

<b>IN THE MATTER</b>	OF APPLICATIONS PURSUANT TO THE RESOURCE MANAGEMENT ACT 1991  AMBERFIELD APPLICATION FOR SUBDIVISION AND LAND USE CONSENTS FOR DEVELOPMENT
<b>APPLICANT</b>	WESTON LEA LIMITED
<b>APPLICATION NUMBER</b>	010.2018.00009853.001 011.2018.00006695.001

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**STATEMENT OF EVIDENCE OF CALEB CLARKE  
STORMWATER AND FLOOD HAZARD RISK  
MORPHUM ENVIRONMENTAL LTD  
29 March 2019**

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## **INTRODUCTION**

### **QUALIFICATIONS AND EXPERIENCE**

- 1 My full name is Caleb Clarke. and I hold the position of Director and Senior Engineer at Morphem Environmental Limited (MEL). I have been in this position since 2001.
- 2 I hold a BE in Environmental Engineering from Unitec Institute of Technology. I have nineteen years' experience in environmental engineering consultancy, specialising in stormwater design, catchment planning and water sensitive urban design.
- 3 I have been involved in the review of several integrated sub-catchment management plans and subdivision consent applications on behalf of Hamilton City Council (HCC) over the last 2 years. Some example projects are given below to illustrate this expertise:
  - a Rotokauri ICMP Water Quality Treatment Concept Development Report
  - b Rotokauri Developments Limited Stage 3-5 Resource Consent and Engineering Plan Approval
  - c Rotokauri North – Sub-catchment ICMP Review
  - d Rotokauri ICMP Lake Waiwhakareke Sub-catchment Options Assessment.

### **INVOLVEMENT IN THE PROJECT**

- 4 I have undertaken a review of the stormwater management aspects of the proposed Weston Lea Amberfield Development – including an assessment of the sub catchment integrated catchment management plan (Sub-ICMP) against asset management, water sensitive urban design and flood hazard management principles.
- 5 At the section 88 RMA assessment Morphem Environmental communicated that the ICMP was lacking a clear Best Practicable Options (BPO) Assessment and this was provided with the following further documentation included in the review:
  - a Stormwater BPO Options Assessment addendum received on 15th June.
- 6 Morphem Environmental contributed to the HCC further information request for additional information on stormwater management and flood hazard effects and Sub-ICMP requirements and have reviewed the following additional documents in response to this request:
  - a Weston Lea Limited, Amberfield Application for Subdivision and Land Use Consents for Development, Resource Consents No: 010.2018.00009853.001 & 011.2018.00006695.001 and response to Hamilton City Council Section 92 Request for Further Information 17 August 2018;
  - b Amberfield Development – Further Information Clarification HG REF: 9820-141842-01, 15 October 18;

- c Amberfield Development – Further Information Clarification HG REF: 9820-141842-01, Updated Plans – Alternative Road Grading, SK260, SK265, SK266, SK267, SK268, SK269, SK270, SK271, all REV 2, 12 October 18;
- d Amberfield Development – Further Information Clarification HG REF: 9820-141842-01, Updated Plans – Stormwater Headwall & Raingardens, SK291, SK292, SK293, SK294, SK295, SK296, SK314, SK315, SK351, SK352, SK354, SK355, SK356, SK357, SK358, all REV 2, 12 October 18;
- e Amberfield Water Balance Technical Memo HG 7 December 2018, and;
- f Amberfield North-East Area Alterations – Civil Engineering Infrastructure Addendum HG 28 February 2019.

#### **CODE OF CONDUCT**

- 7 I confirm that I have read the Code of Conduct for expert witnesses contained in the 2014 Environment Court Practice Note and that I agree to comply with it. I confirm that I have considered all the material facts that I am aware of that might alter or detract from the opinions I express. In particular, unless I state otherwise, this evidence is within my sphere of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

#### **SCOPE OF EVIDENCE**

- 8 The purpose of this statement of evidence is to address matters raised in the applications relating to stormwater and water sensitive urban design principles and consideration of submissions in this regard.
- 9 My evidence covers:
- a Review and assessment of applicant’s Sub-ICMP and stormwater management plan against the relevant statutory provisions;
  - b Response to submissions;
  - c Recommended conditions, and;
  - d Conclusion.

