

IN THE MATTER OF the Resource Management
Act 1991

AND

IN THE MATTER OF a private plan change
request ('Proposed (Private)
Plan Change 40:
Wallaceville') to the Upper
Hutt City District Plan made
by Wallaceville
Developments Limited.

STATEMENT OF EVIDENCE OF ALAN MITCHEL BLYDE

1.0 EXECUTIVE SUMMARY

- 1.1 My name is Alan Mitchel Blyde. I hold a Bachelor of Engineering (Environmental) Hons Degree and a NZ Certificate in Engineering (Civil). I am a Member of the Institute of Professional Engineers of New Zealand and am a Chartered Professional Engineer (CPEng). I am a Technical Director and have worked with Harrison Grierson Consultants Limited (HGCL) for 22 years in the Land Development field of civil engineering.
- 1.2 My involvement in the Wallaceville Plan Change project commenced in March 2014 when I first started investigating civil services, infrastructure servicing for the site and in particular stormwater management options and concepts.
- 1.3 My evidence is specific to stormwater management and disposal from the site. I authored the Stormwater Management Plan (SMP) for the development site as well as the Stormwater Management Principles.
- 1.4 The Stormwater Management Principles have been incorporated into the Structure Plan to ensure that future subdivision and development of the Wallaceville Structure Plan Area will be required to be assessed against these principles.
- 1.5 The purpose of the SMP is to set a framework for the ongoing management of stormwater across the entire Wallaceville site as development occurs in stages. The SMP demonstrates how hydraulic neutrality will be achieved, and also identifies the forms of low impact stormwater technology to be utilised. The stormwater management options included in the SMP cover water quality management and flood attenuation options.
- 1.6 The SMP confirms that we can design stormwater management and disposal measures to cater for both a primary system for frequent rainfall events and a secondary system of overland flowpaths and flood flow attenuation basins and storage areas. The primary system will be sized to cater for the 4% AEP storm event (i.e. the 1 in 25yr event) and the secondary system will be sized to convey and attenuate up to the 1% AEP storm event (i.e. the 1 in 100 yr event) including appropriate freeboard requirement safety factors, and allowances for climate change effects.

- 1.7 Hydraulic neutrality will be achieved on site in that all flood flows for events up to and including the 1% AEP event will be attenuated on site to ensure that any overland flow discharging from the site is no greater than currently discharges (i.e. the post-development flow will be equal to or less than the pre-development flow.)
- 1.8 Each individual house site will discharge stormwater to a localised on-site soakpit which will cater for runoff from the entire house site area and sized for runoff from the 4% AEP storm event. The on-site soakpit will include pre-treatment measures to avoid clogging. This system will be owned and maintained by the individual house owner.
- 1.9 Runoff from roadways and public road areas will be directed to roadside swale drains and catchpits with silt traps, for pre-treatment prior to entering infiltration trenches and soakpits. This roadway system will be sized for the 4% AEP event and forms part of the primary drainage system for the site.
- 1.10 In the event that the individual on-site soakage system and the roadway system described above fails, all stormwater flow will be directed via a secondary overland flowpath system towards a number of much larger storage basins which will be designed to cater for runoff from all storms up to the 1% AEP (1 in 100 yr) event and attenuate this flow so that any runoff leaving the site is no greater than what currently leaves.
- 1.11 All stormwater runoff from primary drainage networks from the site will be treated prior to discharge to ground soakage in accordance with the principles outlined in ARC TP 10 which is an accepted good practice guide.
- 1.12 The Groundwater specialist for the project, EnGeo, installed groundwater monitoring wells on site and have provided us with groundwater levels for the site, including during the winter period. This information confirms that groundwater sits well below the site at a depth varying between 8.5m and 10.3m below ground. Based on this I am confident that there is sufficient depth of unsaturated free drainage soil and gravel material beneath the site to cater for disposal of stormwater to ground soakage.
- 1.13 I have reviewed the points raised by submitters and believe that our design proposals adequately deal with these. A number of submitters raised concerns about the effects of overflows from the stormwater system exiting the site and causing flooding. We have confirmed that our design will ensure hydraulic neutrality is achieved for all storms up to and including the 1% AEP event. Therefore there will be no increase in discharge from the site, post development, for all storms up to the 1% AEP event (1 in 100 yr storm).
- 1.14 A number of submitters recommend the use of sustainable water solutions. I confirm that Low Impact Design measures will be incorporated into the stormwater management system and while it will not be a set requirement, all future landowners will be encouraged (within the Stormwater Management Plan document) to utilise rainwater re-use and potentially also greywater re-use within their private house plumbing systems. The Stormwater Management Plan will provide information on how rainwater re-use could be implemented on individual sites.
- 1.15 Some submitters have recommended retaining the existing farm drains on the site. My evidence confirms that the site ecologist has found all existing farm drains on site to have low ecological value and recommended that these do not need to be protected. I further confirm that it is not practical to retain the drains in order to achieve the best design outcomes for the site.

- 1.16 One submitter does not agree with the use of the bush covenant areas for flood flow attenuation. My evidence confirms that the flood attenuation areas will be kept outside of the existing bush areas on the covenanted areas. The covenant areas conditions allow for the use of the area for flood management measures and stormwater disposal. And further, no measures are proposed to be implemented without gaining prior approval from DOC.
- 1.17 One submitter, GWRC, recommends that flood flow attenuation on site should include for the effects of climate change. My evidence confirms that this will be done. Our calculations have been undertaken within the inclusion of a 16% increase factor to allow for the effects of climate change, and this is a widely accepted appropriate factor.
- 1.18 I have reviewed the Council Hearing Report (Section 42A Report), and the recommendations within, which affect my area of expertise. The report recommends further meetings be held with council in order to reach agreement on all stormwater matters before the hearing. These meetings have been held and my evidence confirms the outcomes of the meetings and following discussions. I believe that we are in agreement with council.
- 1.19 The Council Hearing Report also recommends that changes be made to the Stormwater Management Principles to reflect the agreements made with council and any changes which came out of reaching those agreements. I confirm that we have made the necessary changes to the Stormwater Management Principles and a copy of the document is attached to my evidence.
- 1.20 I reviewed the Peer Review Report of the Stormwater Soakage System, prepared by PDP for council. There were a number of matters of concern raised which my evidence answers and deals with. The Peer Review report concludes that the disposal of stormwater to ground is feasible for the site.
- 1.21 I propose a number of amendments to the Stormwater Management Principles which have been the outcome of points from submitters, as well as discussions with council and a review of the PDP peer review report.
- 1.22 Based on the points described within my evidence, I do not consider that there are any stormwater management constraints which should prohibit the granting of consent for the proposal.

