IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of the hearing of submissions on Proposed Plan Change 5 (Nutrient Management and Waitaki Sub-region) to the Canterbury Land and Water Regional Plan
BY	**MORVEN, GLENAVY, IKAWAI IRRIGATION COMPANY LIMITED**
AND	**WAITAKI IRRIGATORS COLLECTIVE LIMITED**
	Submitters
TO	**CANTERBURY REGIONAL COUNCIL**
	Local authority

STATEMENT OF EVIDENCE OF CRAIG MAXWELL EVANS ON BEHALF OF THE MORVEN, GLENAVY, IKAWAI IRRIGATION COMPANY LIMITED AND THE WAITAKI IRRIGATORS COLLECTIVE LIMITED

Dated: 22 July 2016

INTRODUCTION

Qualifications and experience

1. My name is Craig Evans. I am the General Manager of the Morven Glenavy Ikawai Irrigation Company Limited ("**MGI**").

2. I hold a BSc (Hons) degree in Geology; a Graduate Certificate in Environmental Planning; and I have completed a Graduate Certificate of Project Management as part of a Masters of Business Administration (MBA) degree.

3. I have 26-years of experience in management including 18-years as a hydrogeologist and environmental scientist involved in groundwater, water allocation and water quality environmental management in New Zealand and overseas. My experience that is relevant to this submission includes:

    - I have published three collaborative scientific papers and have recognised expertise in groundwater modelling applications for environmental management and investigations into subsurface fluid movement;

    - While employed at the Taranaki Regional Council I performed multiple studies into the effects of intensive dairying on groundwater and surface water quality and assisted to author the Regional Fresh Water Plan for Taranaki;

    - As a hydrogeologist I have performed many groundwater modelling applications for water abstraction and discharge applications including diffuse source agricultural and land-use models;

    - I was engaged by the Government of Brunei Darussalam to study the Tutong River in Borneo and prepare water quality guidelines for the country.

    - As a consultant I prepared over 100 AEE's and regularly appeared at Hearings and the Environment Court as an expert witness in support of water abstractions for the purposes of irrigation in Southland, Otago, Canterbury, Marlborough and the Hawkes Bay.

4. I have 6-years of experience as an international project manager for mining and oil & gas developments greater than $1B in size and have led feasibility studies to investigate the environmental and economic implications of these investments.

SCOPE OF MY EVIDENCE

5. My evidence will cover the following matters:

- general information about MGI, its resource consent conditions and environmental management strategy;
- issues relating to groundwater quality within the MGI command area and the applicability to the proposed regional rules;
- issues relating to the inadequacy of the section 32 analysis undertaken by Environment Canterbury; and
- the implications of Proposed Plan Change 5 for MGI shareholders.

ABOUT MGI

6. MGI is one of the largest and longest established irrigation schemes in Canterbury, providing water from the Waitaki River to farmers irrigating over 28,000 hectares of land in South Canterbury (refer to Figure 1). Table 1 shows the areas under irrigation, the scheme still has 9,239ha under border-dyke irrigation but these are gradually being converted to spray.

7. The original Redcliffs scheme was first constructed by the Crown in the 1930's and it was not until the 1970's that the Morven and Glenavy areas were developed and then the scheme was privatised in 1989 and sold to the Morven Glenavy Ikawai irrigation Company Limited. Conversion to dairying began in the late-80's and nowadays the scheme is dominated by high intensity dairy farming.

