LPED (Low Pressure Effluent Distribution) – PROVISIONS in AS/NZS 1547:2012
On-site Domestic Wastewater Management.

(a) LPED DOSE LOADING OF LAND APPLICATION SYSTEMS, and
(b) LPED PRIMARY EFFLUENT IRRIGATION SYSTEM

1.0 BACKGROUND

New content has been introduced into AS/NZS 1547:2012 relating to:
(a) LPED dosing of trenches, ETA/ETS beds/trenches and mounds; and
(b) LPED primary effluent irrigation land application system.

The Appendix below details those sections of the Standard covering these two areas.

LPED for both applications was developed in NZ in the 1980s and has become extensively used, with design guidelines incorporating LPED into regional and district procedures for on-site domestic wastewater system management. The LPED concept is however new to Australian practice, and over the years On-Site NewZ has received a number of enquiries as to the background to and use of LPED in NZ. These notes consolidate the information package that has been circulated to enquirers, and is provided for those unfamiliar with the system as context for the introduction of LPED into AS/NZS 1547:2012.

2.0 LPED DOSE LOADING SYSTEM

2.1 LPED dosing: The conventional approach to pump dose loading of trenches (or beds) in on-site individual small diameter perforated dose lines in each trench. Because of the need to ensure sufficient back-pressure in each pressurised distribution line, squirt holes of small diameter and longitudinally spaced at some distance are required so as to achieve equal flow output per unit length of trench. For example a 25-30mm Ø pressure line may have 4-6mm Ø squirt holes at 1,200mm to 1,500mm spacing along the length of a 20m trench. This means that spot loading of effluent under pressure at each squirt hole orifice concentrates the organic and suspended matter in the effluent at 1,200mm to 1,500mm intervals along the trench base area.

LPED nests the pressure line inside a (typically) 100mm slotted drainage coil line (or perforated PVC drainage pipe) so that squirt hole discharges splash up against the internal walls of the enclosing distribution line and spread along that line between squirt holes. This disperses effluent along a much greater portion of the trench base than achieved by the spot loading of the un-nested dose line, thus achieving more effective contact with and use of the infiltrative surfaces of the soil in the trench system.

In the US LPP (low pressure pipe) distribution of effluent into land application systems dominated the design manuals of the 1980s. However, in the US the move to LPED began in the 1990s, and Photo 1 below shows a demonstration system at the University of North Carolina Wheeler Field Training Center. The setting of the system above ground and dosing with clean water is used to demonstrate its effectiveness in achieving uniform outflow along the length of each draincoil line.

2.2 Automatic sequencing valve loading: In the late 1990s a replacement for the manifold inlet system shown in Photo 1 began to be introduced in both the US and NZ. This involved the use of automatic sequencing valves.

The automatic sequencing valve has been adapted from water irrigation technology for use with on-site wastewater applications. It enables dose loading of a fixed volume of wastewater effluent to each lateral (perforated dose line) in a trench or bed in sequence. The dosing system can be set up to serve multiple lines by placing valve units in series. The use of automatic sequencing valves removes the need for manifold and lateral control valves necessary to ensure even flow in a conventional pumped distribution system. The pump chamber and automatic sequencing valve system can also be configured to dose each lateral with its full daily design volume, thus loading it over a five minute or so period, then allowing the system to "rest" for 23 hours 55 minutes. Sufficient storage volume in the voids of the trench aggregate is necessary to store effluent following the pump cycle.
PHOTO 1: University of North Carolina, 1998 – Wheeler Field Training Center Demonstration System (perforated pressure lines nested within flexible slotted draincoil distribution lines)

3.0 LPED PRIMARY EFFLUENT IRRIGATION SYSTEM

3.1 Irrigation System The use of LPED for dose loading primary (septic tank) effluent into close spaced (1m) shallow and narrow trenches (200mm by 200mm) installed within 200mm to 250mm depth of good quality topsoil enables evapo-transpiration and seepage to take place within the enclosing area of this shallow subsurface “irrigation” approach. Originally developed as an LPP trench system in the US [See Note 1 below] for land application over shallow groundwater, the close spaced LPED trench system is designed on an “areal” loading DIR (design irrigation rate) basis.

Figure 1 below illustrates a typical layout for a 3-bedroom dwelling, 5 person occupancy, 700 litres/day wastewater flow and a primary effluent “areal” loading DIR of 5mm/d for irrigation into 200mm to 250mm of topsoil overlaying a sandy loam soil. Six trenches at 1m spacing distribute effluent into a 140m² design area enclosed within a 200m² land application area. Although a pump dosed manifold system is shown in the Figure the preferred dosing method is via automatic sequencing valve, with each trench loaded once per day with a 120 litres dose volume. Figure 1 has been used as the model for Figure M3 (page 169) in AS/NZS 1547:2012.

