described in this standard.

- Understanding the hazards of their activities, implementing the controls for the hazards and using 'Stop Work' authority if they don't understand the hazards, their job tasks, or if they do not feel safe for any reason.

- In addition, employees will participate in determining and implementing the solutions for mitigating the unsafe issue.

4.3 Corporate H&S Staff

Corporate Health & Safety is responsible for:

- Communicating the requirements of this HSS with Arcadis U.S.

- Verifying this standard is being implemented effectively.

- Establishing the clear expectation for Arcadis employees and subcontractors to exercise 'Stop Work Authority', create a culture where 'Stop Work' is exercised freely, resolve 'Stop Work' conflicts when they arise, and hold those accountable who do not to comply with established 'Stop Work' policies.

5. PROCEDURE

5.1 General Safety Requirements

Arcadis and subcontractor employees shall be made aware of their obligation to 'Stop Work' for issues that they consider to be unsafe.

Employees have the authority, obligation and responsibility to stop any task or operation where there are concerns or questions regarding the control of the hazards or risks associated with a task or operation that is being performed.

No work will resume until all 'Stop Work' concerns or questions have been adequately addressed and associated risks have been eliminated or mitigated to acceptable levels to the satisfaction of all parties involved.

All employees are made aware of the actions they shall take, including reporting, when stopping unsafe work.

All indications from personnel that the work is unsafe must be properly investigated as deemed appropriate for the situation. All instances of work being stopped for reasons of health and safety shall be recorded and appropriately investigated. This documentation may be completed using the Tailgate Meeting form or using the Arcadis Incident Investigation process.

Any form of retaliation or intimidation directed at any individual or company for exercising their authority as outlined in this standard will not be tolerated. Disregard for the requirements in this standard shall be addressed with disciplinary actions in accordance with Arcadis policy.

Before work begins, a responsible person shall be defined by the Project Manager for coordination of any 'Stop Work' activities, including hazard and risk assessment and mitigation actions following a 'Stop Work' intervention (refer to the Tailgate Meetings H&S Standard – ARC HSGE001).

5.2 Stop Work Process

In general terms, 'Stop Work' involves:

- Initiating a 'Stop Work.'
- Notifying affected employees, other personnel (including client staff) and supervision.
- Assessing hazards and associated risks.
- Identifying and implementing controls.
- Resuming work once a hazard assessment and controls implementation (if applicable) are approved by a competent person and are satisfactory to all parties involved.
- Communicating the results of the hazard and risk assessment and controls identification resulting from the 'Stop Work.'

5.2.1 Initiate a 'Stop Work'

When a person identifies a perceived or actual unsafe condition, act, error, omission, confusion or lack of understanding that could result in harm to persons, the environment or property, he or she shall immediately initiate a 'Stop Work' intervention.

This intervention shall:

- Be initiated in a positive manner.
- Result in a stop of associated work activities, if there is an immediate risk of injury or accident; removal of all person(s) (also persons not directly related to the Arcadis Work Team) from the area; as appropriate to the issue; stabilization of the situation and making the area as safe as possible, until more permanent solutions can be developed and implemented as appropriate to the situation.
- If there is no immediate risk, address the potentially unsafe issue with the person(s) potentially at risk and/or the person(s) causing the risk. This includes all affected employees of Arcadis, subcontractor, client and other parties.

5.2.2 Notifying the Affected Parties

All personnel affected by the 'Stop Work' situation shall be notified as soon as possible.

5.2.3 Assessing Hazards and Associated Risks

A competent person (e.g., task manager, field supervisor, subject matter expert, H&S resource) shall guide the assessment for potential hazards and risks by involving the affected parties to determine the hazards and assess the associated risks, so that appropriate controls can be identified. This information will be documented on the Tailgate Meeting form or an incident investigation form in 4-Sight.

5.2.4 Identifying Controls

To identify controls that eliminate risk or mitigate it to an acceptable level and to decide on an appropriate course of action, the following questions and others shall be considered:

- How can the risk be controlled or otherwise mitigated to an acceptable level and to the reasonable satisfaction of the parties involved?

- Is a competent person approving the hazard and risk assessment and the identified controls in order to prepare to re- start work?

All affected parties should be in agreement with the hazard and risk assessment and controls identification.

The results of the hazard and risk assessment and controls identification resulting from the 'Stop Work' shall be reported, documented and maintained on either Tailgate Meeting form or the incident investigation form as appropriate for the issue.

5.2.5 Qualifiers for Stopping/Resuming Work

The following should be considered when stopping or resuming work as the result of a 'Stop Work' intervention:

- If the 'Stop Work' intervention is based on a perceived (but not an actual) risk as determined from the hazard and risk assessment, the affected person(s), as appropriate, should:
  - Show appreciation to the initiator for his or her awareness and concern.
  - Proceed with work.
  - Share the learnings with the initiator and involved parties.

- If the 'Stop Work' intervention is based on an actual risk that cannot be immediately assessed and/or controlled on site by the present employees and available resources, work shall be suspended. If the identified controls that mitigate the risk in the 'Stop Work' situation are not within the original scope of work, the change will be managed appropriately, and the Job Safety Analysis (JSA) and Health & Safety Plan (HASP) should be reviewed to include a hazard and risk assessment and identify subsequent controls.

- If the work is in the scope of a permit, the permit issuer shall review/reissue the permit with the necessary changes or modifications.

Work can be resumed only once a competent person with the appropriate level of authority approves the hazard and risk assessment and the implemented controls and all parties are satisfied with the controls.

5.3 Stop Work ("If Not Me, Then Who?") Involving Parties Outside of Arcadis Control

The Arcadis H&S Vision and Policy and our culture of TRACK to Zero puts H&S first in all things. Yet, stopping work or intervening under the Arcadis "If Not Me, Then Who?" concepts when it involves parties outside of Arcadis control must be implemented in such a way to protect the health and safety of our staff members, but also to protect the company from any undue risk and liability. Consequently, a separate guidance document has been developed and included as Exhibit 3.

5.4 Reporting

All planned and unplanned 'Stop Work' interventions shall be documented on the Tailgate Meeting form, in the H&S App as a close call and/or in 4-Sight as a near miss report or incident investigation report, as appropriate to the issue.

Adequate descriptions shall be given of the act, behavior or condition that caused the 'Stop Work' intervention, its hazard and risk assessment and implemented risk mitigations.

Near miss and incident reports shall be reviewed by H&S personnel and reported to senior leaders to:

- Measure participation.
- Determine the quality of interventions and follow-up.
- Track common issues and identify trends and opportunities for improvement.
- Facilitate the sharing of learnings.
- Provide feedback from recognition programs.

The H&S team shall regularly communicate incident details reported by Business Line as well as details regarding common trends and learnings.

6. TRAINING

The "Stop Work" process will be included in H&S Orientation training, in ongoing company communications and reinforced during daily Tailgate meetings.

7. REFERENCES

The following Arcadis H&S Standards are located on the ANA H&S Policies & Integrity intranet page:

Arcadis Health and Safety Plan Standard – ARC HSFS010

Arcadis Incident Investigation H&S Standard – ARC HSMS010

Arcadis Tailgate Meetings H&S Standard – ARC HSGE001

8. RECORDS

Stop Work actions shall be documented in:

- Tailgate Meeting forms;
- Health & Safety App and/or
- 4-Sight

Training records will be stored in Arcadis' Learning Management System so they may be provided, if requested by Arcadis, clients or a regulatory agency. Employees must upload copies of their training records from external vendors to the Arcadis Learning Management System.

9. APPROVALS AND HISTORY OF CHANGE

Julie Santaniello, CSP – Corporate H&S Director of Technical Programs

History of Change

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
15 February 2010	01	Mike Thomas	Original document
17 April 2012	02	Camille Carollo/Tony Tremblay	Executive Summary added
16 January 2013	03	Pat Vollertsen/Tony Tremblay	Revised section 6.0 and Executive summary in regard to training
22 October 2015	04	Tony Tremblay/Julie Santaniello	Section 3 Definitions moved to Exhibit 1; Section 5.3 Stop Work ("If Not Me, Then Who?") Involving Parties Outside of Arcadis Control added and existing section 5.3 renumbered to Section 5.4; text updated in Section 5.4; Document template updated; Exhibit 2 If Not Me, Then Who guidance document added
2 September 2021	05	Anirudh K J/ Julie Santaniello	Template update; hyperlink update; added communication to the Stop Work process in Section 5.2; updated HR Operations email address in Section 8.
11 August 2023	06	Julie Santaniello	Removed Quick Sheet; added reference to the H&S App in Section 5.4 and 8; updated certificate upload process in Section 8.

Exhibit 1 - Definitions

Planned 'Stop Work' is a 'Stop Work' situation previously identified in a Job Safety Analysis, HASP or other standard (e.g., 'Stop Work' trigger)

'Stop Work' is the stopping of all activities associated with a task, condition, situation, action or activity (issue) that anyone views as potentially or is actually unsafe or has the potential to cause loss. 'Stop Work' can be applied to the single issue, a group of issues, or an entire job project or site as applicable.

Exhibit 2 – Abbreviations and Acronyms

ANA	Arcadis North America
Arcadis	Arcadis U.S. Inc.
HASP	Health & Safety Plan
HS	Health and Safety
H&S	Health and Safety
HSS	Health and Safety Standard

Exhibit 3 – If Not Me, Then Who? Guidance Document

ARCADIS Design & Consultancy for natural and built assets

IF NOT ME, THEN WHO?

- H&S SITUATIONS WHERE NO ARCADIS EMPLOYEES ARE INVOLVED OR WHEN ARCADIS DOES NOT HAVE HEALTH & SAFETY RESPONSIBILITY-

Effective: 1 March 2013

This document addresses the "If Not Me, Then Who?" concept in perceived or actual H&S situations (unsafe acts or behaviors, unsafe conditions, etc.) which do not involve our employees or partners and where we are not contractually or statutorily responsible for H&S[1].

For example, what does an Arcadis employee do, when Arcadis has no construction site responsibility but they see that a fence that was erected by a general contractor and is supposed to be protecting this site, has a gap that may allow an unauthorized person to enter the site where they could be injured?

The Arcadis H&S Vision and Policy, and our culture using TRACK to 0 concept put H&S first in all things. Yet we also have the need to protect ourselves from injury and the company from undue risk and liability:

1. Take a minute to think through the situation, related risks, and risks that would result from corrective action (TRACK).
2. Act immediately to safe lives if in your best judgment delay would cost lives or severe injuries (imminent danger).
3. If we see unsafe acts/behavior or conditions that are not imminent dangers: speak up and promptly notify the appropriate party. In a project: liaise with project manager about best person to address (consider H&S responsible person - contractor and client). In other situations, attempt to identify the person with H&S or overall responsibility for the activities.
4. Re-confirm the formal H&S responsibilities (law & contract) with H&S and legal department before doing anything else, or, if action could not be postponed for risk of losing lives/severe injuries, immediately after the action.
5. When having pointed out, or about to point out, areas of concern outside of our scope of responsibilities, accompany with a specific disclaimer[2].
6. Refrain from taking H&S responsibility through further action (actual corrections, audits, reviews or other)[3].

It is noted that the above example actually occurred involving an Arcadis employee. Instead of notifying the appropriate parties of the situation, our employee attempted to fix the contractor fence and got seriously injured in doing so. This resulted in lost time to our employee and a recordable injury against the company.

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QUICK SHEET

Applicability

This HSS assigns responsibilities and expectations for proper utility location and clearance by both Arcadis employees and Arcadis subcontractors at project sites

Need to Know

PMs are responsible for ensuring the requirements of this HSS are followed. Project personnel are responsible for understanding the HSS and Supplemental document, having the minimum 1 year of required training in order to clear sites, understand and apply the requirement for a minimum three reliable lines of evidence for each point of work, know and understand the Arcadis 30-in tolerance Zone requirements.

If and when any line of evidence reveals planned subsurface work will occur within the Arcadis 30-inch Tolerance Zone of known/marked/located/observed utilities or structures, the project team must Stop Work and contact Corporate H&S for a review of steps the team has taken to prevent injury or incident involving the conflict.

Additional details addressing hazards, risk factors, and safe work practices are discussed in the HSS Supplemental document Sections:

1. Best Practices for Project Managers (or Their Delegates) Concerning Utility Clearance.
2. Best Practices for Field Personnel Concerning Utility Clearance.
3. Use and Limitations of Common Underground Locating Technologies and Clearance Methods.
4. Best Practices for State One Call Notification Process and Mark Outs.
5. Emergency Action Plan Guidelines for Utility Strikes.
6. Utility Location Procedures for Aquatic Work Activities.

Arcadis field personnel involved with any strike incidents including contact with a structural feature, subsurface, submerged, and/or aboveground utilities must immediately STOP WORK and contact the Project Manager to discuss the incident. If there are life threatening injuries, or the incident presents a risk to public safety (e.g. natural gas leak, downed live electrical line, flooding, or an unstable building) first call 911 or the available emergency services number for the client site or area and then call the Project Manager. The incident must be reported to Corporate Health and Safety immediately and no later than 24 hours after gaining knowledge of the incident. Compliant notification within 24 hrs. requires an acknowledgement of the notification by Corporate H&S.

The Arcadis standard client and subcontractor contracts contain required terms and conditions defining responsibility for utility clearance and the allocation of risk associated with an impacted utility.

Training

Field staff must complete a minimum of one year of utility clearance-related experience before accepting responsibility for any utility clearance tasks. This experience requires mentorship by a currently trained and experienced Arcadis employee for the processes of; completing DigSafe 811 notifications, developing a working understanding of the types of utilities present at project sites, developing a working understanding of the various reliable lines of evidence, and

participating in on-site training led by another Arcadis employee with detailed knowledge and experience in identifying utilities and structures.

Permits or Forms Required

The Utility Location HSS and associated supplements will be reviewed, and the Utility and Structures Checklist will be prepared during project planning to document and record the location and clearance process for the Site.

1. POLICY

It is the practice of Arcadis and its affiliated companies to implement appropriate, reasonable, and practical standards within acceptable and customary industry practices to promote the health and safety of its employees and avoid and mitigate exposure of risk in the performance of their work. In furtherance of this policy, Arcadis promotes and encourages compliance by all employees with this policy and standards relating to work in the vicinity of subsurface, submerged, or aboveground utilities.

2. PURPOSE AND SCOPE

2.1 Purpose

Arcadis is committed to providing a healthy and safe work environment for our employees, subcontractors, clients, and visitors. To this end, this health and safety standard (HSS) establishes general safety standards and best practices associated with the identification, management and avoidance of subsurface, submerged, and aboveground structures and utilities on project sites.

2.2 Scope

This HSS assigns responsibilities and expectations for proper utility location and clearance by both Arcadis employees and Arcadis subcontractors at project sites.

3. DEFINITIONS

Definitions related to Utility Location and Clearance can be found in Exhibit 1. Acronyms and Abbreviations are found in Exhibit 2.

4. RESPONSIBILITIES

Project staff involved in subsurface and aboveground work activities are expected to read, understanding and comply with this HSS and the ARC HSFS-019 Supplements, specifically ARC HSFS-019 Supplement Sections 2 and 3, make the required DigSafe notification(s), and complete the appropriate checklists during the on-site utility and structures locate and clearance process.

4.1 Project Managers

For every project site having the potential to come into contact with utilities, Project Managers (PMs) are responsible for the requirements of this HSS in that:

- The requirements of this HSS are followed.
- Local regulations governing utility clearance are followed. This includes ensuring local and/or state laws defining activities or depth of intrusive work/excavation requiring utility clearance are reviewed as they vary by location. For further information, refer to the

Common Ground Alliance One Call State Law Directory (https://commongroundalliance.com/map).

- Efforts are made to work with the client, project site representatives, public utility companies, and subcontractors to identify the nature of any utilities and to determine control processes that need to be implemented by Arcadis and the subcontractors to prevent damage to these utilities and to properly manage the effects in the event there is utility damage.

- In jurisdictions where the actual contractor performing the subsurface intrusive work is required to perform utility clearance notifications (811, State One Call, etc.) ***and*** Arcadis is also self-performing the work, Arcadis will complete the clearance notifications and include the ticket number on the Utility Clearance Checklist. Refer to ARC HSFS-019 Supplement Section 4 for Best Practices for State One Call procedures.

- Utility clearance activities are only delegated to a Task Manager or other individual meeting the requirements of Section 4.2 below, as appropriate. However, even if the Project Manager delegates certain responsibilities, the Project Manager maintains primary responsibility for the completion of utility clearance. For additional information on Project Manager responsibilities and best practices, refer to ARC HSFS-019 Supplement 1.

- Prior to beginning subsurface work, Project Managers or designee must review the Utility and Structures Checklist with staff and Arcadis subcontractors (including subs of subs). The Project Manager or designee review must be documented on the Utility and Structures Checklist prior to starting subsurface intrusive work

4.2 Field Personnel Responsibilities

Arcadis field personnel conducting work on a project site having the potential to come into contact with utilities have the responsibility to:

- Read, understand, and follow this HSS and ARC HSFS-019 Supplement document.

- Complete a minimum of one year of utility clearance-related experience before accepting responsibility for any utility clearance tasks. This experience requires mentorship for notifying DigSafe 811, developing a working understanding of the types of utilities present at project sites, developing a working understanding of the various reliable lines of evidence, and participating in on-site training led by another Arcadis employee with detailed knowledge and experience in identifying utilities and structures.

- Request and review the 811 DigSafe notification(s) in place for the appropriate work area(s).

- Prior to beginning any subsurface intrusive work (i.e., any work or activity that breaks the plane of the ground surface), excavation work involving heavy and mechanized equipment, or operating high clearance equipment at the Site, the Utility and Structures Checklist must be completed and signed by the staff member completing or overseeing the clearance. Confirm that the Utility and Structures Checklist was reviewed by the Project Manager or designee as discussed in Section 4.1 above. Review the Utility and Structures Checklist daily prior to starting subsurface intrusive activities to ensure all

utilities are identified and markings are present. A copy of the completed Utility and Structures Checklist will remain on-site during all subsurface intrusive work.

- Use their STOP WORK Authority to eliminate any reasonable concern if utilities cannot be reasonably located and contact the Project Manager to review the STOP WORK situation and confirm the direction of action before proceeding with the work.
- Check that Arcadis subcontractors conduct their own reasonable independent utility clearance efforts as required by state and local laws and the Arcadis subcontractor agreement.
- Be on-site and provide oversight during utility location and clearance activities and any active subsurface intrusive work or activities involving subcontractor under contract to Arcadis.
- If a utility is damaged and repaired during the course of the field event, Arcadis field staff must provide oversight and document that the repair was tested to ensure the repaired utility is competent and complete to prevent further damage to the site when the damaged utility is re-activated.

4.3 Corporate Health & Safety

Corporate H&S is responsible for keeping this HSS up to date with regulatory requirements and best work practices.

Corporate H&S will, as requested, provide guidance to employees and their supervisors engaged in work involving utility location and clearance on the risks and measures prevention utility strikes, including how to recognize the presence of utilities whether overhead, underground, or submerged and how to mark and protect them from damage.

4.4 Arcadis Subcontractor Responsibilities

According to the Arcadis standard subcontract terms and conditions, subcontractors agree to take responsibility for any damages resulting from a utility impact caused by their work. Therefore, Arcadis subcontractors are expected to take reasonable time and diligence to conduct their own independent utility clearance using reasonable standards and processes. Subcontractors have the responsibility to stop their work if utility concerns are identified and will report those concerns to the Arcadis employee overseeing their work activities. Arcadis staff should reinforce these responsibilities with subcontractors during job safety briefings.

In jurisdictions where the actual contractor performing the subsurface intrusive work is required to perform utility clearance notifications (811, State One Call, etc.), the contractor will perform the clearance notification and will provide evidence of the notification to Arcadis (ticket or ticket number, etc.). Refer to ARC HSFS-019 Supplement Section 4 for Best Practices for State One Call procedures.

- If overhead utilities are present in areas where heavy equipment will be operated, ensure adequate clearance is provided. For heavy equipment with extendable or telescoping (e.g., excavators, dump trucks, extendable lift trucks) equipment, evaluate whether the use of a spotter is necessary prior to operating heavy equipment when in proximity to the overhead utility.

- Consider signage and/or other forms of identification to ensure aboveground and overhead utilities that need to be protected during Arcadis work are effectively addressed.

- If a utility is struck and requires repair, the repair must be tested prior to restoring the utility to full service.

5. PROCEDURE

5.1 General Safe Work Practices

Arcadis staff will follow these general safe work practices when working around utilities. Procedures to be followed during utility and structures location and clearance activities are outlined in the following sections of the Utility Location and Clearance Supplemental document:

7. Best Practices for Project Managers (or Their Delegates) Concerning Utility Clearance.
8. Best Practices for Field Personnel Concerning Utility Clearance.
9. Use and Limitations of Common Underground Locating Technologies and Clearance Methods.
10. Best Practices for State One Call Notification Process and Mark Outs.
11. Emergency Action Plan Guidelines for Utility Strikes.
12. Utility Location Procedures for Aquatic Work Activities.

