Response by Dr Douglas Mzila (on behalf of Greater Wellington Regional Council) to issues raised by a number of submitters regarding (1) Aquifers and Bores and (2) Dewatering activities.

Subject Area A: Aquifers and Bores:

I. Rule 146 and Proposed New Rule R146A Investigation and Monitoring bores-permitted activity

Detailed discussions of this rule are addressed in my primary evidence.

The scope of my evidence included assessing submissions relating to the permitted activity for investigation and monitoring bores R146 that were raised in submissions and further submissions relating to protection of the Hutt Aquifer (Waiwhetu aquifer) and also to community drinking supply protection areas in allocation provisions in the PNRP. The recommendations to amend the permitted activity rules from Rule R146: Geotechnical investigations bores- permitted activity.

1. The groundwater resources of the Wellington Region constitute a vital component of public water supply. For example Lower Hutt valley groundwater provides the Wellington four (Wellington City, Lower and Upper Hutt and Porirua) cities with 40% of the water demand and up to 70% during the summer period. Drinking water contamination could have a devastating effect on Wellington water supplies, with wider regional impacts.
2. Since around December 2016 Wellington Water Limited (WWL) have noticed changes in the water quality in the Knights Road wellfield that feeds Hutt City with drinking water through the Waterloo Water Treatment Plant. This includes increasing counts of Total Coliforms and a number of detections of E-Coli. As a result of this WWL have been chlorinating the Hutt City water supply which was up until now considered a secure supply that did not need treatment. This resource is of extreme strategic importance for the resilient supply of water to the four cities, especially during dry periods when river flows cannot sustain water demand
3. Recently, a contamination of groundwater supply in Havelock North made over 5000 people very ill and was also linked to three deaths. Such

contamination in the Waiwhetu aquifer could affect approximately ten times more people than in Havelock North.

4. A suspension of groundwater take due to contamination could also result in severe water shortages for the Wellington region. Furthermore, such levels of contamination could result in the loss of "secure" water supply status for the Waiwhetu aquifer. The findings from the Havelock North incident indicated great significance regarding the issue of bore design and asset management in municipal water supplies.
5. Micro-organisms are filtered out and die off as the water travels through the ground. Very often, because it travels slowly the water in confined aquifer has been there for many years and is free of harmful organisms.
6. These microbes are carried into the aquifer from the surface. The vulnerability of confined aquifers to microbial contamination is increased by bores that penetrate through the confining layer/aquitard. These bores are a special pollution hazard because contaminants can find their way directly into the aquifer. Because there is not a net flow of water out of the bore, any water entering the bore from above will tend to end up in the aquifer.
7. It is therefore important that any permitted activity bores are not advanced through the confining layer/aquitard in any areas identified as within the capture zone for community groundwater supplies. The selection of 5m depth throughout the region follows studies defining the minimum distance to the confining layer.

The proposed rule only applies to the Lower Hutt Aquifer (Waiwhetu) and to community drinking supply protection areas (Map 26, Map 27a, Map 27b, or Map 27c(a)) , ***Power point Fig. 1 &2)***

9. The Hutt aquifer derives its discharge from the Hutt River and becomes progressively confined from Kennedy Good Bridge southwards attaining thick confining layers of approximately 25m at the Petone foreshore. The aquifer discharges offshore through distributed leakages and through submarine springs. ***(Fig. 3 & 4 Power point)***

10. An analysis of borelogs immediately north of the bore field at Knights Road indicates that the confining layer/aquitard is not uniform and could be as shallow as 7m bgl. Detailed seismic studies by NIWA (2015) and further analysis by Earth in Mind (2016) indicates that the Lambton Harbour comprises of highly uneven confining layers and widespread occurrence of springs on the seabed.

11. Earth in Mind (2016) identifies the location of the spring vents on the harbour floor. The three main spring clusters are the Hutt River mouth with vents up to 10m deep below surrounding sea floor (bsf) indicating the depth to the Waiwhetu aquifer is a maximum of 10m bsf at this location. Bore logs from the Somes Island bore (R27/1170) show the Waiwhetu Aquifer as being at 12.5m bsf. Earth in Mind (2016) identified the spring on the northern tip of Somes Island at about 5-6m deep (bsf).

12. The offshore purpose of this rule is to prevent loss of yield through saltwater ingress into the Waiwhetu aquifer by puncturing of the aquitard from off shore installation of investigation and monitoring bores by limiting installations to a maximum depth of 5m under the permitted activity rule (Rule R146).

13. The shallow depth to the Waiwhetu aquifer (7m) at some locations, the shallow depths below sea floor in the Lambton Harbour and the unknown depths in other community requires that a precautionary approach be taken when considering permitted activity rules under R146.

