A ground investigation specification for New Zealand

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ABSTRACT

Until 2017 there was no standard template in New Zealand to assist in the specification and procurement of ground investigations, and so consequently specifications varied significantly from project to project and between organisations. This caused numerous problems: (1) Long project specific specifications were unlikely to be fully read by tenderers (at least within the tender period) while short specifications were unlikely to capture all the appropriate details. (2) Time was wasted writing a fresh specification for each project, adding to costs. (3) There was inconsistent pricing within and between tenders due to the lack of clarity on scope. (4) Inconsistent or unread specifications resulted in confusion about the scope of work, including expectations and practices about the quality standards required, leading to unexpected variations or rework on site.

This paper describes the development of a New Zealand standard specification template. This specification is the fruit of a collaborative process involving major clients, large and small consultants, and ground investigation contractors. It is a free to use, ready-to-go pack of documents which is suitable for small, medium and large projects of any complexity. It is designed to be easy to use, to simplify the procurement process, and to be customisable to suit the specific requirements for more complex projects.

This paper describes how the use of this specification and advice will benefit all parties.

1 THE NEED FOR A STANDARD SPECIFICATION AND GUIDANCE

Until 2017 there was no standard template in New Zealand for the specification and procurement of ground investigation work, so specifications varied significantly from project to project and between organisations. This variation meant that:

- Long specifications were unlikely to be fully read and understood by tenderers (at least within the tender period)
- Short specifications were unlikely to capture all the appropriate details.

This has resulted in a number of problems:

(1) Time was wasted writing a fresh specification for each project, adding to costs.
(2) There was inconsistent pricing within and between tenders due to the lack of clarity on scope
(3) There was confusion about the scope of work, including expectations and practices about the quality standards required, leading to variations or rework on site.

A standard specification, such as the one commonly used in the UK (AGS, 2012) can resolve many of these issues. Procurement of ground investigations should become quicker and more consistent. Once widely used the contents become familiar to all parties, giving a shared understanding of the project scope without the need for lengthy and detailed study of the specification. By setting a realistic benchmark for quality, clients can be confident that – with appropriate supervision – they are getting what they expect, and tenderers can be confident that they will not have to cut corners to have a chance of winning tenders.

2 THE NEED FOR PROCUREMENT GUIDANCE

Client organisations often report difficulty in procuring geotechnical services. Problems are perceived within the investigation process around large cost variations as the ground investigation proceeds, frequently associated with the difficulty of specifying ground investigation requirements. Later in the design and construction phase, problems are common when unforeseen ground conditions lead to construction cost over-runs which are often attributed to failings in the ground investigation.

2.1 Under-scoped ground investigations

Unforeseen ground conditions often have a significant impact on the success of construction projects. The extent of unforeseen conditions and the resultant capital cost increases are commonly linked to an under investment in ground investigation. International research shows a strong correlation exists between low spend on ground investigation and high capital cost over-runs (Figure 1).

Figure 1. Impact of ground investigation expenditure on UK highways contract cost over-runs (Mott MacDonald and Soil Mechanics, 1994)

This under investment occurs for a number of reasons including:

- Clients are awarding tenders for geotechnical services on lowest price conforming, not best value.
- Site investigation scope is being constrained by inappropriate procurement methods.

Clients also systematically over-estimate the amount they actually spend on ground investigation. Some examples of actual ground investigation costs from the UK are presented in Table 1, along with information based on surveys asking how much the client believed they spent. It is worth noting that all parties spent significantly less on ground investigations than they assumed.

The numbers presented in the table are not intended as a guide to the appropriate spend on future projects as they are based on historical spends regardless of outcome. Many of these projects are to likely have gone over-budget as a result of unforeseen ground conditions.

Table 1: Funding of site investigation as a percentage of total project costs (adapted from ICE, Inadequate Site Investigation, Table 2, 1991)

Consumer	**Amount consumer believed they spent on Ground Investigation (% CAPEX)**	**Amount consumer actually spent on Ground Investigation as calculated by researchers (% CAPEX)**
Government authorities	2.20	**0.29**
Manufacturing / commerce	0.76	**0.22**
Civil engineering contractors	0.85	**0.23**
Developers / builders	0.72	**0.11**
Architects	0.29	**0.14**
Multidisciplinary consultants	0.92	**0.23**
Civil engineers	1.94	**0.29**
Structural engineers	0.23	**0.16**
Average	0.99	**0.21**

While a specification cannot resolve problems with under-scoped ground investigations, guidance documents associated with technical specifications can be used to set improved benchmarks and raise awareness of the potential pitfalls and problems.

