Pembroke Watershed Association

2007 Water Quality Testing Report
Presented to the Town of Pembroke, Ma

Submitted by Charles Banks and Patricia McCabe,
Co-Chairs, Water Quality Committee, PWA, May 2008

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Goals of Water Quality Monitoring:

- Identify the reasons for water quality testing and type of tests to be done
- Describe the activities carried out around and on the ponds to reduce nutrient loading and pollution
- Present the water quality testing results completed by Pembroke Watershed Association on Furnace, Oldham, Stetson, Little Sandy Bottom, and Hobomock ponds in 2006
- Provide an analysis of the data and recommendations based on previous studies and current problems

Current Problems Impacting Pembroke Ponds:

- **Eutrophication:** excessively high nutrient loads of Phosphorus and Nitrogen exist, resulting in algae blooms (some toxic to animals) and weed growth. Sources include animal and human waste, fertilizers, sewage, and sediment loads, and muck in pond bottoms. Waters subject to Eutrophication are cloudy (turbid) and green or brown in color, often with bad odor.

- **Sedimentation:** sediment run-off from roads, storm drains, lawns, beach areas, land development projects, reducing water depth and increasing water temperature. Winter road sanding and loss of vegetative barriers near the water increase sediment loading. Furnace Pond average depth is 5 feet.

- **Agricultural impacts:** cranberry bog water use, particularly bog effluent returns high in phosphorus, and possible pesticide run-off.

- **Non-point source run-off:** of nutrients in fertilizers and soaps, human and animal wastes, oil, grease, toxic chemicals and pesticides toxic to aquatic life, via storm drains, land development, streets and driveways, human activities. This is an important source of pollution, much of it controllable.

- **Loss of riparian vegetation and bank stabilization:** waterfront stripped of buffer zones, trees, and aquatic plants, which impacts aquatic and wildlife habitats, encourages erosion of existing shoreline, increases non-point source pollution via run-off and provides no filtration of pollution.

- **Stream alterations via dams:** for bog cultivation or herring management, may lead to stagnation of water and enhanced effects of Eutrophication, and alters natural habitats.

- **Septic failures:** This problem occurs occasionally and may exist in home sites very close to the water.

- **Conflicts in usage of the water:** water is drawn off to Brockton water supply, irrigation for the bogs, water front homeowners use, public use

What was the problem in 2007?

Eutrophication:

- 90% of Massachusetts ponds have symptoms of Eutrophication.

- Phosphorus and Nitrogen loads stimulate the growth of algae, which cloud the water and limit light diffusion. This halts the growth of native grasses and plants in the water, and permits growth of noxious weeds. The habitat for fish and native insects is altered, and algae growth has been identified as a major threat to the diversity and health of native fish populations in the northeast. Both nighttime plant respiration and algae decomposition reduce the available oxygen in the water, threatening the supply for fish- resulting in fish kills in early AM. Furnace and Oldham have intermittently experienced fish kills of this type in the last few years.

- Furnace is a severely eutrophied pond: category 5 in 319 (D) water impairment levels established by the DEP, requiring a TMDL. Stetson pond is also a category 5 (c) in 319 (D) water impairment: listed as nutrients, organic enrichment / low DO and exotic species

- Oldham pond is a category 4 (c) in 319 (D) water impairment: listed as exotic species. Current water quality resembles that of Furnace Pond.

- Hobomock and Little Sandy Bottom Ponds are both Category 2 (unevaluated).

Value of Pembroke’s Ponds:

- Aesthetic beauty: unique to Pembroke is the number of great ponds within the town, providing tremendous natural beauty.
- Part of the valuable South Coastal Watershed, and contributes to the Mass Bay estuary. Stetson Pond is part of the Taunton River Watershed.
- Natural resource: drinking water, irrigation for cranberry bogs and homes.
- Town well water recharge from the ponds.
- Aquatic and wildlife habitats.
- Unique natural features: herring spawning grounds in Oldham and Furnace.
- Recreational resource for the town, including town beaches and fishing access.
- Additional tax revenue from waterfront properties.

Value of testing and monitoring:

- Provides a credible method of collecting information about the health of the pond and the watershed that feeds it.
- Documents observations, sampling, and analysis of data/information utilizing methods supported by Mass. Water watch, DEP, and other government agencies.
- Creates a long term monitoring data set to determine impact of actions and restoration efforts. Long term monitoring demonstrates greater validity than short term, and multi-year sampling reduces the likelihood of inaccurate analysis due to testing bias.
- Testing and monitoring can be used to substantiate cost benefit ratios of restorative plans.

Our goal was to determine the ongoing conditions of five of Pembroke’s Ponds, and correlate to the feasibility studies conducted in 1993 by Baystate Environmental Inc., and in 2001 by C.E.I. This was done using volunteers within the Pembroke Watershed association

Pembroke Watershed Association: Water based testing

Using Google Earth view of our ponds we have included our testing sites, marked in yellow, on each of the ponds. Site identification includes our identifier and the 1988 survey identifier for the same site. We utilized GPS coordinates to determine and standardize our sites.

Map One: overall map that shows all of the ponds

Map Two: Oldham Pond

Map Three: Furnace Pond

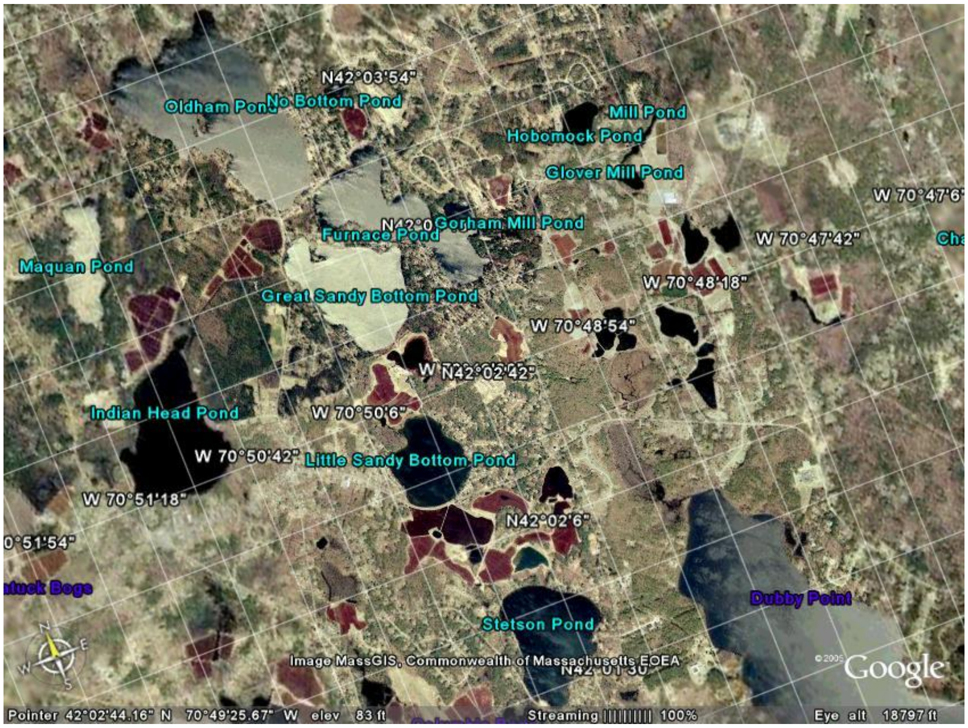
Map Four: Stetson Pond

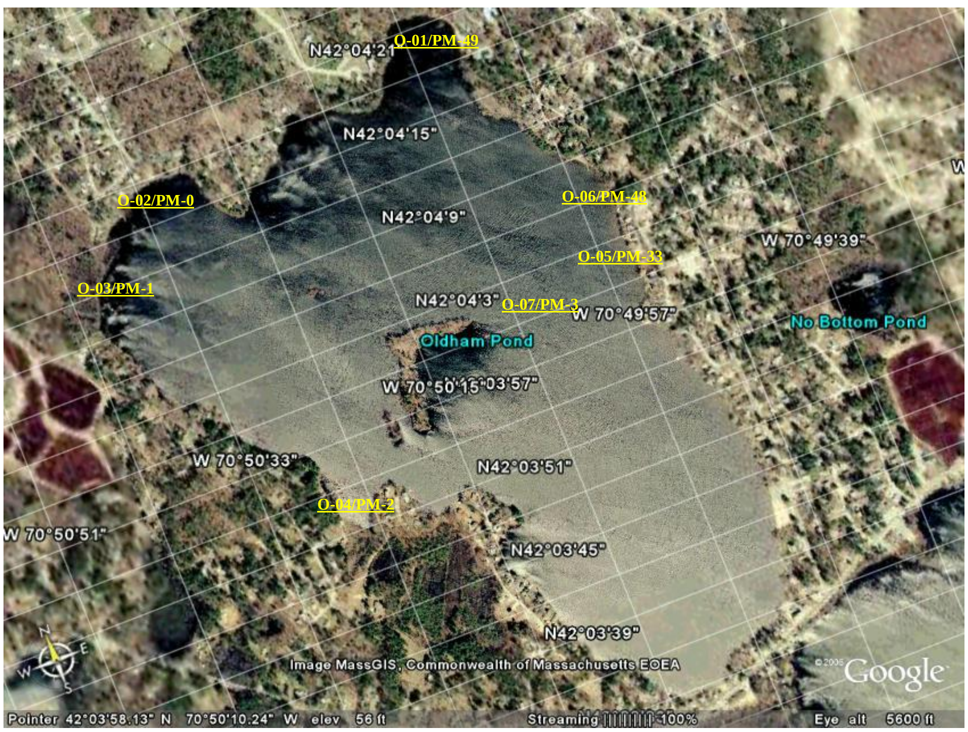
Map Five: Little Sandy Bottom Pond

Map Six: Hobomock Pond

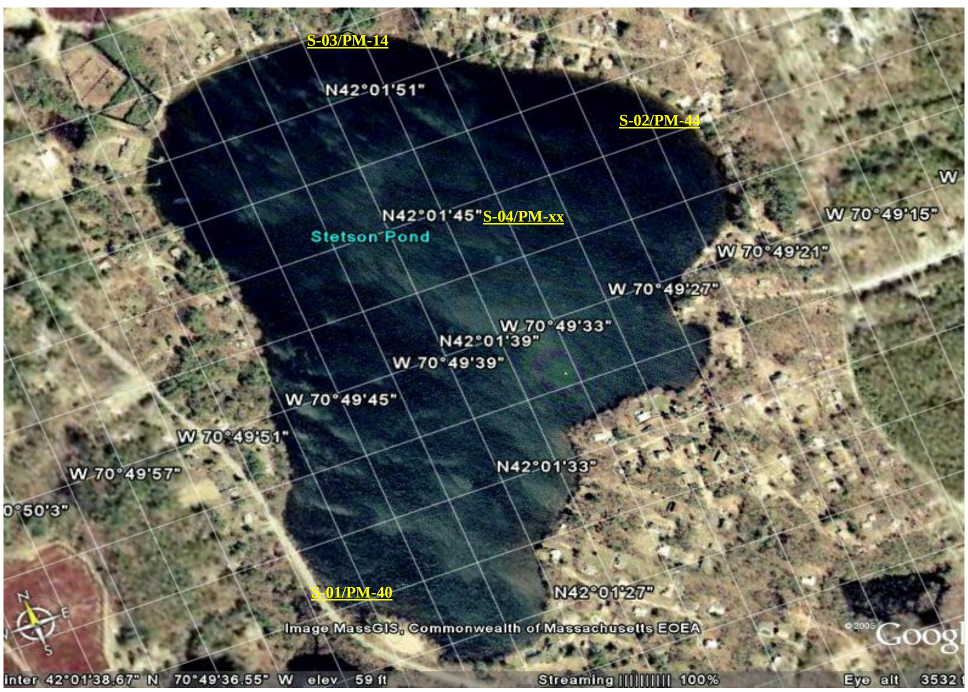
We identified our test sites in yellow on the Google Earth Maps

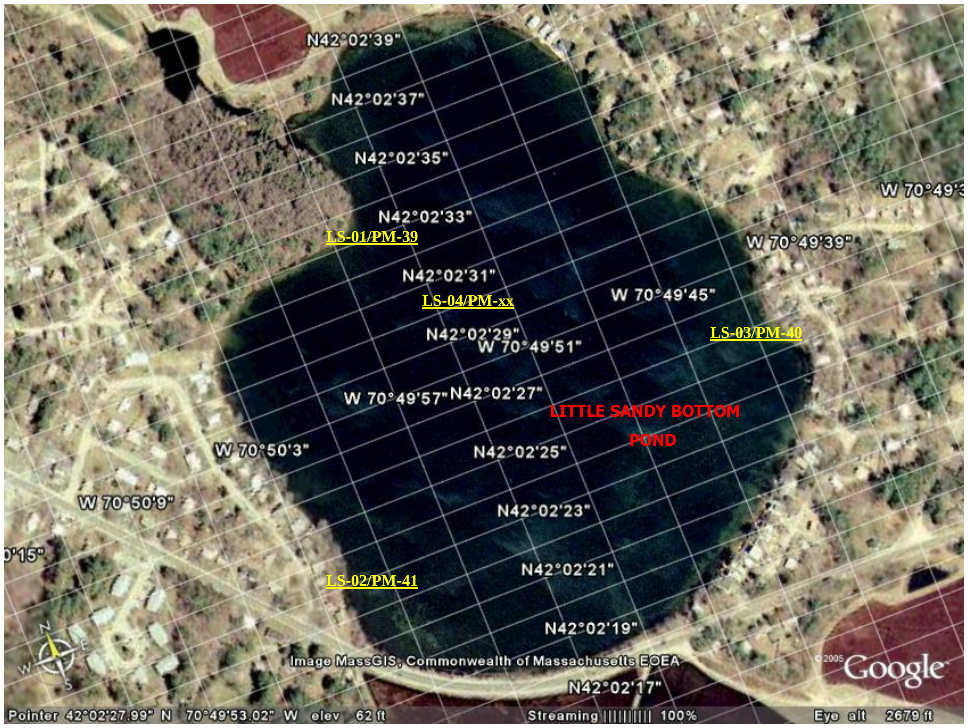
This year we utilized input received from MassDEP and our own experience and moved our sites to deeper water in the same general vicinity, so that our results would be more indicative of overall pond health. We also removed several sites that were too close to other sites and produced possible redundant results.

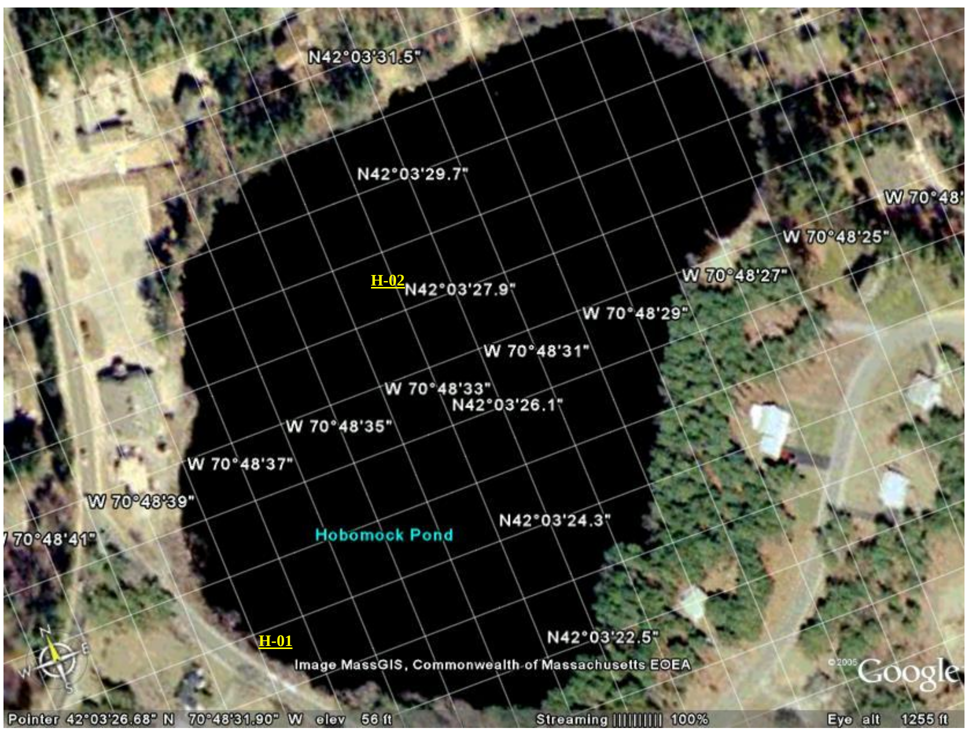

N42°03'54"
Oldham Pond
No Bottom Pond
Mill Pond
Hobomock Pond
Glover Mill Pond
W 70°47'6"
Gorham Mill Pond
Furnace Pond
W 70°47'42"
Maquan Pond
W 70°48'18"
Great Sandy Bottom Pond
W 70°48'54"
N42°02'42"
Indian Head Pond
W 70°50'6"
W 70°50'42"
Little Sandy Bottom Pond
W 70°51'18"
N42°02'6"
Dubby Point
Stetson Pond
Image MassGIS, Commonwealth of Massachusetts EOEA
Google
Pointer 42°02'44.16" N 70°49'25.67" W elev 83 ft
Streaming |||||||||| 100%
Eye alt 18797 ft


N42°04'21"
O-01/PM-49
N42°04'15"
O-02/PM-0
O-06/PM-48
N42°04'9"
W 70°49'39"
O-05/PM-33
O-03/PM-1
N42°04'3"
O-07/PM-3
W 70°49'57"
No Bottom Pond
Oldham Pond
W 70°50'15"
W 70°50'33"
N42°03'51"
O-04/PM-2
W 70°50'51"
N42°03'45"
N42°03'39"
Image MassGIS, Commonwealth of Massachusetts EOEA
Google
Pointer 42°03'58.13" N 70°50'10.24" W elev 56 ft
Eye alt 5600 ft


F-03/PM-36
F-02/PM4
F-01/PM-5
FURNACE POND
F-07/PMxx
F-06/PM-8
F-04/PM-9
F-05/PM-xx
Gorham
Image MassGIS, Commonwealth of Massachusetts EOEA


S-03/PM-14
S-02/PM-44
S-04/PM-xx
Stetson Pond
S-01/PM-40
Image MassGIS, Commonwealth of Massachusetts EOEA


N42°02'39"
N42°02'37"
N42°02'35"
W 70°49'3
N42°02'33"
LS-01/PM-39
W 70°49'39"
N42°02'31"
LS-04/PM-xx
W 70°49'45"
N42°02'29"
LS-03/PM-40
W 70°49'51"
W 70°49'57"
N42°02'27"
LITTLE SANDY BOTTOM
POND
W 70°50'3"
N42°02'25"
W 70°50'9"
N42°02'23"
0'15"
N42°02'21"
LS-02/PM-41
N42°02'19"
Image MassGIS, Commonwealth of Massachusetts EOEA
©2005 Google
N42°02'17"
Pointer 42°02'27.99" N 70°49'53.02" W elev 62 ft
Streaming |||||||||| 100%
Eye alt 2679 ft


N42°03'31.5"
N42°03'29.7"
W 70°48'
W 70°48'25"
H-02
N42°03'27.9"
W 70°48'27"
W 70°48'29"
W 70°48'31"
W 70°48'33"
N42°03'26.1"
W 70°48'35"
W 70°48'37"
W 70°48'39"
70°48'41"
N42°03'24.3"
Hobomock Pond
N42°03'22.5"
H-01
Image MassGIS, Commonwealth of Massachusetts EOEA
©2005 Google
Pointer 42°03'26.68" N 70°48'31.90" W elev 56 ft
Streaming |||||||||| 100%
Eye alt 1255 ft

