



**Double Bay - Hydrogeological  
Geotechnical Impacts Report  
Groundwater and Geotechnical  
Assessment Report by GHD Pty Ltd**  
Proposed amendments and Staff recommendations

---



GHD have recommended amendments to Council's existing planning controls and guidelines based on the findings of their assessment report. The report recommends amendments to the following:

- Woollahra Local Environmental Plan (LEP) 2014
- Woollahra Development Control Plan (DCP) 2015
- Council's DA Guide.

This document outlines the proposed amendments identified in the report and a response from Staff which includes a commentary as to whether Staff support the recommendation with or without modification.

**Note:**

BLUE underline is new text as proposed by GHD.

~~RED strikethrough~~ is existing text which will be deleted as proposed by GHD.

GREEN text shows the proposed modifications recommended by Council Staff.

Underline is new text.

~~Strikethrough~~ is deleted text.

**Table 1: Proposed amendments to Woollahra LEP 2014**

Proposed amendments	Staff recommendation
<p><b>Clause 1.2 Aims of Plan</b></p> <p>(m) to minimise excavation and manage impacts, <u>including the potential impact of the change in the groundwater regime induced by the development.</u></p> <p><b>Modification by Staff:</b></p> <p>(m) to minimise excavation and manage impacts, <u>including the potential impact of the change in the groundwater regime</u><del>induced by the development.</del></p>	<p>Staff support the proposed amendment to Cl1.2(m) subject to the simplification of the wording. Proposed amendments shown in green.</p>
<p><b>Clause 6.2 Earthworks</b></p> <p>(1) The objective of this clause is to ensure that earthworks <u>and associated groundwater dewatering</u> for which development consent is required will not have a detrimental impact on environmental functions and processes, neighbouring uses, cultural or heritage items or features of the surrounding land.</p> <p>(2) Development consent is required for earthworks <u>and associated groundwater dewatering</u> unless—</p> <p>(a) the earthworks <u>and associated groundwater dewatering</u> are exempt development under this Plan or another applicable environmental planning instrument, or</p> <p>(b) the earthworks <u>and associated groundwater dewatering</u> are ancillary to development that is permitted without consent under this Plan or to development for which development consent has been given.</p> <p>(3) In deciding whether to grant development consent for earthworks <u>and associated groundwater dewatering</u> (or for development involving ancillary earthworks), the</p>	<p>Staff support the proposed amendment to Cl6.2.</p> <p><b>Commentary:</b> Cl6.2 is a model local provision under the Standard Instrument which was incorporated into Woollahra LEP 2014. The GHD report recommends amending this model local provision.</p> <p>Accordingly, Staff discussed the proposed changes with DPIE to ensure there are no inconsistencies with the intent of the model clause.</p> <p>DPIE noted that the LEPs for Manly and Hunters Hill include reference to “groundwater dewatering” in their relevant clause, and the proposed wording is according to the Hunters Hill LEP 2012. Accordingly, there is a precedent for this type of amendment to place a greater emphasis on groundwater and dewatering.</p>

Proposed amendments	Staff recommendation
<p>consent authority must consider the following matters—</p> <ul style="list-style-type: none"> <li>(a) the likely disruption of, or any detrimental effect on, drainage patterns and soil stability in the locality of the development,</li> <li>(b) the effect of the development on the likely future use or redevelopment of the land,</li> <li>(c) the quality of the fill or the soil to be excavated, or both,</li> <li>(d) the effect of the development on the existing and likely amenity of <del>adjoining</del> <u>surrounding</u> properties,</li> <li>(e) the source of any fill material and the destination of any excavated material,</li> <li>(f) the likelihood of disturbing relics,</li> <li>(g) the proximity to, and potential for adverse impacts on, any waterway, drinking water catchment or environmentally sensitive area,</li> <li>(h) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.</li> </ul>	<p>Regarding the use of the word “surrounding”, GHD notes that the potential impacts of dewatering may extend a considerable distance away from the development site and that this should be considered when designing development. Accordingly, Staff have no objection to the proposed change.</p> <p>Given the restrictions of the standard instrument, the amendments proposed by GHD are considered to be an appropriate response. Council Staff support the proposed amendment to Cl.6.2.</p>

**Table 2: Proposed amendments to D2.2.11 Geotechnology and hydrogeology in the Double Bay Settlement Zones**

GHD has recommended amendments to *Chapter D5 Double Bay Centre - Section D5.6.7 Geotechnology and hydrogeology* as shown in **Table 2**. Staff support the majority of the proposed recommendations with some modifications. However, Council Staff do not locating the amendments in Chapter D5 of the Woollahra DCP 2015. Chapter D5 only applies to the Double Bay Centre.