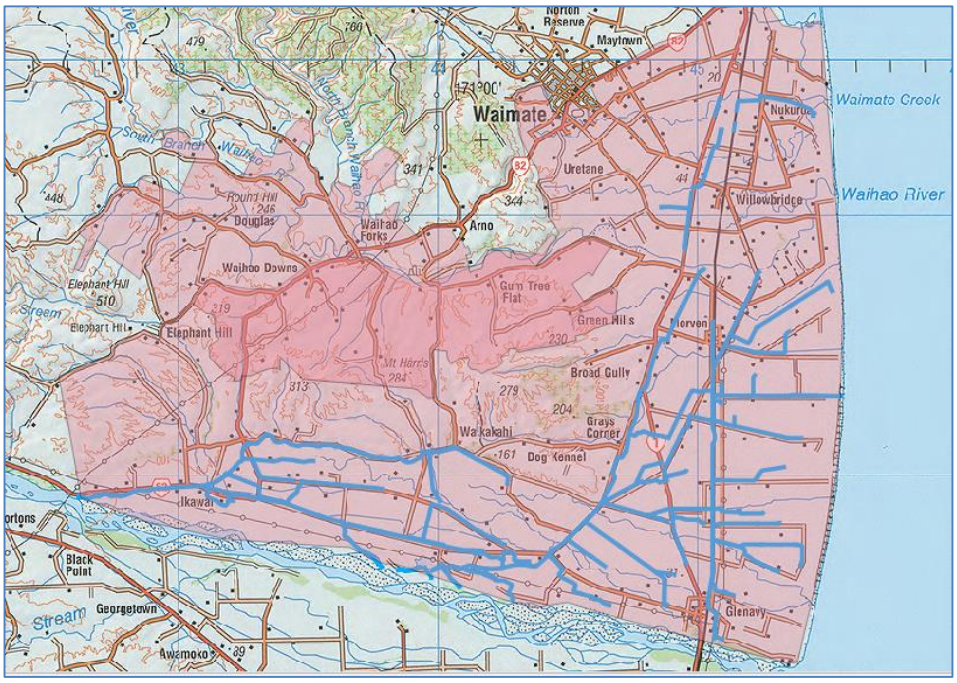

Figure 1: Map showing MGI command area (shaded area).

Table 1: Irrigated areas for the MGI scheme (by shareholding).

	Borderdyke	Spray	Total
Morven Glenavy	7,163	7,356	**14,519**
Redcliff	2,076	5,302	**7,378**
Northern Extension	0	2,881	**2,881**
Waihao Downs	0	3,234	**3,234**
Total	**9,239**	**18,773**	**28,012**
	33%	67%	100%

8. MGI is well-respected for its role in environmental management and the Company has been responsible for numerous environmental improvement projects, land drainage enhancements, and some of the first Farm Environmental Plans in the region. Our shareholding farmers are strongly managed and supported by MGI.

9. The MGI command area falls in the South Coastal Canterbury Area of the Plan and includes part of the Waihao Wainono Area, all of the Morven Sinclairs Area, part of the Northern Fan area and part of the Whitneys Creek area. It appears that Rules 15.5.1 and 15.5.2 may apply in our area and the nitrogen limits in Table 15(m) and it appears that Rules 15.5.11 and 15.5.12 apply and the nitrogen limits in Table 15(p).

OUR SUBMISSION

10. The proposed rule framework is too complex. It is my submission that the environmental outcomes that are sought by Environment Canterbury will not be effective if farmers, and indeed qualified professionals such as myself, cannot even understand them.

11. It is my submission that the rules framework is not supported by the science and is inconsistent with Sections 5 and 15 of the RMA.

12. It is my submission that Environment Canterbury have performed an inadequate Section 32 analysis and the costs and benefits of implementing the proposed rules have not been addressed.

13. Our Environmental Manager, Judith Neilson is also providing evidence under our submission. Judith will explain our Farm Environmental Planning process. Our submission is that irrigation schemes such as MGI should be allowed to self-manage nutrient discharges in the command area and this will be a more effective method than requiring a discharge permit.

GROUNDWATER QUALITY IN THE MGI COMMAND AREA

14. Figure 2 shows the trend in total dairy cattle in Canterbury since 1990 and this trend is applicable to the MGI command area in south Canterbury where the climate and abundance of irrigation water has supported the growth of the industry. The MGI area is not exclusively dairy but the trend shown in Figure 2 is a good approximation of the increased agricultural intensity in the command area.

