LAKE & RESERVOIR ASSESSMENTS
TAR-PAMLICO RIVER BASIN

Tar River Reservoir

Intensive Survey Unit
Environmental Sciences Section
Division of Water Quality

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GLOSSARY

Algae	Small aquatic plants that occur as single cells, colonies, or filaments. May also be referred to as phytoplankton, although phytoplankton are a subset of algae.
Algal biovolume	The volume of all living algae in a unit area at a given point in time. To determine biovolume, individual cells in a known amount of sample are counted. Cells are measured to obtain their cell volume, which is used in calculating biovolume
Algal density	The density of algae based on the number of units (single cells, filaments and/or colonies) present in a milliliter of water. The severity of an algae bloom may be determined by the algal density as follows: Mild bloom = 10,000 to 20,000 units/ml Mild bloom = 20,000 to 30,000 units/ml Severe bloom = 30,000 to 100,000 units/ml Extreme bloom = Greater than 100,000 units/ml
Algal Growth Potential Test (AGPT)	A test to determine the nutrient that is the most limiting to the growth of algae in a body of water. The sample water is split such that one sub-sample is given additional nitrogen, another is given phosphorus, a third may be given a combination of nitrogen and phosphorus, and one sub-sample is not treated and acts as the control. A specific species of algae is added to each sub-sample and is allowed to grow for a given period of time. The dry weights of algae in each sub-sample and the control are then measured to determine the rate of productivity in each treatment. The treatment (nitrogen or phosphorus) with the greatest algal productivity is said to be the limiting nutrient of the sample source. If the control sample has an algal dry weight greater than 5 mg/L, the source water is considered to be unlimited for either nitrogen or phosphorus.
Centric diatom	Diatoms are photosynthetic algae that have a siliceous skeleton (frustule) found in almost every aquatic environment including fresh and marine waters, as well as moist soils. Centric diatoms are circular in shape and are often found in the water column.
Chlorophyll *a*	Chlorophyll *a* is an algal pigment that is used as an approximate measure of algal biomass. The concentration of chlorophyll *a* is used in the calculation of the NCTSI, and the value listed is a lake-wide average from all sampling locations.
Clinograde	In productive lakes where oxygen levels drop to zero in the lower waters near the bottom, the graphed changes in oxygen from the surface to the lake bottom produces a curve known as clinograde curve.
Coccoid	Round or spherical shaped cell
Conductivity	This is a measure of the ability of water to conduct an electrical current. This measure increases as water becomes more mineralized. The concentrations listed are the range of values observed in surface readings from the sampling locations.
Dissolved oxygen	A measurement of oxygen concentrations found at the sampling locations.
Dissolved oxygen saturation	The capacity of water to absorb oxygen gas. Often expressed as a percentage, the amount of oxygen that can dissolve into water will change depending on a number of parameters, the most important being temperature. Dissolved oxygen saturation is inversely proportion to temperature, that is, as temperature increases, water's capacity for oxygen will decrease, and vice versa.

Eutrophic	Describes a lake with high biological productivity and low water transparency.
Eutrophication	The process of physical, chemical, and biological changes associated with nutrient, organic matter, and silt enrichment and sedimentation of a lake.
Limiting nutrient	The plant nutrient present in lowest concentration relative to need limits growth such that addition of the limiting nutrient will stimulate additional growth. In northern temperate lakes, phosphorus (P) is commonly the limiting nutrient for algal growth
Manganese	A naturally occurring metal commonly found in soils and organic matter. As a trace nutrient, manganese is essential to all forms of biological life. Manganese in lakes is released from bottom sediments and enters the water column when the oxygen concentration in the water near the lake bottom is extremely low or absent. Manganese in lake water may cause taste and odor problems in drinking water and require additional treatment of the raw water at water treatment facilities to alleviate this problem.
Mesotrophic	Describes a lake with moderate biological productivity and water transparency
NCTSI	North Carolina Trophic State Index was specifically developed for North Carolina lakes as part of the state's original Clean Lakes Classification Survey (NRCD 1982). It takes the nutrients present along with chlorophyll *a* and Secchi depth to calculate a lake's biological productivity.
Oligotrophic	Describes a lake with low biological productivity and high water transparency.
pH	The range of surface pH readings found at the sampling locations. This value is used to express the relative acidity or alkalinity of water.
Photic zone	The portion of the water column in which there is sufficient light for algal growth. DWQ considers 2 times the Secchi depth as depicting the photic zone.
Secchi depth	This is a measure of water transparency expressed in meters. This parameter is used in the calculation of the NCTSI value for the lake. The depth listed is an average value from all sampling locations in the lake.
Temperature	The range of surface temperatures found at the sampling locations.
Total Kjeldahl nitrogen	The sum of organic nitrogen and ammonia in a water body. High measurements of TKN typically results from sewage and manure discharges in water bodies.
Total organic nitrogen (TON)	Total Organic Nitrogen (TON) can represent a major reservoir of nitrogen in aquatic systems during summer months. Similar to phosphorus, this concentration can be related to lake productivity and is used in the calculation of the NCTSI. The concentration listed is a lake-wide average from all sampling stations and is calculated by subtracting Ammonia concentrations from TKN concentrations.
Total phosphorus (TP)	Total phosphorus (TP) includes all forms of phosphorus that occur in water. This nutrient is essential for the growth of aquatic plants and is often the nutrient that limits the growth of phytoplankton. It is used to calculate the NCTSI. The concentration listed is a lake-wide average from all sampling stations.
Trophic state	This is a relative description of the biological productivity of a lake based on the calculated NCTSI value. Trophic states may range from extremely productive (Hypereutrophic) to very low productivity (Oligotrophic).
Turbidity	A measure of the ability of light to pass through a volume of water. Turbidity may be influenced by suspended sediment and/or algae in the water.
Watershed	A drainage area in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

Overview

The Tar-Pamlico River basin encompasses a 5,440 mi^2 watershed drained by 2,355 miles of streams, and with 634,400 acres classified as salt waters. It is the fourth largest river basin in the state and is contained entirely within the state. From its headwaters within the eastern piedmont ecoregion, the Tar River flows 180 miles southeast towards the coastal plain ecoregion and Pamlico Sound. The river is called the Tar River from its source in Person County to US 17 in the Town of Washington, a distance of about 140 miles. From Washington to Pamlico Sound it is called the Pamlico River. The Pamlico River is entirely estuarine, while the Tar River is primarily freshwater.

Most (about four-fifths) of the basin is located in the coastal plain and is characterized by flat terrain, black water streams, low-lying swamplands, and estuarine areas. Streams are often slow flowing with extensive swamps and bottomland hardwood forests or marshes in their floodplains. The entire basin was designated as Nutrient Sensitive Waters (NSW) in 1989 in response to the problems associated with nutrient loading and the resulting eutrophication.

Three lakes, Lake Devin, Tar River Reservoir and Lake Mattamuskeet, were sampled in by DWQ staff in 2012. Tar River Reservoir below elevation 130' is on the 2010 303(d) List of Impaired Waters for low dissolved oxygen based on data collected in 2008 (http://portal.ncdenr.org/web/wq/ps/mtu/assessment).

