GEOTECHNICAL SITE INVESTIGATION: OBSERVATIONS OF SITE ACCESS, SITE SUPERVISION AND SERVICE PROVING BEST PRACTICES

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ABSTRACT

As geotechnical site investigation becomes inherently more challenging to complete due to site access constraints, elevated project risk profiles and increased public awareness, the importance of sound planning and execution is vital. The intent of this paper is to provide engineers tasked with managing and delivering site investigations with an overview of personal observations of what could be considered industry best practices (Melbourne) in mitigating potential risks associated with service strikes when planning site investigation, especially for high profile projects. Rigorous site access processes, targeted service clearance, including Non-Destructive Digging (NDD), and proficient site supervision are essential for site investigations on large scale infrastructure projects. The creation of larger Joint Ventures, Alliances and project teams has resulted in the development of more stringent safety processes, more thorough permits and heightened safeguards aimed at reducing risks, both perceived and actual, associated with ground breaking activities. With stakeholders and client becoming increasingly more risk averse, there is a greater reliance on engineers to complete site work without incidents or attracting the attention of the public eye.

1 INTRODUCTION

Given the increased awareness of geotechnical works associated with major infrastructure projects, engineering professionals are now faced with acquiring an additional number of permits and approvals when attempting to gain access to a site for investigation purposes. This increase in administrative tasks does not occur by chance, and has seemingly manifested for a range of different reasons. Sites requiring ground investigations are becoming increasingly congested with existing buried infrastructure and assets, with utility owners becoming more aware of risk to their assets, stakeholders not wanting to be subjected to negative media coverage, and engineering organisations looking to avoid costly damages to both revenue and reputation.

Performing a geotechnical site investigation no longer involves throwing a hand auger and DCP into the back of a Ute and heading out to a client's site. Instead it can involve weeks and sometimes months of meticulous planning involving: subcontractor procurement and scheduling, health and safety approvals, organisational approvals, adhering to statutory requirements, client and asset owner requirements, and the overall site investigation brief – all of which are amplified in requirements and scrutiny when working on higher profile projects. This goes beyond the traditional role expected of geotechnical professionals, who are now required to have a greater appreciation of safety and supervision roles in addition to the technical.

Acting solely as a geotechnical practitioner in the field for site investigations appears to be increasingly less common, with most geotechnical professionals having to also act as a site supervisor, with the site supervisor role demanding a safe working mentality to ensure that the protection of site personnel, equipment, public and client interests are prioritised. The result of the focus on project safety and risk minimisation, has led to the technical component of the actual site investigation taking a back seat, with geotechnical engineers being asked to adapt and transform their traditional approaches.

Due to the increased and more profound nature (i.e. public perception, cost, political significance) of modern site investigations in Victoria, and the various mechanisms in which to deliver such projects including Joint Ventures, Alliances and alike project teams have endeavoured to streamline the site access process, while maintaining the original intent, with the view to reduce overall project risk when performing site work. Multidisciplinary teams associated with major infrastructure projects have the potential to foster, collaborate and share common experiences, and drive innovative processes to perform site works in a manner that is safe for all involved, and to act as a tool to reduce the potential for incidents.

For geotechnical professionals, the result of management processes may come in the form of Site Access Permits, Excavation Permits and approvals. This paper intends to articulate first-hand experience of how these processes have been adopted and executed, based on current experience on significant transport infrastructure projects in Victoria.

2 SITE ACCESS

Prior to commencing the scheduling and permit application process to complete a site investigation, the project must first be scoped by the design team in order to ensure sufficient and appropriate information is collected by the site based team. The person(s) performing the scoping must take into account a range of factors including the intention of the site investigation, ground conditions based on experience or available literature, structures and/or earthworks anticipated, assessment and quantification of geotechnical risks, budget constraints, resource constraints and delivery schedules. A result of this is that very rarely, are the site proposed to be assessed located in greenfield sites free of constraints or challenges.

