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1. Introduction

The purpose of this procedure is to describe the processes for managing the risks associated with excavation work.

2. Definitions

2.1 Excavation work

Any work involving the removal of soil or rock from a site to form an open face, hole or cavity using tools or machinery. An excavation certificate shall be issued with a permit when the excavation is greater than 150mm.

2.2 Shoring

Includes the use of timber, steel or other structural material to support an excavation in order to prevent collapse.

2.3 Battering

The process of forming the face or side or wall of an excavation to an angle, usually less than the natural angle of repose, to prevent earth slippage.

2.4 Benching

A horizontal stepping of the face, side or wall of an excavation.

2.5 Competent Person

A person who has acquired through training, qualification or experience, or a combination of these, the knowledge and skill required to perform the specific tasks.

2.6 Excavation Work Area

Area immediately adjacent to the excavation works which may impact the excavation works.

2.7 Utility

Any pipe or cable.

3. Responsibilities

3.1 Manager

- Providing a safe system of work where persons are not exposed to hazards associated with excavations.
- Ensuring that information, instruction, training and supervision of all personnel is provided to enable them to safely perform their work.
- Ensuring risk assessments are conducted by competent personnel before the commencement of work and appropriate control measures are selected.

3.2 Excavation Authoriser

- Trained and competent, having successfully completed RIICCM202E Identify, locate and protect underground services.
- Where applicable, prior to authorising an excavation, all underground services must be potholed and protected. Refer to Locating Underground Services ([WCEF-PD-OHS-040-04](#)).
- Ensuring all risk control measures are in place and issuing an Excavation Certificate in accordance with the relevant Work Permit System prior to the commencement of work. The Excavation Certificate must clearly state the conditions under which the excavation work is to take place. Assisting the Accountable Person in planning and executing work associated with underground services and excavations.

3.3 Accountable Person (AP) (for contractors)

- Establishing, where practicable, systems of work which consider the hierarchy of control when determining the requirement to perform excavation work. Ensuring all personnel know and follow established procedures for excavations.
- Establishing the exact location of other underground services prior to any excavation works. Refer to Locating Underground Services Procedure ([WCEF-PD-OHS-040-04](#)).
- Ensuring JSA's are developed and approved prior to the commencement of work and checking required controls are in place when work is being undertaken.
- Ensuring risk assessments are re-validated at any time the scope of work changes or the risk increases.
- Ensuring only trained, competent personnel perform excavation work.
- Ensuring that a competent person maintains supervision of personnel performing excavation work.

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- Ensuring that management of excess excavated material has been considered, including temporary storage, in accordance with the relevant waste management procedure.
- Ensuring that a record is made of accurate locations of all uncovered subsurface utilities following each excavation by taking measurements, surveying or use of surveying grade GPS equipment. Liaise with the design office to ensure all drawings, including site services drawings are updated upon completion of excavation works.
- Ensuring all work is planned according to engineering requirements /specifications.
- Ensuring suitable barriers are erected to isolate the excavation hazard along with suitable signage.
- There are adequate warning lights around the excavation during hours of darkness.
- All personnel have safe access to plant and equipment at all times.
- Ensuring the Environment team is notified if the excavation will generate excess material as sampling and analysis may be required to determine the appropriate management plan.

3.4 Design Office

- Maintaining all drawings, including subsurface utilities referenced on site services drawings.

3.5 Permit Holder

- Completing a risk assessment (Job Safety Analysis) and ensuring all team members understand the controls to be put in place. For larger excavations a team based risk assessment (TBRA) may be more appropriate.
- Obtaining a Work Permit and Excavation Certificate. Refer to relevant Work Permit System.

3.6 Permit Team Members

- Participating in the development of the Job Safety Analysis (JSA) and comply fully with its requirements.
- Commencing work only when controls identified on the JSA are in place.
- Reviewing and re-signing the JSA if the scope of work, conditions or risk changes or the task ceases for any reason for an extended period of time and recommences.
- Following the conditions specified in the Work Permit, JSA and associated high risk certificates.

3.7 Emergency Management Supervisor

- Ensuring emergency services personnel are trained in rescue techniques.
- When deemed necessary, ensuring appropriate rescue equipment is available for performing a rescue.

4. General Requirements

All excavations to a depth greater than 150 mm require an Excavation Certificate.

Only competent contract personnel are to perform excavation tasks onsite.

