10 March 2017

Attention: Brendon Roberts

Team Leader – Key Sites Assessments
Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

Dear Brendon,

State significant development application – SSD7684 - Staged redevelopment of Cockle Bay Wharf
241 – 249 Wheat Road, Cockle Bay Darling Harbour

Roads and Maritime Services (Roads and Maritime) refers to development application number SSD7684 (the **DA**) lodged by JBA Urban Planning Consultants Pty Ltd on behalf of DPT Operator Pty Ltd and DPPT Operator Pty Ltd (**Proponent**) for a staged development.

The staged development involves the construction of new buildings comprising retail, bars and restaurants, commercial offices and upgrades to public areas (**Project**). The detailed design and construction of the Project will be the subject of separate, future development applications.

The purpose of this letter is to provide comments from Roads and Maritime in respect of the Project.

Roads and Maritime does not support the Project in its current form and would not be in a position to provide any consent required. A more detailed list of concerns is outlined below. Roads and Maritime would appreciate the opportunity to meet with the Developer and the Department to seek to address these concerns.

BACKGROUND

The Project involves development over and around part of the Western Distributor adjacent to 241 – 249 Wheat Road, Cockle Bay. The development includes the construction of a large "land bridge", being a concrete podium structure (**Podium**), to be built over the Western Distributor. The structure will need to be supported with piers located within or adjacent to the area of the Western Distributor.

The Western Distributor is a substantial reinforced concrete structure which is used by a large number of vehicles. It provides one of the main road arteries through the Sydney Central Business District and is an essential and significant component of Sydney's transport infrastructure.

The Project is to be located, in part, within land owned by Property NSW (previously the Sydney Harbour Foreshore Authority). The area of land comprising the Western Distributor is managed by Roads and Maritime and is expected to be transferred from Property NSW to Roads and Maritime following completion of surveys of the relevant parts of the Western Distributor.

The Project also has the potential to impact on the Cross City Tunnel and the Cross City Tunnel assets (including the ventilation stack). There is insufficient information as to whether there could be an impact on the Cross City Tunnel ventilation including air quality and access.

It is essential to Roads and Maritime that, if the Minister grants consent to the DA, the construction and operation of the Project does not compromise the safety or structural integrity of the Western Distributor or the ability of Roads and Maritime to access and maintain the engineering structures forming the Western Distributor (consistent with the intent of paragraph 9 of the Secretary's Environmental Assessment Requirements dated 23 June 2016).

Roads and Maritime has reviewed the DA and has identified a number of matters relating to the Project that if not managed appropriately may impact on the structural integrity of the Western Distributor, the safety of the surrounding road infrastructure and the ability of Roads and Maritime to have sufficient access for ongoing maintenance, repairs and, if necessary, replacement of the Western Distributor.

THE PROJECT

Roads and Maritime has identified the following issues which require consideration, assessment and resolution before the development application should be determined:

a) **Closure of the Western Distributor -** the Western Distributor is critical transport infrastructure. Roads and Maritime will not permit the Western Distributor to be closed to enable construction of the Project including the Podium over the Western Distributor. The proponents will need to properly demonstrate how the Project can be safely and efficiently constructed over the Western Distributor without closure or interruption of traffic flow to Roads and Maritime satisfaction.

b) **Fire Safety –** the Project will have the effect of creating a "tunnel" underneath the Podium. The Proponent will need to demonstrate that there is adequate provision for fire safety underneath the podium having regard to the traffic flow. This provision may, for example, include fire sprinklers and other infrastructure installed as part of the Project.

c) **Security –** the proponent will need to demonstrate to Roads and Maritime satisfaction that the Project does not pose an unacceptable security risk.

d) **Piering Options –** Roads and Maritime has asked the proponent to identify where the piers for the Podium are to be located in relation to the Western Distributor. Roads and Maritime has requested a "no piers" in addition to the proposed "piers" option be investigated and considered. The location of the piers for the Podium in relation to the Western Distributor is required to enable the practical consideration of matters relating to structural integrity, accessibility, safety, security and maintenance, repair, augmentation and replacement. The development application should not be determined until this information has been provided and addressed to Roads and Maritime satisfaction.