High profile site investigations require input from a range of different internal project service teams with varying expertise beyond that of the technical teams. To be permitted to access the site and perform intrusive works, an overall understanding of site conditions must be demonstrated to begin the site access approval process. To demonstrate the commitment to safety and quality management, some programs or projects require the detailed information reviewed and approved by a number of individuals, which are discussed further in Section 2.1.

In general, a Site Information Assessment is nominally the initial step in being granted site access, and forms the basis for the eventual site access permit to be issued.

2.1 SITE INFORMATION ASSESSMENT (SIA)

A Site Information Assessment (SIA) is an integral part of any site investigation program. The SIA documentation is highly detailed and project specific, acting as a checklist for the person planning the site works to consider potential constraints and risks which may adversely impact the overall execution and delivery of the works. All information contained in the SIA is recommended to be tailored for each individual site investigation program, geographical location and purpose, and may be completed considering input from several contributing disciplines if required.

For geotechnical professionals, project and program specific knowledge is required to enable successful permitting and will likely vary in context and content. Potential hazards and risks are recommended to be documented and addressed during the completion of the SIA, with typical consideration for the following inputs required:

- Site location, and methodology of physical access
- Landowner approvals, noting specific access requirements and conditions
- Nominated site supervisor(s) for works
- Summary of the agreed and approved works methodology
- Documentation of potential site hazards and controls (actual and perceived), in the form of SWMS/JSEA
- Mechanical plant and equipment details
- Site safe working procedures and plan (offsets to utilities / infrastructure etc.)
- Requirement for Track Force Protection personnel and brief, if in the rail corridor
- Traffic Management Plans and stakeholder approvals, if in the road reserve
- Requirement for overhead electrical observers,
- Field personnel contact information, evidence of competencies, licences and certification if required
- Asset plans and utilities owner logs and drawings
- Requirement for environmental management considerations
- Identification of potential aboriginal and cultural heritage sensitivities

Following completion of such assessments by the applicant, the access request is submitted for review and awaits approval or endorsement by all project members identified within the project Safety Management Plan, which may include but not be limited to:

- Work Package Lead
- Technical Service Lead
- Stakeholder and Communications Lead
- Environment Lead
- Rail Access / Safe Working Manager
- Health & Safety Lead
- Project Manager / Director

Approval by the relevant members listed above results in the work order being approved, with the works subsequently being ‘given the green light’ for execution.

2.2 SITE ACCESS PERMITS

Site Access Permits (SAP) are issued as part of a document pack or folder which contains the relevant SIA, JSEA/SWMS, project specific permits, stakeholder approvals and plans for site works. Obtaining an approved and signed off version of this document pack is required prior to any form of site work commencing, in order to typically comply with project generated safety and quality management plans. This document pack generally must be in possession of the supervising geotechnical engineer at all times during all site activities both as an aid to assist with onsite processes and for compliance with quality management procedures.

Due to the nature of geotechnical site investigations having a detailed appreciation for the plant, equipment and process involved in order to deliver the works in the context of the overall project constraints is vital. In practice, the technical knowledge of a geotechnical professional plays a key role in gaining this approval.

3 SITE SUPERVISION

As previously discussed, geotechnical professionals are not only tasked with using their technical expertise to provide value to projects and satisfy client requirements, but they are often fundamentally required to act as the primary supervisor on their work site. As experienced on various civil infrastructure projects within Victoria, supervising geotechnical professionals are required to undertake and satisfy mandatory safety supervisor training requirements prior to being permitted to manage and supervise site works. Furthermore, to satisfy the prerequisites of the supervisor role, an appreciation and understanding of several site-based procedures is essential prior to the start of any site investigation works.

Due to the potential risks associated with completing geotechnical investigation activities, professionals are often asked to provide an increasing level of commitment to the supervisory role, and managing the safety protocols often thought to be the responsibility of office based teams. This can be seen as a result of recent trends from legislation, clients and corporations intent on shifting the responsibility for safety more onto the supervising geotechnical team and away from the office based company SH&E teams. Based on feedback and experience from a number of internal and external audits relating to the role of site supervision, it is suggested that best practice actions may include (but not be limited to) the site supervisor sighting subcontractor prestart and maintenance records, licences and competencies, test plant safety mechanisms and failsafe’s, ensuring electrical test tagging is in date and complete, ensuring all parties are aware of the location and contents of the first aid equipment (including checking use by dates), spill kit contents, location of fire extinguishers, review of up to date Safety Data Sheets (SDS), risk registers, plant risk assessments, ensuring all site personnel are aware of plant operations, ensure prestart briefings are attended and signed, and a sound understanding of the Safe Work Method Statement (SWMS)/ Job Safety and Environment Analysis (JSEA).

