BEFORE THE INDEPENDENT HEARINGS PANELS APPOINTED TO HEAR AND MAKE RECOMMENDATIONS ON SUBMISSIONS AND FURTHER SUBMISSIONS ON PROPOSED CHANGE 1 TO THE REGIONAL POLICY STATEMENT FOR THE WELLINGTON REGION

UNDER	the Resource Management Act 1991 (the Act)
AND	
IN THE MATTER	of Hearing of Submissions and Further Submissions on Proposed Change 1 to the Regional Policy Statement for the Wellington Region under Schedule 1 of the Act

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STATEMENT OF EVIDENCE OF STUART JAMES EDGAR FARRANT

FOR GREATER WELLINGTON REGIONAL COUNCIL

TECHNICAL EVIDENCE

HEARING STREAM 5 – FRESHWATER AND TE MANA O TE WAI

30th October 2023

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INTRODUCTION

1 My full name is Stuart James Edgar Farrant. I am a Principal Ecological Engineer and Water Sensitive Design practice lead at Morphum Environmental Ltd.

2 I have read the evidence and statements provided by submitters relevant to the Section 42A report on Hydrological Controls.

3 I have prepared this statement of evidence for Greater Wellington Regional Council (**the Council**) in respect of technical related matters arising from the submissions and further submissions on Proposed Change 1 to the Regional Policy Statement for the Wellington Region (**Change 1**).

4 Specifically, this statement of evidence relates to the matters in the Section 42A Report – Freshwater and te Mana o te Wai.

QUALIFICATIONS AND EXPERIENCE

5 My full name is Stuart James Edgar Farrant. I am a Principal Ecological Engineer and Water Sensitive Design practice lead at Morphum Environmental Ltd; and hold a Bachelor of Engineering (Natural Resources) from University of Canterbury.

6 I have over 16 years' experience working in multiple aspects of freshwater management and ecological engineering. I have worked for Morphum Environmental for 9 years establishing the southern sector office (Wellington) in 2014. Prior to that, I worked for 5 years as an Ecological Engineer in Melbourne, Australia.

7 I have experience working in a range of aspects relating to three waters management including design, technical review and auditing of constructed wetlands, vegetated stormwater treatment/conveyance systems, stream restoration and catchment planning. Specifically, I have extensive experience with the design and delivery of integrated water management strategies and to mitigate adverse Hydrological and water quality effects from urban development at a range of scales.

8 I have contributed to and authored technical design guidelines for Councils/Utilities in New Zealand and Australia (including the Wellington Water 'Water Sensitive Design technical guidelines').

9 I was awarded a 2018 Winston Churchill Fellowship to travel internationally for the purposes of researching leading practice with urban water management in Europe, Scandinavia and USA.

10 In 2020 I was appointed to the Wellington City Council Mayoral taskforce charged with investigating the current state of play with the provision of three waters services across Wellington city and informing recommendations for changes to improve long term outcomes for the community and environment.

11 I am a member of Engineering New Zealand and Co-Chair of The Sustainability Society which is a technical interest group of Engineering New Zealand.

CODE OF CONDUCT

12 I have read the Code of Conduct for Expert Witnesses set out in the Environment Court's Practice Note 2023 (Part 9). I have complied with the Code of Conduct in preparing this evidence. My experience and qualifications are set out above. Except where I state I rely on the evidence of another person, I confirm that the issues addressed in this evidence are within my area of expertise, and I have not omitted to consider material facts known to me that might alter or detract from my expressed opinions.

SCOPE OF EVIDENCE

13 My evidence addresses matters specifically relating to Hydrological Controls.

14 Specifically, it addresses the context and drivers for Hydrological Controls, the influence of expected future development conditions. It also provides an understanding of development hydrology, discusses the proposed Hydrological Control provisions and responds to submission points received from Wellington Water Ltd.

BACKGROUND-RELEVANT RPS PROVISIONS

15 Proposed RPS Change 1 identifies the need to protect Freshwater values through the provision of both Hydraulic Neutrality and Hydrological Controls. This reflects the fact that Hydraulic Neutrality in isolation does not provide ecological benefit and in many instances will worsen outcomes through the attenuation and extended discharge of elevated flowrates. The inclusion of requirements for Hydrological Controls is therefore required to ensure that the future impacts of urban development reflect the principles of Te Mana o te Wai and the aspirations to protect and enhance Freshwater outcomes.