2.0 INTRODUCTION

- 2.1 My name is Alan Mitchel Blyde. I hold a Bachelor of Engineering (Environmental) Hons Degree and a NZ Certificate in Engineering (Civil). I am a Member of the Institute of Professional Engineers of New Zealand and am a Chartered Professional Engineer (CPEng).
- 2.2 I appear in relation to a private plan change request ('Proposed (Private) Plan Change 40: Wallaceville') to the Upper Hutt City District Plan made by Wallaceville Developments Limited to rezone approximately 63 hectares of former Wallaceville Ag-Research site and a small part of the Trentham Racecourse property for residential and commercial uses.
- 2.3 I am a Technical Director and have worked with Harrison Grierson Consultants Limited (HGCL) for 22 years in the Land Development field of civil engineering. At Harrison Grierson I have worked on numerous residential housing, apartment and large-scale infill developments which have required Engineering Infrastructure Assessments to satisfy council that existing infrastructure can cope with the additional requirements generated by further development.

- 2.4 I have been involved in preparation of Infrastructure Assessments, construction observation and design of civil services, roading, earthworks/excavation for many varying density residential housing developments of a similar nature to this development, including: Stages 8 and 9 at Aotea Subdivision, Porirua; Stage 2 at Silverwood Subdivision, Whitby; Springpark Subdivision, Mt Wellington, Auckland; Compass Point Subdivision, Half Moon Bay; Puriri Grove Development, Stages 1-8 Mangere; Randwick Park, Manurewa; Apex Duo Apartments, Mt Wellington and 19-23 St Stephens Ave Apartments, Parnell. I have designed similar soakage disposal systems for a 200 lot subdivision in Taupo. I have designed numerous on-site individual soakage disposal systems throughout Auckland and other parts of the North Island. I have designed a combined soakage system with stormwater quality treatment measures for a 400 lot subdivision in Auckland.
- 2.5 My involvement in the Wallaceville Plan Change project commenced in March 2014 when I first started investigating civil services, infrastructure servicing for the site and in particular stormwater management options and concepts.
- 2.6 I am familiar with the subject site and its surrounds. I first visited the area in late March 2014 and have carried out a number of site visits since to understand site land drainage patterns and general topography across the site. I was also on-site during drilling and soakage testing being carried out and have watched percolation and soakage tests being undertaken into the soils/ gravels on the site. I have travelled the streets bounding the site to understand the natural flowpaths and upstream and downstream stormwater catchments.
- 2.7 Although this is a Council hearing I note that I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note (2014) and agree to comply with the Code. Except where I state that I am relying upon the specified evidence of another person, my evidence in this statement is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions which I express.

3.0 SCOPE OF EVIDENCE

- 3.1 In my evidence I propose to:
- a) Describe the Stormwater Management Plan which I prepared and which was submitted with the Plan Change Request
 - b) Summarise and comment on the submissions received on the application that are relevant to my area of expertise;
 - c) Provide comments on the recommendation of the Council Hearing Report related to my area of expertise;
 - d) Provide comments on a report received from council's peer review consultants, PDP on 23 June 2015, entitled Peer Review of the Soakage System for the Proposed Wallaceville Development; and,
 - e) Provide my recommendation on the Plan Change Request

4.0 SUMMARY OF THE STORMWATER MANAGEMENT PLAN

- 4.1 As noted I prepared the Stormwater Management Plan (SMP) which accompanied the Plan Change application and which supports the Plan Change. I also prepared the Wallaceville Stormwater Management Principles which have been included in the 'Wallaceville Structure Plan' that is proposed to be incorporated into the District Plan.

- 4.2 The Stormwater Management Principles have been incorporated into the Structure Plan to ensure that future subdivision and development of the Wallaceville Structure Plan Area will be required to be assessed against these principles.
- 4.3 The SMP is based on my understanding of the engineering requirements of Upper Hutt City Council and my understanding of the site conditions. My understanding of the site conditions has been informed by a range of investigation work, namely:
- a) Site contours (Calibrated LIDAR data) and features;
 - b) The Ecological Assessment by Morphem Consultants which considers amongst other things site hydrology;
 - c) The Geotechnical Assessment by EnGeo which confirms ground conditions and underlying soil types, which affects soakage capabilities;
 - d) Groundwater investigations and monitoring carried out by EnGeo; and,
 - e) A Soakage Test Report prepared by Harrison Grierson (Appendix C to the SMP).
- 4.4 In developing and proving my stormwater management concepts for the site I have arranged ongoing groundwater monitoring to be undertaken by EnGeo and also arranged for site soakage testing to be carried out by Harrison Grierson. The results of our soakage testing have proved to me that the soils and gravels underlying the site provide excellent soakage capability and can be considered to be free draining. The results of groundwater monitoring of piezometer wells across the site (during summer and winter periods) have confirmed to me that soakage capabilities will not be unduly affected by potential rise in groundwater levels
- 4.5 EnGeo have installed groundwater monitoring wells (piezometers) and undertaken monitoring of these. The results they have provided indicate that groundwater levels have fluctuated between depths of 8.5m below ground level to 10.3m below ground level. These results provide me with the confidence that groundwater levels will not rise to a level that will affect soakage capability and groundwater movement below and across the site. And the significant depth to groundwater level confirms for me that there is a significant depth of free draining soil and gravel material below the site to provide for disposal of stormwater to ground soakage from the development.

