Scenario Planning: Central Canal, Broad Ripple

Prepared for:
Tom Healy and
The Broad Ripple Village Association

Prepared by:
The Environmental Practicum Course
Butler University
Spring 2010

center for urban ecology
Butler University

I. Project Overview 4

II. Introduction 6

- Canal History
- Site Context
- Problem
- Systems Thinking

III. Water Quality 8

IV. Flora 14

V. Fauna 18

VI. Stakeholders 23

VII. Scenario Planning 27

- Business as Usual
- Full Build Out: Linear Park
- Canal Use Change
- Floating Islands
- Climate Change

VIII. References 39

IX. Figures 41

- Figure 1: Contet Map
- Figure 2: Water Quality Sampling Points

X. Appendices 44

- Appendix A: Interview with Dr. Ryan
- Appendix B: Patron Survey and Results
- Appendix C: Business Owner Survey and Results
- Appendix D: IRB approval

I. Project Overview

This report was prepared by the Spring 2010 Environmental Practicum course. Class participants include the following nine students: Conner Burt, Timmy Dawson, Julie Elmore, Richie Giannotti, Kari Maxwell, Sara McDermand, Ellen Miller, Elysha Wiest, and Nishaat Yunus. In January of 2010, the class met with Tom Healy from the Broad Ripple Village Association (BRVA). Members of the BRVA and other stakeholders in the area feel that portions of the Central Canal running through Broad Ripple Village lack the aesthetic appeal and amenities that are necessary to draw people to the area. However, it was also expressed that there is a marked lack of sensitivity towards "nature" in past re-development proposals. The BRVA and other interested parties now seek the development of a promenade that incorporates and highlights "nature" along the Canal. Additionally, there is a concern to prevent negative impacts to the Canal's water quality and environment.

This project focuses on a specific section of the Canal and the scope includes identifying stakeholders, determining what flora and fauna are currently found on site, water quality levels in the Canal, and adjacent land uses. The project will attempt to explore what factors affect the site, future scenarios that may affect the site and how the BRVA and other stakeholders can plan for those events.

I. Project Overview

Project Glossary

CFU: Colony Forming Units, the amount of colony forming E. coli bacterium per 100mL of water

DO: Dissolved Oxygen, measure of gaseous oxygen in found in water bodies

Flora: plants or vegetation found in a particular site

Invasive: species that tend to intrude or encroach in an area

Live Catch Traps: a trap designed to catch a wild animal without injuring it

MPN: Most Probable Number, technique for estimating E. coli abundance in a water sample

Native: species originating naturally in a particular country or region

Non-Native: species not originating from that particular country or region

NTU: Nephelometric Turbidity Units, used to measure turbidity of water

pH: power of Hydrogen measured on a logarithmic scale, pH>7 = basic, pH<7 = acidic, pH = 7, neutral

Photosynthesis: process by which green plants use sunlight to synthesize food from CO2 and water

Sherman traps: a type of aluminum box trap, which is triggered by balance plate, located in the middle of the trap. They come in a variety of sizes but are typically used to trap small mammals

Systems diagram: a figure showing the inputs and outputs of an ecological system

Tomahawk traps: a type of live trap, which looks like a cage. This type of trap is typically used to catch medium sized mammals

Turbidity: relative clarity of water determined by suspended solids such as phytoplankton, algae or sediments

Turbidity Tube: A tube with a secchi disc pattern on the bottom used for measuring turbidity

II. Introduction

Canal History

The idea for the creation of the Central Canal was part of an act that was signed into law by Indiana's governor in 1835. However, construction of the Indianapolis portion of the canal did not start until 1836. Water was first drawn into the Central Canal at the feeder dam in Broad Ripple three years later in 1839. When first opened, The Broad Ripple source filled the Central Canal to approximately eight miles in length. Many years later, in 1871, the Central Canal was purchased by the Indianapolis Water Company. This company used the water to provide power for turbines, which in turn pumped water from wells to Indianapolis residents. It was not until 1904 that the Indianapolis Water Company began to use the water from the Central Canal as a source of drinking water for their customers. Despite the use of the Central Canal as a water source, boat companies were allowed to rent recreational crafts to visitors who would travel up and down the canal's length. Interestingly, the most noteworthy rental area was at Fairview Park which is now Holcomb Gardens at Butler University. In 1976, the Indianapolis Water Company deeded the portion of the Central Canal south of 16th Street to the City of Indianapolis. This section of the Central Canal was then lowered and rebuilt, and now makes up the downtown portion of the Central Canal that exists today.

The "upper portion" of the Central Canal extends for over six miles from its guard lock above the White River Dam in Broad Ripple, about fifty yards northeast of where Guilford Avenue and East Westfield Boulevard intersect, to another junction with the White River around 30th Street. The Central Canal was built to be 60 feet wide and 5 feet deep. Today the Central Canal is still used to provide water for around 60% of Indianapolis residents, around 600,000 people. The Central Canal carries up to 120 million gallons of water per day to the city's largest treatment facility, serving all of downtown Indianapolis and surrounding areas. The Central Canal is currently owned by the Indianapolis Department of Waterworks (DOW), but is managed by an independent contractor, Veolia. A recreational path, The Towpath, also extends along the length of the Central Canal. This path is maintained by the Indianapolis Parks and Recreation Greenways team (IPG).

Site Context

The Central Canal is a unique feature to Indianapolis, and a defining characteristic of Broad Ripple Village. The Canal represents different things to different people. It is perceived by some as a natural waterway, while others perceive it as a blighted ditch and treat it as such. This variation of opinion has led to conflicts over how to use, manage and plan for areas adjacent to and along the banks of the canal. This project will focus on a specific segment of the Canal that stretches between the Monon Trail and Rainbow Bridges, referred to as the site (Figure 1). Plans to re-develop this area were explored by the BRVA several years ago, however, they were problematic because they primarily focused on urban growth and paid little consideration to natural amenities and ecological function. Additionally, there is little data regarding the species present on site.

Problem

Given the urban context of the site, it is a challenge to accommodate growth and human safety while maintaining ecological significance. The ultimate goal for BRVA is to transform the site into a flourishing and natural attraction for Broad Ripple that is better suited for human use

II. Introduction

and ecologically sound. The BRVA seeks a long-term restoration proposal that will re-develop the area responsibly and improve conditions for all stakeholders of Broad Ripple Village and the greater Indianapolis area.

Systems Thinking and Scenario Planning

Systems thinking is an approach that involves exploring how energy moves through various networks within a given location. It focuses on highlighting the current inputs, outputs, interactions and ongoing processes happening within an area of interest. To begin, boundaries for the area are outlined and major systems are identified. Next, systems thinking focuses on how the inputs and components within each of these systems relate to and influence one another. For this project, boundaries for the Broad Ripple site were delineated by the Rainbow Bridge, the Monon Trail Bridge, and a 20ft. buffer extending outward from the north and south banks of the Canal. Water quality, flora, fauna, and stakeholders were recognized as the major systems. For each system, key components, inputs, and outputs were identified, as well as how they interact within the given boundaries. This manner of thinking is like telling a story about how the system functions. By understanding this story, one can better predict how additional inputs or changes in the system could affect the interactions between its components and alter various ongoing processes. Since systems thinking highlights how each element in an area of interest influences the system, it can be a useful tool for scenario planning.

Scenario planning is a process used to develop more reliable management and development decisions. Scenarios are developed to consider alternative outcomes and factors concerning a given system, and will hopefully lead to a better understanding of the system. Scenario planning addresses problems through a systematic inventory and analysis. By working with local stakeholders this project seeks to identify the cultural, natural, biological, historical and recreational resources related to the south bank of the Canal on site. This report will then consider potential scenarios that may affect the Canal in the future, and help shape future decisions regarding the site.

III. Water Quality

A. Problem:

One concern for the BRVA and local stakeholders at the site is water quality. Water quality will be evaluated based on an inventory of the present biological, physical, and chemical properties at three different sample locations along the Canal, and compared to accepted components of aquatic ecosystem health. This data will then be used to explore development and management scenarios that influence local water quality conditions in the short and long term future.

i. Introduction

The City of Indianapolis generates approximately 60% of its drinking water from the Central Canal. The degree of treatment and processing water must be put through before reaching drinking quality standards increases with heightened concentrations of pollutants found in the Canal; therefore, water quality is an ongoing concern. Management and development of the bank between the Rainbow Bridge and Monon Trail Bridge has the potential to affect quality and flow throughout the entire canal, chiefly due to its location at the very start of the canal, where a dam has been built to control withdrawal from the White River. A multitude of factors influence water quality within the Canal, beginning with its source, the White River. The water quality analysis will take into consideration recent concerns of sedimentation build-up, bacterial concentrations, and control of water flow rates and provide insights as to how these features may affect ecosystem health. This inventory will also be helpful when considering future changes to the site.

ii. Methods:

Water quality is gauged by analyzing the combination of its chemical, physical and biological contents. These three characteristics were analyzed using bio-indicators (abundance of chlorophyll and bacteria), dissolved chemical concentrations, and physical parameters (turbidity, temperature, color). Overall, bio-indicators provide a good snapshot of current water quality of the Canal and an indication of biological content. Sampling techniques established by the Hoosier Riverwatch protocol were used. Hoosier Riverwatch is a program of the Indiana Department of Natural Resources Division of Fish and Wildlife, and specializes in training individuals to assess water quality in Indiana, based on its chemical, physical and biological content. Samples were gathered based on the Spring 2008 Volunteer Stream Monitoring Training Manual.

Canal water was collected in sterile containers, from the center of the Canal or White River just below the surface water at the three sampling locations: upstream from the site in the White River behind Broad Ripple Park, within the site, and downstream from the site behind Butler University (Figure 2).

a. Chemical Content:

Canal water from each of the three sample locations was analyzed for chemical properties,

III. Water Quality

including: dissolved oxygen content (DO), pH, nitrate and phosphate concentrations. Results were determined using Hoosier Riverwatch Steam Monitoring kits. Water from each sampling location was mixed with chemical reagents specific for each water quality component, and compared to color tubes with known values of dissolved chemicals. The results of chemical testing are listed in Table 1.

Table 1. Chemical content sampling results

PARAMETER OF WATER QUALITY	WHITE RIVER	SITE	BUTLER UNIVERSITY
DO (mg/L)	8	8	9
DO (% saturation)	81	81	95
pH	7.5	7.5	8
Phosphate (mg/L)	0.3	0.3	0.4
Nitrate (mg/L)	4.4	4.4	4.4

b. Physical Content:

To assess the physical components of the Canal, measurements of water temperature and the level of water clarity were taken. Water clarity was determined by assessing turbidity, the relative amount of suspended particles in the water column that causes it to look murky or cloudy. Water temperature was measured on location at the time of sampling using a hand held thermometer. Turbidity was measured on location using a turbidity tube, and transparency levels were converted into NTUs (turbidity units) using the Hoosier Riverwatch conversion table for water clarity. Results of the physical inventory are outlined in Table 2.

Table 2. Physical content sampling results

PARAMETER OF WATER QUALITY	WHITE RIVER	SITE	BUTLER UNIVERSITY
Temperature °C	17	17	18
Temperature Change	0	0	1
Transparency (cm)	33.9	34.9	38.6
Turbidity (NTU)	20	20	20

c. Biological Content:

The presence of the bacterium Escherichia coli (E. coli) and total chlorophyll concentration was used to assess the biological components of the Canal. E. coli presence and relative abundance was discerned by placing 100mL of water from the three sampling sites into their own sterile trays, closing them off using a Quanti Tray Sealer, and placing them each in an IDEXX Colilert 18 incubator located in Butler University's Center for Urban Ecology. Total coliform bactieria concentration levels were determined by the number of water filled pockets that changed color over the 18 hour incubation period. E. coli presence was discerned by putting the trays under a black light and looking for a glowing, bluish-hue in

III. Water Quality

the pockets. The results of biological sampling are presented in Table 3.