#### **ASSESSMENT METHODOLOGY**

- 10 The following methodologies were utilised to assess the proposed stormwater management documentation and design:

- a Site Visits including Applicants' representatives were conducted by Morphum Staff on 5th June 2018 and 17th September 2018;
- b Meetings with the Applicants agents were undertaken on 24th July 2018 and 6th September 2018.
- c Submissions to the Notified Resource Consent Application were reviewed;
- d Comparison to HCC Operative District Plant (ODP) ICMP Guidelines, and;
- e Comparison to HCC Infrastructure Technical Standards (ITS) and subsequently adopted Waikato LASS Regional Infrastructure Technical Standards (RITS).

Along with review of the application documentation, this has provided me with a full understanding of the development proposals and the stormwater management issues for the site.

#### **SUB-CATCHMENT ICMP ASSESSMENT**

- 11 The Sub-catchment ICMP for the Amberfield Site was lodged in advance of the Subdivision Application and subject to several iterations with the delivery overlapping the Subdivision Stormwater Assessment. A key omission was a formal options assessment which was added to the notified version.
- 12 The Sub-catchment ICMP contains a robust description of ICMP objectives, a description of the Environment and Assessment of Potential Environmental effects. Some areas of less detailed information have been addressed in the responses to requests for information such as the greater detail around outlets and the assessment of post development flow regimes as described in the later sections of this statement of evidence.
- 13 Dean Miller of Tonkin and Taylor has reviewed the Freshwater Ecology aspects of the Sub-catchment ICMP on behalf of HCC and is satisfied the stormwater effects on fresh water ecology are adequately addressed. The application has resulted in the reclamation of intermittent streams and has not clearly shown a minimum earthworks strategy alternative that could have been adopted to avoid this effect of the development. However the applicant has suggested that the proposal represents an optimal balance of layout and yield versus stream retention.
- 14 The Sub-catchment ICMP recommended a Best Practicable Option (BPO) Option 5 comprising of stormwater collection, treatment and disposal at source, disposal to subsurface soakage systems in road reserve, with an occasional additional larger system near river terrace where feasible (if desired). This approach meets the ICMP Objectives and is supported by HCC as the future asset owner.

- 15 Further details provided in the Sub-catchment ICMP include flooding, soakage and water quality concept calculations. Some of these apply to the notified proposal however some have been further progressed and depart from the quantities contained in the Sub-catchment ICMP. An example is the soakage and bioretention within roads which was detailed as swales in the Sub-catchment ICMP has been revised in the s92 response to raingardens in the Harrison Grierson Civil Infrastructure Report 17<sup>th</sup> August 2018.

#### **KEY ISSUES AND ADOPTED MANAGEMENT STRATEGIES**

- 16 The environmental conditions and technical challenges of the Amberfield site provide some key constraints for development or risks requiring measures to address. Methods to manage these issues include avoidance, remedy or mitigation. The key challenges and the mechanisms adopted within the stormwater management for the site are as follows:

#### **PUBLIC TREATMENT AND INFILTRATION PRACTICES**

- 17 The Amberfield site has significant infiltration potential. The applicant has demonstrated that the proposed earthworks will preserve the infiltration capacity at depth and allow this to be utilised as the primary stormwater disposal following pre-treatment in raingardens. This is in accordance with the hierarchy of stormwater management outlined in the RITS which places priority on the strategy of adopting soakage as the primary treatment and disposal method.
- 18 The original proposal was for 10 year ARI capacity soakage on both private and public areas. However council preferred a 2 year ARI capacity for public soakage for the following reasons:
- a The 10 year soakage footprints exceeded the footprint of raingardens requiring complex underground chambers within public areas;
  - b The benefit of this extra infrastructure capacity was low for stormwater flow retention and detention for stream protection which typically targets less than 2 year peak flows, and;
  - c The application proposes a secondary pipe system with 2 year peak flow capacity in the roadway for interim stormwater management (during construction) and secondary flow capacity. This will take overflow from soakage with likely greater than 10 yr capacity (2 yr ARI being greater than half 10 yr ARI peak flow). Furthermore overland flowpaths will be provided within road reserves. Therefore flooding benefits of the 10 year public soakage capacity is low.

The applicant has now adopted a design capacity of 10 year for private soakage and 2 year for public soakage. This is considered appropriate.

- 19 Specific conditions of consent will be required to address performance risks for all public soakage systems in construction and ongoing operation and maintenance including:

- a Soakage testing will be undertaken at the location of proposed soakage devices once bulk earthworks are completed and used to confirm the sizing of soakage devices;
- b Design will need to consider final curve numbers accounting for soil compaction from earthworks or any mitigations employed;
- c Design will need to consider the impact of areas that cannot be disposed to soakage on increasing flows at discharge points, and potentially provide additional mitigation within the system;
- d Protection of treatment and soakage systems is required during earthworks periods to ensure sedimentation does not reduce device effectiveness, and;
- e Operation and Maintenance Plans are required.

