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Green Infrastructure

A guide to the definition, uses, and benefits of green infrastructure

**Interactive Qualifying Project Report completed in partial fulfillment of the Bachelor of Science degree at Worcester Polytechnic Institute, Worcester, MA
November 18, 2008**

Submitted to:
Professor Robert Krueger

In Cooperation With:
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January 27, 2009

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Abstract

This paper was written for the 495/MetroWest Corridor Partnership with the intention of being a general education paper on Green Infrastructure as well as promoting green infrastructure in the 495/MetroWest corridor of Eastern Massachusetts. Methods including online research, library research, and case studies were used in the developing of this paper. The results from our project will be used to assist in distribution of information regarding green infrastructure in this region and promote green infrastructure as a general topic.

Acknowledgements

We would like to take this opportunity to formally thank our project advisor Robert Krueger for his assistance in this project. Without his help, this work would never have come to fruition.

Professor Krueger has been very involved with each of us since our arrival at WPI in the fall of 2006; he was our freshman advisor, answering any questions we might have about WPI and its programs. As we had regular meetings with several other students from our dormitory floor throughout the year, we began to feel quite comfortable around Professor Krueger (even to the point of using first names).

During our sophomore year we continued to talk with Professor Krueger about a variety of topics, eventually leading to our IQP interest. We had originally planned for a project in Germany, but troubling economic times deterred our progress; we eventually agreed that a project here in Worcester would be most beneficial to everybody involved. Quite luckily, Prof. Krueger had an open project fit for three students concerning the work of green infrastructure. Since we three students were all enrolled in Prof. Krueger's Environmental Studies course at the time, we were all quite excited about this opportunity. (Note: Through his excitement and enthusiasm for the subject matter, Professor Krueger inspired one of us to pick up a second major in Environmental Studies!)

As our project is coming to completion, each one of us is extremely fortunate and grateful to have had Rob as our advisor through this process. He has always been willing to talk with us about any questions we may have, professional or personal, and we all see him as much more than an average professor. His openness and compassion for both his work and students are truly characteristics that all educators should strive to possess.

Again, we would each like to thank Professor Robert Krueger for his effort and time spent working with us to complete this project. His compassion (and tolerance) has not gone unnoticed.

-The Team

Andrew Bartley, Edward Shipper, and Christopher Thomson

Authorship Page

Christopher Thomson was the primary author of the tables and figures found within this report. All spreadsheet, graphical representation, and data analysis work was chiefly completed by Christopher. It should be noted that Christopher was not alone in his work; all authors contributed to each aspect of the report in some way, ranging from the role of primary composer to the role of consultant. Christopher was the largest contributor to the data analysis, and still greatly contributed to the research and continuity of the project overall.

Edward Shipper spearheaded a large portion of the research required for this report. This research includes much of the qualitative data, rather than the quantitative. Edward was instrumental in the composition many sections of the paper; his contributions are also heavily weighted towards writing the report itself. Edward completed the large majority of the work for the background section.

Andrew Bartley's largest role has been the chief editor of the paper. Compiling all of the separate sections in a coherent, flowing manner is his top priority. His primary contribution has been to fully articulate the data and findings into a comprehensible report, including the bulk of formatting necessities. Andrew has also served as the primary point of contact between the team and 495/Metrowest.

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Executive Summary

The purpose of our project was to raise awareness in response to sustainability issues facing those municipalities contained within the 495/MetroWest region by promoting the newly completed *Green Infrastructure Toolkit*, produced by the Partnership. In order to raise awareness concerning sustainability issues, a background addressing the question what is sustainability, what types of sustainable issues are confronting the municipalities, and what local governments can do to get involved was written.

In order to promote sustainable development and green infrastructure, a solid foundation in both topics is necessary. Green ideas and eco-friendliness are popular movements throughout the United States and indeed, the world. Beginning with an essential definition was the logical jumping off point. However, sustainable development (SD) and green infrastructure (GI) are two concepts that are in fact difficult to define. An idea that may work for one town or county may not be acceptable or even feasible in a different region. In order to give some insight into different concepts of GI and SD, we looked for examples of GI and SD and actually studied a project that took place in the state of Washington, covering the topics of GI and SD. The Washington State project involved beautifying the land surrounding interstate 90 and the byways (The Conservation Fund, 2007). Another facet of this project was to create an interconnected series of trails that led from the cities to the mountains. This case study demonstrates that the implementation of green infrastructure has vast possibilities and something as simple as making walking trails can help.

The main focus of this project was to gather the contact information for all of the environmental related organizations within the thirty two municipalities of the 495/MetroWest region. These organizations ranged greatly in both presence from town to town as well as complexity. Some smaller towns simply have planning boards while the city of Marlborough, for example, has several

organizations from the New England Wind Fund to a specific organization called Green Marlborough. Our focus was not, however, set on government only organizations. Land trusts and watersheds were also included in our search for contact information. The type of contact information we were looking for included names, phone numbers, fax numbers, addresses, and in some cases, email addresses were included in our search for contacts. With this contact information given to Adam Ploetz at the 495/MetroWest Partnership, the Partnership can go ahead with the distribution of their Toolkit.

After finding the contact information, analysis was performed to see the scope of government, non-government, and quasi government organizations that exist in the region. Considering we are looking at ways to improve the local landscape, it is no surprise that a majority of the environmental organizations in the region are in fact run by the local governments. Government controlled organizations tend to have more authority and do not have to seek approval and do not go through the bureaucratic red tape that a non government organization (NGO) must. The two figures, figures 3 and 4, can be found in the results section of the report. They show the breakdown between the three different types of environmental organizations as well as the overall breakdown of the presence of the different types of trusts, watersheds, and other government boards.

Part of the finalizing of the project was to look at the *Green Infrastructure Toolkit* itself. The toolkit is a digital document which has several links contained within it. Some of the links lead to different areas of the toolkit, while others lead to external sources. In proofing for finalization of the toolkit, making sure all of the links go to the proper locations was paramount. This task had already been performed by the staff at the 495/MetroWest Partnership, however, having another set of people look over it again is always prudent.