e) **Access for Maintenance and Repair** – the proponent will need to be able to demonstrate to Roads and Maritime satisfaction that the Podium will not unreasonably interfere with Roads and Maritime ongoing ability to access the Western Distributor and its surrounds for the purposes of maintenance, repair, augmentation and, if necessary, replacement of the Western Distributor.

f) **Wheat Road –** the proponent will need to provide further details of the arrangements to be made around the Site, particularly around Wheat Road, to enable safe and efficient vehicular access to the Project without unreasonably interfering with existing traffic flows. Roads and Maritime notes that there is currently an approved development for the IMAX Theatre which contemplates potential changes to these roads. Any proposed changes in this development application need to be consistent with any changes approved as part of the IMAX Theatre redevelopment (SSD 7388). The proponent will need to ensure that access, including emergency access, is maintained at all times to the Cross City Tunnel assets including in and around the ventilation stack, to the satisfaction of Roads and Maritime and the Cross City Tunnel operators. In this regard, the Project contemplates the modification of the Harbour Street/Wheat Road and Blackwattle Place intersection to allow left and right turn movements on to Harbour Street, however, the modifications contemplated by the Project would unreasonably compromise through traffic movements in this area and the traffic volumes contemplated by the Project do not warrant traffic control lights. The proposed intersection arrangement should be investigated from a road safety perspective and details of how taxi, pedestrian and vehicle movements will be affected under the proposed modifications and how the changes should be maintained should be considered.

g) **Structural Integrity** – the proponent will need to demonstrate that the Project will not impact on the structural integrity of the Western Distributor and will be designed to meet all relevant safety requirements for the Western Distributor including natural disasters.

h) **Constructability –** the proponent will need to be able to provide details of the methodology of how the Podium is to be constructed over the Western Distributor to ensure the above issues are addressed.

i) **Responsibility** – the proponent will need to demonstrate to Roads and Maritime satisfaction that it will take long term responsibility for the elements of the Project which interface with Roads and Maritime infrastructure to Roads and Maritime satisfaction to ensure that the structural integrity and Roads and Maritime ability to access the Western Distributor for maintenance, repair, augmentation and replacement is not compromised.

j) **Works Authorisation Deed** – the proponent will need to enter into a works authorisation deed with Roads and Maritime relating to the construction of the Project to ensure that the Project is constructed consistently with Roads and Maritime requirements and to Roads and Maritime satisfaction and that the above issues are appropriately addressed.

In any event, Roads and Maritime is of the view that no construction certificate for any part of the Project should be released until such time that the detailed design plans of the structures over the Western Distributor and construction methodology are submitted to and approved by Roads and Maritime.

If the Minister decides to grant development consent for the Project, Roads and Maritime submits that the conditions of consent set out in **Schedule A** of this letter should be imposed.

For the purposes of the DA and any consent the Minister grants to the DA, the "Western Distributor" should be defined as:

> *"the structure and all associated components of the road known as the Western Distributor located in, above, below and adjacent to the land required for the Project, including the footings, anchors, pylons, tie downs, disused deck known as the Stub, road deck, road surface and supporting structures".*

For your reference, Roads and Maritime **encloses** a copy of Roads and Maritime Technical Direction (GTD 2012/001) - Excavation Adjacent to Roads and Maritime Infrastructure.

Roads and Maritime would be pleased to meet with the Department of Planning and Environment to discuss the proposed conditions of consent and their suitability in the circumstances, if the Department so wishes.

If you have any questions, please contact Angela Frew on 8849 2041 or at development.sydney@rms.nsw.gov.au

Yours sincerely

Adam Berry
Principal Network Manager CBD & East Precinct
Network Sydney

SCHEDULE A

Design and Construction of the Project

1. The Proponent must consult Roads and Maritime Sydney Asset Manager at the preliminary and detailed design stages to ensure that the appropriate clearances from the Western Distributor structures are provided to allow for access for inspection and maintenance of those structures and to ensure that the Western Distributor is not adversely affected by the Project or any works undertaken in connection with its construction.