The proposed controls should apply to A, B and C Settlement Zones which includes land zoned R2 Low Density Residential and R3 Medium Density Residential (as shown in Figure 1). As such, the controls should be inserted into *Chapter E2 Stormwater and Flood Risk Management* which would apply to all development applications in the Settlement Zones. This issue has been discussed with representatives from GHD, who agree with the Staff recommendation.

Staff recommend deleting the existing section D5.6.7 Geotechnology and hydrogeology from *Chapter D5 Double Bay Centre*, and insert a new and combined section into Chapter E2 *Stormwater and Flood Risk Management* termed *D2.2.11 Geotechnology and hydrogeology in the Double Bay Settlement Zones*.



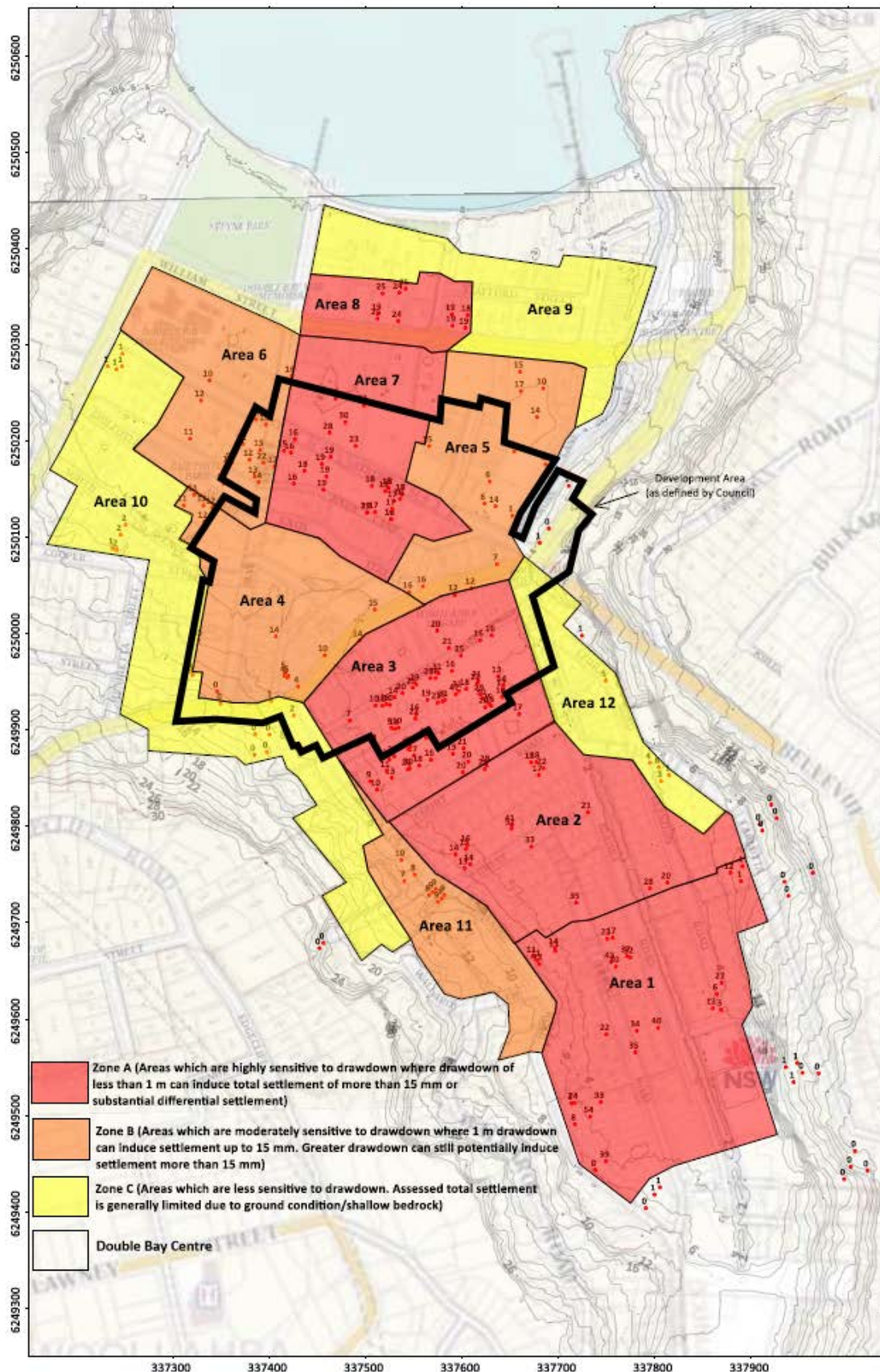


Figure 1: Settlement Zones in the Double Bay Catchment Area, as identified by GHD

Proposed amendments	Staff recommendation
<p><b>Staff modification:</b></p> <p>Delete:</p> <p><del>D5.6.7 Geotechnology and hydrogeology in Chapter D5: Double Bay Centre</del></p> <p>Replace in:</p> <p><u>Chapter E2: Stormwater and Flood Risk Management in D2.2.11 Geotechnology and hydrogeology in the Double Bay Settlement Zones</u></p>	<p>Delete section <i>D5.6.7 Geotechnology and hydrogeology</i> from Chapter D5 Double Bay Centre, and insert a new and combined section into Chapter E2 Stormwater and Flood Risk Management termed <i>D2.2.11 Geotechnology and hydrogeology in the Double Bay Settlement Zones</i>.</p>
<p><b>D5.6.7 Geotechnology and hydrogeology</b></p> <p><b>Introduction</b></p> <p>Council will <del>normally</del> require geotechnical and hydrogeological reports for development applications which include below ground structures.</p> <p>This is because the subsurface conditions within the Double Bay <del>Settlement Zones Commercial Centre</del> generally comprise water charged alluvial sediments to great depth. The alluvium is predominantly sand which is typically loose near the surface but may at some locations be interlayered with soft compressible clay or peat bands at depth.