

**Attachment 6**  
**Geotechnical and Hydrogeological**  
**Reports**

# Guidelines for geotechnical and hydrogeological reports

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## *Introduction*

Guidelines have been prepared to assist applicants, architects and engineers to understand our requirements for the preparation of geotechnical and hydrogeological reports.

If your development proposal includes below ground structures, you must submit geotechnical and hydrogeological reports which contain the information set out in these guidelines. For the purpose of these guidelines, below ground structures means excavation to a depth greater than 300mm below the existing groundwater level, for excavations within 1.5m of the boundary, or otherwise greater than 1.0m in depth.

The geotechnical and hydrogeological report shall comprise, but not limited to:

- ▶ Geotechnical investigation
- ▶ Groundwater monitoring results
- ▶ Interpreted subsurface and hydrogeological conditions
- ▶ Settlement assessment
- ▶ Stability assessment
- ▶ Recommendations on geotechnical design parameters
- ▶ Recommended shoring methods and retaining walls (where applicable)
- ▶ Recommendations on foundation design
- ▶ Recommendation on excavation methods
- ▶ Vibration assessment
- ▶ Recommendations on settlement, groundwater and vibration monitoring.

Further details are discussed in the subsequent sections of these DA Guidelines.

Applicants are advised to discuss these requirements with our Infrastructure and Sustainability Division prior to the submission of a development application.

## *Objective*

To ensure there are no adverse geotechnical or hydrogeological impacts on any surrounding property and infrastructure as a consequence of the carrying out of development (including but not limited to demolition, excavation, sifting, piling and construction).

## *Design Principles*

Buildings must be designed and constructed with appropriate support and retention systems to ensure that:

- ▶ there will be no ground settlement or movement, during and after construction, sufficient to cause an adverse impact on adjoining properties and infrastructure
- ▶ there will be no change to the ground water level, during and after construction, sufficient to cause an adverse impact on surrounding properties and infrastructure

- ▶ vibration during construction is minimised or eliminated to ensure no adverse impact on surrounding properties and infrastructure
- ▶ the risk of damage to adjacent existing property and infrastructure by the new development will be reduced to a level no greater than that from an event with an ‘unlikely’ likelihood of occurrence and ‘minor’ consequence.
- ▶ all below ground structures are fully sealed to prevent the entry of all ground water such that they are fully tanked and no on-going dewatering of the site is required.

### *Adverse Impact Definition*

Generally, an adverse impact can be assumed to be any damage caused to the improvements on adjoining properties by the demolition, excavation or construction on the development site.

### *Development Application - Report Requirements*

Geotechnical and Hydrogeological reports must be submitted with all development applications and address the following items. . The extent to which each of the items is addressed must be determined having regard to the nature of the development, site investigations and sensitivity of the surrounding properties and infrastructure. The author of the report must be satisfied as to the information provided and must be satisfied that, as a consequence of the carrying out of the development, the objectives and design principles of these guidelines will be satisfied.

#### **General**

Reports must be site specific and relate directly to the proposed development. Previous reports and data may be utilised or provided as supplementary information where certified by the author of the report as suitable for the new development.

A qualified and experienced geotechnical and/or hydrogeological engineer must prepare the reports

Should the architectural drawings be changed from a previous application or during the DA process then Council may require a revised geotechnical and hydrogeological report to be submitted

The reports must include a site specific risk assessment matrix with appropriate definitions for qualitative measures of likelihood and consequences for assessing the risk of damage to existing developments by the new development

Visual inspection and use of geological mapping alone will not be satisfactory for geotechnical and/or hydrogeological reports.

#### **Investigations**

Reports must demonstrate:

- ▶ investigation of geotechnical conditions below the proposed depth of excavation and/or founding depth for the development. Generally, the depth to bedrock should be established. As a minimum the following level of investigation is required:
  - a minimum of 2 boreholes extended to at least the likely depth of influence of construction for any site

- Standard Penetration testing within the boreholes. The tests must be carried out at regular depth intervals not exceeding 1.5m in the upper 10m and 3m below 10m depth
- the investigation should also target at least one continuous strength log of the subsurface soils by Cone Penetrometer Testing (CPT) to supplement the information from the boreholes.
- ▶ that the presence of groundwater has been investigated. Where present, the groundwater level must be measured and monitored. (A longer historical record of natural groundwater fluctuations will be valuable as part of the implementation program. A minimum monitoring period of six months is recommended).
- ▶ that where groundwater is present and dewatering is likely to occur on the site the following measures will be implemented:
  - a minimum of two piezometers will be located within the site or in close proximity to it.
  - a minimum of 2 piezometers will be located off site, as close to the site as possible, but outside the zone of influence of groundwater level disturbance by the new development.
  - where established in the footpath area a permanent installation with a cast iron cover and concrete surround is required.

