WHANGAMATĀ HARBOUR SYSTEM

Context, Constraints, and a Pathway Forward

(Foundational Briefing Document – Version 2 Author Ian Holyoake)

EXECUTIVE SUMMARY

The condition of the Whangamatā harbour system is not the result of a single issue, but the outcome of long-term cumulative processes operating from the hills to the ocean.

Sediment is a natural and unavoidable product of this system. However, changes in land use, drainage, infrastructure, and operational practices have significantly increased sediment generation, altered its transport pathways, and reduced the harbour's ability to process and flush it.

Observed evidence across the catchment confirms:

- ongoing bank incision despite stabilisation efforts
- large-scale sediment inputs from land disturbance events
- operational practices contributing directly to sediment transfer
- increasing sediment storage within the lower system

Simple field observations support this understanding. Sediment "jar tests" demonstrate how fine materials and organic content combine to form stable, low-oxygen (anaerobic) layers once mobilised — explaining the persistence of deposits within the harbour.

The key issue is not whether sediment can be stopped — it cannot — but whether it is being understood and managed as a connected system.

A significant constraint to progress is access to existing institutional knowledge. While extensive work has been undertaken over time, this information is fragmented, delayed, or difficult to access. Without early alignment on this knowledge base, there is a high risk of duplicated effort, delay, and ineffective outcomes.

A structured pathway forward is proposed:

1. **Reduce** avoidable sediment inputs
2. **Neutralise** harmful accumulation
3. **Improve** system function over time

This briefing should be read in conjunction with the **Hills → Ocean System Evolution**, and **Urban → Ocean frameworks,** which provides the underlying system context for all observations and recommendations.

1. PURPOSE

This document provides a grounded, system-based explanation of the current condition of the Whangamatā harbour system (including Moana Anu Anu and contributing catchments), and outlines a practical pathway forward.

It is intended to:

- establish a shared understanding of the system
- align stakeholders across agencies and disciplines
- avoid duplication of past effort
- support coordinated decision-making over time

This document is designed to be **transportable** across agencies and applicable to similar systems throughout New Zealand.

2. FRAMING THE ISSUE CORRECTLY

The harbour is often approached as a problem requiring a solution.

That framing is incomplete.

The harbour is not a problem to be fixed — it is a system responding to long-term cumulative change.

Sediment is central to that response — but sediment itself is not the issue.

Sediment is the natural output of the landscape.

The issue is how it is:

- generated
- transported
- stored
- and processed within the system

3. SYSTEM FRAMEWORK REFERENCE – HILLS TO OCEAN

A detailed description of system evolution, sediment pathways, and long-term trajectory is provided in the accompanying **Hills → Ocean System Evolution** document.

That framework demonstrates that:

- the current harbour condition is the cumulative result of catchment-wide processes
- land use and hydraulic modifications have progressively altered system behaviour
- sediment supply, transport, and storage are no longer in equilibrium

Key transitions include:

- conversion from diffuse wetland flow to channelised systems
- progressive hydraulic constrictions (bridge, causeway)
- increased sediment delivery from land-use intensification
- disturbance and redistribution of stored sediments

All current observations and proposed interventions must be understood within this system context.

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4. TRANSITION TO AN ACCELERATED SYSTEM

Human activity has progressively increased system energy and sediment mobility:

- vegetation clearance reduced slope stability
- wetlands were removed or bypassed
- drainage accelerated water movement
- forestry and agriculture increased sediment mobilisation

The result is a shift from:

- slow, buffered systems

to:

- **fast, channelised, high-energy systems**

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5. MODERN SYSTEM DRIVERS (OBSERVED EVIDENCE)

5.1 Channel Incision and Bank Failure

- Flow concentration has increased erosion energy
- Vegetative stabilisation is proving insufficient

Field evidence (Titoki catchment):

- continued bank collapse despite planting

Indicates system energy exceeds mitigation capacity

5.2 Event-Based Sediment Inputs

- Large slips introduce major sediment loads
- Operational responses can worsen outcomes

Field evidence (State Highway 25):

- slip material pushed directly into waterways

Represents avoidable sediment transfer

5.3 Soil Structure Breakdown

- Burnt roots and exposed soils indicate loss of binding
- Increased mobilisation of fine and organic material

