Project Number: PPM-1001

Worcester Technical High School Vernal Pools Study

An Interactive Qualifying Project Report
submitted to the faculty of the
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfillment of the requirements for the
Degree of Bachelor of Science
By

David Nguyen

Date: May 23, 2010

Professor Paul Mathisen, Advisor

Abstract

This project consisted of performing a study on vernal pools, in conjunction with the students of the Environmental Technology program at Worcester Technical High School, to provide suggestions towards improving wetland conditions. The progress provided a learning experience to the students, and also detailed the data that are typically collected as part of the process of certifying a vernal pool. The information is helpful to the school since it shows that they have upheld their promise in maintaining a monitoring program of the pools. It also introduces the students to tools that can be used to assist or expand their learning of environmental technology.

Acknowledgements

I would like to thank the following individuals for their help and support during this project, without all of whom this project would not have been possible:

Professor Paul P. Mathisen, my project advisor, who took a chance by letting me take on this project by myself while guiding me throughout the entire, unfamiliar field of environmental studies that I had not yet encountered before. His assistance was invaluable in helping me navigate the project process.

Mr. Russell J. Anderson, the Head of the Environmental Technology department at Worcester Technical High School, who supervised the work at the school as well as aiding me define the scope of the project. Mr. Anderson devoted a lot of time after school to assist me find resources for the vernal pools, as well as develop the presentation.

Mr. James Gass, of ENSR, who helped provide data findings at the vernal pools and whose field notes I used as a reference throughout the project.

Mr. Peter Crafts, the Director of Vocational/Technical Education, at Worcester Technical High School, who made it possible for me to meet with teachers and staff outside of school hours, as well as provide access to roam around the school to collect data.

The Massachusetts Division of Fisheries and Wildlife (Mass Wildlife) who helped answer many questions about the vernal pool certification process, as well as clarified inaccuracies surrounding the existence of vernal pools listed.

Worcester Technical High School, the project sponsor, as well as the many people who I have met with and helped to create this project including Edwin "Ted" Coghlin and Patricia J. Harmon. Additionally, I have to thank the wonderful students of the Environmental Technology department, especially the freshman and junior class, whom I have gotten the privileged of working with these past few weeks. Thank you for your attention, participation, and respect during my presentation to the class. This project would not have been as successful without the involvement of all the aforementioned individuals mentioned.

Table of Contents

1. Introduction

Ecosystems in the world today are continually changing respectively in response to pollution, global warming, and other external factors. Throughout time, some ecosystems have adapted to their surrounding environments. However, there are those that are threatened by physical harm, which can often leave to permanent, irreversible damage.

It is becoming increasingly noticeable how humans can impact the environment with their actions. Research has shown that greenhouse gases have heated the earth and the increase in temperature can have devastating effects on the environment. There are many deaths blamed as a result of the destruction of ecosystems like Polar bears. Not only are the Polar bears the first species to become endangered due to global warming,[1] they also represent what can happen to a species when ecosystems are attacked.

One type of ecosystem that is being directly affected by human actions is a vernal pool. Vernal pools are defined as seasonal depressional wetlands that occur, mainly under the Mediterranean climate conditions of the West Coast.[2] However, they are also miniature ecosystems that can exist in environments with climatic change. Whether they are present in the West Coast, or in the East, vernal pools are important ecosystems that are home to many a diverse list of plant and animal species, many of them native to that area. As more vernal pools are threatened and often destroyed due to human construction, the endemic species in these locations are becoming endangered. Some of these plant and animal species can live nowhere else, and face the possibility of extinction.[3]

Often times, it is to make room for new buildings and facilities to be built that that these

[1] (Wildlife Library 2010)
[2] (EPA: Wetlands 2008)
[3] (Sacramento Valley CNPS 2009)

vernal pools are destroyed. In California, where vernal pools are most prominent in the United States, the Merced campus of the University of California was built on the largest remaining vernal pool habitat in the state.[4] Whereas the Merced campus was once feared to approximately decimate the ecosystems, including vernal pools, within the 10,000-acre construction site, it has been since been protected due to conservation laws and regulations passed.

Another school that has been built whose construction has impacted vernal pools is Worcester Technical High School. Worcester Technical High School is a vocational school, located adjacent to the city's green hill park in Worcester, Massachusetts, and near wetlands and a vernal pool. The school was opened in 2006 after years of construction and deliberations, including considerations to controlling the negative environmental impacts on the surrounding area.[5] In order to come up with a solution that appeased all concerned groups, the school has promised to uphold regulations and maintain a monitoring program that strives to improve the condition of the neighboring wetlands. Worcester Tech has adapted policies to assist in the protection of these ecosystems and the inhabiting species.

The objective of this project is to incorporate the data collection and certification process wanted by the school into an educational experience. By monitoring wildlife, and vegetation within the Green Hill Park and vernal pool areas at the school, it is hoped that the project will assist the sponsors in providing necessary steps with regards to regulatory conditions, and laws that need to be followed. Also, a concurrent goal is to integrate this experience with the Worcester Technical Environmental Technology program and their learning of vernal pools.

[4] (CNPS 2000)
[5] (WTSH Project: Problem Statement)

2. Background

The background contains historical and current information of the sites encompassing the vernal pools and Worcester Technical High School. The vernal pools status, rules, and the involvement of the Environmental Technology program at Worcester Tech are discussed. Additionally, groups like ENSR, the Green Hill Park Coalition, and the National Heritage and Endangered Species Program are explained. Detailed methods for vernal pool certification, as well as the data collection of the Environmental Technology students are covered. The research that was conducted to provide the background included information on loss of ecosystems, effects of artificial or manmade vernal pools, and GPS/GIS coordinate tracking devices.

2.1 Ecosystems / Endangerment

The term "endangered species" means any species, which is in danger of extinction throughout all or a significant portion of its population other than insects, which are considered pests instead.[6] An ecosystem is a community of all the species populations that occupy a given area, like plants, animals, and all the organisms in between and its nonliving environment. Today, ecosystems are greatly affected by human interference or destruction. Most often, they are destroyed to use the land for construction of buildings and roadways. Tropical forests are the most widely appreciated, endangered ecosystems and have the highest rate of species extinction in the twenty first century.

[6] (FWS. Endangered Species Act of 1973. 1999)

2.2 Vernal Pools

2.2.1 History

Although temporary pools or ponds are found in many places in the world, there are conflicting reports as to where the term originated. In the United States, it is often believed that vernal pools were first discovered in California, where there are still many prominent vernal pools in the region.

A vernal pool is a shallow depression that typically contains water for only part of the year. These pools range in size from a few square feet to several acres. They also vary in appearance, time of filling, and source of water. Although most pools dry out for much of the year, some vernal pools remain wet year-round. In different parts of the world where there are temporary wetlands, their characteristics vary and reflect the climate conditions in that area. Vernal pools provide important habitat for many species of wildlife, including salamanders, frogs, and turtles; they do not support fish. Without these pools many species will no longer exist, as they must return to the vernal pool to breed. These obligate plants and animals are what make vernal pools unique i.e. some salamanders may travel as far as one mile to reach their vernal pools. Vernal pools are important resources for other wildlife by providing water for drinking. Native Americans were thought to have utilized vernal pools in several ways to hunt birds using netted traps, as well as to harvest vegetables[7]. They also serve as wildlife corridors for amphibians and reptiles, allowing them to move to other wetlands; they are considered an important natural resource.

Vernal pools range in size and can vary from small to large. A typical pool may be 30 by 100 feet long and 3 feet in depth. Their size depends on the environments that they are found in.

[7] (CWIS 2002)

Some of the places that they might form are forest areas, in the floodplain of a body of water, within a vegetated wetland, in an open field, and between natural rock formations and other places that water may be retained.

2.2.2 Types of Vernal Pools

Vernal pools outside California are generally small, un-vegetated depressions. They occur in the mid-western and eastern United States. Most of the time, they are covered by shallow water for variable periods from winter to spring, but may be completely dry for most of the summer and fall. These wetlands range in size from small puddles to shallow lakes and are usually found regions of grassland. Beneath vernal pools usually lie a formation of bedrocks and clay in the soil that helps keep water in the pool.

Climatic changes associated with each season cause dramatic changes in the appearance of vernal pools, thus the difference ecosystems ensue. The pools collect water during winter and spring rains, changing in volume in response to varying weather patterns. During a single season, pools may fill and dry several times.

Figure 1: A Vernal Pool in California (California Chaparral 2009)

In years of drought, some pools may not fill at all depending on the area. More than 90% of California's vernal pools have already been lost.[8]

The name is derived from the source of water for many of these pools. Although snowmelt and spring rains often fill vernal pools by the spring, the word "vernal" comes from the Latin world 'vernus' meaning spring, but they can also regain the water by other means. Not all pools are filled by spring snowmelt, however; often they are dry by late summer. Many in New England fill in the fall from precipitation and the rising groundwater table. Snow and spring rains just add more water to these pools. Some pools contain water for a number of years and are semi-permanent, yet dry, or almost dry as the water level fluctuates. Regardless of water source or water level, they are all still considered vernal pools.

Whereas the California vernal pools occur in the west coast, eastern vernal pools are very

[8] (EPA: Wetlands 2008)

different than their sister sites.

Figure 2: A Vernal Pool in Massachusetts (USDA Forest 2004)

The mid-western and eastern vernal pools are especially important for amphibians. A second type of landscape formation with vernal pools are ancient volcanic mudflows, where rapid weathering of volcanic materials have formed dense clay soils and bedrock restricting layers near the soil surface, but these are rarely discussed.[9]

2.3 Certifications and Guidelines

Because of the ongoing threat of endangerment and possible extinction of the aggregate species living in these vernal pools, there is a need to protect these ecosystems. There are protection laws that can be applied to these areas to stop their destruction. These environmental laws and policies require agencies and landowners to consider the effects of a proposed action on

[9] (CWIS 2002)

the environment, determine if a less damaging alternative is available, obtain and comply with necessary wetland permits, and comply with endangered species laws (for vernal pools that support endangered species). There may have to be licenses that will be required if anyone wants to change the area. Federal, state, and local laws and policies regulate certain activities in wetlands, including vernal pools, and may prohibit activities that could harm or harass threatened or endangered wildlife species or migratory waterfowl. Therefore there would be a higher power over seeing the well-being and best interest of the land. For example, in California, the California Environmental Quality Act, a state law, requires public agencies to consider the effects of proposed actions on biological resources. Environmental laws and policies that pertain to vernal pools in California include:

- The federal Clean Water Act (US Army Corps of Engineers, Environmental Protection Agency), Endangered Species Act (US Fish and Wildlife Service), and Migratory Bird Treaty Act (US Fish and Wildlife Service);
- Wetland provisions of the Food Security Act (Natural Resources Conservation Service);
- The state Endangered Species Act and California Fish and Game Code (California Department of Fish and Game), California Environmental Quality Act (County Planning Departments); and
- County General Plan Policies and Habitat Conservation Plan Policies.[10]

In Massachusetts, vernal pools are protected through several regulations, the most prominent among these being the Wetlands Protection Act Regulations. Other regulations, which include vernal pool protection, are the Surface Water Quality Standards, Title V of the Massachusetts Environmental Code, and the Forest Cutting Practices Act Regulations. Many of

[10] (CERES 2002)

these regulations require that the pool be "certified" by the Natural Heritage and Endangered Species Program (NHESP). Certification is a documentation process where evidence of the presence of a vernal pool is collected and submitted as evidence as well as the location maps to the NHESP. The NHESP reviews the submission and subsequently may certify the pool. However, certification only establishes that a vernal pool exists. The protection that is afforded to the pools comes from the application of the various regulations during permit reviews. Originally defined and protected under the Massachusetts Wetlands Protection Act regulations, certified Vernal Pools now also receive protection under Title 5 of the Massachusetts Environmental Code, Section 401 of the Federal Clean Water Act, the Massachusetts Surface Water Quality Standards that relate to Section 401, and the Massachusetts Forest Cutting Practices Act.[11] These regulations help to eliminate direct impacts to certified vernal pools and to minimize indirect impacts.

2.4 ArcGIS

Many vernal pools are small and temporary, thus are not featured on many maps. To find and/or track these pools, it is a good idea to have a system that can be utilized. Using different tools like USGS maps may lead to a discovery of a vernal pool that was not recorded or one that has disappeared. Other types of maps that can be of assistance are topographic maps, where the topography and feature of areas are shown in great detail and GIS. GIS stands for geographic information system. GIS is a way to capture, store, analyze, manage, and present data that has a way to be linked to a specified location. ArcGIS is a computer program that uses GIS data maps in different given layers. Layers can be placed on top of each other to achieve the look of any

[11] (Natural Heritage 2009)

given map. These maps can be made for anything from street maps, to river maps, to topography maps, to contour maps, or anything that one can find in data layer form that they want to make a map of. There are maps of the specified area at proposed vernal pool sites online at the MassGIS website. Varieties of these maps are available for use online, and comprise of the maps recommended and produced by the Natural Heritage Endangered Species Program of the MA Department of Fisheries and Wildlife.

2.5 City of Worcester

2.5.1 History

The city of Worcester is the second largest city in New England, after Boston. Known as the "heart of the commonwealth" because of its location in Central Massachusetts, the city of Worcester has a population of just over 182,000 and consists of 7 high schools.[12] Worcester is currently constructing a new North High School expected to open for the 2011-2012 year and costing $73 million dollars. This, however, is after the completion of the new $94 million dollar Worcester Technical High School that opened in 2006.

2.5.2 Green Hill Park

There is approximately 1250 acres of land that comprise of Worcester parks, including Green Hill Park.[13] The best-known historic park in Worcester is Elm Park, which was purchased in 1854 and is recognized as one of the first purchases of land for a public park in the US.

[12] (CI: Public Schools 2010)

[13] (CI: City Parks 2010)

However, Green Hill Park is Worcester's largest municipal park with over 480 acres and housing a number of activities and facilities.

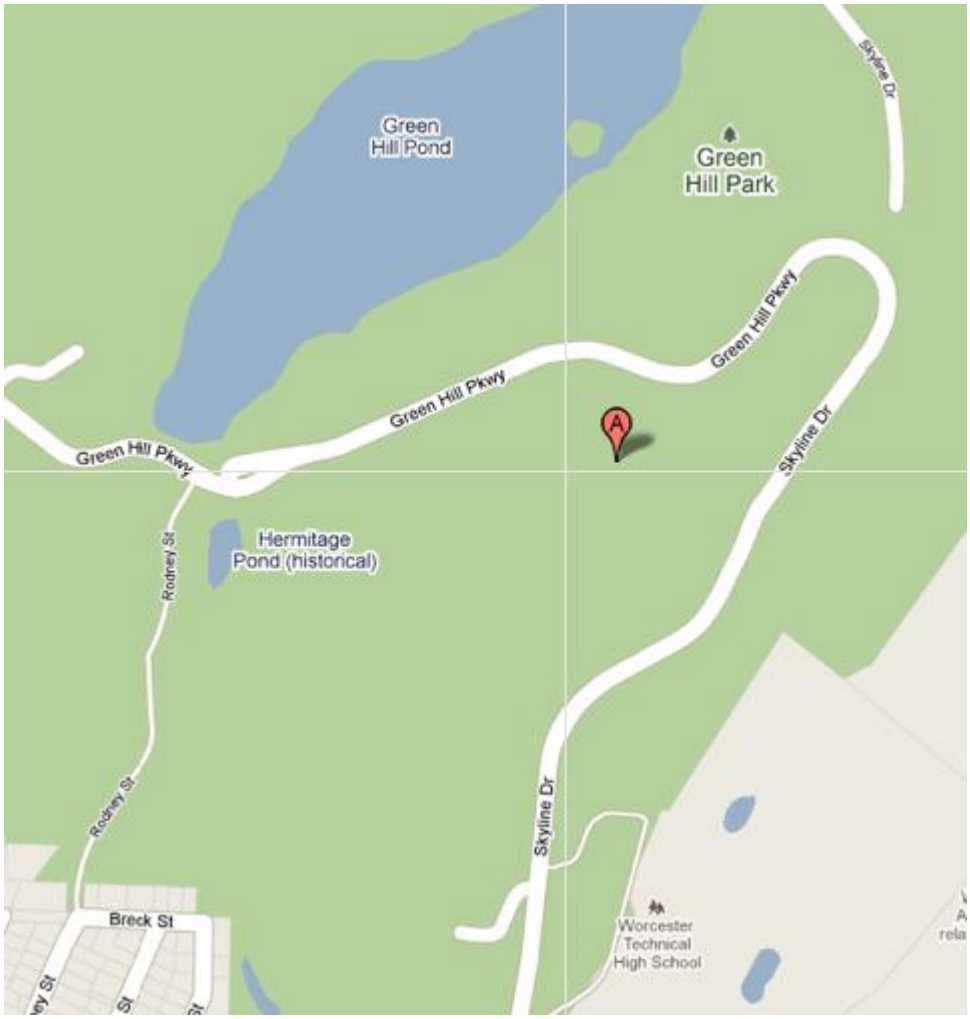


Figure 3: Map of Green Hill Park and its Accompanying Neighborhood

Green Hill Park is located at the top of one of Worcester's seven main hills on the south by Route 9 (Belmont Street) and to the east by Skyline Drive where Worcester Technical High School resides. Some of the facilitates included a toboggan run beginning at Crown Hill, an eighteen hole golf course and clubhouse, a community zoo, boating and swimming on Green Hill Pond. Also, there are two ponds, a zoo, picnic grove, playground, little league field, golf course, and handball courts. Located directly across from the park is the Worcester Parks, Recreation and Cemetery administrative office. The park has been owned and managed by the city for seventy-

four years after it bought it from Andrew Green, whose family had owned the land for several generations. Throughout the seventy-four years since the city bought the parcel of land, it has gone through several changes. The biggest change was the conversion to a recreational park in 1976 (while severing ties from other surrounding areas like the Holland Recreation Area). As a result, several swimming pools were destroyed and the area was designated a neighborhood park. Today, efforts are being made to keep the park intact as much as possible. To enforce these rules the Green Hill Park coalition was formed to preside over matters containing the land in the park, and its neighboring areas.

2.6 Worcester Technical High School Background

In addition to being a high school, Worcester Technical High School, or Worcester Tech, is also four- year vocational school. Worcester Tech opened in 2006 replacing the old vocational high school and relocated to the newly constructed facilities at Skyline Drive. It was designed and built to serve as a resource to the academic and business communities in Central Massachusetts, and as a regional economic engine for adult classes. The academic program of the school is set up to educate and prepare students both academically and technically. It is currently organized into four academies, with twenty-four specific disciplines intended to educate students in state of the art technologies and skills needed to succeed in the modern workplace. The school is divided into four sub-schools, each with six vocations. There is an assistant principal and guidance councilor assigned to each sub-school. The students are divided into two groups: one focuses on trades one week while the other works on academics and then the two groups switch the next week. This ensures that each student gets a good balance of academic and trade work. The schedule takes holidays and other days off into account to be sure

that one group does not get more of one session than the other. To attend Worcester Tech, the enrollment process is similar to that of any vocational school where students are required to apply in advance in order to attend (as opposed to the other public schools where all students are accepted into their district). Once accepted, students apply for a trade or major, which they study for in-depth.

The campus is located at Skyline Drive, in the middle of Green Hill Park. In 1997, after a School Committee vote, the city hired the architectural firm of Lamoureux-Pagano & Associates, who spent several months reviewing reports and making sketches of the proposed area. During construction, there were a number of problems including the environmental ramifications to Green Hill Park and the surrounding areas. In an effort to appease environmental interest groups, the architects strived to avoid destroying several nearby vernal pools for the layout of the building. Additional concerns were voiced about traffic on Skyline Drive and at its intersection with the busy Belmont Street and the people that already lived in the neighborhood. The city's and Parks, Recreation, and Cemetery Department established an agreement whereby solely the Worcester Tech students would use the athletic fields during the first year, after which other city and youth groups would be permitted access. In addition to the environmental issues, the biggest obstacles to completing the school involved funding. But after much deliberation, the school was completed and opened in 2006 with costs totaling $94 million dollars.

2.6.1 Environmental Technology Program

Environmental Technology is a relatively new trade at Worcester Technical High School, not present at the older vocation school. Environmental Technology applies the principles of mathematics, science, engineering, communications, and economics to ensure human health and

safety, and to manage and protect natural resources. The goal of the program is to train students to be an environmental technician and have a role in ensuring public health and safety through the management and protection of natural resources. These environmental technicians' works included a small water operator, a pesticide applicator, a GIS technician, or solar energy technicians are some of the occupations available to people in this field. Additionally, most technicians will pursue more training and education to adapt in their specified fields. The program provides students with a variety of problem solving experiences in environmental oriented activities. The trade offers opportunities for practical experiences through hands-on investigations, service learning, shadowing, internships, and cooperative learning. Students acquire knowledge, values, attitudes, and skills needed to protect and improve the environment. In addition to their core high school courses, the students in the Environment Technology program further explore courses like Earth & Natural Science, Environmental Science, and Natural Resource Management to name a few.

