Further Submission to Stream Two Hearings for "Plan Change 1 to the Natural Resources Plan"

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About this organization.	The NZFFA represents people who own small-scale private forests and/or are interested in the many values of trees. Currently we have over 1200 members representing a good cross-section of the approximately 16,000 entities owning private forests in New Zealand. In the Wellington region, the NZFFA has about 100 members with direct interests or ownership in small scale forestry,

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Summary:

- Our original Submission was S036
- We comment of the S42a report for Stream 2 relating to Objectives:
    - Changes to the wording of WH.02. We approve that removing the text "to more natural levels" is appropriate"
    - Paragraph 288 regarding use of incorrect TAS Visual Clarity data to target forestry. The TAS clarity for Mangaroa River has been substantially reduced. Makara Stream is the only other rural river with substantial areas in forestry that also fails for clarity. We will make our further submissions in Stream 3.
    - Paragraph 338. We side with China Forestry Group. If a TAS can be met in a sub-catchment, but fails in the lower reaches, it seems unreasonable to require land use changes, let alone other mitigations, in sub-catchments that are not at fault.
- We comment on the S42A report for Stream 2 relating to Ecosystem Health and Water Policies:
    - We support the proposed change to the TAS VC for Mangaroa River (1.67m) and the consequential calculated sediment load reductions, but data supporting the numeric 1.67m is limited and should be regarded as interim.
    - We also support the proposed changes to Policies WH.P1 and P.P1 to the effect that improvements are only needed where ecosystem health is degraded. i.e. where TAS and NBL are not already met (S42a report Paragraph 48).
    - We support removal of the column in Table 8.5 and 9.4 for dSedNet mean annual loads.
    - Paragraph 76 relating to WH.P4/Table 8.5 and insufficient water quality monitoring, we agree with the reviewer that "The case for which of these activities need to be managed and how to contribute 'their bit' to achieving the TAS, and the evidence basis for that, is a matter for the future hearing streams covering the policies and rules for rural land use, forestry and earthworks (Hearing Stream 3)"
- Plan Change 1 lists only two rural rivers where suspended fine sediment/median visual clarity (VC) does not meet TAS and National Bottom Lines, but these two failures appear to predicate the intention of GW to restrict the area of land utilised by plantation forestry and to require Plantation Forestry to be a consented process.
- We note that even though the TAS for VC in Mangaroa River has been substantially reduced, the median value still fails for 7 months each year. The sources of sediment should be identified before implementing land use changes.
- We provide details of VC measurements taken over 1 month (Jan/Feb 2025) for Mangaroa River along its length and several of its tributaries. This demonstrates a substantial effect of the Black Stream natural brown water (Coloured Dark Organic Matter, CDOM) for readings taken downstream at Te Marua.
- Black Stream also appears to be a large source of naturally occurring suspended sediment (in addition to CDOM)
- We challenge table WH.P4 (Table 8.5) regarding estimated suspended sediment reductions for Mangaroa River. Current Estimates of required sediment load reductions for Mangaroa River still have a high level of uncertainty.
- We note that extensive forestry harvesting alongside Horokiri Stream has had minimal effect on VC.

- The lack of evidence that forestry is degrading our water ways supports our contention that GW has insufficient stringency of argument to warrant overriding a National Environmental Standard.
- We present Expert testimony from Dr Les Basher. While most of his testimony relates to Stream 3, forestry/earthworks and the use of the Easton Report to identify highly erosion prone land, he does comment on the expectation that water quality attribute states of rivers will approach a level of quality that existed prior to human intervention in NZ. Therefore, Dr Bashers full report is tabled for Stream 2.
- We comment on, and support Wairarapa Federated Farmers submission about the need to identify sources of suspended sediment and to continue monitoring to ensure that any land use changes are working.

Freshwater Objectives Should NOT Generally be Used to Override NES-PF

In relation to the overall Objectives and Ecosystem Health Polices for PC-1, we note a comment published by MFE, **Guiding principle: MFE Guidance Doc**

> Regulation 7 of the NES-F specifies the NES-F regulations are subject to the NES-PF. Where the NES-PF and the NES-F conflict or overlap, the relevant provisions of the NES-PF will prevail over those in the NES-F.

We consider that when preparing Plan Change 1, that GW has chosen to follow NES-Freshwater rather than NES-Plantation Forestry. Certainly, provisions of the NPS-FM are proposed to override the NES-PF and NES-CF.

Objective WH01 and WH02

PC1 headings	**Original Submission by Wgtn FFA in S036**
WH01, to improve health to Wai Ora by 2100	**-**
Objective WH.02, b. the hydrology of rivers and erosion processes, including bank stability are improved and sources of sediment are reduced to a more natural level, and… Also Objective clause Bb in schedule 33 **Schedule 34 Objectives**: B2, avoid an increase in risk of loss of sediment to water relative to the risk of loss that exists from the land in a natural state, and B3. Achieve the discharge standard in Rule WH.R20(c) or Rule P.R19(c) for any discharge of water and sediment from	Natural level for sediment was defined in NPS-FM as that which existed in NZ prehuman. Was that just after the last Taupo eruption or soon after the last Ice age? Use of baseline data or some other agreed TAS rather than natural state would be more realistic. **GW and others need to find a better way of defining natural levels.** **……** **In our opinion, without sediment control measures of the sophistication and scale used for state highway roading, forestry harvest could not achieve these standards (<100g/m^3), even on gentle**

plantation forestry into a surface water body, an	**slopes. The same expectation is not asked of pastoral or arable land uses.**

There are several related objectives here, and some linking back to the Regional Policy Statements (Policy CC.6) as well as the NPS-FM. Wgtn Branch NZFFA omitted to make submission to the Plan Change 1, Regional Policy statement, but support the Wairarapa Federated Farmers appeal.

Objective WH01, to improve health to Wai Ora by 2100.

- We note that Table 3.1 has quite different bottom lines for water clarity and deposited fine sediment than the National Bottom lines outlined in NPS-FM and target attribute states listed in Table 8.4

Objective WH.02, b.

- We reiterate that **more natural levels** of several of the Target Attributes may well be unattainable, as climate change and land clearance mean that more sediment, in its various forms, is inevitable. We also refer to Dr Les Basher's expert testimony, listed as Appendix 2, where he states

  > "The stated goal of achieving no increase in sediment load above the natural state is both inappropriate and unrealistic given the transformation of the land (hydrology and slope stability) since human settlement."

  In practice, these goals relate to setting Target Attribute States based on baseline data and an ambitious desire to maintain or improve the situation over a defined timeframe. We agree that these are desirable, but not at any price. In reality, TAS must be practical and achievable.

  In the case of suspended sediment, we understand that baseline data is not yet available for all tributaries of streams/rivers (sub catchments) above their monitoring points. There is a poor understanding of sources of sediment (both suspended and deposited fine sediment), so targeted remediation or mitigation, without proper investigation of causes and sources, can be misaligned and costly to the community. It is difficult to link effects of land use changes and mitigation strategies to longer term natural variations in sediment and water clarity.

  Indeed, if plantation forestry is removed from 10% or more of hill country and it is later discovered that such removal was no longer warranted, there is no going back. It is no longer acceptable to clear native vegetation for plantation forestry and the land use changes and associated financial hardship will be irreversible.

  We agree with the S42a recommendation on Objective WH.02 to remove the words "to a more natural Level"

Objective WH09 and Table 8.4 Target Attribute States

PC1 heading	Original Submission by Wgtn FFA, S036
Objective WH09, Table 8.4 TAS for rivers. And Table 9.2 (addressed by CFG submission)	The Suspended Fine Sediment/Visual Clarity/black disc test (as a surrogate or indicator measure for suspended solids) for Mangaroa River does not take into account that Black Stream (natural brown water), drains into the Mangaroa river upstream from the test site. Where natural sources of brown water exist, GW are allowed to set a different TAS. **GW, please confirm that you have done so**. Note that Total Suspended Solids and suspended fine sediment and deposited fine sediment results are high quality, so are at odds with the Visual Clarity result. (see table supplied in earlier discussion) **Also, please check that Wainuiomata/Black Creek has an appropriate TAS set for visual clarity**
Policy WH.P4 and Table 8.5 Te Awa Kairangi rural streams and rural mainstems Mangaroa River at Te Marua 2040 10,965 -51	The target for Mangaroa is based on inappropriate TAS. The clarity required is affected by the naturally occurring input from a major peat swamp. A different TAS needs to be set. Also challenge the value shown for Wainuiomata urban stream/Black Creek. This may also be subject to Natural Brown Water and needing a revised TAS. **Alter the TAS**
Policy WH.P26: Managing livestock access to small rivers In addition to national stock exclusion regulations and the region-wide stock access requirements of Rule R98, Rule R99 or Rule R100 in this Plan, restrict livestock access to a river in the Mākara Stream and Mangaroa River catchments where the baseline state for the relevant part Freshwater Management Unit is below the national bottom line for visual clarity	As previously mentioned, the clarity test for Mangaroa River is inappropriate, as it is affected by stream from a major peat swamp. Request Move water monitoring site to above confluence with Black Stream or reset TAS value and /or remove mention of Mangaroa River. **Alter the TAS**