The *Green Infrastructure Toolkit* is a great step forward in getting the municipalities of the region to start undertaking projects of their own. Once the towns get the toolkit from the Partnership,

using of gathered information, it is up to the local governments to start enacting some of the ideas put forth. Every little idea need be taken seriously, as we are all going to have to help in preserving the world around us.

Introduction

Green infrastructure and sustainable development have become ever popular over the past several years as awareness about the state of our planet has been widespread. Green infrastructure and sustainable development are only ideas. Government organizations as well as non-government organizations must collaborate in effort to work towards an overall achievement of implementing “green” plans. This is where the 495/MetroWest Partnership steps in.

The Partnership is a regional advocacy non-profit governed by municipal officials, regional employers, legislators, environmentalists, and educators that addresses the needs of the 495/MetroWest region by enhancing vitality and quality of life while sustaining natural resources (495/MetroWest Corridor Partnership, 2006). The problem with the implementation of these ideas is that municipalities either do not know how to implement them or the basis for “green” ideas is too broad to just be handled by a local government. Directly abutting municipalities can be found in different counties, metropolitan planning organizations, regional planning agencies, regional transit authorities, congressional districts, and watersheds. They can also be found in regional offices for state agencies such as the Massachusetts Highway Department and Regional Employment Boards, as well as a myriad of other government districts designations (495/MetroWest Corridor Partnership, 2006). To combat these issues, the Partnership has created an electronic document referred to as the “toolkit.” The idea behind the toolkit is to provide local governments with the documents the Partnership feels necessary in helping those governments achieving their “green” goals.

The objective of our work with the 495/MetroWest Partnership was to create a comprehensive database of all of the environmental minded government organizations contained within the thirty two municipalities of the 495/MetroWest region. We found the contact information for over 280

organizations just contained within the region alone. However not all of these were government controlled. We included land trusts and other non-government organizations in our database, as it is important to have information about all groups in the region. We analyzed the data about the different types of organizations to better help the Partnership with future programs. Our work will go on to help the 495/MetroWest Partnership to distribute their Toolkit and to help perpetuate the ideas of green infrastructure and sustainable development.

Background

The recent trend of promoting businesses and lifestyles that are more eco-friendly has presented the population with an explosion of different options for change. Perhaps the course of action that will yield the most visible economic and environmental improvement is the implementation of green infrastructure. While green infrastructure could be seen as just another “buzz word” of the new environmental movement, quite the opposite is true. Such an assumption is simply based on a lack of knowledge surrounding the matter. Green infrastructure is a new term, yes, but the idea of green infrastructure easily dates back to 1903 (Benedict & McMahon, 2002); John Olmsted and Fredrick Law Olmstead recognized the importance of interconnectedness in parks and parkways as they relate to public use and enjoyment. As we will go over shortly, this insight is an example of green infrastructure.

The purpose of this paper is to guide those that may be unfamiliar to green infrastructure. Definitions, examples, and the history of green infrastructure will all be covered to a point where readers should have basal understanding upon finishing the reading of this paper.

Definition

Before any sense can be made of this labyrinth of environmental consciousness, spending some time on the actual definition of green infrastructure (GI) would be quite beneficial. Such an expansive concept cannot easily be explained in one phrase. While many different perceptions exist about green infrastructure, its definition, and its implementation, three main ideas appear in available definitions (Davies, MacFarlane, McGolin, & Roe, 2006): (a) that GI involves natural and managed green areas in both urban and rural settings (b) is about the strategic connection of open green areas and (c) that GI should provide multiple benefits for people. Perhaps the following is the most encompassing definition (Davies, MacFarlane, McGolin, & Roe, 2006):

Green infrastructure is the physical environment within and between our cities, towns and villages. It is a network of multi-functional open spaces, including formal parks, gardens, woodlands, green corridors, waterways, street trees and open countryside. It comprises all environmental resources, and thus a green infrastructure approach also contributes towards sustainable resource management.

Although it is rather lengthy and broad, this definition does not exclude any aspect of GI. Ideally, an area planned with GI in mind will have buildings placed far enough apart that they can be incorporated into the natural surroundings. This broad definition faintly leaves one with a slight impression of a seemingly utopian setting, where buildings sparsely populate a bucolic landscape. However, this optimistic language could be a shortcoming; the definition explains an ideal example of green infrastructure, where an area was designed and constructed under this plan. The benefits of GI are still made clear, but the wording almost leads those unfamiliar with GI to believe that it is difficult or impossible to convert current methods to a green infrastructure. Needless to say, this could deter potential adopters of this plan from investigating further.

A much more specific definition can really get to the heart of the matter. Many sources will specifically mention stormwater, rainwater, or wet-weather management; indeed, this is a dominant example and benefit of green infrastructure. Government agencies (EPA, 2008) even define green infrastructure as “an approach to wet weather management that is cost-effective, sustainable, and environmentally friendly.” Despite this definition’s

As stated before, this broad subject can be interpreted in many different ways. For any new concept to be seriously considered in the business world, economic pros and cons need to be presented along with an outline of any investment and maintenance that will be required. While all of those figures are quite specific and there are jobs entirely dedicated to determining such figures, these items

should be at least ethereally touched upon in a GI definition that will be presented to a business or organization. The Conservation Fund (2007) defines green infrastructure (GI) as:

Strategically planned and managed networks of natural lands, working landscapes and other open spaces that conserve ecosystem values and functions and provide associated benefits to human populations.

This definition presents the idea of GI as more of a man-made idea; something that can become a project with measurable milestones and benefits. The word “strategically” implies a sense of control and certainty, which are two concepts that are invaluable to those economically minded. The word “planned” tells the reader “if you dedicate time and resources to this plan, it will be a fruitful endeavor.” The verbiage used here is much more marketable than the previous blanket definition. While there are still many different interpretations of green infrastructure that can be as small-scoping as creating a rain garden to the grand scale of restructuring an entire community, The Conservation Fund’s definition works quite well for a general overview of this new idea.

