

TECHNICAL GUIDELINE**GENERAL TECHNICAL INFORMATION FOR
GEOTECHNICAL DESIGN****~ Part D ~
Environmental Issues**

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No Changes Required In the January 2007 Edition

The following lists the major changes to the November 2004 edition of TG 10d:

1. Nil

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Referenced Documents

EPA Regulation & Guidelines

Section 1: Scope

Section 2: Chlorinated Discharge Management

2.1 When Tank Overflow Occurs

Tank overflow occurs only if several systems malfunction simultaneously. Although such overflow is “designed for” it is not an intended occurrence. A description of how the filling of a tank is controlled and what needs to go wrong for overflow to occur is given below:

- (a) In normal operation, the filling of a tank is controlled by an ultrasonic tank water level detector. This detector operates one (or several) hydraulically operated control valves (HOCVs) usually located near the tank. These valves control the rate at which the tank is filled, and stop filling when design top water level is reached.
- (b) If the ultrasonic detector fails OR an HOCV jams open, then the tank will fill above design top water level until an emergency upper level float switch is tripped. This will telemeter an alarm signal to the control centre, where an operator can remotely switch off the pump which is supplying the tank, and/or (if the tank is gravity fed from another tank) arrange for a field operator to manually close valves.
- (c) The overflow rate (litres per second) depends on how many and by how much the HOCVs jam open, how many supply pumps are operating, and how much demand there is for water from the tank (outflow).
- (d) The overflow system (pipework and dissipator) is designed for the maximum possible overflow rate. ie. all HOCVs jam open, all supply pumps are operating, and there is no demand for water from the tank.
- (e) The probability of the maximum possible overflow rate ever occurring is almost zero, and even for lower rates the probability would be very small. The duration of any overflow event would be unpredictable, but generally short (governed by operator response time). It is doubtful whether the frequency of overflow could be predicted. Operator’s records may have enough data in them to give an idea as to how often a particular tank overflows.

2.2 Disposal of Tank Overflow Water

Tank overflow was traditionally piped down to the nearest watercourse, where it was discharged through an energy dissipater to avoid scour. The watercourse might be either a river or creek with permanent water, or simply a drainage line which was normally dry.

In more recent times it has been recognised that there are occasions when the discharge of chlorinated or chloraminated water to a watercourse (particularly one which contains permanent water) would be environmentally undesirable. It has therefore been considered necessary to pursue designs which ensure that the chlorine/ammonia has the opportunity to evaporate off or be taken up by vegetation/soil before the water reaches the watercourse.

On a recent tank at Strathalbyn North, the design was changed to move the overflow discharge back from the bank of the river to allow the water to pass down a well grassed drainage line, which was protected from scour by a series of pervious rock check dams.

Many tanks have had their overflows directed to farm dams (an arrangement usually welcomed by the landowner), and yet others, where the water previously flowed down steep paddocks causing scour, have had the flow spread over a wide front by installing a "T" manifold on the end of the pipe with several smaller diameter outlets.

These strategies effectively comply with recent EPA regulations (developed specifically for dairy effluent but appropriate also for overflows) which require that discharge be onto land with a slope of less than 5% and at a distance of not less than 100 m from a watercourse (a watercourse being defined as one worthy of a thin blue line on a 1:50 000 map). Where the land slope is > 5% I suggest that a series of pervious rock check dams might be used to prevent scour and slow down the flow. (The EPA do not favour ponding, but this is because the regulations are written around dairy effluent, not potable water or "inert" mud.)

2.3 Disposal of Tank Scour Water

A tank scour is an outlet in the floor of the tank which is used during cleaning operations. The tank is drained down to just above the mud line, and hoses and squeegees etc are used to push the slurried mud down the scour outlet. Tank cleaning is a planned activity, its frequency depending on the quality of water in the tank, its location the system, and how much water passes through the tank. With filtered water, a tank may need cleaning only every five years.

The tank scour outlet is usually connected into the tank overflow pipework, and therefore discharges at the same location. I am given to understand that the EPA requirements (discharge onto land with a slope of less than 5% and at a distance of not less than 100 m from a watercourse) would also apply to tank scour water.

2.4 Documenting Tank Overflow and Scour Discharge Design Criteria

We need to document the above criteria in a way that will be useful to both in-house designers and external consultants. I suggest a "TS" with a helpful commentary suggesting ways in which the requirements might be achieved (as per many Australian Standards).

2.5 Extract from Littlehampton Tank Overflow Recommendations:

Overflow happens only in the case of malfunction of several systems at once - it is not a design condition. Maximum possible overflow rate if all valves are open, all pumps are operating, there is no demand on the system, the tank is full, and all control and alarm systems fail simultaneously is 800 L/s. Probability of overflow at maximum rate is almost zero, and at lower rates is very small. Duration of flow at any overflow would be unpredictable, but generally short.

2.6 Extract from Strathalbyn North Tank Overflow Recommendations

The following recommendations are offered in response to your verbal request to consider alternative means of disposing of the overflow and scour water from the proposed tank. I understand that this design review was prompted by the need to avoid discharging chlorinated water directly into the Angas River, which would be considered environmentally undesirable under current EPA guidelines.

The design presently shown on the drawings involves a standard vertical-flow energy dissipater located at the top of an erosion resistant rocky portion of the bank of the Angas River. The design maximum overflow rate is 230 L/s and the design overflow period is 3 h, giving a maximum design overflow volume of about 2.5 ML.

