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| --- |
| DESIGN BRIEF  Geotechnical investigations  part a – gravel and OTHER material SOURCE INVESTIGATIONS  part B – Existing and NEW road ALIGNMENT investigations  part c - bridgesite and other STREAM CROSSING INVESTIGATIONS  part D - BUILDING INFRASTRUCTURE FOUNDATION INVESTIGATIONS  Revision 4 – 22nd May 2018 |
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# SCOPE OF SERVICES

## PROJECT BACKGROUND and general requirements

### Site Locality

The site is located …

* Attached site map …
* Chainage ….km to Chainage …km
* GPS Co-ordinates …

### Project Description

The proposed project includes the development/upgrade/rehabilitation/construction of the following elements:

* Gravel pit resources …
* Upgrade and/or rehabilitation of an existing road alignment …
* Road pavement failure investigation ….
* Development of a new roadway/carriageway/easement/service corridor…
* A new bridge/major culvert at the … river/creek …
* Building infrastructure, comprising a new school/health clinic/ and associated civil works …
* Headworks infrastructure upgrade …
* Subdivision and land servicing …

The proposed budget for the project is funded from the Capital Works program, and is

The project is planned to be constructed during the months of *…. in 2020/2021…*$......

### Objectives of Geotechnical Investigation

Maybe appropriate to give background history on the Services being sought so the Tenderer has a better understanding of why and how the requirement arose/purpose of the requirement. Delete if not applicable

The general objectives of the geotechnical investigation is to provide the geological and geotechnical data and interpretations necessary for the rational, safe and economical design of the project, to provide data for the preparation of tender documents and for contractors to become informed of the ground conditions so that they will be able to safely and economically construct the project.

Sufficient geotechnical information should be gathered and interpreted to allow a designer to appreciate the limitations and opportunities that the site conditions present. As such, the investigations will be undertaken in the context of identifying geotechnical issues and risks, in order to mitigate them through the design and construction phases of the project.

### Scope of Services of Geotechnical Investigation

Detail the Service required, including any specific personnel requirements (if applicable). Where possible specify in terms of outcomes (describe the functional or performance requirements) rather than specify how it is to be done, etc.

NOTE: Any quantities required, and delivery/completion timeframes MUST be specified in the pricing Schedule and Annexure respectively and don’t need to be repeated here.

The scope of the geotechnical investigation services comprises (delete as appropriate):

Part A – Gravel and other material source investigations

Part B – Existing and new road alignment investigations

Part C – Bridge site and other stream crossing investigations

Part D – Foundation investigations

Details of each part are included in the brief in the following sections.

### Delivery Timeframes

*Amend the timeframes accordingly to suit project requirements*

The geotechnical investigation services will be provided in accordance with the following timeframes.

|  |  |
| --- | --- |
| **Activity** | **Cumulative Delivery Timeframe from Start of Commission** |
| Field Work | *4* weeks |
| Laboratory Testing | *8* weeks |
| Draft Report | *10* weeks |
| Final Report | *12* weeks |

### Traffic Management

Before starting any field works including survey, geotechnical investigations and potholing, prepare and submit Traffic Management Plans (TMP) consistent with the “Provision of Traffic” section in the Department’s Standard Specification for Road Works.

### Standards, Guides and References

Austroads Guide to Road Design, Part 7, Geotechnical Investigation and Design

Geotechnical Site Investigations, Australian Standards AS1726

Methods of Testing Soils for Engineering Purposes, Australian Standards, AS1289 - various

Methods for Sampling and Testing aggregates, Australian Standards, AS1141.3.1-2012

Residential Slabs and Footings, Australian Standards, AS2870-2011

Bridge Design, Foundations, Australian Standards, AS5100.3-2004

Australasia 2016 – Conference on Piling and Deep Foundations

Northern Territory Test Methods (NTTM), refer Department website for current versions.

Department’s Standard Specification for Roadworks

* + 1. **Utility Services**

All services locations shall be obtained through Dial Before You Dig and verified by qualified service locators using GPR or potholing.

### Access to Land and Environmental Requirements

The consultant shall notify landowners of the intention to access their land irrespective of whether the land is freehold, leasehold or aboriginal land trust. Refer to the Department Environmental Management Specification, available on the website, for detailed requirements.

The consultant will endeavour to limit damage to flora and fauna while undertaking the investigation. All excavated pits will be reinstated and compacted by wheel/track rolling.

### Cultural Clearances and Approvals

Check with the Superintendent’s Representative on the status of clearances and approvals before mobilising for fieldwork.

