Te Awarua-o-Porirua Whaitua Committee

MEMO

TO	Te Awarua-o-Porirua Whaitua Committee
FROM	Project Team
DATE	18 October 2018
SUBJECT	Further advice and recommendations for harbour sediment metals objectives

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Background

The Committee received and considered technical advice and recommendations for the setting of sediment metal objectives in the harbour. The Committee did not agree to the recommendations presented and sought further advice from the project team.

That advice, presentation and minutes of the Committee workshop are available in the following documents:

- Recommended harbour objectives
- Technical report associated with harbour modelling results
- PRESENTATION Harbour objective setting TAoPW Committee Workshop – 23 August 2018
- RECORD Te Awarua-o-Porirua Whaitua Committee Workshop - 23 August 2018

This paper provides further advice and recommendations from the project team, including:

- Modified recommendations for harbour sediment metal objectives
- Additional recommendations for total metal load limits and reduction targets

On the basis of:

- Modified advice from referencing fractions of ANZECC guidelines. Recommend being specific about the contaminants for setting objectives and using numeric thresholds, derived from fractions of ANZECC guidelines, to set objectives
- Additional advice on the current conditions in the harbour
- Additional advice on key messages from the scenario modelling results and relationship to sediment reduction targets
- Additional advice on relationship of freshwater metal objectives, harbour metal objectives and limits

New recommendations

1. Set harbour sediment zinc objectives that reflect maintaining current level of risk to aquatic species:
   - Onepoto Arm intertidal – B band – <= 100 mg/Kg
   - Onepoto Arm subtidal – C band – <= 200 mg/Kg
   - Pauatahanui intertidal – A band – <= 40 mg/Kg
   - Pauatahanui subtidal – B band – <= 100 mg/Kg

2. Set harbour scale total zinc load limits and reduction targets in order to achieve freshwater objectives and ensure harbour zinc sediment concentrations do not increase with reducing catchment sediment loads.

	Current total zinc load	Total zinc load limit	Total zinc target
	Annual average (kg/yr)	Annual average (kg/yr)	% reduction from limit
Onepoto Arm	2,650	2,650	40%
Pauatahanui Inlet	580	580	40-45%

3. Set harbour sediment copper objectives that reflect maintaining current level of risk to aquatic species:
   - Onepoto Arm intertidal – A band – <= 13 mg/Kg
   - Onepoto Arm subtidal – B band – <= 32 mg/Kg
   - Pauatahanui intertidal – A band – <= 13 mg/Kg
   - Pauatahanui subtidal – A band – <= 13 mg/Kg

4. Set harbour scale total copper load limits and reduction targets in order to achieve freshwater objectives and ensure harbour copper sediment concentrations do not increase with reducing catchment sediment loads.

	Current total copper load	Total copper load limit	Total copper target
	Annual average (kg/yr)	Annual average (kg/yr)	% reduction from limit
Onepoto Arm	240	240	40%
Pauatahanui Inlet	70	70	40-45%

Project team advice to the Committee

Thresholds to set harbour sediment metal objectives

Committee question: Why are we using ANZECC not numbers?

Response:

The initial project team recommendation included a reference to set objectives as a fraction of the ANZECC guidelines. Using that approach aimed to

a) minimise the risk of metals having an effect on aquatic species in the harbour
b) allow for policy to cover other metals if needed
c) allow for policy to incorporate threshold changes due to new research/technology.

The approach of using fractions of the ANZECC interim sediment quality guideline (ISQG) thresholds follows a risk framework to help indicate the risk that these thresholds are being approached and there is a changing risk that an effect might occur on animals living in the sediment.

The thresholds have been derived from a very limited international dataset, and there are few reliable New Zealand data on sediment toxicology. Uncertainty remains over the degree to which these thresholds protect New Zealand species, but the recommended approach provides a precautionary approach to manage the risk of harm to aquatic species based on our current level of knowledge. It remains a research gap to understand the sediment macroinvertebrate/toxicant relationship for New Zealand estuaries.

This knowledge may change in the future to give different thresholds with stronger understanding about the levels of effect at different metal concentrations. Regional plans and objectives are regularly reviewed, which provide an opportunity to incorporate that updated knowledge at that time through the appropriate plan review process.

While the earlier technical recommendation aimed for greater flexibility to respond to advances in our knowledge, this does not match well with the needs for certainty in planning and for the WIP to specify clear objectives and associated limits and methods to help achieve those objectives. The objectives in the plan change associated with the WIP will have to specify the metals (i.e. zinc and copper) and an outcome to be achieved. In regards to the outcome, the plan change must make a clear statement. This could be through a fraction of the ANZECC guidelines as at the date of the plan change or a number, either way it would not allow for potential future changes. If in future objectives were needed for other metals or thresholds changed this would have to occur through a future plan change at that time.

