Deep Brook Assessment

Newtown, Ct

Prepared By:

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New Town Land Use Agengy

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Introduction:

Upon the analysis of data, Newtown Land Use has found that in parts of the Deep Brook River there are elevated measurements of Conductivity, Phosphorous and even Ammonia that are consistent and rising over the years. Further investigation of these elevated measures can lead to possible ways to find the source to the problem occurring and possible ways to improve or stop the pollution. The aim of this project is too analyze data that can improve the water quality of the river thus improving the ecosystem around and animals that live within the rivers abundances.

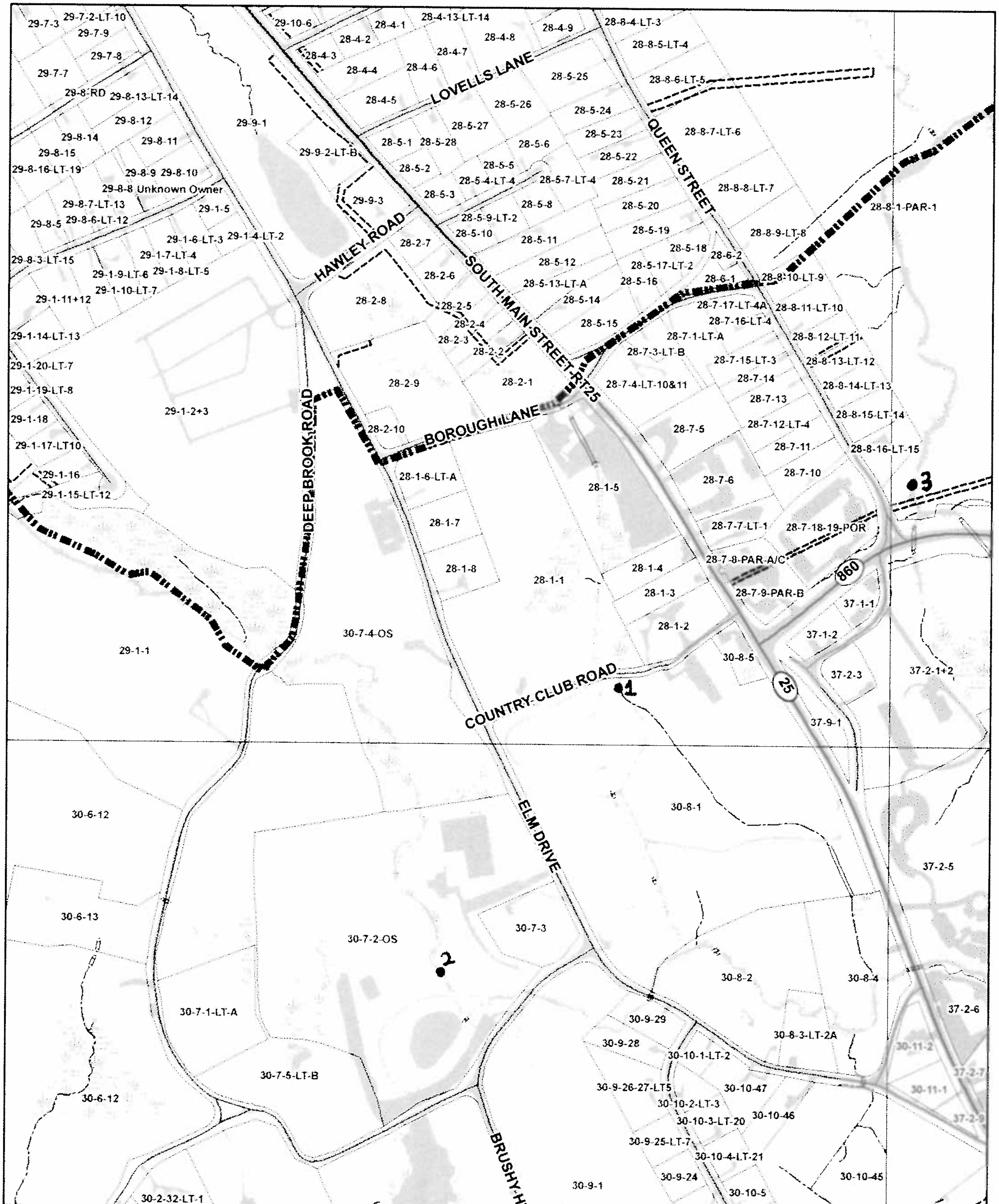
Site Description:

(The Map section below will show the layout of the land and where the various well sites are)

The Deep Brook River flows approximately from east of Route 25 at Park Lane north then east around the old hospital campus to the Pootatuck River. Historically Deep Brook was used for many resources like fishing, mills and more. By 1715, saw mills were set up on Deep Brook, along with a fulling mill. Deep Brook has 4 testing sites 3 of which we are investigating.

DB1 (Country Club Road), DB2 (Deep Brook Road) and DB3 (Queen Street). DB1 and DB2 intersect their tributaries around rout 25 and the combined nutrients effect DB3. DB1 and DB2 do not affect each other they are independent.

The Deep Brook Areas of interest DB1 and DB2 are in residential areas that do not get a lot of "action". DB1 before intersecting with DB2's water flows through a country club area with golf courses and recreational activities. But further up the stream before the DB1 testing site, there is a commercial parking lot with many cars and impervious material in which water flows straight into the river. The rest of the surrounding areas are residential with streets that could pose threats because of their impervious surface. DB2 flows right through a newly renovated town park with a parking area, walking areas, and tennis courts. Various activities are preformed in these vicinities. Further up stream there is agricultural land in use that could pose a threat to the river because of fertilizers and more. One other possible threat to the river is a baseball field that is close enough to the river that its watershed is absorbed into the rivers system so any fertilizer used can contaminated the river. This area of Connecticut is known for its glacial till, outcroppings of rocks and secondary forests that are majorly undeveloped. The Deep Brook River is known for being one of the largest tributaries for the Pootatuck River and very important for the reproduction of trout.



TOWN OF NEWTOWN

TOWN OF NEWTOWN, CT
G.I.S

450 225 0
Feet

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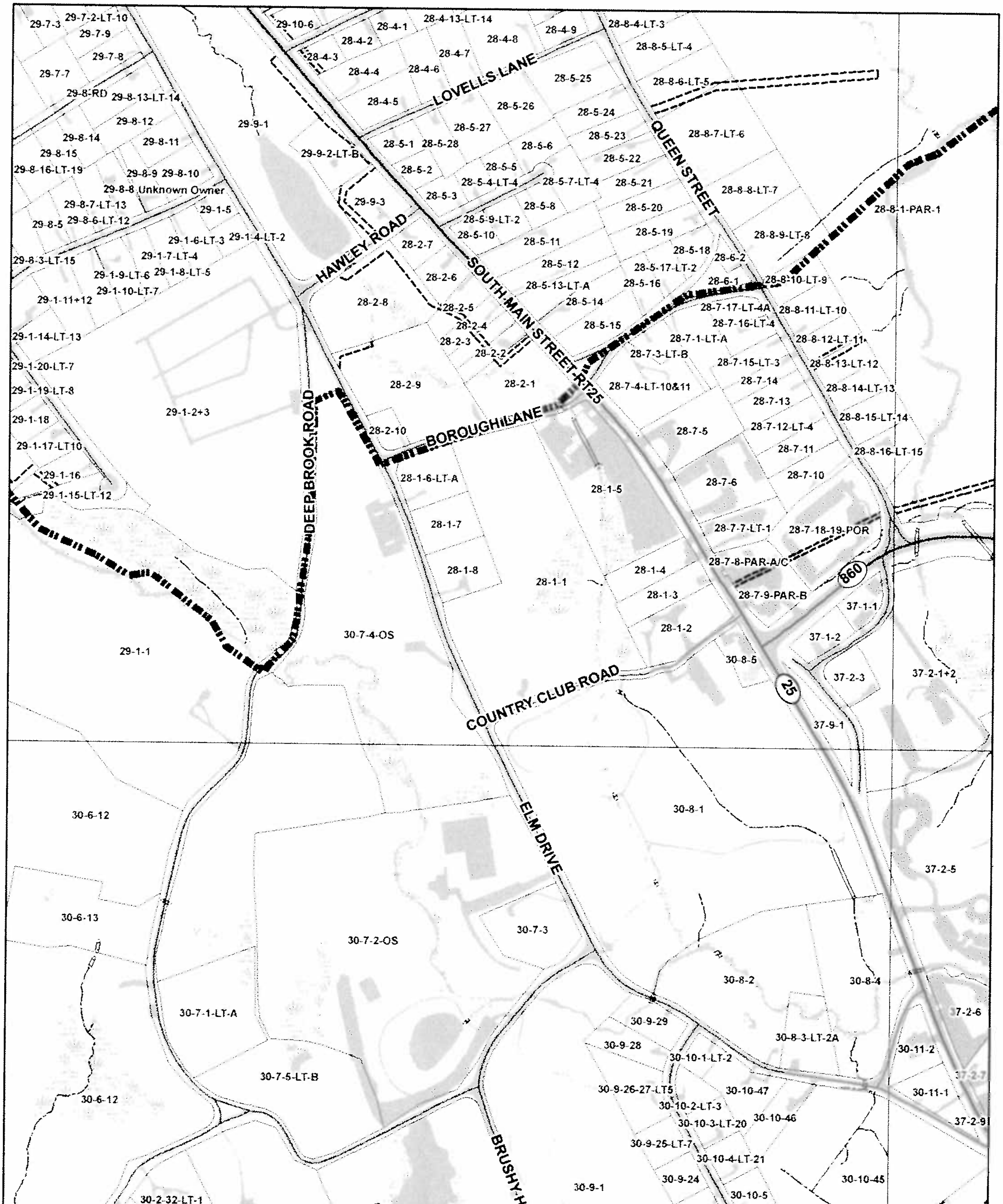

TOWN OF NEWTOWN 1705 CONN.