5.2 Lines of Evidence

When locating utilities and structures three (3) reliable “lines of evidence” must be established to help determine where a subsurface utility may be located. A line of evidence may be a scaled site drawing showing where a utility is located, it could be information obtained verbally from owners or employees who meet the definition of a “knowledgeable person” regarding utility and structural features, it could be established using any number of non-intrusive geophysical methods including but not limited to; ground penetrating radar (GPR), electromagnetic survey (EM), radio-frequency methods (RF), or it could involve probing for or exposing the utility by soft dig technologies (AKA “daylighting” or “potholing”) using air knife, Hydroknife and/or soil vacuum. Some lines of evidence will identify utility locations with a high degree of certainty (e.g., direct connect radio-frequency technique, daylighting, or potholing, sonde tracing, etc.). Other lines of evidence will identify utilities will less certainty (e.g., GPR, historical reports, old design drawings, etc.).

Effective utility locate practices must use multiple lines of evidence until there is a high degree of certainty that the various underground utility services have been adequately located. A minimum of three (3) reliable lines of evidence are required for an appropriate utility clearance as defined in this HSS. All reliable lines of evidence used during the utility clearance procedure will be recorded on the Utility and Structures Checklist or equivalent client-provided checklist or ground disturbance permit. If three (3) reliable lines of evidence have not established certainty regarding the location of a utility, STOP WORK and do not proceed until the certainty has improved, the work has been modified to resolve the lack of certainty. Additional reliable lines of evidence must be utilized until the presence or absence of the underground utility can be established. During work activities, if a line of evidence is lost or not apparent (e.g., paint markings have faded), STOP WORK, and re-establish the line of evidence prior to resuming subsurface intrusive work.

Generally, the following example reliable lines of evidence may be used to meet the minimum three lines utility clearance requirement:

1. Contacting the State One Call or equivalent service (Nationwide "811") in advance of intrusive work is **REQUIRED BY LAW**.. Contacting the State One Call or equivalent service (Nationwide "811") is an acceptable reliable line of evidence when working within or adjacent to the public right of way or easement. Note that the State One Call can provide valuable information regarding locations and types of utilities entering a privately owned property.

   Note: When conducting work on private property or in areas not served by State One Call or equivalent service, teams are to evaluate using a reputable private utility locating company to locate and mark the utilities. **Use of a reputable private utility locator is encouraged for all projects with subsurface or submerged utilities.** When working with a private utility location subcontractor, it is best practice to pre-plan clearance areas, review the necessary clearance equipment needed based on the types of utilities anticipated to be present, and the re-clearing/confirmation of any public utility location markings (State One Call or equivalent service Nationwide "811").

2. Use detailed, scaled site utility plans, preferably in the form of an "as-built" or "record" drawing, to identify and/or confirm utility locations. Document request and/or receipt of utility drawings from the property owner/client on the Utilities and Structures Checklist.

3. Interview(s) with knowledgeable site or client personnel. The following questions should be asked during the interview and answers documented on the Utility and Structures Checklist

   - Employees(s) Name and Affiliation(s) with the site.
   - Types of utilities, including utility composition and location of utilities on-site.
   - Depths of known utilities; and
   - Any other pertinent information regarding utilities on the site.

4. Conduct a detailed visual site inspection of areas around all planned subsurface intrusive work points or areas to identify and/or confirm utility locations. The area needed to conduct a thorough site inspection can vary significantly depending on the number and type of utilities present, notably gravity-fed utilities such as sewers. Sewer network manhole spacing can often include 100-foot distances or greater between manholes. For underground utilities, conduct an inspection for structures that tend to indicate the presence and general location of such utilities, including, but not limited to manholes, vaults, valve covers, valve markers, telephone pedestals, transformer housings, fire hydrants, fire suppression post indicator valves (PIVs), spigots, sprinkler heads, air relief valves, backflow preventers, meters, vent lines, downspouts going into the subsurface, power poles with wiring going into the subsurface and line markers, stakes, and monuments. Saw cut lines and concrete/asphalt repairs often yield valuable information regarding utility locations.

Always discuss the presence of utilities with the site owner, operator, facility representative and/or occupant to identify any potential utilities that might not be readily identified by non-intrusive geophysical clearing methods. Situations where non-intrusive clearance methods may not be effective include:

- Depths > 5 ft. below ground surface (BGS).
- Small diameter or certain utility construction materials (e.g. plastics).
- Multiple layers of surface cover e.g. reinforced concrete, multiple layers of historical roadbed.
- Soil conditions such as dense soils or shallow groundwater table.

A discussion of use and limitations associated with common utility location and clearance geophysical methods is provided in ARC HSFS-019 Supplement Section 3.

Standard operating procedures for utility location in submerged settings are presented in ARC HSFS-019 Supplement Section 6.

The lines of evidence will be recorded on the Utility and Structures Checklist or equivalent client-provided checklist or permit.

Note: If a line of evidence is lost, not apparent, no longer applicable or utility location markings are removed/worn/unclear, or area of previous clearance is not confirmed, STOP WORK and re-establish the line(s) of evidence prior to resuming subsurface intrusive work. **Each location of subsurface intrusive work must have a minimum of 3 reliable lines of evidence.** All lines of evidence used during the utility clearance procedure will be recorded on the Utility and Structures Checklist or equivalent client-provided checklist or permit. The Utility Structures and Checklist is valid for 15 business days from the date of completion. Prior to the end of the 15 day period the checklist detailing the utilities which have been located and marked must be reviewed to verify no new utilities have been identified but are unmarked and, utilities which have been located and marked continue to be clearly marked. Update the checklist with the date of the review and reviewer name to "re-set" the 15-day period. A copy of the completed Utility and Structures Checklist will remain onsite while work involving or in the vicinity of utilities is conducted.

Caution: If and when any line of evidence reveals planned subsurface work will occur within the Arcadis 30-inch Tolerance Zone of known/marked/located/observed utilities, the project team must Stop Work and contact Corporate H&S for a review of the steps the team has taken to prevent injury or incident involving the utility conflict.

5.3 Color Codes Used for Utility Markings

The following colors are used for marking utilities. Some government agencies or large industrial facilities may use additional colors not provided below. Arcadis policy is to assume any paint marking or pin flag color not provided below is a subsurface utility marking until proven otherwise.

If utilities or subsurface anomalies are identified but the utility type or anomalies are not classified, it is recommended the color pink (Temporary Survey Marking) be used to mark the location pending confirmation. Once the type of utility is established, the pink marks will be repainted/remarked to represent the correct type of utility.

COLOR	Utility Line
WHITE	Proposed Excavation
PINK	Temporary Survey Markings
RED	Electrical Power Lines, Cables, Conduit and Lighting Cables
YELLOW	Gas, Oil, Steam, Petroleum or Gaseous Materials
ORANGE	Communication, Alarm or Signal Lines, Cables or Conduit
BLUE	Potable Water
PURPLE	Reclaimed Water, Irrigation and Slurry Lines
GREEN	Sewer and Drain Lines

APWA and ANSI standard Z-53.1

5.4 Locating Technologies

There are several types of locating technologies that can be used to identify and locate utilities in the subsurface. Project teams need to work closely with private utility locators (PUL) in order to best match locating technology with site conditions. To provide the best results, all possible locating technologies should be available for use and implementation at the project location. Any potential interferences should also be discussed up front and then at the project site during utility location activities. Potential interferences could be soil moisture, soil type, standing water on concrete/asphalt, rebar, fencing, and metal structures that are in the subsurface. Employees overseeing locating technology activities should have an understanding of device operation and limitations. For further information, refer to ARC HSFS-019 Supplement Section 3, Use and Limitations of Common Utility Location Technologies and Clearance Methods.

5.5 Clearance Methods

In some cases, proposed subsurface intrusive locations may be pre-cleared using other intrusive methods. Determine the clearance or soft dig method based on-site conditions and utilize the least invasive method possible. The number of subsurface intrusive locations and soil type should be taken into consideration. The following clearance methods are listed from least invasive to most invasive:

1. Vacuum Extraction/Potholing (air or water-based)
2. Air knifing
3. Hydro knifing
4. Probing
5. Hand augering
6. Hand digging
7. Posthole digging

"Single-Point" clearance involves clearing the intrusive location to 110% of the proposed subsurface intrusive area or the diameter plus 2 inches of the largest piece of tooling used in the subsurface (e.g. clear the borehole to 10-in. when setting wells using 8-in. hollow stem auger tooling), or whichever is greater.

"Three-Point" clearance involves clearing the utility using a triangular pattern placed around the proposed borehole location and in a configuration such as to not allow utilities to pass undetected between the clearance boreholes. In some cases, it is more practical to advance three individual slot trenches which connect at each end making a "clearance triangle" instead of advancing multiple boreholes side-by-side. Using the Three-Point clearance triangle trenching method allows for teams to inspect larger areas for potential utilities. The teams can advance trenches along each side of the proposed work area extending down to a target depth based on suspected depth of utilities at the Site. Each method of clearance will be documented on the Utility and Structures Checklist.

Manual clearing methods, such as shoveling, using pickaxes, digging bars (AKA "Spud bars" and other hand tools, should be avoided completely or only used when absolutely necessary and used with caution. Excessive downward force, prying or use in poor/obstructed visibility conditions is prohibited as these tools are known to be capable of damaging utilities.

Surface cover (e.g., asphalt) removal methods that pose excessive downward force, such as jackhammering, must be used with extreme caution. Methods that only cut the surface cover (coring or saw cutting) present less risk due to the absence of the blunt downward force, which could cause collateral damage to shallow subsurface utilities by unintentionally pushing buried debris into the utility. Note that certain utilities are often present at the concrete or pavement/soil interface or encased within the concrete or pavement and are easily damaged during concrete coring or pavement removal. Always work slowly, methodically, and frequently STOP WORK to evaluate conditions during these work activities.

For borings and excavations, if the utility is known to be at depths where hand clearing is not feasible or creates additional safety concerns, no work will be performed within the Arcadis 30-inch Tolerance Zone vertically or horizontally of the utility unless manual clearing of the utility is performed under the oversight of an Excavation Competent Person as defined in ARC HSCS005 HSS Arcadis Excavation and Trenching.

5.5.1 Temporary Backfilling of Pre-Cleared Boreholes

In some cases, it may be necessary to temporarily backfill a pre-cleared / daylighted location until the remaining subsurface activities are performed. At these locations where subsurface intrusive work does not immediately follow pre-clearance, it is important to properly backfill and mark the pre-cleared location in order to protect the utility integrity and maintain the location. In general, wooden stakes, survey flags, whisker markers, paint marking, or other surface markings alone are inadequate because these markings can be easily removed, damaged, or otherwise lost creating uncertainty for the pre-cleared location. Although the specific steps for backfilling a pre-cleared location will depend on site-specific conditions, use the following steps to prevent loss of the pre-cleared location:

- Backfill a pre-cleared location with clean sand or other granular material that is recognizably different from the surrounding subsurface native material. Native soil should not be used to backfill a pre-cleared location that may require further subsurface work.

- Backfill the top 2 feet of a pre-cleared location with dyed sand or gravel to facilitate re-location.
- Place wooden stakes or delineators to mark locations as an additional measure, if practical.
- In the event that the pre-cleared borehole is located on asphalt or concrete and an asphalt cold patch is required, use white paint to mark the intrusive location over the asphalt cold patch.
- In some instances, such as projects potentially affected by unexploded ordinance (UXO), the pre-cleared borehole may require that a PVC pipe of matching diameter be inserted into the pre-cleared borehole, filled with clean sand and affixed with a matching cap. Project teams are to discuss client specific utility location and marking requirements with the project manager prior to conducting work.
- Always use a physical subsurface marker such as described above to identify the pre-cleared borehole location. Don't rely solely on field measurements or GPS coordinates as the only means for locating pre-cleared locations.
- If a utility or anomaly/obstruction is encountered during the pre-clearing process, backfill the hole with the native soil and mark the location with a pink-painted X and/or NO.

In the event that a previously pre-cleared location cannot be located, the location must be re-cleared prior to performing subsurface intrusive work

5.6 Clearance for Working in Vicinity of Subsurface Utilities – The Arcadis Utility Tolerance Zone

Prior to the start of subsurface intrusive activities (i.e., excavating / test pitting, drilling, installing grounding rods, manual soil sampling etc.), all utilities must be located, and steps taken to avoid unintentionally contacting or damaging subsurface utilities. See exemptions for subsurface intrusive work in Exhibit 1 (Definitions). Field Teams are not to procced with subsurface work involving utilities located within 30 inches of a line marking as measured radially (e.g. 360 degrees) from the outermost point of the marked utility. If only the centerline of the utility or utility bank is marked, but the utility width or diameter is known or suspected, the diameter of the utility or utility bank (Exhibit 1) must be incorporated into the Arcadis 30-inch Tolerance Zone, see Figure 1 located in Exhibit 2 for further instructions and an illustration of the Arcadis 30-in. Tolerance Zone.

If and when any line of evidence reveals planned subsurface work will occur within the Arcadis 30-inch Tolerance Zone of known/marked/located/observed utilities or structures, the project team must Stop Work and contact Corporate H&S for a review of steps the team has taken to prevent injury or incident involving the conflict.

If subsurface work using heavy or mechanized equipment must take place within the Arcadis 30-inch Tolerance Zone of the marked utility, the utility must be exposed (daylighted) using soft dig clearance methods prior to starting subsurface intrusive activities as described in Section 5.5 of this HSS.

Note: No heavy or mechanized equipment is permitted to be used within the Arcadis 30-inch Tolerance Zone for the purpose of daylighting the utility.

Once the utility in conflict has been daylighted, and heavy or mechanized equipment use is planned within the Arcadis 30-inch Tolerance Zone of the utility, such work must receive pre-approval by Corporate H&S to review steps the team has taken to assess and mitigate the risk associated with the planned work. Additional excavation safety procedures may have to be developed as part of the Corporate H&S approval to proceed. It should be noted that any disturbance within 30 inches of the marked utility, or disruption of the surrounding bedding materials could affect the integrity of the utility.

For horizontal borings, to avoid striking a utility, damage from vibration, damage by pressure of the advancing boring, do not drill within 30 inches in all directions (3-Dimensional cylinder) of a line marking. Make sure to factor the diameter of the line or utility bank when calculating the extent of the 30-inch Tolerance Zone. When crossing a utility during horizontal drilling, it is recommended that the utility be exposed 30 inches in a 360°-direction. When exposing utilities for horizontal borings, the utility must be exposed (potholed) by soft dig/clearance methods. This recommendation applies even if the operating contractor has technology that places the location to within a few inches. Make sure to factor the diameter of the utility when determining the 30-inch Tolerance Zone. If subsurface work must take place within the 30-inch Tolerance Zone of the line marking, the utility must be exposed (potholed) by soft dig/clearance methods prior to starting subsurface intrusive work (see Section 5.5 for options); no mechanized equipment is permitted for the exposing of the utility. Once the utility has been exposed, if mechanized equipment is planned for use within the 30-inch Tolerance Zone of the utility, such activity must receive pre-approval by Corporate H&S, as necessary, to mitigate or accept the risk associated with the planned work. Additional excavation safety procedures may have to be developed as part of the approval to proceed. It should be noted that any disturbance within the 30 inches or disruption of the bedding materials could affect the integrity of the utility.

Additional cautions for horizontal borings include gravity-fed utilities, such as sewers and storm drains. The depth of these utilities will change (sometimes significantly) as they run across the project site. Project teams need to obtain sewer utility depths in the work area(s) and determine the depth of the sewer at the location where the boring will actually intersect with the sewer line by collecting sewer pipe invert elevations from identified manholes and interpolating those depths to the area of the subsurface intrusive work.

During well installations and well abandonment via mechanical equipment, the Arcadis 30-inch Tolerance Zone rule applies in an outward direction extending from the outermost edge of the largest diameter auger or greatest width tool used for installation and abandonment (e.g. “over drilling”). In cases where wells have been previously installed and the 30-inch rule has not been followed, work proposed using heavy or mechanized equipment falling within the Arcadis 30-inch Tolerance Zone requires approval from Corporate H&S. For more information, see Figure 1 in Exhibit 2 for further instructions.

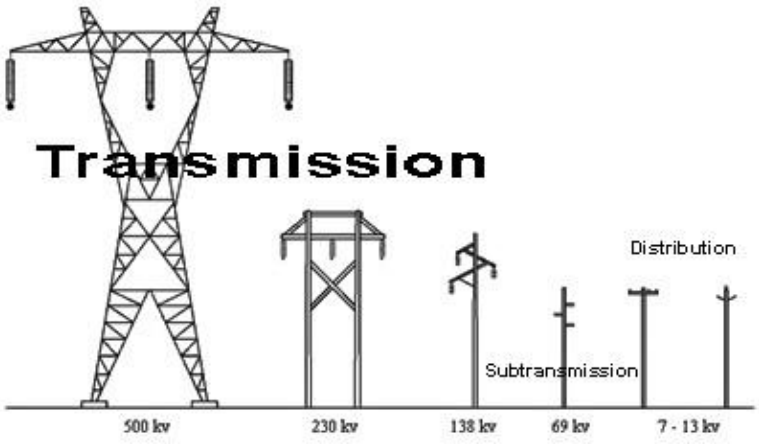
5.6.1 Aboveground Activities causing Subsurface Disturbance in the Vicinity of Underground Utilities

Aboveground work-related activities can cause damage to shallow underground utilities or structures. Asses the intended travel paths, mobilization, staging, and operation of heavy equipment and take steps to ensure shallow utilities are not damaged. If heavy equipment must cross over shallow utilities, the team is responsible for confirming the utilities will be protected.

Other subsurface disturbances may lead to damage such as removing trees/tree stumps, shrubs, or dense vegetation as roots may be entangled with underground piping or structures. For more information, see ARC HSFS-019 Supplement Section 2 Best Practices for Field Personnel Concerning Utility Clearance.

5.7 Acceptable Clearance for Working in Vicinity of Overhead Power Lines and Other Overhead Lines and Structures

No work will be performed by Arcadis or our subcontractor near overhead power lines where any Unqualified Person or equipment is within the limits specified below, unless the power line has been properly covered or de-energized by the owner or operator of the power line, or a qualified electrical subcontractor. Qualified Person approach distances are defined in Exhibit 5A and 5B of **ARC HSFS0006 Electrical Safety Standard**. Illustrations of general types of overhead utility conveyances are provided in **Exhibit 3** - Overhead Power Utility Illustrations



OSHA Electric Power etool illustration

Power Line Voltage Phase to phase (kV)	Minimum Safe Clearance (feet)
50 or below	10
Above 50 to 200	15
Above 200 to 350	20
Above 350 to 500	25
Above 500 to 750	35
Above 750 to 1,000	45

ANSI standard B30.5-1994, 5-3.4.5

5.7.1 Reducing Vehicle and Mechanical Equipment Clearance Requirements

Any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines shall be operated so that a minimum clearance of 10 feet (305 centimeters [cm]) is maintained. If the voltage is greater than 50 kilovolts (kV), the clearance shall be increased 4 inches (10 cm) for every 10 kV over that voltage. However, under any of the following conditions, the clearance may be reduced:

- If the vehicle is in transit with its structure lowered, the clearance may be reduced to 4 feet (122 cm).
- If insulating barriers or “power line shields” rated for the voltage of the line being guarded are installed to prevent contact with the lines, and the barriers are not a part of, or an attachment to, the vehicle or its raised structure, the clearance may be reduced to a distance within the designed working dimensions of the insulating barrier.
- If the equipment is an aerial lift that is insulated for the voltage involved and if the work is performed by a qualified person, the clearance (between the uninsulated portion of the aerial lift and the power line) may be reduced to the distance given in OSHA 1910.333(c)(3)(ii)(C) Table S-5. Reference information from OSHA 1910.333 Table S-5 and NFPA 70E Table 130.4(C)(a) for alternating-current systems and 130.4(C)(b) for the distances associated with direct-current voltage systems is included as Exhibit 5 of ARC HSFS0006 Electrical Safety Standard.

Employees standing on the ground may not contact the vehicle or mechanical equipment or any of its attachments unless:

- The employee is using protective equipment rated for the voltage; or
- The equipment is located so that no uninsulated part of its structure (that portion of the structure that provides a conductive path to employees on the ground) can come closer to the line than permitted in this section of this HSS.

If any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines is intentionally grounded, employees working on the ground near the point of grounding may not stand at the grounding location whenever there is a possibility of overhead line contact. Additional precautions, such as the use of barricades or insulation, shall be taken to protect employees from hazardous ground potentials, depending on earth resistivity and fault currents, which can develop within the first few feet or more outward from the grounding point.

When a machine is in contact with an overhead power line, do not allow anyone to come near or touch the machine. Stay away from the machine and summon outside assistance.

5.7.2 Acceptable Clearance for Working in Vicinity of Non-Electrical Overhead Utilities and Structures

Arcadis field personnel will identify non-electrical overhead utilities and structures and where possible, work is not be conducted within the 30-inch Tolerance Zone of these overhead utilities

and structures. It is recommended that if work will be completed in the vicinity of non-electric overhead utilities, the overhead utilities should be labeled with warning signs, protective barricades, and/or flags. Non-electrical overhead utilities and structures may include, but is not limited to, pipe chases, water lines, ceilings in buildings, etc. Arcadis field personnel will notify its site workers (employees, subcontractors, vendors, etc.) of known overhead utilities and structures during the tailgate safety meeting. See Exhibit 2 for additional details.

