



Method Statement and Risk Assessment For Geothermal Open Loop Borehole Drilling and Installation

For

London Borough of Southwark

Development:	Title & Company	Name	Signature	Date
Owner approved:	Director: Drilling & Servicing Contractors Ltd	Steve Bellamy		28/07/20
Reviewer:	Director of Projects: ICAX Ltd	Gary Page		30/07/20
Reviewer:				
Document status:	Approved (if all signature boxes are signed)			

1.0 Scope

1.1 Sequence of Works

The work on each of the three Sites will comprise of drilling two geo-exchange open-loop boreholes drilled to a provisional depth of 125mbgl, installation of permanent steel well casings, well development and test pumping.

2.0 Methodology

2.1 Access and Egress

The client will ensure that prior to the work beginning, the relevant areas of the site are cleared of materials, general waste and debris to allow clear access to the proposed locations of the boreholes and that the surface is suitably prepared for supporting the static weight of the drilling rig which is 12.5 tonnes and in the order of 32.5 tonnes in operation. Special attention should be given to areas of backfilling such as former basements, old manholes and service ducts to ensure that no risks are posed to the stability of drilling equipment from settlement or collapse of poorly placed fill materials.

All drilling operatives working on the project will hold a valid and current CSCS card as issued by the Construction Skills Card Scheme. Lead drilling crew will also hold NVQ Level 2 Land Drilling Qualifications.

Support vehicles will remain on site with support equipment and may possibly be left overnight.

2.2 General

The precise borehole locations will be agreed with The Main Contractor and ICAX once the utility and infrastructure surveys have been undertaken.

All buried services will be clearly marked out prior to our arrival on site and the borehole locations cleared of both shallow services and deep level infrastructure. If any doubt exists concerning the safety of drilling at a particular location an alternative borehole position shall be agreed in consultation with ICAX and Vital.

Hand dug service clearance pits may be required on the borehole locations if services are in close proximity.

Prior to commencement of any excavation or drilling a Permit to Dig will be issued by the Main Contractor.

2.3 Setting up

The drilling rigs will be manoeuvred onto the borehole position and the stabilising jacks extended where applicable. Suitable timber sleepers will be placed under the feet of the levelling jacks where required and the jacks extended to level the rig. Verticality is to be checked by placing a spirit level on the rotary rig mast on initial set-up and at the start of each shift as a minimum.

Mud tanks, pumps and pump lines are to be set up adjacent to the drilling rig so as to provide a suitable working area. Tanks may be supported on sleepers and timber baulkings as required to provide a firm base for the duration of the drilling works where required.

Water is to be obtained from the Thames Water Hydrants located inTBC

The Main Contractor will be responsible for provision of appropriate barriers and signage during the course of the works when the supply is in use.

2.4 Borehole Drilling

Drilling will be carried out using both cable percussion and rotary methods. Rotary drilling will utilise direct circulation mud and water flush as appropriate to the formation being drilled.

The boreholes will be commenced with cable percussive techniques and temporary 508mm diameter conductor casing installed through any Made Ground and the River Terrace deposits to engage the London Clay. Casing is to be installed until the upper formation is stable enough for the borehole to be advanced with open-hole rotary techniques.

Drilling will continue below the base of the casing using a 450mm bit appropriate to the formation conditions being drilled until a minimum of 3m penetration into competent Upper Chalk is reached. Once the target depth has been reached the borehole will be flushed to remove any remaining cuttings and the drill string removed. As the drill string is removed the borehole will be topped-up with clean drilling mud to maintain a positive hydrostatic pressure in the borehole when required.

2.5 Casing Installation & Grouting

Upon removal of the drill string permanent 340mm Water Well casings will be installed from ground level to approximately 3m penetration into the competent Chalk aquifer.

The lead length of casing will be fitted with a cement grouting shoe. Prior to commencement of grouting, the borehole will be flushed through the grouting shoe to ensure that the annulus is free of debris.

The grout will be placed using a tremmie pipe to the base of the borehole to engage with the cement shoe and will provide a positive upward displacement to ensure uniform and consistent grouting throughout the length of the casing. Grout used for this process will be Sulphate Resistant Cement.

As grouting progresses the drilling fluid arising will be pumped back to the settlement tanks. Grouting will continue until thick consistent grout appears at the surface. Additional topping up may be carried out after the initial curing period.

Following a minimum 24 hour curing period drilling will continue into the Upper Chalk using a 314mm drill bit until the target depth of 125m (To be confirmed) is reached. At this depth the borehole will be flushed clean of debris to leave a clean open hole. This completes the drilling phase of the works for the borehole.

2.6 Temporary Well protection

Upon completion of the drilling phase a temporary flanged well cap will be installed on the well. The cap will also have a dipping access so that quick access for dipping the water level in the well can be maintained.

2.7 Construction of Wellhead chamber

A wellhead chamber will be constructed from ground level following completion of the drilling phase or alternatively at the end of the development and pumping phase depending on a number of factors as the project progresses.

The chamber will consist of rectangular segmental precast concrete sections (Dimensions to be confirmed) bedded on a mass concrete base. The internal depth of the chamber will be approximately 1.25m

Excavations will either be 'battered' back to a slope suitable for the prevailing ground conditions or supported by a proprietary shoring system such as braced sheets and box frames appropriate to the location and ground conditions. Access to the excavation will be by means of a secured ladder which extends 1m above the step off level.

Edge protection will also be in place consisting of hurdle barriers set back at least 1m from the excavation edge.

Reduced dig to expose the wellhead and reach a formation level of approximately 1.4m below ground level will be carried out by mechanical excavator. The mass concrete base will be mechanically placed without man access to the excavation.

The wellhead chamber precast concrete sections or reinforced plastic with concrete backing will be used and any cover slab will be placed using appropriate mechanical lifting arrangements to raise the completed chamber to near ground level.

External backfilling to wellhead chamber will be completed and internal finishing undertaken, comprising refining internal floor gradients, placing an internal drain and re-setting the flange head.