TOWN OF NEWTOWN, CT
G.I.S GEOGRAPHIC INFORMATION SYSTEMS

450 225 0 Feet

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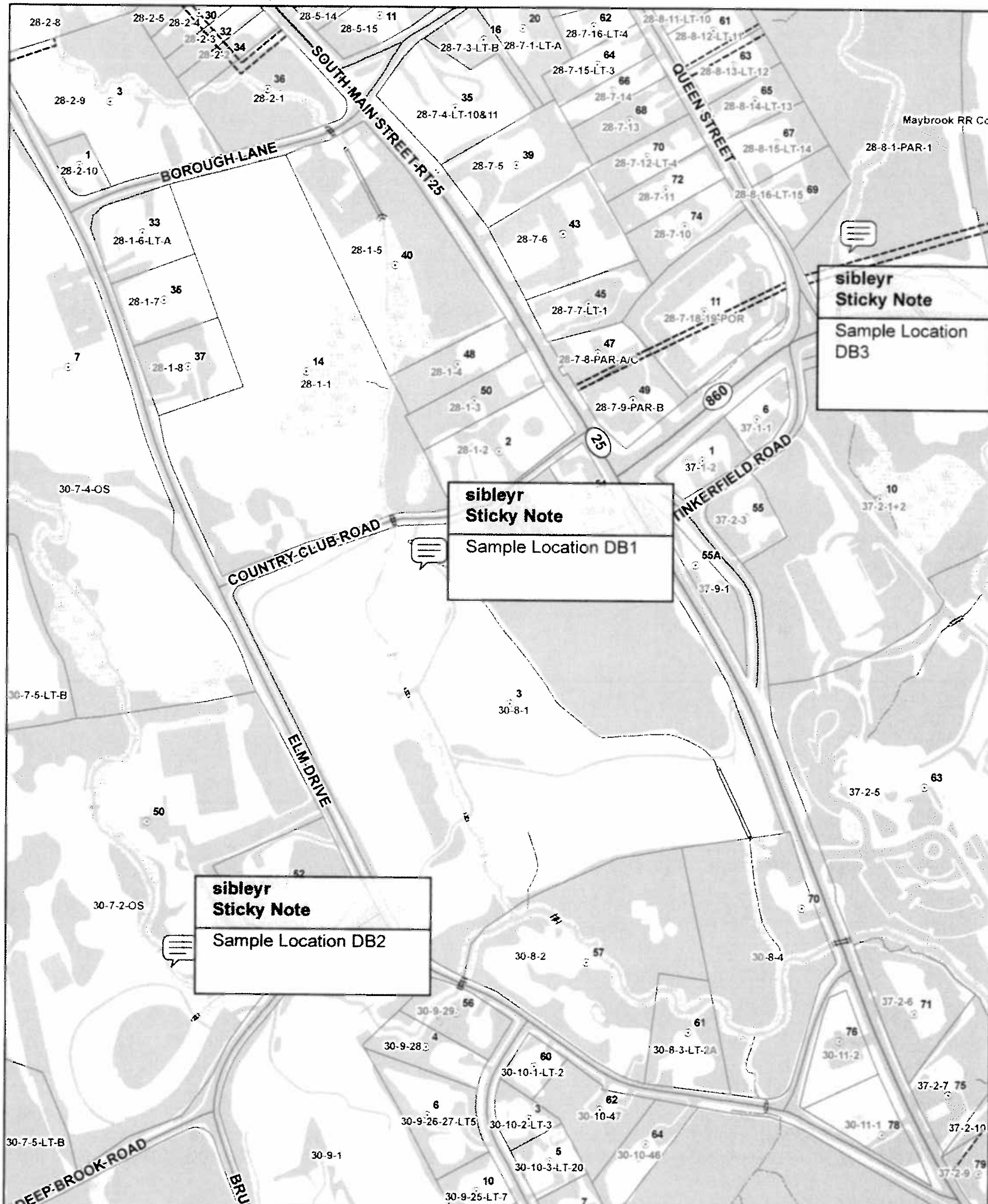

360 180 0 360

Feet

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Rob Sibley January 20,2011

TOWN OF NEWTOWN, CT

G.I.S GEOGRAPHIC INFORMATION SYSTEMS

350 175 0 350 Feet

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Methods:

Beginning in 2006, September and June samples are taken and the conductivity is recorded at each of the same sites (DB1-4). Water samples are taken for not just Deep Brook but also the Pootatuck, Pond Brook, and Halfway River. The samples taken at these sites are then brought to a lab, and there the lab performs the necessary tests. Temperature (c) is taken along with, Conductivity (umhos/cm), total Phosphorus (ug/liter), Ammonia (ug/liter), Nitrate (ug/liter), Coliform Bacteria and eColi Bacteria. Results are then organized and analyzed.

Testing Dates		
6/1/2006	9/21/2006	6/5/2007
9/13/2007	6/12/2008	9/22/2008
6/22/2009	9/29/2009	6/8/2010

Also, during the water sampling a Macroinvertebrates survey is taken in Deep Brook. During the same time we took water samples, a **qualitative** sample of Macroinvertebrates was taken. Rocks would periodically be turned over and the invertebrates present would be recorded. Each different type of Macroinvertebrate is an "indicator" species. The presence of certain species indicated that the water quality is either good or bad

Results:

Deep Brook has 4 testing sites 3 of which we are investigating. DB1 (Country Club Road), DB2 (Deep Brook Road) and DB3 (Queen Street). DB1 and DB2 intersect their tributaries around Rout 25 and the combined nutrients effect DB3. DB1 and DB2 do not effect each other they are independent. **Figures 1,2** and **3** all show the averages for Ammonia, Conductivity and Phosphorous for each of the 4 sites. Looking at each one it is easy to see that between site 2 and 3 there is a increase, whether it be 560-730 (Ammonia), 226-260 (Conductivity), or stayed constant at a higher number than the rest 80-90 (Phosphorus). **Figure 3** shows that the Max Conductivity for Deep Brook was 358 which is well above the minimum of 160. The average of these parameters increase as the water flows downstream, which is a normal occurring situation.

Looking at the yearly averages you could not get a full idea of what was really happening in the river. Once the data was broken up into the different testing months and compared is when a clear trend was shown. **Figures 4 and 5** show the break down separating the months June from September. In September between DB2 and DB3 the variation is generally the same with a wide deviation but when you look at DB2 and DB3 on **Figure 5** you see a clear increase over the years on DB2 from 30-80 and an even steadier decrease over the years from 60-30 for DB3.

Figure 6 shows the total conductivity of deep brook for every date taken (September and June) at every site. DB1 shows clearly that the amount of conductivity is greater that DB2-4. DB1 ranges from 330 to 358 (with one outlier of 160) while DB2-4 range from 42 to 260.

Looking at **Figure 7** the average conductivity of DB1 is 322. The averages for DB2-4 and all less than 200, not even getting close to the same measurement of DB1. Also, now looking at **Figures 8 and 9** the conductivity for the month of September years 2006 through 2010 has been abnormally high for the testing site DB1 and even for June the numbers were especially high.

More supporting data shows on **Figure 10-13,** shows the Deep Brook Conductivity comparing a month in September to the corresponding month in June. All the data indicates that there is a huge increase in the Conductivity at site 1.

The Deep Brook assessment of Macroinvertebrates showed a direct correlation to the phosphorous. In figure 14 you can see the Macroinvertebrates that were found for either DB2 or DB3. At DB2 starting in 2006 the water quality was shown to be good by the Macroinvertebrates observed. The invertebrate found was the Mid-Size Case Fly (Trichoptera) , with a tolerance level of 1 the water quality had to be good for this invertebrate to live there. Then in 2007 the water quality changes to moderately good; this happened because again the Mid-Size Case Fly (Trichoptera) was found but also a MayFly (Ephemeroptera)which has a tolerance level of 4 and is found in moderate water qualities. In 2009 the Mid-Size Case Fly (Trichoptera) was not found and only the MayFly (Ephemeroptera) was showing the water quality decrease and then again in 2010 the Water Beetle was found which is also a moderate invertebrates with a tolerance level of 4 but is known to be found in worse water quality areas such as DB2 as the around of Phosphorous increases. From 2006-2010 the Macroinvertebrates populations at DB2 changed to a less diverse and more tolerant species which correlates to the increase in phosphorus.

