1. Purpose and Scope

a. The purpose of this procedure is to provide general guidance to AECOM employees working in the vicinity of excavations and to ensure that excavations are carried out in a manner that prevents injury or adverse health results to employees, sub-contractors, the public and nearby infrastructure.

b. Where AECOM is appointed to oversee excavation works, this procedure outlines what safe systems of work are required to ensure that excavation activities are carried out in a manner that prevents injury or adverse health results to employees, sub-contractors, the public and nearby infrastructure.

c. This procedure shall apply to all AECOM controlled operations in APAC and all work activities carried out by AECOM APAC Employees, Contractors under AECOM Supervision or AECOM engaged Subcontractors.

2. Procedure

2.1 Planning – Prior to Work Commencing

a. A project specific risk assessment (e.g. Project Safety Plan/ SWMS) shall be developed by the project team, reviewed and approved by the Project SH&E Manager and communicated to all parties via a documented toolbox talk prior to works commencing. The work environment shall be monitored for changing conditions and the risk assessment updated accordingly.

b. The risk assessment should consider at a minimum:

i. The extent and depth of the trench/excavation and time it remains open

ii. Potential for fall into the excavation – access/egress arrangements and public/worker safety, including afterhours arrangements of excavation is not back-filled

iii. The nature of the strata, e.g. clay, sand, rock, etc. as this will impact stability

iv. Potential impacts from exposure to wet weather, seepage, slip zones, surge, groundwater, etc.

v. Employee/vehicle interaction and control of mobile plant working in and around the excavation, including effects of vibration and fumes

vi. Spoil management and any placement of surcharge loading close to edge or within zone of influence

vii. Previous disturbance and/or land use, including consideration of potential services and contamination


c. Control measures identified and agreed shall be consistent with the hierarchy of controls and principles as outlined in the Hazard Recognition and Risk Management Procedure - APAC.

d. Where possible, the risk of entry into excavations should always be eliminated (e.g. use an excavator to remove soil samples to a safe location to conduct sampling, rather than entering an excavation).

a. Where entry into trenches or excavations is absolutely necessary, no one shall enter any trench or excavation until the walls have been adequately cut back or temporary protective structures have been installed, unless the trench or excavation is shallower than the legal minimums and the soil is assessed by a competent person as stable. Questions regarding the safety of trench or excavation entry shall be made to the Competent Person or the Regional SH&E Manager/site safety representative before work commences.

e. Where there is a risk of contact with overhead and/or underground services the full requirements of the Service Identification and Clearance (SIC) Procedure - ANZ, including any required exclusion zones, need to be met before excavation or trenching work is to commence.
In areas adjacent to buildings or structures, adequate steps must be adopted before and during progress of the work to prevent collapse of the building or structure. Any excavation that has the potential to cause structural damage, or extend below the level of the footing of any adjacent structure (including retaining walls) and could potentially affect the stability of the structure, must be assessed by a competent Structural Engineer. Excavation works must not commence until steps are taken to record the existing condition and prevent damage, collapse or partial collapse of any building or structure potentially affected by the excavation as advised by the Structural Engineer.

Where AECOM is responsible for the excavation, a person designated by the AECOM Site Supervisor (SS) shall act as spotter during excavation of the upper 2m of the soil profile. During the excavation, the spotter should continuously visually assess the excavation for indications of the potential presence of underground services and previous ground disturbance such as trench backfill, pea gravel, filling sands, plates, redundant plant/equipment or service marking tape. If these indicators are identified, excavation works must cease immediately and further advice must be obtained from the relevant SIC Approver.

The project specific risk assessment must detail the steps to be taken in the event of an emergency associated with the excavation and trenching (e.g. excavation collapse, engulfment etc.) and project staff should be briefed on this requirement. The Excavation Permit will also prompt for consideration of specific emergency response controls to be implemented, e.g. egress ladders every 6 metres, isolation of power sources if utilities struck, etc.

A pre-start equipment check of the excavator and associated equipment shall be conducted and documented by the excavation contractor prior to commencement of each day's works. The equipment check should include an operational check of all safety critical devices, such as emergency stop buttons (if present). The AECOM SS also needs to ensure that all operators are licenced and needs to obtain a copy that is to be stored in the project folder.

