

VISIONS of ARGO

Alternative Futures for Ann Arbor's Riverfront

Amy Beltemacchi

Amy Hiipakka-Squires

Yasuhiro Ishihara

Oliver Kiley

Alicia LaValle

Michael Wagman

School of Natural Resources and Environment

University of Michigan

2008

ACKNOWLEDGEMENTS

The Visions of Argo Master's Project Team would like to thank the following individuals and groups for their advice, support, and valuable feedback. Without these individuals, this project would not have been

Joan I. Nassauer
Project Adviser, Professor of Landscape Architecture, School of Natural Resource and Environment

Dave Allan.
Project Adviser, Professor of Aquatic Sciences and Associate Dean, School of Natural Resources and Environment

Matt Naud
Project client and Environmental Coordinator for the City of Ann Arbor

Laura Rubin
Project client and Director of the Huron River Watershed Council.

In addition, we would like to thank the Huron River Impoundment Management Plan Committee (HRIMP) Members, the many city staff and researchers consulted throughout the course of this project, as well as our fellow classmates, friends, and family for their advise, encouragement, and recognition.

ABSTRACT

Visions of Argo explores the current and historical state of an urbanized reach of the Huron River in Ann Arbor, Michigan and proposes and evaluates three alternative futures for sustainable riverfront redevelopment. The legacy of historic industrial land use, in conjunction with current physical impacts on hydrologic conditions and river morphology, has clearly impacted the ecological health of the Huron River. The city initiated, Huron River Impoundment Management Plan (HRIMP) Committee, began exploring the complex web of issues affecting the Ann Arbor reach of Huron River in 2007. One key issue that has been under consideration by the city for over a decade and now faces the HRIMP Committee is a decision over whether to remove Argo Dam. Argo Dam does not currently provide many of the functions for which it was created. Increasing maintenance costs, safety hazards, and environmental concerns have initiated discussions about the feasibility and desirability of dam removal. Removing Argo Dam would restore the Ann Arbor portion of the Huron River to a free flowing river and improve ecological conditions, while also exposing riparian land for new uses. Given the opportunity to radically transform the Argo Riverfront under a dam removal scenario, the HRIMP committee is now faced with the question, how should the river be re-imagined? Visions of Argo, describes three plausible visions, differentiated by alternative sets of resident desires and assumptions about future conditions. The scenarios developed in this project are the: (1) Biodiversity + Heritage Corridor, (2) Rainwater Adventure Park, and (3) Sustainable Live/Work Community. Each scenario is used to create designs of their future, which are compared and assessed according to their ecological health, stormwater management, human engagement, and development outcomes. The future visions each succeed in demonstrating how complex issues and different resident desires can lead to a coherent future; thereby enhancing the amenity value of the Huron River, the ecological health of the riparian corridor, and the sense of place along the Argo Riverfront.

Table of contents

Chapter1 – Introduction
A Context for Change ... 8
Visions for Argo ... 10

Chapter 2 – Multi-Scale Analysis
Landform, Climate, River Morphology and Hydrology ... 16
Water Quality ... 22
Human History ... 25
Land Uses Today ... 31
Terrestrial Habitat and Natural Communities ... 39
Aquatic Habitat: Historic and Current Biodiversity ... 48

Chapter 3 – Management and Policy Issues
Dams and Impoundments ... 52
Contamination and Remediation ... 55
Stormwater and Creekshed Management ... 58
Connectivity ... 62
Recreation Management ... 66
Existing Education and New Opportunities ... 70
City and State Plans and Initiatives ... 72

Chapter 4 – Project Methods
The Alternative Futures Process ... 78
HEC-RAS Hydraulic Model ... 86

Chapter 5 – Scenarios and Futures Descriptions
Scenarios for the Argo Riverfront ... 92
Biodiversity + Heritage Corridor ... 96
Rainwater Adventure Park. ... 110
Sustainable Live/Work Community ... 124

Chapter 6 – Anticipated Outcomes

Chapter 7 – Conclusions and Recommendations
Summary ... 146
Lessons Learned ... 147
Future Recommendations ... 148
About the Authors ... 152
References ... 154

Appendix 1 – Species of Special Concern in the Argo Riverfront Site Parklands
Appendix 2 – Fish Presence in the Argo Area
Appendix 4 – Relevent Planning Documents
Appendix 3 – Stakeholders and Topical Experts
Appendix 5 – GIS, Geographic Information System
Appendix 6 – Image Comparison Board

List of Figures

Figure 1: The Argo Riverfront Site Scale (Site Scale)....9
Figure 2: Creeksheds + Ann Arbor City Scale (City Scale)....11
Figure 3: Upper/Middle Huron Watershed Scale (Watershed Scale)....13
Figure 4: Topography of the Argo Riverfront Site....16
Figure 5: Soil Classifications of the Argo Riverfront Site....18
Figure 6: Huron River and 100 Year Floodplain at the Argo Site Scale....20
Figure 9: Gradient of the Huron River....21
Figure 7: A One Year Hydrograph for the Huron River at the Argo Dam....21
Figure 8: A One Month Hydrograph of the Huron River at the Argo Dam....21
Figure 10: Upper, Middle and Lower Huron River as determined by the Huron River Watershed Council....23
Figure 11: Historic Huron River Channel....25
Figure 13: Argo Mills and Lower Town, circa 1870....27
Figure 12: First Dam and Mill Race Built in 1829....28
Figure 14: Argo Dam Postcard, 1907....28
Figure 15: Manufactured Gas Plant Built Within Historic River Channel....30
Figure 16: Watershed Scale-Upper/Middle Huron Land Use (2000)....32
Figure 17: Projected Areas of Population Growth....34
Figure 19: City Scale Ann Arbor Land Use Pattern (2000)....35
Figure 18: Population of SEMCOG Region 1990-2045....35
Figure 20: Site Scale. Argo Riverfront Land Use (2002)....36
Figure 21: Places of interest at the Argo Riverfront Site....37
Figure 22: Watershed Scale - Historic Land Cover Prior to European Settlement....39
Figure 23: Watershed Scale - Upper/Middle Huron River Habitat Connectivity....40
Figure 24: City Scale - Historic Land Cover Prior to European Settlement....42
Figure 25: City Scale - Creeksheds and Ann Arbor Habitat Connectivity....42
Figure 26: Site Scale - Argo Riverfront Habitat Connectivity....43
Figure 27: Map of Natural Areas with Habitat Types....46
Figure 28: Restoration Priority Area Map....48
Figure 29: Hydrograph from USGS gage near Dexter....50
Figure 30: Hydrograph from USGS gage near Argo Dam....50
Figure 31: EPT Values for 70 sites in the Huron River Watershed....51
Figure 32: EPT Scores for Sites Within the Ann Arbor City and Creeksheds Scale....51
Figure 33: Site Plan for Contaminated Soil Removal in 2006-2007....56
Figure 34: 1,4-dioxane plume and area wells....58
Figure 35: Impervious Cover in the Huron River Watershed and around Ann Arbor....60
Figure 36: Stormwater Outlets within the Argo Riverfront Site....61
Figure 38: Road network and SEMCOG Park and Recreation Land....63
Figure 39: Blue-Green Corridor of the Argo Site....63

Figure 40: Greenway Networks (Existing, Under Construction, and Proposed) at the Site, City and Watershed Scale 64
Figure 41: Entrances to the Argo Riverfront Site 66
Figure 42: Analysis of the Existing Complex Recreation Matrix within the Argo Riverfront Area 67
Figure 43: Scenario Process Diagram. 80
Figure 44: Drivers, Assumptions, and Variables at Each Project Scale. 83
Figure 45: TIN model used for river geometry data (2X vertical exaggeration) 88
Figure 46: Example of HEC-RAS Output, X-Y-Z Geometry Plot 89
Figure 47: Example of HEC-RAS Profile Plot 89
Figure 48: Elevation (feet) of the Surface Water at Low Flow Volume (183cfs) 90
Figure 50: Location of reclaimed Land with Seasonal Standing Water 91
Figure 49: Estimate of Reclaimed Land Based on Different Flow Volume 91
Figure 51: Argo Riverfront Reaches. 93
Figure 52: Scenario Framework 95
Figure 53: Master Plan for Biodiversity + Heritage Corridor 97
Figure 54: Ecological Response for Biodiversity + Heritage Corridor 98
Figure 55: Master Plan for Rainwater Adventure Park 111
Figure 56: Ecological Response Plan for Rainwater Adventure Park 112
Figure 57: Master Plan for Sustainable Live/Work Community 125
Figure 58: Ecological Response Plan for Sustainable Live/Work Community 126
Figure 59: Performance Summary 143

List of Tables

Table 1: Relationship of Gradient Class to Channel Characteristics **22**
Table 2: Percentage of land cover within the Upper and Middle Huron River extent. **33**
Table 3: Measures of Fish Diversity in 2 Upstream Tributaries of the Huron River and Argo Pond **50**
Table 4: Abbreviated History of the Manufactured Gas Plant at 841 Broadway. **57**

Chapter1 – Introduction

A Context for Change

As the world becomes an ever more urbanized place, conflicts between the natural and the built environment have proliferated. Fortunately, people are increasingly aware of the environmental problems associated with urban lands and the effect those problems have on their individual quality of life and the vibrancy, health, and sustainability of their communities. Growing environmental awareness has accelerated interest in turning environmental degradation around, restoring impaired ecological systems so they once again provide a range of beneficial services close to where people live and work. However, regeneration efforts require a clear understanding of the challenges and opportunities faced by a particular area. More importantly, these efforts require a clear community vision for what is desired in the future, and how that translates into actual changes on the land.

The Huron River, which passes through Ann Arbor, Michigan, is an ecological and societal resource abundant in opportunities and challenges for regeneration. Over the course of the city's history, the Huron River has been a focal point for development, industry, recreation, and contact with nature. However, the legacies of these uses have left the Ann Arbor reach of the Huron River in a state of impaired ecological health, and as a place lacking a clear identity and relationship to its urban and natural context. Past and current uses of the Huron River are often in conflict with one another. Trying to navigate through the complexities of divergent concerns, from competing recreation interests to habitat conditions and contamination, is a daunting task.

Fortunately, Ann Arbor is home to an active and engaged citizenry that is willing to tackle the challenge of redefining the city's relationship to the river that passes through its core. In 2007, the Environmental Commission in the City of Ann Arbor created the Huron River Impoundment Management Plan (HRIMP) committee to begin exploring the complex web of issues affecting the Huron River as it passes through Ann Arbor. The HRIMP committee consists of over 20 local stakeholders, from residents to aquatic ecologists, who are charged with outlining desired ecological, recreational, and environmental goals, as well as specific management techniques, for enhancing the value of the Huron River.

Standing out among these complex issues has been a growing discussion over the future of the Argo Dam. Argo Dam, situated along an urbanized stretch of the Huron River close to downtown Ann Arbor, is at the crux of many important decisions facing the HRIMP committee. Furthermore, the City of Ann Arbor and The Huron River Watershed Council (HRWC) have been actively discussing the possible removal of Argo Dam over the past decade. Argo Dam is one of many human manipulations that have altered the hydrology of the Huron River, and the dam contributes notably to the river's impaired ecological state.

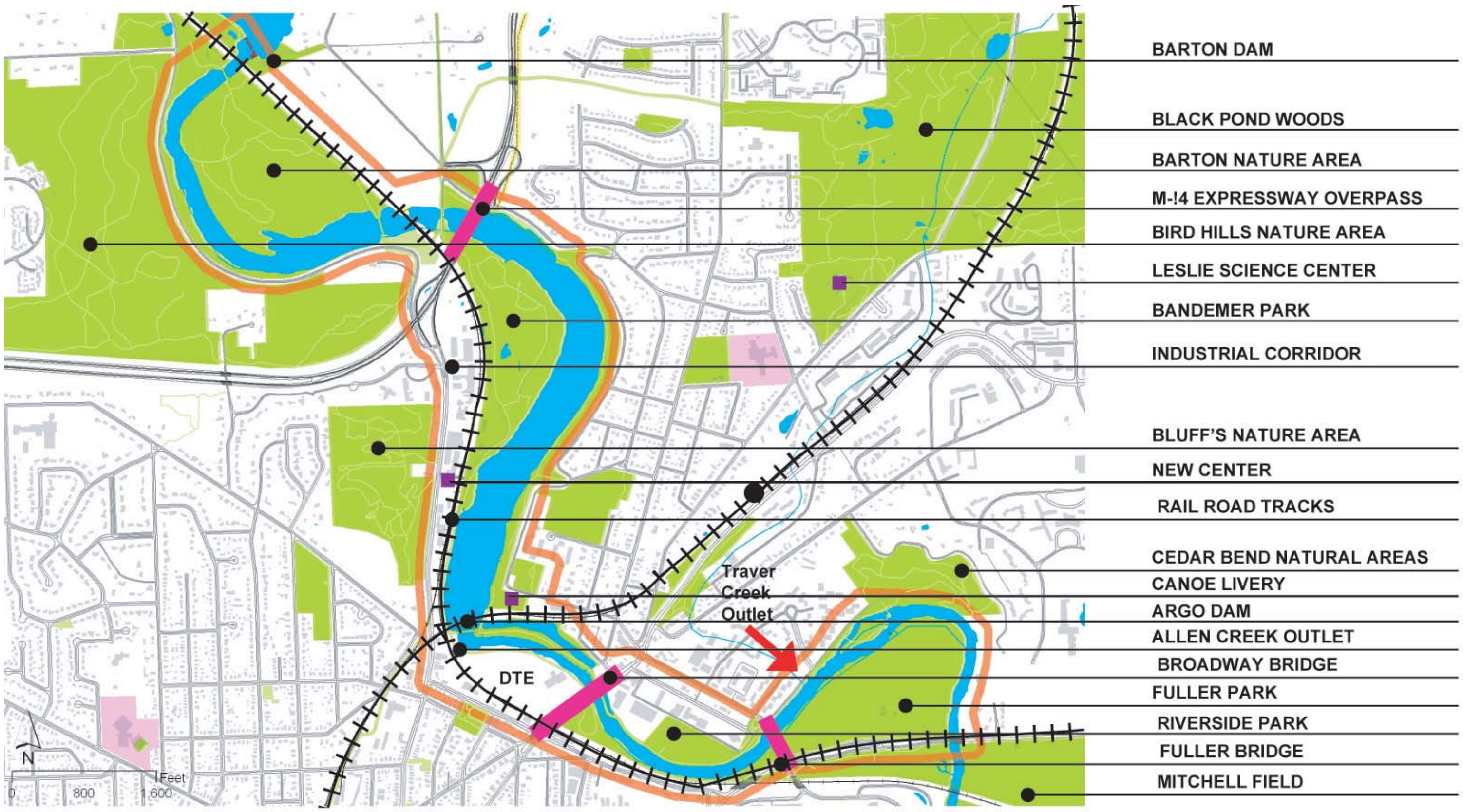


Figure 1: The Argo Riverfront Site Scale (Site Scale).
Source: City of Ann Arbor GIS data

Ann Arbor's relationship with its dams is quite similar to that of many communities in the eastern and mid-western United States. Today, many dams are becoming obsolete, and dam operators are often faced with a decision of whether to continue paying for dam management, or pay for removal. Since dams were constructed for a wide variety of purposes, decisions about dam removal or management are equally as complex. Decisions should consider the current benefits that dams deliver to communities and weigh them against the various ecological, social and economic costs. Equally important is imagining the diversity of landscape changes that are made possible by removing a dam and reclaiming flooded land.

According to the Heinz Center Report (2002) "Dam Removal: Science and Decision Making", the purposes for dam construction include creating recreation amenities, flood control, water supply, water power, energy generation, fire safety, farming, and navigation. Despite the potential benefits of dams, they have a negative impact on the health of river ecosystems in addition to requiring ongoing maintenance costs. Bednarek (2001) notes the following ecological impacts resulting from dams: altered flow regime, decreased biodiversity, shift from free-flowing river (lotic) to impoundment (lentic) system, increased water temperatures, lower dissolved oxygen, altered sediment transport regime, and blocked movement of organisms, debris and nutrients. The decision whether to remove a dam can be driven by many factors, such as structural obsolesce, safety and security concerns, shifts in recreation preference, and desires for river restoration or improvement to water quality and hydrology (Heinz Center, 2002).

While much work needs to be done to assess the feasibility and approach to a possible removal of Argo Dam, the lingering question remains: *what should the riverfront be like if the dam is removed?* Answering that question requires people to explore their own values and desires for what they want the regeneration of a local ecological system to be. The City of Ann Arbor and the HRWC have both realized that the local community will need design visions to help them conceptualize how the river might change in the future.

Visions for Argo

Visions of Argo is an interdisciplinary project that provides illuminating visions of what the future of the Argo Riverfront might be like under different management decisions, possibilities, and assumptions. A University of Michigan, School of Natural Resources and the Environment project, Visions of Argo is a collaborative research and design study which combines the disciplines of landscape architecture and aquatic science to exploring progressive and sustainable visions that enhance human and ecological systems while also securing the Argo Riverfront as a focal point in the City of Ann Arbor. These visions are formulated through interactions between the project team and the HRIMP committee. The future designs for the Argo Riverfront and their subsequent assessment will be used by the City of Ann Arbor and the HRIMP committee to facilitate the decision making process and encourage residents to consider novel "big ideas" for regenerating their city's riverfront.

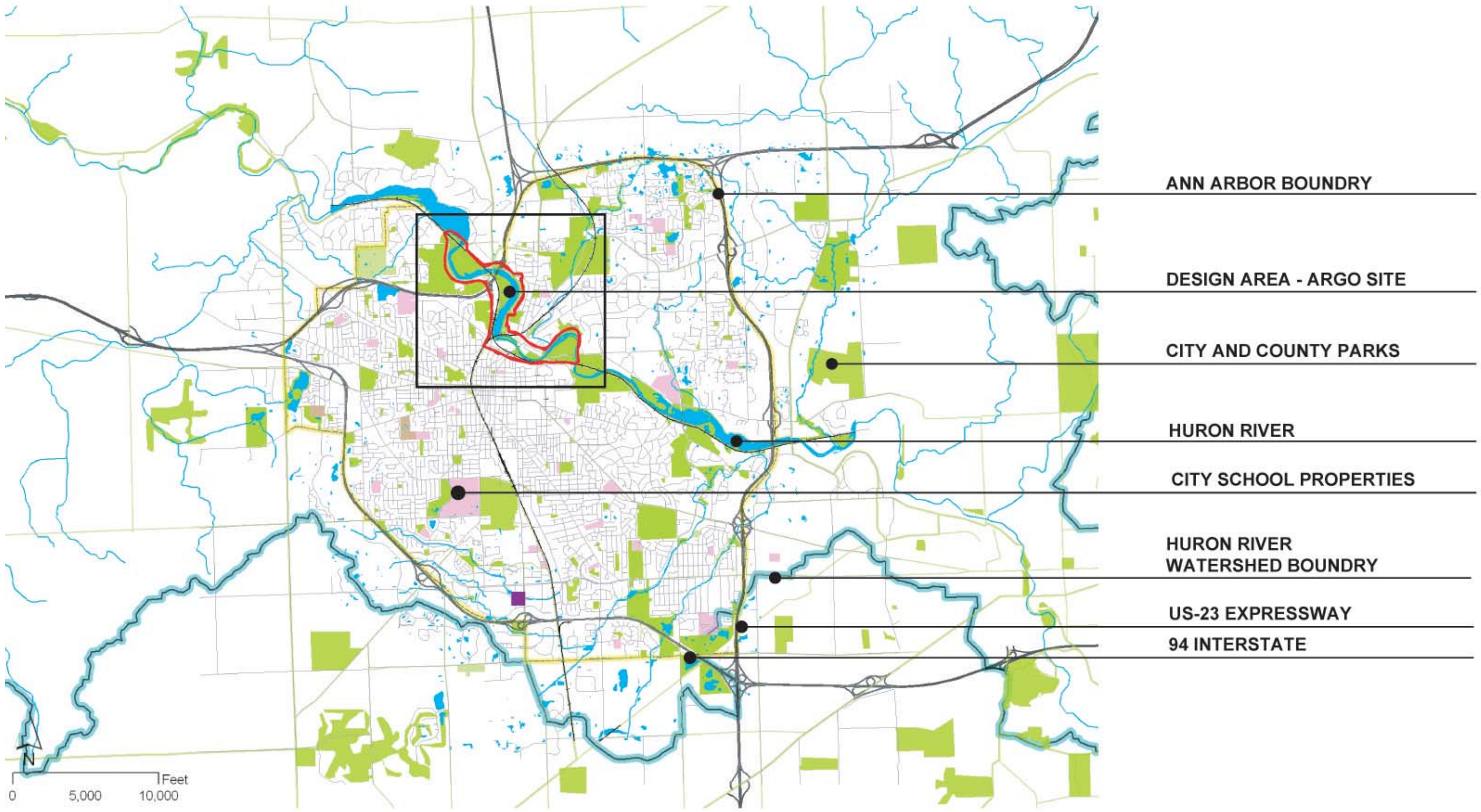


Figure 2: Creeksheds + Ann Arbor City Scale (City Scale)
Source: City of Ann Arbor GIS data

Three separate future scenarios have been developed to help inform and inspire stakeholders as they move forward in the decision making process. Perspectives gathered from stakeholders involved in the HRIMP process were used to identify key issues and as a means of exploring possibilities for the Argo Riverfront. Using this information and making plausible assumptions about what should change in the future led to multiple design solutions, each demonstrating a distinct but coherent vision for a desirable future.

Each future scenario design was required to uphold a set of common goals, which are shared by the project team and the HRIMP committee. These goals act as an underlying force that frames all the designs. These goals are to:

- Position the Argo Riverfront as a focal point for the City of Ann Arbor and enhance the river's amenity value.
- Increase ecological quality and ecosystems services
- Embrace sustainable design management practices to protect the health of the riparian corridor.

The future designs are intended to have transformative effects. Some of the design decisions may act as a catalyst to drive environmental policy, others may change residents' landscaping practices, and others may change how the community lives, recreates and works. The City of Ann Arbor is armed with the desire to change. As a community, Ann Arbor has taken steps towards embracing their sustainable future. Regenerating the Argo Riverfront will provide the city and local stakeholders, with a vital piece of a sustainable solution that will strengthen and support the economic and environmental health of the city while celebrating this area as a unique jewel within the region.

The *Visions of Argo* project identifies three spatial scales. Because each issue related to the Argo Dam exists within broader scales of ecosystem and human processes, decisions can not be made in isolation. When considering choices there must be consideration of the possibilities and challenges these decisions make in the broader scale and vice versa. The alternative futures are designed at the finest scale, which is the **Argo Riverfront Site Scale**. This scale will also be referred to in this report as the **Site Scale.** Encompassing the Argo Riverfront Site Scale is the **Creeksheds + Ann Arbor City Scale** or the **City Scale.** At this scale, attention is focused on *management* and *policy* that relates to Ann Arbor resources with special consideration for the two creeksheds (Allen Creek and Traver Creek) that feed directly into the Argo Riverfront Site. Finally, the broadest scale considered is the **Upper/Middle Huron Watershed** Scale or the **Watershed Scale**. It is important to note that because Argo Dam lies in the middle of the Huron River Watershed, the entire extent of the watershed is not considered; rather the Watershed Scale is short-hand for the Huron River Watershed upstream from the Argo Riverfront Site. At the Watershed Scale, different levels of development intensity or changes in water quality in the upper watershed can have pervasive effects on downstream hydrology and water quality. Thus management and policies that relate to the Watershed Scale are opportunities and challenges at the finer scales.

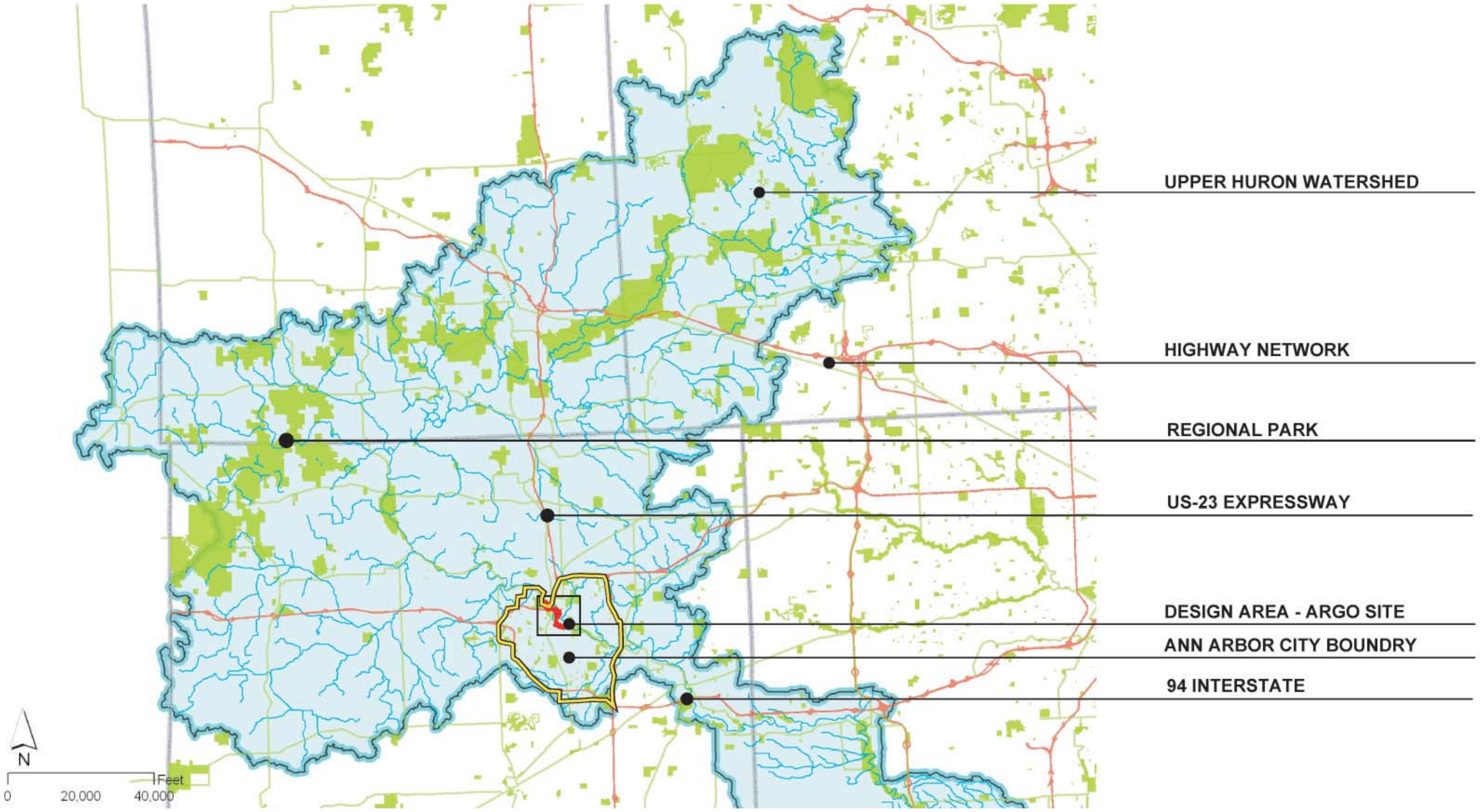


Figure 3: Upper/Middle Huron Watershed Scale (Watershed Scale)
Source: City of Ann Arbor GIS data

Key features of the Argo Riverfront Site include the Argo Dam and Argo Pond, the impoundment associated with the dam. Argo Dam is one of nineteen dams along the main stem of the River with others both upstream and downstream from the site. The first version of the dam was originally built in the early 1800's for hydropower, but today it is no longer used for power generation. The dam, along with 950 acres of land along the Huron River, is currently owned by the City of Ann Arbor, with the majority of the land used for parkland (Butz, 1974).

The Argo Riverfront Site was the historic industrial and transportation center for the City of Ann Arbor, mainly due to the presence of the Huron River and the railroad lines. These past land uses remain today as both identified and potential brownfield sites along the riverfront. The Detroit Edison Company (DTE) site west of the Broadway Bridge is a known brownfield site. Immediately downstream of Argo Dam is a major discharge outlet for downtown Ann Arbor's stormwater sewer system. This system encompasses what was once Allen Creek, but is now entirely piped through the urban area to eventually empty into the Huron River. There is presently a grass roots initiative to daylight areas of this creek and create the Allen Creek Greenway trail and park system through the center of Ann Arbor.

Within the Ann Arbor context, the Argo Riverfront Site is directly connected to the Washtenaw County Border-to-Border Trail Initiative, forming a multiuse greenway network through the Huron River corridor in Ann Arbor and beyond. In addition to this greenway connection, Argo Dam is adjacent to Lower Town, the historic location of Ann Arbor's town center. As part of the city's growth planning, a great deal of effort has been directed towards the sustainable redevelopment of Lower Town. The Argo Riverfront is also close to main downtown area of the city, and opportunities to make the riverfront a more desirable urban destination should be pursued.

The Upper and Middle Huron River is generally less developed than Ann Arbor except for some smaller urban centers. An extensive park system and natural habitat areas extend southwest to northeast through the upper watershed, part of a regionally important ecological system. Given the desirability of living in a rich natural area, there is a strong development pressure throughout the upper watershed. If development is not sensitive to these conditions or does not embrace best management practices, the water quality of Huron River will likely decline in the future, impacting the river's ecological health and amenity value for Ann Arbor' residents.

Chapter 2 – Multi-Scale Analysis

Landform, Climate, River Morphology and Hydrology

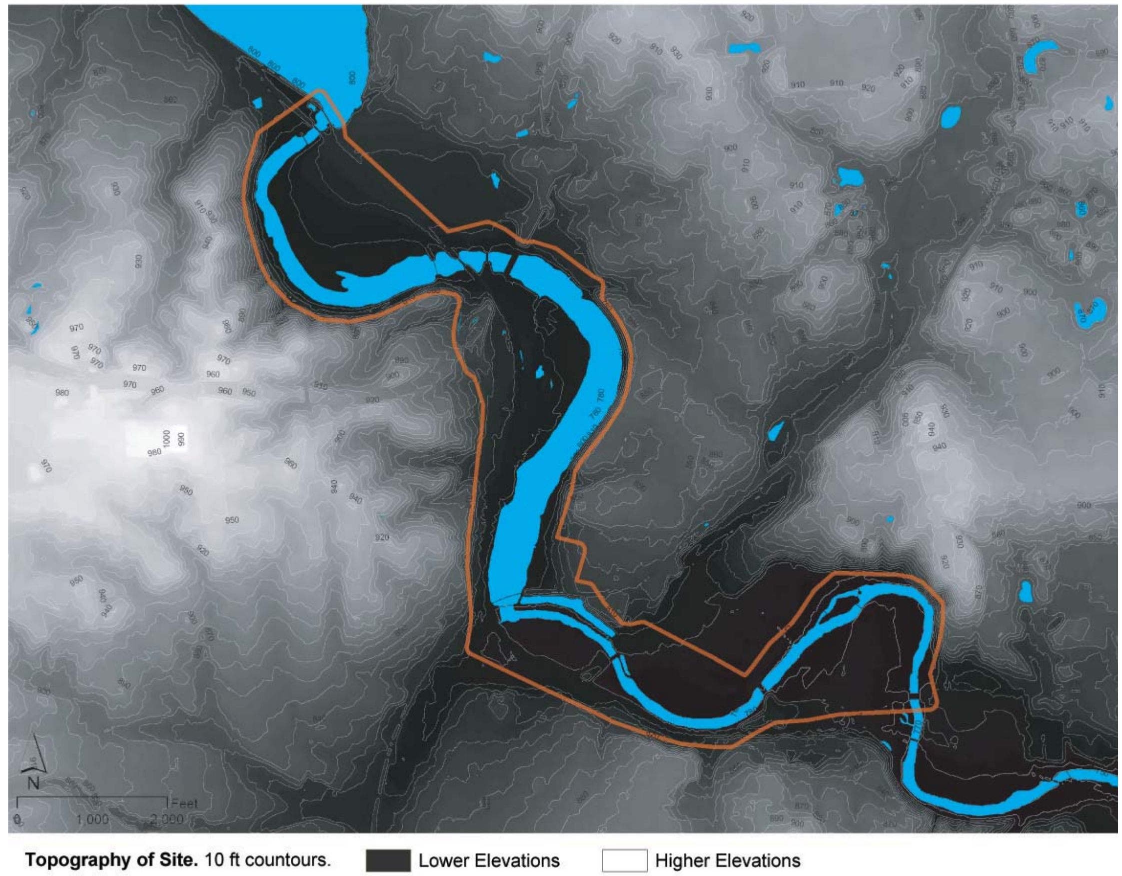


Figure 4: Topography of the Argo Riverfront Site
Digital Elevation Model (DEM) with 10 foot contour lines. The channels of Allen's and Traver Creek can be seen clearly, as can the steep slopes that are characteristic in this area on the outer bends of the river. Source: City of Ann Arbor GIS Data

The Huron River Watershed, was formed during the retreat of the last glacier, the Wisconsin Glacier of the Pleistocene Epoch. As the glacier went through several advances and retreats, carving and reshaping the earth, the direction of flow and the river outlet changed numerous times. The present river channel was formed around 16,000 years ago and the modern topography and soils seen today are the result of postglacial erosion and soil formation processes acting on glacial deposits (Albert et al., 1986).

The watershed is largely a region of end (or recessional) moraines, with associated till plains and outwash deposits. According to the Michigan Department of Natural Resources (MDNR), Huron River Plan (2002): "Both outwash and end moraine geologies contain sand and gravel deposits, and are conducive to groundwater inputs to stream systems, with outwash geology streams having higher base flows. Till plains consist of sorted fine sediments and are more conducive to surface runoff into streams and create flows that are more "flashy". The area around Ann Arbor contains soils of the Miami-Hillside-Conover association with the principle soil as the Miami type including the loam, underlain by the more friable clay, and the more silty loam, underlain by tight permeable clay."

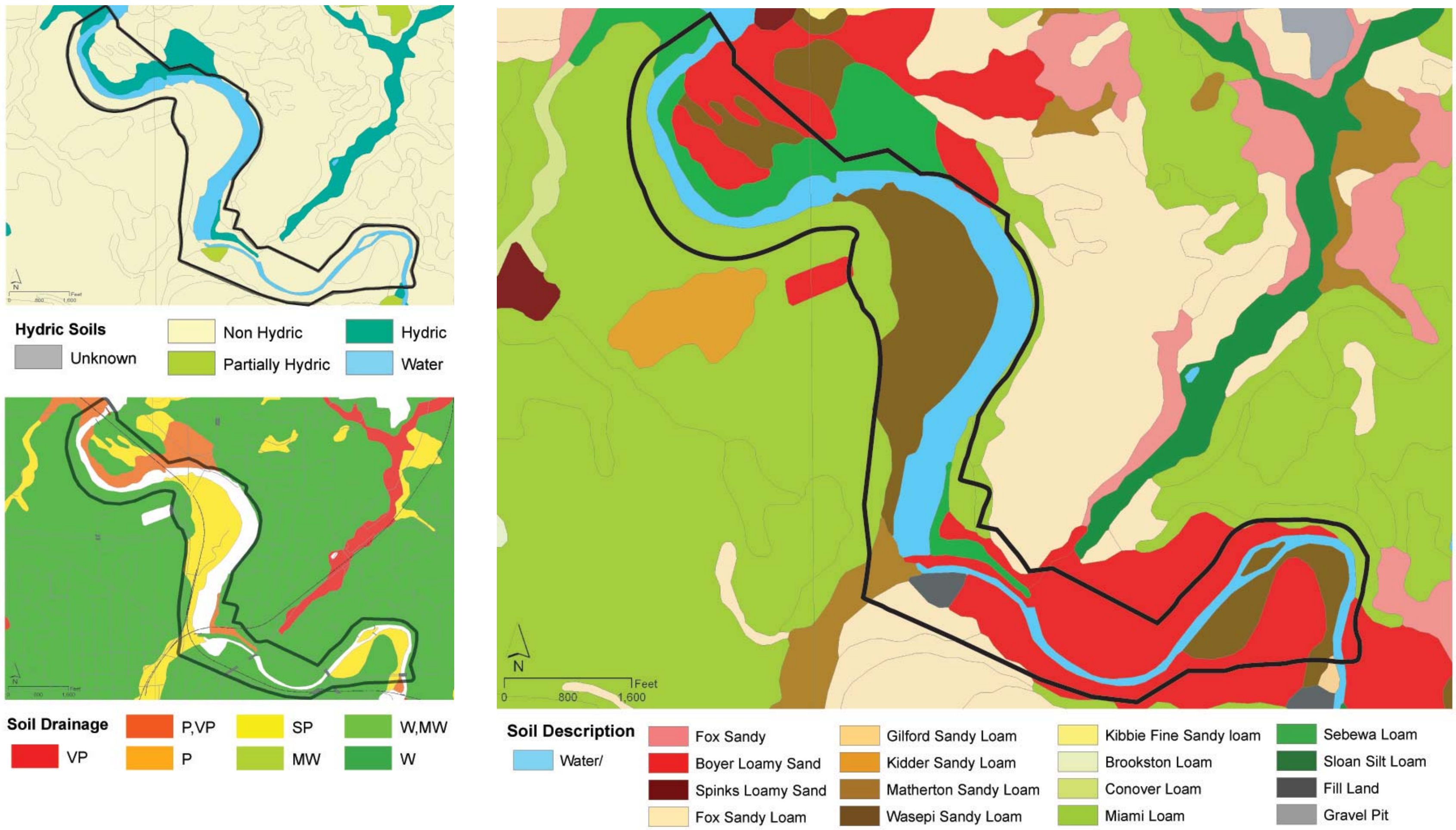


Figure 5: Soil Classifications of the Argo Riverfront Site
Soils information can be used to make informed decisions about the placement of buildings as well as decisions about vegetation restoration and wetland creation. Source: SEMCOG GIS Data

The Huron River Watershed has a humid climate influenced by its location in the Great Lakes region, with cooler summers and warmer winters, yet is in the drier portion of Michigan (MDNR, 1995, MDNR 2002). Ann Arbor receives an average of 30.6 inches of rainfall and 37-38 inches of snowfall per year, based on a 57 year period (MDNR, 2002). Further, since southern Michigan thaws and re-freezes regularly throughout the winter, low and high flows on the Huron River are less variable than more northern rivers (MDNR, 1995). Due in part to higher temperatures and the slightly drier air found in southeastern Michigan, evaporation is higher than many other watersheds in Michigan (Sommers, 1977).