The groundwater level monitoring must be undertaken using either electronic data loggers, or manual monitoring on regular time intervals commensurate with the expected groundwater level fluctuations. This will allow fluctuations in the site groundwater level to be calibrated against natural fluctuations in the groundwater level. The investigations have to be carried out to determine the design parameters appropriate to the development and site. This could include:

- ▶ foundations
- ▶ permanent and temporary supports
- ▶ settlements
- ▶ retaining walls
- ▶ groundwater levels
- ▶ batter slopes
- ▶ vibration
- ▶ dewatering including seepage and off site disposal rates.

## Support and Retention

Reports must:

- ▶ include recommendations as to appropriate temporary and permanent site support and retention measures.
- ▶ predict ground settlements in areas adjacent to the development site resulting from temporary and permanent site support and retention measures and demonstrate that settlement will have no adverse impact on the surrounding properties and infrastructure.
- ▶ demonstrate that permanent earth or rock anchors will not be required on or below any road reserve or other Council property. Council may accept the use of temporary anchors if the applicant can adequately demonstrate that the use of temporary anchors would sufficiently improve the safety of the retention of excavations that may be proposed. The installation of such temporary anchors must comply with the Council's Rock Anchor Policy. (Use of permanent and/or temporary anchors on private property is not allowed without written confirmation by the property owners).

- ▶ show that permanent support and retention measures will be set back a minimum of 900mm (or minimum as advised in the relevant Development Control Plan) from the adjacent property boundaries. This is aimed at minimising the localised damage created by the installation of retention systems and to provide a corridor for perimeter drainage.
- ▶ It may be possible for a new development to be built up to the boundary on a merit-based assessment of the development. This assessment will require the geotechnical/hydrogeological report to confirm the structural adequacy of any adjacent structure including any necessary additional support for the structure as well as suitable groundwater drainage systems as outlined in Hydrogeology.

## Hydrogeology

Reports must demonstrate:

- ▶ the method and rate of dewatering, including the location and disposal of site dewaterings. This includes seepage and stormwater trapped in excavations.
- ▶ that there will be no adverse impact on surrounding property and infrastructure as a result of changes in local hydrogeology (behaviour of groundwater) created by the method of construction. This includes the short-term effects resulting from construction practices, including the method and rate of dewatering and the long-term effects resulting from the support and retention of property and infrastructure after construction has been completed.
- ▶ that temporary changes to the groundwater level, during construction, for Double Bay and Rose Bay settlement areas will be kept within the limits specified in DCP Chapter E2, section E2.2.10.
- ▶ that *temporary* changes to the groundwater level, during construction, will be kept within the historical range of natural groundwater fluctuations in other areas of the LGA outside of the Double Bay and Rose Bay settlement areas defined in DCP Chapter E2, section E2.2.10. Where data is limited or unavailable, reports must demonstrate that changes in the level of the natural water table, due to construction, will not exceed the following limits unless calculations using the results of the site specific field testing, supporting a greater change can be provided and can demonstrate no adverse impact to surrounding properties and infrastructure:
  - ▶ 0.2m within the Double Bay settlement area, Rushcutters Bay and Watsons Bay catchment areas.
  - ▶ 0.3m within the Rose Bay settlement area and in other areas across the LGA.
- ▶ that groundwater drainage systems have been designed to transfer groundwater through or under the proposed development without a change in the range of the natural groundwater level fluctuations.
- ▶ that all below ground structures are fully sealed to prevent the entry of all ground water such that they are fully tanked and no on-going dewatering of the site is required.

For short term dewatering during construction a separate approval is required from Council under S138 of the *Roads Act 1993* where the water is to be discharged to the public road.

Where an impediment to the natural flowpath is created as a result of the nature of the construction methods utilised and/or the bulk of the below ground structure, artificial drains such as perimeter drains and through drainage may be utilised. These systems may only be utilised where it can be demonstrated that the natural ground-flow regime is re-established both upstream and downstream of the site without any adverse effects on surrounding property or infrastructure.