As a result of this additional policy consideration, we have modeified our advice on the use of fractions of the ANZECC ISQG guideline. We instead recommend adopting a numeric threshold objective for zinc and copper concentrations in sediments from the following ‘attribute table’. These attribute states and thresholds are still based on fractions of ANZECC thresholds that are commonly used in estuary health management, representing best current knowledge to minimise the risk of metals having an effect on aquatic species in the harbour. However, this approach provides greater clarity in drafting objectives and a policy response.

Table 1: Sediment metal thresholds for setting objectives

Attribute unit	**Total metal in sediment**			
Attribute state	**Narrative attribute state**	**Fraction of ANZECC ISQG**	**Zn (mg/Kg)**	**Cu (mg/Kg)**
A	Very low risk of harm to aquatic species	<=0.2	<=40	<=13
B	Low risk of harm to aquatic species	<=0.5	<=100	<=32
C	<10% probability risk of harm to aquatic species	<=1	<=200	<=65
D	>10% probability risk of harm to aquatic species	>1	>200	>65

Spatial extent to set objectives and current conditions

Committee question: To what extent can we meet objectives in different parts of the harbour and in hotspots?

Response:

The previous advice recognised the intertidal area is more ecologically diverse, vulnerable and dynamic, while the subtidal area tends to be a more depositional environment and already more impacted by legacy contaminants. This resulted in the recommendation to set different objectives in intertidal and subtidal areas.

The following advice provides further information about the current conditions in each of those environments.

Sediment metal concentrations in intertidal areas tend to be lower than subtidal, as sediments, with associated metal, tend to move through intertidal areas and deposit in the deeper subtidal basins. This is consistent with monitoring of sediment metal concentrations in Porirua Harbour showing that intertidal areas tend to have lower concentrations of metals than subtidal areas.

Monitoring of intertidal areas has provided a 'baseline assessment' over three years from 2008-10 with an update in 2015, and subtidal areas were assessed in 2006 and 2015. The current monitoring is based on two main locations that are representative of intertidal areas across each harbour arm. We tend to see consistency in the 'attribute state' within each of those sampling locations (ie, most replicates collected at each 'sub-estuary' area are similar), though we do see differences across sub-estuaries in the harbour. An investigation was carried out in 2009 to identify hotspots within particular parts of the harbour.

The results of the representative monitoring is outlined in the following tables, with the letters reflecting the 'attribute state' using the thresholds described in Table 1.

Table 2 – estimated attribute state from monitoring of sediment zinc concentrations

Zinc		2006	2008	2009	2010	2015
Onepoto Arm	Intertidal 1		A	B	A	A
	Intertidal 2		B	B	B	B
	Subtidal 1	C				C
	Subtidal 2	C				C
Pauatahanui Inlet	Intertidal 1		A	A	A	A
	Intertidal 2		A	A	A	A
	Subtidal 1	B				B
	Subtidal 2	B				B
	Subtidal 3	B				B

This monitoring indicates that currently there is a low to very low risk of effects in intertidal areas of the harbour and low to moderate (10%) risk of effects in subtidal areas, and Onepoto Arm has higher risk than Pauatahanui Inlet.

The 2009 investigation identified that the sediment zinc concentrations in areas adjacent to the Porirua Stream mouth, Porirua CBD and Semple Street drain were above the C band levels. Harbour sediment modelling indicates that area is predominantly influenced by sediments from Porirua Stream. Semple Street drain makes a small contribution to sediment in this area, though its relatively high estimated metal load may mean it has a greater contribution to sediment metals. Prioritising zinc reductions in catchments that contribute to these hotspots may be part of the overall approach to achieving harbour sediment zinc objectives.

Table 3 - estimated attribute state from monitoring of sediment copper concentrations

Copper		2006	2008	2009	2010	2015
Onepoto Arm	Intertidal 1		A	A	A	A
	Intertidal 2		A	A	A	A
	Subtidal 1	B				B
	Subtidal 2	B				B
Pauatahanui Inlet	Intertidal 1		A	A	A	A
	Intertidal 2		A	A	A	A
	Subtidal 1	A				A
	Subtidal 2	A				A
	Subtidal 3	A				A

This monitoring indicates that there is currently a very low risk of effects in intertidal areas of the harbour and subtidal areas of Pauatahanui Inlet. In the Onepoto Arm there is a very low risk of effects in all the intertidal areas and a low risk of effects in subtidal areas.

What have we learnt from the scenario modelling?