5.4 Downstream Sediment Storage

- Bed levels rising in lower catchment areas
- fresh deposition evident

Field evidence (residential interface):

- system is storing sediment, not flushing it

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6. HARBOUR SYSTEM RESPONSE

The harbour is now characterised by:

- reduced tidal flushing
- increased fine sediment accumulation

- development of anaerobic conditions
- declining ecological function

A reinforcing cycle is occurring:

1. sediment accumulates
2. flushing reduces
3. more sediment is retained
4. system condition declines

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7. VISUAL EVIDENCE – SEDIMENT BEHAVIOUR (JAR TESTING)

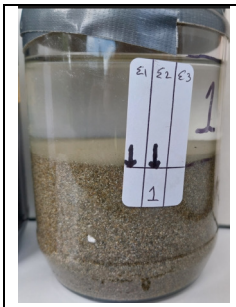
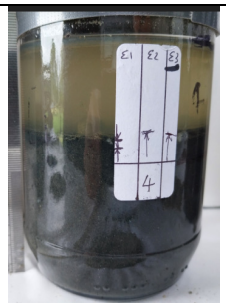
Simple sediment “jar tests” illustrate system behaviour:

- coarse materials settle quickly
- fine particles remain suspended
- organic-rich material forms cohesive, dark layers

These darker layers are consistent with hydric soil conditions formed under low-oxygen environments

In low-energy environments, these materials do not flush — they accumulate and persist.

The jar tests do not replace technical analysis — they provide a clear visual explanation of why sediment accumulation becomes a long-term issue.

				
Clean Ocean sand (surf club)	Sediment load (clays) Wentworth River	Sediment transformation Moanu anuanu interface with Mangroves	Sediment reactor stormwater channel (Casement)	Sediment transformation/ binding Harbour

8. WHY THERE IS NO SIMPLE FIX

- sediment supply is ongoing
- system capacity is reduced
- changes are cumulative and embedded

No single intervention will resolve the harbour condition.

Isolated actions risk:

- shifting problems
- unintended consequences
- repeating past outcomes

9. CRITICAL CONSTRAINT – INSTITUTIONAL KNOWLEDGE

Extensive work has already been undertaken:

- Council studies
- consultant reports
- consent processes
- Environment Court proceedings

However:

Access to this knowledge is fragmented, delayed, or incomplete.

Recent experience confirms:

- delays in LGOIMA responses
- difficulty accessing Court-held material

9.1 Project Risk

There is a risk that effort is spent rediscovering existing knowledge rather than advancing solutions.

This leads to:

- duplication

- delay
- potential escalation pathways

This does not improve outcomes — it delays them.

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10. STRATEGIC REFRAME – MANAGING THE SYSTEM

A structured approach is required:

Reduce

Limit avoidable sediment inputs

Neutralise

Manage accumulation and prevent harmful states

Improve

Restore system function over time

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11. SYSTEM ASSESSMENT – LUIS FRAMEWORK

The Land Use Impact State (LUIS) framework provides a way to:

- assess current system condition
- understand trajectory (improving or degrading)
- compare across the catchment

LUIS shifts focus from isolated issues to system state and direction of change.

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12. GOVERNANCE REALITY

The system spans multiple agencies:

- District Council

- Regional Council
- National policy frameworks
- infrastructure agencies

Many current conditions are shaped by:

- historical decisions
- consent frameworks

This requires coordinated, cross-agency alignment.

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13. LEADERSHIP REQUIREMENT

Progress depends on:

- shared understanding
- access to knowledge
- coordination across institutions

Leadership is required to align these elements.

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14. PROPOSED INITIAL APPROACH

Core Group

- community
- science
- system integration

Immediate Objective

- consolidate existing knowledge
- identify gaps
- align understanding

Critical Enabler

early cooperation from agencies to access existing information

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15. CLOSING POSITION

The harbour is responding to:

- long-term system change
- ongoing sediment inputs
- reduced system capacity

The opportunity is to move from:

- reactive, fragmented responses

to:

a coordinated, system-based approach grounded in shared understanding and existing knowledge.

ATTACHMENT

- Hills → Ocean System Evolution (LUIS Framework)

Hills → Ocean System Evolution

Timeline – Mechanisms – LUIS Trajectory

LUIS
LAND USE IMPACT STATE

LUIS records system condition relative to natural evolutionary function, while trajectory indicates whether pressures or recovery processes are dominant.