GPS Coordinates for Test sites

Oldham Pond				
PWA	**1988**			
O-01	**PM-49**	**Camp Pembroke**	**42.04.330 N**	**70 50.048 W**
O-02	**PM-0**	**Hal's Pipe - off of Arlene Street**	**42.04.257 N**	**70 50.505 W**
O-03	**PM-1**	**Inlet in NE Hanson - Stream From Bogs**	**42.04.158 N**	**70 50.610 W**
O-04	**PM-2**	**SE Inlet in Hanson - off of Marshes**	**42.03.904 N**	**70 50.426 W**
O-05	**PM-33**	**Culvert off of Adams Avenue Beach**	**42.04.180 N**	**70.49.936 W**
O-07	**PM-3**	**S/E Side of Monument Island (Deep)**	**42.03.984 N**	**70.50.079 W**
Furnace Pond				
PWA	**1988**			
F-02	**PM-4**	**Inlet from Oldham**	**42.03.530 N**	**70 49.914 W**
F-03	**PM-36**	**Betty's Pipe**	**42.03.629 N**	**70 49.529 W**
F-04	**PM-9**	**Outlet to River**	**42.03.219 N**	**70 49.199 W**
F-05	**PM-xx**	**Furnace Colony Beach**	**42.03.039 N**	**70.49.348 W**
F-06	**PM-8**	**Brian's Point**	**42.03.275 N**	**70.49.490 W**
F-07		**Deep Hole (Dissolved Oxygen)**	**42.03.282 N**	**70.49.459W**
Stetson Pond				
PWA	**1988**			
S-01	**PM-12.**	**Bog Inlet**	**42.01.882 N**	**70 49.779W**
S-02	**PM-44**	**East Storm Drain**	**42.01.741N**	**70 49.330 W**
S-03	**PM-14**	**Outlet to Chaffen**	**42.01.501 N**	**70 49.823 W**
S-04		**Deep Hole (Dissolved Oxygen)**	**42.01.710 N**	**70 49.493 W**
Little Sandy Pond				
PWA	**1988**			
LS-01	**PM-39**	**West Storm Drain**	**42.02.495 N**	**70 50.055 W**
LS-02	**PM-41**	**South Storm Drain**	**42.02.323 N**	**70 49.97 W**
LS-03	**PM-40**	**East Storm Drain**	**42.02.401 N**	**70 49.678 W**
LS-04		**Deep Hole (Dissolved Oxygen)**	**42.02.474 N**	**70 49.810 W**
Hobomock Pond				
PWA				
H-01		**Drain area from Hobomock Street**	**42.03.393 N**	**70 548.618 W**
H-02		**Deep Hole (Dissolved Oxygen)**	**42.03.439 N**	**70 48.551 W**

In 2007 site adjustments were made due to excessive weed growth in shallow areas. We also eliminated one site each on Furnace (F-01) and Oldham (O-06) where we felt that we were redundant

What are we testing for?

- **Nitrogen -** is a fundamental nutrient and is required by all living plants and animals for building proteins
  Measured in mg/liter
  - Natural range is between 0.1 and 2 mg/l
  - For concentrations >5 mg/l negative impact is certain

- **Phosphorus -** is normally scarce in a <u>normal</u> aquatic environment, is necessary for plant growth, and is abundant on land.
  Measured in mg/liter
  - Concentration should be between .01 and .1 mg/l
  - For concentrations >.05 mg/l impact is light
  - For concentrations >.10 mg/l negative impact is certain

- Note: marked increase in Nitrogen or Phosphorous loads in a pond will encourage the proliferation of algae fueling an overpopulation of bacteria that eat the decomposing algae. Less light diffuses through the water, impacting aquatic plant life. Aquatic life and algae compete for dissolved oxygen, and oxygen levels will plummet, resulting in eutrophic conditions and loss of habitat.

- **Turbidity:** The amount of suspended solids in the water.
  - Measured in NTU (Nephelometric Turbidity units)
  - Level should be between 1.0 and 10.0 NTU
  - Turbidity directly effects transparency (clarity) of the water

- **Dissolved Oxygen (DO):** The amount of oxygen in the water
  - Measured in mg/liter
  - Fish need a DO level >6.0 for warm water species, >7.0 for cold water species
  - DO levels will be higher near the surface due to wind effects, therefore should be measured at a minimum depth of 4 feet

- **pH and Alkalinity:** ability of water to handle acid and basic solutions
  - A pH of 7.0 is neutral, a higher pH means alkaline, a lower pH means acidic.
  - Pond water pH should range between 6.5 and 8.5
  - Alkalinity refers to the ability of the body of water to neutralize incoming acids from precipitation or discharges. Low alkalinity indicates low buffering ability.
  -

- **Secchi Disk Transparency:** directly relates to turbidity, measures clarity.
  - Measured in feet
  - Water clarity: how far down can a Secchi disc be seen.
  - Expected depth should be > 10 feet, with high water quality exceeding 16 feet

Determination of Test Sites:

- The 1988-1993 and 2001 Diagnostic Feasibility studies were used as guides to start our testing program.
- Test locations were determined by the Pond captains in 2005 after a thorough analysis of each pond consisting of:
  - A tour by boat to determine those locations that appeared to require further study, utilizing a GPS to mark the various sites
  - A walk around conducted on land to further assist in determining where we needed to test
  - The feasibility studies
  - Pond maps were then utilized to make the final determination of where we would test.
  - We attempted to match our sites with those locations used in the studies, however we made exceptions where warranted.

Testing Protocol:

- Testing procedures were developed utilizing the following:
  - We filed with for a QAPP with Mass DEP and adjusted our procedures as they suggested.
  - "Testing the Waters" published by the River Network and
  - "Putting Together a Watershed Management Plan
    - A Guide to Watershed Partnerships" published by Mass DCR

- A test criterion was developed and testing forms were created based on sample forms shown in the publications. The forms were modified to capitalize on things we learned in 2005 and 2006. Tests are documented and required forms are completed
  - A water sample form was created to be used at each site/location. Forms included all parameters:
    - Previous days weather conditions and rainfall amounts
    - Water height as measured for each pond
    - Air & water temperature
    - Conditions at each site: water use, wave action, odor, water color, weeds, algae, bottom condition, depth
    - Dissolved Oxygen was included and separate DO forms were discarded

- Testing requirements were chosen by the Water Quality Committee after determining what tests were to be conducted based on pond surveys

- Water Quality sampling training was broken down into several procedures, Volunteers were trained on land first and then by actually doing a live test. 2 or 3 volunteers were trained at one time
  - Setting up and calibrating the DO meters
  - Taking the actual sample
  - Using the Secchi Disk and View Scope
  - Obtaining additional required information
  - Filling in the paperwork

- Water quality Co-Chairs went through additional training to be qualified as instructors. A total of 5 instructors and 22 Volunteers have been trained.

Test Equipment

- We assembled a Secchi Disk and a view scope to measure water clarity
- We obtained a grant for two YSI Mdl 85 Dissolved Oxygen meters to measure
    - Dissolved Oxygen
    - Temperature
    - Salinity
    - Specific Conductance
- Chekmite pH meters were also obtained
- Devices for capturing water samples were assembled based on the actual sample bottles used.
- GPS were obtained to verify test site locations

Data Collection Methods

- We tested for:
    – Dissolved Oxygen, Specific Conductance and salinity - utilizing a YSI Mdl 85 meter we obtained through a grant
    – pH utilizing a Checkmite pH meter we obtained through a grant
    – Secchi Disk transparency - Utilizing a Secchi Disk and a View Scope
    – We obtained a grab sample for each site and that sample was then sent to Analytical Balance labs for analysis. We requested analysis for:
        - Ammonia
        - Alkalinity
        - Chloride
        - Total Phosphorus
        - Turbidity
        - K Nitrogen
        - Nitrates
        - Nitrites
        - Total Nitrogen - calculated from K nitrogen, Nitrates and Nitrites

– Analytical Balance labs, 422 West Grove Street, Middleboro MA performed the required laboratory testing

- Chain of custody rules were followed and adhered to. We utilized Analytical Balance chain of custody forms.

Testing locations and Schedule:

- **Secchi Disk Transparency at "Deep Hole"**
  - Oldham - June, July, Aug, Sept.
  - Furnace - June, July, Aug, Sept.
  - Stetson – June, Aug.,
  - Hobomock – June, Sept
  - Little Sandy - August.
- **Dissolved Oxygen at Deep Hole (4 feet)**
  - Oldham - June, July, Aug., Sept.
  - Furnace - June, July, Aug., Sept.
  - Stetson – July, Aug.
  - Hobomock – June, Sept.
  - Little Sandy - August.
- **pH, Turbidity, Total Nitrogen, Total Phosphorus**
  - Oldham - (5 test sites) - June, July, Aug., Sept.
  - Furnace - (5 test sites) - June, July, Aug. Sept.
  - Stetson - (3 test sites) - June, Aug.
  - Hobomock - (1 test site) - June, Sept.
  - Little Sandy - (3 test sites) – Aug.

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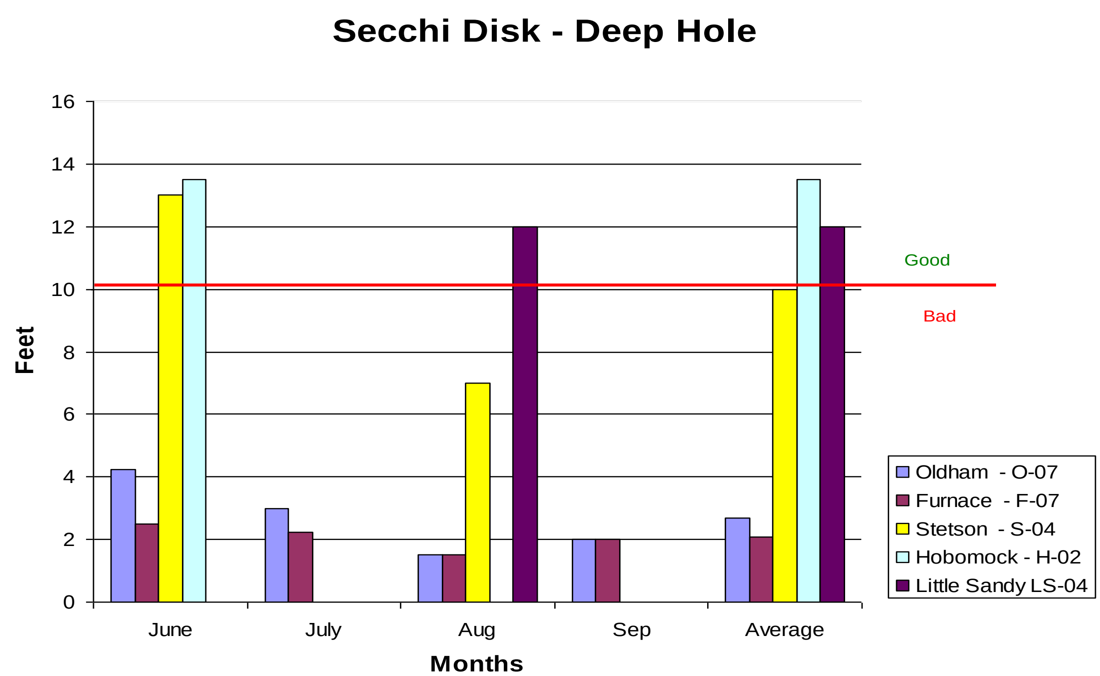
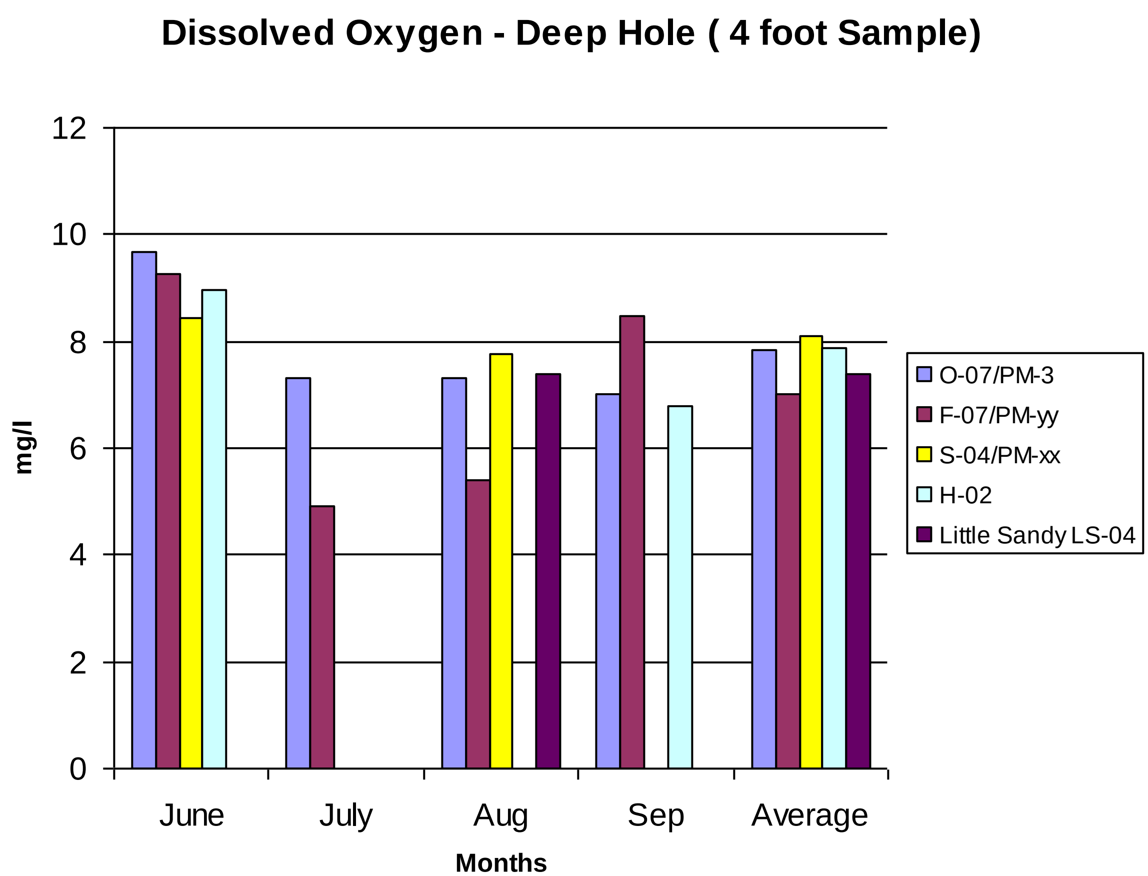
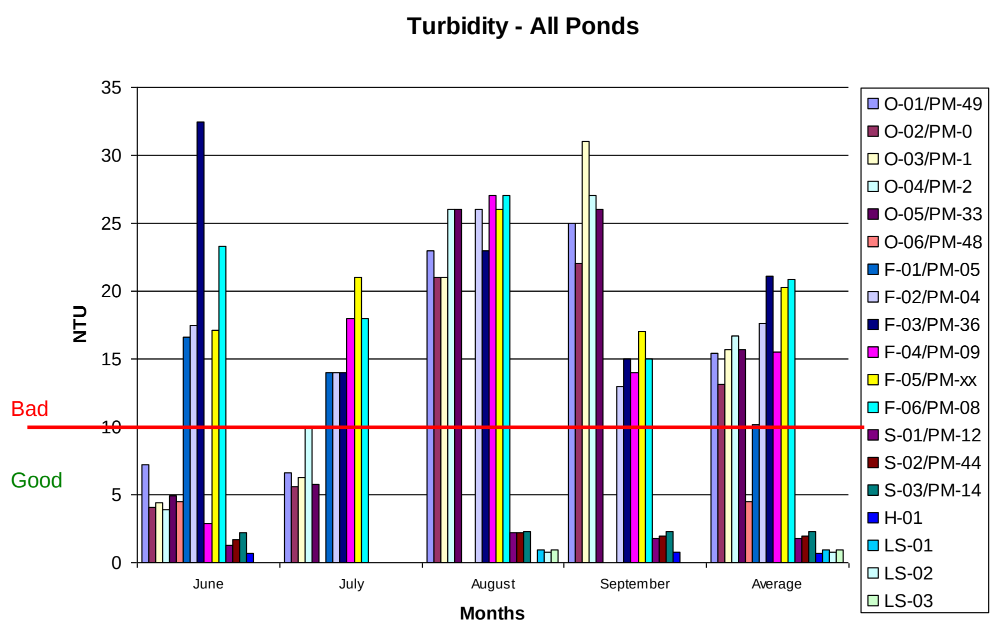
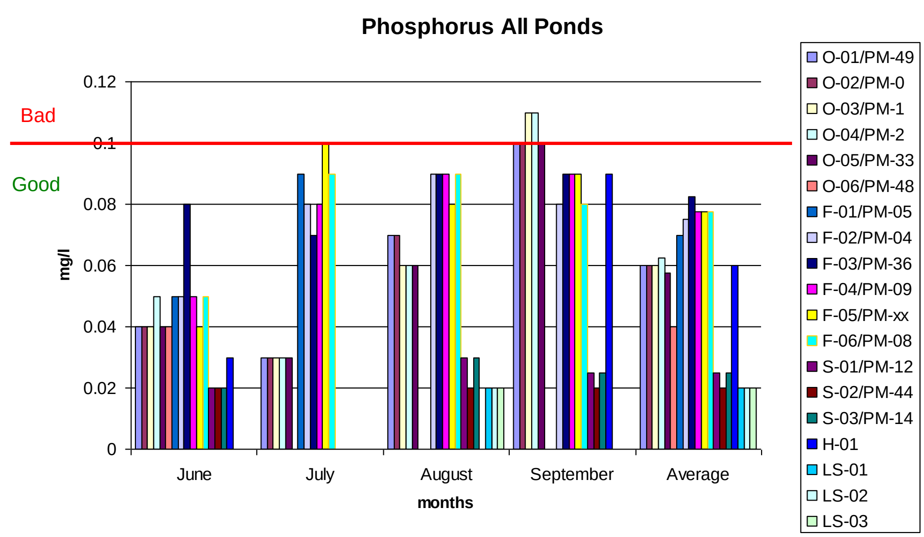
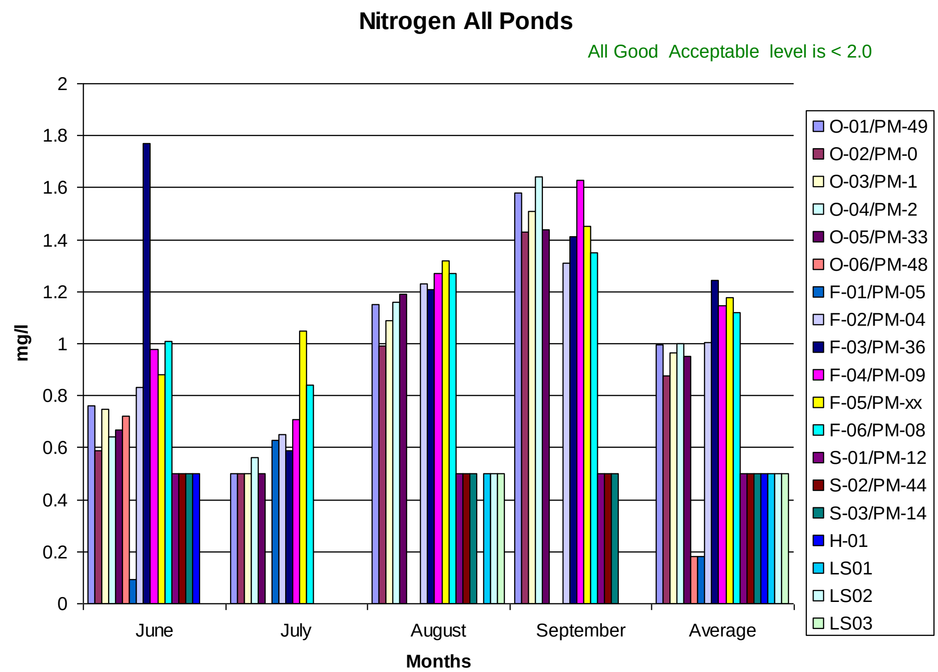