3.2 SITE DOCUMENTATION

3.2.1 SWMS and/or JSEA

A tailored SWMS and/or JSEA for the intended works is a mandatory requirement for any site activities by geotechnical engineers from site walkovers to borehole drilling, cone penetrometer testing, lugeon testing and everything in-between. Due to the technical knowledge requirements of geotechnical site work and the activities that may be included in a brief, a geotechnical engineer is almost always tasked with preparation of this documentation. Other engineering disciplines, who also undertake site investigations, will develop their own site documents as they are more cognisant of the required approach and potential risks. It is not uncommon for graduate and professional level engineers to prepare drafts of such documentation before being reviewed by a more experienced peer prior to issue for approval. For less experienced engineers, developing project safety and access documentation can serve as an aid in developing a strong awareness of potential site work hazards and risks, and identify appropriate controls to create a safe and effective work site. Similarly, for more experienced engineers, the document can be used as a reminder of what is expected of them as a supervisor and reinforce their appreciation and understanding of current best practise.

Occupational Health and Safety regulations specify that all high risk construction work must contain mechanisms to assess risks involved in order to satisfy employer to employee duties. This extends to subcontractors and employees of those sub-contractors and therefore a job specific JSEA/SWMS is used as a risk management mechanism and is provided by sub-contractors to the supervising geotechnical professionals. . It is standard practice for these documents

to be reviewed by safety and site access teams in conjunction with suitably experienced geotechnical professionals to provide value, add context and reinforce understanding of the work at hand.

The intention is to provide the supervisor, who may be different to the document author, with the most up to date information on site including job specific hazards, risks and control methods. It is expected that all supervising geotechnical professionals are fully aware of these documents, their contents and controls prior to any site works.

3.2.2 Prestart Assessment

A prestart briefing (also known as a toolbox meeting) acts as an important daily mechanism for ensuring all work group members are aware of the proposed scope of works for the day, the potential hazards which may be encountered and how they may be minimised. The document complements the JSEA / SWMS and is recommended to be treated as live for the duration of the works. Additions may be made on an as required basis, and the document is to be signed onto by the work group and any site visitors. Most projects generally require a prestart form to be completed on a daily basis as a minimum, whilst others opt to use a multi-day prestart instead where permitted and is to be completed and presented by the supervising engineer.

A well-constructed prestart form generally includes items such as: site specific location, purpose of works, site specific hazards and associated control measures, emergency procedures (including emergency evacuation point, nearest hospital, emergency location reference), identification of first aid trained personnel with location of first aid kits and fire extinguishers, nearest amenities and any site specific procedures.

For geotechnical engineers, this document acts as a guide to what is required from a safety supervision perspective but may also ensure the engineer is aware of the site specific conditions or hazards that they are liable to control in order to keep members of their work party safe from harm.

3.2.3 Site Diary

Daily site diaries are another important project document that not only provides a record of the daily activities on site, but also as a simple method to transmit progress and work activities between the on and off-site teams. Site diaries typically include supervisor details, project number and location details, date, weather, summary of daily activities, duration and reason behind standby/breakdowns, summary of consumables used, contractor events (i.e. waste collection details), works completed / remaining, details and durations of all personnel who attend site noting including 3rd party interactions (e.g. stakeholder discussions or engagement with community members or groups). This document is commonly used by project managers and engineers to relay site information in real time, adding increased value to the client and satisfying work update requests.