Deposited Fine Sediment

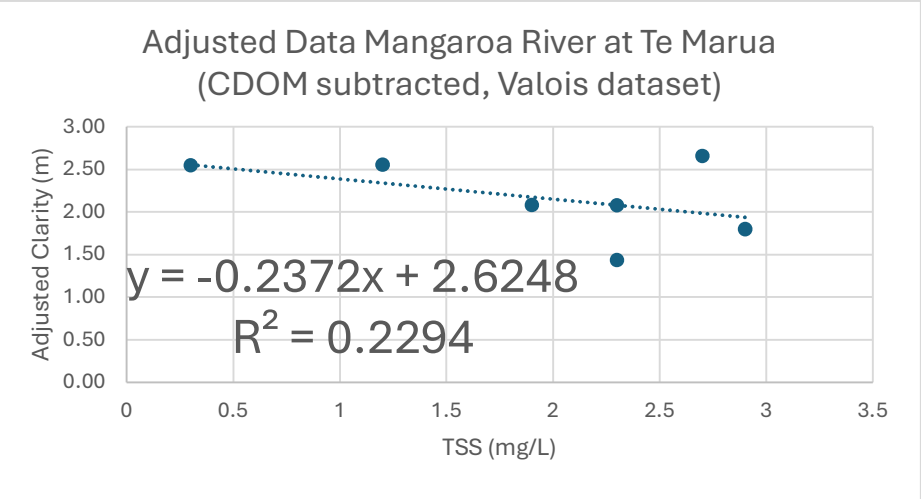
Table 8.4, lists the baseline state for Deposited Fine Sediment for Whakatikei River as grade C (25% cover). We understand that this figure was based on limited data. The current data for Whakatikei River from the GW website (March 2025) shows a median cover of 8.25% based on 11 samples. Lest the grade C category be used to justify land use changes for forestry in this catchment, could you please update the river state to grade A.

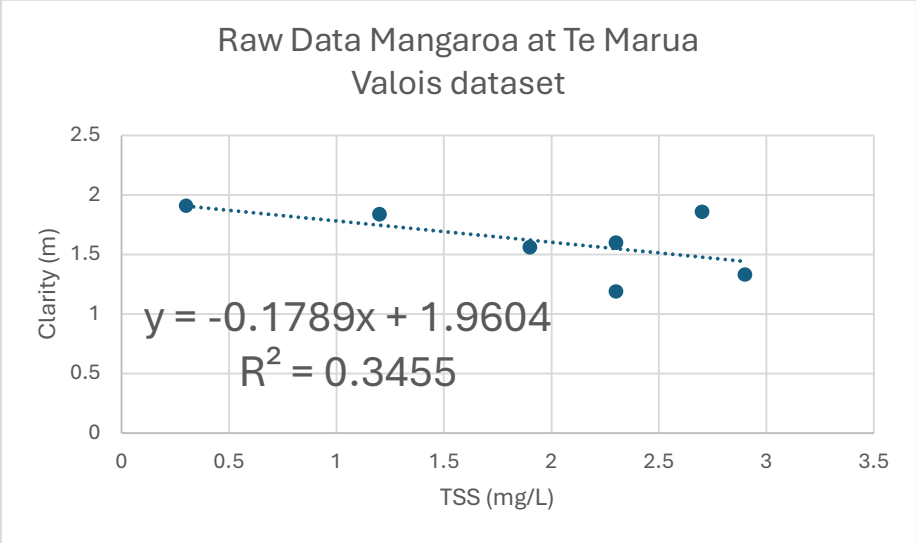
Visual Clarity

We accept and welcome that the S42A report has calculated a revised TAS for VC of Mangaroa River but note that the revised level is based on a very limited data set (9 points) that did not include any VC levels above 2m. Neither did it measure CDOM contributions at high flow levels, the highest cusec value being only 9.88 m^3/s. It is not uncommon for Mangaroa River flow rates to exceed 50 or even 100 m^3/s, albeit that it accepted that CDOM contributions will be very low under flood conditions. We do observe that even at modest flow rates, that CDOM contribution (g440(m^{-1}) can vary by two-fold.

Because of the intermittent sampling programme (monthly), calculations for median VC reflect low flow conditions (as observed by Dr Murray Hicks). Dr Hicks states that when calculating required reductions in sediment load, **it is therefore crucial that VC and TSS are highly correlated at low flow conditions.** However, the relationship is very poor, even when Beam attenuation testing is used to subtract contributions by CDOM, as shown in the plots below.

We conclude that TSS is a very poor predictor of clarity in this range and that calculations for required sediment reductions are unreliable. Instead, more work is required to investigate sources and nature of sediment (along with seasonal variations), and that an appropriate water plan is implemented.





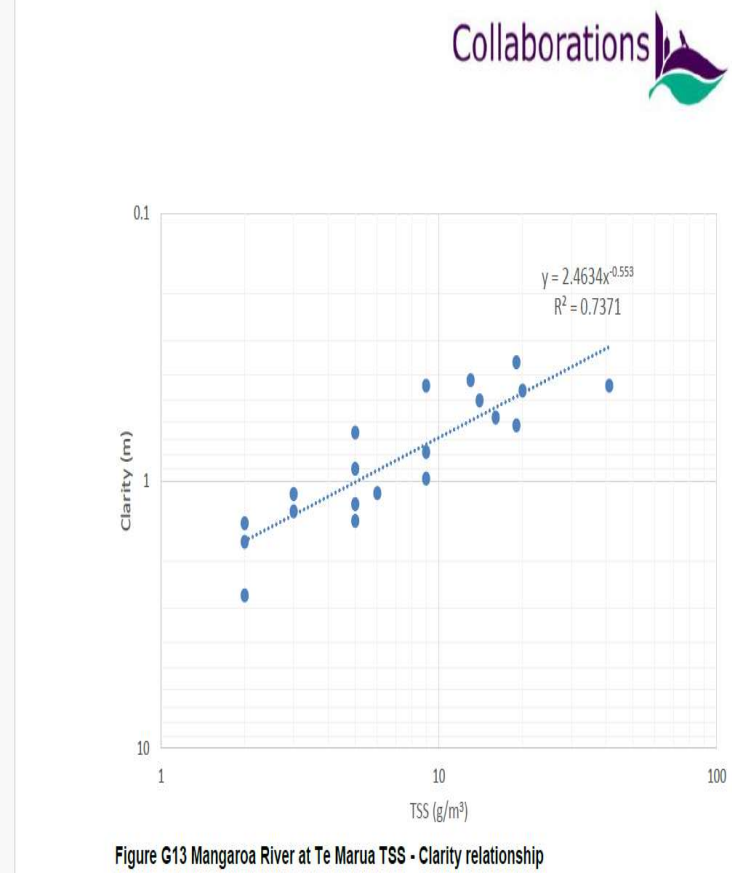


Figure G13 Mangaroa River at Te Marua TSS - Clarity relationship

The last figure is original data from Easton/Blyth Report 2023-006 and paired data from 2016-2020. **Blyth commented that the relationship between TSS and clarity was less reliable for TSS values below 10mg/L**. We agree but also note that the Limit of Quantification of the method is 3 mg/L and that data below LOQ this are usually reported to only 1 significant figure.

Further Observations on TAS for Clarity of Mangaroa River are as follows:

The historic Black disk Clarity data for Mangaroa River has been extracted from the GW website. This covers monthly readings going back to 1997. Whilst the median values over several years show VC median of around 1.4-1.5m, **there are clear seasonal fluctuations** that are not readily explained.

The median values by month, covering 1997-2025, for both visual clarity and median of daily mean flows for each month, are plotted below (next page).

Note that intensive winter grazing is a rare event in the Mangaroa catchment. There are no dairy farms left. Were intensive winter grazing the explanation for the seasonal results, then the drier period in late spring-early summer would have shown a dramatic increase in in visual clarity. This is not the case.

One possibility is that clarity is directly related to flow rate (or median flow rate) and that faster water flows picks up more sediment. The graphs covering almost 28 years suggest an inverse relationship between flow rate and clarity.

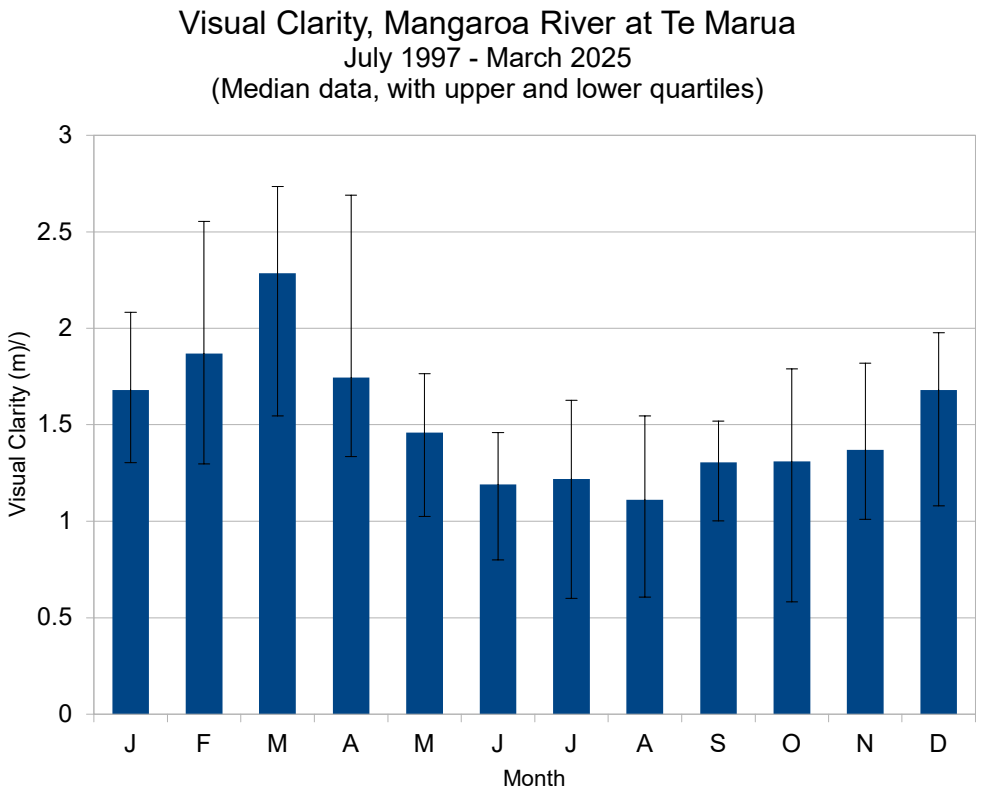
However, our hypothesis is that Mangaroa Peatlands act as a massive sponge that delays water release. Peatland flow is at a minimum in late summer. The stream height gauge near Gorrie Road allows height to be measured and cusecs estimated. As of mid-February 2025, the Black Stream volume is very low (9.5cm deep and estimated flow of 0.03 m^3/s) while the LAWA/GW data for Mangaroa River at Te Marua reads 0.3 m^3/s.