Secchi Disk - Deep Hole
Feet
16
14
12
10
8
6
4
2
0
June
July
Aug
Sep
Average
Months
Good
Bad
Oldham - O-07
Furnace - F-07
Stetson - S-04
Hobomock - H-02
Little Sandy LS-04

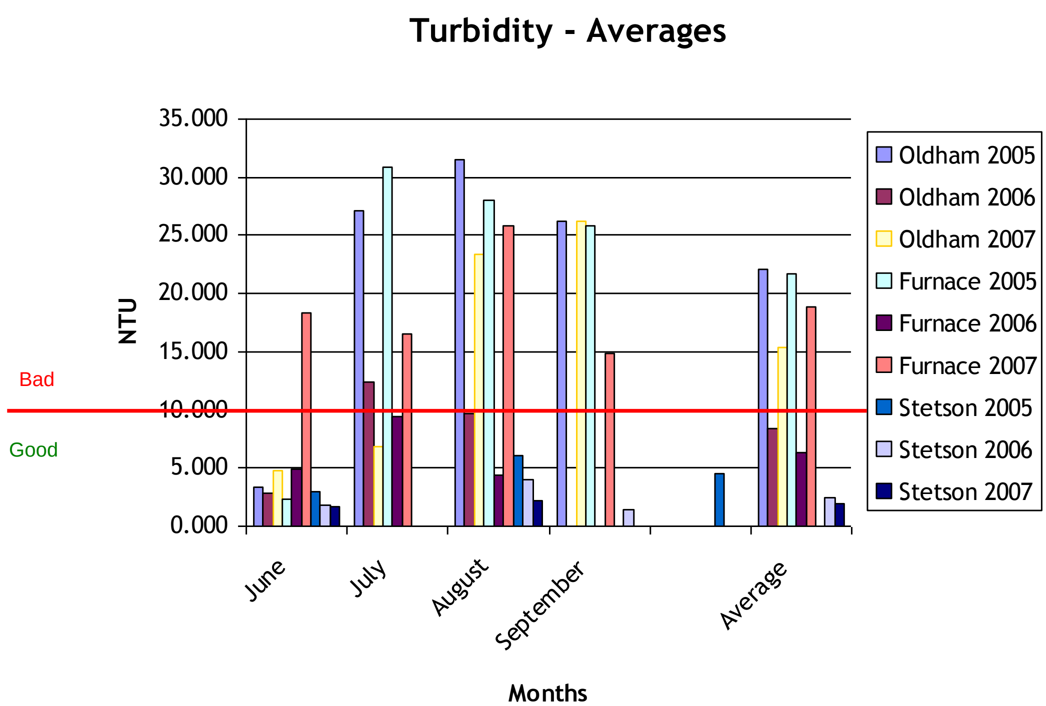

Dissolved Oxygen - Deep Hole (4 foot Sample)
mg/l
12
10
8
6
4
2
0
June
July
Aug
Sep
Average
Months
O-07/PM-3
F-07/PM-yy
S-04/PM-xx
H-02
Little Sandy LS-04

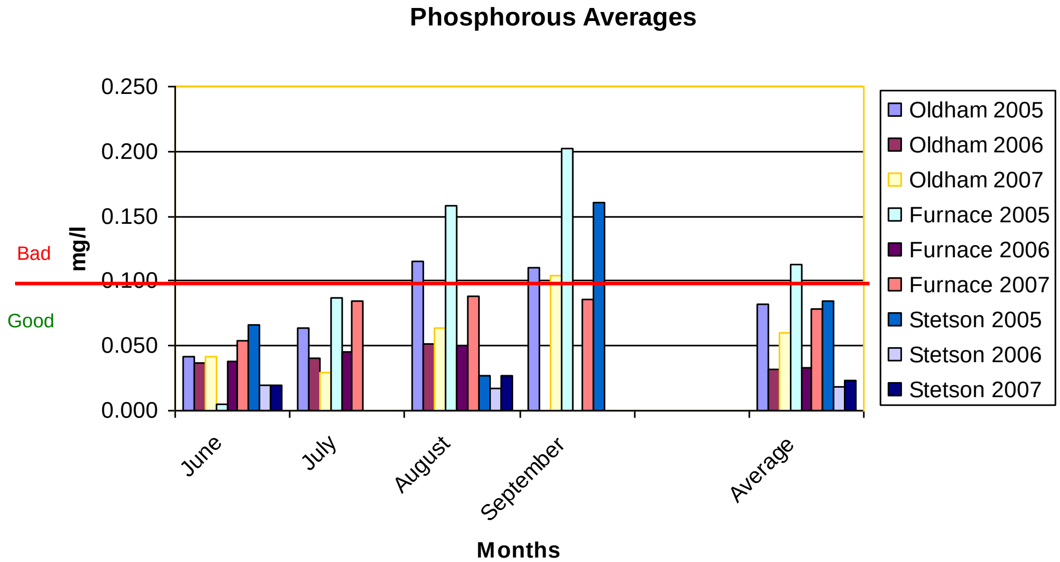

Turbidity - All Ponds
NTU
35
30
25
20
15
10
5
0
Bad
Good
June
July
August
September
Average
Months
O-01/PM-49
O-02/PM-0
O-03/PM-1
O-04/PM-2
O-05/PM-33
O-06/PM-48
F-01/PM-05
F-02/PM-04
F-03/PM-36
F-04/PM-09
F-05/PM-xx
F-06/PM-08
S-01/PM-12
S-02/PM-44
S-03/PM-14
H-01
LS-01
LS-02
LS-03

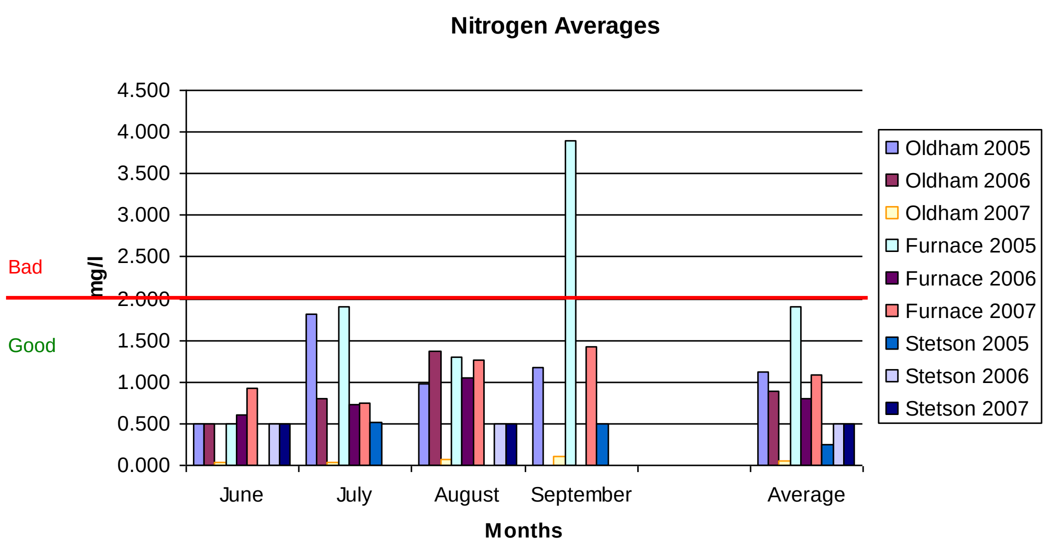

Phosphorus All Ponds
mg/l
0.12
0.1
0.08
0.06
0.04
0.02
0
Bad
Good
June
July
August
September
Average
months
O-01/PM-49
O-02/PM-0
O-03/PM-1
O-04/PM-2
O-05/PM-33
O-06/PM-48
F-01/PM-05
F-02/PM-04
F-03/PM-36
F-04/PM-09
F-05/PM-xx
F-06/PM-08
S-01/PM-12
S-02/PM-44
S-03/PM-14
H-01
LS-01
LS-02
LS-03

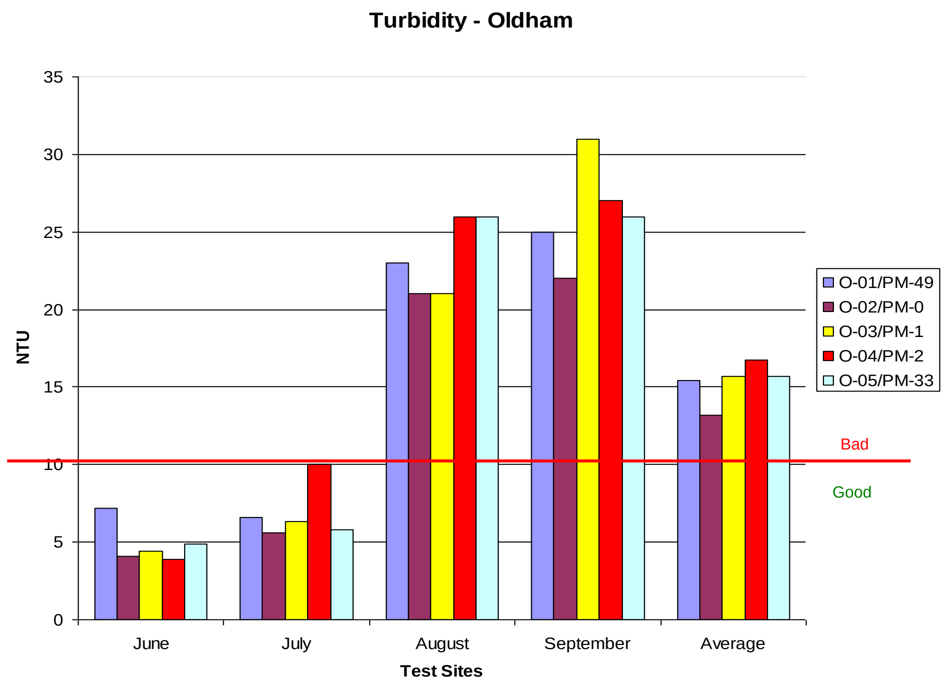


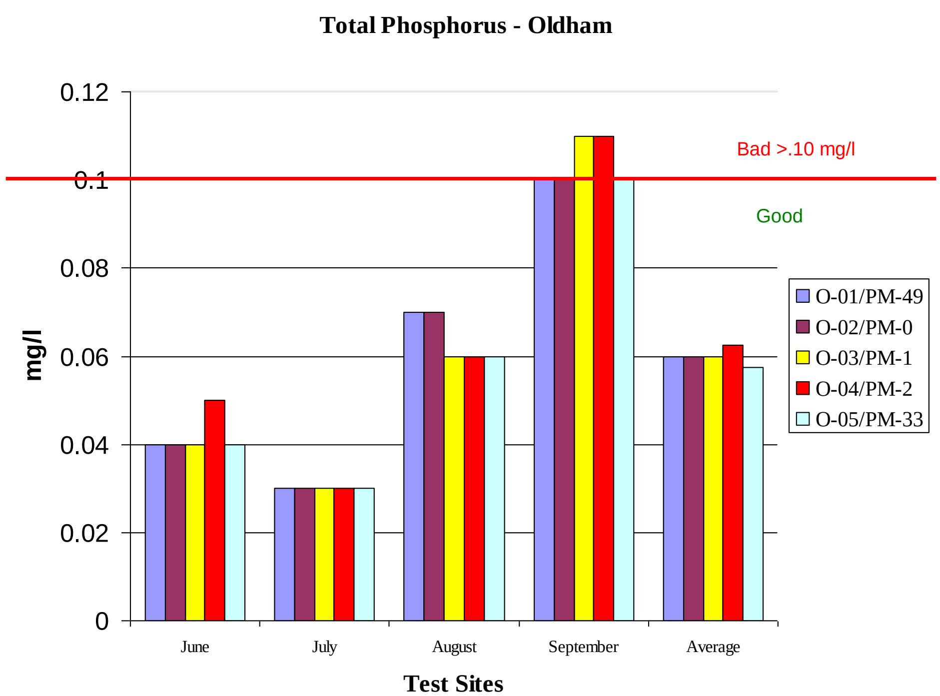
We averaged all years results for comparison for Turbidity, Phosphorous and Nitrogen



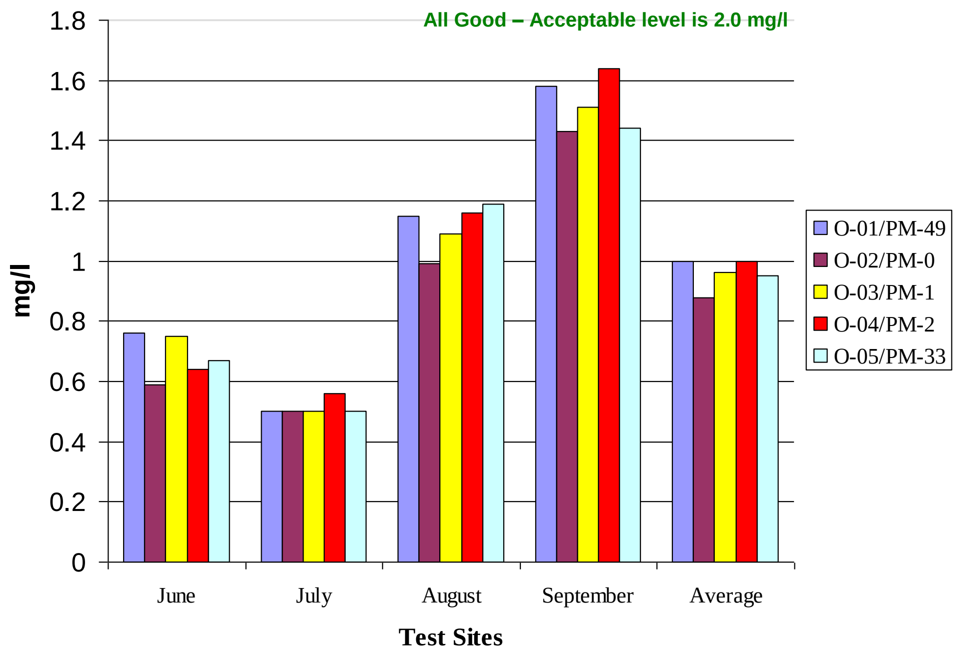

Phosphorous Averages
0.250
0.200
0.150
0.100
0.050
0.000
mg/l
Bad
Good
June
July
August
September
Average
Months
Oldham 2005
Oldham 2006
Oldham 2007
Furnace 2005
Furnace 2006
Furnace 2007
Stetson 2005
Stetson 2006
Stetson 2007


Nitrogen Averages
4.500
4.000
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
mg/l
Bad
Good
June
July
August
September
Average
Months
Oldham 2005
Oldham 2006
Oldham 2007
Furnace 2005
Furnace 2006
Furnace 2007
Stetson 2005
Stetson 2006
Stetson 2007

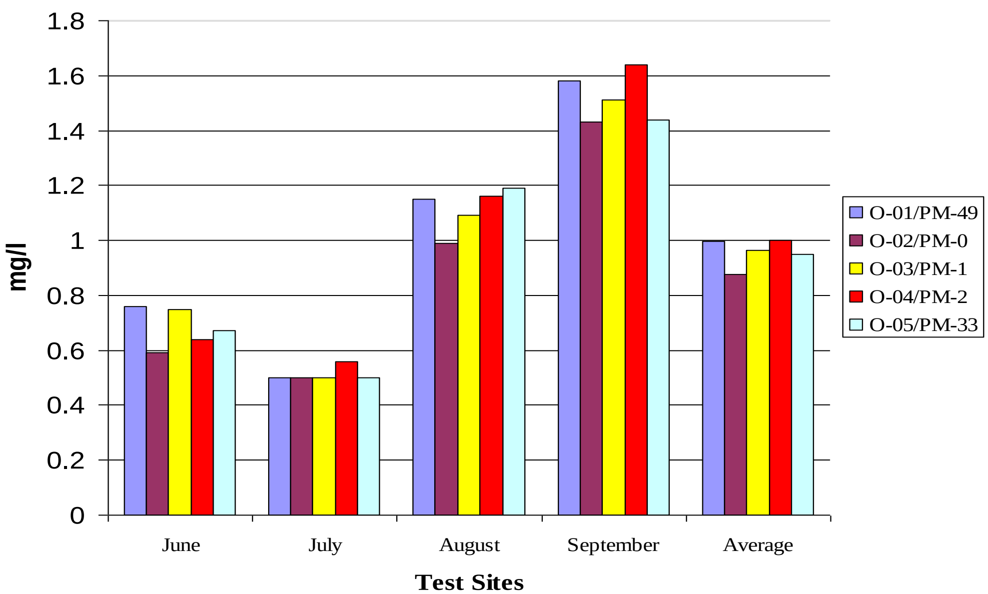

Turbidity - Oldham
35
30
25
20
15
10
5
0
NTU
June
July
August
September
Average
Test Sites
O-01/PM-49
O-02/PM-0
O-03/PM-1
O-04/PM-2
O-05/PM-33
Bad
Good

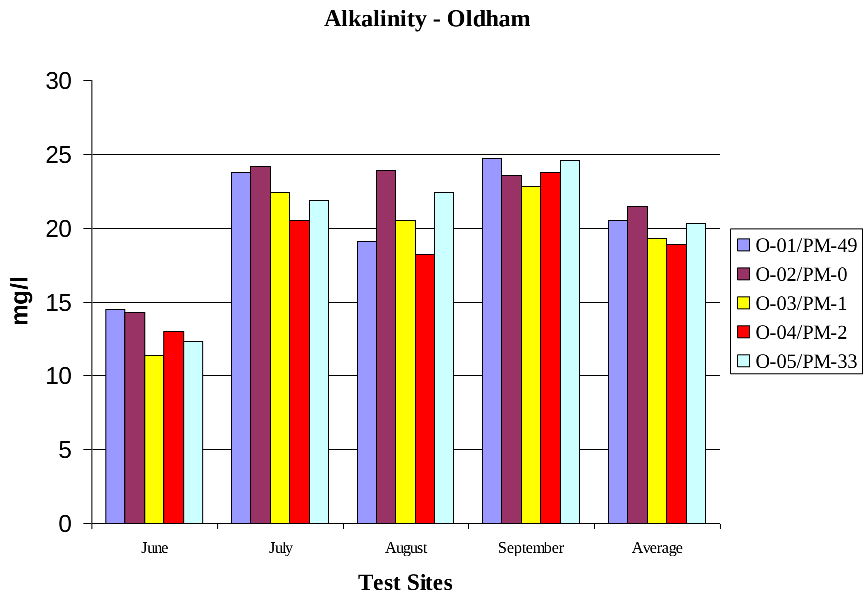

Total Phosphorus - Oldham
0.12
0.1
0.08
0.06
0.04
0.02
0
mg/l
June
July
August
September
Average
Test Sites
Bad >.10 mg/l
Good
O-01/PM-49
O-02/PM-0
O-03/PM-1
O-04/PM-2
O-05/PM-33