2.8 Well development – air lift

Well development is required following borehole drilling to improve the abstraction / discharge efficiency from the borehole. The process removes drilling material adhered to the borehole wall, loose material and suspended solids from the borehole and uses air to lift the material from the borehole in a water suspension to ground level where the water and air are separated prior to disposal.

The well development equipment consists of a 140mm diameter steel rising main with integral 32mm diameter HDPE air line. A cyclone separator on a settlement tank is sited at ground level to receive aerated water from the well. Following separation the waste water is pumped to the discharge point agreed with Thames Water.

In operation, the rising main is assembled in 3m sections and lowered into the borehole using a cable percussion rig. When the rising main is at the required depth air is fed via the air line to the bottom of the well development casing aerating the water at the bottom of the rising main. The aerated water and any suspended loose material will be driven up the rising main to the surface. The water and air are separated at the surface using a cyclone separator, with the air vented to atmosphere and the waste water discharged initially to stilling tanks then pumped to the nearby sewer via a suitable discharge point.

The discharge point is being located by The Main Contractor and meets the access and construction requirements of the Thames Water discharge licence. The discharge provision will need to have sufficient capacity to accept the maximum discharge identified in the licence.

A stand-alone compressor provides air for well development. The air pressure is only applied once the well development equipment is installed down the borehole and as such safely contained. The applied air pressure will be between 5bar and 10 bar (500 – 1000 kPa) depending on the depth of the development. The air line is PE100 HDPE piping.

The well development process is initiated at a depth of approximately 75m below ground level, and advanced at regular intervals to the full depth of borehole (c. 125m below ground level).

At completion of the well development phase, the well development equipment is broken down and recovered to the surface for removal from the project.

2.9 Pumping tests

Scope

Pumping tests will be undertaken on both open loop boreholes with a task aim of assessing the performance potential of the water resource. The pumping tests will be carried out in accordance with BS ISO 14686:2003 *Hydrometric Determinations. Pumping tests for water wells. Considerations and guidelines for design performance and use.*

Testing will be undertaken in three distinct phases: set up and development test, step test, constant rate discharge test. This sequence will be repeated for both boreholes.

The testing phases will run consecutively and continuously for each borehole. The sequencing and indicative durations of each phase will be advised once consultation with the Environment Agency (EA) is complete.

Monitoring

During testing, continuous monitoring of the discharge flow rate from the borehole and the water level in both boreholes will be undertaken. DSC Ltd personnel will be on site for the duration of each testing phase to supervise the operation and manually monitor water levels and flow rates as necessary.

Pump and ancillary equipment

A submersible pump will be lowered to a depth below ground level with a steel rising main to the surface. The rising main will be connected at the surface to the well head with a certified lifting bracket. Flexible 75mm and 100mm diameter hose will be routed to connect the discharge from the pumping tests directly to the discharge manhole on site.

The discharge hose is fitted with a gate valve which will enable the flow rate to be manually controlled. Flow rate is monitored via two in-line flow meters connected to the discharge hose.

Water levels in both boreholes will be monitored during each test using submersible data loggers. Supplementary manual monitoring of the water levels may also be undertaken.

Installation and removal

In operation, the rising main is assembled in 3m sections and lowered into the borehole using a cable percussion rig. The submersible pump forms part of the initial section of rising main. At the required depth the rising main is secured at the well head.

The pump is powered by a 415v sound attenuated generator, an exclusion zone will be created at ground level from the power supply point to the well head to prevent pedestrian or vehicle movement in the vicinity of the supply.

The water is discharged to the agreed discharge point.

The discharge point is to meet the access and construction requirements of the Thames Water discharge licence and will have sufficient capacity to accept the maximum discharge identified in the licence.

At completion of pump testing, the equipment is broken down and recovered to the surface for removal from the project.

Test phases

The test procedure is as outlined below.

Set up and development test

The operation of the pump and monitoring devices will be checked, including data loggers, manual instrumentation and flow controls. Flow is discharged via the on-site manhole

Recovery phase

No pumping is carried out during this phase, which allows the water levels to return to their notional static value. It is defined as 24 hours or when the water levels return to within 95% of their static values prior to testing.

Step test

This comprises increasing the flow rate in up to 5 equal steps. Each step will be up to 120 minute duration. During each step, water level and flow rate will be recorded. The flow rate will be adjusted manually using the gate valve on the discharge hose. Flow is discharged via the on-site manhole

Constant rate discharge test

This comprises a constant rate of pumping, at a rate to be agreed, for 72 hours or a rate as determined following well development. During the test phase, water level and flow rate will be recorded. The flow rate will be adjusted manually using the gate valve on the discharge hose. Flow is discharged via the on-site manhole.

Constant rate recharge test

This comprises a constant rate of pumping at a rate to be determined during the initial phase of pump testing for 72 hours. Flow is abstracted from the designated abstraction borehole and discharged to the designated recharge borehole. During the test phase water level and flow rate will be recorded. The flow rate will be adjusted manually using the gate valve on the discharge hose.

2.10 Well development - Acidisation

Scope

Acidisation in this context is a process used to potentially improve the hydraulic performance of the boreholes in the chalk aquifer.

It involves chemical treatment by the injection of commercial grade hydrochloric acid into the borehole. The acid is introduced in liquid form at a predefined depth.

The hydrochloric acid reacts with the chalk, dissolving the solid material. Carbon dioxide is released in the process as a by-product.

The acid may dissolve chalk on the borehole wall through direct contact and may also be used to enlarge any formation fissures present in the Chalk aquifer by driving the acid through the borehole wall using the gas pressure build-up that occurs during the chemical reaction. Both of these outcomes can improve the hydraulic performance and borehole yield.

Following acidisation, any remaining deposits within the borehole are removed by air lifting (see section 2.8 Well Development – Air Lifting).

Setting out

The site will be vacated by all non-essential staff prior to treatment commencing.