2. The Project must not be constructed within 3 metres of the Western Distributor.

3. The proposed design and construction of the Project must be investigated for integrity and serviceability by a qualified practicing bridge structural and geotechnical engineer(s) to Roads and Maritime satisfaction.

4. The design and construction of the Project must comply with Roads and Maritime Technical Direction (GTD 2012/001) - Excavation Adjacent to Roads and Maritime Infrastructure. A copy of the Technical Direction can be downloaded via the following link: http://www.rta.nsw.gov.au/doingbusinesswithus/engineeringpolicies/technicaldirections.html

5. The Proponent must submit a geotechnical and structural investigation report, design drawings, and the methodology for the proposed construction of the Project to Roads and Maritime for assessment and approval. The Proponent must not commence construction of the Project unless and until Roads and Maritime has approved the geotechnical investigation and structural investigation report, design drawings and construction methodology. If any new structures or footings are proposed near or adjacent to the pylons for the Western Distributor, then Roads and Maritime approval must be obtained at the preliminary and detailed design stages.

6. The Proponent must provide Roads and Maritime with any-time access to the Project to enable Roads and Maritime to carry out inspection, repairs and maintenance of the Western Distributor and the Project must be designed to facilitate these works on an ongoing basis and after construction of the Project is complete.

7. The design of the Project must not prevent Roads and Maritime from undertaking future propping or jacking activities on the Western Distributor associated with joint or bearing repairs/replacement.

8. The design of the land bridge over the Western Distributor must contemplate two options, both the no piers option and a piers option, and consider the potential impacts of both options on road network efficiency and the safety of the land bridge in case of earthquake.

ROAD SAFETY

9. The Project is to be provided with a fire protection and exhaust system such that heat, smoke and exhaust from traffic on the Western Distributor do not endanger persons, the Podium or Roads and Maritime structures, or vehicles on the Western Distributor (a qualified Fire Engineer's Certificate is required). Roads and Maritime is to be consulted prior to issue of a construction certificate for any of the structures adjacent to or over the Western Distributor to ensure that the appropriate systems are incorporated as per the relevant Australian standards.

10. The Project is also to be provided with an air quality assessment and plan that disperses vehicle emissions under the bridge to provide air quality that meets the requirements of the

relevant Australian standards. The assessment should also consider whether there is likely to be any impact on the Cross City Tunnel ventilation.

11. The external facades of the Project must be designed to minimise damage from potential vandalism and debris impacts from passing traffic. Suitable protection screens should be installed on the Project where appropriate to ensure that access is prevented between the Western Distributor and the Project by vandals who may attempt to graffiti any part of the Western Distributor.

12. All external facades of the Project should be positioned and aligned to have a reflectivity that ensures that motorists on the Western Distributor are not blinded or disabled from maintaining control of vehicles. To ensure compliance, assessment of the potential effects of the proposed façade of the Project on the reflectivity and glare environment in the surrounding area is to be undertaken and submitted for Roads and Maritime to review.

13. The Project is to be designed to prevent any falling object from impacting adversely on the Western Distributor or members of the public during construction and operation. In this regard, reference should be made to the Work Health & Safety requirement guidelines which may be provided upon request by Roads and Maritime.

ACCESS

14. Access is required to the Project area so that Roads and Maritime may carry out inspections, maintenance and rehabilitation works on the Western Distributor. The Project shall not preclude or restrict right of access to any part of the structure.

15. Parts of the project that are located below or adjacent to the Western Distributor may require additional strengthening to accommodate Roads and Maritime access and maintenance. As such, the relevant part of the structure of the Project needs to be able to carry a working load of not less than 2.5kPa. Access to these parts of the Project is required for Roads and Maritime 24 hours per day so that Roads and Maritime may carry out inspections, maintenance and rehabilitation works.