Examples

Although a good deal of time has been spent on determining the actual definition of green infrastructure, many aspects of GI remain unclear to those not familiar with the idea. The best way to fully convey the benefits of green infrastructure is to show several quality examples of GI in action, ranging from small projects a single person can accomplish in a day to city-wide efforts that could take years to plan, budget, and accomplish. The examples will focus on the initial cost and time commitment along with the economic and standard of living benefits; smaller examples will be covered first, so that the importance and benefits of these projects are not dwarfed by the magnitude of larger projects. The examples will roughly increase in both investment necessary and palpable payoff. Small, private shifts

towards green infrastructure should not be overlooked. A few quality examples of small green infrastructure are rain gardens, green roofs, and porous pavements (EPA, 2008).

Rain gardens are mentioned first because not only can they absorb water runoff, which allows for water to slowly seep into the soil, but they benefit any type of land use situation: residential, commercial, or industrial (Virginia Department of Forestry, 2008). The Virginia Department of Forestry defines a rain garden as “a man-made depression in the ground that is used as a landscape tool to improve water quality” (2008). Rain gardens are very moldable and tractable projects that can be made in a variety of ways, yet all rain gardens provide very similar benefits. A large portion of a rain garden’s development is simply based on the preference of the property owner. The major choices to be made are mulch selection, planting soil, and the plant species placed in the rain garden; all of the choices should function well together a professional can help determine functionality, or it can be researched independently (Virginia Department of Forestry, 2008). The garden should be made climate specific, both for the region and specific property. Much like a “regular” garden, factors to consider include shade, average temperature, rainfall (which is especially important in a rain garden), and space needed for healthy living. Regardless of the personal choices made, the general result is the same: water retention for increased absorption efficiency.

Another smaller project that can be done on the household level is the installation of a green roof. Just like rain gardens, green roofs can be used on almost any type of building. It should be noted that since each installation is unique, not all green roofs will have identical benefits. However, all green roofs provide similar benefits: less water runoff, longer roof lifespan, sound insulation, heat insulation, air filtration, aesthetic benefits, a possibility of food production, and reduction of heating and cooling costs (Green Roofs for Healthy Cities, 2005). The primary benefit is the runoff water absorption, which in turn creates all of the other benefits just listed. The water is absorbed by soil, so the water doesn’t

run across an impervious roof, dragging along harmful chemicals involved with a traditional roof (Center for Neighborhood Technology, 2008). Since this layer of soil is also covering some of the structural roofing materials, these parts are shielded from the weather, increasing a roof's lifespan. The soil on the roof and especially the water trapped within add to a house's insulation, which is the cause of lowered heating and cooling bills. As mentioned earlier, food production is a strong possibility. If your building has roof access, then maintenance of a vegetable garden is absolutely manageable. These benefits easily pay for the cost of the green roof installation on their own.

The last minor application of green infrastructure to be discussed will be porous pavement. These materials deviate from "normal" pavement by allowing rain water to filter through the pavement (Center for Neighborhood Technology, 2008). Porous pavement obviously can be used on a larger scale, such as roads, highways, and parking lots, but the option of using a porous material is still readily available from any contractor for use in a driveway (ToolBase Services, 2008). The major advantages of porous pavement over traditional dense-grade pavement are 1) elimination of drainage problems through stormwater filtration, and 2) improving local water reservoir quality and water levels through filtration (ToolBase Services, 2008). While generally the use of porous pavements is an idea that makes economic and environmental sense, there is occasionally one drawback. Sometimes the natural soil is not absorbent enough to soak up all the rainwater the local area is subjected to, which can lead to problems with roads constructed with porous pavements. Aside from isolated incidents involving the condition of the existing ground condition, porous pavement is a solid choice with numerous benefits.

Grey-Green Continuum

One last item that should be discussed briefly before presenting a large scale example of green infrastructure is the Grey-Green continuum. A visual representation of the scale is shown below as **Figure 1** (Davies, MacFarlane, McGolin, & Roe, 2006). Although many may not be familiar with this

scale, the concept is quite simple. More conventional forms of infrastructure, such as bus routes and industrial parks fall on the “grey” side of the scale, while places like city parks and green roofs would fall on the “green” side of the scale; many options are not so cut-and-dry as these examples, but the middle “green/grey” area accounts for these numerous applications (Davies, MacFarlane, McGolin, & Roe, 2006). This scale is widely used and accepted amongst organizations that delve into subjects like sustainable development and wildlife conservation.

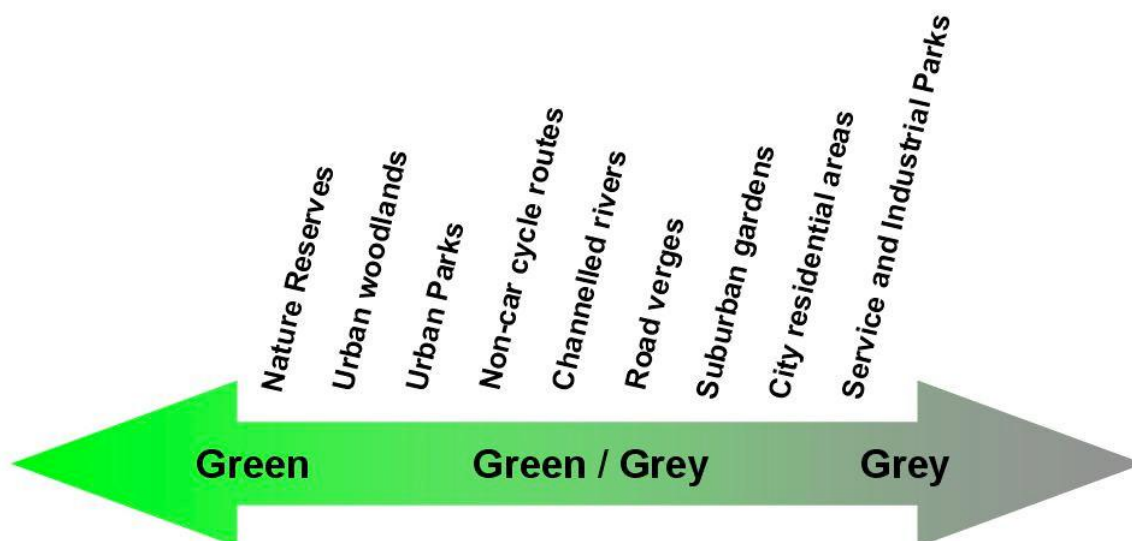


Figure 1: The Grey-Green continuum

Case study: Washington State

Green Infrastructure is only a dream unless we can work together to actually implement the ideas we have already put forth. In this section we will look at a case study from the state of