ICAX will provide a site presence during the works but will not be within the immediate work area.

An emergency drench shower will be provided at the work location by DSC Ltd.

Specific PPE requirements by operatives working in close proximity will be:

- Chemical resistant full body suit
- Chemical resistant hood incorporating respirator and face protection
- PVC gauntlets
- PVC safety boots.

Borehole preparation

The depth of injection will be pre-determined in advance of the works commencing.

Both Geothermal wells will be sealed at all times during the acidisation works, either with the head works for acidisation or a bolted blanking plate as appropriate.

Acid

Commercial grade hydrochloric acid will be used (32% concentration) with inhibitor. The volume of acid utilised is likely to be 2 tonnes per borehole. These will be delivered directly to the work area in 1 tonne IBC's.

Hydrated lime in 25kg bags will be located at each well location, stored on plastic sheeting. This will be utilised to neutralise any acid spills immediately with the resulting slurry recovered for disposal.

Pump and ancillary equipment

The hydrochloric acid will be delivered to site in intermediate bulk containers (IBC's). The IBC's will be connected to the injection plant via a purpose built chemical pump.

The cover plate is bolted onto the borehole casing flange to seal the borehole completely. The cover plate comprises inlet and outlet flanged pipework for injection of acid and controlled release of CO₂ generated during the acidisation process and a pressure gauge (diaphragm protected) to monitor pressures in the borehole. In addition water injection pipework is installed through the cover plate to increase the borehole pressure during the second phase of acidisation should a second phase be required.

For safety the system has secondary pressure release pipework, pressure gauges and an acid bypass system (to allow the acid to be pumped directly to a settlement tank from the IBC).

All circuit pipework is fabricated to withstand the expected pressures and all valves and non-return valves will be rubber lined.

Acid resistant flanged pipework is inserted into the borehole to the predetermined depth, and attached to the acidising plate prior to injection.

A vent pipe is connected to the outlet valve to control venting of carbon dioxide and acid reactants from the borehole. The vent pipe is routed directly to a settlement tank to ensure adequate control of solid and gaseous discharge.

Water Injection pipework

The water injection line will be installed through the cover plate to 5m below the rest water level and a water injection pump capable of providing a maximum flow rate of 2 l/s and a maximum head of 1.5 bar connected. The water supply will be from a fire hydrant and will include a break tank between the hydrant supply and the pump.

Process

A first phase of acid (1 tonne) will be injected at depth in a careful and controlled manner. The borehole will be vented at all times to prevent pressure build up in the borehole and all discharge gas and liquid will be routed through the vent pipe to a settlement tank.

The first phase acid injection will be repeated on the second borehole during a single site activity.

Once complete the acidisation equipment will be removed and air lifting carried out to clear each borehole of any loose debris (see section 2.8 Well Development – Air Lifting).

Following air lift a second phase of acid (1 tonne) will be injected at depth in a careful and controlled manner. Pressure will be allowed to build in the borehole to a predetermined level. Where the gas pressure does not reach that required or subsides, water injection will be utilised to facilitate flow within the borehole during the reactive phase of the process. All discharge gas and liquid will be routed through the vent pipe to a settlement tank.

The borehole back pressure will be allowed to subside; the acidising flange and pipework will then be withdrawn and a further round of airlifting carried out (see section 2.8 Well Development – Air Lifting).

The acidity of the solution will be monitored during airlift and close circulation carried out until a PH of 6 – 7 is recorded when the liquid waste will then be diverted to the discharge point and any solid waste removed by licensed waste carriers.

3.0 Labour Force

3.1 Labour force

Site Manager responsible for Health and Safety: Duncan Bellamy (07836665417)

Other Site Staff:

Chris Hall

James Wilkes

Jonathon Hall

Rees Probert

A combination of staff from the above permitted list may be on site at any time.

All staff are briefed on the contents of this method statement and records are retained.

4.0 Plant, Equipment & Tools

A combination of the following plant, equipment and tools will be used as part of these works.

Type	Model	Power Source
CP Drilling Rig	Dando 3000	Diesel
Rotary Drilling Rig	McDrill Technology MDT 80V	Diesel
De-sanding Plant	Bauer BE100-60L	Electrical
Silenced Generator	200 KVA	Diesel
Air Compressor	Autoprime QI 100	Diesel

All relevant plant test certificates will be made available and copies kept on site in the Project Specific Site File.

All plant ignition keys will be removed from the ignition at all times when plant is not in use.

5.0 Personal Protective Equipment (PPE)

5.1 Mandatory PPE

It is mandatory for all site personnel to have the following when undertaking activities specified in this method statement:

- Hard hat to EN 397
- Hi-Visibility Yellow Vest or Yellow Jacket to EN 471
- Rigger boots to EN 345
- Ear defenders to EN 352
- Gloves to EN 388
- Yellow Overalls to EN471

It is the responsibility of each individual to check that their PPE is in a satisfactory condition. Anyone refusing to wear the correct PPE will be required to leave the site.

5.2 Specific PPE

Activity	Type of PPE				
	Eye/Face	Ear	Hand	Mouth	Other
Grout mixing / operative	Goggles – EN 166	CE approved to EN352	Gloves	Dust mask (3M type 8500)	Overalls
Acidisation	Chemical resistant hood with integral eye protection		PVC gauntlets	Respirator	<ul style="list-style-type: none"> • Chemical resistant full body suit • PVC safety boots

The minimum requirement must be observed when activities are grouped.

6.0 Contacts

Name	Organisation	Contact Details
Steve Bellamy (Managing Director)	Drilling & Servicing Contractors Limited	T: 01455 202651 M: 07836665418 E: steve@dsc.ltd
Duncan Bellamy (Site Manager)	Drilling & Servicing Contractors Limited	M: 07836665417
Mark Hewitt (Managing Director)	ICAX Limited	T: 020 7253 5981 M: 07872 023405 E: mark.hewitt@icax.co.uk
Gary Page (Director of Projects)	ICAX Limited	T: 01406 366518 M: 07785 787747 E: gary.page@icax.co.uk

7.0 Emergency arrangements & First Aid

7.1 First Aid

First Aid Kits will be carried on all site support vehicles.