Following the description of the assessment methodology used for the Tar-Pamlico River Basin, there are individual summaries for each of the lakes and a two-paged matrix that distills the information used to make the lakes use support assessments. For additional information on a particular lake (including sampling data), please go to http://www.esb.enr.state.nc.us/.

Assessment Methodology

For this report, data from January 1, 2008 through December 31, 2012 were reviewed. Lake monitoring and sample collection activities performed by DWQ field staff are in accordance with the Intensive Survey Unit Standard Operating Procedures Manual (http://portal.ncdenr.org/c/document_library/get_file?uuid=522a90a4-b593-426f-8c11-21a35569dfd8&groupId=38364)

All lakes were sampled during the growing season from May through September. Data were assessed for excursions of the state's class C water quality standards for chlorophyll *a*, pH, dissolved oxygen, water temperature, turbidity, and surface metals. Other parameters discussed in this report include Secchi depth and percent dissolved oxygen saturation. Secchi depth provides a measure of water clarity and is used in calculating the trophic or nutrient enriched status of a lake. Percent dissolved oxygen saturation gives information on the amount of dissolved oxygen in the water column and may be increased by photosynthesis or depressed by oxygen-consuming decomposition.

For algae collection and assessment, water samples are collected from the photic zone, preserved in the field and taken concurrently with chemical and physical parameters. Samples were quantitatively analyzed to determine assemblage structure, density (units/ml) and biovolume (m^3/mm^3).

For the purpose of reporting, algal blooms were determined by the measurement of unit density (units/ml). Unit density is a quantitative measurement of the number of filaments, colonies or single celled taxa in a waterbody. Blooms are considered mild if they are between 10,000 and 20,000 units/ml.

Moderate blooms are those between 20,000 and 30,000 units/ml. Severe blooms are between 30,000 and 100,000 units/ml. Extreme blooms are those 100,000 units/ml or greater.

An algal group is considered dominant when it comprises 40% or more of the total unit density or total biovolume. A genus is considered dominant when it comprises 30% or more of the total unit density or total biovolume.

Additional data considered as part of the use support assessment include historic DWQ water quality data, documented algal blooms and/or fish kills, problematic aquatic macrophytes, or listing on the EPA's 303(d) List of Impaired Waters.

For a more complete discussion of lake ecology and assessment, please go to http://portal.ncdenr.org/web/wq/ess/isu. The 1992 North Carolina Lake Assessment Report (downloadable from this website) contains a detailed chapter on ecological concepts that clarifies how the parameters discussed in this review relate to water quality and reservoir health.

Quality Assurance of Field and Laboratory Lakes Data

Data collected in the field via single or multiparameter water quality meters are entered into the Ambient Lakes Database within 24 hours of the sampling date. These data are then reviewed for accuracy and completeness within a week of entry. Data that have not been reviewed are given a 'P' code for 'Provisional'(data has been entered but not been verified for accuracy and/or completeness). Data that have been verified are given an 'A' code for 'Accepted'.

Chemistry data from the DWQ Water Quality Laboratory are entered into the Lakes Database within 48 hours of receipt from the lab. As with the field data, laboratory results are coded 'P' until the entered data is verified for entry accuracy and completeness, after which, the code is changed to 'A'. Generally, laboratory data entered into the Lakes Database are verified within a week following the initial entry.

Data, either laboratory or field, which appear to be out of range for the lake sampled are double checked against field sheets or the laboratory results form by the Lakes Data Administrator for possible data entry error. If there are data entry mistakes, possible equipment, sampling, and/or analysis errors, these are investigated and corrected if possible. If the possible source of an error cannot be determined, the data remains in the database. If an error is determined, the data value is removed from the appropriate database parameter field and placed in the 'Notes' field along with a comment regarding the error. Chemistry results received from the laboratory that have been given a qualification code are also entered into the 'Notes' field along with the assigned laboratory code. Laboratory qualification coded data or data which may be in error due to sampling, handling, and/or equipment problems are only entered into the 'Notes' field and never in the data field(s) in the Ambient Lakes Database.

Additional information regarding the Quality Assurance Program is covered in the Ambient Lake Monitoring Program Quality Assurance Plan. Version 1.1 (July 2012) of this document is available on the ISU website (http://portal.ncdenr.org/web/wq/ess/isu).

Weather Overview for Summer 2012

After a dry, warm winter, May brought beneficial rainfall to the state and ranked as the 10^{th} wettest May on record since 1895 based on statewide average rainfall. The coastal plains and the northwestern region of the state received the most rainfall during this month (Figure 1). Rainfall estimates within the lower Tar River Basin ranged from 105% to 300% of normal levels for the month.

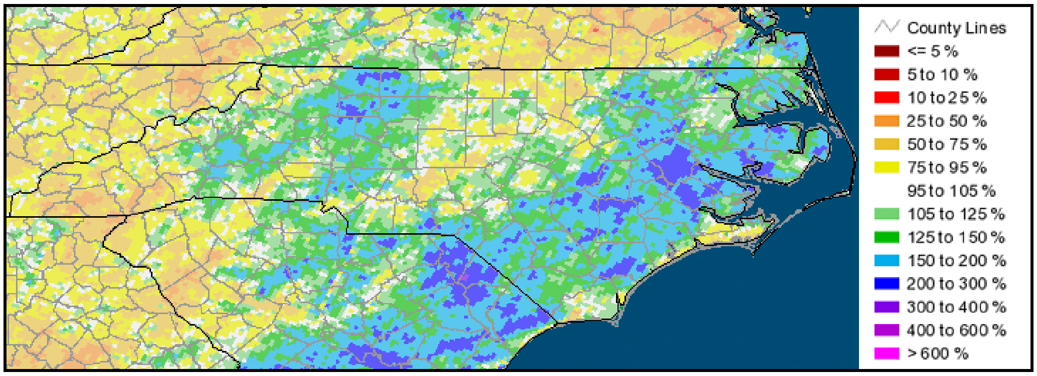

Figure 1. Precipitation for May 2012: Percent of Normal Based on Estimates From NWS Radar
(Data courtesy NWS/NCEP)

The wet conditions in May helped to alleviate most of the short-term concerns with hydrological drought in the state (Figure 2). The Tar River Basin drought conditions shifted from a moderate drought at the beginning of the month to abnormally dry. Temperatures in May for the state were warm, averaging 3.5 degrees F above the normal for the month.