Washington in which they will “enhance a 100 mile corridor of permanent open space lands along Interstate 90 from Seattle to Central Washington” (The Conservation Fund, 2005). This effectively shifts grey areas further to the green side of the Grey-Green continuum. According to the Conservation Fund (2005), project has several key goals:

- Enhance scenic beauty along Interstate 90 and byways
- Create an interconnected trail network from cities to the mountains
- Educate about regional human and natural history
- Improve access to nature for all citizens
- Protect and enhance wildlife habitat and corridors
- Preserve working farms and forests
- Encourage communities to retain their identity and plan for sustainable settlement, employment and natural resource protection

As with most cities that are have a higher than average quality of life, Seattle is complimented with some of the most beautiful scenery making it a rapidly growing city. The Mountains to Sound Greenway Trust began work in 1990 after growing concerns raised by threats to the area’s natural resources. The Trust began work on the creation of a conservation corridor along Interstate 90; the progress is summed up as: “The Mountains to Sound Greenway now stretches 100 miles from the shores of Puget Sound in Seattle to the small town of Thorp in Kittitas County along the interstate and the Snoqualmie and Yakima rivers, and includes nine cities and two counties (Figure 1)” (The Conservation Fund, 2005).

Figure 1 : The area of the Mountains to Sound Greenway (in green).

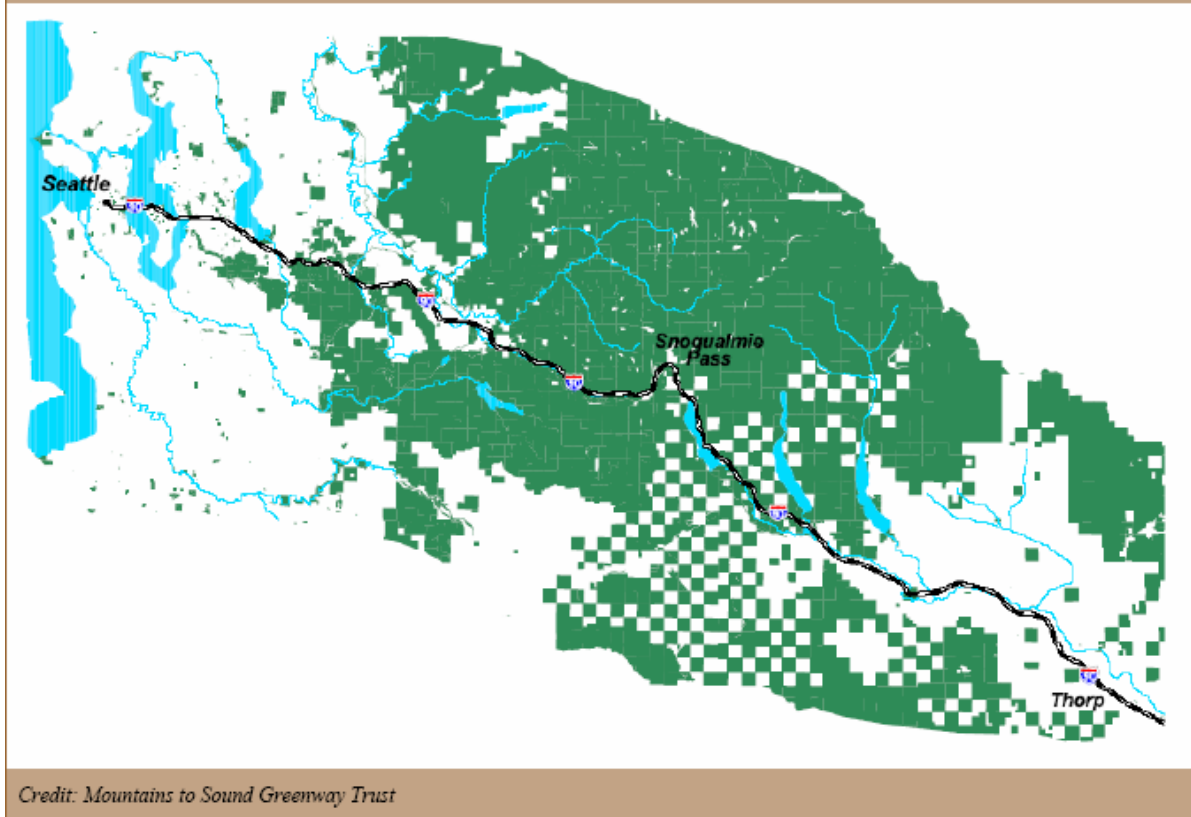


Figure 2: Area of Mountains to Sound Greenway

This area is very vast and contains a combination of publicly and privately owned lands, which even include working forestlands which are essential to the area's economy. The Trust focused on the application of eight principles of Green Infrastructure:

1. Protect green infrastructure before development.
2. Engage a diverse group of stakeholders.
3. Linkage is key.
4. Work at different scales and across boundaries.
5. Use sound science.
6. Fund up-front as a public investment.

7. Green infrastructure benefits all.
8. Make green infrastructure the framework for conservation and development.

(The Conservation Fund, 2005)

A group of citizens and local experts worked with a landscaping architecture firm and the National Park Service to develop the Greenway Concept Plan, which was completed in 1993. This group contained 70 members titled the Technical Advisory Committee, whom developed a goal along with a common vision for how they greenway should be done. The committee “took the plan to the local governments and received their endorsements. The Trust’s approach was to support government actions when they helped advance greenway goals, and otherwise to work collaboratively to find solutions when conflicts arose” (The Conservation Fund, 2005). If the Trust happens to be alarmed with how a local government is planning something, they meet privately with the local officials to discuss the issue and try to look for alternative solutions.