### **Downstream Centralised Public Devices**

- 20 The original proposal included treatment for the majority of the road reserve in raingardens with soakage beneath located within the road reserve. It was requested by HCC that some of these treatment devices were centralised in the public areas where feasible to reduce the asset management and maintenance costs of a large number of distributed private devices.
- 21 In response the applicant included a series of Raingarden Basins where space permitted to centralise public treatment devices. Some of these devices were not supported by HCC due to impacts on recreation space and poor access. Following the addendum to redesign the northern portion layout received 28th February 2019, the remaining 5 raingarden basins comprising approximately 2750m<sup>2</sup> have the potential to treat the runoff from 13.75 Ha of road and private pervious catchment.
- 22 The exact sizing of devices has not been provided within the application but it has been demonstrated that there is sufficient space within the centralised devices and within the road corridor to achieve suitable treatment and soakage. This semi distributed system with some road raingardens to augment modest centralised devices provides good resilience benefits and somewhat optimised Operation and Maintenance and is supported.
- 23 A condition of consent is required to ensure that in all cases the centralised devices must be designed to treat the public road runoff and any run on water from private pervious areas. The upstream private impervious will be connected to private soakage for the relevant events and therefore can be excluded from the Centralised device catchments. Where there is inadequate capacity in centralised devices, additional at source public raingardens are to be provided to treat the equivalent remainder of road catchment as a secondary priority.

### **On-Site Pre-Treatment and Infiltration**

- 24 The proposed private on-site management comprises on-site soakage with 10 yr ARI Capacity with pre-treatment such as underground rainwater harvesting tanks from roofs and catchpit insert filters, permeable paving or similar from driveways.
- 25 The rainwater re-use underground tanks require additional measures in accordance with HCC Practice Note HCC-02 and HCC-03 which weren't included when this option was documented. The applicant states that re-use tanks may or may not be utilised based on consideration of baseflow requirements. In this case alternative pre-treatment options would be required. It is noted that leaf diverters are not considered adequate pre-treatment from roofs in accordance with Practice note HCC-03. It is proposed to add an advice note to clarify the requirements of the on-site re-use or other pre-treatment before soakage.
- 26 The applicant states that as there is no requirement for 10 year attenuation, and the soakage could be changed under contingency to re-use. This is not the case as the downstream system will be designed for 10 year soakage at lot, and there are no proposed primary connections to the stormwater network.
- 27 Clashes between counterfort drains and soakage have been removed from the proposal.
- 28 The proposed system complies with the requirements of the RITS. As with public soakage devices, specific conditions of consent will be required to address performance risks from construction and operation of private stormwater systems including the following:
  - a Soakage testing will be undertaken at the location of proposed soakage devices once bulk earthworks are completed and used to confirm the sizing of soakage devices;
  - b Design will need to consider final curve numbers accounting for soil compaction from earthworks or any mitigations employed;
  - c Protection of treatment and soakage systems is required during earthworks periods to ensure sedimentation does not reduce device effectiveness, and;
  - d Operation and Maintenance Plans are required.

### **Post-Development Flow Assessment**

- 29 The initial documentation did not include a quantitative assessment of the change in impervious areas and flows between pre-development and post-development scenarios including changes to baseflow, frequent storm, and 2, 10, and 100-yr ARI events. Several variables within the proposal would likely effect the resultant flows at the various outfalls including:
  - a Steep roads may require sealed raingardens with no soakage;