Committee question (continued): To what extent can we meet objectives in different parts of the harbour and in hotspots?

Response (continued):

The previous advice had no information from the scenario modelling. This section presents advice from the scenario model.

The scenario modelling of harbour metals has predicted the sediment metal concentrations based on the catchment sediment and metal inputs, but approach appears to have struggled to estimate the likely absolute sediment metal concentrations. This means we should avoid focusing on absolute estimates, but take note of how the estimated concentrations change in each scenario relative to current state.

A key lesson from this modelling is that making large reductions in catchment sediment loads, without also making reductions in metal loads is likely to risk an increase in sediment metal concentrations. Table 4 shows that the catchment loads of sediment into Onepoto arm while zinc marginally increases and the harbour metal modelling estimated sediment zinc concentration increases for BAU compared to current state.

Conversely, making larger reductions in catchment metal loads than sediment loads could allow sediment metal concentrations to reduce, though it's unclear how the existing legacy contamination would affect reductions. Table 4 shows the reduction in sediment loads (48%) is less than the reduction in total zinc loads (60%) and the harbour metal modelling estimated sediment zinc concentration decreases compared to current state.

Sediment copper concentrations reach higher concentrations than current state in both scenarios, with smaller catchment copper load reductions in both BAU and water sensitive scenarios than the sediment load reductions (Table 4).

This suggests that harbour metal load reductions may need to be set at similar levels to the sediment reduction targets to help avoid risks of increasing harbour sediment metals. These may be in the order of 40-45% reductions.

The total zinc reductions to reach that level lie somewhere between the levels estimated for the improved and water sensitive scenarios in Onepoto Arm, and about the same as those estimated for the water sensitive scenario in the Pautahanui Inlet. The total copper load reduction to reach that level may be beyond those estimated by the water sensitive scenario across both arms of the harbour.

The harbour sediment modelling gives us insights into the fate of sediment from particular catchments within the harbour. This indicates that most deposited sediment in Onepoto Arm is from Porirua Stream, while the sources of deposited sediment in Pauatahanui Inlet are mixed, predominantly from Pautahanui, Horokiri and Duck Creek. We don't have the same ability to trace catchments' metal contributions to deposition in bed sediments, though we expect it to follow similar patterns. This means it is difficult to justify tailoring objectives, limits and catchment responses in a spatially detailed way.

Table 4 – modelled annual average metal and sediment loads to Porirua Harbour from surrounding catchments

	Baseline	BAU	Improved	Water sensitive	BAU	Improved	Water sensitive
	Annual average total zinc load (kg/yr)				% reduction from baseline		
Onepoto Arm	2,650	2,670	1,850	1,060	1%	-30%	-60%
Pauatahanui Inlet	580	670	500	310	16%	-14%	-47%
	Annual average total copper load (kg/yr)				% reduction from baseline		
Onepoto Arm	240	260	220	190	8%	-8%	-21%
Pauatahanui Inlet	70	90	70	60	29%	0%	-14%
	Annual average sediment load (tonne/yr)				% reduction from baseline		
Onepoto Arm	2,820	2,500	1,530	1,470	-11%	-46%	-48%
Pauatahanui Inlet	5,190	5,140	3,120	2,820	-1%	-40%	-46%

We recommend setting objectives for the intertidal and subtidal areas of each harbour arm, and setting any limits or load reduction targets at each harbour arm scale. This recognises that we are:

- confident there are different characteristics and current conditions of intertidal and subtidal environments
- uncertain in the sediment and metal load contributions from specific catchments
- uncertain in the fate of sediment and metals from specific catchments across the harbour
- limited in our ability to tailor responses to achieve more spatially explicit objectives.

Relation of freshwater objectives to harbour objectives and limits

Committee question: Will the treatment of metals in the freshwater areas get us to the harbour objective?

Response:

The previous advice had no information about the relationship of the freshwater and harbour objectives

The draft Committee freshwater objectives are estimated to maintain median dissolved zinc and copper concentrations in urban streams and reduce peak concentrations in urban streams in the order of 50%. The objectives seek to maintain current conditions in streams in rural areas.

While the freshwater objectives are set on dissolved metals, there is a reasonable relationship in the literature between total metal loads from catchments and dissolved concentrations in stream, meaning that load reduction targets can be set using total metal loads to help achieve the freshwater objectives.

Setting total metal load reductions targets at these levels for the harbour is likely to support the achievement of dissolved metal objectives in freshwater, provided significant amounts of that load reduction occurs during peak flows and rainfall periods. Approaches that primarily target first-flush of stormwater, either through treatment (eg devices that treat first-flush) or through source control (eg roof painting to reduce first-flush from roofs) will support reductions at those times.