16 Proposed RPS Change 1 includes a suite of new objectives, policies, and methods to achieve improved Freshwater outcomes through Hydrological Controls. This includes the requirements for Regional plans to include policies, rules and/or methods for urban development that require hydrological control to avoid adverse effects of runoff quality and quantity (flows and volumes) and maintain, to the extent practicable, natural stream flows.

CONTEXT AND DRIVERS FOR HYDROLOGICAL CONTROLS

17 Development activities across the Wellington region result in stormwater runoff which discharges to fresh and coastal waters at a range of scales and with varying levels of cultural, ecological and social significance. Discharge of inappropriately managed urban stormwater therefore has the potential to adversely impact on streams, rivers, wetlands, lakes, estuaries and the open coast.

18 Unless managed appropriately, modification for urban development (housing and commercial) causes an increased discharge of contaminants (in particular heavy metals, hydrocarbons, sediments and nutrients), increased runoff **volumes** during frequent small and moderate rainfall, increased runoff **flowrates** during less frequent large rainfall, increased air temperatures (urban heat island), increased water temperatures discharging to waterways, reduced indigenous biodiversity and a community disconnection with historical ecosystems.

19 The combination of these stormwater characteristics are the key drivers of what is often referred to as 'urban stream syndrome' which refers to the poor condition of typical urban waterways and the resultant decline of indigenous biodiversity and freshwater health.

20 Existing requirements in some District Plans and by Wellington water as a condition of consent for 'Hydraulic Neutrality' as defined by Wellington Water are solely focussed on peak flow mitigation and are often incorrectly suggested to support ecological benefits. In practice, typical hydraulic neutrality measures (flow detention and release over an extended timeframe) can contribute to worsened ecological outcomes through the extended duration of high flows and the inability to mitigate the changes in small frequent flow events.

21 As currently implemented in the Wellington region, 'Hydraulic Neutrality' is solely focussed on controlling peak flowrates to limit risks of downstream flooding from events **greater than** 10% Annual Exceedance Probability (10 year Average Return Interval). This is achieved through holding back stormwater in detention tanks or basins and releasing it at a throttled

flowrate to match the calculated pre development peak flowrate. Therefore, in the developed catchment case, the risk of nuisance or damaging flooding should in theory be no greater than the current risk.

22 Where discharge is to a natural, unlined waterway (including intermittent and perennial streams), measures to achieve flood detention in isolation will worsen freshwater outcomes. Extending the duration of artificially high flowrates in stormwater discharges during large rainfall events results in both disturbance to indigenous fish communities and contributes to persistent scour and erosion. These impacts occur where development stormwater discharges directly to a waterway or to a piped stormwater network which discharges to a waterway downstream.

23 Detention measures used to achieve 'Hydraulic Neutrality' provide negligible attenuation of frequent small to moderate runoff in events less than the 10% AEP with flows passing through any detention controls.

24 The relative change in rainfall runoff volumes in small rainfall events is greater than in large events when comparing waterways in undeveloped catchments versus urbanised ones.

25 Natural hydrology is a direct reflection of landcover with a significant volume of rainfall assimilated within a natural catchment rather than discharging to surface waterways. Therefore, in a natural catchment the flowrate within waterways does not vary significantly during frequent small to moderate rainfall events with a more consistent flow regime.

26 These flow conditions enable natural waterways to support resilient riparian plant communities which in turn stabilise the stream edges and enable the development of natural channel form with pools, riffles, meanders and instream habitat required to sustain indigenous biodiversity. This in turn enables these natural streams to be resilient to infrequent occurrences of large peak rainfall events which are able to pass through the steam corridor with limited disturbance and scour.

27 These stable waterway conditions are clearly observed across the Wellington Region where streams exist in protected reserves above the extents of any urban development such as upper Waitohi in Khandallah Park.

28 In developed catchments without Hydrological Controls the change in landcover results in substantially changed rainfall runoff in frequent small rainfall events which results in significant and constant fluctuations in stream flow causing persistent wetting and drying

of riparian margins resulting in ongoing slumping and scour of stream bed. As these unprotected waterways become less stable a rapid cycle of streambed incision, stream bank slumping and mass sediment transport results in profound adverse impacts on indigenous biodiversity and discharge of substantial sediment loads to downstream environments.