The Hills → Ocean system evolved over thousands of years through slow natural geomorphic processes. Over the past 150–200 years human land use and hydraulic modification have accelerated these processes dramatically, altering sediment supply, transport pathways and storage dynamics across the catchment–estuary–coastal system.

This is a classification and communication tool — not a precise scientific instrument.

Timeline	Description / System Mechanism	LUIS State + Trajectory
Pre-human natural system (10,000+ years)	Forested catchments, wetlands and marsh valleys capture sediment and organic carbon. Diffuse water movement across valley floors slows transport. Estuary channels migrate naturally while tidal flushing	LUIS +5

	maintains sand and shellfish systems. Sediment accumulation rates extremely low (background rates). Legacy sediment (beneficial for opportunity diversification).	
Polynesian arrival (~1300 AD)	Initial forest clearance and burning increase erosion slightly. Sediment delivery increases but wetland vegetation systems continue capturing and stabilising sediments. Harbour morphology remains largely intact. Adds to legacy sediment.	
European settlement (~mid-1800s)	Large-scale deforestation, agriculture and drainage increase erosion dramatically. Wetlands and valley vegetation converted to pasture and productive land. Sediment supply to estuaries increases by orders of magnitude compared with background rates. Adds to legacy sediment.	 ↓
Drainage, reclamation and valley modification (late 1800s – early 1900s)	Floodplains modified for farming and settlement. Vegetation capture and restraint reduced. Water moves through defined channels rather than diffuse wetland flow. Stored sediments remain largely buried but system resilience reduced. Creates new sediment.	 ↓
Truck bridge and inlet constriction (~1920s)	Hard fill across inlet margins and narrow bridge opening create a hydraulic pinch point. Flow concentrates and begins incision. Sediment (new and legacy) transport increases downstream toward Moana Anu Anu inlet and harbour.	 ↓
Causeway construction (~1970s)	Additional hydraulic constriction further concentrates flows and reduces tidal exchange width. Upstream formation of channels adjust to altered velocities and sediment transport. Vegetation establishes/stabilizes infill to defined channels	 → -1
Urban development and stormwater networks (late 1900s – present)	Stormwater pipes deliver concentrated runoff, sediments, DOC, nutrients and contaminants directly to waterways. Reduced detention and faster delivery of water and sediments into the harbour. DOC/fines/sands forms floc and mud layers. Vegetation roughness and slack waters traps sediment and lifts baselines. Tidal flush replaced by sediment storage.	 ↓
Marina development and ongoing dredging	Channel dredging alters bed morphology and disturbs previously stored sediments. Lift-and-drift dredging periodically remobilises fines and organic material accumulated over long periods. Redistribution occurs within harbour and offshore plume zones. Slack water DOC/fines/sand in changing fresh/sea water creates layered sediment no longer habitat for shell fish	 ↓
Accelerated runoff and legacy sediment mobilisation (early 1900s – present)	Catchment changes (urbanisation, drainage, forestry, farming, roading) have reduced natural storage and increased surface connectivity. This results in: • **more frequent mobilisation** (including during smaller rainfall events	 ↓

	that previously would not generate pulses) • **more highly mobilised sediment** due to increased flow energy	
Engineered drainage and low-flow organic processing zones (mid 1900s – present)	Drainage networks, stormwater channels, and maintained drains replace diffuse wetlands and shallow flow paths. Some drains become permanently wet, low-energy channels exposed to sunlight and organic inputs. These environments promote algal growth, organic decomposition, microbial activity and DOC production, altering the chemical and physical behaviour of fine sediments transported downstream. Drains are not just transport — they are transformation zones feeding into waterways/marsh/vegetated/mud formations	 ↓
Present day system	Multiple hydraulic pinch points, accelerated sediment supply and modified channels create a system where storage, mobilisation and transport processes are no longer in dynamic equilibrium, resulting in progressive redistribution of sediment and organic material from upstream storage zones into downstream receiving environments. Harbour ecology and morphology show increasing stress indicators – Moanu anuanu now fully changed habitat. Harbour now stressing with shell fish beds retreating and eelgrass loss.	 **approaching -5**