Table 3. Biological content sampling results

PARAMETER OF WATER QUALITY	WHITE RIVER	SITE	BUTLER UNIVERSITY
Total coliform bacteria (MPN/100mL)	11.1	2	6.4
E. coli (MPN/100mL)	42.9	78.2	30.6

iii. Analysis

a. Chemical Content:

Dissolved Oxygen (DO):

DO is an important component of water quality because most aquatic organisms need oxygen in its free elemental state (O_2) in order to survive in the environment. Oxygen is dissolved in the water from the atmosphere and is a byproduct of photosynthesis, the process by which plants derive energy. For these reasons, DO is an effective parameter to measure water quality because it gives an estimate of the healthy plant life in the area. Presence of oxygen is a positive sign, whereas absence of oxygen indicates water pollution. Decomposing organic material or high levels of bacteria consume DO and deplete its levels in the environment. In contrast, excessively high levels of aquatic plants or extreme pressure caused by dams may cause a supersaturation of DO, and cause gas bubble disease which negatively effects stream health. According to Hoosier Riverwatch, the Indiana state water quality standard is >5mg/L and the Indiana average of DO in stream water is 9.8mg/L. Considering the Canal is a lotic habitat (with moving water as opposed to still water), similar DO content was expected at all three sampling locations. Slightly higher DO content was expected at the site because of the pressure build up of the dam and slightly lower downstream behind Butler University, where there is a greater amount of overhanging trees, and therefore increased chance of organic decomposition from lost leaves depleting oxygen stores in the water. After analysis, dissolved oxygen concentrations for the White River and the site were calculated as 8mg/L, while the sampling location Butler University totaled 9mg/L. Though these results varied from our original expectations, the three sites were all very close in measurement to one another, and in line with Indiana state averages.

Nitrates:

Nitrogen is a necessary nutrient for plant growth, a main component of chemical fertilizers, and is also found in sewage and animal waste. At high levels, nitrates (along with phosphates) can contribute to eutrophication, an excessive richness of nutrients which causes dense growth of plant life. Hoosier Riverwatch places the Indiana average of nitrates at 12.32 mg/L, but can range from 0 to 36.08 mg/L and still be considered "normal". Higher nitrate levels were expected at the sample location behind Butler University because of nearby, upstream populations of ducks and geese that contribute to nitrate levels with their

waste products. There is also a storm pipe near this sample location, and due to Indianapolis' Combined Sewer Overflow (CSO) system, a large precipitation event will increase stormwater runoff effects, and may increase nitrate content. After analysis of the three sampling locations, we found the nitrate level to be a constant 4.4mg/L. This is lower than the Indiana average, and falls within the normal range for nitrates in freshwater systems. Uniform nitrate levels were not expected, but due to the constant flow and regulation of Canal these results are not entirely surprising.

Phosphates:

Phosphorous (P) is also an essential nutrient for plant growth and is frequently used to enhance vegetation in terrestrial environments. Phosphorous naturally occurs in aquatic systems in very low concentrations, however, high amounts of phosphorous can be detrimental to the ecosystem. Phosphorous enters the aquatic system through decaying organic materials, wastes, and in-organic man-made products (detergents, fertilizers). In high amounts, phosphorous catalyzes excessive aquatic plant growth, which in turn begins to deplete the amount of dissolved oxygen from plant death and decaying processes. Low dissolved oxygen levels induces hypoxia, which can lead to animal death in some cases. Similar levels of phosphates were expected in all sampling locations due to the lotic nature of the Canal and its uniform depth throughout. Phosphate results are as follows: 0.3mg/L for the White River and the site, 0.4mg/L behind Butler University. These calculations are incredibly close to one another and normal for Indiana water conditions. Phosphates behind Butler University could be slightly higher due to tree canopy overhang, which leads to increased decay of organic materials.

pH:

pH is a common test to determine if a solution is basic (excess of OH- ions) or acidic (excess of H+ ions). Some aquatic organisms are sensitive to the surrounding pH levels, so it is an important measure to consider with regards to water quality. Temperature, algal abundance, and storm runoff can all contribute to pH concentrations. The Indiana state standard for pH is between 6 and 9, and the state average is 8.0. Due to uniform depth and constantly moving water at sampling locations, uniform pH in all three samples was expected. pH measurements for the White River and the site equaled 7.5, whereas the location behind Butler was 8.0. The equipment used to analyze the pH levels between the sampling sites was very hard to differentiate, so human error could be a factor as to why these sites differed slightly in their results.

b. Physical Content:

Water clarity (turbidity) and temperature were analyzed at the three sample locations to assess the physical components of Canal water quality.

III. Water Quality

Turbidity:

Turbidity is caused by suspended matter (silt, algae, clay, etc.) in the water column. It affects transparency of light through the water column and can hinder photosynthesis of aquatic plants as well as clog the gills of fish. It can result from urban runoff, soil erosion, algal blooms, and benthic disturbance. High turbidity causes water to look cloudy or murky. Again, relatively uniform turbidity measures were expected at the three sampling sites due to water movement and uniform depth. Typical ranges for turbidity occur between 0 - 173 NTU (turbidity units), and the Indiana average is 36 NTU. Raw data of water turbidity using the turbidity tube was measured by the amount of centimeters one could see into the water and differentiate between the white and black Secchi disc at the bottom. The White River had a transparency of 33.9cm, the Broad Ripple site: 34.9cm, and behind Butler: 38.6cm. Though this raw data differentiates slightly, the Hoosier Riverwatch conversion places all three sampling locations at 20 NTU, a uniform turbidity level and below the state average.

Temperature:

Temperature affects many biological processes and is a crucial measurement to understand ecosystem health. Temperature can affect the rate of photosynthesis (more photosynthesis occurs at warmer temperatures), the level of dissolved oxygen in a system (colder water holds more), and can affect metabolic rates of aquatic organisms (warmer environments increases metabolic rates, and organisms require more energy to survive). In addition, as a whole, aquatic organisms can only survive in a narrow window of water temperatures. Predicted water temperature at both the site and sampling location behind Butler University to be slightly warmer than the sampling location in the White River because those two sites have a notably smaller volume of water that would change temperature more rapidly than a greater volume of water found at our White River sampling location. This variable is expected to be greatly influenced by the weather and seasonal differences, and at the time of sampling all three locations had similar temperatures, within one degree celsius of each other.

c. Biological Content:

The presence of coliform bacteria and E. coli were used as bio-indicators of water quality in the Canal.

Bacteria Concentration/E. coli:

E. coli is a form of fecal coliform bacteria present in the feces of endothermic (warm-blooded) animals. While these bacteria are naturally present in the digestive tracts of these organisms, they are not found in unpolluted waters. According to the EPA, the presence of E. coli in water is a strong indication of recent sewage or animal waste contamination. This specific type of bacteria can enter the body through ones eyes, ears, mouth, nose, or skin lacerations and can cause serious illness. CSOs (combined sewer overflows), like the system in Indianapolis, is a primary way E. coli can enter the water. Hoosier Riverwatch

states that 41% of Indiana steams are not approved for primary contact recreation due to high levels of E. coli.

High levels of E. coli concentration were expected at all of our sampling locations, especially behind Butler University due to the notable duck and geese populations, as well as the proximity to a CSO storm water pipe. The IDEXX Colilert-18 provided results of total coliform bacteria in the form of most probable number (MPN). Results for total coliform at the White River, the project site, and Butler University sampling location were 11.1 MPN, 2.0 MPN, and 6.4 MPN, respectively. E. coli parameters were 42.9 MPN, 78.2 MPN, and 30.6 MPN, in the same order. All E. coli levels were below the EPA recommended average of 126 MPN, but it is worth noting that the site contained the highest MPN of E. coli of all three sampling locations. This could be due to the fact of a high abundance of ducks and geese in the area or increased traffic and visits by pet owners that may contribute to the increase in E. coli.

IV. Flora

A. Problem:

Plants are an important aesthetic and ecological aspect to any location. A variety of plants are good at filtering groundwater, preventing soil erosion, and providing shelter and food to local animals. As part of this project, an inventory of the flora at the site was conducted with the assistance of Dr. Rebecca Dolan. Identification and inventory of the plants at the site will provide the BRVA with detailed information about what types of plants are on site and in what capacity they are there. Plant species, whether native or non-native, invasive or non-invasive, were identified. This information will be useful when planning future changes to the site.

i. Background

Flora is an important component on site and to the Canal system because it provides valuable ecological services to the site and is a crucial part of the overall effect the site has on its users and the surrounding systems. To understand the context of the site and the flora species present, a historical perspective is needed.

"Central Indiana was originally part of a vast deciduous forest that varied in moisture gradients and exposure and covered most of Indiana" (Ecolab). The dominant species of presettlement forest areas in Marion County included "Sugar Maple (*Acer saccharum*), American Beech (*Fagus grandiflora*), Ash (*Fraxinus* spp.), Hickory (*Carya* spp.), and Oak (*Quercus alba*, *Qborealis*, and others)" (Blewett and Potzger 1951).

ii. Flora Inventory Methods

Construction at the site will affect the flora as well as other components of the system, so planning ahead is critical. If at all possible, this project aims to minimize the negative effects associated with urbanization. The inventory included what types of plants were within the designated boundary of the site, whether or not they were native or invasive, what their potential impact was on the surrounding systems and the quantitative value of the species.

On March 26, 2010, a site visit was carried out with Dr. Rebecca Dolan, a plant ecologist who specializes in Indiana's local flora and directs the Friesner Herbarium at Butler University. Dr. Dolan helped identify the individual species of plants present at the site. Her expertise provided critical insight into what methods were used to complete the inventory. Dr. Dolan explained the site in its current state as an example of what most botanists would call a "waste place."

After assessing the site, Dr. Dolan suggested a method for explaining the quality of the existing flora on the site in a quantitative form. This standardized method, the Floristic Quality Assessment (FQA), was developed by Floyd Swink and Gerald Wilhelm in 1994 based on flora in Chicago, but was later related to flora in Indiana by P.E. Rothrock. It entails identifying the species present on the site and then assigning a Coefficient of Conservativism (C-value) on a scale of 0 to 10. C-Values are an estimate of the fidelity of a plant species to an unaltered plant community (Swink and Wilhelm 1994). For example, a C-value of 0 given to an individual plant species means that it can be found almost anywhere whereas a plant

IV. Flora

with a C-value of 10 is restricted to a high quality natural area. Plants that were introduced to an area were not part of the pre-settlement flora so they cannot be assigned a C-value. The results of the site visit are outlined in Table 4.

Table 4. Flora inventory results

COMMON NAME	SCIENTIFIC NAME	INVASIVE/ NON-INVASIVE	NATIVE/ NON-NATIVE	C-VALUE
Asian Bush Honeysuckle	*Lonicera* sp.	Invasive	Non-Native	
Grape Vine	*Vitis* sp.	Invasive	Native	1 or 3
Siberian Elm	*Ulmus pumila*	Somewhat Invasive	Non-Native	
White Mulberry	*Morus alba*	Invasive	Non-Native	
Wild Mustard	*Brassica sp.*		Non-Native	
Catalpa	*Caltalpa sp.*		Native in Marion Co.	
Tree of Heaven	*Ailanthus altissima*	Invasive	Non-Native	
Kidney-Leaved Buttercup	*Ranunculus abortivus*		Native	0
Dandelion	*Taxaracum officinale*		Non-Native	
Indian Strawberry	*Duchesnea indica*		Non-Native	
Evening Primrose	*Oenothera biennis*		Native	0
Canada Goldenrod	*Solidago canadensis*		Native	0
Japanese Knot Weed	*Polygonum cuspidatum*	Invasive	Non-Native	
Sand Vine	*Cynanchum laeve*		Native	1
Box-Elder	*Acer negundo*		Native	1
Henbit	*Glechoma hederacea*		Non-Native	
Speed-Well (Veronica)	*Veronica* sp.		Non-Native	
Cleavers	*Galium aparine*		Native	1
Wild Onion	*Allium* sp.		Non-Native	
Mullein	*Verbascum thapsis*	Invasive	Non-Native	
Poison Ivy	*Toxicodendron radicans*		Native	1
Autumn Olive	*Elaeagnus umbellata*	Invasive	Non-Native	
Japanese Honeysuckle	*Lonicera japonica*	Invasive	Non-Native	
Burdock	*Arctium minus*		Non-Native	
Honey Locust	*Gleditsia triacanthos*		Native	0

No emergent vegetation was observed at the site, but could be problematic in the future. Even though this does not presently pose a problem to the site, it is problematic at other locations in the Canal.

IV. Flora

iii. Analysis

After completing the inventory, an analysis of the inventory was carried out. Several questions were considered, including why the plants were there, what impact the plants have on other plants and how the plant's presence impacts the system and surroundings.