16. The Proponent must facilitate access to the substructure and superstructure of the Western Distributor, including access via the Project area for inspections, maintenance and rehabilitation works.

17. Given that some parts of the Western Distributor's structures, including the columns and piers and the superstructure, are within close proximity to the Project, it may be appropriate for Roads and Maritime to carry out investigation and maintenance works at the same time as work is being undertaken to construct the Project. The maintenance activities will depend on the result of the investigations and would most likely involve applying a coating system to the bridge structure and/or cathodic protection to the bridge.

ADDITIONAL REQUIREMENTS

18. The Proponent must enter into a Works Authorisation Deed (**WAD**) with Roads and Maritime for the works associated with the Project. The WAD must be executed prior to Roads and Maritime assessment of any required detailed civil design plans. Roads and Maritime fees for administration, plan checking, civil works inspections and project management must be paid by the Proponent prior to the commencement of any construction works.

19. Before commencing any construction works, the Proponent must commission reports to investigate and assess the impacts of the Project on the Western Distributor. Construction

works for the Project may not be undertaken until Roads and Maritime has confirmed in writing that the Project's impacts are acceptable.

20. In constructing the Project, the Proponent must not:

    a) drill or undertake any works to any part of the Western Distributor or that will affect any part of the Western Distributor;

    b) damage any part of the Western Distributor; and

    c) adversely impact on the structural integrity of the Western Distributor.

21. During construction of the Project:
    a) the Proponent must consult with Roads and Maritime to give Roads and Maritime the opportunity to carry out investigation and maintenance activities at the same time as the work on the Project;

    b) the Proponent must ensure that the use of any cranes does not involve the carrying of any "loads" over or above the Western Distributor; and

    c) all works associated with the Project must be at no cost to the Roads and Maritime.

22. A Construction Traffic Management Plan that details construction vehicles' routes, the number of trucks, hours of operation, road closures access arrangements and traffic control should be submitted to Council, Roads and Maritime and TfNSW prior to the issue of a Construction Certificate. The EIS states George Street will be a truck route for the site, this is not supported by Roads and Maritime due to the light rail project and vision for George Street focusing on pedestrian amenity.

Operation and Maintenance of the Project

23. The Proponent must prepare and submit an Emergency Response Plan to Roads and Maritime and the Minster for approval prior to the issue of a construction certificate in relation to the Project. The Emergency Response Plan must include standard operating procedures for managing construction, site emergencies and incidents associated with the Project and the Western Distributor so far as it relates to the Project.

24. During construction and operation of the Project, the Proponent must provide Roads and Maritime with access to the Project and the surrounding land at all times to enable Roads and Maritime to inspect, maintain and repair the Western Distributor. Roads and Maritime will provide at least 48 hours of notice to the Proponent before accessing the Project except where emergency inspection, maintenance or repair is required in which case Roads and Maritime may access the Project and surrounding land without notice. The Proponent must facilitate Roads and Maritime access to the Western Distributor including access within the Project structure and the removal of parts of the Project at the Proponent's cost as reasonably directed by the Roads and Maritime. The Proponent must allow access by persons and all plant and equipment associated with the inspection, maintenance and repair of the Project.

Alterations to or demolition of the Project

25. The Proponent must obtain prior approval from Roads and Maritime for any alterations or additions to the Project.

Vehicle Access to the site

26. The vehicular access movements to the site have not been adequately addressed, the current access provisions are not supported by Roads and Maritime, the proponent is to consult with Roads and Maritime regarding the preparation of a traffic report for subsequent stages of the development. The following points are to be addressed in any subsequent application for the site:

    a) In relation to the Traffic and Parking Assessment (**report**) submitted as part of this application, Roads and Maritime advises previous comments on the vehicular access to the site have not been addressed. These concerns are regarding the modification of the Harbour Street/Wheat Road and Blackwattle Place intersection to allow right turn/left turn movements on to Harbour Street.