Students at Worcester Technical High School alternate weeks in Environmental Technology shop with academic classes. Students in Environmental Technology at Worcester Technical High School will spend approximately 2,000 hours over the course of 4 years studying environmental topics and participating in projects related to the environment.[14] The program is intended to be hands-on/experiential learning. To be most relevant, whenever possible, projects are real world activities in which students' work will benefit the community. This is constantly changing as opportunities present themselves. Some examples are Greenhill farm- Field Station for environmental research, vernal pools monitoring, Blackstone River Watershed protection,

[14] (WTHS: About 2008)

and Urban Energy.[15] Russell Anderson, instructor and head of the Environmental Tech department at the school, teaches the program. Together, he and his students work on different projects at various sites around the city and at Greenhill Park. They typically explore vernal pools at the beginning of April or when the weather permits so.

2.7 Worcester Tech Data Collection

2.7.1 Annual Report

Every year since the school relocated to Skyline Drive, the Environmental Technology has compiled an annual report that lists the data of environmental data surrounding, and encompassing the vernal pools. This report serves the purpose of acknowledging that the school is monitoring the area, as well as allowing the students to participate in the data collection. Assisting in the compilation of the report is Jim Gass of ENSR International, who has regularly accompanied the students and oversees the area. ENSR, a subset of AECOM Technology Corporation, is headquartered in Westford, MA and is a national environmental consultant agency specializing in wetland practices. As part of the negotiations when the school was built, Mr. Gass visited area to provide guidance for new regulatory initiatives and requirements. He would work with the appointed faculty member, this being Mr. Anderson, to ensure that the school upheld its promise to monitor the vernal pools around the school and submit its observations of the land in its annual report.

See Appendix A.

[15] (Environmental Science 2009)

3. Methodology

This section details the process of how to complete the major tasks for this project to attain the project goal. The major tasks for this project include:

- Literature Review and Topic Development
- Monitoring and Assessment of Vernal Pools
- Selection of Vernal Pools
- Curriculum and Classroom Lesson Development

While detailing the steps to verify, and eventually certify a potential vernal pool, the section also details how to integrate the experience with a class of students so that they will learn from the project through a classroom presentation. The data the students were collecting are organized to meet the specifications of the certification guidelines. Compiling a set of data containing information on what needs to be present for certifications helps the students better learn what vernal pools are and how they represent miniature ecosystems. They learn the importance of preservation while getting experience as to write a report and use the associated equipments to collect the data and map the locations.

3.1 Literature Review and Topic Development

Vernal pools are a good topic to focus on because the school is surrounded by Green Hill Park where there are many potential sites. To ensure that the goal can be accomplished, the areas had to be assessed as to whether they would meet the criterias and qualify as a potential site. Data has already been collected throughout the year, but solely for sending it out in an annual report. Whereas the certification process had to be done with many more specifications that are imposed and information needed. The research started by using books and articles on

what vernal pools are as well as the effects that its loss can have. During this research period, Mr. Anderson's class also had to be observed to determine what the scope of the project could be as well as what the students did or did not already know about the equipment and software used, like GIS and the accompanying mapping software.

3.2 Monitoring and Assessment of Vernal Pools

To gather data related to the vernal pools, there were several devices researched and used to relay the information. Tracking the location of the vernal pools to verify the accuracy against maps provided by MassGIS, the Garmin eTrex Venture HC was utilized. The eTrex Venture HC is a portable, high-sensored GPS device, popularly used for geocaching and trekking through heavy terrain that can be configured with GIS. Professor Mathisen personally provided the yellow, handheld unit. Also used to gather data was kit provided by the WPI Civil and Environmental Engineering department. The kit consisted of a microprocessor-based photometer, titled the V-2000, as well as the accompanying agents used to determine the property levels of the water. A photometer is an instrument for measuring light intensity or optical properties of solutions or surfaces. Following a specially designed engine, known as CHEMetrics, the sample solutions are mixed with respective activator solutions and then tested in a vacuvial to measure silicon dioxide, oxygen, nitrate and phosphorous levels.

There were also several devices used by Mr. Gass to collect the information provided in his data sheet, as well as compiled in the annual report. The miniTroll, Model SSP-100, was a device used to measuring temperature and pressure (water level, or depth) within the pools. The system composed of a steel cylinder body, attached to a submersible deployment cable that was placed in the water. Then, the sensors would capture the information and could directly relay it

via software when connected to a computer system.

Additionally a Trimble Pro, a DGPS, was considered among the devices used to collect the data, but was subsequently replaced with the eTrex Venture HC due to a difference in size and portability when trekking through the area. What distinguishes a DGPS (where D stands for differential), against a typical GPS device is that the device accesses different sources of data. DGPS is a method of improving the accuracy of the receiver by adding a local reference station to augment the information available from the satellites. It requires that a GPS receiver, known as the base station, be set up on a precisely known location. The base station receiver calculates its position based on satellite signals and compares this location to the known location.

3.3 Selection of Vernal Pools

At the area encapsulating the school, there are several bodies of water. These include reservoirs, runoffs, ponds, streams, and vernal pools. The vernal pools lay within the school grounds, but also directly outside the perimeter in Green Hill Park. There are four distinct locations throughout that will be focused in the report.

Figure 4: Aerial View of the Neighborhood with the Blue Dots Indicating the Sites

The site areas are labeled Vernal Pool A/B, Vernal Pool C, Vernal Pool D, and the Skyline Drive Pool. For the purpose of the report, all four-site locations will be considered vernal pools unless proven otherwise. Vernal Pools A/B and C are located directly outside of Mr. Anderson's classroom by the parking lot. Although Vernal Pool A/B consists of two basins, the water overflows from A into B when there is a high level of water so will be grouped as one site. Vernal Pool C is situated parallel to Vernal Pool A/B by the building also, next to the automotive driveway. The other two sites, Vernal Pool D (in woods north of school) and the Skyline Drive Pool (near the National Guard Armory), are adjacent to the school by Green Hill Park facing the entrance. Pool C is the only pool where water is manually pumped. It was earlier believed by

the school that that pools C, D and the Skyline Pool were certified, but they do not appear as certified on the MassGIS website. The attached map does show certified pools a few hundred feet east of C & D and south of Skyline. An explanation could be that the coordinates were submitted incorrectly. Mr. Anderson and his class have been primarily monitoring Vernal Pool A/B to compile their data in an annual report that the school sends out. However, they have yet to certify, verify, or done more with this information.

3.4 Curriculum and Classroom Lesson Development

To relay the information gathered throughout the course of the Interactive Qualifying Report, a PowerPoint presentation was created consisting of data assembled when visiting the vernal pools as well as an introduction to GIS, and its different interfaces and implementations. With the current layout of the environmental technology department that there is only one person to teach all four grade levels, there is not enough time to cover all the points on the curriculum. Grade levels are taught different lessons in time, so it is hard to settle on a single topic that is listed as a learning objective on the curriculum, while devoting enough time to make sure that the students can understand the lesson. The focus of the presentation was to provide the students with an understanding of the process involved with vernal pool certification, GIS, and some of the science associated with vernal pools. The students had started regularly collecting data from the pools, but not everyone knew the background information surrounding general vernal pools or the sites that they were gathering from. Not only would the presentation serve as an overview of the IQP, but also would expose the students to applications of the software and devices used while relating it to their studies. As learning to utilize real world applications of environmental technology was an important part of the curriculum, the students would also be introduced to the

equipment used to track the information, as well as how they can incorporate all these layers together to build maps or graphical representations of their data. Topics discussed during the presentation included ArcGIS, the difference between GPS vs. GIS, topographic maps, Vernal pools (consisting of background, species, types), environmental protection laws, and the specific site information to name a few.

4. The Results

This chapter includes the raw data collected and compiled to complete the assessment of the pools, create the lesson plan and presentation, and develop the maps of the site. Many people were consulted including The Massachusetts Division of Fisheries and Wildlife for their advice on how to certify the vernal pools. A variety of books, research articles, and the building plans for the school, including blue prints were also ascertained to conduct the background of the topics presented and the history of the area. The literature review is prefaced in Chapter 2.

4.1 Monitoring and Assessment of Vernal Pools

The location of the four vernal pools (coordinates), tracked with the high-sensored GPS device is presented in the following table.

Table 1: Coordinates of Vernal Pools

Site Area	Latitude	Longitude
Vernal Pool A/B	42.278103	-71.776991
Vernal Pool C	42.278234	-71.776876
Vernal Pool D	42.279758	-71.775157
Skyline Drive Pool	42.281119	-71.776595

Once the coordinates of the pools were found, they were checked against the pools listed on the MassGIS website to verify whether they were indeed certified or not. When viewed with the latest layers (released January 2010) titled "NHESP Certified Vernal Pools" and "Potential Vernal Pools," shown in Figure 5, it is shown that all but one of the vernal pools is listed as certified.

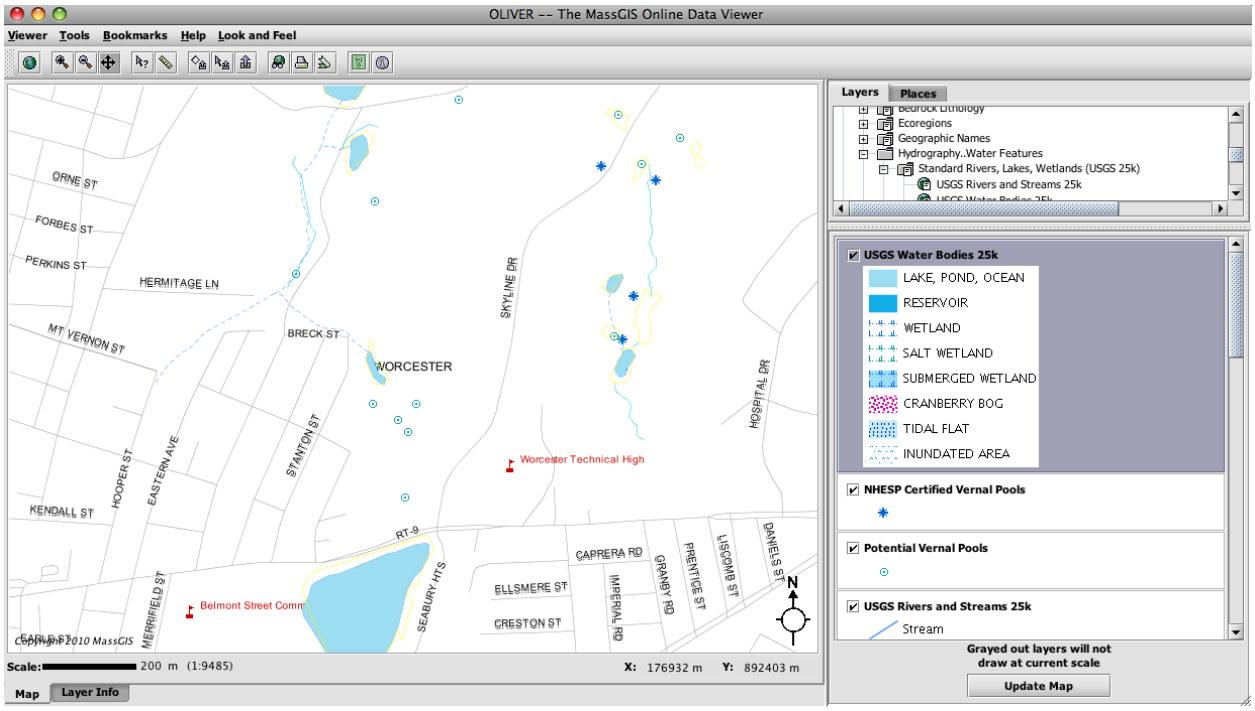


Figure 5: MassGIS map of NHESP Certified, and Potential Vernal Pools (January 2010)

The only site that is listed as a potential vernal pool and thereby not certified is Vernal Pool C.

Organisms in the vernal pool did not appear until the end of March or mid-April. Even then, the species observed were sparse. There were tadpoles found in all the vernal pools, but there was no median among the times they appeared. As varying weather patterns presided over the area, there were inconsistencies among the development of the ecosystems as compared to previous years. The aggregate temperature was colder last year, and the fact that it yielded below average rainfall during the same observational time, March through April, may have affected the timing of the species. Among the obligate species that were observed in the vernal pools were the following: Backswimmers were predominantly found in the Skyline Drive pool as well as appearing Vernal Pool C also; Wood frog larvae were growing in Vernal Pools A/B, C, and D; Bull frogs were in the Vernal Pool A/B, but not C; And finally, fairy shrimps were only found in Vernal Pool D at the end of April. The water levels, and temperature of the pools were not measured, however, because Mr. Gass and Mr. Anderson's class were already doing

that task on a regular basis (daily, or whenever weather permitting).

Applying the phosphate activator solution with the photometer, the phosphorous levels in the vernal pools was also measured to introduce a new data type that served as an introduction for the students into the effects of chemicals levels in the water. The phosphorous levels, as measured in parts per million (mg/Liter) were .032 in Vernal Pool A/B, .029 in Vernal Pool C, .018 in Vernal Pool D, and .021 in the Skyline Drive Pool.

4.2 Selection of Vernal Pools

Using the location-tracking tool by ArcGIS, it was determined that all the vernal pools appeared accurately on the map (applying the coordinates) so there was no more question about whether they were recorded in error. What had been surprising was that the vernal pools assumed to not be certified were listed to the contrary. Therefore, the Massachusetts Division of Fisheries & Wildlife (Mass Wildlife) was contacted to verify the validity of the claims listed on the map. The resulting check by Mass Wildlife, as well as by Mr. Gass, led to the findings that all four sites had been officially certified. When overlaid with an aerial layer, the map of vernal pools with the corrected labels is shown in Figure 6.

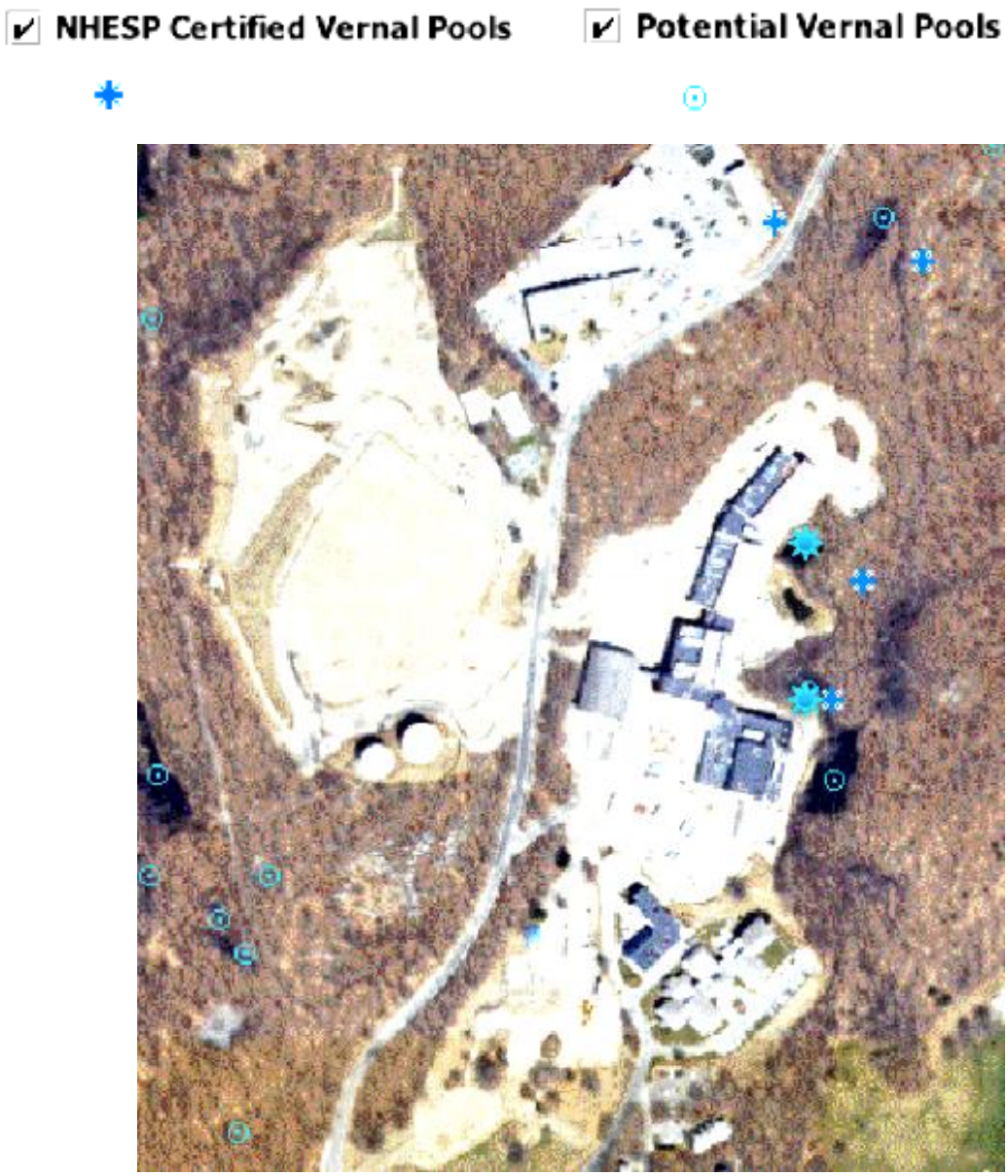


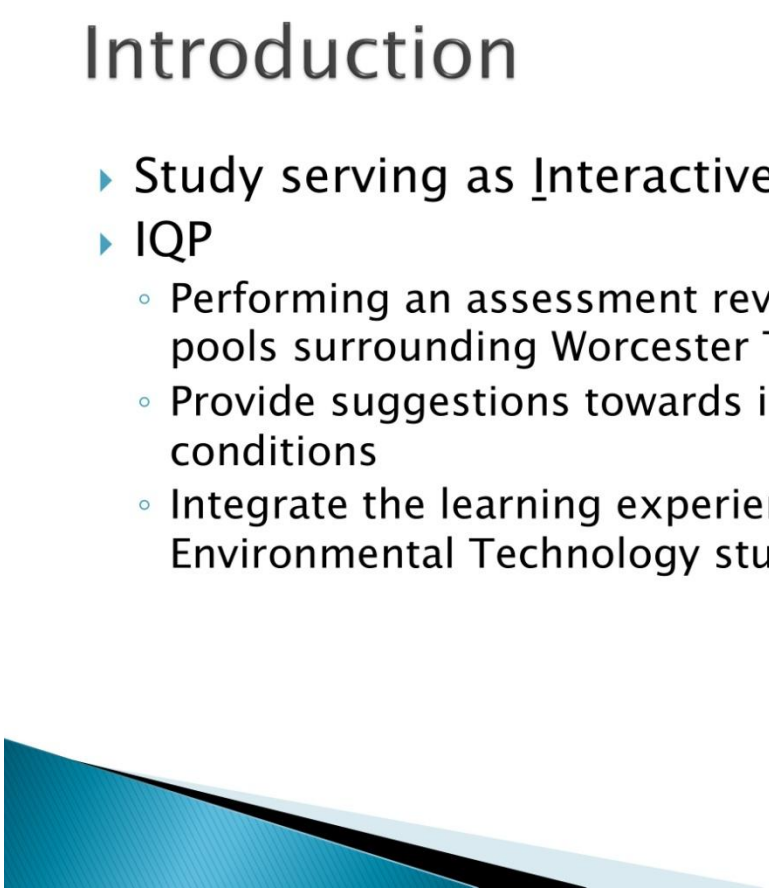
Figure 6: Revised Map with Updated Certified Vernal Pools

4.3 Curriculum and Classroom Lesson Development

To convey the information and engage students, a classroom presentation was developed. This presentation made use of PowerPoint software. The PowerPoint presentation contained a standard informational lecture, while also consisting of questions that was used to engage the students. Specific slides titled "QUIZ GAME" to draw on information and topics that the

students have covered, are working on, or will work on in the future. The following images are some snapshots of the PowerPoint presentation file, along with the accompanying notes and basis behind each section. Major topics that are covered in the presentation include the introduction/goal, GIS, layers in GIS and topographical maps, vernal pools, endangered species, protection laws, Worcester Tech and vernal pools, and equipment. Throughout the presentation, there are interjections of interesting facts, questions, and quiz games added to increase student interest. The complete presentation file can be seen in its entirety in Appendix B.

The first section served as an introductory overview of what the project represents, as well as the objectives and project goal. The discussion involved making sure the students understood what an IQP is.



What is an IQP?