In DB3 the Water quality generally stayed the same over the years with a slight fluctuation. 2006 samples were not taken, but in 2007 the Saddle Case Maker(Trichoptera) was found which has a tolerance level of 0 meaning the water quality had to be pristine. The next year (2008) all that was found was the Mid-Size Case Fly (Trichoptera) and the MayFly (Ephemeroptera). The water quality is still good/ moderately good. The next year, 2009, had the same results but in 2010 only the Mid-Size Case Fly (Trichoptera) was found which has a tolerance level of 1. The stability of the Macroinvertebrates population is indicative of good quality.

(INFORMATION ON MACROINVERTEBRATES CAN BE FOUND BELOW PANEL #'S 6A, 8A, 8B, 11, 12, 13A AND 13B.)

Figure 1

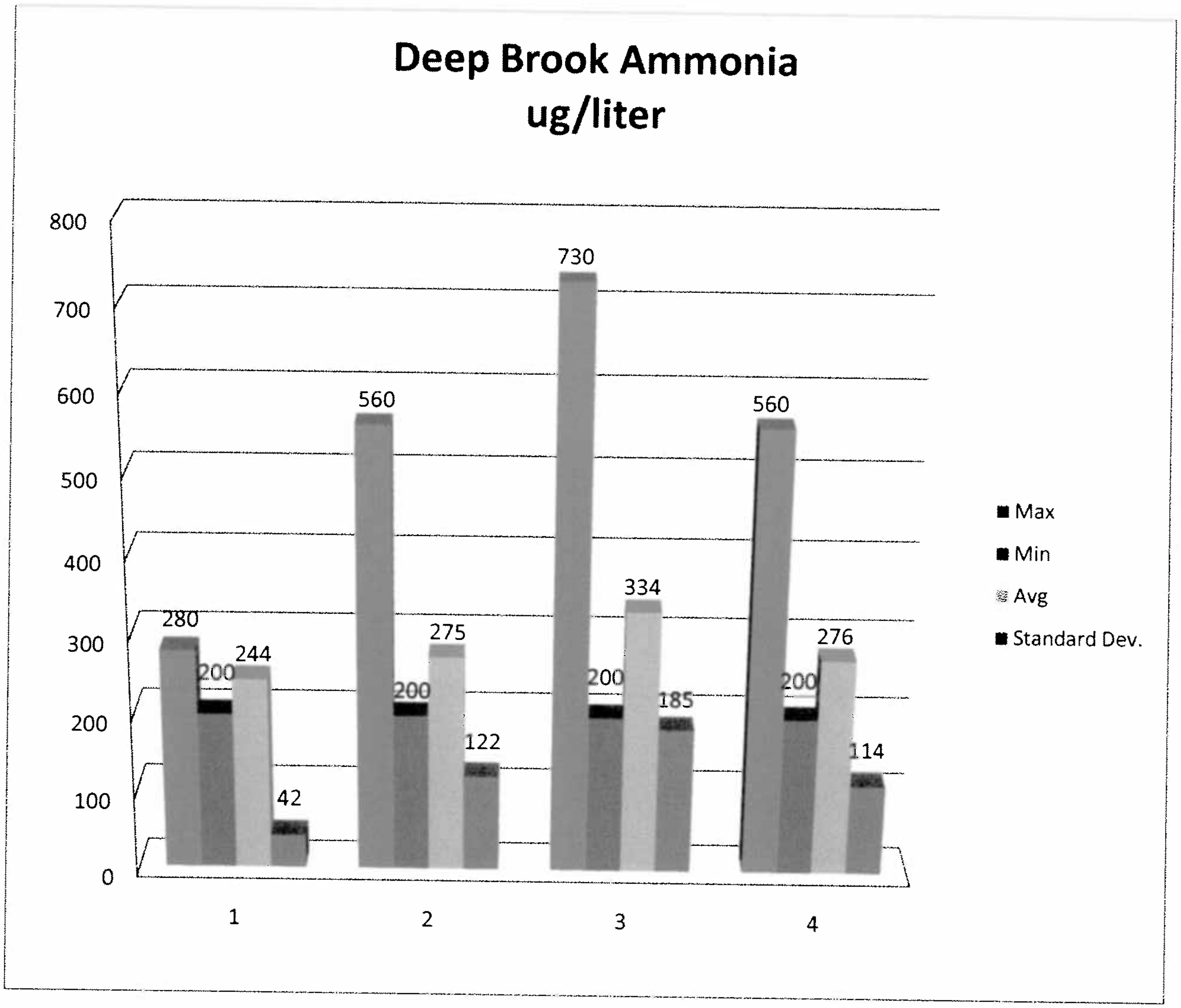

Deep Brook Ammonia
ug/liter
800
700
600
500
400
300
200
100
0
280
200
244
42
560
200
275
122
730
200
334
185
560
200
276
114
1
2
3
4
Max
Min
Avg
Standard Dev.

Figure 2

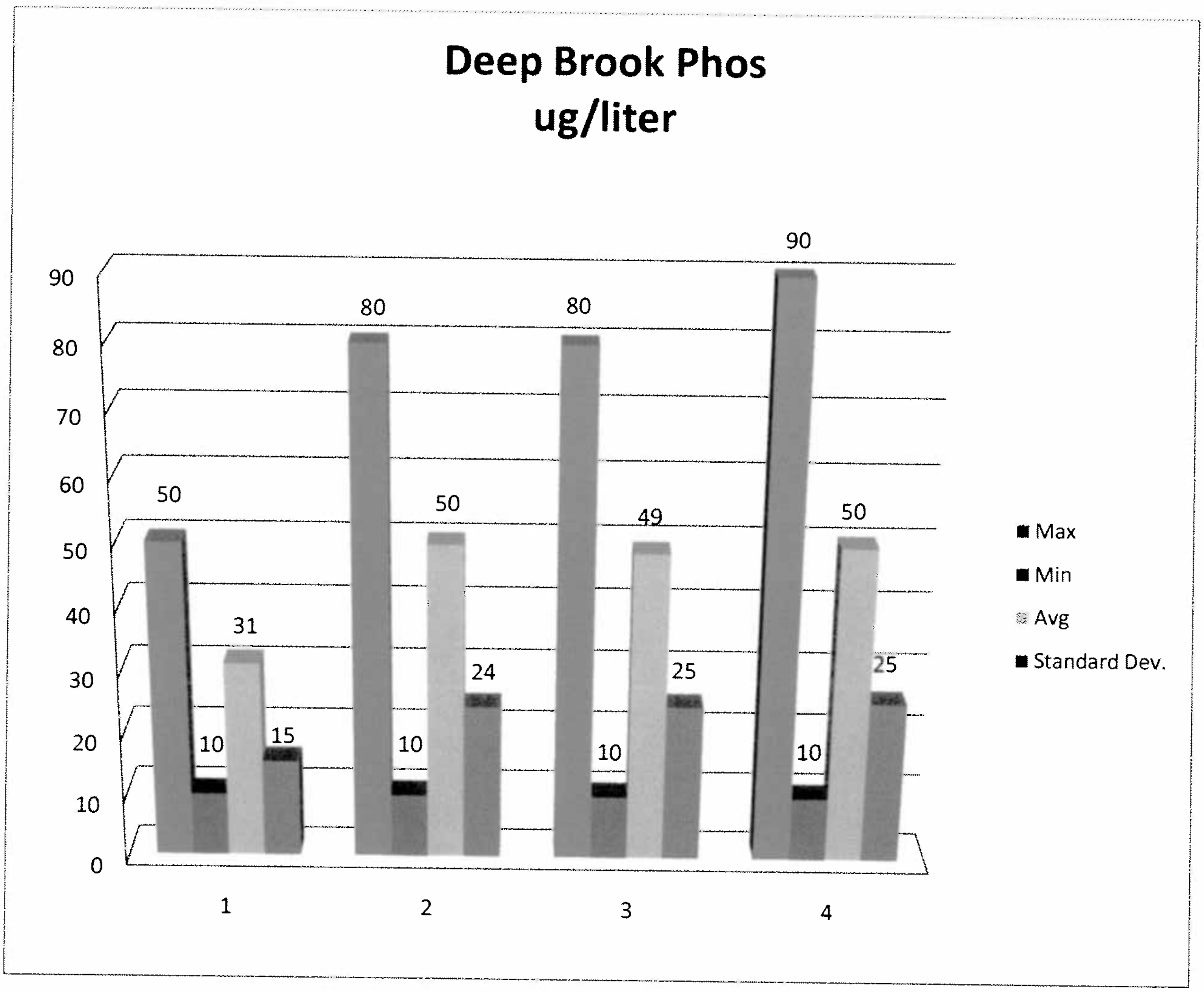
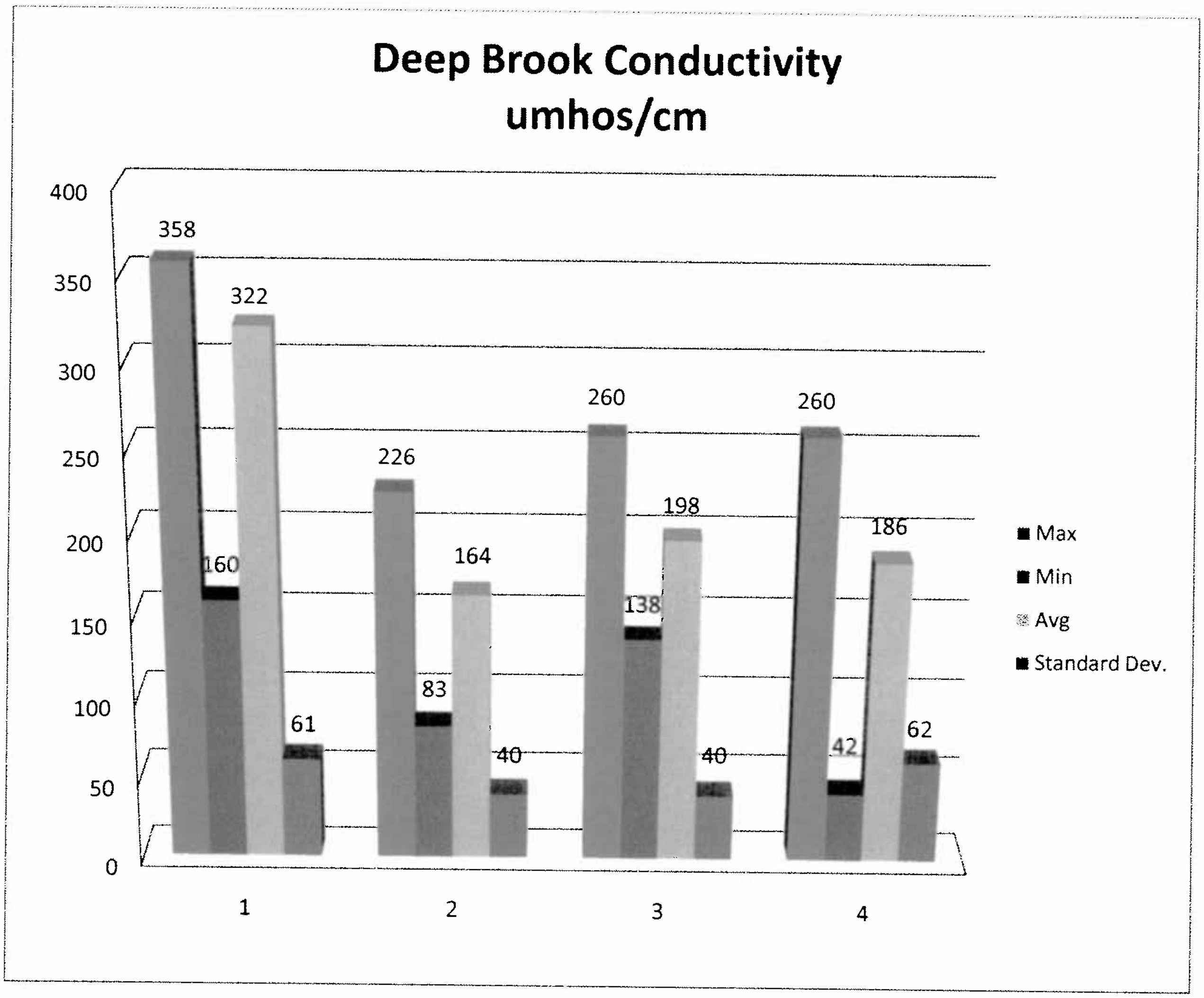