Total Nitrogen - Oldham

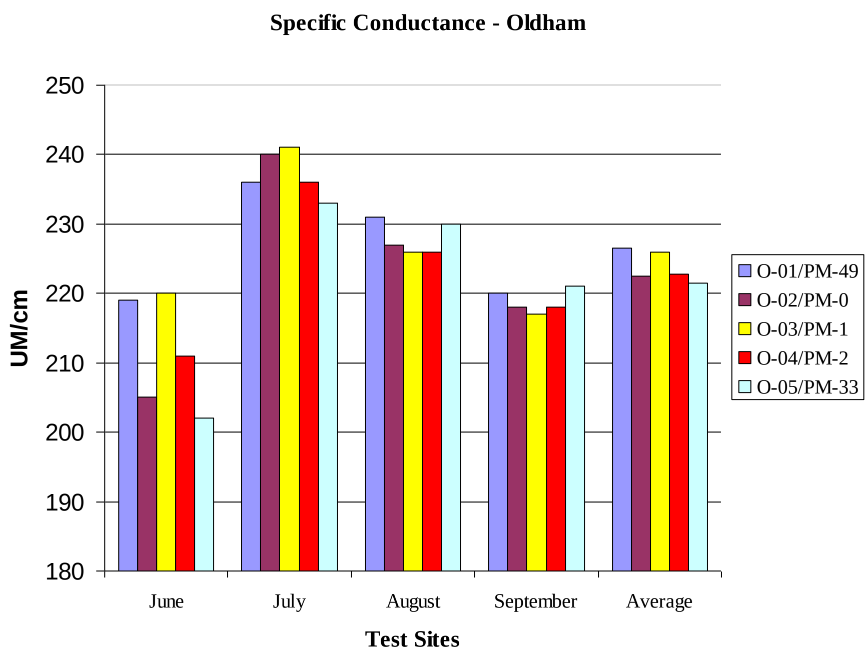


Kjeldahl Nitrogen - Oldham

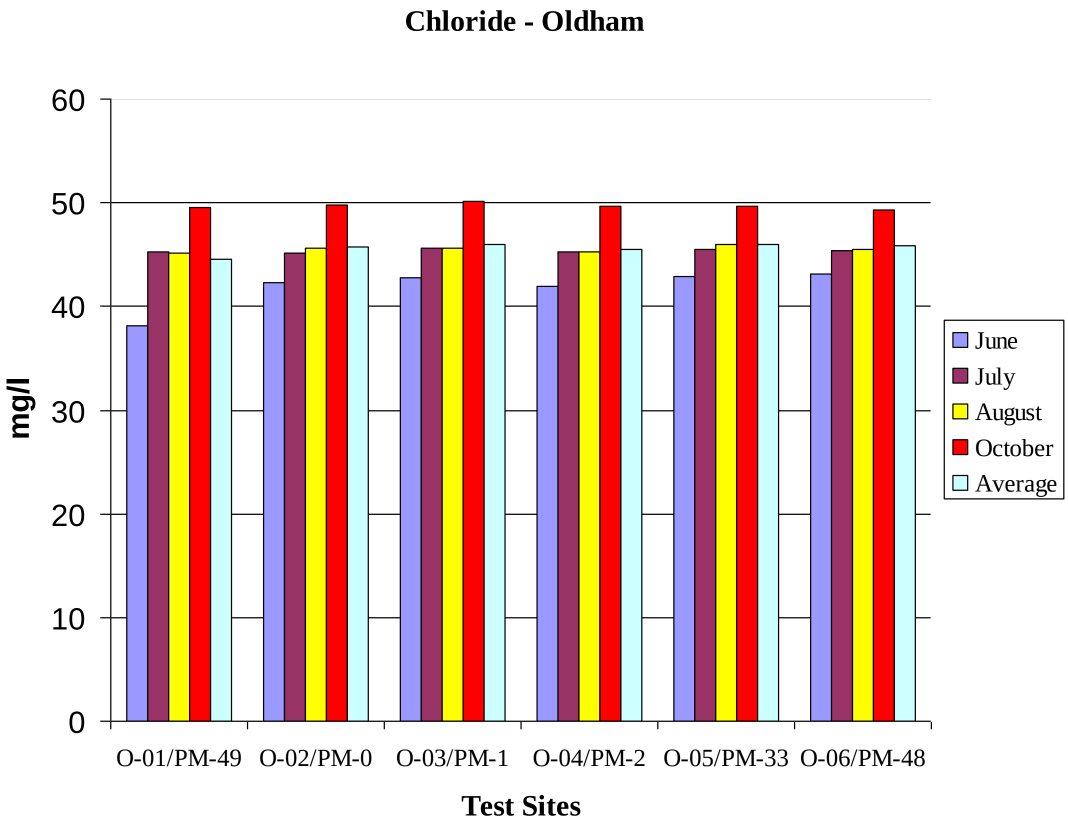


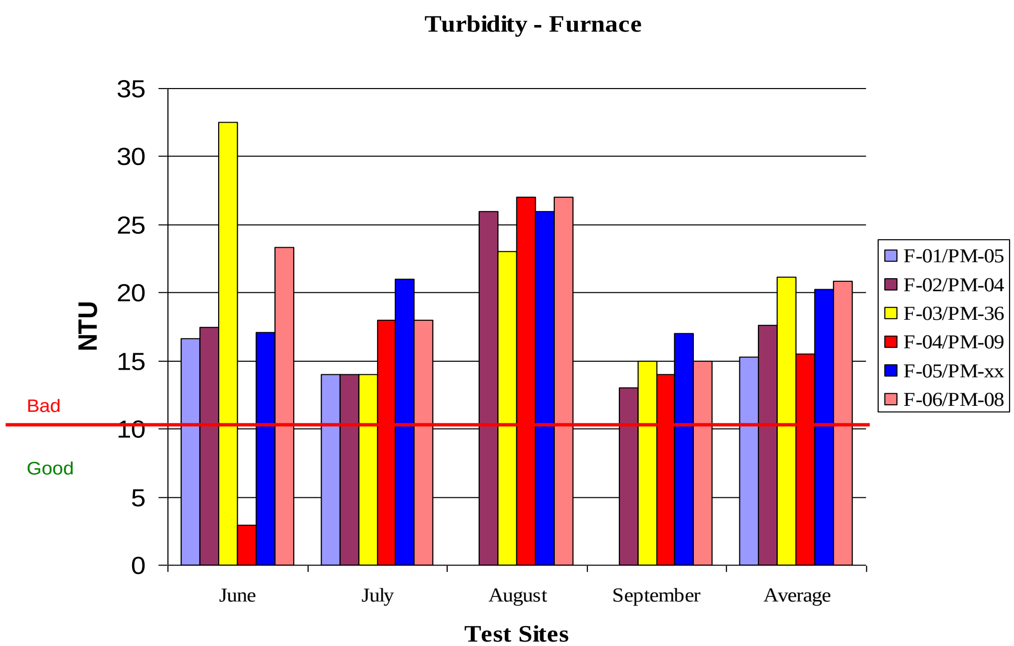


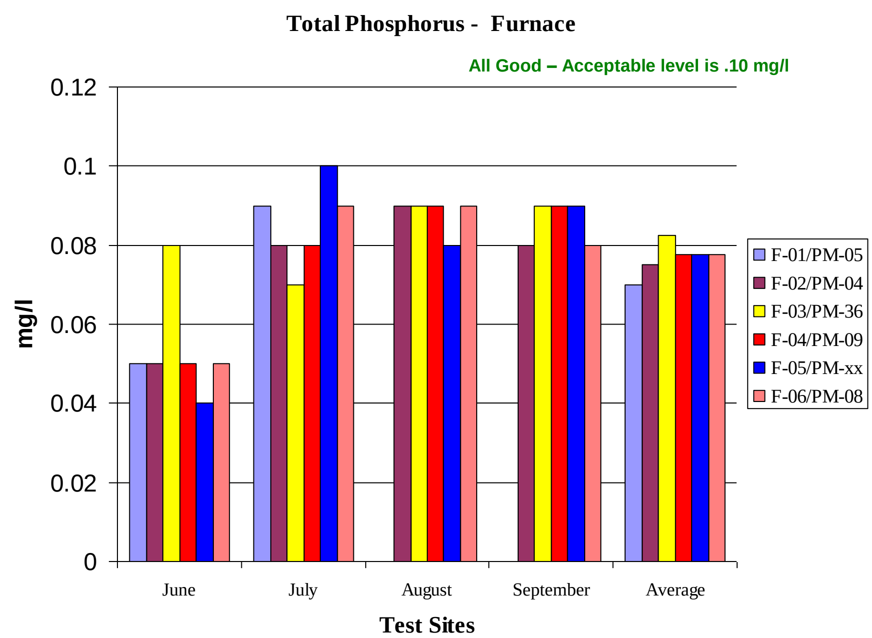
Alkalinity - Oldham
mg/l
30
25
20
15
10
5
0
June
July
August
September
Average
Test Sites
O-01/PM-49
O-02/PM-0
O-03/PM-1
O-04/PM-2
O-05/PM-33

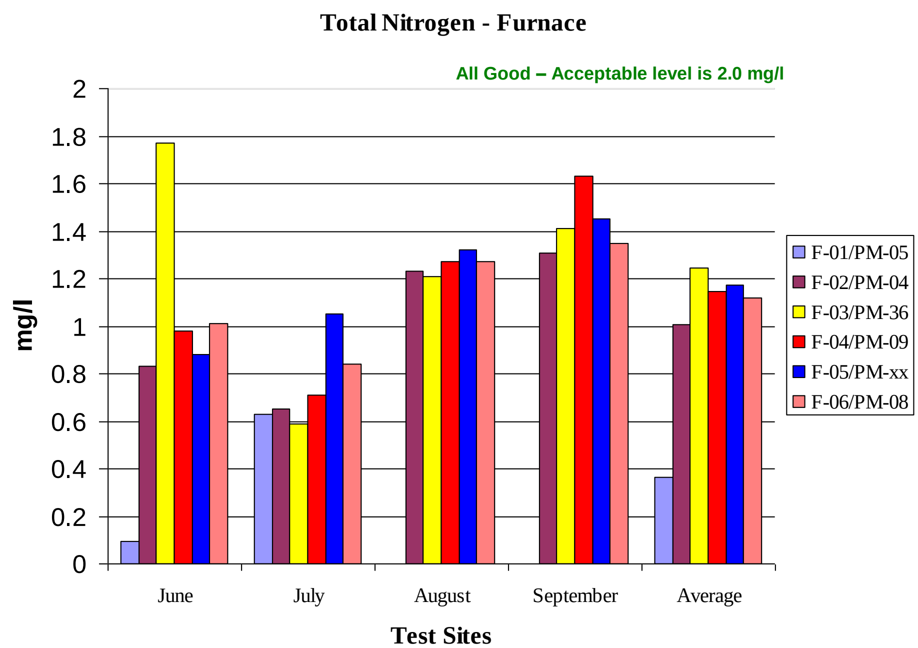


Specific Conductance - Oldham
UM/cm
250
240
230
220
210
200
190
180
June
July
August
September
Average
Test Sites
O-01/PM-49
O-02/PM-0
O-03/PM-1
O-04/PM-2
O-05/PM-33

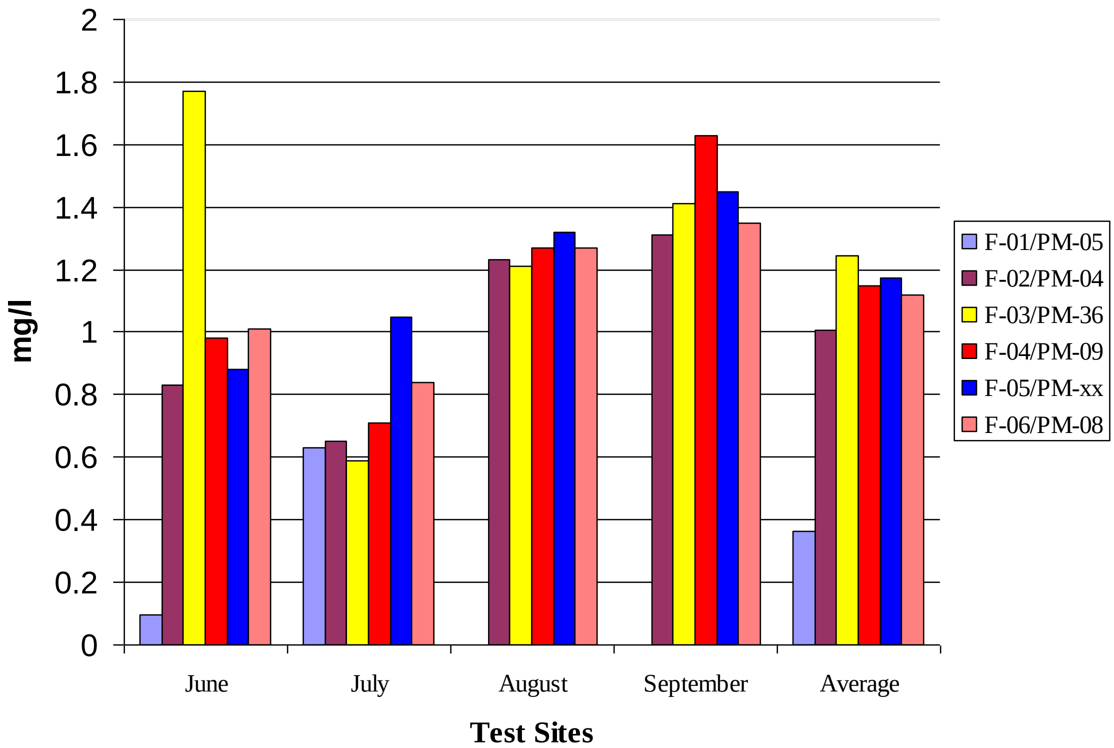

Chloride - Oldham
60
50
40
30
20
10
0
mg/l
June
July
August
October
Average
O-01/PM-49
O-02/PM-0
O-03/PM-1
O-04/PM-2
O-05/PM-33
O-06/PM-48
Test Sites


Turbidity - Furnace
35
30
25
20
15
10
5
0
NTU
Bad
Good
F-01/PM-05
F-02/PM-04
F-03/PM-36
F-04/PM-09
F-05/PM-xx
F-06/PM-08
June
July
August
September
Average
Test Sites

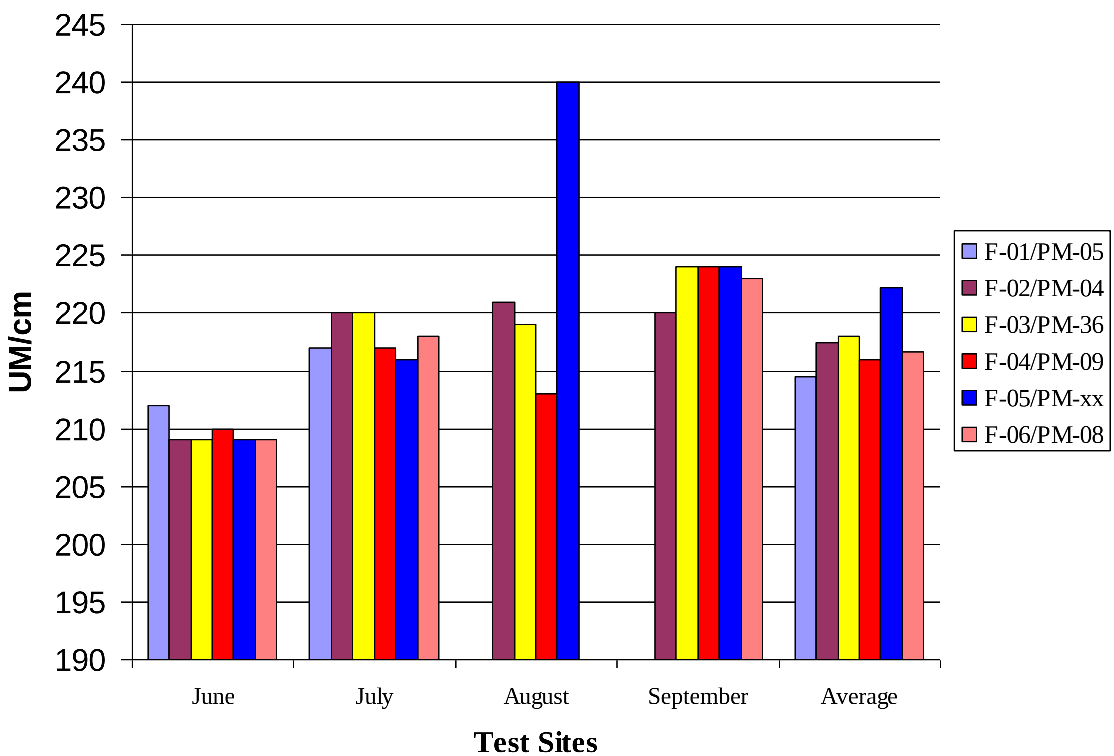

Total Phosphorus - Furnace
All Good – Acceptable level is .10 mg/l
0.12
0.1
0.08
0.06
0.04
0.02
0
mg/l
June
July
August
September
Average
Test Sites
F-01/PM-05
F-02/PM-04
F-03/PM-36
F-04/PM-09
F-05/PM-xx
F-06/PM-08

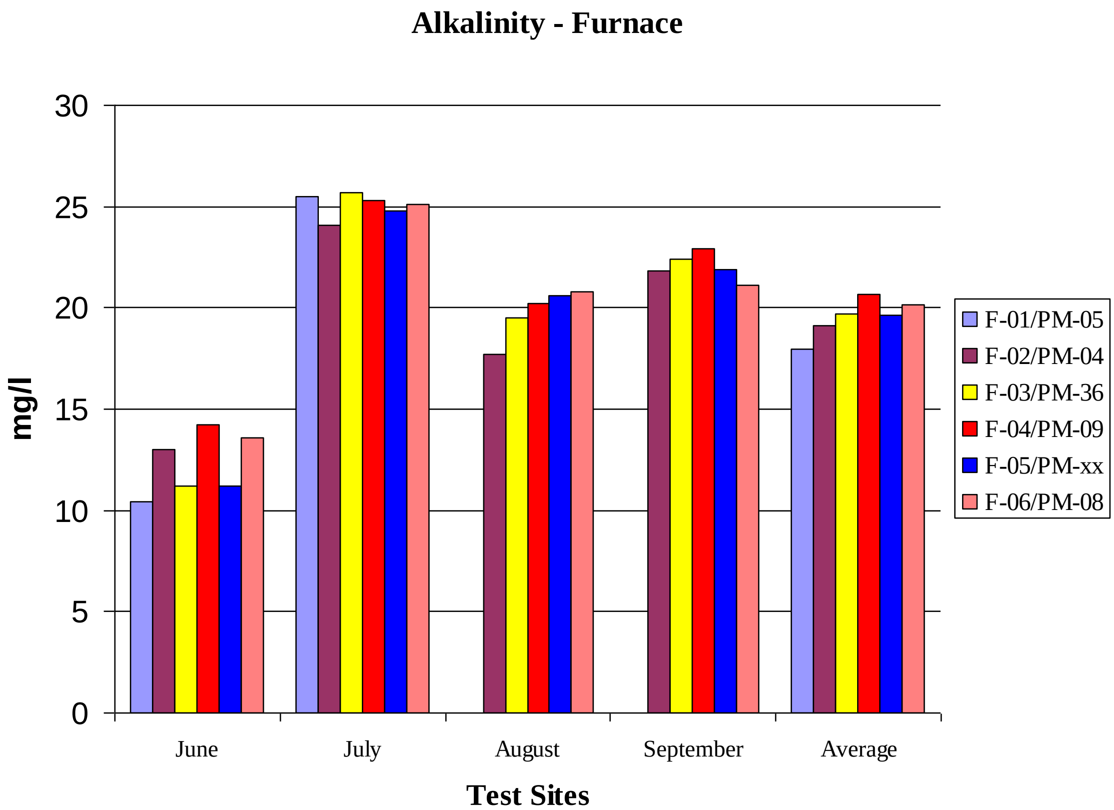

Total Nitrogen - Furnace
All Good – Acceptable level is 2.0 mg/l
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
mg/l
June
July
August
September
Average
Test Sites
F-01/PM-05
F-02/PM-04
F-03/PM-36
F-04/PM-09
F-05/PM-xx
F-06/PM-08