</p> <p><del>The groundwater level in the valley area is generally high and varies between RL 1.0 and RL 2.5. The groundwater level generally varies throughout the Double Bay area and fluctuates with the seasons.</del></p> <p>Any proposed development with below ground structures must consider the sub-surface conditions and the effects of construction on <del>adjacent</del> <u>surrounding</u> properties. In addition, those which are likely to extend below the level of seasonal fluctuations in the groundwater table, must also consider the effect of any changes induced in the sub-surface water levels and the groundwater flow patterns on <del>adjacent</del> <u>surrounding</u> properties. Unless site specific information exists to the contrary, excavations deeper than 1m must be assumed to have this potential to intersect the groundwater level <u>and shall be considered as below ground structures</u>.</p> <p>Council's principal objective is to ensure there are no adverse geotechnical and hydrogeological impacts on any surrounding <del>property</del> <u>properties</u> and infrastructure as a result of development, during and after construction. Typically, adverse geotechnical impacts may include vibration induced settlements from construction methods and equipment and inadequate support of adjacent land during and after construction. Typically adverse hydrogeological impacts may include settlement induced by changes in the groundwater level and seepage problems.</p>	<p>Staff support the proposed amendments (with some minor modifications).</p> <p><b>Commentary:</b> Staff support enhancing the introduction to this section, to recognise the unique characteristics that exist in the Double Bay catchment, and using the word “surrounding” to recognise that the potential impacts of dewatering may extend a considerable distance away from the development site. The introduction has amended to clarify that this section applies to the whole of the Double Bay Settlement Zones (not just the Double Bay Centre).</p>