“The 1990 Farm Bill established the Forest Legacy program within the U.S. Forest Service. Forest Legacy provides federal dollars to buy interests in land from private owners, both through fees and simple purchases and conservation easements. In the latter case the original owner often retains the right to harvest timber from the site. The first Forest Legacy program money in the United States was spent in the Mountains to Sound Greenway. The goals of the Forest Legacy program in Washington State are to “provide present and future timber management opportunities, protect water quality, and provide habitat for native fish, wildlife, and plants.” Since 1993 Forest Legacy staff in Washington State have finalized deals on more than a dozen parcels totaling more than 13,000 acres. So far, program staff have used fee acquisition to protect 250 acres and conservation easements to protect 12,913 acres within the greenway for a total cost of \$15.7 million” (The Conservation Fund, 2005).

Local and national conservation organizations watch for properties that are or might become available. They also try to aid in the transactions between the buyers and the sellers.

The Mountains to Sound Greenway Trust and its numerous associates have been able to protect more than 215,000 acres within the greenway region since its founding. In 2004 the largest acquisition occurred when “conservation easements” were placed upon 90,000 acres (The Conservation Fund, 2005). The Trust does most of its work to try and protect the most visible places along the highway. “As a result, in 1998, I-90 became the country’s first interstate highway to be named a National Scenic Byway” (The Conservation Fund, 2005). The Washington Department of Transportation had taken on some of the challenges put forth by the Trust. The two most influential projects supported by the WSDOT are “(1) a uniform signage program to guide travelers to greenway historic and recreation facilities off the interstate highway and (2) trail construction that will fill gaps in the regional trail system” (The Conservation Fund, 2005). The Trust also has published a book *Mountains to Sound: The Creation of a Greenway across the Cascades* and with the help of WSDOT and the National Park Service they produced a film “Taking Charge: Successful Models for Scenic Towns and Highways” that has been giving to the American Planning Association for distribution. The Trust also assisted in the founding in the “Biosolids Forestry Program in 1995, in cooperation with King County, the Weyerhaeuser Company, the WSDNR, and the University of Washington College of Forest Resources, to recycle treated sewage waste by land application to forests” (The Conservation Fund, 2005). The Trust also helped to develop a program to bring young people from disadvantaged neighborhoods to assist in the improvement of hiking trails. Since its inception, the volunteers of the Trust have planted over 400,000 trees which helps improve the salmon habitats by providing shade to keep stream temperatures cool.

The Trust has had great success in gaining corporate support, reaching out to people in other environmental groups, but are not active, and has become an expert in “the art of sustaining a diverse

coalition” in its board of 64 people” (The Conservation Fund, 2005). Truly, such an example of promoting green infrastructure on the state level is an encouraging example for the nation to follow. In the near future, hopefully many other cities will follow in Washington’s footsteps towards a sustainable future.

Methodology

The work of the 495/MetroWest Partnership cannot be completed successfully or efficiently if they do not have a list of contacts to send their information. These contacts need to include every organization or agency that operates within the MetroWest region. In order to track these contacts down, it is necessary to first take a look at the types of government involvement. Based on the three types (explained in further detail below), it is easier to collect the data without missing any important contacts. Then, it is imperative to provide as much information about each contact as possible. This ensures that information sent out by the Partnership can reach the individuals that will make the decisions.

Types of Government

The first type is full government involvement. This basically breaks down into the government completely runs and operates the organization. Usually organizations in this category work for a cause that is to promote the wellbeing of citizens. For example, many town organizations are arranged by their respective governments because it is a necessity for the town to thrive. Examples include planning board and conservation commissions. These two committees oversee daily operations of the town and ensure that everything is handled to the best of their abilities. However, when there arises a situation where the government recognizes a need but does not have the human resources to achieve the solution the organization falls into the second category, quasi-government.

This type can be found for the various regional planning agencies. These agencies are responsible for the general wellbeing of a particular region and are funded by the government. However, the employees are not government workers. As can be seen in the final database, this section is rather small due to the scope of the task. Examples of these planning agencies include the Boston

Metropolitan Area Planning Council (MAPC) and the Central Massachusetts Regional Planning Commission (CMRPC).

The last type is non-government organization (NGO). These organizations are all privately funded and tend to be centered on one specific goal. Many organizations choose to focus on land trusts, and land use such as the Mass Smart Growth Alliance or environmental advocacy such as the Mass Audubon. These NGOs tended to encompass a large area of land even though they focus on such a specific cause. It should also be noted that NGOs are not constricted to state boundaries. For example, watershed organizations follow the entire watershed. If the watershed starts in Massachusetts but bleeds into Connecticut, the organization does not only deal with one or the other. This ensures that rivers and forests that are looked after by these groups can receive full coverage regardless of state boundaries.

Collecting Contact Information

Once the database is divided into the three types of government involvement, the organizations could be recorded in list form. The first step in achieving this is to simply search online working a top/down approach. Starting with NGO, we searched Massachusetts land trusts. The results led us to a site for the Massachusetts Land Trust Coalition. In turn we were able to navigate the site down to a map where we could select our region and find the associated land trusts in the region of the 495/MetroWest Corridor. A similar process was also used for the quasi-government regional planning agencies. A simple internet search yielded all organizations involved within the specified region.

For the full government section, our methods altered slightly. Instead of blindly searching the internet for organizations, which may or may not yield the proper results, we went to the MetroWest website. There we found a list of all the municipalities that the Partnership is composed. From this list, one town at a time, we went to their website and searched through it until we found a listing of town committees and boards. From this list we pulled out every board and committee that could stand to

benefit from the green infrastructure information 495/MetroWest is trying to circulate. With the completion of this section, we now have a complete listing of the organizations that will make up our database. The next step is to fill out each contact with all relevant information.