The nearest Hospital A&E Department is:

St Thomas' Hospital
Westminster Bridge Road
London
SE1 7EH

Distance =

Tel: 020 7188 7188

8.0 Hazardous substances

The following hazardous materials will be used on site:

- Diesel
- Soda Ash
- Cement
- Hydrochloric acid
- Lime (calcium oxide)

All materials to be handled and stored in accordance with COSHH assessments (See Appendix C).

9.0 Welfare arrangements

Suitable welfare facilities will be made available and maintained by the Main Contractor for the entire duration of the works.

10.0 Environmental

Waste:

All solid and liquid waste generated from the drilling and installation process will be removed from site by skip and tanker as appropriate.

All other aspects will be in accordance with DSC Ltd Environmental Policy.

11.0 Appendices

Appendix A: Risk assessment.

Activity	Hazard	Persons at risk	Degree of risk (DR)			Control Measures	Final (DR)
			S	L	R		
Accessing site	Slips and trips	Site personnel	4	3	12	Wear suitable footwear (PPE) as specified in section 6.1. Do not run on site.	Low
	Leptospirosis	Site personnel	5	2	10	Wash hands thoroughly using anti-bacterial handwash before and after work. Cover all cuts and scratches. No smoking policy on-site. No eating on-site.	Low
	Needles and sharps	Site personnel	4	2	8	Do not put your hands where you cannot see them. Report any needles or sharps observed to the site manager.	Low
Fire	Personal injury, damage to property	Site personnel	5	2	10	Diesel to be held in a suitable bunded container. Fire extinguisher to be present.	Low
Manual Handling	Personal Injury	Site personnel	4	3	12	Plant/equipment >25kg and <50kg to be moved by a minimum of 2 persons. Plant/equipment >50kg and <75kg to be moved by a minimum of 3 persons. Subject to each individual's capabilities and assessment.	Low
Drilling - contact.	Personal Injury	Site personnel	5	3	15	Rig guarding cages and interlock systems to be used in accordance with operators manual and HSE Regulations 2002 during drilling process to prevent contact with rotating parts.	Low
Drilling - noise.	Personal Injury	Site personnel	5	3	15	Ear defenders <u>must</u> be worn by all site personnel within 10m of the drilling rig.	Low

Activity	Hazard	Persons at risk	Degree of risk (DR)			Control Measures	Final (DR)
			S	L	R		
Manoeuvring the rig.	Personal Injury. Damage to equipment.	Site Personnel	4	3	12	Rig to be tracked/driven on site, using on board power and a banksman must be present. The manoeuvring of the drilling rig is the responsibility of DSC Ltd personnel only.	Low
Collapse of rig.	Personal Injury. Damage to equipment.	Site personnel	4	3	12	Legs and load bearing plates, timbers and railway sleepers to be utilised when drilling. Rig to be used by DSC Ltd personnel only.	Low
Working with hazardous substances	Personal injury	Site personnel	3	2	6	COSHH assessments to be followed for all hazardous substances (appendix B). PPE as identified to be worn.	Low
Contact with buried services.	Personal Injury. Damage to equipment.	Site personnel	5	2	10	Existing service plans to be checked. Inspection pits of 1.2m to be dug prior to drilling. All holes to be CAT scanned. Drilling must not be conducted within 1m of marked buried services.	Low
Moving drilling support equipment, loop and tremmie reel with telehandler	Personal Injury. Damage to equipment.	Site personnel	4	3	12	Telehandler to be operated by driver holding relevant CPCS qualification after carrying out daily checks and ensuring security of attachments. Walkover of ground within the working area to be carried out prior to manoeuvring and drilling operatives to work as banksmen when machine is manoeuvring. The telehandler must be fitted with its full compliment of mirrors that must be in a fully serviceable condition for manoeuvring around the work area.	Low

Entering excavations	Falls from ladder access	Site personnel	3	3	9	Condition of ladder and suitability of access to be checked daily prior to entry or more frequently if site conditions change. If adverse site conditions exist access to excavation to be suspended. No personnel to enter excavation without banksman present. Site personnel must not carry anything during access or egress from excavation.	Low
Activity	Hazard	Persons at risk	Degree of risk (DR)			Control Measures	Final (DR)
			S	L	R		
Manoeuvring the rig.	Personal Injury. Damage to equipment.	Site Personnel	4	3	12	Rig to be tracked/driven on site, using on board power and a banksman must be present. The manoeuvring of the drilling rig is the responsibility of <u>DSC Ltd trained personnel only.</u>	Low
Use of compressed air	Air line burst	Site personnel	4	3	12	The air line is procured specifically for the project, is visually checked prior to loading on the loop reel and is rated at 100 bar. The maximum air pressure utilised is 10 bar	Low
Use of compressed air	Air pressure causes rising main to be driven from water well due to complete borehole blockage	Site personnel	3	2	6	The maximum air pressure is 5 bar at 100m and 10 bar at 150m. The downward pressure exerted by the rising main casing gives a factor of safety against uplift of in excess of 3	Low
Working in hours of darkness	Heightened risk due to darkness	Site personnel	4	3	12	No site operations to be undertaken during hours of darkness. Activities restricted to manual checks and shutdown of test if required.	Low
Working in hours of darkness	Poor lighting causing heightened risk of injury	Site personnel	4	3	12	Designated slip and trip free access to be agreed prior to operations. All staff to have helmet and hand torches of adequate power to safely navigate the agreed site accesses.	Low