The AECOM SS shall ensure that the excavation subcontractors have an effective system in place to ensure excavator attachments (e.g. buckets) are adequately secured, both during use and when in transit. On older excavators, safety pins need to be secured in place by the operator each time they change attachment. On newer excavators with hydraulic locking mechanisms, a method for testing that hydraulic locks are working is required. These controls need to be incorporated into the contractor’s SWMS. A record of the pre-work inspection shall be noted in the AECOM SS Field notebook or in the daily toolbox section of the applicable project specific risk assessment (e.g. Project Safety Plan/ SWMS).

The use of an Excavation Permit – APAC, or equivalent) in line with the Permit to Work Procedure - APAC is mandatory where each of the following conditions exist:

i. Where excavation works are under management and control of AECOM

ii. Mechanical excavation work is >150mm deep and wide (including drill bore diameter)

iii. None of the following permit exemption conditions are met:

   • PM and the Regional SH&E Manager agree through the project risk assessment e.g. SWMS/THA/SHEMP that an Excavation Permit adds no value and is not required; or

   • Where the ground penetration is for the purpose of in-situ geotechnical and/or site environmental investigation purposes and conducted with a drilled bore earth penetrating equipment no greater wider than 150mm; or

   • Where the earth material removed is replaced/backfilled or the hole otherwise supported immediately or concurrent with the same excavation formation (e.g. CFA pile, well casing, etc.) to reduce the risk of an open excavation.

A Permit may still be considered an appropriate control for situations exempted above depending on other factors considered in the task risk assessment. Any necessary drawings/plans provided shall be provided as supporting information to the Permit. The Permit shall detail the nature of the proposed works and necessary controls required.
2.2 Walkways, Bridges and Edge Protection

a. Where personnel or equipment are required to travel across, or over, excavations or trenches on walkways or bridges, guardrails conforming to the applicable standards are to be provided and properly fitted in accordance with the manufacture guidelines/specifications.

b. Personnel working near the excavations, but not directly involved in the excavation process, are to be protected from falls by suitable guardrails or equivalent edge protection and are to meet the requirements of the relevant National and/or Local/State legislation for Fixed Platforms, Walkways, Stairways and Ladders - Design, Construction and Installation. The hierarchy of controls provides for the following order of preference with fall protection measures:
   i. Hard barriers such as handrails or jersey blocks
   ii. Soft physical barriers such as mesh, bunting (at least 2m back from the edge)
   iii. Flagging (at least 2m back from the edge)

c. Signage should also be erected as per any risk assessment control recommendations, e.g. Danger: Deep Excavation.

d. Where practicable excavations and trenches should be backfilled prior to the end of shift. A risk assessment should be conducted in order to determine additional controls, such as road plates, temporary fencing, etc. that may be implemented to ensure the security and safety of the excavation when left unattended.

2.3 Shoring Systems and Ground Support

a. Cave-ins present the largest risk to all workers involved in excavation or trenching. However, strict compliance will prevent or minimise the risk of accidents. Controls must be implemented at 1.5m; however, if an increased risk of cave-in is present due to site conditions, controls may be required at depths of less than 1m and are required where a competent person has requested this to occur.

b. A shoring system will not be required if the nature and slope of the side of the excavation has been assessed by a Competent Person and there is no reasonable likelihood of a fall or dislodgement of earth, rock or other material from a height of more than 1.5m (measured vertically) that may bury, trap or strike a person who is in the excavation.

c. Any excavation deeper than 1m must be inspected by a Competent Person at the intervals determined during the risk assessment of the work. Competence of the person assessing the need for shoring systems shall be verified through qualification in structural, civil and/or geotechnical engineering (or equivalent) and relevant experience with the particular ground conditions and/or shoring system under consideration and should be covered under the Excavation Permit process.

d. Common safety techniques / protective systems used to control earth movement during excavations are outlined below.

<table>
<thead>
<tr>
<th>Sloping</th>
<th>Benching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sloping is the removal of soil away from the side of the excavation / trench, until the walls are at a safe angle of incline from the floor / base of the trench. The angle (from 26 - 90 degrees) will vary depending of the soil type, location, and environmental exposure.</td>
<td>Benching is the excavation / formation of one or more series of horizontal steps with vertical surfaces between levels.</td>
</tr>
</tbody>
</table>

Sample of a simple slope system

Sample of a simple multiple bench system
**Shoring**

A structure such as metal, hydraulic or sheet timber (trench box) shoring system is used to brace tightly against the vertical walls of the trench to support the site and prevents cave-ins. Shoring can also prevent the collapse of a nearby structure.