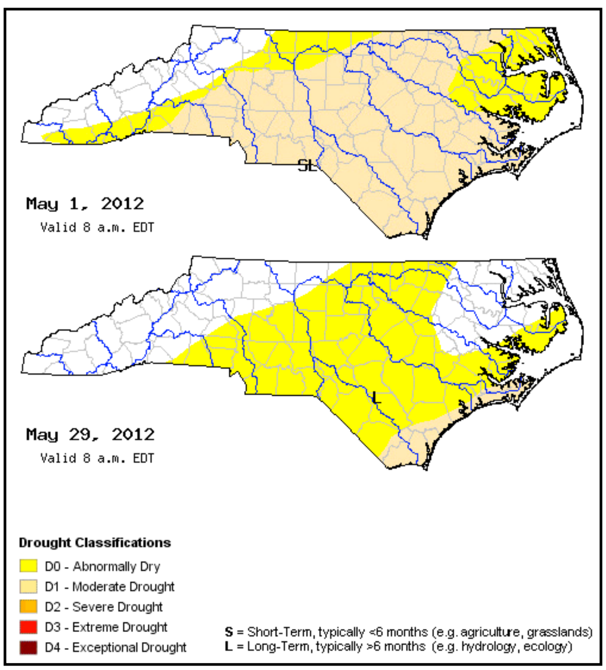

Figure 2. US Drought Monitor for North Carolina , May 2012
(Courtesy of NC DENR Division of Water Resources)

June temperatures in North Carolina were much cooler than normal, despite a heat wave that began on the last few days of the month. Overall, June 2012 ranked as the 29th coolest June since1895. The last half of June was also drier with most of the state receiving 75% less than the normal rainfall for the month (Figure 3).

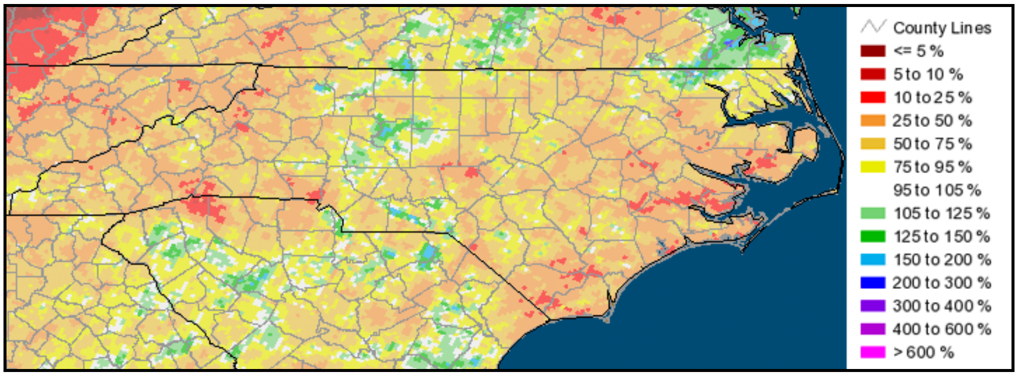

Figure 3. Precipitation for June 2012: Percent of Normal Based on Estimates From NWS Radar
(Data courtesy NWS/NCEP)

Early June was the first time in two years that the state was not experiencing some measure of drought. However, dryness and heat in late June demonstrated how quickly the climate pattern can shift. Normally, extreme heat is not unusual in July and August, this heat usually last for only a few days. In contrast, the heat of late June 2012 occurred much earlier and lasted for many days.

July 2012 remained warm and, overall, the temperatures for the month ranked as the 3rd warmest for the state since 1895. Rainfall was closer to normal for a typical July in the state. However, not all areas of the state experienced adequate rainfall, particularly the southern-most region of the Coastal Plain (Figures 4). Estimated rainfall within the Tar River Basin ranged from 50% below normal for the month to almost 300% above normal in some isolated areas. Drought conditions had almost disappeared within the river basin by late July (Figure 5). Abnormally dry conditions remained in most of Johnston and southwestern Wilson counties.

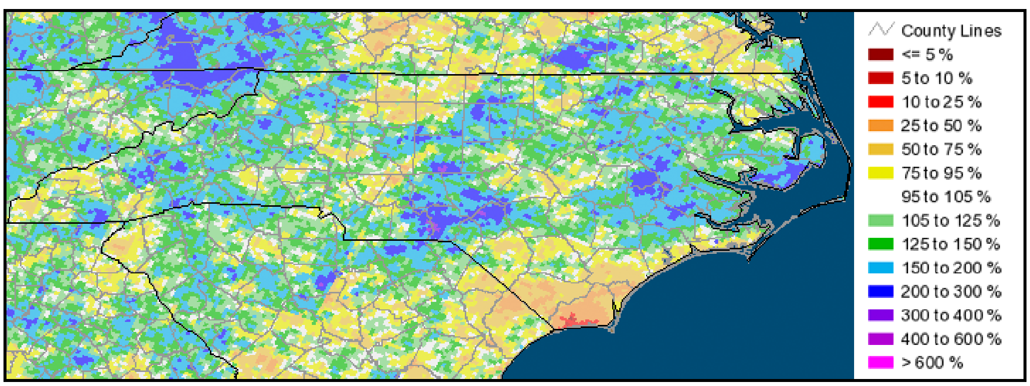

Figure 4. Precipitation for July 2012: Percent of Normal Based on Estimates From NWS Radar
(Data courtesy NWS/NCEP)

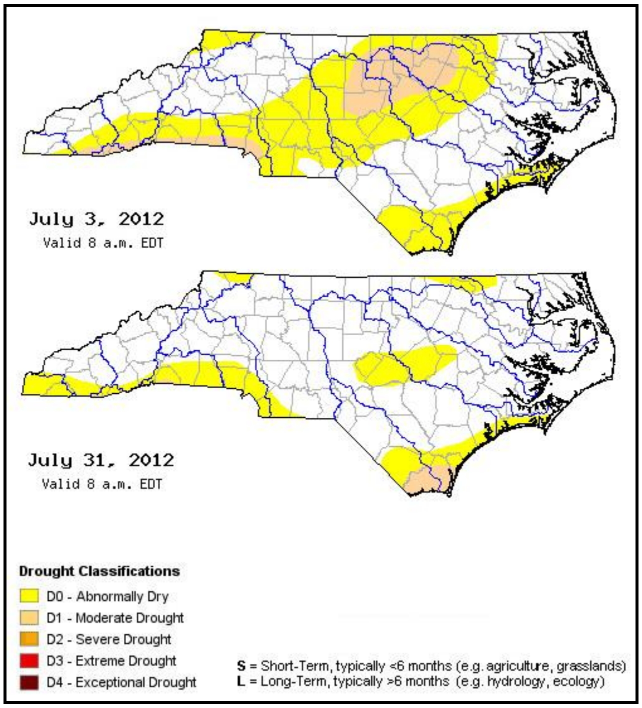

Figure 5. US Drought Monitor for North Carolina , July 2012
(Courtesy of NC DENR Division of Water Resources)

Temperatures in August 2012 averaged near normal in the state. Early August started out warmer while late August was cooler. Rainfall totals for the month were also closer to normal for the month, with wetter conditions occurring in the east and drier conditions present in the west. In August, some parts of the state experienced a few days of very heavy rainfall which resulted in localized flooding (Figure 6). Rainfall within the Tar River Basin was 128% of normal in August and temperatures averaged -0.49 °F of normal.