Machine excavation is not permitted within 1 vertical metre either side of existing or identified high risk services.

Consideration must be given to any gas testing requirements.

Excavations that may result in contact or interference with contaminated soil or groundwater require prior input from the Occupational Hygiene and the Environment team, in accordance with the relevant site's approved Site Management Plan (SMP), such as the Arsenic Site Management Plan for CSBP Kwinana ([CSBP-GM-ENV-023-02](#)). An approved SMP is required by the Department of Water and Environmental Regulation (DWER) when it considers that specifying restrictions in the site classification does not provide adequate control on the long term use of the site. The SMP defines how the site is to be managed or monitored to ensure the risks from contamination remain at an acceptable level.

If there is any potential contaminated soil or groundwater in the Northern Territory then refer to the [NT Contaminated Land Guideline](#) and Waste Management and Pollution Control Act (WMPC Act).

Any excess material generated from excavations must be suitably contained and sampled by the Environment team to determine suitable reuse or disposal methods.

Laboratory analysis of material samples may take up to 10 days depending on the nature and location of the analysis. Analysis and potential offsite disposal costs should be considered prior to the commencement of work.

Kleenheat Operations Reticulation Network Excavations utilise the Kleenheat Barricading Excavating and Reinstatement Procedure ([KHO-PD-MNT-050-01-02](#)).

4.1 Confined Space Requirements

An excavation will be considered a confined space if it meets the definition of a confined space, regardless of the depth of the excavation. Given the nature of both historical and current chemical and fertiliser manufacturing operations, any works that disturb the ground may expose people to significant risk. As such, all excavations greater than 150mm are to be considered a confined space unless deemed otherwise through consultation with the safety department. Refer to relevant site procedures for confined space.

5. Executing an Excavation

5.1 Identifying Underground Service

Refer to WesCEF Locating Underground Services ([WCEF-PD-OHS-040-04](#)) for guidance on managing the risks associated with identifying, locating and protecting underground services prior to executing any excavation. Specifically refer to section 4.6 for requirements when uncovering electrical utilities.

5.2 Managing Unidentified Services

When unidentified services are encountered during an excavation, work shall stop immediately and workers are to exit the excavation work area. The nominated Excavation Authoriser and AP are to be made aware of the unidentified service. Work may only recommence once the service has been identified and located in accordance with Locating Underground Services ([WCEF-PD-OHS-040-04](#)), proven to be redundant, or a TBRA conducted for works to proceed.

5.3 Managing Unexpected Asbestos, Buried Waste or Contamination

If buried waste, soil or water contamination or asbestos is encountered or suspected during an excavation, work shall stop immediately and workers are to exit the excavation work area. The nominated Excavation Authoriser and AP are to be made aware of the contamination who will contact the Occupational Hygienist or Environmental Department. Advice will be provided on requirements if personnel have been exposed to contamination, appropriate controls to proceed with the excavation and management of waste. Asbestos will be managed in accordance with the Asbestos Management Plan.

Contaminated soil may be detected by odour and/or unusual colours or texture compared to natural soil in the area. Contamination in water may also be detected by odour and colour. If in doubt contact the AP for advice.

Refer to [Appendix 1](#) for illustrated examples.

5.4 Excavation Methods

5.4.1 Non Destructive Excavation (NDE)

Non-destructive excavation techniques are those that are the least likely to damage underground services and include hydro-excavation, pneumatic excavation and the use of plastic or small hand tools, such as a trowel. Care should be used to avoid contact when using NDE techniques to expose a service.

Precautions must be taken during an excavation to ensure that all hazards associated with the initial digging process are controlled.

- The use of a vacuum truck or hand digging must be assessed to ensure that the excavation does not become unstable as the depth increases ([see 6.3 excavation shoring](#)).

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- When using a vacuum truck for an excavation, extra precautions must be taken due to the fall potential hazard. As the depth of the excavation increases, the stability of the edges decreases. The operator of the vacuum hose must be restrained so that there is no potential to fall into the excavation. This risk can be controlled with the use of harnesses and lanyards as detailed in the Working at Height Guide Manual ([WCEF-PD-R&S-0018](#)).

5.4.2 Hand Excavation

Hand excavation is the use of all other hand tools not specified in NDE including all types of shovels, picks, crow bars, sledge hammers, post hole diggers and mattocks. When conducting hand excavation in the vicinity of services, proper techniques shall be used to minimise the likelihood of damaging the service, i.e. do not use full body weight on shovel, insert the shovel on an incline etc.