Deep Brook Phos
ug/liter
90
80
70
60
50
40
30
20
10
0
50
10
31
15
80
10
50
24
80
10
49
25
90
10
50
25
1
2
3
4
Max
Min
Avg
Standard Dev.

Figure 3



Deep Brook Conductivity
umhos/cm
400
350
300
250
200
150
100
50
0
358
160
322
61
226
83
164
40
260
138
198
40
260
42
186
62
1
2
3
4
Max
Min
Avg
Standard Dev.

Figure 4

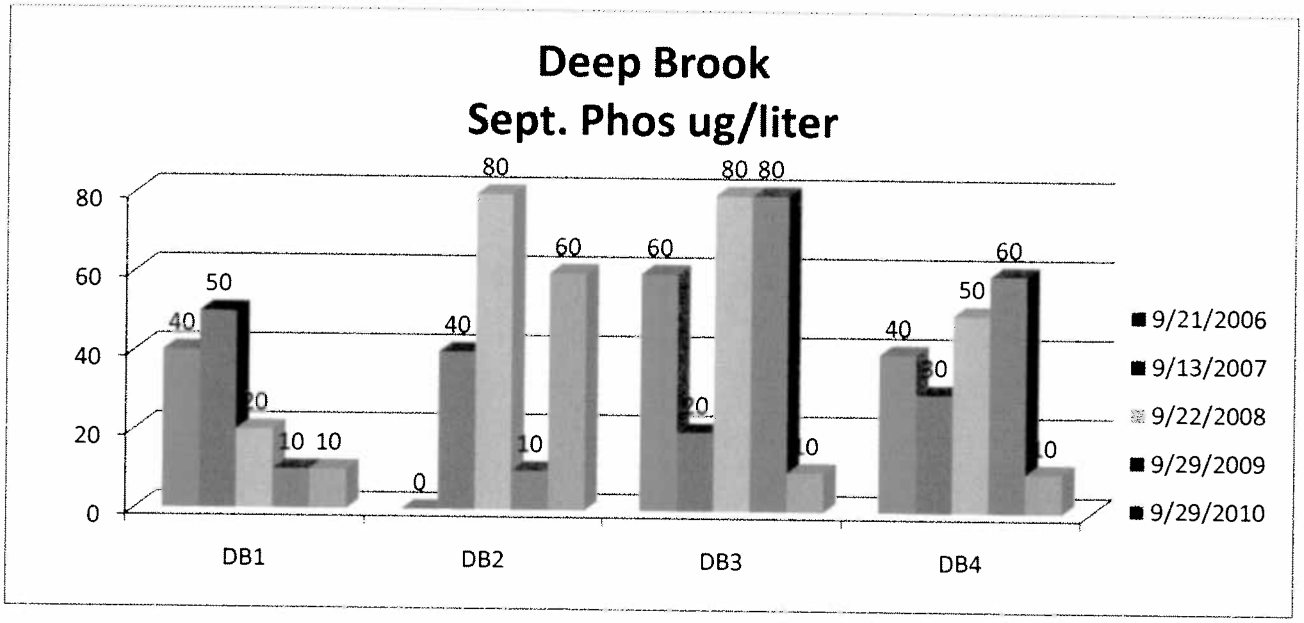


Figure 5

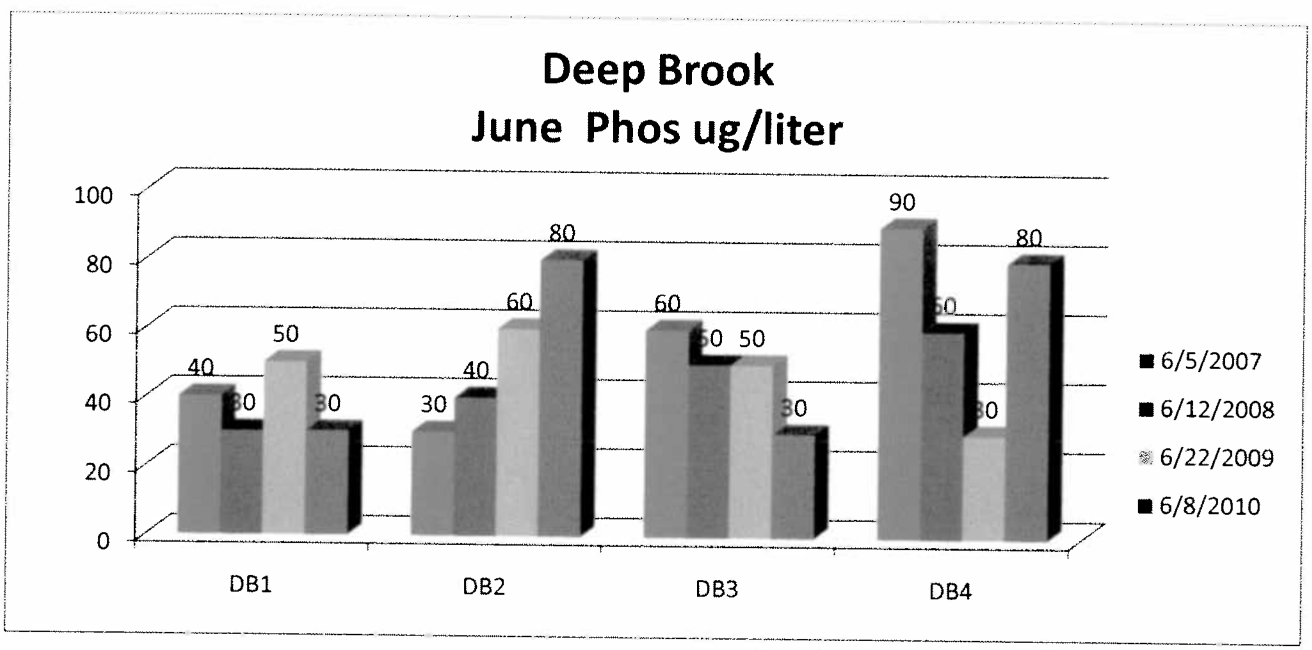


Figure 6

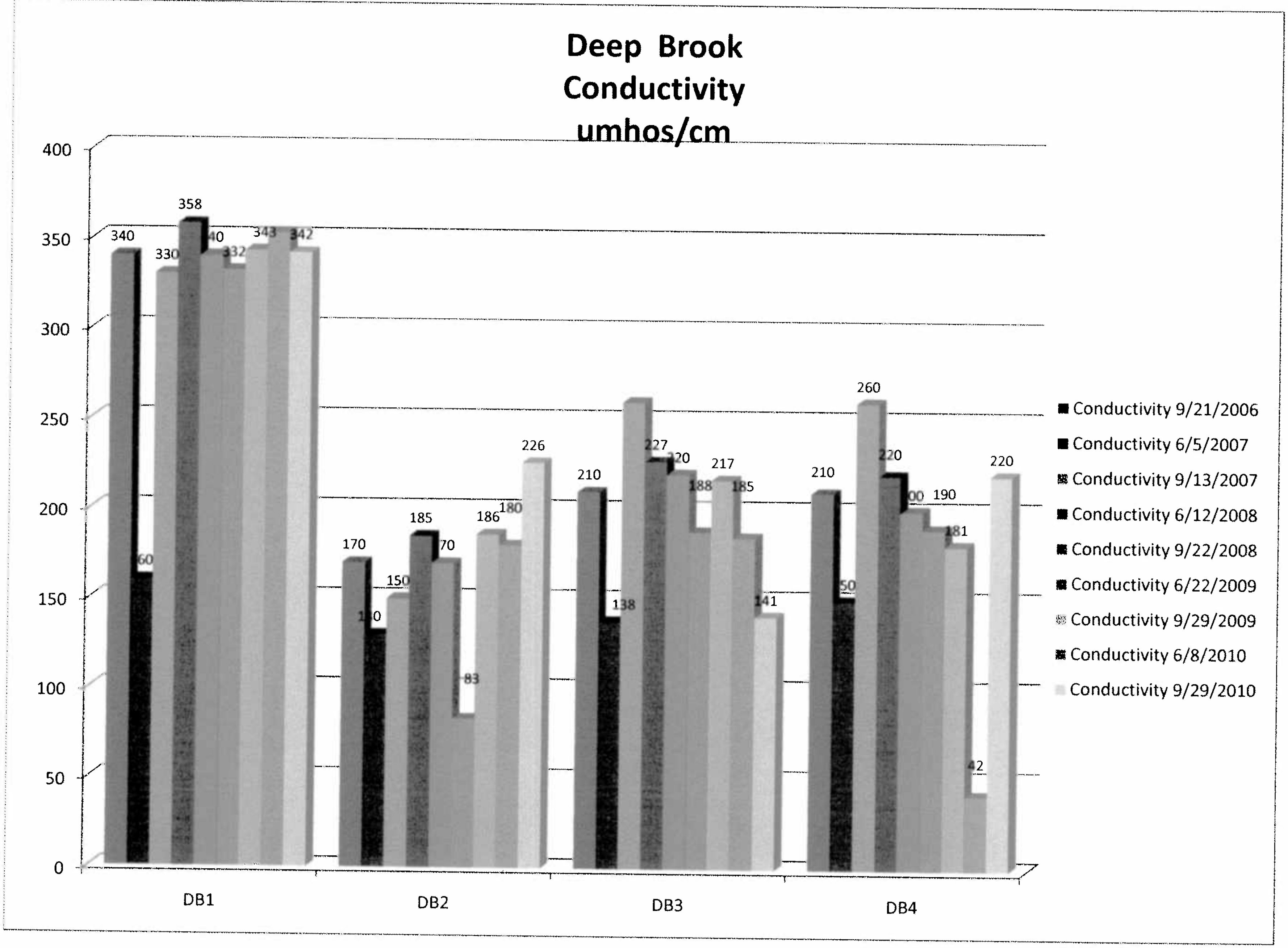

Deep Brook
Conductivity
umhos/cm
400
350
300
250
200
150
100
50
0
DB1
DB2
DB3
DB4
Conductivity 9/21/2006
Conductivity 6/5/2007
Conductivity 9/13/2007
Conductivity 6/12/2008
Conductivity 9/22/2008
Conductivity 6/22/2009
Conductivity 9/29/2009
Conductivity 6/8/2010
Conductivity 9/29/2010