The main stem of the Huron River drains an the 900 square mile watershed as it flows through the southeast Michigan counties of Oakland, Ingham, Livingston, Washtenaw, Monroe and Wayne (MDNR, 2002). The main stem is approximately 136 miles long and there are 367 linear miles of tributaries that contribute to the overall watershed (Wittersheim, 1993). If the river were unimpeded by dams there would be approximately 38 miles of gravel-cobble-boulder substrate that would be characterized by riffles and rapids and interspersed with deep pools (MDNR, 1995).

River channels are dynamic and constantly changing as the water flows over the river bottom. Changes in flow regime, sediment loading, and man-made channel modifications affects channel cross section, gradient, and the natural river morphology. River morphology refers to the shape of the river channel including channel width, depth, and sinuosity and the processes that form this shape (MDNR, 1995). Figure 6 shows the current Huron River channel and the 100 year floodplain. Hydrology, which refers to the quality, movement and distribution of water, determines how much water enters the river through groundwater or surface flows and what the temporal patterns of those flows are. Consequently, hydrology has a profound impact on river morphology. For instance, increased stormwater flows can accelerate bank erosion, which overtime changes the alignment of the river. The interaction between hydrology and river morphology occur naturally in all river systems, and rivers are constantly readjusting to reach an equilibrium.

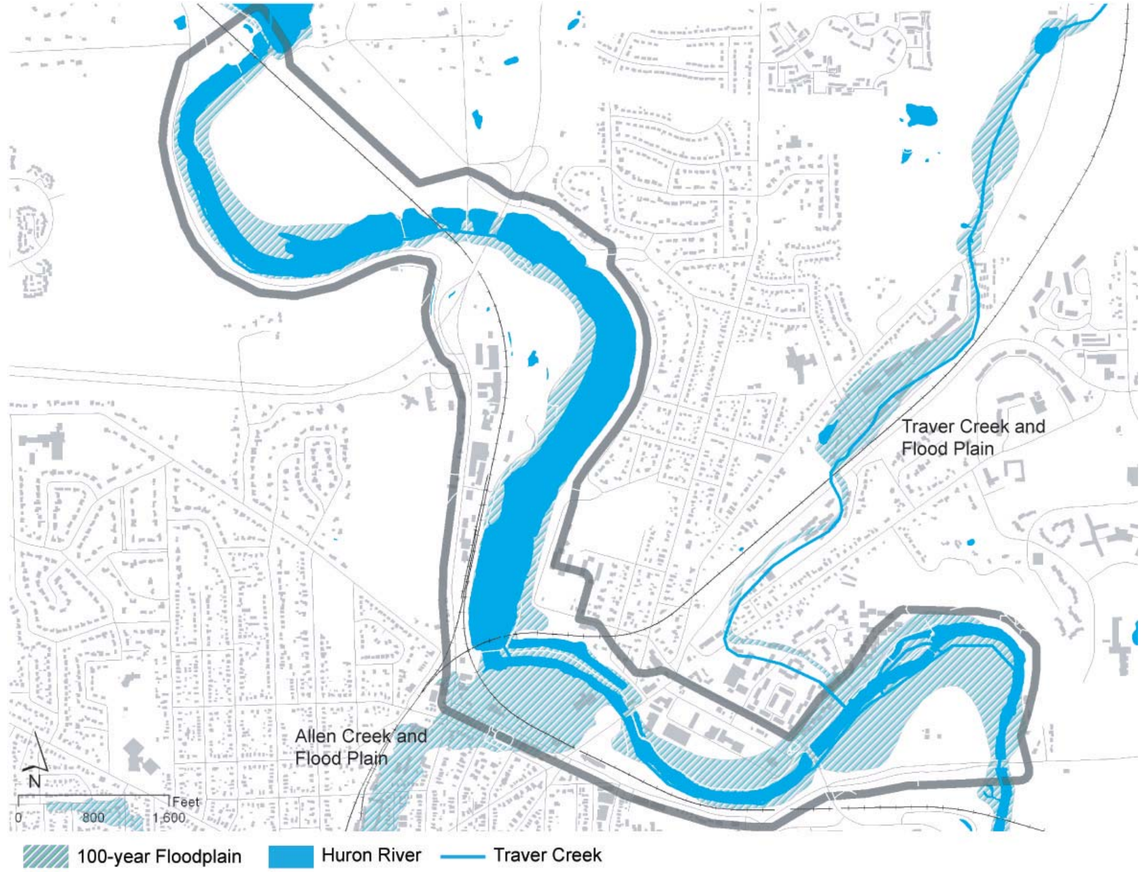


Figure 6: Huron River and 100 Year Floodplain at the Argo Site Scale
Dark blue refers to the existin Huron River channel. Hatched area is the 100 year floodplain for the Huron River, Allen Creek and Traver Creek
Source: City of Ann Arbor GIS Data

Comparing a river's channel width to a comparable river of the same discharge volume provides insight into hydrologic conditions and channel morphology. An overly wide channel is the result of fluctuating flows or excessive sediment loading; while, overly narrow channels are produced by bulkheads along the bank or by channel dredging (MDNR, 1995). Between Ann Arbor and Ypsilanti, the natural channel is about 100-124 feet wide. At Argo Dam, the channel is 142 feet wide, at a discharge of 437 cubic feet per second, compared to the expected width of 114 feet (MDNR, 1995). This width is probably due to flow fluctuations and the armored bottom (MDNR, 1995). Figure 7 shows the yearly flows at the Argo

Site U.S. Geological Survey (USGS) gage (downstream of the dam). Over a shorter time period, Figure 8, a real-time hydrograph, shows these sometimes extreme, daily flow fluctuations at the gage over a one month period, from late February-March 2008. It is not completely clear why these fluctuations are so extreme on a run-of-the-river dam; however, it is possible that these fluctuations are due to the way the floodgates are calibrated to let water through. In particular, the floodgates may not be fine enough in their adjustments, either releasing too much or too little water in response to changing water flow volumes.

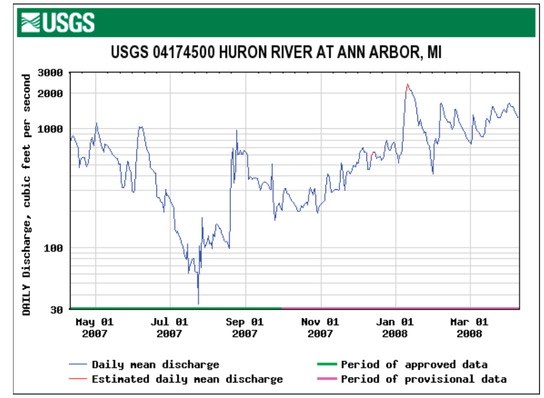


Figure 7: A One Year Hydrograph for the Huron River at the Argo Dam.
Source: (USGS, 2008b)

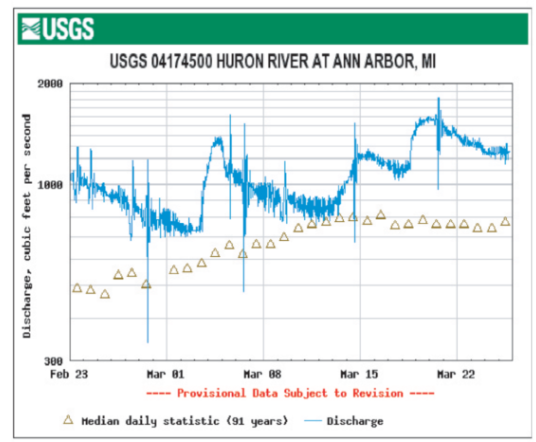


Figure 8: A One Month Hydrograph of the Huron River at the Argo Dam
Source: (USGS, 2008a).

The Huron River originates in Big Lake in north-central Oakland County, at an elevation of 1018 feet, discharging into Lake Erie at an elevation of 572 feet (MDNR, 2002). The average gradient of the mainstem is 2.95 feet per mile with some portions steeper than average, others with a more gradual drop (MDNR, 2002). The stretch of river that extends through the City of Ann Arbor generally exceeds the average, with the river dropping 42 feet total in this section (MDNR, 1995).

Varying gradients create diverse types of channels and therefore different kinds of habitat for fish and other aquatic life. The greater the variation, the greater habitat complexity will exist. Steeper gradients allow faster water flows with accompanying changes in depth, width, channel meandering, and sediment transport (Knighton, 1984). Aquatic fauna are typically most diverse and productive in parts of a river with gradients between 10 and 69.9 feet per mile; however, these are very rare in Michigan (MDNR, 2002).

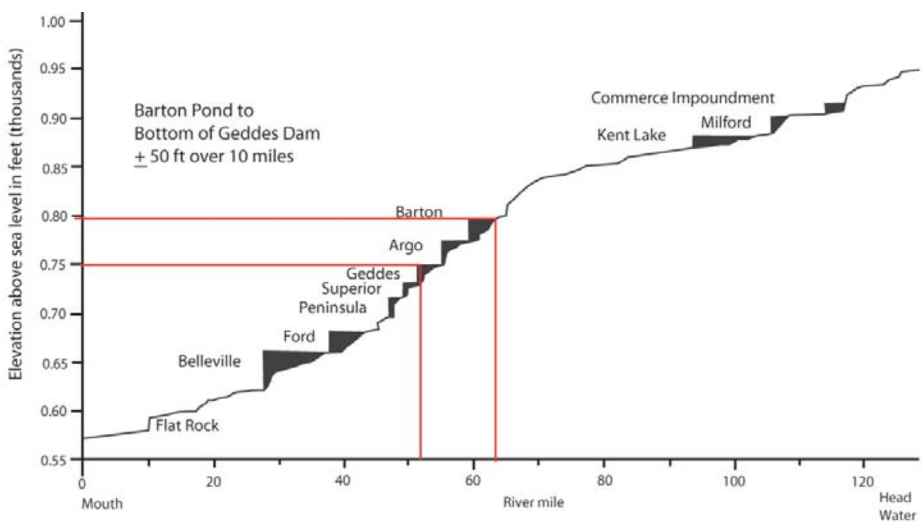


Figure 9: Gradient of the Huron River

Source: MDNR, 1995

Gradient Class	Channel Characteristics
0.0-2.9 ft/mi	mostly run habitat with low hydraulic diversity
3.0-4.9 ft/mi	some riffles with modest hydraulic diversity
5.0-9.9 ft/mi	riffle-pool sequences with good hydraulic diversity
10.0-69.9 ft/mi	established, regular riffle-pool sequences with excellent hydraulic diversity
70.0-149.9 ft/mi	chute and pool habitats with only fair hydraulic diversity
150 ft/mi	falls and rapids with poor hydraulic diversity

Table 1: Relationship of Gradient Class to Channel Characteristics

Source: MDNR, 2005

According to historic hydraulic modeling data, used for a floodplain study by the MDEQ, the river bottom elevations at the Barton Dam railroad trestle are 770 feet and at Fuller Bridge 751 feet. Therefore, the gradient averages 5.3 feet per mile within the 3.6 mile stretch of the river that flows through the Argo Riverfront Site. This means, in a more natural undammed condition, riffles and pools would be expected with diverse hydraulic conditions and likewise diverse habitat possibilities.

Water Quality

The Huron River Watershed Council (HRWC) typically described the Huron in terms of the "Upper Huron", the "Middle Huron" and the "Lower Huron". The HRWC has developed distinct management programs for these three reaches of the river and much of the research that has been conducted uses these extents for analysis. For the purposes of this project only the Upper Huron and a subsection of the Middle Huron were considered. This is because the Argo Riverfront Site is located within the Middle Huron and any actions taken downstream from the Argo Riverfront site will not affect flows or water quality considerations at the Site level.

The Upper Huron includes the headwaters of the Huron River and tributaries that feed into the main river channel upstream of Portage Lake in Washtenaw County. The Upper Huron constitutes 60% of the watershed, with 14 impaired waterbodies that do not meet state water quality standards due to excessive phosphorus, poor macroinvertebrate communities, excessive levels of Mercury or Polychlorinated Biphenyls (PCBs), and low levels of dissolved oxygen (DO), as designated by the State of Michigan (HRWC 2006b). Four of these impaired waterbodies are Kent Lake, Brighton Lake, Ore Lake, and Strawberry Lake. All share excessive phosphorus above the established Total Maximum Daily Load (TMDL). These have been set at concentrations of 30 ug/L, 30 ug/L, 20 ug/L, and 20 ug/L for the four lakes respectively (HRWC, 1996).

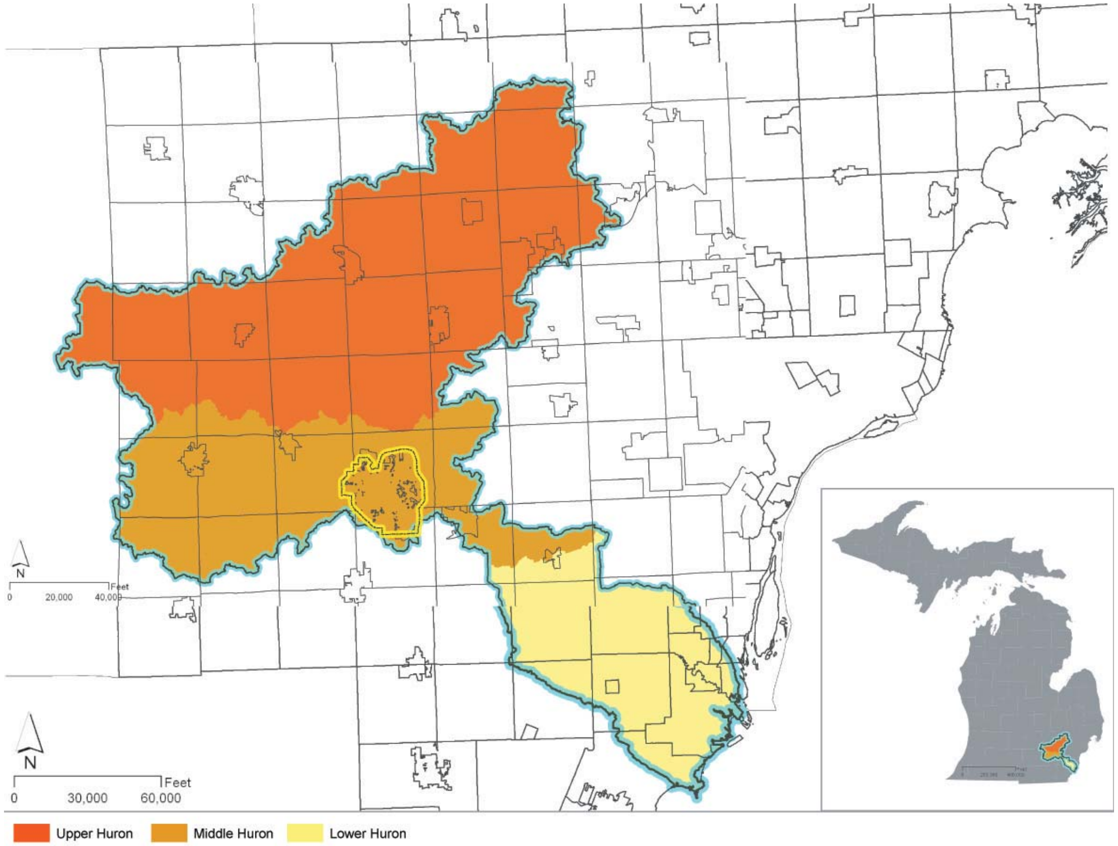


Figure 10: Upper, Middle and Lower Huron River as determined by the Huron River Watershed Council

The "Middle Huron," home to over half the human population of the Huron River Watershed, begins with Mill Creek in western Washtenaw County and extends downstream to Belleville Lake in western Wayne County. The "Middle Huron" contains the largest areas of agriculture as well as the most urbanized areas in the Huron River Watershed. This segment of the river is the major source of the water quality problems in this watershed. Excessive nutrient levels and high level of sediment entering the river system impact the communities of the middle segment of the Huron River Watershed (Brenner et al., 1999). The Michigan Department of Environmental Quality (MDEQ) has identified the two most significant water quality problems as high phosphorus and *Escherichia coil* (*E. coli*) concentrations (MDEQ, 2001).

The Middle Huron River traveling through Ann Arbor was placed on Michigan's 303(d), Impaired Waterbodies List, due to the presence of elevated levels of the pathogen *E. coli*. The listed segment is about five miles of the Huron River running from Argo Dam to Geddes Dam, at Dixboro Road. Efforts to identity and correct the sources of impairment along this reach of the Huron River presents a significant opportunity to enhance the overall health of the river.

Section 303(d) lists Michigan water bodies that are not attaining one or more designated uses and require the establishment of TMDLs to meet and maintain water quality standards. As a result of this listing, designated recreational uses are restricted. Ford and Belleville Lakes, impoundments on the Huron River downstream of Ann Arbor area, are also listed on Michigan's 303(d) list. Low DO levels and high phosphorus concentrations caused by nutrient enrichment through stormwater runoff, contribute to algal blooms and fish kills in both impoundments. The Ann Arbor area contributes an estimated 14% of the total phosphorus load, 11,580 pounds annually, at Ford and Belleville Lakes (HRWC, 1996). Additionally, the City of Ann Arbor contributes up to 67% of the total phosphorus load to the Middle Huron (HRWC,1996). Phosphorus is an essential nutrient in water bodies. However, excessive concentrations of phosphorus can cause extensive growth of aquatic plants and algae, leading to depletion of DO in the water. This extensive growth of nuisance algae and plants leads to depletion of DO in the water, causing fish kills as well as reducing recreational opportunity along the river. Total Phosphorus (TP) measures all forms of phosphorus that exist in a water sample. The typical level of TP for a river in Michigan is 30 ug/L (HRWC, 2005). Nutrient monitoring results conducted by the Huron River Watershed Council for the Middle Huron River Initiative (1996) shows that all of the streams that run through Ann Arbor had TP concentrations significantly exceeding 30 ug/L through most of the monitoring season, while upstream of the Middle Huron area, the creeks and mainstem had TP concentrations below or at 30 ug/L, during the years 2003-2005.

A limnologist from the University of Michigan, sampled 18 sites along the Huron River from June, 2003 to October, 2005 as part of an Environmental Protection Agency (EPA) Science To Achieve Results (STAR) program. These sites included one at Barton Pond, one downstream of Barton Pond, one downstream of Argo Dam, and one at the outlet for Allen Creek (Lehman, 2008). These data show that the site downstream of Argo Dam consistently had higher TP levels than the upstream sites. The HRWC have also been sampled various creeks throughout Ann Arbor Creeks including Allen's Creek, in 2003 and 2004 (HRWC, 2005). However, both the EPA STAR project and the HRWC chemistry sampling need additional and continual monitoring at both high and low flow rates to make conclusive assertions about water quality at the Argo Riverfront Site Scale.

Human History

Figure 11: Historic Huron River Channel
The Huron River's channel morphology has been altered by the historical uses of man, specifically by the construction of dams for the harnessing of energy.
Sources: Gardner, W.S. (1906); City of Ann Arbor GIS data. All original documents are geo-referenced to current data in ArcGIS.

Early Settlement and the Huron River

The Huron River was historically a trade route for several Native American tribes. The river's headwaters allowed a portage connection to the Grand River for east-west travel by canoe from Lake Huron to Lake Michigan (Butz, 1974). The Huron River was also a notable landmark for overland travel. A trading post for the Potowatomi and Huron tribes was established where several trails converged. The point in the river where Broadway Bridge is today, was once a clear and shallow section of the river which was easily forded (Shackman, 2006). The first European settlers also found this site appealing, and the confluence of Allen's Creek and the Huron River was the site selected for the first settlement in Ann Arbor. In 1825, one year after John Allen and Elisha Rumsey co-founded the City of Ann Arbor, Allen describes the setting by saying, "Our river is the most beautiful I have beheld and abounding with the most valuable fish" (Shackman,1993).

The high gradient in this area allowed early energy needs to be harnessed from the river. Almost immediately, Ann Arbor settlers began building mills along Allen's Creek and the Huron River. Between 1829 and 1830, Anson Brown built the first Argo Dam just north of the confluence with Allen's Creek. Much of the water was diverted down a mill race which serviced several mills including a grist mill, a woolen mill, and the large Swift and Co. flour mill (Shackman 1993, Butz 1974). Over the next 60 years, the Argo Dam and mill race were operated by several families in generally the same configuration (Scobey et al., 2008).

Argo Dam was not alone in harnessing energy from the Huron River and mill dams were appearing everywhere there was a high gradient to capture energy. It has been suggested that the thousands of mill dams built in the eastern United States so affected pre-settlement wetlands through sedimentation, that those areas known today as floodplains are actually fill terraces and the incised channels that are considered the natural historic river forms are in fact not natural archetypes for meandering streams. (Walter and Merritts, 2008) There is some evidence of historic fill activities along the Argo Riverfront, particularly at Bandemer Park where nearly a fifth of the park land is an old river channel filled in with urban waste and soil by prior owners (City of Ann Arbor, 1999).

By 1839, the Michigan Central Railroad tracks were laid along the Huron River, which ultimately connected Ann Arbor to, Detroit in the east and Chicago in the west. This led to the construction and prosperity of other industries and businesses along the riverfront including tanneries, slaughterhouses, taverns and hotels. This riverfront district became known as 'Lower Town' and both sides of the river were developed. The north side of the river was dominated by commerce, industry, and civic institutions such as city hall. The south side included industry and residential growth. This floodplain terrace became home to many working class residences including a large percentage of immigrant and African American households (Scobey, D., Kuras, A., & Kortesoja, K., 2008).

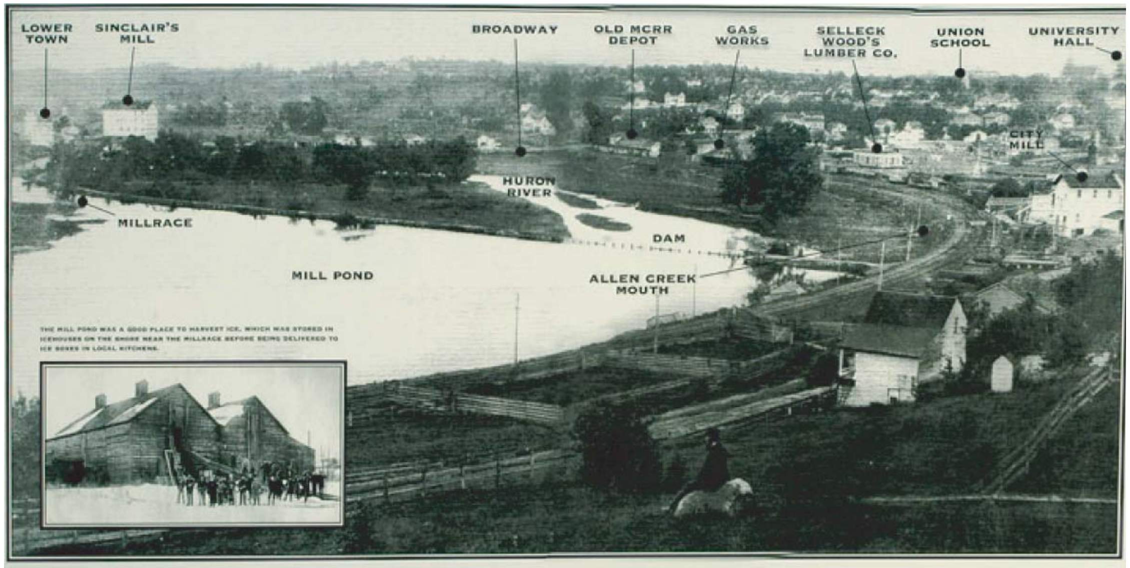


Figure 13: Argo Mills and Lower Town, circa 1870
View of Argo Dam and Mill race from west side of Argo impoundment (a.k.a. Mill Pond). Top of Argo Dam can be seen in foreground with historic river channel in background. Source: Bentley Historical Library

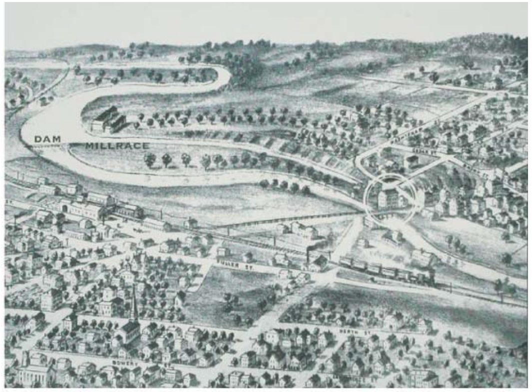


Figure 12: First Dam and Mill Race Built in 1829
Source: Scobey, D., Kuras, A., & Kontesoja, K., 2008

Figure 14: Argo Dam Postcard, 1907
Source: Scobey, D., Kuras, A., & Kontesoja, K., 2008

In 1837, the University of Michigan was moved from Detroit to Ann Arbor. The campus was built southeast of the Lower Town area. This event would eventually shift the downtown of Ann Arbor to its present location and slowly change much of the character of the town.

The Ann Arbor Water Works Company was built in 1885 to supply potable water to the city; by 1893, a sanitary sewage system was in place as well. This meant that Ann Arbor was no longer dependant on Allen Creek for these services. Additionally, upstream land clearing and sedimentation was resulting in muddy spring floods which were contaminated with animal, human, and industrial wastes. In 1923, eighty-seven of the one hundred property owners along the main branch of the creek petitioned the City of Ann Arbor to pipe Allen's Creek (Shackman, 2006). By 1926, Allen's Creek was no more than another stormwater sewer pipe (Shackman, 1993). Allen Creek's relegation to the underground stormwater drainage pipes marked the beginning of this practice.

Other manipulations to the flow of water in the Huron River watershed and associated land uses were also being implemented in this era. One such manipulation, the Manufactured Gas Plant (MGP), became a common industry from 1805 through to the end of the 20th century (Hatheway, 2006). This industry converted coal to manufactured gas which was used for streetlamps, industrial manufacturing and later motor vehicles. Several MGPs were established in the Lower Town area, because of its proximity to both the rail station and the Huron River. The rail station allowed for the importation of coal, the raw material needed for coal gasification, and the Huron River provided the water for the steam powered operation as well as the natural means for waste disposal. In 1899, a MGP was built immediately southeast of the Argo Dam on the south side of the Huron River. In 1915, land owners, Washtenaw Gas Co. and Eastern Michigan Electric negotiated relocation of the Huron River channel (City of Ann Arbor, 2007b). The former river channel was filled and rerouted to the north. The result of this rerouting forced the water of the Huron River to make a sharp, approximately 90 degree, turn to the east immediately after the Argo Dam. This reconfiguration remains to this day in large part due to the contamination left behind by the Manufactured Gas Plant in the former river channel.

Fires in 1904 and 1913 hurt the riverside mills (Shackman, 1993). The changing landscape and economy of the growing university town had made Ann Arbor less dependant on the waterfront industries. In 1905, Eastern Michigan Edison Company (later to become Detroit Edison Company) began purchasing water and flowage rights on the Huron River with the intention of creating nine hydroelectric dams (Butz, 1974). In addition, Eastern Michigan Edison Company purchased properties abutting the river where dams would affect water level changes. This included the purchase of Argo Dam and powerhouse which was converted into an electrical power generation station (Scobey et al., 2008). In 1912, Detroit Edison began the hydroelectric construction era by building the 25 foot tall Barton Dam. This was followed by the rebuilding of the Argo Dam which occurred in 1913, raising the head from 8 to 14 feet (Butz,1974). An 1887 map, created by J.M. Swift demonstrates that the Argo Pond water level changed from about 768 feet above sea level to its current level of 774 ft above sea level (Atwell-Hicks Maps, 1887). The year 1916 saw the construction of Geddes Dam, 1919 Superior Dam , 1925 French Landing Dam, and 1927 Rawsonville Dam (Scobey et al., 2008).

Construction of hydropower dams ceased after 1927 due to unanticipated events, and the westernmost dams planned for Delhi and Dexter were never built (Scobey et al., 2008). One cause was the impact of the Great Depression altering the economics of both supply and demand. The other reason was geophysical in nature, caused by the human settlement that would lead to a long trend of altered hydrology on a regional scale impacting site level possibilities. In the original plan to construct nine dams, total energy output was predicted to generate 45 million kilowatt hours annually (Butz, 1974). However, the extensive clearing and drainage of the land by settlers of the Huron River area had created a system where runoff to the river was more rapid than originally anticipated. This meant higher than expected seasonal fluctuations in flow. Dams could not retain all the water to be used for power production during high flows nor was there as much power production as anticipated during drier seasons (Butz, 1974). Argo Dam

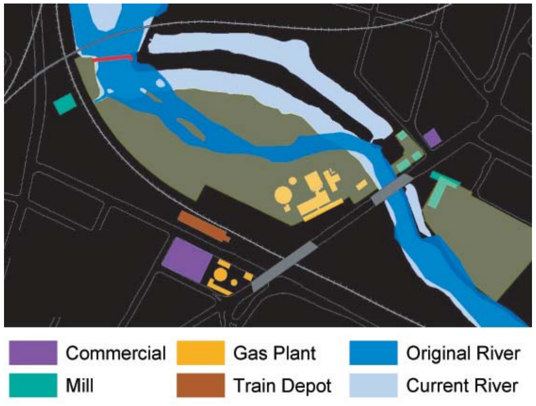


Figure 15: Manufactured Gas Plant Built Within Historic River Channel.
Source: (Sanborn, 2001) (Gardner, W.S. 1906) , City of Ann Arbor GIS data. All Original documents geo-referenced to current ArcGIS data.

was victim to the shifting pressures of the landscape and economy. It was operated until 1959 when it was concluded that the energy generated from Argo Dam did not justify the costs of operation. In 1963, the City of Ann Arbor purchased Argo, Barton, Geddes, and Superior Dams. While hydroelectric power has been reinstated at Barton and Superior, it still remains economically infeasible to put Argo Dam back on the energy grid.

Parks and the River

Along with the purchase of the dams in 1963, the City of Ann Arbor acquired 950 acres of land along the Huron River to develop park space (Adams et al., 2004). This allowed for nearly continuous riverside parks within Ann Arbor city limits along one or both sides of the Huron River. This area added to the already rich tradition in Ann Arbor of riverside parcels being purchased for public parks and open space.

The tradition of riverside parks began at the beginning of the twentieth century when many local residents began to petition the City of Ann Arbor about their concerns with the unpleasant situation around the Michigan Central Railroad Station (Scobey et al., 2008). Before the advent of the automobile, the area around the train station would create visitors' first impression of Ann Arbor. However, at that time, all four corners around the crossing of Broadway Bridge and the Huron River were occupied by commercial and industrial uses that were often emanating noticeable pollution and odor (Shackman, 2006). Mayor Royal S. Copeland once wrote, "our city is damaged in the eyes of the traveling public by the unsightly and disgraceful outlook from the [train] car windows" (Scobey et al. 2008).

Beginning in 1902, the City of Ann Arbor began acquiring riverside property. A small portion was donated by the Michigan Central Railroad; however, many land owners asked high prices for their land and the city resorted to condemning the property in order to only pay land owners what the city deemed a fair value. In those early days, the Ann Arbor Parks Commission realized the value of connecting city parks, and in 1905 they wrote a report outlining a plan that could be Ann Arbor's fist greenway initiative. The following bullet points are taken from the Ann Arbor Daily Times on December 18th, 1905 regarding the "Report of Park Commissions on the six mile boulevard system" (Scobey et al., 2008):

> *"This requires that we develop a system of parks and boulevards, the latter forming broad rivers bringing the country into the town and broadening into little parks at places best suited naturally for it. We should exert our efforts:*
>
> - *To develop and preserve the river banks.*
> - *To develop the ravines along the river. Such places offer unlimited opportunity for pleasant walks and resting places.*
> - *To develop drives from parts of the city which are so unfortunate as to lie away from the river. These should be partly on the numerous ridges which command distant views and enable one to look down upon the tops of lofty trees and shrubs lining the neighboring ravines. Such views should be preserved for the benefit of future generations.*

- *To develop drives and walks along the river bank. What is more restful to the tired than a walk or drive along the beautiful river?*
- *To develop small parks along the boulevards in more level districts. These parks should be developed principally as play grounds. They should not be too small nor need they be extremely large . The development of the park idea should not be abused to such an extent as will interfere with the pleasure of the children. Such a condition would injure the entire undertaking.*

The plan included two boulevards with parks on either side with trees planted in the median. One would connect Ann Arbor and Ypsilanti along the Huron River and the other that would connect existing parks within city limits down to the Huron riverside. In 1905, the renowned landscape architect Fredrick Law Olmstead was commissioned to assess the landscape from Ypsilanti through Ann Arbor and beyond for a potential route for the Huron River Boulevard. (Scobey et al., 2008)

Around the same time, another internationally distinguished landscape architect, O.C. Simonds, was hired to begin design of the newly acquired lands (City of Ann Arbor, 1999). Simonds was a pioneer in the American design tradition of parks that highlighted natural character. In Ann Arbor, he designed both Nichols Arboretum for the University of Michigan and Cedar Bend Park for which he demonstrated particular enthusiasm to the City of Ann Arbor for the park site:

> *One gets beautiful views of the city and valley of the Huron. The river banks and portions of the hillside are covered with attractive native trees and shrubs. Every city should try to secure for posterity an attractive native woodlands. It is not so important to develop the park by introducing carefully kept lawns and flower beds, but it is important to retain the native growth.*
>
> -- O. C. Simonds. Letter to the Ann Arbor Parks Commission, 1905.

The open and picturesque oak-hickory forest, the connections to the riverside, and the view of the hilltops provided by Cedar Bend Park and adjacent Island Park soon became favorite recreational sites for Ann Arbor residents. The narrow road that curved into switchbacks up the slope soon became know as "Lover's Lane" offering romantic views of the river valley. Remnants of the old gazebo at the turnout at the top of the hill can still be found. (City of Ann Arbor, 1999)

The full realization of the 1905 Parks Commission Report was not realized during this era; however, a significant amount of work was done in this decade. By 1911, the foundation for the Ann Arbor riverside park system had been laid with roads and trails providing access to what today consists of Fuller, Broadway, Riverside, Island, and Cedar Bend parks (Scobey et al., 2008).

Land Uses Today

Overlaying the complexity of political boundaries, property ownership, regulations, and policies; human impacts on the land patterns within the watershed have significant affects on the Huron River. Human developments have fragmented the original vegetative cover, created significantly more impervious cover, and affected drainage patterns, erosion, water quality and habitat connectivity associated with the river.

Upper / Middle Huron Watershed Scale

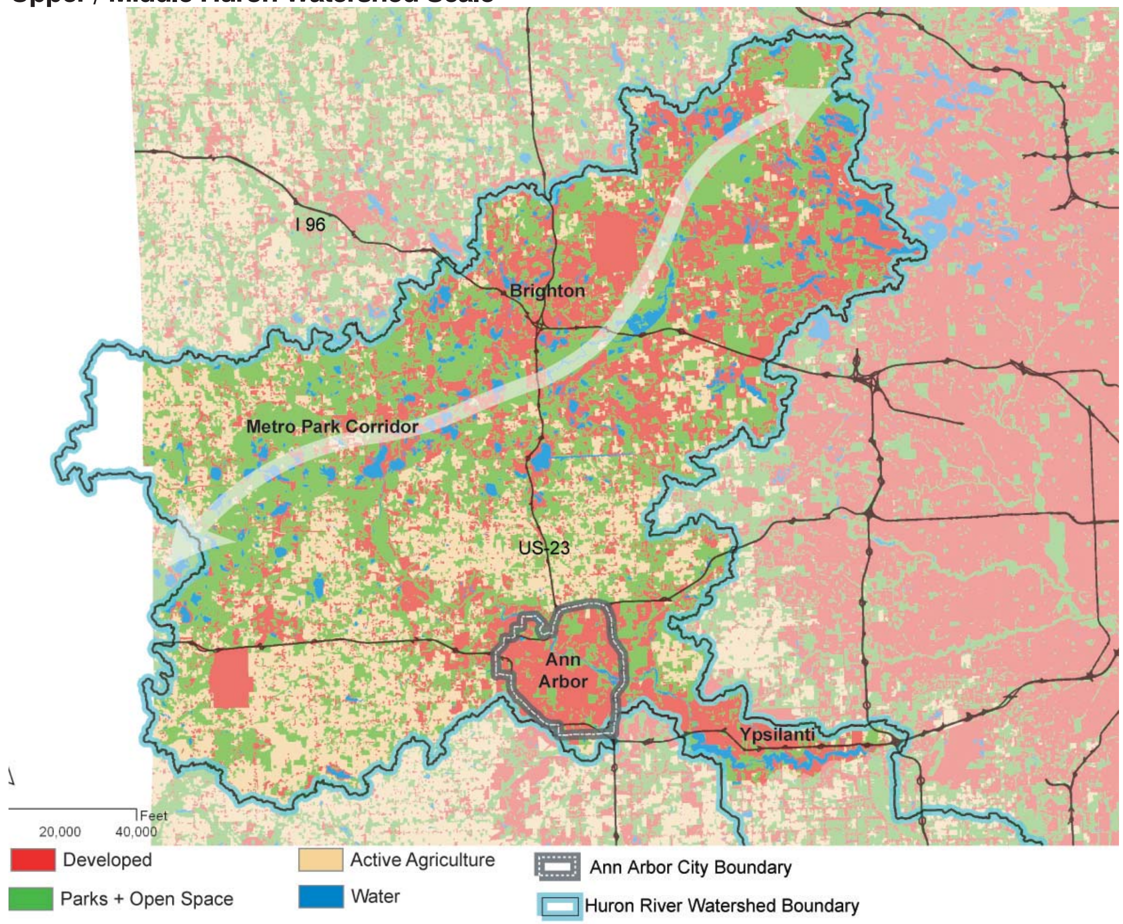


Figure 16: Watershed Scale-Upper/Middle Huron Land Use (2000)
Source: SEMCOG, 2007

The Upper Huron River is generally less developed than Ann Arbor except for a few smaller urban centers such as Brighton in Livingston County. An extensive park network, the Huron-Clinton Metro Park, and natural habitat areas traverse through the upper watershed, forming part of a regionally important ecological system. The Metropark system spreads through Livingston, Macomb, Oakland, Washtenaw, and Wayne counties, and includes 13 individual parks that cover approximately 24,000 acres of land. The Metropark system was first proposed in 1939 by the Michigan State Legislature and approved in 1940. The first Metroparks opened to the public in 1942. (Huron-Clinton Metroparks, 2002).