5.8 Reporting Utility Incidents

Arcadis field personnel involved with any strike incidents including contact with a structural feature, subsurface, submerged, and/or aboveground utilities must immediately STOP WORK and contact the Project Manager to discuss the incident. If there are life threatening injuries, or the incident presents a risk to public safety (e.g. natural gas leak, downed live electrical line, flooding, or an unstable building) first call 911 or the available emergency services number for the client site or area and then call the Project Manager. The incident must be reported to Corporate Health and Safety immediately and no later than 24 hours after gaining knowledge of the incident. Compliant notification within 24 hrs. requires an acknowledgement of the notification by Corporate H&S. Team must provide critical details of the incident when notifying Corporate H&S such as; 3rd party involvement, any injuries, known extent of damage and estimate of potential repair cost, service interruption, and client reporting requirements. The project team and field staff will use the Arcadis Utility Line Strike Investigation Form to record initial details of the incident as part of the notification process.

Selected utility strike incidents may also utilize a conference call with operations management to review findings and lessons learned. The Business Line H&S Director will make the determination concerning the need to have the incident investigation review call and will arrange the call, if deemed necessary.

5.9 Relationship of this HSS to the Project Specific HASP

With the exception of the Utility and Structures Checklist, this HSS and the supplement documents, are not required to be printed and attached to project HASPs. Project teams have discretion to include such supplements as a BMP or reference guide when developing a project HASP. During project health and safety planning, this HSS will be reviewed and applicable clearance technologies and methods will be documented on the Utility and Structures Checklist.

Additionally, emergency response procedures specific to utility strikes should be addressed. See ARC HSFS-019 Supplement Section 5 which provides general guidelines for emergency response to utility strikes. Applicable information may be attached to the HASP or the Utility and Structures Checklist to facilitate communication of response expectations.

5.10 Required Contract Terms and Conditions

The Arcadis standard client and subcontractor contracts contain required terms and conditions defining responsibility for utility clearance and the allocation of risk associated with an impacted utility. These terms and conditions have prescribed language concerning subsurface work that is presented in Arcadis client contracts and the Arcadis subcontractor contracts, which can be found on the ANA Intranet Legal webpage. If such provisions cannot be agreed upon, the reasons are documented and other risk-management actions should be identified, such as limits of liability, add additional physical investigations, additional lines of evidence or utility location, assignment

of risk to subcontractors, etc. In addition, any changes to these terms and conditions require approval by Legal Services.

6. TRAINING

Employees responsible for coordinating or conducting utility clearance activities will be familiar with the requirements of this HSS and the supplemental documents. Arcadis in-house 8-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) refresher may provide awareness-level training regarding this utility location and clearance HSS.

Field staff must complete a minimum of one year of utility clearance-related experience before accepting responsibility for any utility clearance tasks. This experience requires mentorship by a currently trained and experienced Arcadis employee for the processes of; completing DigSafe 811 notifications, developing a working understanding of the types of utilities present at project sites, developing a working understanding of the various reliable lines of evidence, and participating in on-site training led by another Arcadis employee with detailed knowledge and experience in identifying utilities and structures.

7. REFERENCES

- Occupational Safety and Health Administration (OSHA) 29 CFR Subpart P, Excavations, 1926.651, Specific Excavation Requirements.
    - Common Ground Alliance State Law Directory - https://commongroundalliance.com/map
    - Arcadis Utilities and Structures Checklist:
        - Excel Version - Utility and Structures Checklist
        - PDF Version - Utility and Structures Checklist
    - Arcadis Utility Line Strike Investigation Form
    - The Arcadis ARC HSFS-019 Supplement Documents include the following Sections:
        - Section 1 - Best Practices for Project Managers (or Their Delegates) Concerning Utility Clearance
        - Section 2 - Best Practices for Field Personnel Concerning Utility Clearance
        - Section 3 - Use and Limitations Associated with Location Technologies and Common Utility Clearance Methods
        - Section 4 - Best Practices for State One Call Procedures and Notifications
        - Section 5 - Emergency Action Plan guidelines for Utility Strikes
        - Section 6 - Utility Location SOP for Aquatic Work Activities
    - Figure 1 – 30-Inch Tolerance Zone
    - Arcadis H&S Standard ARC HSCS005 Excavation and Trenching

- Arcadis H&S Standard ARC HSFS0006 Electrical Safety Standard

8. RECORDS

8.1 Utility Clearance Records

All records (maps, checklists, and documentation of communications) used to determine the location of utilities should be retained and kept in the project file.

9. APPROVALS AND HISTORY OF CHANGE

Approved by Julie Santaniello, CSP – Corporate H&S Manager of Technical Programs

History of Change

Revision Date	Revision Number	Standard Developed/Reviewed by or Revised By	Reason for change
13 December 2006	01	Mike Thomas/Pat Vollertsen	Original document
26 March 2007	02	Mike Thomas/Pat Vollertsen	Put in new company format
15 May 2007	03	Mike Thomas/Pat Vollertsen	Added nation-wide 811 number
6 September 2007	04	Mike Thomas/Pat Vollertsen	Changing over to new template format
22 February 2008	05	Mija Coppola	Changing over to new template format
13 January 2009	06	Mija Coppola	Define lines of evidence
4 October 2010	07	Sam Moyers/Mija Coppola	Reformatting and addition of utility clearance information
13 February 2012	08	Sam Moyers/Mija Coppola	Modified link information for utility strike reporting, clarified local/state requirements in section 4.1 and 4.3

Revision Date	Revision Number	Standard Developed/Reviewed by or Revised By	Reason for change
28 January 2013	09	Tony Tremblay	Utility and Structures Checklist revised; hyperlink updated
12 February 2013	10	Amanda Tine/Tony Tremblay	Clarified clearance boundaries for Unqualified staff in Section 5.7 and added information about vehicles and equipment being used near power lines in Section 5.7.1
15 March 2013	11	Kurt Merkle, Rebecca Lindeman / Tony Tremblay	Added additional text to HSS for recent lessons learned, added section 5.4 (Locating Technologies) and 5.5 (Clearance Methodologies), added additional details to section 5.6 when working in close proximity to subsurface utilities, and added Supplement 6 - Utility Location SOP for Aquatic Work Activities.
07 July 2013	12	Andrew McDonald/ Tony Tremblay	Removed HSFS-019 Supplement 1, Utility Definitions. Added hyperlink for One Call and State Law Directory. Segregated evidence of sewer or storm drains in USC list. Removed Sam Moyers and added Andrew McDonald as author.
26 September 2014	13	Andrew McDonald/Tony Tremblay	Added Exhibit 1. Definitions and 30-inch tolerance zone. Clarified use of 811 or state one call as a reliable line of evidence. Added best practice to cover backfilling of pre-cleared boreholes. Updated USC list to cover soft dig termination depths and PM review.
23 February 2015	14	Tony Tremblay	Page number correction

Revision Date	Revision Number	Standard Developed/Reviewed by or Revised By	Reason for change
10 May 2016	15	Denis Balcer/Sharon Lingle/Alec MacAdam/Andrew McDonald/Tony Tremblay/Julie Santaniello	ES and Section 4.2 - define subsurface intrusive work; clarify employees providing oversight of utility contractors, Arcadis requirements of operating and interpreting results of utility clearance equipment, and utility clearance before all subsurface intrusive work. Sections 1 and 5.8- changed submarine to submerged. Section 4.1 – added contacting public utility companies to help clear utilities. Section 4.2 – Clarified requirement to complete one year of utility clearance-related experience. Section 4.2 and 4.3 - Added discussion on aboveground activities causing subsurface disturbances. Added responsibility to clear overhead utilities when heavy equipment will be used and to evaluate use of a spotter. Added that repairs to damaged utilities need to be verified as competent and complete. Section 5.2 – Clarified reliable lines of evidence for each subsurface intrusive work point and degrees of certainty. Added all work within 30-inch Tolerance Zone needs Corp H&S preapproval. Section 5.6 and Exhibit 1- Clarify subsurface intrusive work and activity and exemptions for subsurface intrusive work. Section 5.6.1 – Add requirement to evaluate aboveground activities that may lead to subsurface disturbances that may cause damage to shallow underground utilities or structures.

Revision Date	Revision Number	Standard Developed/Reviewed by or Revised By	Reason for change
10 May 2016	15	Denis Balcer/Sharon Lingle/Alec MacAdam/Andrew McDonald/Tony Tremblay/Julie Santaniello	Section 5.7.2 – added non-electric overhead utilities and structures other than power lines need to be identified and marked if working in that area. Section 9 – Changed reviewer from Tony Tremblay to Julie Santaniello. Exhibit 1 – added definitions of Utility Strike, Daylighting, Potholing, Subsurface Intrusive Work, Subsurface Intrusive Activities, and Utility Bank. HSS and Supplements placed on new Arcadis headers. Updated Supplement revision numbers to be consistent with HSS. Supplement 2 revised. Utility Clearance and Structures Checklist and Utility Strike Investigation Form revised.
17 March 2017	16	Alec MacAdam/Julie Santaniello	Hyperlink updates; minor formatting; Utility Clearance and Structures Checklist revised.
13 May 2020	17	Alec MacAdam/Denis Balcer/Greg Mason/Julie Santaniello	Updated HSS format. Combined HSS Supplements, revised HSS sections, revised the Utility & Structures Checklist, added Exhibit 2 - Acronyms and Abbreviations.

EXHIBIT 1 - Definitions

Aboveground Utilities - For the purpose of this procedure, aboveground utilities include, but are not limited to: any aboveground line, pipe, conduit, system, or facility used for producing, storing, conveying, transmitting or distributing communication or telecommunications signals, electricity, gas, liquid, petroleum and petroleum products, coal slurry, hazardous liquids or gases, water under pressure, steam, sanitary sewage, storm water, or other materials, liquids, or gases.

Daylighting – exposing underground utilities or structures through soft dig technology/clearance prior to completing subsurface intrusive activities.

e.g. - Exempli gratia. Latin for “for the sake of example.” Use it to introduce one or more examples.

Excavation - Any man-made cut, cavity, trench, or depression, in an earth surface formed by earth removal into which a person can bodily enter.

I.e. - I.e. is the abbreviation for “id est” and means “in other words” or “in essence”.

Kilovolt (kV) - One kilovolt is equal to 1,000 volts (v), which are the potential difference that would move one ampere of current against one ohm of resistance. The kilovolt is a multiple of the volt, which is the SI derived unit for voltage.

Overhead Utilities and Structures – Overhead water lines, overhead pipe chases, ceilings in buildings.

Potholing – exposing underground utilities or structures through soft dig technology/clearance prior to completing subsurface intrusive activities.

Subsurface Intrusive Activities – For the purposes of this procedure, subsurface intrusive activities include, but are not limited to excavations, vertical drilling, installing grounding rod, soil sampling, etc.,

Subsurface Intrusive Work – Is any work or activity that breaks the plane of the ground surface. Exemptions include soil sampling using a non-conductive sampling tool to a depth of 6 inches below ground surface (bgs), placement of survey flagging to a depth of 6 inches bgs, and placement of non-conductive survey stake(s) to a depth of 6 inches bgs).

Subsurface Utilities - For the purposes of this procedure, subsurface utilities include, but are not limited to: any underground line, pipe, conduit, system, or facility used for producing, storing, conveying, transmitting or distributing communication or telecommunications signals, electricity, gas, liquid, petroleum and petroleum products, coal slurry, hazardous liquids or gases, water under pressure, steam, storm water, or sanitary sewage; underground storage tanks; tunnels and cisterns; and septic tanks and lines.

Utility Bank – a structure containing two or more conduits. A conduit is a single enclosure containing one or more facilities.

Utility Strike – An unplanned contact of a utility (i.e., overhead utilities, buildings, structures, aboveground utilities, underground utilities. or submerged utilities) during the course of work that results in; damage requiring repairs, making a report to the utility owner, or requiring further assessment to evaluate the potential for damage.

Utility Tolerance Zone – The area within 30 inches measured radially (e.g. extending in all directions) from the outside diameter of a located/marked utility in which special care is to be taken. If the centerline of the utility is marked, the diameter of the utility or utility bank/trench must be incorporated into the 30 inches. This area must be hand cleared with non-mechanized equipment. Once the utility has been exposed, if mechanized equipment is planned for use within the Arcadis 30-inch Tolerance Zone of the utility, such activity must receive pre-approval by Corporate H&S, to mitigate or accept the risk associated with the planned work. See Figure 1 – 30-inch Tolerance Zone.

Exhibit 2 – Acronyms and Abbreviations

ANA	Arcadis North America
Arcadis	Arcadis U.S. Inc.
ARC	Arcadis
APM	Associate Project Manager
APL	Acoustic Pipe Location
AKA	Also Known As
BGS	Below Ground Surface
cm	Centimeter
EM	Electromagnetic
ft.	Feet
GPR	Ground Penetrating Radar
HS	Health and Safety
H&S	Health and Safety
HSS	Health and Safety Standard
HAZWOPER	Hazardous Waste Operations and Emergency Response
HSFS	Health and Safety Field Safety
HSCS	Health and Safety Construction Safety
https	Hypertext transfer protocol secure
in.	Inch
kV	Kilovolt
m	Meter
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
PIV	Post Indicator Valve
PUL	Private Utility Locator
PM	Project Manager
RF	Radio Frequency

RFD	Radio Frequency Detection
SOP	Standard Operating Procedure
TM	Task Manager
TZ	Tolerance Zone
UXO	Unexploded Ordinance

Exhibit 2 Figure 1 – Arcadis Tolerance Zone Illustration

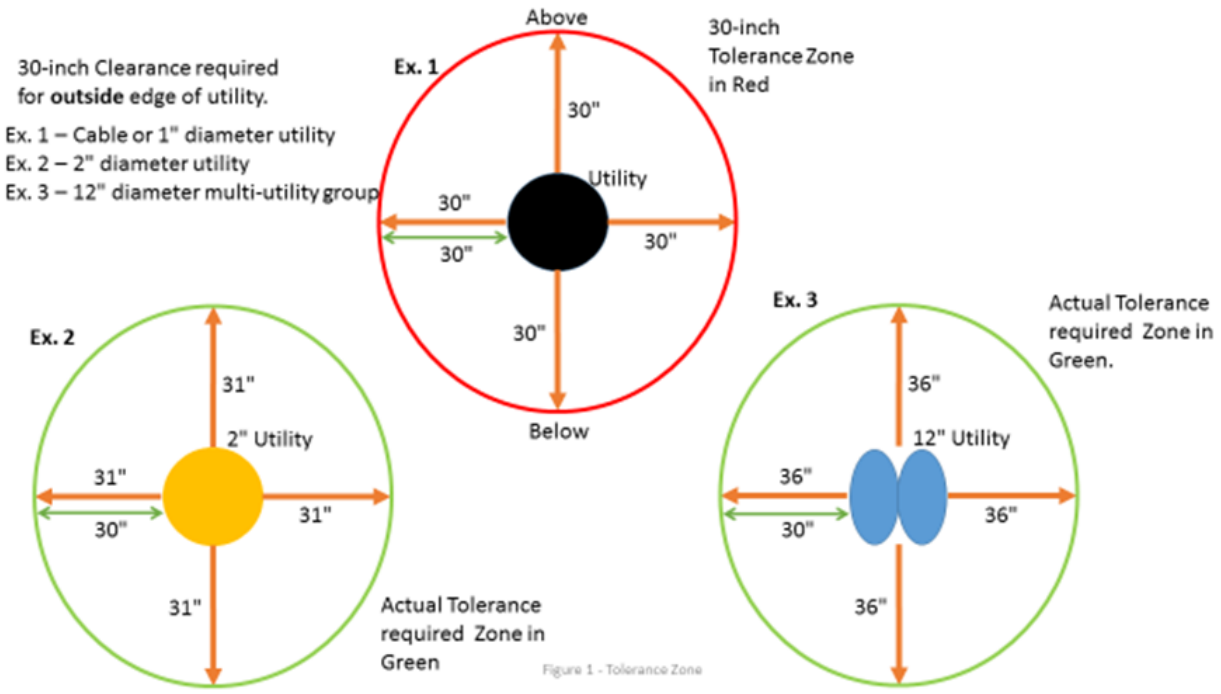
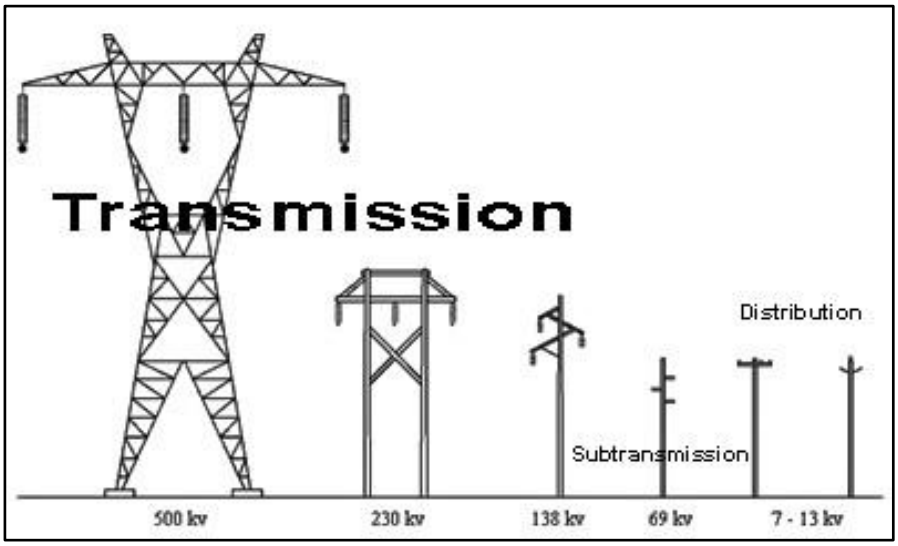
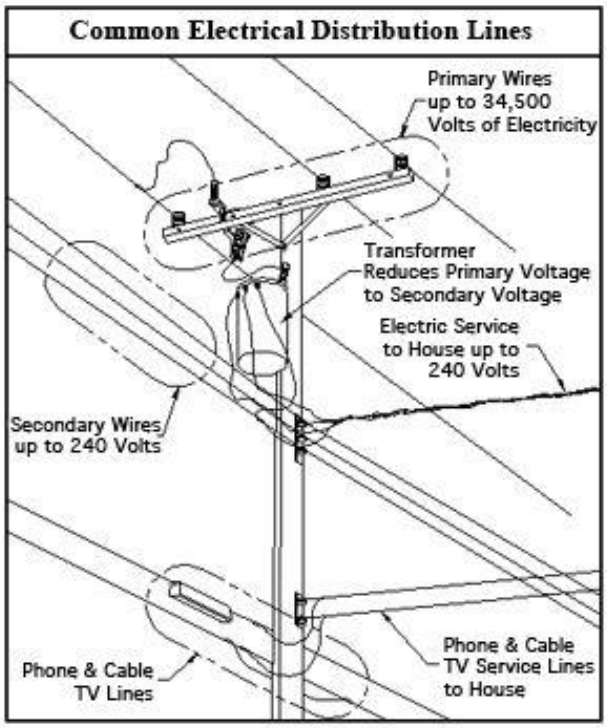


Exhibit 3 – Overhead Power Utility Illustrations





Attachment E
Supplemental Plans

Silica Exposure Control Plan

Project Name: Clyde Former MGP Site16 Sodus StreetClyde, New York 14433
Project Number: 30251446
Date: 1/23/2025

Task Description:
Drilling

1) *Arcadis Silica Competent Person:* Kaitlyn Fleming *Phone:* 619-727-1921
The above individual will ensure requirements stipulated in this plan are implemented and has the authority to take corrective measures and/or revise this plan to ensure employee, contractor and/or public exposure to silica dust remains below the respirable inhalation time weighted average action level of 25 µg/m3 over an 8-hour period.

2) *What material will the team be working with on this project?*
Asphalt

3) *The following work activity will be performed on this project which have a potential for silica dust exposure:*

Drilling/coring (rig mounted)

The following controls will be utilized to mitigate exposure to silica dust hazards:
Based on the activity entered above, the following OSHA/Arcadis activity category is:
Rig-mounted core saws or drills

4) *The controls to be utilized include:*
Use tool equipped with integrated water delivery system that supplies water to cutting surface.
Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.

4a) *Respiratory Protection:*

	≤4 HRS	>4HRS		≤4 HRS	>4HRS
Indoors or Enclosed Area:	None	None	Outdoors:	None	None

Additional Housekeeping Requirements:
Arcadis prohibits dry sweeping or dry brushing where such activity could contribute to employee exposure to respirable crystalline silica unless wet sweeping, HEPA-filtered vacuuming or other methods that minimize the likelihood of exposure are not feasible.

Arcadis prohibits use of compressed air to clean clothing or surfaces where such activity could contribute to employee exposure to respirable crystalline silica unless:
The compressed air is used in conjunction with a ventilation system that effectively captures the dust cloud created by the compressed air; or
No alternative method is feasible (requires concurrence with a CIH).

5) Air Monitoring Requirements for Activities with an Assigned Respirator APF Listed in Section 4a.

☐ Real-time air monitoring for silica is not required for this project.

☐ Real-time air monitoring will be conducted during work activities where employees or contractors are exposed to or have the reasonable probability to be exposed to silica dust hazards. Silica air monitoring will include use of an aerosol monitor equipped with a Dorr-Oliver cyclone kit for respirable dust evaluation. Although not permitted to be the sole method of determining employee exposure, real-time air monitoring for silica will be performed in the employee breathing zone (personal air monitoring) and also performed at the perimeter of the work area (exclusion zone boundary). The results will be documented and submitted to Corporate H&S upon completion of the project. Air samples for laboratory analysis will also be required unless excepted from collection by a CIH.