The Principal will be responsible for obtaining approvals to undertake the work, including heritage and environmental, Aboriginal Areas Protection Authority (AAPA), and Land Council (if on Aboriginal land).

The Consultant is required to comply with cultural, heritage, environmental or other conditions determined by the AAPA and all other relevant authorities during field works. Avoid disturbance of all restricted work areas or sites of significance.

If any survey and /or investigation work is to be done on Aboriginal Land Trust land, the consultant is required to obtain ”Permits to Enter” from the respective Land Council. The Consultant will need to obtain access permits from the relevant authorities for the purpose of site visits and investigations. Permits for access to Aboriginal Land will need to be obtained from the relevant Land Councils. Permits for access to parks will need to be obtained from the relevant park managing authority.

Relevant clearance and approval information is appended to this Brief.

### Liaison

Nominate a Project Officer who will be responsible for overall co-ordination and liaison on the project.

### Surveying

Survey the location of all boreholes, test holes etc in the field using appropriate methods, and show the locations on drawings included in the draft report. GPS co-ordinates (in northings and eastings) and RL shall be provided for all test pits, boreholes etc. Provide the datum used for these data.

### Excavation Hole Logging

Log all test pits using the Department's standard proforma logging sheets and comply with requirements of AS 1726. Complete all columns in the logging sheets. These sheets are intended to be used as a prompt; they are not exhaustive and do not necessarily cover all details needed. Each job will have its own requirements and the field operator will need to decide about the inclusion of additional data observed during the fieldwork. Final log sheets for the report shall be clean and written up clearly or typed. Moisture content profiles and other relevant tests shall be shown on the logs.

Ensure that all field notes, bore logs, photos, electronic data and drilling records are copied or downloaded daily as a backup for data security.

### Other Precautions In Carrying Out Work

Comply with all requirements under acts, ordinances, regulations, by-laws, orders and rules and other special requirements of proper Authorities concerning storage, transport and use of materials, plant, equipment; work processes and safety precautions.

Observe all rules and regulations in force in the area where the works are to be carried out.

Where any current Australian Standard published by Standards Australia is appropriate to storage, transport and use of materials, plant and equipment, to work processes or to safety precautions, the provisions of such standard shall be observed except if it conflicts with any statutory or special requirements of proper Authority in which case the latter shall apply.

In the absence of any such statutory or special requirements or relevant Australian Standard, ensure that suitable procedures are observed and all proper care is taken.

Take all necessary precautions to ensure that no fire hazard is created in carrying out the works.

## PART A – GRAVEL AND OTHER MATERIAL Source INVESTIGATIONS

### Aims and Requirements

Conduct a gravel and material search investigation for proposed materials in specified areas to assess the quantity and quality of deposits available which are suitable for fill, subgrade and pavement construction.

Investigation areas have been identified by coordinates and suitable Goggle maps supplied (included as attachment). The consultant must not extend the investigation beyond these boundaries without written approval from the Superintendent.

Test pitting will not be undertaken closer than 125m of an existing roadway or 25m of a stream bank.

### Scope of Field investigations

The scope of field work to be carried out comprises:

* Excavate test pits to establish stratigraphy of deposits, or shallower if practical refusal occur, by means of a backhoe or mini-excavator. Use of an auger is **not** allowed due to possible damage to gravel particles and changes to soil characteristics. Test pits should be spaced on a grid of about 40m to 50m to cover the designated area. Smaller grid spacing can be used to better define deposit limits if required.
* Log the soil profile (and weathered rock, if encountered) of each test pit to Australian Standards (AS 1726).
* Record start and end chainages of insitu soil units
* Record moisture content variations and groundwater encountered.
* All depths are to be recorded in metres.
* Photograph each test pit. Use a suitable scale for reference.
* Record and provide GPS coordinates of all test pits.
* Samples of appropriate mass must be taken to ensure an accurate assessment of the material types within the nominated area can be made. It is recommended that as a minimum samples should be taken from every second test pit. Samples should be taken from individual horizons as well as composite samples from the total depth of material considered suitable. All samples must be identified clearly with area number, test pit number and depth the sample was taken from (in metres).

### Laboratory Testing

Laboratory testing of samples will be undertaken in a NATA accredited laboratory and all test reports must be NATA endorsed. Samples must be tested for Particle Size Distribution, Atterberg Limits (wet preparation) Linear Shrinkage, and California Bearing Ratio (CBR) 4 days soaked. CBR testing shall be at 100% MMDD and 95% MMDD, using 4.5kg surcharge, for assessment for use as base, sub-base, subgrade and fill. Comply with the following standards:

AS 1289 Method of Testing Soils For Engineering Purposes

The consultant will discuss with the Department any additional testing considered necessary, such as stabilisation testing, blending, crushing, pre-treatment and the like, and seek approval from the Superintendent prior to undertaking such testing.