3.2 Siphon Dosing of LPED Irrigation Lines

Colin Ashby, Consulting Engineer of Warkworth, NZ, advised On-Site NewZ in January 2010 of a development he has been involved in with David Kay of Vortech regarding a non-stalling siphon system for distributing septic tank effluent into LPED irrigation fields. Colin has been working with David on siphon systems for over 10 years, and this latest development, known as the “Super Siphon”, incorporates years of their operational experience in siphon use for dosing LPED land application systems. He submits that for sites with sufficient gravity head a siphon dosed system offers considerable advantages over a pump dosed system.
Colin and David claim the Super Siphon has a broader performance envelop than past siphon systems, has a readily adjustable stroke height between 180mm and 390mm (and up to 3m stroke if need be), has a very low head loss, and with a 50mm port size has a better flow rate than existing 110mm ported siphons. It will not stall at any stage if flow is interrupted.

They have produced a design manual and spread sheet developed over the last 12 years as an aid to designing Super Siphon dosed LPED primary effluent irrigation fields. These are available on CD at no charge as an aid to designers of on-site wastewater systems on sites where siphon dosing is a viable option. For a copy of the CD contact Autoflow Ltd, 18 North Road, Kaitaia 0410, Ph: (09) 408 6080, Fax: (09) 408 6081, e-mail autoflowltd@xtra.co.nz.

For a full description of the Super Siphon and associated technical details go to the 2011 web-site: http://sewagetreatment.co.nz/super-siphon.html

[Note 1: Refer to "United States Environmental Protection Agency, Office of Water, Washington, D.C. EPA 832-F-99-076, September 1999 Decentralized Systems Technology Fact Sheet Low Pressure Pipe Systems"

Fig. 1: LPED Primary Effluent Irrigation Layout

Notes:
1. System designed for 3 bedroom dwelling, 5 persons, 700 litres/day design flow.
2. System installed in 250mm depth topsoil over sandy loam soil, DIR 5mm/d for primary effluent.
3. Recommended dosing method is 6-way automatic sequencing valve (not the manifold system as illustrated), with each trench loaded once daily with a 120 litres dose volume.
4. By "improved septic tank" is meant septic tank with effluent outlet filter.
5. A 100mm diameter slotted drainage coil line (as per Photo 1) is usually adopted instead of the rigid PVC 100mm diameter distribution line.
6. Not to scale.

A: LPED DOSE LOADING

A1: 1.9 Definitions [page 15]
LPED line: A pressure line perforated with drilled squirt holes and nestled in a distribution line.

A2: 5.5.3.5 Distribution system [page 51]
The effluent distribution system shall be designed to accept the discharge from the wastewater treatment unit and to convey it securely and evenly to the land application area. The effluent shall be uniformly distributed over the design area to help achieve effective aerobic/anaerobic decomposition within the soil.

C5.5.3.5 Pressure-dosed distribution systems ensure that effluent is applied at the design hydraulic loading rate (DLR) uniformly throughout the design area. When used in conjunction with automatic sequencing valves hydraulic design is simplified, and each element of the land application area receives its proportioned dose over a few minutes each day, enabling a rest period throughout the remainder of the 24-hour period.

A pressure-dosed distribution system can consist of pressure compensating drip emitter lines, perforated lines or LPED lines, with siphon or pressure-pump dosing units, and with the flow split to the separate pressure lines by the provision of an orifice plate in the rising main or the provision for alternating loading of separate lines. The use of automatic sequencing valves with pressure dosing provides for continuous alternation of loading. The type of distribution system should be detailed in the design report.

A3: L5.1 General [page 144]
Trenches and beds may be gravity loaded using a distribution pipe, or pressure dose loaded using a perforated pipe or LPED lines (see 5.5.3.5). Discharge control trenches (see L6.2) shall always be dose loaded.

A4: CL5.3 [page 146]
In these figures:
(d) LPED lines are used to distribute effluent under manifold pressure dosing or automatic sequencing valve into either trenches or beds. (Note that LPED lines are used also in LPED shallow subsurface irrigation of primary effluent (see 5.5.3.5 and M5).

A5: L6.3 Dose loading of effluent [page 148]
Where pressure dose loading of effluent by siphon or pump is used, the designer shall determine trench or bed lengths and perforated pipe details appropriate to the system layout and the siphon or pump duties.

CL6.3
Dose loading of treated effluent by LPED lines and automatic sequencing valves is recommended as providing for more effective control in achieving uniform and even distribution over the design area (see 5.5.3.5). LPED avoids the spot loading inherent in perforated lines and provides more effective distribution of effluent along the full length of the trench or bed system.