Figure 7

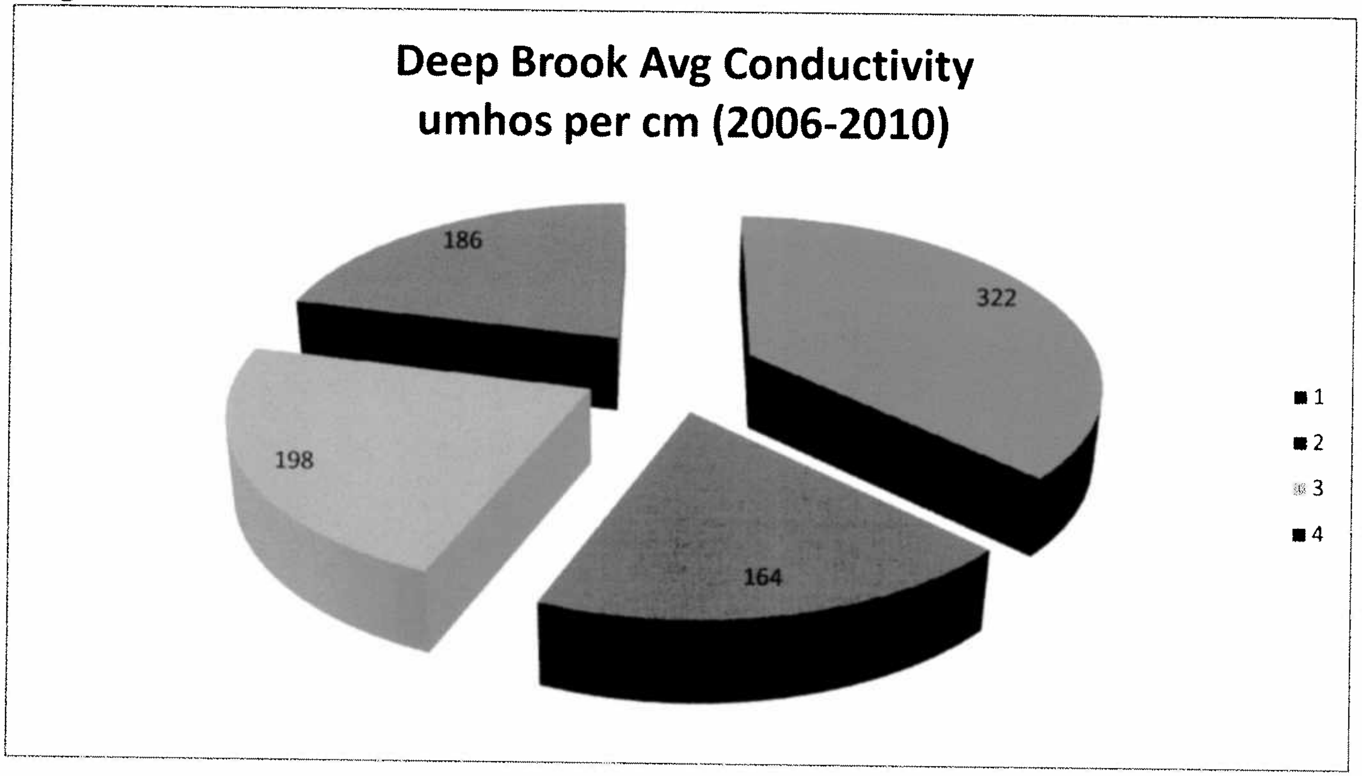

Deep Brook Avg Conductivity
umhos per cm (2006-2010)
186
322
198
164
1
2
3
4

Figure 8

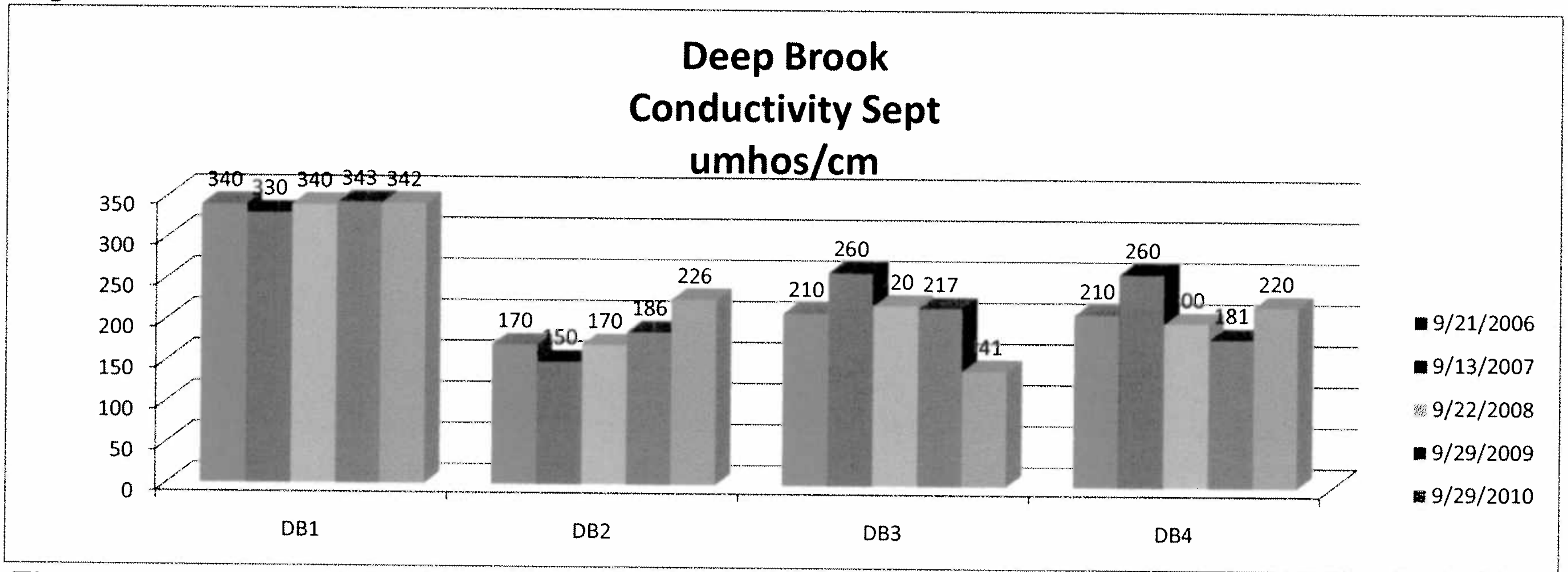


Figure 9

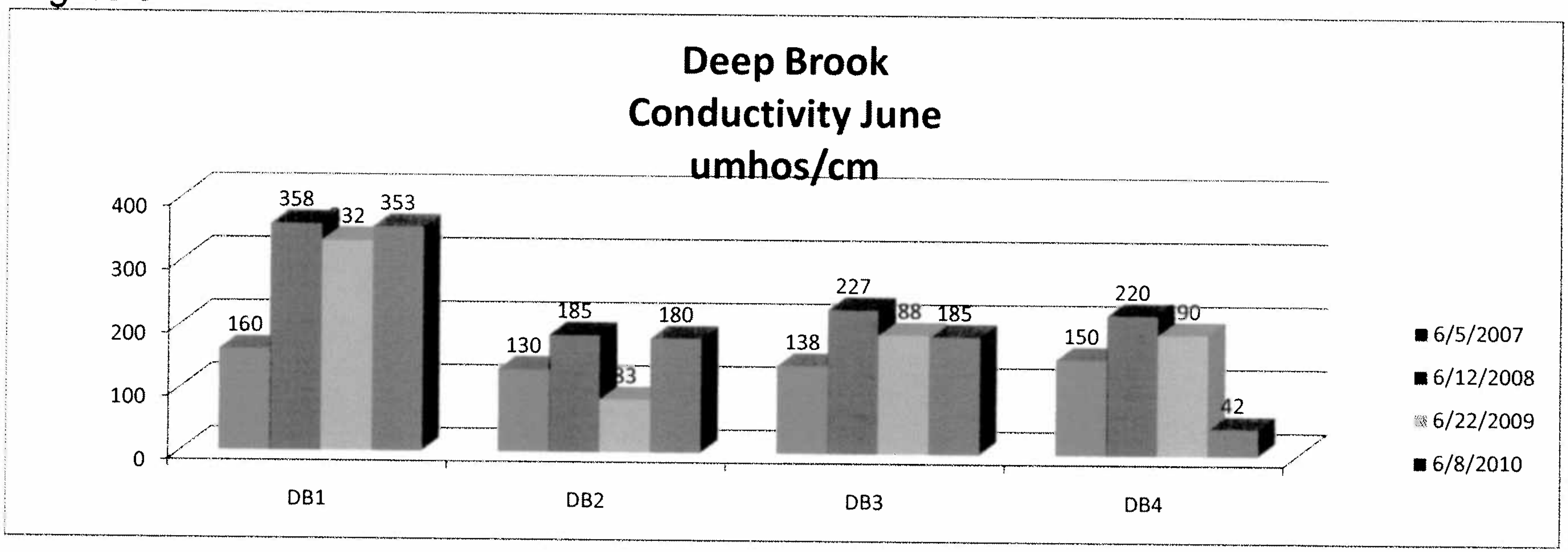


Figure 10

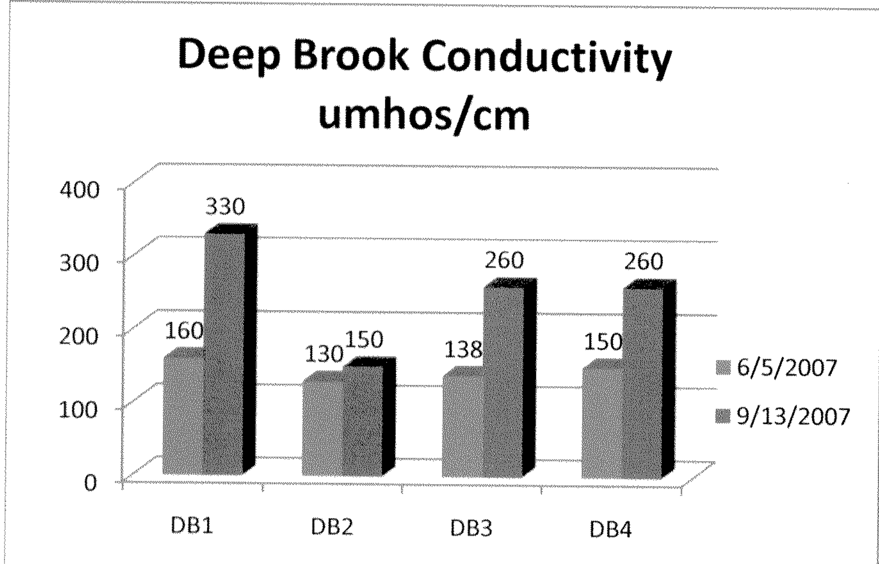


Figure 11

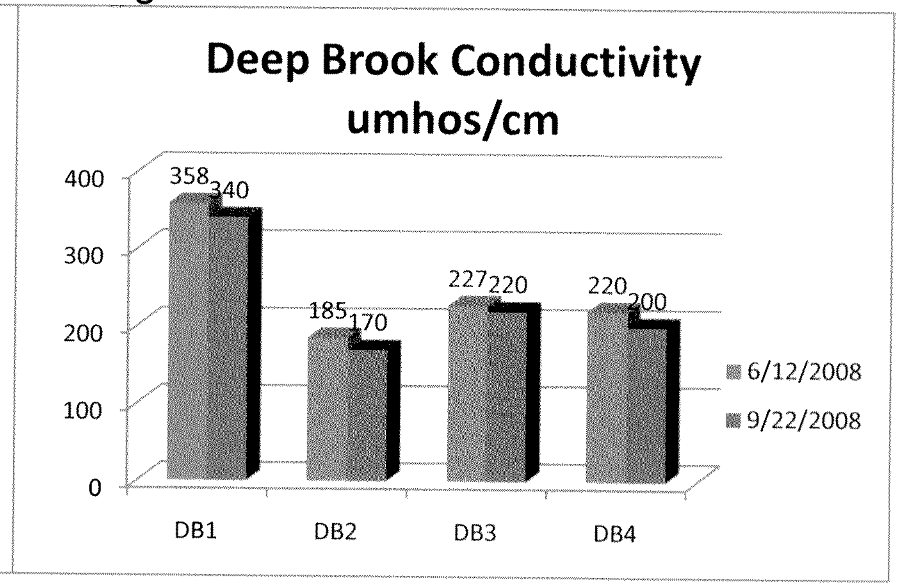


Figure 12

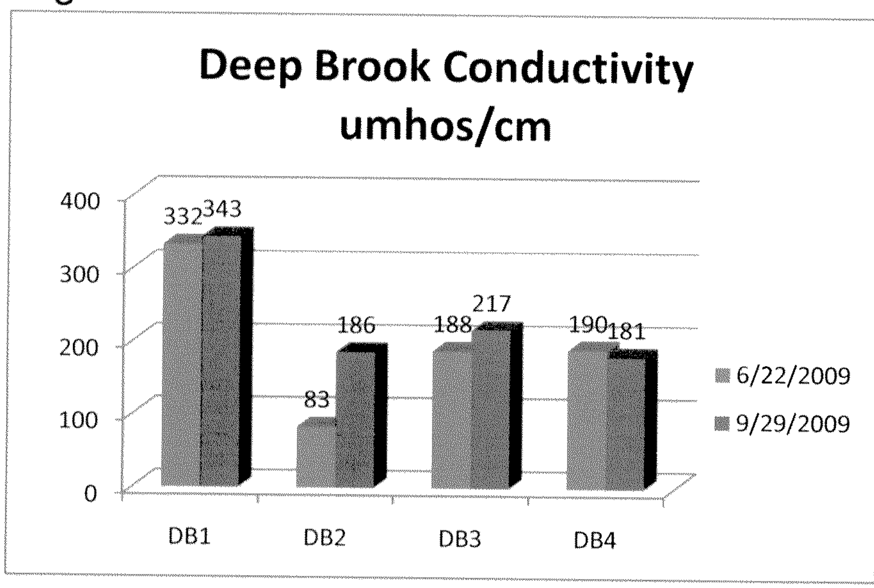


Figure 13

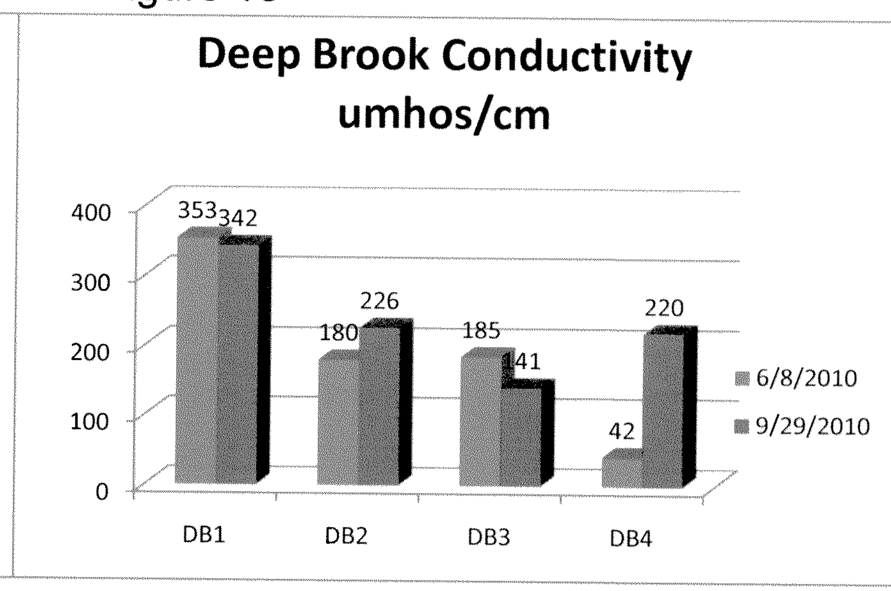


Figure 14

Date	Macroinvertebrate Deep Book 2	Macroinvertebrate Deep Brook 3
6/1/06	Mid-Size Case Fly (Trichoptera) TL=1	
6/5/07	Mid-Size Case Fly (Trichoptera) TL=1 MayFly (Ephemeroptera) TL=4	Saddle Case Maker(Trichoptera) TL=0
6/18/08	MayFly (Ephemeroptera) TL=4 Water Penny Beetle (Coleoptera) TL=4	Mid-Size Case Fly (Trichoptera) TL=1 MayFly (Ephemeroptera) TL=4
6/22/09	MayFly (Ephemeroptera) TL=4	Mid-Size Case Fly (Trichoptera) TL=1 MayFly (Ephemeroptera) TL=4
6/8/10	Water Penny Beetle (Coleoptera) TL=4	Mid-Size Case Fly (Trichoptera) TL=1

TL= Tolerance Level

0- Least tolerant. Most wanted
1- Tolerant. Most wanted
2- 4- Most tolerant. Moderately wanted

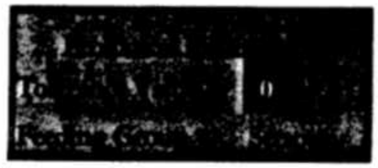
PANEL # 6A

SADDLE CASE MAKER

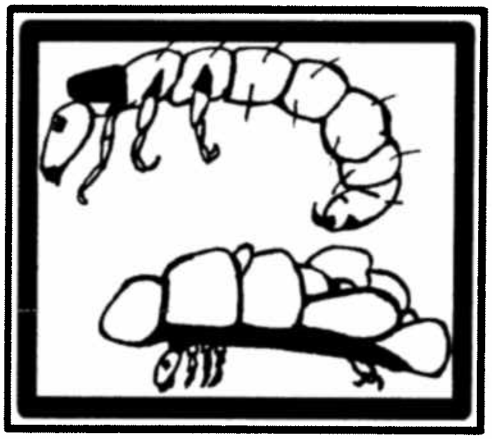
Genus *Glossosoma*

Family Glossosomatidae

Order Trichoptera



Side view of Glossosoma larva without and in case



Key features to look for:

- ☐ Small oval stone case, turtle shell shape.
- ☐ Case is made of 15-25 very small pebbles.
- ☐ Underside of the case has 2 round openings.
- ☐ Larva body is cylindrical and slightly arc shaped.
- ☐ Larvae has light body with dark head and legs.
- ☐ No larger than 1/4 inch.

side view of case