### Reporting (*Provide either a factual report or an interpretative report)*

*Amend this section into one report if a consolidated report is required*

*.*

Provide a Factual Report, including the following as a minimum:

* Introduction, outlining scope and objectives
* Site description and regional geological setting
* Fieldwork methods and results including equipment used
* Laboratory testing results
* Map showing test pit locations
* Appendices as required to present all photographs, mapping, logs, field testing and laboratory testing, GPS coordinates.

Provide an Interpretative Report, with discussion on the following:

* Executive summary outlining all critical points of the investigations, including identification of risks and mitigation strategies;
* Comments on the suitability of deposits and materials encountered, including quality and quantity (in table form) of each deposit for use as fill, subgrade and pavement layers;
* Maps clearly showing test pits, deposit and materials depths, boundaries of potential deposits for pavement, subgrade and fill materials identified within the designated area; include cross-sections as appropriate to assist with push-up planning.
* Discussion of any pre-treatment required of the material to produce suitable pavement materials including test results and field observations that support any recommendations;
* Advise of potential problems or risks which may be experienced in the use of materials in the temporary and permanent works proposed, including discussion and recommendations on topsoil and vegetation removal requirements;
* Recommendations appropriate to the identified aims and objectives of the investigation and supporting test data;
* Other information considered relevant and obtained during the investigation.

Other report requirements:

* The report will be issued in draft form to the Department for review and comment. Any comments from the review shall be addressed and incorporated into the final report.
* Final report to be provided in electronic form as a pdf document.
* Allow for meetings with the Department to discuss the findings and finalise the report.

**Schedule of Rates – T18-xxxx**

**Project: XxxxxXxxxx**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Item** | **Description\*\*** | **Unit** | **Qty** | **Rate**  ***(incl. GST)*** | **Total Cost of Disbursements**  ***(Incl. GST)*** |
| 1 | Mobilisation and de-mobilisation | Unit | 1 | **$** | **$** |
| 2. | Accommodation | Day |  |  |  |
| 3. | Dial Before You Dig | Unit | 1 | **$** | **$** |
| 4. | Technicians – all field work including sampling and logging. | Hour |  | **$** | **$** |
| 5. | Vehicle | Km | Rate | **$** | **$** |
| 6. | Particle Size Distribution | Test |  | **$** | **$** |
| 7. | Atterberg Limits (Wet preparation) including Linear Shrinkage | Test |  | **$** | **$** |
| 8. | CBR (Including MMDD) | Test |  | **$** | **$** |
| 9. | Hire of excavator/backhoe | Day |  | **$** | **$** |
| 10. | Report | Unit |  | **$** | **$** |

|  |  |
| --- | --- |
| **TOTAL AMOUNT Including GST** | **$** |

**\*\* Add/delete items as required**

## PART B – EXISTING AND NEW ROAD ALIGNMENT INVESTIGATIONS

## *AA*mend sample depths and spacing accordingly to suit project scope and requirements

### Aims and Requirements

Specific aims of the investigation are described below.

* Investigate subsurface conditions along the existing road alignment.
* Investigate subsurface conditions along a proposed new road alignment
* Sample and test materials for suitability as construction materials.

In addition to the specific aims outlined in this brief, in carrying out the work the Consultant is required to use their experience and knowledge of the materials to advise of any potential geotechnical issues or problems which may be encountered in the temporary and permanent works proposed.

### Desk Top Study and Terrain Evaluation

Undertake a desk top study to collect, collate and review available information to inform the investigation and interpreted site and terrain conditions. Sources of information to be considered as part of the desk top study include:

* Topographic maps
* Aerial photographs, both contemporary and historic
* Geological maps and associated commentaries
* Soil and land suitability mapping
* Groundwater mapping
* Past site investigation reports for nearby sites

### Scope of Field Investigations

#### General Requirements

The scope of field work to be carried out comprises:

* Carry out site mapping to record relevant observations including, but not limited to:
  + Rock outcrops and exposures in cuttings
  + Soil exposures in scrapes, pits, river banks, creek and stream channels, erosion gullies and the like.
  + Slope movements
  + Ground subsidence and sinkholes
  + Swampy low lying and poorly drained areas
  + Surface cracking and gilgai topography
  + Vegetation changes
  + Groundwater conditions including surface springs, seepage and soaks
* Excavate test pits to target depths by a mechanical backhoe or mini-excavator. Auger drilling is not permitted. Minimise damage to flora and fauna.
* Conduct Dynamic Cone Penetration (DCP) test from the surface at each test pit to target depth (or practical refusal). DCP refusal is defined as, “when eight blows will cause a penetration of less than 20mm” (AS1289.6.3.2 – 1997).
* Any areas where there will be a road cutting, deeper test pits will be required to assess the subsurface materials for reuse and excavatability assessment. A larger machine may be required.
* Record groundwater and moisture content observations.
* Reinstate and backfill all test pits. Do not leave them open.
* Log soil profiles, terrain and drainage to current Australian Standards. Maintain field log books.
* Record start and finish chainages of insitu soil units and report.
* Collect bulk disturbed samples appropriate for the stratigraphy, in particular, each pavement layer and soil type encountered. Collect sufficient sample mass to allow for appropriate laboratory testing.
* Map/locate test pits and DCP locations with GPS coordinates in Northing and Easting. If a road chainage is available, record that also.
* Photograph all test pit locations, equipment set-ups and terrain in the field. Provide digital images of those photographs in the report.

#### Specific Requirements for Existing Sealed Pavement Investigations

* Log road surface features, condition and pavement deformation and failure modes. Record drainage conditions and features.
* Excavate test pits as follows:
  + On existing roads for widening, upgrade and rehabilitation projects, excavate test pits (also called potholing) generally in an outer wheel paths to a depth of *1m* below subgrade or shallower if refusal occurs, at *150m* intervals generally. Adapt spacing to capture terrain and soil units.
  + For investigations at localised project sites, such as intersections, pavement failures and the like, position test pits to gain suitable coverage of ground conditions.
* Conduct Dynamic Cone Penetration (DCP) test from the top of subgrade of each test pit to 1.5m depth (or practical refusal).
* Sealed pavement requirements:
  + Saw cut the seal/asphalt prior to removal and dispose of off site.
  + Ensure excavated material from the test pit is placed in such a way that pavement gravel is separate from any subgrade/fill.
  + Prior to commencement of backfilling, cut any seal back to produce a clean edge level with the existing seal.
  + Commence backfilling with excavated subgrade/fill material to top of subgrade level. Add water as required to assist with compaction and place in layers of 200mm loose maximum. Compact with a vertical rammer.
  + Pavement layers to be cement stabilised. Prior to placing in test pit, add water and cement to pavement material and mix thoroughly. Compact with a vertical rammer.
  + Level finished pavement surface and remove any loose gravel.
  + Broom any loose material from sealed pavement.
  + Place cold mix evenly over the pavement and compact. Cold mix should be slightly domed in the centre to shed water.

#### Specific Requirements for Upgrading Existing Unsealed Roads

* Log road surface features, condition and pavement deformation modes. Record drainage conditions and features.
* Excavate test pits as follows:
  + On existing unsealed roads for widening, upgrade to seal and larger scale pavement failure investigations, excavate pits generally in an outer wheel path to a depth of *1m* or shallower if refusal occurs, at *250m* intervals generally. Adapt spacing to reflect terrain and soil units.
* Conduct Dynamic Cone Penetration (DCP) test from the surface at each test pit to 1.5m depth (or practical refusal).
* Excavate test pits in the foundation material of the floodways, creeks and drainage lines to a target depth of 1.5 meters. Conduct DCP tests adjacent to each test pit to target depth of 1.5 meters (or practical refusal) to get parameters for foundation design.
* Unsealed pavement test pit backfilling requirements:
  + Commence backfilling with excavated subgrade/fill material to top of subgrade level. Add water as required to assist with compaction and place in layers of 200mm loose maximum. Compact with a vertical rammer.
  + Pavement layers do not require stabilisation. Prior to placing in test pit, add water to pavement material and mix thoroughly. Compact with a vertical rammer.

#### Specific Requirements for New Road Alignments

* Excavate test pits as follows:
  + On new road alignments, excavate pits generally on the proposed centreline, to a target depth of *2m* or shallower if refusal occurs, at *250m* intervals generally. Adapt spacing to reflect terrain and soil units.
* Collect undisturbed samples of compressible materials for appropriate testing.
* Collect Samples for Acid Sulphate Soil (ASS and PASS) as required.
* Conduct Dynamic Cone Penetration (DCP) test from the surface at each test pit to 2.0m or practical refusal.
* Excavate test pits in the foundation material of the creeks and drainage lines to a target depth of 2 meters.
* All test pits to be backfilled and tamped in layers.
* In areas of deep cut, generally greater than 3 to 4m, boreholes will be required to investigate soil and weathered rock profiles, including type, quality, and excavatability characteristics. Borehole drilling to be undertaken in accordance with Part D of this Brief.