3.2.4 Permits and Approvals

Site specific permits and approvals vary based on site location, landowner and type of works proposed, each varying in requirement and processes. Geotechnical professionals involved on projects as either the project managers or supervisors may be required to procure and complete the relevant permits and approvals that affect their site or scope of works. Navigation of the specific requirements and identification of various land owner types have not be discussed in this paper but have been acknowledged as they vary with different state respective statutory requirements.

3.2.5 Additional Documentation

In addition to the documentation discussed above, additional safety management plans may be required to be included within the site documentation. For high profile projects within the Melbourne metropolitan area, it can be inevitable that interfaces between the fieldwork team and road or rail reserves will occur resulting in additional rail safety or traffic management plans being required. As supervising engineers are responsible for the set up and management of their site, a sound knowledge of the site specific traffic management plans is essential. Traffic management plans must be in place and compliance with approved plans checked and endorsed by the relevant stakeholders prior to the start of any intrusive works. Similarly, rail permits to work and notice of excavation policies should be adhered to and understood by the site supervisor.

To assist in the supervisory role on projects, geotechnical professionals are typically provided with Supervisor Handbooks, which provide detailed information on safety, quality and management requirements, processes and procedures which are essential for the project to be undertaken in a controlled, safe and efficient manner. Typical handbook or similar material specifics will not be discussed in this paper but are acknowledged as a part of the supervisory commitments.

4 SERVICE CLEARANCE

Ground disturbance of any type inherently carries a degree of risk, and one of the most significant risks that geotechnical site investigation endeavours to mitigate is that of damaging a service. Site investigations are occurring in increasingly complex sites and due to site spatial constraints, the complexity of services and utilities that have been constructed within the built environment, risk likelihood and consequence becomes elevated. As a result, the cost of potentially damaging a service or asset can affect a company or individual not only financially but also their reputation. Due to the perceived risk of site investigations on projects, it is essential that sound procedures and refined techniques are employed when assessing a site for underground assets. Geotechnical engineers are tasked with understanding these procedures and must be experienced with understanding information provided by specialist contractors and utility providers for this process to be effective.

4.1 ACCESS AND EXCAVATION PERMITS

Excavation permits have been developed in-house by engineering consultancies and contractors and are generally adopted for use by organisations in an effort to minimise potential for site works of any kind to disrupt or damage a service, with a focus on ground disturbance activities. It is essential that disruptions to underground or overhead services be kept to zero. Therefore well refined and comprehensive permits are developed.

The excavation permit must be completed and signed off by the supervising geotechnical engineer prior to any type of intrusive works, in accordance with the project safety and quality management procedures. The excavation permit may be staged into a number of stages addressing key hold points, each requiring assessment and sign offs prior to progressing to the next stage. Potential stages may include:

1. Site Access
2. Service Location Proximity Checks
3. Service Detection and Location
4. Non-Destructive Digging (NDD)
5. Drilling Pre-Start Check
6. Reinstatement and Completion

The first stage involves assessing the site access via desktop review and informs the permit holder of the specific details for the excavation. Although similar to the aforementioned site access procedure, if the site engineer has not authored the prior site access documents then this will assist their due diligence. This further encourages the geotechnical engineer to think about the logistical operations of their site, property type (private, rail, public, etc.), drill rig orientation (offsets to assets, set up of rod racks, etc.), access and egress, requirement for traffic management, council approval, ecological supervision requirements, area clear of cultural or heritage significance, permit to work approvals, overhead spotter requirements and excavation location positioning away from significant infrastructure in a practical sense. In some cases this initial step can prevent organisations from facing additional financial costs, time losses and reputational detractions as well as management errors and perceptions that may otherwise be missed.

Creating a ‘mud map’ of the site location involves the compiling of as many details of the as-built service environment as possible and then sketching the services onto a drawing. In Victoria, the primary central source of information for the creation of the ‘mud map’ is through the use of the Dial Before You Dig (DBYD) service available online (see Section 4.2). The information received from the DBYD service is used in conjunction with any other documentation that may be potentially obtained from the client, landowner or specific asset owner. The intention of the ‘mud map’ aside from due diligence obligations, is to assist in selecting the most effective location for the ground breaking works that will require the minimum number of additional permits and applications, and to also aid the physical service identification process, while still providing the required geotechnical information. A reduction in time spent obtaining additional permits and applications can result in being able to attend site more quickly and thus being able to make delivery deadlines sooner. The ‘mud map’ is then used to assist completion of the service location proximity check within the second stage of the excavation permit.