       Roads and Maritime previously raised concerns to the modification of the existing traffic control lights at Harbour Street/Blackwattle Place intersection. The report dated October 2016, does not reflect the existing operations of this traffic control light, this intersection experiences significant levels of congestion and queues can extend through the intersection both north and south bound on Harbour Street, especially during peak periods. Existing traffic conditions show vehicles travelling northbound to the Western Distributor can queue back to Bathurst Street. The introduction of another phase will only impact on the through traffic at this location further and is not supported. Priority is given to north and southbound movements through this intersection. A right turn phase would reduce through movements. The traffic volumes generated by the development would not warrant traffic control lights in accordance with the Traffic Signals Guide Section 2 Warrants.

       Roads and Maritime suggests the applicant should consider a left-in left-out restricted movement at the Wheat Road/Harbour Street intersection provided it is priority controlled.

    b) Details are required regarding the proposed trip distribution to and from the site

    c) An assessment should be undertaken on the available area for vehicles to queue on Wheat Road on approach to the intersection of Wheat Road and Harbour Street.

    d) An electronic copy of all future intersection modelling should be provided to Roads and Maritime for review.

    e) The proposed intersection arrangement with the adjoining development should be investigated from a road safety perspective, the arrangement of entering from Harbour Street and vehicles turning from the Porte Cohere to go into the basement parking appears to show cars driving on the incorrect side of the road.

    f) Turn paths shall be provided to show the largest vehicles and coaches can turn left from Wheat Road onto Harbour Street to travel northbound. Turn paths are also required for the new road through the site illustrating all types of vehicles can use the turnaround facilities proposed site.

    g) Details are required for taxi ranks locations, service vehicle loading and unloading within Wheat Road.

    h) Further details of how the proposal is improving pedestrian accessibility to and from Cockle Bay.

Technical Direction

Geotechnology

Transport Roads & Maritime Services

GTD 2012/001 27 APRIL 2012

Excavation adjacent to RMS infrastructure

Background

The number and size of ground excavations in close proximity to Roads and Maritime Services (hereafter referred to as "RMS") infrastructure have increased steadily in recent years. It is imperative that the design and construction of the supporting structures to these excavations are adequate to provide security to the road infrastructure and its operations.

Purpose

The purpose of this document is to provide a technical direction for all proposed excavations by private and commercial developments with their influence zones, and/or any temporary structures extending onto the road reserve and RMS easements. It sets out the requirements for RMS concurrence upon referral of a Development Application involving excavation adjacent to classified roads affecting the road infrastructure.

This technical direction is an integral policy document for the management of excavation related geotechnical risks within the Work Authorised Development (WAD) Approval framework.

The document lists the contents of submission required for RMS review and it also details technical requirements for the design and construction of retaining walls for these excavations.

Scope

This document applies to retaining structures (typically embedded cantilever and propped/anchored retaining structures) constructed to support the sides of excavations which are within close proximity to the roadway. It also outlines the requirements for installing ground anchors and instrumentation as part of these excavations. Proponents must contact the RMS Project Manager for areas that are not covered by this Technical Direction.

It should be noted that the RMS review relates to the impact on its road assets and does not relieve the wall designers and property developers of their obligations with respect to any other statutory requirements as part of the development.

For:	Engineers, Works Supervisors, Surveillance Officers and Councils		
Enquiries:	Supervising Geotechnical Engineer (Standards)	Phone:	8837-0248
Amendment / Addition to:		Ref File: GEO 4364	xxxxxxxx

Referral from Consent Authority

Where the consent authority refers a development application to RMS for comment and an excavation is proposed as described above then the consent authority is to be advised that the developer needs to comply with this Technical Direction.

Submission to RMS

The following documents are to be submitted for RMS concurrence at least six weeks prior to commencement of construction:

Dilapidation Survey: RMS may require a dilapidation survey for sensitive assets where there is a potential risk of damage caused by the proposed development. The dilapidation survey must cover RMS assets within the influence zone of the excavation. Where applicable these may include the road pavement, associated subsurface drainage structures, bridges, traffic signal structures and other road assets.