2.2 Ground investigation procurement and management challenges

2.2.1 Pre-determined scopes of work

In an attempt to create a fair and comparable tendering process for ground investigation work it has become common in New Zealand to provide a pre-determined scope of investigation to be priced.

Although the aim of this approach to provide comparable tenders is laudable, it often fails in practice. Tenderers are aware that they are being engaged as technical experts to re-scope the investigation as they judge necessary and that therefore they can (and should) change the scope to meet the actual project needs. It then becomes a simple process to work out what the 'minimum acceptable' scope for the investigation might be. By under-pricing aspects of the tender that they expect to later remove from the scope they can submit a lower price and increase their chances of winning. The client's desire for a fair tender process has been subverted. In addition, such a reduced scope is unlikely to optimally manage the client's risk and will result in more conservative design assumptions and therefore expensive construction. The client will get a lower cost investigation but a higher overall project cost and greater risk of variations during construction.

By partially locking consultants in to a pre-determined scope this approach also significantly limits the opportunities for the application of in-depth local knowledge, innovation and risk-sharing.

2.2.2 Tendering on price

It is standard practice to include price as a scoring attribute when tendering ground investigation work, with weightings commonly between 40% and 100% of the total criteria.

A ground investigation serves two primary purposes:

(1) Providing data for analysis and design
(2) Reducing uncertainty about ground conditions to reduce construction cost variations (i.e. control of risk).

Procurement approaches which focus on the cost of the geotechnical investigation, risk pushing the scope of investigations down as part of the competitive tender. Such 'minimum scope' investigations might achieve the first goal of a site investigation (to provide information for design) but are unlikely to meet the second goal (reducing project risk) and are therefore likely to lead to significant increases in construction cost.

3 DEVELOPMENT OF THE NEW ZEALAND GROUND INVESTIGATION SPECIFICATION

As a result of the problems described above the need for a standard specification with supporting procurement guidance was identified.

3.1 Governance

A Governance Group was set up to oversee the project. This group was tasked with providing leadership and governance oversight to the working group, agreeing the scope of the guidance/specification, and coordinating reviews on behalf of their respective organisations.

A Working Group was established to prepare the guidance in line with best practice under the oversight of the Governance Group. The membership for both groups is presented in Table 2.

Table 2: Governance and Working Group Membership

Governance Group	
Name	**Representing**
Sarah Sinclair	Auckland Council
Mike Stannard	MBIE
Stuart Finlan	NZ Transport Agency
Chris Beasley	Auckland Transport
Tony Fairclough	EQC & NZGS
Jean de Villiers	Watercare
Steve Faulkner	NZ Drillers Federation
Marco Holtrigter	CETANZ CPT
Ross Roberts	Auckland Council

Working Group	
Name	**Representing**
Ross Roberts	Auckland Council
Harry Wahab (Beca)	MBIE
Gilles Seve	MBIE
Stuart Finlan	NZ Transport Agency
Sally Hargraves	TerraFirma Engineering
Guy Cassidy	ENGEO Limited
Tony Fairclough	Tonkin & Taylor
Stephen Grace	Watercare
Steve Faulkner	NZ Drillers Federation
Marco Holtrigter	CETANZ CPT

The membership of these groups was designed to bring in a broad range of skills, and to include representation from key clients, large and small consultancies, and contractors. In addition to these core members, specialist input was sought as needed from technical experts.

3.2 Aims of the specification

The Governance Group set the key desired outcomes of the specification and associated guidance documents as:

a) Consistent, transparent and repeatable site investigation tendering by client organisations (limited to the technical aspects and excluding contractual and tendering terms) that is accepted by the building and infrastructure industries as a de facto standard.
b) Consistency of pricing by site investigation suppliers.
c) A clear understanding of the quality standards expected in ground investigation works by suppliers of ground investigation services. These quality standards align with best international practice.
d) The collection of ground investigation data in a format that can easily be stored in an electronic database.
e) A clear understanding of the required minimum standards for health and safety practices associated with the ground investigation works.
f) A document that can easily be up or down scaled depending on the nature and complexity of the project and the level of information required or contractors that need to be engaged.
g) Alignment with the MBIE/NZGS Module 2.
h) A bill of quantities with basis of payment and methods of measurement.