Likely Future Trajectory (If Pressures Continue)

Future Projection	System Mechanism	Projected LUIS
Continued land-use intensification	Forestry harvesting cycles, farming intensity and earthworks increase sediment pulses into catchments.	
Urban expansion and infrastructure growth	Larger stormwater networks, roads and impervious surfaces accelerate runoff and reduce natural detention capacity.	
Wastewater, greywater and nutrient loading	Nutrient inputs stimulate organic production and microbial activity in tidal channels and wetlands.	
Larger vessels and dredging demand	Maintaining navigable channels requires increasing dredging volumes, disturbing historic sediments.	
System response	Progressive marsh expansion, harbour shallowing, ecological stress, reduced tidal flushing and increasing flood vulnerability upstream.	 **likely within decades if pressures continue**

LUIS grading system

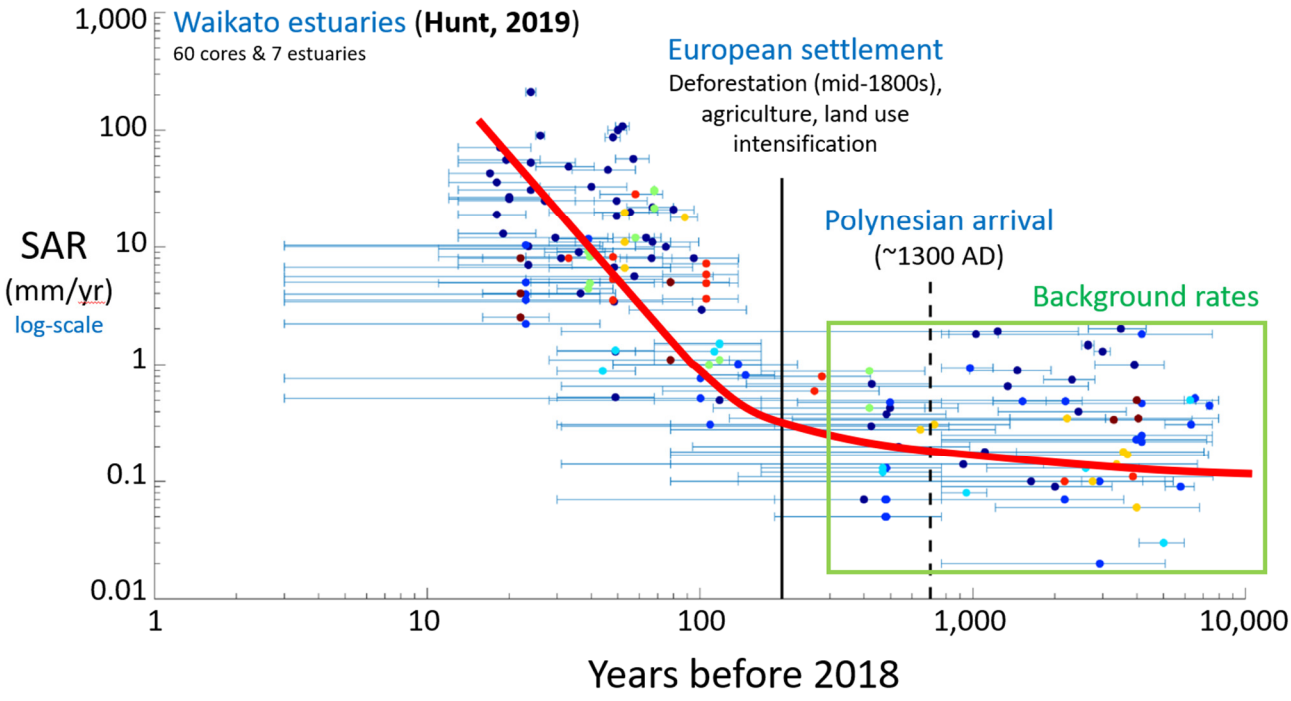
LUIS + 5 diversity + resilience

LUIS – 5 system collapse or loss of ecological function (restart of diversity in another state)



Trajectory

Source: WRC (Hunt 2019) analysis of sedimentation from 60 cores and 7 estuaries – plot of



sediment (averaging) has escalated from 0.1mm projected to 100mm in 2019 terms.