SITE CONDITIONS

- 4.6 On the surface, water enters the site from a number of points from Alexander Road, to the south of the site. A minor tributary stream from the Southern Hills catchment flows into the triangle of flat land south of Alexander Road. The Ecological Assessment considers that this is likely to be a perennial watercourse (based on vegetation presence and substrate sorting) and that the stream form appears stable with little indication of elevated flows in preceding days of moderate rainfall. Where the stream exits the bush line (at the toe of the slope) the stream enters a basic excavated straight drain. Almost the entire flow of the stream dissipates through infiltration over the first 20–30 m of this drain. This drain would remain, or an equivalent similar drain would be created nearby, as future development occurs on the piece of land. It is proposed that primary stormwater runoff from the triangular piece of land will be discharge to ground soakage, locally on this part of the site.
- 4.7 Drainage from the industrial development south of Alexander Road is contained within UHCC culverts which drain away from the site and which do not drain across Alexander Road to the Wallaceville site.

- 4.8 A number of cut farm drains are located through the Plan Change site. These drains include four culverts which are constructed beneath Alexander Road with drainage being more concentrated on the eastern side of the property. The drains are thought to have been constructed to control surface drainage and reduce the areas of saturated land for agriculture. The two main drain systems on the site (northern and southern - see Map 1 in Appendix A to the Ecological Assessment) culminate at existing soakage holes. The existing soakage hole for the north drain is located within Grants Bush, and is proposed to be retained. The soakage hole for the southern drain is located on land to be retained by the Wellington Racing Club. As the development of the site proceeds into the southern portion of the site, it is proposed that this soakage hole will no longer be used and additional/ new storage basins/ wetlands/ soakage disposal areas will be constructed to cater for the existing soakage hole to be lost.
- 4.9 The Plan Change site generally falls from southeast to northwest, at a relatively flat average grade of approximately 0.7%. Existing overland flowpaths across the site generally run as sheet flow towards the Rail Corridor, Trentham Racecourse and Summerset retirement village to the northwest of the site and a smaller catchment drains as sheet flow across the Flood Plain Remnant conservation covenant area and towards the Trentham Defence Force land to the south west corner of the site along Alexander Road.
- 4.10 As part of my assessments, I have reviewed the groundwater monitoring results and the document prepared by EnGeo entitled Response to Request for Further Information: Wallaceville Soakage System, dated 5 June 2015. That document confirmed our expectations and understanding with respect to groundwater levels and movement across the site and the nature of the underlying gravel layers which have significant storage zones and high transmissivity.

The document, prepared by EnGeo's Senior Hydrologist, Mr Huw Williams, confirms that there is a layer of unsaturated gravel with high transmissivity from a depth of 6.0m to 8.5m below ground level. This zone is available to provide significant groundwater storage beneath the site. This zone is also available to transport groundwater away from the site towards Hutt River. The gravel layers extend below this depth but were found to be affected by groundwater. Above the aforementioned zone (i.e. above 6.0m depth below ground) the site is underlain by unsaturated ground material comprised of medium to large cobbles with silt. This material is also free draining (as proven by our own soakage testing) but to a lesser degree than the gravel layer at 6.0m to 8.5m depth.

STORMWATER MANAGEMENT MECHANISMS

- 4.11 The purpose of the SMP is to set a framework for the ongoing management of stormwater across the entire Wallaceville site as development occurs in stages. The SMP demonstrates how hydraulic neutrality will be achieved, and also identifies the forms of low impact stormwater technology to be utilised. The stormwater management options included in the SMP cover water quality management and flood attenuation options.
- 4.12 The SMP seeks that the stormwater mechanisms are integrated into the overall development landscape. In this way, the proposed options will not be designed in isolation, but rather, will be integrated within the wider development as part of access networks and the provision of open space and recreation areas.
- 4.13 In determining appropriate stormwater management measures for the proposed development, I have taken into account the following council standards and engineering practice:
- Stormwater drainage systems must consist of both a primary system for more frequent rain events and a system of secondary flowpaths for higher intensity rain events.

- The primary system shall be designed for the following events:
 - 4% AEP rainfall event for commercial and residential areas.
 - 1% AEP rainfall event for all situations where secondary overland flowpaths are not available.
- Secondary flowpaths shall be designed to cater for the full 1% AEP rainfall event less any appropriate contribution from the primary system.
- The proposed stormwater system shall provide no increase of runoff into the receiving body, where this is not possible, result in minimal increase which will have no more than minor adverse effects.

4.14 For the overall site, the treatment of runoff can be achieved using designed grassed/ planted swale drains and infiltration trenches. These will generally be installed along all roadways to cater for road runoff. For each individual house site, stormwater discharge will be to ground soakage but a number of options for pre-treatment are proposed to safeguard against clogging and silting-up of the soakage pits. These include the use of Settling Chambers; Filter Trenches; and Raingardens.

4.15 For areas of high density or multi-unit development, it is expected that larger shared treatment devices may be used (subject to specific engineering design at resource consent and then engineering approval stages). These could include larger Raingardens or proprietary "off the shelf treatment devices". Where the development involves a Unit-title development structure, then the treatment devices would be on private land/ common property and be maintained by a Body Corporate or similar management entity. Where the multi-unit development entails individual fee simple titles on smaller parcels of land, then shared treatment and soakage disposal areas may be incorporated on public land, owned and operated by Council (this would be subject to further detailed design and negotiation with Council).

4.16 Flood attenuation for the overall site can be achieved through the use of wetlands/ ponds, underground storage devices and increased designed/ engineered onsite ponding and flood flow attenuation areas. The proposed storage must cater for the storage required for flow attenuation for the increased runoff resulting from development of the site for all storms up to the 1% AEP event.

4.17 I summarise below the main solutions and concepts which are proposed for stormwater management on the site, as also outlined within Harrison Grierson's Stormwater Management Plan (SMP) report.

- General Site Drainage solutions.
- Water Quality Management solutions.
- Water Quantity Management solutions.
- Implementation Concepts.
- Maintenance Concepts.