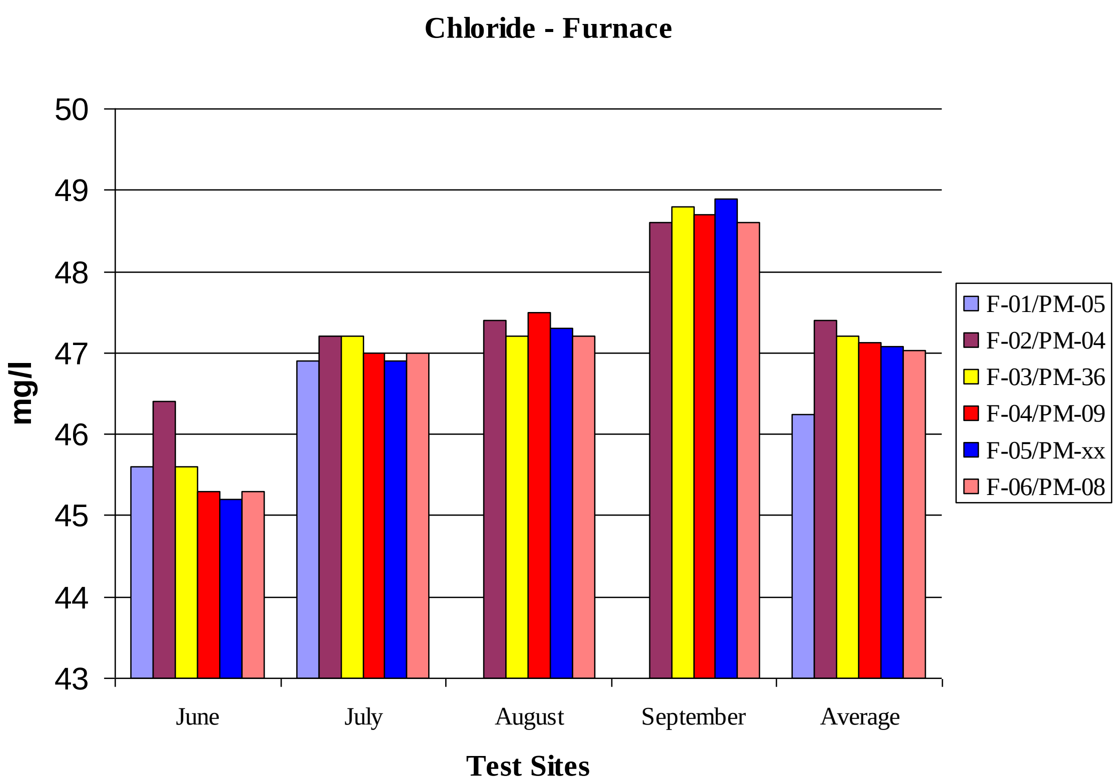
Kjeldahl Nitrogen - Furnace

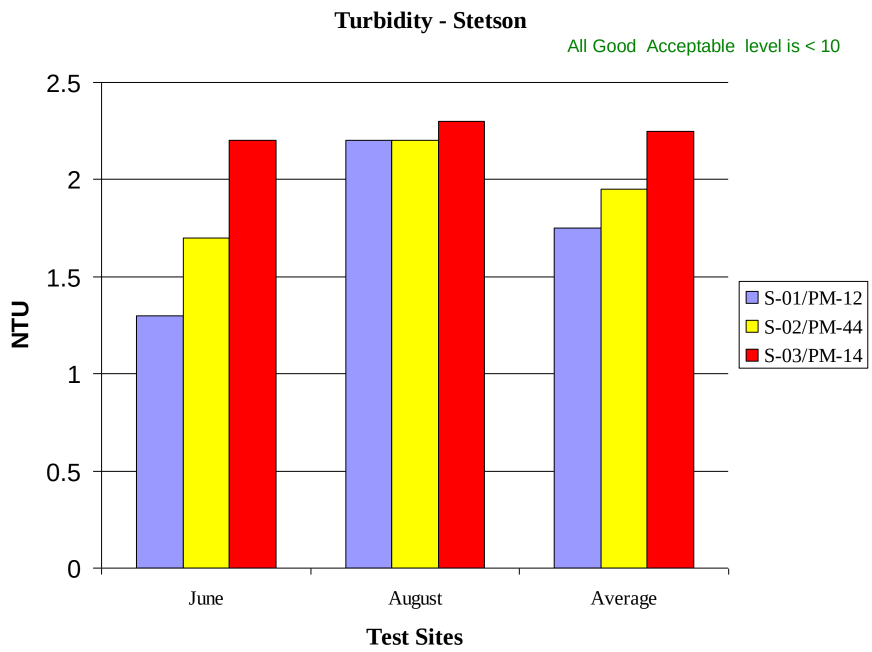


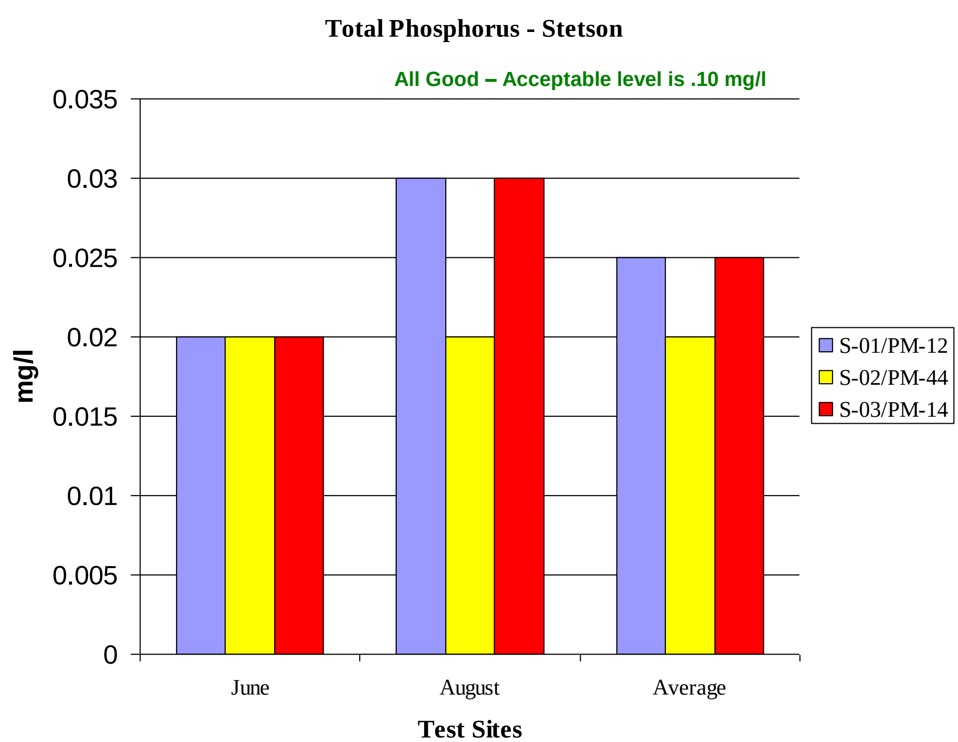
Specific Conductance - Furnace

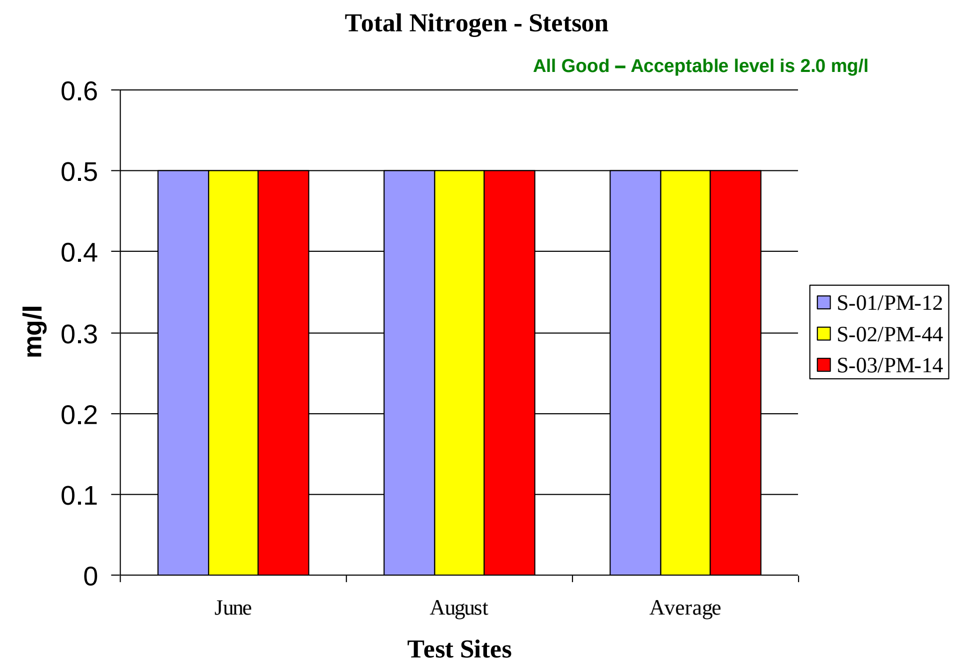



Alkalinity - Furnace
30
25
20
15
10
5
0
mg/l
June
July
August
September
Average
Test Sites
F-01/PM-05
F-02/PM-04
F-03/PM-36
F-04/PM-09
F-05/PM-xx
F-06/PM-08

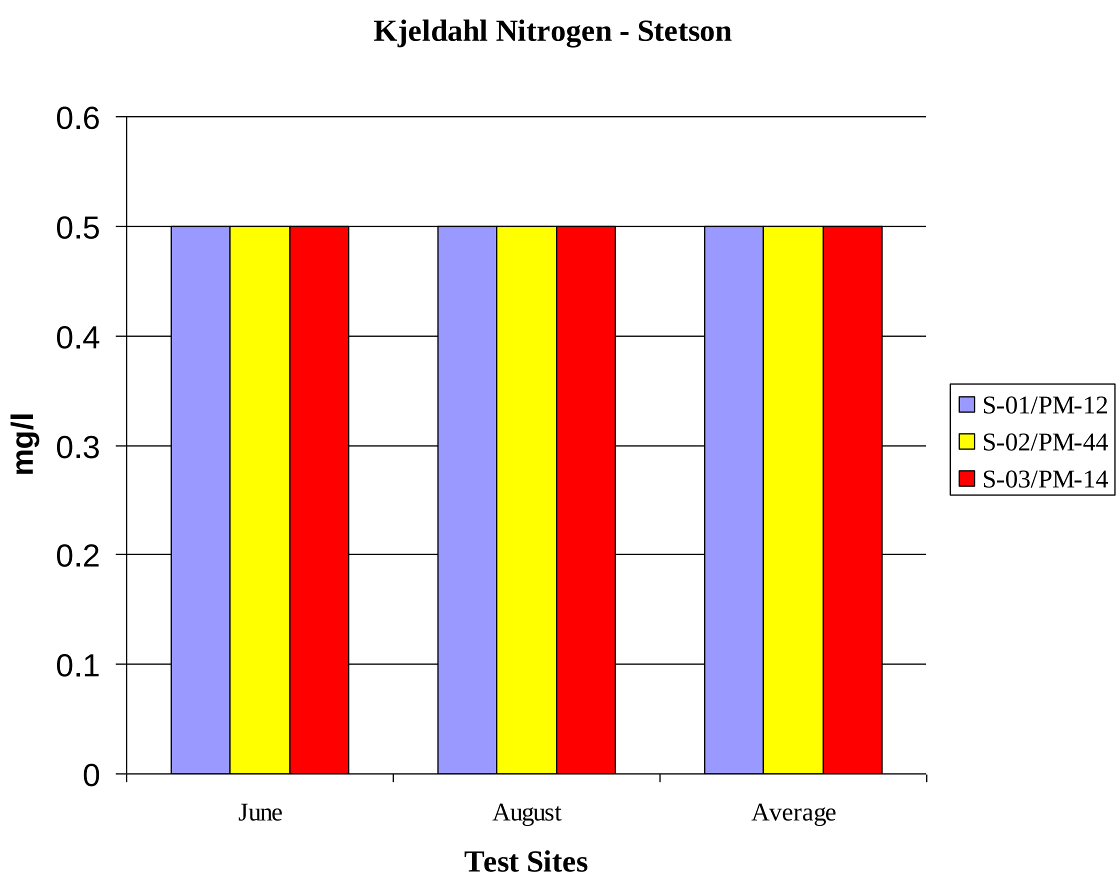

Chloride - Furnace
50
49
48
47
46
45
44
43
mg/l
June
July
August
September
Average
Test Sites
F-01/PM-05
F-02/PM-04
F-03/PM-36
F-04/PM-09
F-05/PM-xx
F-06/PM-08


Turbidity - Stetson
All Good Acceptable level is < 10
2.5
2
1.5
1
0.5
0
NTU
June
August
Average
Test Sites
S-01/PM-12
S-02/PM-44
S-03/PM-14

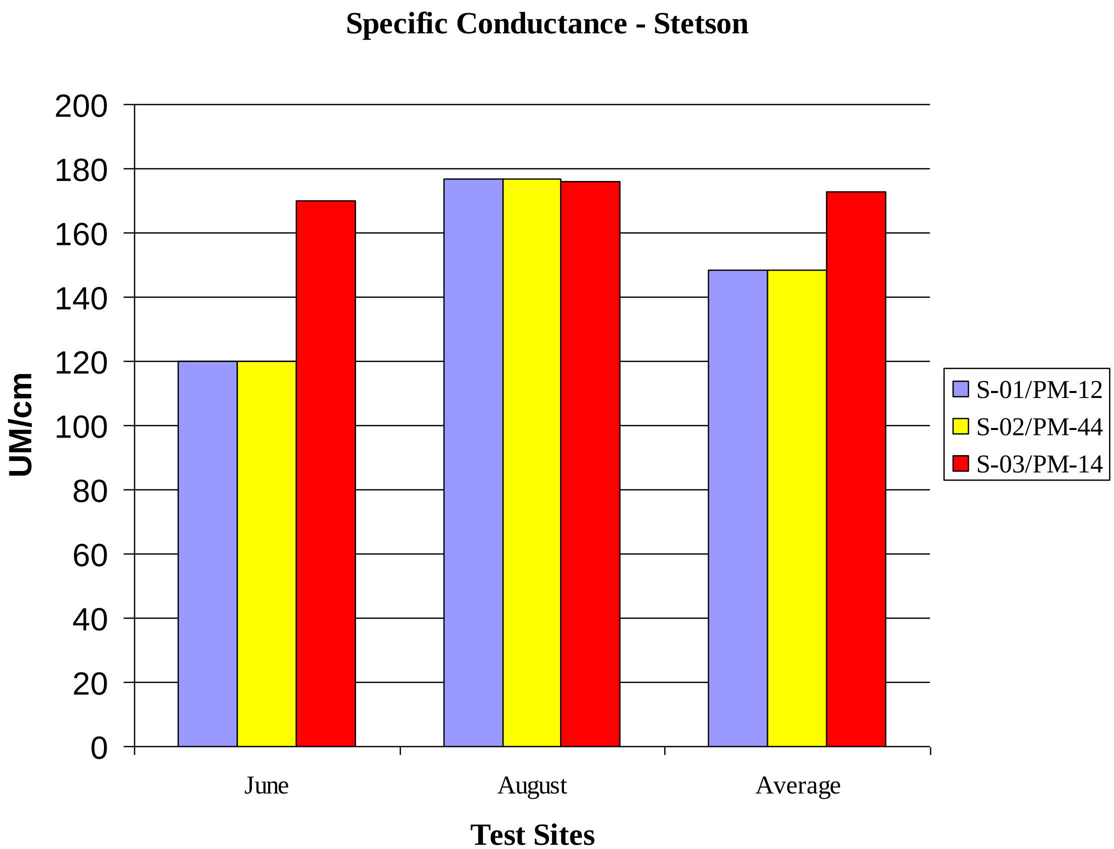

Total Phosphorus - Stetson
All Good – Acceptable level is .10 mg/l
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
mg/l
June
August
Average
Test Sites
S-01/PM-12
S-02/PM-44
S-03/PM-14