Aerosol monitor selected for use on this project: _____

Frequency of air sample collection for laboratory analysis: _____

Air samples will be submitted to the following laboratory: _____

6) Medical Surveillance

Employees performing work activities where exposure to silica dust is known to be or has a reasonable probability to be above the OSHA 8-Hr TWA action level of 25 µg/m3 will participate in silica medical surveillance in conjunction with their annual HAZWOPER physical. New entrants into the silica medical surveillance program at times when the HAZWOPER physical is not due will coordinate the required surveillance with WorkCare and then maintain the surveillance with their HAZWOPER physical going forward.

7) Additional Instructions

Signatures:

Veronica Bean	1/23/2025
Preparer Name Printed	Date
Veronica L Bean	
Preparer Signature	

Attachment 2

TGI for Soil Description

TGI – Soil Description

Rev: 5

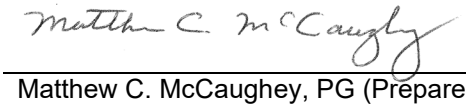
Rev Date: June 20, 2024

Version Control

Issue	Revision No.	Date Issued	Page No.	Description	Reviewed By
	0	May 20, 2008	17	Original SOP	Joe Quinnan Joel Hunt
	1	September 2016	15	Updated to TGI	Nick Welty Patrick Curry
	2	February 16, 2018	15	Updated descriptions, attachments and references in text	Nick Welty Patrick Curry
	3	April 15, 2022		Minor description edits, intro of grain-size K analysis, revised boring log template	Matt McCaughey Patrick Curry
	4	June 5, 2023	All	Annual review completed by SME.	Patrick Curry
	5	June 20, 2024	All	Annual review completed/approved by Patrick Curry	Patrick Curry

Approval Signatures

Prepared by: 6/20/2024



Matthew C. McCaughey, PG (Preparer) Date

Reviewed by: 6/20/2024

Patrick Curry, PG (Subject Matter Expert) Date

1 Introduction

This Arcadis Technical Guidance Instruction (TGI) describes proper soil description procedures based on visual inspection and testing of soil cores and samples. This document has been developed to emphasize field observation and documentation of details required to:

- Make hydrostratigraphic interpretations guided by depositional environment/geologic settings
- Provide information needed to understand the distribution of constituents of concern; properly design wells, piezometers, and/or additional field investigations; and develop appropriate remedial strategies.

2 Intended Use and Responsibilities

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

3 Scope and Application

This TGI should be followed for unconsolidated material unless there is an established client-required specific procedure or regulatory-required specific procedure. In cases where there is a required specific procedure, it should be followed and should be referenced and/or provided as an appendix to reports that include soil classifications and/or boring logs. When following a required non-Arcadis procedure, additional information required by this TGI should be included in field notes with client approval.

This TGI incorporates elements from various standard systems such as ASTM D2488-06, Unified Soil Classification System, Burmister and Udden Wentworth. However, none of these standard systems focus specifically on contaminant hydrogeology and remedial design. Therefore, although each of these systems contain valuable guidance and information related to correct descriptions, strict application of these systems can omit information critical to our clients and the projects that we perform.

This TGI includes the following attachments:

- **Attachment A –** Field Soil Description Guide
- **Attachment B –** Particle Size System Comparison
- **Attachment C –** Description of Logging Terms
- **Attachment D –** Blank Boring Log
- **Attachment E –** Completed Boring Log

This TGI does not address details of health and safety; drilling method selection; boring log preparation; sample collection; or laboratory analysis. Refer to other Arcadis procedure, guidance, and instructional documents, the project work plans including the quality assurance project plan, sampling plan, and health and safety plan (HASP), as appropriate.

4 Personnel Qualifications

Soil descriptions should only be performed by Arcadis personnel or authorized sub-contractors with a degree in geology or a geology-related discipline. Field personnel will complete training on the Arcadis soil description TGI in the office and/or in the field under the guidance of an experienced field geologist with at least 2 years of prior experience applying the Arcadis soil description method.

5 Equipment List

The following equipment should be taken to the field to facilitate soil descriptions:

- Field book, field forms or digital devices to record soil descriptions
- Field book for supplemental notes
- This TGI for Soil Descriptions and any project-specific procedure, guidance, and/or instructional documents (if required)
- Field card showing Wentworth scale
- Munsell® soil color chart
- Tape measure divided into tenths of a foot
- Stainless steel knife or spatula
- Hand lens
- Water squirt bottle
- 4-ounce glass jars with lids (for collecting soil core samples)
- Personal protective equipment (PPE), as required by the HASP
- Digital camera

- Folding table

6 Cautions

Drilling and drilling-related hazards including subsurface utilities are discussed in other procedure documents and site-specific HASPs and are not discussed herein.

Soil samples may contain hazardous substances that can result in exposure to persons describing soils. Routes for exposure may include dermal contact, inhalation and ingestion. Refer to the project specific HASP for guidance in these situations.

7 Health and Safety Considerations

Field activities associated with soil sampling and description will be performed in accordance with a site-specific HASP, a copy of which will be present on site during such activities. Know what hazardous substances may be present in the soil and understand their hazards. Always avoid the temptation to touch soils with bare hands, detect odors by placing soils close to your nose, or tasting soils.

8 Procedure

8.1 General Procedures

- Select the appropriate sampling method to obtain representative samples in accordance with the selected sub-surface exploration method, e.g., split-spoon or Shelby sample for hollow-stem drilling, acetate sleeves for direct push, bagged core for sonic drilling, etc.
- Proceed with field activities in required sequence. Although completion of soil descriptions is often not the first activity after opening sampler, identification of stratigraphic changes is often necessary to select appropriate intervals for field screening and/or selection of laboratory samples.
- Set up boring log field sheet.
    - Determine the proper units of measure. Drillers in both the US and Canada generally work in feet due to equipment specifications. Field geologists typically record drilling depths, core recovery, and sample intervals in feet and grain size in millimeters
    - Use the Arcadis standard boring log form (**Attachment D**). *Note that as of April 2022, several digital logging applications are available through the FieldNow™ program and the Fulcrum app. A future revision of this TGI, likely in early 2023, will emphasize digital logging methods and field boring log forms will no longer be acceptable. FieldNow is discussed further in Section 10.*
    - The boring log template includes a graphic log of the primary soil texture to support quick visual evaluation of grain size. The purpose of the graphic log is to quickly assess relative soil permeability. Note, for poorly sorted soils (e.g., glacial till), the principal component may not correlate to permeability of the sample. In this case, the geologist should use best judgement to graph overall soil type consistent with relative soil permeability. For example, for a dense sand/silt/clay till, the graphic log would reflect the silt/clay, rather than sand.

    - Record depths along the left-hand side at a standard scale to aid in the use of this tool.
- Examine each soil core (this is different than examining each sample selected for laboratory analysis) and record the soil conditions in accordance with guidelines provided in Section 8.2.
- At the end of the boring, record the amount of drilling fluid used (if applicable) and the total depth logged.
- At a minimum, a written or digital boring log should be prepared with the following information:
    - Describe type of surface material (asphalt, grass, topsoil, gravel, etc.)
    - Describe the type of fill or non-native soils and estimated depth to native soils
    - Record sample intervals (soil cores, environmental and/or geotechnical samples)
    - Describe soil conditions in accordance with this TGI
    - Record moisture content and estimated depth to water table or saturated zone
    - Record the total depth and document why drilling was stopped (refusal, target depth achieved, etc.)

8.2 Soil Description Procedures

The standard soil description order is presented below.

- Depth
- PRIMARY TEXTURE
- Principal and Minor Components with Descriptors
    - % Modifiers and grain size fraction
    - Angularity for very coarse sand and larger particles
    - Consistency or Density
    - Plasticity for silt and clay
    - Dilatancy for silt and silt-sand mixtures
- Sorting
- Moisture Content
- Color
- Notes

Depth. To measure and record the depth below ground surface (bgs) of top and bottom of each stratum, the following information should be recorded.

- Measured depth to the top and bottom of sampled interval. Use starting depth of sample based upon measured tool length information and the length of sample interval.
- Length of sample recovered, not including slough (material that has fallen into hole from previous interval), expressed as fraction with length of recovered sample as numerator over length of sampled interval as denominator (e.g., 36/60 for 36 inches recovered from 5-ft [60-inch] sampling interval).
- Thickness of each stratum measured sequentially from the top of recovery to the bottom of recovery.
- Any observations of sample condition or drilling activity that would help identify whether there was loss from the top of the sampling interval, loss from the bottom of the sampling interval, or compression of the sampling interval. Examples: 14/24, gravel in nose of spoon; or 36/60 bottom 12 inches of core empty.

Determination of Components. Obtain a representative sample of soil from a single stratum. If multiple strata are present in a single sample interval, each stratum should be described separately. More specifically, if the sample is from a 2-foot-long split-spoon where strata of coarse sand, fine sand and clay are present, then the resultant description should be of the three individual strata unless a combined description can clearly describe the interbedded nature of the three strata. Example: SAND, fine; with interbedded lenses of Silt and Clay, ranging between 1 and 3 inches thick.

Identify principal component and express volume estimates for minor components on logs using the following standard modifiers.

Modifier	Percent of Total Sample (by volume)
and	36 – 50
some	21 - 35
little	10 - 20
trace	<10

Determination of components is based on using the Udden-Wentworth particle size classification (see below) and measurement of the average grain size diameter. Each size class differs from the next larger class by a constant ratio of ½. Due to visual limitations, the finer classifications of Wentworth's scale cannot be distinguished in the field and the subgroups are not included. Visual determinations in the field should be made carefully by comparing the sample to the Soil Description Field Guide (**Attachment A**) that shows Udden-Wentworth scale or by measuring with a ruler.

The following table summarized the modified Udden-Wentworth Scale for grain size classification. Note that gravel is a size category encompassing the granule, pebble, cobble, and boulder size classes.

Udden-Wentworth Scale (Modified by Arcadis, 2008)				
Size Category	**Size Class**	**Millimeters**	**Inches**	**Standard Sieve #**
Gravel (Cobble)	Boulder	256 – 4096	10.08+	
	Large cobble	128 - 256	5.04 -10.08	
	Small cobble	64 - 128	2.52 – 5.04	
Gravel (Pebble)	Very large pebble	32 – 64	0.16 - 2.52	
	Large pebble	16 – 32	0.63 – 1.26	
	Medium pebble	8 – 16	0.31 – 0.63	
	Small pebble	4 – 8	0.16 – 0.31	No. 5 +
	Granule	2 – 4	0.08 – 0.16	No.5 – No.10

Sand	Very coarse sand	1 -2	0.04 – 0.08	No.10 – No.18
	Coarse sand	½ - 1	0.02 – 0.04	No.18 - No.35
	Medium sand	¼ - ½	0.01 – 0.02	No.35 - No.60
	Fine sand	1/8 -¼	0.005 – 0.1	No.60 - No.120
	Very fine sand	1/16 – 1/8	0.002 – 0.005	No. 120 – No. 230
Fines	Silt (subgroups not included)	1/256 – 1/16	0.0002 – 0.002	Not applicable (analyze by pipette or hydrometer)
	Clay (subgroups not included	1/2048 – 1/256	0.00002 – 0.0002	

Identify components as follows. Remove particles greater than very large pebbles (64-mm diameter) from the soil sample. Record the volume estimate of the greater than very large pebbles. Examine the sample fraction of very large pebbles and smaller particles and estimate the volume percentage of the pebbles, granules, sand, silt and clay. Use the jar method, visual method, and/or wash method (Appendix X4 of ASTM D2488) to estimate the volume percentages of each category.

Sieve and hydrometer grain-size analysis can be used to vet the visual description, as well as used to estimate hydraulic conductivity. Lab or field sieve analysis is advisable to characterize the variability and facies trends within each hydrostratigraphic unit. It is recommended that sieve-hydrometer analysis be performed on representative samples from each soil type to estimate the fraction of each grain size category using ASTM D422 Standard Test Method for Particle-Size Analysis of Soils. If desired sieve sizes can be specified to follow the Udden-Wentworth classification (U.S. Standard sieve sizes 6; 12; 20; 40; 70; 140; and 270) to retain pebbles; granules; very coarse sand; coarse sand; medium sand; fine sand; and very fine sand, respectively.

Several empirical formulas provide a reliable means of estimating hydraulic conductivity (K) from grain-size distribution data, provided that the formation does not contain abundant fines that result in cohesive or plastic behavior or include cobble-sized grains (Payne et al. 2008). Grain-size analysis can help bracket the permeability of hydrostratigraphic units (HSUs) and identify order-of-magnitude spatial variations in K. Arcadis has completed modifications to the Excel-based program HydroGeoSieveXL (Devlin 2015) to process sieve data quickly and estimate K. The tool calculates estimated K values from grain-size data using 15 different empirical formulas. A decision matrix then selects which of the formulas is relevant for the soil type and calculates an average K.

Principal Component. The principal component is the size fraction or range of size fractions containing the majority of the volume. Examples: the principal component in a sample that contained 55% small to medium pebbles would be “PEBBLES, small to medium”; or the principal component in a sample that was 20% fine sand, 30% medium sand and 25% coarse sand would be “SAND, fine to coarse” or for a sample that was 40% silt and 45% clay the principal component would be “CLAY and SILT”.

The boring log form (**Appendix D**) includes a graphic log to visually illustrate a relative estimate of soil permeability. To use the graphic log, place an ‘X’ or shade the appropriate column for the primary soil texture. If the soils have a high percentage of a secondary soil texture (i.e., when the ‘and’ modifier’ is used), it’s acceptable to mark off the appropriate column for the secondary soil texture in this instance. However, care should be used to avoid marking off the columns for other minor soil textures because doing so will make it difficult to determine the relative soil permeability of the poorly sorted soils.

As noted above, for poorly sorted soils such as glacial till, the principal component may not correlate to permeability of the sample. In this case, the geologist should use best judgement to graph overall soil type consistent with relative soil permeability.

Minor Component(s). The minor component(s) are the size fraction(s) containing less than 50% volume. Example: the identified components are estimated to be 60% medium sand to granules, 25% silt and clay; 15% pebbles – there are two identified minor components: silt and clay; and pebbles.

Include a standard modifier to indicate percentage of minor components (see particle size table) and the same descriptors that would be used for a principal component. An example of minor constituents with modifiers include: some silt and clay, low plasticity; little medium to large pebbles, sub-round.

8.2.1 Secondary Descriptors

The following are the descriptors used outside of the principal and minor components. Note that plasticity should be provided as a descriptor for clay and clay mixtures. Dilatancy should be provided for silt and silt mixtures. Angularity should be provided as a descriptor for pebbles and coarse sand.

Angularity. Describe the angularity for very coarse sand and larger particles in accordance with the table below (ASTM D-2488-06). Figures showing examples of angularity are available in ASTM D-2488-06 and the Arcadis Soil Description Field Guide (**Appendix B**).

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Sub-Angular	Particles are like angular description but have rounded edges
Sub-Rounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges.

Plasticity. Describe the plasticity for silt and clay based on observations made during the following test method (ASTM D-2488-06).

- As in the dilatancy test (described below), select enough material to mold into a ball about ½ inch (12 mm) in diameter. Mold the material, adding water, if necessary, until it has a soft, but not sticky, consistency.
- Shape the test specimen into an elongated pat and roll by hand on a smooth surface or between the palms into a thread about 1/8 inch (3 mm) in diameter. If the sample is too wet to roll easily, it should be spread into a thin layer and allowed to lose some water by evaporation. Fold the sample threads and reroll repeatedly until the thread crumbles at a diameter of about 1/8 inch. The thread will crumble when the soil is near the plastic limit.

Description	Criteria
Non-plastic	A 1/8-inch (3 mm) thread cannot be rolled at any water content.
Low	The thread can barely be rolled, and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

Dilatancy. Describe the dilatancy for silt and silt-sand mixtures using the following field test method (ASTM D-2488-06).

- From the specimen, select enough material to mold into a ball about ½ inch (12 mm) in diameter. Mold the material adding water, if necessary, until it has a soft, but not sticky, consistency.
- Smooth the ball in the palm of one hand with a small spatula.
- Shake horizontally, striking the side of the hand vigorously with the other hand several times.
- Note the reaction of water appearing on the surface of the soil.
- Squeeze the sample by closing the hand or pinching the soil between the fingers, and not the reaction as none, slow, or rapid in accordance with the table below. The reaction is the speed with which water appears while shaking and disappears while squeezing.

Description	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing

Note that silt and silt-sand mixtures will be non-plastic and display dilatancy. Clay mixtures will have some degree of plasticity but do not typically react to dilatancy testing. Therefore, the tests outlined above can be used to differentiate between silt-dominated and clay-dominated soils.

Sorting. Sorting is the opposite of grading, which is a commonly used term in the USCS or ASTM methods to describe the uniformity of the particle size distribution in a sample. Well-sorted samples are poorly graded and poorly sorted samples are well graded. Arcadis prefers the use of sorting for particle size distributions and grading to describe particle size distribution trends in the vertical profile of a sample or hydrostratigraphic unit because of

the relationship between sorting and the energy of the depositional process. For soils with sand-sized or larger particles, sorting should be determined as follows:

Description	Criteria
Well Sorted	the range of particle sizes is limited (e.g., the sample is comprised of predominantly one or two grain sizes)
Poorly Sorted	A wide range of particle sizes are present

You can also use sieve analysis to estimate sorting from a sedimentological perspective; sorting is the statistical equivalent of standard deviation. Smaller standard deviations correspond to higher degree of sorting (see Remediation Hydraulics, 2008).

Consistency or Density. This can be determined by standard penetration test (SPT) blow counts (ASTM D-1586) obtained when using hollow-stem auger drilling methods and a split spoon sampling device. Otherwise, some field tests are available as outlined below. When drilling with hollow-stem augers and split-spoon sampling, the SPT blow counts and N-value is used to estimate density. The N-value is the blows per foot for the 6" to 18" interval. For example, for a 24-inch split spoon soil core, the recorded blows per 6-inch interval are: 4/6/9/22. Since the second interval is 6" to 12", the third interval is 12" to 18", the N value is 6+9, or 15. Fifty blow counts for less than 6 inches is considered refusal. In recent years, more common drilling methods include rotary-sonic or direct push. When blow counts are not available, density is determined using a thumb test. Note however, the thumb test only applies to fine-grained soils.

Fine-grained soil – Consistency

Description	Criteria	Blow Counts (6-12 to 12-18-inch split spoon interval)
Very soft	Easily penetrated several inches by thumb	N-value < 2
Soft	Easily penetrated one inch by thumb	N-value 2-4
Medium Stiff	Indented about ½ inch with much effort	N-value 5-8
Stiff	Indented with ¼ inch with great effort	N-value 9-15
Very Stiff	Readily indented by thumbnail	N-value 16-30
Hard	Indented by thumbnail with difficulty	N-value > than 30

Coarse-grained soil – Density

Description	Criteria	Blow Counts (6-12 to 12-18-inch split spoon interval)
Very loose	Density classification of coarse-grained soils is only required when blow counts from standard penetration tests are performed during hollow-stem auger drilling	N-value 1- 4
Loose		N-value 5-10
Medium dense		N-value 11-30
Dense		N-value 31- 50
Very dense		N-value >50

Moisture Content. Moisture content should be described for each soil sample in accordance with the table below (percentages should not be used unless determined in the laboratory). *Note that some drilling methods (e.g., sonic) can compress and dry out the sample during drilling. Therefore, it can be difficult to determine if a sample is saturated, or merely moist. In this case, care should be taken to try and determine a static water level within the borehole by measuring depth to water through the drill casing, if possible.*

Description	Criteria
Dry	Absence of moisture, dry to touch, dusty
Moist	Damp but no visible water
Wet	Visibly free water

Color. Color should be described using simple basic terminology and modifiers based on the Munsell system. Munsell alpha-numeric codes are required for all samples. If the sample contains layers or patches of varying colors this should be noted, and all representative colors should be described. The colors should be described for moist samples. If the sample is dry, it should be wetted prior to comparing the sample to the Munsell chart.

Notes. Additional comments should be made where observed and should be presented as notes with reference to a specific depth interval(s) to which they apply. Some of the significant information that may be observed includes the following.

- Odor - You should not make an effort to smell samples by placing near your nose since this can result in unnecessary exposure to hazardous materials. However, odors should be noted if they are detected during the normal sampling procedures. Odors should be based upon descriptors such as those used in NIOSH “Pocket Guide to Chemical Hazards”, e.g., “pungent” or “sweet” and should not indicate specific chemicals such as “phenol-like” odor or “BTEX” odor.
- Structure
- Bedding planes (laminated, banded, geologic contacts).
- Presence of roots, root holes, organic material, man-made materials, minerals, etc.
- Mineralogy

- Cementation
- NAPL presence/characteristics, including sheen (based on client-specific guidance).
- Reaction with HCl - typically only used for special soil conditions, such as caliche environments.
- Origin, if known (Lacustrine; Fill; etc.).

8.3 Example of Soil Descriptions

The standard generic description order is presented below.

