

How Many Deaths Does it Take? Access to and Egress from Oxidation / Effluent Ponds

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Abstract

Fourteen people have drowned in effluent and oxidation ponds in the last decade alone. The inadequacy of fencing and egress provisions were noted in coronial reports in all cases. As professionals involved in designing, detailing, reviewing, and operating ponds of all types, we have a duty to learn from these unfortunate past events so risks of further fatalities are reduced.

There are standards for swimming pools, but not ponds.

What about the other ponds we have created; open-excavation borrow pits, stormwater detention basins and wetlands to name some? If it is man-made, under Health and Safety legislation, the defined Person Conducting a Business or Undertaking (PCBU), has a responsibility to protect against any consequential health or safety risks. This duty applies to both current operational ponds and new ponds being contemplated.

This paper will look at what can be learnt from past fatalities, what guidance exists and what design and operational improvements we can make.

Key Words

Oxidation Ponds, Effluent Ponds, Pond Access, Pond Egress, Pond Safety, Pond Signage, Pond Fencing, Pond Escape, Tyre Ladders, PE Pond Ladders, Pond Escape Ladders, Water Storage Pond

Background

Following a drowning in a Local Authority oxidation pond in early 2019, Beca was invited to review access and egress provisions at a number of ponds. This paper provides a summary of what has been learnt from that process.

There have been fourteen fatalities in oxidation / effluent / water storage ponds in NZ in the last decade; six pre-schoolers, a teenager trapped in a water storage pond, two workers who drowned whilst working on equipment pontoons, a farmer who slipped into a PE lined pond whilst trying to rescue a lamb, a tanker driver who slipped into a steep-sided concrete lined pond, and three farmers who drove tractor/quad bikes into ponds. When was the last one; could the next one be at one of your sites or one of your designs? In addition to these, there are a

number of incidents where utes, tractors, ride-on lawn mowers, and even small planes have ended up in ponds, but their occupants were able to be rescued and so generally escape public attention and record.

Current Guidance

There are standards and guidance documents for swimming pools, but little regarding oxidation and effluent ponds. What there is has proved inadequate in preventing the loss of fourteen lives in the last decade.

- NZ Water Oxidation Pond Guidelines 2005 – *“Fences are essential to keep livestock out of pond areas and to deter public access. The large areas of land usually involved, tend to make climb-proof fencing expensive, although from a health and safety perspective, its use is desirable. In many cases, the “front*

entrance” to ponds is security fenced in this manner, with the “back door” being left at stock proof fencing. Normal 7 or 8 wire stock-proof fences are usually all that is provided”.

It is silent on egress provisions.

- IPENZ Practice Note 21 – Farm Dairy Effluent Ponds, 2017 - *“At the very least, a secure five-wire fence, preferably with netting and an electric fence ‘hot wire’ should be constructed. In some locations, a higher fence such as deer fencing will be appropriate. To provide greater security around the site, gates that lead into more hazardous areas such as effluent ponds, must have lockable gates. ... Working around water, including servicing of pumps and stirrers on ponds, requires a minimum of two people, including one person available always for support and/or for rescue if problems arise. Lifejackets must be provided and worn if out on a pontoon or working around deep water”.*
- WorkSafe, 2017 - Staying Safe in and around Farm Dairies - 2017. *“Ponds with synthetic liners should have exit devices. ... Have rescue lines and a lifebuoy close to the pond. ... Fence the pond and put up warning signs to stop people entering”.*
- Dairy NZ
 - *Fencing - All ponds should be fenced off with a netting fence to prevent stock and children from accidentally falling into the pond. Locked gates are essential and electric fences can also be used.*
 - *Escape ladders - All ponds should have at least one permanently placed ladder or alternative escape means in case a person falls into the pond. You can have a life buoy available in the area too.*
 - *Anchor points - Pontoons should have anchor points to improve stability.*