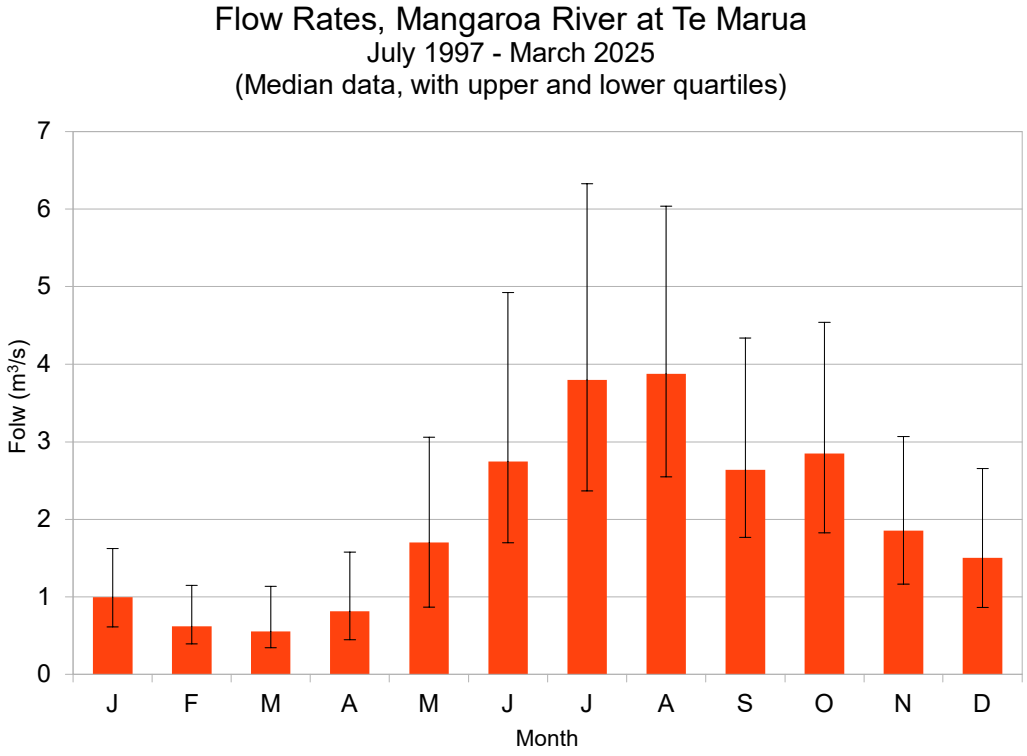
We need more relative flow data for winter and spring flow rates or more data via Beam Attenuation to refine this hypothesis.

Another possibility might relate to effects of frost. Mangaroa Peatlands are a frost hollow, and conceivably winter frost (heave) might dislodge peat particles at the surface that can then enter Black Creek. Investigation as to the nature (organic/mineral) and particle size of sediment would help unbundle this scenario.

We think that the contribution of CDOM to water clarity varies across the seasons, and that use of a fixed adjusted TAS of 1.67m is an oversimplification.

Figure 1: Black Disc Visual Clarity for Mangaroa River at Te Marua Compared to Flow Rate (raw data downloaded from GW website)





Horokiri Stream Clarity and Forestry Harvesting

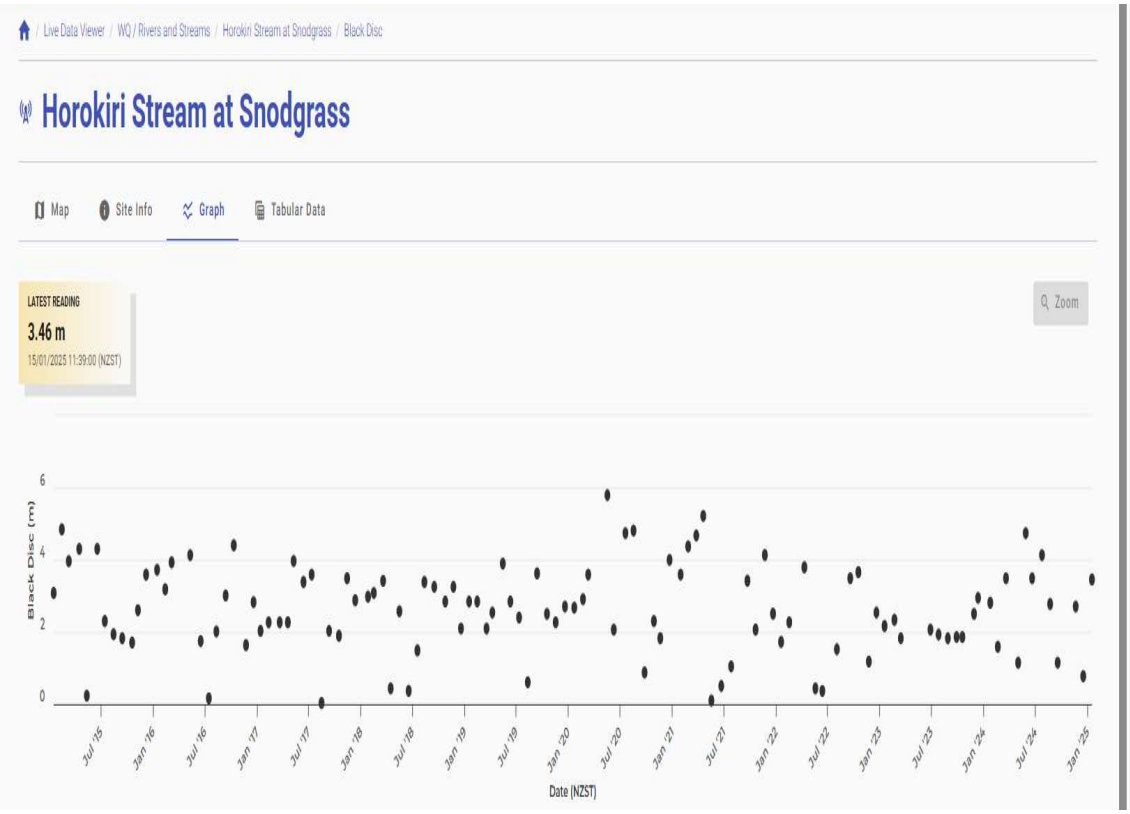
Both the Wellinton NZ Farm Forestry Association (S036) and the China Forestry Group (S288) submissions discussed evidence of water quality (including suspended sediment) held by GW that relates to forestry catchments.

Horokiri Stream VC data is an example of the lack of impact that forestry harvesting has on water clarity (at best, only a minor impact).

Over the last 3-4 years, extensive harvesting of the Puketiro Forest (catchment for Horokiri Stream) has occurred. The transmission Gully motorway opened in early 2021, before sediment controls were deconstructed, and prior to that the contractors had been accused of multiple breaches of consents in relation to sediment discharges.

> *News, NZ Herald 9 June 2020: There have been a whopping 167 consent breaches, incidents/failures, and unconsented activities at the troubled Transmission Gully site.*
> *The revelations are the latest blow to the billion-dollar lower North Island road, and come despite the project receiving a top gong at the annual International Erosion Control Association Environmental Excellence Awards.....*
>
> *News, NZ Herald 1 March 2024: Greater Wellington Regional Council has dismissed 17 charges related to the mega Transmission Gully highway and is instead going down another legal avenue to protect the environment.*
> *The charges were dismissed in August last year with the majority of them related to sediment discharges from open earthworks into water across the project.*

Figure 2 below shows Visual Clarity readings for Horokiri Stream between 2015 and 2025



Note: Jan 2015 to Jan 2025 median black disc clarity = 2.62m. TAS is 2.3m

We note that quite a few of the low readings do not correspond to peak flows, so at least some instances of low VC may be due to earthworks or forestry activities. Notwithstanding some of the low VC readings, the median VC value still exceeds the National Bottom Line and the TAS. **The relatively brief period of extensive forest harvesting does not appear to have caused issues**.

Photograph (date Feb 2025) taken from Battle Hill Farm Park looking across Transmission Gully. Most of the forestry harvesting has occurred over the previous 3 years and was still active when this photo was taken

Are Monitoring points at Representative Sites

Wairarapa Federated Farmers make the point that the official monitoring stations for water quality (especially at Mangaroa and Makara Stream) are not representative of all that goes on. We agree. The proposed water plans will need to be far more proactive in identifying sources of sediment and other environmental parameters.