Key behaviors to look for:

- ☐ This caddisfly larva is often attached to the surface of rocks in fast current.
- ☐ May not move at all when in the tray. If so it will crawl slowly along the bottom of the tray.

Points of Note:

This organism can be confused with other small case building caddisflies like *Apatania* and *Neophylax*. This caddisfly can be abundant under appropriate conditions.

Look very carefully for these very small caddisfly larvae. It may be easier to located by observing rocks in the stream before any kicks are made.

MOST WANTED

Panel 6 of pocket guide.

PANELS # 8 A & B

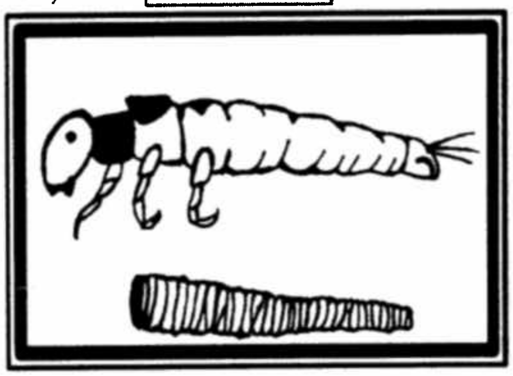
MID-SIZE PLANT CASE BUILDERS

Genus *Brachycentrus and Lepidostoma*

Family Brachycentridae and Lepidostomatidae

Order Trichoptera

Brachycentrus **Panel 8A**



Key features to look for:

- [ ] Case constructed of organic material only.
- [ ] Each case is made from either strips or small blocks.
- [ ] Case and larvae taper from front to back.
- [ ] Larvae have light bodies with dark head and legs.
- [ ] At most 1/2 inch in length.

Lepidostoma **Panel 8B**

Key behaviors to look for:

- [ ] Cryptic neither will move around the tray very much.
- [ ] Cases may be attached to sticks, leaves, or larger rocks.
- [ ] When crawling, they resemble hermit crabs.

Points of Note:
These caddisfly larvae can be very abundant under the appropriate conditions. Look carefully when the sample contains old leaves, sticks, or bark.

MOST WANTED

Panel 8 of pocket guide.

PANEL # 11

FLAT-HEAD MAYFLY

Genus *Stenonema*

Family Heptageniidae

Order Ephemeroptera

Key features to look for:

☐ Very flat body with long thin legs.