- *Signage - Warning signs can be used to keep people out of the area but direct communication with people is important too. Talk with farm staff, contractors and visitors about the effluent pond risks.*

Learnings from Fatalities

Fencing

Six of the fourteen deaths were pre-schoolers, and how they accessed the ponds cannot be precisely determined in all cases, but deficiencies were found in perimeter fencing and gates that would have provided access. This same issue has been found in Australia with those most at risk being pre-schoolers and the aged. In a guidance note, WorkSafe highlights that:

- Children are not small adults and perceive things differently to adults
- Children have less strength, co-ordination and understanding of situations than adults
- Children want to explore, try new things, push boundaries.

To this, we can add:

- They may not be able to read and/or understand signs
- They may not be able to swim
- They don't know how to save themselves or even of the need to do so.
- They can't climb up slippery batter slopes
- They are unlikely to recognise any egress options
- Any cries for help are less likely to be heard.

Notwithstanding the risk to children, it is noteworthy that a farmer drowned trying to rescue a lamb that had gone through fencing into an oxidation pond.

Perimeter fencing deficiencies can be summarised as:

- Complete absence of fencing
- Fencing and gates that be climbed; e.g. ladder gates, timber railings, netting with large foot-holds, see photos 1 and 2.
- Low-level fencing
- Horizontal line-wires at lower levels with gaps of greater than 100 mm, enabling them to be spread apart, see photos 3 and 4.
- Lower portion of fence loose, so can be crawled under
- Gaps under gates and fences greater than 100mm see photo 5.
- Fences being stock-proof but not child/small animal proof; they need to be both. See photo 6.

What might current best practice look like?

- Minimum of 1800 mm high (less likely to be climbed)
- Horizontal line-wire spacing in lower portion less than 100 mm (as recommended in a Coronial finding and consistent with swimming pool and building code requirements)
- Vertical stay-wire spacing less than 100mm to restrict foothold / climbing
- Barbed Tension wire clipped along top and bottom of netting, with barbs at 100 mm centres
- Maximum clearance beneath fences and gates less than 100 mm.

Products

- Cyclone 16/1900 HT Tightlock Deer Fawning Netting with an 89H x 240W mesh over the lower 800mm. Deer netting was accepted by Worksafe at Gore wastewater treatment plant (WWTP)

- Summit Steel XTM 19/1800 MT Forged Knot Security Netting, with a 100H x 50W mesh over the full height
- Cyclone HT Reverse Twist 1.6 x 100 Barbed Wire.

We must remember that ponds can be, and are, attractive places – a magnet; smooth reflective waters, peaceful with birdlife present, maybe with coloured buoys floating on the surface, some have decoy ducks floating on them, splashing water from aerators. In fact, they can be so appealing that they can be perceived to be a safe place to play, operate model boats, and it has been known for tourists to swim and wind-surf on them until advised of the contents. The contents and invisible dangers being an unknown to the very young, tourists, and aged.

Fences are however easily damaged by grounds maintenance and mowing in close proximity to the fence, rendering them ineffective as a barrier – especially to small children and small animals. Spraying of grass along fence-lines is recommended so the mower has an operating clearance.

Egress

Internal batters of ponds tend typically to be around:

- 3:1 for clay liners and concrete wave bands
- 2.5:1 for rock protected batters
- Up to 2:1 for sheet liners
- 1.5:1 for stone baffle walls between pond cells.

But when in service, they all become slippery and difficult to get out of. Once a person is in a pond, how do they get out?

The farmer who was trying to save a lamb couldn't get out and drowned trying. The tanker driver who couldn't get out of the steep-sided pond (see photo 8). The child

who drowned and couldn't be recovered because there were no ready means of access available, despite such access facilities having been available for more than 10 years.