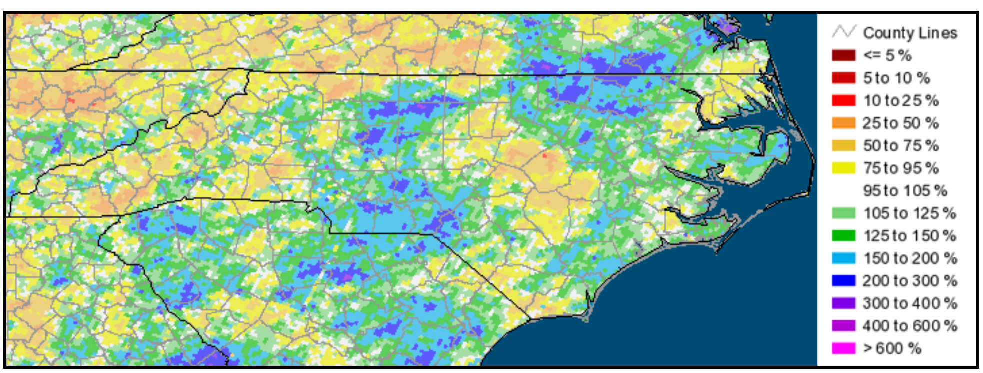

Figure 6. Precipitation for August 2012: Percent of Normal Based on Estimates From NWS Radar
(Data courtesy NWS/NCEP)

Drought conditions throughout the state were greatly diminished in August 2012 as compared to previous years. By the end of the month, only a few regions of abnormally dry conditions existed in the state (Figure 7).

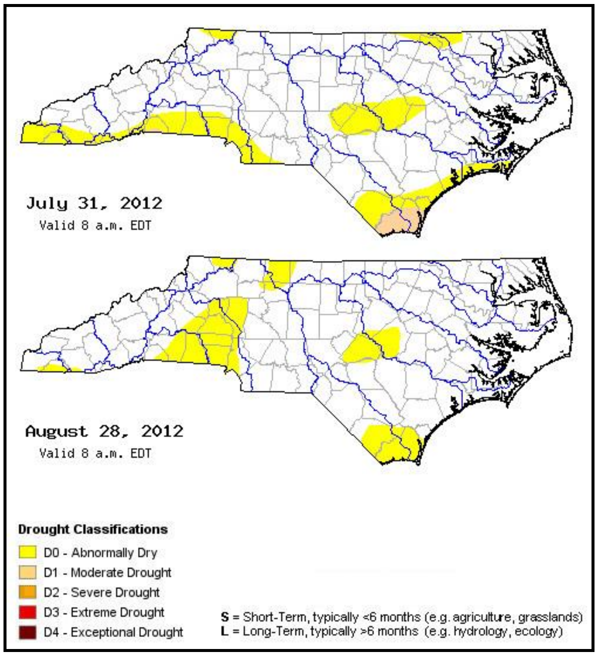

Figure 7. US Drought Monitor for North Carolina, August 2012
(Courtesy of NC DENR Division of Water Resources)

September storms brought substantial rainfall to central and western NC, while the coastal plain and southwestern corner of the state remained dry (Figure 8). The rainfall amounts helped to maintain stream and reservoir at or near normal levels throughout most of the state. Temperatures were cooler than normal for the central piedmont and coastal plain and within the normal ranges for the mountains.

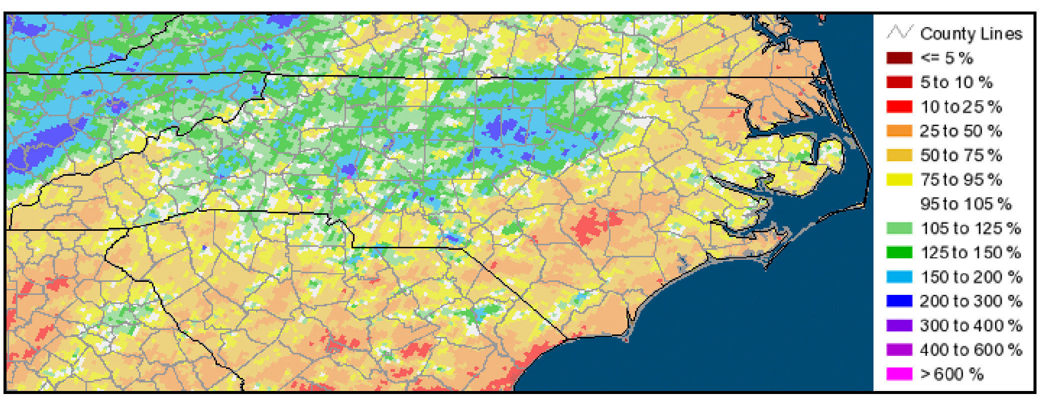

Figure 8. Precipitation for September 2012: Percent of Normal Based on Estimates From NWS Radar
(Data courtesy NWS/NCEP)

Drought conditions in the state continued to decline in September with abnormally dry conditions persisting in three isolated regions of the state (Figure 9). Dry conditions in the Fall are viewed more favorably in that they assist the agricultural harvest period in the state.

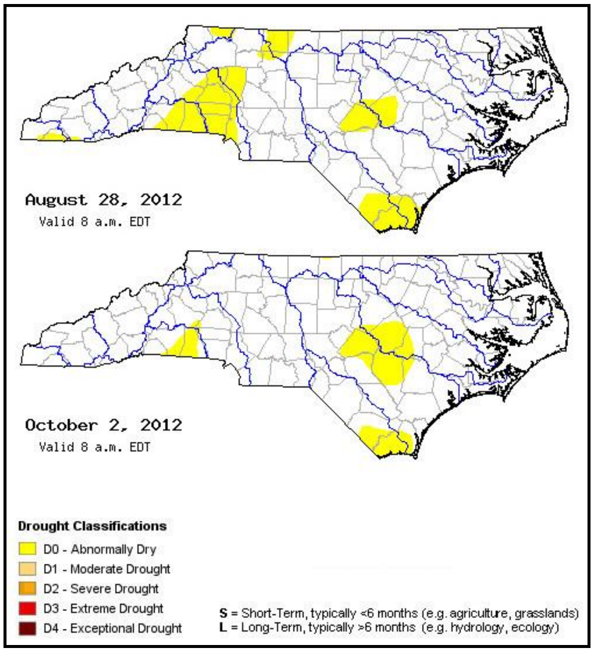

Figure 9. US Drought Monitor for North Carolina, September 2012
(Courtesy of NC DENR Division of Water Resources)

LAKE & RESERVOIR ASSESSMENTS

HUC 03020101

Lake Devin

Ambient Lakes Program Name	Lake Devin	
Trophic Status (NC TSI)	Eutrophic	
Mean Depth (meters)	5.0	
Volume ($10^6 m^3$)	1.60	
Watershed Area (mi^2)	1.0	
Classification	WS-II HQW NSW CA	
Stations	TAR001C	TAR001E
Number of Times Sampled	5	5

Lake Devin is a small lake located in the City of Oxford. Primarily used for public fishing, this lake originally served as the water supply source for the city. DWQ staff sampled Lake Devin from May through September, 2012.