- ▶ that groundwater drainage systems are designed for a design life of 100 years.
- ▶ that the groundwater drainage system is designed to be easily maintained. Council will require a positive covenant to ensure the continued functioning and maintenance of the approved groundwater system. Laboratory tests to approved standards should be carried out to determine the clogging potential of any proposed filters used in the design of the drainage system for the new development.
- ▶ that where there is the potential for a damming effect created by several consecutive below ground structures, this potential impact has been the subject of hydrogeological modelling to demonstrate no adverse impact on the surrounding property or infrastructure. The extent of modelling must consider the potential for future development to extend the damming effect and must, as a minimum, extend between street blocks.
- ▶ that where below ground structures are in close proximity to each other (typically less than 3m) no allowance for natural groundwater flow through these narrow corridors has been included in the design of perimeter or through drainage.

## Vibration

Reports must:

- ▶ demonstrate that there will be no adverse impact on the surrounding properties and infrastructure as a result of vibration created by the method of construction used for the development. As a minimum, reports must demonstrate compliance with the vibration limits for human comfort which comply with Assessing Vibration - a technical guideline by Department of Environment and Conservation NSW (DEC), 2006 and the vibration limits for structural damage is to comply with German Standard DIN 4150-3 -Vibrations in buildings -Part 3: Effects on structures. In this regard;
- ▶ A minimum vibration from site works (including demolition, excavation, and construction) is
  - not to exceed the following limits at any time, as measured from the site boundary:
  - For continuous vibration: Maximum peak velocity of 0.28 mm/s
  - For intermittent vibration: Maximum peak velocity of 2.5 mm/s and maximum vibration dose value of 0.2 m/s<sup>1.75</sup>
  - For Impulsive vibration: Maximum peak velocity of 2.5 mm/s

These are the minimum standards. Some locations may be more susceptible to vibration impacts and require more stringent vibration limits to protect human comfort and prevent structural damage.

- ▶ Note: Factors that may influence vibration impacts include, but are not limited to:
  - Ground conditions; and
  - Sensitive buildings in the vicinity of the site, e.g. heritage, age, construction type and materials of buildings.
- ▶ recommend appropriate plant, equipment and construction methods.

## Implementation Plan

The Implementation Plan will normally be part of the Conditions of Consent for the development and generally are not required to be submitted in association with the DA.

The implementation plan will comprise of the *monitoring program*, *contingency plan* and *construction methodology*. The plan is to include the locations of vibration monitoring sensors, trigger levels for anticipated vibration types and buildings in the neighbourhood, and frequency of monitoring.

## Monitoring Program

As a minimum, vibration monitoring sensors are to be installed and monitored at adjacent properties. The trigger level for the vibration monitoring will be set in consultation with the Structural Engineer following completion of the pre-construction dilapidation surveys of the adjacent buildings, and review geotechnical conditions and construction methodology.

The geotechnical and hydrogeological monitoring program for the development should include pre-set acceptable limits for the variation of:

- ▶ settlements associated with temporary and permanent structures;
- ▶ deflection or movement of retaining mechanisms (shoring, braces, etc.);
- ▶ vibration in accordance with Woollahra DCP, Chapter E2, section E2.2.10 Groundwater (hydrogeology);
- ▶ groundwater changes calibrated against natural groundwater fluctuations.

It should also:

- ▶ include the location and type of monitoring systems to be utilised;
- ▶ include recommended hold points to allow for the inspection and certification of geotechnical and hydrogeological measures by a geotechnical engineer.
- ▶ relate back to the contingency plan should the present acceptable limits for variation be exceeded.

## Contingency Plan

Should vibration limits be exceeded at any time during construction, the construction activity causing vibration must cease until the measures to limit the vibration are implemented.

A *Contingency Plan* must be prepared for situations where the monitoring shows the preset acceptable limits for the geological and hydrogeological parameters are exceeded. This could include details of measures to be adopted for restoring groundwater, additional support or bracing, remedial works and alternative procedures. Where possible, the contingency measures should be linked back to the monitoring program to enable early warning and time for preventative measures to be implemented

## *Construction Methodology*

The construction methodology must address all aspects of the construction process as it relates to the geotechnical and hydrogeological requirements. Generally, this will include the method and staging the excavation, installing monitoring devices, support and retention measures, groundwater control, retention of groundwater flow paths and reinstatement. It may also include appropriate plant and equipment to minimise vibration, localised damage from installation of supports and noise.