Extended working hours	Tiredness leading to increased injury risk	Site personnel	4	3	12	Staff to ensure they have a minimum of 8 hrs continuous rest after any single night shift. Maximum of consecutive night shifts will be followed by a minimum of one days rest before returning to work.	Low
External macro influences	Personal Injury	Site Personnel	4	3	12	Undertake final reality check prior to commencing operations taking into account any extra issues at the moment of the task being done such as weather / time of day / lighting / other contractor trades present / general public	Low
Activity	Hazard	Persons at risk	Degree of risk (DR)			Control Measures	Final (DR)
			S	L	R		
Acid injection	Hose leaks and bursts	Site personnel	4	3	12	All equipment must be suitable for the task. Equipment to be inspected for damage prior to use. Fittings to be checked and securely connected. In the event of any failure the source of acid will be immediately diverted to a waste tank by means of a safety diverted valve located On the inlet from the tanker	Low
Acid injection	Pressure surge	Site personnel	4	4	16	A non return valve is fitted to the delivery pipe from the tanker to prevent any surge and pressure during injection returning to the tanker	Low
Acid injection	Ground instability	Site Personnel	3	3	9	All equipment must be installed to allow all personnel to be safe distance from the borehole Stringent observation of the immediate area during injection for any adverse ground movement Control of borehole pressure at all times	Low

Acid injection	Acid fumes / gasses	Site Personnel	4	3	12	Vent tank to be situated at a safe distance from the working area. Attention must be paid to wind direction/changes during venting. Refer to COSHH risk assessment and material data sheet. There is potential for residual gases to be left in the borehole following acidisation. Continue to monitor and vent during air lift process	Low
----------------	---------------------	----------------	---	---	----	---	-----

Appendix B: Degree of risk estimation classifications

Severity Classifications		
1	Minor	Minor accident, resulting in no serious injuries or lost time; little or no damage to property or the environment.
2	Moderate	Potential injury necessitating less than 3 days off work; damage to property or the environment requiring remedial work.
3	Serious	Accident reportable under RIDDOR; serious damage to property or the environment.
4	Major	Accident resulting in serious or permanent injury; major or permanent damage to property or the environment.
5	Catastrophic	Accident resulting in death or severe disablement; destruction of property; irreversible damage to the environment.

Probability Classifications		
1	Improbable	No known instances of such an event occurring.
2	Remote	Past experience suggests that events rarely occur.
3	Possible	Experience shows that events occur on occasions.
4	Probable	Experience shows that events occur frequently.
5	Likely	Very likely to happen unless actively prevented.

Degree of Risk (DR)		
0-5	Low	Ensure controls are adhered to and activity need not alter.
6-10	Moderate	Tolerable, but efforts should be made to reduce the risk where cost-effective and reasonably practicable.
11-15	Substantial	All practicable measures must be taken to reduce the level of risk; tolerable only where further risk reduction is impracticable or disproportionate to the risk involved.
16-25	Extreme	Unacceptable except in extraordinary circumstances; all control measure must be taken regardless of cost.

Degree of Risk (DR) Matrix						
		Severity				
		5	4	3	2	1
Probability	5	25	20	15	10	5
	4	20	16	12	8	4
	3	15	12	9	6	3
	2	10	8	6	4	2
	1	5	4	3	2	1

Appendix C: COSHH Assessments

Sheet 1 of 11: Diesel

Sheet 2 of 11: Soda Ash

Sheet 3 of 11: Ez Mud Plus

Sheet 4 of 11: Ez Mud Gold

Sheet 5 of 11: Quik-Gel (Bentonite)

Sheet 6 of 11: Quik-Trol

Sheet 7 of 11: Penetrol

Sheet 8 of 11: Con Det

Sheet 9 of 11: Cement

Sheet 10 of 11: Hydrochloric acid

Sheet 11 of 11: Hydrated Lime

Appendix C: Sheet 1 of 11

Product	Diesel	
Properties	Liquid	
Composition	Complex mixtures of distillate hydrocarbons mainly paraffinic, naphthenic and aromatic in the range C10-C28. Catalytically and thermally cracked hydrocarbons may be present. Included may be small concentrations of cetane number improvers (organic nitrates), Flow improvers (ethylene vinyl acetate copolymers), a lubricity additive (long-chain ester), silicone anti-foam additives and HM C&E markers/dye. These additives do not contribute any additional hazard.	
Use	Fuel for plant.	
Frequency of use	Frequent	
Quantities held	950 litres	
Risk	Low	
Hazards	Potential to cause skin cancer. Injection of fuel under skin may have serious medical effect. Classified as dangerous for the environment.	
Exposure time	Long term exposure limit - (8 hour TWA reference period) 5 milligrams per cubic metre. Short term exposure limit - (15 minute reference period) 10 milligrams per cubic metre.	
First aid	Inhalation	Fumes or vapour may cause irritation to eyes and mucous membrane and drowsiness leading to loss of consciousness. If inhalation of vapour causes irritation or drowsiness remove to fresh air. Get medical advice if the symptoms continue.
	Skin	Unlikely to cause irritation on single contact. Prolonged or repeated contact may cause dermatitis which could eventually lead to irreversible skin disorders. Wash skin as soon as possible with soap and water. Change contaminated clothing and launder before reuse. Get medical advice if irritation persists.
	Eyes	May cause irritation with short-term redness and stinging. Wash out thoroughly with large amounts of water. If redness and/or irritation continues get medical advice.
	Ingestion	The swallowing of small amounts is unlikely to have adverse effects; larger amounts may cause irritation with diarrhoea and vomiting. Wash mouth out with water and give water to drink. If large amount has been swallowed get medical advice. DO NOT INDUCE VOMITING BECAUSE OF THE DANGER OF ASPIRATION.
Fire	Extinguish with Dry Powder Foam, foam or Water Fog. For small fires use CO ₂ . Do not use water jets. Note – Flash Point 55°C Fires in closed or confined spaces should be tackled by trained personnel who should wear breathing apparatus.	
Controls/PPE	Avoid skin contact. Wear Impervious gloves. Wear eye protection to BS166 Ensure good ventilation. Keep containers out of direct sunlight.	