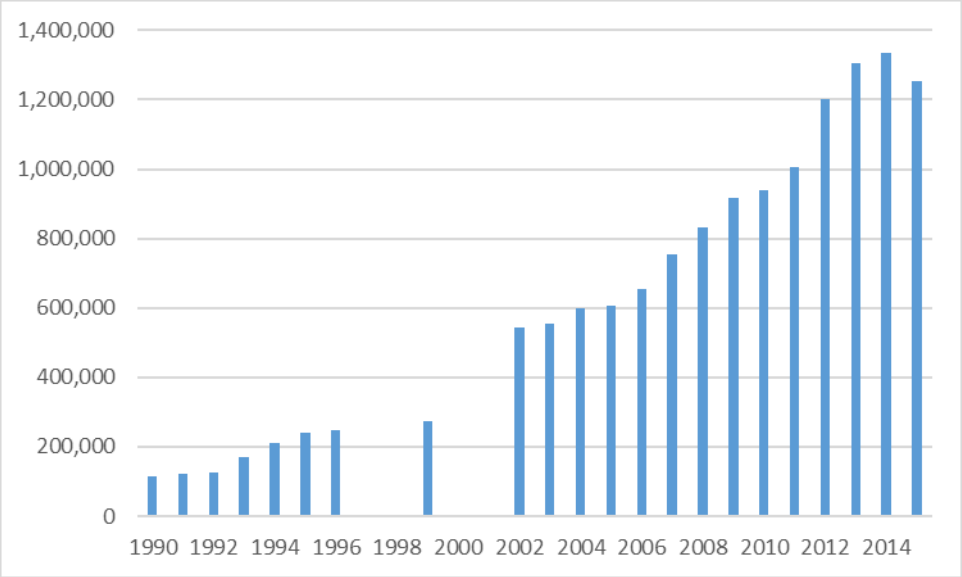

Figure 2: Total dairy cow numbers in Canterbury (Source: Statistics New Zealand).

15. Environment Canterbury perform state of the environment monitoring in seven shallow wells within the MGI command area and all of the groundwater nitrate observations exhibit an increase in nitrate-N levels (Figure 3) consistent with the increase in dairy cow numbers. There is no doubt that the shallow groundwater quality is affected by agricultural land-use intensity. This is well known relationship that is replicated and published throughout New Zealand.

16. Some of the data in Figure 3 also exhibits “spikes” in groundwater nitrate-N above the recommended drinking water guideline of 11.3 mg/L (as nitrogen). These spikes may be contamination events, sampling or analytical anomalies but the important aspect of the data is the long-term trend. The groundwater quality averages 4.2 mg/L-N overall and is generally well below the drinking water guideline. Environment Canterbury noted in the Section 32 report that the groundwater quality and surface water quality within the command area is “generally better than the regional averages for Canterbury” (referencing Shaw and Palmer (2015)).

	Min	Max	Mean
J40/0053	3.8	10.4	5.3
J40/0077	2.3	13.8	5.3
J40/0106	0.1	4.8	3.4
J40/0118	2.6	4.2	3.3
J40/0163	2.9	14.1	5.4
J41/0018	0.7	7.7	3.0
J41/0054	1.5	6.0	3.3

Figure 3 – Groundwater nitrate observations from the MGI command area (1990 – 2016).

17. Observations of the water quality in the local spring-fed streams are also a good approximation of the groundwater quality after reasonable mixing. During low flow the spring-fed streams and rivers in the catchment are being sustained by the discharge of this same shallow groundwater (the river base flow). Assuming that the period January to March is the best indication of low flow conditions, the surface water quality sites in Figure 4 exhibit nitrogen concentrations of between 0.4 to 2.5 mg/L-N[1].

[1] Expressed as total nitrogen (TN) because nitrogen speciation in groundwater typically changes when discharged to rivers (ratio of nitrate-nitrogen and ammoniacal-nitrogen).