Secchi depths in 2012 (0.7 to 1.2 meters) were indicative of reduced light penetration into the water column. Field observations by staff indicated that the lake water had a brownish-green coloration. Surface dissolved oxygen ranged from 5.2 to 8.1 mg/L and surface pH ranged from 6.5 to 8.8 s.u. (Appendix A). The thermocline in this lake near the dam generally occurred at a depth of four meters from the surface in 2012.

Nutrient concentrations in Lake Devin in 2012 were similar to those previously recorded by DWQ for this lake. Total phosphorus ranged from 0.03 to 0.05 mg/L and total Kjeldahl nitrogen ranged from 0.73 to 0.89 mg/L. Ammonia and nitrite plus nitrate concentrations were at or below DWQ laboratory detection levels. Chlorophyll *a* values ranged from 13 to 39 μg/L, which is lower than values recorded for this lake in 2007. Phytoplankton assemblages were characterized from water samples collected near the dam (TAR001E) in 2012. Based on the density of algal cells in these samples, which were greater than 30,000 units/ml, it was determined that severe blooms were present in Lake Devin during the monitoring period. Algal assemblages were diverse in the early part of the summer (May and June), then became dominated by the small filamentous bluegreen alga *Planktolyngbya* in July and August. *Microcystis* was the dominant alga in the August, comprising 41% of the sample biovolume. *Microcystis* is a bluegreen alga known to produce a toxin which has caused health concerns in other states. To date, no known human or animal health problems related to *Microcystis* toxin have been documented in North Carolina.

Lake Devin was determined to exhibit elevated biological productivity (eutrophic conditions) in 2012 based on the calculated NCTSI scores. This lake has varied from moderately productive (mesotrophic) to exceptionally productive (hypereutrophic) since it was first monitored by DWQ in 1989.

Tar River Reservoir

Ambient Lakes Program Name	Tar River Reservoir			
Trophic Status (NC TSI)	Eutrophic			
Mean Depth (meters)	6.0			
Volume ($10^6 m^3$)	16.00			
Watershed Area (mi^2)	2007.0			
Classification	WS-IV B NSW CA			
Stations	TAR015E	TAR015G	TAR017C	TAR017F
Number of Times Sampled	5	5	5	5

Tar River Reservoir is the primary water supply source for the City of Rocky Mount. Completed in 1971, this reservoir is located on the confluence of the Tar River and Sapony Creek and is open to the public for boating and fishing.

DWQ field staff monitored Tar River Reservoir monthly from May through September 2012. Surface dissolved oxygen ranged from 5.4 to 8.8 mg/L and surface pH ranged from 6.7 to 7.9 s.u. (Appendix A). Secchi depths were low and ranged from 0.5 to 1.1 meters. Staff field notes indicated that the lake water appeared to be greenish-brown in color. Tar River Reservoir, below elevation 130 feet, was placed on the 2010 303(d) List of Impaired Waters for low dissolved oxygen readings measured in 2008. Surface dissolved oxygen readings in 2012 were not below the state water quality standard of 4.0 mg/L for an instantaneous reading.

Total phosphorus concentrations in Tar River Reservoir ranged from 0.04 to 0.09 mg/L and total Kjeldahl nitrogen ranged from 0.60 to 1.00 mg/L. Total organic nitrogen ranged from 0.59 to 0.99 mg/L. The availability of nutrients in the lake water supported the growth of algae which resulted in chlorophyll *a* values that ranged from 20 to 63 µg/L. Chlorophyll *a* values near the dam at TAR017F in May (40 µg/L) and in June (43 µg/L) as well as in the Sapony Creek arm at TAR017C in May (63 µg/L) were at or greater than the state water quality standard of 40 µg/L. Results of an Algal Growth Potential Test conducted in August indicated that algae growth in Tar River Reservoir was limited by the nutrient, nitrogen (Table 1).

Table 1. Algal Growth Potential Test Results for Tar River Reservoir, August 8, 2012.

Station	Maximum Standing Crop, Dry Weight (mg/L)			Limiting Nutrient
	Control	C+N	C+P	
TAR017C	1.88	10.29	1.78	Nitrogen
TAR017F	1.76	9.14	1.63	Nitrogen
TAR015G	1.98	11.62	1.70	Nitrogen

Freshwater AGPT using *Selenastrum capricornutum* as test alga

C+N = Control + 1.0 mg/L Nitrate-N

C+P = Control + 0.05 mg/L Phosphate-P

Phytoplankton assemblages were characterized in 2012 from samples collected near the dam (site TAR017F). Moderate to severe algal blooms were noted from the analysis of these samples. The phytoplankton blooms peaked in June but remained substantial through September based on cell density. Bluegreen algae dominated the algal assemblages in 2012, but no particular taxa dominated the samples by unit density. The phytoplankton samples were dominated by the toxin-producing bluegreen, *Aphanizomenon*, which comprised 60% of the sample biovolume in July. To date, no known human or animal health problems have been documented in North Carolina in association to the presence of this bluegreen alga.

Hydrilla, an invasive aquatic weed, was observed along much of the shoreline of this reservoir by field staff. The City of Rocky Mount has partnered with the Division of Water Resources and the Wildlife Resources Commission to control hydrilla in Tar River Reservoir through the use of herbicides and grass carp stocking.

Based on the calculated NCTSI scores for the 2012 sampling season, Tar River Reservoir was determined to exhibit elevated biological productivity or eutrophic conditions. This reservoir has exhibited this trophic state since it was first monitored by DWQ in 1989.

LAKE & RESERVOIR ASSESSMENTS

HUC 03020105

Lake Mattamuskeet

Ambient Lakes Program Name	Lake Mattamuskeet
Trophic Status (NC TSI)	Hypereutrophic
Mean Depth (meters)	0.6
Volume ($10^6 m^3$)	10.20
Watershed Area (mi^2)	na
Classification	SC
Stations	PAS0123A
Number of Times Sampled	5

Lake Mattamuskeet is located in the Coastal Plains of North Carolina. Situated on a vast peninsula lying between Albemarle Sound on the north and the Pamlico River on the south, this natural lake is within the Mattamuskeet National Wildlife Refuge. Lake Mattamuskeet, which is the largest natural lake in North Carolina, is shallow with no natural outlets. There are no overland tributaries into the lake and recharge is the result of precipitation and water intrusion from a man-made canal system. These canals were originally built to provide outlets from the lake to Pamlico Sound. Water from the sound frequently enters the lake and this has resulted in a change from freshwater to brackish conditions in the lake. The surrounding land is primarily used for agriculture with some residences located near the lakeshore. Lake Mattamuskeet is a very popular site for recreational fishermen, hunters and wildlife enthusiasts who come to watch and photograph flocks of migratory waterfowl.

Lake Mattamuskeet is divided by the NC Highway 94 causeway (constructed in 1942), which effectively divides the lake into two distinct basins. The western segment of Lake Mattamuskeet is turbid and dominated by phytoplankton while the eastern and larger segment of the lake is less turbid and dominated by submerged macrophytes. It is these plants that support a significant waterfowl population. Water exchange between the two segments of the lake occurs through five culverts located along the causeway.

