

Interactive comment on “River water quality changes in New Zealand over 26 years (1989–2014): Response to land use and land disturbance” by Jason P. Julian et al.

Anonymous Referee #1

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General comments The manuscript provides a comprehensive, robust and well-written analysis of relationships between landscape and land use indicators, and water quality in New Zealand. The research adds to analyses already conducted on water quality spatial and temporal trends in New Zealand. The manuscript is considered publishable in its current state, with some minor clarifications suggested below. I recommend retaining all the supplied supplementary material.

Specific comments L202 Were stock numbers normalized by total catchment area or by area of grassland per catchment? If the former, please comment on whether there were scenarios of under-estimation of stock density due to non-grassland area. L240 Were all the landscape variables independent of each other? L392 Did the sites that

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had positive relationships between NO_x and Q coincide with those which had positive relationships between P and Q? L436 Can some explanation for the ‘Nineteen of the catchments experienced significant or ‘meaningful’ decreases in CDOM since 1989.’ be provided? L770 I assume a reduction in N input to streams due to increased wetland coverage would be at a pollution swap cost of increased greenhouse gas emissions. The authors may wish to consider including a comment around this.

Technical comments L16 Can a more specific phrase than ‘outweighs’ be used? L16-17 check grammar – missing word been i.e. ‘...been cleaned up...’ L21 Suggest reword ‘from 1989 and 2014’ to ‘from 1989 to 2014’ L 22 Suggest breaking in to two sentences: ‘The NRWQN consisted of 77 sites...’ L26 Please clarify if ‘nitrate-nitrite-nitrogen’ means both nitrate-N and nitrite-N, possibly by using the term ‘total oxidised nitrogen’. L28 Suggest ‘greatest negative impact’ L34 Suggest rewords as ‘and mobilized nutrients.’ L35 Suggest reword as ‘...expertise in fields of geospatial analysis...’ L45 and L48 Please provide appropriate references as these cause-effect relationships may not be ubiquitous L52 Re ‘Historically, water quality in rivers was managed to meet minimal standards’ In rivers where? And what is meant by minimal standards? L84 and throughout. Suggest avoiding abbreviations in the first word of a sentence L85 Suggest rewords as ‘...highest rates of agricultural land intensification...’ L86-87 I suggest the NZ example would be of value to other developed countries that are intensifying, and possibly of less relevance to developing countries, where point source issues may still dominate water quality problems. Please consider. L123 suggest adding words for clarity ‘... (NRWQN), which is operated and maintained by...’ Table 1 An added column containing references to the methods used to analyse each parameter would be helpful. L147 Which DEM is referred to as ‘This DEM...’? and why was rescaling from 25m to 30m resolution required? L150 Please describe the River Environment Classification (REC, v2.0) to the extent that your methods can be repeated by a reader. L153 Suggest italicising ‘sensu’ L154 Suggest reword as ‘ratio of the total length of REC streams to catchment area.’ L169 Please define ‘annual water yield’ L180 Please clarify the meaning of ‘...and maps land use for 2008 and 2012 as well for 12 classes.’,

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particularly re 12 classes of what? L191-192 Past tense if probably appropriate here. L210 Suggest reword as 'Land disturbance, defined here as bare soil, ...' L212 Can you describe the extent to which you, or de Beurs et al (2016) ground-truthed the disturbance index against measures of bare soil, to give the reader confidence in the method? L231-232 Please clarify what is meant by 'actual values' in this context. L371 and 372 Please clarify – COND and pH decreased with increasing Q? L396, 451 Check spelling of phosphorus L513. Which four nutrient variables are referred to here? Figure 5 What does the direction of the symbol arrows mean? Also, I suggest using the explanation in the text 'catchments that exceed ANZECC guidelines for DRP are indicated in by grey-filled markers' rather than the current caption text because the latter is hard to understand.

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