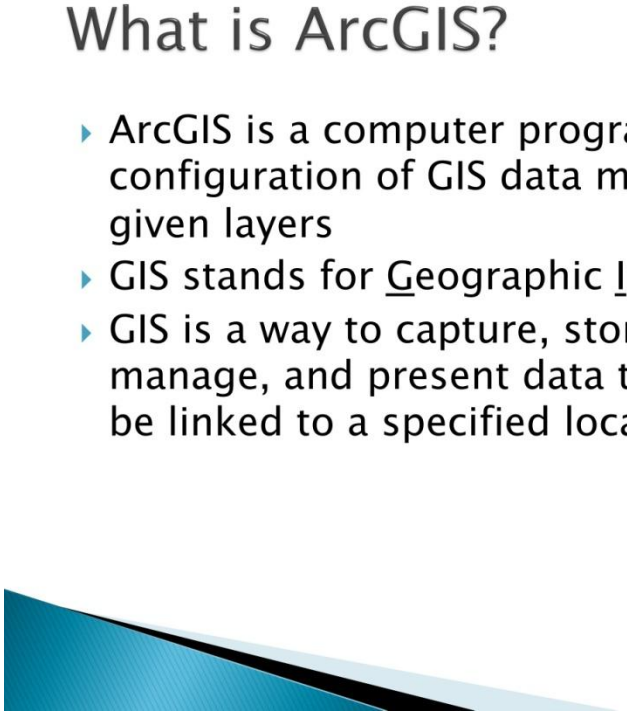
-An Interactive Qualifying Project (IQP) at WPI is a project, which deals with the relationship between technology and society.

-The goals of the Plan are to promote learning by doing through project work, maximize student choice in designing their own educational programs.

-Projects topics usually chosen outside major to knowledge of breadth, chance to go abroad and study off campus.

Figure 7: Introduction Slide and Associated Discussion Notes

The second section introduces GIS, the software ArcGIS and its features. Students have not yet been formally taught what GIS is and how it can be used. Although there is GIS software equipped on the school computers in their classroom, they have yet to utilize it. Topics discussed during this section include how GIS differs from GPS.



What does GPS stand for?
Global Positioning System

Difference between GPS and GIS?
GIS (Geographic Information Systems) is tool to display and analyze information geographically. GPS (Global Positioning Systems) is a technology that uses satellites to give one its position on the Earth with the aid of a GPS device or unit. GPS can be incorporated into GIS by using a GPS device to collect points, lines, or polygons, which can be imported into a GIS application for future analysis and interpretation.

Source of maps can also be found using Google

Figure 8: ArcGIS Slide and Associated Discussion Notes

After giving an overview of GIS, the next section demonstrates the use of layers. Multiple layers are placed on the screen to form an outline of the school area, Green Hill Park, and the surrounding vernal pools. The data from the maps list the potential and certified vernal pools as of January 2010. The maps are displayed using the free data viewer (OLIVER) that can be obtained online at the MassGIS website.

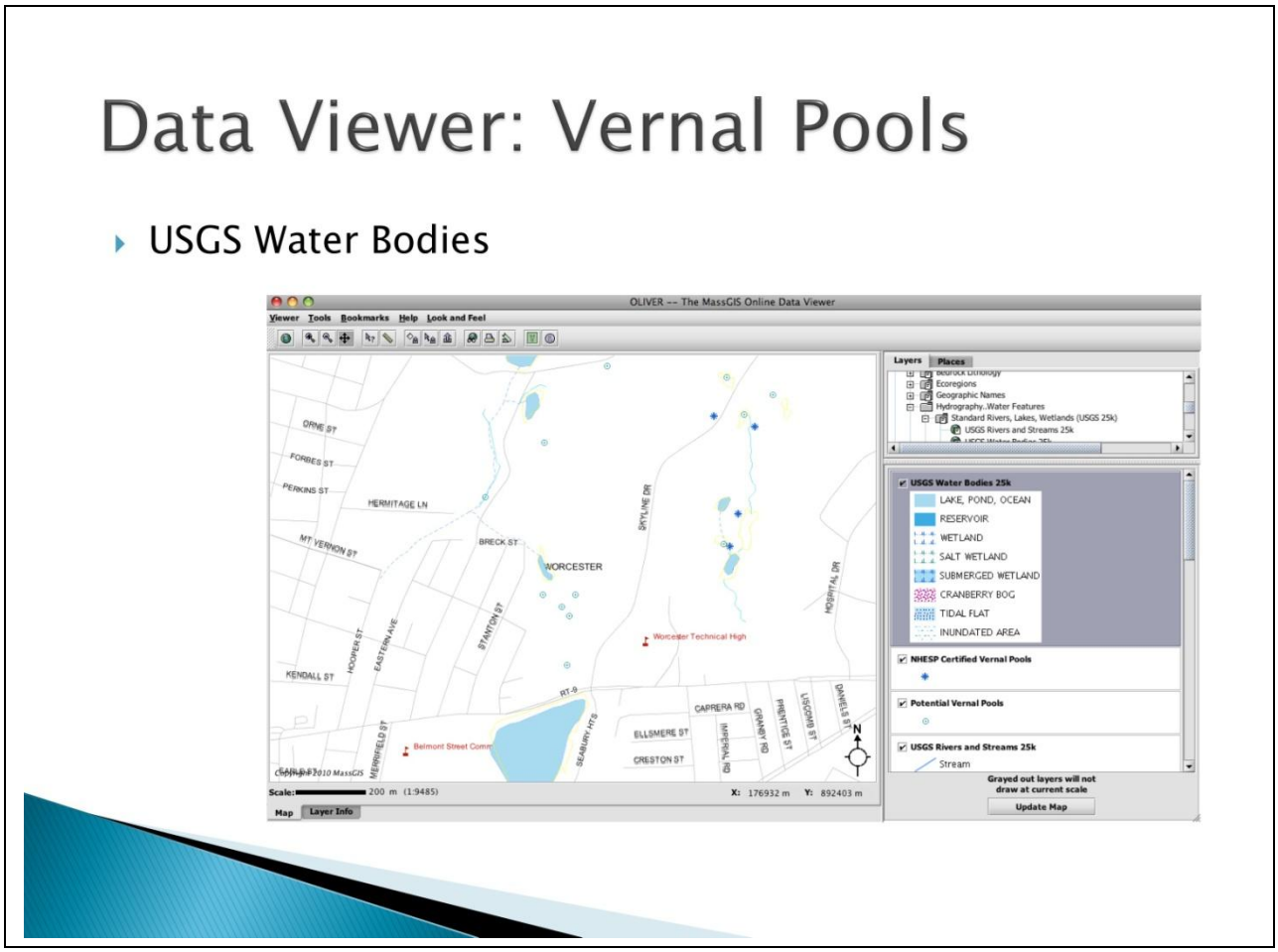
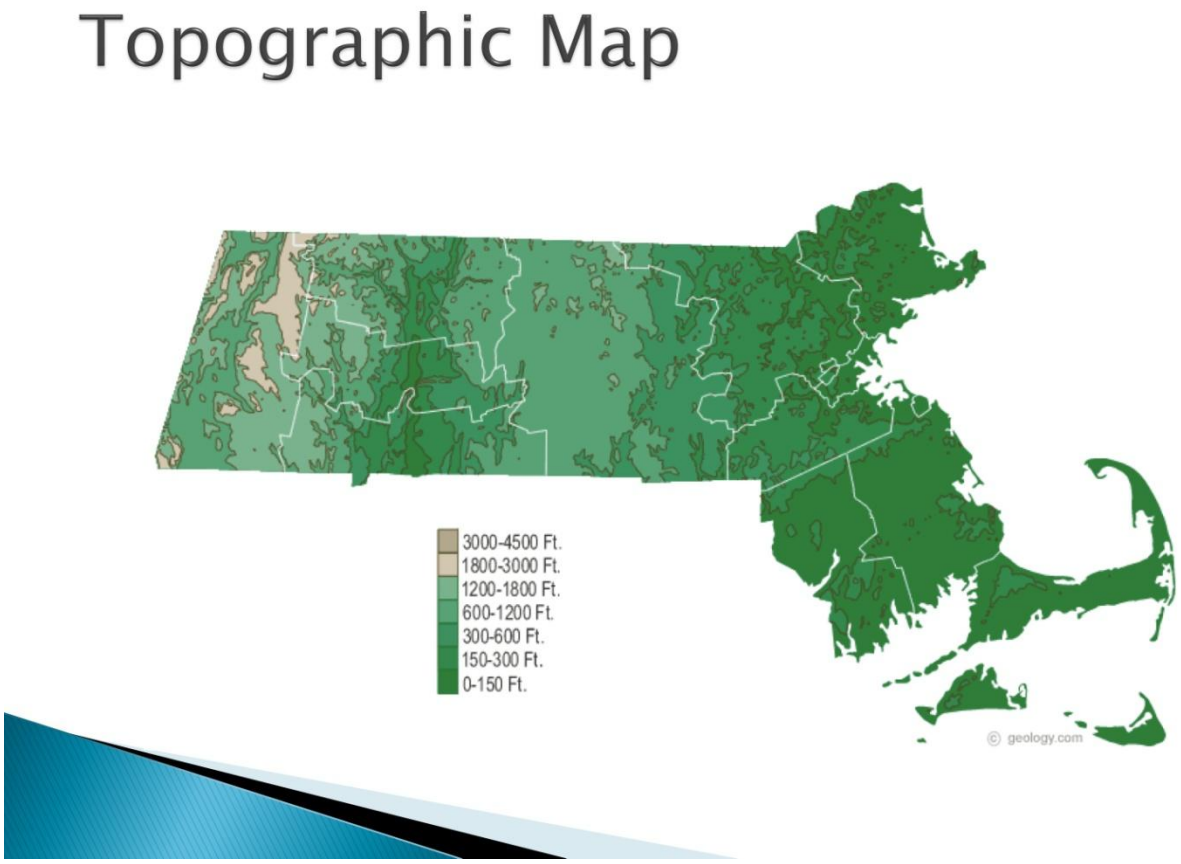


Figure 9: Data Viewer Slide

Topographic and aerial maps are discussed next. The maps are defined, and then used to show the view of the school. The discussion involved making sure the students understood what topographical maps are, and how to read them.



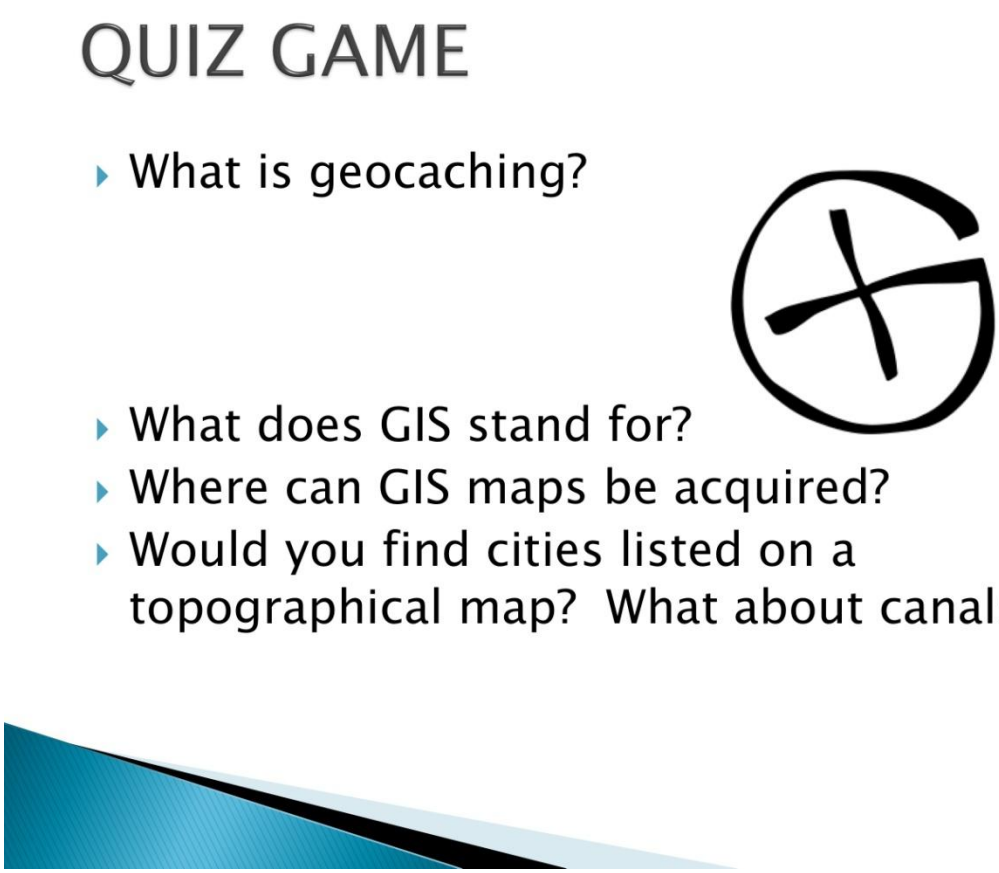
What is a topographic map?
A topographic map is a type of map characterized by large-scale detail and quantitative representation of relief, usually using contour lines in modern mapping; a topographic map shows both natural and man-made features.

Topographic maps are based on topographical surveys. Performed at large scales, these surveys are called topographical in the old sense of topography, showing a variety of elevations and landforms.

Contour lines are curved or straight lines on a map describing the intersection of a real or hypothetical surface with one or more horizontal planes.

Figure 10: Topographic Map Slide and Associated Discussion Notes

The first QUIZ GAME slide includes questions assessing students on the information in previous slides, as well as provides discussion as to what geocaching is.



What is geocaching?
Geocaching is an outdoor activity in which the participants use a GPS receiver or other navigational techniques to hide and seek containers (called "caches") anywhere in the world. A typical cache is a small waterproof container containing a logbook. Larger containers can also contain items for trading, usually toys or trinkets of little value. Geocaching is most often described as a "game of high-tech hide and seek," sharing many aspects with treasure hunting.

Would you find cities listed on a topographical map? What about canals?
YES and YES
Man-made features refer to things such as cities, towns, railroads, canals, dams, bridges and parks. On a topographic map, these man-made features are usually shown with symbols, which can be identified using a map key or with knowledge of typical symbols used on topographical maps.

Figure 11: QUIZ GAME #1 Slide and Associated Discussion Notes

Although students have been collecting data from the pools regularly, not all the students have been taught beyond the general definitions of what vernal pools are. Specifically, the notes provide discussion that vernal pools are found in different climates all over the world, the origin, and also the obligate species versus organisms associated with the area.

What is a vernal pool?
A vernal pool is a shallow depression that typically contains water for only part of the year.

How vernal pools got their names?
The name is derived from the source of water for many of these pools. The word "vernal" comes from the Latin world 'vernus' meaning spring. Spring melts the snow that fill these pools, or the climate changes leads to increased rain and elevated levels of water.

Many vernal pools are small and temporary, thus are not featured on many maps. To find and/or track these pools, it is a good idea to have a system that can be utilized. Using different tools like USGS maps may lead to a discovery of a vernal pool that was not recorded or one that has disappeared. Other types of maps that can be of assistance are topographic maps, where the topography and feature of areas are shown in great detail and GIS.

Figure 12: Vernal Pools Slide and Associated Discussion Notes

Integrating with the topic of vernal pools, an overview of types of ecosystem and endangered species are defined and discussed next.

What is an endangered species?
Any species, which is in danger of extinction throughout all or a significant portion of its population other than insects, which are considered pests instead.

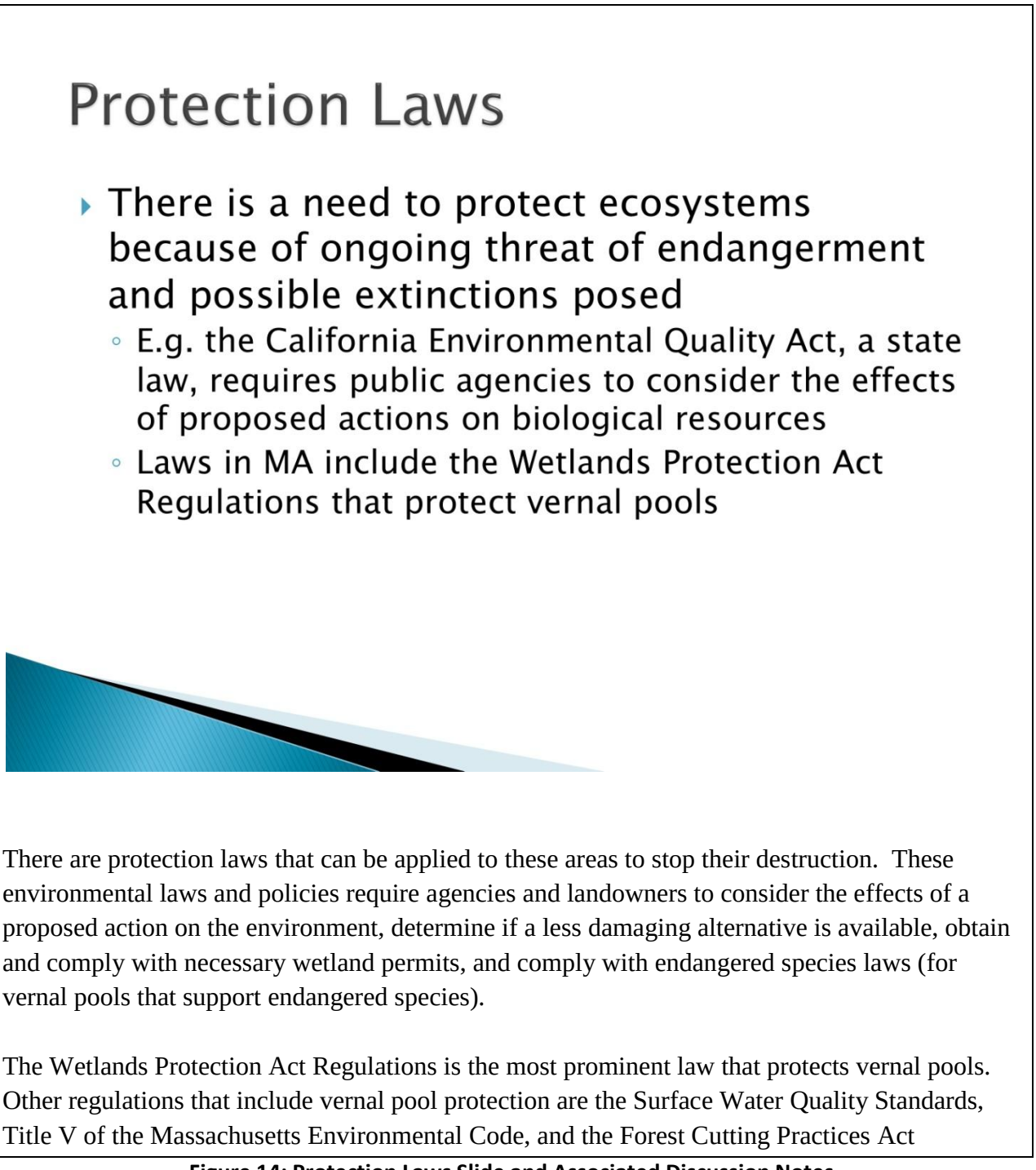
What is an ecosystem?
An ecosystem is a community of all the species populations that occupy a given area, like plants, animals, and all the organisms in between and its nonliving environment.
PIC: Coral reefs are an example of a marine ecosystem

What type of ecosystem is considered the most endangered?
Tropical forests are the most widely appreciated, endangered ecosystems and have the highest rate of species extinction in the twenty first century. (FWS. Endangered Species Act of 1973. 1999)

Interesting Fact
More than 90% of California's vernal pools have already been lost. (EPA: Wetlands 2008)

Figure 13: Endangered Species Slide and Associated Discussion Notes

After introducing the threat that impact endangered species and their ecosystems, the next section focuses on the topic of protection laws that shield these habitats from harm. Examples of laws that protect vernal pools and its surrounding ecosystems are given.

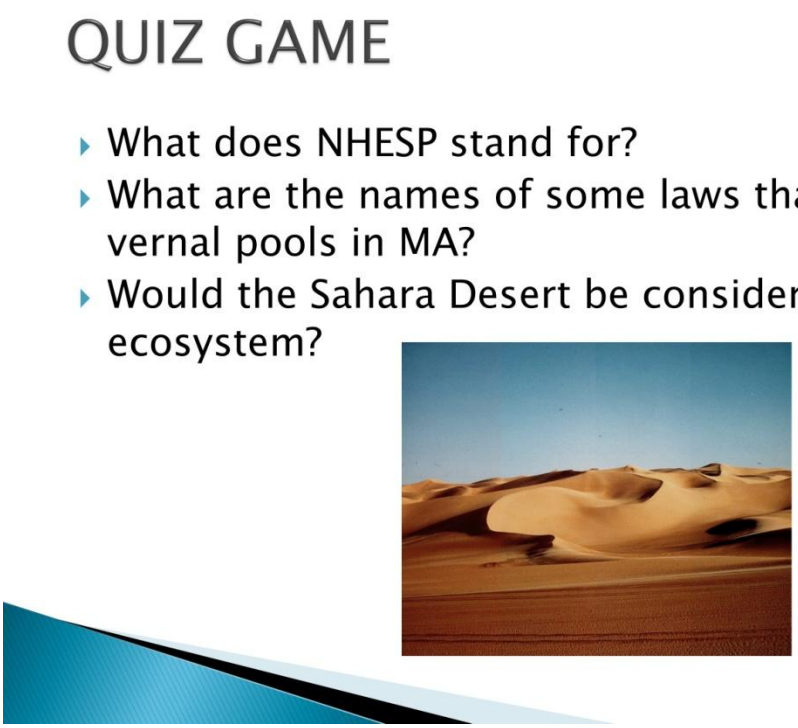


There are protection laws that can be applied to these areas to stop their destruction. These environmental laws and policies require agencies and landowners to consider the effects of a proposed action on the environment, determine if a less damaging alternative is available, obtain and comply with necessary wetland permits, and comply with endangered species laws (for vernal pools that support endangered species).