Design documentation: The design documentation must be presented in a format that is readily understood by engineers. The structural engineering report must detail an accurate geometry of the retention scheme, load and design assumptions, load cases, structural section properties / material parameters including analysis output (such as moment and shear envelopes and deflections). Cross sections at critical sections of the proposed excavation showing the geotechnical model used for design must be clearly indicated. The geotechnical report on which the design is based must be provided with the design documentation. The design report must include both temporary and permanent structures where applicable.

Drawings: The Drawings must show the layout of the proposed structure(s) relative to RMS assets including but not limited to roads, tunnels, bridges, embankments, walls, noise walls and traffic signals. Longitudinal and cross sections showing the proposed structures and RMS assets must be drawn at critical locations. The construction sequence must be shown on the Drawings.

Specifications : Copies of the specifications are to be included where necessary to interpret the design and Drawings.

Instrumentation and Monitoring:

The instrumentation layout proposed for the monitoring of movement as a result of the excavation must be included in the Drawings together with the frequency of monitoring, trigger levels and action to be taken when trigger levels are exceeded.

Construction

Following RMS concurrence, construction is to be carried out in accordance with the Drawings, and specifications accepted by the RMS. Any modifications to the design, following acceptance, must be referred to RMS for concurrence.

Work-As-Executed (WAE) Drawings: Upon completion of construction the WAE Drawings of the retaining structures supporting the RMS infrastructure, including stabilisation measures in the case of excavation in rock must be submitted to RMS for record purposes.

For:	Engineers, Works Supervisors, Surveillance Officers and Councils		
Enquiries:	Supervising Geotechnical Engineer (Standards)	Phone:	8837-0248
Amendment / Addition to:		Ref File: GEO 4364	xxxxxxxx

Technical Requirements

Design Standards

Retaining structures must be designed in accordance with the relevant RMS documents and the current edition of the following Standards as appropriate, unless otherwise specified in this document. Where conflicting information occurs, the RMS document is to take precedence.

AS 1726 Geotechnical Site Investigations

AS 1170 Structural design actions – General principles

AS 5100 Bridge design – Scope and general principles

AS 3600 Concrete structures

AS 2159 Piling – Design and installation

The design of the proposed structures must be in accordance with AS 5100 unless otherwise specified in this document. The design life of permanent retaining wall structures is 100 years and the design of these walls and associated elements is to be include both short term and long term effects. In particular, the unplanned excavation as detailed in Section 13.3.1 of AS 5100.3 for stability design must be considered.

Geotechnical Investigations

As a minimum, geotechnical investigations are to be undertaken in accordance with AS 1726 to develop surface/subsurface geological models and groundwater conditions and to determine the properties of the soil and rock units. The geotechnical field investigations and laboratory testing must be comprehensively carried out to determine the site conditions and geotechnical material parameters for the detailed design and construction of the retaining structure. These investigations must be carried out to a minimum of 3 metres below the final excavation level. Investigation by test pits is generally not considered acceptable. Non core and rock core drilling using triple tube sampling is the preferred technique. Where proposed excavations are predominantly in rock, the geotechnical investigations must define adverse defect mechanisms (joints, fault zones, volcanic intrusions, weak zones etc) which may have an adverse impact on the development and adjacent RMS Infrastructure. Where excavations are in excess of 10 metres depth in rock, an assessment of the rock stress state and its effects on the excavation is required.

Utilities

The nature of any utilities located within the zone affected by the proposed excavation must be established. The effect of the excavation on these utilities must be analysed and reported. The requirements of utility owners and the sensitivity of these utilities to ground movements must be taken into account in the design and construction.

Where the utility owner requirements are not established, the design must consider either the effect of ruptured utilities or the underpinning of such utilities.