14. In my opinion a permitted activity rule for investigation bores to a depth of 5m bsf under R146 should be adequately conservative to limit any risks to puncturing the aquitard and also avoid groundwater contamination at the same time allowing most geotechnic activities such as foundations and house piling without requiring consent.

15. Centreport Ltd provided alternative explanations to the presence of shallow coarse sands in the CPA area. It was agreed that the aquifer does not extend into the CPA and bores to any depth within the CPA area could be under R146.

II. Subject Area A: Category A reclassification in the Hutt Aquifer from 15 m bgl to 10m bgl.

16. The submitter: WWL suggest that the policy should consider working from the top of the aquitard rather than the bottom of the aquitard and propose a depth of 10m bgl instead of 15m bgl. The current delineation of Category B is groundwater below 15m bgl throughout the Waiwhetu aquifer (Fig. 4 Power point). WWL submits that Category A should be conservative to ensure allocation cannot draw from the Waiwhetu aquifer.

17. The purpose of the proposed change is to ensure the sustainability of groundwater resources from the Waiwhetu aquifer to supply the four cities under the bulk water consent. Reductions in available supply could result in water restrictions more so during the summer dry months.

18. The Waiwhetu aquifer under Category B allocation provides the Wellington's four cities (Wellington City, Lower and Upper Hutt and Porirua) with 40% of the water demand and up to 70% during the summer period.

19. The Category B groundwater is separated from Category A groundwater in the shallow subsurface by an aquitard of varying thickness.

20. There are currently no consented takes from Category A groundwater in the Lower Hutt Aquifer. Groundwater takes from Category A are limited by the general poor quality of water in the shallow subsurface and also saline water movements due to tidal influences.

21. Generally, Category A groundwater in the Lower Hutt area is accessed only for shorter periods of time such as during prolonged dewatering activities that are related to infrastructure developments.

22. I therefore do agree that the depth of Category A in the Hutt Valley should be changed from 15m to 10m. Below are my reasons for supporting this proposed change:

23. Abstraction of groundwater below the confining layer which could be as shallow as 13m bgl will result in the depressurization of the Waiwhetu aquifer resulting in reduction of yield from this Category B aquifer.

24. Recent geotechnical bore monitoring at depths of 13.5m and 14m bgl (Fig. 4 Power point) from T&T indicates that the installations exhibit artesian pressure conditions characteristic of the Waiwhetu aquifer as compared to shallow groundwater (Category A) shown on the same plots.

25. From the graphs on Fig. 4 it is evident that the Waiwhetu aquifer (Category B) at Hutt City Building is located less than 15m bgl. Taking into consideration the thickness of the aquitard it is recommended that a depth of 10m bgl should be used as a guideline in delineating between Category A and Category B groundwater.

26. The changing from 15 to 10 meters is not likely to change allocation take volumes for each of the categories in the Lower Hutt Valley.

III. Subject Area A: Measures to prevent saline intrusion and the risk increase with climate change

27. The submitter- WWL (s135/117) submit that it would be more appropriate to specify a datum in Policy P121 rather than just sea level. S135 suggests the datum could be Wellington vertical datum 1953.

28. The submitter is concerned that where fresh water aquifers interface with the coast there is a risk that significant groundwater abstraction will alter the freshwater-saltwater interface.

29. The purpose of Policy P121: is to prevent salt water intrusion into aquifers. Where fresh water aquifers interface with the coast there is a risk that significant groundwater abstraction will alter the freshwater-saltwater interface. Policy P121 sets management levels for aquifers on the Kāpiti Coast and the Hutt Valley to ensure the saline interface does not migrate landward and compromise the water quality in the fresh water bores. There is no connectivity of groundwater and the sea in the Wairarapa Valley hence no further analysis was undertaken for this region.

30. I agree and confirm that levels are based on the Wellington Vertical Datum-1953. This datum is referred to as the mean sea level. Therefore I agree that the level should be based on this datum which is actually the mean sea level.

31. The HAM3 groundwater allocation model is based upon the groundwater level monitoring data which was reduced to this vertical survey datum (Wellington Vertical Datum-1953, or WVD-53). GWRC groundwater level monitoring sites to provide elevation data for consenting trigger levels are based on the same datum. Therefore reference should be to this datum (WVD-53). The WVD-53 datum is used in the GWRC Hilltop database.

IV. Effects of climate change on saltwater intrusion into aquifers:

32. Wellington Recreational Marine Fishers Association (s32/001) submit that the effects of climate change are not correctly described in the proposed Plan and "we" now have deeper low pressure systems that cause sea level to rise.

33. I agree that management effects of climate change should be taken into account in managing abstractions to prevent saltwater intrusion into the Hutt aquifer. Below is my discussion on how climate change has been factored in the modelling of groundwater allocations for the Lower Hutt Aquifer:

34. The groundwater allocation model (HAM3) did consider the potential effects of sea level rise due to climatic factor changes (Earth In Mind, 2016 sections 9.1 to 9.4). Sea level rise over the last 100 years are averaged at 2mm per year i.e. with a total 0.20m over this period (Wellington Vertical Datum (WVD-53). The model also considers sea level rises due to compounding factors of land subsidence caused by tectonic activities. Baseline modelling conditions use a sea level rise of 0.2m i.e. sea level rise that has occurred over the last 100years.