- b Some centralised raingardens would not be able to employ soakage close to the edge of the river terrace;
  - c Allowance for loss of soakage capacity over time, and;
  - d Changes to infiltration at pervious surfaces from earthworks and compaction.
- 30 A water balance assessment was requested to provide an estimation of the change in flows in the watercourses on the site from the development. This was considered important to determine whether the reliance on soakage was likely to either reduce or increase in-stream hydrology to the detriment of aquatic ecology or to promote erosion.
- 31 An infiltration versus runoff assessment was provided for Stream 2. This was based on several assumptions and did not provide a future runoff assessment including sensitivity to the items above. However this assessment did generally show that the existing runoff volumes are very low and therefore the streams are primarily baseflow fed and currently have adapted for small runoff volumes. The reliance on primary disposal of stormwater to soakage devices post development will be highly likely to result in a similar condition of base-flow fed hydrology with road catchments that have a 2 year level of service discharging infrequent high flows that can provide freshening runoff in the stream channels. On the same token it has to be assumed that as per the existing high infiltration pattern the shallow groundwater hydrology will respond similarly under post development conditions such that stream base flows are maintained without generating erosion and stability issues.
- 32 An important consideration at detailed design will be ensuring that the variables above of soakage provision and infiltration capacity are considered in final sizing of public soakage devices, to ensure that erosive flows are not generated at the outfalls and in receiving stream environments. A condition of consent will be required.
- 33 The proposal has indicated that infiltration capacity at the soil surface will be reduced by earthworks but will remain high. The application has not proposed specific measures to ensure this is the case. A condition should be provided to require preservation of soil capacity in accordance with Section 8.5.11 - Compacted soil remediation, in the Waikato Regional Stormwater Guideline, or else infiltration losses from earthworks compaction across the site are to be incorporated in runoff calculations for sizing downstream infrastructure.

### **Flooding**

- 34 The impact of flooding from development of the site needs to consider free drainage of upstream areas, safe conveyance of secondary flows within the site and avoiding vulnerability from floodwater reaching the site in this case from the Waikato River.

- 35 The HCC Section 92 request item 14 requested confirmation that the relevant devices, pipes and overland flow paths are designed for the inflow catchment from across Peacockes Road to the south of the site. This was confirmed by the applicant that the 12d model accounts for secondary flows along Peacockes Road, including both sides of Peacockes Road.
- 36 This response in my opinion is not satisfactory and does not address the full request. The submission of Neil and Carolyn Edwards (26) of 71 Weston Lea Drive points out that stormwater flows from 84 Weston Lea Drive are not accommodated in the design. It is not clear the extent of catchment draining to this location. There appears to be potential to provide for overland flow to the north and primary piped reticulation to the northeast however this will require some changes to levels. It is therefore recommended that a condition of consent is included to require provision of primary and secondary infrastructure to convey maximum probable development flows from all adjacent sub-catchments currently draining through the site.
- 37 Safe conveyance within the site includes secondary runoff from some private lots sloping away from the road across neighbouring lots. Several parts of the proposed development include private properties sloping away from the road that will discharge secondary flows to downslope properties. The Regional ITS requires upslope properties to have primary systems sized for 50 yr ARI events. An alternative of an easement across downslope properties would also mitigate risk. The applicant proposes that the risks to the downslope properties are negligible and can be accommodated by normal dwelling design. Falling all properties to the road would result in excessive earthworks. It is therefore recommended that a condition of consent is provided to require upslope properties to have primary systems sized for 50 yr ARI events or an easement through downslope properties in favour of upslope properties to convey stormwater secondary flows to Road reserve or Jointly Owned Access Lots (JOALs).
- 38 Safe conveyance within the site includes secondary flows along roads. Some groups of properties drain to JOALs and these will need to accommodate overland flows from upstream properties within their footprint. Roads conveying overland flows to their low points will likewise need to be designed to accommodate overland flow paths for their specific catchments at depths and velocities that comply with safety requirements. The section 92 response from the applicant indicated that most but not all areas could comply with this at preliminary design. Given the moderate slope and the relatively short catchment runs to the river, it is very likely that overland flows can be accommodated with minor earthworks adjustments within the current layout. It is therefore recommended a condition of consent is required to ensure the assessment of overland flow depths and velocity and to require modifications to the earthworks and roading design (as necessary) to meet flood depth requirements.