Proposed amendments	Staff recommendation
<p><b>Objective O1:</b></p> <p>O1 There will be no ground settlement or movement, during and after construction, sufficient to cause an adverse impact on <del>adjoining</del> <u>surrounding</u> properties and infrastructure.</p>	<p>Staff support the proposed amendment to the objective.</p> <p><b>Commentary:</b> Staff support using the word “surrounding” to recognise that the potential impacts of dewatering may extend a considerable distance away from the development site.</p>
<p><b>Insert new control</b></p> <p><u>C1 All development must satisfy the above design objectives.</u></p>	<p>Staff do not support the new Control proposed by GHD.</p> <p><b>Commentary:</b> All development must respond to the objectives of Woollahra DCP 2015 and this does not need to be stated as a control.</p> <p>Staff do not recommend that the proposed C1 is included in amendments to the Woollahra DCP 2015.</p>
<p><b>Delete existing control and replace with new controls</b></p> <p><del>C1: Excavation below 1m is accompanied by a geotechnical report and a structural report to demonstrate that the works will not have any adverse effect on the neighboring structures.</del></p> <p><u>C2: Development applications must include a design statement and supporting drawings that show the design measures proposed to minimise risks and to ensure that no adverse impacts will occur.</u></p> <p><u>C3: Geotechnical and hydrogeological reports with supporting design statements must be submitted with all development applications which include below ground structures.</u></p> <p><b>Staff modification:</b> <u>C2 Development applications which include below ground structures must include the following documents:</u></p> <ul style="list-style-type: none"> <li>• <u>Structural report</u></li> <li>• <u>Geotechnical and hydrogeological reports</u></li> <li>• <u>Design statement and supporting drawings that show the design measures proposed to minimise risks and to ensure that no adverse impacts will occur.</u></li> </ul>	<p>Staff support the new controls subject to them being combined due to their similar nature. Modified text is identified in <u>green</u>.</p> <p><b>Commentary:</b> The proposed controls have strengthened the requirement for an applicant to provide additional consultant reports. Currently these are only required if excavation is proposed below 1m. GHD are recommending that this requirement is applied to all development.</p> <p>However, Staff recommend that the controls specify that only development applications which include below ground structures must include these technical documents. This will prevent the unnecessary burden or confusion for applicants proposing minor works that do not involve below-ground structures.</p> <p>In addition, GHD have not explained why the requirement for a ‘structural report’ has been removed. Council’s Drainage Engineer has advised that issues relating to structure are not always adequately address in the geotechnical and hydrogeological report. Accordingly, and for abundant certainty, Staff recommend retaining the requirement for a structural report.</p>

Proposed amendments	Staff recommendation
<p><b>Insert new control</b></p> <p><u>C4 A qualified and experienced geotechnical and/or hydrogeological engineer must prepare the reports.</u></p> <p><u>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.</u></p>	<p>Staff support the proposed control.</p> <p><b>Commentary:</b> This matter is currently addressed in Council's DA Guide, Attachment 6 (pages 3 and 10). Staff support elevating this guideline into a new control in the DCP.</p>
<p><b>Insert Control C5</b></p> <p><u>C5 Where groundwater is present and dewatering is likely to occur on the site the following measures must be implemented:</u></p> <ul style="list-style-type: none"> <li><u>A minimum of two piezometers must be located within the site or in close proximity to it</u></li> <li><u>Where piezometers are established in the footpath area a permanent installation with a cast iron cover and concrete surround must be provided</u></li> <li><u>Existing piezometers must be used where they are available</u></li> <li><u>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.</u></li> </ul> <p><b>Staff modification:</b></p> <p><u>C5: Where groundwater is present and dewatering is likely to occur on the site, the requirements of Council's DA Guide under the 'Investigations' section must be implemented.</u></p>	<p>Staff do not support the proposed Control C5.</p> <p><b>Commentary:</b> The proposed controls, except for the third bullet point highlighted, are currently included in Council's DA Guide, Attachment 6 (page 4).</p> <p>These are highly detailed technical matters which are not appropriate for inclusion in the DCP.</p> <p>However, to ensure that these matters are addressed during the DA process, Staff recommend that this matter is included in the DA Guide and a cross-reference is included in the DCP control. (Recommended text is shown in green).</p>
<p><b>Proposed new control C6</b></p> <p><u>C6 Temporary changes to the groundwater level, due to construction, must not exceed 0.2 m from the average monitored pre-construction groundwater level unless calculations using the results of specific field testing, support a greater change and demonstrate that the change will not induce settlement greater than the characteristic surface movement of a Class S site as defined in Table 2.3 of Australian Standard AS2870-2011.</u></p>	<p>Staff support the proposed control to ensure that the impacts of construction are appropriately considered during the DA assessment process.</p>
<p><b>Proposed new Control C7</b></p> <p><u>C7 As required by Council's Guidelines, geotechnical and hydrogeological reports must contain an Implementation Plan, including a Monitoring Program, Contingency Plan and Construction Methodology.</u></p> <p><u>The applicant is advised to have an appropriate current insurance policy to cover the reinstatement/repair of damages to surrounding properties as a result of new development.</u></p>	<p>Staff generally support the proposed Control C7, subject to its simplification. However, Staff do not support the proposed additional text which relates to highly detailed technical matters which are not appropriate for inclusion in the DCP (and would not form part of the assessment process).</p> <p><b>Commentary:</b> The proposed control is currently contained in Council's DA Guide, Attachment 6</p>