The land uses in the Upper / Middle Huron River Watershed are presented in Figure 16 depicting South East Michigan Council of Governments (SEMCOG) data on year-2000 land use data. Generally, the band of park and natural land cover forming the Metropark system extends through the northern and western edges of the watershed, encircling a chain of lakes. Nested within this area and at the intersection of US-23 and I-96, lies the City of Brighton and a web of suburban and exurban developments. To the south of the natural land cover band is an agricultural zone that circles around the City of Ann Arbor. Ann Arbor dominates the middle stretch of the Huron River corridor and has grown into the City of Ypsilanti, which follows the Huron River to the southeast towards southern Detroit (Table 2).

Land Use	% cover
Developed	32.6
Park and natural land cover	39.6
Agriculture	22.7
Water	5.1

Table 2: Percentage of land cover within the Upper and Middle Huron River extent.

Source: SEMCOG 2000 data

Outside the Huron River Watershed boundary to the north, west, and south, agricultural land uses dominate the region. To the east of the Huron River watershed is the Detroit Metropolitan Region, an extensive amalgamation of suburban municipalities that have merged into a distinct zone. In the north east corner of the Huron River watershed, Detroit sprawl is beginning to cross into Livingston County from Oakland County. There is a strong development pressure throughout the upper watershed given the desirability of living in a rich natural and recreation area. If development is not sensitive to these conditions or does not embrace best management practices, the water quality of Huron River could be impacted. The map below shows anticipated household growth for the SEMCOG region by the city and township municipalities in the seven-county metropolitan region (SEMCOG, 2001). Much of the heaviest development is focused around Ann Arbor and around Brighton, the later of which is located within the Metropark network.

The growth predictions presented in Figure 17 are based on year-2000 projections. Since then, SEMCOG has released the report "A Region in Turbulence and Transition: The Economic and Demographic Outlook for South East Michigan through 2035" (Grimes & Fulton, 2007) which characterizes the growth and changing human environment in southeast Michigan. Figure 18 shows the anticipated population trends from 1990 through 2035. Note that southeast Michigan has already entered a

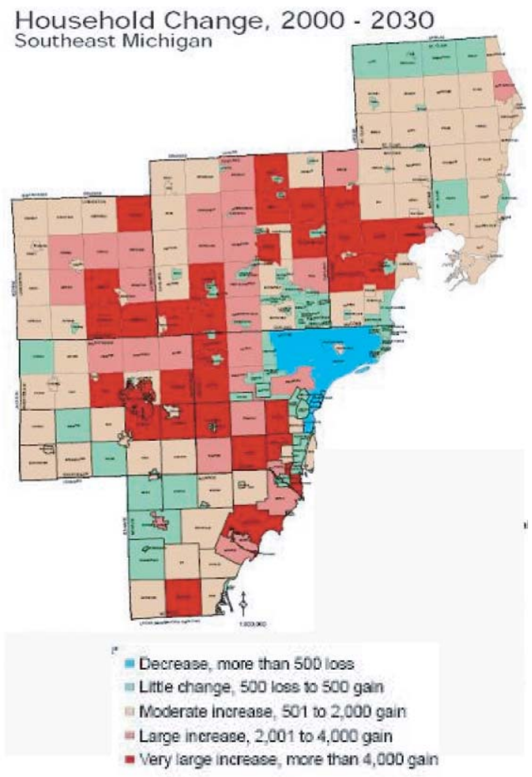


Figure 17: Projected Areas of Population Growth
Red reflects townships and municipalities that are expected to grow between 2000 and 2030. Source: SEMCOG, 2001.

period of declining population, which is expected to continue to decline until roughly 2017 in great part to loss of jobs in the area and economic instability (Grimes & Fulton, 2007).

In light of the gloomy economic forecast, Grimes & Fulton (2007) suggests that a state-wide effort to transition from a manufacturing-based economy into a knowledge-based economy that emphasizes education might prove the healthiest to the region over time. Opportunities to capitalize on an educated workforce and knowledge-based economy can be pursued at a variety of scales and certainly within Ann Arbor and the Argo Riverfront.

Creeksheds and Ann Arbor City Scale

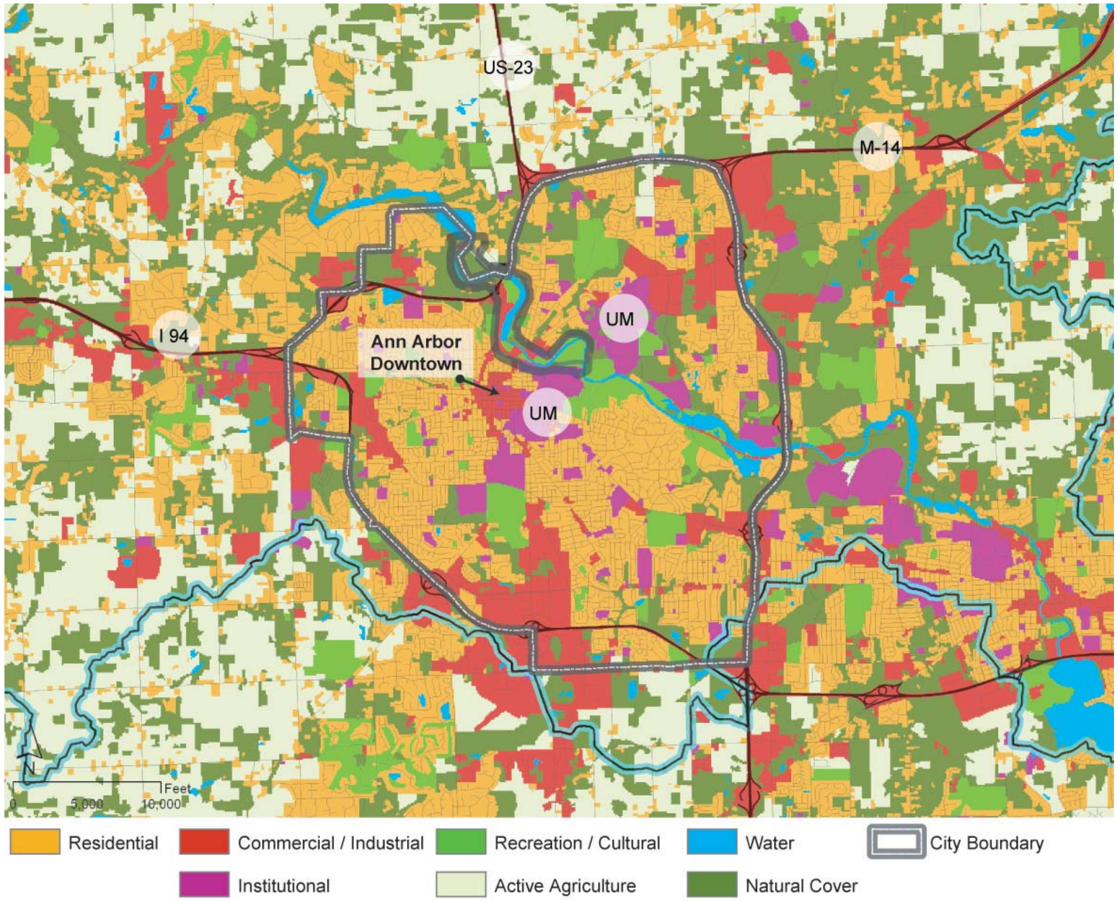


Figure 19: City Scale Ann Arbor Land Use Pattern (2000)
Source: SEMCOG, 2007

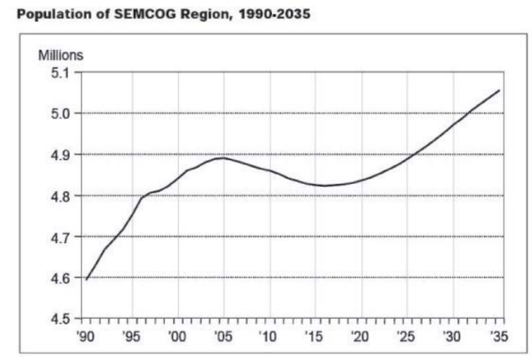


Figure 18: Population of SEMCOG Region 1990-2045
Source: Grimes & Fulton, 2007

Ann Arbor is generally delineated by three highways with US-23 running north-south, and M-14 and I-94 running east-west. Within the area defined by these highways, the land is heavily developed, with the majority of the open space existing as city operated parks. Large institutions, most notably the University of Michigan (U of M), occupy central locations within the City of Ann Arbor and straddle both sides of the Huron River, with Central Campus located to the south and North campus to the north. The downtown core of Ann Arbor is roughly in the middle of city, with additional commercial nodes oriented around major highway interchanges at the "edges" of the city.

Outside of the highway band is a mosaic of suburban expansion which is slowly replacing the agricultural landscape that has historically surrounded Ann Arbor. To the south-east of Ann Arbor, the urban fabric begins to bleed into the City of Ypsilanti, closely following the main Huron River channel as it progresses downstream.

Argo Riverfront Site Scale

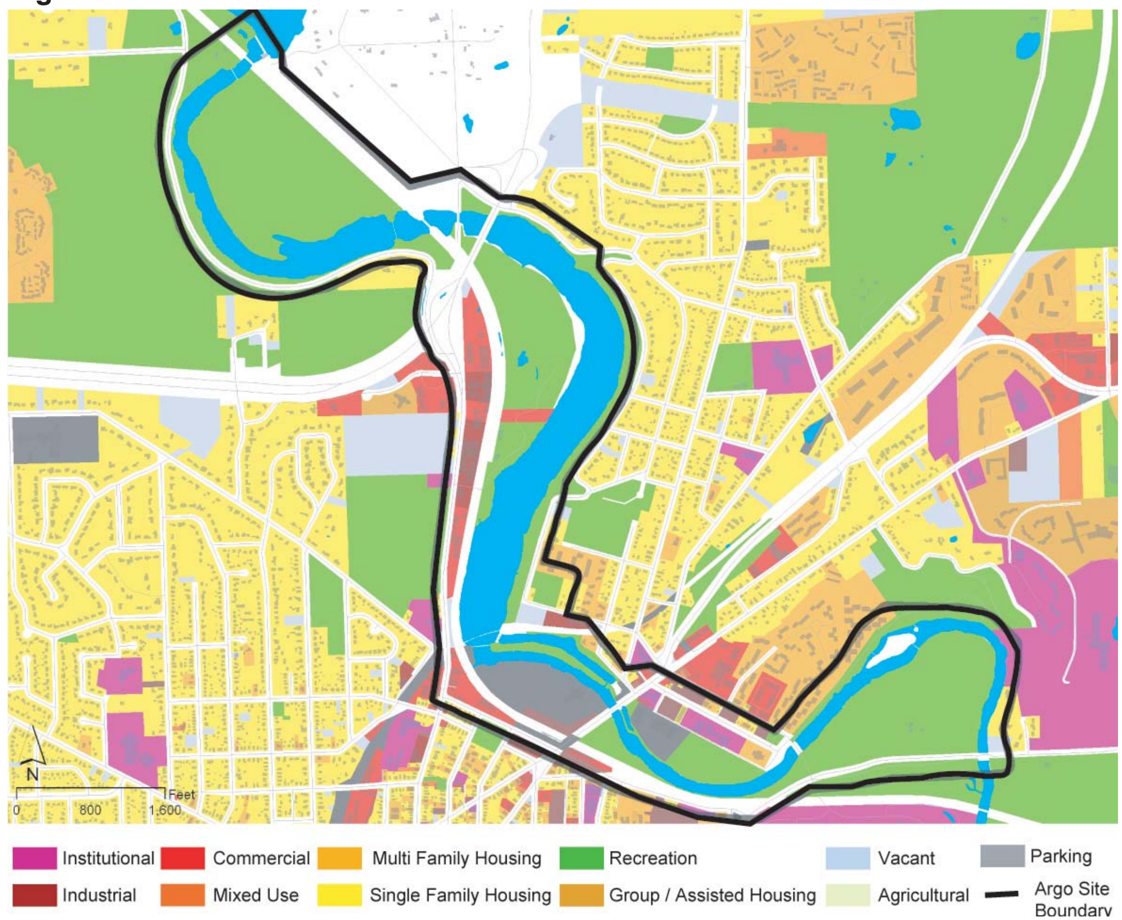


Figure 20: Site Scale. Argo Riverfront Land Use (2002)

Single family residential neighborhoods dominate the surrounding lands to the southwest and northeast of the Argo Riverfront. The downtown core of Ann Arbor, along with the University of Michigan's, Central and Medical Campuses all lie to the south of the River. The redevelopment district of Lower Town is located north of the river just downstream from Argo Dam. Source: City of Ann Arbor GIS data

Figure 21: Places of interest at the Argo Riverfront Site

The majority of the adjacent land around the Huron River is park space, with some industrial, commercial, and residential lands as well. The Argo Riverfront Site, used throughout this project, is generally delineated by the major roads and railroad lines encountered when moving away from the river channel. These boundaries were expanded in certain areas where there was an opportunity to create a stronger entrance or connection into riverside park areas.

The upper section is bounded by Barton Park to the north and the edge of Bird Hills Park to the south. Both of these parks are managed for their natural qualities by the City's Natural Areas Preservation Program (NAP). Restoration efforts are targeted in these park spaces to maintain diverse habitats. Trails loop through these park spaces, providing access for birding, hiking, and other passive low-impact activities.

The middle section, from the M-14 Bridge south to Argo Dam, is bounded by Argo Park on the east shore and Bandemer Park on the west. Bandemer Park tapers off to the south and is replaced by a corridor of industrial, commercial and office properties running along Main Street, including the New Center, home to the Huron River Watershed Council (HRWC). Bandemer Park serves a variety of functions. These include the rowing team facilities, a new disc golf course the City of Ann Arbor is currently developing, and additional natural space managed under the NAP. Across the river, Argo Park is characterized by a steep slope dropping down quickly to the river's edge. A boardwalk provides pedestrian access along the north section of the park, but transitions into a muddy path as it turns south. Argo Park is also managed for its natural qualities under the NAP.

The center reach, from Argo Dam down to the Maiden Lane Bridge is an unusual and complicated stretch of the river. The river takes a sharp bend after Argo Dam, where the Allen's Creek drain enters the Huron River. Just south of Broadway Bridge is "841 Broadway", the location of the Detroit Edison Company (DTE) brownfield property. North of the river at this point, contains the earthen embankment and mill race infrastructure once used to generate hydropower. After the Broadway Bridge, both sides of the river are again lined with park space, Broadway Park to the south and Riverside Park to the north. Both of these parks provide open lawn space for casual or programmed recreational activities. Riverside Park in particular contains play structures and a baseball diamond.

The lower reach, from Maiden Lane to the Fuller Bridge, is characterized by a large bend in the river that curves around Fuller Park to the south, a hub for soccer within the city, and Island Park and Cedar Bend Park on the northern bank of the river. Island Park forms a series of small islands within the main channel of the Huron, and is a popular picnic destination and a place for casual recreation. Adjacent to Island Park is a large multi-family residential development. Cedar Bend Park is an NAP managed park and also an O.C. Simonds historical landscape site currently targeted for restoration activities. After the river passes Cedar Bend Park, it touches part of the U of M North Campus property, before continuing onward outside of the project site.

Terrestrial Habitat and Natural Communities

Upper / Middle Huron Watershed Scale

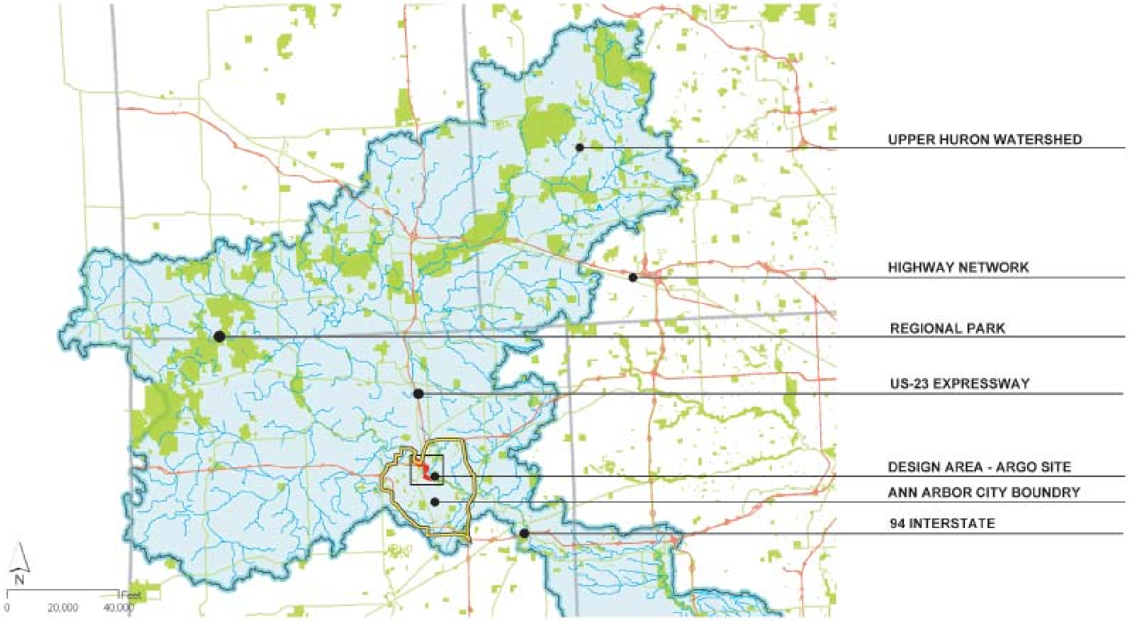


Figure 22: Watershed Scale - Historic Land Cover Prior to European Settlement
Surveyed Between 1816-1856. Source: SEMCOG, 2000

At the Watershed Scale there are woodlands, prairies, and other open spaces which provide habitat for more than 100 species of mammals, birds, reptiles, and amphibians (HRWC, 2006a). These habitats are fairly well connected by the metropark and the Huron River corridor; however, there are still opportunities for increased connectivity for species.

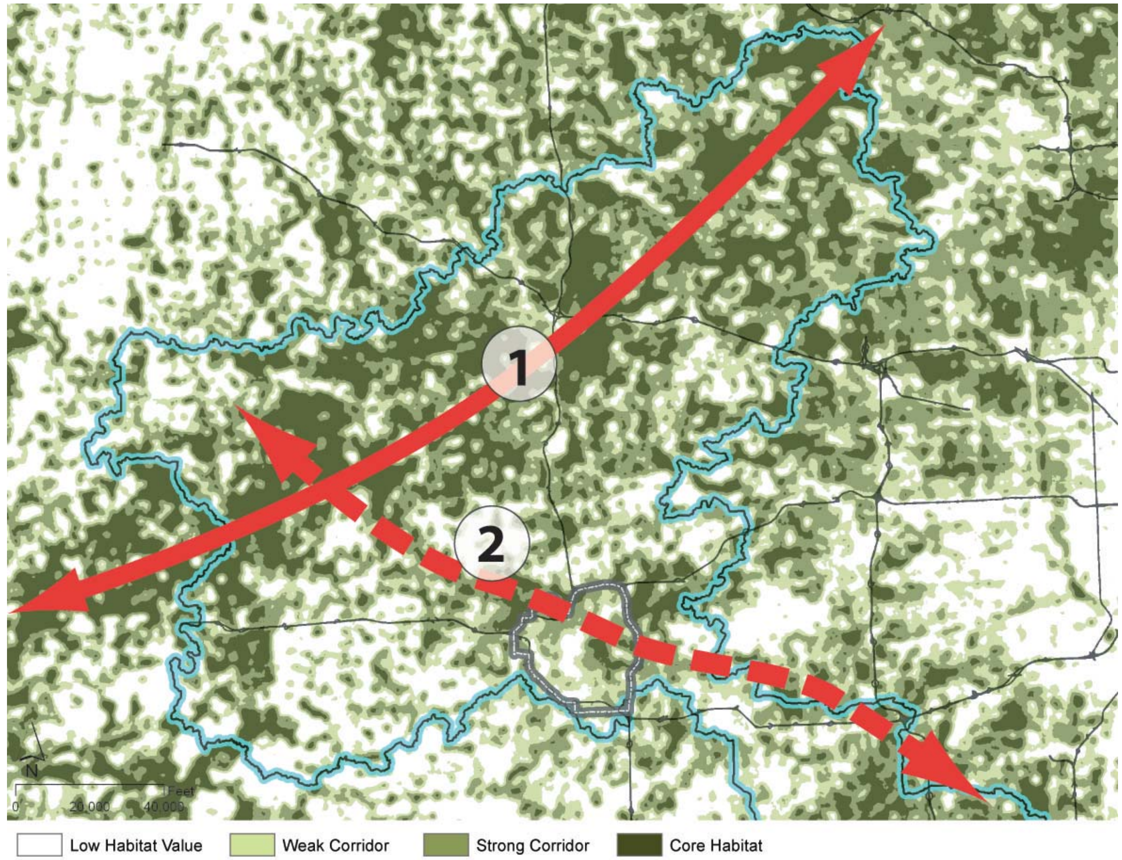


Figure 23: Watershed Scale - Upper/Middle Huron River Habitat Connectivity.
This map shows the gradient of the natural cover connectivity in and around the Huron River Watershed. Darker green illustrates the area where natural cover is more connected. On the other hand, lighter green illustrates the area where natural cover is less connected and fragmented. This analysis was generated using a neighborhood analysis in ArcGIS with 1/4 mile radius. Source: MGDL, 2007

Creeksheds and Ann Arbor City Scale

At the Ann Arbor City Scale, the land cover near the Huron River was historically dominated by oak openings (sometimes referred to in literature as oak barrens) and oak hickory forests, both which thrived on the well drained soils (SEMCOG, 2000). According to original General Land Office (GLO) (1819) land cover surveys/plat maps conducted in Michigan between 1816 and 1856, the Argo Riverfront site was mapped as oak-hickory forest. The Allen Creek floodplain was comprised of oak barrens and wet prairies.

Today however, these areas are fragmented by human development. Currently, two core habitat areas are found along the Ann Arbor reach of the Huron River Corridor, one centered on Bird Hills Park and Barton Park and the other centered on the Nichols Arboretum, Furstenberg Park and parts of Gallup Park, just downstream of Fuller Park. The core habitat provided by these parks includes heterogeneous landscape communities suitable for a variety of species. The plant communities within these park including emergent marsh, wet meadow, wet prairie, dry prairie, old field, wet shrubland, dry shrubland, wet forest, mesic forest, and dry forest (City of Ann Arbor, 1999). Between these two habitat cores, the area along the main stem of the Huron River appears highly fragmented. From Argo Dam to the Fuller Bridge, habitat is patchy, and what open space exists is highly homogenous with large areas of turf grass that provide little habitat value.

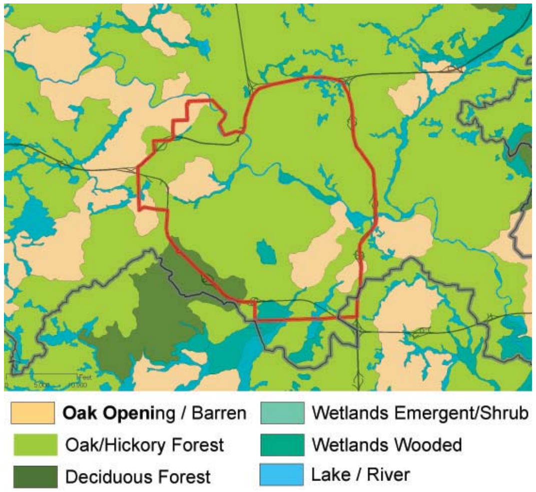


Figure 24: City Scale - Historic Land Cover Prior to European Settlement
Surveyed Between 1816-1856. Source: SEMCOG, 2000

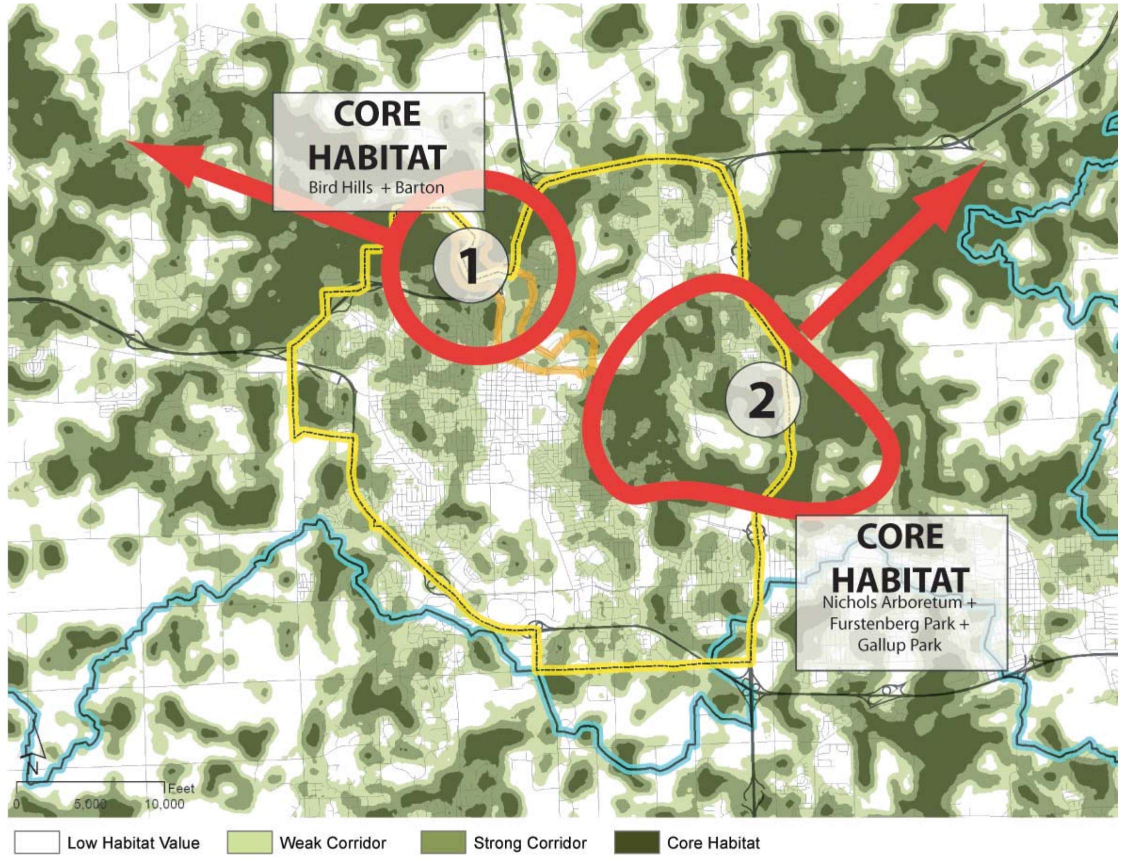


Figure 25: City Scale - Creeksheds and Ann Arbor Habitat Connectivity.
This map shows the gradient of the natural cover connectivity in and around the Huron River Watershed. Darker green illustrates the area where natural cover is more connected. On the other hand, lighter green illustrates the area where natural cover is less connected and fragmented. This analysis was generated using a neighborhood analysis in ArcGIS with 1/8 mile. Source: MGDL, 2007

Argo Riverfront Site Scale

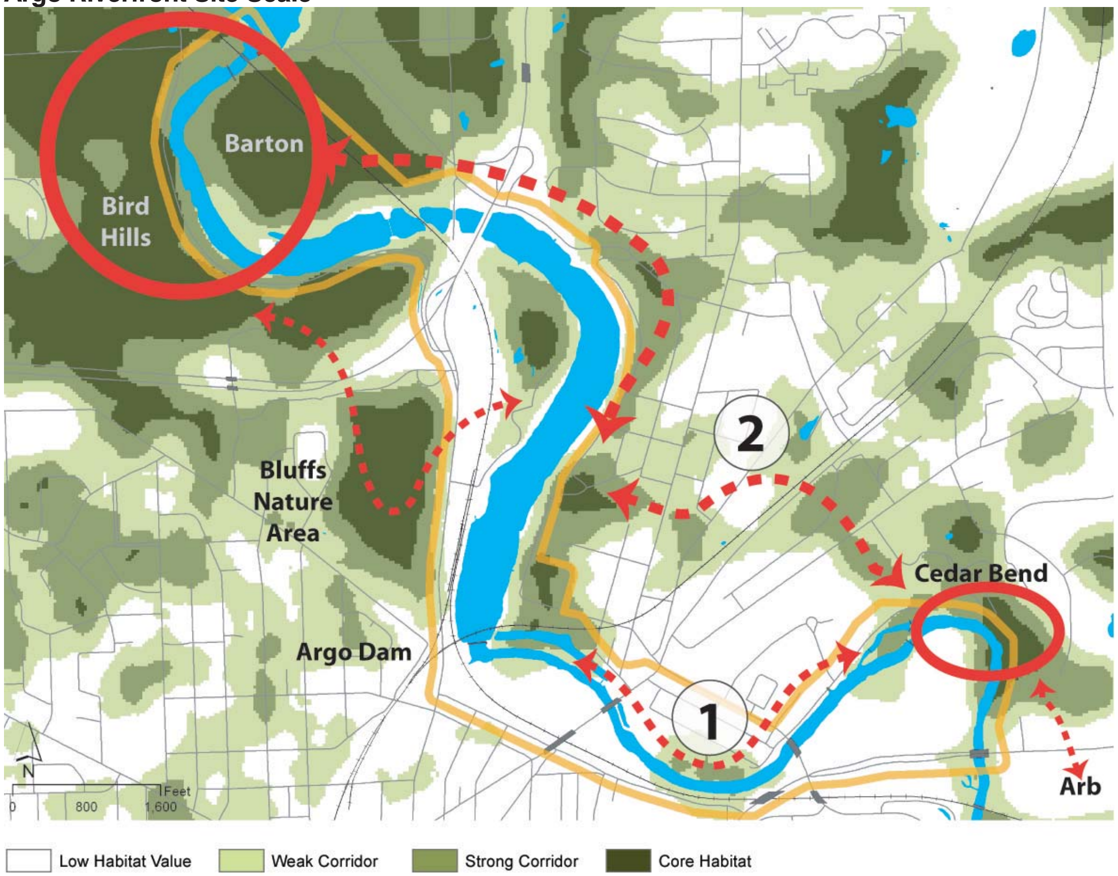


Figure 26: Site Scale - Argo Riverfront Habitat Connectivity
This map shows the gradient of the natural cover connectivity in and around the Huron River Watershed. Darker green illustrates the area where natural cover is more connected. On the other hand, lighter green illustrates the area where natural cover is less connected and fragmented. This analysis was generated using a neighborhood analysis in ArcGIS with 1/16 mile radius. Source: MGDL, 2007

The Argo Riverfront Site Scale, especially from the Argo Dam to the Fuller Bridge, is one of the key segments for improving habitat connectivity along the Huron River within the Ann Arbor area. Opportunities for connecting through this segment include:

- Continue to implement restoration or protection practices on existing natural areas in order to expand existing core habitat and enhance ecological function of existing habitat core.
- Consider neighborhood backyard habitat programs that allow connections through the existing residential neighborhoods.
- Enhance the riparian corridor and wetland habitat from Argo Dam downstream towards Cedar Bend Park.

Wetland and riparian areas are increasingly of interest to the public as there is more recognition of the vital services that these areas can provide. Communities increasingly protect, restore, and re-create these areas to regain lost functions. For instance, wetlands provide a variety of ecosystem services such as wildlife habitat, stormwater filtering and storage, waste and pollutant uptake, and aesthetic interest. Riparian areas along the banks of rivers help filter overland stormwater flows before entering rivers, thereby protecting banks from more severe erosion and costly restructuring. They also provide corridors for fauna to move up and down the river; improve the water quality by shading and lowering temperatures; and contribute to the formation of woody debris along the banks.

The Argo Riverfront Site has a diversity of wetland and riparian communities. The City of Ann Arbor's Natural Areas Preservation's (1999) publication "Along the Huron: Natural Communities of the Huron River Corridor in Ann Arbor, Michigan" describes the natural areas in the project site which include Barton, Bird Hills, Bandemer, Kuebler Langford, Argo, and Cedar Bend Parks. The main ecological communities described by the City of Ann Arbor's NAP Division (1999) include:

Emergent Marsh – Found along pond, river and stream edges. Characterized by non-woody plants growing year-round in standing water while growing upright out of the water. Diversity of damselflies and dragonflies, frogs and turtles, birds, and muskrats. Emergent Marsh wetlands are found in Barton, Bird Hills, and Argo Park.

Wet Meadow – Found in low moist areas, with standing water common in spring and early summer, but not otherwise year-round. Sedges are the dominant plant species, with the vegetation community providing habitat for butterflies and other special insects, variety of birds, and small mammals. Wet meadows are found in Barton and Bandemer.

Dry Prairies – Open areas of vegetation dominated by grasses, dry prairies feature well-drained soils that support tall grasses and perennial species. Prairies are increasingly seen as an aesthetic amenity and an inspiration for many natural habitat gardens. Natural dry prairie habitat exists in Barton and Bandemer as well.

Old Field – Relatively open sites with grasses, wildflowers, and scattered shrub species. Community forms when agricultural lands are abandoned, allowing natural and invasive species to re-colonize.

Old Field sites present challenging restoration problems, and can be seen in Barton, Bird Hills, Bandemer, and Kuebler-Langford Parks.

Wet Shrublands – Thick with woody species in areas with seasonally standing water and often adjacent to water features and other wetlands. Many shrub species are used by birds for nesting, such the Indigo Bunting, Gray Catbird, Yellow Warbler, and Willow Flycatcher. Wet Shrublands are found in Barton and Bandemer Parks.

Wet Forests – Found in flat, poorly drained bottomlands along streams and rivers. Typically floods in the spring and contains tall trees with a dense canopy. Found in Barton and Bird Hills Parks.

Mesic Forests – Occurs in better drained areas but supplied with ample moisture. Mostly closed canopy with a thriving multi-layered understory. Examples of mesic forest can be found in Barton, Bird Hills, Bandemer, Argo, and Kuebler-LangfordParks.

Dry Forests – Found in well-drained areas, with relatively open canopies. Tend to be dominated by Oaks and related species. Particularly open examples of dry forests are considered oak openings or savannas, a rare but historically special vegetation community. Dry forests can be found in Argo, Kuebler-Langford, and Cedar Bend Parks.

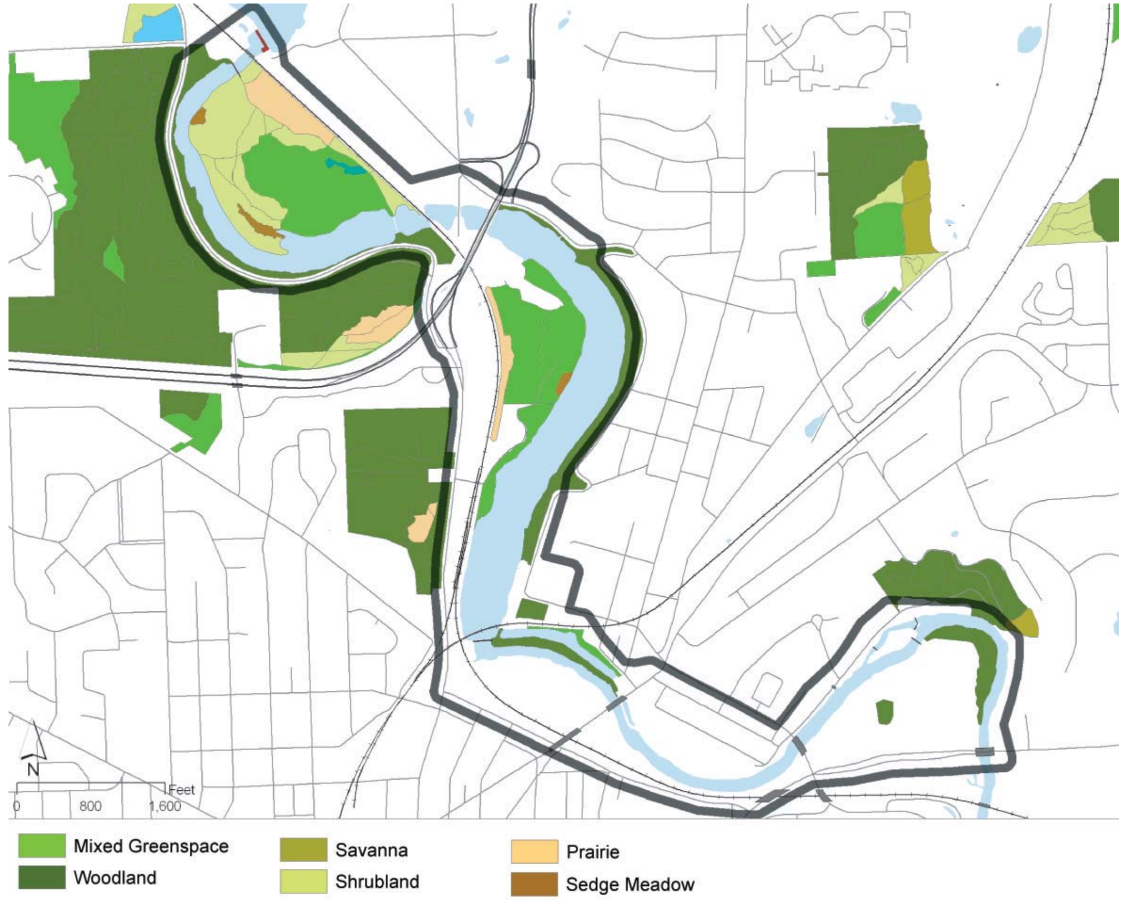


Figure 27: Map of Natural Areas with Habitat Types

These habitat areas are based on the identified management areas of Ann Arbor's Natural Areas Preservation (NAP) group. There are some differences in the labeling between this GIS information and the more specific plant communities identified in the Along the Huron resource book. Source: City of Ann Arbor GIS data

The designated and managed natural areas constitute a majority of the Argo Riverfront's shoreline. These natural areas certainly play an important role in protecting the health and natural quality of the river. However, there are areas between these managed lands, some of it formally developed park space, which has less developed natural vegetation and is an opportunity to further expand the riparian habitat. Specific areas include:

- The northern shore of Argo Pond along Barton Drive near the M-14 exit.