- 39 Safe conveyance within the site includes discharging to streams and the Waikato River. Spill points for overland flowpaths are at locations of stormwater outfalls or bridge abutments. It is therefore recommended a condition of consent is required to ensure the assessment of overland flow depths and velocity and to require modifications to the earthworks and roading design to meet flood depth requirements. All discharge points for overland flows will need to be suitably protected against flooding and erosion impacts
- 40 The Flooding risk from the Waikato River has several aspects to consider:
- a 100 year including climate change design levels.;
  - b Dam Break Scenario risk, and;
  - c Impacts of infilling on river flood conveyance.
- 41 The applicant has indicated design levels of 20.1m RL (upstream) and 19.5m RL (downstream) have been adopted for the site including freeboard allowance for climate change. This includes 1m allowance for climate change that was assessed to represent approximately 13% additional flow capacity from existing (no climate change) 100 year ARI flows. The lowest areas are located to the downstream north of the site. The layout and levels of this northern area have been modified since the original application with the lowest developed area lifted by approximately 1.7m to now have a lowest level of 22.05m RL on Road 2 at chainage 780. The applicant has demonstrated that the 100 year ARI flood risk in the river is adequately mitigated by these levels being well above the design levels. It is noted that the Waikato River system is controlled by releases from a series of hydro dams and therefore risk of extreme flows are less likely.
- 42 The applicant's flood risk assessment included a Karapiro Dam Break Scenario that provides a level of 26.3m RL. With the northern redesign approximately 25 houses on Road two would be affected by this scenario. The applicant has indicated that risk management of a Dam Break Scenario is a regional matter, with remote possibility of occurrence, similar to Tsunami Management in Coastal Areas. I concur with the low likelihood of risk.
- 43 The altered design in the northern area has removed any infilling within the Waikato River 100 year floodplain and therefore impacts on water levels through the site from infilling are no longer a potential impact.

#### **Stormwater Outfalls**

- 44 Initial civil engineering plans 141842-(2001-2023) Rev 3 described 18 distributed stormwater outfalls throughout the proposed development. In order to reduce the maintenance liability upon HCC and retain favourable environmental outcomes, Morphum Environmental recommended that

several outfalls were to be assessed for the consolidation of stormwater discharges or realignment to match existing catchment discharge points more closely.

45 A site visit was undertaken on 17th September 2018 in conjunction with the applicant, HCC, WRC and Morpium Environmental. Discussions were held with John Van Rooy, Asset Maintenance Team Leader – City Waters regarding the proposed number of stormwater outfalls and respective positions. He indicated that the proposed number of outfalls were satisfactory, and that the following would be required to be considered:

- a Availability of maintenance access to outfalls for small scale plant equipment from the embankment without disturbance of vegetation;
- b Outfalls directly discharging into the Waikato River should be readily accessible by small boat in order to undertake physical inspection, and;
- c Outfalls should be orientated to reduce erosion to stream banks, and have appropriately designed erosion mitigation structures in place .

46 The Stormwater Detail Plan Addendum submitted on 26th February 2019 outlined a final arrangement including 16 outfalls with several relocated in order to service the proposed stormwater basins. Detailed engineering design of specific outfalls and associated erosion mitigation structures including safe discharge of secondary flows will be required at engineering plan approval stage.

47 Aquasocks' were originally proposed to serve as erosion mitigation devices at outfalls located at elevated locations along the embankment, however permanent erosion mitigation structures have now been proposed at all outfalls, with 'aquasocks' removed from the design plan.

48 Discharge of groundwater from counterfort drains will be directed onto the lower eastern embankments of the development. A collection manifold drain will be implemented parallel to the Waikato River in order to consolidate flows to a common outlet. Appropriate erosion mitigation structures will be required at these discharge locations, with detailed design to be submitted at engineering plan approval stage.

### **Construction Effects**

49 The proximity of the site to the Waikato River Receiving Environment and the general slope towards the river highlight construction stage sediment discharge as a particular risk of the proposed development. Mitigations include the presence of soils on the site with high infiltrative capacity resulting in reduced runoff and erosion potential. The Applicant has demonstrated the potential erosion and sediment controls that can be utilised including staging of works, cleanwater diversion

and sediment ponds. Particular items requiring attention in detailed design of erosion and sediment controls include:

- a Construction of outfalls. These are located below temporary sediment ponds and will require specific measures to prevent discharges during their construction. The applicant proposes to install these by hand to reduce vegetation clearance and disturbance on the river bank;
- b Interim stage discharge management. The applicant proposes to discharge runoff to a piped system following completion of bulk earthworks and decommissioning of temporary sediment ponds, but prior to commissioning of on lot soakage and public raingarden/soakage systems. Whilst this is supported in order to prevent siltation and loss of performance in the permanent stormwater treatment devices, the interim period will require careful mitigation of erosion and sediment effects such as on lot staging, rapid re-stabilisation, sediment controls and potentially downstream devices. The increased flows as impervious surfaces are created but prior to commissioning of permanent treatment devices will need to be mitigated at outfalls and downstream and potentially remediated, and;
- c Monitoring of erosion and sediment controls and for any discharge effects during both bulk earthworks and house construction stages of construction.

50 It is considered that suitable erosion and sediment control measures that address these issues are technically feasible but these will need to be ensured by appropriate conditions of consent.