Proposed amendments	Staff recommendation
<p><u><i>In addition, statements for the design and construction of the below ground structures must be supplied from a suitably qualified and experienced geotechnical or hydrogeological engineer. The design statement must confirm that the design of the below ground structures has been undertaken in accordance with approved standards (such as Australian or British Standards, etc.) where applicable. The engineer must also provide a certificate to confirm that the completed structure conforms to the design.</i></u></p> <p><b>Staff modification:</b>  <u><i>C7: Any geotechnical and hydrogeological reports must contain an Implementation Plan, including a Monitoring Program, Contingency Plan and Construction Methodology.</i></u></p> <p><u><i>Note: All reports and requirements must be prepared in accordance with Council's DA Guide. Geotechnical reports must be prepared by an appropriately qualified Geotechnical Engineer who is NER registered with a minimum of 10 years practice in the geotechnical field in the last 15 years.</i></u></p>	<p>(page 7). Staff have no objection to elevating this requirement to the DCP. However, we recommend simplifying the control as shown in <b>green</b>.</p> <p>In addition, Council's Drainage Engineer has advised that a note should be included to ensure that all reports are prepared consistent with the DA Guide and by an appropriately qualified consultant.</p> <p>(Recommended text is shown in <b>green</b>).</p>
<p><i>Note: Section, objective and control numbers will be amended so that these are consequential, should Council endorse the changes for public exhibition.</i></p>	