The Wetlands Protection Act Regulations is the most prominent law that protects vernal pools. Other regulations that include vernal pool protection are the Surface Water Quality Standards, Title V of the Massachusetts Environmental Code, and the Forest Cutting Practices Act

Figure 14: Protection Laws Slide and Associated Discussion Notes

The second QUIZ GAME slide assesses students on information in the previous slides, as well as focuses on an organization that they worked with in the past. Also included is a question that forces them to think what they have learned thus far in order to answer it.



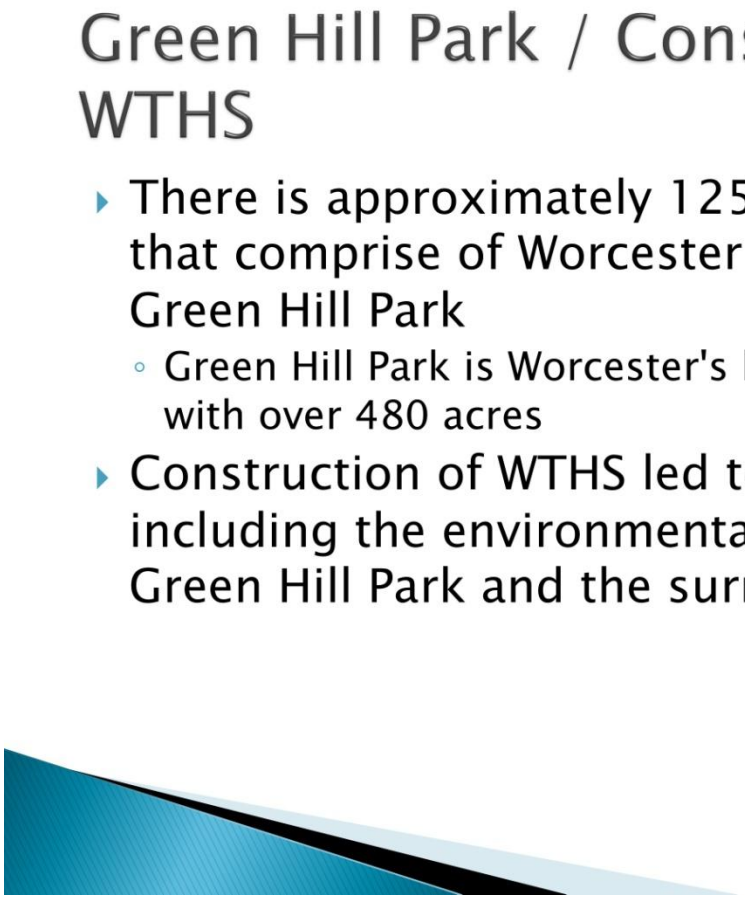
What does NHESP stand for?
Natural Heritage and Endangered Species Program (NHESP)

What are the names of some laws that protect vernal pools in MA? (MULTIPLE ANSWERS)
The Wetlands Protection Act Regulations is the most prominent law that protects vernal pools. Other regulations that include vernal pool protection are the Surface Water Quality Standards, Title V of the Massachusetts Environmental Code, and the Forest Cutting Practices Act Regulations.

Would the Sahara Desert be considered an ecosystem?
Yes, because there are living organisms and vegetation.
Examples of living organisms are lizards, scorpions, snakes (Sidewinder and Cobra)
Example of vegetation are- nuts, Acacias.

Figure 15: QUIZ GAME #2 Slide and Associated Discussion Notes

Next, the background of the construction of Worcester Technical High School and its agreement to oversee the land with the Green Hill Park Coalition is discussed. The discussion relates the construction of the school to that of another campus which faced the same environmental dilemmas

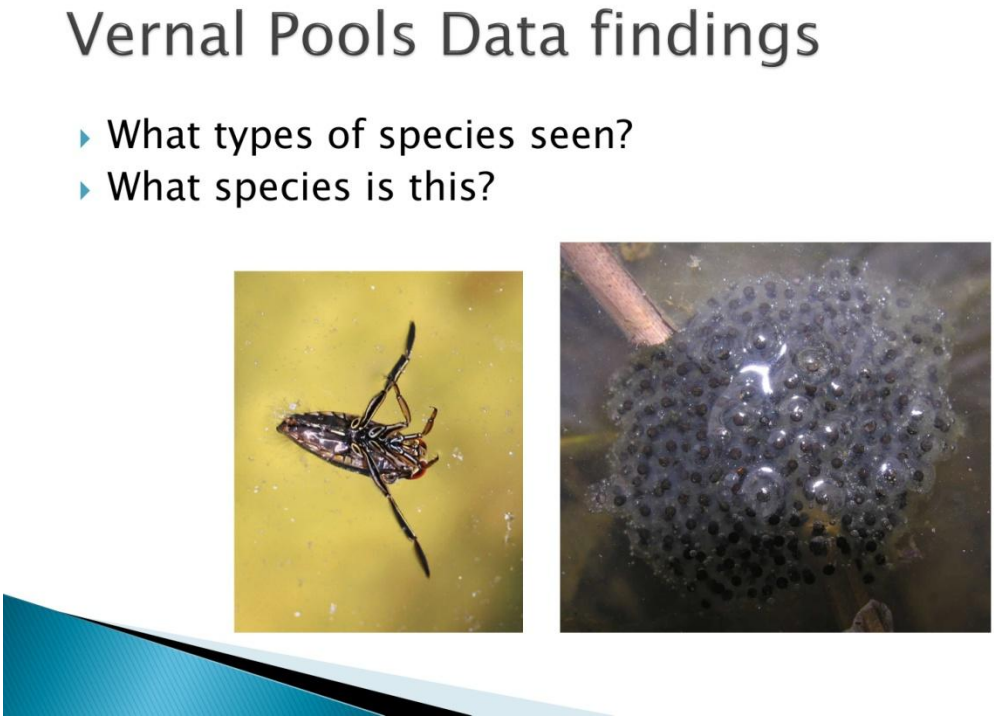


In an effort to appease environmental interest groups, the architects strived to avoid destroying several nearby vernal pools for the layout of the building

INTERSTING FACT
In California, where vernal pools are most prominent in the United States, the Merced campus of the University of California was built on the largest remaining vernal pool habitat in the state. Whereas the Merced campus was once feared to approximately decimate the ecosystems, including vernal pools, within the 10,000-acre construction site, it has been since been protected due to conservation laws and regulations passed. (CNPS 2000)

Figure 16: Green Hill Park / Construction of WTHS Slide and Associated Discussion Notes

The next section presents the brief results of the data collection during the visits to the vernal pools. Some of the species found are listed, as well as trends in the aggregate temperature and weather conditions that could have contributed to the differing results from last year. Finally, the effects of phosphorous levels in the water are discussed as they were measured also.



What species is this? (Left)
Backswimmers found in Skyline Drive pool and some at Pool C
What species is this? (Right)
Wood frog larvae found primarily in Skyline Drive pool

NOTE: Phosphates are not toxic to people or animals unless they are present in very high levels. Digestive problems could occur from extremely high levels of phosphate.

What causes fluctuating phosphorous levels?
Rainfall can cause varying amounts of phosphates to wash from farm soils into nearby waterways.

Figure 17: Data Findings Slide and Associated Discussion Notes

Rounding out the presentation is a section that introduces several of the devices used to collect the data. The specific equipments are shown, and the notes define what type of ways they can be utilized.

What is a photometer?
A photometer is an instrument for measuring light intensity or optical properties of solutions or surfaces. The V-2000 is microprocessor-based photometer that can also be used to measure any type of cuvette or vial, designed for photometric analysis.
Follows a CHEMetrics engine (Silicon dioxide, oxygen, nitrate and phosphorous).

The **eTrex Venture HC** is a portable, high sensored GPS device that can be configured with GIS. Popularly used for geocaching, and trekking through heavy terrain.

What is DGPS?
The DGPS requires that a GPS receiver, known as the base station, be set up on a precisely known location. The base station receiver calculates its position based on satellite signals and compares this location to the known location. The difference is that the device accesses different sources of data, and therefore has accuracy levels vary also.

Figure 18: Equipments Slide and Associated Discussion Notes

5. Conclusion

The goal of this project was to perform an assessment review of vernal pools adjacent to Worcester Tech, and also incorporate the relevant experiences into an educational process for the high school students. Throughout the lesson planning and meetings with Mr. Anderson, there was discussion of the curriculum and the topics that had not yet been covered due to time constraints. During the preparation for the certification guidelines, background history was compiled on the nature of vernal pools, the history with the construction of Worcester Technical High School surrounding green Hill Park, and on Geographical Information Systems (GIS). These points, along with an overview of topics that the students had not yet learned including different types of maps, ecosystems, and equipments were focused on during the lesson. Additionally, the proposed site information had to be gathered from each pool as outlined in the annual report. While the united objective of trying to certify the selected vernal pool changed upon discovery that all the pools within the area had already attained certifications, the stages of the project remained intact. When it was revealed that all the vernal pools selected had already been certified, the focus of the project to review the vernal pools did not change.

What the certification process originally represented was a capstone of all the data collected and lessons the students had learned. The certification process of vernal pools in Massachusetts is done by having citizens submit the required documents. Because the students had regularly been visiting the pools and writing down their observations, with the combined resources of the data collection from Mr. Gass, most of the information needed for submission had already been gathered. The final component that is required for submission in a certification packet, along with the evidence of obligate species in the pool and the observation form, is a map of the area with the proposed vernal pools located.

The students were shown how use GIS to create different maps based on their specifications. They were introduced to GIS, the ArcGIS software suite and several maps as examples with different layers of representation. There were geographical inaccuracies listed among the maps provided by MassGIS that had to be corrected, missing pieces of information within the database that comprised the annual report, as well as a way to relate the information of the data that the students were arbitrarily collecting to their studies. Before the lesson, the students had not yet been exposed to GIS, nor had taken advantage of the software that they had installed on their school computers. The goal in teaching the students these skills is so they can utilize the maps to convey what they have been learning by pinpointing each location they had visited or as a concurrent tool to assist with their data collecting.

Based on the results of the site assessments, it is fair to say that the school is adequately monitoring the vernal pools. Additionally, they are still able to provide an ecosystem for the obligate species that habituate these areas. While the students had been gathering data on their visits to the vernal pools, they were not yet been familiar with GPS/GIS and how they can use those tools to plot their findings on a map. The addition of GIS is an important tool that has many uses in the field of environmental studies.

As the students move forward, it was important that they received a greater understanding of the sites that they were visiting as well as how they can apply their data collecting to convey what they had learned. These tools can be applied in the future also. As a result of creating the lesson plan and visiting the sites regularly, it can be concluded that vernal pools are an important topic to include into the high school curriculum, especially for environmental studies, where many lessons can be taught from knowledge of their ecosystems. From observations during the presentation, it can be deduced that the inclusion of motivational tools, such as quizzes,

interesting facts, and others ways to engage the students will increase their participation during the class and, hopefully, help them retain the knowledge of what they learned.

What was accomplished during this project included the review/assessment of the pools, and the development of the PowerPoint presentation to help incorporate materials into the education program at Worcester Technical High School. Through the help of Mr. Gass as well as the guidance of Mr. Anderson and his class, the vernal pools appear to be in good condition, and so too will the collaboration between the committees as the evaluations continue in the future. It is evident that the Environment Technology department is using the area around the school to its advantage and, should the monitoring of the vernal pools be upheld, it will continue to play a large role in educating the students.

6. Appendices

6.1 Appendix A: Annual Report

WORCESTER PUBLIC SCHOOLS | **WORCESTER TECHNICAL HIGH SCHOOL**

ENVIRONMENTAL TECHNOLOGY
R.J.Anderson, Instructor

One Skyline Drive, WORCESTER, MA, 01605
TEL. 508-751-7645 andersonr@techhigh.us

Environmental Technology

Greenhill Park Report 08-09

It has been a busy year for the environmental program at Worcester Technical High School and Greenhill Park played a major role as the focus of our activities.

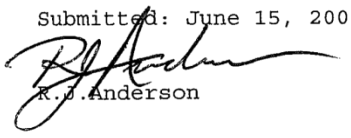
- In September, Mass Audubon took us canoeing on Greenhill Pond
- In October, Mass Wildlife took us fishing on Greenhill Pond
- We continued monitoring the vernal pool with the help of wetland biologist Jim Gass of ENSR. (see attachments)
  - Automated pumping for Pool C has proved a success.
  - We studied the biodiversity in the Vernal pool using the Shannon Weaver & Simpson Biodiversity Indices.
- The December Ice storm caused serious damage in the park.
  - Students surveyed trail damage and helped clean a section of the East Side Trail. (See attached Trail Report)
  - EnvTec Students helped graduate students from Worcester State College collect storm damage data in the park for a GIS study they are conducting in Worcester County.
- Greenhill Farm manager, Harry Carr, arranged a meeting with EnvTec, Horticulture, and VetTech teachers as well as Rob Caroll, city gardener, to brainstorm ideas of making the farm and school more compatible. (see attached report)
  - We arranged for Painting Department to make signage for the animal pens.
  - Students hatched pheasant chicks for zoo.
  - An educational video was made at the farm with EnvTec students, Channel 11, Worcester Tree Initiative and foresters from the DCR to air this fall.
  - A sample nursery of ALB resistant trees was planted at the farm with signs prepared by EnvTec, painting and sheet metal departments. Graphics printed brochures on tree planting.
  - An overnight camping trip was planned for, but not realized due to staffing issues, with the help of Mr. Antonelli.

- We received an award from the State for our work in protecting the Blackstone River Watershed
    - We made an educational video with Channel 11 about the effects of stormwater and what can be done about it.
    - We did stormdrain stenciling around school to spread the word about stormwater issues.
- Students worked with the Greater Worcester Land Trust and the USDA to survey the park for Asian Longhorned Beetles.
    - We have offered to help the Worcester Tree Initiative with replacement tree planting and educational outreach.
- Urban Ecology was a major topic covered this year and the park provided a site for our field studies.
    - We collected data on Urban Trees planted around the school to input into a GIS data base and analyze using CityGreen Software.
    - We collected data on Bird Biodiversity in and around the park.

Next year we plan to continue working in park.

- We plan to collect data on vernal pools for a study being done by Harvard University.
- Harvard University would also like us to collect data on Trees & Global Warming and the spread of the Wooly Adelgid.
- We have a unique opportunity to study the newly created vernal pools next to the Vietnam Memorial to collect data and study their evolution over the years to come.
- We plan to build more birdhouses for cavity nesting birds including wood ducks.
- Next year, the Environmental Program will partner with the Horticulture program which could result in more opportunities to help in the park, greenhouse and to promote planting trees to help restore Worcester's Urban Landscape which has been devastated by the ALB.
- We would like to place interns with the Parks Department to give students valuable work experience while providing help to park.

Submitted: June 15, 2009



R.J. Anderson

ENSR INTERNATIONAL
2 Technology Park Drive
Westford, MA 01886
(978) 589-3000
FAX (978) 589-3035
www.ensr.com

ENSR International
11 Phelps Way/PO Box 506
Willington, CT 06279
(860) 429-5323
FAX (860) 429-5378

Vernal Pool Monitoring and Inspection Report Form
Worcester Vocational High School Site
Worcester, Massachusetts

Date: 7/6/06

Inspector: James Gass

Inspector's Title: Wildlife and Wetland Biologist

CURRENT SITE STATUS:

Site Area	Current Monitoring Activities	Current Condition
Vernal Pool A/B	Periodic Water Level Monitoring	Good
Vernal Pool C	Periodic Water Level Monitoring	Good
Vernal Pool D	Periodic Water Level Monitoring	Good
Skyline Drive Pool	Periodic Water Level Monitoring	Good

Other Observations: At the time of today's visit (12:20 p.m.), the water level in Pool C was at approximately 32.25", which is 8.25" above the interim minimum water level depth of 24.0". There was no monitoring of Pool C in the first week of July in 2005, so a corresponding depth from this time last year is unavailable.

The water depth in Reference Pool A/B is lower than it was at last visit (currently at approximately 16.5", was 19.75" on 6/27/06). The Skyline Drive Pool is also slightly lower this visit. It is currently at approximately 37.0", down 0.25" from last visit (approximately 37.25"). A corresponding depth from this time last year for both these pools is unavailable.

The water depth in Reference Pool D was also lower this visit (approximately 29.75", was approximately 32.25" on 6/27/06). A corresponding depth from this time last year is unavailable.

ENSR INTERNATIONAL
2 Technology Park Drive
Westford, MA 01886
(978) 589-3000
FAX (978) 589-3035
www.ensr.com

ENSR International
11 Phelps Way/PO Box 506
Willington, CT 06279
(860) 429-5323
FAX (860) 429-5378

Vernal Pool Monitoring and Inspection Report Form
Worcester Vocational High School Site
Worcester, Massachusetts

Date: 6/27/06

Inspector: James Gass

Inspector's Title: Wildlife and Wetland Biologist

CURRENT SITE STATUS:

Site Area	Current Monitoring Activities	Current Condition
Vernal Pool A/B	Periodic Water Level Monitoring	Good
Vernal Pool C	Periodic Water Level Monitoring	Good
Vernal Pool D	Periodic Water Level Monitoring	Good
Skyline Drive Pool	Periodic Water Level Monitoring	Good

Other Observations: At the time of today's visit (11:10 a.m.), the water level in Pool C was at approximately 32.75", which is 8.75" above the interim minimum water level depth of 24.0", and also 11.75" higher than it was on 6/29/05 (21.0").

The water depth in Reference Pool A/B is higher than it was at last visit (currently at approximately 19.75", was 17.25" on 6/23/06); and is 9.25" higher than it was on 6/29/05 (10.5"). The Skyline Drive Pool is also higher this visit. It is currently at approximately 37.25"; up 0.75" from last visit (approximately 36.5"), and up 4.0" from this time last year (33.25").

The water depth in Reference Pool D was also higher this visit (approximately 32.25", was approximately 30.0" on 6/23/06), and is 2.5" higher than it was on 6/29/05 (29.75").

ENSR INTERNATIONAL
2 Technology Park Drive
Westford, MA 01886
(978) 589-3000
FAX (978) 589-3035
www.ensr.com

ENSR International
11 Phelps Way/PO Box 506
Willington, CT 06279
(860) 429-5323
FAX (860) 429-5378

Vernal Pool Monitoring and Inspection Report Form
Worcester Vocational High School Site
Worcester, Massachusetts

Date: 6/23/06

Inspector: James Gass

Inspector's Title: Wildlife and Wetland Biologist

CURRENT SITE STATUS:

Site Area	Current Monitoring Activities	Current Condition
Vernal Pool A/B	Periodic Water Level Monitoring	Good
Vernal Pool C	Periodic Water Level Monitoring	Somewhat Low
Vernal Pool D	Periodic Water Level Monitoring	Good
Skyline Drive Pool	Periodic Water Level Monitoring	Good

Other Observations: At the time of today's visit (12:30 p.m.), the water level in Pool C was at approximately 18.0", which is 6.0" below the interim minimum water level depth of 24.0", and also 6.0" lower than it was on 6/23/05 (24.0").

The water depth in Reference Pool A/B is lower than it was at last visit (currently at approximately 17.25", was 20.0" on 6/15/06); but is 1.25" higher than it was on 6/23/05 (16.0"). The Skyline Drive Pool is also lower this visit. It is currently at approximately 36.5"; down 4.0" from last visit (approximately 40.5"), and down 0.5" from this time last year (37.0").

The water depth in Reference Pool D was slightly lower this visit (approximately 30.0", was approximately 33.0" on 6/15/06), and is 0.75" lower than it was on 6/23/05 (33.75").

ENSR INTERNATIONAL
2 Technology Park Drive
Westford, MA 01886
(978) 589-3000
FAX (978) 589-3035
www.ensr.com

ENSR International
11 Phelps Way/PO Box 506
Willington, CT 06279
(860) 429-5323
FAX (860) 429-5378

Vernal Pool Monitoring and Inspection Report Form
Worcester Vocational High School Site
Worcester, Massachusetts

Date: 6/15/06

Inspector: James Gass

Inspector's Title: Wildlife and Wetland Biologist

CURRENT SITE STATUS:

Site Area	Current Monitoring Activities	Current Condition
Vernal Pool A/B	Periodic Water Level Monitoring	Good
Vernal Pool C	Periodic Water Level Monitoring	Good
Vernal Pool D	Periodic Water Level Monitoring	Good
Skyline Drive Pool	Periodic Water Level Monitoring	Good

Other Observations: At the time of today's visit (1:30 p.m.), the water level in Pool C was at approximately 28.75", which is 4.75" above the interim minimum water level depth of 24.0", but 12.25" lower than it was on 6/17/05 (41.0").