29 These unstable waterway conditions are clearly observed across the Wellington Region where streams exist below urban development such as Papawai in Mt Cook.

30 Current development practices are typically driven by a desire to optimise development yields within a given footprint. Housing typologies have in recent years evolved from almost entirely free-standing dwellings to increasing multi-unit developments to increase yield further. Commercial development increasingly results in larger span roof areas and large areas of carparking/hardstand with a desire to optimise the 'useable' proportion of any given lot.

31 Due to the variable topography of the Wellington Region and desire to provide drive-on level access and slab on grade (a structural engineering practice using a concrete slab to provide the building foundation), residential and commercial developments often involve extensive earthworks to modify and retain land. Current development practice therefore results in extensive areas of impervious landcover (roofs, roads and hardstand), highly compacted and modified soils, minimal vegetation and disconnect from historical or remaining watercourses.

CONSIDERATION OF FUTURE DEVELOPMENT CONDITIONS

32 Climate projections by NIWA and the Ministry for the Environment are generally agreed that the future climate across the Wellington Region will include increased frequency and intensity of heavy rainfall events interspersed with prolonged dry periods. Temperatures are also projected to increase across the Region (particularly in summer/autumn) with increased maximum temperatures and increased "Hot" days (Tmax >25).

33 Extended periods of low/no rainfall followed by periods of high intensity rainfall will change the pattern of contaminant accumulation and wash off from urban impervious surfaces with an expectation of increased incidence of 'flashy' flows combined with increased contaminant concentrations during rainfall combined with elevated water temperatures.

34 Whilst not specifically addressed further in this evidence, it is well documented that many of the urban waterways across the Wellington Region are adversely impacted by existing

urban stormwater discharges including active erosion, poor water quality and declining ecological values.

35 These existing impacts on waterways are observed from modest levels of uncontrolled development with even small changes in imperviousness resulting in significant shifts in flow characteristics in small rainfall and the resultant impacts discussed previously.

36 Changes in already modified land, such as conversion of rural land to urban (greenfield development) and intensification of existing urban areas (brownfield development or infill), will cause a change, and generally a worsening, of existing impacts through increased impervious surfaces, further reduction in vegetation cover, modification to waterways (including bank lining and installation of outfall structures) the discharge of urban contaminants including heavy metals, nutrients, sediments, hydrocarbons, micro plastics and temperature.

37 Future greenfield and infill redevelopment without robust and resilient mitigation of stormwater impacts through Hydrological controls will contribute to and exacerbate ongoing decline in waterway health and will not support the intent of regulatory drivers of the NPS-FM.

38 Ongoing and increasing adverse impacts on waterways due to an absence of appropriate Hydrological Controls (volume reduction) will likely also result in substantial ongoing financial costs for design, consenting and construction of instream retaining structures to protect assets such as roading, utilities and private/public property. Outside of formal greenfield development areas these costs are often borne by Territorial authorities without any ability to seek redress from private developers who have directly contributed to the downstream impacts through uncontrolled stormwater discharges. Costs of lost indigenous and taonga species and degradation of the mauri of waterways is not able to be monetised.

39 A continuation of existing development practice without the requirement for Hydrological Controls will accelerate the decline in environmental and social outcomes across the Wellington Region. In particular, a continuation of Business as Usual will result in the following;

39.1 Ongoing loss of indigenous biodiversity in waterbodies due to persistent scour and disturbance of natural stream form

39.2 Reduced quality of water in waterways due to instream sediment mobilisation and discharge of urban contaminants adversely impacting on cultural, ecological and social values

39.3 Ongoing loss of terrestrial biodiversity through reducing riparian habitat and fragmented connections or ecological corridors

39.4 Reduced resilience to future climate change including both large shocks (floods/droughts) and changing seasonal patterns

39.5 Increased costs and further loss of freshwater values through the construction of instream retaining structures to 'control' ongoing scour and erosion resultant from modified hydrology

39.6 Continuing disconnect between communities and the natural environment.

UNDERSTANDING DEVELOPMENT HYDROLOGY

40 The conversion of natural vegetated land to impervious surfaces (roofs, hardstand and roads) prevents or limits the natural processes of interception, evaporation and infiltration of rainfall resulting in modified stormwater runoff. These changes have traditionally been well understood and designed for with regards to infrequent flood events (greater than 10% AEP for example) but are less understood for the more frequent rainfall events which impact freshwater health.