5.4.3 Guided and Light Machine Excavation

Hand operated machines (e.g. jackhammer), small machinery designed for removal of topsoil (e.g. bobcat, mini digger with bucket attachment) and large machinery which is guided by electronic tracking system and is used for the purpose of trimming ground levels. This includes graders, scrapers and bull dozers with tracking systems in use. This does not include the use of attachments used for penetrating the soil for the purpose of soil loosening e.g. rippers, ploughs.

5.4.4 Machine Excavation

All other power machinery including excavators, drag lines, post hole diggers, all types of drills and augers, trench digger.

5.5 Services

5.5.1 Low Risk

Low risk services are those which do not pose a risk to the environment, production or due to their physical properties. These include fire water, scheme water, bore water, storm water, cooling water and earthing grids.

5.5.2 Medium Risk

Medium risk services are those which potentially are environmentally harmful, minor effect on production, are non-flammable but potentially can lead to dangerous atmospheres. These include effluent, waste water, telephone, communications, low voltage power, carbon dioxide and nitrogen.

5.5.3 High Risk

High risk services are those that pose a high risk to safety and production if damaged. These include high voltage power, fibre optics, natural gas, hydrogen, ammonia (liquid and gaseous) and syngas.

5.6 Minimum Approach Distance

Prior to commencing an excavation, the nominated Excavation Authoriser shall calculate the Minimum Approach Distance (MAD) for the proposed method of excavation as per Table 1 below. If a MAD cannot be ascertained or if preferred, NDE techniques must be used.

Table 1: Minimum Approach Distances

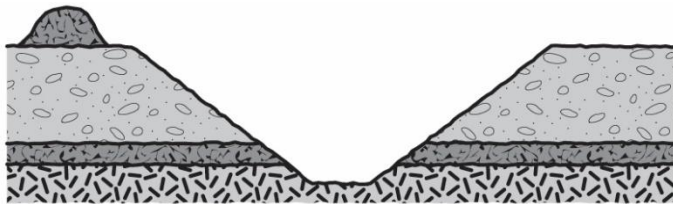
Risk of Service	Excavation Technique		
	Hand	Guided	Machine
High	450	600	1000
Med	200	400	800
Low	100	250	500

6. Excavation Stability

All excavation work must be risk assessed and any identified engulfment hazards must be reduced by either a temporary support system, battering, benching or other forms of retaining structures.

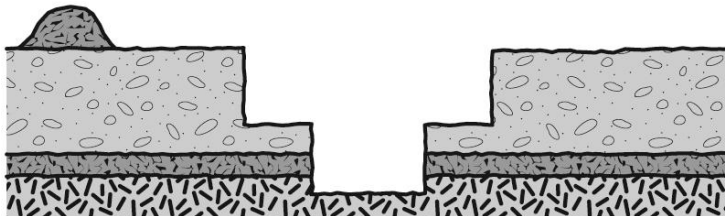
6.1 Battering

Battering is where the wall of an excavation is sloped back to a predetermined angle to ensure stability. Battering prevents ground collapse by cutting the excavated face back to a safe slope.



6.2 Benching

Benching is a method of preventing collapse by excavating the sides of an excavation to form one or more horizontal levels or steps with vertical surfaces between levels.



6.3 Excavation Shoring

Any excavations that presents a risk if earthwork falling/ dislodging or requires a person to work in an excavated area that is at least 1.5 metres deep, must be shored in a manner which prevents it from collapsing or moving.

Unnecessary or unused nails or spikes must be removed from all excavation timbers.

Walings are provided in an excavation support system to hold back the side or horizontal pressure exerted by the material in the excavation walls. When walings are also used to support a platform which will carry personnel or material, extra structural timber is essential to prevent the walings slipping down the sheeting. This prevents the toms from dislodging which could lead to a collapse of the support system.

6.4 Undercut Excavation Sides

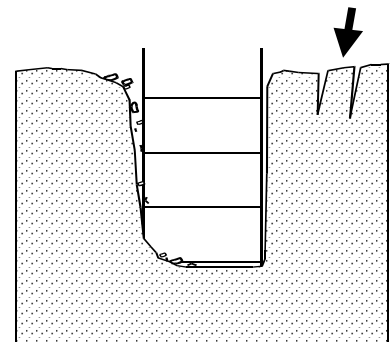
Excavation supports or wider excavation may be necessary to make the excavation safe for workers if the side of the excavation has been undercut.