The service location proximity check involves repeated diligence to locate all services potentially affected or near the intrusive works, including both overhead and underground services. Proximity checks should be carried out initially at a desktop level, followed by confirmation during site inspection, during physical service detection and prior to NDD

works. This process is proposed to ensure that all minimum proximity clearances, specified by the asset owner, can be achieved to avoid further additional permits or resource allocations.

Service proving and detection involves the supervising engineer engaging and working with specialist subcontractors to locate services (if any) in proximity to planned excavation locations in accordance with AS5488-2013 (Refer to section 4.2). Any confirmed services are suggested to be added onto the 'mud map', which should also indicate offset measurements for all known proved assets with respect to the planned excavation. In the event the planned location does not comply with minimum asset owner specific excavation permit requirements, the intrusive works are recommended to be relocated. If this is not possible, additional processes and procedures may be initiated to further manage the risk. Once complete the geotechnical professional and specialist subcontractor representative should both sign authorisation to proceed with non-destructive digging (NDD discussed in Section 4.2.3).

4.2 SERVICE LOCATION PROCEDURE

Geotechnical engineers are generally tasked with attending site accompanied by specialist subcontractors to locate and prove services prior to intrusive works. Service location and detection must be completed to AS5488-2013 in order to provide value to geotechnical engineers and fulfil organisational requirements. This will typically involve obtaining DBYD information and creating a mud map prior to attending site; performing a site inspection with the specialist contractor to physically identify and locate known and unknown services; non-destructive digging to clear an area to nominal depth prior to geotechnical excavation. The intention of this procedure is to prevent the geotechnical site investigation from affecting any underground or overhead assets as these may be costly and life threatening if damaged. Being familiar with the basics of service location is essential in providing value to the client and also for the site investigation.

4.2.1 DBYD AND MUD MAPS

Dial Before You Dig is a free national referral service that is aimed at preventing damage and disruption to a range of national infrastructure assets and services. Before any site investigation works begin, it is essential that all Dial Before You Dig plans are procured and used within 28 days. Plans that are more than 28 days old must be reapplied for and obtained prior to performing any site works, including site walkovers. For geotechnical engineers it is essential that they perform their due diligence prior to attending site. This includes contacting asset owners for further clarification, additional plans, and permits as required. A 'mud map' must then be created for the site to assist in the on-site service detection procedure. The 'mud map' will typically involve a plan view of the site with all known assets drawn and overlayed onto the image/drawing, with the use of different colours generally being of value to the user (e.g. white lines for communication services). The final product can form an invaluable tool for the geotechnical engineer attending site since a clear understanding and view of the service assets on site is readily available. This contrasts with taking a large volume of plans and permits to site without performing due diligence where an increased potential for items to be missed or similarly errors moving between different documents on a tablet or portable computer is probable. It should be noted that a 'mud map' is a tool for assisting service detection and should be used in addition to all DBYD plans, as built drawings and plans during the service detection process as errors in the 'mud map' may cause costly changes or delays to site works if solely relied upon. Examples of potential errors include drawing a service in an incorrect location, incorrect service type identification, offset and proximity measurement errors, land boundary identification errors and use of outdated aerial/plan view drawings. As a result, an error may cause planned borehole's to be moved and potentially subjects a program to a delay while new permits are procured, subcontractors are managed, and plans are updated. In general, fill materials, cracks in concrete from differential settlement, warning signs, hydrant markers, property owners or managers and site personnel (if occupied) can provide indications and details of potential service locations.