- The western shore of Argo Pond south of Bandemer and north of Argo Dam.
- Along the Detroit Edison Company (DTE) property at 841 Broadway.
- City parkland at Broadway Park, Riverside Park, Fuller Park, and Island Park.
- On the west bank of the Huron River along Island Drive.
- The southern bank of the Huron River across from Riverside Park.

Additionally, Figure 28 details the park lands that have been identified as a restoration priority. Typically, areas that are dominated by native populations of organisms will have a higher priority than lands that are already overrun with exotic species. This system insures that high quality habitat will remain high quality and is diligently attended to by restoration crews. This map will allow restoration efforts to be efficiently maximized and will guide decisions about where preservation or restoration should occur versus other activities. In combination with this restoration priority map, *Appendix 1: Species of Special Concern in the Argo Riverfront Site Park lands* can be used to redirect restoration towards a species of interest, be it an endangered or rare species to the area or perhaps highlight a non-native or exotic species that is relied upon by a species of concern.

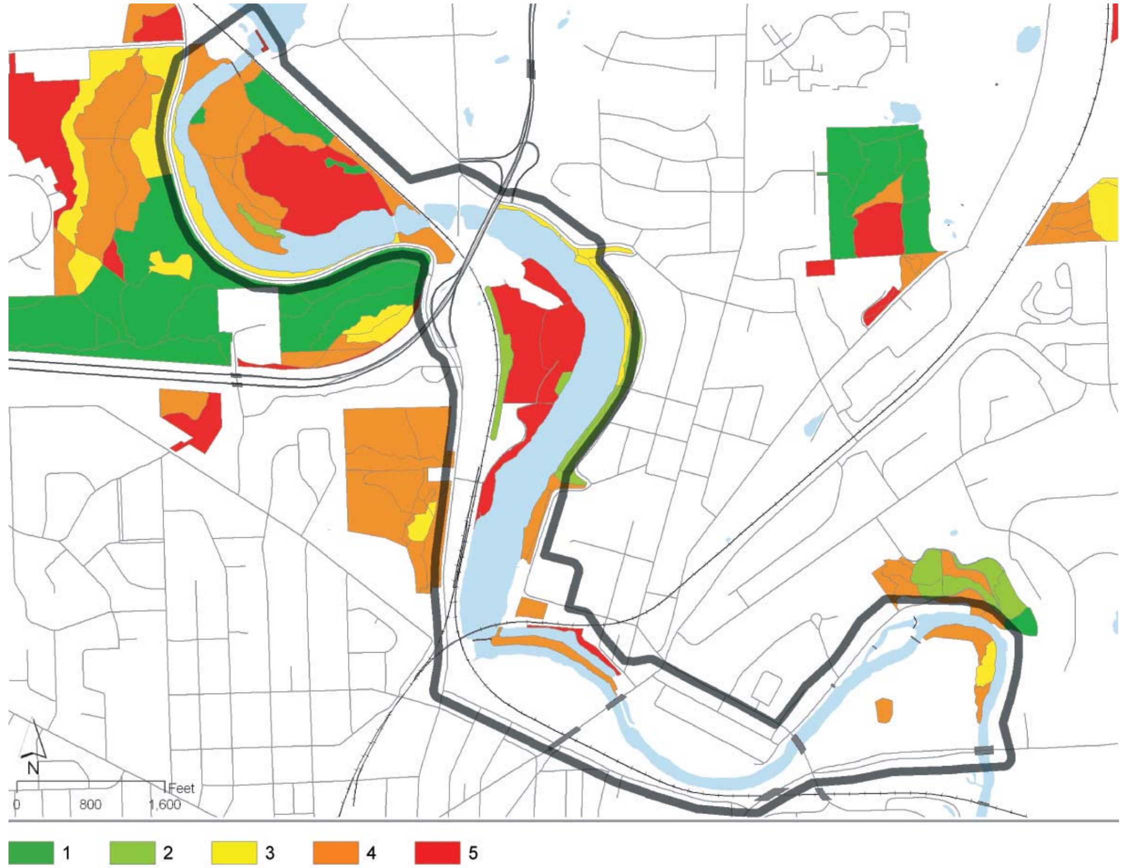


Figure 28: Restoration Priority Area Map
Priority areas are ranked from 1=Highest Restoration Priority. to 5= Lowest Restoration Priority
Source: City of Ann Arbor GIS data

Aquatic Habitat: Historic and Current Biodiversity

Aquatic habitat has been heavily impacted by the changes that have been made to the river's hydrology. Dams, such as Argo Dam, have created barriers to connectivity as well as altered the speed of flow, temperatures, substrates, sedimentation patterns, and nutrient transport of the Huron River. These impacts have a cumulative effect on the species diversity and population trends of aquatic organisms.

Fish Populations

Except for Mill Creek, all tributaries of the Huron are listed as second quality warm water areas (MDNR, 1995). Mill Creek was listed as top quality warm water, but should probably be reclassified (MDNR, 1993). The Michigan Department of Natural Resources (MDNR) generally views the Huron River as a high quality warm water fishery with some tributaries cold enough to support a 2nd quality trout fishery (MDNR, 2002). At least 99 species of fish are present in the river (MDNR, 1995). Five native species are threatened (silver shiner, redside dace, southern redbelly dace, eastern sand darter, and sauger) and one native species is endangered (northern madtom catfish). Through both intentional and accidental introductions, 12 non-native fish species have entered the river system. From 1972 to 1974, all the impoundments in Ann Arbor were treated with rotentone to eliminate common carp and non-game species (Carl, 1982). From the late 1970s onward, the MDNR has actively stocked the Huron River with a variety of game and cold water fish. Through the 1980s, the MDNR stocked the river with an average of 30-40 thousand coho salmon a year. Currently the MDNR tends to stock steelhead trout fingerlings.

Surveys conducted by the MDNR Institute for Fisheries Research (IFR) in Fleming Creek in 2001 and Mill Creek in 2002 show a number of fast and well oxygenated water indicator species such as creek chub and mottled sculpin (*Appendix 2: Fish Presence in Argo Area*). Infante (2005) sampled five sites in Mill Creek and two sites in Fleming Creek. Four of her five Mill Creek sites were dominated by mottled sculpins, while the fifth was dominated by creek chub and white suckers. Fleming Creek tended to have more diverse fish assemblages, but mottled sculpins and creek chub were also the most common fish in those sites. Data collected by the IFR from Argo Pond in 2002 however, indicate a much less diverse fish assemblage dominated by bluegills. Table 3 shows that even though Argo Pond has a higher species richness than the two creeks, it has poorer diversity scores than the two creeks. These results may also underestimate the number of invasive common carp, *Cyprinus carpio*, present in the pond (David Allan, personal communication, 2008).

United States Geological Survey (USGS) gages (Figure 29 and Figure 30) show that the river is much flashier (has a higher rate of flow change) by the gage just downstream of Argo Dam than an upstream gage by Dexter with similar discharge levels. The USGS stopped operating the Dexter gage after 1977. The negative effect, that changing flow regimes from natural seasonal cycles to regulated regimes has on fish communities has been well documented (Grabowski and Iseley, 2007, Almodovar and Nicola 1999, and Bain et al. 1988). If the impoundment were removed, it is likely that the species represented would be more similar to the upstream community present in Mill Creek (David Allan, Personal Communication 2007). Additionally, if the dam were to be removed, the city is looking at the feasibility of establishing a cold water fishery in this area by releasing cooler water from the hypolimnion (deeper stratified water) in Barton Pond during the warmer summer months.

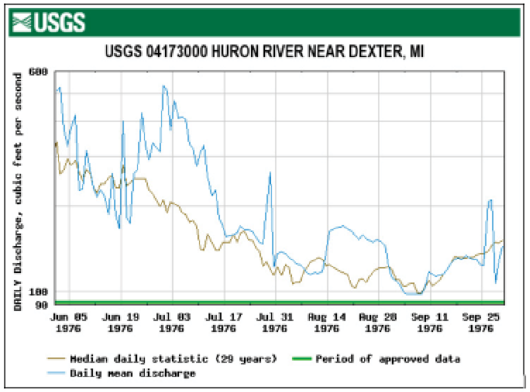


Figure 29: Hydrograph from USGS gage near Dexter.
Source: USGS, 2008b-Nation

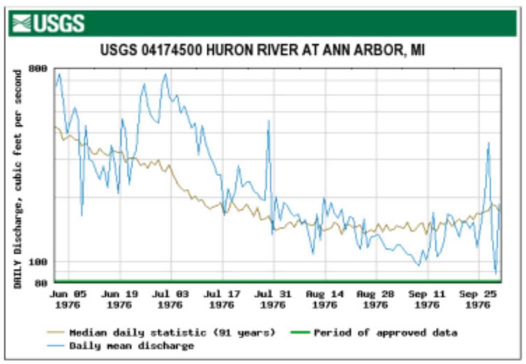


Figure 30: Hydrograph from USGS gage near Argo Dam.
Source: USGS, 2008b-Nation

	Fleming Creek	Mill Creek	Argo Pond
Species Richness	10	16	18
Shannon/Weiner	1.52	1.61	1.29
Simpson D	0.26	0.26	0.48

Table 3: Measures of Fish Diversity in 2 Upstream Tributaries of the Huron River and Argo Pond
Shannon-Weiner Index: Water quality based on fish species. Range 0-5 (<1=Polluted, 1-3=Moderately Polluted, 3-5=Clean
Simpson D Index: Probability any two individuals picked at random are from same species. Range 0-1 (0=Less Likely/ Infinite Diversity, 1=More Likely/No Diversity)

Invertebrate populations

Due to their relatively immobile larval stage and often limited range of pollution tolerances, aquatic invertebrates can be very useful in identifying the levels of pollution in river ecosystems and potential impacts to fish populations and other aquatic organisms (Hilsenhoff, 1988). In 1992, a Surface Water Quality Division (SWQD) survey of macro-invertebrates was conducted (Anon 1991, MDNR 1993). Fifteen sites on the main branch of the Huron were tested and all but the most upstream site was rated as slightly to moderately impaired. Starting in 2001, the Huron River Watershed Council (HRWC) has conducted yearly fall and spring invertebrate surveys as part of its *Adopt-a-Stream Program*. Invertebrates were identified to family level and Ephemeroptera, Plecoptera, and Trichoptera (EPT) Index Scores were generated from the number of different families found that were in the Ephemeroptera (mayfly), Plecoptera (stonefly), and Trichoptera (caddisfly) orders. Mayflies, stoneflies, and caddisflies, generally tend to be less tolerant of organic pollution, low oxygen, slow flows, and higher temperatures. They are therefore often used as indicators of good water quality. Figure 31 shows that many upstream locations have invertebrate communities that are intolerant to organic pollution, but in the Creeksheds and Ann Arbor City Scale (Figure 32), EPT scores tend to be lower indicating poorer water quality. Increasing flow rates in the Argo area could improve EPT values, especially if associated with additional substrate heterogeneity and woody debris.

Aquatic vegetation

Macrophytes occur throughout the Huron River, including the free flowing lotic environments upstream of Barton Dam. Rooted, submerged plants are common in lotic environments where the current has slowed and fine-grained soils are present (Cushing and Allan 2001). However, the more lentic, or standing water, habitats created by impoundments are often characterized by both increased biomass and diversity of macrophytic organisms. Several of these are considered invasive species such as purple loosestrife, Eurasian milfoil, and curly leaf pondweed. The latter two species can often form dense mats of sub-surface vegetation that interfere with recreational activities such as fishing, swimming and boating

(Eggers and Reed, 1987). Additionally, when dense colonies of macrophytes occur, they can impact ecosystem processes and result in changes in physical processes such as increased sedimentation and fluctuations of temperature. They can also affect daily fluctuations of chemical parameters such as oxygen, pH, and nutrient cycling rates. Finally they are apt to increase microbial activity (Wetzel, 2001; Cooke et al., 2005; Holdren et al., 2001).

In the Limno-tech study, the definition for the presence of a "nuisance condition" was that "the species totally dominates . . . by forming dense low-growing meadows or impenetrable surface mats of vegetation"(Limno-tech, 2007 pg. 5). A September 2006 survey (Limno-tech, 2007), found nuisance conditions in 16% and 30% of Barton and Geddes Ponds areas respectively. In contrast, Argo Pond had relatively low nuisance conditions of only 4% of its surface area. However, this is probably because Argo is the only impoundment that undergoes regular maintenance (cutting/mowing of emergent vegetation) to facilitate recreational rowing. Additionally, these percentages are likely to be substantially under representative of the actual condition there due to their sampling methodology. Overall Limno-tech calculated a community quality rank of 4.1 for the Argo impoundment (Southeastern Michigan lakes typically have community quality values between 4.0 and 6.5). This is indicative of a community dominated by invasive and opportunistic species such as Eurasian milfoil and coontail (Limno-tech, 2007).

A variety of control mechanisms limit aquatic vegetation with both mixed efficacy and cost. If the Argo Dam were removed, the occurrence of nuisance colonies of aquatic vegetation would certainly decrease due to the relatively high gradient and water velocities. Management techniques commonly used to manage nuisance levels of aquatic vegetation are usually divided into 4 categories:

- physical/mechanical methods
- chemical methods
- biological methods
- environmental methods

Mechanical harvesting currently occurs in Argo Pond; however, the cuttings are usually not removed from the impoundment, but instead accumulate on the bottom of the reservoir which further fills in the impoundment. Limno-tech suggested disposing of the cuttings offsite. Chemical and biological control methods were not encouraged by Limno-tech due to their specificity and the likelihood that new species would colonize to take over the niche left behind by the targeted species. Environmental methods that could be used in Argo Pond include dredging, drawdown and dam removal.

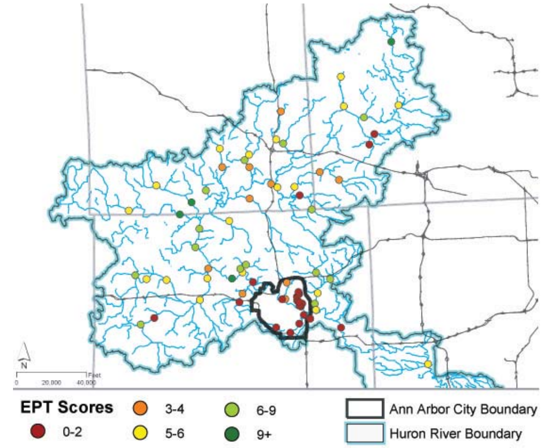


Figure 31: EPT Values for 70 sites in the Huron River Watershed.
Higher values indicate invertebrate communities with lower pollution tolerances. Source: HRWC, 2005

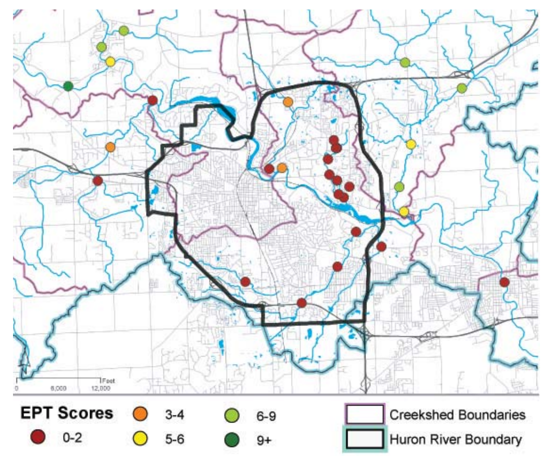


Figure 32: EPT Scores for Sites Within the Ann Arbor City and Creeksheds Scale.
Higher values indicate invertebrate communities with lower pollution tolerances. Source: HRWC, 2005

Chapter 3 – Management and Policy Issues

Dams and Impoundments

Argo Dam is one of nineteen dams along the main stem of the Huron River and one of 96 found within the entire reach of the Huron River watershed. Argo Dam is 18 feet high and1,940 feet long, of which 190 feet constitutes the spillway and gates and 1,750 feet an earthen embankment. The impoundment behind Argo Dam is about 94 acres and extends roughly one mile upstream. Argo Dam has a high hazard risk rating due to its urban location and large impoundment, both of which raise safety concerns among city officials (U.S. Army Corps of Engineers, 2004). High hazard ratings are assigned to dams whose failure would likely result in loss of life and major property damage. The Detroit Edison Company (DTE) brownfield site at 841 Broadway, just below the spillway, poses a contamination risk in the advent of severe flooding. Unfortunately, Argo Dam is of limited use for flood control as the impoundment is maintained at maximum water level and the dam has a limited ability to control release rates (Matt Naud, personal communication, April 6, 2006).

In 1995, Argo Dam was identified in the Michigan Department of Natural Resources (MDNR) Huron River Assessment (HRA) as a candidate for removal to restore high-gradient fluvial habitat, especially since it no longer serves its original purpose of hydropower generation (MDNR, 1995). Restoring the gradient at Argo would recapture a locally rare river type, as many high-gradient stretches in Lower Michigan are submerged behind dams. Argo Dam was identified as an extreme case of a dam contributing to large fluctuations in the downstream flow regime (Blumer, 2003). Furthermore, if the dam is removed and the impoundment drained, approximately 50 acres of land would be exposed and available to the city to develop as park land (Adams et al., 2004).

The Huron River Watershed Council (HRWC) has been working with the City of Ann Arbor over the past decade to discuss the removal of Argo Dam and beginning to examine key questions affecting the decision. Previous studies have identified dam removal as possible as there does not appear to be contamination of the sediment trapped behind the dam. Previous research at the School of Natural Resources and the Environment examined the social benefits and change in ecological value for the dam. The results of that project indicate that the residents of Ann Arbor could benefit from dam removal, and recommend pursuing such options (Adams et al., 2004, Helfand et al., 2007).

Considering direct benefits and costs to removal, it is often cheaper to remove a dam structure rather than pay on-going maintenance costs, especially when dam operators are faced with re-licensing or a major repair cost. Presently, maintaining Argo Dam costs the city $15,000 a year, $45,000 every five years, and an additional $140,000 every 15-20 years for routine maintenance work (Adams et. al. 2004). These costs do not include larger scale renovations that are needed at longer time scales. Helfand et al. (2007, unpublished manuscript) estimated the removal cost of the Argo Dam structure itself at $146,000, with another $180,000 for bank stabilization and riparian management following removal. This estimation was done in 2005 and therefore these figures do not account for inflation. Clearly, the long-term savings favor dam removal. Additionally, the city currently faces the prospect of rebuilding the toe-drains along the earthen embankment at Argo Dam, a cost which could exceed $400,000 dollars. Given the choice between paying for the toe-drain repairs and removing the dam, the economics again favor removal.

Many facets of the Argo Dam are management challenges. The City of Ann Arbor is required to pay on-going maintenance costs which may soon exceed even the costs of a possible removal. Since the dam does not serve as an energy or revenue source its value lies in the limited recreation functions that the impoundment provides. Removing the dam allows the channel to be reconfigured, which can be redesigned to accomplish many different goals. There is an opportunity to restore riparian habitat and improve the aquatic habitat within the Huron River. In addition, the high gradient of this reach of the river could provide alternative recreational outlets currently unavailable in the area.

The process for removing small dams, those typically less than 25 feet in height, is generally fairly straight forward (American Rivers, 2002; Graber et al., 2001). However, issues of sediment mobility, channel erosion, habitat impacts, and exotic species invasion, must be carefully addressed by the removal plan (Graber et al., 2001). Often complex permitting processes are required to address these concerns and ensure that dam removal does not impact other infrastructure along the river channel, a significant concern in an urbanized area such as Ann Arbor (American Rivers, 2002).

Timing the dam removal is crucial to minimize impacts. The removal process should be sensitive to the life-histories of species of concern, such that stress induced by the dam removal does not coincide with critical spawning times, migration, or other higher-risk activities. Furthermore, the timing should avoid flood-prone times of year and coincide with the revegetation scheme such that sediment is not exposed for extended periods of time (Graber et al., 2001).

Removing the structure itself requires securing site access and taking safety precautions, which are typically governed through the permitting process. For smaller dams, the impoundments are typically de-watered by opening gates or modifying the dam structure. De-watering activities can take place sequentially over a longer time horizon if conditions require. The dam structure itself is typically demolished with hydraulic hammers or claws mounted onto backhoe equipment. In some circumstances explosives are needed (Graber et al., 2001).

As impoundments age, they begin to fill in with deposited sediments, which can impact the immediate and downstream ecology (Poff & Hart, 2002). Sedimentation in Argo Pond has reduced the quality of the fish habitat and contributed to increases in vegetation growth as the average pond depth decreases. Nutrient deposition in the pond is also accelerating eutrophic conditions, further degrading the habitat.

Carefully managing the sediment captured behind dams is a central issue of any dam removal scenario (American Rivers, 2002; Heinz Center, 2002; Graber et al., 2001). Dams typically trap upwards up 95% of all sediment entering the impoundment, although this estimate is less for run-of-the-river dams such as Argo Dam (Heinz Center, 2002). While the amount, type, mobility, and potential contamination of sediment are necessary information, it is worth noting that sediment dispersal is not necessarily a negative process. In many cases the downstream extents below the dam were sediment starved and unable to reach an equilibrium between sediment deposition and erosion along the banks (American Rivers, 2002). In the case of Argo Dam, limiting sediment mobility would appear to be preferred, as there are some sensitive cobble riverbed areas downstream, as well as the Geddes Pond impoundment which is already impacted by high sediment levels.

Graber et al. (2001) discusses three typical approaches to managing sediment:

- **Natural Erosion:** Sediment is allowed to naturally erode as the main channel carves a new course through the sediment bed. The volume of sediment released under this scenario is often comparable to sediment mobility during larger flood-events, to which the river can usually respond. Natural erosion is the least-cost approach, although the impacts need careful evaluation.
- **Sediment Removal:** Mechanical dredging can be used to remove sediment likely to erode prior to de-watering and dam removal. Dredging requires a careful evaluation of the likely river alignment, channel configuration, and bank stabilization. Downstream sediment traps can be constructed to slow water and drop out sediment for easier collection to remove sediment mobilized within the new channel.
- **Sediment Stabilization:** This process relies on incremental reductions in the impoundments water level, allowing exposed land to be revegetated and/or stabilized in succession. Regrading of the sediment can be incorporated to create specific bank conditions.

More often however, these techniques are all used in a combined approach that best responds to the specific site conditions. The following are many approaches utilized in actual dam removal case studies (Graber et al., 2001):

- Controlled drawdown with stabilization and acceptable levels of natural erosion.
- Removing critical sediments prior to natural erosion.
- Natural erosion with selective stabilization once river channel approaches equilibrium.
- Natural erosion with a downstream sediment trap and removal system.
- Partial sediment removal with remaining portion stabilized.
- Relocation and stabilization of selected sediment on-site.

An engineering study was conducted by Barr Engineering (2002), which estimated that 184,000 cubic yards of sediment could be dredged from the Argo impoundment. Further, this preliminary survey suggests that the sediments are not contaminated. More comprehensive analysis would be required before the permitting and approval processes. The exact method chosen for managing sediment will depend greatly on the desired functions and outcomes of the decision to remove the dam.

Contamination and Remediation

Contamination issues around the Argo Riverfront Site offer distinct challenges and opportunities to future plans for the area. Future land use, policies, construction and restoration all must consider the contaminants and the possible implications to human and ecological health. In particular, the proximity of contamination to the Huron River poses additional risks, particularly under a dam removal scenario, where high levels of disturbance can mobilize contaminants and transfer them into the river channel. Once in the channel they can be widely distributed and remediation will become more difficult. Soil, ground water, surface water, and biota are all systems of potential contaminant transfer and need to be carefully considered in planning.

Two contamination issues impact the Argo Riverfront Site. The first issue is site specific at the Detroit Edison Co. property at 841 Broadway. Facts and assumptions about this contamination directly influence design decisions at the Argo Riverfront. The other issue is the city-wide issue of 1,4-dioxane contamination in the ground water, which is an exceedingly complex and uncertain matter. Responses to the 1,4-dioxane contamination must be addressed city-wide, so it plays a secondary role to this research project. Nevertheless, it can be a key consideration for future decisions along the Argo Riverfront as more becomes known about nature of the contamination.

The site specific contamination is at the former Manufactured Gas Plant (MGP) at 841 Broadway, which has been classified by the Michigan Department of Environmental Quality (MDEQ) as a brownfield. The 14-acre parcel is classified as an Underground Storage Tank (UST) field acknowledging the former industry's practice of storing waste products such as coal tars in underground tanks (MDEQ, 2005). This plant was operated under the ownership of several different companies over time. It was acquired by MichCon in the 1940's and dismantled in the 1950's. (City of Ann Arbor, 2007b). Today it is owned by the Detroit Edison Company (DTE) after a merger with MichCon Gas Company in 2001. Current zoning classifies the site for limited industrial use. The western area of the site is undeveloped with grass cover. The eastern area is where the former MGP was located and today is used as a service facility including offices, service center, garage and parking. None of the above ground MGP structures remain (City of Ann Arbor, 2007b)

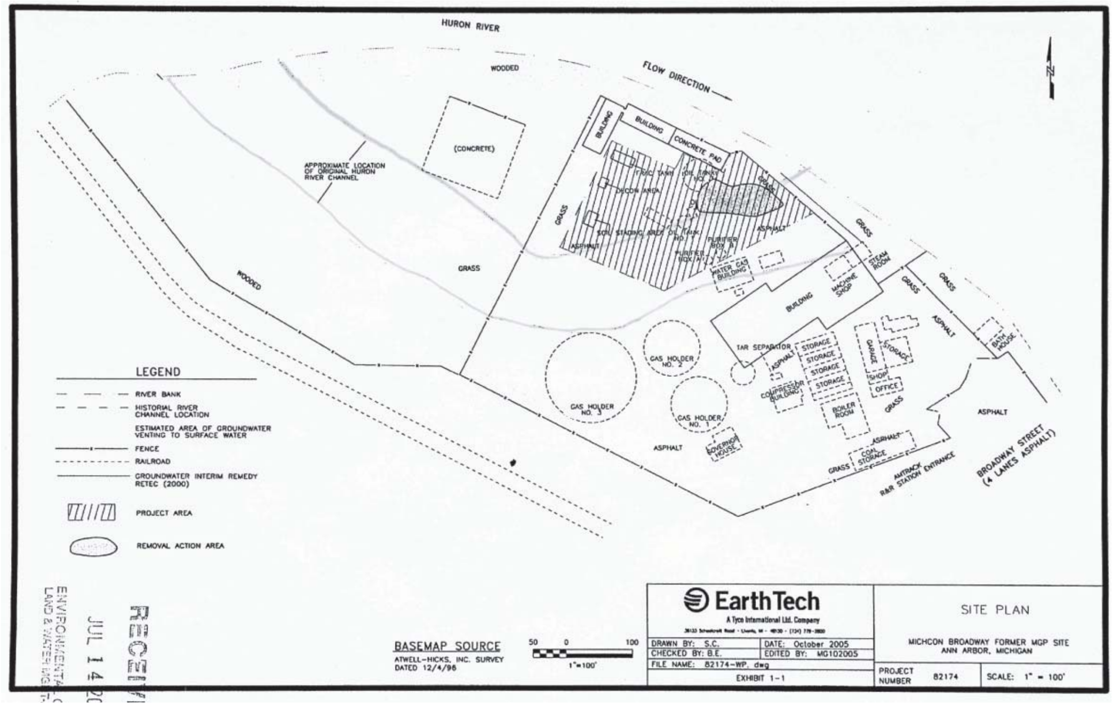


Figure 33: Site Plan for Contaminated Soil Removal in 2006-2007.
Original river channel outlined in gray on site map. Current building footprints represented with solid lines. Former MGP structures, none of which remain, are represented with dotted lines. Source: MDEQ, 2006

The initial site investigation in 1985 revealed a wide range of toxic organic and inorganic materials including benzene, toluene, ethyl benzene, xylene (BTEX), cyanaide, cadmium and nickel. Samples from the site also had very high Polynuclear Aromatic Hydrocarbons (PNA's) which were 1,000 to 100,000 times higher than expected backround levels (MDEQ, 1985).

The 1985 report recommended that the materials be removed from the soils and groundwater. The site is compared to a nearby MGP on Beakes Street that had not been in operation for 85 years and still had high contaminant levels. Based on that information, it is suggested that natural cleanup would take centuries and that "Groundwater purging without soil removal and/or induced flushing would appear inefficient" (MDEQ, 1985).

In 1996, a remedial investigation was conducted and the process included the installation of 15 monitoring wells and advancement of 24 soil borings from the previous study (City of Ann Arbor, 2007b). In 1998, tar stained soil was removed from two locations in the north central portion of the site and the southern bank of the Huron River. A total of 1,600 cubic yards of contaminated soil was removed to an off-site facility. In August 2006, a permit was issued to DTE by the MDEQ for Floodplain/Water Resource Protection related work including removal of 3,000 cubic yards of contaminated soil from the site within the 100-year floodplain of the Huron River (MDEQ, 2006).

Currently DTE has not filed a Remedial Action Plan (RAP), the full extent of contamination is unknown, and there is no plan in place to address all the aspects of site contamination. The obstacles encountered with pursuing the RAP has been that monitoring and natural processes have forced series of "emergencies" or Interim Responses which take precedence over the RAP, and have placed DTE in reactionary mode. For instance, coal tars have seeped to the surface several times since the initial site investigation in 1985 (Edwards, 1987, Vicki Katko, personal communication, February 5, 2008), requiring immediate removal or other remediation. Currently the RAP process is delayed due to the latest Interim Response resulting from the new surface level contamination. The latest soil removal operation was permitted to take place through December 2007.

Abbreviated History of the Manufactured Gas Plant at 841 Broadway	
1899	Ann Arbor Gas Company constructs MGP
1914	Washtenaw Gas Co purchases operation
1915	Washtenaw Gas and Eastern Michigan Edison negotiate relocation of the Huron River channel
1938	Washtenaw Gas properties acquired by Michigan Consolidated Gas Company (MichCon)
1955	Gasification plant dismantled
1984	Michigan Department of Environmental Quality (MDEQ) requests site investigation
1985	EDI Engineering and Science completes initial site investigation. According to investigation subsurface soils are contaminated with inorganics, heavy metals and volatile organics. Surface soils contain lower concentrations of the same contaminants. Groundwater was also contaminated with lead, nickel, mercury, zinc, arsenic, and cyanide, all above safe drinking water standards.
1995	$300,000 was appropriated from the Michigan State Environmental Protection Bond Fund for a Remedial Investigation of the site.
1996	Fluor Daniel, GTI conducts Remedial Investigation
1998	Removal of 1,680 cubic yards of tar stained soil and debris completed. Soils disposed off site as non-hazardous waste.
2000	An Exposure Pathway Analysis report is submitted to the MDEQ for review.
2006	Permit Issued by MDEQ for removal of 3,000 cubic yards of contaminated soil in floodplain. Expired Dec. 2007

Table 4: Abbreviated History of the Manufactured Gas Plant at 841 Broadway.
Sources: MDEQ, 2006.; City of Ann Arbor, 2007; MDEQ, 1985; Scobey, D., Kuras, A., & Kortesoja, K., 2008.

The second contamination source concerning this project is a groundwater contamination plume. The source of the groundwater contamination, discovered in 1985, is located higher in the watershed at Wagner Road in Ann Arbor, has been slowly been moving through the groundwater table and contaminating city wells. The contamination source site, currently owned by Pell Life Sciences (PLS), was then owned by Gelman Sciences Inc. From 1966 through 1986, Gelman Sciences produced medical filters using 1,4-dioxane as an organic solvent that is most often used as a stabilizer in chlorinated solvents (MDEQ, 2004). The compound 1,4-dioxane is completely soluble in water and is held together by

Figure 34: 1,4-dioxane plume and area wells
Sources: Michigan Center for Geographical Information Pall Life Sciences Department of Environmental Affairs Well Database January 5th 2004 and Washtenaw County Michigan, Department of Environmental Health Regulation

strong bonds that prevent it from breaking down readily in groundwater. High doses of 1,4-dioxane have been shown to cause cancer in mice and it is presumed to be a human carcinogen through long-term exposure to low doses (MHSRC, 2004).

Since 1997, PLS has continuously operated a comprehensive groundwater remediation system, one of the largest groundwater purging remediation in the state, to address the known groundwater contamination present in two relatively shallow underground aquifers. As of 2004, PLS has treated over 2.2 billion gallons of groundwater and removed over 56,000 pounds of 1,4-dioxane from the affected aquifers. Remediation is expected to continue.

Investigations initiated after 2000 reveled contamination was also present in the deepest aquifer which is referred to as the Unit E aquifer (Pall Corp, 2004). Because the primary source of Ann Arbor's municipal water supply relies on water drawn from the Huron River well upstream of the Unit E flow path, the plume does not present an imminent threat to public health or a known threat to the environment. Yet as a precautionary measure, to ensure the safety of its citizens, the City of Ann Arbor has created a restricted zone for well water access to potable water in the area contaminated by, or predicted to be soon contaminated, by the moving plume in Unit E.

The Pell Feasibility Study identifies and screens eleven different options for the remedial technologies available to address the Ann Arbor 1,4-dioxane contamination in the worst of the aquifers (Pall Corp, 2004). All of the alternatives that are examined involve interception or reduction in contaminant levels to acceptable levels before reaching potential receptors.

The contaminated soils on this site will impact planning and require the removal and capping of the contaminated soils. Until the degree and nature of soil and groundwater contamination is fully understood, remediation options are yet not explicitly identified. For the purposes of the Visions of Argo study the complexities of this contamination issue are beyond the study scope. In this case, design decisions would have to be revisited in response to the changing conditions.

Stormwater and Creekshed Management

Managing stormwater runoff, especially from urbanized areas, can benefit the health of river systems. Urban stormwater systems impact rivers in the following ways:

- Stormwater flows carry pollutants from roads, including oil, gasoline, coolant fluids, and sediments through the storm sewer pipes where they discharge into rivers.
- Stormwater surface flows moving across lawns pick up excess nutrients and fertilizers, which are then conveyed to nearby rivers causing excess nutrient loading.

- Water from storm sewers moves rapidly through the pipe network and into rivers, causing severe spikes in the river's hydrograph. These high volume, fast moving flows accelerate bank erosion and do not allow streams to naturally stabilize themselves.
- Many older storm sewer systems combine with the sanitary sewers in overflow conditions, which carries household waste directly into rivers, increasing *Escherichia coli (E. Coli)* counts and severely impacting water quality.
- Storm sewers reduce the infiltration rates of the urban landscape, decreasing the aquifer recharge. As a consequence, the base flow of river systems tends to decline over time.

Two major creeksheds feed into the Huron River at the Argo Riverfront Site. Allen's Creek drains most of the west and southwest portions of the city, and empties into the main Huron River channel just below Argo Dam. The outlet point is entirely armored, aimed at protecting the banks from the combined effect of the turbulent dam release water and the stormwater flows. The percentage of impervious cover, which does not allow infiltration, is relatively high in Allen's creeksheds, over 45% in 1995, and certainly higher today (Allen's Creek Watershed Group, 2001). Additionally, nearly all of Allen's Creek exists below ground as a fully piped stormwater system which is significantly undersized given today's stormwater flows. In 1926, while Ann Arbor was creating the underground pipe work for Allen's creek, the Ann Arbor News wrote an article about the 100th year birthday of the city: "Planned as part of the city's permanent sewerage to take care of the drainage from the creek's watershed for all time to come, it is probable that the concrete house for John Allen's creek once completed, will remain intact on the two hundredth anniversary of the founding of Ann Arbor" (Shackman, 2006). This turned out to be overly optimistic. In 1947, and again in 1968, flooding was caused due to failure of the Allen' Creek pipes which were sized in an era of significantly less impervious cover in Ann Arbor's west side. In 1983, a 1.1 million dollar bond measure was passed to repair pipes but laying larger pipes has been deemed too expensive (Shackman, 2006).

The second creekshed flowing into the project site is Traver Creek to the north. Traver Creek is less urbanized and most of the creek remains in a natural open channel. Nevertheless, it is still impacted by urban stormwater flows and has required substantial engineered solutions to stabilize the creek's banks. In addition to the two creeksheds, a series of smaller stormwater pipes empty into the Argo Riverfront Site (Figure 36). These pipes accommodate flow from land in the watershed that drains directly into the Huron River main stem.