## *Further Investigations*

Reports may include recommendations for further investigations to be carried out prior to construction. Each case will be considered on their merits and whether or not further investigations are required prior to the granting of development consent or whether the additional information can be provided after the granting of consent but before the issue of a construction certificate.

## *Construction Certificate Application - Report Requirements*

The following additional information may, as a condition of consent, be required before issue of the Construction Certificate:

- ▶ dilapidation reports
- ▶ details of dewatering method with licences as appropriate
- ▶ finalised Implementation Plan incorporating finalised Geotechnical and Hydrogeological Monitoring Program, Contingency Plan and Construction Methodology.
- ▶ further geotechnical and hydrogeological investigations as may be required by special consent conditions or as recommended in the geotechnical and/or hydrogeological report submitted with the Development Application
- ▶ design certificate from suitably qualified and experienced geotechnical and/or geotechnical engineer confirming that the design of the new below ground structure has been undertaken in accordance with approved standards (such as Australian or British Standards, etc) where applicable.

## *Construction Phase*

The works on the site must be inspected and monitored in accordance with the Implementation Plan, Geotechnical and Hydrogeological Monitoring Program and any other recommendations made in the geotechnical and/or hydrogeological engineer must conduct monitoring and inspection. Copies of inspections and monitoring reports must be supplied to the Principal Certifying Authority.



### *Occupation Certificate - Report Requirements*

A record of inspections and monitoring as required by the Implementation Plan and Geotechnical and Hydrogeological Monitoring Program must be submitted in report form to the Principal Certifying Authority for approval prior to release of the Occupation Certificate. A geotechnical/hydrogeological engineer must certify that all work, including groundwater drainage systems has been carried out in accordance with the applicable development consent conditions and the recommendations of the geotechnical and hydrogeological reports.

### *Further Information*

A checklist of the above-mentioned geotechnical and hydrogeological requirements is attached. If you need further information about our requirements for geotechnical and hydrogeological reports please telephone our Development Engineer on 9391 7000.

## *Definitions*

**Geotechnical Engineer** means NPER registered with a minimum of 10 years practice in the geotechnical field in the last 15 years

## *Geotechnical and Hydrogeological Requirement Check List*

### **Development Application**

#### **Geotechnical and/or hydrogeological reports to include:**

- Site specific risk assessment matrix
- Results of geotechnical investigation including boreholes, CPT and groundwater level piezometers.
- Recommended pertinent geotechnical design parameters.
- Recommendations on appropriate temporary and permanent site support and retention measures.
- Method and rate of dewatering where required.
- Proposed groundwater drainage systems and laboratory tests to determine filter clogging potential.
- Recommended appropriate plant, equipment and construction methods to limit vibration.

#### **Implementation Plan comprising the following:**

- Monitoring program including various preset acceptable limits, location and type of monitoring systems and recommended hold points.
- Contingency Plan including details of measures to be adopted to restore groundwater level or to provide any necessary additional support.
- Construction Methodology to address all aspects of the construction process relating to the geotechnical and hydrogeological requirements.

Recommendations for further investigations to be carried out prior to construction.

## **Development Consent**

The approval of the Development Application by the Council may contain the following conditions:

- DA Standard Conditions of Consent - Geology and Hydrogeology
- Special Conditions of Consent

## **Construction Certificate Application**

Depending upon the conditions of consent, the following information may be required:

- Dilapidation reports
- Details of dewatering
- Finalised implementation plan
- Further geotechnical and hydrogeological investigation report when required
- Design Certificate from a suitably qualified and experienced geotechnical and/or hydrogeological engineer

## **Construction Phase**

A suitably qualified and experienced geotechnical and/or hydrogeological engineer must supply the following reports:

- Construction inspection reports
- Geotechnical and hydrogeological monitoring reports
- Occupation Certificate

**Prior to the release of the Occupation Certificate, the following information must be supplied:**

- Final construction inspection report
- Final geotechnical and hydrogeological monitoring report
- Certificate from a geotechnical and/or hydrogeological engineer to confirm that the completed structure conforms to the design.