Some have tried using marine-grade rope ladders and cargo net principles; however; the materials used have apparently degraded rapidly in the wastewater and with continuous exposure to UV from sunlight. The degraded materials can then break away, becoming entangled in pumps, agitators / aerators, etc., creating other dangers for maintenance staff having to clear them. If such systems are installed, they need to be regularly checked and replaced to maintain a serviceable condition.

For sheet-lined ponds, the author is aware of two PE ladder escape systems available in NZ that are welded to the liner; one from Viking (see photo 11) and the other from AEL (see photo 12), although others are available offshore. Both systems are suggested to have a design life similar to that of the pond lining material.

For other pond linings: concrete, stone, earth/clay, grassed, only one viable solution is known to be available; the tyre ladder (see photo 13). Despite being promoted by Dairy NZ since 2011 as a simple, low-cost solution (<https://www.dairynz.co.nz/environment/effluent/effluent-storage/effluent-pond-safety/>), it is not recognised as necessary by many as there is no standard requiring pond escape provisions, despite the many deaths in ponds. Failure to provide egress provisions should no longer be seen as an acceptable option.

What spacing should egress provisions be installed at? This is a question with a developing answer. The manufacturer of one of the PE ladder options provides one with every pond installation, but recommends additional units be installed at 60m centres. The other recommends one on each side of a pond. Few take up these recommendations as a cost-saving measure, yet what price on a life? Internationally, we have seen images of PE-lined ponds with egress ladders at what appears to be 5 – 6 m spacing but have been unable to find any regulatory documents for this at this time.

At the Gore WWTP, subsequent to a WorkSafe Notice, egress provisions have been installed at each corner of each pond, at between approximately 240 – 430 m spacings. Note that Worksafe issued this notice for failure to provide a means of egress as a separate notice to that regarding fencing. This now sets a minimum precedent for every other pond in NZ; i.e. each corner of a pond. Remember when nominating spacings that those in the pond will be swimming in saturated clothes / overalls or at very least wading in thick sludge (see photo 10).

As a minimum, this author suggests they would be located:

- Adjacent to all inlets and outlets
- At points where sampling and monitoring are carried out
- At points where maintenance is required, such as aerator and pump locations
- At pond corners, where the grade is less steep
- At 50 m centres maximum, between those above. By comparison, ladders in Marine wharf applications are typically 30 – 60m centres (UK 30 m with handholds midway between, USA 50 – 60 m).

In addition to egress ladders, Dairy NZ also promotes a perimeter rope with floats and buoys, anchored at pond corners (see photo 14). Escapees can then make their way to the nearest corner, using the rope for additional support. The corner anchor ropes have knots along the rope to allow the escapee to pull themselves up the flatter slope at corners. The Pondco Liners system uses ropes manufactured from a blend of polypropylene and polyethylene; coming with a 20-year warranty.

Whatever safety provisions are incorporated, they all need checking and maintenance, the same as the pond system itself, so this needs to be allowed for.

Signage

Signage is a recommended requirement; however, there is little practical guidance for this: what size, at what height, what wording, where and at what spacing?

Whilst accepting that perimeter signage on fences is necessary, would it have prevented any of the deaths in the last decade? Probably not and definitely not of the pre-schoolers. However, signage does act as a deterrent and reminds passers-by of why they should not enter and is a reminder for adults to explain and provide guidance to children.

To do this, good signage needs to be clear and concise. It is the message that has to be understood, and the words in lay-speak; e.g. do members of the public understand what an oxidation or effluent pond is? Thus, it may be more effective to use the term "Sewage Pond", which may be a greater deterrent, based on the "yuk-scary" factor. Given the high number of tourists and non-English speaking residents in NZ, international "No Entry" symbology should also be incorporated. It is suggested that two Danger signs be utilised with only two lines of text beneath, incorporating the access prohibition symbol;

On perimeter fence-lines
"Danger / Sewage Ponds / DO NOT ENTER"
 and for every gate;
"Danger / Sewage Ponds / KEEP GATE LOCKED".