6.5 Other Excavation Hazards

The following are examples of hazardous situations or activities associated with excavations. In the event that any of the following hazards are identified, work must stop and corrective actions must be taken immediately to eliminate the hazard.

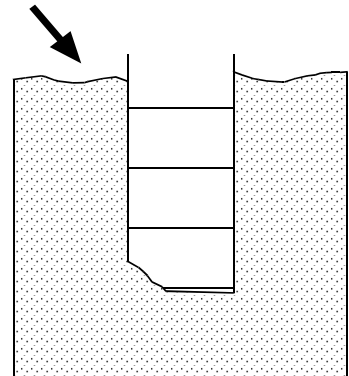
6.6 Cracks Near and Parallel to the Edge of the Excavation

Cracks indicate that the ground support system has shifted. The support may be inadequate or incorrectly placed. Collapse may occur suddenly.



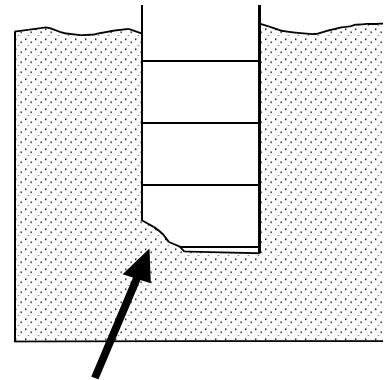
6.7 Subsidence Alongside the Excavation

This means there has been soil movement below the surface that increases the pressure against the supports. Soil movement may be caused by seepage behind the support.



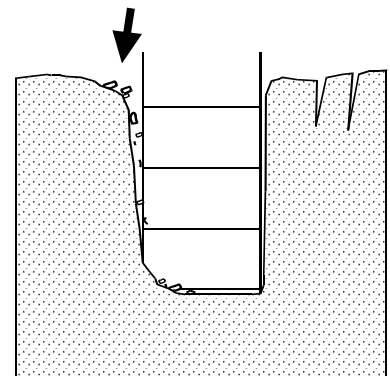
6.8 Water Swelling or Uplift of the Excavation Bottom

This indicates soil movement at the toe of the support system. The danger is that if support timbers are undermined they may kick-in and cause a sudden collapse. This indicates a wet, unstable soil where an adequate trench support system is vital for safety.



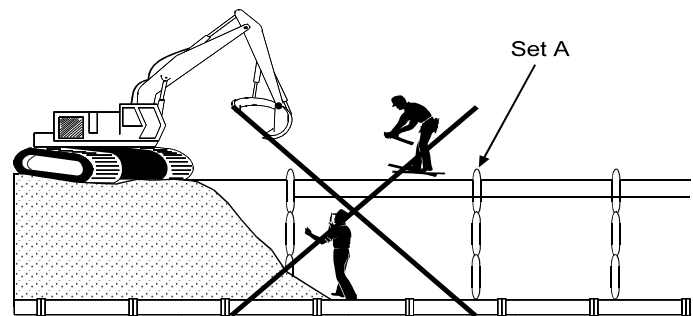
6.9 Surface Soil Falling into the Excavation

This indicates an unstable soil. Workers in the trench are in danger from falling material which may cause eye or body injury. Support timbers should project a minimum of 200 mm minimum above ground level.



6.10 Working in Excavation Outside the Support System

Work should be performed from within the safety of the trench support system both when installing and removing timbers.



The workers in the trench in a dangerous situation. Workers should not be in front of set A while an excavator is backfilling.

6.11 Stability of Adjacent Buildings/Structures

If an excavation is likely to adversely affect the stability of any building, structure or road it must not commence until the aforementioned are protected by means of shoring or other appropriate means.

Every effort must be made to ensure these buildings and footings are not disturbed in any way, for example whilst digging, undercutting supporting soil or any other factor that could affect the existing structure.

6.12 Excavation In or Near Previously Dug Ground

When an excavation is to be completed parallel to a previously dug service the soil may be waterlogged leading to less wall stability and potential collapse. This situation requires special attention as it may not be obvious.

6.13 Water Entering an Excavation

Water will cause loss of strength in clay, silt and gravelly soils which may cause an excavation to collapse without warning.