Water Clarity Measurements along Mangaroa River

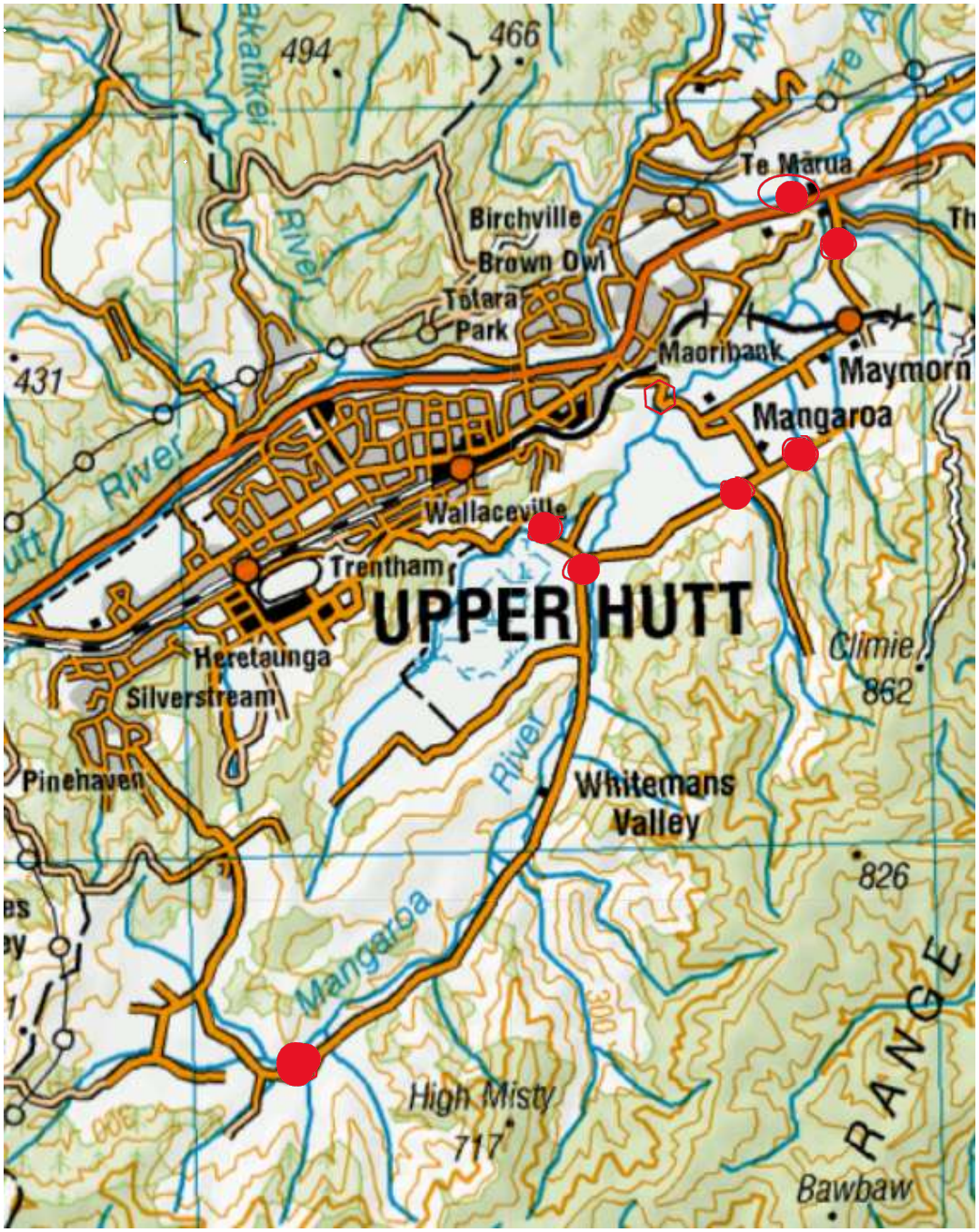
As a tool to identify the influence of Black Stream Coloured Dark Organic Matter (CDOM) and to identify sources of sediment, Eric Cairns, a former Senior Scientist with over 40 years of laboratory experience, undertook black disc and SHMAK Clarity tube readings at various spots along Mangaroa river and some of its tributaries. (Jan-Feb 2025)

Most of the tributaries ran clear, and because stream flow rates are low, and long pools are needed to take measurements, there is physical difficulty in finding suitable pools to measure VC beyond 2-3 m.

The map and photos below illustrate some of the sites along the river, including views of peat-stained coloured water (CDOM)

The Table on page 14 shows data only for readily accessible larger tributaries and identified “Hot Spots” where VC was lower than expected.

Figure 3: Sampling points for Mangaroa River (red dots)



Caption for both photos. Confluence of Mangaroa River with the Hutt River at Te Marua. Brown stain in foreground is peat stain from Mangaroa. Photo date early January 2025

Caption. Periscope and tape measure to measure black disc visibility at Mangaroa River at intersection of Mangaroa Valley Road and Whitemans Valley Rd (above confluence with Black Stream). Larger size black spots were used in subsequent work, as defined in the official method.

Caption: Close up of Black Stream shallows, intended to show particles/cloudiness of the stream (opalescence). Discrete particles can be seen with the naked eye. These are most likely organic peat fragments which will break down over time.

Caption for above: Alternative periscope used at sampling point just above confluence with Black Stream. 111c Mangaroa Valley Road. Photo date 29 Jan 2025

Note: Clean river, little to no algae or periphyton, almost no Deposited Fine Sediment.

Caption: Sampling point just below confluence of Mangaroa River and Black Stream (water much darker than at TeMarua). Clarity decreased by 1.3m, data not tabulated here. 111c Mangaroa Valley Road. Photo date 29 Jan 2025

Caption: Blaikies stream outlet viewed from inside culvert, Fairly low VC as listed in Table 1

Caption: Both branches of Blaikies stream drain the Maymorn Farm Subdivision. Sediment pond in foreground. (Photo obtained by screen capture of promotional video)

Table 1: Selected Clarity Readings for Mangaroa River and some Tributaries

Clarity in metres via Black Disc or (SHMAK Clarity Tube, data in brackets). SHMAK data is typically less than periscope and tape measurements.

Sampling Site/ Date	17/01/2025	29/01/2025	4/02/2025	9/02/2025	12/02/2025	19/02/2025
Mangaroa River at Te Marua below SH2 bridge	1.45	2.2	2.15	2.7		2.05
Blaikies Stream just downstream of culvert in Maymorn Rd		1.13	1.0 (0.68)		(0.58)	(0.56)
Colletts stream at Colletts Rd	2.05	1.9	1.7			1.9 (0.84)
Cooleys Stream at Mangaroa Valley Rd	>2.6		3.1			>3.3
Mangaroa River at Mangaroa Hill Rd	1.45	2.4	1.5	2.2		2.1 (0.88)
Black Stream at Wallaceville Road culvert	0.26		(0.10)	(0.13)		(0.13)
Mangaroa River at intersection between Mangaroa Valley Rd and Whitemans Valley Road	2.2	2.55	2.85	2.15	2.18	2.32
Stream adjacent to 836 Whitemans Valley Road (near Russells Rd)			0.55 (0.26)		(0.77)	(0.76)

(Note, most tributaries viewed contained high quality clear water, and for simplicity, their data is not reported here)

Brown highlighted data is downstream of Mangaroa Peat Lands (Black Stream). Blaikies Stream drains a current urban development and earthworks site and is also subject in a minor way to roadside stormwater runoff. Colletts Stream and the site near Russells Road drain recent forestry harvest sites (last 2-3 years).

The baseline clarity values are not known for Blaikies, Colletts or Russell's Road streams. Some smaller side streams are rich in minerals and associated flocculated deposited Fine Sediment (DFS).

Interpretation of Mangaroa River Clarity data:

The visual clarity (VC) data covers only a short period (1 month). The operator was self-trained, but the methodology is simple. Black disc readings are somewhat subjective, and therefore subject to bias and higher uncertainty. The method used is equivalent to that specified in section 3.32 of National Environmental Monitoring Standards, Water Quality, Part 2 of 4: Sampling, Measuring, Processing and Archiving of Discrete River Water Quality Data, Version: 1.0.0,Date of Issue: March 2019

Notwithstanding potential limitations of the data, it is shown that:

- For Mangaroa River at Te Marua, VC data are consistent with the range of values reported on the GW website (albeit taken at different days and times)
- Mangaroa River VC for black disc is substantially reduced below the confluence with Black Stream.
- VC data for Mangaroa River at Te Marua is often worse than at Whitemans Valley/Mangaroa Valley Rd corner, but not always. There are several significant tributaries downstream of Whitemans Valley/Mangaroa Valley Rd corner that can either add (dilute) or subtract from VC values taken upstream.
- We don't have enough VC data to show seasonal fluctuations of Mangaroa River at the intersection of Whitemans Valley/Mangaroa Valley Rd.
    - Very likely there are other contributions to suspended solids above this point, **but the median VC here may very well be above the TAS of 2.2m**.
- At the actual confluence with Black Stream, the downstream VC **was 1.3m less** than just above the confluence.
- Black Stream itself was full of suspended sediment (presumably organic peat debris) as well as CDOM, so could be regarded as a valid natural suspended sediment source. However, a small number of livestock do sometimes have access to Black Stream.
- At the main river sampling locations downstream of the Black Stream confluence, the periphyton growth in January was prolific, but reduced considerably over the following month. Collett's stream (draining a recent forestry harvest) also had a lot of periphyton that appeared to decrease over the month.
- Even accounting for dilution of the main river by other tributaries, there are indications of self-cleaning factors occurring in the stream. Willow roots are capable of holding back sediment, as can periphyton growth. There may be other factors (including flocculation) affecting the dynamics of suspended sediment.
- The VC results taken at Te Marua do not identify the source or variation in VC at various spots upstream.
- It may be that alternative laboratory methods (such as Beam Attenuation) can unbundle the relative contributions of suspended sediment and CDOM, but as noted, Black Stream is also a significant contributor of **"natural" suspended sediment**.
- Since this report was drafted, the S42A reports recommend reducing the TAS for clarity to 1.67m. We would regard that as an interim value as it is based on a limited dataset.
- Clearly urban development at Maymorn Farm subdivision was contributing suspended sediment in Mangaroa River over the monitoring period. The VC levels for both branches of Blaikies Stream (just above the culvert) are a great deal lower than the main river.