4.18 The general site drainage solutions include:

- Collecting and diverting existing upstream flows (currently conveyed through open drainage channels and drainage pipelines) into existing and proposed soakage basins/ wetlands/ ponds
- Installation of roadside swale drains, infiltration trenches and soakage pits

- Installation of on-site soakage pits and associated private drainage for individual allotments.
- Enhancement of existing soakage area in Grants Bush. This basin would likely be increased in size to provide greater flood flow storage volume. From an engineering perspective this proposal is feasible and Harrison Grierson's landscape architect and the project ecologists (Morphum Ltd) have also confirmed that this proposal is feasible and suitable from their perspectives. We understand that this proposal and the design of any stormwater disposal measures and management areas within Grants bush will require consultation with DOC, which would occur as part of detailed design processes. The conditions governing the use of the Grants Bush covenant area allow stormwater management measures as we propose. In the event that DOC do not agree with the management measures proposed, then an alternate area would be required to provide for a soakage or attenuation basin catering for flood flow storage. This alternate area can be provided for elsewhere on the site, but would likely mean the loss of some house development area.
- Construction of new flood attenuation basins in the Grant's Bush public open space / covenant area and in Area B of the Structure Plan. As above, any new stormwater management measures within Grant's Bush would be designed in consultation with DOC.

4.19 The new attenuation basins may be designed as either a dry pond/ soakage area or an engineered wetland, or a combination of the two. The location of the new flood attenuation basin in Area B will be determined as part of the future Structure Plan for this area, and in consultation with the Department of Conservation and Council.

Water Quality Management Solutions

- 4.20 The proposed water quality management solutions involve the use of a series of treatment systems, including onsite low impact devices and larger devices in order to form a treatment train, which will improve the treatment efficiency for the site as a whole.
- 4.21 The at source devices could include devices such as swales, rain-gardens, filter strips and infiltration trenches, which will also incorporate a soakage component in order to improve treatment efficiency and mitigate increased stormwater volumes, while at the same time, serving to recharge the groundwater network.
- 4.22 The larger treatment devices considered appropriate include a potential wetland together with grassed and vegetated roadside swale drains. This possible solution would provide a high treatment efficiency level together without compromising existing ecological and amenity values. Over the life of the wetland, the maintenance costs are low and the maintenance works can be carried out without major constraints. The proposed roadside swale drains and infiltration trenches sized to provide flood storage and attenuation will be grassed and landscaped and thus provide additional treatment for the run-off.
- 4.23 Additionally, the implementation of pre-treatment devices on the piped systems servicing sub-catchments with high risk of floating pollutants is considered appropriate and will be assessed and confirmed during the detailed design phase of each future development stage. The maintenance of a pre-treatment device is relatively inexpensive and quick. The main advantage of their use is the reduced cleaning frequency of the downstream wetland/s, swales, infiltration trenches and soakage disposal areas.

Flood Attenuation and Water Quantity Management

- 4.24 There will be an increase in stormwater run-off volume generated by the proposed development, due to increased site imperviousness. Determination of increased run-off volumes at the time of Detailed Design, also needs to take into consideration, the effects of climate change.
- 4.25 To provide flood storage and attenuation for flows discharged from future development sites the intention is to ensure that individual future allotment sites and public roadways cater for and attenuate stormwater flows for the 4% AEP storm events in accordance with Council's Code of Practice. Devices for individual development sites could include: rain gardens, swales, filter strips, infiltration trenches and soakage systems. Devices for roadways include: swale drains, infiltration trenches and soakage pits with storage capability. At the detailed design phase for each development stage, specific site testing shall be undertaken to confirm the soakage potential of the ground and demonstrate how the onsite devices can be used to provide flow attenuation.
- 4.26 Stormwater runoff for events greater than this (i.e. up to the 1% AEP storm event) will be catered for and attenuated through the use of larger soakage/ storage attenuation basins, possible wetland(s) and possible open drains with flood storage capacity. The size of these proposed larger on-site attenuation areas will also be finalised at Detailed Design Stage to reflect the actual storage requirements and to ensure that post development runoff does not exceed pre-development levels (i.e. achieving hydraulic neutrality).
- 4.27 I do not consider that it is appropriate to comprehensively design stormwater management in its entirety at this juncture. This is because the design will be dependent upon the nature and extent of future staged development. The Detailed Design process will consider, from the existing storage volume perspective, the amount of storage volume existing onsite and the volume that will be lost due to the proposed development. A solution which offsets any lost storage will take into account temporary and/or permanent at source solutions as well as overall permanent solutions.
- 4.28 The maintenance of the treatment, storage and disposal devices will fall with the landowner (i.e. individual allotment owners) except where these are located in public roadways or reserves and are proposed to cater for the road runoff or shared combined stormwater discharges from multi-unit developments. In these cases the maintenance and ownership of the devices would sit with Council. Specific operation and maintenance manuals incorporating stormwater and landscape requirements will be prepared and provided at the detailed design stages.
- 4.29 Based on the proposed approach, and subject to the specific recommendations I make below in relation to submissions and the s42A Report, I am confident that the proposed SMP will adequately address stormwater issues associated with development in accordance with the Plan Change. In particular I am confident that overland flow beyond the site boundary will be no greater than current levels and that the stormwater discharges will be adequately treated.
- 4.30 Based on our site soakage testing and EnGeo's groundwater monitoring results I am confident that soakage capability beneath the site will be suitable to achieve this.

5.0 RESPONSE TO SUBMISSIONS

- 5.1 I have considered the matters raised by submitters under the following headings:
- More detailed hydrological assessments

- Use of sustainable water solutions
- Use of Grants Bush and the Floodplain Remnant covenant
- Use of the existing drainage system (perhaps more a Morphum question – at least partly)
- Flood Protection
- No off-site effects from stormwater run-off

MORE DETAILED HYDROLOGICAL ASSESSMENTS

5.2 Four submitters have raised matters relating to the detail of the assessment of hydrological matters completed in support of the Plan Change.

5.3 The Upper Hutt Town and Country Association (5) notes that

There is some constraint on removing stormwater from the site. We are in favour of solutions which use local soakage and storage buffering. We are concerned that the inevitable overflows have not been seriously addressed so we consider that the stormwater proposal as written is unsatisfactory.