41 Councils across Aotearoa (including Waikato Regional Council and Auckland Council) have in recent years required **retention** of a portion of stormwater in an attempt to mitigate adverse Hydrological impacts. These retention requirements are typically given as a rainfall depth to be captured and retained within the site or development boundary and are now routinely applied in greenfield development areas through Integrated Catchment Management Plan requirements and regional consents.

42 These retention depths are often hard to achieve in large scale centralised devices and are typically promoted at a lot scale (private devices) with public spaces (roads) mitigated through separate council owned retention devices (i.e. soakage from base of raingardens).

43 Limited local research exists to accurately define the 'natural' hydrology in undeveloped land uses and to quantify the contributing components of the natural water balance. Requirements to achieve a specified retention depth are currently based on limited

calibrated modelling which looks solely at gauged stream flows and catchment rainfall to estimate the proportion of rainfall to be retained. This is often undertaken on already highly modified land (historically cleared for farming) and is not considered representative of natural undeveloped conditions.

44 Currently, a 5 year, $13.7 million research program being led by Scion called *'Forest Flows'* is investigating the real time (5 minute increments) components of the water cycle in New Zealand forests to quantify the proportion of rainfall that is intercepted and transpired by vegetation, evaporated from exposed surfaces/shallow soils, infiltrated to ground and/or conveyed as surface runoff. Final results are to be published in 2024 but provisional findings indicates approximately 60% of the total rainfall volume is retained within forested catchments and not discharged as surface runoff during even large rainfall events.

45 It is anticipated that the level of detailed data being captured for this research and the focus on quantifying all components of the natural water balance will provide a comprehensive understanding of how the management of urban stormwater can mimic the natural water balance and hydrology to provide a high level of protection (and enhancement) for freshwater systems.

46 An earlier 2002 research project *"Land cover effects on water availability (Project 2167)"* was funded through the MfE Sustainable Management fund with the aim to review existing verified data on the influence of forest cover on catchment runoff. This included both plantation and indigenous cover which is considered representative of what once covered the catchments across the country.

47 Interception storage is the amount of precipitation that is captured (by foliage and bark) and evapotranspired back to the atmosphere from vegetation. Based on data presented in Project 2167 this is approximately 2 mm (rainfall depth) for evergreen indigenous forest with 26 – 42% reduction in mean annual runoff volume depending on forest type. For Broadleaved indigenous forest the interception loss is estimated at 30% of the mean annual rainfall volume. Native shrub is higher at 37% interception loss.

48 Throughflow is the portion of precipitation that reaches the ground either directly or as drips once interception is at capacity. Based on Project 2167, for indigenous forests an average throughflow of 59% is observed.

49 Baseflow is the portion of rainfall which reaches the ground (as throughflow) and infiltrates to shallow soils to flow laterally towards waterways and sustain low flows within channels

between rainfall events. These are the flows that are observed within streams during dry periods which Project 2167 found to be 20-27% of annual precipitation for indigenous forest cover.

50 Based on the above summaries it is inferred that the surface runoff during rainfall events would be in the order of 30-40% under natural indigenous forest cover.

PROPOSED HYDROLOGICAL CONTROLS

51 Hydrological controls are measures which aim to match the predevelopment flowrates across the full spectrum of rainfall events. This requires measures to match the pre development amount or volume of runoff from a site which represents the natural 'loss' of water from evaporation and transpiration. This is typically termed **retention** and is increasingly required for new developments by councils across Aotearoa.

52 Retention differs from detention in that the captured volume of runoff must not be discharged back to surface flows and is effectively held on the site to replicate the natural function of evapotranspiration or deep infiltration.

53 Retention is therefore typically achieved through either capture and reuse of rainwater/stormwater from impervious surfaces or the capture and controlled infiltration of rainwater/stormwater.

54 Dedicated infiltration systems are often limited by the permeability of the already modified (compacted) soils, historical contamination and potential for instability and unintended 'seepages' on down gradient properties. This reduces the ability to provide retention via infiltration in most areas of the Wellington Region outside of Kāpiti and areas of alluvial gravels such as parts of the Hutt Valley and Wairarapa.