### Laboratory Testing

Laboratory testing of samples will be undertaken in a NATA accredited laboratory and all test reports must be NATA endorsed. Comply with the following standards:

AS 1289 Method of Testing Soils For Engineering Purposes

Soil tests shall generally include:

* Insitu moisture content (if required add to scope),
* CBR test (4 days soaked) at 95%MMDD on each sample tested.
* CBR test (4 days soaked) at 95%MMDD and 100%MMDD **only** on each pavement gravel sample tested.
* Particle Size Distribution
* Atterberg limits including linear shrinkage (Wet Preparation).

Other tests that may be required include consolidation testing, triaxial testing, and rock strength testing. Conform to Australian Standards for these tests.

Sample soil and groundwater at culverts for chemical testing to determine aggressivity to buried elements.

### Reporting (Provide either a factual report or an interpretative report)

*[Amend this section into one report if a consolidated report is required]*

Provide a Factual Report, including the following as a minimum:

* Introduction, outlining scope and objectives
* Site description and regional geological setting
* Fieldwork methods and results including extents of natural surface soil units.
* Laboratory testing results
* Appendices as required to present all photographs, mapping, logs, field testing and laboratory testing.
* Prepare suitable plans showing all test pit (and borehole) and DCP locations, giving all grid co-ordinates, and also show the chainages and offset distances as measured on site from the centreline of existing or proposed road
* Appendices as required to present all photographs, mapping, logs, field testing and laboratory testing, GPS coordinates.

Provide an Interpretative Report, with discussion on the following:

* Executive summary outlining all critical points of the investigations, including identification of risks and mitigation strategies
* Completeness and reliability of the field and laboratory testing
* For pavement failure investigations, advise of cause/s of failure and remedial options
* Geotechnical model appropriate for the proposed project, including longitudinal sections, showing test pits, DCP data, correlations of pavement layers, groundwater, and laboratory test results
* Interpreted rock, soil and groundwater profiles in cuttings
* Batter slope requirements in proposed cuttings, including stabilisation requirements;
* Excavatability issues for areas of cut and trenching excavations
* Extent of topsoil and unsuitable ground, including soft and compressible soil profiles
* Re-use potential of materials won from cuttings
* Recommendations on design parameters, including, but not limited to;
  + CBR values for supporting subgrade materials
  + Batter slopes in cut and fill
  + Geotechnical parameters for treatments of soft ground
* Erosion control advice for cuttings and fill batters
* Relevant construction methodologies
* Geotechnical risks to be addressed by the designer
* Other information considered relevant and obtained during the investigation;
* Appendices as required to present all photographs, mapping, logs, field testing and laboratory testing, GPS coordinates.

Other report requirements:

* The report will be issued in draft form to the Department for review and comment. Any comments from the review shall be addressed and incorporated into the final report.
* Final report to be provided in electronic form as a pdf document.
* Allow for meetings with the Department to discuss the findings and finalise the report.

**Schedule of Rates – T18-xxxx**

**Project: XxxxxXxxxx**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Item** | **Description\*\*** | **Unit** | **Qty** | **Rate**  ***(incl. GST)*** | **Total Cost of Disbursements**  ***(Incl. GST)*** |
| 1 | Mobilisation and de-mobilisation | Unit | 1 | **$** | **$** |
| 2 | Traffic Management Plan and site traffic management including signs and VMS | Unit | 1 | **$** | **$** |
| 3. | Services locator and Dial Before You Dig | Unit | 1 | **$** | **$** |
| 4. | Technicians – all field work including DCP testing, sampling, logging and reinstatement of test pit. | Hour |  | **$** | **$** |
| 5. | Vehicle | Km | Rate | **$** | **$** |
| 6. | Particle Size Distribution | Test |  | **$** | **$** |
| 7. | Atterberg Limits (Wet preparation) including Linear Shrinkage | Test |  | **$** | **$** |
| 8. | CBR (Including MMDD) | Test |  | **$** | **$** |
| 9. | Moisture Content | Test |  | **$** | **$** |
| 10. | Hire of excavator, rammer | Unit |  | **$** | **$** |
| 11. | Report | Unit |  | **$** | **$** |

|  |  |
| --- | --- |
| **TOTAL AMOUNT Including GST** | **$** |

**\*\* Add/delete items as required**

## PART C - BRIDGESITE AND OTHER STREAM CROSSING INVESTIGATIONS

## *A*mend sample depths and spacing accordingly to suit project scope and requirements

### Aims and Requirements

Specific aims of the investigation are described below.