### **Operation and Maintenance**

51 The applicant has displayed a good level of consideration of maintenance in the documentation including important factors of access to outfalls and public devices, and maintenance and monitoring of infiltration capacity of soakage devices. It is considered that suitable operation and maintenance plans can be provided with detailed design as part of engineering approval.

### **SUBMISSIONS**

52 Six Submissions to the applications have raised stormwater matters. These were as follows:

53 Submission 11: Mary Elizabeth Cave-Palmer 16 Silva Cres, Riverlea, Hamilton. Submitter opposed the proposed discharge of stormwater in extreme rainfall events into local open space and to the Waikato River. Points raised include extreme rainfall events increasing in frequency and roof runoff will pollute the river. I believe the proposal addresses this in the design of water quality treatment and disposal to soakage for frequent events (including climate change allowance) which carry the bulk of any contaminant load. The extreme rainfall event discharges are safely managed

within overland flowpaths discharging at locations of bridge abutments and stormwater outfalls which will include consideration of safe overland flow discharge at detailed design phase.

- 54 Submission 20: Dick Kin Chan and Hua Hong Zhong, 43 Balfour Cres, Riverlea. This states that stormwater should not be discharged into the river upstream of the water treatment plant, drainage design must take account of climate change and requests that stormwater infrastructure is in place before development starts. In line with normal land development processes, erosion and sediment controls will be put in place before earthworks commence and stormwater infrastructure will be delivered before subdivision titles are issued. Primary disposal of stormwater for most of the development will be to soakage with pre-treatment, and water quality treatment will be provided for all discharges not to soakage. All systems will be designed including allowance for climate change.
- 55 Submission 21: Jian Hua Lin and Xiu Zhen Zhang, 12 Sheriff Place. Identical to submission 20 see above.
- 56 Submission 26: Neil and Carolyn Edwards, 71 Weston Lea Drive. Opposes generally, and specifically on the grounds that no connection is provided to the existing drain along the boundary between 71 and 84 Weston Le Drive and discharges onto the subject property. The submitter states that the drain on the subject property has been piped and creates a backwater flooding issue on their land. The submission seeks conditions of consent requiring a solution is developed in consultation with surrounding land owners to allow conveyance from the upstream properties, including not unreasonably limiting the disposal options for development of the upstream properties. The discharge in question is not specifically addressed in the proposal and is not shown on the post development catchments. Addendum Plans received 26-02-2019 show an area of fill in this location (Approximate Chainage 140m on Road 2) with the spill point at the intersection of roads 1 and 2 at a RL of 38.3 approximately 1m above the ground level adjacent to the drain in question and approximately 50m to the north. It is noted that there is a road connection indicated in the plans heading west from this intersection. A condition of consent to address this issue is required.
- 57 Submission 30: Raymond Alan Hoare 99c Howell Ave. This submitter requests that the development makes far better provision for a riverbank reserve to guard against erosion possibility in the distant future. As demonstrated by the post development flow assessment for Watercourse 2 the soakage will reduce frequent erosive flows being discharged from the development, therefore reducing the likelihood of erosion in the watercourses of the site descending the riverbanks. Outfalls will also be designed to protect against erosion from infrequent large flows including overland flows. Slope stability is assessed by Mr John Brzeski as being suitably considered in the application. The

earthworks area does not extend onto the river banks, so any existing risk is not expected to be exacerbated.

58 Submission 67: Samuel Richard Edwards, 41 Malcolm Street Hamilton. The submitter requests that the proposal include increased riparian protections and that extra attention be paid to surface flooding resulting from creation of impervious surfaces. Similar to submissions 11, 20 and 21 the aspects of the proposal including water quality treatment and soakage for 10 year flows on lot and 2 year flows on road reserves will adequately manage frequent storms. The overland flows from extreme events will be required to pass safely to stable discharge points to watercourses or the river. The development area avoids the 100 year ARI with Climate Change Waikato River floodplain.

#### **RECOMMENDED CONDITIONS OF CONSENT**

59 I can confirm that I have reviewed and contributed to the Draft Conditions of Consent for stormwater and flood protection included with the Section 42A report and that they address the appropriate mitigation required as discussed in my evidence.

#### **CONCLUSION**

60 In summary, it is my opinion that stormwater constraints for the subdivision have been adequately considered through site investigations, modelling, assessment and analysis. Further information is required at detailed design stage to confirm the recommendations made at Resource Consent stage and to demonstrate adherence to the recommended stormwater conditions.



Caleb Clarke  
29 March 2019