Appendix C: Sheet 2 of 11

Product	Soda Ash	
Properties	White, odourless, granular powder, stable.	
Composition	Sodium carbonate 60-100%	
Use	Treat out hardness due to calcium in make-up water. Raise pH.	
Frequency of use	Frequent	
Quantities held	1 tonne	
Risk	Minimal	
Hazards	May cause eye, skin and respiratory irritation. Incompatible with strong acids. Decomposition products include carbon monoxide and carbon dioxide.	
Exposure time	Sodium carbonate OEL/MEL 10mg/m ³	
First Aid	Inhalation	If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
	Skin	Wash with soap and water. Get medical attention if irritation persists.
	Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritant persists.
	Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Fire	Suitable extinguishing media includes water fog, carbon dioxide, foam and dry chemical. Decomposition in fire may produce toxic gases. Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.	
Controls/PPE	Use in well ventilated area. Localized ventilation should be used to control dust levels. Use dust/mist respirator (95%). Use gloves. Wear coveralls. Use dust proof goggles. Eyewash fountains and safety showers must be easily accessible.	
Handling	Avoid contact with eyes, skin or clothing. Avoid creating or inhaling dust	
Accidental release	Use appropriate protective equipment. Avoid creating and breathing dust. Scoop up and remove.	
Storage	Store away from acids. Store in a cool, dry location.	

Appendix C: Sheet 3 of 11

Product	EZ-Mud Plus	
Properties	White to grey, liquid, mild hydrocarbon odour, stable.	
Composition	Hydrotreated light petroleum distillate 10-30%	
Use	<p>Can reduce reactive shale and clay formations. Can improve borehole excavation stability.</p> <p>Can enhance slurry rheological properties.</p> <p>Can alleviate mud rings, bit balling and booting-off in clay formations.</p> <p>Can reduce drill pipe torque and pumping pressure.</p> <p>Can minimise rod chatter in diamond core drilling.</p> <p>Can create "stiff-foam" and maintain foam integrity.</p> <p>Can flocculate non-reactive solids in reserve pit at low concentrations.</p>	
Frequency of use	Frequent	
Quantities held	1 tonne/1000 litres	
Risk	Minimal	
Hazards	<p>May cause eye, skin and respiratory irritation.</p> <p>May cause headache, dizziness and other central nervous system effects.</p> <p>Maybe harmful if swallowed.</p> <p>Keep away from heat, sparks and flame.</p> <p>Decomposition products include ammonia, oxides of nitrogen, carbon monoxide and carbon dioxide.</p>	
Exposure time	Hydrotreated light petroleum distillate OEL/MEL 5mg/m ³ .	
First Aid	Inhalation	If inhaled, remove from area to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.
	Skin	Wash with soap and water. Get medical attention if irritation persists. Remove contaminated shoes and discard.
	Eyes	In case of contact immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
	Ingestion	Get medical attention. If vomiting occurs, keep head lower than hips to prevent aspiration.
Fire	<p>Suitable extinguishing media includes water fog, carbon dioxide, foam and dry chemical.</p> <p>Decomposition in fire may produce toxic gases.</p> <p>Use water spray to cool exposed surfaces.</p> <p>Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.</p>	
Controls/PPE	<p>Use in well ventilated area to control dust levels.</p> <p>Localized exhaust ventilation should be used in areas without good cross ventilation.</p> <p>Use organic vapour respirator with dust/mist filter. In high concentrations, supplied air respirator or self-contained breathing apparatus must be worn.</p> <p>Use impervious rubber gloves.</p> <p>Wear rubber apron.</p> <p>Use chemical goggles; also face shield if splashing hazard exists.</p> <p>Eyewash fountains and safety showers must be easily accessible.</p>	
Handling	<p>Avoid contact with eyes, skin or clothing.</p> <p>Avoid breathing vapours. Wash hands after use. Launder contaminated clothing.</p>	
Accidental release	<p>Use appropriate protective equipment.</p> <p>Prevent from entering sewers, waterways or low areas.</p> <p>Isolate spill and stop leak where safe.</p> <p>Contain spill with sand or other inert materials. Scoop up and remove.</p>	
Storage	Store away from oxidizers. Keep container closed when not in use.	

Appendix C: Sheet 4 of 11

Product	EZ Mud Gold	
Properties	Off white, powder, odourless, stable.	
Composition	Anionic polymer	
Use	Additive	
Frequency of use	Frequent	
Quantities held	Small	
Risk	Minimal	
Hazards	<p>Incompatible with strong oxidizers. Can decompose to produce ammonia, oxides of nitrogen, carbon monoxide or carbon dioxide. May cause eye, skin and respiratory irritation. Airborne dust may be explosive.</p>	
Exposure time	No data available	
First Aid	Inhalation	If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
	Skin	Wash with soap and water. Get medical assistance if irritation persists.
	Eyes	In case of contact, immediately flush eyes thoroughly with water for at least 15 minutes. Obtain medical assistance if irritation persists.
	Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Fire	<p>Suitable extinguishing media – water fog, carbon dioxide, foam, dry chemical. Full protective clothing and approved self-contained breathing apparatus required for full fire fighting personnel.</p>	
Controls/PPE	<p>Ensure adequate ventilation. Not normally needed but if required use dust/mist respirator (95%) If exceed occupational exposure limits or limits are unknown wear NIOSH certified, European Standard EN 149 or equivalent respirator when using product. Normal work gloves. Normal work coveralls. Wear safety glasses or goggles to protect against exposure.</p>	
Handling	<p>Avoid contact with eyes, skin or clothing. Avoid creating or breathing dust. Material slippery when wet. Prevent from entering sewers, waterways or low areas. Scoop up and remove.</p>	
Accidental release	<p>Use PPE. Avoid breathing or creating dust. Scoop up and remove.</p>	
Storage	<p>Store away from oxidizers. Store in cool dry location. Product has a shelf life of 36 months.</p>	