The water depth in Reference Pool A/B is essentially the same as it was at last visit (currently at approximately 20.0", was 21.0" on 6/5/06); and is 1.0" higher than it was on 6/17/05 (19.0"). The Skyline Drive Pool is also at essentially the same level this visit. It is currently at approximately 40.5"; up 0.5" from last visit (approximately 40.0"), and up 1.25" from this time last year (39.25").

The water depth in Reference Pool D was slightly higher this visit (approximately 33.0", was approximately 32.75" on 6/5/06), but is 3.0" lower than it was on 6/17/05 (36.0").

ENSR INTERNATIONAL
2 Technology Park Drive
Westford, MA 01886
(978) 589-3000
FAX (978) 589-3035
www.ensr.com

ENSR International
11 Phelps Way/PO Box 506
Willington, CT 06279
(860) 429-5323
FAX (860) 429-5378

Vernal Pool Monitoring and Inspection Report Form
Worcester Vocational High School Site
Worcester, Massachusetts

Date: 6/5/06

Inspector: James Gass

Inspector's Title: Wildlife and Wetland Biologist

CURRENT SITE STATUS:

Site Area	Current Monitoring Activities	Current Condition
Vernal Pool A/B	Periodic Water Level Monitoring	Good
Vernal Pool C	Periodic Water Level Monitoring	Good
Vernal Pool D	Periodic Water Level Monitoring	Good
Skyline Drive Pool	Periodic Water Level Monitoring	Good

Other Observations: At the time of today's visit (3:30 p.m.), the water level in Pool C was at approximately 36.75", which is 12.75" above the interim minimum water level depth of 24.0", and 2.25" higher than it was on 6/7/05 (34.5").

The water depth in Reference Pool A/B is also slightly higher than it was at last visit (currently at approximately 21.0", was 18.75" on 5/31/06); and is 3.5" higher than it was on 6/7/05 (17.5"). The Skyline Drive Pool is also higher this visit. Its level is currently at approximately 40.0"; up 1.0" from last visit (approximately 39.0"), and up 0.5" from this time last year (39.5").

The water depth in Reference Pool D was also slightly higher this visit (approximately 32.75", was approximately 32.0" on 5/26/06), but is 3.25" lower than it was on 6/7/05 (36.0").

ENSR INTERNATIONAL
2 Technology Park Drive
Westford, MA 01886
(978) 589-3000
FAX (978) 589-3035
www.ensr.com

ENSR International
11 Phelps Way/PO Box 506
Willington, CT 06279
(860) 429-5323
FAX (860) 429-5378

Vernal Pool Monitoring and Inspection Report Form
Worcester Vocational High School Site
Worcester, Massachusetts

Date: 5/31/06

Inspector: James Gass

Inspector's Title: Wildlife and Wetland Biologist

CURRENT SITE STATUS:

Site Area	Current Monitoring Activities	Current Condition
Vernal Pool A/B	Periodic Water Level Monitoring	Good
Vernal Pool C	Periodic Water Level Monitoring	Somewhat low
Vernal Pool D	Periodic Water Level Monitoring	Good
Skyline Drive Pool	Periodic Water Level Monitoring	Good

Other Observations: At the time of today's visit (11:45 a.m.), the water level in Pool C was at approximately 17.0", which is 7.0" below the interim minimum water level depth of 24.0", and 10.0" lower than it was on 6/2/05 (27.0"). Jim Bedard, the facilities manager, turned the pump on at approximately 12:15 p.m. I advised him to run it for two days.

The water depth in Reference Pool A/B is also slightly lower than it was at last visit (currently at approximately18.75", was 19.75" on 5/26/06); and is 1.25" lower than it was on 6/2/05 (20.0"). The Skyline Drive Pool is also lower this visit. Its level is currently at approximately 39.0"; down 1.0" from last visit (approximately 40.0"), and down 2.5" from this time last year (41.5").

The water depth in Reference Pool D was also slightly lower this visit (approximately 32.0", was approximately 32.75" on 5/26/06), but is 5.0" lower than it was on 6/2/05 (37.0").

ENSR INTERNATIONAL
2 Technology Park Drive
Westford, MA 01886
(978) 589-3000
FAX (978) 589-3035
www.ensr.com

ENSR International
11 Phelps Way/PO Box 506
Willington, CT 06279
(860) 429-5323
FAX (860) 429-5378

Vernal Pool Monitoring and Inspection Report Form
Worcester Vocational High School Site
Worcester, Massachusetts

Date: 5/26/06

Inspector: James Gass

Inspector's Title: Wildlife and Wetland Biologist

CURRENT SITE STATUS:

Site Area	Current Monitoring Activities	Current Condition
Vernal Pool A/B	Periodic Water Level Monitoring	Good
Vernal Pool C	Periodic Water Level Monitoring	Somewhat low
Vernal Pool D	Periodic Water Level Monitoring	Good
Skyline Drive Pool	Periodic Water Level Monitoring	Good

Other Observations: At the time of today's visit (2:00 p.m.), the water level in Pool C was at approximately 21.75", which is 2.25" below the interim minimum water level depth of 24.0", and 17.75" lower than it was on 5/27/05 (39.5"). Jim Bedard, the facilities manager, was on vacation today, so the water pump was not turned on.

The water depth in Reference Pool A/B is also slightly lower than it was at last visit (currently at approximately19.75", was 22.5" on 5/19/06); and is 2.75" lower than it was on 5/27/05 (22.5"). The Skyline Drive Pool is also lower this visit. Its level is currently at approximately 40.0"; down 2.0" from last visit (approximately 42.0"), and down 3.0" from this time last year (43.0").

The water depth in Reference Pool D was also slightly lower this visit (approximately 32.75", was approximately 33.0" on 5/19/06), but is 4.75" lower than it was on 5/27/05 (37.5").

ENSR INTERNATIONAL
2 Technology Park Drive
Westford, MA 01886
(978) 589-3000
FAX (978) 589-3035
www.ensr.com

ENSR International
11 Phelps Way/PO Box 506
Willington, CT 06279
(860) 429-5323
FAX (860) 429-5378

Vernal Pool Monitoring and Inspection Report Form
Worcester Vocational High School Site
Worcester, Massachusetts

Date: 5/19/06

Inspector: James Gass

Inspector's Title: Wildlife and Wetland Biologist

CURRENT SITE STATUS:

Site Area	Current Monitoring Activities	Current Condition
Vernal Pool A/B	Periodic Water Level Monitoring	Good
Vernal Pool C	Periodic Water Level Monitoring	Good
Vernal Pool D	Periodic Water Level Monitoring	Good
Skyline Drive Pool	Periodic Water Level Monitoring	Good

Other Observations: At the time of today's visit (1:00 p.m.), the water level in Pool C was at approximately 35.75", which is 11.75" above the interim minimum water level depth of 24.0", and 7.25" higher than it was on 5/16/05 (28.5"). Due to almost two weeks of rain, this was the first time during the survey period that the depth in Pool C has exceeded the interim water level depth. American toads were heard calling from the pool.

The water depth in Reference Pool A/B is slightly higher than it was at last visit (currently approximately 22.5", was 19.25" on 5/8/06); and is 2.0" higher than it was on 5/16/05 (20.5"). However, the Skyline Drive Pool is considerably higher this visit. Its level is currently at approximately 42.0"; up 6.5" from last visit (approximately 35.5"), and up 0.5" from this time last year (42.5"). The Skyline Drive Pool had many American toad larvae.

The water depth in Reference Pool D was also slightly higher this visit (approximately 33.0", was approximately 32.75" on 5/8/06), but is 4.25" lower than it was on 5/16/05 (37.25").

ENSR INTERNATIONAL
2 Technology Park Drive
Westford, MA 01886
(978) 589-3000
FAX (978) 589-3035
www.ensr.com

ENSR International
11 Phelps Way/PO Box 506
Willington, CT 06279
(860) 429-5323
FAX (860) 429-5378

Vernal Pool Monitoring and Inspection Report Form
Worcester Vocational High School Site
Worcester, Massachusetts

Date: 5/8/06

Inspector: James Gass

Inspector's Title: Wildlife and Wetland Biologist

CURRENT SITE STATUS:

Site Area	Current Monitoring Activities	Current Condition
Vernal Pool A/B	Periodic Water Level Monitoring	Good
Vernal Pool C	Periodic Water Level Monitoring	Somewhat low, see observations below
Vernal Pool D	Periodic Water Level Monitoring	Good
Skyline Drive Pool	Periodic Water Level Monitoring	Good

Other Observations: At the time of today's visit (1:30 p.m.), the water level in Pool C was at approximately 20.75", which is 3.25" below the interim minimum water level depth of 24.0", and 11.25" lower than it was on 5/9/05 (32.0"). I advised Jim Bedard, the facilities manager, to activate the water pump at 1:40 p.m., which he did. I also discovered American toad eggs in the shallows of the eastern section of the pool (approximately a week old), and advised Jim to run the pump all day on 5/13/06 so as to raise the water level enough to protect the eggs from desiccation. The water level will be well above 24.0" by 5:00 p.m. on 5/13/06.

Rainfall is continuing to ameliorate dry conditions regionally, but the water level in the reference pools remains variable. The water depth in Reference Pool A/B is slightly lower than it was at last visit (currently approximately 19.25", was 19.75" on 5/2/06); and is 1.75" lower than it was on 5/9/05 (21.0"). However, the Skyline Drive Pool is slightly higher this visit. Its level is currently at approximately 35.5"; up 0.75" from last visit (approximately 34.75"), but down 8.5" from this time last year (44.0"). The Skyline Drive Pool had American toad larvae.

The water depth in Reference Pool D was slightly higher this visit (approximately 32.75", was approximately 32.5" on 5/2/06), but is 4.25" lower than it was on 5/2/05 (37.0").

ENSR INTERNATIONAL
2 Technology Park Drive
Westford, MA 01886
(978) 589-3000
FAX (978) 589-3035
www.ensr.com

ENSR International
11 Phelps Way/PO Box 506
Willington, CT 06279
(860) 429-5323
FAX (860) 429-5378

Vernal Pool Monitoring and Inspection Report Form
Worcester Vocational High School Site
Worcester, Massachusetts

Date: 4/28/06

Inspector: James Gass

Inspector's Title: Wildlife and Wetland Biologist

CURRENT SITE STATUS:

Site Area	Current Monitoring Activities	Current Condition
Vernal Pool A/B	Periodic Water Level Monitoring	Good
Vernal Pool C	Periodic Water Level Monitoring	Somewhat low, see observations below
Vernal Pool D	Periodic Water Level Monitoring	Good
Skyline Drive Pool	Periodic Water Level Monitoring	Good

Other Observations: At the time of today's visit (11:00 a.m.), the water level in Pool C was at approximately 18.75", which is 5.25" below the interim minimum water level depth of 24.0", and 20.25" lower than it was on 4/26/05 (39.0"). I advised Jim Bedard, the facilities manager, to activate the water pump at 12:20 p.m., which he did. Whenever possible, Jim will commence pumping activity first thing in the morning when the water depth is below the 24" mark. The water level should be 24.0" or more by the end of today.

Much needed rainfall on 4/22/06 brought 0.55" of precipitation to the region, but conditions continue to be drier than at this time last year. The water depth in Reference Pool A/B is slightly higher than it was at last visit (currently approximately 17.75", was 16.0" on 4/21/06); but is 3. 5" lower than it was on 4/26/05 (21.25"). Same goes for the Skyline Drive Pool. Its level is currently at approximately 35.5"; up 0.25" from last visit (approximately 35.25"), but down 7.0" from this time last year (42.5").

The water depth in Reference Pool D was also slightly higher this visit (approximately 32.0", was approximately 31.5" on 4/21/06), but is 4.5" lower than it was on 4/26/05 (36.5").

ENSR INTERNATIONAL
2 Technology Park Drive
Westford, MA 01886
(978) 589-3000
FAX (978) 589-3035
www.ensr.com

ENSR International
11 Phelps Way/PO Box 506
Willington, CT 06279
(860) 429-5323
FAX (860) 429-5378

Vernal Pool Monitoring and Inspection Report Form
Worcester Vocational High School Site
Worcester, Massachusetts

Date: 5/2/06

Inspector: James Gass

Inspector's Title: Wildlife and Wetland Biologist

CURRENT SITE STATUS:

Site Area	Current Monitoring Activities	Current Condition
Vernal Pool A/B	Periodic Water Level Monitoring	Good
Vernal Pool C	Periodic Water Level Monitoring	Somewhat low, see observations below
Vernal Pool D	Periodic Water Level Monitoring	Good
Skyline Drive Pool	Periodic Water Level Monitoring	Good

Other Observations: At the time of today's visit (11:00 a.m.), the water level in Pool C was at approximately 20.0", which is 4.0" below the interim minimum water level depth of 24.0", and 14.5" lower than it was on 5/2/05 (34.5"). I advised Jim Bedard, the facilities manager, to activate the water pump at 11:35 a.m., which he did. Whenever possible, Jim will commence pumping activity first thing in the morning when the water depth is below the 24" mark. With the rain, the water level should be 24.0" or more by the end of today.

Rainfall on 5/1/06 through 5/2/06 is helping to ameliorate dry conditions. The water depth in Reference Pool A/B is slightly higher than it was at last visit (currently approximately 19.75", was 17.75" on 4/28/06); but is 1.25" lower than it was on 5/2/05 (21.0"). However, the Skyline Drive Pool is slightly lower this visit. Its level is currently at approximately 34.75"; down 0.75" from last visit (approximately 35.5"), and down 7.75" from this time last year (42.5").

The water depth in Reference Pool D was also slightly higher this visit (approximately 32.5", was approximately 32.0" on 4/28/06), but is 4.5" lower than it was on 5/2/05 (37.0").

ENSR INTERNATIONAL
2 Technology Park Drive
Westford, MA 01886
(978) 589-3000
FAX (978) 589-3035
www.ensr.com

ENSR International
11 Phelps Way/PO Box 506
Willington, CT 06279
(860) 429-5323
FAX (860) 429-5378

Vernal Pool Monitoring and Inspection Report Form
Worcester Vocational High School Site
Worcester, Massachusetts

Date: 4/2106

Inspector: James Gass

Inspector's Title: Wildlife and Wetland Biologist

CURRENT SITE STATUS:

Site Area	Current Monitoring Activities	Current Condition
Vernal Pool A/B	Periodic Water Level Monitoring	Somewhat low
Vernal Pool C	Periodic Water Level Monitoring	Somewhat low, see observations below
Vernal Pool D	Periodic Water Level Monitoring	Somewhat low
Skyline Drive Pool	Periodic Water Level Monitoring	Somewhat low

Other Observations: At the time of today's visit (11:45 a.m.), the water level in Pool C was at approximately 20.0", which is 4.0" below the interim minimum water level depth of 24.0", and 9.75" lower than it was on 4/20/05 (29.75"). Jim Bedard, the facilities manager, had been running the water pump for approximately an hour before my arrival. Jim is now taking a proactive stance, checking the water gauge on a daily basis (in the morning), and commencing pumping activity when the water depth falls below the 24" mark. The water level will be 24.0" or more by the end of the day.

Unusually dry conditions continue to persist this spring, and the water depth in Reference Pool A/B is once again lower than it was at last visit (currently approximately 16.0", was 18.75" on 4/12/06); and is also 1.75" lower than it was on 4/20/05 (17.75"). Same goes for the Skyline Drive Pool. Its level is currently at approximately 35.25"; down 2.5" from last visit (approximately 37.75"), and down 5.25" from this time last year (40.5").

The water depth in Reference Pool D was also slightly lower this visit (approximately 31.5", was approximately 33.25" on 4/12/06), and is 4.0" lower than it was on 4/20/05 (35.5").

ENSR INTERNATIONAL
2 Technology Park Drive
Westford, MA 01886
(978) 589-3000
FAX (978) 589-3035
www.ensr.com

ENSR International
11 Phelps Way/PO Box 506
Willington, CT 06279
(860) 429-5323
FAX (860) 429-5378

Vernal Pool Monitoring and Inspection Report Form
Worcester Vocational High School Site
Worcester, Massachusetts

Date: 4/12/06

Inspector: James Gass

Inspector's Title: Wildlife and Wetland Biologist

CURRENT SITE STATUS:

Site Area	Current Monitoring Activities	Current Condition
Vernal Pool A/B	Periodic Water Level Monitoring	Good
Vernal Pool C	Periodic Water Level Monitoring	Somewhat low, see observations below
Vernal Pool D	Periodic Water Level Monitoring	Good
Skyline Drive Pool	Periodic Water Level Monitoring	Good

Other Observations: The water level in Pool C is currently at approximately 18.5", which is 5.5" below the interim minimum water level depth of 24.0", and 9.5" lower than it was on 4/13/05 (28.0"). Jim Bedard, the facilities manager, was advised to turn on the water pump, which he did at approximately 1:00 p.m. on 4/12/06. ENSR recommends that pumping activity commence prior to the water depth reaching the 24" mark in order to stay ahead of the water leaching out of the pool.

The water depth in Reference Pool A/B is also slightly lower than it was at last visit (currently approximately 18.75", was 19.0" on 4/7/06), but is still 0.5" lower than it was on 4/13/05 (19.25"). Same goes for the Skyline Drive Pool. Its level is currently approximately 37.75"; down 0.25" from last visit (approximately 38.0"), but down 4.75" from this approximate time last year (42.5").

The water depth in Reference Pool D was slightly higher this visit (approximately 33.25", was approximately 32.75" on 4/7/06), but is 3.0" lower than it was on 4/13/05 (36.25").

ENSR INTERNATIONAL
2 Technology Park Drive
Westford, MA 01886
(978) 589-3000
FAX (978) 589-3035
www.ensr.com

ENSR International
11 Phelps Way/PO Box 506
Willington, CT 06279
(860) 429-5323
FAX (860) 429-5378

Vernal Pool Monitoring and Inspection Report Form
Worcester Vocational High School Site
Worcester, Massachusetts

Date: 4/7/06

Inspector: James Gass

Inspector's Title: Wildlife and Wetland Biologist

CURRENT SITE STATUS:

Site Area	Current Monitoring Activities	Current Condition
Vernal Pool A/B	Periodic Water Level Monitoring	Good
Vernal Pool C	Periodic Water Level Monitoring	Good, see observations below
Vernal Pool D	Periodic Water Level Monitoring	Good
Skyline Drive Pool	Periodic Water Level Monitoring	Good

Other Observations: Due to recent rain/snow events on 4/3/06, 4/4/06 and 4/5/06 (>1.25" total precipitation), combined with the activation of the water pump on 3/29/06, the water level in Pool C is currently at approximately 24.0", the interim minimum water level depth. This is 11.75" higher than last visit (approximately 12.25"), but 8.5" lower than on this date last year (32.5"). ENSR recommends that pumping activity commence prior to the water depth reaching the 24" mark in order to stay ahead of the water leaching out of the pool.

The water depth in Reference Pool A/B is also higher than it was at last visit (currently approximately 19.0", was 15.25" on 3/29/06), but is still 2.5" lower than it was on this date last year (21.5"). Same goes for the Skyline Drive Pool. Its level is currently approximately 38.0"; up one inch from last visit (approximately 37.0"), but down 5.75" from this time last year (42.75").

The water depth in Reference Pool D was slightly lower this visit (approximately 32.75", was approximately 33.0" on 3/29/06), but is 4.5" lower than it was on this date last year (36.5").

ENSR INTERNATIONAL

2 Technology Park Drive
Westford, MA 01886

(978) 589-3000
FAX (978) 589-3035
www.ensr.com

ENSR International
11 Phelps Way/PO Box 506
Willington, CT 06279

(860) 429-5323
FAX (860) 429-5378

Vernal Pool Monitoring and Inspection Report Form
Worcester Vocational High School Site
Worcester, Massachusetts

Date: 3/29/06

Inspector: James Gass

Inspector's Title: Wildlife and Wetland Biologist

CURRENT SITE STATUS:

Site Area	Current Monitoring Activities	Current Condition
Vernal Pool A/B	Periodic Water Level Monitoring	Somewhat low
Vernal Pool C	Periodic Water Level Monitoring	Low, see observations below
Vernal Pool D	Periodic Water Level Monitoring	Somewhat low
Skyline Drive Pool	Periodic Water Level Monitoring	Somewhat low

Other Observations: Due to below average rainfall over the last 28 days (0.50" total precipitation), Vernal Pool C presently has a depth of approximately 12.25". At this level, the depth of the pool is 11.75" below the interim minimum water depth of 24". ENSR advised Jim Bedard, the school facilities manager, to activate the water pump until the minimum water level is attained. He did so at 1.30 p.m., and will check the water level before leaving at 5:00 p.m. ENSR recommends pumping activity commence prior to the water depth reaching the 24" mark in order to stay ahead of the water leaching out of the pool.

The water depth in Reference Pool A/B is also somewhat low for this time of year (15.25," was 23.0" on 4/1/05), as is Reference Pool D (33.0", was 36.5" on 4/1/05). Skyline Drive pool is also unseasonably low, at 37.0". It was 42.75" on 4/7/05.