After viewing what information was available on average for each contact we decided on tracking down the information we could on the following entries:

- First Name
- Last Name
- Phone Number
- Fax Number
- Street Address
- Town/City
- Zip Code
- E-Mail Address

Using the above entries for our database allows the user to contact each organization in a variety of ways. However, in our search to fill in all the voids, there were a few fields that remain blank. Reasons for this include: no fax number listed due to either no fax machine or lack of interest, vacant positions for the organizations, or simply no contact information was provided on their respective websites.

As far as the actual contact person for each organization, we either chose the organizational president or director. In the case that an organization had two or more similar titles, we chose the person permanently on staff, and not just the one who sits in on meetings. There were a few rare occurrences where a particular organization routed all mail to a secretary. However, it is important to see that it is not necessarily the head of the organization that receives the future information, but rather to find the best person to make the important decisions. Once the contact person is identified, the rest of the entries correspond to the contact information associated. For example, phone numbers and email addresses correspond directly to the contact name where applicable.

Results

Through our research we have found that many communities can greatly benefit from the implementation of green infrastructure. However, the majority of communities are quite lost regarding the first step of beginning this project; large projects like these can face great challenges getting off of the ground, especially without a plan of action. Realizing this, 495/Metrowest has determined that if smaller organizations are tasked with the job of spreading the information, the word can travel faster and more effectively. This cannot be accomplished if each organization does not have a list of contacts to which they can send information. The following section will provide our analysis of this problem.

Database

Based on the information above outlining our methods to completing a database, we set to work hunting down contacts. The majority of all contact information was researched online. It should also be noted that because of today's reliance on technology, some organizations that were deemed "could benefit from receiving information" do not have standard mailing addresses or telephone contacts. Instead, all correspondence is done through electronic mail. Yet others had no contact information at all, and thus were deleted from our list of contacts.

The completed database can be found in Appendix B: Final contact database. This database includes two separate forms of contacts as well as a specific form of organization. The organization will be discussed in detail in the following section. However, in an effort to develop a complete list of all possible contacts, we also included all previously known information that was given to us by the 495/MetroWest Partnership. This included, but not limited to, all commissioners and board members of the municipalities that are represented by the Partnership. Since most of these contacts are elected officials and not necessarily organizations, further information was recorded and included in the

database. An example of this is the year their term ends. This will help to remind the Partnership of any updated contact information may be needed if the position is up for re-election.

Organization

There are two major areas of organization that need to be kept in mind when developing a database. First, a list of contact information is of no use if it cannot be searched through and sorted for a particular need. In order to accomplish this, a certain organizational method must be employed. In order to be able to sort and manage the information, the contacts should be arranged in a well thought-out and organized table. For our purposes we chose to use Microsoft Excel for its ability to sort and arrange cells quickly and efficiently by a variety of criteria. It is possible to arrange the entire list according to any particular category as established in the creation.

Second, more than coding system should be used to offer more versatility in organizing the contacts; for our database we chose two coding categories. These two categories will allow the user to search through the database and organize the contacts according to government involvement and commonality. For example, all the non-government organizations can be grouped together and/or all the conservation commissioners can be grouped together. In order to show the coding system of each type, below are two tables that show the coded symbol as well as its corresponding meaning. In the database, next to each contact in its own category, the coding symbol will be placed. This will be how the user can sort the information.

Amount of Government Control

Non-Government, privately funded	N
Quasi-Government, publicly funded, no government employees	Q
Government run and operated	G

Table 1: Coding for Government Control

As is clearly visible above, the coding system is very straightforward. The second to last column of the database will contain one of the above three symbols, an N, Q, or G. By sorting the database according to this code, all organizations that are related can be grouped together. Similarly, for the types of organizations each related entry can be grouped together. However, due to the wide variety of organizations, we have chosen to use a numerical system in lieu of an alphabetic system. This decision was made for two reasons. First, the alphabetic system was already being used by the previous coding system with the government control. Second, using letters for each type of organization would likely get very confusing. In an effort to keep the table simple and easy-to-use, Table 2: Coding for Organizations will show our coding system for the various types of organizations.

Types of Organizations

Land Trusts	1
State Conservation	2
Planning	3
Watershed	4
Conservation Commission	5
Park and Recreation	6
Open Space	7

Building	8
Community Preservation	9
Ponds and Lakes	10
Development	11
Waters	12
Other Organizations	13

Table 2: Coding for Organizations

As can be inferred from the organization types, this type of coding system is more a way to group together the various organizations on the municipal level. However, there still exist groups that included both regional and state level organizations. It should be noted that number 13 refers to all other organizations in the list that do not fall into any one of the above twelve categories. This group contains the organizations that may appear in only one or two municipalities or are specialized groups devoted to a particular cause in the area.

Reasoning

With the entire database now complete and an appropriate coding system installed, it is important to observe any trends or patterns in the data. Given that this is only a list of organizations associated with green infrastructure and planning, there are some trends and patterns that will be overlooked for obvious reasons, including, but not limited to similar mission statements and overall goals. The best way we found to observe any patterns or peculiarities was to use our above mentioned coding systems and graph our results in a pie chart. This graphical representation of the data can show the percentage share of each group as related to the whole. Ideally, this method will show any dominance in a particular set of data.

The most important set to look at is the government control. By analyzing this set of data, we can determine the government's current role in implementing green infrastructure as it pertains to the 495/MetroWest Partnership. Below is the graphical representation of the data set in which only the government control was considered. Using the same coding system as stated above, the results can be found in Figure 3 Government Control.