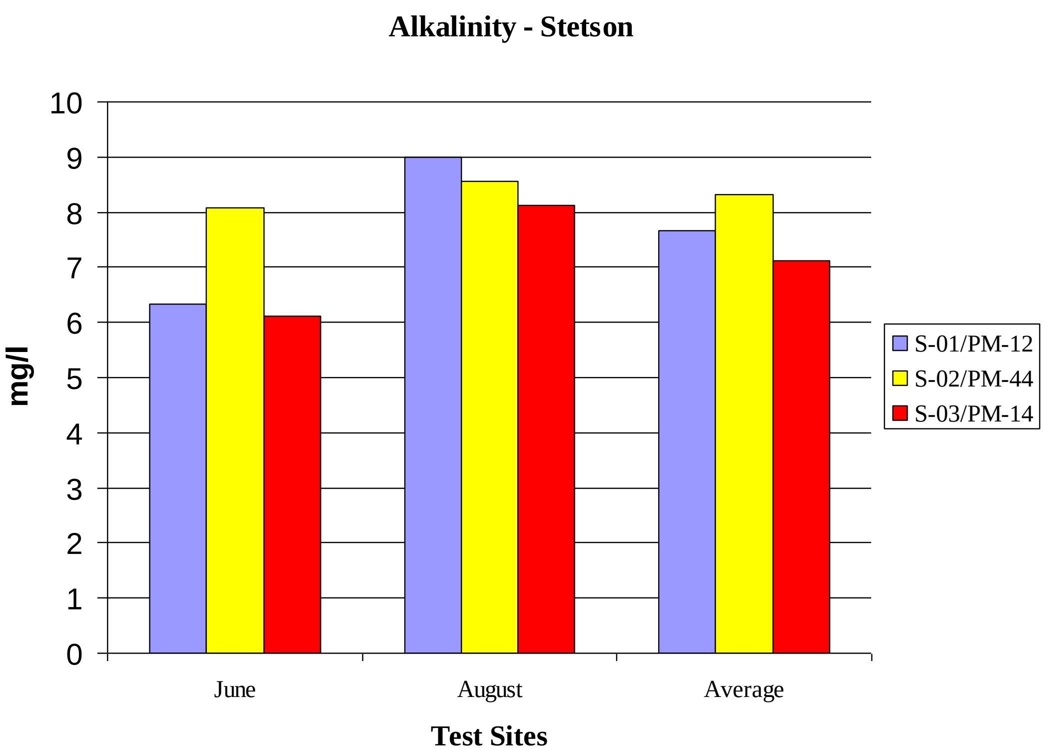


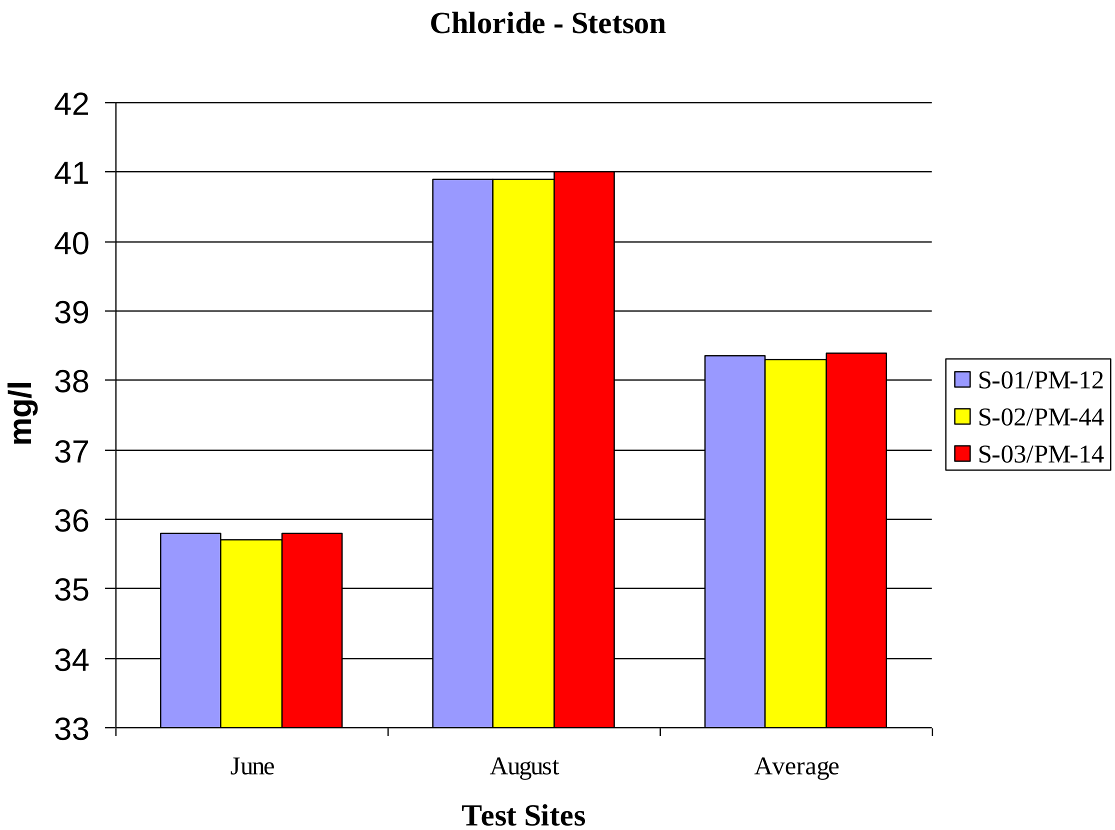
Total Nitrogen - Stetson
All Good – Acceptable level is 2.0 mg/l
0.6
0.5
0.4
0.3
0.2
0.1
0
mg/l
June
August
Average
Test Sites
S-01/PM-12
S-02/PM-44
S-03/PM-14

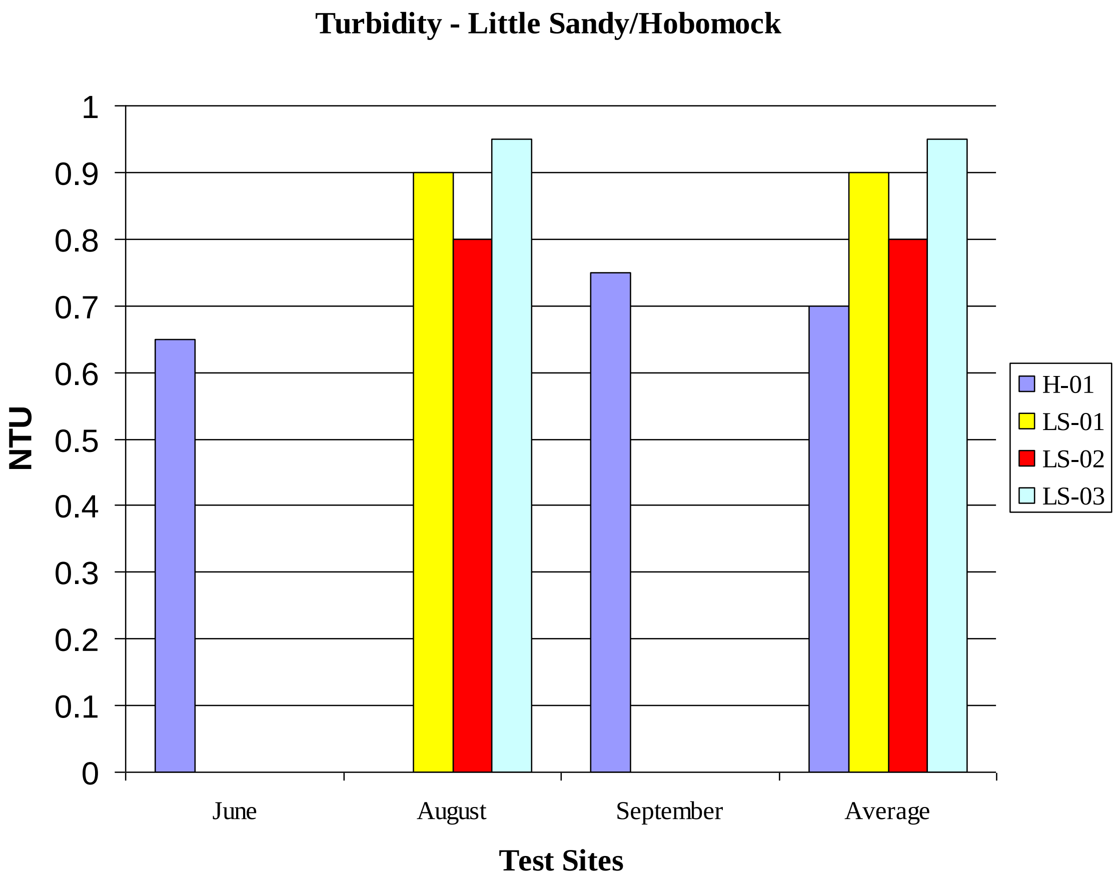


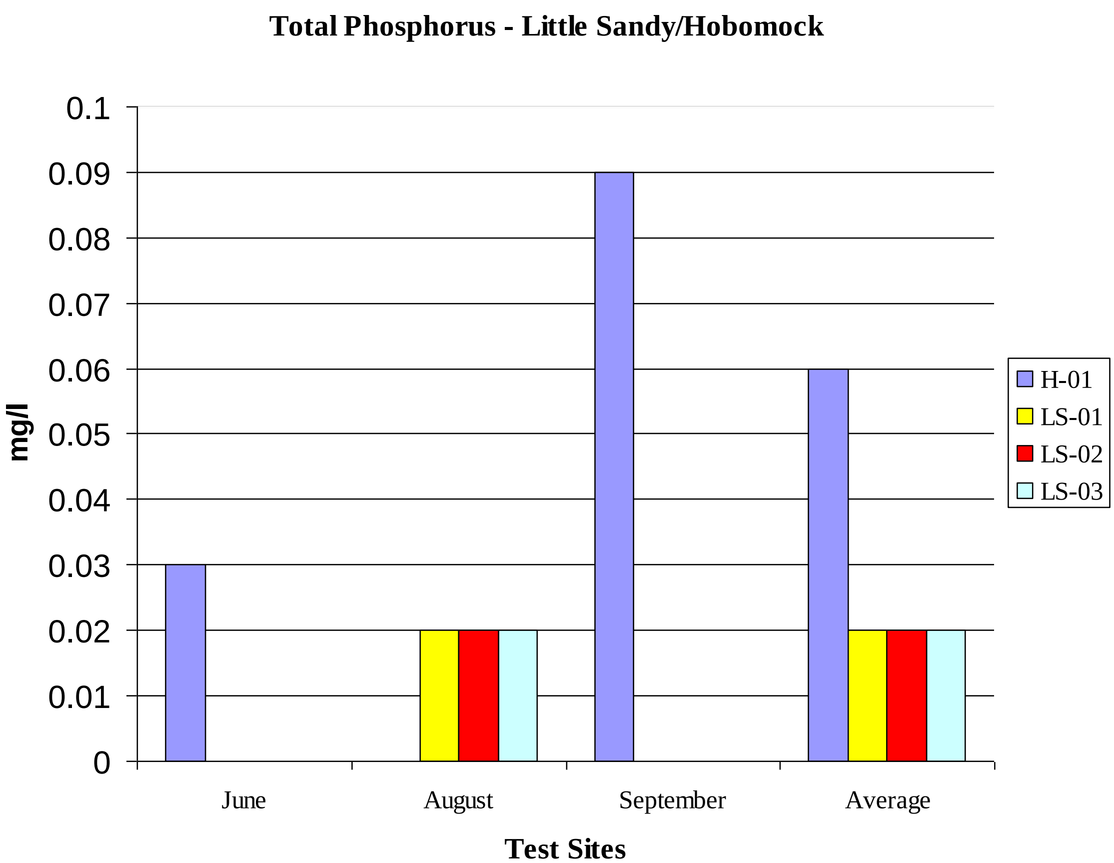
Kjeldahl Nitrogen - Stetson
0.6
0.5
0.4
0.3
0.2
0.1
0
mg/l
June
August
Average
Test Sites
S-01/PM-12
S-02/PM-44
S-03/PM-14


Specific Conductance - Stetson
200
180
160
140
120
100
80
60
40
20
0
UM/cm
June
August
Average
Test Sites
S-01/PM-12
S-02/PM-44
S-03/PM-14

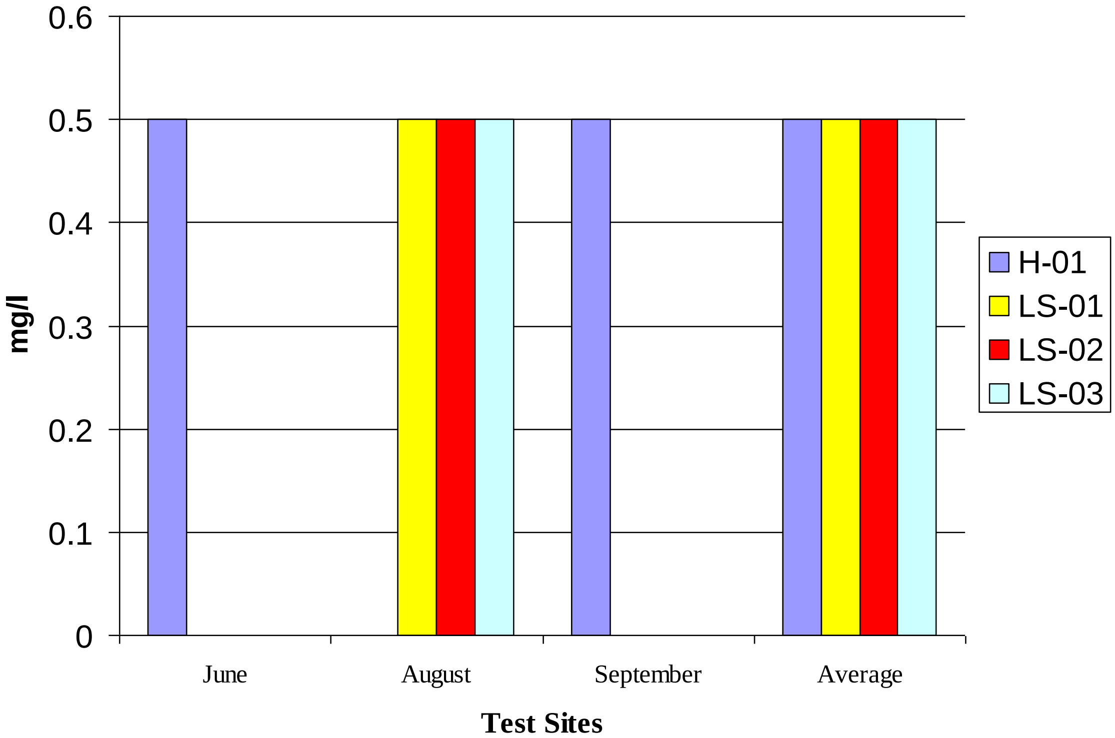

Alkalinity - Stetson
10
9
8
7
6
5
4
3
2
1
0
mg/l
June
August
Average
Test Sites
S-01/PM-12
S-02/PM-44
S-03/PM-14


Chloride - Stetson
42
41
40
39
38
37
36
35
34
33
mg/l
June
August
Average
Test Sites
S-01/PM-12
S-02/PM-44
S-03/PM-14

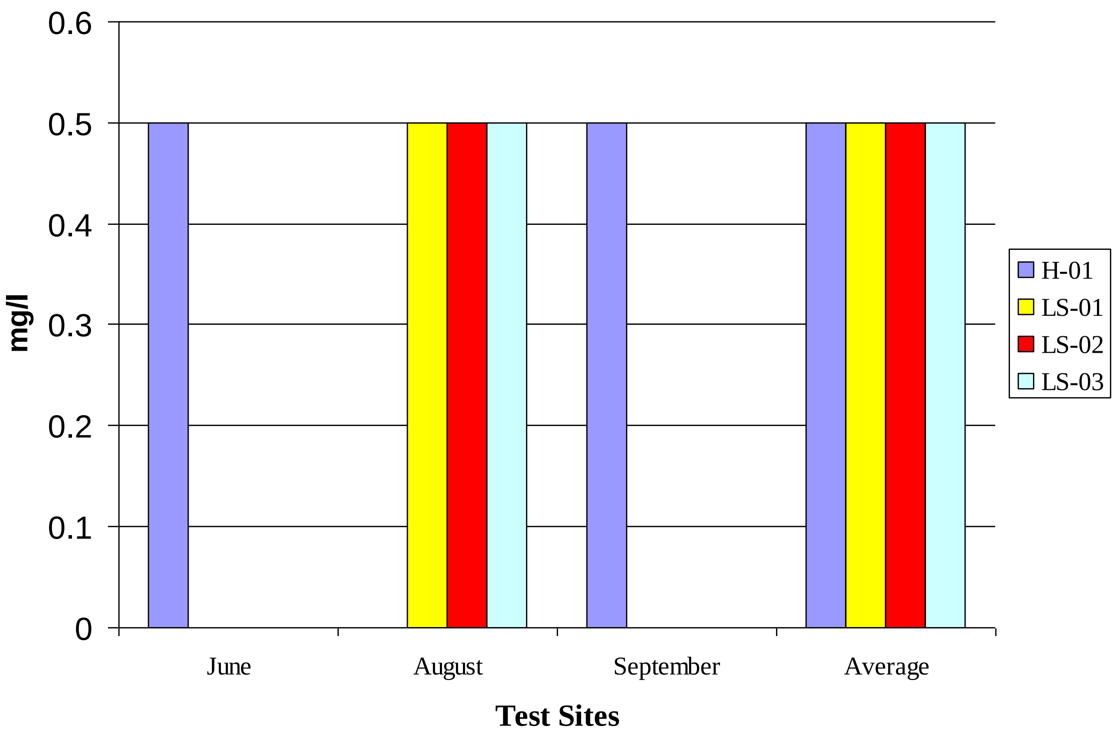

Turbidity - Little Sandy/Hobomock
NTU
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
June
August
September
Average
Test Sites
H-01
LS-01
LS-02
LS-03


Total Phosphorus - Little Sandy/Hobomock
mg/l
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
June
August
September
Average
Test Sites
H-01
LS-01
LS-02
LS-03

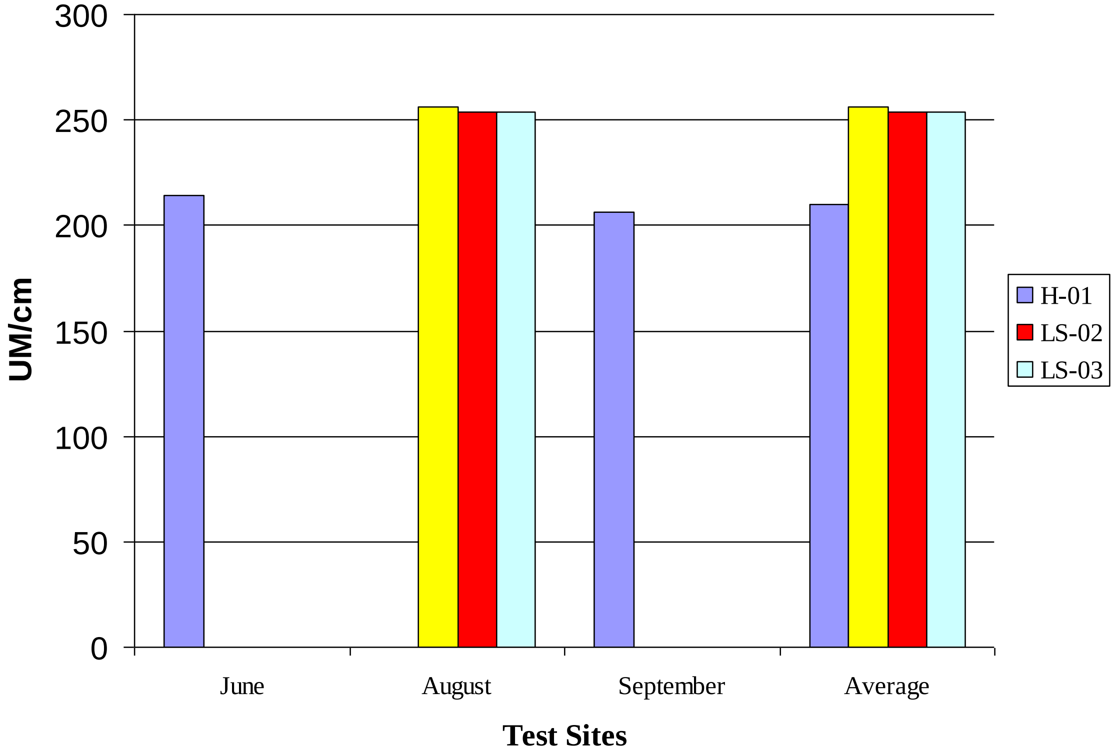
Total Nitrogen - Little Sandy/Hobomock



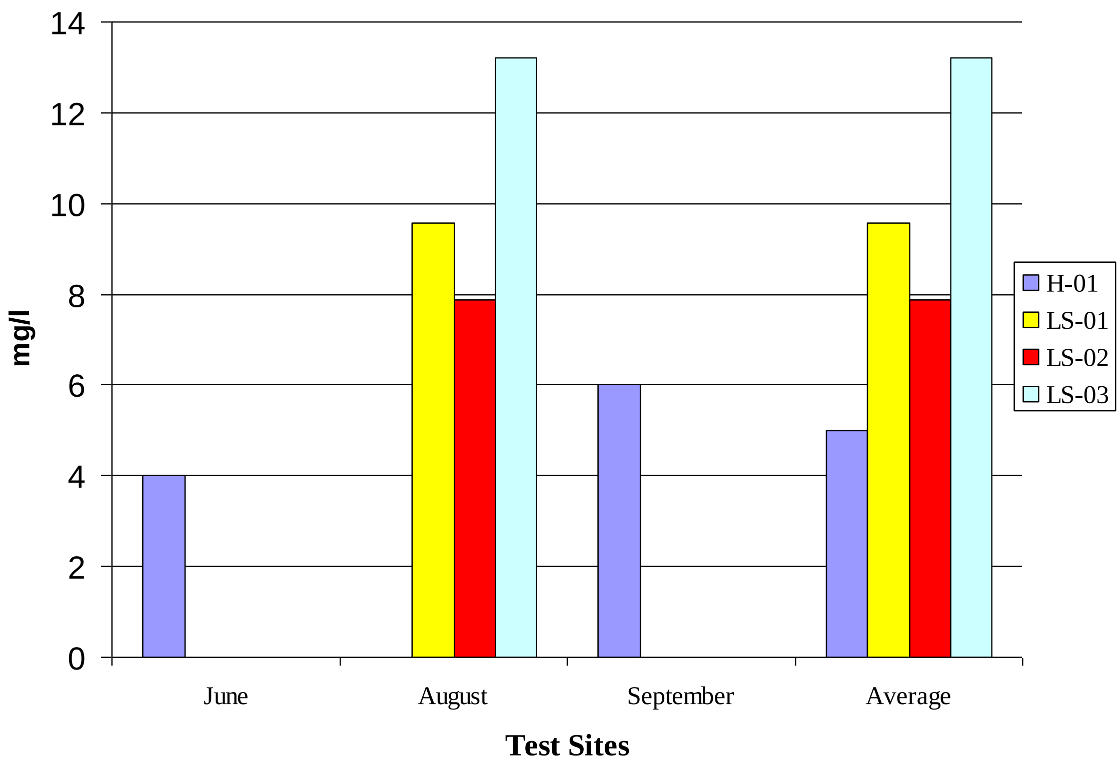
Kjeldahl Nitrogen - Little Sandy/Hobomock