55 Rainwater reuse tanks connected to internal non potable demands provide a means of mitigating the increased stormwater volumes from urban development whilst also mitigating the potential adverse impacts from contaminants which are diverted from the stormwater system to either the wastewater network (via toilet flushing or laundry) or to infiltration (when used for irrigation etc).

56 The connection of rainwater tanks to consistent reuse demands which are utilised throughout the year (such as toilet flushing and/or cold-water laundry) are fundamental to ensure that water reuse provides retention benefits throughout the year. Rainwater tanks connected solely for exterior uses (such as garden watering) do not provide reliable

Hydrological benefits over most periods of the year due to tanks being in bypass mode throughout winter months.

57 Other measures such as green roofs and permeable paving provide retention of small rainfall events but will typically only mitigate the direct rainfall onto their surface.

58 Internationally, innovations are being implemented to automate tank controls enabling private rainwater tanks to efficiently support retention and detention and tailor baseflow discharges to sensitive stream environments but to date these innovations have not been utilised in New Zealand.

59 Rainwater reuse tanks (or infiltration where appropriate) are readily incorporated into the design of new builds with numerous suppliers available to provide high quality, cost effective and reliable tanks, connections and pumps which are easily installed by registered plumbers.

60 The reuse of water from the tank replicates the natural interception whilst the infiltration via soakage may contribute to shallow interflow and help sustain baseflow in streams along with other sources from pervious landcover.

61 In addition to quantified benefits in terms of mimicking the natural hydrology, the use of on-lot measures such as rainwater reuse provide a wide range of co-benefits in terms of network resilience, water quality improvements (in terms of contaminants and temperature), community health and wellbeing and urban ecology.

62 Without the inclusion of Hydrological Control to provide required retention through a combination of reuse and infiltration it is anticipated that future urban development will exacerbate existing stream degradation with loss of indigenous biodiversity and sediment/contaminant transport to fresh and coastal waters. It is therefore emphasised that through development done well there is the real potential to enhance existing conditions (due to current lack of meaningful management) and enable urban waterways to be progressively restored.

63 Hydrological Control is therefore recognised as offering cost effective and resilient solutions to a wide range of often complex landuse related problems whilst simultaneously supporting other non-financial benefits to communities and indigenous ecosystems.

64 In a local Wellington context, it is recognised that technical guidance will be required to provide consistency and specificity on how the Hydrological Control provisions in the RPS

can be met. This could readily define a range of 'deemed to comply' solutions that would be accepted as achieving the intended retention of initial rainfall runoff through means such as rainwater reuse tanks and infiltration systems. This would in turn support regulatory approvals and provide development certainty similarly to the already implemented 'Hydraulic Neutrality' technical guidance.

RESPONSES TO SUBMISSIONS

65 The following provides responses to points raised in submissions from Wellington Water Ltd (WWL). These relate to technical elements of the definition and application of Hydrological Controls.

66 WWL queried why the "*The definition refers to annual means rather than annual peaks".* It is important to understand that the implementation of Hydrological control is intended to replicate (as much as possible) the natural flow regime of undeveloped catchments which vary in terms of rainfall runoff relationships across the seasons and between rainfall depending on antecedent dry spells and levels of soil saturation. The term 'peak flows' relates more to the infrequent large rainfall events whereas Hydrological Control is more focussed on the retention of the initial volume (or rainfall depth) across a range of small and frequent events. Detailed Hydrological modelling of all small rainfall events which accurately reflects the influence of vegetation, seasonal evaporation and shallow soil storage is particularly complicated so the definition of Hydrological Controls has intentionally allowed for the management of the annual water balance volumes to therefore align with the natural water balance which is known to support stable and resilient waterways. The components of a water balance are expressed as annual mean volumes to reflect the subtle variabilities between years due to variability with climate systems.

67 WWL suggested that *"The practicability test for brownfield and infill developments may be better served with a more specific target".* The notified definition uses the term 'minimised…as far as practicable' to reflect the inherent challenges with integrating comprehensive Hydrological Controls in some instances. Examples include large scale commercial developments where large span roofs may not be connected to comparable reuse demands or where high-density apartment developments result in very high demands relative to the 'shared' roof area. These challenges need to be worked through constructively with the development community and Wellington Water with the need remaining for Hydrological Control if the intent is to protect downstream waterways and

the values they support. Examples from recent Fletcher Living developments in Auckland for high density apartments and international examples of 'Industrial Ecology principles' can be considered in the deliberations around practicality of what can realistically be achieved.