* Investigate subsurface conditions at the proposed river/creek crossing
* Provide geotechnical recommendations to enable design and construction of the bridge/culvert/crossing structure

In addition to the specific aims outlined in this brief, in carrying out the work the Consultant is required to use their experience and knowledge of the conditions encountered to advise of any potential problems which may be experienced in the design and construction of temporary and permanent works proposed.

### Desk Top Study

Undertake a desk top study to collect, collate and review available information to inform the investigation and interpreted site conditions. Sources of information to be considered as part of the desk top study include:

* Topographic maps
* Aerial photographs, both contemporary and historic
* Geological maps and associated commentaries
* Soil and land suitability mapping
* Groundwater mapping
* Past site investigation reports for nearby sites

### Scope of Field Investigations

#### General Requirements

* All fieldwork must be undertaken by an experienced professional geotechnical engineer or engineering geologist.
* Carry out site mapping to record relevant observations including, but not limited to:
  + Rock outcrops and exposures, including cuttings
  + Soil exposures and bed loads in channel areas
  + Slope movements
  + Ground subsidence
  + Swampy low lying and poorly drained areas
  + Vegetation as indicator of subsurface conditions
  + Groundwater conditions including springs and soaks
  + Bank erosion characteristics

#### Specific Requirements for Bridge Sites

* Drill boreholes at each bridge site, targeting approaches, abutment and mid-crossing areas. Drill boreholes to target depths of about 20m (or deeper if conditions dictate). Commence coring when rock is encountered and continue until a significant distance of competent rock has been encountered. This depth will depend on conditions encountered in relation to the intended pile size and type, but is likely to be 6 pile diameters or 9m into distinctly weathered rock. Supervise drill rig operations full time in the field. Map the x and y location of boreholes and other relevant features with a GPS.
* Record GPS co-ordinates and determine accurate relative level RL of all borehole locations.
* Log drill returns and core returns according to best practice industry standards in the field. Execute SPT tests in overburden soils or completely weathered materials. Collect disturbed samples and SPT samples for laboratory tests.
* Record groundwater levels, and collect samples for aggressivity testing.
* Collect undisturbed samples at appropriate intervals, for laboratory tests including in-situ density, PSD, Atterberg limits, moisture content, consolidation testing and triaxial testing as appropriate.
* Photograph all cores, the drilling set-ups, the existing crossings, ground conditions and terrain in the field. Provide images of those photographs in the report.
* Excavate supplementary test pits along the proposed alignment to assist with developing the geotechnical model of the site. Log and sample the testpits according Departmental requirements in the Brief.
* Undertake investigations required to determine extent of unsuitable ground in the vicinity of approach embankments.

#### Specific Requirements for Stream Crossing Sites

Where borehole investigations are not required for culvert and causeway structures, conform to the following requirements:

* Excavate test pits as follows:
  + On proposed alignments, excavate pits generally on the proposed centreline, to a target depth of *2m* or shallower if refusal occurs. Adapt spacing to reflect terrain and soil units, however, aim to excavate test pits in channel, bank and approach areas to characterise stratigraphy present at the crossing.
* Conduct Dynamic Cone Penetration (DCP) test from the surface at each test pit to 2m depth (or practical refusal).
* Sample rock exposures for index strength testing
* Unsealed pavement test pit backfilling requirements:
  + Commence backfilling with excavated subgrade/fill material to top of subgrade level. Add water as required to assist with compaction and place in layers of 200mm loose maximum. Compact with a vertical rammer.
  + Pavement layers do not require stabilisation. Prior to placing in test pit, add water to pavement material and mix thoroughly. Compact with a vertical rammer.
* Undertake investigations required to determine extent of unsuitable ground in the vicinity of approach embankments and base slabs.

### Laboratory Testing

#### Soil Testing

Carry out the following testing work on representative soil samples.:

* insitu moisture content
* PSD and
* Atterberg limits (including linear shrinkage) (wet preparation).

If the Consultant determines that more tests are required to characterise the material types and mechanical properties, for example consolidation testing, the Consultant shall seek approval from the Department to do so, including the number of extra tests and any cost variation.

Sample soil and groundwater for chemical testing to determine aggressivity to buried elements.