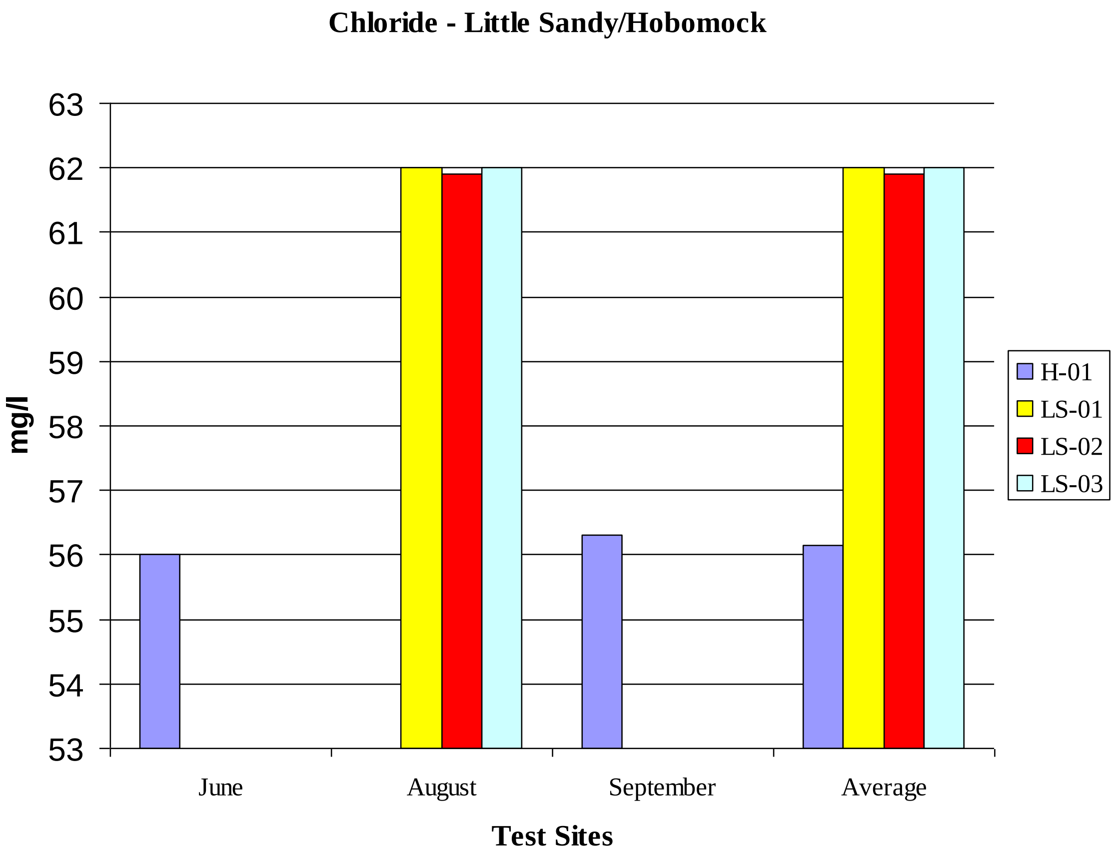


Specific Conductance - Little Sandy/Hobomock



Alkalinity - Little Sandy/Hobomock





2007 Accomplishments

The Water Quality committee was heavily involved with the PWA's filing for a Quality Assurance Project Plan (QAPP) with MassDEP.

An approved QAPP on file with the state gives credibility to our testing program and means that the state will consider our results to be valid.

As part of this process we:

- Rewrote our training and qualification procedures and published an amended training program.
- Implemented a Quality Control (QC) program.
- Reviewed and adjusted our testing program to better serve the needs of our ponds
- Reviewed and amended our testing forms
- Obtained grants for additional testing equipment.

Summary of 2007 results:

Physical Characteristics of Pond water: Summer rainfall was substantially low resulting in significant drop in water volume in all of the ponds.
During the summer months we recorded the presence of algae at testing sites:

Furnace: July-5%, August – 100%, October >75%
Oldham: August 5-25%, September > 50 -75%
Stetson: 10%- 15% in October
Hobomock and Little Sandy: Minimal to none.

Furnace Pond had 1 documented test site in August with blue-green algae (toxic) with all sites either a thin or very thick 100% coating. There were intermittent sitings of blue-green algae late August in shallow areas.

Oldham Pond had 1 documented test site in August with blue-green algae (toxic), and also had extensive heavy weed growth in shallow water during the latter months. There was heavy infestation of blue-green algae species in the south-westerm cove in September.

Heavy weed infestation was particularly significant Oldham and to a lesser degree in Furnace. Stetson also noted increased weed growth in shallow areas.

Furnace Pond had water temperatures exceeding 85 degrees at multiple sites in August, with excessive algae growth. The high temperatures were due to a lack of overhead canopy that is usually provided by trees and an average depth of less than 5 feet.

Physical finding trends demonstrate continued eutrophication of Furnace and Oldham ponds, with extensive algae blooms, and additional impacts observed in Furnace and Stetson in the fall, relating to Bog effluent returns. Lack of buffer zones, failed or clogged storm drains, effluent from old and active bog channels, and non-point source pollution excess have been the primary culprits.

Chemical Findings:

All of the ponds exhibit some degree of water quality disturbance, however, Furnace and Oldham ponds continue to show deterioration and require urgent attention.

The primary problems found through chemical testing were:

- elevated turbidity
- low Secchi disc readings
- Excessive weed growth in shallow waters, especially on Oldham

Recommendations: Furnace Pond

- Furnace is a category 5 severely impaired pond, with 10 feet of muck holding a tremendous amount of reactive phosphorus. This means that even with no additional source of phosphorus the pond will continue to deteriorate rapidly.

- Furnace experienced extensive algae blooms, weed overgrowth, invasive species of weeds, intermittent low dissolved oxygen levels (with 2 major fish kills in 2004, none in 2005, 2006 or 2007), further loss of depth (average depth 5 feet, max depth 8.5 feet), increased temperature which impairs the fish habitat.

- Gorham Mill pond, the Furnace pond outlet, has become a shallow, algae and weed choked swamp, evidenced by the increase in amphibious species, minimal fish, and high mosquito breeding areas due to stagnation. This is the fate of Furnace Pond within a very short time unless action is taken to restore the depth, remove the phosphorus sources (muck, non-point source and bog effluent), increase the buffer zones, and insist on best management practices (street sweeping, storm drain management) around the pond and in the watershed.

- Loss of Furnace Pond will result in loss of recharging some of the wells upon which our drinking water supply is maintained, the ultimate loss of Oldham which drains into Furnace, loss of tax revenue from waterfront property, health issues related to mosquito infestations, the loss of the Herring run which is dependent upon a continuous water connection from Oldham to the Herring run, and bog water use, and a major recreational resource to the town of Pembroke.

- A Dredging Feasibility study was conducted by CEI in the spring. They recommended some find of dredging solution be found. We agree with this recommendation and per the recommendations from the 1993 feasibility study and our current findings, this is absolutely necessary for the survival of this pond.

- Long term monitoring of both land and water based water quality will be paramount to determine the success of the action plan to restore and preserve Furnace Pond.

- The Town of Pembroke has taken steps to purchase the cranberry bogs that effect Furnace. This provides a solid first step to limit point source pollution. Management of waterways and non-point pollution sources between the bog channels and pond will need to be addressed.

- Additionally action must be taken to increase buffer zone management around the pond, through tree planting, encouragement of buffering at the water's edge on residential properties, and cleaning of storm drains to reduce sediment loading.

Recommendations: Oldham Pond:

- Oldham Pond is a category 4 impaired pond with significant eutrophication. Chemical analysis of the water demonstrated some sites with water quality in worse condition than Furnace. Oldham has greater depth and water volume, which probably explains why the pond has not demonstrated the degree of algae blooms or biological degradation found in Furnace. The muck is as deep, and has high loads of reactive phosphorus, which is the primary phosphorus source, along with old northeast cranberry bog streams. Oxygen levels have been a problem, and in 2004 there were fish kills on Oldham, however like Furnace oxygen levels have stabilized since. Non-point source contamination needs to be addressed, particularly with storm drain management, beach erosion and drainage, and need for buffer zones in public areas.

- In 2007 Oldham pond did not have high levels of nutrients, however the pond was overcome with heavy weed growth in almost all shallow areas. 2007 also saw severe drought conditions which resulted in extremely low water levels. This also caused a very reduced flow of water from Oldham to Furnace pond. There were several instances of blue algae documented on Oldham, particularly in the southwest corner.

- The survival of Oldham is of equal importance with the restoration of Furnace. Loss of Oldham would be tragic, resulting in loss of a primary recreational resource for the community, loss of the Herring spawning site, tax revenues from water-front homes, loss of some of Pembroke's wells that would not be recharged, and a habitat for many species.

- It is our recommendation that in concert with the dredging of Furnace Pond, some form of remediation must also be conducted on Oldham Pond if both Furnace and Oldham are to survive. We are also recommending that a feasibility study be conducted on Oldham, to identify the actual problem areas and necessary remediation.

- Long term monitoring of both land and water based testing of the ponds is mandatory to determine the success of actions taken to restore and preserve Oldham and Furnace Ponds. Therefore we recommend chemical testing at a regular interval for the foreseeable future.

- Oldham Pond is currently rated as a category 4(c) on the 2006 list of impaired waters. One of our goals for the near future is to have MassDEP change this to reflect the actual condition of the pond and change the rating to a category 5.

Recommendations: Stetson, Little Sandy Bottom, and Hobomock Ponds:

- Stetson Pond: This pond is currently rated as a category 5 by MassDEP. Stetson has one large source of phosphorus loading that must be checked: the cranberry bog effluent that is returned to Stetson in the fall. Utilization of best management practices to reduce non-point source pollution, improvement in storm drain management, and management of the cranberry bog effluent would be of value on this pond Close monitoring for invasive weeds is important. The Town of Pembroke has taken steps to purchase the cranberry bogs that effect Stetson and the pond should start seeing improvement once the bogs stop production.

- Little Sandy Bottom Pond: Results show that the pond is in good shape, and needs a preservation plan to keep it that way. The removal of the bog effluent a few years ago has improved the water quality results (comparing 1993 to current test results), showing that reducing phosphorus loading can improve water quality. Little Sandy Bottom Pond needs buffer zones put in at route 27 and the old beach front area and attention to best management practices, storm drains, and run-off.

- Hobomock: results show that water quality is good, but weeds are over-abundant and clarity is a problem. Best management practices, close monitoring for invasive weeds, and possibly weed application may be needed for preservation. This pond needs monitoring, and no other action is recommended at this time.

Pembroke Watershed Association water quality team, 2006
Co-Chairs of Water Quality Committee: Charlie Banks and Patti McCabe

Pond Captains:
Furnace: Patti McCabe
Oldham: Charlie Banks
Little Sandy Bottom: Steve Downing
Stetson: Jim McClarnon and Fred Baker.

Certified instructors for volunteer water quality training:
Jerry Fusco, Charlie Banks, Patti McCabe. Jim McClarnon, Deb Tranberg

Certified volunteer water samplers:
5 Instructors and 22 Volunteers

- Oldham Pond
  - Charlie Banks - Instructor
  - Hal Johnson
  - Dudley Sepeck
  - Robert Buckley
  - Peter Metcalf
  - Norm Shepherd
  - Ray Palumbo
  - Terry Banks
- Furnace Pond
  - Jerry Fusco - Instructor
  - Patti McCabe - Instructor
  - Chuck McCabe
  - Ray Holman
  - Scott MacInnes
  - Brian Shea
  - Deb Tranberg (take off instructor- did not retrain last year)
  - Erin Sullivan (remove- she did not retrain or participate)
  - Bill Doherty (remove same reason)
- Stetson Pond
  - Robert Shannon
  - Mitchell Cahill
  - Fred Baker
  - David Spaulding
  - Jim McLarnon - Instructor
  - Jim Muldoon
- Little Sandy Bottom Pond
  - Arthur Boyle
  - Steven Downing
  - Becky Paul
- Hobomock Pond
  - Howard League
  - Andy Key

- Jason Potrykus

Storm Drain Stencil Project:

- Patti McCabe, Scotty MacInnes, Cindy Champagne: Furnace
- Mitch Cahill: Stetson
- Andy Key and Miles Prescott: Hobomock
- Kathy Hanson: Oldham
- Boy Scouts in Pembroke participating in the program

Appendix # 1 2005-2006 Land-based Efforts to Improve Water Quality:

- Reviewed the 1993 and 2001 Pond surveys as a basis for water quality management plan

- Utilized the Mass Water Watch website and DEP publications and classes through COLAP and the Rivernet Association to develop a knowledge base, obtain protocols and formats for surveying and documenting results.

- Conducted an overall pond survey to determine primary problems and create an action plan for 4 ponds. Hobomock pond completed their pond survey later in 2005 and presented their findings to the PWA.

- Identified Best Management Practices and worked with the town government to strive to implement these: DPW, Conservation Commission, and Selectmen were used as contacts and were very supportive of the efforts of the PWA.

- Provided BMP education to the public through presentations at PWA meetings, at the library, and via the news, and developed liaison with the schools.

- Held a Second Annual pond clean-up day to remove debris from the shoreline/pond edges, over 40 participants, great success. This impacted a section of each pond, and continued what is now an annual event.

- Requested that the street sweeper be used to remove sand and debris from the roads in the spring and again in the summer around streets which directly impact the ponds.

- Asked that the town clean the storm drains directly draining into the pond, increase the number of storm drains, and look at newer retrofit and LID methods of reducing non-point source pollution.

- Placed signs at boat ramps to encourage clean-up of boats after removal from the ponds

- Catch basin stenciling was begun at all pond storm drain sites. This project will be ongoing, with the intent of stenciling storm drains at higher elevations and in neighborhoods, all of which drain into the ponds.

- Studied the impact of residential development on the buffering capacity of the shoreline. The findings are included in this report.

Best Management Practices for Water Quality Preservation is Buffer Zones:

Storm water run-off + pollutants = poor water quality!

- **Create and Maintain Vegetated Buffer Zones**: establish and maintain trees, bushes, perennials, sedges, and aquatic plants, next to the water, on hills, in all areas with run-off, to improve filtration capacity, maintain habitats. 90% of run-off will be captured by a well planned buffer zone and 80% of pollutants will be removed by the plants.

- **Native plantings:** within the waterfront 100 foot zone. Native plants don't require fertilizing or watering once established.

- **Remove exotic invasive plants:** destroys native habitats

- **Curve** ramps, walkways, grass or dirt paths to avoid run-off straight down to the water.

- **Avoid phosphorus based fertilizers:** try to avoid all fertilizers and use organic products which are environmentally friendly whenever possible.

- **Rain gardens** and **rain barrels:** to catch and filter runoff and conserve water.

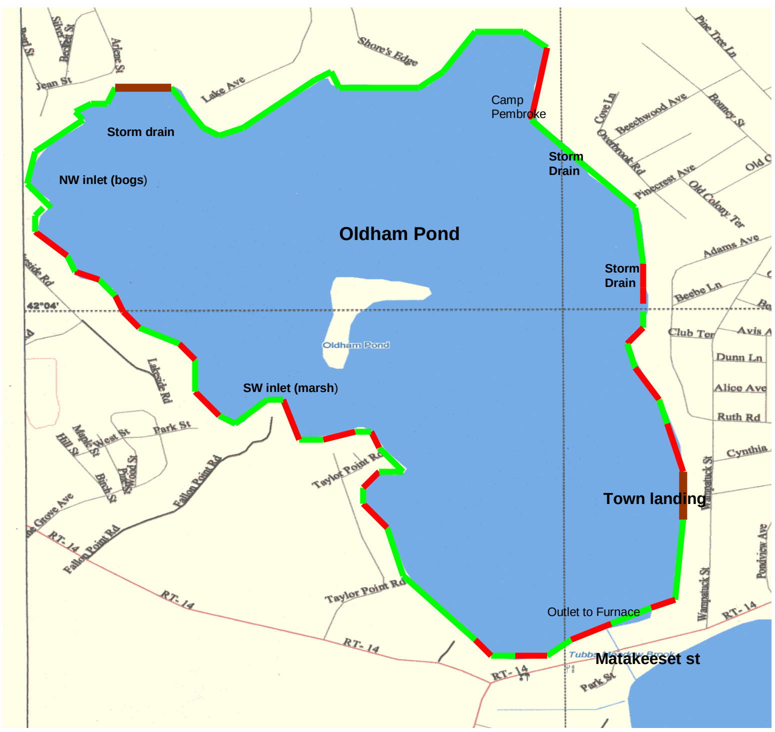
- **LID efforts**, such as pervious pavements, new storm drain designs, and enviro-friendly landscape designs. Storm drain management cannot be emphasized enough!

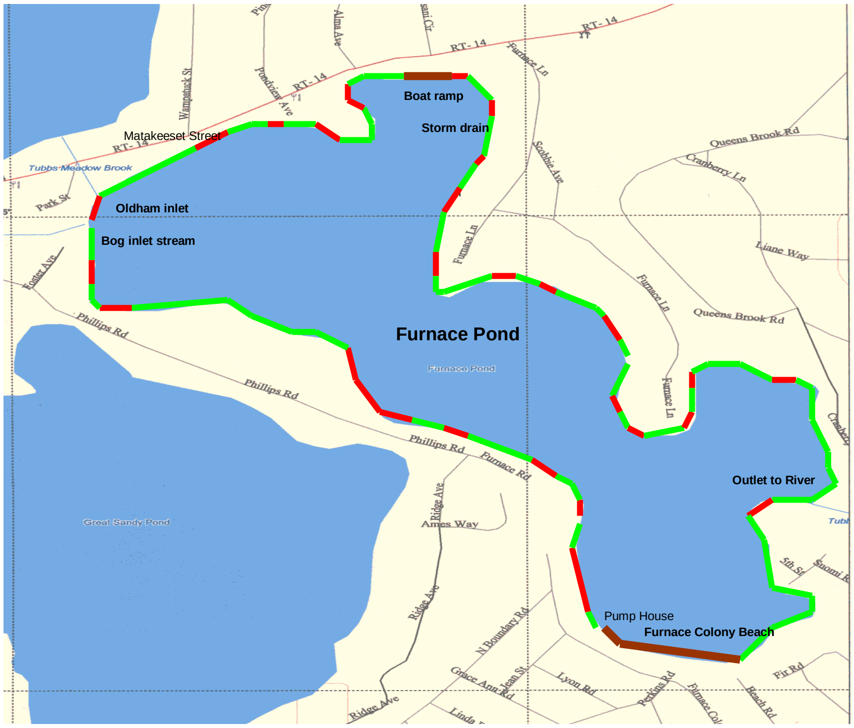
- **Support by-laws:** that improve water-quality and best management practices, and support efforts that improve water quality and natural landscaping.