- Depth
- PRIMARY TEXTURE
- Principal and Minor Components with Descriptors
    - % Modifiers and grain size fraction
    - Angularity for very coarse sand and larger particles
    - Consistency or Density
    - Plasticity for silt and clay
    - Dilatancy for silt and silt-sand mixtures
- Sorting
- Moisture Content
- Color
- Notes

10-15 feet CLAY, trace silt, trace small to very large pebbles, subround to subangular up to 2" diameter; medium to high plasticity, stiff, moist, dark grayish brown (10YR 4/2). NOTE: Lacustrine; laminated 0.1 to 0.2" thick, laminations brownish yellow (10YR 4/3).

10 -15 feet SAND, medium to very coarse, little granules to medium pebbles, subround to subangular, trace silt; poorly sorted, wet, grayish brown (10YR5/2).

Unlike the first example where a density of cohesive soils could be estimated, this rotary-sonic sand and pebble sample was disturbed during drilling (due to vibrations in a loose sand and pebble matrix) so no density description could be provided. Neither sample had noticeable odor so odor comments were not included.

9 Waste Management

Project-specific requirements should be identified and followed. The following procedures, or similar waste management procedures are generally required.

Water generated during cleaning procedures will be collected and contained onsite in appropriate containers for future analysis and appropriate disposal. PPE (such as gloves, disposable clothing, and other disposable equipment) resulting from personnel cleaning procedures and soil sampling/handling activities will be placed in plastic bags. These bags will be transferred into appropriately labeled 55-gallon drums or a covered roll-off box for appropriate disposal.

Soil materials will be placed in sealed 55-gallon steel drums or covered roll-off boxes and stored in a secured area. Once full, the material will be analyzed to determine the appropriate disposal method.

10 Data Recording and Management

10.1 Digital Data Collection Process Overview

Digital data collection is the Arcadis standard using available FieldNow® applications that enable real-time, paperless data collection, entry, and automated reporting. Paper forms should only be used as backup to FieldNow® digital data collection and/or as necessary to collect data not captured by available FieldNow® applications. The Field Now® digital form applications follow a standardized approach, correlate to most TGIs and are available to all projects accessible with a PC or capable mobile device. Once the digital forms are saved within FieldNow®, the data is instantly available for review on a web interface. This facilitates review by project management team members and SMEs enabling error or anomalous data detection for correction while the staff are still in the field. Continual improvements of FieldNow® applications are ongoing, and revisions are made as necessary in response to feedback from users and subject matter experts.

10.2 Digital Data Collection Tools for Soil Descriptions

Arcadis is transitioning from the use of paper forms to a digital soil description logging process using web-based FieldNow applications accessible on field tablets and smart phones. Company-wide roll out of a FieldNow application for soil descriptions is targeted by the end of 2022.

Paper forms are included in Revision 3 (April 2022) of this Soil Description TGI. Specifically, a blank boring log and completed boring log are provided in **Attachment D** and **Attachment E**. Additional guidance and examples of the digital data collection tools for soil descriptions will be provided in the next revision to this TGI.

10.3 Additional Guidance

The general logging scheme for soil descriptions is described in this document. Depending on project data quality objectives, specific soil description parameters that are not applicable to project goals may be omitted at the project manager's discretion. In any case, use of consistent procedures is required.

Completed logs and/or logbook will be maintained in the task/project field records file. Digital photographs of typical soil types observed at the site and any unusual features should be obtained whenever possible. Photographs should include a ruler or common object for scale. Photo location, depth and orientation must be recorded in the daily log or logbook and a label showing this information in the photo is useful.

For projects involving soil logging and soil sampling, the soil sample should be recorded on the Arcadis boring log form and the field logbook based on Data Quality Objectives for the task/project.

11 Quality Assurance

Soil descriptions should be completed only by appropriately trained personnel. Descriptions should be reviewed by an experienced field geologist for content, format and consistency. Edited boring logs should be reviewed by the original author to assure that content has not changed.

12 References

ASTM D-1586, Test Method for Penetration Test and Split-Barrel Sampling of Soils.

ASTM D-2488-00, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)

ASTM D422, 63rd Edition, 1972 - Standard Test Method for Particle-Size Analysis of Soils.

Devlin, J.F. 2015. HydroGeoSieve XL: an Excel-based tool to estimate hydraulic conductivity from grain-size analysis. Hydrogeology Journal, DOI 10.1007/s10040-015-1255-0.

Folk, Robert L. 1980. Petrology of Sedimentary Rocks, p. 1-48.

Payne, F. C., Quinnan, J. A., & Potter, S. T. 2008. Remediation Hydraulics. Boca Raton: FL: CRC Press.

United States Bureau of Reclamation. Engineering Geology Field Manual. United States Department of Interior, Bureau of Reclamation. http://www.usbr.gov/pmts/geology/fieldmap.htm.

Munsell® Color Chart – available from Forestry Suppliers, Inc.- Item 77341 “Munsell® Color Soil Color Charts.

Field Gauge Card that Shows Udden-Wentworth scale – available from Forestry Suppliers, Inc. – Item 77332 “Sand Grain Sizing Folder.”

NIOSH Pocket Guide to Chemical Hazards.

Attachment A

Soil Field Reference Guide

The purpose of this attachment is to present a field reference guide for use during soil logging. Field staff are encouraged to bring a laminated copy of this reference guide into the job site.

SOIL DESCRIPTION FIELD GUIDE (APRIL, 2022; REV. 3.0)

ARCADIS Design & Consultancy for natural and built assets

FINE-GRAINED SOILS

Description	Criteria
	Descriptor - Plasticity
Nonplastic	A 1/8-inch (3 mm) thread cannot be rolled at any water content.
Low	The thread can barely be rolled, and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.
	Descriptor - Dilatancy
No Dilatancy	No visible change when shaken or squeezed.
Slow	Water appears slowly on the surface of soil during shaking and does not disappear or disappears slowly when squeezed.
Rapid	Water appears quickly on surface of soil during shaking and disappears quickly when squeezed.
Minor Components with Descriptors	
	Moisture
Dry	Absence of moisture, dry to touch, dusty.
Moist	Damp but no visible water.
Wet	Visible free water; soil is usually below the water table. (Saturated)
	Consistency
Very soft	N-value < 2 or easily penetrated several inches by thumb.
Soft	N-value 2-4 or easily penetrated 1 inch by thumb.
Medium stiff	N-value 5-8 or indented about 1/2 inch by thumb with great effort.
Stiff	N-value 9-15 or indented about 1/4 inch by thumb with great effort.
Very stiff	N-value 16-30 or readily indented by thumb nail.
Hard	N-value > than 30 or indented by thumbnail with difficulty.
Color using Munsell	
Geologic Origin (if known)	
Other	

EXAMPLE OF SOIL DESCRIPTION AND PHOTO

10-15 feet CLAY, trace silt, trace small to very large pebbles, subround to subangular up to 2" diameter; medium to high plasticity, stiff, moist, dark grayish brown (10YR 4/2). NOTE: Lacustrine; laminated 0.1 to 0.2" thick, laminations brownish yellow (10YR 4/3).

DESCRIPTION ORDER

Depth Interval
PRIMARY TEXTURE (e.g., SAND)
Principal and Minor Components with Descriptors:
- % Modifiers and grain size fraction
- Angularity coarse sand and larger
- Consistency or Density
- Plasticity for silt and clay
- Dilatancy for silt and silt-sand

Sorting for granular sediments
Moisture Content
Color
Other NOTES

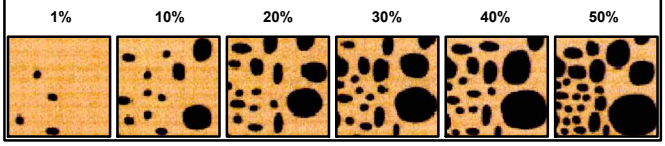
MINOR COMPONENTS % MODIFIERS

Modifier	Percent of Total Sample (by volume)
and	36 - 50
some	21 - 35
little	10 - 20
trace	<10

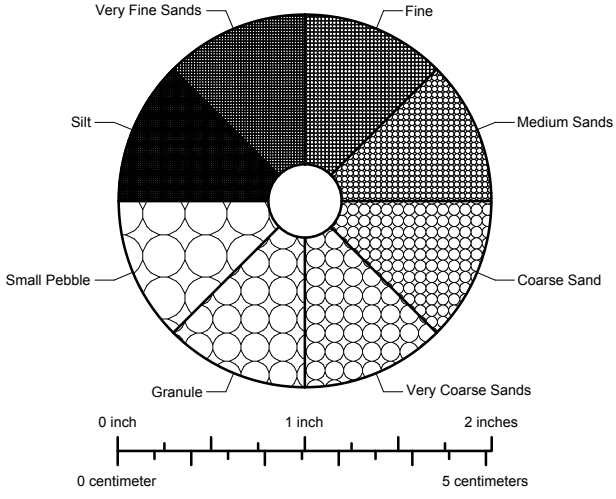
UDDEN-WENTWORTH SCALE

Fraction	Sieve Size	Grain Size	Approximate Scale
Boulder		256 - 4096 mm	Larger than volleyball
Large Cobble		128 - 256 mm	Softball to volleyball
Small Cobble		64 - 128 mm	Pool ball to softball
Very Large Pebble		32 - 64 mm	Pinball to pool ball
Large Pebble		16 - 32 mm	Dime size to pinball
Medium Pebble		8 - 16 mm	Pencil eraser to dime size
Small Pebble	No. 5+	4 - 8 mm	Pea size to pencil eraser
Granule	No. 10 - 5	2 - 4 mm	Rock salt to pea size
Very Coarse Sand	No. 18 - 10	1 - 2 mm	See field gauge card
Coarse Sand	No. 35 -18	0.5 - 1 mm	See field gauge card
Medium Sand	No. 60 - 35	0.25 - 0.5 mm	See field gauge card
Fine Sand	No. 120 - 60	0.125 - 0.25 mm	See field gauge card
Very Fine Sand	No. 230 - 120	0.0625 - 0.125 mm	See field gauge card
Silt and Clay. See SOP for description of fines	Not Applicable	<0.0625 mm	Analyze by pipette or hydrometer

PARTICLE PERCENT COMPOSITION ESTIMATION



GRAPH FOR DETERMINING SIZE OF PARTICLES



FOR COARSE-GRAINED SOILS

Description	Criteria
	Descriptor - Angularity
Angular	Particles have sharp edges and relatively planar sides withunpolished surfaces.
Subangular	Particles are similar to angular but have rounded edges.
Subround	Particles have nearly planar sides but have well-roundedcorners and edges.
Round	Particles have smoothly curved sides and no edges.
Minor Components with Descriptors	
	Sorting Cu= d60/d10
Well Sorted	Near uniform grain-size distribution Cu= 1 to 3.
Poorly Sorted	Wide range of grain size Cu= 4 to 6.
	Moisture
Dry	Absence of moisture, dry to touch, dusty.
Moist	Damp but no visible water.
Wet	Visible free water; soil is usually below the water table. (Saturated)
	Density
Very loose	N-value 1 - 4
Loose	N-value 5 - 10
Medium Dense	N-value 11 - 30
Dense	N-value 31 - 50
Very dense	N-value >50
Color using Munsell	
Geologic Origin (if known)	
Other	
	Cementation
Weak Cementation	Crumbles or breaks with handling or little finger pressure.
Moderate Cementation	Crumbles or breaks with considerable finger pressure.
Strong Cementation	Will not crumble with finger pressure.
	Reaction with Dilute HCl Solution (10%)
No Reaction	No visible reaction.
Weak Reaction	Some reaction, with bubbles forming slowly.
Strong Reaction	Violent reaction, with bubbles forming immediately.

EXAMPLE OF SOIL DESCRIPTION AND PHOTO

10 -15 feet SAND, medium to very coarse, little granules to medium pebbles, subround to subangular, trace silt; poorly sorted, wet, grayish brown (10YR 5/2).

ON THE ORIGINAL DRAWING.
USE TO VERIFY FIGURE
REPRODUCTION SCALE

SOIL DESCRIPTION FIELD GUIDE (APRIL, 2022; REV. 3.0)

ARCADIS Design & Consultancy for natural and built assets

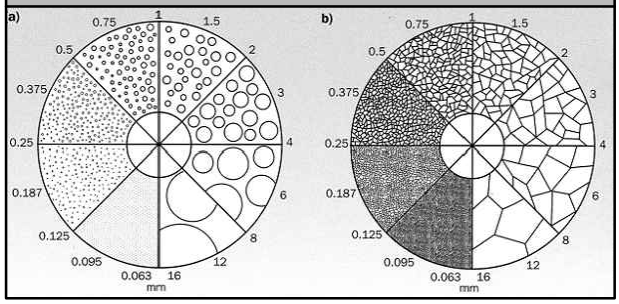
VARIATIONS IN SOIL STRATIGRAPHY

Term	Thickness of Configuration
Parting	0 - to 1/16-inch thickness.
Seam	1/16 - to 1/2-inch thickness.
Layer	1/2 - to 12-inch thickness.
Stratum	> 12-inch thickness.
Pocket	Small erratic deposit, usually less than 1 foot in size.
Varved Clay	Alternating seams or layers of sand, silt, and clay (laminated).
Occasional	≤ 1 foot thick.
Frequent	> 1 foot thick.

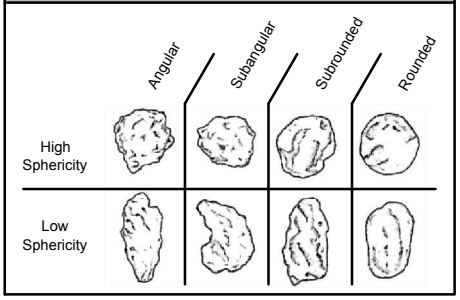
SOIL STRUCTURE DESCRIPTIONS

Term	Description
Homogeneous	Same color and appearance throughout.
Laminated	Alternating layers < 1/4 inch thick.
Stratified	Alternating layers ≥ 1/4 inch thick.
Lensed	Inclusions of small pockets of different materials, such as lenses of sand scattered through a mass of clay; note thickness.
Blocky	Cohesive soil can be broken down into small angular lumps, which resist further breakdown.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear to be polished or glossy, sometimes striated.

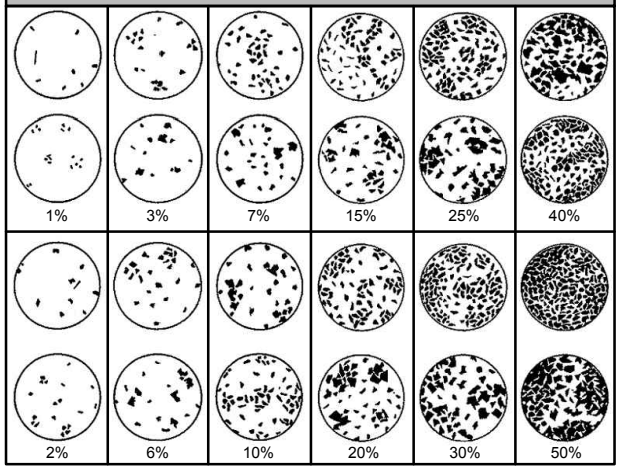
GRAPH FOR DETERMINING SIZE OF PARTICLES



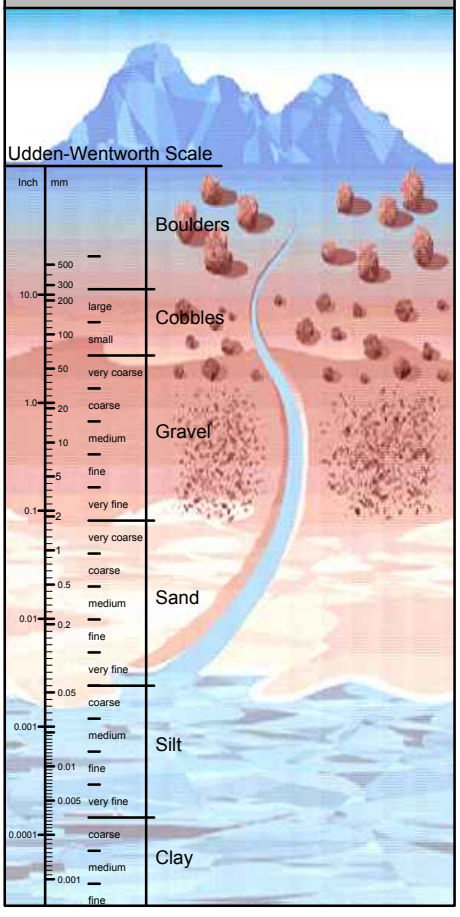
ANGULARITY CHART



PARTICLE PERCENT COMPOSITION ESTIMATION



SORTING



SETTLING TABLE (SILT/CLAY)

Diameter of Particle (mm)	<0.625	<0.031	<0.016	<0.008	<0.004	<0.002	<0.0005
Depth of Withdrawal (cm)	10	10	10	10	5	5	3
Time of Withdrawal	hr:min:sec	hr:min:sec	hr:min:sec	hr:min:sec	hr:min:sec	hr:min:sec	hr:min:sec
Temperature (Celsius)							
20	00:00:29	00:01:55	00:07:40	00:30:40	00:61:19	04:05:00	37:21:00
21	00:00:28	00:01:52	00:07:29	00:29:58	00:59:50	04:00:00	
22	00:00:27	00:01:50	00:07:18	00:29:13	00:58:22	03:54:00	
23	00:00:27	00:01:47	00:07:08	00:28:34	00:57:05	03:48:00	
24	00:00:26	00:01:45	00:06:58	00:27:52	00:55:41	03:43:00	33:56:00
25	00:00:25	00:01:42	00:06:48	00:27:14	00:54:25	03:38:00	
26	00:00:25	00:01:40	00:06:39	00:26:38	00:53:12	03:33:00	
27	00:00:24	00:01:38	00:06:31	00:26:02	00:52:02	03:28:00	
28	00:00:24	00:01:35	00:06:22	00:25:28	00:50:52	03:24:00	31:00:00
29	00:00:23	00:01:33	00:06:13	00:24:53	00:49:42	03:10:00	
30	00:00:23	00:01:31	00:06:06	00:24:22	00:48:42	03:05:00	

10 inches
9 inches
8 inches
7 inches
6 inches
5 inches
4 inches
3 inches
2 inches
1 inch
1/10in

0 mm
10 mm
20 mm
30 mm
40 mm
50 mm
60 mm
70 mm
80 mm
90 mm
100 mm
110 mm
120 mm
130 mm
140 mm
150 mm
160 mm
170 mm
180 mm
190 mm
200 mm
210 mm
220 mm
230 mm
240 mm
250 mm

Attachment B

Particle Size System Comparison

The purpose of this attachment is to illustrate how the Udden-Wentworth particle sizes and descriptive terms compares to other particle size systems.

When in the field, it is a customary practice to compare current soil descriptions to historical soil boring logs for reference purposes. When reviewing boring logs prepared by others, field staff should first note the particle size system used and recognize these particle size systems may differ. This will avoid confusion when cross referencing between historical and new boring logs and when reviewing existing geologic cross-sections.

For example, a well-sorted sand with grain sizes ranging from 1 to 2 mm should be classified as a very coarse sand by the Udden-Wentworth system. As shown in this attachment, the same particle size would be classified as a medium sand by the United Soil Classification System. The later system has fewer particle size grades and in general, is less descriptive than the Udden-Wentworth system.

PARTICLE SIZE SYSTEM COMPARISON

Grain size distribution in millimeters (mm)

Udden-Wentworth — Remediation Geologists and Engineers

		V. Fine	Fine	Medium	Coarse	V. Coarse	Granule	Pebbles				Cobbles	
								Small	Medium	Large	V. Large	Small	Large
CLAY	SILT	SAND					GRAVEL						
0.039	0.065	0.125	0.25	0.5	1	2	4	8	16	32	64	128	256
	1/16	1/8	1/4	1/2									

United Soil Classification System — Geotechnical Engineers

		Fine	Medium	Coarse	Fine	Coarse	
CLAY	SILT	SAND			GRAVEL		COBBLE
	0.074	0.42		2	4.75	19	75 300

U.S. Dept. of Agriculture — Soil Scientists

		V. Fine	Fine	Medium	Coarse	V. Coarse	
CLAY	SILT	SAND					GRAVEL
0.002	0.05	0.10	0.25	0.5	1	2	75

Remediation Hydraulics 2008, page 195): The Udden-Wentworth scale is preferred "...because the geometric progression of grain-size diameter also reflects relationships that are important when considering the erosion and deposition of sediments during the depositional process. The correlation between increasing grain size and degree of sorting and permeability is the most important, as permeability structure is responsible for the mobile and immobile porosity within aquifer systems. "

Attachment C

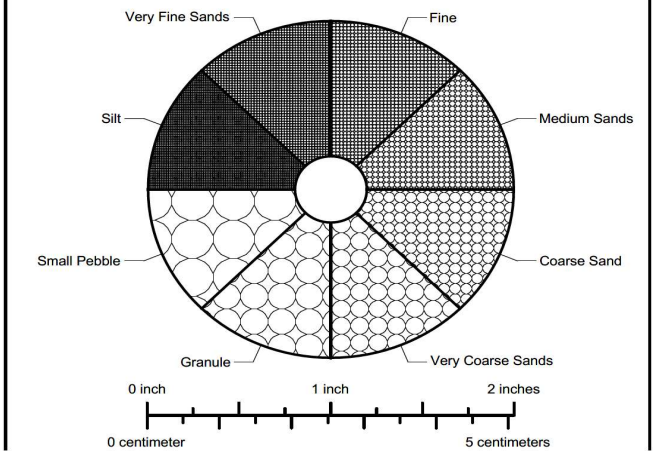
Description of Soil Logging Terms

The purpose of this attachment is to concisely define the soil logging terms used when filling out boring logs. During report preparation, project staff could use this sheet as an index placed in front of the completed boring logs. Also, it can serve as a supplemental reference sheet during field activities.