☐ 3 very long tails at the end of the abdomen.

☐ Single set of wing pads.

☐ Small round gills on the sides of the abdomen.

☐ Very broad flat head with large eyes.

Key behaviors to look for:

☐ This mayfly nymph is very mobile and can move and swim fast when in water.

☐ Doesn't move well in the net.

☐ Occasionally it may swim by undulating from side to side.

☐ It will try to hide on any flat dark colored object like stones, leaves, and other invertebrates.

Points of Note:

This mayfly can be found in many of the streams across Connecticut. They can be found by slowly lifting cobbles out of the water. They may run to the other side of the rock. Be sure not to confuse this organism with the 2-tailed version (*Epeorus*). The legs, gills, and tails tend to break off during the collection process.

MODERATELY WANTED

Panel 11 of pocket guide.

PANEL # 12

WATER PENNY BEETLE LARVA

Genus *Psephenus*
Family Psephenidae
Order Coleoptera

Top view

Key features to look for:

- [ ] Small disc shape organism.
- [ ] Very flat.
- [ ] Uniformly brown.
- [ ] No visible head or legs from top view.

Key behaviors to look for:

- [ ] Sticks very well to rocks.
- [ ] Glides along the bottom of the tray.
- [ ] May curl up when disturbed
- [ ] Very cryptic.

Bottom view

Points of Note:
Water penny beetle larva are very distinctive. They can also be very hard to locate in the field. Look very closely at the surfaces of rocks. Water penny beetle larva will adhere extremely close to the surface. These organisms can be locally abundant when conditions are appropriate.

MODERATELY WANTED

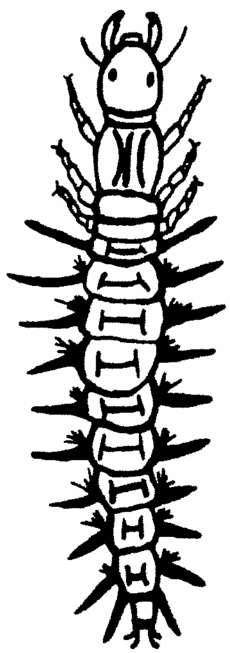
Panel 12 of pocket guide.