There were many invasive species at the site, the most abundant being Honeysuckle. Honeysuckle is a problem all across the state; it is highly invasive and has infected many disturbed areas and the edges of forests or woody areas. Interestingly enough, the Wildlife Conservation Service actually promoted planting honeysuckle for erosion control in the 1950's to 60's, but now the city spends large amounts of money to eradicate the incredibly invasive plant. Honeysuckle, as well as many other non-native species, blooms or leafs out earlier than native species, creating shade that can prevent natives from growing. Invasive species also tend to take up more nutrients and water from the soil. As much of a pest as honeysuckle can be, the density of its growth managed to hold some trash, which prevented it from entering into the Central Canal.

While the majority of the plants at the site were non-native species, there were a few native plants present. The invasive plants excelled at outcompeting the natives for necessary resources such as sun, nutrients, and water. It should be noted that the native plants were present in much smaller numbers. For most native plants, including Catalpa, Box Elder, and Goldenrod, there was only one plant of each species observed at the site. This is typical of most of the native plants observed at the site, although a few species had more than one plant present. Of the native plants present, most were not indicative of a high-quality habitat according to Dr. Dolan and the Conservation Coefficients assigned to them. Another non-native of interest at the site was the Tree of Heaven, which is now illegal to plant in Indiana. The Tree of Heaven is a fast growing tree that was probably planted close to the site before it was illegal to plant them, or established on its own. Wind and animals also help disperse seeds overtime and allow invasives to continually establish at the site, as well as other places along the Central Canal. Image 1 illustrates a systems diagram developed for the site based on the floral inventory.

IV. Flora

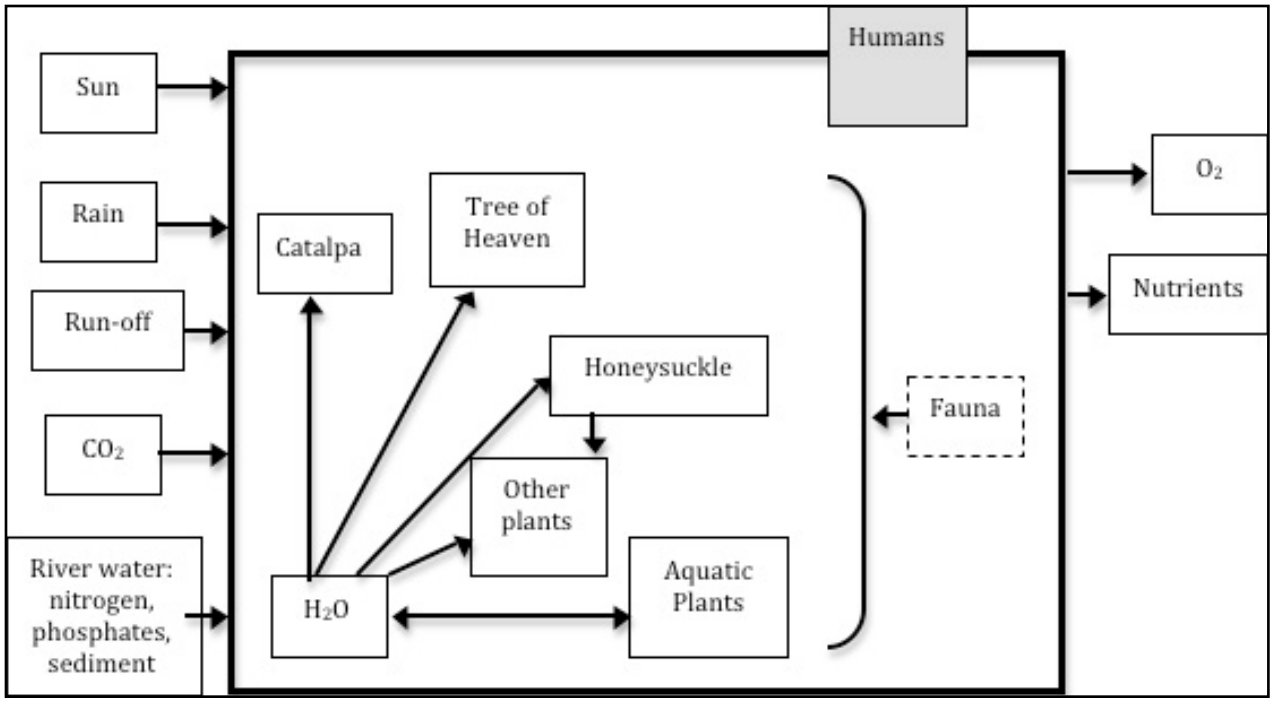


Image 1. Systems Diagram for Floral Inventory

Since the site is not actively managed or maintained, invasive species will likely remain a problem. Even though the site was not being used for a specific purpose, it is important to consider the plants growing there because they will continue to spread more densely not only on site, but also onto surrounding areas that are more desirable to local stakeholders where maintaining an aesthetically pleasing landscape is important.

V. Fauna

A. Problem:

Wildlife species observed or expected in the project area can be both a blessing and a curse. Many swildlife pecies are considered a nuisance because they contribute to the degradation of the site, however, there is the possibility that desirable species utilize the habitat provided by the Canal and the site. Knowing what species are present is imperative to understanding how wildlife species use the banks of the Canal, and the Canal itself. A comprehensive inventory of species is necessary prior to recommending management or policy changes in regards to the site, as well as other locations along the Canal.

i. Introduction

The Canal provides habitat for numerous wildlife species. Before recommending any development or management changes to this habitat it is important to determine what animals are present on site. Several species that use the Canal are considered desirable to the public. People using the Canal for leisure or recreation find wildlife species pleasing to observe and also feed the ducks and geese in the area. These seemingly natural amenities combined with cultural activities have the potential to make the site a draw for Broad Ripple Village.

Several species on-site are also considered a nuisance or non-desirable. The geese and ducks found in the area roam freely on sidewalks and paths adjacent to the canal. Their droppings litter the sidewalks and public areas, and have the potential to track unwanted diseases or microbes into Broad Ripple Village destinations. Mice and other rodents reproduce rapidly and spread disease through bite wounds, parasites, and by contaminating food and water with their waste. The main concern regarding mammals residing in the canal is the issue of muskrats making their burrows into the canal banks. Muskrat burrow openings are typically found 24 inches either above or below the water level. The burrows tend to compromise the stability and integrity of the canal edges, causing the bank to collapse and slide. This is of particular concern to Veolia, who manages the canal and is concerned with flow rates.

ii. Methods

Site visits and trapping were conducted to inventory wildlife species at the study site. There is an extensive list of species that are expected to be present on site based on historical accounts, scientific studies, habitat, and natural history. This information is needed to make ecologically responsible recommendations about future changes to canal infrastructure and management, to ensure viability of the future projects, and the creation of an appealing space.

a. Mammals

Trapping for small mammals was conducted because, after the initial observation visit on March 5th, there was no evidence of larger mammal activity. Traps were opened from 7:30pm to 8:00am for two evenings to obtain a replicable and consistent sampling. Holes of various sizes were found that could possibly be small mammal burrows. This, combined with the close proximity of dumpsters from the local businesses, formed the conclusion that

small mammals like mice and possibly voles would be found.

The equipment used was chosen to ensure safe and effective trapping methods. Sherman Box Traps are small traps that measure 2 inches by 2.5 inches by 6.5 inches. They were packed with cotton to allow the wildlife a nesting area and warmth over night. It was baited with a mixture of peanut butter and granola. Tomahawk Traps were also used and come in a variety of sizes. The Tomahawk Trap we used measured 7 inches by 7 inches by 24 inches. It was baited with a variety of nuts. Both traps used are "live" traps, which is designed to capture wildlife without injury.

The two types and sizes of traps used were chosen based on the potential for small mammals on site. On the first day of trapping, two larger Tomahawk traps were placed on both the East and the West ends of the site and 15 smaller Sherman box traps were placed in the area on the site between the larger traps, totalling 212.5 trap hours (12.5 hours x 17 traps). On the second day, three large Tomahawks were placed on the site along with 13 smaller Sherman box traps totalling 200 trap hours (12.5 hours x 16 traps). A total of 412.5 trap hours conducted on site.

The species captured while trapping on site were as follows:

- **Norway Rat** (*Rattus norvegicus)*: A husky, brownish rodent that weighs about 11 ounces. They range 13 to 18 inches long including the 6 to 8 1/2 inch tail. Their fur is coarse and mostly brown with scattered black on the upper surfaces. The underside is typically grey to yellowish-white. They are found in urban and suburban neighborhoods and eat almost any type of food.

- **Muskrat** (*Ondatra zibethicus*): A large, stout, semi-aquatic rodent weighing about 2-4 pounds. Average length is 18 to 25 inches long with a tail that is 8 to 11 inches. Its head is broad and blunt with short ears barely visible beyond the fur. The muskrat's coat is practically waterproof and is soft, dense, and grayish brown in color. Its tail is scaled, nearly hairless, and somewhat flattened on the sides. They generally inhabit wetlands with an abundant supply of aquatic vegetation and primarily eat aquatic plants.

Common species expected on site due to sighting or evidence of habitat, but not trapped are as follows :

- **Deer Mice** (*Peromyscus maniculatus*): A small nocturnal rodent weighing about 1 ounce. They are about 3 to 4 inches long with a tail that ranges from 2 to 5 inches. The fur is gray to reddish-brown with a white belly. They are most commonly found in outdoors in hollow tree logs or piles of garbage and eat seeds, small fruits and berries, beetles, caterpillars, grasshoppers, leafhoppers, and an underground fungus.

- **House Mice** (*Musculus Domesticus*): A small rodent with relatively large ears and small eyes that weighs about ½ an ounce. They are about 5 1/2 to 7 1/2 inches long, including the 3 to 4 inch tail. The fur is either gray or brown. They usually live in structures such as houses or farms and eat plants, but they will also eat meat and dairy products

V. Fauna

The following species were not captured, but observed in and around the site:

• **Mallard** (*Anas platyrhynchos*): Duck weighing about 2 to 3 pounds. They are about 22 to 25 inches long with a wing span of about 32 to 38 inches. The male has a bright green head, black rear end and a yellowish orange bill tipped with black. The female Mallard is light brown with a dark brown bill. They inhabit most wetlands and shallow water sources and eat Aquatic plants, insects, mollusks, crustaceans, and seeds.

• **Canada goose** (*Branta canadensis*): Large water fowl that weighs about 7 to 19 pounds. They are about 30 to 43 inches long with a wing span of about 50 to 71 inches. They have a black head and neck, white chinstrap, light tan to cream breast and brown back. They reside anywhere near bodies of water and eat aquatic vegetation, grass, roots and young sprouts. They also eat grain and corn from agricultural areas.

b. Turtles

Turtles have been known, in the recent past, to utilize the site as a basking area (Ryan, 2010). The site provides basking areas for turtles in the form of downed brush and other areas easily accessible from the water. For this reason, basking species, particularly map turtles (*Graptemys* sp.) and red eared sliders (*Trachemys scripta*), are the turtles most likely to be seen at the site (Ryan, 2008). It is quite likely that soft shell turtles (*Apalone* sp.) are also at the site as there are known nesting sites within a quarter mile. This species does not bask however, and thus are unlikely to be seen.

Site visits

A site visit was conducted on March 5th between 3 and 4pm. Conditions were sunny, clear and approximately 45 degrees. Numerous ducks, Mallards, and Wood Ducks, were seen using the site. Just Southwest of the project site geese were present, and it is assumed that the geese also utilize the site. A Belted Kingfisher flew over the site as well. There is extensive evidence of mollusks based on shell remnants present both on the banks of the site and in water. It is also expected live mollusks are present in other times of the year or further into the canal. On the north bank two dead Mallard ducks were observed as well as a remnant pupa, believed to be that of a monarch butterfly.

The following site visits were conducted in conjunction with trapping efforts :

• March 26th between 7:00pm and 7:30pm. A Belted Kingfisher was observed stopping over at the site.

• March 27th between 8:00am and 8:15am. A Norway rat was caught on the West end of the site and a muskrat was caught on the East end of the site.

• April 1st between 7:00pm and 7:30pm. No wildlife was observed.

V. Fauna

• April 2nd between 8:00am and 8:15am. No animals were caught however a Downy Woodpecker was observed. Table 5 summarizes the results of the faunal inventory site visits.