35. A combination of factors in (34) above is projected to result in a 0.8m rise by 2090 or 1m by 2115. The HAM3 model adopts a high sea rise scenario of 1.5m as a basis for assessing the vulnerability of the Waiwhetu aquifer. This worst case scenario will result in reduction of approximately 30% in aquifer yield.

36. Using the above worst case scenario it is projected that a combination of sea level rise and land subsidence will result in approximately 0.45m change in head over the duration of this PRNP. However, I recommend that saline intrusion risk management measures and minimum levels should be reviewed every 10 years.

37. Maintaining water levels above sea level at the foreshore of the Hutt Valley at 2m and cessation of take at 1.7m (based on groundwater levels averaged over 24 hours) should maintain adequate positive pressure head despite effects of

sea level rise and land subsidence. It is anticipated that any movement of the saltwater fresh water interface will be detected by robust monitoring systems both in the Hutt Valley.

38. It is found appropriate that cessation of groundwater takes in a catchment management unit in the Kapiti Coast should occur when the water level at the foreshore falls below 1m above mean sea level (based on groundwater levels averaged over three days).

39. Groundwater abstraction from the Kapiti Coast is significantly less than the Wellington's Lower Hutt aquifer and offshore discharges are spread over several kilometers. A robust saltwater monitoring network that includes levels and conductivity monitoring systems at a number of sentinel wells has been installed. This network monitors the effects of abstractions from the Kapiti borefield and it contains robust trigger levels to track the movement of the saltwater/freshwater interface.

Subject Area B: Dewatering

40. It is important to recognise that dewatering and groundwater control has the potential to impact on the groundwater environment. In general terms, long duration dewatering has a greater potential to cause significant impact, compared to short term dewatering.

41. Conversely, it should be recognized that, say, a shallow excavation for construction of a manhole that may take only a few weeks to complete has much less potential for impact, and may only require a quick review to confirm impacts are not a significant concern.

42. Issue: WWL and KCDC propose that the Rule 140 Dewatering – permitted activity rule should be revised by removing maximum time limit on dewatering if all other conditions are met. Both submitters are concerned that the rule causes unnecessary and costly consenting requirements more specifically dewatering required for the establishment and maintenance of regionally significant infrastructure. WWL seeks clarification on the length of dewatering whether it's a calendar month or any 30 continuous days.

43. DM Response: I have discussed potential effects of dewatering in my main evidence. NZTA recognises effects of large scale dewatering on their infrastructure and proposes to strengthen the rule by referring to effects on structure integrity rather than just the observed effects.

44. I agree with Ms Rita O'Brian (KCDC) paragraph 4.3 that KCDC have a extensive experience in dewatering due to the nature of their environment of high water tables. I also agree with Ms O'Brian that they are using dewatering best practices that provide adequate mitigations against negative effects such as effects on geotechnical and other structures and also effects on water resources. Ms O'Brian also refers to a collaborative experience in which I (GWRC) modelled potential dewatering and the dewatering KCDC undertook which was in agreement with modelling results. I also agree with Ms O'Brian paragraph 4.3 that one size does not fit all.

45. I am of the opinion that KCDC are using best practice approaches to dewatering in order to reduce or eliminate effects to the environment. I do agree that

reduced consenting requirements that are based on gained knowledge should lead to less costs and also less delays in completing infrastructure upgrades.

46. However, in my opinion any large scale and long term dewatering including dewatering for the establishment and maintenance of regionally significant infrastructure has a potential to cause significant environmental effects.

47. It should be noted that these rules also apply to third parties who might not have the skills and technology for environmentally protective dewatering that is available to KCDC or WWL. It should also be recognised that the rule also protects infrastructure owned KCDC, WWL or other authorities from third party dewatering activities. For example: KCDC were identified as potentially adversely affected party given they are the authority responsible for the public water supply which is located adjacent to the proposed dewatering around Bridge 2 for the Transmission Gulley Project.

48. A longer period of time for dewatering required for the establishment and maintenance of regionally significant infrastructure or any emergency works could be undertaken through consenting or through a global consenting process.

49. WWL are in the process of applying for a global dewatering consent. The application recognises and identifies high and low risk areas and also proposes various responses commensurate with identified levels of risk. Developing such a risk matrix and also leveraging on experience could assist KCDC in developing and applying for a global dewatering consent. Detailed investigations would only be required in areas identified with higher risks. Fig. 5 (Power point) is a map showing areas (developed by WWL) of different dewatering risks.