I recommend instead a dissipater set in the existing drainage line near the pumping station (in conjunction with some erosion control and access upgrade works in the drainage line downstream of it) for the following reasons:

- (a) The depression just outside of the pumping station compound is a natural drainage line already fairly well protected against erosion by swamp vegetation.
- (b) The point of discharge of this drainage line into the river is very well protected against erosion by vegetation.
- (c) The overall gradient of the drainage line is reasonable.
- (d) The overall length of the drainage line between the proposed dissipater location and the river, its hydraulic roughness, and the vegetation density on it, should be sufficient (in association with the check dams proposed), to ensure effective dispersal of any free chlorine dissolved in the overflow water.

This "Technical Note" was prepared by Ed Collingham, 12/11/2003
(Ex Principal Engineer Geotechnical)

Section 3: ASR (Aquifer Storage and Recovery) Notes For & Against

3.1 Notes Generally Arguing in Favour of Its Use for Urban Water Supply In West Java

Bores or wells are normally used only to extract the natural (and usually very ancient) groundwater from an aquifer. But it is also possible to inject water into an aquifer to store it for later extraction. This technique has become known as Aquifer Storage and Recovery or ASR. Usually the same bore can be used for both extraction and injection.

An aquifer used in this way may be considered as an underground reservoir which, unlike a surface reservoir, is naturally protected against evaporation and contamination.

Additional advantages of ASR are:

- (a) The storage capacity of most aquifers is very large compared to the annual demand on them;
- (b) The cost of converting existing extraction bores to double as injection bores is minimal; and
- (c) ASR can be implemented on the small or large scale, and in stages, without large cost penalties.

To prevent the clogging of the bore and/or the aquifer, and to prevent contamination of the water already in the aquifer, it is normally desirable to treat the water prior to injection, ideally to drinking water standard. In a domestic or industrial water supply system, treatment prior to injection, rather than after extraction, does not usually add significantly to the overall cost of supply.

ASR would therefore seem to be an ideal component of any strategy designed to provide sustainable water supplies in West Java where there is:

- (a) A surplus of water in the wet season;
- (b) A shortage in the dry season;
- (c) An established and widespread use of groundwater; and
- (d) A limited number of sites remaining for the construction of cost-effective surface storages.

The main problem with implementing ASR in West Java is seen to be not technical but institutional and regulatory.

Once water is injected into an aquifer it is tappable by anyone with a bore into that aquifer, even if they are located some considerable distance away. Water in an aquifer, whether natural or injected, knows nothing of the land ownership boundaries on the surface.

Therefore, if ASR is to be implemented, it becomes even more imperative that communities recognise that the aquifers beneath them are a community asset, and the water in those aquifers a community resource, both of which can, and should be, managed in a sustainable way.

Currently it is often “first comers”, or those with the biggest or deepest bores, that mine out a groundwater resource. (Or worse, those with pressing liquid-waste disposal problems that contaminate a groundwater resource rendering it, and possibly the aquifer itself, unusable.)

For the costs of ASR to be properly shared between the beneficiaries, aquifers would need to be proclaimed, bores licensed, fees charged for extraction, and the proceeds used to fund injection.

It would not always be necessary to provide a specific water supply for injection. In many cases recharge could be done from the normal reticulation system with only slight modification to that system. When demand from the system was low (and when surplus surface water was available) flow would be diverted to recharging the aquifer. Peak and/or dry season demand from the system would be supplemented by pumping from the aquifer.

3.2 Notes Generally Arguing Against Its Use for Urban Water Supply In SA

1. An aquifer used for storage should be regarded as a “chemical reactor” – the stored water will:
 - React with the aquifer medium (usually inorganic chemical reactions)
 - React with the native water in the aquifer (usually inorganic and some organic)
 - “React” with itself (usually organic and biological decay)
2. The injected water will travel furthest from the injection point in the more permeable layers of an aquifer. As time passes native groundwater will diffuse into the injected water from less permeable layers above and below.
3. Because of 1 and 2, the recovered water is likely to have changed chemically and biologically from that which was injected and (because of the normally low quality of South Australian groundwaters) usually for the worse.
4. This may limit the efficiency of the system – only a percentage of the injected water may be recoverable. Percentages such as 40 to 70 are commonly quoted, and as low as 10 known.
5. At “water supply system” scales, injection is neither straightforward nor cheap:
 - The rate at which water can be injected into an individual well may not be very high Positive pressure (rather than simple gravity) injection may be required
 - An extensive borefield may be required Power consumption to inject (and extract) may be a significant operating cost
 - Injection must be interrupted frequently and regularly to clean the well screen
 - Reverse flow may be required every few hours to remove sediment
 - Chemical cleaning may be required daily to remove chemical and/or biological clogging
6. For these reasons, many successful ASR schemes to date are “opportunistic” e.g.:

- Stormwater can be allowed to recharge an aquifer slowly between storm events, and under gravity via only one or two wells, from a wetland where the water is stored and stabilised
 - If there is an existing system of extraction wells (such as in the Angas-Bremer irrigation areas) they can be utilized as injection wells
 - There is often an additional advantage in such irrigation areas – the aquifer is usually depleted, so it is relatively easy to get the water in
7. There is the problem of keeping “ownership” of water injected into an aquifer – it can travel long distances and be easily poached by others.

This “Technical Note” was prepared by Ed Collingham, 21/04/2002
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