Table 5. Fauna inventory and trapping summary

COMMON NAME	SCIENTIFIC NAME	CLASSIFICATION	TRAPPED	OBSERVED
Norway Rat	*Rattus norvegicus*	Mammal	Yes	Yes
Deer Mouse	*Peromyscus maniculatus*	Mammal	No	No
House Mouse	*Musculus Domesticus*	Mammal	No	No
Meadow Vole	*Microtus pennsylvanicus*	Mammal	No	No
Prairie Vole	*Microtus ochrogaster*	Mammal	No	No
Muskrat	*Ondatra zibethicus*	Mammal	Yes	Yes
Short Tailed Shrew	*Blarina brevicauda*	Mammal	No	No
Eastern Chipmunk	*Tamias striatus*	Mammal	No	No
Eastern Gray Squirrel	*Sciurus carolinensis*	Mammal	No	No
Fox Squirrel	*Sciurus niger*	Mammal	No	No
Mallard	*Anas platyrhynchos*	Bird	No	Yes
Wood Duck	*Aix sponsa*	Bird	No	No
Canada Goose	*Branta canadensis*	Bird	No	Yes
European Starling	*Sturnus vulgaris*	Bird	No	No
House Sparrow	*Passer domesticus*	Bird	No	No
Belted Kingfisher	*Megaceryle alcyon*	Bird	No	Yes
Downey Woodpecker	*Picoides pubescens*	Bird	No	Yes
Soft Shelled Turtle	*Apalone* sp.	Reptile	No	No
Map Turtle	*Graptemys* sp.	Reptile	No	No
Red Eared Slider	*Trachemys scripta elegans*	Reptile	No	No
Monarch Butterfly	*Danaus plexippus*	Insect	No	Yes* Pupa

iii. Analysis

After concluding site observations and trapping, an extensive list has been compiled of species that currently use or could potentially use the site. A limited number of species were encountered, this is likely due to the site's current management, poor habitat quality and urban context. The urban context is of particular importance. Since the site is relatively 'cut off' from other more naturalized habitats, it is unclear as to whether the site would attract or be able to support large populations of any species. However, it is very close to the white River corridor and if the site were to be restored and managed with native vegetation, there

V. Fauna

is a possibility of encountering a more diverse suite of species. Supplemental feedings for ducks and geese are also a factor in attracting what is considered, by some, to be undesirable species. Image 2 illustrates the systems diagram prepared based on the faunal inventory.

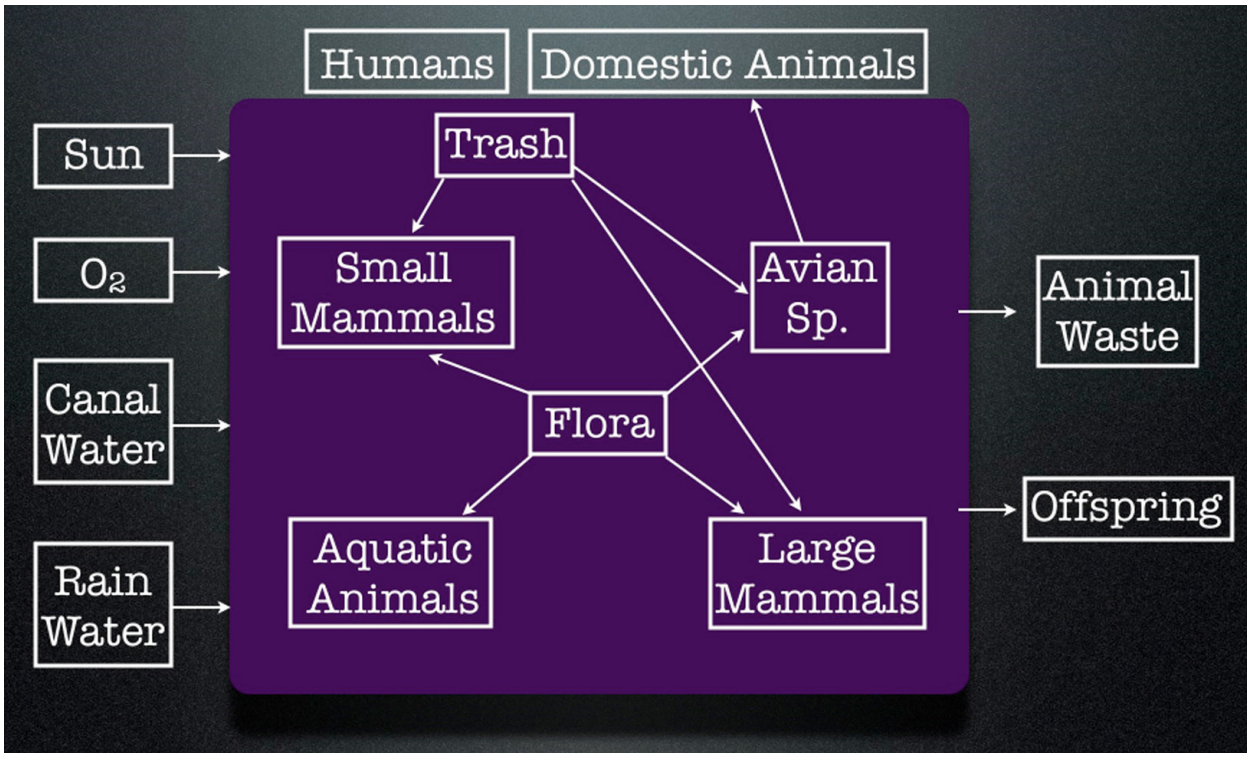


Image 2. Systems Diagram od Faunal Inventory

VI. Stakeholders

A. Problem

Broad Ripple Village is a neighborhood of diverse shops, restaurants, nightlife and residents. As one of Indianapolis' historic and multicultural neighborhoods, Broad Ripple attracts a wide range of visitors from all over the city, state and country. As a result, the aesthetic appeal is extremely important for the Broad Ripple area. The Central Canal is an integral part of Broad Ripple that not only provides visitors with recreational opportunities, but serves as a water source for teh city. However, the South bank of the Canal at the project site located in the middle of a commercial district of Broad Ripple, has become an eyesore. This section is poorly managed and dominated by invasive vegetation. Invasive species do not provide proper habitat and are not a good food source, limiting wildlife species and presenting a management problem.

Tom Healy and the BRVA are interested in improving the conditions of the site in order to increase visitation, create a vibrant user experience, and improve the local economy. They have little data concerning the site. This inventory seeks to identify groups and individuals who will be affected by future changes or developments to the site. Stakeholders were identified, organized and ranked. Then stakeholders' perceptions of the site and opinions as to what should be done to the site in the future were also ranked and recorded. This is important to ensure that any future management decisions about the site will include the voice of the community which will promote ownership and buy in for maintenance or renovations.

i. Introduction

Conducting an inventory and analysis of stakeholders is essential to this project. There are several different organizations and individuals with a vested interest in the site and future improvements. The inventory of stakeholders began by first defining and identifying what constituted a stakeholder for the purposes of this project. In the context of this report a stakeholder refers to an individual, group or company with a vested interest in changes to the site. A heavy focus was placed on stakeholders because their input and cooperation will be key to any future development or management decisions regarding the site. Generating excitement by relevant stakeholders will allow them to take ownership in the canal and to become invested in its improvement.

A fundamental stakeholder was Veolia Environmental Services. It is the organization that controls the Canal and is responsible for the quality and distribution of its water. Veolia has a 20-year public-private contract to manage the city's waterworks system. Veolia is an important organization to contact because it controls nearly every aspect of the canal and any developments or management decisions must have its approval. Its stake in this project cannot be any higher and, as a result, close cooperation and communication is a must. By talking to stakeholders, we will be able to cater to what they want. Also, by educating stakeholders in the changes that are to be made, they will know what they can do to care for and further improve the canal.

VI. Stakeholders

ii. Methods

Stakeholder opinions were gathered via voluntary survey. A survey was chosen because it has the potential to reach a large audience, the information gathered from each respondent is consistent, and the information is easy to analyze. Its purpose is to gather information to determine what opinions of the Central Canal exist in Broad Ripple as well as what improvements stakeholders would like to see.

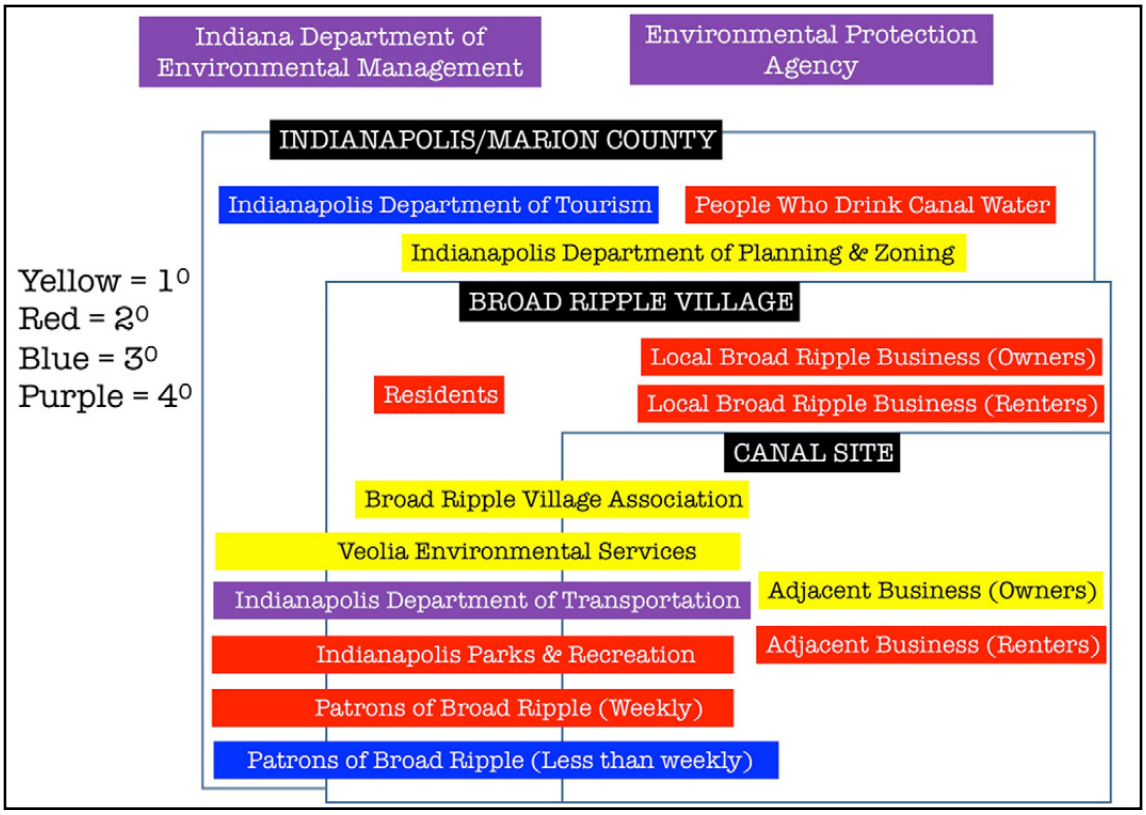


Image 3. Stakeholders Systems Diagram

The systems diagram developed in earlier stages of the project was influential in developing the surveys (Image 3). The significance placed on the visitors to the Broad Ripple area and the business owners in the diagram identified them as primary targets of the surveys. For this project, key stakeholders in the inventory were ranked according to several different factors including proximity to the site, involvement in the project and control of important aspects of the project. Primary groups are identified as business/building owners adjacent to the site, the Broad Ripple Village Association, Veolia Water Company and the Indianapolis Department of Planning and Zoning. Secondary groups were identified to be property renters, residents and frequent visitors of the Broad Ripple area, consumers of canal water and Indianapolis Parks and Recreation. Primary and secondary stakeholders were determined based on their authority in the project. Organizations, businesses and individuals that had decision making abilities were regarded as primary, while those who had important influence, but little capability of making changes were considered secondary. However, each of these groups has valuable input in the process and end result of the project.