(Individual tributaries not tabulated here. We are not claiming that Suspended Sediment levels exceed the permitted limits).

Environmental Effects of Pulses of Suspended Sediment

- A focus of Regional and National Policy Statements and NRP-Plan Change 1 is to minimise **all forms** of sediment getting into waterbodies, but the TAS and National Bottom lines actually focus on quite different data. Clarity is typically measured monthly at specified monitoring points.
- The objective has then shifted to meeting median values for clarity (and **therefore data obtained mostly at low water flows**), for which Suspended Sediment or TSS (and other measures including turbidity, and beam attenuation) are surrogate measures, but not identical to VC.
- Monthly records of VC are incapable of determining actual suspended sediment yield.
- The vast bulk of sediment comes in flood events and landslides, so short pulses of murky water, which might have minor effects on stream ecology, have only a low probability of being picked up at monthly sampling. It is infrequent flood events (and associated land slips and bank erosion) that delivers the vast majority of sediment to harbours and estuaries.
- Since the ultimate standard is median visual clarity (60 readings over 5-6 years), we should not be alarmed by pulses of murky water, provided discharges are minor and less than say 5% of the time.
- Continuous sediment discharge is another matter. The proposed discharge limits (Policy WH.P30) will require laboratory analysis to monitor their magnitude, but no consideration is given to their temporal nature (short pulse or continuous).

Discharge Limits, Policy WH.P30 and Schedule 34

PC1 heading	**Original Submission by Wgtn FFA, S036**
• Policy WH.P30: Discharge standard for earthworks The discharge of sediment from earthworks over an area greater than 3,000m^2 shall: (a) not exceed 100g/m^3 at the point of discharge where the discharge is to a surface water body, coastal water, stormwater network or to an • Same for Policy P.P28: Discharge standard for earthworks sites	• Note, this rule does not apply to forestry. • The peak discharge limit is too low and barely colours the water. A vehicle driving on a gravel roadway, even with small scale sediment traps in place by a culvert (as per NES-CF), would fail this test. Walking tracks in the Orongorongo Valley fail this test. (see photo) • We note that the discharge limit only applies to discretionary activity rules. • **Please raise discharge limits to 1000g/m^3**

Revised Comment.
Visual clarity of water containing suspended sediment very much depends on particle size. The author has now prepared finely ground Mangaroa clay and determined that the proposed limit of 100g/m^3 can correspond to SHMAK clarity tube readings as low as 0.2m.

We acknowledge that the limit is intended to apply to forestry (schedule 34)

Notwithstanding that, a short pulse of cloudy water, such as when a vehicle crosses a stream, or of sediment traps overflowing during rain events, should be allowed for.

We suggest that an alternative field test limit (say using a SHMAK tube) should be a simple way for field operators to gauge what they are doing. Results will then be available immediately and may allow prompt remediation of the issues.

Existing designs of roadside sediment traps may fail the discharge standard, but would fail only during significant rainfall (short pulses)

Policy WH.P4, Calculated Reduction in Sediment Loads for Catchments

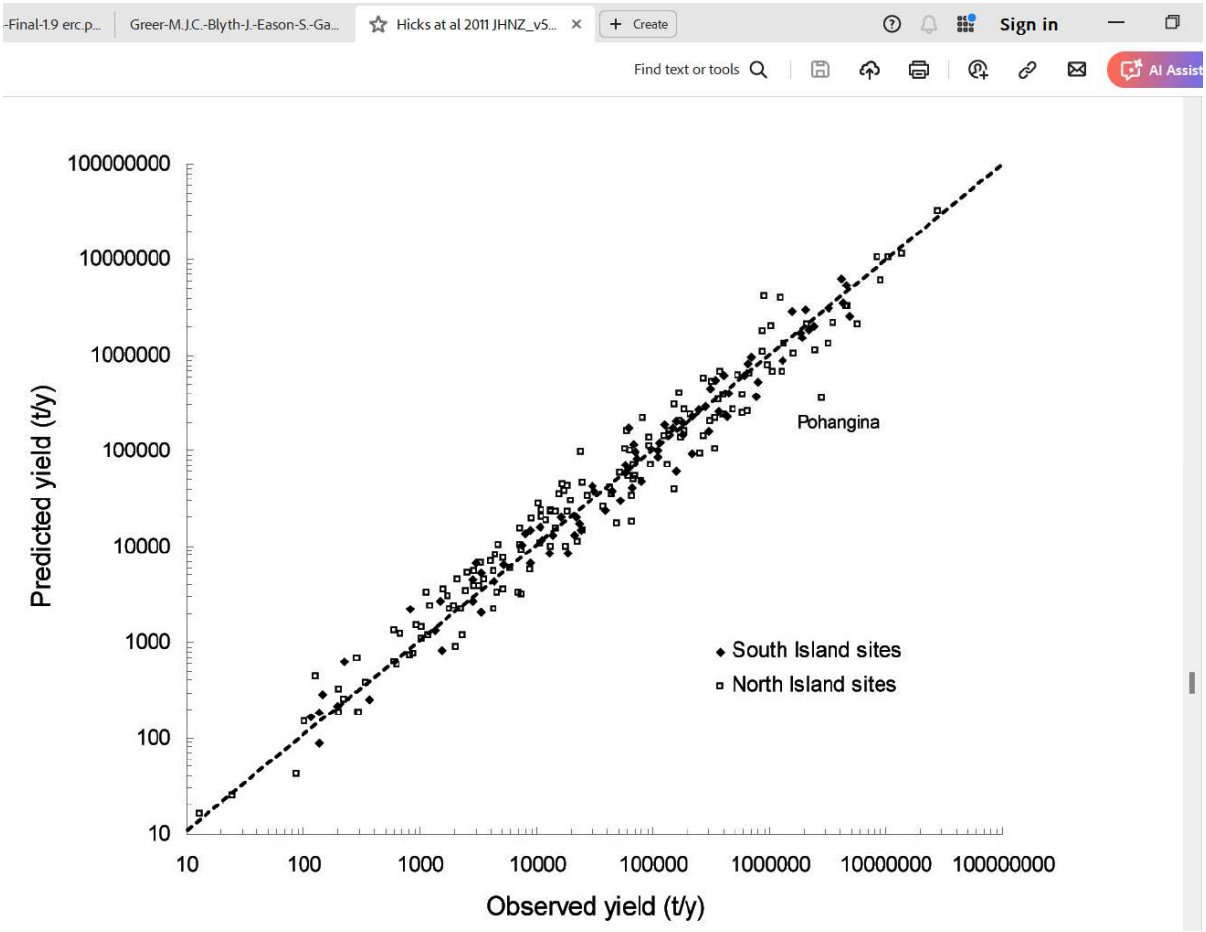
PC1 heading	Original Submission by Wgtn FFA, S036
Policy WH.P4 and Table 8.5 Te Awa Kairangi rural streams and rural mainstreams, Mangaroa River at Te Marua 10,965 tonnes annual baseload, -51% calculated sediment reduction loads by 2040	The target for Mangaroa is based on inappropriate TAS. The clarity required is affected by the naturally occurring input from a major peat swamp. A different TAS needs to be set. Also challenge the value shown for Wainuiomata urban stream/Black Creek. This may also be subject to Natural Brown Water and needing a revised TAS. **Alter the TAS**

In our original submission, I mistakenly stated that visual clarity was used to calculate both suspended and deposited fine sediment loads into the Hutt River. That was incorrect. Such sediment loads were estimated by Easton and Blyth using dSEDNET modelling.

Method Uncertainty for Calculated Reduction in Sediment Loads

The graph below reveals a level of uncertainty in the dSEDNET modelling, where predicted and observed sediment yields are plotted. Part of the uncertainty will be variations one year to the next, but for the Mangaroa River case, at around 10,000 t/year, there is nearly a tenfold range of observed values for the same predicted yield.

This graph also emphasizes that it is very difficult to relate remedial actions, taken to limit suspended sediment, to the observed effects. You are rarely certain that your policy changes had any beneficial effects. Dr Les Basher, Appendix 2 also makes this point.



The precision of estimated required sediment load reductions, as listed in Table 8.5, relies on accurate measures of Suspended Sediment or Total Suspended Solids (TSS). TSS is estimated from measures of Visual Clarity, and the relationship may be calibrated for each site if enough data is available.

We say that both the baseline measure of suspended sediment and calculated reductions in sediment load are unreliable.

Easton and Blyth used a simple relationship published by Hicks to calculate the required reduction in sediment load.