Shoreline Pond surveys

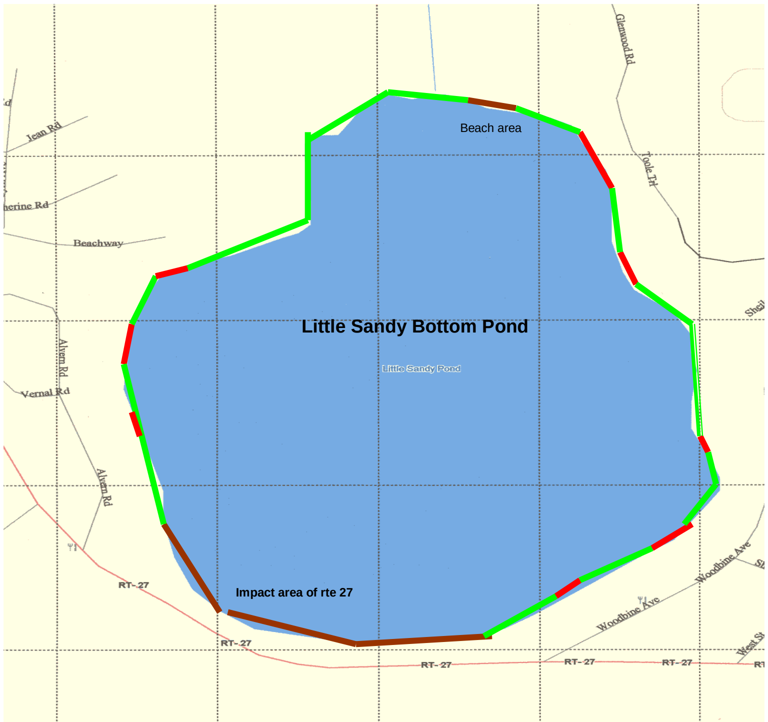
- The following slides indicate the approximate degree of suburban development at each of the ponds, including buffer zones, impervious public ramps, and impact of roads.

- ___: buffered areas
- ___: no buffer zone
- ___: public unbuffered areas




Furnace Pond
Boat ramp
Storm drain
Matakeeset Street
Oldham inlet
Bog inlet stream
Outlet to River
Pump House
Furnace Colony Beach
Tubbs Meadow Brook
Great Sandy Pond
RT- 14
Phillips Rd
Furnace Rd
Furnace Ln
Queens Brook Rd
Cranberry Ln
Liane Way
Ames Way
Ridge Ave
N Boundary Rd
Lyon Rd
Perkins Rd
Beach Rd
Fir Rd
Park St
Wampatuck St
Alma Ave
5th St
Grace Ann Rd


Stetson Pond
Blueberry lane beachfront
Bog inlet
Storm Drain
Hill with Ramp
Hill with ramp
Main Road
Outlet to Chaffin
Boat Ramp and beach
Blueberry Ln
Kenholm Rd
Stetson Heights Rd
High Ave
Stetson Ave
Lake Ave
Plymouth St
Fish St
W Fish St
Marion Way
Bartlett St
Beech St
Carver St
High St N
B St
D St
Elmer Ave
Nye St
Johnson St
RT-36



Buffered and Unbuffered Areas Around the Ponds

(conservative estimates)

Pond	Public Unbuffered	Private Unbuffered	Buffered
Oldham	7%	38%	55%
Furnace	10%	35%	55%
Stetson	5%	30%	65%
LSB	17%	18%	65%

Appendix #2 - Raw data

Oldham

pH		(S.U)	DET	0.14	
	June	July	August	September	Mean
O-01/PM-49			6.97	8.15	3.78
O-02/PM-0			7.19	8.63	3.955
O-03/PM-1			6.96	8.63	3.8975
O-04/PM-2			6.79	8.1	3.7225
O-05/PM-33			6.8	8.17	3.7425
			6.96		1.74
Turbidity		NTU	DET	0.25	
	June	July	August	September	Mean
O-01/PM-49	7.2	6.6	23	25	15.45
O-02/PM-0	4.1	5.6	21	22	13.175
O-03/PM-1	4.4	6.3	21	31	15.675
O-04/PM-2	3.9	10	26	27	16.725
O-05/PM-33	4.9	5.8	26	26	15.675
	4.5				1.125
Phosphorus, Total		(ug/l)	DET	0.01	
	June	July	August	September	Mean
O-01/PM-49	0.04	0.03	0.07	0.1	0.06
O-02/PM-0	0.04	0.03	0.07	0.1	0.06
O-03/PM-1	0.04	0.03	0.06	0.11	0.06
O-04/PM-2	0.05	0.03	0.06	0.11	0.0625
O-05/PM-33	0.04	0.03	0.06	0.1	0.0575
	0.04				0.01
Total Nitrogen		(mg/l)	DET	0.5	
	June	July	August	September	Mean
O-01/PM-49	0.76	0.5	1.15	1.58	0.9975
O-02/PM-0	0.59	0.5	0.99	1.43	0.8775
O-03/PM-1	0.75	0.5	1.09	1.51	0.9625
O-04/PM-2	0.64	0.56	1.16	1.64	1
O-05/PM-33	0.67	0.5	1.19	1.44	0.95
	0.72				0.18
Dissolved Oxygen		mg/l			
	June	July	August	September	Mean
O-01/PM-49	8.93	7.4	9.03	6.91	8.0675
O-02/PM-0	9.1	7.25	8.4	6.34	7.7725
O-03/PM-1	8.52	7.09	7.99	7.92	7.88
O-04/PM-2	8.95	6.28	7.34	7.42	7.4975
O-05/PM-33	9.57	7.33	7.76	7.52	8.045
O-06/PM-48	8.91				2.2275
O-07/PM-3	9.68			7.01	4.1725
Kjeldahl, Nitrogen		(mg/l)	DET	0.05	
	June	July	August	September	Mean
O-01/PM-49	0.76	0.5	1.15	1.58	0.9975

O-02/PM-0	0.59	0.5	0.99	1.43	0.8775
O-03/PM-1	0.75	0.5	1.09	1.51	0.9625
O-04/PM-2	0.64	0.56	1.16	1.64	1
O-05/PM-33	0.67	0.5	1.19	1.44	0.95
O-06/PM-48	0.72				0.18

Specific Conductance		Um/cm	DET	0.5	
	June	July	August	September	Mean
O-01/PM-49	219	236	231	220	226.5
O-02/PM-0	205	240	227	218	222.5
O-03/PM-1	220	241	226	217	226
O-04/PM-2	211	236	226	218	222.75
O-05/PM-33	202	233	230	221	221.5
	220				55

Alkalinity			DET	4	
	June	July	August	September	Mean
O-01/PM-49	14.5	23.8	19.1	24.7	20.525
O-02/PM-0	14.3	24.2	23.9	23.6	21.5
O-03/PM-1	11.4	22.4	20.5	22.8	19.275
O-04/PM-2	13	20.5	18.2	23.8	18.875
O-05/PM-33	12.3	21.9	22.4	24.6	20.3
	10.2				2.55

Chloride		(mg/l)	DET	10	
	June	July	August	September	Mean
O-01/PM-49	47.9	49.7	50.1	51.7	49.85
O-02/PM-0	47.7	50.1	50.1	51.6	49.875
O-03/PM-1	47.9	50.2	50.2	51.8	50.025
O-04/PM-2	48.1	50.1	49.9	51.8	49.975
O-05/PM-33	48	50	50	51.7	49.925
	48.3				12.075

<u>Stetson</u>

pH

	June	August	Mean
S-01/PM-12	7.35	7.54	7.445
S-02/PM-44	7.33	7.25	7.290
S-03/PM-14	7.35	7.18	

Turbidity

	June	August	Mean
S-01/PM-12	1.3	2.2	1.750
S-02/PM-44	1.7	2.2	1.950

S-03/PM-14	2.2	2.3	2.250

Total Nitrogen

	June	August	Mean
S-01/PM-12	0.5	0.5	0.500
S-02/PM-44	0.5	0.5	0.500
S-03/PM-14	0.5	0.5	0.500

Phosphorus, Total

	June	August	Mean
S-01/PM-12	0.02	0.03	0.025
S-02/PM-44	0.02	0.02	0.020
S-03/PM-14	0.02	0.03	0.025

Dissolved Oxygen

	June	August	Mean
S-01/PM-12	8.38	7.36	7.870
S-02/PM-44	8.3	7.65	7.975
S-03/PM-14	8.64	7.8	8.220
S-04/PM-xx	8.45	7.78	

Kjeldahl, Nitrogen

	June	August	Mean
S-01/PM-12	0.5	0.5	0.500
S-02/PM-44	0.5	0.5	0.500
S-03/PM-14	0.5	0.5	0.500

Specific Conductance Um/cm

	June	August	Mean
S-01/PM-12	120	177	148.500
S-02/PM-44	120	177	148.500
S-03/PM-14	170	176	173.000

Alkalinity

	June	August	Mean

S-01/PM-12	6.34	9			7.670
S-02/PM-44	8.07	8.55			8.310
S-03/PM-14	6.12	8.13			7.125

Chloride

	June	August	Mean
S-01/PM-12	35.8	40.9	38.350
S-02/PM-44	35.7	40.9	38.300
S-03/PM-14	35.8	41	38.400

Furnace

pH		(S.U)	DET	0.14	
	June	July	August	September	Mean
F-01/PM-05	7.96				1.99
F-02/PM-04	8.36		7.28		3.91
F-03/PM-36	8.63		6.8	6.24	5.42
F-04/PM-09	8.04		6.94	6.67	5.41
F-05/PM-xx	9.07		6.98	6.35	5.60
F-06/PM-08	9.12		6.74	6.36	5.56

Turbidity		(mg/l)	DET	0.25	
	June	July	August	September	Mean
F-01/PM-05	16.6	14			7.65
F-02/PM-04	17.5	14	26	13	17.63
F-03/PM-36	32.5	14	23	15	21.13
F-04/PM-09	2.9	18	27	14	15.48
F-05/PM-xx	17.1	21	26	17	20.28
F-06/PM-08	23.3	18	27	15	20.83

Phosphorus, Total		(ug/l)	DET	0.01	
	June	July	August	September	Mean
F-01/PM-05	0.05	0.09			0.04
F-02/PM-04	0.05	0.08	0.09	0.08	0.08
F-03/PM-36	0.08	0.07	0.09	0.09	0.08
F-04/PM-09	0.05	0.08	0.09	0.09	0.08
F-05/PM-xx	0.04	0.1	0.08	0.09	0.08
F-06/PM-08	0.05	0.09	0.09	0.08	0.08

Total Nitrogen		(mg/l)	DET	0.5	
	June	July	August	September	Mean
F-01/PM-05	0.094	0.63			0.18
F-02/PM-04	0.83	0.65	1.23	1.31	1.01
F-03/PM-36	1.77	0.59	1.21	1.41	1.25
F-04/PM-09	0.98	0.71	1.27	1.63	1.15
F-05/PM-xx	0.88	1.05	1.32	1.45	1.18
F-06/PM-08	1.01	0.84	1.27	1.35	1.12

Dissolved Oxygen

	June	July	August	September	Mean
F-01/PM-05	8.84	5.00			3.46
F-02/PM-04	9.52	5.10	10.10	8.16	8.22

F-03/PM-36	9.28	6.26	6.32	7.47	7.33
F-04/PM-09	6.52	6.46	6.07	7.80	6.71
F-05/PM-xx	10.04	5.89	11.07	8.64	8.91
F-06/PM-08	9.99	5.15	5.40	8.52	7.27
F-07/PM-yy	9.27	4.90	10.10	8.47	8.19

Kjeldahl, Nitrogen		(mg/l)	DET	0.1	
	June	July	August	September	Mean
F-01/PM-05	0.09	0.63			0.18
F-02/PM-04	0.83	0.65	1.23	1.31	1.01
F-03/PM-36	1.77	0.59	1.21	1.41	1.25
F-04/PM-09	0.98	0.71	1.27	1.63	1.15
F-05/PM-xx	0.88	1.05	1.32	1.45	1.18
F-06/PM-08	1.01	0.84	1.27	1.35	1.12

Specific Conductance		um/cm	DET	0.5	
	June	July	August	September	Mean
F-01/PM-05	212	217			107.25
F-02/PM-04	209	220	221	220	217.50
F-03/PM-36	209	220	219	224	218.00
F-04/PM-09	210	217	213	224	216.00
F-05/PM-xx	209	216	240	224	222.25
F-06/PM-08	209	218		223	162.50

Alkalinity			DET	4	
	June	July	August	September	Mean
F-01/PM-05	10.4	25.5			8.98
F-02/PM-04	13	24.1	17.7	21.8	19.15
F-03/PM-36	11.2	25.7	19.5	22.4	19.70
F-04/PM-09	14.2	25.3	20.2	22.9	20.65
F-05/PM-xx	11.2	24.8	20.6	21.9	19.63
F-06/PM-08	13.6	25.1	20.8	21.1	20.15

Chloride		(mg/l)	DET	10	
	June	July	August	September	Mean
F-01/PM-05	45.6	46.9			23.13
F-02/PM-04	46.4	47.2	47.4	48.6	47.40
F-03/PM-36	45.6	47.2	47.2	48.8	47.20
F-04/PM-09	45.3	47	47.5	48.7	47.13
F-05/PM-xx	45.2	46.9	47.3	48.9	47.08
F-06/PM-08	45.3	47	47.2	48.6	47.03

<u>Little Sandy/Hobomock</u>

pH	(S.U)	DET	0.14
	June	August	September
H-01	7.82		7.84
LS-01		7.6	
LS-02		7.6	
LS-03		7.97	

Turbidity	(mg/l)	DET	0.25
	June	August	September
H-01	0.65		0.75
LS-01		0.9	
LS-02		0.8	
LS-03		0.95	

Total Nitrogen

	June	August	September
H-01	0.5		0.5
LS-01		0.5	
LS-02		0.5	
LS-03		0.5	

Phosphorus, Total

	June	August	September
H-01	0.03		0.09
LS-01		0.02	
LS-02		0.02	
LS-03		0.02	

Dissolved Oxygen

	June	August	September
H-01	8.61		6.31
H-02	8.97		6.78
LS-01		8.35	
LS-02		7.22	
LS-03		6.95	
LS-04		7.34	

Kjeldahl, Nitrogen

	June	August	September
H-01	0.5		0.5
LS-01		0.5	
LS-02		0.5	
LS-03		0.5	

Specific Conductance

	June	August	September
H-01	214		206
LS-01		256	
LS-02		254	
LS-03		254	

Alkalinity

	June	August	September
H-01	4		6.01
LS-01		9.58	
LS-02		7.87	
LS-03		13.2	

Chloride

	June	August	September
H-01	56		56.3
LS-01		62	
LS-02		61.9	
LS-03		62	

Pembroke Watershed Association
P. O. Box 368, Pembroke, MA 02359-0368

Water Sample Collection Data Sheet

Date: _________

Sampling Station # S-01 Watershed: South Coastal

Pond or River: Stetson GPS Location: __________________

Town: Pembroke, MA Water level: ________________ft

Today's weather:____ Rainfall: _______in.

Yesterday's weather:____ Rainfall :_______in.

Day before's weather:____ Rainfall: _______in.

Site location: S-01 ____

Sample taken from: Boat, Bank, Wade, Dock, Other________________________________

Depth at sample area: _______ft. Air temp: _________ºF Surface Water temp: _____ºF

Water Use:	None, Fishing, Boating, Skiing, Swimming
Water Color:	Clear, Cloudy, Milky, Foam, Brown (muddy), Grey (Silty), Green
Water Odor:	None, sewage, Oil, Chlorine, Rotten egg, Other _________________________
Algal Growth:	None, 5%, 10%, 15%, 20%, 25%50%, 75%, >75% Algae Color Green, Blue Green
Bottom Appearance:	Not visible, Sludge, Sand, Rock, weeds, Other __________________________
Weed Growth in sample area:	None visible, surface, submerged % of weeds _________
Water Characteristics:	Large waves, Small Waves, Smooth, still
Current at sample area:	Fast, Slow, Still

Chemistry sample: Yes no Time: _______am pm Depth _______ft. Bottle ID#_________

E-coli sample: Yes no Time :_______am pm Depth _______ft. Bottle ID#_________

DO Grab sample: Yes no Time :_______am pm Depth _______ft. Bottle ID#_________

DO Meter sample: Yes no Time: _______am pm Depth _______ft.

DO ________ mg/l __________ % Water Temp ________

Turbidity _______Conductivity ______ pH _______ Salinity ______

Secchi Disk Transparency: Yes No Time: _______am pm Depth _______ft. .

Quanta Certified tester ____ Date ___________ Time______

Print & Sign

Comments:____
____
____
____
____

Sample taker name:____ Date:________ Time:_________

Print & Sign

Witness:____ Date:________ Time:_________

Print & Sign

Pembroke Watershed Association

P. O. Box 368, Pembroke, MA 02359-0368

Dissolved Oxygen at Deep Hole

Date: _________

Sampling Station # ___________________ Watershed: _______________________

Pond or River: ___________________ GPS Location: __________________

Town: Pembroke, MA Water level: _________________ft

Today's weather: ____ Rainfall: _______in.

Yesterday's weather: ____ Rainfall: _______in.

Day before's weather: ____ Rainfall: _______in.

Site location: ____

Sample taken from: Boat, Bank, Wade, Dock, Other__________________________________

Depth at sample area: _______ft. Air temp: _________ºF Surface Water temp: _____ºF

Water Use: None, Fishing, Boating, Skiing, Swimming
Water Color: Clear, Cloudy, Milky, Foam, Brown (muddy), Grey (Silty), Green
Water Odor: None, sewage, Oil, Chlorine, Rotten egg, Other ________________________
Algal Growth: None, 5%, 10%, 15%, 20%, 25%50%, 75%, >75% Algae Color Green, Blue Green
Bottom Appearance: Not visible, Sludge, Sand, Rock, weeds, Other _______________________
Weed Growth : None visible, surface, submerged % of weeds _________
Water Characteristics: Large waves, Small Waves, Smooth, still
Current at sample area: Fast, Slow, Still

DO sample reading: _____ Mg/l ____ % Time: ______am/pm Depth__**4**__ft. Water temp ______ ^{0}F

DO sample reading: _____ Mg/l ____ % Time: ______am/pm Depth__**7**__ft. Water temp ______ ^{0}F

DO sample reading: _____ Mg/l ____ % Time: ______am/pm Depth__**10**_ft. Water temp ______ ^{0}F

DO sample reading: _____ Mg/l ____ % Time _______am/pm Depth ____ft. Water temp ______ ^{0}F

Secchi Disk Transparency: Yes No Time: _______am/pm Depth _______ft.

Comments:____
____
____
____
____

Sample taker name:____ Date:________ Time:_________
PRINT & SIGN

Witness:____ Date:________ Time:_________
PRINT & SIGN