VERNAL POOL DATA SHEET
Worcester Technical High School
Environmental Technology

GENERAL INFO

SITE NAME: _____ DATE:_____

OBSERVER:_____ START TIME:_____END:_____

COUNTY:_____MUNICIPALITY: _____ TOPO QUAD: _____

WEATHER:_____

DIRECTIONS TO SITE:

_____

_____

POOL CHARACTERISTICS

POOL TYPE (check): __natural swale/depression __excavated pit/ditch __impoundment

WATER LEVEL (check): __full __>50%full __<50%full __dry

POOL DIMENSIONS (at max capacity): _____m x _____m

WATER QUALITY (check): __clear __tea-colored __algae-green

STRUCTURE OF VEGETATION WITHIN/OVERHANGING POOL (ESTIMATE % COVER):

____trees ___scrub/shrub ___floating vegetation ___emergent vegetation

DOMINANT PLANT SPECIES WITHIN/OVERHANGING POOL (optional):

_____

_____

_____

LANDSCAPE CONTEXT (check all that apply): __upland forest __forested wetlands

__emergent/scrub-shrub wetland __agricultural field/grassland __suburban

STRUCTURE OF HABITAT WITHIN 100m OF POOL:

_____

GENERAL NOTES/COMMENTS:

_____

_____

_____

_____

_____

Dip-Netting Field Data Sheet

Cell ID#: _____ **Pond ID #:** _____ **Date:** _____
Observers: _____
Air Temp: _____ **Water Temp:** _____ **Start Time:** _____ **End Time:** _____
Water Clarity (cm): _____ **Water Depth (max, cm):** _____ **Weather:** _____

Sweep #	1	2	3	4	5	6	7	8	9	10
Anura	#col / #cnt	#col / #cnt	#col / #cnt	#col / #cnt	#col / #cnt	#col / #cnt	#col / #cnt	#col / #cnt	#col / #cnt	#col / #cnt
Caudata										
Invertebrates										
Other										

Additional Notes:

Sketch

N

Dipnet031401.doc

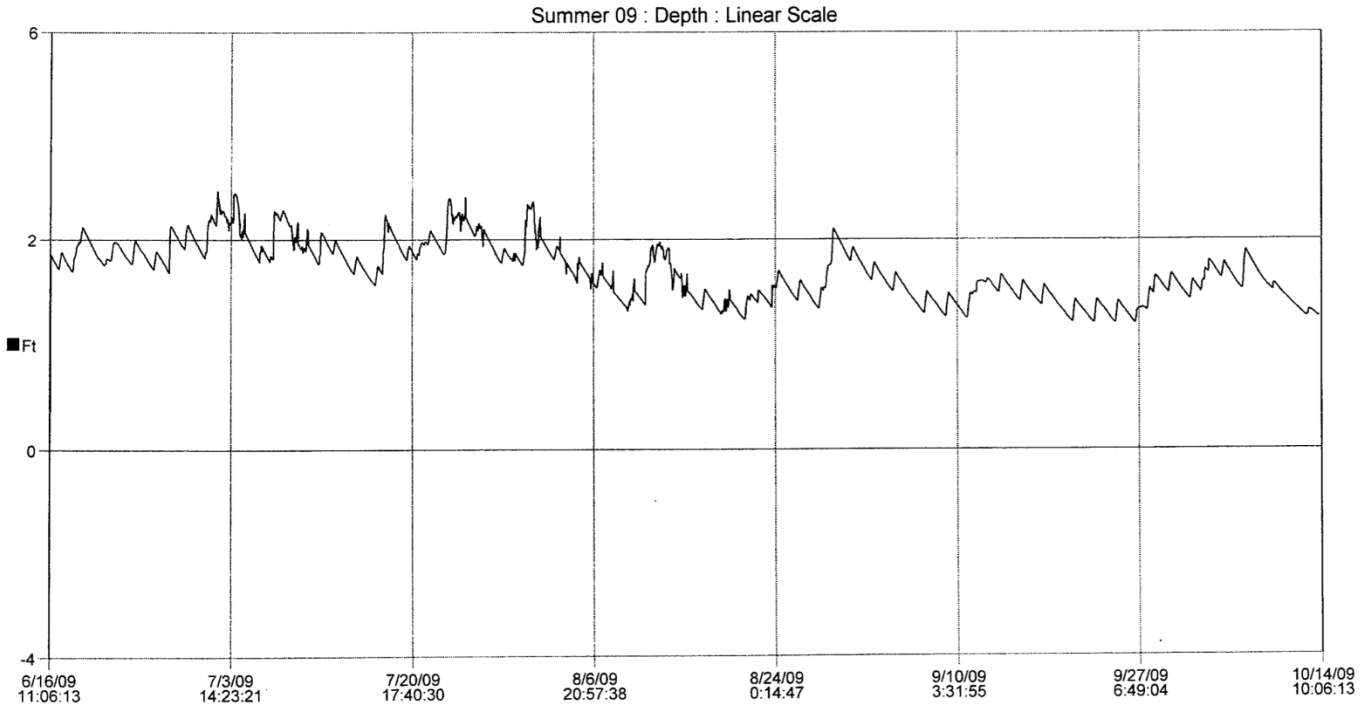
Egg Mass Counts - Field Data Sheet

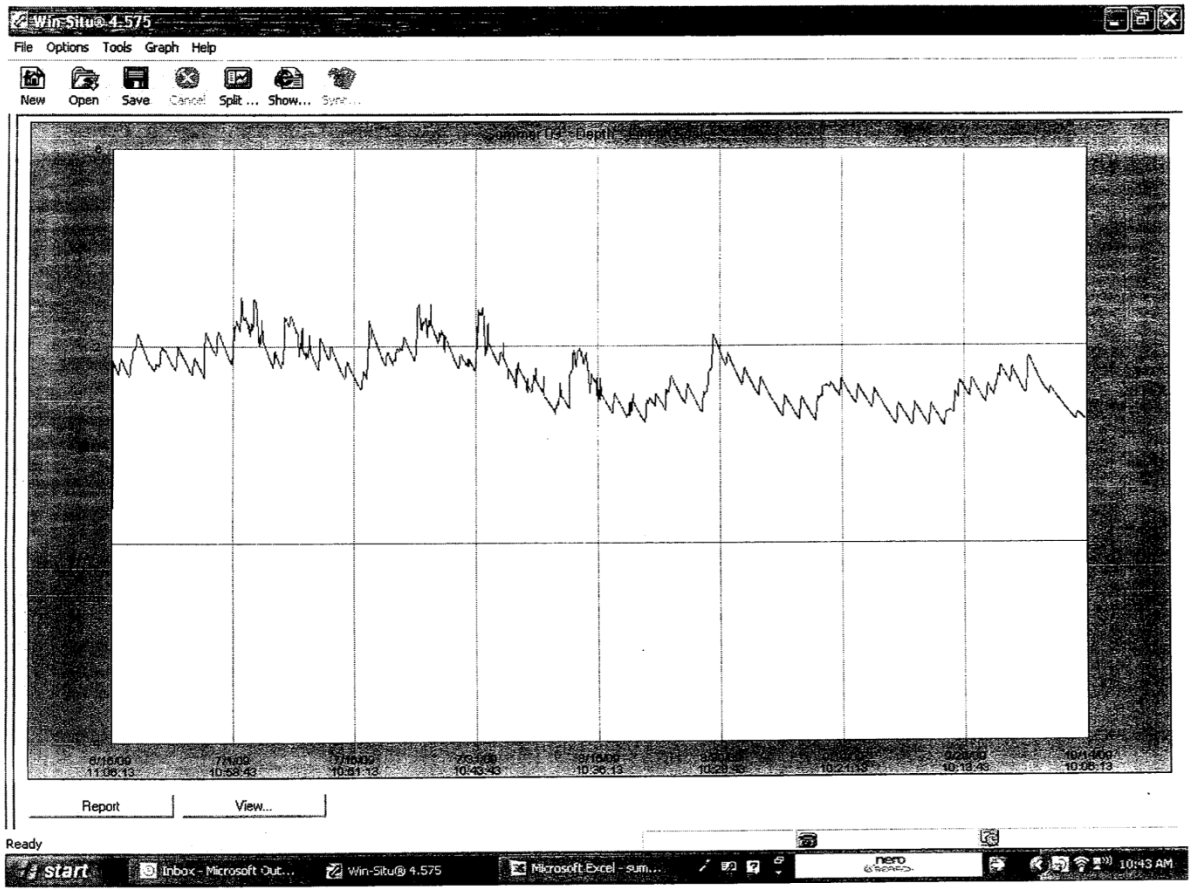
Cell ID#: _____ **Pond ID #:** _____ **Date:** _____
Observer: _____ **Crew:** _____
Air Temp: _____ **Water Temp:** _____ **Start Time:** _____ **End Time:** _____
Water Clarity (cm): _____ **Water Depth (max, cm):** _____ **Weather:** _____

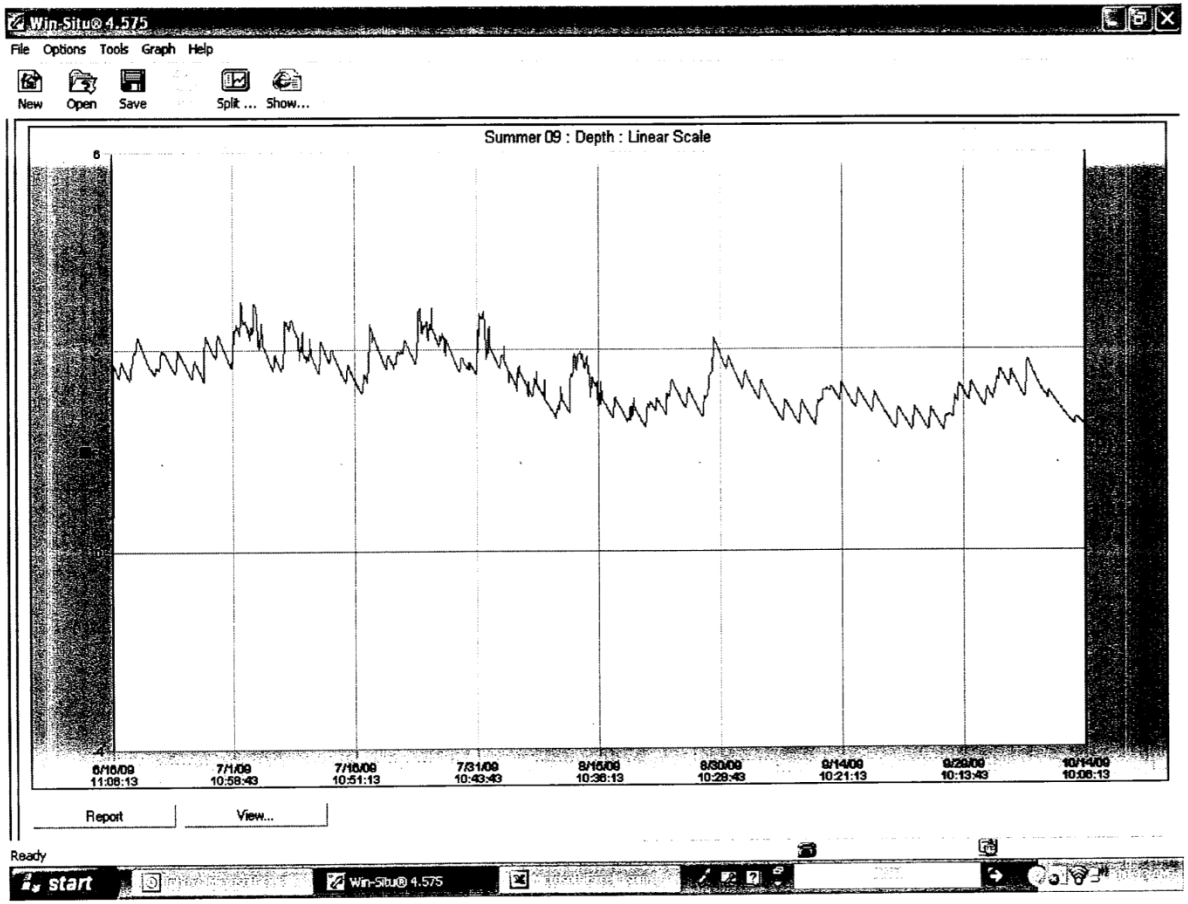
Wood Frog						Spotted Salamander					
Locus No.	# egg Masses	Stage	Locus No.	# egg masses	Stage	Locus No.	# large (c/m)	# small (c/m)	Locus No.	# large (c/m)	# small (c/m)

Egg Mass Locations													Comments

In-Situ Inc.




Win-Situ@ 4.575
File Options Tools Graph Help
New Open Save Cancel Split ... Show... Sync...
Report
View...
Ready
start
Inbox - Microsoft Out...
Win-Situ@ 4.575
Microsoft Excel - sum...
10:43 AM


Win-Situ® 4.575
File Options Tools Graph Help
New Open Save Split ... Show...
Summer 09 : Depth : Linear Scale
6
4
6/16/09 11:08:13
7/1/09 10:58:43
7/16/09 10:51:13
7/31/09 10:43:43
8/15/09 10:36:13
8/30/09 10:28:43
9/14/09 10:21:13
9/29/09 10:13:43
10/14/09 10:06:13
Report
View...
Ready
start
Win-Situ® 4.575

NAME_____

May 12, 2009 Dip Net Data Pool C

Directions: Go to Shopshare/EnvTec folder/Urban Ecology/Mod 6/lesson 2/spreadsheet And input this data into the Biodiversity index. Record below.

#1Team Sophea #3 Team Kyle #4 Team Tina

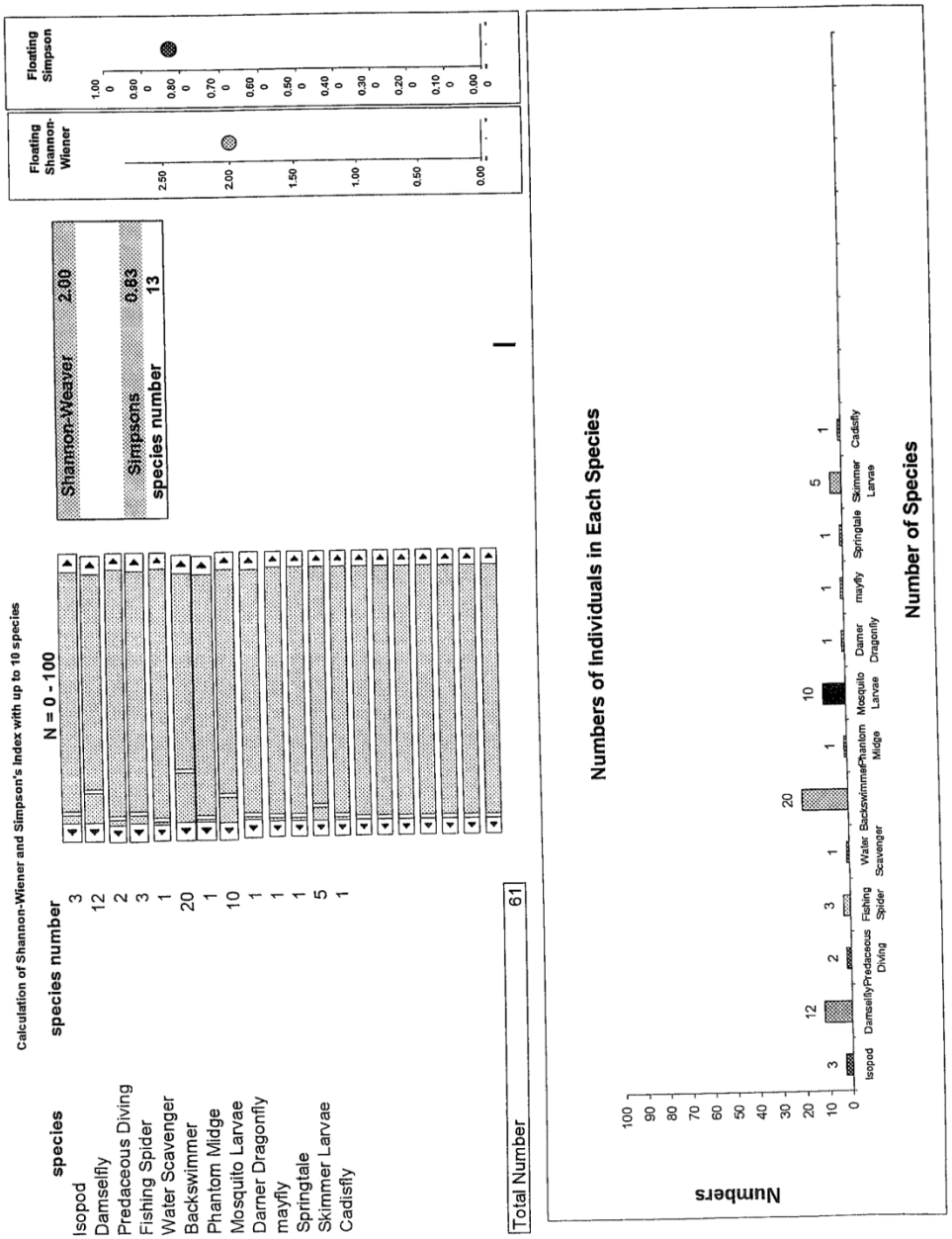
2	Spring Peeper
300 +	Tadpole [toad]
3	Isopod
12	Damselfly
2	Predaceous Diving Beetle Larvae
3	Fishing Spider
3	Water scavenger beetle
1	Phantom midge
20	Backswimmer
10+	Mosquito Larvae
1	Darner Dragonfly Larvae
2	Dragonfly Larvae
1	Mayfly
1	Springtale
5	Skimmer Larvae
1	Cadisfly

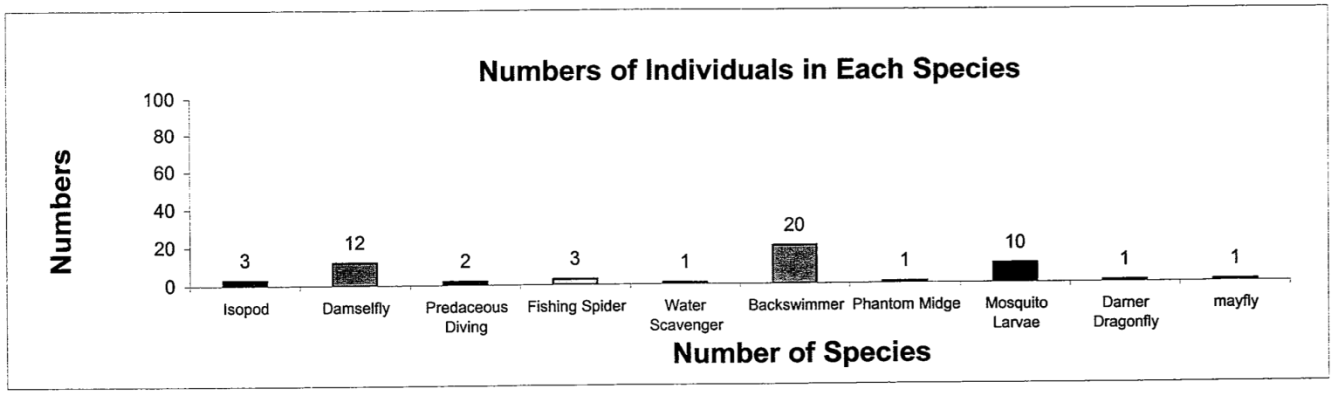
Shannon-Weaver Index:_____

Simpson Index:_____

Species Richness:_____

Worcester Technical High School
Environmental Technology
Dip Net Data 5/12/09
Invertebrate Biodiversity Vernal Pool C




Numbers of Individuals in Each Species
Numbers
100
80
60
40
20
0
3
12
2
3
1
20
1
10
1
1
Isopod
Damselfly
Predaceous Diving
Fishing Spider
Water Scavenger
Backswimmer
Phantom Midge
Mosquito Larvae
Darner Dragonfly
mayfly
Number of Species