Types of Acceptable Ground Support

Whilst most types of ground support structures can be considered, the following types are not generally considered acceptable as permanent retention structures:

- Use of steel sheet pile walls below the groundwater table.
- Wall toes founded above the final excavation levels on unsupported rock ledges with rock quality inferior to Class III sandstone (Pells Classification System) or where the rock has adverse defects.

Design Loads and Combinations

Design loads and load combinations must be in accordance with AS 5100, but with a minimum uniformly distributed live traffic load (UDL) of 20 kPa for the serviceability limit state. This minimum UDL must be applied on the road which represents the most adverse loading condition for the retaining structure. The Accompanying Lane Factors given in AS 5100 may be applied to the UDL for multiple lanes.

The design must take into account construction loads, loads from neighbouring structures and other surcharge loads as required by the relevant design standards. A minimum UDL of 10 kPa must be applied for the serviceability limit state for loads other than traffic loads.

Particular loads or load cases may need to be considered for design of the retaining structures impacting on RMS infrastructure, and the developer must inform themselves of any special requirements before commencing design.

Groundwater Levels

Design groundwater levels must take into account both short term, long term and accidental groundwater levels in the vicinity of the retaining structure. Possible damming effects leading to elevated water pressures should be considered.

Where drainage measures are proposed to relieve water pressures behind the structure these must be readily accessible for inspection and maintenance. This requirement may apply either during the construction phase or the in-service phase of the structure.

Design groundwater levels and drainage details must be shown on the Drawings.

Ground Anchors

Where proposed ground anchors are located in whole or in part within the road reserve and RMS easements, the following requirements applies :

- Only temporary ground anchors will be permitted;
- Ground anchors are to be designed and tested in accordance with AS 5100;

- Temporary ground anchors must have a minimum design life of 2 years. Where ground anchors are required for more than 18 months they must be designed as permanent anchors;
- No anchor forming part of the works must be stressed to greater than 75% of the tendon UTS under either working load or test load;
- No part of any ground anchor must be less than 2 metres below the surface within the State road reserve and RMS easement.
- Once the anchors are no longer required to carry load, all structural connection between the anchors and the proposed development must be removed.

'Nails and Bolts' used as structural support elements are treated the same as ground anchors.

Ground Deformation and Wall Deflection

The prediction of vertical and horizontal deflections of the proposed retaining structure for each stage of construction and in the long term must be provided in the design documentation. These deflections must be presented in graphical form at critical sections for the full height of the retaining structure.

Retaining wall structural deflections must not result in any damage to RMS assets. Ground deformation estimates must consider the full zone of influence of the proposed excavation and include the following:

- Demolition of existing retaining or support structures.
- Construction of the retention elements.
- Excavation and deflection of the retention elements.
- Groundwater drawdown.
- Consolidation of soils.
- Other site specific work or processes affecting ground deformation

Permissible deflections will be determined by RMS on a case by case basis, taking into account the sensitivity of RMS assets to movements, the proximity of the structure to such assets and the ground movements that will occur within RMS property or the road reserve. However, total serviceability deflection of the wall in any one direction acceptable for non-sensitive RMS assets is to be limited to 0.5% of the excavated height or 30 mm, whichever is the lesser. Generally, the permissible movements on infrastructure assets should be clarified with RMS prior to the design.

Instrumentation and Monitoring

RMS requires geotechnical instrumentation and monitoring where infrastructure assets may be affected by the proposed excavation. These include bridge structures, associated foundations, existing wall structures etc adjacent to the proposed excavation. Instrumentation and monitoring may be required for the following retaining wall types:

- Cantilever retaining walls with a retained height exceeding 3 metres
- Propped or anchored walls with a retained height exceeding 6 metres

Where required, instrumentation will generally include a minimum of two inclinometers installed to at least 3 metres below the toe level of the walls. Where the groundwater level is above the final excavation level a number of piezometers must also be installed. Other monitoring systems such as a Total Station Survey system (using remote data capture or other technology) may also be required depending on the nature of the development and RMS assets affected by the development.