Appendix C: Sheet 5 of 11

Product	Quik Gel, BH20, Geo Pro Lite and Geo Pro Select	
Properties	Free Crystalline Silica. Powder.	
Composition	Hydrous Silicate of Alumina, Wyoming Sodium Bentonite, Sodium Montmorillonite	
Use	Borehole grouting	
Frequency of use	Frequent	
Quantities held	Medium	
Risk	Low	
Hazards	Avoid skin and eye contact. Repeated inhalation of excessive exposure may cause silicosis or other respiratory ailments.	
Exposure time	No data available	
First aid	Inhalation	Irritation to lungs, nose and throat. Remove person to fresh air. If breathing is irregular, administer oxygen. Seek immediate medical attention.
	Skin	Potential irritant. Wash skin with soap and water. If irritation persists seek medical advice.
	Eyes	Potential irritant. Wash eye with copious amounts of clean water. If irritation persists seek medical advice.
	Ingestion	Do not induce vomiting. Wash mouth out with water. Seek immediate medical attention.
Fire	Non flammable	
Controls/PPE	Wear rubber gloves. Avoid skin contact. Wash hands after use. Wear eye protection (BS EN166). Wear respirator with particulate filter (P2 or FFP2). Use in well ventilated area.	
Accidental release	If uncontaminated, sweep up or collect and reuse product. Product becomes slippery when wet.	
Storage	Store out of the weather. Product becomes slippery when wet. Avoid contact with water in walk areas.	

Appendix C: Sheet 6 of 11

Product	Quik-Trol	
Properties	Solid, white, powder, stable.	
Composition	Carbohydrate	
Use	Filtrate Reducer	
Frequency of use	Frequent	
Quantities held	Small	
Risk	Minimal	
Hazards	Incompatible with strong oxidizers. Can decompose to produce carbon monoxide or carbon dioxide. May cause eye, skin and respiratory irritation. Airborne dust may be explosive.	
Exposure time	Cellulose derivative UK WEL 10mg/m3.	
First Aid	Inhalation	If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
	Skin	Wash with soap and water. Get medical assistance if irritation persists.
	Eyes	In case of contact, immediately flush eyes thoroughly with water for at least 15 minutes. Obtain medical assistance if irritation persists.
	Ingestion	Under normal conditions, first aid procedures are not required.
Fire	Suitable extinguishing media – water fog, carbon dioxide, foam, dry chemical. Full protective clothing and approved self-contained breathing apparatus required for full fire fighting personnel.	
Controls/PPE	Ensure adequate ventilation. Not normally needed but if required use dust/mist respirator (95%) Normal work gloves. Wear clothing appropriate to the work environment. Wear safety glasses or goggles to protect against exposure.	
Handling	Avoid creating or breathing dust. Avoid dust accumulations. Material slippery when wet.	
Accidental release	Avoid breathing or creating dust. Scoop up and remove.	
Storage	Store away from oxidizers. Store in dry location. Product has a shelf life of 36 months.	

Appendix C: Sheet 7 of 11

Product	Penetrol	
Properties	Green, liquid, coconut odour, stable.	
Composition	Coco Diethanolamide 10-30% Diethanolamine 1-5%	
Use	Can reduce or eliminate bit balling. Can reduce surface tension of drilling fluid, which allows faster chip removal without continuously grinding hard shale formations. Can improve drilling efficiency by preferentially coating the bottom-hole assembly and drill string. Can minimise differential sticking. Can increase bit life and reduce drill pipe and bottom-hole assembly wear.	
Frequency of use	Frequent	
Quantities held	100 litres	
Risk	Minimal	
Hazards	May cause eye, skin and respiratory irritation. Avoid contact with oxidizers. Incompatible with strong acids, zinc, copper and copper alloys. Decomposition products include oxides of nitrogen, carbon monoxide and carbon dioxide.	
Exposure time	Diehanolamine OEL/MEL 3ppm	
First Aid	Inhalation	If inhaled, remove from area to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.
	Skin	Wash with soap and water. Get medical attention if irritation persists. Remove contaminated clothing and launder before reuse.
	Eyes	Remove contact lenses. In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
	Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Fire	Suitable extinguishing media includes water fog, carbon dioxide, foam and dry chemical. Decomposition in fire may produce toxic gases. Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.	
Controls/PPE	Use in well ventilated area. Localized exhaust ventilation should be used in areas without good ventilation. Respiratory protection not normally required, but if significant exposures are possible then an organic vapour respirator is recommended. Use polyvinylchloride gloves. Wear rubber apron. Use chemical goggles; also face shield if splashing hazard exists. Eyewash fountains and safety showers must be easily accessible.	
Handling	Avoid contact with eyes, skin or clothing. Avoid breathing vapours.	
Accidental release	Use appropriate protective equipment. Wear self-contained breathing apparatus in enclosed areas. Prevent from entering sewers, waterways or low areas. Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.	
Storage	Store away from oxidizers. Store in a cool well ventilated area. Keep container closed when not in use.	

Appendix C: Sheet 8 of 11

Product	Con Det	
Properties	Red, liquid, alcohol odour, stable.	
Composition	Isopropanol 1-5% (Anionic Surfactant)	
Use	A wetting agent that keeps drill bits clean. Slow breakup of cuttings while being transported from bit to surface. Counteract the sticking tendencies of clays, reduces wall packing, bit balling, booting-off and the formation of mud rings. Setting of cuttings at the surface in low solids fluid systems.	
Frequency of use	Occasional use	
Quantities held	19 litre plastic drums	
Risk	Minimal	
Hazards	May cause eye and skin irritation.	
Exposure time	OEL/MEL 400 ppm	
First Aid	Inhalation	If inhaled, remove from area to fresh air. If breathing is difficult or respiratory irritation develops get medical attention.
	Skin	Wash with soap and water.
	Eyes	Remove contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes, and get medical attention if irritation persists.
	Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Fire	Suitable extinguishing media includes water fog, carbon dioxide, foam and dry chemical. Decomposition in fire may produce toxic gases. Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.	
Controls/PPE	Use in well ventilated area. Localized exhaust ventilation should be used in areas without good ventilation. Respiratory protection not normally required, but if significant exposures are possible then an organic vapour respirator is recommended. Use impervious rubber gloves. Use safety glasses or goggles to protect against exposure. Normal work overalls suitable.	
Handling	Avoid contact with eyes, skin or clothing. Avoid breathing vapours.	
Accidental release	Use appropriate protective equipment. Prevent from entering sewers, waterways or low areas. Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.	
Storage	Keep container closed when not in use. Product shelf life – 12 months	