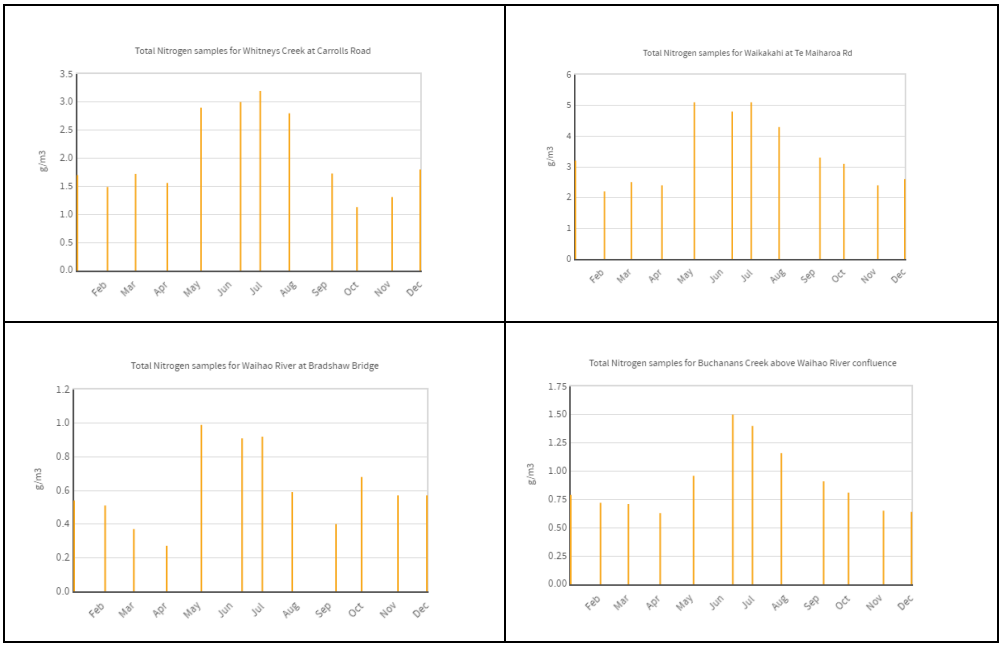

Figure 4: Nitrogen concentrations in spring-fed streams of the MGI command area (Source: Land and Water Aotearoa website).

ASSESSMENT OF ENVIRONMENTAL EFFECTS

Modelling

18. Environment Canterbury is relying upon Overseer as the management tool for prescribing nutrient loading limits. The Overseer model is fraught with issues and limitations which I am sure the Hearing Committee is well aware of through many submissions on the topic. All of the experts agree that Overseer is not a receiving water model.

19. In seeking to regulate land use and the discharge using tools such as Overseer, Environment Canterbury is returning to pre-RMA activity-based management. It is my opinion that a focus on the activity and the rate of nutrient loading to land will lead to unduly conservative outcomes unless the effects on the receiving water after reasonable mixing are also taken into consideration. Inadequate information has been presented by Environment Canterbury regarding the effects on the environment, as I would have expected under Section 15 of the RMA. This issue is not at all addressed by Overseer and is the realm of complex hydrological models and the expertise of the hydrogeologist.

20. Overseer is a decision-support tool that deals with nutrient budgets at the soil level and so it estimates losses to the environment. Overseer may give an indication of nutrient losses below the soil rooting zone, in other words it estimates the discharge to soil, but it does not estimate the discharge to water or the effects after reasonable

mixing. The leachate and nutrients must still travel through the deeper soil, unsaturated zone and then mix in the groundwater below and there are many opportunities for denitrification and for phosphorus to become bound to the soil within this travel pathway. The result is that the use of Overseer will lead to conservative outcomes, notwithstanding that many experts also dispute the accuracy of the Overseer results.

21. Modelling complexities aside, I can see the logic that if the rate of discharge is reduced then it follows that the increase of mobile constituents like nitrate-N in the receiving water must also be reduced. The data that I have presented in Figure 3 shows the corollary of this, increased land use intensity is leading to increased groundwater nitrate levels. Nonetheless I have two main concerns when it is employed for Environment Canterbury's proposed rule framework:

- It fails to address Section 5 of the RMA. In paraphrased terms, whether the discharge, after reasonable mixing, is acceptable when the effects on water quality are compared with the social and economic needs of the community (I expected that these issues would have been addressed in the Section 32 report but they have not been); and

- It fails to address the hydrogeological dynamics and the mixing zone, which is a concept that I wish to address in my evidence now.

22. Nature is full of equilibriums and the concept of reasonable mixing in groundwater is no exception. As shown in Figure 3, there has been an increase in groundwater nitrate since about 1990 due to increased agricultural intensity. In a highly developed mature catchment like the MGI command area the rate of discharge of nutrients to land is not likely to increase further and over the long-term we expect the groundwater system to reach a state of equilibrium where there is no further increase in nitrate levels after reasonable mixing[2]. At this juncture there is a significant disconnect between the activity-based rules framework that relies upon Overseer to limit the discharge and the actual effects on the environment and this leads to conservative outcomes.

23. The shallow groundwater systems underlying the MGI command area are dominated by alluvial gravel lithology (porosity of around 20%) and finer sediment such as clay (porosity of around 30%). At the lower end porosity (20%) the upper 10-metres of the unconfined groundwater in the MGI area contains 560 Mm^3 of water in storage.

[2] Complex numeric modelling is required to address the diffuse source and often temporal nutrient loading, the rate of groundwater flux, reasonable mixing and the time of concentration of the contaminants in water. The groundwater system offers significant storage and is constantly moving ("flushing").

24. The groundwater is continuously flowing towards the coast and average the rate of groundwater flux in the upper 10 metres of aquifer along the 22km length of the MGI command area is about 1,046 litres/second[3]. This is an approximation of the mixing zone in the unconfined aquifer.