Two versions of the survey were designed, one for patrons and one for business owners (Ap-

pendix B and C). Surveymonkey.com was the main platform used to distribute the survey. A secondary method was to approach patrons and business owners in person and verbally conduct the survey. Both surveys included open ended and close-ended questions to obtain a variety of answers. The targeted businesses are those bordering or adjacent to the site because they will be the ones most affected by any changes made to the site. Patrons were randomly selected on site and also had the opportunity to complete the survey online. Information was kept confidential and anonymous and was only used for research purposes.

iii. Analysis

The stakeholders group obtained 100 surveys from Broad Ripple patrons and 10 from business owners. After an analysis of the patron survey it is quite obvious that the main reason people visit Broad Ripple is for food. In fact, 92 of the 100 people surveyed said that food is one of the main reasons they go to Broad Ripple. Furthermore, when asked to name the top 5 most frequently visited establishments in Broad Ripple, all of the top 5 most frequently mentioned establishments were restaurants. Besides food the second most popular reason for patrons to visit Broad Ripple is for recreational purposes. When asked how often they used the Canal Tow Path or the Monon Trail patrons most frequently responded weekly. It is also quite obvious that both patrons and business owners would like to see major cleaning done in and around the Canal. When asked an open ended question about what changes or enhancements need to be done to the Central Canal, 45 out of 100 patrons and 5 out of 10 business owners mentioned cleaning in their answer. Patrons also wanted to see improvements to the Canal Tow Path such as added lighting, seating, and paving of the path. Many Business owners would like to see added native flora in the area in the form of landscaping. Patrons also mentioned enhancing the natural aspects of the Central Canal by replacing concrete and rocks with native plantings. When asked what are some immediate concerns for the Central Canal, the majority of patrons cited pollution, followed by protection of wildlife, and trail maintenance. Business owners responded cleanliness, erosion, and cutting away trees. The results of the surveys can also be found in Appendix B and C.

iv. Conclusion

The survey reached an extensive representation of patrons as well as business owners and operators both adjacent to the site and in the surrounding area. Thorough analysis of the survey data revealed fundamental perspectives people have regarding the canal, its current state and what it represents. It is clear that there are many agreements between people about what the canal is and what should be done to it. For current views of the canal, patrons often commented that it is a scenic recreational area frequented by most on a weekly basis. It is also highly regarded as a legitimate wildlife habitat with both indigenous and nonnative species. However, there was a percentage of respondents who noted the canal is dirty, somewhat polluted and, as a result, relatively ugly.

Patrons had an equal amount of input for what the canal could be and what changes/improvements could be made to it. For the most part, respondents regarded the canal as a potentially fantastic aspect of the Indianapolis area. However, it is undermined by fundamental flaws such as polluted water, ugly eroded banks covered in trash and neglected walkways. As

VI. Stakeholders

a result, the canal fails to live up to its potential. The main changes patrons called for were simply solutions to these problems. They noted increased sanitation of both the water and banks, collection of trash, restoration of walkways as well as protection of wildlife were the fundamental adjustments that need to be made to the canal.

VII. Scenario Planning

After completing the inventory and analysis phase, the scenario planning phase of the project was carried out. The advantage of scenario planning is that several factors can be explored together showing how certain combinations could magnify each other's impact. The class developed five plausible scenarios to pursue. Groups considered the joint effect of many factors on the future of the site. The systems thinking model discussed earlier was also applied to the scenarios explored. By understanding the story of the site as detailed by the inventory and analysis, better predictions on how future changes to the site could affect the interactions between its components and alter various ongoing processes.

A. Business as Usual

The business as usual scenario is based on what will potentially happen if the site is maintained in its current state. Based on the findings from the inventory and analysis phase of the project for the flora, fauna, water quality and stakeholder groups, several possible issues will occur at the site if left as is.

Water Quality:
If the parking spot and remainder of the site are left the way they are, oil from cars that park in the lot will wash straight into the canal, particularly in times of heavy rains following notably hot weather. The bank of the canal is not long enough or planted with high quality plants to trap of filter the oil out of the run-off before it hits the water. The issue of erosion that was mentioned in the flora section above, could pose a large problem not only for the quality of the water at the site, but also for the stabilization of the bank that is necessary to maintain water flow to the treatment plants. Water quality will not improve if the site is managed the way it is and will most likely decrease. While the analysis of the water quality taken at the site fell within the "good" range based on standards in Indiana, increased sedimentation due to the spread of invasive plants with weak root systems will increase the water turbidity, raising costs for the water company to filter out, which in turn will raise the cost of water bills for Indianapolis residents. Highly turbid water gives it a cloudy appearance that is not appealing to people who partake in recreational activities along the canal. If more dumpsters are installed at the site, as mentioned earlier, this will lead to more trash and debris getting into the water, which will eventually begin to effect the water quality indicators. If trash is visible in the water and the water quality decrease, it could lead to undesirable smells and a poor overall appearance. Not only people be less interested in walking and taking the children to play near the site, they may eventually be unwilling to pay their water bills if they are aware that the canal provides water to about 60% of Indianapolis. This could lead to displeased residents who end up protesting and demanding that their water source be drastically improved or that a new water source is used. This would lead to massive overhead costs for the city of Indianapolis and a potential shortage of water if the source is no longer used an alternate source is not established.

Flora:
It is highly likely that the honeysuckle will continue to dominate the site, considering its highly invasive nature. While it is effective at keeping trash out of the canal, it is not an ideal plant for supporting local wildlife because it prohibits the growth of other plants. Eventually the non-native invasive plants will outgrow the existing native plants and most likely take

VII. Scenario Planning

over, covering most if not all of the site and spreading into other areas. The Siberian Elms have the potential to reduce canal flow rates if they fall over into the canal, as a result of several storms that are common to the area. When large amounts of ice forms on the tree branches during winter, this can weigh down large branches and potentially pull down the rest of the tree if the root system is weak. Additionally, if plants with longer root systems are not installed, the sedimentation will increase that contributes to decreasing the rate of flow of the canal, making it more suitable for Milfoil. Milfoil, an example of emergent vegetation, is not problematic at the site currently, but if extreme eradication efforts do not continue in nearby areas, it could become a problem, especially since it will be difficult to get the dredging equipment that far up the canal because of the bridges. This problem could be exacerbated by current management practices because the site is exposed to full sun and experiences run off from parking areas. This influx of nutrients and lots of sun exposure encourage milfoil growth. Additionally, algal bloom could pose a problem if the depth of the canal at the site decreases and nutrient levels continue to increase from run off.

Fauna:
If honeysuckle and other non-native plants continue to invade, a decrease in the number of migratory birds that pass through the site may be observed because the flowers on many of these non-native plants are high in sugar, but not fat, which is a necessary long-term energy source for the birds. A decrease in birds would not only affect the other fauna, but may also upset the stakeholders who enjoy the birds as an aesthetic addition to the site.
Since one muskrat was trapped at the site, it is possible they will continue to inhabit the site and make more burrows in the future. This can lead to increased problems of erosion because the plants that are currently there do not have the root system that is necessary to control sedimentation and erosion, especially if the muskrat population increases. If more muskrats move into the site, their deep burrows could weaken the bank and eventually cause the parking lot extension located behind Franks Gourmet to fail due to lack of support from the bank.

As more businesses move into the area surrounding the site, more dumpsters become necessary to handle increased waste. If more dumpsters are present, the rat and pest population will inevitably increase. Rats are not only seen as an unattractive nuisance to business owners and pedestrians, but they are also incredibly dangerous in large numbers because of their quick rate of reproduction and the fact that they can act as vectors for harmful diseases to other animals and humans. If the homeless population does increase, as mentioned earlier, the rats would be an even greater issue because they would be living in close proximity to humans who are probably already immuno-suppressed from living outdoors with poor shelter, lack of healthcare and a limited food supply. An increased rat population could also overtake the food source for birds and other fauna at the site, which would lead to rats overtaking the site and other animals dying out or having to find new places to inhabit, lowering the number of desirable fauna at the site.

Stakeholders:
Considering 80% of people who were surveyed think of the site as a ditch, the current state of affairs will only contribute to that problem and it will obviously get worse. If the aesthetic appeal of the site is not improved, people who use the site may continue to litter, which can

potentially get into the canal and visually pollute it. If people's perception of the canal worsens and individuals think of it as a ditch rather than a water source or a necessary natural amenity for Indianapolis residents, the problem will only escalate. When high wind storms hit the area, trees with weak root systems can knock over power lines, which is incredibly dangerous for people passing by if live wires are out in the open. The trees could also fall into the roadway causing traffic problems and frustrated business owners if people are not able to get to their store. If one or more of the existing trees falls over onto the parking extension at the site, it could hit a car or a person. If a tree falls the other way into the canal, its roots could rip up the concrete and cause damage to the parking extension. Property owners would probably be responsible for this damage, which they would not be pleased about. If they continue to manage the site way it is and homelessness increases in the area because of the difficult economic situation, the site could be used by homeless people as shelter because of the overwhelming growth of honeysuckle, which would make it easier to go unseen by authorities. If customers from nearby businesses pass through the site, their impression of it will likely worsen because of the presence of homeless people, which may deter them from future visits to the site, decreasing business in the area. If the teenagers in the area continue to use the site and the bridges as a "hang out" location, people who pass by may feel threatened or uncomfortable, particularly due to the presence of their malnourished dogs. Dogs' feces as well as excess trash will continue to build up, making the site less desirable over time. If no changes are made to the site, business could potentially decrease in the area, which would be problematic because Broad Ripple is a popular area not only for locals, but also for college students and people visiting the area.

Conclusion:

In conclusion, continuing on with business as usual will affect the flora, fauna, water quality and stakeholder groups in a variety of negative ways. Unfortunately, carrying on with business as usual will not affect just one component of the system, such as water quality, but it will affect the entire system at the site because they all interact. If the negative perception of the site and the canal continues it will result in further degradation of both the site and the canal. This could in turn result in lower business in the area, a negative perception of Broad Ripple as a whole, and increased water rates for Indianapolis customers to make the water sufficiently clean for drinking.

VII. Scenario Planning

B. Full Build Out - Linear Park

A linear park atmosphere is one possible future scenario. Tom Healy and the BRVA have explored a full build out option in the past, and have expressed an strong desire to improve the image of the area, while maintaining its unique and cultural character. The design might include grassy areas that extend about 20 feet from the back of the canal to pedestrian malls, seating and destination nodes. It will also include native tree and plant installations. This type of design and construction will capitalize on the aesthetic appeal of the site. Similar designs have proven successful in other cities like Paris, France and Battle Creek, Michigan. This design will satisfy the needs of patrons, business owners, flora diversity and water quality.

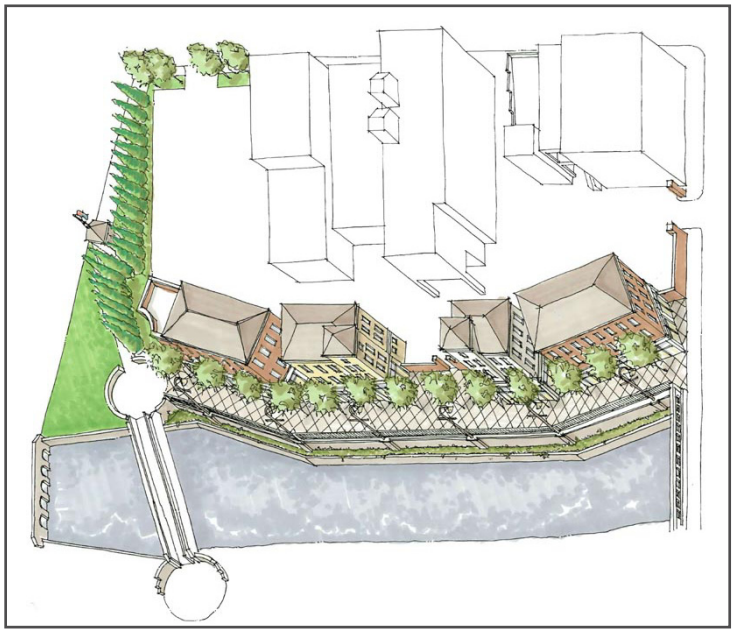


Image 4. Sample Birdseye View of Build Out Scenario

A considerable amount of construction will go into building either of the promenades illustrated in Images 4 and 5. Bordering businesses will have to be consulted and their approval will be needed if they own that property. Additinally, applicable design codes nad standards will need to be considered. The first image would require more development, and potentially sub-dividing lots that border the canal. The canal side promenade would hopefully attract businesses to build on site. This would allow storefronts to face the canal and take advantage of its aesthetic appeal.

