



Article 77

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Performance of a Dry Extended Pond in North Carolina

A dry extended detention (ED) pond relies on settling as the primary mechanism to remove pollutants from stormwater runoff. A dry ED pond is normally empty during dry weather, but rapidly fills up with runoff during a storm event. The stored runoff is gradually released over a period of one to three days, allowing an opportunity for pollutants to settle out to the floor of the pond. Settling can be a very important pollutant removal mechanism, but it does have its limits. Earlier performance monitoring indicated that dry ED ponds had low to moderate ability to remove most stormwater pollutants (see article 64). This conclusion, however, is considered provisional, as many of the dry ED ponds that were monitored failed to achieve their target extended detention times due to design problems. A recent study by Stanley (1994) sheds new light on the potential performance of well-designed dry ED ponds.

Stanley and his colleagues monitored a demonstration dry ED pond in a small coastal plain watershed in North Carolina, and also conducted experiments to explore the settling behavior of stormwater pollutants. The dry ED pond served a 200 acre watershed, composed of a mix of single family, multifamily and commercial land uses (total imperviousness= 29%). Located near Greenville, NC, the watershed had the sandy soils and low relief characteristic of the coastal plain.

The dry ED pond was designed to provide a maximum of 72 hours of detention for the first half-inch of runoff through the use of a vertical perforated pipe at the pond's outlet. Any runoff in excess of the half-inch was bypassed through a concrete spillway, and was not treated. The pond ranged in depth from eight to 11 feet deep when full, but was designed to fully drain after a storm event. Like many other "dry" ED ponds, the 1.75 acre grass bottom of the pond has gradually become more soggy since it was constructed in 1991, and some portions near the outlet are reverting to a shallow wetland.

The pond's performance was monitored during eight storm events in 1992, that ranged from about a half-inch to two inches of rainfall. One storm, however, was a real whopper. This storm dropped a total of 9.28 inches of rain over a period just less than five days. As a consequence, about 70% of the total runoff volume bypassed the pond through the spillway during this rare

storm and was not treated. Thus, Stanley's sampling effort provides a glimpse of how well ED ponds perform during extremely large and rare storm events.

The overall results of the performance monitoring were generally consistent with prior studies (Table 1). Removal of particulate pollutant that are prone to settling was moderate to high, and removal of predominantly soluble pollutants (not subject to gravity) was low or negligible. This behavior was particularly evident when nitrogen and phosphorus was considered. Removal of the particulate fraction of nutrients was moderate (33 to 43%) while removal of soluble nutrient fractions was poor (+ 10% to -9%). Consequently, the combined removal rate for total phosphorus and nitrogen was a modest 14% and 24%, respectively. Removal rates for trace metals predominantly found in

Table 1: Median Pollutant Removal Rate Observed in the Greenville Dry ED Pond (N=8)

Water Quality Parameter	All Storm (%)	Big Storm* (%)
Total Suspended Solids	71	25
Particulate Organic Carbon	45	19
Particulate Nitrogen	43	22
Particulate Phosphorus	33	17
Cadmium	54	12
Chromium	49	16
Copper	26	11
Lead	55	19
Nickel	43	27
Zinc	26	11
Ammonia (NH ₄ -N)	9	20
Nitrate-N	(-2)	6
Total Dissolved Phosphorus	(-9)	6
Dissolved Organic Carbon	(-6)	(-5)
Total Phosphorus	14	—
Total Nitrogen	26	—

* Removal Rate includes pollutants that bypassed the pond through the emergency spillway and were not subject to settling