MEMO	
ATTENTION	Rebecca Clarkson
FROM:	Carina Sim-Smith
CC	
DATE:	22 November 2022
REGARDING	Benthic and water column effects of Waikato west coast mussel nursery

COAST & CATCHMENT
ENVIRONMENTAL CONSULTANTS

BACKGROUND AND SCOPE

North Western Mussels Ltd (NWML) are applying for consent for a new 700 ha spat catching and spat holding farm ('nursery farm') off the coast of Raglan/Whāingaroa. The farm will consist of four, well-separated blocks that are located approximately 3 km offshore in waters ≥20 m deep. Blocks A–C are each 180 ha in size, while Block D is 160 ha in size. Each block will be approximately 2 km × 1.5 km in size. Spat caught on the farm will be held there until they are up to 90 mm in length (average of 70 mm). Depending on the mussel size, they will be transported over land to Waikato East Coast farms, either still attached to the spat rope or as single seed. North Western Mussels are also considering using the proposed farm to on-grow hatchery spat in the future. It is acknowledged that a Plan Change will be necessary for the farm to be used for holding spat beyond 20 mm in length, or for on-growing hatchery spat.

A benthic survey of the proposed farm sites found that the substrate in Blocks A–C was predominantly sand, with a small percentage of mud (~10%). Block D contained a larger percentage of mud (~20–30%). Total organic content at all sites was very low (<0.14%). Epifauna was very sparse, and no sensitive habitats such as rocky reef or biogenic habitats were observed at the site. Macrofaunal communities had moderately low richness (mean = 12–16 taxa/grab) and moderate abundance (mean = 36–68 ind./grab). The community was dominated by small, common mobile taxa e.g., polychaetes, amphipods, cumaceans, the decapod *Ogyrides delli*, and the bivalves *Dosinia* sp. and *Mactra ordinaria*, which are widespread around the New Zealand coast in exposed, sandy areas (Grange, 2017).

Coast and Catchment were contracted to provide a desktop assessment of the potential benthic and water column effects (excluding hydrodynamic effects) of the proposed nursery farm.

POTENTIAL BENTHIC EFFECTS

The benthic effects of inshore mussel farming are well understood and are mainly related to the accumulation of biodeposits (mussel faeces and pseudofaeces), shell, live shellfish and other organisms below the farm, which alter the physical, chemical and biological characteristics of the seafloor (e.g. see Keeley, 2013; Forrest *et al.*, 2015). Typical responses include:

- Increased sedimentation leading to reduced particle size and the minor enrichment of marine sediments within and slightly beyond farm boundaries (i.e., up to 100 m). This may have an associated effect on benthic communities. Associated ecological effects are typically in the low to moderate range for areas that don't have particularly sensitive, vulnerable, or special benthic communities.

- The accumulation of live shellfish and shell material under the farm, which can provide food and a hard substrate for other benthic species (e.g., the eleven-armed starfish, ascidians, sponges and calcareous polychaetes), which typically leads to a more diverse epifaunal community then what was originally present on the soft sediment.
- The deposition of other fouling biota that either fall naturally to the seabed, or which are deliberately or incidentally removed during farm operations.

Multiple assessments of inshore Coromandel and Firth of Thames mussel farms show that concentrations of organic matter are very slightly elevated under the farms (≤10% higher than reference sites, with elevated concentrations extending 25 m to 100 m beyond the farms (Forrest *et al.*, 2015; Newcombe *et al.*, 2019). This tends to increase benthic productivity and cause minor changes in the composition of infaunal benthic communities beneath the farms that are generally consistent with effects associated with mild, positive enrichment (Keeley, 2013). Numbers of opportunistic polychaetes tend to increase slightly, but other major infaunal groups such as molluscs, crustaceans and echinoderms generally remain comparable between farmed and unfarmed locations.

Offshore mussel farms are frequently located in high-energy, dispersive environments, such as the proposed farm sites. Deposition of organic matter from those offshore farms will be dissipated over a much wider area, reducing the accumulation of organic matter under the farm. Very little information is available on the benthic impacts of offshore mussel farms. The magnitude of benthic impact will depend on the farm stocking density, hydrodynamics, and the substrates and benthic community present. Studies on overseas offshore mussel farms have found little, to no, significant increase in organic matter on the seafloor. Similarly, impacts of offshore mussel farms on benthic communities are usually small, though some changes in community composition, abundance and richness have been observed (Lacoste *et al.*, 2018; Mascorda Cabre *et al.*, 2021). A benthic survey of a New Zealand offshore mussel farm found that total organic matter and total nitrogen concentrations were slightly, but statistically significantly higher, under the farm, but there were no significant differences between the abundance, richness or diversity indices of the benthic macrofaunal communities in the farm and reference sites (Sim-Smith, 2021).

Overall, given the lack of sensitive habitats at the site, the common macrofaunal species present, and the highly dispersive environment, the potential benthic effects of the proposed nursery farm are likely to be **less than minor.** However, given the lack of data available on the impacts of offshore mussel farming in New Zealand, it is recommended that benthic monitoring is conducted to provide further information on the benthic impacts of offshore mussel farms.

POTENTIAL WATER COLUMN EFFECTS

Shellfish filter plankton and particulates from the water column, retain a portion for energy and growth, and release dissolved nutrients and particulate waste. Upon harvest, shellfish farms result in a net reduction of nutrients (mainly nitrogen) from the environment (see Stenton-Dozey & Broekhuizen, 2019; van der Schatte Olivier *et al.*, 2020 for reviews). However, there is a possibility that shellfish farms may cause:

- a localised depletion of plankton within the farm; or,
- an increase in dissolved nutrients around the farm, both from their excretion and by accelerating the remineralization of nitrogen from an organically enriched seabed. This

may enhance the growth of phytoplankton, macroalgae and bacteria in the wider environment.

Mussel aquaculture has the potential to cause the depletion of plankton and suspended particulate matter (SPM) in the water column. Modelling of large mussel farms (50 ha) in the Firth of Thames estimated that they could consume >20% of the phytoplankton that passes through a farm, though effects did not extend far beyond the farm boundaries. This is equivalent to 1–2% of the total phytoplankton population present in the farm volume (Broekhuizen *et al.*, 2004). However, fortnightly water quality monitoring for over a decade in the Wilson Bay Aquaculture Management Area did not detect any obvious effects of the mussel farms on plankton communities (Stenton-Dozey & Zeldis, 2012; Stenton-Dozey, 2013; Keeley *et al.*, 2015).

Mussels and associated biofouling organisms excrete ammonia into the water column, which is oxidised into nitrites and nitrates by bacteria. In addition, farm biodeposits may cause an increase in microbial activity in the seabed, and consequently, an increase in ammonia generated. This increase in ammonia production has potential to cause a localised increase in nitrogen around the farm. However, any impacts will be strongly dependent on environmental conditions around the farm, and very little data is available to quantify this effect (Cranford *et al.*, 2006; Chamberlain & Page, 2013; Stenton-Dozey, 2013). In a well-flushed environment, mixing and dispersion will rapidly dilute farm derived nutrients, and any nutrient enrichment beyond the farm boundaries is difficult to detect (Zeldis, 2008; Fisheries NZ, 2020).

In summary, given that the proposed sites are located in deep waters in a highly dispersive environment, the effects of the proposed nursery farm on the water column are assessed as **negligible.**

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