5.4 I agree with the submitter's statement that local soakage and storage buffering should be favoured and I confirm that this is the design approach which has been detailed for the development proposal within our SMP report and as described above. Stormwater Management for the site will be designed to ensure that hydraulic neutrality is achieved, so that there is no increase in site runoff for all storms up to the 1% AEP event from pre-development runoff to post-development.

5.5 Mary Beth Taylor (16) and Tony Chad (17) both state that the development will put a substantial additional load on storm water systems (amongst other infrastructure) and request that Council require a:

...thorough hydrology reports to determine how best to deal with flood plain remnants and existing drains.

5.6 Harrison Grierson stormwater engineers have undertaken significant on-site soakage testing to determine the soakage capability of the ground underlying the site. We have reviewed groundwater levels and monitoring results provided by EnGeo, to satisfy ourselves that groundwater levels across the site will not compromise soakage capability for the site. We have undertaken calculations to determine, based on the achieved soakage rates, what storage volumes are required, to provide the necessary attenuation and floodplain storage. I have been personally involved in either undertaking or reviewing the abovementioned calculations and assessments. We have worked with other experts engaged on the project included planners and an urban designer to ensure that there will be sufficient land area available set aside to provide these necessary storage volumes.

5.7 Stephen Pattinson (19) notes the intention for disposal of stormwater through attenuation ponds, but states that no indication is given of how much attenuation is required to achieve neutrality. Mr Pattinson requests that Council obtain information from the developer to ensure the current baseline flood levels are known and to satisfy itself that the developer's methodology for achieving stormwater neutrality is sound and will not worsen the current situation.

- 5.8 Section 3.2 of our SMP identifies the land area requirements which could be required for a potential storage basin for the Plan Change Area and our calculations in Appendix C outline the storage volume requirements for the entire Wallaceville site to achieve hydraulic neutrality. I suggest this document will answer Mr Pattinson's queries. I also confirm that it is appropriate that at the subdivision and development design stage more detailed flood attenuation modelling and storage sizing be undertaken.

The project ecologist, Mr Mark Lowe states within his evidence (Section 4.8) that there is potential to co-locate well designed stormwater management elements within the open areas of the covenants.... and that "This notion is supported in the special conditions for the covenants."

Concerns related to additional load on the existing drainage system is addressed in the section below titled 'Use of Existing Drainage System'.

USE OF SUSTAINABLE WATER SOLUTIONS

- 5.9 Three submitters make comment in relation to the use of sustainable water solutions.
- 5.10 GWRC (14) notes that the proposed stormwater neutrality approach and the use of stormwater attenuation devices is consistent with the relevant provision of the Regional Policy Statement. It supports the use of a Stormwater Management Plan and the recommendation to use a suitable low impact design stormwater management approach, including the use of roadside swales, rain gardens and rain tanks as well as constructed treatment trains to improve treatment efficiency.
- 5.11 Mary Beth Taylor (16) and Tony Chad (17) both seek that a 'grey water system' is implemented throughout the development to reduce the load on the stormwater system.
- 5.12 With respect to the submissions of Mary Taylor and Tony Chad, our assessments and calculations confirm that discharge of stormwater to ground via soakage can be suitably achieved on the site in combination with on-site storage. Water re-use for irrigation and landscape watering will be encouraged to future landowners within the Stormwater Management Plan, which will be provided to all future landowners. However implementation of a greywater system or measures is not considered to be necessary specifically for the purpose of reducing load to the stormwater system. It should be remembered that this development will not discharge stormwater to existing downstream or public stormwater drainage networks. All stormwater disposal is to be on-site. Further, any greywater generated will need to be discharged to council's wastewater sewer network, potentially adding load to that infrastructure.
- 5.13 However, any future landowner within this proposed development would be free to install water re-use and greywater systems when developing their individual house sites and private plumbing and drainage system. Discussions held with Council's development engineers Mr Lachlan Wallach and Mr Jeff Haste indicate council's strong desire for rainwater re-use and potentially greywater use also. Therefore all future house owners will be encouraged, within the Stormwater Management Plan guideline document, to implement these measures as much as possible, however we reiterate it is at the landowner's discretion.

USE OF THE EXISTING DRAINAGE SYSTEM

- 5.14 GWRC (14) states that:

Esplanade reserve and stream/drain setbacks for development should be sufficient to allow for watercourse migration, maintenance access (machine) and recreational use into the future. The

effects of flash flooding and debris flows (if applicable) may also need to be investigated. Sufficient width should be provided along watercourses to allow for sustainable management into the future, with the potential for structural works required to protect assets or private land being avoided through setbacks and riparian management.

- 5.15 The existing drains will not be retained and therefore this concern is not relevant. All grassed swales and stormwater devices such as raingardens, wetlands and storage basins will be designed in accordance with good engineering practice and with reference to ARC Technical Publication No 10.
- 5.16 Forest and Bird Upper Hutt (20) request that the drainage system be turned into a stream.
- 5.17 The evidence of Mr Mark Lowe of Morphem Ltd deals with the ecological aspects of the proposal and the site, and identifies that the existing drainage channels and network on the site is either highly modified/ degraded or consists of engineered farm drains with minimal ecological value. From a stormwater management perspective it is my view that for this site it is preferable to construct new drainage channels and a network consisting of a well designed and laid out treatment and disposal train. These measures will be based around Low Impact Design (LID) principles.

USE OF THE CONSERVATION COVENANTS

- 5.18 The Upper Hutt Town and Country Association (5) states that it
- ... do[es] not agree with the suggestion that Grant's Bush or the Floodplain Forest Remnant should be the location for flood attenuation basins. This land is covenanted for conservation reasons and is not there for other purposes.*
- 5.19 I note that there is an existing large soakage pit in Grants Bush which is proposed to be enhanced and made safe for public access. Further upgrade of this facility can only be undertaken in agreement with DoC, and Council as future land owner. The proposed new facilities are provided for under the covenant documents. These facilities will need to be designed so that they do not affect the existing indigenous vegetation, and will require sign-off by the Department of Conservation. I have consulted with Mr Mark Lowe of Morphem Ltd who has confirmed their view that such facilities can be designed to achieve both the ecological and stormwater attenuation outcomes.