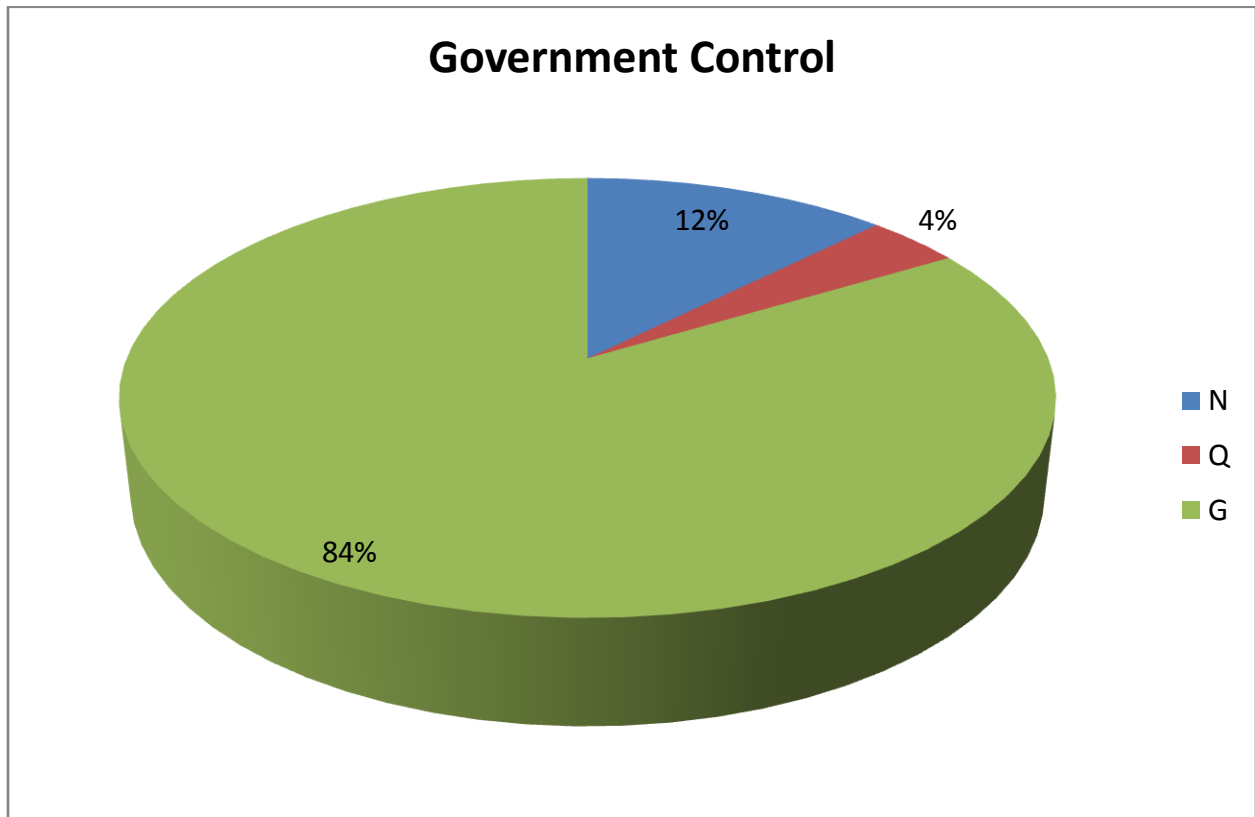


Figure 3 Government Control

Based on the graph it is easy to see the impact the government has on green infrastructure. This is not entirely unexpected however. Most of the time when making a building or town more “green” this includes constructing new buildings or renovating older buildings. Since this process is not cheap, most organizations that do not receive public funding simply cannot financially support such a

change. It should also be noted that many of the non-government organizations are more concerned with preservation of resources rather than the implementation of new or renovated infrastructure.

The second graph will focus on the other coding system: types of organizations. This analysis hopes to show any further insight into the specific type of organization that appears to be the best for implementing any sort of infrastructure. Below is a similar pie chart with each of the thirteen types shown as a percentage for the whole.