68 WWL expressed that *"It is unclear whether the modelling is based on an undeveloped state or the surrounding catchment also being in an undeveloped state? This would affect water flowing onto the site and water attenuation".* Modelling should be based on the potential impact and influence of the development site only, rather than the entire catchment. This reflects the fact that in most instances developers can only influence activity within their site and cannot control externalities. It is understood and accepted that in many instances this will mean that existing waterways remain adversely impacted from existing uncontrolled urban stormwater but the principle is to facilitate continuous improvement through all new development including Hydrological Control which responds to their site as a minimum. This will result in individual development sites demonstrating that the stormwater runoff is generally in accordance with undeveloped conditions. Therefore, as redevelopment occurs across the catchment progressive improvements can be realised.

69 Local examples of this approach include the Living Pa development at Victoria University-Te Herenga Waka which has been designed to replicate the natural flow conditions which would have been expected at the headwaters of Kumutoto Stream on the premise that if all future development adopted the same hydrological and water quality measures in could support resilient and thriving indigenous biodiversity.

70 WWL expressed that *"It is unclear what purpose the (a) clauses serve. The (b) clauses re to address stream scour that adversely impacts aquatic ecosystem health. If the (a) clauses are trying to achieve a different outcome to the (b) clauses, then this should be reflected in the policies. Currently the policies are only referring to one outcome, related to stream form".* Both clauses are intended to mitigate for changes in flow characteristics that impact on stream health predominantly through post developed stormwater runoff causing persistent scour and instability. Clause (a) is considered the most important as it reflects the changes in flow from the very small and frequent rainfall events that contribute to chronic instability and adverse stream health outcomes. Therefore, by providing Hydrological Control to 'mimic' an undeveloped state there needs to be retention of small frequent rainfall events.

71 Clause (b) reflects the concept of a 'channel forming flow' which is generally agreed to be the flowrate that defines the overall structure of a stream with flows in excess of this event able to breach the stream banks and engage adjacent flood benches. In practice this is less

well defined at a regional scale due to variability in stream geomorphology, topography, geology and general land modification. The inclusion of clause (b) does however reflect the reality that measures such as rainwater reuse and infiltration will have a finite capacity and that overflow in the intermediate events (up to the 'channel forming' flowrate) will result in runoff which exceeds the pre-developed state. Clause (b) therefore requires detention of these intermediate flows to maintain the flowrate within the channel at a rate which is understood to reflect the natural form of the stream and reduce the risk of substantial geomorphological change occurring. This can be achieved in tandem with typical detention measures adopted to achieve 'Hydraulic Neutrality'.

CONCLUSIONS

72 Proposed RPS Change 1 identifies the need to protect Freshwater values through the provision of both Hydraulic Neutrality and Hydrological Controls.

73 Development activities across the Wellington region result in stormwater runoff which discharges to fresh and coastal waters at a range of scales and with varying levels of cultural, ecological and social significance. Discharge of inappropriately managed urban stormwater therefore has the potential to adversely impact on streams, rivers, wetlands, lakes, estuaries and the open coast.

74 The inclusion of requirements for Hydrological Controls is required to ensure that the future impacts of urban development reflect the principles of Te Mana o Te Wai and the aspirations to protect and enhance Freshwater outcomes.

75 Natural hydrology is a direct reflection of landcover with a significant volume of rainfall assimilated within a natural catchment rather than discharging to surface waterways.

76 Hydrological controls are measures which aim to match the predevelopment flowrates across the full spectrum of rainfall events. This requires measures to match the pre development amount or volume of runoff from a site which represents the natural 'loss' of water from evaporation and transpiration. This is typically termed retention.

77 Retention is typically achieved through either capture and reuse of rainwater/stormwater from impervious surfaces or the capture and controlled infiltration of rainwater/stormwater.

78 Without the inclusion of Hydrological Control to provide required retention through a combination of reuse and infiltration it is anticipated that future urban development will

exacerbate existing stream degradation with loss of indigenous biodiversity and sediment/contaminant transport to fresh and coastal waters.

DATE:

30/10/2023

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