		Shannon-Wiener calculation		Simpson calculation	
	p	lnp	plnp	ni(ni-1)	(ni-1)/N(N-1)
1	0.049	-3.0123	-0.1481	6	0.0016
2	0.197	-1.6260	-0.3199	132	0.0361
3	0.033	-3.4177	-0.1121	2	0.0005
4	0.049	-3.0123	-0.1481	6	0.0016
5	0.016	-4.1109	-0.0674	0	0.0000
6	0.328	-1.1151	-0.3656	380	0.1038
7	0.016	-4.1109	-0.0674	0	0.0000
8	0.164	-1.8083	-0.2964	90	0.0246
9	0.016	-4.1109	-0.0674	0	0.0000
11	0.016	-4.1109	-0.0674	0	0.0000
12	0.016	-4.1109	-0.0674	0	0.0000
13	0.082	-2.5014	-0.2050	20	0.0055
14	0.016	-4.1109	-0.0674	0	0.0000
15	0.000	0.0000	0.0000	0	0.0000
16	0.000	0.0000	0.0000	0	0.0000
17	0.000	0.0000	0.0000	0	0.0000
18	0.000	0.0000	0.0000	0	0.0000
19	0.000	0.0000	0.0000	0	0.0000
20	0.000	0.0000	0.0000	0	0.0000
totals	0.041	-3.1946	1.9997		0.8262

$$H = -\sum_{i=1}^{M} p_i \ln p_i \qquad S = 1 - \sum_{i=1}^{M} \frac{n_i(n_i - 1)}{N(N-1)}$$

species number 13

Field Notes

SAMPLE

Environmental Technology
WTHS room B021

Vernal Pool Water Level Monitoring Report for the month of__________

Name Master Key Grade________ Date submitted:________

	Date	Water Level	Other observations (weather, wildlife, etc)
1.	MAR 25 2009	220	Low! WoodFrog @ Skyline
2.	MAR 26 2009	219	Pump!
3.	MAR 27 2009	270	High Stop Pumping - Spring Peepers
4.	MAR 28 2009	Rain Over Weekend	
5.	MAR 30 2009	3.70	Drizzle water High
6.	MAR 31 2009	3.40	Sunny Peepers
7.	APR 01 2009	3.50	
8.	APR 02 2009	3.46	
9.	APR 03 2009		
10.	APR 06 2009	3.40	no pumping
11.	APR 07 2009	3.50	water bugs weather: cold, rain
12.	APR 08 2009	3.70	water went down weather cold cloudy
13.	APR 09 2009	[illegible]	water bugs [illegible]
14.	APR 10 2009	3.48	[illegible]
15.	APR 13 2009	3.50	1.40 water / sunny and windy
16.	APR 14 2009	3.[illegible]	[illegible]
17.	APR 15 2009	3.20	hear woodfrogs Water heating
18.	APR 16 2009	3.30	water: 68° Air: 83° snapping [illegible]
19.	APR 17 2009		
20.	APR 27 2009		Am Toad Thrilly call
21.	APR 28 2009	[illegible]	[illegible] frogs
22.	APR 29 2009	[illegible]	[illegible]
23.	APR 30 2009		[illegible]
24.	MAY 01 2009	3.20	water 54° Air 65° Tree frogs [illegible]
25.	MAY 04 2009	3.17	water algie and gross stuff
26.	MAY 05 2009		
27.	MAY 06 2009	3.36	redwinged blackbird tadpoles call
28.	MAY 07 2009		52° woodfrog
29.	MAY 08 2009	3.[illegible]	water: [illegible] [illegible] frogs
30.	MAY 11 2009	3.6	water 51° Air 64° water foliage
31.	MAY 12 2009 *	3.35	Mr Gess visit see insects Attached [illegible]

Sample (entries 1–3)

April 7th! water - 43° Air - 40°

temp 45 air temp 38°

April 13th water 40 Air: 30

water 45 Air 54°

APR 29 2009

Dip-Netting Field Data Sheet

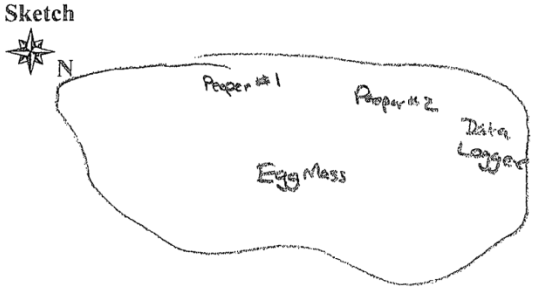
Cell ID#: Pool C **Pond ID #:** _____ **Date:** APR 29 2009
Observers: Mr Gass Junior ET + Freshman ET Aweek Class
Air Temp: 70° **Water Temp:** 58° **Start Time:** 9:45 am **End Time:** 10:30 am
Water Clarity (cm): _____ **Water Depth (max, cm):** _____ **Weather:** _____

Sweep #	1	2	3	4	5	6	7	8	9	10
Anura Without Tails=Frogs & Toads	nt	#col / #cnt	#col / #cnt	#col / #cnt	#col / #cnt	#col / #cnt	#col / #cnt	#col / #cnt	#col / #cnt	#col / #cnt
Spring Peeper	2									
Am Toad eggs										
Am Toad tadpole										
Caudata With Tails=Salamanders										
None										
Invertebrates No Backbones										
Isopod										
2 Dragon Fly Larvae										
Water Strider										
Wat Scavenger Beetle										
Water Boatman										
Mosquito Larvae										
Other										

SAMPLE
Environmental Technology
WTHS room B021

Additional Notes:
Water Level 3.20 pumping
Dip Nets Distributed to
6 Shallow trays for Students
to look for life forms
Previous 3 days Record high
Temps. 80-90°

Sketch



Dipnet031401.doc

SAMPLE
Environmental Technology
WTHS room B021

TRAIL REPORT

Environmental Technology WTHS MAR 13 2009

Reporter's Name: Moe Fines Date:

Crew Members Moe, Larry, Curly, Shemp

Weather sunny no wind Temp 55°

Trail Name: East Side Trail Color Blaze Blue

Location: (Highlight on attached map and describe below)

Location Description: Trail areas surveyed from Work Tech high
A. Parking Lot West over hill accross Skyline Drive
B Past Quarry C Down accross Belmont Street to Bell Pond
and D Along Bell Pond to top of Bell Hill

Observations and/or work done: (mark section letter location on map & describe below)

Section A: WTHS to Skyline Drive and up hill (Moe)
Numerous large brambles Blocking trail
Lots of work Need to cut + remove Branches
Work Needed

Section B: from Water tanks Past Quarry
Not many trees so not many Brambles
Trail ok in this section. No major work need

OK

Section C: Quarry to Belmont
Branches Blocking trail

Needs work

Section D: Along Bell Pond to Bell Hill
Brambles, hanging tree tops and whole trees
across trail

Needs Lots of Work

Additional forms with specific details attached

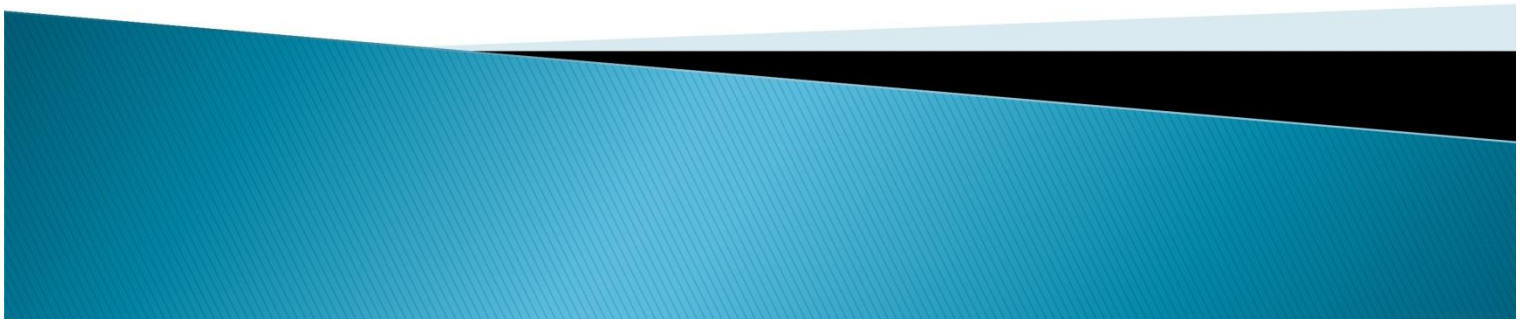
6.2 Appendix B: PowerPoint Presentation

Worcester Technical High School Vernal Pools Study

An Interactive Qualifying Project

By David Nguyen

28 April 2010



Introduction

- Study serving as Interactive Qualifying Project
- IQP
  - Performing an assessment review of the vernal pools surrounding Worcester Technical High School
  - Provide suggestions towards improving wetland conditions
  - Integrate the learning experience with the Environmental Technology students.

What is ArcGIS?

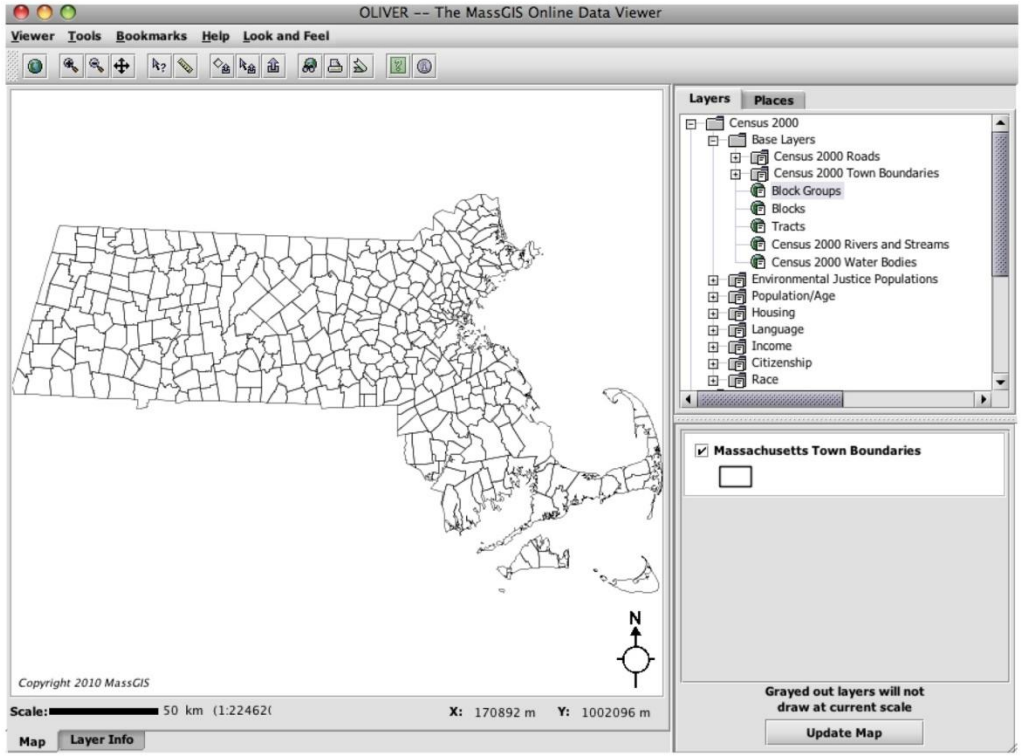
- ArcGIS is a computer program that allows the configuration of GIS data maps in different given layers
- GIS stands for Geographic Information System
- GIS is a way to capture, store, analyze, manage, and present data that has a way to be linked to a specified location

ArcGIS Features

- Layers can be placed on top of each other to achieve the look of any given map
- Maps can be made for anything from street maps, to river maps, to topography maps, to contour maps, or anything that one can find in data layer form
  - Maps of the specified area (proposed vernal pool) can be found through sites online like the MassGIS website

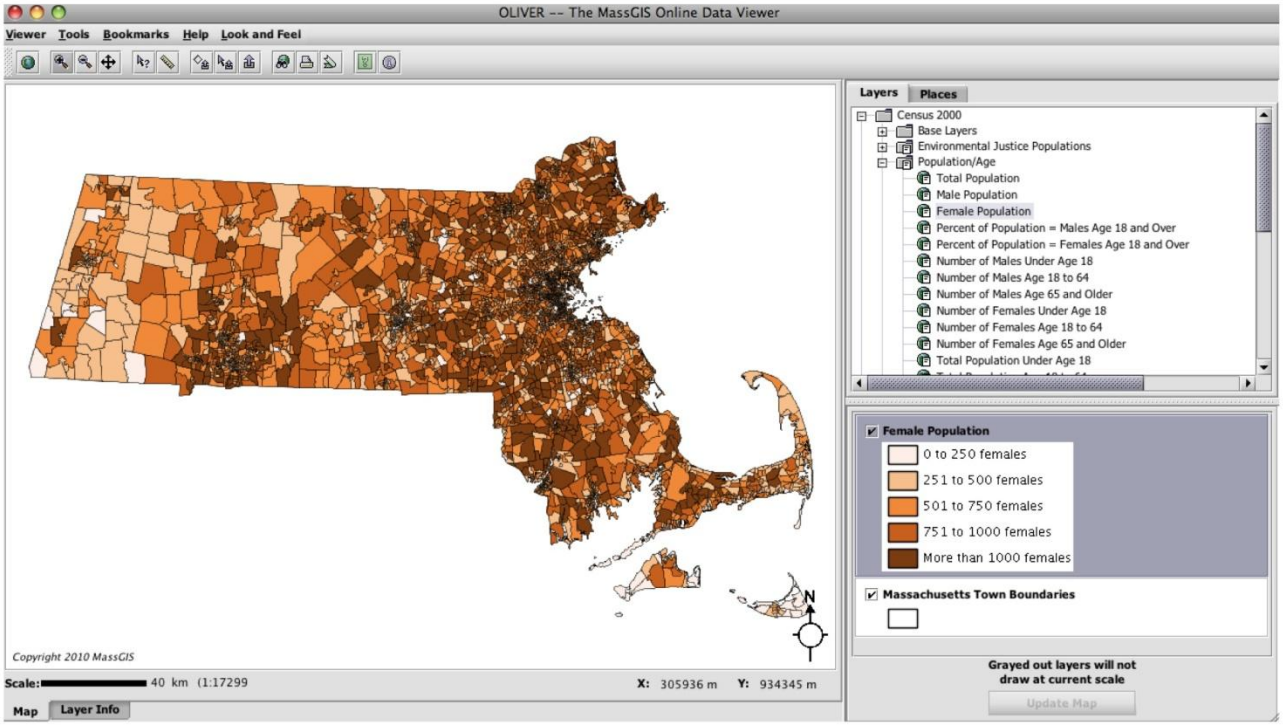
MassGIS Data Viewer (OLIVER)