FLOOD PROTECTION / ATTENUATION

- 5.20 GWRC (14) notes that the stormwater neutrality design should allow for appropriate climate change and that although this issue is addressed in the SMP it isn't reflected in the principles.
- 5.21 I agree with the GWRC and recommend that the 'Flood Attenuation' section of the principles be amended as follows:

Flood attenuation for the overall site will be achieved through the use of wetlands/ ponds, underground storage devices and increased onsite ponding/flooding. The proposed storage must cater for the storage required for flow attenuation for the increased runoff resulting from development of the site for all storms up to the 1% AEP event and must take into account the effects of climate change.

- 5.22 GWRC (14) also recommends that all flooding (i.e. the Probably Maximum Flood being the 0.0001% AEP event) should be avoided.
- 5.23 This is a requirement I have never encountered and see no engineering reason to design for or allow for an event of such low probability. UHCC's standards do not have any requirements in support of this. The requirement is impractical and infeasible for this type of development. Following discussion with council's development engineers, it has been confirmed that they are of the same opinion.

NO OFF-SITE EFFECTS FROM STORMWATER RUN-OFF

- 5.24 Two submitters have raised concerns about the effects of stormwater from the development on their properties.
- 5.25 The Ministry of Primary Industries (13) is concerned to ensure that discharge of stormwater to ground does not affect their site.
- 5.26 As shown on our Overland Flowpath Plans contained within the SMP, the majority of the site and catchment area drains away from MPI's site. There is no intention to divert flows towards the MPI site. The proposal to discharge stormwater to ground as close to the point source as possible will ensure that groundwater levels are relatively consistent across the entire site and not concentrated in any part.
- 5.27 Welholm Developments Limited (18) notes reference in the plan change to existing overland flowpaths across the site generally falling towards the Trentham Racecourse and retirement village, and wishes to ensure that the village is not subjected to any increase in such flows as a result of development on the plan change site.
- 5.28 I consider that the stormwater management proposals and intent as detailed within the SMP and in the Stormwater Management Principles to ensure no increases in discharge occur following development, will alleviate Welholm Developments Limited's concerns.

6.0 THE SECTION 42A REPORT

In the following sections of my evidence I have evaluated and responded to the submission points that are relevant to my area of expertise from the Council Hearing Report.

- 6.1 *Recommendation: Council and Wallaceville Developments Limited (WDL) continue to discuss the proposed approach to stormwater management with a view to reaching resolution prior to the hearing.*
- 6.2 My colleague, Andrew Jackson, the infrastructure and civil engineer for the development, and I met with council's Development Engineers, Mr Lachlan Wallach and Mr Jeff Haste on 24th June 2015 to discuss the findings of the peer review report, carried out by PDP on behalf of council. I believe at that meeting we reached agreement on the outstanding matters raised within PDP's report. The majority of this agreement was based around our confirmation to council that the further testing and analysis of soakage capability and groundwater effects from stormwater disposal at the site, would be carried out as recommended by PDP. These assessments would be carried out at future Detailed Design stages.

- 6.3 Council Development Engineers agreed that it is appropriate for this information to be supplied at Detailed Design stage once more detailed information is available on the final development form. They agreed that this information is not required to be provided prior to the hearing, and the current level of information is sufficient to confirm the feasibility of the proposal to discharge stormwater to groundwater via soakage systems.
- 6.4 At the meeting, we all accepted that PDP's report concludes that disposal of stormwater to groundwater is feasible for this site.
- 6.5 *Recommendation: Depending on the agreement reached through further discussions, changes may be recommended to the **Wallaceville Stormwater Management Principles** and proposed new section 2.6.9D.*
- 6.6 We confirm that a number of changes will be made to the **Stormwater Management Principles** and these are summarised below:
- A section entitled *Specific Information to Accompany Applications for Subdivision or Development* has been added. This addresses the additional information on soakage testing/ groundwater monitoring results/ groundwater mounding assessments/ contaminant transport assessments and final flood flow attenuation assessments, which must be provided at future detailed design stage and prior to any development proposals receiving consent approvals.
 - The Flood attenuation section is updated to reflect that on-site attenuation will cater for all storms up to and including the 1%AEP event. Sizing for attenuation requirements will be based on the assumption that all primary disposal measures have failed completely. This section is also updated to include a requirement to allow for climate change within design sizing.

7.0 PDP PEER REVIEW REPORT OF THE SOAKAGE SYSTEM

- 7.1 On 23rd June 2015 a report was received from council, prepared by their sub consultants Pattle Delamore Partners Limited (PDP), which provided a peer review of the Stormwater Soakage System.
- 7.2 On 24th June 2015, my colleague, Andrew Jackson and I met with Mr Lachlan Wallach and Mr Jeff Haste of council to discuss the findings of the report and to endeavour to resolve with council any outstanding concerns.
- 7.3 On 25th June 2015 I undertook telephone discussions with one author of the PDP peer review report. I explained that Mr Lachlan Wallach of Council had instructed us to undertake discussion with PDP, following our meeting, explain what was discussed, and to endeavour to reach agreement with PDP. Subsequent to the telephone discussion with PDP we have been informed to direct all queries and responses to the peer review report directly to Ms Felicity Boyd at Council and I have done this on 30th June 2015.

I summarise below the main queries or concerns raised by PDP within the Peer Review Report and also provide my response.