#### Rock Testing

Carry out the following testing work on recovered rock core samples:

* Point load strength at 1m intervals
* UCS testings at 3m intervals

### Reporting

*[Amend this section into one report if a consolidated report is required]*

Provide a Factual Report, including the following as a minimum:

* Introduction, outlining scope and objectives
* Site description and regional geological setting
* Fieldwork methods and results
* Laboratory testing results
* Appendices as required to present all photographs, mapping, logs, field testing and laboratory testing.
* Prepare suitable plans showing all borehole and testpit locations, giving all grid co-ordinates, and also show the chainages and offset distances as measured on site from the existing bridges.

Provide an Interpretative Report, with discussion on the following as a minimum:

* Completeness and reliability of the field and laboratory testing
* Prepare longitudinal sections showing sub-surface soil and rock profiles for each bridge/culvert/crossing site, showing boreholes and test pits and other exposure information. The sections shall represent distribution of sub-surface soil layers, SPT values, moisture content and ground water levels (if encountered), and classes of weathered rock. Include Point load strength testing data.
* Geotechnical model appropriate for the proposed project, including a description of the engineering characteristics of the soils and rocks observed at the site.
* Extent of topsoil and unsuitable ground, including soft and compressible soil profiles
* Erosion control measures for temporary and permanent works.
* Recommend basic design parameters and tolerances on those values for use by bridge and road design engineers for the strength, stability, and serviceability design of embankment, culvert, causeway and bridge structures.
* Recommendations on pile and embankment design parameters, including, but not limited to;
  + Ultimate bearing pressures for pad footings, bored and driven piles as appropriate.
  + Shaft adhesion values for each soil and rock layer encountered, upwards and downwards.
  + Estimates of embankment settlements
* Discuss constructability constraints and methodologies (eg floating core stones, groundwater, collapsing ground, compressible soils, reactive clay profiles, variable depth to bedrock, strength reversal with depth etc).
* Geotechnical risks to be addressed by the designer
* Other information considered relevant and obtained during the investigation;

Other report requirements:

* The report will be issued in draft form to the Department for review and comment. Any comments from the review shall be addressed and incorporated into the final report.
* Final report to be provided in electronic form as a pdf document.
* Allow for meetings with the Department to discuss the findings and finalise the report.

### General Requirements for Borehole Drilling

#### Drilling

Diamond core drilling will be HQ size. Seek approval from the Superintendent for other sizes. Determine the best drilling methods. Obtain greater than 90% core recovery, preferably 100%. Inform the Superintendent immediately if high core recovery is not being achieved.

Boreholes shall be drilled in any order specified by the Superintendent but the Superintendent will endeavour to organise the drilling program to minimise the time taken in setting up. The Superintendent may also specify the drilling of additional boreholes at any time.

Inform the Superintendent immediately if any holes are offset from the required location because of access problems, underground services or errors.

#### Ground Water Level

Measure the ground water level in sands at least 30 minutes after boring and in silts and clays at least 24 hrs after boring. Where casing is used, measure the ground water level before and after pulling the casing.

#### Drilling, Sampling And Testing In Overburden

Description of Materials

The following properties of overburden materials shall be recorded:

• Material type (texture), according to particle size distribution

• Colour

• Consistency/density

• Moisture Content

#### SPT Testing

Conduct SPT testing in soils at nominal intervals of 1.0m or as directed by the Superintendent. SPT results should be corrected for rod length, overburden pressure, etc. as necessary. Extreme care should be taken to ensure that SPT testing is conducted in undisturbed soil. If appropriate, seal part of the sample for moisture content testing. PSD and Atterberg testing shall be determined at a number of locations down the profile, particularly where SPT tests are conducted. Moisture content shall be determined at all SPT test depths.

All samples submitted shall be adequately identified as specified in AS 1726.

Store all samples in a suitable cool, shaded location after logging, sealing and labelling.

#### Disturbed Samples

The cost of recovering such samples will be calculated based on time spent in recovering such samples and will be paid at the working hourly rate.

Materials strained from the drilling fluid and any material recovered from the drill rods or drilling bit will not be accepted as a representative sample.

#### Undisturbed Samples

At nominal intervals, or as directed by the Superintendent, an undisturbed sample shall be recovered in cohesive materials, using a "thin wall" open drive or piston sampler, as appropriate. The area ratio of the sampler should not exceed 10% (as specified in AS1726), or close to it. Ensure the diameter of the recovered sample is not less than 50mm.

All samples submitted shall be adequately identified as specified in Australian Standards. After logging, sealing and labelling, samples shall be stored in a suitable cool, shaded location.

#### Vane Shear Test

When requested by the Superintendent, in situ vane shear tests shall be carried out in accordance with the requirements of Australian standards.

#### Depth of Drilling

Deeper drilling is required if large core stones are suspected, to prove that solid bedrock has been encountered.