Activities considered out of scope were:

a) Site investigation activities beyond collection and collation of factual data (eg geotechnical interpretation, desk studies, design)

b) Specialist activities which are not conducive to a standardised approach or which are developing quickly so would be prevented from future improvements by a standardised specification (e.g. geological mapping, some geophysical methods).

3.3 Reviews and industry consultation

After internal reviews within the organisations represented in the Governance Group, a draft specification was released on the NZGS website for industry review in April 2016. Feedback was received over the six month consultation period from 26 individuals and 9 companies (Worksafe NZ, Tonkin & Taylor, Opus, DataTran, Beca, Perry Geotech, ENGEO and NZ Transport Agency). This feedback was incorporated into a new revision of the specification, which was issued in final status as Revision 0 in April 2017.

It is anticipated that as the document is used in practice, further revisions will be required. To streamline the collection of this feedback an online survey has been set up to allow easy tracking and compilation of feedback from multiple sources.

4 STRUCTURE OF THE SPECIFICATION

The specification comprises four compatible volumes that, when used together, are intended to enable an appropriate quality of ground investigation and a simpler, clearer and more consistent tendering process. Of these only Volume 1 would be used on all projects.

4.1 Volume 0: Commentary, introduction and guidance

This volume provides general advice regarding the correct application and intended use of the specification and the procurement of geotechnical services. It does not form part of the specification, although the specification is intended to be read in conjunction with this document.

It also provides (as appendices) a set of standard templates and guidance which may be useful in improving the consistency of ground investigation practice but do not form a part of the specification. These templates include:

- Standpipe piezometer installation instruction sheets / as-built records
- CPT data records
- Permit to dig

Each of these templates is considered appropriate for use on many projects, but will be superseded by project or client specific versions. This allows the consultants involved to use their own preferred templates where they already exist or where they are more appropriate for the project and site requirements.

4.2 Volume 1: Master specification

The master specification comprises a series of unambiguously worded clauses which are intended as minimum requirements to meet current standards and comply with established good practice. These minimum requirements have been set for the geotechnical investigation techniques which are most commonly used in New Zealand. It is implicit that only the sections relevant to the specific investigation being undertaken are applied to a particular project.

The specification is fixed in content and scope. Project specific requirements, including identification of which sections of the specification are relevant to that project, are defined in Volume 2 (the project specific requirements). This way the specification can be scaled to suit a range of project sizes.

4.3 Volume 2: Project Specific Requirements

The project specific requirements document is a template in MS Word format designed to be completed by the client and geotechnical professional to give details on which aspects of the specification will apply to the project, and any changes to the standard wording. Clients may choose to create their own versions of this document to suit their specific procurement and technical requirements.

4.4 Volume 3: Bill of Quantities

An example Bill of Quantities, together with a preamble which defines payment terms, is provided in spreadsheet format for ease of use. This is designed to be compatible with the specification and allow easy management of a ground investigation by defining consistent payment and measurement methods. It is also the preferred tool to clearly define the scope of work to the consultant or contractor. Some parties may choose to use the specification alone with their own alternative method of measurement.

5 CONCLUSIONS

The New Zealand Ground Investigation Specification provides an easy-to-use set of minimum requirements to meet current standards and comply with established good practice for commonly used ground investigation practices in New Zealand in a cost effective and consistent manner.

It also advises on best practice guidance for procuring good-quality site investigation and streamlines the procurement and investigation management to improve the efficiency of ground investigations.

It is based around good practice with New Zealand specific content to suit our specific requirements and expectations. It has been endorsed by the New Zealand Geotechnical Society, the New Zealand Drillers Federation, EQC, the NZ Transport Agency, the Ministry for Business Innovation and Employment, Auckland Council, Auckland Transport and Watercare.

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REFERENCES

AGS, (2012) *UK Specification for Ground Investigation.* Second edition. ICE Publishing, London.

Institution of Civil Engineers, (1991) *Inadequate site investigation; a report on inadequate site and ground investigations leading to construction delays and additional costs*. Thomas Telford Publishing, London.

MBIE, (2016) *Practice Advisory 17: Well planned ground investigations can save costs*. 30 June 2016. ISBN: 978-0-947497-63-7. https://www.building.govt.nz/building-code-compliance/b-stability/b1-structure/practice-advisory-17/

Mott MacDonald and Soil Mechanics, (1994) *Study of the Efficiency of Site Investigation Practices*. Transport Research Laboratory, Workingham, TRRL Project Report 60.