Mounting height is suggested at 1 m above ground within the active eye range of school children, and as a minimum, fence-line signage located 25 m either side of every corner / change of direction of the perimeter fence, 25 m either side of every gate, and at a maximum spacing of 50m between these.

Operational Considerations

In addition to the provision of best practice fencing and egress, there are other considerations that need to be addressed by employers / PCBUs.

Businesses have the primary responsibility for the health and safety of their workers and any other workers they influence or direct. They are also responsible for the health and safety of people at risk from the work of their business.

Primary duty of care means that a business has the primary responsibility for the health and safety of workers and others influenced by its work. All businesses must ensure, so far as is reasonably practicable, the health and safety of:

- its workers
- any other workers who are influenced or directed by the business.

A business must also look after other people who could be at risk by the work of the business, for example customers, visitors, children and young people, or the general public.

Primary duty of care is a broad overarching duty which includes, but is not limited to, a business having effective practices in place for:

- providing and maintaining a work environment that is without risks to health and safety
- providing and maintaining safe plant and structures
- providing and maintaining safe systems of work
- ensuring the safe use, handling and storage of plant, structures and substances.

Is batter grazing separated from the ponds to prevent animals entering and slipping into the ponds? Is its location non-obstructive to maintenance operations? Can stock be moved without them going pond-side of fencing? Should the lower portion of stock fence have line-wires at 100 mm centres to minimise chance of small animals getting pond-side?

What access control security procedures are in place?

Are 'Lone Working' procedures in place?

Have you made sure workers expected to work in pond locations can swim?

Do you have Operating Procedures in place for pond maintenance and monitoring tasks?

What tasks are deemed to necessitate two-person attendance? Is this reflected in Operating Procedures?

Is safety equipment a conditional requirement within the Operating Procedures and readily

available for use on site; life jackets, life-buoys on life lines, eye-wash and first-aid kits, etc?

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Author Biography

Graeme Wells is a Registered Designer and Associate, with over 49 years' experience, working in a multi-disciplinary capacity across central/local government; the last 32 specifically in the wastewater sector with Beca, 10 in full-time site roles. He is known for his inter-discipline co-ordination, thoroughness and attention to detail, attributes which have come to the fore in this project. Email: graeme.wells@beca.com

Appendix 1 Photos



Photo 1 -By climbing – ladder gate



Photo 2 - Large mesh netting



Photo 3 - Going through gaps



Photo 4 - Squeezing through wires



Photo 5 - Crawling under the bottom



Photo 6 - Stock-proof fence not necessarily child or small animal-proof



Photo 7 - They were at work



Photo 8 - Steep batter slopes

PE Batter slopes



Photo 9 - Floating pontoons

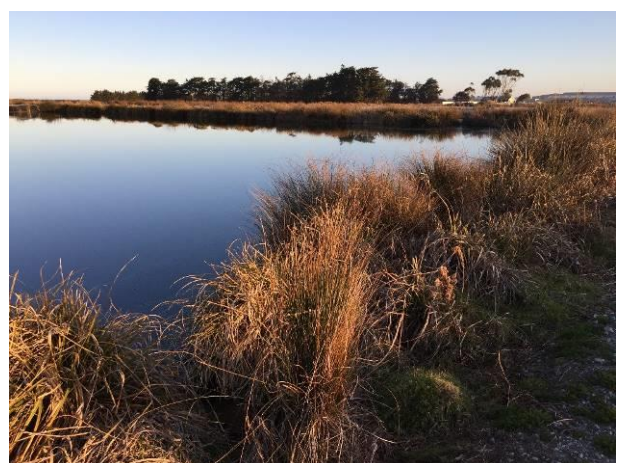


Photo 10 - Sludge layer in invert



Photo 11 - Viking Geoladder



Photo 12 - AEL Hi-vis Safety Ladder



Photo 13 - Tyre Ladders



Photo 14 - Float and Buoy Line