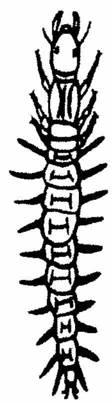
PANELS # 13A & 13B

DOBSONFLY AND FISHFLY

Genus *Corydalus and Nigronia*
Family Corydalidae
Order Megaloptera

Corydalus (Dobsonfly larva) *Nigronia* (Fishfly larva)





Key features to look for:

- ☐ Elongate body with a pair of long thin appendages on each section of the abdomen.
- ☐ Large pinching mouth parts.
- ☐ Set of hooks at the end of the abdomen.
- ☐ Nigronia can be up to 2 inches and do not have gills at the base of the abdominal projections.
- ☐ *Corydalus* can be extremely large (up to 4 inches) and a tuft of fluffy gills at the base of each abdominal projection.

Panel 13B

Key behaviors to look for:

- ☐ Very mobile, both will be very active crawling or wiggling in the tray.
- ☐ Will curl the abdomen around your finger if picked up.
- ☐ May cling to the net.

Panel 13A

Points of Note:
Large *Corydalus* are capable of inflicting a painful pinch with their mandibles. Please use care when handling these organisms.

MODERATELY WANTED

Panel 13 of pocket guide.

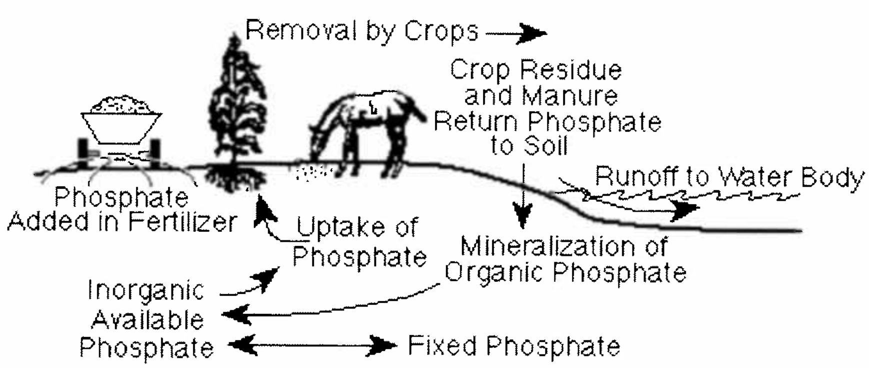
Discussion:

Phosphorus-

Phosphorus is common in agricultural fertilizers, manure, organic wastes (sewage), and is a micronutrient. It is the key to plant life, supplying them with the energy needed to grow. But when vastly abundant in water it can be detrimental speeding up eutrophication of rivers and lakes (the reduction of dissolved oxygen in water caused by an increase of mineral and organic nutrients intake-USGS). Although Phosphorus is essential for plant growth it is a great threat to water quality. The concentration of Phosphorus is usually low in fresh water, which causes algae growth to be limited. When lakes and rivers are polluted with Phosphorus, large growths of algae occur. The more algae in water can reduce clarity and can lead to less available dissolved oxygen and poses a major threat to fish and other aquatic animals. Agriculture contains/pollutes many soluble phosphates, organic phosphates, and inorganic. Phosphorus is one of the three nutrients used in fertilizers and is frequently used in agriculture land use, commercial land use and even residential.

The Cycle:

Phosphorus is added to a system, which is then absorbed by the surrounding plants. Animals may eat the plants containing the phosphate which is then absorbed into their system, where it is excreted into manure and back into the soil. Once back in the soil the Phosphorus is broken down and is then used again for the nutrients of pants and animals but can also spread to nearby water sources. Phosphorous also is naturally occurring in rock, soils and mineral deposits. The effect of breaking down of the soils, rocks and minerals through weathering, erosion cause them to leach Phosphorous ions into the surrounding soil. Other causes of elevated Phosphorous levels may be untreated sewage, fertilizer used for commercial or residential business and agriculture.



(http://www.extension.umn.edu/distribution/cropsystems/DC6795.html)

Soil erosion is a major contributor of Phosphorus to streams. Phosphorous does not move very quickly though soil when being broken down, but its movement can easily be increased by rainfall or any sort of water flow. This causes the nutrients in the soil to travel faster and for greater distances. Bank erosion occurring during floods can transport a lot of Phosphorous from the river banks into a stream. Sediment (like Phosphorous) in the snow gets caught from the frequent freezing and unfreezing, when thawed the snow releases the pollutants and they flow to the nearest water source. A USGS study on Cape Cod, Massachusetts was conducted on the ability of phosphorus moving within ground-water. They found it can easily leech into the ground water and discharge into surface water areas like lakes rivers stream banks, almost anywhere within the watershed of that area.

Conductivity-

"Electrical conductance is a measure of the capacity of a substance to conduct an electrical current. The specific electrical conductance (conductivity) of water is a function of the types and quantities of dissolved substances it contains, normalized to a unit length and unit cross section at a specified temperature." (USGS). Fluctuation in the measurement of conductivity can be caused by the amount of rainfall, the temperature, snowmelt and more. Any addition of water into a river or body of water being tested can cause a dilution or in the case of snow melt an increase in nutrients like salt which will cause the conductivity to go up. There seems to be a direct correlation between groundwater and conductivity of streams. For example, if a river is tested to have low conductivity then you can hypothesis that, that particular stream has a very low groundwater input than a stream that has high conductivity. Also, a USGS study in Colorado, USA, showed that conductance was found to vary throughout the year due to the variability in stream flow. Conductivity of the streams and river can also be directly effect by the geology of which the water flows through. For example, streams/rivers that flow through granite bedrock tend to have a lower conductivity while those that flow through limestone and clay soils test higher in conductivity. Urban runoff can affect the conductivity whether it be ions like salt that increase conductance or oil/gas that lowers the conductance (since oil is not a conductor its lowers the conductivity and kills plant and animal life)

Ammonia-

About three-fourths of the ammonia produced in the United States is used in fertilizers. At high levels of ammonia, fish may experience increased respiratory activity, oxygen uptake, and increased heart rate which often leads to death. Exposure to high amounts of Ammonia can lead to skin damage, eye and gill damage to aquatic and land creatures. Ammonia can cause infertility, impaired growth rates, kidney and liver failure and for fish reducing the ability to "breath". Sources of high Ammonia levels maybe:

Agricultural: ammonia rich fertilizers, livestock waste (barnyards, feedlots, pastures). excretion of fish and other livestock as a normal part of their metabolism contain ammonia.

Residential and Urban: Ammonia containing cleaning products, septic systems, ammonia rich fertilizers.

Atmospheric: Ammonia is brought abundant in the atmosphere because of incomplete combustion of fuel like in cars, domestic heating, burring waste, wood and more. Once in the Atmosphere rain water can carry Ammonia ions into water systems polluting them.

Conclusion:

Macroinvertebrates: Each different type of Macroinvertebrate is an "indicator" species. Certain one mean the water quality is great, and others mean that the quality is bad. The results showed that in DB2 the water quality corresponds with the phosphorous proving that the water quality is being diminished. Diversity of Macroinvertebrate in the river in that section has decreased along with the loss of less tolerant species.

Baseball Field: On the site near DB2 there is a baseball field that was recently put in since 2006. The field could be causing the pollution of the river since the field is directly in the water shed of the river, and it is mostly likely fertilized to maintain grass. Also the baseball field is composed of dirt and grass, the dirt is mostly sand, silt and clay which during rainfall or the daily watering of the field may cause phosphorous from the sediment to seep into the ground water and leach into the river.

Agricultural: On the site of DB2 there is an agricultural field adjacent to the river. This crop land could definitely be using fertilizers which would add phosphorous and ammonia to the water in the river. Runoff water that is not absorbed into the ground can flow straight into the river or be absorbed by the ground water which can then also be brought into the river then again.

Roads and impervious surfaces and residential areas: road, parking areas and any place with an impervious material on it pose threats. These materials causes for unnatural flow of water and the ability for water on the surface to pick up particulates such as oil, salt, waste, that could increase and/or decrease conductivity, add pollutants, contaminate water, and increase the phosphorous and ammonia in the river. Also, sewage from septic tanks in residential yards could be contaminating the water in the river. Protein when digested and excreted can then contain phosphorus and ammonia ions, which can then (when not properly treated) can leak into the water source. . Both sites BD2 and DB3 have many residential areas and impervious surfaces around them.

It is quite possible that the source of Deep Brooks Pollutions in sites 2 and 3 can be traced the residential areas, agriculture, roads/impervious surfaces, and areas used for recreation. These areas can be the cause to rising phosphorous levels over the year, decreased water quality, high concentrations of conductivity and elevated ammonia levels.

Plan:

Continuing the water quality study is need, and possible courses of action should be take. For example, test the soils at local homes around the river, at the baseball field, near the parking lots and impervious surfaces and also at the agricultural field. Those results can help lead to possible ways of preventing these pollutants in entering the water supply. Storm drain can be put in, proper rain water systems, cleaning of the rivers riparian zone, proper disposal and treatment of waste and possible restrictions on fertilizer use.

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