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e. Shoring systems must be certified for use. Ground support systems (shoring, shields or other temporary works) shall be designed by a suitably qualified engineer with supporting information available on drawings/plans. Installation of such systems shall be by competent persons who have received instruction and information on the particular system, and once installed shall be verified as correctly installed in accordance with drawing and/or plan prior to use/entry. This verification shall be documented and may be evidenced in practice by a stamped or signed as-built drawing, completion of installation checklist, temporary works design sign-off, receipt of an installation certificate or similar. Trench boxes / shields are made of strong material capable to withstand cave-ins. Trench boxes/shields have dual purpose; they can be a permanent structure or portable and therefore moved as work progresses. This method is commonly used when there is no support for adjacent structures.

f. If caissons or cofferdams are required, they must be certified and installed by a competent person. The caissons and cofferdams must be of sound construction and secured in position to prevent movement.

g. Any changes proposed to the design of a ground support system shall be assessed, authorised and signed off by a suitably qualified engineer prior to use.

### 2.4 Persons Entering a Trench over 1.5m in Depth

a. Any trench or excavation with an excavated depth of 1.5 metres is considered “high risk construction work” for which a SWMS/THA must be prepared before work commences. Note some countries within Asia Pacific have specified a depth of 1.2 metres and local legislative requirements must always be considered as part of project safety planning.

b. An emergency response plan must be prepared for any work in a trench > 1.5m (refer Emergency Preparedness and Response Procedure – APAC).

c. If safe access and egress in a trench is by ladders, at least one ladder giving access and egress to the trench shall be installed and allow access/egress from both ends of the trench in the event of a collapse at one end.

d. The ladder should be placed within a safe distance or in accordance with the applicable statutory requirements (e.g. Queensland - within 9m, but as per Excavation permit consider 6m guidance) from where the person will be working, secure against movements (top and bottom) and protrude above the trench by 1m.

e. Consideration of electrical hazard (below and above ground) shall be made when selecting the ladder to be used in excavation.

### 2.5 Water Accumulation and Dewatering

a. Accumulation of water in excavations or trenches can cause cave-ins. Personnel shall not work in excavations when water is accumulated or water is accumulating, unless adequate support systems are in place to prevent cave-ins and safety measures are adopted / implemented (e.g. safety harness, to prevent personnel falling into the trenches, isolation of any electrical cables and equipment). In addition, adequate dewatering methods of appropriate design and capacity must also be in place to ensure proper control of accumulating water. The AECOM SS must monitor the dewatering operations.

b. When excavations prevent the natural drainage of surface water, the surface water is to be controlled by ditches, barriers, adequate drainage or other suitable means to prevent surface water from entering the excavation or accumulating near the excavation.

c. If the excavation is likely to collect or retain water including overnight / weekend periods (e.g. predicted weather forecast), the excavation must be suitably fenced off or properly covered to prevent unauthorised access.
d. If there is a risk or possibility of water eruption or rising water (including other liquids), the supervisor must provide means of evacuation to enable personnel to quickly reach or be in a position or place of safety. These means must be properly identified in the risk assessment and a rescue plan must be in place.

2.6 Inspection and Environmental Controls

a. Suitable erosion and sediment control measures must be put in place to ensure that sediment is contained within the perimeter of the excavation area. All stockpiles must have suitable erosion and sediment fences / devices in place. Additional consideration must be made for stockpiles that will be on site for an extended period / long term storage and consideration given to covering the stockpile to prevent material leaving the confines of the site.

b. Stockpile material shall be placed on the lower side of the excavation area away from watercourses and catchments. In addition, stockpiles shall be positioned in a way that in the event of heavy rainfall, the runoff will not descend into the excavated area.

c. Each day before the start of work or shift, the supervisor (or other competent person) must inspect excavations, adjacent areas, and protective systems (guardrails, fences etc.). This inspection is to verify that the controls in place for the excavation are effective and in accordance with the drawing/plan/permit. If the supervisor finds evidence of a situation that could result in a possible cave-in, protective system failure, or other hazardous condition, the supervisor must cease all work near the excavation area and take the necessary control and corrective measures. Personnel are not to return to the work area until the necessary corrections are implemented and a return to work approval has been given by the supervisor. Inspections are to be documented as per Excavation Inspection Checklist - APAC, or equivalent.

d. Inspections are also to be conducted after each heavy rainfall or other hazard-promoting occurrence. Minimum inspection frequency shall be daily but may be further prescribed in the project risk assessment, SHEMP, SWMS and/or Excavation Permit.

