Memorandum

To	Tabitha Manderson
From	Rex H Corlett
Office	Christchurch Environmental Office
Date	12 July 2016
File	5-P0796.00/003PN
Subject	AFFCO NZ Meatworks Effluent Discharge Consent Application: Feasibility of Re-lining Existing Ponds

1. Qualifications and Experience

1.1. My full name is **Rex Hylton Corlett**.

1.2. I am the **Principal Engineer – Rural** with Opus International Consultants Ltd (Opus) based in Christchurch. One of my primary roles at Opus is to provide specialist civil engineering advice in the investigation, design and construction of rural infrastructure. I have a particular interest in infrastructure for dairy farms, including effluent systems, and was the lead author for the following good practice guides:

- Practice Note 21 (PN21): Farm Dairy Effluent Pond Design and Construction
- Practice Note 27 (PN27): Dairy Farm Infrastructure

1.3. My formal qualifications are: MBA (Tech Mgmt), BSc, NZCE (Civil). I am a Chartered Professional Engineer (CPEng) and a Fellow of the Institution of Professional Engineers New Zealand (FIPENZ).

2. Scope of Opinion Request

I have been requested to provide a professional opinion that covers the following questions and issues relating to the upgrading of the AFFCO Fielding meatworks waste ponds:

2.1. What would be the challenges associated with re-lining the existing ponds?

2.2. What would be best practice if you were to reline ponds, how long might it take?

2.3. Can you give an opinion as to what sort of cost might be looking at to do this (assuming that you could); state any assumptions you need to

2.4. In your professional opinion, is it possible to measure permeability of the existing liners?

3. Considerations

There are a number of issues that need consideration for the relining and upgrading of existing ponds, including:

3.1. Firstly, what is the highest expected water table below the ground surface level (GSL)? Neil Thomas suggest that adjacent to the site that the water table is only about 2.0 metres below GSL. Engineering best practice is that the base of any storage pond should to be at least 0.5 metres (but preferably 1.0 metres) above highest known water table level to prevent liner failure through hydrostatic uplift. A relined pond with perimeter bunds would be necessary to retain the required volumes of liquid waste above the GSL at the site.

3.2. Given the age of the ponds and the evidence provided by Neil Thomas, in my opinion it is almost certain that the ponds would have a comparatively high leakage rate. Undertaking a water balance calculation such as suggested by Mr Thomas would give an indication of leakage rate. A high resolution 48 hour “pond drop test”, such as the Opus Pond Drop test, could also be undertaken to determine the rate of seepage in millimetres/day and hence infer the permeability rate of any liner (if present). However, it would need to be determined if this test was practical for the site, and if a suitable testing time slot was available when there were no inflows into the pond.

Taking “push tube” samples into the existing liner (if present) is theoretically another option possible but is not favoured as they are only a point sample which may not represent the whole pond surface. Furthermore, they require draining of the pond to get access to the pond base.

3.3. If a new storage pond system were to be considered, the quantity of suitable material that can be reasonably cut out and reused to form the new pond perimeter bunds is unknown at this time. In my opinion it is likely that much of the material would not be suitable because of its saturated condition. Relying on wind and temperature to dry the material out would be problematic, especially if it is intended that construction be completed during wetter or colder periods of the year.

3.4. I would expect that all sludge and much of the excavated material would need to be cut to waste, or otherwise disposed of. After 40 years it will be saturated, contaminated and have high odour and will therefore require disposal to an approved site using appropriate safe procedures.

3.5. Good practice, as set out in PN21, requires a liner permeability rate of less than 1×10^{-9} metres/second. This can be achieved with a geomembrane such as HDPE or EPDM. Clay liners are difficult to construct and the build cost for such ponds is often higher overall than for geomembrane liners.

3.6. Gas venting behind a new geomembrane liner is a must if considering relining existing pond where decaying organics and gas will remain in the soil below and behind the new liner. Without vents gas can build up behind the liner and cause it to “balloon up”.

3.7. The slope of the existing pond batters below water level are unknown. New batter slopes need to be 2 (horiz): 1 (vert) or flatter to avoid the risk of batter slope materials slumping down in behind the liner.