#### Description of Materials

Logging is to be carried out prior to sampling and testing. Describe in accordance with AS 1726. Use the following classification groups, as a minimum:

• Nature (ie. bedrock, boulders, etc);

• Group;

• Degree of weathering;

• Rock strength;

• Spacing and type of discontinuities and fractures.

• Dip of bedding, fractures and features, fracture filling and plane irregularity;

• Sample type;

• Core recovery, %

• Rock Quality Designation;

• Comments.

#### Rock Cores

***Sampling and Testing***

To preserve rock core for viewing, where required, core shall be wrapped in plastic or sprayed with a lacquer to preserve it in the as recovered condition.

Conduct UCS testing of rock in the 50% humidity conditioned state or a saturated condition or both. Do not allow samples to dry out before testing. Conduct point load index testing (PLIT) in both P&N directions and determine the anistrophy of the rock. Conduct UCS and PLIT and determine a correlation between PLI and UCS, if possible.

***Core Photography***

Photograph all cores in the core trays in the field during drilling while wet, before sampling. Particular attention shall be paid to core photography to ensure high quality photos result. Clean down the cores before photography, and should be wet when it is photographed. The core should take up the whole area of the photograph. Photos to be dated. Close up shots of important features should be provided, as well as photography in the splits.

***Core Storage***

All recovered core shall be carefully boxed using metal core boxes 400 mm wide x 1000 mm long.

If core recovery is less than 100% or where cores have been removed for inspection and testing, polystyrene spacers equal in length to the core loss shall be placed in the appropriate position in the box. Details, such as removed for UCS testing or core loss, shall be recorded on the polystyrene.

Ensure the core is not damaged during transit. Store core boxes in a safe cool location.

Core trays should be labelled with project name, borehole, drill run and depth, and date.

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| --- | --- | --- | --- | --- | --- |
| **ITEM** | **DESCRIPTION \*\*** | **EST QTY** | **UNIT** | **PRICE *(including GST)*** | **EXTENDED AMOUNT *(including GST)*** |
| **1** | **Supervision, Logging of all Boreholes, sampling for laboratory testing, by a Senior Geotechnical Engineer** | **Hrs** | **100** | **$** | **$** |
| **2** | **Establishment of Contractor and consultant including all equipment, suitable Barge and drilling rigs on site with full accomodation, mobilisation and de-mobilisation on completion of the investigation** | **Lump Sum** | **1** | **$** | **$** |
| **3** | **SPT Testing (6 minimum in each borehole)- Provisional if ordered by superintendent** | **No.** | **48** | **$** | **$** |
| **4** | **Core boxes and accessories for Eight boreholes** | **No.** | **16** | **$** | **$** |
| **5** | **Rotary Drilling and casing** | **m** | **80** | **$** | **$** |
| **6** | **Water carting for drilling** | **Lump Sum** | **1** | **$** | **$** |
| **7** | **Drilling Fluid** | **Lump Sum** | **1** | **$** | **$** |
| **8** | **Point load test(2 per hole) - Provisional if ordered by superintendent** | **No** | **16** | **$** | **$** |
| **9** | **Piston/Tubex sampling for Triaxial for Undisturbed samples minimum 2 per hole** | **No** | **16** | **$** | **$** |
| **10** | **Triaxial undrained testing- Provisional if ordered by superintendent** | **No** | **4** | **$** | **$** |
| **11** | **Atterberg’s limits including Linear shrinkage, Particle Size Distribution, Moisture Content- Provisional if ordered by superintendent** | **No** | **8** | **$** | **$** |
| **12** | **Aggressivity test to soil- Provisional if ordered by superintendent** | **no** | **2** | **$** | $ |
| **13** | **aggressivity test to surface water (2 Nos) and groundwater (2 Nos) - Provisional if ordered by superintendent** | **no** | **4** | **$** | $ |
| **14** | **Form drilling Platform and access track** | **Lump Sum** | **1** | **$** | **$** |
| **15** | **Preparation and review of report by a senior geotechnical engineer** | **hrs** | **40** | **$** | $ |
| **16** | **Final Geotechnical Investigation report**  **(2 HARD COPIES AND electronic format)** | **Lump Sum** | **1** | **$** | **$** |

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| --- |
| SCHEDULE OF RATES (DRILLING) |

**NOTE: Any item that is GST free, please provide details**

|  |  |
| --- | --- |
| **Total** |  |

**\*\* Add/delete items as necessary**

## PART D – BUILDING INFRASTRUCTURE FOUNDATION INVESTIGATIONS

This Part is not included in this Brief.