A6: L10 PRE-COMMISSIONING TESTS [page 150]
A pre-commissioning test shall be carried out on pump dosed systems after all on-site components, including the pump, have been installed but prior to covering the effluent distribution system in the trench or bed (see also 6.2.5.2):
(a) Fill the pump chamber to ‘pump-on’ level with water;
(b) Start the pump;
(c) Check perforated lines to ensure that water flows uniformly from all squirt holes; and where LPED lines are installed, check that uniform distribution is being achieved along the length of the distribution line;
**B: LPED Primary Effluent Irrigation**

**B1: 1.9 Definitions [page 15]**

**LPED irrigation:** Shallow subsurface irrigation of effluent into topsoil through low pressure effluent distribution (LPED) lines

**B2: M2.3 LPED irrigation [page 156]**

Effluent quality suitable for LPED irrigation systems shall be equal or better than that obtained from a well maintained septic tank of minimum primary treatment capacity of 3,000 litres for a 5-person, 3-bedroom design flow which is fitted with an outlet filter able to retain all solid particles of 3 mm or greater.

**B3: M5 LPED IRRIGATION (PRIMARY AND SECONDARY EFFlUENT) [page 158]**

In LPED irrigation systems, primary or secondary treated effluent shall be distributed into shallow trenches laid in a suitable depth of good quality topsoil. The minimum topsoil depth shall be 250 mm for LPED irrigation on to underlying Category 5 or 6 soils.

**CM5**

LPED lines consist of a pressure line perforated with drilled squirt holes and nestled in a distribution pipe. The dosed flow into the distribution pipe facilitates the longitudinal distribution of effluent into the soil along the full length of each shallow trench, thus avoiding spot loading of effluent at each perforation.

LPED irrigation trenches are 200 mm wide by 200 mm deep excavated in the topsoil layer to enable shallow distribution of effluent into the soil below and surrounding the trench system, thus facilitating uptake and removal of nutrient and wastewater through plant transpiration and seepage.

**B4: M6.2 Design irrigation rate [page 159]**

Irrigation rates shall be either selected from the DIR (design irrigation rate) set out in Table M1 for the natural soils in the area, or be determined by a water-balance calculation (see Appendix Q).

**CM6.2**

The design irrigation rates in Table M1 are for secondary or disinfected secondary treated effluent for drip and spray irrigation, and primary and secondary treated effluent for LPED irrigation. They are ‘areal’ loading rates applied to the area of the drip line, spray, or LPED line layout (see Figures M1 to M3).

Irrigation rates depend on the soil category and the rate of evapotranspiration by the vegetation being irrigated. The DIR values in Table M1 represent a conservative approach for the sizing of irrigation areas.

**B5: TABLE M1**

**RECOMMENDED DESIGN IRRIGATION RATE (DIR) FOR IRRIGATION SYSTEMS –LPED Irrigation [page 160]**

**B6:CM9.1 [page 162]**

In LPED irrigation systems, effluent is discharged into the shallow and narrow aggregate filled trench system to enable contact with the treatment bacteria in the aerobic upper layer of the soil surrounding trenches and to facilitate nutrient and moisture uptake and evapotranspiration by the vegetative groundcover between trenches.

**B7:M9.3 Sloping sites [page 162]**

On sloping ground, all irrigation lines shall be installed along the contour unless the line has non-leakage emitters, when lines may run down slope within the manufacturer’s specifications. Shallow and narrow trenches for LPED systems shall be carefully constructed along the contour. The ingress of surface and seepage water into the land application area shall be controlled or prevented. A cut-off trench or diversion drain shall be constructed up-slope to divert surface and groundwater away from the irrigated area.

LPED systems are not appropriate on slopes greater than 25% due to uncertainty with even distribution being achieved on steep land.

Pipes for LPED systems shall be laid in 200 x 200 mm trenches in aggregate of 10 – 15 mm size, clean and free of soil or organic matter (see Figure M3).

The LPED irrigation system shall distribute the effluent uniformly throughout the LPED trenches, with the dosing system consisting of a 25 – 30 mm perforated pipe installed in an 80 – 100 mm distribution pipe.

The final layer of aggregate and the topsoil cover shall not be placed until after the pump pre-commissioning test and even distribution of effluent has been confirmed (see L10).

The preferred method of pressurising the LPED lines is to use an automatic sequencing valve system. The final details of perforated pipe size and squirt holes in the LPED system should be confirmed by hydraulic design.

The pre-commissioning test shall be carried out as in L10 for pump distribution to trenches and beds.

Pressurised distribution of primary effluent through LPED lines laid in shallow and narrow trenches in good quality topsoil enables both seepage and evapotranspiration mechanisms to handle applied effluent. The water balance can be derived as for ETA/ETS bed considerations rather than trench/bed considerations.

A fourth type of irrigation system is LPED (low pressure effluent distribution) of primary effluent (from a septic tank with outlet filter) into close spaced narrow and shallow trenches installed in a good depth of topsoil (see Figure M3). In some circumstances secondary effluent may be used in LPED irrigation systems.