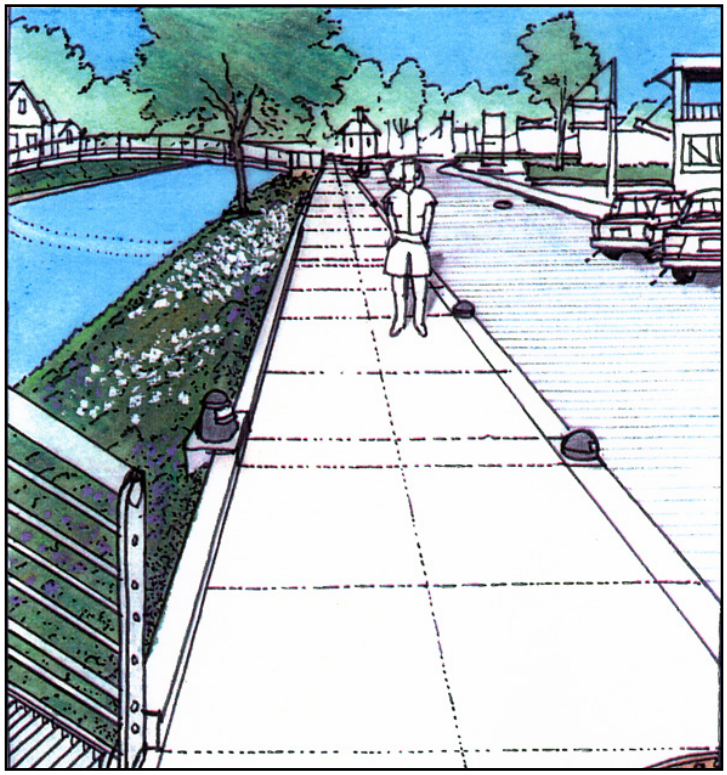


Image 5. Sample Perspective of Build Out Scenario

Image 5 illustrates a more pedestrian focused design. This could be an alternate to the promenade design outlined in Image 1, or be a transition design that extends from the promenade proposed for the site and follows the canal as it moves west. This design includes pedestrian scale lighting for improved safety and improved landscaping along the bank of the canal.

VII. Scenario Planning

Water quality is likely to improve with the careful design and installation of this scenario. While the conventional design of a promenade or pedestrian walk wowuld increase run off effects, a design with an eye on sustainability could actually minimize these effects. Selecting paving materials that are permeable could help filter stormwater runoff from adjacent parking lots and slow it down before reaching the canal, and reduce erosion. Additionally, landscape components of both designs should include native plants. Native plants have deeper root systems that can stabilize the canal banks and further slow erosion effects. Another option is to plant the slopes as 'rain gardens'. These rain gardens then act to further mitigate stormwater effects.

Drastically improving the aesthetic of the site will change attitudes associated with it. If the area surrounding the canal looks clean and green, visitors to the area may be less likely to throw trash on the site. Interpretive signage may be another way to increase visitor awareness and improve their experience. Signage that explains the history of the canal, canal use, sustainable design elements installed on site, and facts about wildlife may improve perception of the canal, and in turn, improve treatment of the canal by visitors.

Flora and fauna will improve in some areas, and become worse in others. This scenario would remove a lot of current habitat. As outlined in the inventory and analysis phase, this habitat is not necessarily desirable, however several species are still utilizing it. The build out scenario that includes native plant installations may attract a different suite of animal species and discourage others. However, the urban context of the site will still be very limiting in the types and numbers of species that can be supported. One solution is to include ramps or logs to allow for the turtles to bask in the area.

Maintenance would be a recurring cost. The landscaping would need to be maintained and the sidewalk would need to be cleared of trash. By using mostly native plant species, the maintenance would be limited. However, relevant stakeholders must be identified and brought into the project to ensure its continued maintenance.

VII. Scenario Planning

C. Canal Use Change

The canal has various meanings to different people who are involved with and affected by the waterway. To some, it is merely an extension of the sewage drainage pipes that dissect the city. To others, it is a pristine natural amenity that should be preserved at all costs. In reality it functions as an open pipe that carries water to be treated and supplied to 60% of the city. It is also the backdrop to the popular tow path, and part of the greenway system linking Broad Ripple to other cultural destinations. In a survey issued to various Broad Ripple residents and visitors, 64% agreed that the canal was scenic, 55% recreational, and 47% polluted. Not surprisingly, the range of responses demonstrates the wide range of perceptions about the canal.

Furthermore, the central canal is currently owned by the city and managed by Veolia. In 2002, the City of Indianapolis awarded Veolia a 20-year contract for rights to its water service. Upon expiration, it is not known if Veolia will retain rights to the canal. Additionally, there are plans for a secondary water source to address concerns that the canal may not be able to meet peak demands with a growing population.

If the canal's management were to change, it is plausible that perceptions about the canal would change over time. Depending on the new management, an emphasis or disregard for ecological issues could impact how Broad Ripple patrons view the canal. Furthermore, if a secondary water source were implemented, the canal's importance to the city would decline. This scenario will examine the implications of a "canal use change," and how that might affect the nature of the canal.

Possibilities

Population growth in Indianapolis is certainly rising at a moderate pace. From 2006 to 2008, Indianapolis grew at a rate of 0.4 percent consistently. Other Midwest cities have seen much higher fluctuation and variability (Table 6).

Table 6. Annual Growth Rates of 7th District Cities with Populations Over 200k

CITY, STATE	2001	2002	2003	2004	2005	2006	2007	2008
Chicago, IL	0.0	-0.4	-0.4	-0.5	-0.7	-0.4	0.2	0.7
Detroit, MI	-1.0	-0.8	-0.2	-0.3	-0.3	-0.2	-0.2	-0.5
Indianapolis, IN	0.4	-0.1	0.1	0.1	0.2	0.4	0.4	0.4
Milwaukee, WI	0.0	0.2	0.2	0.3	0.2	0.2	0.0	0.3
Fort Wayne, IN	-0.3	-0.3	-0.5	-0.5	-0.1	0.6	0.8	0.4
Madison, WI	1.3	1.6	1.1	1.3	0.9	0.9	1.3	1.4
Des Moines, IA	0.5	-0.9	-0.9	-1.3	0.2	-0.4	0.5	1.2

Source: Annual Estimates of the Resident Population for Incorporated Places over 100,000, US Census Bureau

If Indianapolis continues to grow at steady moderate rates, the supply of drinking water will certainly need to be addressed. If the canal already supplies 60% of the Indianapo-

lis population, an increase in population would certainly put stress on the canal and treatment plants to maintain the water needs of Indianapolis residents. The result in population growth could be solved in various ways. First, the canal would continue to be the primary water source, and capital improvements to increase the capacity of the plant would need to be undertaken. With increased demand, the price for utilities would increase, giving consumers the incentive to use less water or pay a premium. With respect to politics and policy, this would be very unfavorable to residents.

The other option is to implement a secondary water source, which would decrease the stress on the central canal to provide for more residents. This seems like a more sustainable and long-term outcome. Likewise, current management has had recent complaints about its management techniques. A management change may increase efficiency and provide for the growing population.

Considerations

A management change could have the following effects: a new source of water for the city, which would decrease the importance of the canal; a company with different views on how to manage the canal as a recreational area; management that is willing to consider ecological considerations or management that disregards these ecological processes.

A new source of water would certainly decrease the importance of the canal. When almost 60% of the drinking water of Indianapolis is supplied by the canal, there is a deliberate effort to maintain current water flows so that the city sufficiently supply its population. Therefore, current management is very weary of change. Anything that threatens the shape, depth, or flow of the canal is too high of a liability. With a second water source, this would change. There would be less stringent requirements for improvements, and more creative solutions could be implemented to maintain the canal as an ecological entity. This increases the possibility for development and maintenance. For example, instead of rip-wrap to discourage erosion, bio-logs and native plants could be used. Specifically at the site, transforming it into a park scenic walkway would be much easier. At the same time, as importance decreases it is plausible that management and maintenance will decline as well. There would be little incentive to maintain high levels of water quality, and patrons may view the canal with less favor. Since only 14% of survey respondents viewed the canal as a drinking water source, this outcome is unlikely.

Unquestionably, new management could have serious implications on the nature of the canal. If the new company viewed recreation differently than Veolia, the canal could be transformed into a more recreational entity. For example, the canal is a great slow moving waterway that would be perfect for canoe transport. If new management viewed recreational activities within the canal favorably, kayaking or canoeing may prove to be an enjoyable form of transportation. Adjustments would need to then be made for launch sites, bridge clearings and other technicalities.

Furthermore, the degree to which new management views ecological implications will have serious impacts on the canal. With a priority toward ecological considerations, flora, fauna and water quality may improve. Certainly invasive plants that inhabit much of the bank would be controlled and new niches created for native fauna. On the other hand, disregarding ecological

VII. Scenario Planning

considerations could have the opposite effect. Any natives that are planted in the near future may be replaced by more cost-effective methods (such as rip-wrap). Overall, management of the canal will play a large role in its future.

Water Quality

If a change in canal management alters the adjacent land uses of the canal, water quality will be affected. Management that favors the landscaping of native plants that naturally reduce bank soil erosion or utilizing floating islands that absorb excessive pollutants in the waterway would improve parameters of water quality. If a management change results in less strict regulations as to the use of the canal, recreational uses may increase. In central Indiana, much of the drinking water comes from Geist Reservoir and Indiana Water Works. This company allows boats, canoes, fishing, and other recreational activities on its water source. Recreational use of the canal could potentially increase water quality due to the public desiring to keep the canal clean for leisure activities. It could also decrease water quality due an increased amount of people frequenting the canal, potentially elevating the amounts of direct inputs, such as litter, into the water system. If changes in canal characteristics (width, depth, flow rate) are allowed with a change in management, water quality could be altered as well. Adjacent land use managed for wildlife habitat could increase the amount of coliform and E. coli bacteria present in the canal waterway. Ultimately, water quality will be most affected by inputs, nearby land uses, and the desires of stakeholders.

Flora and Fauna

The extent of change on flora and fauna depend on the type of canal use change that takes place. If new management disregards ecological considerations of the canal, flora and fauna will suffer. Especially on the banks, more stringent policies that govern the installment of rip-wrap could have serious implications for flora and fauna.

At the site, most of the flora present were deemed invasive or waste plants.. Almost no aquatic plants were observed. In general, most plants present would not pose a threat to the ecosystem if lost, because they are invasive or non-desirable species . One consideration may be made for the native catalpa tree present, and the food sources for migrating birds. The birds rely on the invasive honeysuckle plant as a food source. Therefore, removing honey suckle may have a negative impact on migrating birds.

On the other hand, if new management policies and decisions consider ecological factors, significant positive changes could take place that would improve the health of the canal ecosystem. Examining the site, native erosion controlling plants could be installed to help prevent sedimentation and water flow. Companies like JF New have done numerous projects very successfully, and could adapt a solution specifically for the canal. For example, along the St. Joseph River, they successfully stabilized an 80 ft section of river that had been essentially washed out by using a mix of native grasses and shrubs. Under new management, this scenario would be possible at the site. Veolia has consulted with JF new on the Canal stabilization project this past fall, taking into account turtle research and habitat requirements for one desirable species, while trying to discourage the undesirable muskrats. This demonstrates that ecological considerations can be made without sacrificing economic interests.

VII. Scenario Planning

Stakeholders

Stakeholders may have the biggest interest in a canal use change. A survey concerning the current perception of the canal demonstrated that many second and third degree stakeholders in Broad Ripple do not even identify the canal as a water source. A majority of survey participants considered the canal as polluted and largely unsuitable to the public. Safety was also a common concern. Many Broad Ripple patrons expressed interest in utilizing the canal for recreational purposes and as increased wildlife habitat. New management of the canal that takes the community's interests into consideration and encourages the Broad Ripple community to take part in maintaining the canal for recreational and ecological purposes may increase the overall public perception of the area. In addition, education that promotes awareness of the canal's function as a natural habitat for local biodiversity, recreational area, or any other possible future use will likely alter the community's impression of the area. If patrons are aware of the canal's significance to the Broad Ripple area, they may be less likely to view the area as an "eyesore" and be more willing to take pride in maintaining the waterway and its immediate surrounding areas. On the contrary, if a change in management does not regard the wishes of stakeholders, it is likely that the current perception of the canal will stay the same or worsen.

VII. Scenario Planning

D. Floating Islands

When developing and considering possible scenarios for the future of the canal, the floating island scenario was identified by Tom Healy as an interesting prospect for managing and beautifying the canal. They have been considered for the canal because they bring about benefits to the environment as well as the wildlife in the area in an innovative way.