9.3 Methodology

For WTWT sites and three TAoP sites with available data (Horokiri Stream at Snodgrass, Pāuatahanui Stream at Elmwood Bridge, and Porirua Stream at Milk Depot), the proportional change in sediment load required to meet visual clarity targets was estimated using the approach in Hicks *et al.* (2019) (also reported in Neverman *et al.* (2021)):

$$PR_v = 1 - (V_o/V_b)^{1/\alpha}$$

Equation 1

PR_v = minimum proportional reduction in load required to achieve the objective
V_o = target median visual clarity
V_b = baseline median visual clarity
α = co-efficient used in power law relationship between SSC and clarity, note TSS has been preferred in this analysis (see Section 9.2).

The exponent (data revised Feb 2025) used for Mangaroa River (-0.561) is at the extreme end of the range for all rivers sites calibrated. **One needs to ask why it is so different, and whether the value is valid.**

In my opinion (E Cairns), the R^2 correlation value for the Mangaroa data in also not good. In my previous analytical chemistry role, we would have said that an R^2 correlation of 0.65 was terrible and not fit for calculating quantitative results. In effect, only about 40% of the variance seen in Visual Clarity is explained by TSS and clearly other factors have a major influence. (An R^2 value of 1.0 is the very best.)

Table: Ranked Regression data for all calibrated sites Clarity vs TSS, from the data presented by Blyth 28 Feb 2025, combined with earlier data.

Site	Exponent	R^2 correlation
Waiwhetu	-1.003	0.25
Hulls Creek	-0.819	0.90
Wainuiomata	-0.798	0.93
Pakuratahi	-0.775	0.64
Elmwood	-0.773	0.57
Black Creek	-0.766	0.78
Karori	-0.762	0.54
Glenside	-0.745	0.61
Taupo	-0.734	0.26
Horokiri	-0.727	0.66
Hutt above Te Marua	-0.721	0.52
Kaiwharawhara	-0.718	0.74
Hutt at Boulcott	-0.709	0.74
Orongorogo River	-0.697	0.56
Milk Depot	-0.692	0.72
Makara	-0.677	0.72
Wakatikei	-0.59	0.59
Mangaroa at Te Marua	-0.561	0.65
Stokes Valley	-0.499 outlier	0.70

The original calibration graph showing the relationship between black disc clarity and TSS is shown below. I have stretched the axes to allow a more 1:1 view, 2 orders of magnitude each way. It appears that there are now more calibration points available, but neither the revised raw data nor graph for Mangaroa were presented in Blyth's revised 28 Feb 2025 statement.

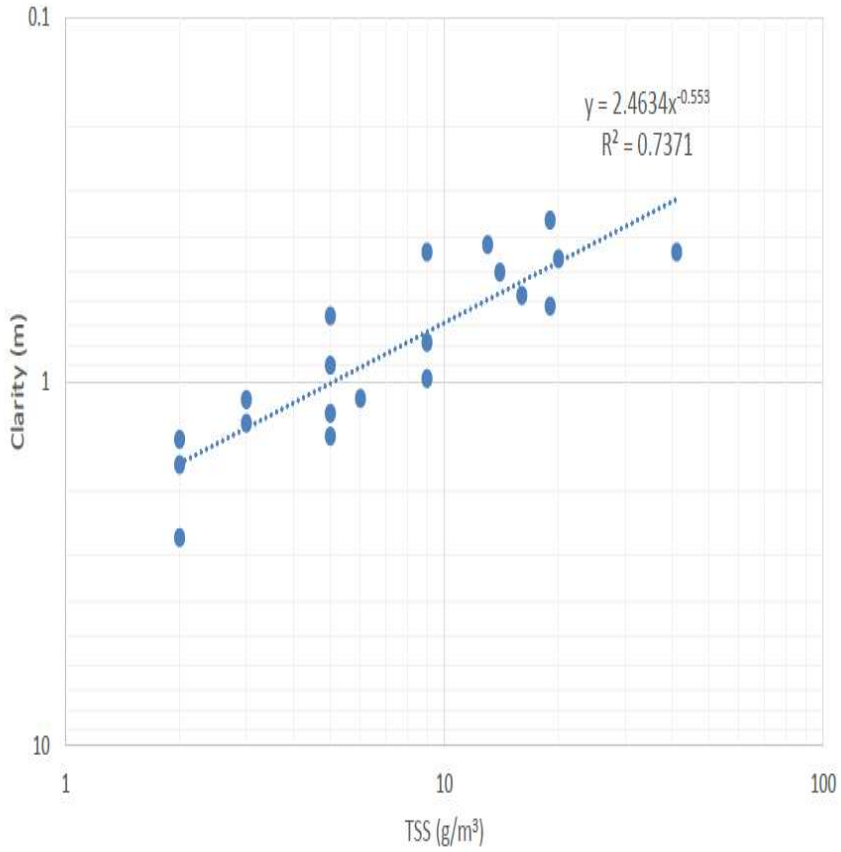


Figure G13 Mangaroa River at Te Marua TSS - Clarity relationship

I asked Dr. Murray Hicks (former NIWA expert and coauthor of relevant guidance documents) for expert help to understand measurement uncertainties of the predicted sediment load reductions. Dr Hicks perceived a conflict of interest, so he declined to prepare an expert statement, but he did provide the following in an email to me, in relation to the original data presented in Report No. 2023-006 Date: 10/10/2023.

> "……That said, at least for the Mangaroa River case, there do appear to be some grounds to question the magnitude of the predicted sediment load reduction. Indeed, while Section 4 of our guidance document recommends first pursuing the "simple" load reduction evaluation approach (as followed by Greer et al in their Chapter 9), it says if that throws up a significant reduction in load then the underpinning assumptions behind the simple approach should be reviewed and ideally a more detailed dynamic modelling assessment should be followed.
>
> A key assumption in the Mangaroa case is that the VC around its monitored median is responsive only to TSS (or SSC), when pretty clearly it's also influenced by CDOM (Coloured Dissolved Organic Matter) thanks to Black Creek at least. (This would also help explain the near factor-of-10 data scatter at the low end of the VC vs TSS plot, and around the median VC value). This then raises the questions:
>
> - How much of the median VC (or it's inverse, beam attenuation) is stemming from CDOM vs from suspended sediment?
> - Where are these two components coming from under median conditions?
> - How would mean annual sediment load reduction (mainly effected during storm runoff) impact on the balance of CDOM and SS at and consequent VC at baseflow conditions? (Again, the relatively flat and noisy VC-TSS response at Mangaroa suggests not much.)
> - How reasonable is the target VC chosen for the Mangaroa site given the upstream input of a CDOM signal?
> - Would it have been better locating the TAS monitoring site upstream of Black Creek? And if it had been, what would the baseline VC be?"

Dr Hicks was also kind enough to refer me to Guidance documents issued by NIWA to assist Regional Councils with their obligations under the RMA.

The guidance documents have been useful in highlighting both the recommended process that GW should follow and the method uncertainty for the calculated sediment reductions.

Both Dr Hicks and the guidance document that he coauthored, indicate that Easton and Hicks should have done more work at the time for Mangaroa River and Makara Stream.

The guidance document issued by MFE, Ministry for the Environment. 2022. *Guidance for implementing the NPS-FM sediment requirements*. Wellington: Ministry for the Environment, also says that

> "Indeed, under the NPS-FM (2020), modelling can provide information in the absence of complete and scientifically robust data (ie, monitored data). **The proviso is that local authorities "take all practicable steps to reduce uncertainty (such as through improvements to monitoring or the validation of models used)" (NPS-FM, clause 1.6, Best information)."**

The earlier Data for Mangaroa River (requiring > 50% reduction in suspended sediment) was surely a key driver for Plan Change 1. In our view, the required yield reductions from just two rural rivers (Mangaroa and Makara) have predicated the approach used by GW to control and restrict forestry as a land use, as directed in the NPS—FM section 3.12;

> to identify limits on resource use that will achieve the TAS….:

Making Limits on Resource Use seems to have overridden seeking other ways to mitigate risk or effects of humans on the environment.

In Plan Change 1 the only other rural river that significantly fails TAS for suspended sediment is Makara Stream. For that catchment there is still a need to carry out detailed assessment including origins of sediment, before requiring land use changes. It may well be that riparian protection and better controls on earthworks are the only actions required (not a change of land use *per se*).

We wish to reiterate that baseline data for suspended and deposited fine sediment for the extensively forested Whakatikei, Horokiri and Pakuaratahi catchments do not show issues with sediment and that TAS for sediment are being met.

Another criticism of using estimated required reductions in **annual sediment loads** for Mangaroa River is that **median VC will be at a low river flow**. Low flows are dominated by CDOM and peat/periphyton debris, not necessarily mineral suspension, so **calculating required reductions to meet TAS, based on annual sediment load, is misleading**.

However, the required reduction in **total/annual** suspended sediment load is clearly being used to justify reductions/changes in land use. We suspect that soil disturbance, either at land subdivision or earthworks for roading, is the main contributor to suspended sediment over and above natural sources, not growing or harvesting plantation pines.

Forestry roads are largely one-off infrastructure, so over the long term, earthworks related to forestry should gradually reduce.

Again we say that before implementing restrictions on land use (a significant financial penalty), that a lot more data to show source of sediment in sub-catchments (by land use activity) is required.

Need for Robust Regulatory Limits

The Target Attribute States listed in Tables 8.4 and 9.2 effectively become regulatory limits. There are likely to be considerable consequences if groups of land users fail to achieve TAS in a catchment or sub catchment.