2.7 Materials, Vehicles, Loads and Equipment Near or Above the Excavation

a. To avoid endangering any person during excavations, it is a safety requirement that materials, vehicles, loads, equipment etc. must not be placed, stored or piled within the buffer zone or zone of influence and near the edge of any excavation.

b. If the excavation is in the vicinity of moving traffic, then additional controls (e.g. use of concrete barriers) may be required to prevent inadvertent access to the excavation by vehicles (see Traffic Management Procedure – APAC).

c. It is also a requirement that no load/s (spoil, equipment, etc.) are placed or operated near the edge of any excavation unless a suitable support system has been designed to support the load/s.

d. The nature of the soil and surroundings must be taken into consideration when determining the type and strength of the support system. At no time should any persons be in the working radius of the plant, nor should any person be in the trench while excavating the trench. The Excavation Permit and/or risk assessment for the activity shall consider safe systems of work for mobile plant operating in vicinity of the excavation and at all times the zone of influence shall not be encroached. See figure right.

e. All excavations must be backfilled as soon as reasonably practical. Where excavations must remain open for a period of time (e.g. whilst waiting on laboratory soil analysis) the excavations must be adequately barricaded (based on the existing site security) and signage must be erected to warn personnel of the open excavation hazard. As outlined in Section 2.2, personnel working near the excavations but not directly involved in the excavation process are to be protected by suitable guardrails or equivalent edge protection.
2.8 Hazardous Atmospheres

a. Confined spaces may exist in excavations where there is limited access or egress and in which a hazardous gas, vapour, dust or fume or an oxygen deficient atmosphere may occur.

b. To prevent exposure to harmful levels of atmospheric contaminants, entry into trenches and excavations greater than 1.5m in depth in which a hazardous atmosphere exists, or could reasonably be expected to exist, such as in excavations in landfill areas or excavations in areas where hazardous substances are stored nearby, must be considered as a confined space (see Confined Space Procedure – APAC).

c. On sites where there is potential for chemical exposure from soil or groundwater encountered during excavation, or where there is risk of an explosive atmosphere being generated during excavation (e.g. where flammable products (e.g. petrol) have been/are being stored, or where naturally occurring methane pockets may be encountered in the geology), an air monitoring program shall be implemented by the AECOM SS or their delegate for the duration of the works. Monitoring could include the use of a Photoionization Detector (PID) to monitor vapour exposure to workers at the site, a Combustible Gas Detector (CGD) to monitor for flammable/explosive vapour mixtures (LEL), or dust monitoring devices to assess volumes of dust being generated.

d. The AECOM SS shall record the results of monitoring in accordance with the project specific risk assessment (e.g. Project Safety Plan/ SWMS) and any applicable Permit to Work System (PTWS). Some gases and vapours are heavier than air (e.g. hydrocarbon vapours) and can collect at the bottom of trenches and excavations. Therefore, the AECOM SS must ensure that readings are taken at the upper, middle and lower levels of excavations. Plant that uses a combustion engine (e.g. excavators, air compressors, pumps etc.) should not be used inside an excavation unless controls are in place to ensure emissions from the combustion engine do not accumulate and present a risk to workers (see Confined Space Procedure - APAC. The build-up of exhaust gases in an excavation, particularly carbon monoxide, can be fatal.

e. Where AECOM is responsible for site works involving excavation an Excavation Permit - APAC must be completed daily (except under requirements of Section 2.1 k iii) prior to all mechanical excavation activities. If hand tools are used instead of mechanical excavation, this permit is not required. The permit must be issued to the excavation contractor by an authorised Permit Issuer immediately prior to the commencement of excavation works and each day thereafter that excavation work continues at the site. In all cases, all workers at the site must comply with the requirements of permits issued for the works. This permit shall be valid for no more than one shift (12 hours maximum) and a new permit shall be completed on site if there are any significant changes to the work scope/area (e.g. high rainfall, change in excavation dimensions/location).

f. Each permit must be signed off by the AECOM SS at the completion of each day’s excavation activities. Before signing off the permit, the AECOM SS shall ensure that all excavation works are complete for the day and that any excavation which remain open are effectively secured to prevent inadvertent access and where required are signposted accordingly to identify the hazard (e.g. ‘Danger- Deep Excavation’).

g. All completed permits shall be maintained on site for the duration of the excavation works and stored in the project file on completion of these works.