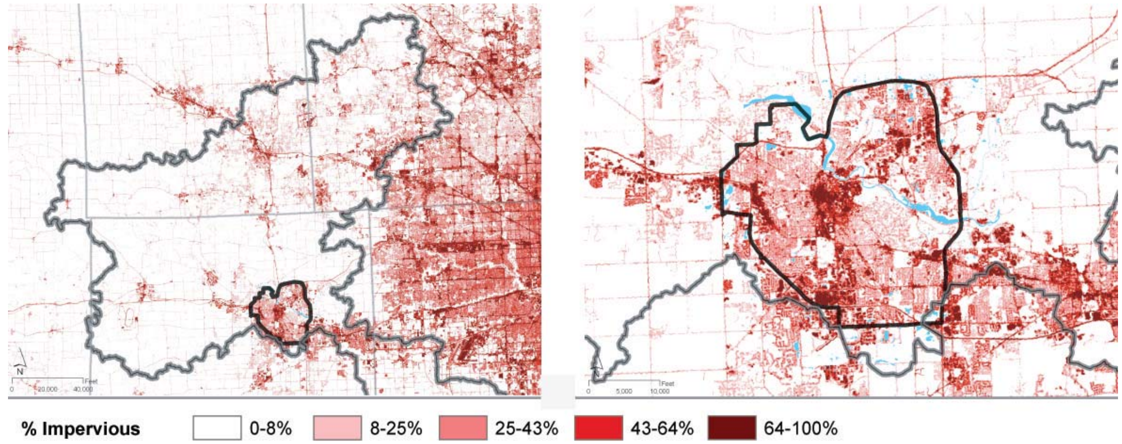


Figure 35: Impervious Cover in the Huron River Watershed and around Ann Arbor
Source: MGDL, 2008

Fortunately there is a growing awareness of the problems caused by conventional storm sewer systems, and many municipalities are taking action to protect the health of their rivers. The opportunities to improve stormwater systems and reduce impacts on rivers include a host of ecological, engineering, and political techniques. Approaches can typically be divided between those that reduce the flows of stormwater entering the storm sewer systems and those that mitigate the impact of stormwater once it reaches an outlet point, in this case the Huron River.

Low Impact Development (LID) techniques often rely on vegetated swales, bio-retention basins, green roofs, and stormwater wetlands to collect, filter, slow, and infiltrate stormwater prior to entering stormwater pipes. These practices aim to limit runoff from a particular property or site to a predevelopment volume. Once stormwater reaches the river or drainage channel, live staking, fascines, and others techniques utilizing vegetation can be used to stabilize banks against the erosive force of high volume, high speed stormwater flows. Such solutions often have additional advantages when combined with efforts to broaden the riparian corridor, such as providing habitat for wildlife or aesthetic interest for people. The specific restoration activity will depend largely on available land, the intended uses for the space, and opportunities to connect to existing riparian areas (See Figure 37). When trying to manage stormwater simultaneously to improving habitat along the river corridor, careful attention needs to be paid to where the city storm drains empty into the Huron River. These point source discharges can quickly erode the river banks if not managed properly.

To reduce storm sewer volumes, engineered solutions can also be adopted, utilizing pervious paving materials and on site rainwater collection systems such as rain barrels, cisterns and detention basins.

Gabions or other constructed reinforcement help protect banks from erosion. Political solutions can create incentives for the use of ecological or engineered practices, such as stormwater tax credits and the current NPDES II regulations.

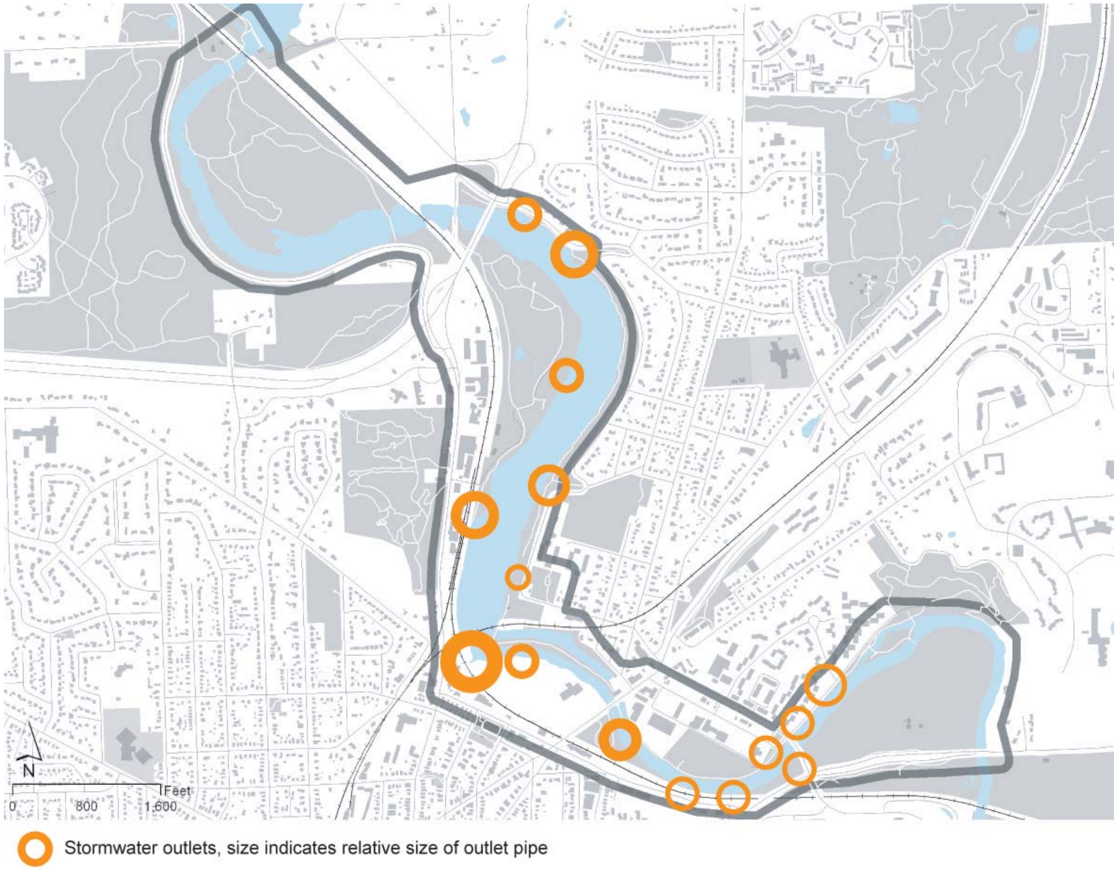
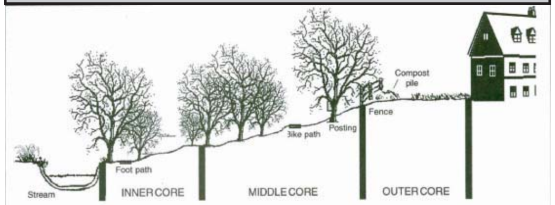


Figure 36: Stormwater Outlets within the Argo Riverfront Site
This information may not complete and some smaller outlet points may be missing.. Source: City of Ann Arbor (interpreted from a partial city map of the stormwater system)

The City of Ann Arbor and local non-profit organizations have taken a lead in promoting the use of Best Management Practices (BMP's) for stormwater management. Some city parks, such as Buhr Park in the Mallet's Creek watershed in the southeast of the City, have created "wet meadow" areas with the help of community non-profits. A variety of native vegetation that quickly absorbs water is planted in the basin to filter stormwater flows. The Buhr Park "wet meadow" is not an actual wet meadow community, but

RIPARIAN BUFFER ZONES



Characteristics	Inner Core	Middle Core	Outer Core
Width	25 feet, plus wetlands and critical habitats	25 to 50 feet, depending on stream order, slope, and 100 year floodplain	25 foot minimum setback to structures
Vegetative	Undisturbed forest, Reforest if grass	Managed forest, some clearing allowable	Forest or turf
Allowable Uses	***Very Restricted*** e.g., flood control, utility right of ways, floodpaths, etc.	***Restricted*** e.g., some recreational uses, some stormwater practices, bike paths, tree removal	***Unrestricted*** e.g., residential uses including lawn, garden, compost, yard wastes, most stormwater practices

Riparian Buffer Zones, Widths, Uses, Vegetation Types
Source: HRWC, 2008

Riparian buffers are a critical component to improving river water quality and enhancing habitat. Riparian buffers are also an on-site approach to managing stormwater, in particular overland surface flows, which riparian buffers can filter as water moves towards the river channel. Ideally, a riparian buffer should consist of three zones described in Figure 37 and be vegetated with native vegetation.

The middle and outer zones perform the majority of the water filtering functions. The SMRC (2008) fact sheet on Riparian Buffers summarized independent research studies, which found that these filter areas could significantly reduce quantities of total suspended solids (TSS), total phosphorous (TP), and total nitrogen (TN), even when less than 10-meters wide. Trees planted in the inner and middle zones help shade and cool water, provide woody debris that enhances in-stream habitat, stabilize and secure banks, and creates habitat for terrestrial organisms.

600 feet	Bald eagle, cavity nesting, ducks, heron rookery, sandhill crane, neotropical migrants
450 feet	Pileated woodpecker, kingfisher
300 feet	Beaver, mink, salmonids
200 feet	Deer
165 feet	Muskrat
100 feet	Frog, salamander, turtle

is nevertheless an example of native vegetation, which provides habitat for butterflies and insects, also serving a stormwater function. Deep-rooted vegetation increases the infiltration capacity of this wetland basin.

Programs at the City, County, and Watershed Level related to stormwater management for river health include:

- Within the City of Ann Arbor
  - Stormwater Credits
  - Phosphorous Fertilizer Ordinance
  - Allen's Creek Greenway Collaborative
  - Mallet's Creek Restoration Projects
  - Allen's Creek Stormwater Initiative
  - Mary Beth Doyle Park
- Washtenaw County Drain Commissioner
  - RiverSafe Homes Project
- HRWC
  - Impervious Surface Study
  - Riparian Buffer Initiative
  - Adopt-a-Stream Program (many partners)
  - Middle Huron Stream Monitoring Program
- Other Issues
  - NPDES Regulations / Compliance Issues

Connectivity

Overlaying human connectivity networks on the land has impacts on the ecological connectivity of the watershed. Transportation networks can fragment habitat systems and create runoff that accelerates erosion in river channels. In addition, where we choose to impact the land and water for the purpose of our own travel has cultural implications for how much we see, think about, and appreciate the ecological services and aesthetic amenities provided by rivers and natural areas.

Road Network.

The imprint of the automobile and the roads are unsurpassed in making a lasting legacy on the Michigan landscape. The web like imprint, as seen in the road network image in Figure 38, connects major urban hubs to each other as well as creates networks around the hubs.

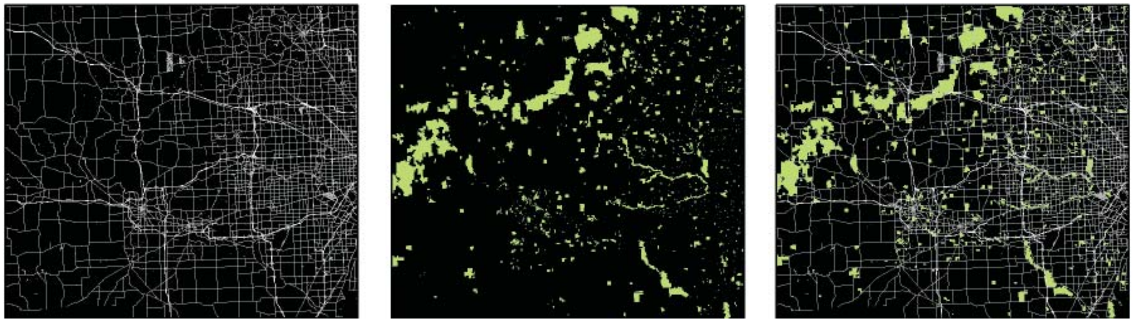


Figure 38: Road network and SEMCOG Park and Recreation Land

Source: SEMCOG, 2007

The road network acts to create both connectivity and boundaries. The parks and recreation land map (Figure 38), displays the same extent as the road network, but the pattern on the land is quite different; broken into small patches and generally lacking in discernable pattern. When the road and park land is combined, the order becomes more apparent. The segregation and definition of parks and recreation spaces within the larger community respond in large part to the road network and municipal boundaries rather than ecological communities. Large natural features, such as steep slopes or open water, would not accept the application of roads and as such were spared the fragmentation.

Figure 39: Blue-Green Corridor of the Argo Site

The River Habitat can combine with the Terrestrial Habitat to form a strong Blue/Green Corridor. Source: SEMCOG, 2007

Within Ann Arbor, and at the Argo Riverfront Site, The Huron River and the historic legacy of human activity around the river has allowed many opportunities to gather a large amount of connected green space. It has also presented some distinct challenges. The City of Ann Arbor has been actively purchasing the land adjacent to the Huron River Corridor and in doing so has created a blue/green corridor (Figure 39). This corridor is the cornerstone to creating a robust ecological corridor. Ecological integrity must be considered when planning land use within the blue/green corridor.

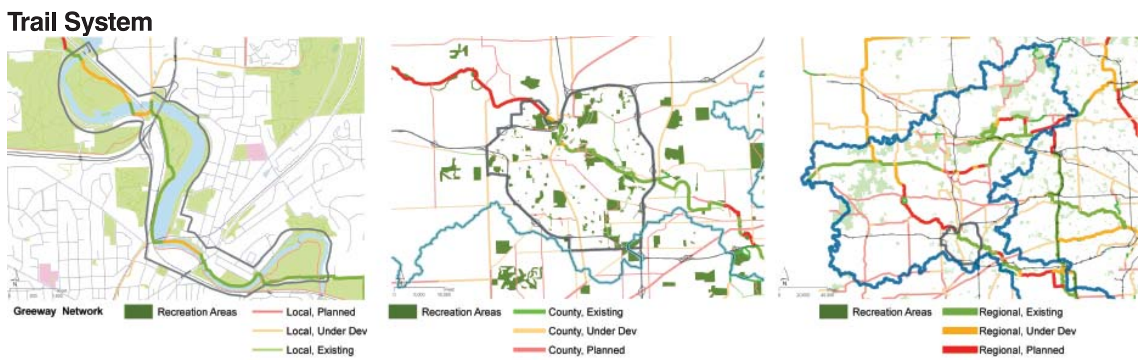


Figure 40: Greenway Networks (Existing, Under Construction, and Proposed) at the Site, City and Watershed Scale
Source: Greenway Collaborative (2008)

At the Watershed scale, the trail system is quite disconnected compared to the road network, with non-motorized trails typically constrained to existing park and recreation lands. However, there is growing interest and support for enhancing non-motorized trails, often referred to as greenways, throughout the entire southeast Michigan area. Figure 40 shows, across all three scales, the hierarchy of greenways under consideration (Greenway Collaborative, 2008). At the Argo Riverfront Site, existing trails constitute parts of the county Border-to-Border trail system, the Huron River Greenway Trail, the Allen's Creek Greenway, and the City of Ann Arbor Non-motorized Transportation Plan.

The removal of Argo Dam, with the pedestrian connection across the river is an important design consideration. Removing the dam would remove this crossing and could have major effects on the pedestrian use patterns within the site, as well as disrupting the connectivity in the other trail initiatives. In all of the trail initiatives, the bridge on the Argo Dam is a key linkage point in the broader trail systems. In April 2003, the City of Ann Arbor was awarded a Green Ways Initiative Land Grant in the amount of $31,000 to support the construction of a walkway over the Argo Dam, and continuation of a bicycle path along the Huron River to Lakeshore Drive (Greenway Initiative, 2005).

Existing greenway plans also identify key points of interruption in the trail system. Though not always evident when looking at a map, the user experience on the trails through the Argo Riverfront is one of disorienting interruptions to continuous travel. These typically occur at the major bridge crossings or a railroad junction, where the park user has to diverge from the riverside experience and cross at a higher point. For instance, Broadway and Maiden Lane bridges provide access for cars across the river yet are hindrances for the trail system along the river. The current Huron River Greenway plan identifies the north side of the Maiden Lane Bridge to have a crossing at the river-grade. These crossing improvements are consistent with the Border-to-Border trail system for Washtenaw County as well as the City of Ann Arbor Non-motorized Transportation Plan (2007).

Identifying points of connectivity both inside and outside the site are important considerations for this project. Equally important is looking at disconnects in the trail systems and determining places where connections would greatly enhance the functions of these areas.

Railroad crossings.

At the Argo Riverfront Site level, the southern edge of the river is lined by a contiguous railroad corridor. This railroad corridor forms a substantial physical barrier for legal, 'at grade' crossings. This railroad corridor provides unique challenges for connecting the Argo Riverfront to the bulk of Ann Arbor to the south. Currently, the only at-grade crossing along the railroad is found at Lakeshore Drive and Main Street, providing access to the rowing facilities. This is the only access to the rowing facilities and is an unpaved access road hinged on easements from adjacent landowners and the Michigan Central Railroad. Both of these are due to expire soon and due to change in policies the railroad in particular may be disinclined to allow this crossing in the future. This particular example highlights the difficulties faced when trying to access and connect into the Argo Riverfront.

Entrances

There are numerous "illegal" points of access to the park such as the crossing at the north end of State Street down the embankment to Broadway Park, as well as just north of Depot on North Main that allows access to the walking path along the river, and access to the Argo Dam bridge. Both of these access points are illegal, as by law pedestrians cannot traverse on railroad property at non designated crossings. Rethinking entrances can help define the Argo Riverfront as a recognizable asset for the Ann Arbor community. Strategic placement of entrances can also contribute to minimizing disruption to the ecological connectivity, and dissolve issues of illegal property crossing noise and traffic, and can be considered an active recreation destination. Because reflective and active destinations are very intertwined in the current park programming, there is sometimes a conflict of interest among user groups for the type of experience desired along the river and in different parks. These tensions can be addressed by changes in spatial allocation of recreation types. In addition, strategic programming and potential regulations might enforce policies where different seasons or times of the day are allocated for different recreational user groups.

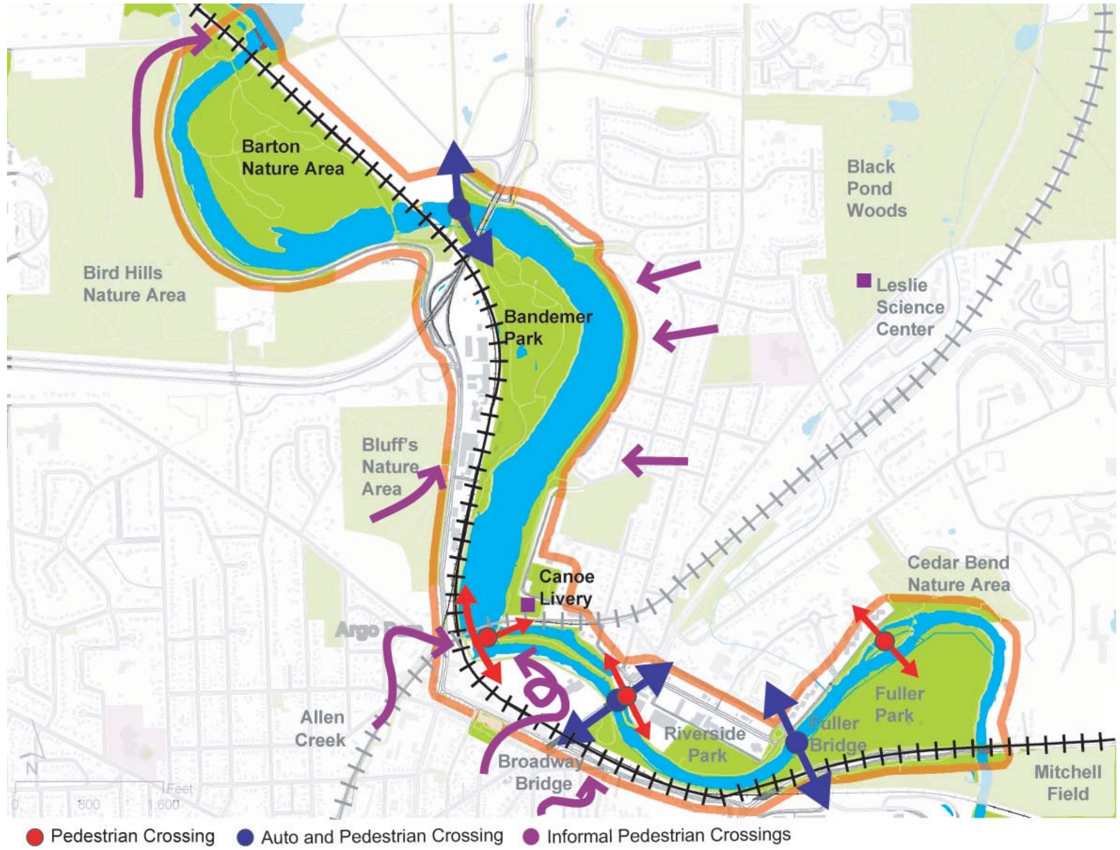


Figure 41: Entrances to the Argo Riverfront Site

Sources: City of Ann Arbor GIS data and project team field survey.

Recreation Management

Recreation opportunities at the Argo Riverfront Site are varied and present complex management challenges and opportunities, all of which have implications for the health of the river. The variety of park spaces along the Argo Riverfront, make for a complex matrix of activities, ranging from lower density activities (hiking, bird-watching, fishing) to higher density activities (soccer, rowing, frisbee golf). In general, the areas allocated for lower density recreation are quieter and more naturalized and can be thought off as a more reflective recreation destination. The higher density recreation areas tend to generate more

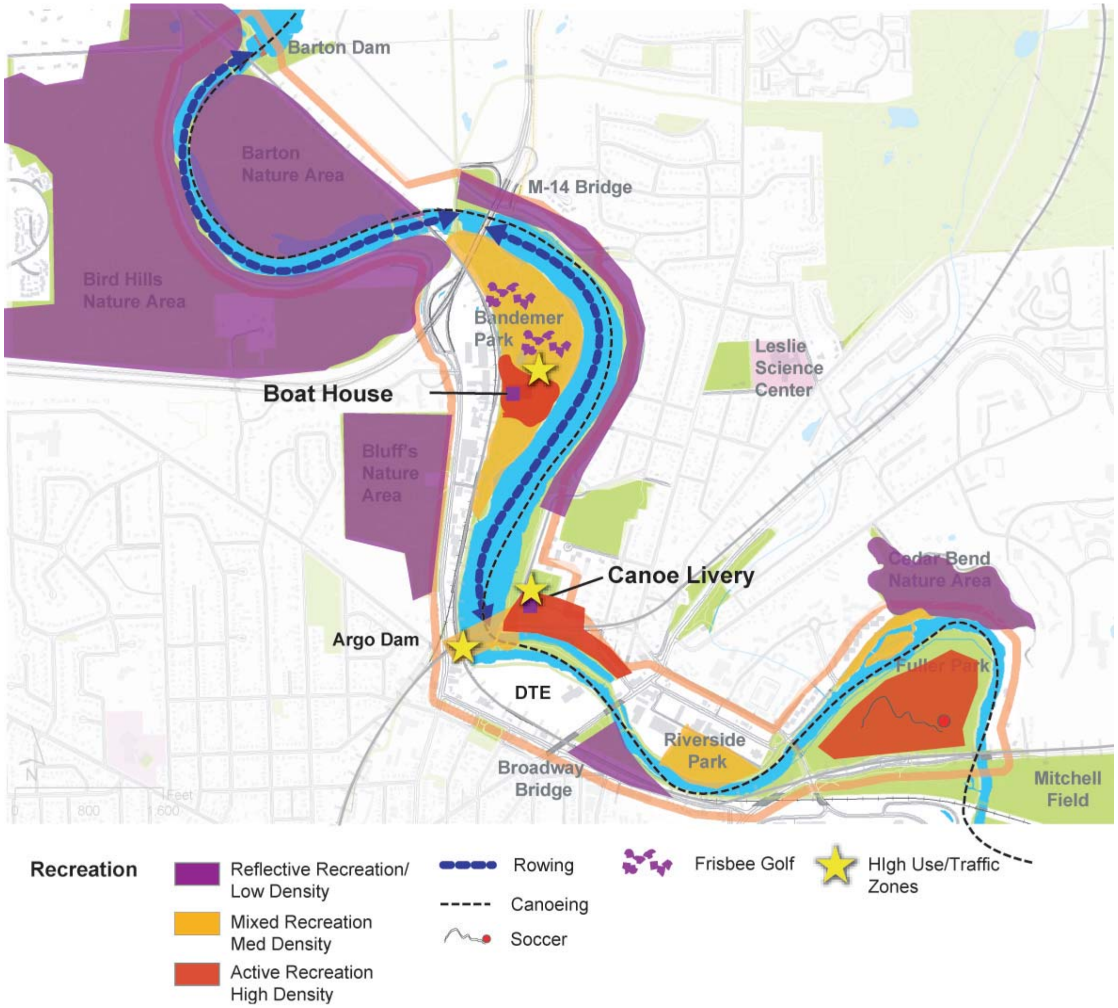


Figure 42: Analysis of the Existing Complex Recreation Matrix within the Argo Riverfront Area

Sources: City of Ann Arbor GIS data and project team field survey

noise and traffic, and can be considered an active recreation destination. Because reflective and active destinations are very intertwined in the current park programming, there is sometimes a conflict of interest among user groups for the type of experience desired along the river and in different parks. These tensions can be addressed by changes in spatial allocation of recreation types. In addition, strategic programming and potential regulations might enforce policies where different seasons or times of the day are allocated for different recreational user groups. For water sports, there is another level of complexity added as some are reliant on the conditions created by the dam, while others are impaired by current dam conditions. Even more, others are completely impossible with the given conditions, but could be possible with either a faster flowing river and/or improved water quality. For water sports, capacity management also should be considered for implications for the health of the river.

Canoeing and Kayaking

The City of Ann Arbor operates two liveries at Argo and Gallup parks. At Argo Park, most patrons rent boats to paddle through the City of Ann Arbor downstream to the livery at Gallup. A portage around Argo Dam is currently the only obstacle to continuous boating from Argo Livery to Gallup Park Livery. Patronage of the liveries continues to increase. Last year, approximately 30,000 patrons paddled and, another 40,000 patrons visited Gallup and Argo last year for special events, meeting or other purpose. Just five years ago, Argo was only open on the weekends, with only 47 canoes available to rent and kayaks were not even offered. In 2007, the liveries offered 140 canoes, 65 kayaks and additional paddle and rowboats. As an indication of the rise in demand for paddling experiences on the river, rentals at the livery in the first week of 2007 doubled from the first week of 2006 (HRIMP, 2007a).

The liveries offer several community programs, including paddle parties, brunch paddles, river day camps, preschool programs, senior programs, wetland exploration by canoe, full moon paddles, instruction workshops, corporate trips, and festival support. In 2006, the liveries generated revenue of $323,000 with $300,000 in expenses. The profit earned at the liveries used to provide resources in other park areas (HRIMP, 2007a). Both liveries have a public boat launch and are frequented most on weekends by private boat owners. Private boat owners are allowed to launch motorized crafts less than 10 horsepower. All boats must abide by a no wake regulation (HRIMP, 2007a).

One suggestion that has elicited a fair amount of interest among stakeholders and the City of Ann Arbor is the idea that whitewater boating could be a possibility in the Argo Riverfront Area. According to the Michigan Department of Natural Resources (MDNR), removing Argo Dam would provide an excellent stretch of river for high-gradient canoeing and kayaking (MDNR, 1995).

Sailing

Sailing opportunities are offered at the Barton Pond area outside the Argo Riverfront Site.

Rowing

The rowing community in Ann Arbor is growing, and the teams represent a significant number of stakeholders in the Argo Dam decision process. The impoundment's ability to accommodate rowing in Ann Arbor is the most well recognized benefit of Argo Dam. Removal of the dam would mean that rowing could no longer be accommodated at this site.

There are four main groups that participate in organized rowing events on the Huron River, including the Ann Arbor Rowing Club (AARC) which is open to the public, the University of Michigan men's crew team, the Huron High School crew team and the Pioneer High School crew team (HRIMP 2007b). About 400 rowers are active in these organizations annually (Batterman, 2006). In addition to the rowing organizations, there are a few rowers who paddle the Huron River unaffiliated. The rowing organizations stagger their scheduled time on the river to maximize use without reaching carrying capacity with times ranging from before dawn to dusk with peak usage from late afternoon to early evening on weekdays (Batterman, 2006). Typically, rowers begin at the Argo dam and continue upstream on Argo Pond past M-14 before turning around at the pedestrian bridge just east of Baron Pond. This stretch of river, from Barton to Argo Dam is nearly two miles long, the longest continuous stretch of the river for rowing in within the City of Ann Arbor.

However there are several challenges associated with rowing at Argo Pond; both advocates for and against rowing have cited several ways that existing conditions are not ideal for a rowing facility. There is a continual need to manage and control the invasive vegetation on Argo Pond. This growth limits usable open water so the excessive growth of aquatic vegetation is currently managed by the costly and unsustainable practice of daily weed "mowing". As cuttings from aquatic plants have a tendency to root and spread, there is every reason to believe that this problem will only continue as a self perpetuating cycle without changes in natural resource management practices. The four bridges that cross Argo Pond are also a hindrance and often navigation is slowed by two boats attempting to squeeze by one another, clashing oars as they encounter the obstacles of the bridge foundations (Batterman, 2006). The new Beal Boathouse built in 2002 was constructed under a 15 year renewable lease with the City of Ann Arbor and in 2006 the older storage buildings were demolished by the city due to decay (Batterman, 2006). The new boathouses are already filled to capacity and there is often a wait for the dock space. Not only are the existing faculties undersized for the currently expanding user base but the land also hinges on a non-permanent leasing situation with the City of Ann Arbor. Finally, there is no centrally located area which can be used for spectator viewings and this limits the possibilities for regatta competitions and other large gatherings.

Alternative sites that might accommodate rowing are under consideration and include Barton Pond, Gallup Pond and even Belleville Lake, where currently the University of Michigan women's team rows. Barton Pond briefly hosted the UM team 30 years ago, however Barton Hills residents complained of the early morning noise caused by coaches bull horns and motor boats (Batterman, 2006). There is some discussion of switching to direct earpieces for coaching which is a switch that many rowing teams have already made. The motorized boats would be a concern as Barton Pond is Ann Arbor's potable water supply. Electric motors are one option that has been discussed but more research and negotiations with the City of Ann Arbor and Barton Hills Village would be required. Gallup Pond is shorter than either Argo or Barton but much wider and would offer the best opportunities for regattas. Because Gallup is already Ann Arbor's busiest boating area with canoes, fishing craft, paddleboats and other small crafts; therefore, programming would be essential to the viability of this venue. All possible sites would need to have a boathouse, docks, ample parking and legal pedestrian and automobile access to the river in order to be a viable alternative for the current rowing clubs.

Fishing

The river and its impoundments are popular among the fishing community. The common catch includes bass and bluegill, though walleye, northern pike and catfish are also available. Anglers fish from the bank, fishing platforms extending form the bank, and bridges. During normal summer flow conditions, anglers safely wade and fish the entire river from the Broadway Bridge to the headwaters of Geddes impoundment. Trailer fishing boats can be launched into Geddes and Argo impoundments. The entire Ann Arbor reach is accessible to anglers by canoe or other small, portable boats. Fishing can impact ecosystems however, particularly when access to the water is informal and necessitates trampling bank vegetation. Opportunities to enhance the ease and attractiveness of fishing can be combined with improving the ecological consequences by carefully designing access points.

Swimming

There is currently no swimming allowed at the Argo Riverfront Site nor in any part of the Huron River extending through the City of Ann Arbor. The City of Ann Arbor does not currently have the capabilities to perform monthly swimming beach testing; nor do they have the ability to quickly address poor results, specifically those after a rain event. City officials are concerned that occasional positive test results will lead to misperceptions about the river's overall water quality (Cheryl Saam, personal communication, September 10, 2007).

Existing Education and New Opportunities

Ann Arbor has an abundant and well recognized collection of formal and informal educational opportunities. While there are some that focus on the overall health of the watershed, few programs focus on the Huron River itself and there is room for expanding educational opportunities to truly embrace our understanding of the amenities provided by the river. Forms of education lie along a continuum of formality from informal to formal or structured programming. Along this continuum lie examples educational programming such as:

- **Awareness:** Meant to illuminate a problem or a concept, rather than solve a problem directly. Using art or advertising is a common medium for spreading awareness. Ecologically-focused art shows, and educational signage are just examples of awareness that could be incormorated at the Argo Riverfront Site.
- **Demonstration:** Showcases a method or concept through a process of which can be hands on or visual. Many times demonstrations take a large scale issue, and demonstrate it at a smaller scale to show how the issue could be solved. Examples of demonstration that could happen at the Argo Riverfront Site are wetlands that clean part of the Huron River or forms of energy creation such as windmills or hydro-turbines. These methods perform a function, but not enough to sustain a whole city.
- **Functional:** A process of demonstration and full-scale change, typically performed by teaching, then performing. Functional education currently occurs and will continue to occur at the Argo Riverfront Site. One of the greatest examples is restoration. Ann Arbor and the schools have strong programs to teach and practice research and restoration.

The abundant nature areas in Ann Arbor provide opportunities for expanded informal programming. These areas, although not pristine, are relatively "natural" and allow for ecologically focused learning. Park areas allow for more organized programming. Schools, non-profit organizations, and learning centers provide opportunity for formal and structured learning. Argo Riverfront provides plentiful opportunities for both formal and informal learning. Existing facilities within or near the Argo Riverfront Site include:

- **The New Center:** A home base for non-profit resource, technology, and service support. It is to the Huron River Watershed Council, which is a strong advocate for the protection of the Huron River.
- **Argo Livery:** Provides Huron River patrons and community high school students experience in paddling and fishing through a grant funding for high school physical education. In addition, the Ann Arbor Public Schools Science Environmental Education Endowment program teaches school age children about water testing, aquatic life, and stormwater.
- **Leslie Science and Nature Center:** 50 acres of fields, prairie, woods, and pond to provide natural science and environmental education programs for youth and their families.
- **University of Michigan:** Oriented towards research and field study. Land owner of the Nichols Arboretum along the Huron River.

Areas that have been highly disturbed by urban life could be places for highly formal or structured programming. These areas allow for artistic creativity with an ecological focus, as well as provide places for structures to demonstrate environmental concepts. Using informal programming to maximize and connect formal programming will enhance educational connectivity. Using the Huron River as a backdrop for meaningful ecological education, with the support of existing programs and facilities, we can start to enhance and create a very connected network of educational programming.

City and State Plans and Initiatives

The Argo Riverfront is a complex area that has changed form and function dramatically over the course of Ann Arbor's establishment and growth. While originally the heart of the city, through its industrial focus, most of those activities have since moved away, shifting the Ccity away from the river. Lower Town, the area north of Broadway Bridge, has declined signifigantly in recent years but has become a focus for redevelopment. Other opportunities to expand the economic capacity of the Argo Riverfront have surfaced as well.

The Argo Riverfront Site falls within a series of city planning activities. The city plans that cover portions of the project site include: West Area Plan (1995), North Main Street / Huron River Corridor Plan (1988), Northeast Area Plan (1999).

Of these plans, the one that is most current and considers the Argo Riverfront Site most directly is the Northeast Area Plan which has within it the Lower Town Plan (1999). Currently, much of Lower Town is under redevelopment, intending to become "Broadway Village", a new mixed-use development that features a mixture of housing types, affordability, and commercial uses. Key aspects of the Lower Town plan calls for the redevelopment of the current DTE properties, including the 841 Broadway site, which could tap into brownfield redevelopment resources. Increasing pedestrian connections to the riverfront also needs to be explored, as larger buildings currently limit access to the waterfront except for a few key areas. The plan also calls for the continued protection and enhancement of Traver Creek, which runs through Lower Town.

Cool Cities Initiative

The Cool Cities Initiative is a state level program started in 2003. It is "an urban strategy to revitalize communities, build community spirit, and most importantly, retain our knowledge workers who are leaving Michigan in alarming numbers" (Cool Cities, 2008). Ann Arbor, which is home to the University of Michigan, can build off of this initiative and promote itself as an exciting place to live. The Michigan Economic Development Corporation (2004b) surveyed current college students and recent graduates in an effort to define what made a Cool City. The respondents, with an average age of 23.3 years, stated that the following contributed to a Cool City in order of importance:

- *The core value factor:* different lifestyles, diversity, art/culture, gathering places, 4-season interest, music scene, walkable streets, historic architecture, many different jobs, service oriented business.

- *The outdoor factor:* adventure sports, scenic beauty, trails & parks, beaches & waterfront, environmental concerns.
- *The 3rd Place Factor:* Professional sports, casinos, malls/shopping, nightlife, people of their age. Note, the 1st place is home, 2nd place is work, so the 3rd places are other public spaces.
- *The safety and security factor:* public schools, place for family, safe streets, sense of community.
- *The economic factor:* Affordable, low taxes, low traffic congestion, friends & family.
- *The convenience factor:* public transportation, warm weather.
- *The entrepreneurial factor:* own business potential.

The initiative found that Ann Arbor was identified as the most desirable place to live within Michigan among the creative class. When expanded nationally, Ann Arbor was ranked 6th, although given the sampling of students within Michigan, this is likely a bias. Nevertheless, it highlights that Ann Arbor contains many of the features embodied by a Cool City, and suggests that an expansion of the factors listed above can solidify Ann Arbor's position.

Michigan Brownfield Law

In Michigan, a brownfield site is land or a building(s) that is unused or only partly used, and is considered derelict or contaminated. Reclaiming brownfield sites in urban environments can be used to turn contaminated properties into areas of economic growth. Under Michigan's brownfield law (MI State Housing, 2008), owners and operators of blighted or abandoned sites are no longer required to pay for clean-up actions unless they caused the problem. Buyers and lenders are now protected from liability under Michigan law.

Reclamation is frequently done by using redevelopment incentives that turns a blighted site into an equally attractive proposition as moving into a cheaper suburban location. As industry frequently settled near the water's edge, there are many opportunities to reclaim waterfront access and use by reclaiming past industrial areas. Gas Works Park, in Seattle Washington is perhaps the iconic waterfront reclamation park from what used to be the former Seattle Gas Light Company (an MGP).