4.2.2 CABLE LOCATOR AND GROUND PENETRATING RADAR (GPR)

Specialist contractors will generally be able to provide a range of service location methods and techniques to geotechnical engineers. The most common service location apparatus used on high profile projects are the use of the high precision cable locator (detection wand as it is colloquially known) and ground penetrating radar (GPR). A specialist subcontractor will generally print the DBYD asset plans to A3 and use them in conjunction with their cable locator and GPR – A3 plans or larger are preferred by specialist locators as they make identification clearer in asset dense areas. Alternatively, a locator may bring a tablet or personal computer to site and use georeferenced DBYD plans in real time, although this approach appears to still be in its infancy. A typical cable locator unit contains multiple

inbuilt antennas that can emit various frequencies at selected strengths. The cable locator can be used in several ways to detect services and provide information to geotechnical engineers, providing depth and alignment of services. The size, type and number of assets are confirmed on site between the use of DBYD plans, utility pits, as-built drawings, visual aids (signs, hydrant markers) and outlets.

The first method of identification via the use of the cable locator unit is through direct induction where the detection receiver is connected to a conductible material (i.e. copper/mild steel) or trace wire and a current is induced. The receiving 'wand' is then able to pick up the induced signal to depths generally <2.5m below ground surface level. If no trace wire, utility pit, or conduit is able to be accessed the locator may then use an induction method. The detection receiver may be placed on the ground above a service and current transmitted through the ground in an effort to induce a signal. This method has the potential to cause the signal to 'bleed' onto other services and may not provide valuable or accurate results. If the aforementioned methods are unsuccessful or the asset is not made of a non-conductible material (i.e. PVC or ceramic), an insulated conductive metal rod may be fed into a conduit or asset (i.e. storm water drain) and a current induced.

Where the use of the cable locator is not effective or possible the ground penetrating radar may be used, and the experience of the specialist contractor will generally dictate the quality of results achieved. From experience and based on the results available as an output from using the GPR, this method should not be relied on solely as an indication on depth, location, size and type of an underground asset. The output obtained from the GPR will generally only show disturbances in density of the substrate and not provide images of the services – sometimes potential services have been non-destructively excavated and instead found to be rail sleepers. Poor quality outputs of GPR may be potentially due to a wide range of densities being present within the target area, moreover the results seem to be questionable when scanning over concrete ground slabs, but further specifics will not be discussed in this paper. It is common practice for service locators to mark on the ground the assets with temporary ground paint, using different colours to differentiate utility types. A single colour i.e. pink may be used for assets where a service is potentially located but no exact details can be determined. All unknown services that are in immediate proximity should be managed based on asset owner provided guidelines (generally in DBYD documents). Where this cannot be achieved due to budget or resource constraints, excavations should be moved.

Once the service location and detection has been complete, the geotechnical engineer must then choose an appropriate location for the intrusive works keeping in mind the site restrictions including but not limited to overhead assets, access and egress, type of plant and equipment required, site set out and ground conditions. It is advisable to clear an area such i.e. 2m x 3m box as opposed to a single point in the event an item such as a borehole needs to be moved due to unforeseen circumstances.

4.2.3 NON-DESTRUCTIVE DIGGING (NDD)

Non-destructive digging is used by specialist locators and geotechnical engineers to clear areas and boreholes of assets so that they are not disrupted or damaged. The typical minimum depth for NDD used by organisations for ground disturbance works in the Melbourne area is 1.5m below ground surface level. This depth has been chosen on general consensus since most assets are generally located in between the ground surface and around 1.5m depth. This is not always the case as from first-hand experience some services closer to rail level crossings are generally as deep as 2.1m below ground surface level (deep sewers can be >5.0m below ground level). Depending on the project requirements and restrictions NDD may be performed in a range of different ways. Using a hand auger and performing manual 100mm lift intervals is seen as generally acceptable and may aid more budget restrictive projects. On high profile projects, blanket bans on all intrusive works are typically in place until NDD is complete and the only acceptable method of NDD is via hydro excavation vacuum trucks (NDD Truck) and trailers. Where test pits or other various forms of ground disturbance activities are required and the NDD phase omitted, suitable substitute measures should be implemented and agreed upon to appropriately manage the risks.