3. Responsibilities

a. Project Manager

The Project Manager (PM) is responsible for ensuring:

i. That staff visiting sites where excavations are present are made aware of the hazards associated with working around excavations;

ii. Where AECOM is responsible for site works involving excavation, a competent person is appointed as a AECOM Site Supervisor;

iii. Any required regulatory notifications are made prior to works commencing; and

iv. A project specific risk assessment (e.g. Project Safety Plan/Safe Work Method Statement (SWMS)) is developed and approval prior to works commencing.
b. **AECOM Site Supervisor**

The AECOM Site Supervisor (SS) is responsible for ensuring:

i. Excavation works are conducted in accordance with this procedure and any additional client specific requirements, where AECOM is in control of a site (e.g. appointed as a Principal Contractor or client appointed Site Supervisor);

ii. The Excavation Permit is issued to contractors in accordance with this procedure; and

iii. The provisions of the project specific risk assessment (e.g. Project Safety Plan/ SWMS on site are implemented on site).

c. **AECOM Field Staff**

AECOM field staff are responsible for ensuring:

i. They adhere to the controls identified in the project specific risk assessment (e.g. Project Safety Plan/ SWMS) when working around excavations and trenches).

4. **Training**

a. Training shall be provided for all employees undertaking excavation related activities including erecting shoring. The training will be appropriate to the risk level associated with the excavation related tasks performed and any specific state/local regulations (e.g. Excavation Safety in AECOM University).

5. **Terms and Definitions**

a. **Competent Person**

Person, who, by way of training, knowledge and/or experience, is capable of classifying soils and is also capable of identifying existing and predictable hazards in excavation/trenching work area and who has the authority to take or recommend prompt corrective measures to eliminate them. A civil / geotechnical engineer or similarly qualified person with relevant experience. The person must also be familiar with the requirements in the regulation

b. **Cave-ins**

Cave-ins are the movement of soil into an excavation, including the loss of soil from under a trench support system. This movement can be fatal to personnel if the cave-in occurs when personnel are working near or within the excavation

c. **Excavation**

A man-made cut, cavity, trench, or depression in an earth surface formed by earth removal. Examples:

i. A trench, ditch, shaft, well, tunnel, pier hole, cutting, caisson or cofferdam

ii. A hole drilled in the earth

d. **Trench**

A horizontal or inclined way or opening:

i. The length of which is greater than its width and greater than or equal to its depth;

ii. That commences at and extends below the surface of the ground; and

iii. That is open to the surface along its length

e. **SWMS**

Safe Work Method Statement

f. **Underground Service**

A cable, pipe or other object laid or installed underground for the transmission, transportation or storage of electricity, communications or a substance

6. **References**

a. Emergency Preparedness and Response Procedure – APAC S3[APAC]-010-PR1

b. Hazard Recognition and Risk Management Procedure – APAC S3[APAC]-209-PR1

c. Confined Space Procedure – APAC S3[APAC]-301-PR1

d. Traffic Management Procedure - APAC S3[APAC]-306-PR1
e. Service Identification and Clearance (SIC) Procedure - ANZ S4AN-783-PR1

7. Records
   a. Excavation Inspection Checklist – APAC S3[APAC]-303-FM1
   b. Excavation Permit – APAC S3[APAC]-303-FM2
   c. Service Identification and Clearance Checklist – ANZ S4AN-783-FM1

8. Appendix
   a. Appendix 1 – Minimum Safe Approach Distances (Guidance Only)

9. Change Log

<table>
<thead>
<tr>
<th>Rev #</th>
<th>Change Date</th>
<th>Description of Change</th>
<th>Location of Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>June 20, 2018</td>
<td>Initial Release</td>
<td>All</td>
</tr>
</tbody>
</table>
Appendix 1  Minimum Safe Approach Distances (Guidance Only)

* Check with asset owner as greater clearances may be required.

# Greater distances apply on towers and high voltage transmission conductors.