COLORADO PROFESSIONALS IN ONSITE WASTEWATER (CPOW)
GUIDELINES FOR THE DESIGN AND INSTALLATION OF NON-PRESSURIZED
DRIP DISPERSAL SYSTEMS (NDDS)
REVISED APRIL 4, 2016

1.0 BACKGROUND

Non-Pressurized Drip Dispersal Systems (NDDS), previously known as Low Pressure Pipe or “Bell-Patt” systems, have successfully been used in Colorado since the early 1980’s (Church, 1997). NDDS are typically used in clay soils with poor percolation rates by providing appropriate effluent distribution for absorption with incidental evapotranspiration. The Office of the State Engineer in a letter dated July 31, 1995, indicated that “it complies with the statutory requirement of returning the effluent to the stream system in which the well is located.”

NDDS utilize small diameter dispersal pipe (typically 2”) with ¼ inch orifices placed at the “6 o’clock” position, spaced at 8” on center. Laterals are installed by using a “trencher” to install shallow (12” to 30” deep) trenches, at two feet on center. A typical trench width is 8”. Laterals within each zone are placed level, from the proximal to the distal ends, and within the zone. Laterals are connected at the proximal ends by a zone manifold. A typical NDDS system is comprised of multiple zones, with the effluent to each supplied from a main manifold, which distributes effluent from the pumped supply line.

In developing these guidelines, the CPOW NDDS Committee (Committee) decided to adopt much of the historic design criteria which had a history of successful function. The Committee developed more explicit requirements for soils and separation to a limiting condition. To keep sizing similar to previous systems, the Committee used the sizing formula in Section 43.10.C.4 of CDPHE OWTS Regulation #43, and included an “adjustment factor” of 2.15. The adjustment factor was calculated by comparing sizes determined using the previous formula with sizes from the sizing formula in Section 43.10.C.4 of Regulation #43.

2.0 DIAGRAMS

The attached diagrams illustrate a typical NDDS system.

3.0 CDPHE OWTS REGULATION #43

Colorado Department of Public Health and Environment Water Quality Control Commission Onsite Wastewater Treatment System Regulation #43 does not include specific requirements for NDDS. However, CDPHE has confirmed that the NDDS falls within the requirements of Section 43.12(B) for Evapotranspiration and Evapotranspiration/Absorption Systems in Regulation #43 and concurs that local public health agencies may approve designs of NDDS that follow the criteria set forth within this document.
4.0 DESIGN AND INSTALLATION STANDARDS

The following design and installation standards will apply to NDDS:

1) NDDS shall be designed by a Colorado Registered Professional Engineer.
2) Trenches shall be excavated into undisturbed soils, unless installed in suitable fill material as described below.
3) Trenching shall not occur when soils are wet enough for the soils to smear. In terms of moisture content, this can be considered to be at or above the “plastic limit” for the soils.
4) Trenching shall be done with a trencher, unless otherwise specified in the engineer design and approved by the local public health agency. Examples of where excavation with a backhoe would include, but not be limited to: slopes exceeding 12% and soils with cobbles.
5) Trenches shall be spaced at 2 feet center to center, and shall be 8 inches wide, unless otherwise specified in the engineer design and approved by the local public health agency.
6) Laterals installed within the trenches shall be 2 inches in diameter.
7) Lateral piping material shall consist of: Schedule 40 PVC, Class 200 PVC (SDR 21), or equivalent.
8) Lateral orifices shall be ¼ inch, at 8” on center, in the six o’clock position.
9) Trench depth shall not exceed thirty (30) inches and trench length shall not exceed one hundred (100) feet. The trench bottom shall be level ± two (2) inches.
10) NDDS shall be dosed
11) Options for effluent distribution include:
   a) Manual Rotation using 2-inch or similar ball valves
   b) Automated Rotation using an automatic distributing valve (ADV)
12) Dose Volume: NDDS using manual rotation:
   a) The dose volume shall be sufficient to completely fill the following pipe components:
      i) the supply line from the pump to the first primary manifold,
      ii) the primary manifold,
      iii) the supply lines from the primary manifold to the zone manifolds,
      iv) the zone manifolds
   b) The dose volume shall be sufficient to fill the following pipe components to 25-50% of capacity:
      i) Perforated distribution laterals
13) Dose Volume-NDDS using an ADV:
   a) The dose volume shall be sufficient to completely fill the following pipe components:
      i) The supply line from the pump to the ADV
      ii) The supply line from the ADV to the zone manifolds
      iii) the zone manifolds
   b) The dose volume shall be sufficient to fill the following pipe components to 25-50% of capacity:
      i) perforated distribution laterals.
14) The NDDS shall include an “air relief valve” or “snifter” to allow the system to gravity drain back to the tank and into the distribution system, once the pump shuts off. Where the supply line from the pump runs “uphill” to the primary manifold or an ADV, the valve shall be
located at the high point in the supply line. Where the supply line from the pump runs downhill to the primary manifold or ADV, the valve shall be located inside the tank, to prevent siphoning of effluent from the tank to the supply line.

