Package Treatment Plant Operation and Management

Land Application and Appropriate Re-Use of Treated Effluent

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Introduction

In this session we will cover:

- The quantity and quality of package treatment plant effluent
- Issues relating to land application of effluent
- Irrigation / effluent management systems in general

Effluent Quality

- Quality of package treatment plant effluent should as a minimum meet:
- Secondary Standard
  - BOD_5 20 mg/L
  - Suspended solids 30 mg/L
  - Total P <20 mg/L
  - Total N <10 mg/L
- Many well designed and maintained plants will be able to achieve much better than this

Effluent Quality

- Absolute performance criteria for nutrients might be required:
  - e.g. NH_3-N 5 mg/L (annual median), 10 mg/L (maximum or 80th percentile) (EPA Vic), Total P 0.5 mg/L, or
  - Minimum percentage reduction e.g. 75% reduction in Total Nitrogen, in relation to influent, but
- What is most important is that the treatment plant removal and the land application area assimilation capacity (together) are sustainable

Effluent Quality

- Bacterial indicator organisms (thermotolerant coliforms, E.coli) performance criteria are set according to the land application or discharge option e.g. <10,000cfu/100ml for turf irrigation but nothing about human contact, <1,000 cfu/100ml non-contact raw food (ANZECC Guidelines), <10 cfu/100ml (AS/NZS 1547:2012)
- Total free residual chlorine, if used, should be within an appropriate range, e.g. 0.2 - 2.0 mg/L (NSW Health, requires disinfection if disposal is shallower than 300mm beneath surface)
- pH should be within the range 6.5 - 8.5

Effluent Quantity

- Effluent quantity (load) is determined by the plant size and population or operation served by the plant
- Hydraulic load can be considerable for the largest plants (2,500 EP or 750 kL) and should not be underestimated
- Need to get away from the way of thinking that “because it is treated effluent”, quantity and quality are not major issues!

Discharges to Water

- Discharge to waters was formerly approved by the EPA and older systems which discharge to waters are still licensed by the (EPA) e.g. Hunter River
- Generally, new private systems would not be approved to discharge to waters in NSW

Land Application of Effluent

- In the past, land application of effluent from package treatment plants was rather neglected by comparison with design and performance of the treatment plant itself
- Many of the older package treatment plants will have undersized and potentially poorly performing land application areas which would be unlikely to meet modern standards or performance requirements
- These are increasingly called into question as systems are inspected, reviewed and expanded

Guidelines

- Established guidelines for small domestic systems e.g. AS/NZS 1547:2012 and the “Silver Book” provide some suitable background for consideration of site and soil assessment, assigning loading rates and the sizing of land application areas
- Many of the principles apply to larger systems, but more attention to detail and a higher level of sophistication in the application of the principles is necessary to optimise design and maximise beneficial reuse of effluent and to avoid the problems becoming unsurmountable

Guidelines

- There are also guidelines primarily developed for large scale municipal treatment works which provide important background, particularly for land application of effluent from the larger package treatment plants e.g.
  - Interim Guidelines for the Management of Private Recycled Water Schemes, NSW DWE, 2008, and
  - The Utilisation of Treated Effluent by Irrigation, NSW EPA, 1995
- Various water balance approaches e.g. AS 1547:1994 and water balance computer packages e.g. MEDLI and many others
- Some NSW coastal Councils now using DAFs and automatically consider non-domestic systems high risk

Issues for Consideration

- There are a wide range of issues for consideration in land application area design and approval:
  - Hydraulic load
  - Organic load
  - Nutrient load
    - Nitrogen
    - Phosphorus
  - Public health issues
    - Disinfection
    - Contaminant pathways
  - Buffer distances

Hydraulic Load

- Need to do a water balance
- Especially important in some NSW coastal locations where wet weather storage is a consideration. DAFs require daily water balances. Need appropriate climate data and consider the suitability of nearest Met. Station
- Synthetic data available - Data Drill/SILO data
- Consider the relative merits of daily versus monthly data (daily balances less conservative than monthly)
- Need to understand crop factors

Organic Load

- Organic load - generally not limiting unless effluent has high BOD (food industry waste, wineries, breweries etc.)
- Need to do a mass balance

Nutrient Load

- Nutrient load - both N and P are major issues
- Nutrient load is commonly limiting
- Need to do nutrient balances
- These will commonly be more sophisticated than those used for small domestic systems if they are to optimise land application area design, but
  - They need to be based on sound data and done by experienced practitioners
- Beware simple nutrient modeling packages