**Table 3: Proposed amendments to Attachment 6: Geotechnical and Hydrogeological Reports Council's DA Guide**

Proposed amendments	Staff recommendation
<b>Design Principles (P 2)</b> <b>Amend text in point one:</b> <ul style="list-style-type: none"> <li>There will be no ground settlement or movement, during and after construction, sufficient to cause an adverse impact on <del>adjoining</del> <u>surrounding</u> properties and infrastructure.</li> </ul>	<p>Staff support the proposed amendment to this part of the Guide.</p> <p><b>Commentary:</b> Staff support enhancing the design principle to recognise that the potential impacts of dewatering may extend a considerable distance away from the development site.</p>
<b>Adverse Impact Definition (P 3)</b> <b>Amend text for Adverse Impact Definition</b> Generally, an adverse impact can be assumed to be any damage caused to the improvements on <del>adjoining</del> <u>surrounding</u> properties by the demolition, excavation or construction on the development site.	<p>Staff support the proposed amendment to this part of the Guide.</p> <p><b>Commentary:</b> Staff support amending the definition to recognise that the potential impacts of dewatering may extend a considerable distance away from the development site.</p>
<b>Development Application – Report Requirements Investigations (P 3-4)</b> <b>Amend dot point three under Investigations</b> <ul style="list-style-type: none"> <li><del>If below ground structure is proposed,</del> the investigation should also target at least one continuous strength log of the subsurface soils <del>by Cone Penetrometer Testing (CPT)</del> to supplement the information from the boreholes. <u>As a guide, the following tests can be considered for the continuous strength log:</u> <ul style="list-style-type: none"> <li><u>Cone Penetration Test (CPT) where the soil strata as proven during the borehole investigation shows the presence of compressible soil (soft to firm clay/clayey soil; soft to firm peat/peaty soil) or where the soil strata has a total thickness of greater than 3 m.</u></li> <li><u>Dynamic Cone Penetration (DCP) where the soil strata as proven during the borehole investigation, comprises soil with a total thickness of no more than 3 m and without compressible soil layers.</u></li> </ul> </li> </ul>	<p>Staff support the proposed amendment to this part of the Guide.</p> <p><b>Commentary:</b> This detailed technical information is based on GHD's analysis and assessment. Staff have no objection to revising and enhancing the existing guidelines based on GHD's updated analysis.</p>
<b>Amend dot point four under Investigations</b> <ul style="list-style-type: none"> <li>that the presence of groundwater has been investigated. Where present, the <u>pre-construction</u> 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).</li> </ul>	<p>Staff support the proposed amendment to this part of the Guide to clarify that the groundwater level must be measured pre-construction.</p>
<b>Amend dot point four under Investigations</b> <ul style="list-style-type: none"> <li>that where groundwater is present and dewatering is likely to occur on the site, the <del>following measures will be implemented;</del> <u>the piezometric monitoring of the groundwater will be required as per the requirements given in Clause D5.6.7 of the Development Control Plan.</u> <ul style="list-style-type: none"> <li><del>a minimum of two piezometers will be located within the site or in close proximity to it.</del></li> </ul> </li> </ul>	<p>Staff do not support removing the existing technical requirement from this guideline to Chapter D5.6.7, new Control C5 of Woollahra DCP 2015.</p> <p><b>Commentary:</b> Due to the detailed and highly technical nature of this control, Staff recommend that the requirements for the new Control C5 in Chapter D5.6.7 of Woollahra DCP</p>

Proposed amendments	Staff recommendation
<ul style="list-style-type: none"> <li><del>• 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.</del></li> <li><del>• where established in the footpath area a permanent installation with a cast iron cover and concrete surround is required.</del></li> </ul> <p><del>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.</del></p> <p><b>Staff modification:</b></p> <ul style="list-style-type: none"> <li>- that where groundwater is present and dewatering is likely to occur on the site, the following measures <u>must</u> be implemented: <ul style="list-style-type: none"> <li>• <u>A minimum of two piezometers must be located within the site or in close proximity to it</u></li> <li>• <u>Where piezometers are established in the footpath area a permanent installation with a cast iron cover and concrete surround must be provided</u></li> <li>• <u>Existing piezometers must be used where they are available</u></li> <li>• <u>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.</u></li> </ul> </li> </ul>	<p>2015 are retained in this section of the Guide and not included as a DCP control.</p> <p>The proposed inclusion in the DA Guide which incorporates the advice from GHD is identified in the Staff modification.</p>
<p><b>Development Application – Report Requirements: Support and Retention (P 5)</b>  <b><i>Amend last dot point</i></b></p> <ul style="list-style-type: none"> <li>- 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 <del>as well as suitable groundwater drainage systems as outlined in Hydrogeology.</del></li> </ul>	<p>Staff support the proposed amendment to this part of the Guide.</p> <p><b>Commentary:</b> GHD have identified that this is unnecessary text which can be removed, as it is implied by the earlier text.</p>
<p><b>Development Application – Report Requirements: Hydrogeology (P 5)</b>  <b><i>Amend dot point two under Hydrogeology</i></b></p> <ul style="list-style-type: none"> <li>- 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 <u>impediment of the</u></li> </ul>	<p>Staff support the proposed amendment to this part of the Guide.</p> <p><b>Commentary:</b> The proposed amendment clarifies the technical nature of the requirement to ensure its consistent interpretation.</p>