3.8. If considering remedial works to existing ponds the following would need to be undertaken; preliminary investigations and testing, professional design, obtaining necessary consents., Completing a well-managed earthworks construction programme could take up to six months, and possibly up to twelve months depending on constraints such as; weather, consents, contractor availability, and minimising disruption to meat works operations.

3.9. Prior to construction good practice requires an extensive investigations programme, including deep test pits and materials sampling for laboratory tests. These tests will assist in classifying materials and determine their suitability for construction.

4. Costs

4.1. Some typical rough order of costs (ROC) rates for the relining of ponds on the scale envisaged are:

- HDPE liner supply and installation with gas venting: $12.00 per m^2
- Earthworks cut pond base to waste: $5.00 per m^3

4.2. Further costs will be incurred with connections to existing infrastructure and the installation of agitation and pumping equipment if required.

4.3. A project ROC can be built up once the required waste pond volumes are confirmed. Following an investigations programme, and preliminary design, a more accurate cost estimate exercise can be completed.

5. Further Comments

5.1. My experience, albeit on a smaller scale, is that where there is significant ground contamination and saturation it is often easier and cheaper to abandon existing storage ponds rather than trying to reconstruct them. Sludge must still be removed but cut to waste material from the new pond excavation can be used to fill the old ponds and restore the site for agricultural use.

5.2. The preferred location operationally for waste pond owners is often constrained by site factors such as; topography, water table, connection to existing infrastructure, suitability of construction materials, and distance to buildings and boundaries. A good site operationally is often one that allows gravity flow of liquids without the need for costly pumping.

5.3. Deeper cut ponds, or ponds built up above ground surface level, will allow more storage volume for the same plan area where space is limited. However for the AFFCO site, water table level is a major constraint. A variety of upgrading options should be considered to provide a cost effective solution while meeting engineering good practice.

5.4. The required total pond storage volume can often be lessened by either:

- Reducing the amount of water and waste liquid entering the storage pond, for example by solids separation or pre-treatment, and/or
- Selecting low application irrigation equipment and maximising the land area that is able to be irrigated

5.5. Environment Southland's Water and Land Plan provides some useful guidance in its *Rule 34 – Industrial and trade processes* as reproduced below.

Rule 34 – Industrial and trade processes

(a) The discharge onto or into land, in circumstances where contaminants may enter water, of wastewater, sludge or effluent from industrial and trade processes, other than agricultural effluent, is a discretionary activity provided the following condition is met:

(i) any pond, tank or structure used to store the waste-water, sludge or effluent prior to discharge is certified by a Chartered Professional Engineer as:

(1) being structurally sound;

(2) meeting the relevant pond drop level outlined below, when tested in accordance with the methodology in Appendix P.

Maximum Depth of Pond (m) excluding freeboard	Maximum Allowable Pond Level Drop (mm per 24 hours)
<0.5	1.2
0.5 to 1.0	1.4
1.0 to 1.5	1.6
1.5 to 2.0	1.8
>2.0	2.0

Appendix P – Effluent Pond Drop Test methodology

- Testing is undertaken over a minimum period of 48 hours.
- Testing recording equipment is to be accurate to not more than 0.8 mm.
- Continuous readings are to be taken over the entire test period at not more than 10 second intervals.
- Data analysis is undertaken by a party independent of equipment installer.
- Any change in pond fluid level over the test period needs to be accounted for.
- Ponds must be at or over 75% design depth before a test can be undertaken.
- The pond has been de-sludged in the 12 months prior to the test being undertaken and there shall be no sludge or crust on the pond surface during the test.
- The pond surface is not frozen during any part of the testing.
- An anemometer shall be installed for the duration of the test and at no time shall the wind speed exceed 10 metres per second during the test.

6. Assumptions

6.1. My opinions on the performance of the existing ponds are based solely on the following written evidence I have been provided with including:

- Appendix A Figures
- Appendix E Conceptual Design
- Statement of Evidence By Neil Thomas

6.2. It should be noted that I have not visited the site, or undertaken my own independent investigations or assessments as to; the subsurface geology, materials that the ponds were constructed with, or methods by which the ponds were constructed.