All surface drainage must be directed away from the excavation during construction. Consideration must be given to seepage from underground water (especially in known contaminated areas onsite), pipes and other sources of water. Additional PPE must be worn as a precaution and work must cease if groundwater is seeping up from a known contaminated area onsite. For excavations at CSBP, the Occupational Hygienist and Environmental Department must be notified so water samples can be taken and sent to the laboratory for analysis in accordance with the Arsenic Site Management Plan - CSBP Kwinana ([CSBP-GM-ENV-023-02](#)).

7. Working In and Around Excavations

7.1 Pipes In or Adjacent to Excavations

Where pipes are alongside or crossing an excavation there is a hazard from potential pipe failure. Some gases are heavier than air and will collect as an unseen hazard in the bottom of the excavation. In this situation temporary support for the pipe is required along with a ladder adjacent to the hazard to allow quick escape. This situation should be brought to the attention of the Excavation Authoriser.

7.2 Redundant or Abandoned Utility Services

When utility services have become redundant, decommissioned from service or abandoned, the utility provider must remove the service from the road reserve or make the service safe regarding interference to adjacent infrastructure and environment. The utility provider is to maintain records of these abandoned services to enable information to be provided via Dial Before You Dig as required.

7.3 Excavation Barriers

If any excavation presents a potential fall risk to personnel working in the excavation or in adjacent areas, then hard barriers are required to isolate the hazard.

Hard barriers must incorporate a top and mid rail (kick plate/board may be required, this requirement must be individually assessed for each excavation) similar to those required for working at height handrails.

7.4 Excavation Signage

Excavation signage must be erected around the hazard and warn of the risk present. Below is an example of the type of sign required.



7.5 Location of Plant, Material and Loads to an Excavation

The person in control of the excavation process must ensure that no plant, material or other loads are placed near the excavated area in a position that may cause the sides of the excavation to collapse or the aforementioned to fall into the excavation.

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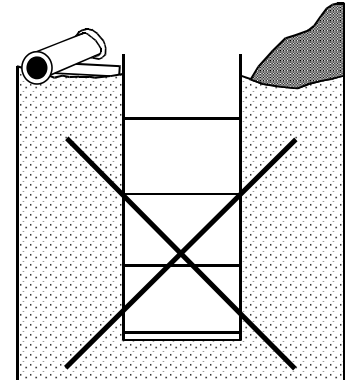
The following are examples of hazardous situations or activities that involve the above. In the event that any of the following hazards are identified, work must stop and corrective actions must be taken immediately to eliminate the hazard.

7.5.1 Excavated Material, Pipes, Tools or Timber Close to Edge of Excavation

These are a hazard likely to injure workers in the trench if accidentally knocked or otherwise fall into the trench.

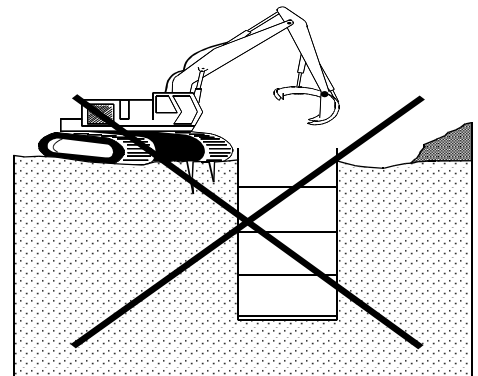
Heaps close to the trench add load to the trench face. The probability of cave-in without warning is increased.

Heaps should not be closer to the edge than one third of the trench depth.



7.5.2 Machines Moving too Close to Edge of Excavation

The machine may damage the support system. Where close working is unavoidable because of space limitation, the support system must be designed to cope with the extra loading due to the machine.



7.5.3 Nearby Machines Causing Vibrations

These may be stationary plant machines such as compressor or pile driver. Vibrations also may be due to adjacent railway traffic, road vehicles or mobile compactors further along the excavation or at adjacent road works.

The support system must be adequate to cope with the extra load the vibrations may cause.

7.6 Working in an Excavation

Entries/exits to and from excavations must be controlled in order to reduce the risk of falling. Fixed ladders shall be used where practicable and all personnel shall maintain three points of contact at all times.

Personnel must not use support timbers to access or egress excavations as falls may occur or the support structure may be weakened.

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An additional person is required to be in the immediate vicinity if work is to be performed in excavations that are at least 1.5 metres in depth.