Floating Islands are a man-made structure that supports development and growth of an ecosystem. Islands are constructed from matrix sheets, derived from non-woven 100% recycled PET plastic. The matrix sheets are then bonded together with marine foam to provide buoyancy. After construction, the islands are planted and launched into an aquatic system. BioHaven by Ion Exchange is the primary manufacture of floating islands. They come in a variety of sizes ranging from 25 to 250 square feet. The prices of these islands range from $750 to $7,500, plus the cost of plants.

Water Quality and Flow

Nutrient levels are reduced in any water system with Floating Islands by supporting the growth of microbes and plants. Measuring only the impact of microbes, one square foot of a floating island is sufficient to reduce nitrate by over 10 grams per day, ammonia by up to 0.7 gram per day, and phosphate by 0.5 grams per day. Along with removing unwanted nutrients, Floating Islands reduce the amount of carbon dioxide from the atmosphere. With growing concerns about greenhouse gases and their impacts on global climate, floating islands represent a unique way to sequester carbon in, on, and under islands.
The banks of the canal have experienced erosion due to both natural and outside causes, such as animal habitat. Floating islands effectively dampen wave activity and act as buffers while preventing against wind and wave erosion. Floating Islands would help delay or even discontinue erosion on the banks of the canal, while potentially providing habitat to wildlife.

The water flow in the canal is very important to Veolia. If a floating island was placed in the canal, the flow of water under the island would be affected depending on the type of roots the vegetation contains. The roots do not anchor to the bottom of the canal, they simply fall underneath. Depending on the thickness and density of the root, the water would flow normally underneath the island. The size of the island could potentially affect the flow, but a solar-powered pump can be inserted into it and used to circulate water through the island preventing any major hindrance of the water flow under the island.

Water from the canal is free to enter the island structure from below as well as from the top, thereby providing for a larger water flow through the island structure. Wave action will likely force water into the nutrient channels in surges and these surges will move through the nutrient channel network with each wave that passes. Movement of water into and out of soil and flotation chambers will likely be slower than water movement through the nutrient channels and will be governed by an advection or diffusion process in which the rate of water flow passing through the island structure will equal the plant's ability to return moisture to the air plus the net rate of pond water flow into the nutrient channel network. Factors that will affect

VII. Scenario Planning

the nutrient channel network flow rate are density, length, and diameter of flow channels and strength and frequency of wave action in the canal. In the absence of wave action, movement of water through the soil or flotation chambers will still occur due to capillary action and advection or diffusion, although at a reduced rate.

Flora and Fauna

Planting palettes for floating islands are extremely diverse. A carefully designed planting strategy can either encourage or discourage activity and use of ducks and geese. Depending on what is planted, the island can lure waterfowl away from another site and provide more secure nest sites, or plants can be selected that are not conducive to waterfowl.

The maintenance of floating islands can be manually maintained and managed or allowed to grow naturally. Weeds and invasive species can establish on the islands, however, maintenance is not difficult, but it will require a person to access islands placed in the canal. Planting/ installing with perennials, will likely reduce maintenance needs. The rules that apply for maintenance are the same as if one was tending to a garden.

The purpose of artificial floating wetlands is to mimic nature and thus provide similar water quality improvements and increase habitat diversity. Installing floating islands on-site has the potential to improve water quality and be replicated in all areas of the canal. The vegetation that is planted on the island not only brings an aesthetically pleasing cover, but provides habitat and food for wildlife and is an effective way to clean different water systems and benefit surrounding environments. The cutting down of various trees on the banks of the canal will require a new source of shade for the canal. The island would provide shade for the canal, while lowering the temperature of the water in the canal. The milfoil in the canal requires a lot of sun. By having floating islands, it would reduce the amount of milfoil, a problematic source of vegetation.

Image 6. Before and after comparison of canal with installation of floating islands

VII. Scenario Planning

E. Climate Change

Climate change in Indiana, similarly in the rest of the Midwest states, is expected to drastically change precipitation patterns while temperatures rise. Even under the lowest expectations, the number of days over 90 degrees are expected to double from today's count. The number of and frequency of large rain events will also rise, increasing instances of flash floods events. Even with these rains, drought will be a major problem during the summer months when there will less rainfall and hotter temperatures (Union for Concerned Scientists).

Due to the drastic differences in water availability, it can be expected that, under this scenario, the canal will experience increased erosion during flash flood events while experiencing decreased flow during summer drought months. Erosion of the banks makes the canal wider and shallower, changing how water flows to the treatment facility, as well as depositing sediments. Drought, on the other hand, will be greatly tied to the flow within the White River. Water into the canal is controlled by Indianapolis Water, and is managed by Veolia. The source of the Central Canal is at the Broad Ripple Dam, just East of the site.

Reduction of flow is one of the main concerns under a climate change scenario. The Central Canal is essentially an open-air pipe, which uses gravity, rather than pressure, to transport water. This also means, the force pushing the water into the Central Canal is a major factor in the flow rate within the Central Canal.

Drought is a huge concern due to increased temperature and variable precipitation events. This could translate into lowered flow in the Central Canal thus decreasing the water available to the citizens of Indianapolis. It is important to remember that drought conditions can be dependent on many things, one large portion of which is the demand for water. Climate change simply increases the drought effects of water usage (Bates *et al*). In Indianapolis, the times of peak water use and demand, particularly during the summer months, would the already limited supply of water flowing through the Central Canal.

Flooding would be the other major concern under a climate change scenario. In addition to heavier precipitation, the Central Canal would further be taxed due to its location within an urban setting. Urban waterways and infrastructure are those most affected by the increase of stormwater because they are not located within traditional flood plains, or are built to hold only a certain capacity of water. In addition to possible flooding of business and residential areas, flooding could weaken the banks of the Central Canal. This could lead to loss of structural integrity, particularly in those areas where the bank acts as a levy between the Central Canal and the White River.

Wildlife in and around the canal would likely be affected aversely as well. The canal is currently a relatively predictable system since the flow and water levels are maintained at a relative constant. If this predictability is taken away, then wildlife may not adapt as readily.

VIII. References

Ballenger, L. (n.d.). *Blarina brevicauda.* Retrieved April 21, 2010, from http://animaldiversity.ummz.umich.edu/site/accounts/information/

Bates, B. Z. (2008). *Climate Change and Water. Technical Paper of the Intergovernmental Panel on Climate Change*. Geneva: IPCC Secretariat.

BioHaven Floating Islands. (2010). Retrieved April, from Floating Island International: http://www.floatingislandinternational.com/index.php

Blewett, M. B. (1951). The Forest Primeval of Marion and Johnson Counties, Indiana in 1891. *Butler University Botanical Studies* , 40-52.

Burt, C. (2010, March). Personal Communication: Dr. Thomas Dolan.

Central Canal Society of Indiana. (n.d.). *Central Canal*. Retrieved March 2010, from http://www.ind-canal.org/Central_Canal.html

Encyclopedia.com. (n.d.). *Muskrat*. Retrieved April 2010, from http://www.kaweahoaks.com/html/muskrat.html

Floating Island. (n.d.). Retrieved April 2010, from Floatingisland.info: http://www.floatingislands.info/

Floating Islands. (n.d.). Retrieved April 2010, from Ion Exchange, Inc. : http://www.ionxchange.com/bio_floating_island.htm

Greenways Foundation. (n.d.). *Central Canal Towpath*. Retrieved April 2010, from http://www.indygreenways.org/canal/centralcanal.htm

Holmes, K. J. (1998). *Mice.* Minneapolis: Bridgestone Books.

Illinois Department of Health. (n.d.). *House Mouse Prevention and Control*. Retrieved April 2010, from http://www.idph.state.il.us/envhealth/pcnorwayrat.htm

Illinois Department of Public Health. (n.d.). *Norway Rats*. Retrieved April 2010, from http://www.idph.state.il.us/envhealth/pcnorwayrat.htm

Indiana Department of Natural Resources. (2008, Spring). Hoosier Riverwatch Volunteer Stream Monitoring Training Manual. Indianapolis: INDR.

Lifewater Canada. (n.d.). *Drilling and Well Constrcution Reference Manual, Section 16: Water Quality Testing.* Retrieved March 2010, from http://www.lifewater.ca/Section_16.htm

Marian College EcoLab. (n.d.). *EcoLab.* Retrieved April 2010, from http://www.marian.edu/wetland/nh_flora.shtml

Mayntz, M. (n.d.). *Mallard.* Retrieved April 2010, from http://birding.about.com/od/birdprofiles/p/mallard.htm

National Press Association. (n.d.). *Mice*. Retrieved April 2010, from http://www.pestworldforkids.org/mice.html

VIII. References

Peterson, G. D. (2003). Scenario Planning: A Tool for Conservation in an Uncertain World. *Conservation Biology* , 358-366.

Rothrock, P.E. 2004. Floristic quality assessment in Indiana: The concept, use, and developmentof coefficients of conservatism. Final Report for ARN A305-4-53, EPA Wetland Program Development Grant CD975586-01. 96 pp

Ryan, T. J. (2008). Movement and Habitat Use of Two Aquatic Turtles (*Graptemys geographica* and *Trachemys scripta*) in an Urban Landscape. *Urban Ecosystems* , 213-225.

Ryan, T. (2010, April 9). Ph.D. (Julie Elmore and Sara McDerman, Interviewers)

Super-enhanced aquatic floating island plant habitat. (2010). Retrieved April 2010, from Free Patents Online: http://www.freepatentsonline.com/y2005/0183331.html

Swink, F. and G. Wilhelm (1994). Plants of the Chicago Region, 4th ed., *Indiana Academy of Science*, Indianapolis, 921 pp.

Tungesvick, K. (2002). *Floral Inventory of the Marian College Cultural Landscape*. Restoration Nursery.

Union of Concerned Scientists. (2009). *Confronting Climate Change in the U.S. Midwest.* Cambridge: Union of Concerned Scientists.

US Environmental Protection Agency. (2006, November). *Drinking Water Contaminants*. Retrieved April 2010, from http://www.epa.gov/safewater/contaminants/ecoli.html#one

Willamette Riverkeeper. (n.d.). *E. coli Monitoring.* Retrieved April 2010, from http://www.willametteriverkeeper.org/programs/ecoli/e_colimain.htm