The NC Division of Water Quality's Intensive Survey Unit (ISU) received a request for water quality monitoring assistance from the United States Fish and Wildlife Service (USFWS) and the Lake Mattamuskeet Wildlife Refuge. The purpose for this monitoring is to determine what differences exist in nutrient concentrations, turbidity and suspended solids between the eastern and western segments of Lake Mattamuskeet.

This lake was monitored monthly from May through September by DWQ field staff. Sampling sites visited in 2012 were located along the length of the lake, with three sites located east of the Highway 94 causeway and three located west of the causeway. In addition to the lake sites, the water in four out-flowing canals was also sampled (Figure 10 and Table 2).

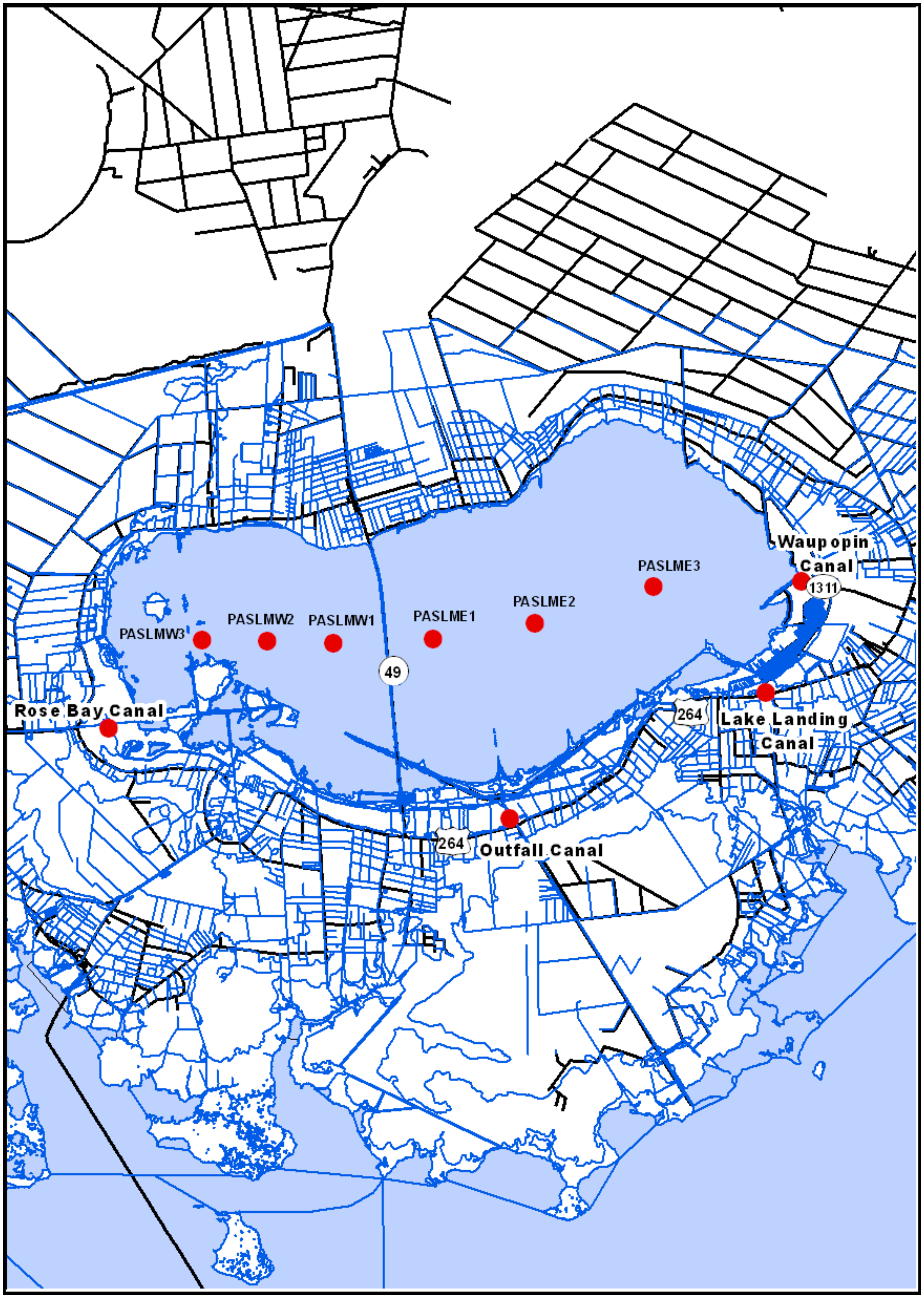

Figure 10. 2012 Sampling Sites on Lake Mattamuskeet.

Table 2. Lake Mattamuskeet Canal Sampling Sites.

Site	Site
Rose Bay Canal	PASLMRBC
Outfall Canal	PASLMOC
Lake Landing Canal	PASLMLLC
Waupopin Canal	PASLMWC

In 2012, Secchi depths in Lake Mattamuskeet ranged from 0.2 to 0.7 meter (mean maximum depth was1.2 meters). Surface dissolved oxygen ranged from 7.3 to 9.8 mg/L and surface pH values ranged from 8.1 to 9.1 s.u (Appendix A). Conductivity values in this lake are consistently elevated due to the intrusion of salt water. In 2012, conductivity ranged from 2000 to 2450 umhos/cm. Surface salinity values ranged from 1.06 to 1.26 ppt. This range would be considered as mildly brackish.

Total phosphorus in Lake Mattamuskeet ranged from 0.02 to 0.11 mg/L and total Kjeldahl nitrogen ranged from 1.2 to 3.1 mg/L. Ammonia and nitrite plus nitrate values were at or below DWQ laboratory detection levels at all six sampling sites. Chlorophyll *a* values ranged from 15 to 71 µg/L. Of the 30 chlorophyll *a* samples analyzed in 2012, 50% were greater than the state water quality standard of 40 µg/L and all of these occurred at the sampling sites located west of the Highway 49 causeway. Total solids ranged from 11 to 78 mg/L and turbidity ranged from 7.3 to 31 NTUs. The shallow nature of this lake allows for re-suspension of bottom sediments and organic materials by wave action and by wind mixing.

Water samples from the east and west sides of Lake Mattamuskeet were collected on September 6, 2012 and shipped to the Environmental Protection Agency, Region IV Laboratory for Algal Growth Potential Tests (AGPT). The purpose of this analysis is to determine which nutrient, nitrogen or phosphorus, is limiting to the growth of algae in each side of the lake (Table 3). Based on the test results, phosphorus was found to be the limiting on both the east and west sides of Lake Mattamuskeet.