Since 1996, Michigan's groundbreaking brownfield redevelopment program has provided two incentives to redevelop environmentally-contaminated properties:

- Credits against Single Business Tax (SBT). Credits are available on a case-by-case basis, to help with the expense of demolition, environmental cleanup, and other remedial action needed to facilitate reuse of undesirable properties. Credit are available for up to 10% of eligible investments to a limit of $30 million

- Reimbursement of some costs through "tax increment financing"-allows projects to capture state and local property and school taxes to pay for cleanup-related costs (Miller Johnson, 2008).

Multiple projects are using brownfield incentives including a parcel in the Lower Town development, as well as two other projects in the Ann Arbor downtown area.

Renewable Energy Challenge

In 2005, Ann Arbor established a challenge (Renewable Energy Challenge) for the city to use 30% renewable energy for municipal operations by 2010, 20% renewable energy for the city as a whole, and a 20% reduction in green house gas emissions from the emission levels of 2000 (City of Ann Arbor, 2008a).

Support programs that will help the City achieve this goal include:

- Energy Challenge Awards Program – A recognition and support program for businesses and commercial operations that incorporate energy conservation or renewable generation capacity into their facilities.
- 5000 Solar Roofs – A program targeted at helping to install solar water heaters and photovoltaic systems and roofs throughout the city. A University of Michigan study found that over 86% of the city's 27,000 homes are capable of utilizing solar energy for at least some of their needs.
- Redevelopment efforts at the Argo Riverfront Site can take advantage of these programs. If the land is developed primarily for park space, there may still be opportunities to incorporate energy generation into the design in a visually powerful manner. For instance, wind turbines or photovoltaic systems could be installed on the roofs of new recreation facilities and bridges, overpasses, and other high wind or solar accessible areas. Potentially, the dam could remain in place and be re-commissioned for electricity production if it is likely to contribute to a net gain in the city's renewable energy capacity.

The Parks, Recreation and Open Space Plan

The City of Ann Arbor has continuously been recognized for its "green" image. The dense city center and allocation of open spaces, both private and public, as well as the river valley topography with large patches of tree cover contribute to the feeling of openness. The Greenbelt millage, providing for 30-year funding to acquire easements, development rights and properties is one way the City of Ann Arbor intends to help preserve the open and green image of the Ann Arbor region (City of Ann Arbor, 2006).

The other method of "green" preservation falls under a dedicated parks and recreation planning committee. The City of Ann Arbor has a history of recreational planning. The Parks, Recreation and Open Space Plan (PROS Plan), set for 2006-2011 is intended to continue the process of recreational planning to fulfill the current and future needs of the residents of Ann Arbor. This plan inventories, evaluates and sets goals for the city's vision for its parks, recreation and open space throughout the City of Ann Arbor. Part of the PROS Plan process is to engage citizens when prioritizing needs. Through the use of public workshops, focus group meetings, and a telephone survey, participants expressed their top priorities for 2006-2011 as (City of Ann Arbor, 2006):

- Acquiring riverfront land to create a continuous greenway along the Huron River
- Improvement of general park maintenance
- Development of a linked system of trails and park connections
- Development/dedication of an off-leash dog park facility
- Development of additional playing fields for soccer
- Improvement of river and water activities
- Preservation of natural areas particularly within active recreation and neighborhood parks
- Development of a greenway along the Allen Creek floodway
- Development and funding of senior and teen-specific programs
- Development of indoor recreation facilities (multi-use)
- Expansion and enhancement of environmental education opportunities

Huron River Impoundment Management Plan

In March of 2006, the Ann Arbor Environmental Commission passed a resolution that created the Huron River and Impoundment Management Plan (HRIMP) Committee. The committee will develop recommendations for managing the Huron River and share these with the Environmental Commission. The anticipated date for forwarding recommendations to City Council has been planned for July 1, 2008 (City of Ann Arbor, 2008b). In December 2006, 16 individuals were appointed to the committee by the Environmental Commission. These stakeholders include city staff, Huron River Watershed Council staff, nearby property owners and recreations users and organizers (S*ee Appendix 3: Stakeholders, Topical Experts and Clients for a list of HRIMP Committee members*).

Our Visions of Argo team members have attended many of these planning meetings to stay abreast of issues and concerns of the local community. The alternative future process used by our team has been informed from the resident desires expressed in these meetings. Though both the HRIMP process and the Visions of Argo project have been cooperative in nature. However objectives, goals, and methodologies were always different; and therefore the outcomes and recommendations of both groups are parallel but not synonymous.

Stakeholder interests that have been identified from the HRIMP Committee meetings include:

- A desire, from a planning perspective, to redevelop under-utilized areas within the built fabric of Ann Arbor rather than expand development into greenfields.
- A desire to create more job opportunities within the city while encouraging higher densities, but providing for a more vibrant and pedestrian oriented city.
- A desire to maintain or improve potable water quality from Barton Pond. Additionally, improve the water quality in other impoundments which are perceived to be undesirable for prolonged human contact, and are experiencing algal blooms and invasive aquatic weed infestations.
- A desire to accommodate all recreational users in a strategic and well programmed way that simultaneously meets the interests of as many users as possible.
- A desire to promote and support community access to the Huron River, as a way to gain a better appreciation for this natural resource.
- An interest in seeing additional recreational uses and facilities introduced or reintroduced: These include but are not limited to: improved and diversified fishing opportunities, improved rowing facilities, windsurfing, swimming, white water kayaking, camping and leisure activities such as festivals, concerts, firework displays, and dining.

Chapter 4 – Project Methods

The Alternative Futures Process

Overview

A growing body of research includes the use of alternative scenarios as a means of integrating science, design, and policy, in future land planning. A scenario is a set of alternative assumptions that guides plausible landscape changes (Steinitz et al., 2003). The consequence of those assumptions is the future, the result of a proposed scenario manifested as landscape pattern (Steinitz et al., 2003). Normative scenarios are a specific type of scenario that makes prescriptive recommendations about the future. They suggest what should happen in the future, rather than what is likely to happen given existing trends. Normative scenarios make assumptions based on the goals of a particular society, establishing these goals as drivers that create desirable alternative futures, which in turn create a plausible inspiration for action (Nassauer & Corry, 2004).

> The future policy goals that drive normative landscape scenarios should be imaginative, speculative, or didactic assumptions about societal values. The goals should be plausible, but the plausibility criterion is inspiration for policy action rather than probability of landscape change. (Nassauer & Corry, 2004, p.347)

A key question in developing a normative scenario is "how *should* the landscape change?" Framing scenarios in this way allows policy makers, developers and community member to imagine new landscapes that meet societal goals and develop new patterns with explicit functional intent (Nassauer & Corry, 2004). A strength of the alterative futures process is that spatially explicit future landscape patterns can be compared and assessed across criteria deemed important to the community, decision-makers, or stakeholders.

Alternative futures for the Argo Riverfront were developed based on plausible design and management decisions aligned with stakeholder interests, specifically the Huron River Impoundment Management Plan (HRIMP) committee. Under the premise that sustainability should be an overarching tenant of all alternative futures proposed, developing the futures focused on improving environmental, social-political, and economic issues, the three broad tenants of sustainable development as defined by the United Nations in *Our Common Future* (1987). The alternative futures process used in this Visions of Argo project, relies on the following terminology:

- **Common Goals:** Common goals are shared by all scenarios. Each goal is to be met by each future and each goal should reflect the values of the involved parties, including the researchers, stakeholders, and the greater society.

- **Scenario Drivers:** Each scenario has a unique set of drivers, which define the direction, scope, and intention of the proposed scenario. The drivers inform specific design and management decisions by prioritizing different desired outcomes (i.e. habitat creation prioritized over recreation development).
- **Variable Assumptions:** Statements or claims made about a particular issue in response to existing or current uncertainty. These issues are typically beyond the control of the involved parties, but nevertheless require a plausible assumption to be expressed in order for the future to be developed. Alternative assumptions about an issue shape the scenario and lead to different future conditions.
- **Key Variables:** Key variables are the major issues of concern to the involved parties, and constitute the basis for assessing and comparing the alternative futures.
- **Design and Management Decisions:** The design and management decisions refer to the specific and critical design choices or management decisions which are to be expressed in the resulting futures.

The alternative future process used by this project relies heavily on the project team and feedback network to validate, verify, and critique proposals generated by the project team. The overall alternative futures process utilized in this project is presented in Figure 43. While back-and-forth relationships between specific steps are highlighted, it is important to realize that discoveries in later stages can require returning to earlier stages, giving the entire process its own cyclical character. However, the general flow is from discovery, where issues are identified and placed within a context of broader research and design; to process, where scenarios are formulated, explored, and refined; and finally to resolution, where scenarios are translated into explicit spatial patterns that can be evaluated and shared among stakeholders to aid decision making.

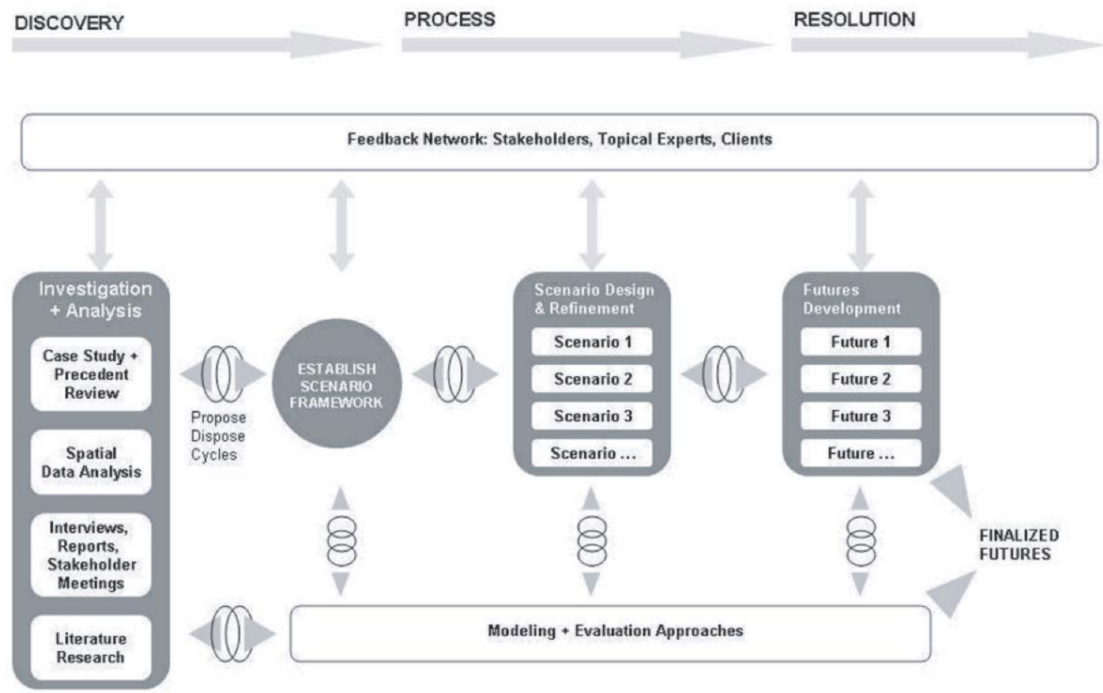
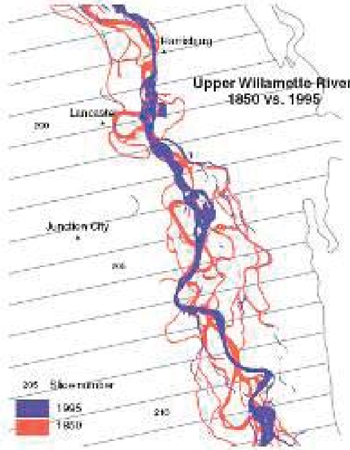


Figure 43: Scenario Process Diagram.

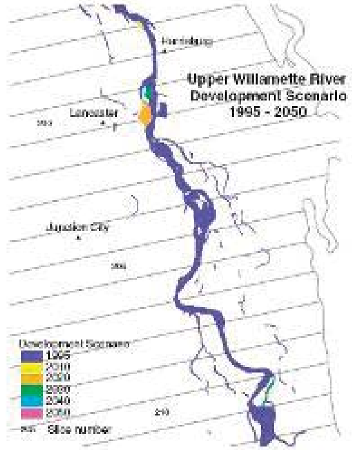
The alternative futures process embraces many aspects of ecologically-based design emanating from the field of landscape architecture. The iterative design process proposes new ideas and then analyzes these ideas in a process of careful critique and evaluation which leads to the disposal of inconsistent ideas. The propose-dispose cycles are a way of freely exploring possible ideas, and then stepping back to consider their implications and evaluate their performance (Lyle, 1999).

In addition to these propose-dispose cycles, a *feedback network*, comprised of stakeholders, the project client groups, and topical experts, (See *Appendix 3: Stakeholders, Topical Experts and Clients*) provides crucial insight and direction to the project development. Feedback is incorporated at every stage of the process, often multiple times, and provides a dialogue between the ideas embodied in the normative scenarios and the public. Approaches used to gather feedback included (1) formal presentations to stakeholder groups with a response questionnaire and (2) informal review sessions where in-progress work was presented to local experts. Finally, *modeling and evaluation methods* are considered throughout the entire process. Like

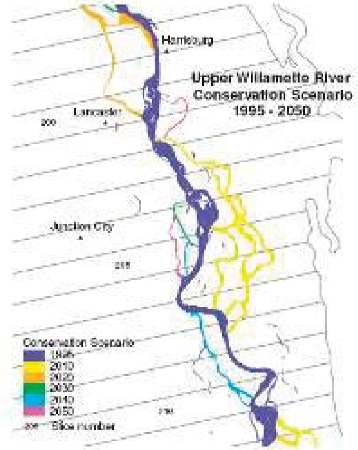
ALTERNATIVE FUTURES FOR THE WILLAMETTE RIVER BASIN, OREGON



Historic v.s. Existing River Channels



Development Scenario 2050



Conservation Scenario 2050

Source: Hulse et al., 2002

The Willamette River Basin is about 180 miles long and encompasses 11,478 square miles (Hulse et al., 2002). Alternative futures for the Willamette River Basin, Oregon, proposed future scenarios that present the alternative visions of the watershed. The objective of the study was to provide scientific data and analyses that help both policymakers and local citizens make better decisions about land and water use in the region.

In this study, three alternative future visions for the basin through the year 2050 was presented based on the input from local citizens, stakeholders, organizations, and governments regarding future trends in urbanization, rural residential development, agriculture, forestry, and water use in order to reflect a range of plausible policy options. These future scenarios are chosen in order to delineate a plausible range of alternatives as defined by representative citizens. These scenarios were intended not as predictions, but rather to illustrate a range of plausible options for future land and water use in the basin. Plan Trend 2050 assumes that the existing long-term plans and policies including forest plan and land use planning system will be fully implemented. Development 2050 is market-oriented scenario that emphasizes short term economic gain in marking land and water use decisions. Conservation 2050 is emphasizes on the ecological services, implementing conservation and restoration of native habitats for aquatic and terrestrial organisms.

Assumptions were translated into spatially explicit designs, articulated as maps of land use/land cover in the watershed. Each scenario is also evaluated in terms of the likely effects of consequent land use patterns on important natural resources. In order to evaluate and compare the potential effects of each scenario on ecosystem health under future land use patterns, variety of indicators were used based on each objective, including water availability (Dole and Niemi, 2004), ecological condition of streams in the basin (Sickle, J.V., et al., 2004), terrestrial wildlife (Schumaker et al., 2004)

Source: Dole and Niemi, 2004, Hulse et al., 2002, Sickle, J.V., et al., 2004, Schumaker et al., 2004 the feedback network, modeling and evaluation methods provide a mechanism for providing ongoing feedback and assessing the futures performance.

Investigation + Analysis

The first step of the alternative futures process is to define key issues in the project and understand those issues in relation to the broader body of knowledge. To accomplish this, the project team conducted interviews with key stakeholders, attended the Huron River Impoundment Management Plan (HRIMP) Committee meetings, spoke with topical experts, and read numerous pubic reports and documents pertaining to all three spatial scales of the project (See Appendix 3: Stakeholders, Topical Experts and Clients and Appendix 4: Relevant Planning Documents).

After identifying key issues, several methods were used to gain a better understanding of each. First, a targeted literature review of specific topics was conducted to gain a broader perspective of the issue. Additionally, a review of case studies and precedents was conducted, both for built projects and proposed projects, to examine possibilities that have been pursued in similar circumstances. The literature and case studies reviewed came from many fields of study including ecology, aquatic sciences, public policy, land planning and design. Exploration of case studies and precedents helps ground proposals made in subsequent stages in the realm of plausibility.

Geographic Information Systems (GIS) data inventory and analysis were conducted on a variety of spatial scales (See Appendix 5: Utilized GIS Information for a full listing of data) to further explore project possibilities and directions for design and management. By overlaying and running data analysis processes on pertinent information from many different data sources, the data inventory became a comprehensive exploration of existing systems and landscape patterns. The original analysis in this phase was intended to be exploratory in nature; a means of quantitatively evaluating specific issues raised by stakeholders, spatially integrating relevant documents, and creating visual tools for identifying opportunities or constraints. The results of the investigation and analysis phase are presented in Chapter II and III of this report.

Each explored issues manifesting primarily at one particular scale, but nevertheless influenced by forces at broader scales, and in turn affecting issues at finer scales. This is particularly true of ecosystems processes, which are nested in a hierarchy of scales (Lyle, 1999). One clear result of this investigation was the establishment of three scales of study (Site, City, Watershed), which helped guide the decision making framework. During this process a series of issue matrices were created listing all of the important issues that were identified during the investigation phase and cross-referenced with that issue's relevant scales.

Establish Scenario Framework

The alternative futures approach relies on identifying common goals, scenario drivers, alternative assumptions, key variables, and making design/management decisions. Common goals are identified early in the process and inform the operating environment for the process. For example, a common goal might be that all scenarios will embrace sustainable best management practices. Scenario drivers highlight the normative scenario approach and embody the one defining issue that shapes the outcomes of each alternative future. Making plausible assumptions is often critical to the alternative futures process given uncertain existing or future conditions. Making clear assumptions provides a mechanism for moving towards a decision point. Alternative assumptions for a given issue are then selected based on their compatibility with the scenario drivers. The key variables are then typically focused at the Site Scale, which is where physical landscape interventions can be targeted and evaluated between the future patterns. Finally, the framework identifies many management and design decisions that need to be made to support each different alternative future outcome.

In *Visions of Argo*, placing key issues within the categories of goals, drivers, assumptions, variables, and management / design decisions required careful attention to scale. It was important to recognize that not all issues are immediately relevant or controllable at the Argo Riverfront Site Scale, but nevertheless have an important impact at the site. The following image presents the relationship between drivers, assumptions, and variables across the spatial scales:

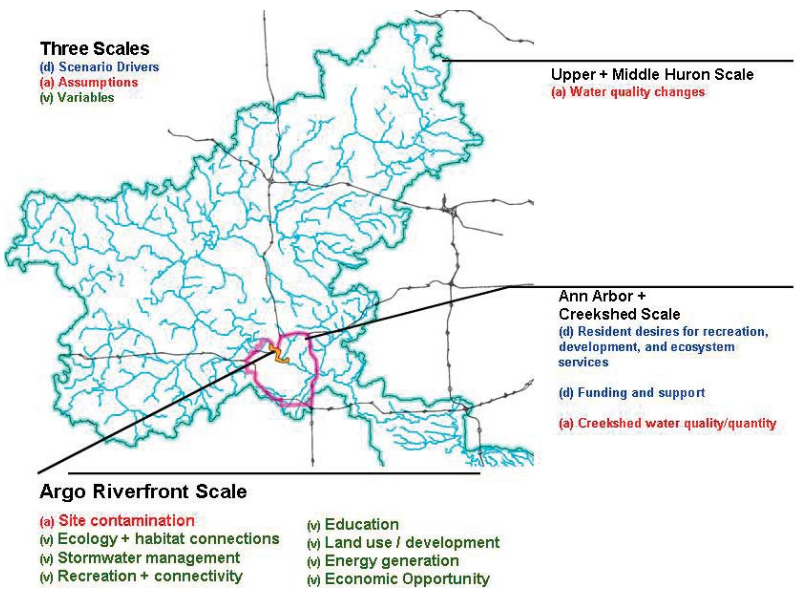


Figure 44: Drivers, Assumptions, and Variables at Each Project Scale.
Scenario Drivers are highlighted in blue, Assumptions in red, and Variables in green.

At the Watershed Scale, the overriding assumption pertains to the future state of water quality, which might decline in response to development pressure, improve in response to greater stewardship and management efforts, or remain relatively constant. Water quality at the Watershed Scale has a direct effect on water quality at finer scales and can constrain or expand options at those scales.

The Creeksheds + Ann Arbor City Scale encompass the physical city as well as Allen's Creek and Traver Creek that empty along the Argo Riverfront. The *drivers* for the scenarios were identified at this middle scale: resident desires and funding support. Through the course of the project, the team explored many issues which initially looked as if they would be the scenario drivers. One of these was the decision of whether to remove the dam and how the removal process would proceed. However, this and others were in fact subordinate to broader concerns. In this case, residents and stakeholders should first identify what services the Argo Riverfront *should* provide, and/or what ecological processes *should* be accommodated, etc. Once these questions are answered the approach to the dam removal will be a logical conclusion. In other words, the *normative* choices about what should happen must inform the specific intervention, policy, or management strategies.

An *assumption* at the Creekshed + Ann Arbor City Scale was that, that any future must include consideration of stormwater management strategies for Allen's Creek and Traver Creek. A progressive best management practice approach could improve water quality and effectively reduce water volumes and flow rates discharging into the Huron River during and after rain events. Differing creekshed management strategies could suggest very different responses to water quality and flow issues at the Argo Riverfront Site Scale. Three variable assumptions where considered: (1) wide-spread neighborhood-scale best management practices implemented to reduce run-off volumes, (2) creeks in channels and pipes are daylighted and restored with riparian buffers, and (3) Allen's Creek and Traver Creek Greenways are constructed with large scale stormwater infiltration and detention facilities. In all cases, it was assumed that the recently proposed stormwater tax credit system will go into an effect to encourage a reduction of impervious surfaces.

At the Argo Riverfront Site, an important assumption is that contamination exists at the Detroit Edison Company (DTE) site, and might be exposed or impacted during dam removal. For each scenario a different assumption was made about the severity of this contamination: (1) the contamination is isolated and can be removed to off-site treatment, (2) the contamination is isolated and can be cut and capped on-site, (3) there is pervasive contamination throughout the site that requires engineered and institutional controls.

As part of developing the scenario framework, the project team considered how the key variables would be evaluated, ultimately allowing comparisons to be drawn between resulting scenarios. Considering the qualitative and quantitative evaluation criteria, early in the alterative futures process, helps to focus the key variables around understandable concepts. The evaluation criteria also informs how different scenarios and their associated future might perform differently or could be improved relative to the other alternatives.

Scenario Design + Refinement

Once the scenario framework was established, the project team could begin exploring different combinations of drivers and assumptions as a means to articulate and define distinct scenarios. The relationship between the scenario framework and the design of specific scenarios was highly iterative, and many rounds of proposing and disposing were required to develop the scenarios. Nevertheless, the resulting framework relied on two drivers (resident desires and level of funding) and three assumptions (upstream water quality changes, Ann Arbor stormwater management, and contamination) to explain the different scenarios.

Given the normative objective of this alternative futures project, the team only considered scenarios that were aligned with the following common goals established during the process: (1) position the Argo Riverfront as a focal point for the City of Ann Arbor and enhance the river's amenity value; (2) increase ecological quality and ecosystems services; (3) embrace sustainable design and management practices to protect the health of the Huron River riparian corridor.

Subsequent rounds of combining and refinement were made, with a conscious effort to explore both scenarios that better met the common goals and were increasingly distinct alternatives. Attention was given to scenarios that embraced a plausible and compatible relationship between drivers and assumptions. Three scenarios were distilled at the conclusion of the scenario design process and used as the basis for the initial alternative futures drafts. To aid the design of the futures, each key variable in the framework was assigned a qualitative objective target for each scenario. These targets aligned with each scenario's overall drivers and assumptions, and greatly simplified the design process.

Futures Development

The futures take the form of plan drawings, perspectives, elevation drawings and three-dimensional renderings, as well as descriptive text and diagrams that explain how the site functions. The futures are aimed to evoke stakeholder feedback and evaluation. Midway though the futures development process, five alternative futures were presented to the stakeholder group consisting of HRIMP and city staffs, to solicit feedback on the feasibility, desirability, and functionality of the futures. This feedback was used not only to redesign the futures, but also to reconsider the underlying scenarios driving the futures. At other points in the process, scenarios and futures were presented to individual topical experts for additional feedback (See *Appendix 3: Stakeholders, Topical Experts and Clients* for list of individuals consulted).

After drafting the futures, each was assessed according to the evaluation criteria for the key variables. In many instances, these criteria were compared to existing conditions as means to gauge whether the scenarios met the common goals embraced by all three scenarios. The summary of this evaluation is presented in Chapter 6: Anticipated Outcomes.

HEC-RAS Hydraulic Model

Why a Model?

Development of a future based on each scenario should respond to site conditions and a specific program, including desirable amenities and expected ecological functions. The program reflects not only the guidelines of each scenario but also site conditions that limit or enhance the opportunity of the site specific program. The design feasibility and plausible assumptions of alternative futures for the Argo Riverfront are influenced by the river channel morphology and water level variability. However, in the event of the dam removal, one of the main issues for the future landscape design at Argo Riverfront is uncertainties about the new river morphology that might result.

Riparian vegetation and animal communities are strongly influenced by hydrologic regimes including seasonal water level variability and stream reaction to storm events. Typical riparian ecosystems, such as emergent marsh, wet meadow, and wet prairie, which can be seen along the Huron River, are associated with seasonal water level variability and a distinct physical condition. For instance, the emergent marsh community is found along pond, river and stream edges in shallow year-round standing water. On the other hand, the wet meadow community is found in low wet areas where standing water is common through the spring and early summer, but not year round. Seasonal changes of base flow, relatively high discharges in spring, and low discharges in summer, alters the water level along the river and provides a variety of wet conditions through out the area.

Design opportunities along the river are also influenced by hydrologic change after the dam removal. For example, recreational facilities including natural trail and fishing docks and educational facilities such as fish hatcheries, should be tied into the habitat restoration along the river. Siting of canoe and kayak runs, should consider the gradient of river flow that is mainly measured with the existing river bottom grade.

The main objective of the hydraulic modeling is to inform channel design and the land use plan for future visions in the event of dam removal, focusing on the following goals.

- Estimate the river bottom elevation
- Estimate the seasonal variability of water levels
- Estimate the reclaimed land

Methods and Results

In order to achieve these goals, we used Hydrological Engineering Center's River Analysis System (HEC-RAS), distributed as freeware by the U.S. Army Corps of Engineers. Its ability to model steady and unsteady flows, sediment transport, and water temperatures has led to it being commonly used by many agencies to manage rivers, harbors, and other public waterways since its public release in 1995. We constructed an initial model to reflect the existing channel of the Argo Riverfront Site and then created subsequent models to explore the effect of changing several variables such as the impacts of removing the dam and altering the volume of water in the river during rain events and seasonal changes. The output from this model is used to evaluate and refine the channel characteristics of our final scenarios. Recognizing the potential utility of the geographic information system (GIS) environment to streamline the modeling process, HEC-Geo RAS, was used for data preparation and visualization of the modeling results.

Water elevation is simulated based on river geometry, channel roughness, flow rate and boundary condition with a one dimensional energy balance equation. The river geometry is given in the form of channel cross-sections at selected intervals along the river. This river cross-section data is traditionally acquired through field surveys in which x, y, and z-coordinates of the river channel bottom and the river bank are measured, using GPS or physical gauging.

Recognizing the potential utility of the GIS environment to streamline the modeling process, HEC-Geo RAS, is also distributed, as a free extension package for ArcVIew3.x (ESRI) by the U.S. Army Corps of Engineers, and is used for data preparation as well as for visualization and measurement of the modeling results.

In order to produce river geometry data for HEC-RAS, we created a triangular irregular network (TIN) model using GIS. The river bottom terrain model is interpolated based on the river channel cross-section that is acquired form the Michigan Department of Environmental Quality (MDEQ) (historic hydraulic modeling data in HEC-2 format) and the Argo Pond Sediment Sampling Study (Barr Engineering Co., 2002). These two sources included data for 23 cross-sections along a 19,533 foot long segment of the river. Cross-section data from MDEQ was originally measured for floodplain mapping using HEC-2 and was recorded as an elevation at the streambed. On the other hand, cross-section data from the Argo Pond Sediment Sampling Study was recorded as the depth of the water. In order to maintain the consistency of the dataset for terrain interpolation, both cross-section datasets were converted to water depth and then subtracted from water surface elevation. Further, because of the lack of cross-section information downstream of the dam, we used a construction document of the Argo Dam as supplemental information for the river bottom elevation.

The river bottom terrain model was then combined with the river bank terrain model which is then interpolated based on one foot contour lines provided from the City of Ann Arbor. The TIN model that is used for river geometry data is shown in Figure 45.

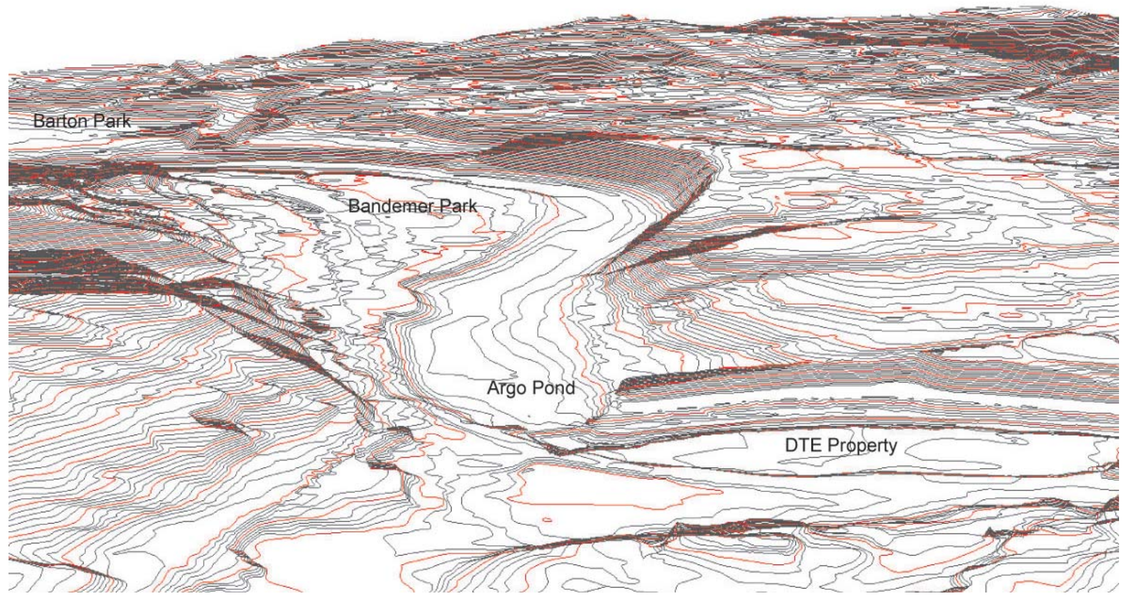


Figure 45: TIN model used for river geometry data (2X vertical exaggeration)

In order to estimate seasonal water level fluctuations along the Argo Riverfront Site, we conducted a steady flow analysis using HEC-RAS. The steady flow analysis of the modeling system is intended for calculating water surface elevation for steady flow (seasonal flow). The volume of water flowing along the study sections was based on the estimated water flows in a published report by the MDEQ (2001). In this study, discharge in cubic feet per second (cfs) was estimated using a United States Geological Survey gage data of statistical monthly means for the years 1915 to 1997. The gage is located on the Huron River at Wall Street in Ann Arbor, Michigan, in-between Allen Creek and Traver Creek. In order to estimate the water level at high flow season and low flow season, we used average flows in May and August from the report. The water flow volume used for the water level estimate is shown in Table 5.

	May	August
Huron River	606	183
Allen Creek	4.45	1.34
Traver Creek	1.87	0.57

Table 5: Average Flows (cfs) of the Huron River compared to Allen and Traver Creeks.

Figure 46: Example of HEC-RAS Output, X-Y-Z Geometry Plot
Shows water surface elevation after the dam removal at a flow volume of 606 cfs

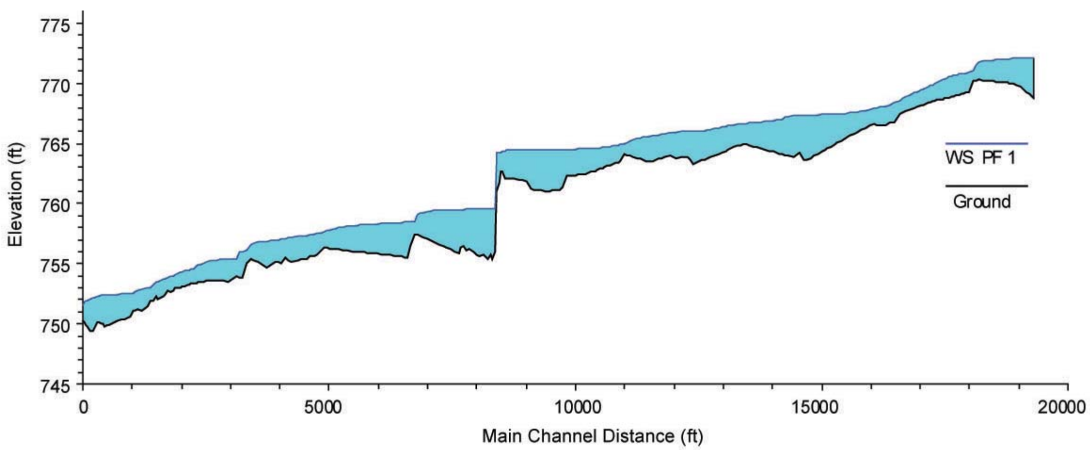


Figure 47: Example of HEC-RAS Profile Plot
Shows water surface elevation after the dam removal at a flow volume of 606 cfs.

Figure 48: Elevation (feet) of the Surface Water at Low Flow Volume (183cfs)

GeoRAS is used to import the HEC-RAS output into ArcView 3.x (ESRI) in order to visualize and measure the water level and reclaimed land after dam removal. Using GeoRAS tools, water surface is interpolated for each flow volume simulation (606cfs at high flow and 183cfs at low flow) that was calculated in HEC-RAS.

Figure 48 shows the change of the water surface elevation (feet) along the river after the dam removal. From Barton Dam to the M-14 overpass the elevation change is greater than from the M-14 overpass to the area by Argo Dam. After the dam removal, the water surface elevation drops approximately five feet along the dam area.

Figure 49 illustrates the seasonal difference of estimated reclaimed land area based on the high and low flow volume. At high flow volume (606 cfs in May), the area of the reclaimed land after dam removal is estimated to be around 27 acres including the mill race (3 acres) and the south edge of Barton Park (2 acres). At low flow volume (183 cfs in August), the area of the reclaimed land is estimated to be around 39 acres including mill race (3 acres) and the south edge of the Barton Park (2 acres). Most of the reclaimed lands are located along the edge of the Bandemer Pak and the southern part of the Argo Park.

Riparian vegetation and animal communities are strongly influenced by hydrologic regime such as seasonal water level variability. Along the Huron River, riparian ecosystems, including emergent marsh, wet meadow, and wet prairie, are associated with seasonal water level variability. In order to inform the design utilizing the reclaimed land, the location with seasonal standing water is identified based on the seasonal difference of the flow volume (Figure 50). Roughly 27 acres of reclaimed land will be maintained above water through the entire season. On the other hand, 12 acres of reclaimed land will be inundated with water in the spring. Major part of lands with seasonal standing water is found around the Bandemer Park.

In this project, we assessed the river morphology after the dam removal event, while focusing on the estimation of the reclaimed land and surface water elevation based on the seasonal steady flow. These estimations were used to inform the designs at the Argo Riverfront Site, providing critical input for the decision of landscape elements, landscape patterns, and programming along the river that is altered after the dam removal.

Further analysis, including floodplain analysis of major storm events and assessment of flow velocity based on a new channel design, will be needed in order to discuss further detailed design decisions such as kayak and canoe runs, river bank stabilization, and new construction of the stormwater treatment wetland along the river. Furthermore, a sediment transportation calculation would be the critical analysis for assessing the risk management and the stabilization method of the sediment. Further development of the HEC-RAS model with sediment transportation analysis will inform the feasibility and engineering solutions for the sediment stabilization management along the river.

