

**Project 5 Phase I: Grand Lake (Oklahoma) Watershed Implementation Project,
Task 5.1, Subtask 5.1.5, *Update estimates of potential loading from near-lake
septic systems***

Letter Report

**FY 2004 319(h) Project 5
CA #C9-996100-12**

Literature reviewed for an ongoing septic system study conducted by Oklahoma State University (OSU) and Grand River Dam Authority (GRDA) on Grand Lake indicates a need for updated nutrient loading estimates for near-shore onsite waste water treatment systems. The most recent estimates are listed in a 1995 report by OSU and Oklahoma Water Resources Board (OWRB). According to this report, septic systems are estimated to contribute 1,396-4,656 kg/yr of phosphorus to the lake with no loading rates reported for nitrogen. This estimate is based on phosphorus loading from 9,366 houses near the shore line with the following assumptions: 1) all utilize septic systems and 2) houses are occupied by 3.5 people for 60 days/yr.

Updated nutrient loading rates were calculated from data available in the United States Environmental Protection Agency (USEPA) Onsite Wastewater Treatment Systems Manual (2002) regarding human nutrient loading rates to septic systems and nutrient removal rates by properly operation systems. Two methods were utilized in calculations to provide a range of nutrient loading estimates.

Method 1:

2006 US Census Bureau data were used to estimate population growth since the 1995 study described above. This data indicate a 30% population growth rate in the Grand Lake area resulting in a total of 12,176 near-shore houses. Loading rate estimates were calculated using the following assumptions: 1) all houses utilize septic systems, 2) houses occupied by 3.5 people for 100 days/yr and 365 days/yr, and 3) 10% septic system failure rate (Knowles, 1998).

Application of listed failure rate resulted in 1,217 failed systems and 10,958 properly operating systems at any one time. Based on population growth and listed assumptions, nutrient loading rates by septic systems into groundwater are:

100 days/year occupancy:
Total Nitrogen: 66,420 kg/yr
Total Phosphorus: 2,003 kg/yr

365 days/year occupancy:
Total Nitrogen: 240,683 kg/yr
Total Phosphorus: 7,325 kg/yr

Method 2:

Current Geographical Information System (GIS) data from the ongoing OSU/GRDA study has classified 2004 houses covering 69.5 km of 2,092 km total shoreline around the lake. Assuming a constant development rate along entire shoreline; this figure results in a potential total of 60,322 near-shore houses on Grand Lake. Personal observations of Grand Lake indicate that levels of development are not constant over entire shore line; therefore, loading rates were calculated at four development levels.

Estimates for each development level were calculated using the following assumptions: 1) Thirty three percent of houses utilize septic systems, 2) houses occupied by 3.5 people for 100 days/yr and 365 days/yr, and 3) ten percent septic system failure rate. Estimated nutrient loading rates for both occupancy assumptions are listed below (Table 1).

Table 1. Estimated Nutrient Loading Rates at Different Levels of Development

% of Shoreline Developed	Total Nitrogen (kg/yr)		Total Phosphorus (kg/yr)	
	100 days/yr	365 days/yr	100 days/yr	365 days/yr
100	108,587	393,482	3,275	11,975
75	81,443	295,121	2,456	8,982
50	54,293	196,740	1,637	5,987
25	27,150	98,381	819	2,995

Estimates using both methods are for groundwater loading only. Factors that should be considered before using these figures for other calculations or management policy are:

- 1) Nutrient load in groundwater will differ from that entering surface water due to site specific characteristics such as soil type, hydraulic retention time, terrain slope, and nutrient concentrations present in soil.
- 2) Soil removal rates given by USEPA (2002) are for a properly sited and functioning septic system. Personal observation and soil classification indicate many sites having moderate to severe limitations for septic systems possibly resulting in diminished nutrient removal rates.
- 3) Error associated with estimates of failure rates, house occupancy time, and number of houses using septic systems.

It is possible that septic systems are contributors of chemical and biological contaminants to Grand Lake. Based on the OSU and OWRB (1995) study, septic systems only contribute 0.2% of total P-loading. Published studies have indicated that near-shore septic systems influence the water quality parameters analyzed in the current OSU/GRDA study. However, this study has found no definitive evidence of septic system influence on the water quality of Grand Lake to date. Efforts to evaluate pharmaceuticals and hormones are underway and may indicate septic system input upon completion.

Works Cited

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