Description of Logging Terms

Note: Soil descriptions based on Arcadis Technical Guidance and Instructions (TGI) procedures. Key terms defined below.

GRAPH FOR DETERMINING SIZE OF PARTICLES



Udden Wentworth Soil Sizes

Boulder	> 256 mm
Large Cobble	128 to 256 mm
Small Cobble	64 to 128 mm
Very Large Pebble	32 to 64 mm
Large Pebble	16 to 32 mm
Medium Pebble	8 to 16 mm
Small Pebble	4 to 8 mm
Granule	2 to 4 mm
Very Coarse Sand	1 to 2 mm
Coarse Sand	0.5 to 1 mm
Medium Sand	0.25 to 0.5 mm
Fine Sand	0.125 to 0.25 mm
Very Fine Sand	0.062 to 0.12 mm
Silt/Clay	<0.065 mm

Primary Texture *(e.g. CLAY, SILT, SAND, GRANULE, PEAT, MUCK, FILL, etc.)*
List particle size with the highest percentage per sample interval (e.g. SAND)
Always CAPITALIZE the primary texture
Follow primary texture with a comma followed by grain-size descriptors, etc.

Minor Texture

And	(36 to 50%)
Some	(21 to 35%)
Little	(10 to 20%)
Trace	(>10%)

Angularity

Angular	Sharp edges
Sub-Angular	Rounded edges
Sub-Rounded	Well-rounded
Rounded	Smooth curved edges

Sand Density (Blow Counts/ft)

Very Loose	0-4
Loose	5-10
Medium Dense	11-30
Dense	31-50
Very Dense	<50

Silt/Clay Consistency (Blow Counts/ft)

Very Soft	0-2,	thumb easily penetrates several inches
Soft	3-4,	thumb easily penetrates one inch
Medium Stiff	5-8,	thumb indents 0.5 in. with much effort
Stiff	9-15,	thumb indents 0.25 in. with great effort
Very Stiff	16-30,	thumbnail is readily intended

Sorting

Well Sorted	1 to 3 Particle Sizes
Poorly Sorted	4+ Particle Sizes

Moisture Content

Dry	Dry to touch
Moist	No visible water
Wet	Visible free water

Plasticity (for silts and clays)

Non-Plastic	3 mm thread can not be rolled
Low Plasticity	3 mm thread can barely be rolled
Medium Plasticity	3 mm thread can easily and quickly rolled, but not rerolled
High Plasticity	3 mm thread can be rolled slowly, but can be rerolled

Dilatancy (for silts and silt-sand mixtures)

None	No visible change in the specimen
Slow	Water appears slowly during shaking / disappears slowly or not at all upon squeezing
Rapid	Water appears quickly during shaking / disappears quickly upon squeezing

Example Description

10 -15 feet SAND, medium to very coarse, little granules to medium pebbles, subround to subangular, trace silt; poorly sorted, wet, grayish brown (10YR5/2).

Attachment D

Blank Boring Log

The purpose of this attachment is to present a blank field form for use during soil logging. A digital version (Microsoft Excel) of this field form is available from the authors (upon request). If project specific modifications to this boring log template are warranted, please contact the Site Investigation Community of Practice leader for further assistance.

BORING LOG

ARCADIS

Boring ID:		**Project Name:**		**Page:**	/
Permit ID:		**Date Started:**		**Ground Elevation:**	
Site Address:		**Date Completed:**		**Vertical Datum:**	
City, State:		**Total Depth:**		**Northing:**	
Drilling Co:		**Depth to Water:**		**Easting:**	
Driller:		**Hole Diameter:**		**Horizontal Datum:**	
Drilling Method:		**Core Device:**		**Prepared by:**	
Boring Status:		**Drilling Fluid:**		**Reviewed by:**	

Drilling Information				Graphical Log for Primary Texture									Soil Description (Udden-Wentworth System)	Field Notes
				Fines		Sand					Gravel			
Drilling Depth (ft bgs)	Core Interval (ft)	Core Recovery (inches)	Vapor Reading (ppm)	clay	silt	very fine	fine	medium	coarse	very coarse	granule	pebble	cobble	boulder	Depth Interval (ft), PRIMARY TEXTURE, Principal and Minor Components with Descriptors (% modifiers and grain size fraction, angularity for coarse sand and larger, consistency/density, plasticity for silt and clay, dilatancy for silt/silt-sand); Sorting, Moisture Content, Color. NOTES: *Texture Modifiers: Trace (<10%), Little (10 to 20%), Some (21 to 35%), And (36 to 50%)*	Driller's Observations, Geologic Formation, Field Screening Results, Sample Interval etc.

BORING LOG

Boring ID: _____ **Project Name:** _____ **Page:** _____ / _____

Drilling Information				Graphical Log for Primary Texture										Soil Description (Udden-Wentworth System)	Field Notes
				Fines		Sand					Gravel				
Drilling Depth (ft bgs)	Core Interval (ft)	Core Recovery (inches)	Vapor Reading (ppm)	clay	silt	very fine	fine	medium	coarse	very coarse	granule	pebble	cobble	boulder	Depth Interval (ft), PRIMARY TEXTURE, Principal and Minor Components with Descriptors (% modifiers and grain size fraction, angularity for coarse sand and larger, consistency/density, plasticity for silt and clay, dilatancy for silt/silt-sand); Sorting, Moisture Content, Color. NOTES: *Texture Modifiers: Trace (<10%), Little (10 to 20%), Some (21 to 35%), And (36 to 50%)*	Driller's Observations, Geologic Formation, Field Screening Results, Sample Interval etc.

Attachment E

Completed Boring Log

The purpose of this attachment is to provide an example of a completed boring log for reference purposes to field staff. The example provided is for a soil boring completed outside the waste mass of a closed municipal landfill near Baltimore, Maryland. The objective of the drilling program was to determine the depth to groundwater to determine the appropriate depth interval to install a soil gas monitoring well and groundwater monitoring well across the first water-bearing zone. The site geology consists of unconsolidated sediments of the Mid-Atlantic Coastal Plain, specifically the Upper Patapsco formation. These sediments were deposited in a moderate gradient fluvial environment during the Cretaceous period. The landfill was constructed into a regional clay confining unit.

BORING LOG

ARCADIS

Boring ID:	MW-08	**Project Name:**	Acme Landfill	**Page:**	1 / 1
Permit ID:	MD-PG-100	**Date Started:**	7/18/2018	**Ground Elevation:**	50.5 ft
Site Address:	100 Landfill Road	**Date Completed:**	7/18/2018	**Vertical Datum:**	NAVD 88, feet
City, State:	Baltimore, Maryland	**Total Depth:**	35 ft below ground	**Northing:**	123456.79
Drilling Co:	Earth Matters	**Depth to Water:**	19 ft below ground	**Easting:**	123456.79
Driller:	Rod E. Piper	**Hole Diameter:**	2-inch	**Horizontal Datum:**	NAD 83 feet, MD State
Drilling Method:	Direct-push/hollow-stem	**Core Device:**	5-foot macrocore sampler	**Prepared by:**	Sandy Pebbles
Boring Status:	completed as well	**Drilling Fluid:**	none	**Reviewed by:**	Clay Brown

Drilling Information				Graphical Log for Primary Texture											Soil Description (Udden-Wentworth System)	Field Notes
				Fines		Sand					Gravel					
Drilling Depth (ft bgs)	Core Interval (ft)	Core Recovery (inches)	VOC Vapor Reading (ppm)	clay	silt	very fine	fine	medium	coarse	very coarse	granule	pebble	cobble	boulder	Depth Interval (ft), PRIMARY TEXTURE, Principal and Minor Components with Descriptors (% modifiers and grain size fraction, angularity for coarse sand and larger, consistency/density, plasticity for silt and clay, dilatancy for silt/silt-sand); Sorting, Moisture Content, Color. NOTES: *Texture Modifiers: Trace (<10%), Little (10 to 20%), Some (21 to 35%), And (36 to 50%)*	Driller's Observations, Geologic Formation, Field Screening Results, Sample Interval etc.
0 to 1			< 1												0-0.5 ft, topsoil with organics	Grass covered area
1 to 2			< 1				X								0.5-5 ft, SAND, fine, trace silt, trace pebble, round; poorly sorted, moist, yellowish brown (7.5 YR 5/8). NOTE: some cementation, does not react with HCl	continuous macro-core logging
2 to 3	0-5	43.2/60	< 1				X									
3 to 4			< 1				X									cemented sand @3.6-4 ft
4 to 5			< 1				X									
5 to 6			< 1				X	X	X						5-10 ft, SAND, fine to coarse, round to subround; well sorted, moist, light to strong brown (7.5 YR 6/4 to 7.5 YR 5/6).	
6 to 7			< 1				X	X	X							
7 to 8	5-10	40.8/60	< 1				X	X	X							
8 to 9			< 1				X	X	X							
9 to 10			< 1				X	X	X							
10 to 11			< 1				X	X	X						10-12.5 ft, same as above with trace silt	
11 to 12			< 1				X	X	X							
12 to 13	10-15	36/60	< 1				X	X	X							
13 to 14			< 1				X	X	X						12.5 to 15 ft, same as above, color change to pink (7.5 YR 7/3) and reddish yellow (7.5YR 6/8)	
14 to 15			< 1				X	X	X							
15 to 16			< 1						X	X					15-18.9 ft, SAND, coarse to very coarse, round to subround; well sorted, moist, strong brown (7.5YR 5/6) to reddish yellow (7.5YR 6/6)	
16 to 17			< 1						X	X						
17 to 18	15-20	55.2/60	< 1						X	X						
18 to 19			< 1		X	X	X								18.9-22.7 ft, SAND, very fine to fine, and SILT, coarse to very coarse, poorly sorted, wet, light gray (7.5YR 7/1)	water table encountered @ 18.9 ft
19 to 20			< 1		X	X	X									
20 to 21			< 1		X	X	X									
21 to 22			< 1		X	X	X									
21 to 23	20-25	36/60	< 1		X	X	X									
23 to 24			< 1	X	X										22.7-25 ft, CLAY and SILT, high plasticity, soft to stiff at 25 ft, dry to moist, light gray (2/5YR 7/1) w/ red mottling (2.5YR 4/6)	Middle Patapsco Confining Unit
24 to 25			< 1	X	X											
25 to 26			< 1	X	X										25-31.1 ft, CLAY and SILT, high plasticity, stiff; dry to moist, light gray (2/5YR 7/1) with red mottling (2.5YR 4/6)	
26 to 27			< 1	X	X											
27 to 28	25-30	30/60	< 1	X	X											
28 to 29			< 1	X	X											
29 to 30			< 1	X	X											
30 to 31			< 1	X	X											
31 to 32			< 1		X											
32 to 33	30-35 ft	60/60	< 1		X											
33 to 34			< 1		X										31.1-35 ft, SILT, low plasticity, high dilatancy; wet, gray (7.5YR 7/1)	End of direct-push boring @ 35 ft
34 to 35			< 1		X											

Attachment 3

TGI for Monitoring Well Installation

TGI – Monitoring Well Installation

Rev: 2

Rev Date: August 30, 2023

Version Control

Issue	Revision No.	Date Issued	Page No.	Description	Reviewed By
	0	4/24/2017	All	Re-written as a TGI	Marc Killingstad Peter C. Frederick
	1	6/23/2022	All	Put into new template format, reviewed and made minor revisions	Whitney Plasket Marc Killingstad
	2	8/30/2023	All	Annual review completed by SME. Updated Rev 1.	Marc Killingstad

Approval Signatures

Prepared by:		8/30/2023
	Whitney Plasket	Date
Reviewed by:		8/30/2023
	Marc Killingstad	Date

1 Introduction

This Technical Guidance Instruction (TGI) describes methods used to install groundwater monitoring wells in unconsolidated aquifers. It is assumed that the monitoring well to be installed has been properly designed, including sizing of the filter pack and screen, the length of the screen, total depth of the well, material strength and compatibility and surface completion. Typical monitoring wells are constructed of manufactured screen and engineered filter pack and are generally suitable for formations with granular materials having a grain size distribution with up to 50% passing a #200 sieve and up to 20% clay-sized material. Monitoring wells installed in formations finer than this may not be able to produce turbidity free water.

2 Intended Use and Responsibilities

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

3 Scope and Application

The monitoring well installation procedures set forth herein are consistent with the approach and methods presented in the American Society of Testing and Materials (ASTM) *D5092 – Standard Practice for Design and Installation of Groundwater Monitoring Wells* (ASTM D5092). As such, following this TGI in combination with proper well design (see appropriate TGI and/or consult with appropriate subject matter expert), well development (see appropriate TGI), groundwater sampling procedures (see appropriate TGI), and well maintenance and

rehabilitation (see appropriate TGI and/or consult with appropriate subject matter expert), will result in a monitoring well suitable for: (1) collection of groundwater samples representative of the surrounding formation and free of artificial turbidity; (2) measurement of accurate groundwater levels; and (3) hydraulic testing of formation sediments immediately adjacent to the open interval of the well to assess hydraulic properties (e.g., slug testing).

Monitoring well boreholes in unconsolidated (overburden) materials are often drilled using the hollow-stem auger drilling method; however, other drilling methods are also suitable for installing overburden monitoring wells and may be appropriate given site-specific geologic conditions or project objectives. These methods include drive-and-wash, spun casing, rotosonic (sonic), dual-rotary (Barber Rig), and fluid/mud rotary with core barrel or roller bit. Direct-push techniques (e.g., Geoprobe® or cone penetrometer) and driven well points may also be used in some cases within the overburden.

Monitoring wells to be installed within consolidated materials such as fractured bedrock are commonly drilled using air rotary, water-rotary (coring or tri-cone roller bit), or sonic drilling methods. For guidance when installing monitoring wells in consolidated materials, please consult the appropriate subject matter expert and, if available, the applicable guidance document.

The drilling method to be used at a given site will be selected based on site-specific consideration of anticipated drilling/well depths, site or regional geologic knowledge, type of monitoring to be conducted using the installed well, project objectives, and cost. Consultation with the appropriate subject matter expert is also strongly recommended.

No oils or grease will be used on equipment introduced into the boring (e.g., drill rod, casing, or sampling tools). No polyvinyl chloride (PVC) glue/cement will be used in constructing or retrofitting monitoring wells that will be used for water-quality monitoring.

Coated bentonite pellets are generally not recommended because of potential chemical incompatibilities between the coating material and groundwater chemistry.

Specifications of materials to be installed in the borehole will be obtained prior to mobilizing onsite. These materials generally include:

- Well casing (length, material, and diameter);
- Well screen (length, material, diameter, and slot size);
- Grout (typically neat cement grout, which is 5-6 gallons of water per 94 lb. bag of Portland Type I/II cement *with no bentonite* but, as applicable, up to 5% bentonite can be added);
- Filter pack (filter pack type and fine sand seal type, as applicable); and
- Bentonite (type, as applicable/needed, non-coated pellets or tablets are generally preferred over chips).

Well materials will be inspected and, if needed, cleaned, or replaced prior to installation. The field task manager or field team lead will communicate with the drilling company ahead of time to make sure the materials meet the required specification for well construction.

NOTE: If installing monitoring wells for per- and polyfluoroalkyl substances please refer to *TGI for Per- and Polyfluoroalkyl Substances (PFAS) Field Sampling Guide*.

4 Personnel Qualifications

Arcadis field personnel will have completed or are in the process of completing site-specific training as well as having current health and safety training as required by Arcadis, client, or state/federal regulations, such as 40-hour HAZWOPER training and/or OSHA HAZWOPER site supervisor training. Arcadis personnel will also have current training as identified in the site-specific Health and Safety Plan (HASP) which may include first aid, cardiopulmonary resuscitation (CPR), Blood Borne Pathogens (BBP) as needed. The HASP will also identify any access control requirements.

Prior to mobilizing to the field, Arcadis field personnel will review and be thoroughly familiar with relevant site-specific documents including but not limited to the field implementation plan (FIP)/task-specific work plan, Quality Assurance Project Plan (QAPP), HASP, historical information, and other relevant site documents.

Arcadis field personnel will be knowledgeable in the relevant processes, procedures, and TGIs and possess the demonstrated required skills and experience necessary to successfully complete the desired field work. Personnel responsible for overseeing drilling operations will have at least 16 hours of prior training overseeing drilling activities with an experienced geologist, environmental scientist, or engineer with at least 2 years of prior experience.

Arcadis personnel directing, supervising, or leading well installation activities will have a minimum of 1 year of previous environmental monitoring well installation experience. Field employees with less than six months of experience will be accompanied by a supervisor (as described above) to ensure that proper well installation techniques are employed.

Additionally, the Arcadis field team will review and be thoroughly familiar with documentation provided by equipment manufacturers and become familiar with the operation of (i.e., hands-on experience) all equipment that will be used in the field prior to mobilization particularly the selected drilling method/rig.

Monitoring well installation activities will be performed by persons who have been trained in proper well installation procedures under the guidance of an experienced field geologist, engineer, or technician. Field sampling is typically performed for soil or bedrock characterization as part of monitoring well installation; therefore, field personnel will have undergone in-field training in soil or bedrock description and sample collection methods, as described in *TGI for Soil Drilling and Sample Collection, TGI for Bedrock Core Collection and Description, and TGI for Soil Description*.

5 Equipment List

The following materials may be required during soil boring and monitoring well installation activities:

- Site Plan with proposed soil boring/well locations;
- Field Implementation Plan (FIP)/Work Plan that includes site map with proposed well locations, well construction details (tabulated and drawings) which will include well casing material and size, well screen material and size, length of screen, target depth and screen interval, filter pack material, development methods, and previous boring logs (as available);
- Field Sampling Plan (FSP), and site-specific Health and Safety Plan (HASP);
- Personal protective equipment (PPE) as required by the HASP;

- Traffic cones, delineators, caution tape, and/or fencing as appropriate for securing the work area, if such are not provided by drillers;
- Appropriate soil sampling equipment (e.g., stainless steel spatulas, knife);
- Soil and/or bedrock logging equipment as specified in the FIP/work plan or other appropriate project documents;
- Appropriate sample containers and labels;
- Drum labels as required for investigation derived waste handling;
- Insulated coolers with ice, when collecting samples requiring preservation by chilling;
- Photoionization detector (PID) or flame ionization detector (FID);
- Ziplock style bags;
- Water level or oil/water interface meter;
- Locks and keys for securing the well after installation;
- Decontamination equipment (bucket, distilled or deionized water, cleansers appropriate for removing expected chemicals of concern, paper towels);
- Engineer's tape/measuring wheel;
- Weighted tape;
- Disposable bailers;
- Forms/notes:
    - Tablet with digital forms
    - Field notebook
    - Chain-of-custody forms
    - Digital camera (or smart phone with camera);
    - Appropriate field forms, consider including a photo of the well head and a Google Earth map showing the well location.

Prior to mobilizing to the site, Arcadis personnel will contact the drilling subcontractor or in-house driller (as appropriate) to confirm that appropriate sampling and well installation equipment will be provided. Specifications of the sampling and well installation equipment are expected to vary by project, and so communication with the driller is necessary to ensure that the materials provided will meet the project objectives. Equipment/materials typically provided by the driller could include:

- Drilling equipment required by the ASTM standard guidance document D1586, when performing split-spoon sampling;
- Disposable plastic liners (when drilling with direct-push equipment);
- Drums for investigation derived waste (IDW);
- Equipment to move IDW drums, if required;
- Drilling and sampling equipment decontamination materials;
- Decontamination pad materials, if required;

- Traffic cones, delineators, caution tape, and/or fencing as appropriate for securing the work area, if required; and
- Well construction materials.

6 Cautions

- Prior to beginning field work, underground utilities in the vicinity of the drilling areas will be delineated by the drilling contractor or an independent underground utility locator service. See Arcadis standard for proper utility clearance protocol.
- Prior to beginning field work, contact the project technical team (including Project Hydrogeologist) to ensure that all field procedures, logistics (e.g., access issues, health and safety issues, communication network, schedules, etc.), and objectives are clearly understood by all team members.
- Some regulatory agencies require a minimum annular space between the well or permanent casing and the borehole wall. When specified, the minimum clearance is typically 2 to 3 inches on all sides (e.g., a 2-inch diameter well requires a 6-inch diameter borehole). In addition, some regulatory agencies have specific requirements regarding grout mixtures and well seal materials. Determine whether the oversight agency has any such requirements prior to finalizing the drilling and well installation plan. If installing a monitoring well into consolidated sediments, refer to regulatory agency rules regarding casing.
- The maximum screen length may also be dictated by regulatory agencies. If installing a monitoring well with greater than a 10-ft screen, refer to regulatory agency rules regarding screen length.
- If dense non-aqueous phase liquids (DNAPL) are known or expected to exist at the site, refer to the project specific documents for additional details regarding drilling and well installation to reduce the potential for inadvertent DNAPL remobilization. Similarly, if light non-aqueous phase liquids (LNAPLs) are known or expected to be present as “perched” layers above the water table, refer to the *DNAPL Contingency Plan*. Follow the general provisions and concepts in the DNAPL contingency plan during drilling above the water table at known or expected LNAPL sites.
- Avoid using drilling fluids or materials that could impact groundwater or soil quality or could be incompatible with the subsurface conditions. Water used for drilling and sampling of soil or bedrock, decontamination of drilling/sampling equipment, or grouting boreholes upon completion will be of a quality acceptable for project objectives. Consider testing of water supply as necessary.
- Similarly, consider the compatibility between the well materials and the surrounding environment. For example, PVC well materials are not preferred when DNAPL is present. In addition, some groundwater conditions leach metals from stainless steel or are corrosive to metal well materials, and some remedial technologies are incompatible with certain materials of construction. If questions arise, contact the CPM and Project Hydrogeologist/Technical Lead to discuss.
- Specifications of materials used for backfilling the borehole will be obtained, reviewed, and approved to meet project quality objectives. Bentonite is not recommended where DNAPLs are likely to be present or in groundwater with high salinity. In these situations, neat cement grout is preferred.
- As noted above, coated bentonite pellets are not recommended for monitoring well construction, as the coating could impact the water quality in the completed well.