Table 3. Algal Growth Potential Test Results for Lake Mattamuskeet, September 6, 2012

Station	Maximum Standing Crop, Dry Weight (mg/L)			Limiting Nutrient
	Control	C+N	C+P	
PASLME2	0.56	0.62	3.20	Phosphorus
PASLMW2	0.76	0.82	1.45	Phosphorus

Freshwater AGPT using *Selenastrum capricornutum* as test alga

C+N = Control + 1.0 mg/L Nitrate-N

C+P = Control + 0.05 mg/L Phosphate-P

Lake Mattamuskeet was determined to exhibit extremely elevated biological productivity, or hypereutrophic conditions, based on the calculated NCTSI scores. Lake Mattamuskeet was previously determined to be hypereutrophic in June 2002 (during which time the region was experiencing a drought). Prior trophic state measurements had determined that the lake was eutrophic as far back as 1981 when DWQ first sampled Lake Mattamuskeet.

Appendix A - Tar-Pamlico River Basin Lakes Data
January 1, 2008 Through December 31, 2012

	SURFACE PHYSICAL DATA								PHOTIC ZONE DATA											
Lake	Date	Sampling Station	DO mg/L	Temp Water C	pH s.u.	Cond. µmhos/cm	Secchi Depth meters	Percent SAT	TP mg/L	TKN mg/L	NH3 mg/L	NOx mg/L	TN mg/L	TON mg/L	TIN mg/L	Chla µg/L	Solids Total mg/L	Total Solids Suspended mg/L	Turbidity NTU	**Total Hardness mg/L**
LAKE DEVIN	September 26, 2012	TAR001C	7.5	22.7	6.5	64	0.7	87.0%	0.03	0.79	0.02	0.02	0.81	0.77	0.04	25.0	61	<6.2	6.2	15.0
	September 26, 2012	TAR001E	7.6	23.3	6.5	64	0.7	89.1%	0.04	0.81	<0.02	<0.02	0.82	0.80	0.02	20.0	62	8.5	7.7	
	August 8, 2012	TAR001C	6.1	29.1	6.8	62	0.8	79.5%	0.04	0.73	<0.02	<0.02	0.74	0.72	0.02	24.0	62	7.8	8.5	
	August 8, 2012	TAR001E	5.2	29.0	6.8	62	0.8	67.6%	0.04	0.80	<0.02	<0.02	0.81	0.79	0.02	21.0	58	<6.2	6.3	14.0
	July 19, 2012	TAR001C	7.6	31.5	8.4	66	0.7	103.2%	0.05	0.89	<0.02	<0.02	0.90	0.88	0.02	39.0	65	8.5	8.1	
	July 19, 2012	TAR001E	8.0	30.8	8.8	66	0.9	107.3%	0.04	0.88	<0.02	<0.02	0.89	0.87	0.02	31.0	63	6.5	6.2	13.0
	June 7, 2012	TAR001C	6.5	24.9	6.9	67	0.8	78.5%	0.04	0.82	<0.02	<0.02	0.83	0.81	0.02	21.0	64	9.0	5.5	
	June 7, 2012	TAR001E	7.1	24.6	7.5	66	0.9	85.3%	0.04	0.80	<0.02	<0.02	0.81	0.79	0.02	16.0	65	<6.2	4.0	16.0
	May 10, 2012	TAR001C	6.6	21.7	6.7	69	0.9	75.1%	0.04	0.86	<0.02	<0.02	0.87	0.85	0.02	19.0	69	7.0	6.9	
	May 10, 2012	TAR001E	8.1	21.9	7.4	68	1.2	92.5%	0.03	0.84	<0.02	<0.02	0.85	0.83	0.02	13.0	67	<6.2	4.6	16.0
TAR RIVER RESERVOIR	September 6, 2012	TAR015E	5.9	27.8	6.7	98	0.6	75.1%	0.09	0.76	0.02	0.12	0.88	0.74	0.14	27.0	99	13.0	14.0	
	September 6, 2012	TAR015G	7.7	28.7	7.2	81	1.0	99.6%	0.06	0.72	<0.02	<0.02	0.73	0.71	0.02	26.0	80	<6.2	5.0	
	September 6, 2012	TAR017C	5.6	28.9	6.7	56	0.8	72.7%	0.07	0.90	<0.02	<0.02	0.91	0.89	0.02	26.0	75	7.5	6.4	
	September 6, 2012	TAR017F	7.3	28.6	7.2	73	0.9	94.3%	0.06	0.70	<0.02	<0.02	0.71	0.69	0.02	38.0	75	6.8	5.2	19.0
	August 8, 2012	TAR015E	5.6	30.6	6.8	98	0.5	74.9%	0.07	0.76	<0.02	<0.02	0.77	0.75	0.02	32.0	96	11.0	12.0	
	August 8, 2012	TAR015G	6.5	31.3	7.4	101	1.0	88.0%	0.04	0.60	<0.02	<0.02	0.61	0.59	0.02	27.0	89	<12	5.1	
	August 8, 2012	TAR017C	6.3	31.1	7.2	92	0.8	85.0%	0.06	0.79	<0.02	<0.02	0.80	0.78	0.02	25.0	89	6.8	7.7	
	August 8, 2012	TAR017F	6.3	31.3	7.1	99	0.9	85.3%	0.04	0.61	<0.02	<0.02	0.62	0.60	0.02	23.0	88	<6.2	5.8	29.0
	July 18, 2012	TAR015E	5.4	29.5	7.2	111	0.5	70.8%	0.06	0.70	<0.02	<0.02	0.71	0.69	0.02	22.0	100	7.5	9.2	
	July 18, 2012	TAR015G	8.0	31.1	7.2	114	1.1	107.9%	0.04	0.65	<0.02	<0.02	0.66	0.64	0.02	20.0	98	<6.2	4.8	
	July 18, 2012	TAR017C	7.9	30.7	7.5	98	0.8	105.8%	0.05	0.80	<0.02	<0.02	0.81	0.79	0.02	24.0	92	<6.2	6.8	
	July 18, 2012	TAR017F	8.0	30.9	7.7	105	0.9	107.5%	0.04	0.70	<0.02	<0.02	0.71	0.69	0.02	25.0	90	<6.2	5.2	27.0
	June 11, 2012	TAR015E	7.9	26.1	7.9	97	0.5	97.6%	0.09	0.82	<0.02	<0.02	0.83	0.81	0.02	30.0	100	9.8	11.0	
	June 11, 2012	TAR015G	8.7	27.2	7.9	92	0.8	109.6%	0.06	0.70	<0.02	<0.02	0.71	0.69	0.02	29.0	90	<6.2	5.5	
	June 11, 2012	TAR017C	7.0	26.5	7.6	85	0.6	87.1%	0.06	0.83	<0.02	<0.02	0.84	0.82	0.02	36.0	94	7.0	7.1	