IX. Figures

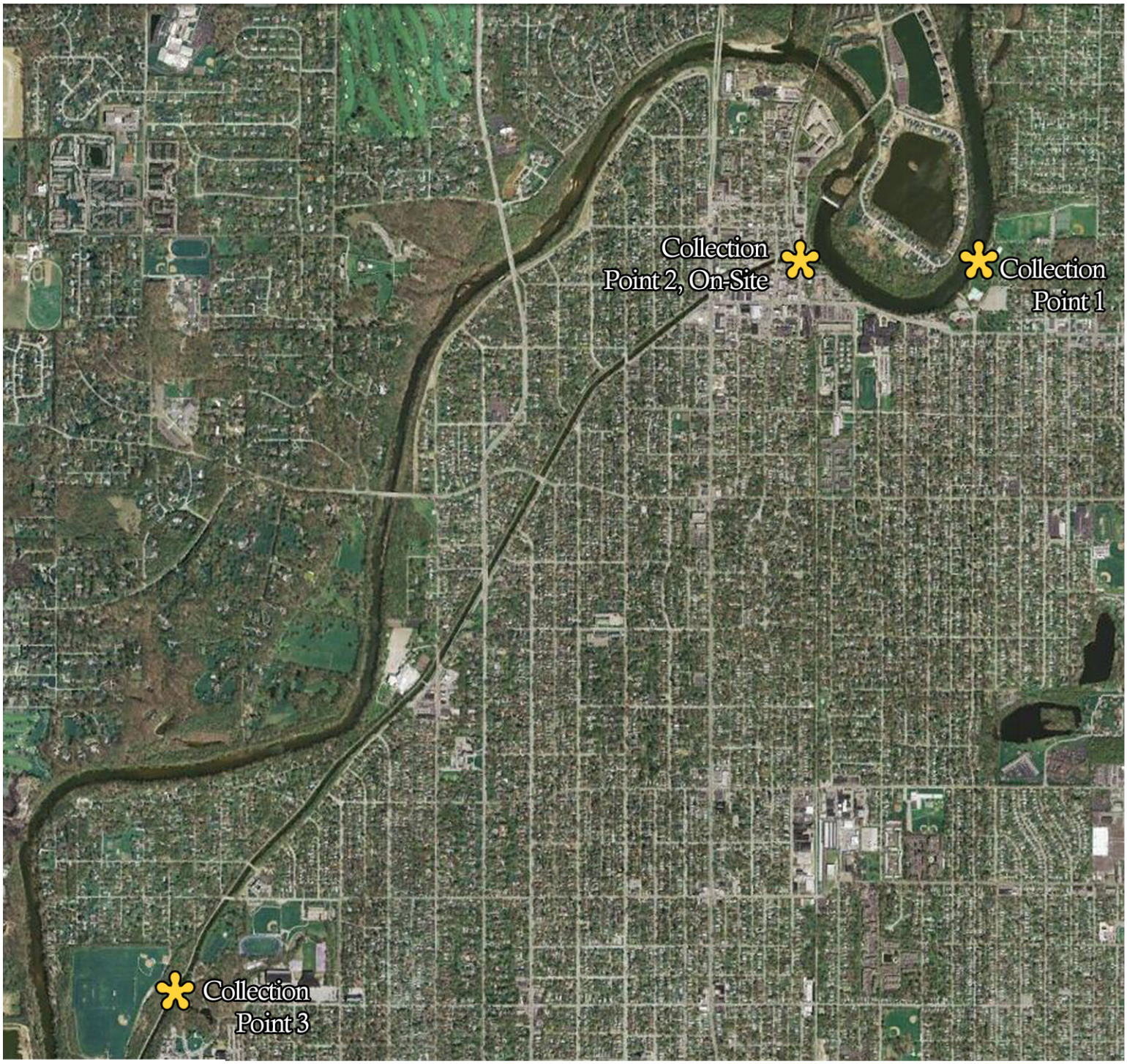
Scale: 1" = .10 miles

0 1 2

0 .10 .20

Figure 1: Context Map
Scenario Planning: Central Canal
Broad Ripple, Indianapolis

N



Scale: 1" = .40 miles

0 1 2

0 .40 .80

Figure 2: Water Quality Collection Points
Scenario Planning, Central Canal
Broad Ripple, Indianapolis

N

X. Appendices

Appendix A

Interview w/ Travis Ryan

Would you, as the Turtle expert, expect to find turtles at the project site?

A. Yes, I've seen them there before.

So they bask on all the junk down there?

A- Yes. [See my paper] A basking site is located there.

What species are found on site? Are some more prevalent than another?

A- Basking behavior will see map turtles and red eared sliders although I would also consider the soft shell turtle to be likely to be found there. Just south and west of the site is were we've seen the soft shell turtles nesting. They're not a prominent basker but their activity within a quarter mile of there has been documented.

What makes the canal such a successful habitat?

A- The availability of basking sites is probably why they are in that area in general, up in Broad Ripple.

Would they nest up there?

A- They could get up and out of there however most of nesting is observed on the opposite bank because it gets more sun. So I would not consider that bank to be particularly good nesting habitat.

From your experience what gets people so riled up about turtles?

A- I think it's because this is the connection with wildlife people have in the city. They don't see birds or squirrels as wildlife, raccoons are nuisance but turtles represent wildlife in the city. The symbol of this is the turtle sculpture near Mediterranean café. I can't tell you how many people stop, and ask what I'm doing and once given and explanation, are really excited about turtles. They see it's something wild in the city and they don't get an opportunity to see that although it's probably around them more than they recognize…. Difficult to overstate how much people will stop and ask about the turtles. Almost to the point that it's annoying and you're like "gosh I have to go out and deal with this again." You get a little tired of talking about turtles.

Appendix B

Patron Survey Table				
#	Question	Answer Choices	Rationale	Results
1	How often do you visit Broad Ripple? (the area between College Ave. & Keystone Ave. and 64th st. & 60th st.)	Daily, Weekly, Monthly, Less Than Monthly, and Never	It is likely that the more a patron visits Broad Ripple the more knowledgeable and observant they will be concerning future improvements to The Site.	Daily: 17
				Weekly: 61
				Monthly: 20
				Less Than Monthly: 2
				Never: 0
2	For what reasons do you generally visit Broad Ripple?	Food, Shoping, Art/Music Events, Nightlife, Work, Recreation, and Other	The reason why a patron usually visits Broad Ripple will likely affect how they view the area and any potential improvements to The Site.	Food: 92
				Shopping: 47
				Art/Music Events: 24
				Nightlife: 39
				Work: 5
				Recreation: 54
				Other: 15
3	List your top 5 most frequently visited establishments in the Broad Ripple Area.	Five Blank Fields	This question was asked to help determine what areas of Broad Ripple get the most foot traffic and what types of businesses are visited the most.	Q'Doba: 38
				Brothers: 26
				Noodles: 24
				Bagel Deli: 20
				Union Jacks: 16
4	How often do you use the Monon trail and/or canal tow path?	Daily, Weekly, Monthly, Less Than Monthly, Never	Both the Monon Trail and Canal Tow Path directly border The Site. This question was asked to help approximate the current levels of foot traffic around The Site.	Daily: 10
				Weekly: 32
				Monthly: 15
				Less than Monthly: 25
				Never: 18
5	Which of the following describes the Central Canal in Broad Ripple? Check all that apply.	Scenic, Drinking Water Source, Eyesore, Polluted, Recreational Area, Historic Landmark, Wildlife Habitat, and Other	It is important to know how patrons currently view the The Central Canal in order to determine some possible ways to improve their views through future improvements.	Scenic: 64
				Drinking Water Source: 14
				Eyesore: 14
				Polluted: 47
				Recreational Area: 55
				Historic Landmark: 33
				Wildlife Habitat: 60
				Other: 6
6	Does the presence of wildlife affect your perception of The Central Canal in Broad Ripple? Why?	Yes, No, and Blank Field	Any future construction would inherently affect the wildlife in The Central Canal. This question was asked in order to guage the level of value Broad Ripple patrons attributed to wildlife in The Central Canal.	Yes: 65
				No: 35

Appendix B

Patron Survey Table				
#	Question	Answer Choices	Rationale	Results
7	Would you support developments that increase accessibility to The Central Canal and adjacent businesses in Broad Ripple?	Yes, No	A large part of this project was to assess patrons' willingness to support future projects. This question was designed to present one possible outcome of future improvements to determine patrons' level of support.	Yes: 89
				No: 11
8	What changes or enhancements do you think need to be done to The Central Canal in Broad Ripple? (Between the rainbow bridge and Monon Trail bridge)	Blank Field	This was a straightforward question allowing patrons to express any opinions or ideas that they felt should be done to the canal in the future.	Clean: 45
				Improve Path: 16
				Landscape: 14
				Water Recreation: 3
				More Restaurants/Seating: 8
				Protect Wildlife: 8
				Prevent Loiterers: 2
				Improve Safety: 6
				Pest Control: 2
9	What are some immediate concerns to The Central Canal in Broad Ripple?	Blank Field	The scenario planning phase of our project was focused on deciding what possible changes would affect the canal in the near future. This question was asked in order to ascertain what patrons believed to be future concerns for the canal.	Pollution/Water Quality: 40
				Protection of Wildlife: 10
				Landscaping: 5
				Safety: 6
				Trail Maintanence: 8
				Underutilized: 3
				Invasive Plants: 1
				Loiterers: 2
				Erosion: 3

Appendix C

Business Survey Table				
#	Question	Answer Choices	Rationale	Results
1	Is your business adjacent to the Central Canal between the Rainbow Bridge and the Monon Bridge?	Yes, No, and Business Name:___	The potential effects of any future developments affect each business differently depending on proximity to The Site and what the developments may be.	Yes: 10
				No: 0
2	Which of the following describes the Central Canal in Broad Ripple? Check all that apply	Scenic, Drinking Water Source, Eyesore, Polluted, Recreational Area, Historic Landmark, Wildlife Habitat, and Other	It is important to know how business owners currently view the The Central Canal in order to determine some possible ways to improve their views through future improvements.	Scenic: 1
				Historic Landmark: 2
				Wildlife Habitat: 2
				Polluted: 6
				Recreational Area: 2
				Eyesore: 3
				Drinking Water: 2
				Unnoticed: 2
3	Does the presence of wildlife affect your perception of The Central Canal in Broad Ripple? Why?	Yes, No, and Blank Field	Any future construction would inherently affect the wildlife in The Central Canal. This question was asked in order to guage the level of value Broad Ripple business owners attributed to wildlife in The Central Canal.	Yes: 8 Why: Geese negatively affect perception, Ducks and Turtles positively affect perception
				No: 2 Why: Wildlife will always be there
4	Would you support developments that increase accessibility to The Central Canal and adjacent businesses in Broad Ripple?	Yes, No	A large part of this project was to assess business owners' willingness to support future projects. This question was designed to present one possible outcome of future improvements to determine business owners' level of support.	Yes: 7
				No: 1
				Did Not Respond: 2
5	Would you be willing to financially support maintenance and general upkeep of The Central Canal in Broad Ripple?	Yes, No	Not only is it important to guage the level of support, it is important to find out the willingness of business owners to support future projects financially.	Yes: 2
				No: 4
				Maybe: 1
				Did Not Respond: 3

Appendix C

Business Survey Table				
#	Question	Answer Choices	Rationale	Results
6	Would you be willing to sacrifice extra parking spaces in order to improve visual appeal along The Central Canal in Broad Ripple?	Yes, No	On the South bank of The Site there is almost no flat land remaining that is not being used for parking. Any future developments would most likely lower the available space for parking.	Yes: 2
				No: 3
				Maybe: 2
				Did Not Respond: 3
8	Would improvements to The Central Canal in Broad Ripple improve your customers' experience?	Yes, No	This question was asked in order to assess how important business owners felt the canal was to the success of their business.	Yes: 7
				No: 0
				Maybe: 1
				Did Not Respond: 2
9	What changes or enhancements do you think need to be done to The Central Canal in Broad Ripple? (Between the rainbow bridge and Monon Trail bridge)	Blank Field	This was a straightforward question allowing business owners to express any opinions or ideas that they felt should be done to the canal in the future.	Landscaping: 3
				Clean: 2
				Less Trash: 1
				Ask Tom: 1
				Beautification: 1
				Picnic Tables: 1
				No Graffiti: 1
				More Parking: 1
				Utilize Like Downtown: 1
				Monitor Loitering: 1
				Plant Native Plants: 1
10	What are some immediate concerns to The Central Canal in Broad Ripple?	Blank Field	The scenario planning phase of our project was focused on deciding what possible changes would affect the canal in the near future. This question was asked in order to ascertain what business owners believed to be future concerns for the canal.	Bug problem: 1
				Trash: 1
				Weeds: 1
				Erosion: 2
				Ugly: 2
				Clenliness: 3
				Rip Rap: 1
				Cutting Away Trees: 2

Appendix D

BUTLER UNIVERSITY

Institute for Research and Scholarship

4600 Sunset Avenue
Indianapolis, Indiana 46208-3485
(317) 940-9766
Fax: (317) 940-9074
Email: birs@butler.edu
Web: http://www.butler.edu/birs

INSTITUTIONAL REVIEW BOARD

DATE:	May 10, 2010
TO:	Marjorie Hennessy CUE
FROM:	Robert Holm, Director Institute for Research and Scholarship
RE:	IRB Protocol
TITLE:	Scenario Planning for the Indianapolis Central Canal and BRVA
SUBMISSION TYPE:	New Study
ACTION:	DETERMINATION OF EXEMPT STATUS
DECISION DATE:	May 6, 2010

On behalf of the Institutional Review Board (IRB), I am pleased to announce that your application for research involving human subjects has been approved as exempt. As such, there will be no further review of your protocol, and you are cleared to proceed with the procedures outlined in your protocol.

As an exempt study, there is no requirement for continuing review. Your protocol will remain on file with the IRB as a matter of record. Although your study is exempt from a continuing review, you and your research team are not exempt from ethical research practices and should therefore employ all protections for your participants and their data which are appropriate to your project.

The duration of the IRB approval is from May 6, 2010 to May 31, 2010. Any modifications to your protocol or any extension to the approval period must be evaluated by the IRB before being implemented, as some modifications may change the review status of this project

I offer my congratulations on your approval and wish you success on your research. Should you desire additional assistance or clarification, please call me at 9766.