Specialist operators use the NDD trucks to clear areas, boreholes, and also prove assets where required. It is generally advisable to use the NDD truck to clear a hole to 130% of the intended diameter in a further effort to minimise the potential for asset disruption in the event an unknown asset borders the chosen location. A maximum water pressure of 2000 kPa is used to prevent damage to the assets and care should be taken when vacuuming in non-cohesive materials since the larger NDD trucks can remove large volumes of soil in a matter of seconds.

Where the NDD refuses at depths shallower than 1.5m below ground level, all works should cease and the package lead, technical lead, access co-ordinator or project manager must be contacted to seek guidance based on their experience or knowledge of similar situations. In general discussions will result in the NDD of additional locations within the same area to prove whether the refusal is consistent or false (i.e. could be a discrete floater).

Once NDD is complete, the hole must be temporarily covered or backfilled with sand or gravel to prevent any type of incident or injury from the excavation and clearly marked with the use of items such as paint, stakes or flags. For highly trafficked areas that are used by numerous users, it can be possible to bury a small note in a plastic bag or equivalent so that this can be retrieved prior to geotechnical drilling or equivalent. Similarly, in highly vegetated or similar coloured landscapes (that make observing backfill placed after NDD difficult), brightly coloured sand and gravel may be used to cap the top 100mm or chosen equivalent, Offset measurements to easily identifiable objects and photographs should also be taken. All excavated spoil should be disposed of by the specialist contractor as per the project requirements, governing state or local laws.

4.3 COMMENCEMENT OF SITE INVESTIGATION WORKS

Finally, a pre-start check prior to the start of the 'main' geotechnical activities is required and must be completed and signed off by the supervising engineer. This includes a check that all previous steps within an excavation permit type system have been completed, site access is approved and in date, pre-start photos are taken, permits are checked and activated, rig security is in place, any subcontractors that are required are on site, JSEA/SWMS is completed and that NDD has definitely been completed to 1.5m or greater. The successful completion of this step allows these further ground disturbance activities to begin and further geotechnical data to be obtained (should commence during NDD process).

5 CONCLUSION

Geotechnical site investigation on projects are complex and require geotechnical professionals to develop and refine a plethora of skills that are often not traditionally seen as being explicitly associated with their technical expertise. The role of geotechnical engineers now involves astute knowledge of site access protocols, excavation permits and processes, an understanding of service location and clearance and an ability to perform as dual role as technical expert and site supervisor. Navigation of these key concepts is vital in providing value to projects, clients and outcomes. Inter-disciplinary co-ordination, active input from office-based safety teams and engagement of experienced and senior personnel are all key aspects of modern site investigation and should be constantly explored in an effort to support this type of endeavour. Similarly service detection and clearance must play a vital and important part of any intrusive works and tailored to meet both organisational, project and budget requirements. The site supervisory roles of geotechnical engineers are largely becoming the major component of any project campaign including a sound understanding of the processes and expectations. Negligence and poor attitudes towards safety requirements and responsibilities is unacceptable, and will only increase the risk of incidents, cost over runs, quality of outputs and rescind reputations. Young graduate and professional level engineers should be mentored and nurtured when learning the requirements, risks and expectations of being site supervisors as the consequences of noncompliance are inevitably rising. Sound planning should generally result in greater time, cost and quality outcomes for clients and organisations.

6 ACKNOWLEDGEMENTS

Ian Ullah (AECOM Australia Pty Ltd, Principal Engineering Geologist) for acting as my supervisor and mentoring me throughout both this process and also on the aforementioned high profile projects. Thank you for providing invaluable feedback and helping me grow as a young engineer. Anthony Mann (AECOM Australia Pty Ltd, Associate Director) and the wider AECOM Melbourne Ground Engineering + Tunnelling team for providing support and aiding my development. Jan Krestyn (AECOM Australia Pty Ltd, Principal Engineer, Team Leader - Ground Engineering + Tunnelling) for providing me with countless opportunities to broaden my skills, trusting my judgement and always encouraging my geotechnical endeavours. I would also like to acknowledge the wider project teams I have worked with in various Technical Advisory roles that have helped me gain an appreciation of the requirements of a 'modern day' engineer, and for fostering my development. Of course, this would not be possible without our clients that have provided the foundations for the aforementioned to be possible.

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