- Layer of MA town boundaries



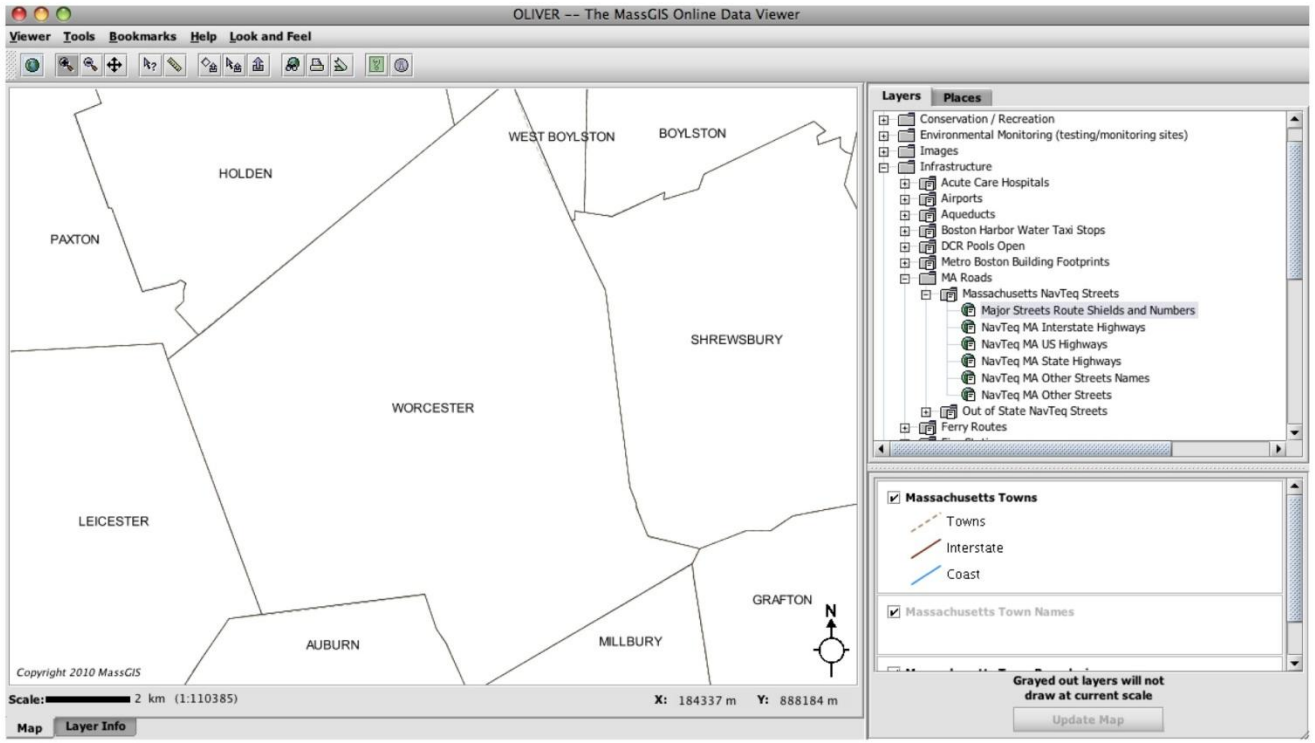
Data Viewer: Female Population

- According to 2000 Census



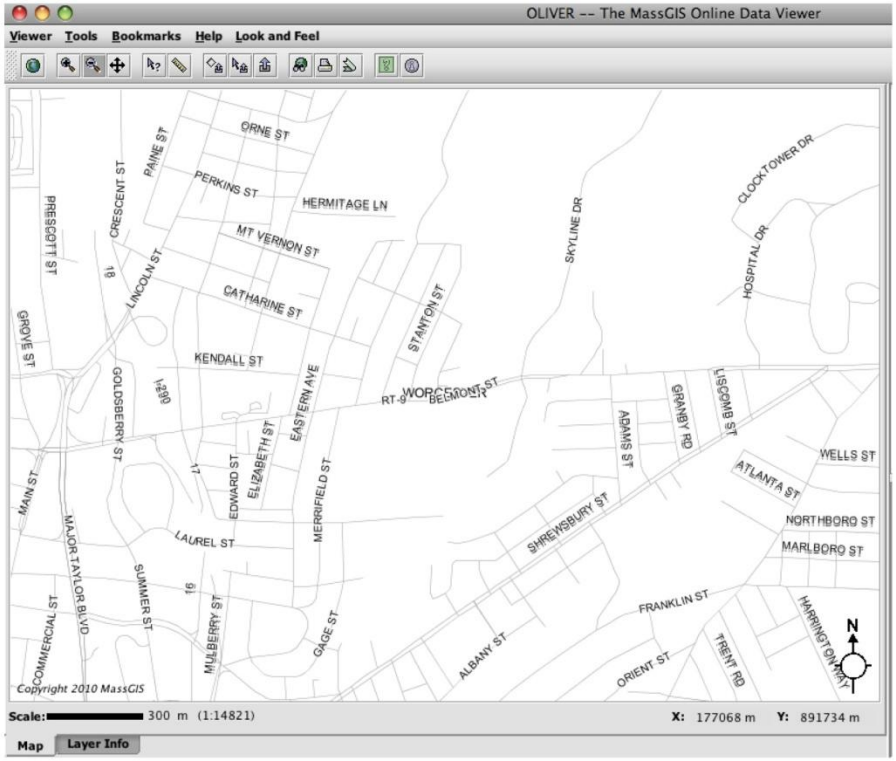
Data Viewer: Massachusetts

- Worcester county



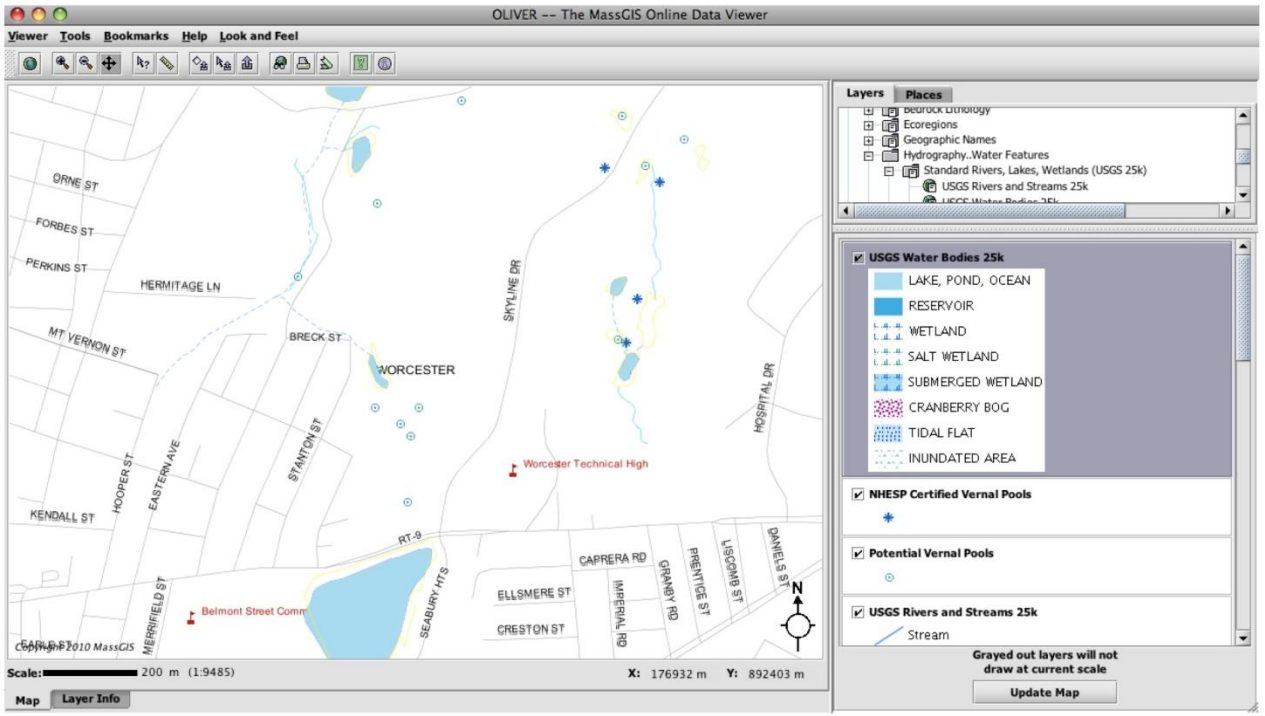
Data Viewer: Route 9

- Belmont Street

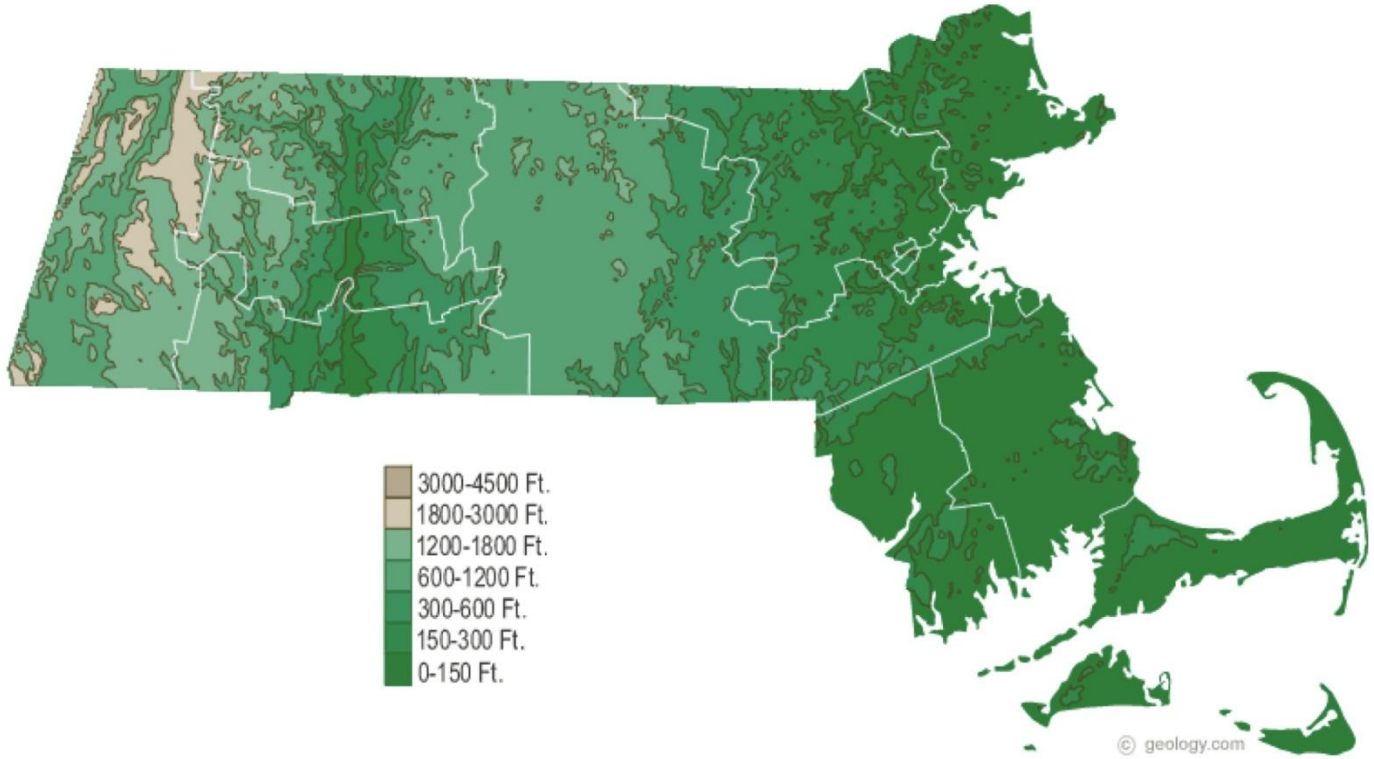


Data Viewer: Vernal Pools

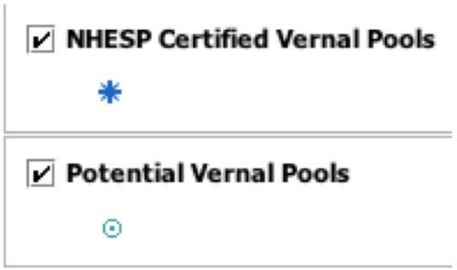
- USGS Water Bodies

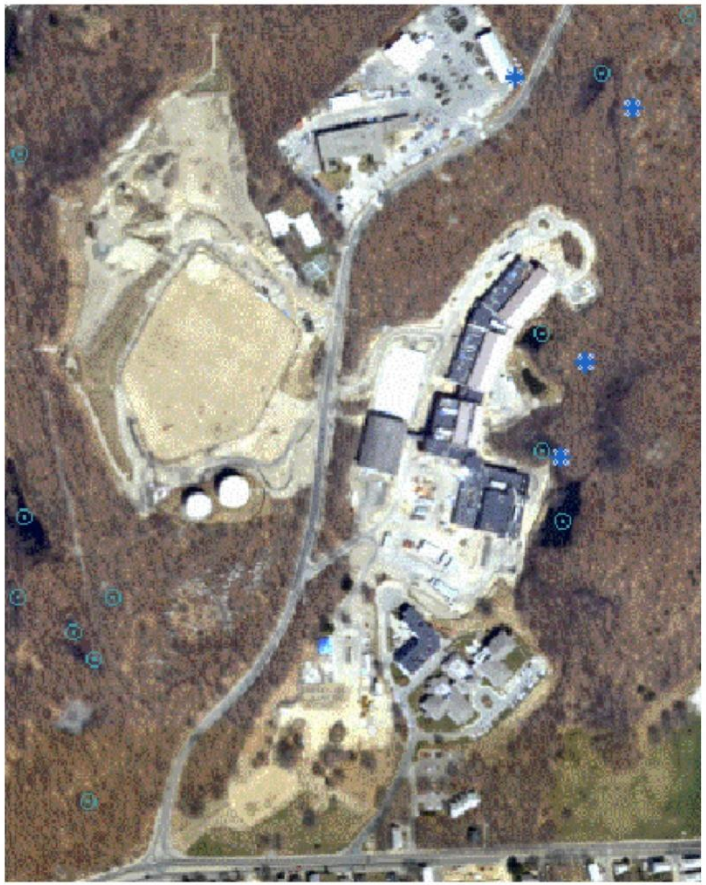


Topographic Map



Vernal Pools Aerial View





QUIZ GAME

- What is geocaching?

- What does GIS stand for?
- Where can GIS maps be acquired?
- Would you find cities listed on a topographical map? What about canals?

Vernal Pools

- What is a vernal pool?
  - Pools range in size from a few square feet to several acres
  - Vary in appearance, time of filling, and source of water
  - Most pools dry out for much of the year, some vernal pools remain wet year-round

Vernal Pools Continued

- Vernal pools provide important habitat for many species of wildlife that do not support fish
- Without these pools many species will no longer exist, as they must return to the vernal pool to breed

Species Found in Vernal Pools?

What are they?

Types of Vernal Pools

- Characteristics vary and reflect the climate conditions in that area in different parts of the world (temporary wetlands)
- Vernal pools outside California are generally small, un-vegetated depressions
  - Occurs in the mid-western and eastern United States

Endangered Species

- What is an endangered species?
- What is an ecosystem?
  - Today, ecosystems are greatly affected by human interference or destruction

Vernal pools are destroyed to use the land for construction of buildings and roadways

Protection Laws

- There is a need to protect ecosystems because of ongoing threat of endangerment and possible extinctions posed
  - E.g. the California Environmental Quality Act, a state law, requires public agencies to consider the effects of proposed actions on biological resources
  - Laws in MA include the Wetlands Protection Act Regulations that protect vernal pools

QUIZ GAME

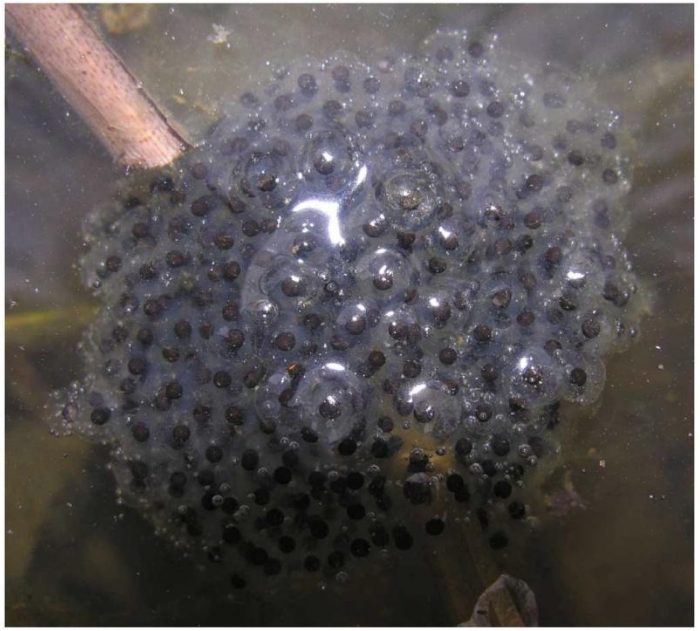
- What does NHESP stand for?
- What are the names of some laws that protect vernal pools in MA?
- Would the Sahara Desert be considered an ecosystem?

Green Hill Park / Construction of WTHS

- There is approximately 1250 acres of land that comprise of Worcester parks, including Green Hill Park
  - Green Hill Park is Worcester's largest municipal park with over 480 acres
- Construction of WTHS led to problems including the environmental ramifications to Green Hill Park and the surrounding areas

Vernal Pools Data findings

- What types of species seen?
- What species is this?

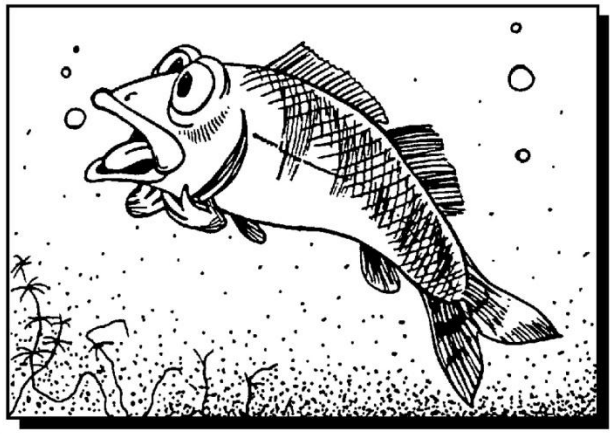


Phosphorous effects

- Phosphorus (forms Phosphates PO4) is one of the key elements necessary for growth of plants and animals
  - Exist in three forms: orthophosphate, metaphosphate (or polyphosphate) and organically bound phosphate

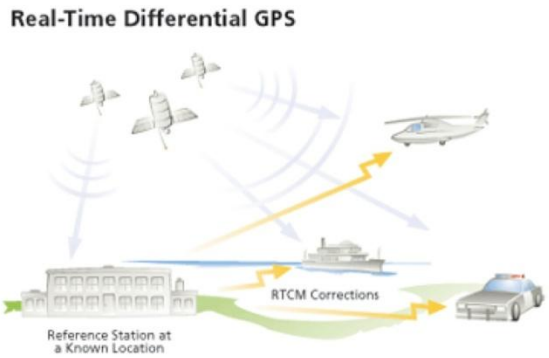
Phosphorous Levels

- Phosphate will stimulate the growth of plankton and aquatic plants which provide food for fish.
  - may cause an increase in the fish population and improve the overall water quality
  - excess of phosphate enters the waterway, algae and aquatic plants will grow wildly, uses up large amounts of oxygen
    (known as eutrophication)



Equipment

Trimble Pro



Equipment Continued

V-2000

eTrex Venture HC

QUESTIONS?

6.3 Appendix C: Problem Statement

Problem Statement

Worcester Technical High School is located adjacent to the city's Green Hill Park, and near wetlands and a vernal pool. During the planning and construction stages for the school, the Green Hill Park coalition and other environment protection groups raised concerns about the school's location and impact on these areas. As part of the agreement, Worcester Technical High School created an Environmental Studies program, and agreed to monitor and report environmental conditions, so as to reduce any negative impact by the school on these environmentally sensitive areas. The city has contracted with ENSR, an environmental company, to ensure WTHS compliance and vernal pool conditions, especially during the spring breeding system.

The Worcester Technical High School Environmental Program and students needs help with systems development, monitoring, and reporting on water and wetlands conditions, and coordinating with ENSR. The Environmental program also needs to create vernal pool data to share with ENSR. Specifics to be monitored and measured include:

- Water quality
- Water levels
- Wildlife
- Vegetation

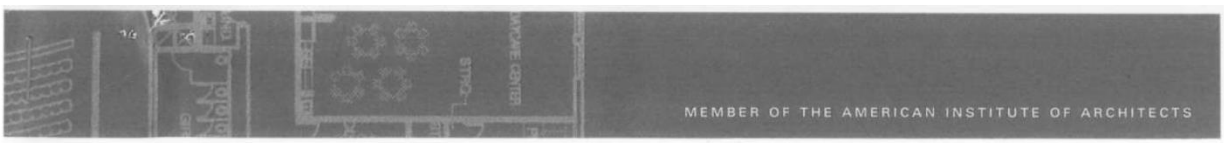
Proposed IQP:
Monitoring vernal pools, wildlife and vegetation at Green Hill Park during Spring breeding season.

The goal of this project is to contribute to the history and database of the vernal pools located at One Skyline Drive, in partnership with the City of Worcester Parks and the Green Hill Coalition (The location of Worcester Technical High School.)

There are five aspects within the scope of the project:

1. Establish baselines in partnership with WTHS students majoring in Environmental Technology re: the water quality & monitoring water levels during the spring breeding season.
2. Create digital recording in partnership with WTHS students majoring in Environmental Technology of water levels, wildlife and vegetation within the vernal pools and document 2009 standards.
3. Plot vernal pools and surrounding vegetation using GPS/GIS
4. Develop breeding season protocols for researching and working within the vernal pool environment.
5. Develop PowerPoint & on-line tutorial standards for yearly breeding season and Environmental Technology school year use for students and teacher.

Yearly breeding system results to be published on the WTHS Environmental Technology Web Site.



MEMBER OF THE AMERICAN INSTITUTE OF ARCHITECTS

LAMOUREUX · PAGANO
ASSOCIATES, ARCHITECTS

Richard J. Lamoureux, Sr.

Michael A. Pagano

Richard J. Lamoureux, Jr.

Kathryn Crockett

Eric D. Moore

Robert Para, Jr.

16 March 2006

Mr. Peter Crafts, Director
Vocational/Technical Programs
Worcester Vocational High School
2 Grove Street
Worcester, MA 01609

Re: Worcester Vocational High School – Phase II
ENSR's & LPA's Participation – Schools Environmental Program

Dear Mr. Crafts:

As requested by the City at meeting on the 28th of February, on behalf of the City the School has to provide further input / coordination w/ ENSR regarding the school's environment al program, Meeting is scheduled on the 20 th March for that purpose. At the meeting on the 28th, LPA was provided with a copy of your program summary and this has been provided to ENSR. We advised that a meeting be scheduled with our office, ENSR and the responsible parties (contact) with the school. The four issues were summarized in the 2/23/06 letter to the City (attached).

1. Monitoring Water Levels and Reporting/Recording:

   a. Dialog, contact information directly between ENSR's field biologist needs to be established, to schedule monitoring, reporting and recording. Typically ENSR is on-site once a week or every other week from mid-March to mid-June.

   b. LPA has a proposal to the City to purchase a water level recorder, and provide to the school. School to schedule installation and instructions to the responsible parties (contact). Discuss if this data is advantageous to have this season, is the school going to be responsible to maintain, if not LPA / CR Environmental requires an amendment to the contract to do so.

   c. ENSR will continue to report to the City/DEP/GHPC through LPA (by contact 60 days after Substantial Completion) and by pending agreement through this season.

2. Data Collection and Observations:

   a. ENSR as noted will continue to forward their reports to the City/DEP/GHPC, through the Architect until this point. The Post construction distribution protocol to be determined.

   b. School should establish their own internal tracking and recording system and make data available to the City/DEP/GHPC if requested.

14 East Worcester Street Worcester Massachusetts 01604 tel 508.752.2831 fax 508.757.7769 www.lamoureuxpagano.com

3. Protocol for Hydration if Required:

   a. Well, pump and connection to the VP-C was established as part of the construction contract to maintain water during construction as a temporary measure and to offset ex-filtration from VP-C, which is greater post construction.

   b. ENSR, and the projects Environmental Consultants anticipate that VP-C and surrounds will reach equilibrium, in time. Recommendation from ENSR and consultants is that the system should be allowed to function without adding water.

   c. Data was presented to the City/DEP/GHPC outlining recommendations from the project engineers and Environmental consultants on 7/13/05 and recommendations for DEP and clarify/revise condition #15 of the settlement agreement.

      No action or approval of recommendation was taken by DEP and LPA's interpretation of the DEP's position is a general acknowledgement of data presented, and that the general required level of water required to meet the conditions shall be determined by the independent monitoring of consultant, ENSR, and that they will record data and conditions and report to DEP, at the next scheduled meeting on June 15, 2006.

   d. We assume that, at that time after the vernal pool season has ended, a clearer picture will be in hand, and can be reviewed, City/DEP/GHPC. After review, additional work or clarifications will be issued.

   e. In short, the pump will not be required to be operated unless ENSR advises to do so, and protocol, communication must be established directly between ENSR/the school's responsible party.

4. Protocol for Distribution of reports and actions (discussed above)

Sincerely,

Robert Para, Jr., A.I.A.
Project Architect

RP/pf

cc: via e-mail Jill Dagilis
Rick Trifero
Tom Ellis
Dennis Lowry
Tim O'Sullivan

File

9815/Corres/Owner/9815CO-CLI1c(WVHS).doc

7. Bibliography

Brooks, Robert. "Photo Gallery - Vernal Pools." *Northeastern Research Unit NE-4251*. USDA Forest Service, 07/16/2004. Web. 17 March 2010. <http://www.fs.fed.us/ne/amherst/photogallery/index.html>.

"California Wetlands Information System." *CWIS - Vernal Pool*. California Resources Agency, 01/17/2002. Web. 23 February 2010. <http://ceres.ca.gov/wetlands/whats_new/vernal_sjq.html>.

"City Parks." *City Parks | City of Worcester, MA*. City of Worcester, 2010. Web. 11 March 2010. <http://www.ci.worcester.ma.us/dpw/parks-rec/city-parks>.

"Endangered Species Act of 1973." FWS. *Endangered Species Act of 1973*. Digest of Federal Resource Laws of Interest to the U.S. Fish and Wildlife Service, 08/03/2007. Web. 5 March 2010. <http://www.fws.gov/laws/lawsdigest/ESACT.html>.

"Environmental Technology Curriculum Overview." *Environmental Science & Technology*. Worcester Technical High School, 2009. Web. 5 March 2010. <http://portal.techhigh.us/Teachers/andersonr/Pages/default.aspx>.

Ormsby, Tim. *Getting to Know ArcGIS Desktop: The Basics of ArcView, ArcEditor, and ArcInfo Updated for ArcGIS 9 (Getting to Know series)*. 2nd. Redlands, CA : Esri Press, 2004. 572. Print.

"Polar Bear." *Wildlife Library*. National Wildlife Federation, 02/19/2009. Web. 2 February 2010. <http://www.nwf.org/Wildlife/Wildlife-Library/Mammals/Polar-Bear.aspx>.

"Public Schools." *Public Schools | City of Worcester, MA*. City of Worcester, 2010. Web. 9 February 2010. <http://www.ci.worcester.ma.us/living-working/public-schools>.

"Vernal Pool Certification." *Natural Heritage*. MassWildlife Department of Fish and Game, 012/13/2009. Web. 21 March 2010. <http://www.mass.gov/dfwele/dfw/nhesp/vernal_pools/vernal_pool_cert.htm>.

"Vernal Pools: More Than Just "Rain Buddies"." *Sacramento Valley CNPS*. Sacramento Valley - California Native Plant Society, 03/27/2009. Web. 25 January 2010. <http://www.sacvalleycnps.org/Conservation/vernalpools/vernalpools.htm>.

"Vernal Pools: Liquid Sapphires of the Chaparral." *California Vernal Pools*. California Chaparral Institute, 02/07/2009. Web. 24 March 2010. <http://www.californiachaparral.com/vernalpools.html>.

"Wetland Types." *EPA*. Environmental Protection Agency, 11/21/2008. Web. 3 February 2010. <http://www.epa.gov/owow/wetlands/types/vernal.html>.