25. We need to use complex numeric models to handle spatial and temporal variability and complex geology, but in very simple terms we can predict the effect of the nitrogen loss to groundwater, as shown in Table 2. If there is 20 kgN/ha/year losses, the effect on the upper 10m of groundwater is to increase the nitrogen concentration by 1.00 mg/L (as nitrogen). However, we also know that the groundwater is in flux and the nitrogen is also being discharged from the system. The low flow spring-fed streams are a very good surrogate for this process and as presented in Figure 4 the concentrations are 0.4 to 2.5 mg/L-N.

Table 2: Ballpark calculation of nitrogen in groundwater concentrations from diffuse source losses.

Maximum nitrogen loss rate	20	kg/ha/yr
MGI command area	28,000	ha
Annual N Load	560,000	kg/yr
Calculation of Nitrogen Concentrations		
Effect on groundwater in storage (if fully mixed)	0.001	kg/m3-N
	1.00	mg/L-N

26. It is notable that there is no threat to the life-supporting capacity of water and ecosystems implied by the water quality observations. Nitrate levels are well below the human drinking water guideline of 11.3 mg/L-N and nitrate does not pose a threat to freshwater ecosystems anyway. This drinking water guideline appears to be driving many of the objectives of PC5 but no-one appears to be asking the question about appropriate this is, and whether a virtually singular focus on drinking water guidelines outweighs all other considerations including the economics of farming. Nitrogen is converted to its ammoniacal form in aquifers and rivers where reducing conditions may exist. Ammonia can be toxic to fish under certain pH and temperature conditions but none of the ammoniacal-N concentrations are high enough for this. Phosphorus poses no threat to the life-supporting capacity but does encourage macrophyte growth in rivers which is a nuisance to humans, provides habitat for some organisms but also renders the habitat unsuitable for other kinds of aquatic fauna. I make this

[3] Using Darcy's Law and a hydraulic conductivity (K) of 1e-3 m/s which is mid-range for typical gravel aquifers. The length of the MGI command area perpendicular to the hydraulic gradient is 22km and assuming a 10m average thickness.

point because in the absence of adverse environmental effects and threats to the life-supporting capacity of ecosystems, one of the main outcomes of PC5 is an adverse effect on the economy.

27. Given that the capability and technology exists to simulate the potential effects on the environment after reasonable mixing, is it then appropriate to rely upon an activity-based discharge model like Overseer when regulating a multi-billion-dollar industry that is enabling the community to meet its social and economic needs and well-being? My opinion is that it is not appropriate given the strength of the science and the legal requirements set out in Section 5, 15 and 32 of the RMA.

28. Allowing the irrigation schemes to self-manage and maintain good management practices while monitoring the environmental effects of the agricultural activities would be a preferred outcome. We can ensure that nutrient discharges are reduced, and as a minimum not worsened and monitor the actual effects on water quality to see if it improves or flat-lines. This is a better alternative to the risk of over-prescribing the nutrient limits and harming the social and economic base of the community.

"High Risk" Activities

29. The Section 32 report explains that irrigation is classified as a high-risk activity in the context of nutrient management. This comment illustrates the even greater risk that Environment Canterbury is taking with its focus on Overseer and nutrient losses from soil. The Section 32 report has not recognised that the proposed rule framework aimed at managing nutrient losses to the land is not taking into account the full and holistic positive effects on the environment due to irrigation.

30. Irrigation is not only an important factor to enable communities to meet their economic and cultural well-being, it also offers many other benefits to the environment. Irrigation increases the soil moisture in the soil and as a result increases recharge to groundwater. The water-table is higher in an irrigated catchment and spring-fed streams flow more reliably. Without irrigation there are some catchments in Canterbury where spring-fed streams will dry up, at least in their headwaters, or as a minimum that will revert to being more ephemeral.

31. Border-dyke irrigation is an inefficient use of water. There is no doubt that there are greater water and nutrient losses from pastures under border-dyke irrigation. This is recognised in Overseer and as a result border-dyke irrigation does come out worse off in the PC5 framework. In the MGI command area we have been experiencing about 10% conversion from borderdyke to spray irrigation each year, but possibly this conversion rate may accelerate once PC5 becomes fully operative. This may be

considered a “win” in the context of nutrient management but a holistic view also needs to be taken.

32. Environment Canterbury have not assessed the holistic environmental effects of irrigation. Although border-dyke irrigation is an inefficient use of water it is also promotes the greatest amount of groundwater recharge compared with other forms of irrigation. As the conversions from border-dyke to spray continue there will be a reduction of aquifer recharge and a lowering of the water-table. There will be an associated reduction in the flows of spring-fed streams.