Where monitoring is required, it is to be carried out at the following stages:

- Before commencement of construction of retaining structures where appropriate to determine baseline readings. Two independent sets of measurements must be taken confirming measurement consistency.
- After construction of the retaining structures, but before commencement of excavation.
- After excavation to the first row of supports or anchors, but prior to installation of these supports or anchors.
- After excavation to any subsequent rows of supports or anchors, but prior to installation of these supports or anchors.
- After excavation to the base of the excavation.
- After de-stressing and removal of any row of supports or anchors.
- One month after completion of the permanent retaining structure or after three consecutive measurements not less than a week apart showing no further movements, whichever is the later.

Instrumentation and monitoring must be carried out by a competent person experienced in the equipment used. The results of each monitoring stage must be reported to the design engineer. Before work proceeds to the next stage the design engineer must verify that based on the monitoring results and the inspections carried out the structure is performing in accordance with the design intent and that where trigger levels have been exceeded, action has been taken in accordance with the monitoring plan. Verification by the design engineer must constitute a 'Hold Point' for each stage of construction.

RMS must be informed immediately when the trigger levels are exceeded.

The monitoring detailed above does not override any monitoring scheduled by the design engineer or required for any other reason. However, the monitoring detailed above may be included in monitoring programs prescribed by others provided all the requirements described in this document are incorporated into the monitoring program or plan.

Thresholds

It is recommended that the following trigger threshold criteria be adopted and shown on the Drawings:

- **Alert**: If lateral displacements are less than 80% of agreed value, excavation could be continued.
- **Action**: If lateral displacements are greater than 80% but less than 100% of the agreed value, RMS should be notified and the monitoring data be reviewed. The frequency of monitoring should be increased.

- **Alarm**: If lateral displacements are greater than the agreed value, the RMS Project Manager must be advised immediately in which case the excavation works is to be terminated. A comprehensive Risk Management / Contingency Action Plan is to be implemented with measures taken to safeguard the road infrastructure.

Hold Points

Construction must be carried out in accordance with the Council approved plans and work method statements agreed by the RMS. Construction must not proceed to the next stage until preceding 'Hold Points' have been released.

Completion of the each stage of construction listed below constitutes a 'Hold Point'. At each 'Hold Point', certification must be provided by a Chartered Professional Engineer that the conditions listed after each stage of construction below have been met before releasing each 'Hold Point'.

1. After construction of the retaining structures, but before commencement of excavation:
   a. Certify that the structures have been constructed in accordance with the approved Drawings.

2. After excavation to and installation of the first row of supports or anchors:
   a. Certify that the geotechnical conditions are in accordance with those described in the geotechnical report. If not, specify actions required and confirm that these actions have been carried out.
   b. Certify that the anchors/supports have been constructed in accordance with the approved Drawings.
   c. Certify that the anchors have been tested and passed in accordance with RMS requirements.

3. After excavation to and installation of any subsequent rows of supports or anchors:
   a. Certify that the geotechnical conditions are in accordance with those described in the geotechnical report. If not, specify actions required and confirm that these actions have been carried out.
   b. Certify that the anchors/supports have been constructed in accordance with the approved Drawings.
   c. Certify that the anchors have been tested and passed in accordance with RMS requirements.

4. After excavation to and construction of the base of the excavation:
   a. Certify that the geotechnical conditions are in accordance with those described in the geotechnical report. If not, specify actions required and confirm that these actions have been carried out;
   b. Certify that the excavation base conditions have been constructed in accordance with the approved Drawings;

5. After de-stressing and removal of any row of supports or anchors:
   a. Certify that all temporary anchors have been de-stressed, removed or disconnected from the permanent retaining structure.

Access to Site

Access to the site by RMS Engineers must be allowed for the purpose of reviewing compliance to the requirements of this document and the Work Authorised Development documents agreed with RMS.

For:	Engineers, Works Supervisors, Surveillance Officers and Councils		
Enquiries:	Supervising Geotechnical Engineer (Standards)	Phone:	8837-0248
Amendment / Addition to:		Ref File: GEO 4364	xxxxxxxx