Where the TAS is not a default NBL but has been set by council (as in the case for the revised TAS VC Mangaroa River) there needs to be a high level of confidence, underpinned by robust science, that the level is correctly set. We say that the science and amount of data used is not yet robust, and that is why we propose that the revised TAS of 1.67m is accepted as an interim value.

Consequences of an FMU Failing to meet TAS

It may well be that median VC values over a number of years from an official monitoring point fail to meet TAS due to naturally occurring events such as severe weather and landslides or leakage

of suspended sediment from peatlands. PC1 also defines some time periods by which TAS are to be met.

Potentially landowner activities may be restricted as a result failing to meet TAS. It is not clear in the plan whether failure to meet TAS just lifts activities to discretionary status, (if an activity is controlled) or what happens if an activity is not controlled (e.g. pastoral use). Legal challenges to council decisions could be very costly. We suggest that a disputes resolution procedure needs to be in place to resolve issues before they get to court.

Appendix 1, Letter of support from Dr Les Basher

7/1/25

Eric Cairns

Wellington Branch

New Zealand Farm Forestry Association

Dear Eric

Attached are comments on the three aspects of the Wellington Branch NZFFA submission on Plan Change 1 to the Natural Resources Plan of Greater Wellington Regional Council for which you sought advice. That is:

- the proposal to restrict forestry harvest from about 10% of the steepest forestry land in two Whaitua, based on erosion risk modelling to identify target land,
- the relative erosion susceptibility of greywacke slopes in the area, and;
- the stated goal of achieving no increase in sediment load above the natural state.

In my opinion the approach to identifying target land is flawed and it is highly arguable whether the controls proposed are justified, considering greywacke is one of the least erodible rock types in New Zealand.

Yours sincerely

Dr Les Basher

Appendix 2, Dr Les Basher expert testimony

(Appended as PDF, 8 pages)

EroSed Services

Memo

To: Eric Cairns

From: Dr Les Basher

cc:

Date: 20/12/24

Re: Statement of support for aspects of the Wellington branch NZ Farm Forestry Association submission on Plan Change 1 to the Natural Resources Plan of Greater Wellington Regional Council

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Introduction

Proposed Change 1 to the Natural Resources Plan (NRP) of Greater Wellington Regional Council (GWRC) includes changes that relate to sediment generation from land disturbance activities associated with commercial forestry (earthworks and harvesting). The Wellington branch of NZ Farm Forestry Association (referred to hereafter as simply NZFFA) prepared a submission on the Plan Change and have requested commentary on aspects of their submission related to:

- the proposal to restrict forestry harvest from about 10% of the steepest forestry land in the Whaitua Te Whanganui-a-Tara and Te Awarua-o-Porirua Whaitua, based on erosion risk modelling to identify target land;
- the relative erosion susceptibility of greywacke slopes in the area and their relative erosion risk under plantation forest, including during the window of vulnerability;
- the stated goal of achieving no increase in sediment load above the natural state.

These are areas in which I have professional expertise.

Background and qualifications

My full name is Leslie Robert Basher. I have a BSc (geology, University of Canterbury) and PhD (soil science, Lincoln College). I am a member of several relevant professional societies including the New Zealand Society of Soil Science, the New Zealand Geosciences Society and New Zealand Association of Resource Management. I am currently self-employed (since October 2020) as a consultant on erosion and sediment issues. Prior to this I worked for Manaaki Whenua – Landcare Research (and its predecessor organisations) for 43 years as a scientist and research programme leader. During this time I was involved in many erosion research programmes and I completed numerous contracts on erosion for all the major land uses in New Zealand (forestry, pastoral farming, horticulture, urban). My career focused on measurement and modelling of erosion processes, along with their mitigation. I remain a Research Associate of MWLR.

My previous relevant work experience includes multiple reports and papers on erosion-related risks (landslides, debris flows, surface erosion processes) associated with plantation forestry[1]. I led work that developed the Erosion Susceptibility Classification for the National Environmental Standard for Plantation Forestry[2]. I have led development of an approach to better characterise landslide and debris flow risks at forestry operational scale by independently considering both susceptibility (to landslides and debris flows) and climatic drivers of the frequency of these events[3].

[1] For examples:

- Phillips C, Marden M, Basher LR 2018. Geomorphology and forest management in New Zealand's erodible steeplands: an overview. Geomorphology 307: 93–106;
- Basher L, Harrison D, Phillips C, Marden M 2015. What do we need for a risk management approach to steepland plantation forests in erodible terrain. New Zealand Journal of Forestry 60(2): 7–10;
- Marden M, Basher L, Phillips C, Black R 2015. Should detailed terrain stability or erosion susceptibility mapping be mandatory in erodible steep lands? NZ Journal of Forestry 59 (4): 32–42;
- Phillips C, Marden M, Basher L 2015. Forests and erosion protection – getting to the root of the matter. New Zealand Journal of Forestry 60(2): 11–15;
- Amishev D, Basher L, Phillips C, Hill S, Marden M, Bloomberg M, Moore J 2014. New forest management approaches to steep hills. MPI Technical Paper 2014/39. Prepared for MPI by Scion, Landcare Research and University of Canterbury.
- Basher LR, Hicks DM, Clapp B, Hewitt T 2011. Sediment yield responses to forest harvesting and large storm events, Motueka River, New Zealand. New Zealand Journal of Marine and Freshwater Research 45: 333–356

[2] Basher L, Barringer J 2017. Erosion Susceptibility Classification for the NES for Plantation Forestry. Landcare Research Contract Report LC2744 for the Ministry for Primary Industries;
Basher L, Lynn I, Page M 2015. Update of the Erosion Susceptibility Classification (ESC) for the proposed National Environmental Standard for Plantation Forestry - revision of the ESC. MPI Technical Paper No. 2015/13. Prepared by Landcare Research for the Ministry for Primary Industries (Landcare Research Contract Report LC2196).

[3] Basher L, Barringer J, Spiekermann R 2019. Assessment of landslide and debris flow susceptibility for Nelson Forests estate. Landcare Research Contract Report LC3569 for Nelson Forests Ltd.;
Basher L, Rosser B 2020. Analysis of rainfall frequency and magnitude, OneFourtyOne New Zealand forest estate: implications for landslide hazard. Landcare Research Contract Report LC3730 for OneFourtyOne New Zealand.

As a basis for providing this assessment, I have read the NZFFA submission, the erosion modelling report (Easton et al. 2023), and relevant parts of the GWRC Proposed Plan Change 1. My comments are restricted to those areas for which I have technical expertise.

Assessment of erosion risk modelling and identification of target land

GWRC use a modelling approach, documented in Easton et al. (2023), to assess erosion risk and identify land proposed for restrictions on forestry and pasture land uses. Erosion risk would normally be evaluated as a function of susceptibility of the land to erosion, frequency of erosion-causing events and consequences of those events. The Easton et al. (2023) approach really only assesses susceptibility even though the word "risk" is used.

Easton et al. (2023) provided what they call spatial erosion risk layers to GWRC to allow identification of "the most erodible 10% by area" of land currently in forestry in each Whaitua. To do this they use the model dSedNet to characterize surface, bank and landslide erosion risk. Surface and landslide erosion are then amalgamated to a single hillslope risk layer. Surface erosion is estimated by a New Zealand version of RUSLE which provides sediment yield predictions (t ha^{-1} yr^{-1}). Risk of landslide erosion is simply estimated as a function of slope angle rather than using a spatially distributed modelling approach which would far better reflect spatial variation in landslide risk/susceptibility. This approach defines any land steeper than 26° as "at risk". Bank erosion is expressed as relative susceptibility of stream reaches derived from Smith et al. (2019).

The modelling approach used is, in my opinion, deeply flawed

- Landslide erosion is likely to be the largest contributor to long-term sediment yield, therefore it is important to assess this as accurately as possible. The crude approach to landslide erosion does not use the power of the available Digital Elevation Model to be able to predict spatial variation in landslide erosion and more accurately predict the most susceptible areas, methods which are currently being used elsewhere in New Zealand[4]. Zoning by slope angle is simplistic and inappropriate in my opinion. Furthermore, the choice of a threshold slope angle of 26° based on the data presented in DeRose (2013) and Dymond et al. (2016) is also problematic. The data presented in those two papers was based on analysis of Tertiary soft rock hill country rather than greywacke. This terrain

[4] See for example Smith HG, Spiekermann R, Betts H, Neverman AJ (2021). Comparing methods of landslide data acquisition and susceptibility modelling: examples from New Zealand. Geomorphology 381

is far more susceptible to landslide erosion than greywacke and therefore the choice of this threshold slope angle for greywacke slopes is completely inappropriate.

- In my opinion the use of the Revised Universal Soil Loss Equation (RUSLE) on steep pasture and forested slopes is problematical, considering that the model has never been well calibrated for these conditions. Easton et al. (2023) note that RUSLE predicts high erosion rates even with extensive native woody vegetation cover, and it is rainfall and slope angle that have the dominant effects on modelled erosion rates. The map of RUSLE-modelled surface erosion is largely a slope map and in my view the predictions of sediment yield (t ha^{-1} yr^{-1}) are likely to be highly unreliable and have high uncertainty.
- Combining landslide and surface erosion into a single risk layer also seems inappropriate to me. Easton et al. (2023) argue it was done to "to provide a single risk layer that is easier to understand and disseminate than two separate layers" and "provides flexibility of mitigation options for potential treatment". In my opinion, because the two processes require completely different mitigation approaches (acknowledged by Eason et al. 2023) they need to be assessed separately so that the appropriate mitigation(s) are selected.