33. Border-dyke conversions are happening anyway, but PC5 is likely to accelerate it and this will improve nutrient losses but give rise to significant adverse effects on the flows in spring-fed streams, the available habitat and the life-supporting capacity of aquatic ecosystems. Many spring-fed streams in the MGI command area, such as the Waikakahi Stream are highly valued as fish habitats. It would be better not to accelerate these changes and let them occur at a rate that the ecosystem can handle. Possibilities also exist for irrigation schemes and individuals to offset impacts using augmentation flows and other methods, but these also take time to plan and implement.

SECTION 32 ANALYSIS

34. Following the Resource Management Amendment Act 2013, the new section 32(2) sets out the requirements for assessing whether the proposed plan change will meet the objectives in the most appropriate way. It is my submission that the Environment Canterbury have not met the requirements of Section 32(2) and that they have flaws in the analysis that they have performed.

35. I assume that this Hearing Committee will form its own view on whether you have the best information on which to make decisions, but it is my opinion that you do not. Section 32(2) of the RMA requires that benefits and costs are to be quantified and they have not been. It is my opinion that these issues are significant and that they need to be considered.

36. If the nutrient limit is lowered too far then there will be quantifiable reduction in agricultural productivity. According to the Ministry of Primary Industries the dairy industry alone is worth $17B to the New Zealand economy in 2016. On the ratio of dairy cows (Statistics New Zealand) this equates to about $3.2B of economic value to the region of Canterbury[4]. Even a 5% reduction in productivity is a staggering

[4] Statistics New Zealand:

Dairy cattle in New Zealand in 2015	6,485,535
Dairy cattle in Canterbury in 2015	1,253,993

$160M reduction in economic benefits in Canterbury. The decision-maker should ensure that they are very confident that the environmental benefit is sufficient to outweigh this cost. This science has not been presented by Environment Canterbury.

37. The most effective methods to give effect to the perceived environmental benefits have not been adequately evaluated. The prescriptive approach that Environment Canterbury have framed into proposed Plan Change 5 is quite possibly the least effective method available because:

- It is too complex to be understood. If the community cannot understand the rules frame work then it cannot possibly be an effective management tool.

- The complexity is expensive. It will necessitate an increased use of consultants by farmers in order to obtain the support that they will need to comply with the assessment, consents and compliance activities that it will generate. The complexity also increases the likelihood of non-compliance with consent conditions, which in turn increases the costs to farmers and to Council.

- Environment Canterbury have not presented their own costs to decision-makers, ratepayers and stakeholders. In the Section 32 analysis I expect to see the following information:

    - The increases in staff members or consultants to handle the increased workload to process the additional discharge permit applications;

    - The increases in compliance and enforcement staff, and expenses, associated with the monitoring and compliance actions for the new discharge permits (the s32 report says there may be 2,450 permits).

    - The effect of these increased costs on the long-term budget and rates for the region.

- Cost to farmers have not been presented. I mentioned the increased cost to farmers due to compliance and complexity, but even without these costs there are still increased consent application fees and monitoring costs that will be borne by the community.

38. The costs need to be presented so that they can be weighed up against the perceived environmental benefits and also whether the best management method is being selected. However, MGI would be satisfied if the proposed rules were changed to make nutrient discharges in the scheme area a permitted activity. Self-management of the issue is likely to be more effective and can be delivered at little or no increased cost.

CONCLUSION

39. Groundwater and surface water quality monitoring does indicate an increasing trend of nutrients in water due to intensified agricultural land-use. However, it has not been established that this trend will worsen and current levels are still, on average, lower than any recognised environmental guideline. Furthermore, there is little or no evidence of adverse effects or threats to the life-supporting capacity of water or ecosystems.

40. Irrigation has a significant positive environmental impact, on water flows and ecosystems, community and the economy and this outweighs the perceived benefit of the rules proposed in PC5, and it certainly outweighs the costs involved.

41. A robust assessment of the environmental effects of PC5 and a robust Section 32 analysis has not been performed. Given the lack of adequate information and the almost certain impact on farming communities it would be better to take a conservative approach involving:

- Maintaining or reducing current nutrient loads using GMP;
- State of the Environment monitoring to adjust nutrient budgets if required;
- Allowing the irrigation schemes to self-manage as permitted activities using the existing FEP framework.

Craig Evans

22 July 2016