Proposed amendments	Staff recommendation
<p><a href="#">critical groundwater flow path due to</a> support and retention of property and infrastructure after construction has been completed.</p>	
<p><b>Amend dot point three under Hydrogeology</b> that temporary changes to the groundwater level, during construction, will be kept within the <a href="#">limits as specified in Clause D5.6.7 of the Development Control Plan</a> <del>historical range of natural groundwater fluctuations. 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 0.3m 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.</del></p> <p><b>Staff modification:</b> that temporary changes to the groundwater level, during construction, will be kept within the <a href="#">limits as specified in Chapter D5.6.7 of Woollahra DCP 2015.</a></p>	<p>Staff support the proposed amendment to this part of the Guide.</p> <p><b>Commentary:</b> Staff support the deletion of this element, as this has been included as a control in Chapter D5.6.7, of the Woollahra DCP 2015. However, Staff recommend simplifying the cross reference.</p>
<p><b>Development Application – Report Requirements: Hydrogeology (P 5)</b> <b>Delete dot points four to seven</b></p> <ul style="list-style-type: none"> <li><del>— that in areas where the construction affects existing development within a shadow zone of an earlier construction, temporary changes in the level of the water table during construction will not exceed 0.15m, unless calculations using the results of the site specific field testing, supporting a greater change are provided and demonstrate no adverse impact to surrounding properties and infrastructure. The temporary shadow zone during dewatering should be taken as an area within 20m of the earlier construction, unless site specific calculations can demonstrate that a different lateral extent should be adopted.</del></li> <li><del>— that where data is limited or unavailable, the permanent change in the level of the natural water table due to the carrying out of the development will not exceed 0.2m 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 property and infrastructure.</del></li> <li><del>— that in areas where the construction affects existing development within a shadow zone of an earlier construction, the permanent change in the water table due to the carrying out of the development will not exceed 0.1m. The permanent shadow zone of an earlier construction with full penetrating cut-off walls but without appropriate subsurface drainage should be taken as a distance equal to one building width along the groundwater flow path both in front and behind the earlier construction, unless site specific calculations can demonstrate that a different lateral extent should be adopted.</del></li> </ul>	<p>Staff support the proposed amendment to this part of the Guide.</p> <p><b>Commentary:</b> The three thresholds have been summarised into a single threshold which has been elevated into the DCP. This simplified, and strengthened approach is supported by Staff.</p> <p>The final bullet point refers to groundwater drainage systems. However, Council's Drainage Engineer has identified that our preferred approach is to tank basements, and therefore a reference to a groundwater drainage system is not required.</p>

Proposed amendments	Staff recommendation
<p><del>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.</del></p>	
<p><b>Development Application – Report Requirements: Hydrogeology (P 6)</b>  <b>Amend from second paragraph on page 6</b>  Where an impediment to the <a href="#">critical</a> natural <a href="#">groundwater</a> flow path 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 <a href="#">it</a> can be demonstrated that the natural ground<del>water</del> flow regime is re-established both upstream and downstream of the site without any adverse effects on surrounding property or infrastructure.</p> <ul style="list-style-type: none"> <li><del>that groundwater drainage systems are designed for a design life of 100 years.</del></li> <li><del>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.</del></li> <li><del>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.</del></li> <li><del>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.</del></li> </ul> <p><b>Staff modification:</b>  Where an impediment to the <a href="#">critical</a> natural <a href="#">groundwater</a> flow path 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 <a href="#">it</a> can be demonstrated that the natural ground<del>water</del> flow regime is re-established both upstream and downstream of the site without any adverse effects on surrounding property or infrastructure. <a href="#">The groundwater drainage systems must be designed for a design life of 100 years.</a></p>	<p>Staff support the deletion of four of the bullet points. However, the top one relating to a design life of 100 years should be retained.</p> <p>The Staff modification shows our recommendation, with the amendments shown in <a href="#">green</a>.</p> <p><b>Commentary:</b> Staff do not support removing the first bullet point, which refers to:</p> <p><i>‘that groundwater drainage systems are designed for a design life of 100 years’.</i></p> <p>As all groundwater drainage systems should be designed to operate for 100 years.</p> <p>The top four bullets can be deleted as these refer to groundwater drainage systems. However, Council’s Drainage Engineer has identified that our preferred approach is to tank basements, and therefore a reference to a groundwater drainage system is not required.</p>