Figure 50: Location of reclaimed Land with Seasonal Standing Water

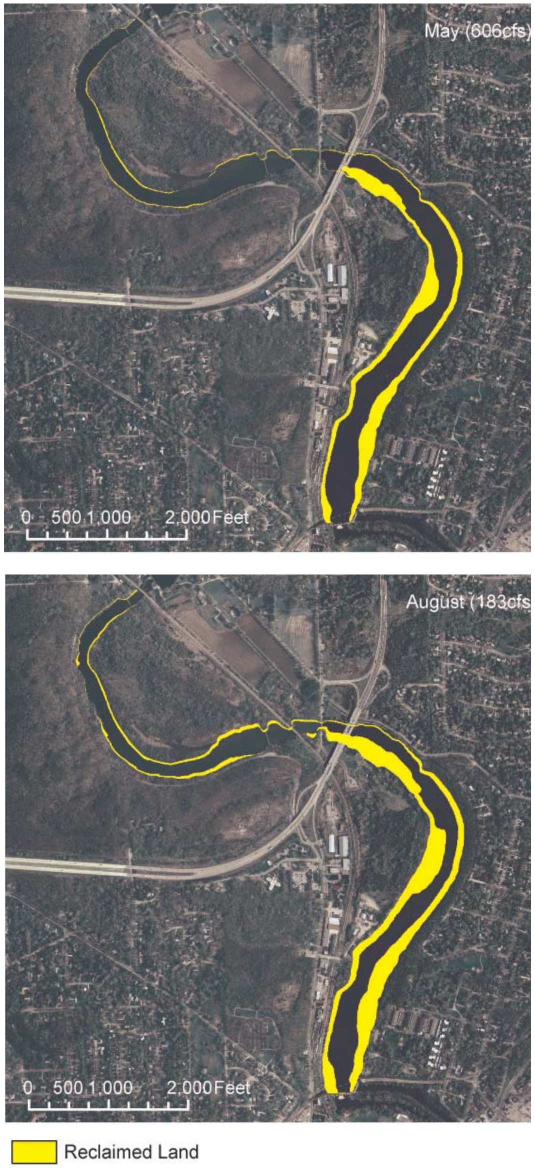


Figure 49: Estimate of Reclaimed Land Based on Different Flow Volume

Chapter 5 – Scenarios and Futures Descriptions

Scenarios for the Argo Riverfront

One of the greatest revelations of the *Visions of Argo* project, and one that should empower the local public, is that the primary driver for what should happen is really about what people want to have happen. The myriad of technical issues, from dam removal and brownfield contamination, to channel reconfiguration and sediment management, should be subordinate to the overall desire of what the space is to become. These complex technical issues can in fact be resolved in many different ways; and the decision of which methods to employ should be based on their compatibility with broader overall objectives. Figure 52 presents the final scenario framework that was developed towards the end of the alternative futures process:

The following sections describe each of the scenarios and their resulting futures created in this project. The scenario descriptions focus on the relationships between the drivers and assumptions and how they inform the objectives for the key variables of (1) ecology, (2) stormwater, (3) human engagement, and (4) development. The scenario description is followed by the designs plans, perspectives, and detailed write-ups for each future. For the purposes of consistency, each future will be presented in the same sequence, beginning first with an overview of changes to river morphology and the riparian corridor as a whole, and then breaking the areas of the Argo Riverfront down by reach. The following explains the sequence describing each future:

Ecological Response – This section considers the entire Argo Riverfront; explaining the dam removal decisions, resulting changes to river form, impact on aquatic communities, and how upland habitat types are created, expanded, or connected.

Argo Reach – This includes the area immediately surrounding the dam, including the mill race and the approach leading upto the Argo Dam. In addition, this reach includes the Detroit Edison Company (DTE) brownfield at 841 Broadway and Allen's Creek outlet.

Bandemer Reach – Encompasses the current Argo Pond impoundment, extending from upstream of Argo Dam to the M-14 overpass. This includes Bandemer Park on the west side of the river and Argo Park on the east side of the river. It also includes the Main Street Corridor, extending along North Main Street from Depot Street north to the M-14 ramp.

Barton Reach – This includes the extent of the Huron River from Barton Dam downstream to the M-14 bridge. It encompasses all of Barton Park as well as the river banks along Huron River Drive on the south and west side of the river following Bird Hills Park.

Riverside Reach – Extends east of the Broadway Bridge, including Broadway and Riverside Park and the riparian edge following the railroad tracks east to the Maiden Lane Bridge. This reach also includes the DTE properties adjacent to Riverside Park and extends into Lower Town.

Fuller Reach – Extends from the Maiden Lane Bridge to the Fuller Bridge. Encompasses Fuller Park, Island Park, and Cedar Bend Park, as well as adjoining roads.

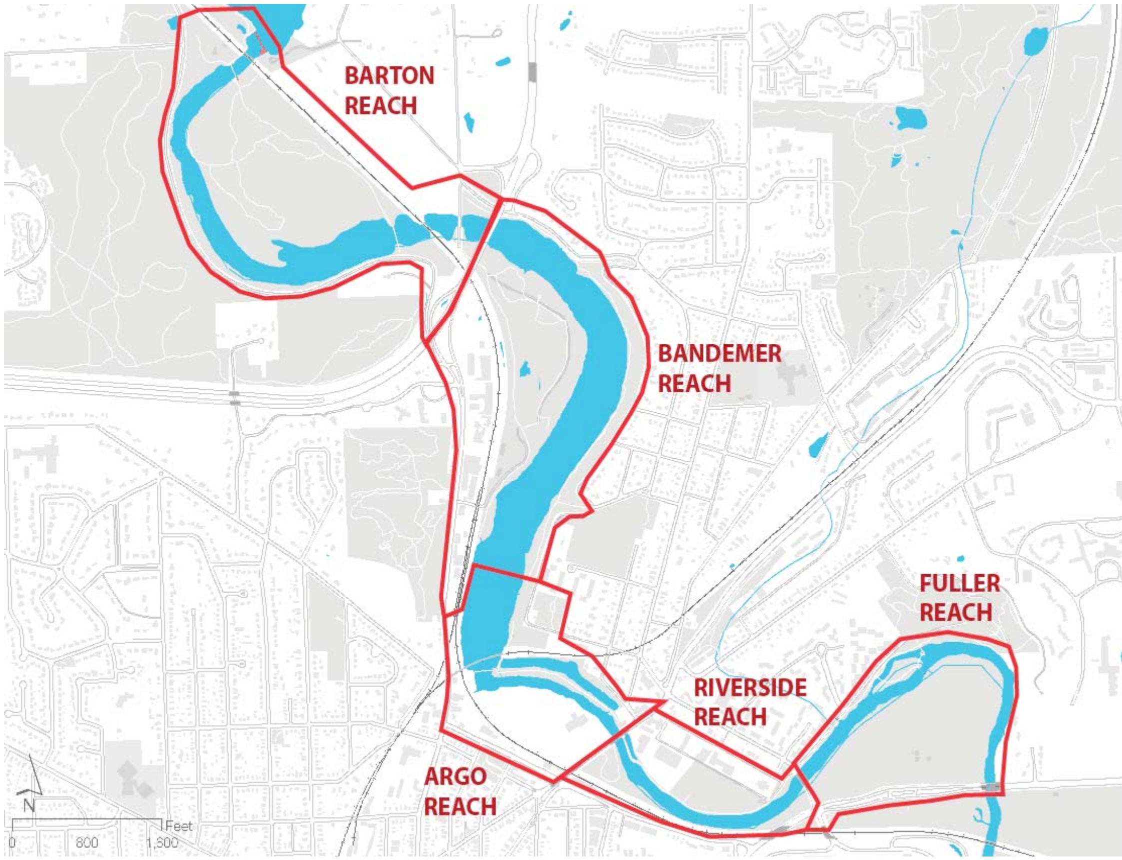


Figure 51: Argo Riverfront Reaches.

VISIONS OF ARGO: SCENARIO FRAMEWORK

COMMON GOALS

Goal One	Position the Argo Riverfront as a focal point for the City of Ann Arbor and enhance the river's amenity value.
Goal Two	Increase ecological quality and ecosystem services.
Goal Three	Embrace sustainable design and management practices to protect the health of the riparian corridor.

	ALTERNATIVE SCENARIOS / FUTURES	"a place for nature" **Biodiversity + Heritage Corridor**	"a place for recreation" **Rainwater Adventure Park**	"a place for living" **Sustainable Live/Work Community**
SCENARIO DRIVERS	Resident Desires	Enhance ecological quality and promote stewardship & education opportunities.	A connected & dynamic riverfront, active recreation, swimmable waterfront, and cleaned stormwater.	Connect urban feel, sustainable live/work/play, alternative transit strong connection to hospital & UofM.
	Funding Support	Public / Limited Budged Reliance on grants and institutional support for restoration + programs	Public / High Investment	Private Investment
VARIABLE ASSUMPTIONS	Changes in Upstream Water Quality	Remains the same as today	Improves over time	Declines over time due to increasing development
	Ann Arbor Creekshed Management Approach	Zero-runoff neighborhood scale BMP programs implemented and combined with daylighted creek channels	"Big Water" - a sequence of large rainwater parks and greenways created along the creeks to retain and filter water.	Large scale bioengineered stormwater treatment facility (cattail marsh) combined with city stormwater tax.
	Contamination	Isolated contamination, soil removed for off-site treatment.	Isolated contamination, soil cut and capped on-site.	Widespread contamination, engineered and institutional controls eliminate risk.
ECOLOGY	Habitat Objective	Expand "core habitat" areas and improve the matrix quality. Prioritize biodiversity, species protection, and restoration activities.	Create a well-connected habitat "corridor." Focus on enhancing ecosystem services and functions over addressing specific species of concern.	Utilize stepping stone "patches" to enhance connectivity along the Riverfront. Focus on connection between ecology and human health and wellness.
	Aquatic	Restore historic biodiversity	Habitat for game fish species (cold water release)	Mitigate existing impairment
	Riparian	Widest continual buffer	Balance access with riparian enhancement	Prioritize as a human waterfront, bioengineering solutions
	Wetlands	Design for biodiversity	Stormwater management and services prioritized	Wetlands a park space, demonstrate cleaning processes
	Uplands	Enhance matrix quality, and make new connections	Retain or enhance connections as part of development	Utilize native vegetation throughout redevelopment scheme

KEY VARIABLES

ECOLOGY			
Habitat Objective	Expand "core habitat" areas and improve the matrix quality. Prioritize biodiversity, species protection, and restoration activities.	Create a well-connected habitat "corridor." Focus on enhancing ecosystem services and functions over addressing specific species of concern.	Utilize stepping stone "patches" to enhance connectivity along the Riverfront. Focus on connection between ecology and human health and wellness.
Aquatic	Restore historic biodiversity	Habitat for game fish species (cold water release)	Mitigate existing impairment
Riparian	Widest continual buffer	Balance access with riparian enhancement	Prioritize as a human waterfront, bioengineering solutions
Wetlands	Design for biodiversity	Stormwater management and services prioritized	Wetlands a park space, demonstrate cleaning processes
Uplands	Enhance matrix quality, and make new connections	Retain or enhance connections as part of development	Utilize native vegetation throughout redevelopment scheme
STORMWATER			
Treatment Scope	Manage on-site runoff through naturalistic wetlands and enhanced riparian buffers.	Manage stormwater at outlets along the Huron River. On-site runoff treated.	Incorporate Low-Impact-Development techniques to treat on-site runoff in a visible manner.
HUMAN ENGAGEMENT			
Education	Stewardship, hands-on activities, establish restoration HQ	Vivify ecosystem processes, demonstration focus	Passive recreation, demonstration focus
Recreation	Passive / low-impact recreation emphasis. Birding, fishing, boating should avoid conflict with nature.	Active recreation - focus on adventure sports (kayak, BMX, skateboard). Swimming beach.	Leisure and entertainment focus, enhance nightlife, cultural amenities, expand urban experience.
Connectivity	Emphasis on trails, river as a corridor for people	Increase access to the water front, riverfront as a destination	Connect human land uses, pedestrian / bike emphasis, expand urban grid
Culture	Highlight and restore historical artifacts (i.e. dam structure, mill race, industrial buildings).	Retain iconic cultural artifacts, emphasize relationship between built and natural environment.	Enhance relationship to major institutions, design for rehabilitation, healing, and wellness.
DEVELOPMENT			
Land Use	Retain as open public land, limit new facilities construction. Re-purpose existing buildings.	Retain as public land. New facilities created to provide new amenities.	Land swapping with private sector, blend of public/private space after development.
Economic Model	Manage as a non-profit, cost saving approaches (seedbanks) build off volunteer support.	Land as revenue for the city, pay for access to specific amenities (i.e. skatepark).	Private development model, build off brownfield support, expand city tax base.
Energy	Zero-impact renewable energy (solar or wind) to power site amenities. No visual impact.	Harness wind/solar energy for site power. Highlights green infrastructure as an amenity.	Harness energy to power site as well as new development (micro-turbines), wind/solar/hydro power.

MANAGEMENT + DESIGN DECISIONS

Future Dam State	Flood Control	Railroad Crossings	Fisheries, stocking
Mill Race	Habitat Patterns	Main Street Improvements	Market / performances
River Form	Riparian Buffer Design	Business / Offices	Community Gardening
Sediment Management	Wetland Vegetation	Housing Mixes / Types	Education Programs
Weed Removal	Sustainable Practices	Recreation Amenities	Multi-purpose facility

Figure 52: Scenario Framework

The final scenario framework describes the different drivers and assumptions that define each scenario, as well as the objectives each scenario should meet within each of the key variables. At the bottom of the framework is a list of the crucial design and management decisions that addresses

Great News

Ann Arbor creates a haven for nature enthusiasts, researchers, and residents.

On the observance of Earth Day, Ann Arbor officially completed the last major link in the Ann Arbor Biodiversity + Heritage Corridor. This ecological corridor along the Huron River showcases restoration, stewardship, and education activities and firmly acknowledges our connection to the local ecosystem and the services it provides. Working with non-profits, local foundations, research institutions, and public agencies, the City of Ann Arbor has truly transformed the Argo Riverfront into a corridor that celebrates nature.

People continue to enjoy the area for passive recreation uses, such as bird watching, fishing, hiking, and boating. However, access has been carefully designed to minimize disruption on the breeding habits of important waterfowl, amphibians, and other rare species dependent on large patches of habitat. Nearby neighborhoods are also actively participating in making this a high quality nature area by implementing rain gardens and habitat programs along back yards and streetscapes. This is the first large scale neighborhood redesign geared specifically toward habitat connectivity in the State of Michigan.

While great emphasis has been placed on ecological integrity, community activism and collaboration also ensured the preservation of many historic features of the site. One especially significant landmark is the Argo Dam pedestrian bridge crossing over the river. Without the removal of this dam none of this would have been possible but the preservation of this remnant and the accompanying signage help remind visitors of the important role this site in the river has had to the history of the area.

In order to preserve the Argo Riverfront as "a place of nature" the land has been placed in a conservation land trust. This ensures that the corridor remains open space in the community and serves as a constant reminder to our responsibility and dedication to the biodiversity and heritage of the Ann Arbor community and its place in the Huron River Watershed.

Biodiversity + Heritage Corridor

Scenario Description

Drivers:

This scenario emerges from a desire among Ann Arbor residents to emphasize ecological restoration of the Argo Riverfront Site in a manner that respects the historical legacy of the area. Coupled with this desire for restoration is that public expenditures should be minimized. This condition promotes partnerships with non-profits, major institutions, and public agencies to help finance restoration activities. The Argo Riverfront Site provides a wealth of education opportunities that align with the outreach objectives of local foundations and the research interests of institutions and public agencies

Assumptions:

This scenario aligns with three assumptions. The first assumption is that water quality entering the Argo Riverfront Site from Barton Pond is not likely to change, thus, enhancing the riparian edge with wetlands to increase water quality as it passes through the project site. Secondly, the stormwater runoff volumes and quality from the City of Ann Arbor, are greatly improved. Stormwater cleaning is achieved through a "zero-runoff" neighborhood-scale stormwater management program along with extensive day-lighting along the creek corridors. The final assumption is that the extent of contamination at the Detroit Edison Company (DTE) brownfield (841 Broadway) is isolated and known. In the interest of restoring the river to a more historic and ecological condition, the contaminated soil is excavated and moved to an off-site treatment facility, allowing the river to curve in a manner similar to the historic river channel below the former Argo Dam.

Variables:

Ecology: The overall emphasis is on enhancing the biodiversity of the existing natural areas along the Argo Riverfront Site by creating or expanding native core habitat. A wide riparian zone enhances the water quality and provides essential habitat. Backyard-habitat programs along key corridors facilitate the movement of wildlife between the river and upland areas.

Stormwater: The outer edges of the floodplain within the Argo Riverfront Site are designed to carefully balance stormwater filtering and retention with broader habitat objectives. Allen's Creek, now daylighted, converges with the Huron River in off-channel wetlands filtering and slowing excessive stormwater volumes.

Human Engagement: Human utilization of the Argo Riverfront Site is highly sensitive to ecological conditions with access to the waterfront carefully controlled to minimize impacts and retain large contiguous patches of habitat. Recreational programming focuses on passive activities, restoration and education.

Development: : Many historic artifacts and buildings are retained and repurposed to pay homage to the past and provide educational opportunities. Re-purposed structures are retrofitted as green buildings and sustainable practices are presented to patrons in ways that are replicable by local property owners.

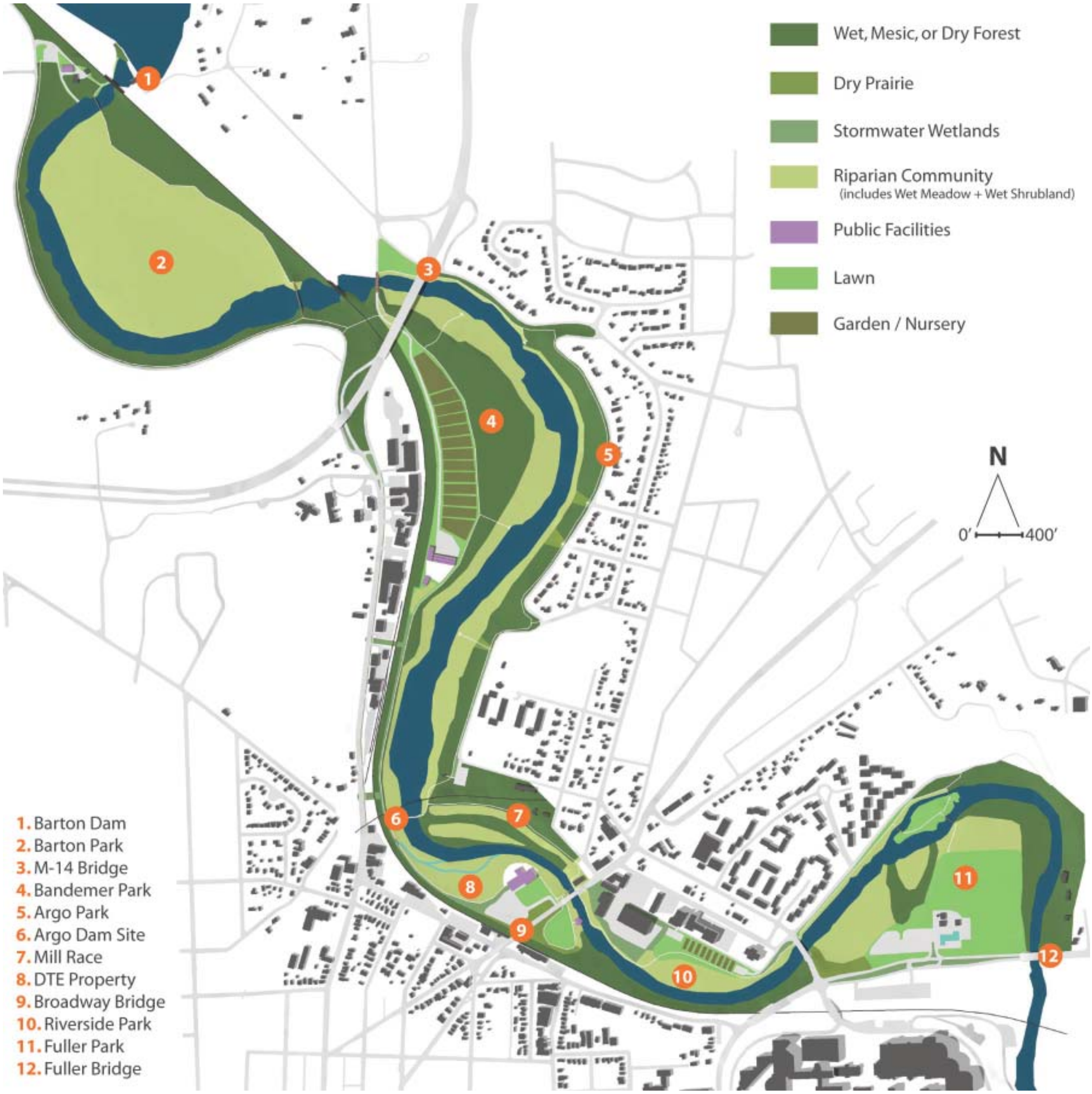
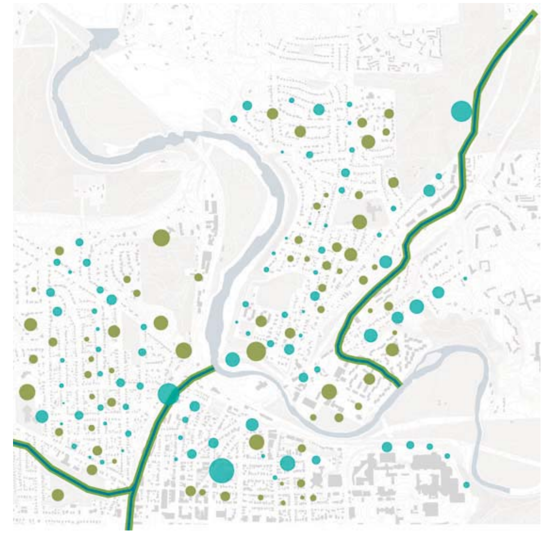


Figure 53: Master Plan for Biodiversity + Heritage Corridor



Context

Human Use

Habitat

River Form

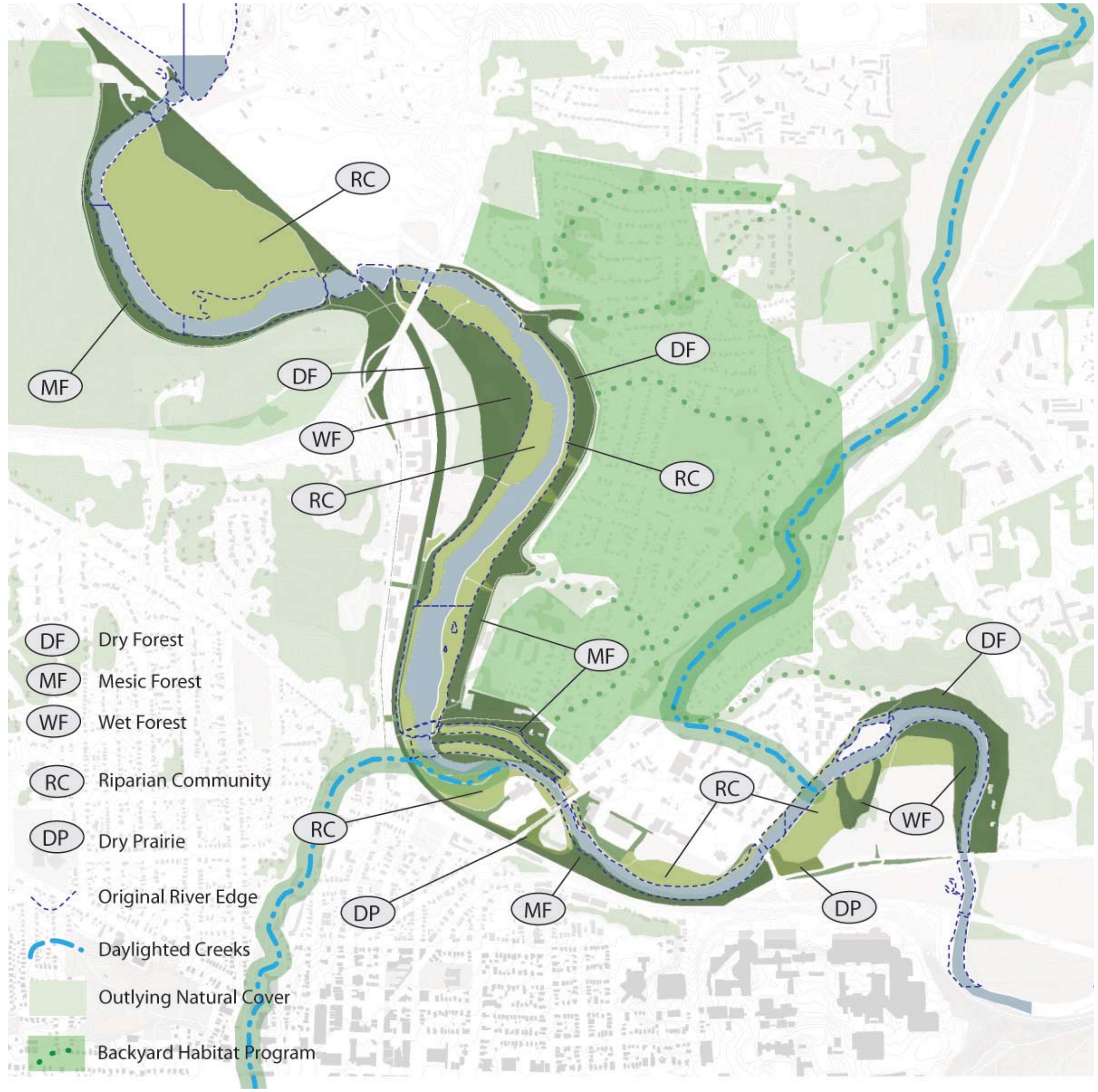


Figure 54: Ecological Response for Biodiversity + Heritage Corridor

Plan depicts the plant communities occurring along the expanded riparian corridor. Riparian communities include wet meadow, wet shrubland, and potentially emergent marsh habitat. Also shown is the backyard habitat program target area and the daylighted creek channels.

Alternative Future

Ecological Response

The overall objective of increasing biodiversity in this scenario, recommends removing the Argo Dam as a means to reconnect two sections of the Huron River and reclaim valuable riparian land. Historically, this stretch of the river had one of the steepest gradients, and dam removal can restore this gradient with fast flowing water conditions. These conditions favor a more diverse native river fish species, such as large-mouth bass, darters, and redhorses, over the less diverse small mouth bass and bluegill community that currently dominates Argo Pond.

The dam removal process utilizes a gradual drawdown strategy over a series of years, carefully stabilizing exposed banks with native bioengineering solutions, such as root wad revetment, live fascines and brush mattresses. This gradual drawdown process minimizes sediment mobility and in turn, impacts aquatic habitat downstream. As the river channel narrows, the current 90-degree bend below Argo Dam is converted into a smoother curve once the bank armoring is removed. To some degree, the river is allowed to find its own alignment within an expanded floodplain and this gradual bend would reflect the historic curve of the river prior to alterations due to industrial development. Reclaimed land allows new wet meadow and wet shurbland communities to be created in the riparian corridor. Seasonal flooding in these communities is important for discouraging invasive species. Periodic prescribed fires can be used to encourage wet meadows, a locally rare habitat type, over the wet shrubland community. Existing emergent marsh communities, currently in small patches around Barton Park and Argo Park, will likely be eliminated as the water level declines. Opportunities to recreate emergent marsh conditions can be considered where less steep portions of the river create slower moving water conditions.

PRIVATE-PUBLIC PARTNERSHIPS

Master Plan of park spaces along the Detroit River
Source: DRC, 2005

The Tri-Centennial State Park is the first urban State Park in Michigan and located in the heart of downtown Detroit. Comprised of 31 acres along the once highly industrialized banks of the Detroit River, the Park focuses on educational programming, nature-based recreation, and entertainment. The four distinct areas of the park are: a wetland area intended to allow for student science-studies, an upland hardwood and meadow environment, a restored harbor ideal for viewing Detroit's annual firework show, and an interpretive center for education. Ultimately, these areas will traverse the River Walk which will span a 5.5 mile stretch from the Ambassador Bridge to beyond the MacArthur Bridge at Belle Isle. Stretches that cross property lines have been granted easements from private owners to increase connectivity. The key to the success of this project has been the private-public partnerships formed to make this Riverfront project a reality. This partnership has currently invested more than $250 million with an additional $47 million still needed to set up an endowment for the future of the River Walk.
Source: DRC, 2005

Site Plan of Argo Reach

A Riparian Wetlands at DTE

Argo Reach

a. The contaminated soil at the DTE property is removed for off-site treatment, an approach which is more cost-effective in Michigan than elsewhere given that Michigan houses one of the nation's soil disposal facilities. The armored bank which was formerly necessary to prevent erosion on the DTE property is removed and the river channel becomes more closely aligned with a historic form, curving smoothly below the former dam site.

b. Allen's Creek, which has been daylighted though a parallel city initiative enters into the Huron River along this smoother bend in the river. Much of the DTE site is lower as a result of excavation, allowing a broad floodplain wetland to enhance this connection between Allen's Creek and the Huron River. Allen's Creek now meanders through the floodplain wetlands prior to joining the river mainstem. The riparian community in this area emphasizes wet shrubland species, which better buffer and stabilize the new softened Allen's Creek channel. This area functions as a captivating example of re-adapted use of brownfields into areas of high ecological value.

c. The DTE building at 841 Broadway is purchased by research institutions to create a new river research center. Part of the facility contains a fish nursery to increase populations of rare native fish as part of the river restoration project. Educational programming at this facility includes interpretive signage and guided tours of the biodiversity being fostered here.

d. The mill race topography is generally preserved, both as a historic landmark and as an area that supports a population of endangered plants. The former mill race is an opportunity to discuss the relationship between ecological processes of succession and habitat fragmentation and "man-made" environments. The site prompts questions such as, "what responsibility do we have to protect endangered species that are thriving in artificial landscapes?"

e. The watered portion of the mill race will drain as the water level in the impoundment drops during the dam removal process. Sediment can be dredged from the impoundment and put into the mill race. Once the drawdown is complete, the lowlands of the partially filled mill race can be planted with early pioneer floodplain and/or wetland vegetation to begin rebuilding the sediment as proper soil.

f. The existing dam sill is maintained in order to prevent erosion caused by the drop in elevation between the impoundment river bed and the downstream river bottom. Careful restructuring of the bottom will ensure that canoes can still pass easily along the main channel. The drop in elevation between the impoundment river bed and the downstream river bottom, nearly seven feet, is allowed to naturally readjust itself.

g. Pedestrian paths along this reach are designed to minimize human impacts along the waterfront. The mill race path is moved to the north side, just below the rail-road tracks, allowing the mill race berm to be free from further human disturbance.

URBAN STREAM DAYLIGHTING PROJECT

As cities grow, they often begin to bury their streams into pipes as a way to continue to develop land and needed roads. An unfortunate result of this development is an increase in flooding due to the loss of pervious surfaces. Many outdated pipes can no longer handle the large flows and water begins to flood the streets. Communities like Kalamazoo, Michigan have become concerned with this problem and have begun to explore "daylighting" these once buried streams.

In 1986, Kalamazoo was redeveloping their downtown. Daylighting Arcadia Creek gained support as a way to bring interest to the downtown as well as address the flooding problems. The massive restoration activities resulted in five blocks of daylighted stream and a large retention pond (once home to a parking lot) that holds the high winter flows with slow release to the stormwater sewers and in the summer serves as an entertainment amphitheater that generates $12 million annually.

Source: NPS.

Site Plan of Bandemer Reach

A Waterfront Boardwalks

B Native Plant Nursery

h. The gradual removal process allows portions of Argo Dam to remain intact. The end structures of the dam are retained at the end of the removal process, both as a historic landmark and to support a redesigned pedestrian bridge that maintains the existing river crossing.

i. A pedestrian path is created on the south side of the river between the railroad tracks and the former DTE site. Smaller boardwalks and observation decks cross over the floodplain wetlands, and provide views up and down the river while maintaining a larger habitat patch.

j. The existing canoe livery operations are relocated upstream near the Barton Dam. The existing buildings and grounds are repurposed into a joint venture with the Audubon Society. Features including decks and blinds for wildlife viewing, wildlife rescue and rehabilitation facility, open space for public programming, and a lending library or rental facility for scopes, binoculars and hand held Global Positioning System (GPS) units which the public can use to help collect data on types, and frequency of wildlife sightings.

k. The historic DTE hydropower plant building on the northeast side of Broadway Bridge becomes a museum featuring the importance of the Huron River and the Argo Riverfront Site to local history.

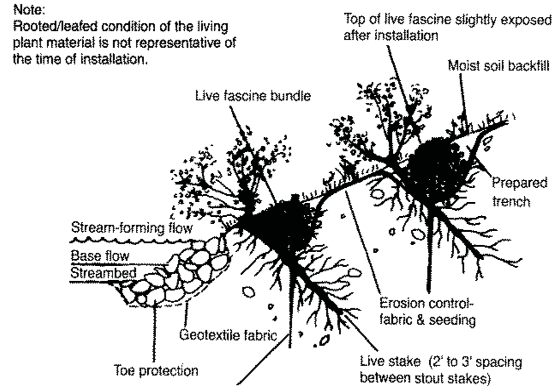
Bandemer Reach

a. Land reclaimed along this reach is stabilized with native vegetation, creating broad riparian wetlands and a vertically structured riparian edge. The lowland riparian areas are primarily wet meadow communities. The upper floodplain zone is mostly clay fill which can be managed as, a wet forest with a focus on invasive species removal and as larger areas of contiguous habitat along the riparian corridor. Runoff from the upland portions of the site can be filtered through the riparian area as well. Boardwalks with lookouts are again used throughout this reach on the Bandemer side of the river.

b. The east bank of the river currently has a pedestrian path partway up a steep and highly eroding slope. A boardwalk currently exists along a portion of the north side of this reach closer to the M-14 bridge. This boardwalk now transitions into a formal walking path at the edge of Long Shore Drive, eliminating the informal path along the water edge. The new pathway still provides views over the river in between the trees, but maintains the riparian edge for undisturbed habitat use.

c. The current rowing facilities, no longer usable given the removal of Argo Dam, are repurposed by the City of Ann Arbor into an education and restoration center, the Bandemer Ecology Center. Portions of the property are set aside for education opportunities, such as volunteer training programs, classes, native plant demonstrations, etc. The majority of the site is utilized as a native plant nursery, initially growing plants to be used in restoring the Huron River channel, and later used to provide free or low cost plant materials for the neighborhood habitat programs and specific restoration projects throughout the city. A seed-bank facility also sells seeds and seedlings as a for-profit

LIVE FASCINES



Fascine construction
Source: ADFG, 2008; ODNR, 2005

Live fascines are long bundles of live woody vegetation (typically live willow or red-osier dogwood) buried in a streambank in shallow trenches placed parallel to the flow of the stream. The plant bundles sprout and develop a root mass that will hold the soil in place and protect the streambank from erosion

Site Plan of Barton Reach

service to the public. The Bandemer Ecology Center is designed as a fully sustainable "off-grid" facility that harvests and re-circulates rainwater for the nurseries, relies on solar energy, treats waste-water through a bioengineered wetland system and utilizes stormwater Best Management Practices (BMPs) throughout the design.

d. The current Bandemer entrance off North Main Street is closed, being readapted into a habitat opening from Bluffs Nature Area. The edges along the railroad corridor is managed as a dry forest with oaks and understory forbs.

e. Access into the Bandemer Ecology Center is provided by the Park Road Bridge, where a car crossing already exists.

f. The portion of Bandemer Park on the north side of the river is retained as open space, and features a small boat launch pier, allowing canoes and other non-motorized craft to access the river without disturbing the vegetation along the banks.

g. Tunnel and small underpasses are created at key intervals along North Main Street to allow small mammals and other organisms to cross the river. The sidewalk is expanded slightly, with a native vegetation buffer creating a safer and more pleasant walking experience along North Main, while also becoming an aesthetic amenity.

Barton Reach

a. With the water level declining, additional land is exposed along Huron River Drive. This land is used to create carefully designed access points to the waters edge for fishing, bird watching, and other activities. By gaining additional land, the road bed can be extended slightly at key areas, adding much needed bike lanes but also providing additional parking areas, reducing the likelihood of people parking along the shoulder and damaging the vegetation or eroding the steep banks.

b. On the opposite side of the river, along the edge of Barton Park, there is currently a complex arrangement of habitat communities. This is largely preserved with an emphasis on reestablishing emergent marsh areas. Many of the existing trails are removed, to allow the area to become a much larger contiguous habitat that is less disturbed by people.

c. At Barton Dam, the park space to the west is renovated as the headquarters for Ann Arbor's canoe livery service. With the removal of Argo Dam, an uninterrupted stretch of river now exists from Barton Park to Gallup Park.

WILDLIFE UNDERPASSES

Examples of wildlife underpasses.
Source: CPWS, 2008, Florida Habitat, 2007

Roads and traffic have serious impacts on wildlife in a number of ways including decreasing the quality and amount of natural habitat, segregating wildlife populations, and increasing the frequency of vehicle-wildlife collisions. Wildlife underpasses can be an important solution to maintain the connectivity of patches of high quality habitat for a number of wildlife species.

Banff National Park in Alberta, Canada built 22 wildlife underpasses in the 1980s to mitigate the effects of the Trans-Canada Highway on wildlife populations. Since then, at least 10 species of animals have used these structures (as well as two wildlife overpasses constructed) over 84,000 times (Clevenger, 2007). Initial findings indicate that passes should be placed between patches of higher quality habitat and that there is a learning curve associated with the time it takes different animals to learn to use these structures.

BROWNFIELD AGRICULTURE

Community plots on the vacant lands of Chicago
Source: Resource Center, 2007

There are more than 90,000 vacant lots in Chicago which represents over 6,000 acres of underused land. Combines with a highly underserved community, there lies an opportunity to provide not only greenspace, but a sustainable future for the community (Coleman, 2004).

City Farm is an organic farm started by The Resource Center, a grassroots organization with a sustainable focus. It is located adjacent to two of Chicago's very diverse neighborhoods, Cabrini Green and The Gold Coast. The farm produces 30 varieties of tomatoes as well as beets, carrots, potatoes, lettuce, herbs and melons, all on top of a once vacant lot. The key to the farm is it is completely movable.

Vacant land is leased and cleaned up. A protective clay barrier is put down to protect from contaminants leaching into the soil used for the plants. Fresh soil is brought in and fertilized using trimming generated from surrounding Chicago restaurants. The land is then planted and tended to by the unemployed and homeless of the community. The produce is sold to local restaurants and at the on-site market stand to the public. Besides offering up greenspace and healthy food options, the farm provides education on sustainable, organic farming and job creation for the community (Resource Center, 2007). When the land becomes available for redevelopment, the compost is moved to other vacant lands within the city and the cycle starts again.