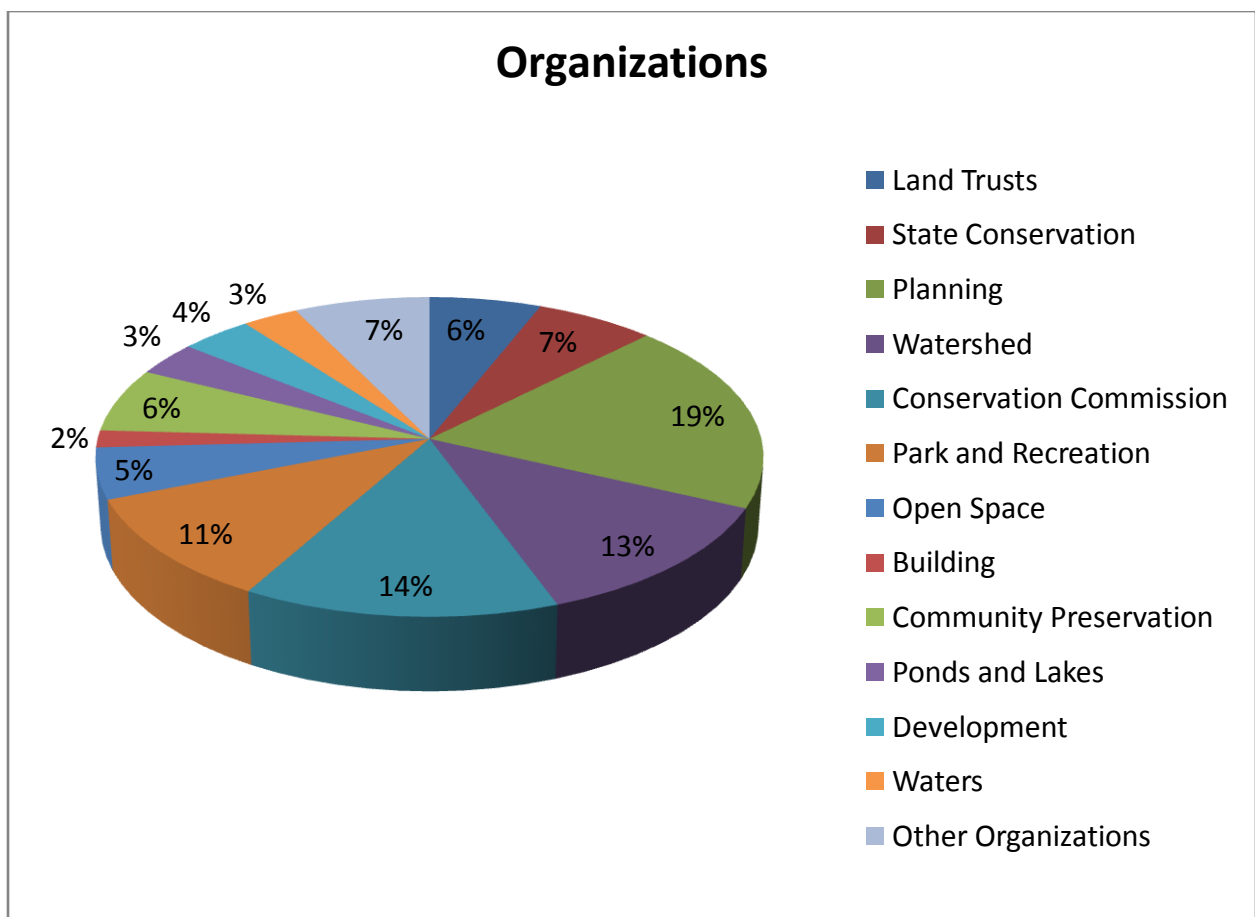


Figure 4 Types of Organizations

As far as any trends or patterns are concerned, it appears that more than half of all organizations can be divided amongst four types. The largest representation is community preservation followed by the conservation commissions. Both of these organization types fall under the government

controlled category as well. It can be inferred from this graph that the 495/MetroWest Partnership should be dealing in large part with individual communities in the areas of preservation, conservation, and recreation. Additionally, the watershed organizations certainly cannot be overlooked since they form up a modest amount of representation as well. However, it should be noted that although this contact list we have developed is quite thorough, it does not represent statewide (or national) interest in green infrastructure. It only deals with those organizations that happen to fall under the Partnership's operational area. Knowing this, we cannot make any other conclusions regarding statewide green infrastructure programs. The aim of this report was to study the Partnership's operational area, not the entire state of Massachusetts. Without data encompassing the entire Commonwealth, our data would need to be extrapolated; such action would result in unreliable data, but again, we are only reporting on the Partnership's operational area.

Conclusions and Recommendations

Since the primary goal of the Toolkit is to be widely distributed so that smaller municipalities and agencies can take green infrastructure into their own hands, the analysis of which organizations will receive the toolkit is quite important. This section will further analyze the data from the previous section, providing a basis for recommendations to the Partnership.

Governmental Role with Recipients

To effectively “sell” an idea or program, you must know your audience well. By looking at Figure 3 Government Control Figure 3 we can see that the type of organization most likely to go through the project, by a wide margin, is some sort of government agency. Again, an organization classified as “government” organization receives government money and are staffed through the government. Perhaps the toolkit would benefit from being geared more towards the government than general interest; while the idea is to appeal to as broad of an audience as possible, 84% of the toolkit recipients will be from one demographic. Weighing broad appeal versus likelihood of use is an area that may need to be revisited.

However, just labeling an agency as “government” is a generalization at best. The activities of such organizations need to be taken into account also, which is what will be looked into next.

Function of Recipients

Of all the organizations receiving this toolkit, the two largest groupings are planning and development agencies, which constitute ~33% of the recipients, and the group of water-related agencies (governing watersheds, rivers, lakes, etc.) which is ~27% of the recipients. Those groups each are a large part of the toolkit’s audience and each have a very different role than the other. A planning

agency will be concerned about the feasibility of new building codes, the costs of improving existing structures, and the possibilities of subsidies. A watershed organization will be much more concerned with finding an incentive for the surrounding communities to adopt measures that minimize pollution that will end up in a water supply. While there certainly some overlap with those two goals, the reasoning behind the goals and the methods of implementing the plans will be vastly different.

Recommendations

As mentioned before, the concepts of weighing general interest versus the likelihood of implementation must constantly kept in mind. If one broad-scoping paper that relies more on the volume of recipients than the percentage of the audience making change is desired, then the toolkit is fine as is. However, it seems that an organization that is a proponent of progressive change in a local arena would be more concerned with people making a difference. If that is the case, the Partnership should strongly consider releasing more than one version of the toolkit, each aimed at a different demographic. As seen above, gearing the entire project more towards governmental agencies receiving the toolkit (which is over 80% of the total audience) would be a great idea. A few strong ideas for “specialized” toolkits would be:

- Planning boards and developmental organizations
- Watershed agencies and similar water protection groups
- Parks, playgrounds, and other places reliant on volunteer work
- Public buildings, such as schools and government workplaces
- Entirely urban areas with limited open spaces

The major problem foreseeable with these small toolkits can be dealt with easily. There will obviously be a time commitment necessary for making several different versions, but this problem is not as large as one might think. Most of the work will be minor tweaking done to the current toolkit, merely highlighting pertinent information and omitting superfluous items. Additionally, since a distribution list has already been made, minimal work would be put into finding additional recipients of the new toolkits.

With several slight adjustments, several smaller toolkits could be released so that the same number of organizations receive this valuable information, but the items presented would be especially useful due to specialization.

Appendix A: Mission and Organization of 495/MetroWest Corridor Partnership

Taken from the 495/MetroWest Corridor Partnership website (495 MetroWest Corridor Partnership, 2006), the Partnership describes its history as:

In 2003, a group of visionary regional leaders created the 495/MetroWest Corridor Partnership to serve as an advocacy organization for the thirty-two municipalities in the "Arc of Innovation" region along I-495. Since then, the Partnership has amassed an impressive record of accomplishment addressing transportation, water resources, workforce development, brownfields reclamation, housing, and permitting issues, while being recognized by policymakers as the voice for a region crucial to the Commonwealth's economy.

The group has clarified their goals into six major priorities (495 MetroWest Corridor Partnership, 2006); each of these priorities will be a focus of research in legislation and incentives. The six priorities are:

- Economic Development
- Transportation
- Water Resources
- Housing
- Workforce Development
- Permitting

Many task forces and teams complete individual reports that provide necessary information for the Partnership to make decisions concerning these priorities. This report is an example of such work for the partnership. Working with community leaders using the given data, the Partnership brainstorms feasible solutions for many of today's sustainability concerns.

Appendix B: Final contact database

[Note: Due to formatting difficulties, please find the final contact database link below to the Excel document which houses the database]



Final Contact
Database

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