15) An inspection port, connected to the distal end of one lateral in each zone shall be installed. The inspection port shall extend at least 12” above grade, or may be left “below grade” if placed into a protective accessible cover flush to grade. The port shall include a 1/8-1/4” drilled hole, for an air release.

16) No irrigation shall be allowed over the soil treatment area.

17) Upon completion of the NDDS soil treatment area, the area shall be seeded. Seeding shall be done in a manner that does not damage the system. Recommendations for seed mixes can be obtained from the local Natural Resources Conservation Service and/or the county public works departments responsible for grading, erosion and sediment control permitting.

18) In observing the construction of the NDDS, the engineer or system contractor shall utilize appropriate equipment to assure that the distribution laterals are installed within the elevation tolerances of ± two (2) inches.

19) Four (4) feet of vertical separation is required to subsurface materials or limiting conditions unsuitable for treating septic tank effluent. Examples of limiting conditions include:
   a) Fractured media which includes granite and gneiss and weathered or decomposed facies of the same
   b) Coarse gravel
   c) Permeable and jointed materials such as sandstone and shale.
   d) Seasonally high groundwater table

20) For sites without suitable soils necessary to meet the required four feet of vertical separation to subsurface materials or limiting conditions unsuitable for treating septic tank effluent, the requirements of sections 4.0.1, 4.0.2 and 4.0.3 shall be followed, as applicable.

21) System Sizing shall conform to section 4.0.4.

4.0.1 Fill with Existing Soils

For sites without suitable soils necessary to meet the required four feet of vertical separation to subsurface materials or limiting conditions unsuitable for treating septic tank effluent, where a minimum of six (6) inches of existing suitable soils (exclusive of topsoil) are present above the limiting condition, the design engineer shall submit a fill plan that, at a minimum, addresses the following:

1. Removal and storage of topsoil.
2. Type of fill material to be placed and manner of placement, as follows:
   a. Fill material shall be of similar texture to the existing soils and shall be placed to achieve a similar density as the existing material.
   b. Fill side-slopes shall not be steeper than 3:1 (3 horizontal to 1 vertical)
   c. Methods of placement, to include lift thickness and level of compaction.
   d. Grade of fill to assure adequate drainage of precipitation runoff.
3. Testing of fill material, to include, at a minimum, percolation testing in the fill, to verify that the permeability is similar to the existing soils, and to establish a long term acceptance rate (LTAR).
4. Preparation of the surface of the existing soil, prior to placement of the fill, to include, at a minimum, scarification followed by placement and compaction of the fill material.

5. Replacement of topsoil, to include, at a minimum:
   a. Placement prior to trenching and placement of dispersal laterals, so that native soil, fill and topsoil can be mixed.

4.0.2 Fill with Minimal Existing Soils

For sites without suitable soils necessary to meet the required four feet of vertical separation to subsurface materials or limiting conditions unsuitable for treating septic effluent, where **less than** six (6) inches of existing suitable soils (exclusive of topsoil) are present above the limiting condition, the design engineer shall submit a fill plan that, at a minimum, addresses the following:

1. Removal and storage of topsoil.
2. Type of fill material to be placed and manner of placement, as follows:
   a. Fill material shall be of similar texture to soil types 2A, 3A, or 4A, from Table 10-1 in CDPHE OWTS Regulation #43.
   b. Fill side-slopes shall not be steeper that 3:1 (3 horizontal to 1 vertical)
   c. Methods of placement, to include lift thickness and level of compaction
   d. Grade of fill, to assure adequate drainage of precipitation runoff
3. Preparation of the surface of the existing soil or limiting condition, prior to placement of the fill, to include, at a minimum, scarification followed by placement and compaction of the fill material.
4. Replacement of topsoil, to include, at a minimum:
   a. Placement prior to trenching and placement of dispersal laterals, so that native soil, fill and topsoil can be mixed.

4.0.3 Fill to Address Irregular Topography

Where “fill” is required due to irregular topography which does not allow maintaining the pipe depth within the 12-inch to 30-inch limits, the installation shall include fill rather than cutting to level the ground. Cutting removes vegetation and root systems which are essential to the operation of NDDS. Where fill will be placed for these conditions, it must meet the requirements for fill described in 4.02 above.