- Heat of hydration during neat cement grout curing must be considered to avoid damage to PVC well materials. The annular space for a typical monitoring well is small enough that heat of hydration should not create excessive temperature increases which may damage PVC well material. However, washouts in the borehole can lead to thick accumulations of grout which can produce enough heat during curing to weaken and potentially damage PVC casing. If heat of hydration is a concern, contact the Project Hydrogeologist/Technical Lead to address the issue.
- Similarly, it is imperative that backfill volumes (filter pack and well seal) be estimated and then closely monitored to ensure that materials are not 'lost' to the formation. If estimated volumes do not reasonably match actual volumes, contact the Project Hydrogeologist/Technical Lead to address the issue.

7 Health and Safety Considerations

Field activities associated with monitoring well installation will be performed in accordance with a site-specific HASP, a copy of which will be present on site during such activities. The HASP may require that the drilling company provide their own HASP and/or Job Safety Analyses (JSAs).

The HASP will be followed, as appropriate, to ensure the safety of field personnel. Review all site-specific and procedural hazards as they are provided in the HASP, and review Job SafetyAnalysis (JSA) documents in the field each day prior to beginning work.

Prior to drilling, utility clearance must be performed (see Section 6). Appropriate personal protective equipment (PPE) must always be worn in accordance with the task and the HASP.

Working outside at sites with suspected contamination may expose field personnel to hazardous materials such as contaminated groundwater or NAPL (e.g., oil). Other potential hazards include biological hazards (e.g., stinging insects, ticks in long grass/weeds, etc.), and potentially the use of sharp cutting tools (scissors, knife). Only use non-toxic peppermint oil spray for stinging insect nests. Review client-specific health and safety requirements, which may preclude the useof fixed/folding-blade knives and use appropriate hand protection.

If thunder or lightning is present, discontinue drilling and sampling until 30 minutes have passed after the last occurrence of thunder or lightning.

8 Procedure

The procedures for installing groundwater monitoring wells are presented below:

Hollow-Stem Auger, Drive-and-Wash, Spun Casing, Fluid/Mud Rotary, Sonic, and Dual-Rotary Drilling Methods

1. Prior to monitoring well installation, determine the expected volumes of filter pack and seal materials including grout (neat cement or cement-bentonite) and bentonite (if applicable).
2. Locate boring/well location, establish work zone, and set up sampling equipment decontamination area.
3. During well installation, record construction details, measurements, and tabulate materials used (e.g., screen and riser footages; filter pack volume; bags of cement/sand; volume of grout; etc.) in the field notebook as well as appropriate field forms.

4. Advance boring to desired depth.
    a. Collect soil and/or bedrock samples at appropriate interval(s), document, and store samples for laboratory analysis as specified in the FIP/Work Plan.
    b. Decontaminate equipment between samples in accordance with the *TGI for Groundwater and Soil Sampling Equipment Decontamination* or if installing monitoring wells for per- and polyfluoroalkyl substances please refer to *TGI for Per- and Polyfluoroalkyl Substances (PFAS) Field Sampling Guide* for both sampling and decontamination guidance.
    c. A common sampling method that produces high-quality soil samples with relatively little soil disturbance is described in *ASTM D1586 – Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils* (ASTM D1586). Split-spoon samples are obtained during drilling using hollow-stem auger, drive-and-wash, spun casing, and fluid/mud rotary.
    d. Sonic drilling produces soil cores that, for the most part, are relatively undisturbed, but note that when drilling in consolidated or finer-grained sediment the vibratory action during core barrel advancement may create secondary fractures or breaks.
    e. Dual-rotary removes cuttings by compressed air or water/mud and allow only a general assessment of geology.
5. Describe each soil sample as outlined in *TGI for Soil Description* and document descriptions in the field notebook and/or field tablet or field forms and photo document the samples. It should be noted that electronic logs must be backed up and transferred to a location accessible to other project team members as soon as feasible to retain and protect the field data. During boring advancement, document all drilling events in field notebook or field forms, including blow counts (number of blows required to advance split-spoon sampler in 6-inch increments) and work stoppages. Blow counts will not be available if sonic, dual-rotary, or direct-push methods are used.
6. Before installing a screen, it is important to confirm that the borehole has been advanced into the targeted saturated zone. This is particularly important for wells installed to monitor the water table and/or the shallow saturated zone, as the capillary fringe may cause soils above the water table to appear saturated. If one or more previously installed monitoring wells exist nearby, use the depth to water at such well(s) to estimate the water-table depth at the new borehole location.

    NOTE: *To verify that the borehole has been advanced into the saturated zone, it is necessary to measure the water level in the borehole. For boreholes drilled without using water (e.g., hollow-stem auger, cable-tool, air rotary, air hammer), verify the presence of groundwater (and/or LNAPL, if applicable) in the borehole using an electronic water level meter, oil-water interface probe, or a new/decontaminated bailer. For boreholes drilled using water (e.g., drive and wash, spun-casing with roller-bit wash, sonic, or water rotary with core or roller bit), monitor the water level in the borehole as it re-equilibrates to the static level.*

    In low-permeability units like clay, fine-grained glacial tills, shale, and other bedrock formations, it may be necessary to wait overnight to allow the water level to equilibrate. Document depth to water in the borehole on the appropriate field forms and field notebook. If there are questions concerning the depth of the well/screen interval, consult with the project technical lead prior to finalizing well depth/screen interval. To the extent practicable, ensure that the depth of the well below the apparent water table is deep enough so that the installed well can monitor groundwater year-round, accounting for seasonal water-table fluctuations. When in doubt, err on the side of slightly deeper well installation.

7. Upon completing the borehole to the desired depth, if a screened well construction is required, install the monitoring well by lowering the screen and casing assembly through the augers or casing. Monitoring wells typically will be constructed of 2-inch-diameter (although sometimes 4-inch), flush-threaded PVC or stainless steel slotted or wire wrapped well screen and blank riser casing. Smaller diameters may be used if wells are installed using direct-push methodology or if multiple wells are to be installed in a single borehole, according to the well design as outlined in the FIP/Work Plan. The screen length and other construction details will be specified in the FIP/Work Plan based on regulatory requirements and specific monitoring objectives. Monitoring well screens are usually 5 to 10 feet long, but the screen length will depend on the purpose for the well and the objectives of the groundwater investigation and will (in most cases) be determined prior to the field mobilization.

   NOTE: *The slot size and filter pack gradation will be predetermined in the Work Plan (or equivalent) or FSP and based on site-specific grain-size analysis (sieve analysis) or other geologic considerations or monitoring objectives. Consult the Project Hydrogeologist and/or subject matter expert if there are questions/concerns regarding the filter pack and slot size specified. If the screen slot size and filter pack have not been based on site-specific grain-size analysis, consider collecting soil samples during well installation so future wells can be properly designed.*

   NOTE: *A blank sump may be attached below the well screen if the well is being installed for DNAPL recovery /monitoring purposes. If so, the annular space around the sump may be backfilled with filter pack during placement around the well screen.*

8. A blank riser will extend from the top of the screen to the level specified in the FIP/Work Plan (e.g., approximately 2.5 feet above grade if a stick up or just below grade where a flush-mounted monitoring well is specified).

   NOTE: *For wells greater than 50 feet deep, placement of centralizers may be desired to assist in centering the monitoring well in the borehole during installation. Refer to the FIP/Work Plan and/or consult with the Project Hydrogeologist/Technical Lead.*

9. When the monitoring well assembly has been set, using a tremie place the washed silica filter pack in the annular space from the bottom of the boring to a height above the top of the screen as specified in the FIP/Work Plan (typically placed to at least 2 feet above the top of the well screen). The filter pack will be placed, and drilling equipment extracted in increments until the top of the sand pack is at the appropriate depth.

   NOTE: *It is very important to verify that the expected volume of filter pack matches with the actual amount placed. There can be differences due to irregularities in the borehole geometry. Washout of the borehole will result in the need for greater than calculated well materials. If a difference of more than 10% is noted, consult with the Project Hydrogeologist/Technical Lead. The filter pack will be consistent with the screen slot size and the soil particle size in the screened interval, as specified in the FIP/Work Plan.*

10. After placement of the filter pack, preliminary well development is recommended be performed to ensure that the filter pack settles and does not bridge within the annular space and to remove any fines accumulated in the well during installation. This typically entails gently surging the entire well screen to prevent filter pack material bridging and to settle the filter pack prior to well seal installation. For recommended procedures, please refer to the *TGI for Monitoring Well Development*. Monitor the placement of the filter pack (e.g., with a weighted tape measure) and, as necessary during preliminary development (i.e., settlement), add filter pack to ensure proper thickness/height above screen is attained.

11. Depending on the project-specific requirements and applicable federal/state/local regulations, a well seal comprised of either fine sand or hydrated bentonite will then be placed in the annular space above the filter pack, typically at a minimum of 2 feet thick—follow the specifications outlined in the FIP/Work Plan). If non-hydrated bentonite is used, allow sufficient time for hydration to occur (typically a minimum of 30 minutes, but follow manufacturer's recommendations and/or specifications outlined in the FIP/Work Plan). Potable water may be added to hydrate the bentonite if the seal is above the water table. Monitor the placement of the fine sand/bentonite seal (e.g., with a weighted tape measure).

    NOTE: *Coated bentonite pellets are generally not recommended for monitoring well construction because of potential chemical incompatibilities between the coating material and groundwater chemistry.*

12. During the extraction of the augers or casing, a neat cement or cement/bentonite grout will be placed in the annular space from the well seal to a depth as specified in the FIP/Work Plan (e.g., approximately 2 ft. below groundwater surface). It is recommended that grout be placed with a tremie pipe. Ensure that seal materials are mixed at the proper ratios with water following manufacturer's recommendations.

    NOTE: *If it is necessary to install a monitor well into a permeable zone below a confining layer (i.e., confined conditions), particularly if the deeper zone is believed to have water quality that differs significantly from the zone above the confining layer, then a telescopic well construction may be considered.*

    In this case, the borehole is advanced approximately 3 to 5 feet into the top of the confining layer (depending upon the thickness of the confining layer), and a permanent casing (typically PVC or stainless steel) is installed into the socket drilled into the top of the confining layer.

    The casing is then grouted in place. The preferred methods of grouting telescoping casings include (1) pressure-injection grouting using an inflatable packer installed temporarily into the base of the casing, such that grout is injected out the bottom of the casing until it is observed at ground surface outside the casing; (2) displacement-method grouting (also known as the Halliburton method), which entails filling the casing with grout and displacing the grout out the bottom of the casing by pushing a drillable plug, typically made of wood to the bottom of the casing, following by tremie grouting the remainder of the annulus outside the casing; or (3) tremie grouting the annulus surrounding the casing using a tremie pipe installed to the base of the borehole.

    In all three cases, the casing is grouted to the ground surface, and the grout is allowed to set prior to drilling deeper through the casing. Refer to the FIP/Work Plan, Project Hydrogeologist, and/or subject matter expert for the completion of non-standard monitoring wells, including telescopic wells.

13. Install the monitoring well surface completion as specified in FIP/Work Plan. Typical completions are a locking, steel protective casing (extended at least 1.5 feet below grade and 2 feet above grade) over the riser casing and secure with a neat cement seal. Alternatively, for flush-mount completions, place a steel curb box with a bolt-down lid over the riser casing and secure with a neat cement seal. In either case, the cement seal will extend approximately 1.5 to 2.0 feet below grade and laterally at least 1 foot in all directions from the protective casing and will slope gently away from the casing to promote drainage away from the well.

14. When an above-grade completion is used, the riser will be sealed using an expandable locking plug and the top of the well will be vented by drilling a small-diameter (1/8 inch) hole near the top of the well casing or through the locking plug, or by cutting a vertical slot in the top of the well casing. When a flush-mount installation is used, the riser will be sealed using an unvented, expandable locking plug.

15. Monitoring wells will be labeled as specified in the FIP/Work Plan. If not specified, use indelible ink or paint with the appropriate designation on both the inner and outer well casings and/or inside of the curb box lid. If called for, mark a consistent measuring point by cutting a V in the PVC casing or marking the measuring point in black.
16. After completing the well installation, lock the well, clean the area, and dispose of materials in accordance with the procedures outlined in Section 9 below.
17. After completing well installation, finalize documentation and follow data management procedures outlined in Section 10 below.
18. For final well development guidance and procedures, please refer to the *TGI for Monitoring Well Development.*

Direct-Push Method

The direct-push drilling method may also be used to complete soil borings and install monitoring wells. Examples of this technique include the Diedrich ESP vibratory probe system, GeoProbe®, or AMS Power Probe® dual-tube system. Environmental probe systems typically use a hydraulically operated percussion hammer. Depending on the equipment used, the hammer delivers 140- to 350-foot pounds of energy with each blow and provides the force needed to penetrate very stiff to medium dense soil formations. The hammer simultaneously advances an outer steel casing that contains a dual-tube liner for sampling soil. The outside diameter (OD) of the outer casing ranges from 1.75 to 2.4 inches and the OD of the inner sampling tube ranges from 1.1 to 1.8 inches.

The outer casing isolates shallow layers and permits the unit to continue to probe at depth. The double-rod system provides a borehole that may be tremie-grouted from the bottom up. Alternatively, the inside diameter (ID) of the steel casing provides clearance for the installation of small-diameter (e.g., 0.75- to 1-inch ID) micro-wells.

If direct-push drilling has been determined to be a viable method for site conditions and project objectives, procedures for installing monitoring wells in soil using the direct-push method are described below.

1. Locate boring/well location, establish work zone, and set up sample equipment decontamination area.
2. Advance soil boring to designated depth, collecting samples at intervals specified in the FIP/Work Plan. Samples will be collected using dedicated, disposable, plastic liners. Collect and describe samples in accordance with the procedures outlined in Steps 4 and 5 above. Collect samples for laboratory analysis as specified in the FIP/Work Plan.
3. Upon advancing the borehole to the desired depth, install the micro-well through the inner drill casing. The micro-well will consist of approximately 1-inch ID PVC or stainless-steel slotted screen and blank riser. The filter pack, well seal, and neat cement/cement-bentonite grout will be installed as described, where applicable, in Steps 9 through 12 above.
4. Install surface completion (protective steel casing or flush-mount), as appropriate and as described in Steps 13 through 15 above.
5. After completing the well installation, lock the well, clean the area, and dispose of materials in accordance with the procedures outlined in Section 9 below.
6. After completing well installation, finalize documentation and follow data management procedures outlined in Section 10 below.

Driven Well Point Installation

If specified in the FIP/Work Plan, well points installed by pushing or driving using a drilling rig or direct-push rig (or hand-driven where possible) will typically consist of a 1- to 2-inch-diameter threaded steel casing with either 0.010- or 0.020-inch slotted stainless-steel screen. The screen length will vary depending on the hydrogeologic conditions of the site. The casings will be joined together with threaded couplings and the terminal end will consist of a steel well point. Because they are driven or pushed to the desired depth, well points do not have annular backfill materials such as sand pack or grout. Refer to the FIP/Work Plan and/or consult with the Project Hydrogeologist/Technical Lead and/or subject matter expert for specific guidance on drive point installation procedures/specifications.

9 Waste Management

IDW, including soil cuttings and excess drilling fluids (if used), decontamination liquids, and disposable materials (well material packages, PPE, etc.), will be placed in clearly labeled, appropriate containers, or managed as otherwise specified in the Work Plan (or equivalent), FSP, and/or IDW management guidance document.

Investigative-Derived Waste (IDW) generated during drilling activities, including soil and excess drilling fluids (if used), and decontamination liquids, will be stored on site in appropriately labeled containers and disposed of properly. Disposable materials will be stored and disposed of separately. Containers must be labeled at the time of collection and will include date, location(s), site name, city, state, and description of matrix contained (e.g., soil, PPE).

Waste will be managed in accordance with the *TGI for Investigation-Derived Waste Handling and Storage,* the procedures identified in the FIP/work plan or QAPP as well as state-, federal- or client-specific requirements. Be certain that waste containers are properly labeled and documented in the field log.

10 Data Recording and Management

Digital data collection is the Arcadis standard using available FieldNow® applications that enable real-time, paperless data collection, entry, and automated reporting. Paper forms should only be used as backup to FieldNow® digital data collection and/or as necessary to collect data not captured by available FieldNow® applications. The Field Now® digital form applications follow a standardized approach, correlate to most TGIs and are available to all projects accessible with a PC or capable mobile device. Once the digital forms are saved within FieldNow®, the data is instantly available for review on a web interface. This facilitates review by project management team members and SMEs enabling error or anomalous data detection for correction while the staff are still in the field. Continual improvements of FieldNow® applications are ongoing, and revisions are made as necessary in response to feedback from users and subject matter experts.

If not using FieldNow®, all well drilling/installations activities will be documented on appropriate field/log forms as well as in a proper field notebook and/or Personal Digital Assistant (PDA) and/or tablet. All field data will be recorded digitally or with indelible ink. Field forms, logs/notes (including daily field and calibration logs), digital records, and chain-of-custody records will be maintained by the field team lead. Any deviations or omissions from this TGI will be documented.

Additionally, all documents (and photographs) should be scanned and electronically filed in the appropriate project directory for easy access. Pertinent information will include personnel present on site, times of arrival and departure, significant weather conditions, timing of well installation activities, soil descriptions, well construction specifications (screen and riser material and diameter, sump length, screen length and slot size, riser length, filter pack type and volume, type of well seal (fine sand or bentonite seal) and volume, type and volume of grout (neat cement or cement-bentonite), and other materials used.

Management of the original documents from the field will be completed in accordance with the site-specific QAPP. Records generated as a result of this TGI will be controlled and maintained in the project record files in accordance with project requirements.

Initial field logs and forms will be transmitted to the Arcadis CPM and/or Technical Lead at the end of each day unless otherwise directed by the CPM. The field team leader retains copies of the field documentation.

Locations of newly installed wells will be documented photographically and/or on a site sketch. If appropriate, a measuring wheel, engineer's tape, or handheld GPS will be used to determine approximate distances from key site features or estimated coordinates.

The well location, ground surface elevation, and inner and outer casing elevations will be surveyed using the method specified in the FIP/Work Plan. Generally, a local baseline control will be set up. This local baseline control can then be tied into the appropriate vertical and horizontal datum, such as the National Geodetic Vertical Datum (NGVD)of 1929 or North American Vertical Datum (NAVD) of 1988 and the State Plane Coordinate System. At a minimum, the elevation of the top of the inner casing used for water-level measurements should be measured to the nearest 0.01 foot. Elevations will be established in relation to the NGVD of 1929 or the NAVD of 1988. A permanent mark will be placed on top of the inner casing to mark the point for water-level measurements.

11 Quality Assurance

Quality assurance procedures will be conducted in accordance with the Arcadis Quality Management System or the site-specific QAPP. Refer to the QAPP or FIP/sampling plan/work plan for specific requirements.

All drilling equipment and associated tools (including augers, drill rods, sampling equipment, wrenches, and any other equipment or tools) that may have come in contact with soil will be cleaned in accordance with the procedures outlined in the appropriate TGI. All well construction materials will be inspected and cleaned (as necessary) prior to well installation.

Field-derived quality assurance blanks will be collected as specified in the FIP/work plan and/or site- specific QAPP, depending on the project quality objectives. Typically, field rinse blanks (equipment blanks) will be collected when non-dedicated equipment (e.g., split-spoon sampler, stainless steel spoon) is used during soil sampling. Field rinse blanks will be used to confirm that decontamination procedures are sufficient and samples are representative of site conditions. Trip blanks for VOCs, which aid in the detection of contaminants from other media, sources, or the container itself, will be kept with the coolers and the sample containers throughout the sampling activities and during transport to the laboratory.

Operate all monitoring instrumentation in accordance with manufacturer's instructions and calibration procedures. Calibrate instruments at the beginning of each day and verify the calibration at the end of each day. Record all calibration activities in the field notebook.

12 References

American Society for Testing Materials (ASTM) D5092 - *Standard Practice for Design and Installation of Ground Water Monitoring Wells*. American Society for Testing Materials. West Conshohocken, Pennsylvania.

American Society of Testing and Materials (ASTM) D1586 - *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils*. American Society for Testing Materials. West Conshohocken, Pennsylvania.