Public Health Issues

- Important to consider the use to which land applied effluent is to be put (fit for purpose)
- Important to limit surface irrigation spray hazards:
  - Spray height and distance, aerosolisation and wind drift
- Beware irrigation of crops for consumption
- No direct aerial irrigation of fruit and vegetable crops that are consumed uncooked
- Drip irrigation of stone fruit trees and vines is appropriate

Public Health Issues

- Consider the relative merits of surface and subsurface irrigation, particularly in the light of the need for and suitability of disinfection
- Subsurface drip irrigation reduces risk significantly
- Concerns about long term health and environmental effects of residual chlorine
- UV offers an alternative for disinfection, but need to build redundancy into system in case of lamp failure
- Also requires high clarity effluent (<1 NTU)

Public Health Issues

- Schedule irrigation on ovals, golf courses and school grounds for late afternoon or early evening to ensure maximum time interval (withholding period) between application and use
- Ensure sensitive receptors e.g. washing lines, pools, children's play areas etc. are separated from irrigation areas by appropriate buffer distances
- Ensure irrigation areas are suitably signed to warn of treated wastewater application

Buffer Distances

- Many older land application areas were designed with inappropriate buffer distances
- Suggest adopt AS/NZS 1547:2012 risk based approach, or
- NSW Guideline values of:
  - 250m from domestic groundwater bores
  - 100m from permanent watercourses
  - 40m from intermittent watercourses and dams
  - 6m (up-gradient) and 3m (down-gradient) of property boundaries, driveways, swimming pools and buildings
- SCA buffer requirements more stringent

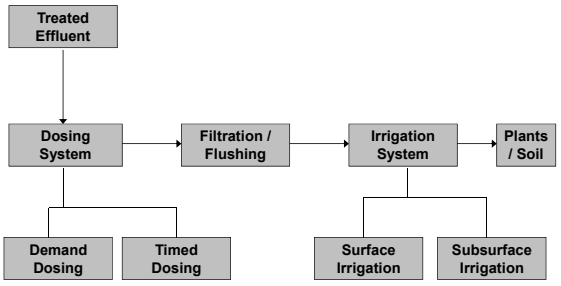
Irrigation of Effluent

- The components and configuration of an irrigation system are as crucial to effective operation as the area size
- Must be managed to minimise public health risks as effluent quality is not always consistent
- Inappropriate irrigation methods defeat the purpose of treating effluent to a higher standard
- The water and nutrient balance are only half of the design equation

Irrigation of Effluent

- The use of inappropriate components will result in eventual failure
- Details of the specific components should be obtained (including a hydraulic design) prior to approving a system
- Designers should be aware of suitable components to compliment their designs

Typical Irrigation System Components



Irrigation Systems Common Issues

- Pumps are often of insufficient capacity to service appropriately sized irrigation areas, even when divided into smaller zones
- Common rotary sprinklers and spray heads operate correctly with ~4-10m head at the top of system and flow rates of 2-6L/min for each sprinkler operating
- Subsurface irrigation systems typically require a 10-30m head operating pressure

Irrigation Systems Common Issues

- Sprinkler operating head + friction loss in the pipe will almost always require most if not all of this head capacity (limited room for static lift)
- Uneven effluent distribution is a significant contributor to irrigation area failure
- Typical NSW Health domestic AWTS/STS system pumps may be undersized, a larger pump may be required
- A one size fits all approach to pumps not practical
- Proper hydraulic design essential for commercial scale systems (yet rarely required or done!)

Irrigation Systems Management

- Filtration of effluent should be considered essential to effective irrigation
- Cylindrical mesh filters commonly used for older surface irrigation (typically 150 mesh, 100 micron rated filters)
- Disc filters are essential for subsurface irrigation systems
- Good quality filters prevent build-up of bio-slimes and blockage of emitters
- Flushing also required

Irrigation Systems Application Area Management

- May need to rotary hoe or improve ground
- Divert run-on water
- Do not irrigate low growing crops which are not cooked before eating
- Erect warning signs
- Keep clear of clotheslines, swimming pools, barbeques, outdoor seating, picnic benches, children's play areas and other sensitive receptors

Rule-of-Thumb Sizing Irrigation Systems

- While not trying to be prescriptive or site specific, the following information can provide a good "check" for irrigation area sizing
- The information is based on recent experience in temperate coastal areas of NSW and incorporates:
  - Mean monthly climate values (conservative)
  - Typical domestic wastewater flow rates and quality
  - Appropriately conservative DIRs for a range of soil types

Rule-of-Thumb Sizing Irrigation Systems