4.0.4 System Sizing

The minimum NDDS system area shall be calculated using the following formula:\(^ 1\):

\[
NDDS\ Area = (Design\ Flow \div LTAR) \times Size\ Adjustment\ Factor
\]

Where:  
NDDS Area\(^ 1\): Soil treatment area, in square feet  
Design Flow: Flow in gallons per day
**LTAR**: Long Term Acceptance Rate, in gallons per day per square foot, from Table 10-1 in CDPHE Regulation #43

**Size Adjustment Factor**: From Table 1 below

1. The minimum area so calculated shall be comprised of the lateral trenches, the area between the lateral trenches, plus an additional one foot outside the outermost distribution laterals and the proximate and distal ends of the laterals. Each lineal foot of distribution lateral shall be the equivalent of two (2) square feet of NDDS area.

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Percolation Rate</th>
<th>Size Adjustment Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>3A</td>
<td>61-75</td>
<td>2.2</td>
</tr>
<tr>
<td>4</td>
<td>76-90</td>
<td>1.7</td>
</tr>
<tr>
<td>4A</td>
<td>91-120</td>
<td>1.5</td>
</tr>
<tr>
<td>5</td>
<td>121+</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Note: The December 2014 revisions to this document were to address necessary modifications to the “Size Adjustment Factor” for the design of a NDDS. These modifications were provided in order to more accurately associate the sizing of a NDDS under this document and Regulation 43 to the historic design criteria for this type of system.

### 5.0 SPECIAL REGIONAL AND LOCAL GEOLOGICAL CONDITIONS

The soils analysis required in Regulation #43 is sufficient to characterize most subsurface conditions; however, for certain conditions, additional research, site evaluation and analysis are necessary. OWTS professionals need to understand the local geological conditions and how those conditions relate to the design, installation and performance of OWTS.

While the standards noted in this document should address the majority of site conditions for the design of a NDDS, it is not the objective of this guidance to inform OWTS professionals how to design or review NDDS for all geological conditions in the State of Colorado. The CPOW NDDS Guidance Committee is aware that there are specific geological conditions which may require slight modifications to these design standards in order to ensure that the NDDS is properly designed. Guidance for these situations should be science based and the information provided should encompass as much technical data as necessary and to provide an avenue for consistency for designers and regulators in the future. Subsequent to a request by a few counties, CPOW has provided an example of such a document relative to the Dawson Arkose Formation located within the Denver Basin. For those OWTS professionals practicing within the Denver Basin, the Dawson Arkose information, located in Appendix A, should be carefully reviewed, understood, and applied.

CPOW is available to assist any group which defines a geological condition that falls into the above noted category and warrants additional site-specific criteria.
References:

Natural Resources Conservation Service Field Book for Describing and Sampling Soils, National Soils Survey Center NRCS-USDA, September, 2002 (NRCS Field Book),

July 31, 1995 letter from Office of the State Engineer

APPENDIX A
SPECIAL REGIONAL GEOLOGICAL CONDITIONS IMPACTING THE DESIGN AND INSTALLATION OF NDDS

The Dawson Arkose formation is found in the Front Range of Colorado within the hydrogeological area known as the “Denver Basin”. Figure 1, in the paper titled “Stratigraphy of the Uppermost Cretaceous and Lower Tertiary Rocks of the Denver Basin” illustrates the extent of the Dawson Arkose. Although cementation of the Dawson Arkose can vary from non-cemented to indurated, in some locations, the Dawson Arkose has the characteristics of Type 3A and 4A soils, from Table 10-1 in Regulation #43. If the Dawson Arkose is present on the site, the site evaluator shall determine whether it is suitable for the installation of NDDS, and provide a statement in the site evaluation report stating the characteristics of the Dawson Arkose that render it suitable.

At a minimum, the site evaluator shall evaluate the following characteristics:

1. Whether the material is fractured and jointed
2. The cementation class of the Dawson Arkose. Using the cementation classes from the Rupture Resistance Table on page 2-50 of the Natural Resources Conservation Service Field Book for Describing and Sampling Soils, National Soils Survey Center NRCS-USDA, September, 2002 (NRCS Field Book), the following cementation classes will be considered suitable: Non-Cemented (NC), Extremely Weakly Cemented (EW), Very Weakly Cemented (VW), Weakly Cemented (W). The following cementation classes will be considered unsuitable: Moderately Cemented (M), Strongly Cemented (ST), Very Strongly Cemented (VS), Indurated (I).
3. The Dawson Arkose material within four vertical feet of the deepest infiltrative surface of the trenches.
4. The soil class from Table 10-1, as determined from the tests, as specified in Regulation #43, in order to determine the associated Long Term Acceptance Rate (LTAR).

The table below summarizes characteristics 1 and 2 above. A “yes” answer to either question below means the material is unsuitable for the installation of a NDDS.

<table>
<thead>
<tr>
<th>DAWSON ARKOSE CHARACTERISTIC</th>
<th>ANSWER (A YES ANSWER MEANS THE DAWSON ARKOSE IS UNSUITABLE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is material fractured and/or jointed?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>2. Is the cementation class, M, ST, VS, or I?</td>
<td>Yes / No</td>
</tr>
</tbody>
</table>