Attachment 4

TGI for Monitoring Well Development

TGI – Monitoring Well Development

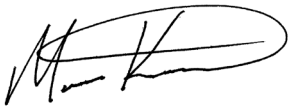
Rev: 2

Rev Date: April 5, 2023

Version Control

Issue	Revision No.	Date Issued	Page No.	Description	Reviewed By
	0	4/24/2017	All	Re-written as TGI	Marc Killingstad
	1	4/12/2022	All	Updated to new format and some minor content changes	Marc Killingstad
	2	4/5/2023	All	Annual review completed by Marc Killingstad. Updated document revision number and date, version control and signature page.	Marc Killingstad

Approval Signatures

Prepared by:		4/5/2023
	Jay Erickson (Preparer)	Date
Reviewed by:		4/5/2023
	Marc Killingstad (Subject Matter Expert)	Date

1 Introduction

This Technical Guidance Instruction (TGI) covers the development of screened wells used for obtaining representative groundwater information and samples from granular aquifers (i.e., monitoring wells).

Note: This TGI only applies to monitoring well development and not remediation (injection/extraction) well development.

2 Intended Use and Responsibilities

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

3 Scope and Application

The objectives of monitoring well development are:

1. Repair damage to the borehole wall from drilling that can include clogging, smearing or compaction of aquifer materials;
2. Remove fine-grained sediment from the formation and filter pack that may result in high turbidity levels in groundwater samples;
3. To re-sort formation and filter pack material adjacent to the well screen;

4. To recover any drilling fluids (if used) that may affect the permeability of the formation and filter pack or alter the water quality around the well; and
5. To optimize the well efficiency and hydraulic communication between the well screen and the formation.

Successful monitoring well development is dependent on the following:

1. Hydrostratigraphy – Permeable formations containing primarily sand and gravel are more easily developed due to lower percentages of silt and clay material. Water in permeable formations can be moved in and out of the screen and/or through the formation easier than in less permeable deposits.
2. Well Diameter – Development tooling including brushes, surge blocks, pumps and jetting tools are more readily available for wells 4 inches in diameter and greater.
3. Well Design – Wells with filter packs and screens designed to match the formation through the analysis of formation sieve samples are easier to develop. An important aspect to well design is to minimize the size of the annular space between the formation and well screen. Adequate room must be allowed for the proper installation of well materials, but not too large as to prevent/reduce communication with the surrounding formation.
4. Drilling Methods – Different drilling methods result in varying amount of borehole damage and, therefore, impact the degree to which development will be successful.

Well development methods for monitoring wells include the following:

1. Bailing – Use of a bailer to remove water and sediment from the well casing. This technique does little to remove fines from the filter pack and may lead to bridging of sediment since the flow is in only one direction, toward the well screen. The most effective use of bailing during monitoring well development is in conjunction with other methods (e.g., surging/swabbing) to remove fines accumulated in the monitoring well between cycles of other development methods.
2. Pumping/over pumping – Use of a pump to remove water and sediment from the well casing, over pumping involves pumping the well at a rate that exceeds the design capacity of the well. Similar to bailing, this technique does little to remove fines from the filter pack and may lead to bridging of sediment since the flow is in only one direction, toward the well screen. Small diameter monitoring wells have the additional constraint on pump size and flow rates which further limit the effectiveness of this methodology.
3. Backwashing (rawhiding) – Consists of starting and stopping a pump intermittently to produce rapid pressure changes in a well. This method can produce better results than pumping alone since the procedure involves movement of the water in and out of the screen and formation. However, in many cases the surging action is not rigorous enough to fully develop the well and might be considered the final phase of development after a more rigorous method has been used. Again, small diameter monitoring wells have the additional constraint on pump size and flow rates which further limit the effectiveness of this methodology.
4. Surging/swabbing – Use of a mechanical surge block or swabbing tool to operate like a piston with an up and down motion. The downstroke causes a backwash action that breaks up bridged sediment and the upstroke pulls the dislodged sediment into the well. This method works well for both small and large diameter monitoring wells. Care should be taken on the downstroke so as not to force fines back into the formation, frequent pumping/purging during surging help to keep fines out of the well. Double surge blocks are recommended, and this is typically the most effective method for development of monitoring wells.

5. Jetting – Use of a tool fitted with nozzles that direct streams of water horizontally into well screens at high velocity. Due to the size of the tooling, this method is better suited for wells 4 inches in diameter and larger. The method is also more effective with wire-wrapped/continuous slot screens due to the increased open area. Jetting requires specialized equipment and concurrent pumping to prevent reintroducing fines into the filter pack. Additionally, depending on the configuration of the tool, jetting may require subsequent surging/pumping to remove fines dislodged in the filter pack and formation. Typically, jetting is not a preferred option for new well development but may be effective as part of a re-development/rehabilitation effort.

For most situations, surging/swabbing coupled with bailing or pumping to remove dislodged materials is recommended.

Final well development for properly designed and constructed monitoring wells may begin after the annular seal materials have been installed and allowed to cure, since these wells are designed to retain approximately 90% of the filter pack material. This cure time is typically at least 24 to 48 hours after the sealing materials have been installed.

This TGI is meant to provide a general guide for proper development of newly installed monitoring wells.

A site-specific field implementation plan (FIP) for well installation and development detailing the specific methods and tools is strongly recommended to provide site-specific instruction and guidance.

4 Personnel Qualifications

Generally, Arcadis field personnel will have completed or are in the process of completing site-specific training as well as having current health and safety training as required by Arcadis, client, and/or state/federal regulations, such as 40-hour HAZWOPER training and/or OSHA HAZWOPER site supervisor training. Arcadis personnel will also have current training as specified in the Health and Safety Plan (HASP) which may include first aid, cardiopulmonary resuscitation (CPR), Blood Borne Pathogens (BBP) as needed. In addition, Arcadis field sampling personnel will be knowledgeable in the relevant processes, procedures, and TGIs and possess the demonstrated required skills and experience necessary to successfully complete the desired field work. The HASP and other documents will identify other training requirements and access control requirements.

The designated Field Manager is responsible for periodic observation of field activities and review of field generated documentation associated with this TGI. The Field Manager is also responsible for implementation of corrective action if problems occur (e.g., retraining personnel, additional review of work plans and TGIs, variances to QC sampling requirements, issuing non-conformances, etc.).

Prior to mobilizing to the field, personnel will review and be thoroughly familiar with relevant site-specific documents including but not limited to the task-specific work plan or field implementation plan (FIP)/field sampling plan/work plan, Quality Assurance Project Plan (QAPP), HASP, historical information, and other relevant site documents.

Field personnel assigned to install and develop monitoring wells are responsible for completing their tasks in accordance with the specifications outlined in this TGI and other appropriate and relevant guidelines.

Monitoring well development activities will be performed by persons who have been trained in proper well development procedures under the guidance of an experienced field geologist, engineer, or technician.

5 Equipment List

Required equipment depends on the selected method and should be detailed in the site-specific FIP; however, the following are typically required.

- Approved site-specific Health and Safety Plan (HASP)
- Approved site-specific FIP which will include site map, well construction information/borehole information, and development plan
- Personal protective equipment (PPE) and health and safety equipment, as required by the HASP
- Field notebook and/or smart device (phone or tablet)
- Cleaning/decontamination equipment
    - Non-phosphate laboratory soap (Alconox or equivalent), brushes, clean buckets or clean wash tubs—new buckets or tubs will be purchased if it cannot be determined if the presentitems are clean
    - Distilled or de-ionized water for equipment decontamination
- Monitoring well keys
- Water-level meter
- Down-hole multiparameter water quality sonde (e.g., YSI)
- Plastic sheeting (e.g., Weatherall Visqueen) to protect all down-hole sampling equipment fromcontact with potential sources of contamination
- Well development forms/logs
- Well construction logs/diagrams
- Weighted tape (of sufficient length for maximum site depth)
- Turbidity meter
- Camera
- Watch/timing device

6 Cautions

Different USEPA regions and/or state regulatory agencies may stipulate deviations from this document. It is the responsibility of the Project Team (Project Manager and Technical Lead) to be fully aware of the requirements from the applicable regulatory framework.

Prior to beginning field work, the project technical team will ensure that all field logistics (e.g., access issues, health and safety issues, communication network, schedules, etc.) and task objectives are clearly understood by all team members. An internal call with the project technical team to review the FIP/field sampling plan/work plan scope and objectives is strongly recommended prior to mobilization to ensure that the field work will be effectively and efficiently executed.

Where surging is performed to assist in removing fine-grained material from the sand pack, surging must be performed in a gentle manner. Excessive suction could promote fine-grained sediment entry into the outside of the sand pack from the formation.

Avoid using development fluids or materials that could impact groundwater or soil quality or could be incompatible with the subsurface conditions.

In some cases, it may be necessary to add potable water to a well to allow surging and development, especially for new monitoring wells installed in low permeability formations. Before adding potable water to a well, the Certified Project Manager (CPM) and/or Project Hydrogeologist must be notified, and the CPM shall make the decision regarding the appropriateness and applicability of adding potable water to a well during well development procedures. If potable water is to be added to a well as part of development, the potable water source should be sampled and analyzed for constituents of concern, and the results evaluated by the CPM prior to adding the potable water to the well. If potable water is added to a well for development purposes, at the end of development the well will be purged dry to remove the potable water, or if the well no longer goes dry then the well will be purged to remove at least three times the volume of potable water that was added

7 Health and Safety Considerations

Field activities associated with monitoring well development will be performed in accordance with a site-specific HASP, a copy of which will be present on site during such activities.

Appropriate PPE will be worn at all times in line with the task and the site-specific HASP.

Review all site-specific and procedural hazards as they are provided in the HASP, and review Job Safety Analysis (JSA) documents in the field each day prior to beginning work.

Access to well locations may expose field personnel to hazardous materials such as contaminated groundwater or NAPL (e.g., petroleum hydrocarbons, chlorinated solvents). Other potential hazards include pressurized wells, stinging insects that may inhabit well heads, other biological hazards (e.g., ticks in long grass/weeds around wellhead), and potentially the use of sharp cutting tools (scissors, knife). Open well caps slowly and keep face and body away while allowing to vent any built-up pressure to vent. Only use non-toxic peppermint oil spray for stinging insect nests. Review client-specific health and safety requirements, which may preclude the use of fixed/folding-blade knives and use appropriate hand protection.

Do not enter confined spaces unless following appropriate confined space entry procedures specified in the HASP.

If thunder or lightning is present, discontinue sampling until 30 minutes have passed after the last occurrence of thunder or lightning.

8 Procedure

As indicated above, for most monitoring wells, gentle surging coupled with bailing or pumping to remove dislodged sediment is recommended.

8.1 Preliminary Well Development

After installation of the primary filter pack around the monitoring well screen, preliminary well development is recommended be performed to ensure that the filter pack settles and does not bridge within the annular space. The preliminary well development steps are as follows:

1. Measure and record depth to water, total depth of well, and depth to top of the sand pack in the annulus.
2. Use steel or weighted bailer to remove any fines that have accumulated in the bottom of the well.
3. Lower an appropriately sized double-surge block into the screened portion of the well on a rigid pipe or high-density tubing and gently cycle up and down to force water in and out of the screen slots and formation. A two-foot throw is recommended (use tape or chalk marks on the pipe or tubing); however, the entire length of well screen must be gently surged.
4. Start above the screen and gently surge over two-foot intervals while working down to the screen bottom.

NOTE: Care must be taken not to surge the well too aggressively at this point as the casing is not well-supported and damage could occur. The objective is to create enough surging action to settle the primary filter pack and provide some preliminary removal of accumulated materials before final development.

NOTE: If possible, ensure that the developer surges the block upward faster than downward to pull the fines out of the filter pack, instead of forcing them back in (and allowing for proper settlement).

5. Monitor the total depth of the well periodically during surging to ensure that we are not pulling excessive amounts of filter pack through the screen and remove any debris accumulated in the well with a weighted bailer or pump.
6. Re-measure the top of the sand in the annulus to see if more sand pack is necessary. Remove any fines that have accumulated out of the well using a submersible pump or weighted bailer.

NOTE: If the monitoring well was drilled using mud rotary drilling methodology or if significant fines were encountered during the well installation, consider adding a commercially available 'mud' dispersant (e.g., AQUA-CLEAR PFD, Nu Well 220, etc.) as part of the preliminary development. This will help to break up the 'skin' along the borehole wall created by either the drilling fluid or smearing during drilling and assist in final development. Follow manufacturer's directions for dosing, and the mixture should be worked through the entire saturated screen interval by gently surging or brushing.

8.2 Final Well Development

After sufficient time has passed to allow for proper curing of the well seal/grout (i.e., 24 to 48 hours), final well development can be performed. Final well development steps are as follows:

1. Don appropriate PPE (as required by the site-specific HASP).
2. Place plastic sheeting around the well.
3. Clean all equipment entering each monitoring well, except for new, disposable materials that have not been previously used.
4. Open the well cover while standing upwind of the well, remove well cap. Insert PID probe approximately 4 to 6 inches into the casing or the well headspace and cover with gloved hand. Record the PID reading in

the field notebook. If the well headspace reading is less than 5 PID units, proceed; if the headspace reading is greater than 5 PID units, screen the air within the breathing zone. If the PID reading in the breathing zone is below 5 PID units, proceed. If the PID reading is above 5 PID units, move upwind from well for 5 minutes to allow the volatiles to dissipate. Repeat the breathing zone test. If the reading is still above 5 PID units, don the appropriate respiratory protection in accordance with the requirements of the HASP. Record all PID readings.

5. Obtain an initial measurement of the depth to water and the total well depth from the reference point at the top of the well casing. Record these measurements in the field logbook. It is recommended to use a weighted tape for the total well depth measurement.
6. The depth to the bottom of the well should be sounded and then compared to the completion form or construction diagram for the well. Any discrepancies should be reported immediately to the CPM and/or Project Hydrogeologist. If sand or sediment is present inside the well, it should first be removed by bailing. Do not insert bailers, pumps, or surge blocks into the well if obstructions, parting of the casing, or other damage to the well is suspected. Instead report the conditions to the CPM and/or Project Hydrogeologist and obtain approval to continue or cease well development activities.

NOTE: If the monitoring well was drilled using mud rotary drilling methodology or if significant fines were encountered during the well installation, it is recommended that a commercially available 'mud' dispersant (e.g., AQUA-CLEAR PFD, Nu Well 220, etc.) be included as part of the final well development to effectively break up the 'skin' along the borehole wall created by either the drilling fluid or smearing during drilling.

Per manufacturer's instructions, the general procedure for adding dispersant is as follows:

i. Determine volume of water in screen area and double the calculated volume to account for water in gravel pack and formation interface

ii. Once the water volume is determined, calculate the required treatment volume of dispersant need per manufacturer's recommendations

iii. Mix thoroughly before introducing into well

iv. The preferable application method utilizes a tremie line with the product applied into the screened area

v. Mixture should be thoroughly blended in well, then agitated via surging/swabbing/brushing repeatedly (e.g., every two hours) for a period of up to 24 hours

vi. The dispersant should sit for at least 6 to 8 hours or overnight before continuing well development activities

7. After allowing the dispersant to sit for the required time (if dispersant is used), start the mechanical development by lowering an appropriately sized double-surge block (or similar) into the well on a rigid pipe or high-density tubing.
    i. Surging should start above the screen to reduce the possibility of "sand-locking" the surge block. Initial surging should be with a long stroke and at a slow rate (20 to 25 strokes per minute)
    ii. After surging above the screen, the well should be cleaned via bottom-loading bailer, submersible pump, or inertia pump tubing with check valve to the bottom of the well

iii. Begin surging at the lower end of the screen, gradually working upward, surging in 2-ft intervals until the entire screen has been developed.

iv. Surge the well a minimum of 10 throws per 2-ft screen interval.

v. Each interval may require several surge cycles to achieve the best development.

vi. The entire length of well screen must be surged.

vii. Ensure that the developer surges the block upward faster than downward to pull the fines out of the filter pack, instead of forcing them back in (and allowing for proper settlement)

viii. measure total depth of the well periodically during surging to ensure that excessive amounts of sediment are not being pulled through the screen. Remove any debris accumulated in the well via simultaneous airlifting (if a combined tool is available) or with bailing/pumping.

8. After completing a cycle of surging, lower a bottom-loading bailer, submersible pump, or inertia pump tubing with check valve to the bottom of the well and gently bounce on the bottom of the well to collect/remove accumulated sediment, if any. Remove and empty the bailer, if used. Repeat until the bailed/pumped water is free of excessive sediment and contact at the bottom of the well feels solid. Alternatively, measurement of the well depth with a weighted tape can be used to verify that sediment and/or silt has been removed to the extent practicable, based on a comparison with the well installation log or previous measurement of total well depth.
9. After surging the well for a minimum of two cycles and removing excess accumulated sediment from the bottom of the well, re-measure the depth-to-water and the total well depth from the reference point at the top of the well casing. Record these measurements in the field log book.
10. Remove formation water by pumping/bailing.

    i. Where pumping is used, measure and record the pre-pumping water level.

    ii. Operate the pump at a relatively constant rate

    iii. Measure the pumping rate using a calibrated container and stopwatch, and record the pumping rate in the field log book

    iv. Measure and record the water level in the well at least once every 5 minutes during pumping

    v. Record any relevant observations in terms of color, visual level of turbidity, sheen, odors, etc.

    vi. Pump or bail until termination criteria specified in the site-specific FIP are reached

    vii. Record the total volume of water purged from the well

NOTE: The FIP may also specify a maximum turbidity requirement for completion of development. Unless otherwise specified the maximum turbidity should be 50 NTUs or less

11. While developing, take periodic water level measurements (at least one every five minutes) to determine if drawdown is occurring and record the measurements on the Well Development Log.
12. While developing, calculate the rate at which water is being removed from the well. Record the volume on the Well Development Log.
13. While developing, water is also periodically collected directly from the well or bailer discharge and readings taken of the indicator parameters: pH, specific conductance, and temperature. Development is

considered complete when the indicator parameters have stabilized (i.e., three consecutive pH, specific conductance, and temperature readings are within tolerances specified in the project work plans or within 10% if not otherwise specified), the extracted water is clear and free of fine sediment and most importantly, when acceptable volume of water has been removed and/or a sufficient amount of surging has been performed.

14. In certain instances, for slow recharging wells, the parameters may not stabilize. In this case, well development is considered complete when minimal amounts of fine-grained sediments are recovered, and an acceptable volume of water has been removed.
15. If the well goes dry, stop pumping or bailing. Note the time that the well went dry. After allowing the well to recover, note the time and depth to water. Resume pumping or bailing when sufficient water has recharged the well.
16. Contain all development water in appropriate containers.
17. When complete, secure the lid back on the well.
18. Place disposable materials in plastic bags for appropriate disposal and decontaminate reusable, downhole pump components and/or bailer

9 Waste Management

Investigation-Derived Waste (IDW), including purge water and decontamination liquids, will be stored on site in appropriately labeled containers and disposed of properly. Disposable materials will be stored and disposed of separately. Containers must be labeled at the time of collection and will include date, location(s), site name, city, state, and description of matrix contained (e.g., water, PPE). Waste will be managed in accordance with the *TGI – Investigation-Derived Waste Handling and Storage*, the procedures identified in the FIP/field sampling plan/work plan or QAPP as well as state-, federal- or client-specific requirements. Be certain that waste containers are properly labeled and documented in the field log.

10 Data Recording and Management

Digital data collection is the Arcadis standard using available FieldNow® applications that enable real-time, paperless data collection, entry, and automated reporting. Paper forms should only be used as backup to FieldNow® digital data collection and/or as necessary to collect data not captured by available FieldNow® applications. The Field Now® digital form applications follow a standardized approach, correlate to most TGIs and are available to all projects accessible with a PC or capable mobile device. Once the digital forms are saved within FieldNow®, the data is instantly available for review on a web interface. This facilitates review by project management team members and SMEs enabling error or anomalous data detection for correction while the staff are still in the field. Continual improvements of FieldNow® applications are ongoing, and revisions are made as necessary in response to feedback from users and subject matter experts.

All well development activities will be documented on appropriate log forms as well as in a proper field notebook and/or PDA. Additionally, all documents (and photographs) should be scanned and electronically filed in the appropriate project directory for easy access. Pertinent information will include personnel present on site; times of arrival and departure; significant weather conditions; timing of well development activities; development

method(s); observations of purge water color, turbidity, odor, sheen, etc.; purge rate; and water levels before, during, and after pumping.

Management of the original documents from the field will be completed in accordance with the site-specific QAPP. Records generated as a result of this TGI will be controlled and maintained in the project record files in accordance with project requirements.

Development activities will be documented on appropriate field logs as well as in a proper field notebook. All field data will be recorded digitally or with indelible ink. Field forms, logs/notes (including daily field and calibration logs), digital records, and chain-of-custody records will be maintained by the field team lead. Any deviations or omissions from this TGI should be documented.

Initial field logs and forms will be transmitted to the Arcadis CPM and/or Technical Lead at the end of each day unless otherwise directed by the CPM. The field team leader retains copies of the field documentation.

11 Quality Assurance

Quality assurance procedures will be conducted in accordance with the Arcadis Quality ManagementSystem or the site-specific QAPP. Refer to the QAPP or FIP/sampling plan/work plan for specific requirements.

12 References

American Society for Testing Materials (ASTM), Designation D5521-05. *Standard Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers*. American Society for Testing Materials. West Conshohocken, Pennsylvania.