Appendix C: Sheet 9 of 11

Product	Cement	
Properties	Powder	
Composition	Calcium silicates, alkalis, chromium salts.	
Use	Installation of covers.	
Frequency of use	Very infrequent.	
Quantities held	Small	
Risk	Medium	
Hazards	<p>R41 Serious damage to eyes (Irritant). Contact with wet cement, wet concrete or wet mortar may cause irritation, dermatitis or burns. Contact between cement powder and body fluids (e.g. sweat and eye fluid) may also cause skin and respiratory irritation, dermatitis or burns. Contains soluble chromium (VI). May produce an allergic reaction.</p>	
Exposure time	<p>WEL respirable dust 4mg/m³, 8hr TWA WEL inhalable dust 10mg/m³, 8hr TWA</p>	
First Aid	Inhalation	Remove person to fresh air. If nose or airways become inflamed seek immediate medical attention.
	Skin	Remove contaminated clothing. Wash skin with water and soap. If irritation persists seek medical advice.
	Eyes	Wash eye with copious amounts of clean water. If irritation persists seek medical advice.
	Ingestion	DO NOT INDUCE VOMITING. Wash mouth out with water. Seek immediate medical attention.
Fire	No combustible.	
Controls/PPE	<p>Avoid skin contact. Wear Disposable vinyl gloves. Wash hands after use. Wear eye protection (BS EN 166). Wear respirator with particulate filter (P2 Or FFP2). Use in well ventilated areas.</p>	

Appendix C: Sheet 10 of 11

Product	Hydrochloric Acid (HCL)	
Properties	Colourless to yellowish liquid. Aqueous solution. Stinging odour. Corrosive. Irritant.	
Composition	Hydrochloric acid 25% - 36%. pH < 0.1 (20 °C)	
Use	Acidisation of Water Well installations.	
Frequency of use	Very infrequent.	
Quantities held	Small	
Risk	Medium	
Hazards	Irritating to respiratory system Causes severe skin burns and eye damage May be corrosive to metals. Avoid contact with Sodium Hypochlorite and alkalis Disposal together with normal waste is not allowed. Do not allow the product to enter drains	
Exposure time	EH40 WEL Time Weighted Average (TWA) 1ppm, 2 mg/m3 EH40 WEL Short Term Exposure Limit (STEL) 5ppm, 8 mg/m3	
First Aid	Inhalation	Remove person to fresh air. If unconscious place in recovery position and seek medical attention.
	Skin	Remove contaminated clothing immediately. Wash skin with soap and plenty of water. Seek medical advice.
	Eyes	Wash eyes with copious amounts of clean water also under the eyelids for at least 15 minutes. Seek medical advice from an eye specialist immediately. Go to an ophthalmic hospital if possible.
	Ingestion	DO NOT INDUCE VOMITING. Wash mouth out with water then drink plenty of water. Seek immediate medical attention.
Fire	Non combustible and non flammable. Under fire conditions gives off Hydrogen Chloride gas. Gives off Hydrogen by reaction with metals. Fire-fighters must wear self-contained breathing apparatus.	
Controls/PPE	Wear acid resistant protective clothing Avoid contact with skin and eyes. Do not breathe vapours. Wear impermeable and suitable acid resistant gloves. Wear suitable safety eye protection, goggles or acid resistant hood. Use in well ventilated areas or wear respirator if exposure limit time is exceeded. Keep away from heat. Keep container(s) tightly closed. Keep people away from and upwind of any spill or leak	

Appendix C: Sheet 11 of 11

Product	Hydrated Lime	
Properties	White or off white fine powder. Odourless. pH 12.4	
Composition	Calcium dihydroxide. Ca(OH) ₂	
Use	Neutralisation of acid used in Acidisation of Water Well installations.	
Frequency of use	Very infrequent.	
Quantities held	Small	
Risk	Medium	
Hazards	Irritant. Can cause serious damage to eyes. Avoid inhalation of dust. May cause respiratory irritation. Corrosive. Causes burns. Avoid contact with skin, eyes and clothing. Do not wear any contaminated clothing at home. Do not allow large spillages to enter any watercourse On small spillages keep product dry if possible	
Exposure time	Occupational Exposure Limit (OEL) respirable dust 1mg/m ³ , 8hr TWA Short-term Exposure Limit (STEL) respirable dust 4mg/m ³ , 15mins	
First Aid	Inhalation	Move source of dust or remove person to fresh air. Obtain immediate medical attention.
	Skin	Carefully and gently brush off contaminated body surfaces. Then immediately wash skin with plenty of water. Remove contaminated clothing. If necessary seek medical advice.
	Eyes	Wash eye(s) with copious amounts of clean water. Seek medical advice.
	Ingestion	DO NOT INDUCE VOMITING. Clean mouth out with water then drink plenty of water. Obtain medical attention.
Fire	Non flammable, non oxidising. Only use CO ₂ /Dry Powder or Foam to extinguish surrounding fire. Do NOT use water.	
Controls/PPE	Working clothes (PPE) must fully cover all exposed skin (full length trousers and sleeves) Do not wear contact lenses. Wear tight fitting eye protection with side panels or equivalent. It is advisable to have an eyewash kit readily to hand. Wear suitable protective gloves. Wear caustic resistant shoes or boots. Wear a respirator with a particulate filter if exceeding the limits above. Use in well ventilated areas but keep dust levels to a minimum. Keep unprotected persons away	