- 7.4 *Further testing and analysis is required covering soakage rates and capability for the entire site; further testing and monitoring is required on groundwater levels; further analysis is required on the effects of soakage disposal on groundwater levels and groundwater mounding; further analysis is required on the potential for transport of contaminants via stormwater, into the groundwater below and downstream of the site; further analysis is required of the direction of groundwater flow away from the site.*

- 7.5 I confirm that we consider all of the above testing and analysis requirements as recommended by PDP are necessary at the resource consent application stage and will be carried out prior to any development occurring on site. I have discussed this with Mr Wallach and Mr Haste of council and we are in agreement that it is appropriate for this information to be provided at detailed design stage, when the final layout and development proposals are available.
- 7.6 *Concentrating flows in a few large basins creates a greater risk of groundwater mounding impacts and distributing discharge to a larger number of basins is recommended.*
- 7.7 I believe that PDP have not fully understood that the large basins are to be provided only for secondary overland flows (i.e. for storm events above the 1 in 25yr event). All primary flows from storms up to the 1 in 25yr event will be discharged at as close to the source as possible and via a variety of disposal methods, including on-site soakpits on each house site, raingardens/ grassed swales/ soakpits and infiltration trenches along roadways as well as numerous smaller soakpits scattered around the development site. The final design of this sitewide system will be undertaken at detailed design stage as final development plans become available.
- 7.8 *The current proposed design for roadside swale drains, infiltration trenches and soakpits is considered overcomplicated and also has the potential for partially treated stormwater to reach the ground through soakholes.*
- 7.9 I do not believe the system configuration is overcomplicated and have implemented the same designs on subdivisions of similar scale and topography successfully. I have discussed the reasoning for our design with Mr Wallach and Mr Haste from council, who understand the rationale. I do however confirm that at detailed design stage, there is no problem with developing a simplified design as recommended by PDP, if council are not in agreement with our design proposal as the best option for this site. Generally our design proposal for the roadside soakage systems including grassed swale, infiltration trench, catchpit and soakpit all operating in conjunction with each other, exceeds the treatment and disposal capabilities of the standards outlined in council's Code of Practice.
- 7.10 I do not believe the "main contaminant of concern" as identified by PDP, being" bacteria due to high concentrations possible in residential areas from dogs and birds" will be a significant concern and risk to underlying groundwater. However I do confirm that further assessment will be undertaken at detailed design stage, on the potential for transport of these contaminants into groundwater below the site and downstream of the site. I confirm that there are a number of stormwater quality treatment measures which could be incorporated into the stormwater management for the site to remove bacterial contaminants if it was found that these were an issue.
- 7.11 *In PDP's peer review report, they note 3 points of concern with respect to the Proposed Stormwater Management System for the development. These are 1. It is not clear whether the on-site systems are for roofwater or roofwater plus hardstand. 2. The conceptual design for the roadside swales and soakage system is overly complex. 3. The soakage basins appear to be open to underlying gravels.*
- 7.12 With respect to the first query, I confirm that our design allowances will provide for not only runoff from roofwater, but also from the hardstand areas as well as the landscape areas on each house site. As required by council.
- 7.13 With respect to the second query, I have explained the perceived complexity under section 7.9 above.

- 7.14 With respect to the third query, the soakage basins are open to underlying gravels to provide for good soakage. The basins will not hold standing water and therefore will not be prone to waterfowl, which appears to be a point of concern to PDP with respect to bacterial contaminants from birds and ducks.
- 7.15 *The proposal to size on-site soakage areas for the 10% AEP events does not comply with council requirements to design for the 4% AEP event.*
- 7.16 I confirm that our design (as currently proposed) is based on designing and sizing all on-site soakage areas for the 4% AEP event, in compliance with council's requirements.
- 7.17 *Further discussion is required on the effects of overland flowpaths from the site in the event of failure of the on-site soakage systems.*
- 7.18 Our plans, attached within Appendix B of the SMP report, show where existing overland flowpaths travel (pre-development) and where the future overland flowpaths will travel (post development). It is clear that we do not propose to change the direction of the overland flowpaths as they leave the site. They will continue to be directed where they currently discharge. Our SMP confirms that we will attenuate all flows on-site for **up to** the 1% AEP event (1 in 100yr) so that overland flow discharging in a 1% AEP event is the same as currently occurs predevelopment.
- 7.19 Following discussion with Mr Wallach and Mr Haste we agreed that we will upsize the proposed storage basin sizing so that it is based on the assumption that all other soakage systems on-site have failed (i.e. we will not deduct the 4% AEP event flows from the 1% AEP event flows in determining secondary overland flows). This future design requirement will be reflected in the Stormwater Management Principles.
- 7.20 I confirm that our current design proposals are based around the assumption that we are required to attenuate all flows for up to and including the 1% AEP event (1 in 100yr) to ensure that all flows leaving the site will be the same post-development as they are pre-development. This is the concept of hydraulic neutrality. It should be noted that no attenuation is proposed to be provided for storm events which exceed the 1% AEP event as this has not been a council requirement in the past.
- 7.21 *The PDP peer review report states they are unfamiliar with the use of open soakage basins and propose an alternative design incorporating infiltration trenches.*
- 7.22 I believe PDP have missed the point, that the soakage basins are intended for secondary overland flow control only. I am therefore not concerned about bird related contaminants reaching the basin. Furthermore the basins are intended to remain dry and not be standing waterbodies attracting birdlife. They are for flood flow control.
- 7.23 *The PDP peer review report raises a number of queries and recommends further testing and analysis. The report suggest some design changes. However the report concludes that disposal of stormwater to ground soakage is feasible for this site.*
- 7.24 I generally agree with PDP's recommendations with respect to the further testing and analysis being required, but that it should occur at resource consent application stage, once detailed designs have been worked through. Where PDP recommend design changes to the stormwater management system proposed for the site, I confirm my belief that our designs are suitable and have proven track record on similar sites, however our designs can be easily amended to suit the recommendations of PDP if that is what council require at detailed design stage.

7.25 I agree with PDP's final conclusion, that the level of investigation and assessment work we have undertaken to date, confirms that disposal of stormwater to ground soakage is feasible for this site.

8.0 CONCLUSION AND RECOMMENDATIONS

8.1 The approach to stormwater management for the Wallaceville Development Plan Change site will ensure that groundwater levels are recharged; that stormwater runoff from the site can be suitably controlled and discharged to ground soakage; that stormwater runoff will be treated to a high quality prior to discharge to ground; and that stormwater flooding effects will be controlled through on-site flood flow storage and attenuation measures.