The hillslope modelling approach provides a relative assessment of erosion risk, rather than an absolute assessment. This is because a) it uses three different metrics for the 3 processes (surface erosion – t ha^{-1} yr^{-1}, landslide – all slopes >26°, bank erosion – relative susceptibility), and b) it only considers local risk within the two Whaitua rather than having a regional or national perspective. Consider the statement in the S32 report (p107) that "All plantation forestry activities in these FMUs are permitted activities under the NES-PF regulations, because there is no land in these FMUs that is identified on the NES-PF erosion susceptibility classification system to be of very high (red) risk. However, the erosion susceptibility mapping undertaken for Greater Wellington (Easton S., Nation T., Blyth J., 2023) shows that there is land that is currently used for plantation forestry in these FMUs that has a very high risk of erosion." In my opinion, this land is far from "at very high risk to erosion" and the NES-PF erosion susceptibility mapping is a better expression of the real (moderate) risk of erosion .

In my opinion the modelling is not fit-for-purpose, simplistic and inappropriate. GWRC have not demonstrated that the land for which controls are proposed is truly high erosion risk and that the proposed controls are justified.

Relative erosion susceptibility of greywacke

Most of the hilly land likely to be proposed for retirement from forestry is underlain by greywacke. Analysis of the relative susceptibility of different types of rocks to erosion was one of the bases of the Erosion Susceptibility Classification (ESC) developed for the NES for Plantation Forestry (Basher et al. 2015 – see Table 1). There is a wide range of rock strength across New Zealand with greywacke (Gw in Table 1) classed as very strong (i.e. one of the least erodible rock types in New Zealand). As a result the hilly greywacke land in these Whaitua is classed as moderately susceptible to erosion in the ESC and a proposal to require retirement of some of this land seems completely at odds with management of forestry under the NES-PF on a consistent national basis.

Table 1 Relative rock strength of different unweathered rock types (Table 7 from Basher et al. 2015)

Rock strength	**Rock type[1]**
Extremely weak	Ng, Rm, Ta, Sc, Lp, Kt, Tp, Ft*, Vu*, Pt, Wb, Us*, Uf*
Very weak	Mo, Ft*, La*, Vu*, Af, Gr*, Us*, Uf*
Weak	Mf, Me, Lo, Mx, Ac
Strong	Tb, Vb, Cl, Gl, Mm, Mb, Sm, Sb, Cw, Li*
Very strong	Vo, Ar, Si, Cg, **Gw**, Li*, Sx, Sy
Extremely strong	In, Gn, Um, Gs, Ma

[1] Symbols follow Lynn et al. (2009); *These rock types exhibit a range of rock strength

This lower susceptibility of greywacke slopes to landslides is also illustrated by the figure included in the NZFFA submission (Fig. 1). This figure shows quite clearly that greywacke slopes produce far fewer rainfall-induced landslides than Tertiary soft rock slopes. This process (rainfall-induced landslides) is likely to be the dominant sediment-producing process both in the long-term and during infrequent high-intensity storms and greywacke, and is the process typically targeted for mitigation in hill country.

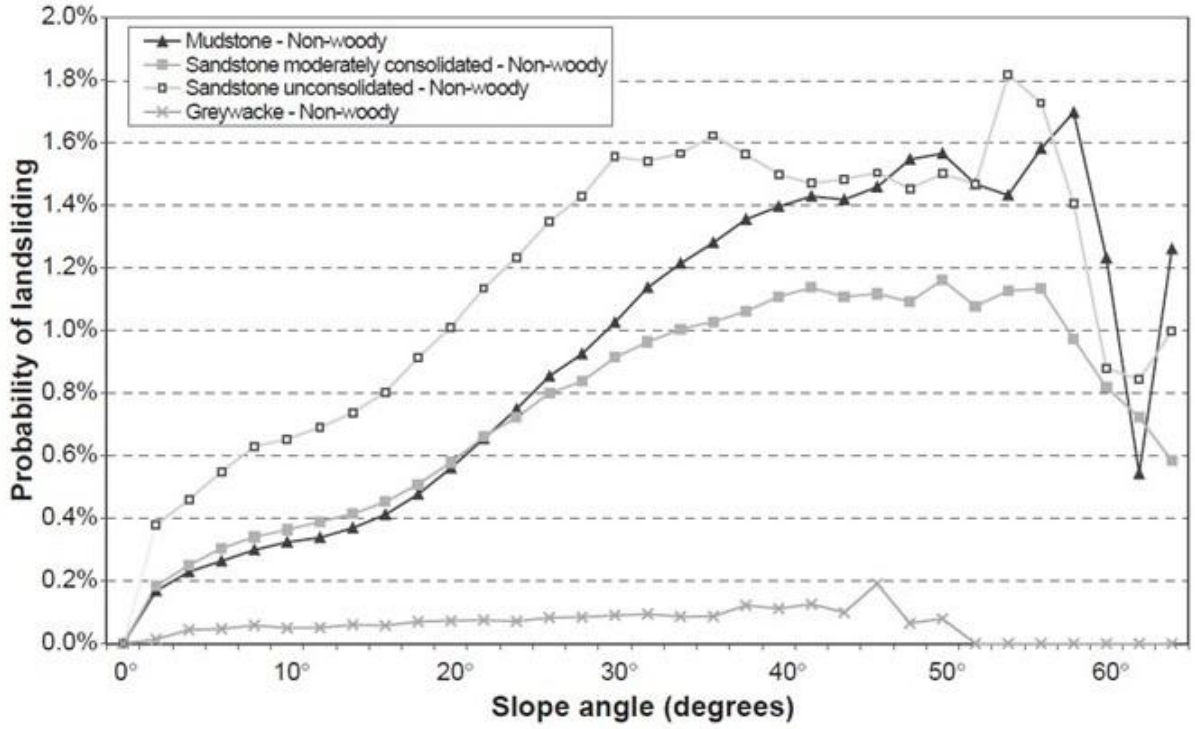

Figure 1 Graph of landslide probability (under non-woody vegetation) versus slope angle for the four main rock types in Manawatu–Wanganui hill country (from Dymond et al. 2006).

While greywacke slopes are typically relatively stable under closed canopy plantation forest, when the trees are harvested the risk of erosion increases for a period of time as a result of changes in hillslope hydrology and soil strength. This “window of vulnerability” can last up to 8 years. While harvested greywacke slopes do have increased susceptibility to erosion post-harvest (both landsliding and surface erosion as a result of earthworks), in my opinion the extent of increase would be far lower than for less stable rock types. I am not aware of any studies that have examined post-harvest erosion from greywacke slopes nor compared post-harvest erosion from greywacke with other rock types.

Sediment loss not above natural

GWRC appear to have a goal of returning hydrology and erosion to more natural rates by 2040. Objective WH.02, b. states “the hydrology of rivers and erosion processes, including bank stability are improved and sources of sediment are reduced to a more natural level“. Similarly in Schedule 34 (Plantation Forestry Erosion and Sediment Management Plan) one of the objectives

(Management Objective B2) is to “avoid an increase in risk of loss of sediment to water relative to the risk of loss that exists from the land in a natural state“.

In my opinion this is both inappropriate and unrealistic. Much of the land in these two Whaitua would originally have been forested. Much of the forest has been removed and this will have increased both total runoff and flood flows, and likely increased sediment load from a range of processes including landslides and bank erosion. In addition, parts of the Whaitua have been developed for housing and this will also have increased total runoff and peak flows. Therefore returning hydrology and erosion to more natural rates seems unrealistic and inappropriate to me.

While NZFFA suggests a need to find a better way of defining natural levels, in my opinion natural levels are not appropriate because they would be difficult to achieve given the changes in hydrology and slope stability that have occurred since human settlement.

In my opinion the practicality of both achieving and measuring " no increase in sediment load above the natural state" is highly questionable. There are two reasons for this:

- firstly, it is expensive and time consuming to measure sediment load therefore reliable measurements are infrequently carried out in New Zealand;
- secondly, sediment load is typically highly variable at all temporal scales (storm event to annual). Annual sediment load can range enormously (e.g. a study of the Motueka River estimated annual sediment load to range from 0.006 to 1.6 M t) and therefore identifying the impact of relatively small changes in land use is near impossible. In addition impacts of land use change are often assessed via modelling, but the models typically have large error limits and are also inadequate for identifying the impact of small land use changes.

Conclusions

The proposal to restrict forestry harvest from about 10% of the steepest forestry land in the Whaitua Te Whanganui-a-Tara and Te Awarua-o-Porirua Whaitua, based on erosion risk modelling to identify target land is poorly founded and inappropriate. It is arguable whether the controls proposed are justified considering greywacke is one of the least erodible rock types in New Zealand, and plantation forest on greywacke has a low relative erosion risk including during the window of vulnerability. I agree with the NZFFA submission that “the case to prohibit

plantation forestry from the highest 10% relative risk of erosion prone forestry land does not stack up and may not reduce sediment levels in water bodies".

The stated goal of achieving no increase in sediment load above the natural state is both inappropriate and unrealistic given the transformation of the land (hydrology and slope stability) since human settlement.

I agree with the NZFFA submission that rather than prohibit plantation forestry from the steepest slopes, GW should explore other ways of mitigatng the risk of erosion from steep slopes after harvesting and should allow the stricter ESC controls under the NES for Commercial Forestry to take effect before introducing more stringent land use controls.

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