A dedicated watch person is required to be present if work is to be performed in excavations that are classed as a confined space.

7.6.1 Minimum Clearance Zone

Any service being worked on in an excavation requires a minimum clearance zone of 300mm around the service from the work location. If a 300mm clearance zone is not possible then additional controls are required to prevent impact with other services (known or unknown) and be documented on the JSA. The additional controls need to provide a physical barrier between the service been worked on and other services (known or unknown within 300mm). If a physical barrier is not possible then ensure selected tools and equipment to complete the task are non-intrusive to prevent impact with other services.

7.6.2 Authorising Work in an Excavation

Prior to work commencing within an excavation the excavation authoriser must authorise the area as safe. This needs to consider entry/exit points, minimum clearance zones with other services and confined space entry requirements.

8. Post Excavation

All excavation backfilling is to be completed as per site Engineering Standards.

8.1 Maintaining Site Drawings

Following all excavation works, the Responsible Officer or Accountable Person shall ensure that a record is made of accurate locations of all uncovered subsurface utilities by taking measurements, surveying or use of surveying grade GPS equipment. Information recorded is to be included onto the relevant site services drawings or other appropriate and accessible media.

8.2 Service Visual Indicators

Prior to backfilling excavations, all services within the excavated area are required to have visual indicators installed where required as per site Engineering Standards and Australian Standards.

8.3 Service Physical Barriers

Prior to backfilling excavations, all services within the excavated area must have physical barriers (e.g. clay tiles) installed where required as per site Engineering Standards and Australian Standards.

9. Deviations to Procedure

Deviations to procedure may be required for emergency situations. Any deviations must be approved in writing by the Business Unit Manager or equivalent.

10. References

Barricading Excavating and Reinstatement Procedure ([KHO-PD-MNT-050-01-02](#)).

Basic Safety Rules ([CSBP-GM-11-035-02](#))

Confined Space ([CSBP-GM-11-031-52](#))

Confined Spaces Procedure ([KHP-GM-OHS-070-02](#))

Arsenic Site Management Plan - CSBP Kwinana ([CSBP-GM-ENV-023-02](#)).

Solid Waste Management ([CSBP-GM-ENV-060-02](#))

Waste Management ([KHP-PD-ENV-060-01](#))

Gas Testing ([CSBP-GM-11-031-33](#)).

Gas Testing and Monitoring ([KHP-GM-OHS-070-11](#))

Work Permit System ([CSBP-GM-11-031-51](#)).

Permit to Work System ([KHP-GM-OHS-070-01](#))

Permit to Work Procedure ([KHO-PD-OHS-070-0](#))

WesCEF Asbestos Management Plan - Procedure ([WCEF-PD-OHS-130-01](#))

WesCEF Locating Underground Services ([WCEF-PD-OHS-040-04](#))

WesCEF Penetration Procedure ([WCEF-PD-OHS-040-06](#))

Job Safety Analysis ([CSBP-GM-11-031-23](#))

Job Safety Analysis ([KH-SF-OHS-050-02](#))

Excavation / Penetration Certificate ([KHP-SF-OHS-070-03](#))

Penetration Certificate ([CSBP-SF0948](#))

Safe Working at Height ([KHP-GM-OHS-070-06](#))

Working at Height Guide Manual ([CSBP-GM-11-031-02](#)).

Occupational Safety and Health Act 1984

Occupational Safety and Health Regulations 1996

Code of Practice 'Excavation Work' 2018 (Safe Work Australia, WHS Act)

Code of Practice 'Excavation' 2005 (Commission for Occupational Safety and Health)

AS 5488-2013 Classification of Subsurface Utility Information (SUI)

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11. Appendix 1 – Examples of Possible Soil Contamination

	
<p>Unusual coloured soil – green clay indicating possible contamination</p>	<p>White material – buried waste - fluorosilic acid neutralised with lime</p>
	
<p>Black layers – buried lead sulphate waste</p>	<p>Change in soil – black layer with rubble – not like other soil in the area</p>

12. Appendix 2 – Historical Excavation Incidents

Incident Date	Incident Number	Incident Location	Incident Description
31/05/2021	INC-83865	Sodium Cyanide	Contact with LV service while cutting pipe using reciprocating saw.
23/07/2018	INC-70875	Fertilisers	Whilst carrying out ongoing excavation work, HV network control cable was damaged by an excavator.