8.2 I consider that the stormwater management approach set out in the SMP will meet the intent to formalise and set a framework for the ongoing management of stormwater across the entire Wallaceville site as development occurs in stages. The SMP demonstrates how hydraulic neutrality for the site will be achieved, and also identifies the forms of low impact stormwater technology to be utilised for the site's development

8.3 I consider that the SMP is appropriately integrated into the Plan Change through the Stormwater Management Principles.


8.4 I consider that the Peer Review report prepared by PDP for Council has concluded that discharge and disposal of stormwater to ground soakage is feasible for this site. I consider that all of the additional testing/ analysis/ and assessments recommended by PDP within the peer review report can and should be provided but that it is appropriate for these to be provided at Detailed Design/ resource consent application stage.

8.5 I consider that the 3 points of concern, raised by PDP within their peer review report, with respect to the proposed stormwater management system, have all been adequately responded to within section 7.0 of my evidence, above.

8.6 Based on the above, I do not consider that there are any stormwater management constraints which should prohibit the granting of consent for the proposal.

8.7 My specific recommendations are:

- a) Adopt the revised Stormwater Management Principles
- b) Make changes to the Stormwater Management Principles as described under section 6.6 above.

DATE	3 July 2015
NAME	Alan Blyde
POSITION	Technical Director. CPEng. MIPENZ.
SIGNED	

WALLACEVILLE STORMWATER MANAGEMENT PRINCIPLES

GENERAL SITE DRAINAGE

The general site drainage solutions include:

- Collecting and diverting existing upstream flows across the site and into existing and proposed soakage basins/ wetlands/ ponds; installation of roadside swale drains, infiltration trenches and soakage pits;
- Installation of on-site soakage pits and associated private drainage;
- Protection and enhancement of existing soakage area in Grants Bush; and
- Construction of new flood attenuation basins (which, at resource consent and engineering design phase, may be designed as either a dry pond/ soakage area or an engineered wetland, or a combination of the two)
- The preferred location for the new flood attenuation basins is in the Grant's Bush and the Floodplain Forest Remnant Covenant Area, subject to agreement under the conditions of these covenants.

All primary drainage conveyance systems and individual site disposal areas will be sized for the 4% AEP storm event. All secondary overland flow paths and flood flow storage areas will be sized for the 1% AEP storm event, [including an allowance for climate change effects](#).

STORMWATER DISPOSAL

Overall site stormwater disposal intentions:

For the treatment of overall site runoff, the use of a series of treatment systems is proposed, including onsite low impact devices and larger devices in order to form a treatment train, which will improve the treatment efficiency for the site as a whole. Design of stormwater treatment devices will be in accordance with Greater Wellington Regional Council requirements and will take consideration of ARC TP:10.

At source devices will include swales, rain-gardens and rain tanks, which will also incorporate a soakage component in order to improve treatment efficiency and mitigate increased stormwater volumes, while at the same time, serving to recharge the groundwater network. Grassed/ planted swale drains and infiltration trenches will generally be installed along all roadways to cater for road runoff.

Individual house site stormwater disposal intentions (Wallaceville Living Precinct only):

Stormwater disposal via ground soakage but with the incorporation of a number of options for pre-treatment to safeguard against clogging and silting-up of the soakage pits being:

- Settling Chambers;
- Filter Trenches; and
- Raingardens.

High-density or multi-unit development stormwater disposal intentions:

Stormwater disposal via larger shared treatment devices (subject to specific engineering design) including larger Raingardens or proprietary "off the shelf treatment devices".

Where the multi-unit development entails individual fee simple titles on smaller parcels of land, then shared treatment and soakage disposal areas will be incorporated on public land, owned and operated by Council (this would be subject to further detailed design and negotiation with Council).

Where the development involves a unit-title development structure, the treatment devices will be on private land / common property and be maintained by a Body Corporate or similar management entity.

FLOOD ATTENUATION

Flood attenuation for the overall site will be achieved through the use of wetlands/ ponds, underground storage devices and increased onsite ponding/flooding. The proposed storage must cater for the storage required for flow attenuation for the increased runoff resulting from development of the site for all storms up to the 1% AEP event [including allowance for climate change effects](#).

STORMWATER SPECIFIC INFORMATION TO BE PROVIDED WITH APPLICATIONS FOR SUBDIVISION AND DEVELOPMENT

- All secondary overland flow paths and flood storage areas shall be designed to accommodate the 1% AEP storm event and the design shall show how overland flowpaths will dissipate flow downstream.
- The design of the system shall demonstrate that the proposed soakage disposal is suitable through permeability tests, that it is a viable long term solution, that silt entry will be minimised.
- The design of the system shall identify any assumptions regarding the maximum area of impermeable surfaces, and whether it is appropriate to restrict the maximum percentage of such impermeable areas in future land use.
- The design shall ensure that the proposed stormwater system shall not result in ponding of stormwater on the ground for more than 48 hours following a 1% AEP storm event, unless the ponding is part of the stormwater treatment systems.
- The design shall identify whether the adoption of a minimum freeboard for habitable buildings is necessary, and if so, the amount of such freeboard.
- The design shall ensure that secondary overflow paths are identified and protected
- Any primary drainage conveyance systems which do not have secondary overland flowpaths shall be designed to accommodate the 1% AEP event
- All primary and secondary drainage conveyance systems shall be designed and constructed to ensure ease of maintenance.
- The design and construction of soakage systems shall give due allowance to long-term pore clogging of the receiving environment, including the adoption of mechanisms to require owners to maintain soakpits if they do become blocked.

In addition, the following further information/ testing/ analysis and calculations must be provided to council for their approval:

- Detailed soakage/ percolation testing across the specific area of the site, being developed, using the council approved testing methodology (to be agreed with council prior to testing occurring).
- Assessments of the effects from stormwater disposal on-site to ground soakage, on groundwater mounding (this may include 'slug' testing).
- Assessment of long-term effects on soakage capability for the site, as it may be affected by seasonal groundwater level changes.
- Assessment of the potential for transport of contaminants within the stormwater discharges from the site, into the groundwater system below and downstream of the site.