	June 11, 2012	TAR017F	8.6	27.0	7.8	87	0.6	108.0%	0.06	0.85	<0.02	<0.02	0.86	0.84	0.02	43.0	90		5.5	27.0
	May 23, 2012	TAR015E	8.1	24.4	7.6	93	0.5	97.0%	0.09	0.68	<0.02	0.12	0.80	0.67	0.13	33.0	100	10.0	10.0	
	May 23, 2012	TAR015G	8.7	24.6	7.7	85	0.7	104.5%	0.07	0.68	<0.02	0.10	0.78	0.67	0.11	31.0	90	<6.2	6.6	
	May 23, 2012	TAR017C	8.5	24.8	7.2	69	0.5	102.5%	0.08	1.00	<0.02	<0.02	1.01	0.99	0.02	63.0	94	7.0	5.8	
	May 23, 2012	TAR017F	8.8	24.5	7.5	77	0.6	105.5%	0.07	0.75	<0.02	0.04	0.79	0.74	0.05	40.0	96	<6.2	5.6	22.0
LAKE MATTAMUSKEET	September 17, 2012	PASLME1	8.3	23.4	7.8	2270	0.5	97.5%	0.04	1.40	<0.02	<0.02	1.41	1.39	0.02	19.0	1430	20.0	12.0	
	September 17, 2012	PASLME2	8.5	23.5	8.6	2320	0.6	100.1%	0.03	1.30	<0.02	<0.02	1.31	1.29	0.02	18.0	1500	15.0	7.3	
	September 17, 2012	PASLME3	8.3	23.5	8.6	2180	0.6	97.7%	0.04	1.50	<0.02	<0.02	1.51	1.49	0.02	27.0	1400	21.0	11.0	
	September 17, 2012	PASLMW1	9.1	24.7	8.6	2000	0.4	109.6%	0.05	2.20	<0.02	<0.02	2.21	2.19	0.02	45.0	1300	42.0	15.0	
	September 17, 2012	PASLMW2	9.0	24.7	8.6	2100	0.3	108.3%	0.05	2.40	<0.02	<0.02	2.41	2.39	0.02	46.0	1300	35.0	16.0	
	September 17, 2012	PASLMW3	9.9	24.9	8.6	2120	0.3	119.6%	0.05	2.60	<0.02	<0.02	2.61	2.59	0.02	50.0	1340	42.0	18.0	
	September 6, 2012	PASLME1	7.7	27.4	9.0	2350	0.4	97.4%	0.05	1.40	<0.02	<0.02	1.41	1.39	0.02	29.0	1460	24.0	14.0	
	September 6, 2012	PASLME2	7.4	27.6	9.2	2450	0.6	93.9%	0.04	1.20	<0.02	<0.02	1.21	1.19	0.02	18.0	1490	22.0	8.3	
	September 6, 2012	PASLME3	7.9	27.7	8.9	2170	0.5	100.4%	0.06	1.40	<0.02	<0.02	1.41	1.39	0.02	26.0	1390	42.0	17.0	
	September 6, 2012	PASLMW1	9.2	28.6	9.0	2060	0.5	118.8%	0.07	2.90	<0.02	<0.02	2.91	2.89	0.02	62.0	1330	61.0	26.0	
	September 6, 2012	PASLMW2	8.7	28.7	8.8	2110	0.4	112.6%	0.06	2.60	<0.02	<0.02	2.61	2.59	0.02	56.0	1330	53.0	9.6	
	September 6, 2012	PASLMW3	9.1	28.8	9.1	2040	0.3	117.9%	0.06	2.20	<0.02	<0.02	2.21	2.19	0.02	63.0	1280	39.0	17.0	
	July 30, 2012	PASLME1	7.3	29.5	8.5	2340	0.6	95.8%	0.03	1.80	<0.02	<0.02	1.81	1.79	0.02	20.0		14.0	9.5	
	July 30, 2012	PASLME2	7.3	29.9	8.8	2340	0.7	96.4%	0.02	1.50	<0.02	<0.02	1.51	1.49	0.02	15.0		11.0	7.9	
	July 30, 2012	PASLME3	7.4	29.8	8.9	2340	0.7	97.6%	0.04	1.50	0.02	<0.02	1.51	1.48	0.03	17.0		18.0	10.0	
	July 30, 2012	PASLMW1	8.9	30.1	8.6	2280	0.3	118.0%	0.06	2.70	<0.02	<0.02	2.71	2.69	0.02	58.0	1440	36.0	17.0	
	July 30, 2012	PASLMW2	8.5	30.1	9.1	2280	0.2	112.7%	0.05	2.80	<0.02	<0.02	2.81	2.79	0.02	66.0	1420	39.0	18.0	
	July 30, 2012	PASLMW3	8.5	29.9	8.8	2220	0.2	112.3%	0.06	3.10	<0.02	<0.02	3.11	3.09	0.02	71.0		46.0	23.0	
	June 25, 2012	PASLME1	8.1	28.9	8.9	2450	0.3	105.2%	0.04	2.30	<0.02	<0.02	2.31	2.29	0.02	32.0	1630	14.0	9.2	
	June 25, 2012	PASLME2	8.0	29.2	8.7	2430	0.4	104.4%	0.03	2.00	<0.02	<0.02	2.01	1.99	0.02	31.0	1560	13.0	8.2	
	June 25, 2012	PASLME3	8.1	29.0	8.2	2410	0.3	105.3%	0.04	2.40	<0.02	<0.02	2.41	2.39	0.02	36.0	1560	15.0	10.0	
	June 25, 2012	PASLMW1	9.1	29.7	9.1	2450	0.3	119.8%	0.05	2.70	<0.02	<0.02	2.71	2.69	0.02	48.0	1620	23.0	10.0	
	June 25, 2012	PASLMW2	9.4	30.2	9.1	2440	0.3	124.8%	0.05	2.80	<0.02	0.05	2.85	2.79	0.06	63.0	900	29.0	11.0	
	June 25, 2012	PASLMW3	9.5	30.5	8.6	2450	0.3	126.8%	0.06	2.70	<0.02	<0.02	2.71	2.69	0.02	54.0	1660	32.0	14.0	
	May 24, 2012	PASLME1	8.8	24.6	7.8	2380	0.3	105.7%	0.07	2.00	<0.02	<0.02	2.01	1.99	0.02	36.0	1480	49.0	19.0	
	May 24, 2012	PASLME2	9.2	24.9	8.5	2410	0.3	111.2%	0.06	1.80	<0.02	<0.02	1.81	1.79	0.02	25.0	1480	46.0	16.0	
	May 24, 2012	PASLME3	9.2	24.7	8.6	2510	0.3	110.8%	0.07	2.10	<0.02	<0.02	2.11	2.09	0.02	31.0	1550	48.0	20.0	
	May 24, 2012	PASLMW1	9.8	26.3	8.2	2380	0.3	121.5%	0.08	2.70	<0.02	<0.02	2.71	2.69	0.02	48.0	1510	56.0	21.0	
	May 24, 2012	PASLMW2	9.5	26.2	8.1	2360	0.2	117.6%	0.09	2.70	<0.02	<0.02	2.71	2.69	0.02	48.0	1470	57.0	25.0	
	May 24, 2012	PASLMW3	9.5	27.2	8.1	2320	0.2	119.7%	0.11	3.00	<0.02	<0.02	3.01	2.99	0.02	45.0	1460	78.0	31.0	