Site Plan of Riverside Reach

A Community Gardens

B View down the Riparian Corridor

Riverside Reach

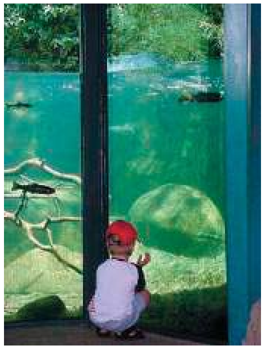
a. The river edge, along both Broadway Park and Riverside Park is expanded into a much wider riparian buffer. Existing mesic forests are preserved, and wet meadows are created along Riverside Park in a wide band that continues into Fuller Park. Invasive species growing along the banks are removed and replaced with an array of native vegetation. Pedestrian paths are kept outside this riparian buffer, although a few controlled access points are provided along the river, letting pedestrians view the river and allow boats to pull up and rest without damaging the banks.

b. Broadway Park is re-planted into a sustainable children's garden. A variety of explorative features combine activity with learning, explaining the processes that occur in the river, and demonstrating how dams and dam removal affect the health of the river. An underwater "river walk" creates a viewing room to look under the water and directly see fish, bottom sediment, and the existing river ecosystem in process.

c. A new bridge connects the existing boardwalks along both sides of the river, providing an improved pedestrian experience at the water level.

d. Riverside Park becomes a flexible landscape. In addition to the wider riparian buffer, the edges of the park are used for stormwater collection and retention during rain events, helping to capture runoff from surrounding buildings and hard surfaces. The interior of the park, which receives abundant sunlight, is developed into a very large community gardening facility. Playing off the historic agricultural use of the property, the Riverside Community Garden Center allows residents to grow food for sale in the local farmer's market at Kerrytown or for personal sustenance. Interpretive signage speaks to the urban agricultural past of the site that once had slaughterhouses, mills and an agricultural manufacturing and supply works. Signage also speaks to the transformation of the site to its new sustainable urban agriculture mission

BEHOLDING A RIVER



Left: The Rill, a 250 foot long watercourse demonstrating natural water course movement. Right: Visitors viewing the river

Source: Left image Hines, 2007. Right image USFS, 2008

At the Montshire Museum and Science Park in Vermont, an indoor museum, moves outdoors to engage visitors of all ages through a hands- on landscape. The Museum and the park are located on 110 acres along the Connecticut River and can be explored by over five miles of trails. The most notable exhibit is The Rill, a 250-foot long watercourse that follows a path from the museum towards the river, allowing visitors to understand the concepts of water movement through dams, sluices, and other such obstacles (Hines, 2007)

The over 250 daily visitor to Oden State Fish Hatchery operated by the MDNR in northern Michigan experience the river in unique way. This stream viewing chamber allows for distinctive educational opportunities where visitors can see the daily life of aquatic wildlife in their native environment (Denison, 2004).

Michigan has the only one east of the Mississippi and receives over 250 visitors daily (Denison, 2004).

Source: Denison, 2004, Hines, 2007

COMMUNITY BACKYARD HABITATS

An example of a backyard habitat.
Source: NWF, 2008

Many natural resource organizations are encouraging residents to certify their yards as a backyard habitat. Changing one yard at a time is a step in the right direction and creating wildlife habitat at a community level not only creates contiguous habitat connectivity but strengthens a community's awareness and stewardship values.

A Community Wildlife Habitat provides habitat for wildlife throughout the community--in individual backyards, on school grounds and in public areas such as parks, community gardens, places of worship and businesses. Additionally, residents gain understanding about sustainable gardening practices such as reducing or eliminating chemical fertilizers and pesticides, conserving water, planting native plants, removing invasive plants and composting. Certification is based on a points system with an individualized plan (NWF, 2008).

In New Jersey, The Wildlife Habitat Incentives Program and the New Jersey Audubon Society Nature Center of Cape May provides technical and cost-sharing assistance to homeowners to develop wildlife landscapes for local and migratory wildlife. Assistance is provided through landscape design and habitat workshops. Homeowners are required to submit a landscaping plan that covers at least 1000 square feet and must establish at least 20 new trees or shrubs, or 40 herbaceous plants. (New Jersey Audubon, 2008).

Site Plan of Riverside Reach

A Aerial view of Fuller / Island Park

Fuller Reach

a. Recognizing the impacts of large lawn areas as generally detrimental to river health, Fuller Park, which contains many soccer fields intensively used by the city, is renovated to incorporate stormwater management wetlands and an expanded riparian buffer. The south bank of the river, which already contains some small off-channel wetlands, is converted into a much larger contiguous wetland system, managed for enhanced habitat biodiversity. Slower water conditions along the edge of the park create an opportunity for new emergent marsh wetlands. The restored floodplain forests are nurtured on the Fuller side to enhancing the species diversity and foster the old growth that was once noted and slated for preservation in the original O.C. Simonds master plan.

b. Cedar Bend Park and Island Park are slated for historic restoration based on the original O.C.Simond's master plan.

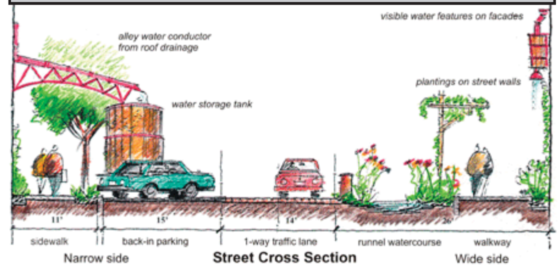
Other Design + Programming Features

a. A Neighborhood Backyard Habitat Program is implemented, where all members of the community, including residential, business, and commercial entities participate in creating habitat on their land, from small garden containers on balconies, to native plantings and restoration on larger land pieces.

b. A Neighborhood stormwater program recognizes innovative Best Management Practices. Though frequently thought of as city-based programs, it will include the use of pervious pavements, green roofs, and other techniques that allow infiltration. This program in particular supports neighborhood scale rain gardens and rain barrels at the residential level. There is also a decrease in assessed taxes for participating households.

c. Bank restoration and habitat improvement techniques are used throughout the Argo Riverfront Site to create conditions favorable to a historically diverse fish community that relied on the faster moving waters.

GROWING VINE STREET



Street Cross Section showcasing stormwater Best Management Techniques
Source: GVS, 2005

In a densely populated neighborhood of Belltown, a Seattle community, residents have joined to change the view from a concrete and glass landscape to that of green. Residents have created a continuing project known as "Growing Vine Street". The project begins with an eight block length continuous park that is intended to act as a watershed to collect stormwater and treat it through biofiltration before release into Elliott Bay. The park demonstrates the benefits of reclaiming stormwater coupled with creating a desirable, green space both for people to enjoy and providing wildlife habitat.

Adjacent to the park, stormwater runoff from each of the buildings bordering Vine Street will be collected in large cisterns which will supply the water for the stream when needed and for landscaping needs. Residents who are not directly adjacent have taken interest and have installed rain barrels for their homes as well. The project has been a successful demonstration. By spreading the knowledge of water quality, residents have taken that knowledge and applied it their homes.

Lessons learned by the team include the importance of continuity of leadership and the key role of local government as a facilitator in the collaboration between government, private developers, and local residents (GVS, 2005)

Great News

New Adventure Park attracts regional interest in the "Cool City" of Ann Arbor.

The Argo Riverfront in Ann Arbor Michigan has earned national recognition as an exemplary park space that fuses adventurous recreation opportunities with a transformative stormwater management system. With the removal of Argo Dam the City of Ann Arbor began building local support to turn the Argo Riverfront into a landscape focused on a wide variety of recreation opportunities. After the successes and momentum of the Allen's Creek Greenway project and the Ann Arbor Greenbelt, the new park was made possible by residents' willingness to finance the initial construction costs. The park is not only a source of pride and focus for Ann Arbor, but has also become a significant regional attraction.

Building on Michigan's "Cool Cities" initiative, the new park space provides a host of adventure sport opportunities, including an urban skatepark, BMX course, disc golf field, and most notably a sequence of challenging kayak runs. Integrated throughout the park space is a series of visually captivating stormwater wetlands that capture and treat urban runoff from the Allen's Creek and Traver Creek watersheds. The treatment wetlands, along with broader efforts to enhance the Huron's water quality, have made a swimming beach possible once again along the Argo Riverfront.

While 'touchable water' activities are emphasized, the riverfront also showcases green infrastructure. Corridors of native vegetation and stormwater wetlands enhance ecological health at the same time new bridges, crossings, and access improvements bring more people to the river. Consequently, the Rainwater Adventure Park completes a vital link in the natural and recreation corridor along the Huron River.

Rainwater Adventure Park.

Scenario Descriptions

Drivers:

The underlying premise for the this scenario is that Ann Arbor residents want to create a regionally significant park that offers unique recreation opportunities and also provides vital ecosystem services to protect the health of the Huron River. There is a strong desire to make the river a place where people can once again swim. In order to accomplish this transformative and costly undertaking, Ann Arbor residents have elected to finance dam removal, park construction, and stormwater management through a city millage.

Assumptions:

An underlying assumption is that policy changes within the entire watershed, result in tougher standards for water quality, and provides funding that allows municipalities to treat stormwater through large-scale projects. In Ann Arbor, these policies allow the Allen's Creek and Traver Creek greenways to be constructed, which feature sequences of large treatment wetlands. Similar activities have resulted in cleaner water throughout the Huron River, which helps make swimming possible at the Argo Riverfront Site. Soil contamination on the DTE site is isolated and able to be remediated through a cut and cap strategy. A partnership between DTE and the City of Ann Arbor has successfully implemented this strategy, and the land becomes available as urban park space. Furthermore, engineered controls on the property allow a large scale stormwater wetland to be created and separated from the ground water table, which slows and filters stormwater discharge from the mouth of Allen's Creek.

Variables:

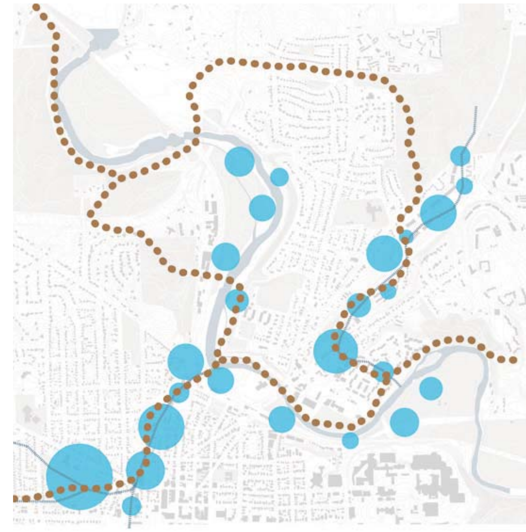
Ecology: Pools and riffles within a meandering river form provide areas of slower, deeper water interwoven with shallower faster moving sections resulting in improved water quality from oxygenation. As part of the design of new recreation facilities, habitat corridors are created linking preserved core areas together in an intricate network.

Stormwater: A combination of off-channel stormwater wetlands and "big water" treatment wetlands along the creeks ensure that the stormwater surges entering the Argo Riverfront Site are minimized. On-site runoff is captured in visually engaging features that demonstrate the cleansing processes of the landscape.

Human Engagement: Access to cleaner water creates an opportunity for a swimming beach, and other high contact water sports. Adventure sports, such as skateboarding, mountain biking, BMX biking, and kayaking, create venues for regionally significant events.

Development: All of the re-developed land is retained and managed by the City of Ann Arbor. and well integrated with new Lower Town development projects. Access fees to many of the facilities will finance maintenance and incremental program expansion. Solar and wind energy is utilized through innovative and iconic installations to power the site amenities.

Figure 55: Master Plan for Rainwater Adventure Park



Context

Human Use

Habitat

River Form

Figure 56: Ecological Response Plan for Rainwater Adventure Park

There is an emphasis on creating off-channel stormwater wetlands in the reclaimed land areas, which combine with creekshed greenways to manage high volumes of stormwater. River form assumes a pool and riffle morphology in response to sediment patters, historic form, and river gradient.

Alternative Future

Ecological Response

Removing Argo Dam creates an opportunity to expand the riparian corridor at the same time improving aquatic habitat conditions. With a wider riparian corridor, there are more opportunities to manage urban stormwater runoff before it enters the Huron River, where high water volumes erode banks, deposit excess sediment and nutrients, and contribute to declining water quality. Ideally, rainwater should be infiltrated where it falls, but in Ann Arbor's already developed urban area, this is often difficult and existing stormwater systems still pipe high quantities of water directly into the Huron River. Off-channel wetlands alone cannot address Ann Arbor's stormwater runoff. However the creekshed greenways, which create large stormwater management features, help to infiltrate and filter some of the runoff before it enters the Argo Riverfront Site.

Argo Dam is removed with a relatively rapid drawdown of Argo Pond beginning early in the year. As the impoundment is drawn down, sediment that has accumulated near the stormwater drains is reshaped along the new river edge and stabilized with a series of bioengineered solutions. Moving the sediment in this manner creates off-channel depressions oriented just downstream from the existing stormwater outlets. Large stormwater treatment wetlands can be established in these areas. Wet meadow vegetation can be used in these wetlands as it is adapted to survive a range of water level fluctuations. Excess nutrient deposition in these areas will tend to favor invasive species, which can often better mobilize higher nutrient levels. High levels of management may be required to remove of invasive vegetation as necessary.

The overall shape of the river becomes more sinuous, moving back and forth around the new stormwater wetland areas, creating a pool and riffle morphology. Two pieces of evidence support this form. Existing sedimentation patterns are aligned with the stormwater outlet points. Sediment deposition occurs when fast moving stormwater enters the slower moving river water, and this sedimentation begins to shape the river form. Historically, this form is apparent as well, given that the stormwater outlet points often align with historical valleys or ravines in topography, and would be a site for historic sedimentation. Also, the new gradient of the river, at 5.3 feet/mile, suggests that a pool and riffle morphology can occur (MDNR , 1995). In addition to creating land for stormwater management, the pool and riffle morphology contributes to a diverse aquatic ecosystem condition.

DOYLE PARK-BIG WATER

Site Plan or Doyle Park in Ann Arbor, MI
Source: Washtenaw County, 2008

Beth Doyle Park (formerly known as Brown Park) is a public park owned by the Malletts Creek Drainage District, but leased to the City of Ann Arbor Parks and Recreation Department. The original pond located within the park was constructed in 1977 to store water for flood control during heavy seasonal storms. The pond is directly located along Mallets Creek which experiences water quality issues from urban pressures including phosphorus loading, sedimentation, and flooding. In 2000, the Malletts Creek Restoration Plan recommended reconstruction of the pond to improve habitat, reduce downstream phosphorus pollution by 25% (under federal mandate) and continue to provide flood control, while providing for recreational activities (Washtenaw County, 2008). The pond reconstruction cost $2.1 million dollars and has reduced phosphorus inputs by 800 lbs a year (City of Ann Arbor, 2007a). The pond is designed as a meandering stream with a riparian zone for flooding. Wetland plantings and natural woody debris are planted for water and habitat health.

Site Plan of Argo Reach

A Argo Kayak Run

B DTE Skatepark

Argo Reach

a. The curving river form makes a wider, gentler turn passing through the historic dam site, requiring that all remnants to the dam be removed, both for engineering and safety reasons. The river then follows, relatively closely to the path prior to dam removal along the edge of the DTE site. The overall river form effectively lengthens the path of the main channel, minimizing the severity of drops in the channel. At the former Argo Dam location, careful restructuring of the bottom ensures that canoes can still pass easily along the main channel.

b. The DTE property is remediated through a cut and cap strategy. This strategy allows the contaminated soil in the eastern edge of the property to be covered with clean fill from the western portion of the site close to the Allen's Creek outlet. This excavation raises the land surface in the contaminated area above the floodplain. Finally, a concrete cap covering the contaminated soil, forms the basis for a new urban skatepark and BMX course, which occupies much of the DTE site as well as parts of Broadway Park.

c. The excavated portion of the DTE property close to Allen's Creek is converted into another large scale stormwater treatment wetland. Discharge from Allen's Creek, flows through this perched wetland system, to be retained or filtered during storm events. This wetland is cut off from the usual groundwater flow by a liner.

d. A channel carries water out of the wetland and along the railroad tracks, under the Broadway Bridge, and through Broadway Park where water is released into the Huron River. Small turbines can be located along this drainage channel, capturing energy from the stormwater and using or storing it to power site amenities.

e. A special art installation above the Broadway Bridge "activates" when energy is generated in the stormwater channel, creating a vivid awareness of stormwater processes.

f. The mill race is restructured as an intermediate to advanced level kayak run. A portion of the water is diverted from the main Huron River channel further upstream near the existing canoe livery site. The water is maintained at a flat level until this channel enters the mill race area. At this point, the channel begins to drop quickly around boulders and other obstacles, forming an exciting and challenging kayak run. The area of the former mill race which is not used for the kayak run is filled with wet meadow species.

g. A portage is provided on the now reconstructed and reinforced mill race berm which can be used both by paddlers going downstream, who would like to avoid the fast flowing rapids and by the white water kayakers, who would like to cycle through the course several times in quick succession.

ANN ARBOR'S MUNICIPAL BEACH

In 1917, Detroit Edison offered to develop the east shore of the new Argo Pond as a beach if the city of Ann Arbor agreed to pay future maintenance costs. Detroit Edison trucked in sand and built three docks, and a beach house in the same area where today Argo boat livery is located. In 1938 the city purchased the land outright for one hundred dollars. Local residents and former lifeguards recount days where more than 1000 people would use the facility. In 1936 Detroit Edison drained Argo Pond to repair the dam and at the time the city decided to make improvements on the beach. Later that year sand, cement and gravel were hauled onto the river ice. When the ice melted an island was formed just off the beach for sunbathing. Today this island has filled in with trees and shrubs and it is all that remains of the municipal beach era.

Source: Revised from Ann Arbor Observed (Grace Shackman, 2006)

Site Plan of Bandemer Reach

A Bandemer Beach

B Bandemer Kayak Run

Bandemer Reach

a. At the upstream end of Bandemer, constructed below the M-14 overpass, is the entrance to another kayak run. Again, water is diverted along a level "aqueduct-like" channel and follows the uphill edge of the stormwater wetland. Partway through Bandemer, the steep portion of the kayak run begins, taking adventurers though a beginner to intermediate level kayak run. Again, a special landing and path is constructed to allow kayakers to quickly return to the start of the run for repeated sessions.

b. The existing disc golf course has continued to be enhanced. The spaces between the courses have been restored with a wet forest community. Shallow depressions between the courses capture stormwater from the surrounding land, and gradually filter it as it moves towards the river. These depressions should be monitored and maintained to exclude invasive species.

c. The northern-most shore of Bandemer, just below the entrance to the kayak run, is a re-created public beach. Under the pretense that upstream water quality has improved, the beach is also located above most of the city's major stormwater outlet pipes, ensuring the cleanest possible water quality. The beach functions as an interactive wading space given the fast flowing conditions now present in the river. Large rocks and boulders have been constructed as J-Hook vanes to stabilize the bank and to create slower pools in which people can splash around and enjoy. Softer sands and gravels, deposited along this bank, form a pleasant surface to for walking and sunbathing.

d. A bath-house, café and recreational equipment rental facility are located in Bandemer Park, enhancing the function of this space as an outdoor recreation hub and meeting space.

e. Given the broad objective of creating a highly accessible public space, two new bridge crossings are created, aligned with enhanced entrances along Long Shore Drive. The new bridges are intended to be commissioned works of public art, fusing innovative design with aesthetic interest and function.

f. The Lakeshore Drive entrance off North Main Street is closed to car traffic; however it remains zn important pedestrian and bike entrance to the Site.

g. A crossing at North Main has an on-demand traffic signal for recreational users to cross safely. This crossing allows enhanced connectivity to Bluffs Park. To the west of North Main Street, which is already popular among off road bikers. This crossing help enhance the regional draw of bikers to the Argo Riverfront Site and beyond.

h. The North Main Street Corridor is redesigned as a more functional public greenway. Lanes are narrowed slightly and property easements expanded to create a separate bike lane and pedestrian walk.

J-HOOK VANES

The completed J-Hook structure shown here with root wads extending into the pool, provides critical rearing habitat.
Source: WFHI, 2007

A downstream view of a completed J-Hook vane and the associated root wad and treetop for habitat complexity.

The J-hook is designed to roll water away from the bank into a pool. This stabilizes the bank and creates excellent fish habitat.
Source: WFHI, 2007

Site Plan of Barton Reach

A Barton Fishing Piers

i. The planned pedestrian crossing between the Bandemer Bridge near M-14 and Huron River Drive has been expanded to allow cars to cross the railroad as well. This crossing allows traffic to cross the river and access the park spaces without having to merge onto and off from M-14.

j. Each stormwater outlet pipe has an associated wetland marsh along the river's edge. The use of wet meadow plants helps to stabilize the banks of the river and areas outside of the stormwater wetlands.

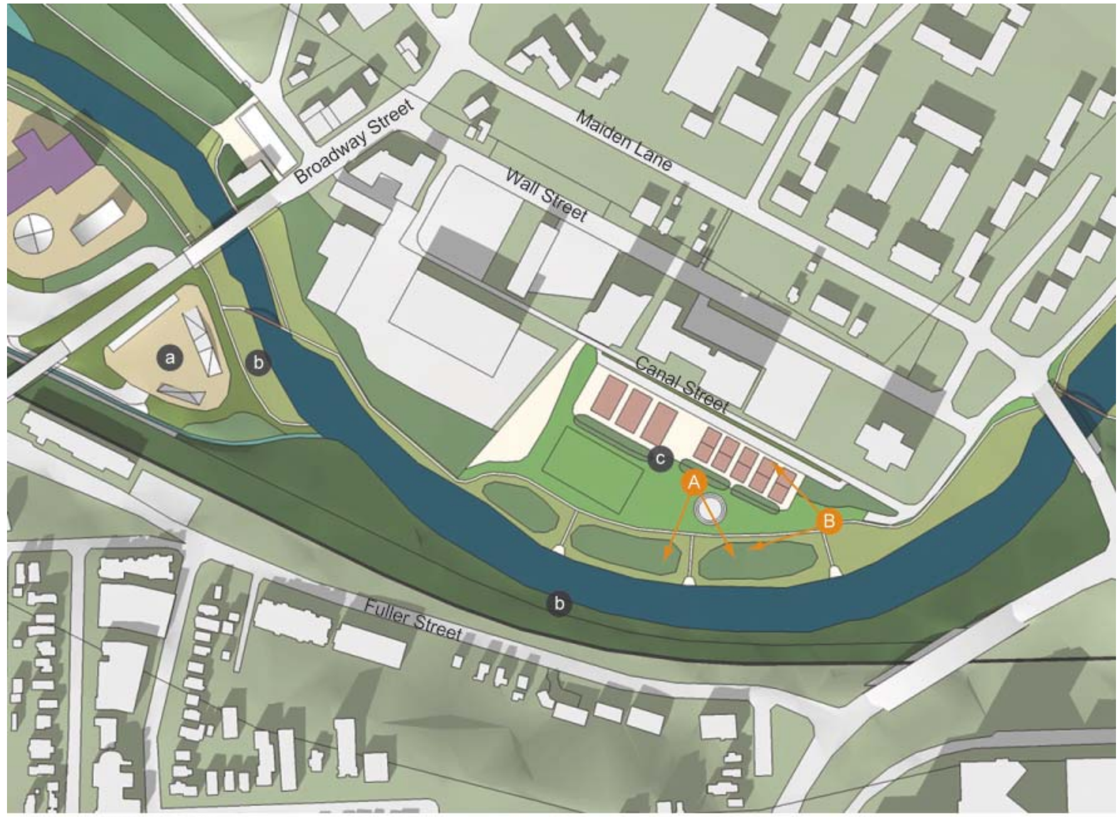
Barton Reach

a. The river reach upstream of the M-14 bridge is managed as a trout fishing hotspot. Summer coldwater releases from the deeper stratified water of Barton Pond allow for the management of a popular put-and-take brown trout fishery. Fish are stocked annually in late March, and the fishery is managed as catch-and-release until the end of April (opening of the Michigan trout season). A harvest fishery is operated in May and June, designed to remove all trout from the river before water temperatures exceed their lethal limit. Cold water releases from Barton Dam, combined with a stocking schedule, encourages active use of the river for sport fishing.

b. With the drawdown of Argo Pond, additional land is reclaimed to create a boardwalk with fishing piers off of Huron River Drive. Additional parking spots are built at regular intervals along Huron River Drive.

c. On the Barton side of the river, the existing path along the old edge of the water is converted into a boardwalk. New piers extend from this boardwalk through the reclaimed wetlands to fish landings, providing additional access points. The complex arrangement of habitat communities is largely preserved with an emphasis on re-establishing emergent marsh areas. The water levels are maintained slightly higher that under the Biodiversity + Heritage Corridor scenario due to the rapids under M-14 bridge. Therefore the existing emergent wetland along the southern bank of Barton Park is well maintained.

d. The canoe livery operations are relocated near the Barton Dam park space, again building off the intact river reach from Barton Dam to Gallup Park.



Site Plan of Riverside Reach

A The Riverside Green

B Riverside Park Spaces

Riverside Reach

a. Broadway Park forms a contiguous space with the new skatepark facility on the DTE property opposite the Broadway Bridge. New walks along the Allen's Creek channel and Huron River boardwalk connect these two spaces. Upland slopes, such as those up to the Broadway Street surface, are planted with dry prairie species in an organized and aesthetically pleasing planting scheme. These plants are well adapted for little to no watering, are low maintenance, attract pollinators, and display a variety of colorful flowers throughout the summer and fall.

b. The edge of the Huron River along Broadway Park is converted into a riparian buffer, balancing the space requirements for the skatepark with critical runoff filtering functions. Further downstream on the south side of the river, stormwater outlets are modified to include off-channel sediment forebays as a minimum stormwater treatment device in the very limited space.

c. An additional pedestrian bridge crosses into Riverside Park. The old mill race area, along the DTE property, is connected to a larger network of off-channel wetlands along the Huron River. A wide section of Riverside Park is converted into these additional stormwater wetlands, which collects rainwater from the Lower Town storm drains for filtering and retention, prior to releasing it into the main river channel. Remaining areas of Riverside Park are utilized as an active recreation facility and plaza space, including a small performance area. New tennis courts, basketball courts, a half-sized soccer field, and a playground are added to this urban space. Native perennials and shade trees create pleasant out-door rooms for nearby residents or employees. A final pedestrian bridge creates a pedestrian crossing lower to the water below the Maiden Lane Bridge.

Site Plan of Fuller Park

A Aerial view of Fuller Park / Island Park

Fuller Reach

a. On the Fuller Park side of the river, the existing wetland depressions are expanded and connected with narrow channels, forming a stronger continuous habitat chain along the edge of the park, while also capturing stormwater from the maintained soccer facility. This is also an opportunity to utilize the riparian corridor for emergent marsh habitat which was disrupted further upstream from the river channel drawdown.

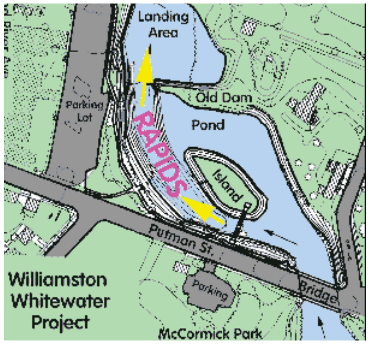
KAYAK RUNS: MICHIGAN'S FIRST MAN-MADE RAPIDS

The Red Cedar Rapids in Williamston, MI; kayakists attempt to maneuver the Red Cedar Rapids in Williamston, MI
Source: Photos taken by Jeff Tyler, personal webpage, http://homepage.mac.com/erikcarlson/web/williamston.html

The Red Cedar Rapids, is Michigan's first man-made rapids course, located in Williamston, Michigan, situated along the Red Cedar River. Before the rapids, the historical dam, built in 1840, was washed out by flooding in 1975 (Barnett, 1999). In the early 1990s its replacement was under consideration by City officials.

Local kayak enthusiasts set out to explore the option of transforming the decaying dam into a place where all levels of kayakers and canoeists could enjoy the river. The old mill pond would be restored while accommodating migrating fish as well as creating a recreational amenity. After conducting research, they found the rapids idea was feasible and cost less than replacing the dam.

The rapid run itself runs 1,000 feet and drops six feet, relying more on natural features, and less on engineering. The run includes four small drops and a broad range of flow, from as little as three cubic feet per second, which is ideal for novices and up to 3,000 cubic feet per second, for whitewater (Barnett, 1999). Cost was $767,000, which was realized by a DNR Natural Resources Trust Fund grant of $342,700 and $425,000 from the sale of bonds by the Williamston Downtown Development Authority (personal website, 1999).



Williamston Whitewater Project Rapids
Source: Barnett, 1999

Great News

A national icon of sustainable design and riverfront redevelopment in the Midwest.

Ann Arbor has transcended the economic downturn of the early 21st century, becoming a catalyst for urban revitalization. At the center of this paradigm shift is the redevelopment of the Argo Riverfront that was once constrained by the complicated legacy of an industrial past. Partnering with private developers the City of Ann Arbor has established regenerative park spaces that blend into new pedestrian oriented riverfront communities.

The redevelopment of Lower Town in Ann Arbor has spread to the riverfront as well, resulting in a successful mixed-use development that showcases the best sustainable design practices, including green architecture, biological treatment systems, renewable energy, and stormwater management. Businesses, offices, and entrepreneurial start-ups have taken advantage of new mandates for renewable energy and the knowledge-focused workforce of the University of Michigan.

Ann Arbor has also capitalized on the expanding opportunities of the health care market. The University of Michigan Hospitals are now receiving national acclaim as pioneers in rehabilitation-oriented landscapes and programming that expedites patient recovery and contribute to the health and wellness of area residents. Cultural amenities, entertainment venues, and an attractive night scene make the Argo Riverfront truly a place to live, work and play.

Sustainable Live/Work Community

Scenario Description

Drivers:

The sustainable development focus for this scenario is driven by Ann Arbor residents' recognition that the riverfront is currently an under-utilized urban amenity. The urban character of the lands surrounding the Argo Riverfront Site can be brought down to the river, along with people and businesses, creating a unique re-energized space for Ann Arbor. The current economic downturn in Michigan has prompted the city to partner with private and public entities to finance development efforts along the riverfront.

Assumptions:

Upstream water quality continues to decline due to insensitive development patterns in the Upper Watershed. Ann Arbor has responded by implementing a stormwater tax system to encourage businesses and homeowners to utilize stormwater Best Management Practices (BMPs). Contamination on the DTE site is determined to be widespread, and removal is both potentially more deleterious to groundwater and public health and too costly. A combination of engineered and institutional controls will cap and contain pollutants, allowing the land to be developed to residential standards and be re-woven into the urban fabric.

Variables:

Ecology: The ecological concept for the redevelopment, relies on protecting the most important habitat patches and then creating "stepping stones patches" throughout the new development. Argo Dam is removed, and the prior dam site becomes a steep naturalized gradient run that enhances the movement of fish, woody debris, and other organisms along this stretch of the Huron River. River bed modification at the Argo site maintains a higher water level throughout the old Argo Pond site.

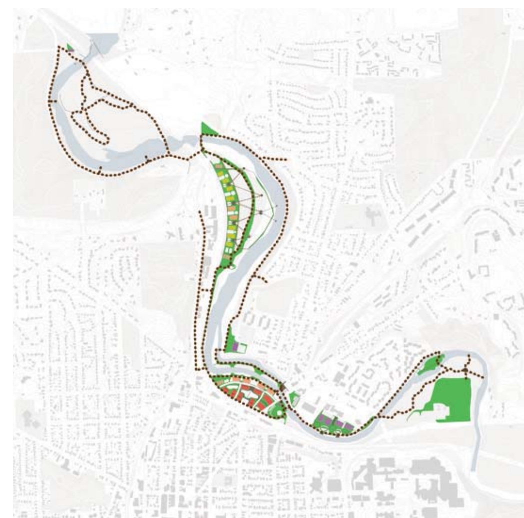
Stormwater: Given declining water quality in the Huron River, the Argo Riverfront Site redirects some of the river's base flow into large treatment wetlands. At the end of these wetland systems, river water is cleaned and revealed in pubic engaging spaces that allow interaction with clean water. On-site runoff is treated through extensive utilization of Low Impact Development (LID) strategies that utilize stormwater as an amenity. Water from rooftops is collected for gray-water uses, excess water is stored in cisterns for irrigating native vegetation, and the remaining water is filtered in the off-channel wetlands.

Human Engagement: Mixed-use development creates a lively urban experience as the central unifying feature for sustainable lifestyles. Pedestrian and bicycle connectivity from greater Ann Arbor and throughout the site creates a walkable community.

Development: Several districts interweave, including an industrial arts live/work community, a mixed use 24-hour riverfront, and a civic center with public amenities. New structures and some existing buildings are designed to meet Leadership in Energy and Environmental Design (LEED) standards and the entire area meets the Sustainable Sites Initiative criteria. A micro-turbine system within the main river channel is combined with photovoltaics, passive solar energy, and wind generators, to allow the entire redevelopment to be powered "off the grid.".

Figure 57: Master Plan for Sustainable Live/Work Community

Context



Human Use

Figure 58: Ecological Response Plan for Sustainable Live/Work Community

Alternative Future

Ecological Response

New development along the Argo Riverfront faces the risk of further impacting the health of the Huron River. Fortunately, rethinking the form and function of the Argo Dam is an opportunity to dovetail sustainable development with ecologically enhancing landscape interventions. Reclaimed land can be used as habitat stepping stone patches that fit into the development areas themselves, which can connect larger preserved areas of habitat together.

In this scenario, Argo Dam is removed, returning the river to a free flowing form. However, two sections of rapids are constructed to concentrate river grade changes in two places, one near M-14 and the other near the existing Argo Dam site. These grade changes are controlled to create sediment traps, which limit sediment mobility downstream, and maintain higher water levels. This preserves some of the existing functions of the impoundment condition, and creates a sections of rapids, which cool and oxygenate the water.

Manipulating the river bed and grade drop at Argo Dam may be necessary if it is found that excess sediment, debris, and refuse litters the riverbed. Huron River Impoundment Management Plan (HRIMP) committee members have mentioned the possibility of an old rail car, scrap metal, and industrial refuse, underwater upstream of Argo Dam. Removing these obstructions will require extensive dredging and manipulation. This creates the opportunity to re-grade the bed in such a way to maintain a higher and flatter water condition than expected under other scenarios. A higher water level preserves part of the mill race, allowing hydropower to be reinstated, and enhances the capacity to boat in the upstream direction. The M-14 grade manipulation creates rapids that hold back water, maintaining the existing water level around the emergent marsh habitat in Barton Park

Habitat

River Form

COMMUNITY LID PAVES THE WAY

One way communities have been participating in the movement towards a more sustainable future is through the use of Low-Impact Development (LID) within their own neighborhoods. With LID, stormwater can be viewed as a resource rather than piped and hidden as a human waste product.

Stormwater LID attempts to model the natural water cycle before development began; through infiltration, storage, filtration, evaporation, and detention. Neil Weinstein, executive director of the LIDCenter in Beltsville, Maryland says LID "is based on developing controls and strategies for targeted resources or regulatory objectives, not just on modifying flood-control approaches" (Hager, 2003). A team led by Joan Iverson Nassauer demonstrates how a lot size LID project in Maplewood, Minnesota, a suburb of Minneapolis-St. Paul, can be successful and accepted.

Two blocks of residential street, planned for repaving with curb and gutter sewers due to periodic flooding problems, were retrofitted with site LID. Residents volunteered and participated in the installation of small rain gardens purposefully set within their yards. These rain gardens slowed water runoff and allowed the water to infiltrate rather than drain into the lake along with the silt and contaminants that are typical of urban stormwater runoff. Because of the success of this small project the City of Maplewood and many other St. Paul suburbs are incorporating or planning to incorporate nearly 250 more rain gardens into other neighborhoods (Hager, 2003). This growing trend throughout the country has the potential to improve streams, rivers and lakes in all our communities.
Source: Hager, 2003

NICHOLS ARBORETUM


Before


After


After

Before and After pictures of the bank stabilization process and terraced entry places along the Huron River in the Nichols Arboretumr
Source: SEMIRCDC, 2008

At the Nichols Arboretum in Ann Arbor, erosion control and stormwater management have resulted in some serious concerns due to the complex and steep terrain, as well as increasing impervious surface areas upstream and uphill from the Arboretum. At the River Landing site, these problems were compounded by concrete rubble, heavy use and lack of vegetation to create unstable riverbanks.

However, in 2006, after a two year collaborative effort between the Southeast Michigan Resource Conservation and Development Council, the City of Ann Arbor and the Nichols Arboretum were able to increase the stability of the riverbank through a variety of "soft engineering" techniques such as native plant fascines, seedlings, plugs, and rock rip-rap. Concrete and rubble were removed and the slope was regraded while rock rip-rap was put at the base of the shoreline. Cuttings of red osier dogwood, willow, elderberry and high bush cranberry were used with thicker stems being used for live stakes and thinner stems used in the fascines. Live stakes were planted lower on the slope while the fascines were added just above. Above the shrubs, plantings of native prairie grasses and wildflowers keep open views while maintaining the slope and providing valuable wildlife habitat.

The landing is now a popular destination in the arboretum for bird watching, canoeing, fishing and picnics. Interpretive signs detail both the natural history as well as the restoration techniques used here.

.

PRIVATE-PUBLIC PARTNERSHIPS RECONNECTING A CITY TO THE RIVER

The City of Milwaukee Riverwalk has connected the community with the river from the downtown area
Source: MKEDCD, 2008

The City of Milwaukee produced the Riverwalk Initiative in 1988 with the intent to use the river to connect downtown development with business and leisure activities, improve public access to the river and increase property values thereby putting a renewed focus on the river as a destination for residents, employees, and visitors (MKEDCD, 2008). Since the 1990s, the Milwaukee Riverwalk has grown in manageable sections ultimately covering 3 miles along the Milwaukee River through the city's downtown and the Historic Third Ward and continues to be improved (Sweeney, 2005).

One such section includes the 'Beerline', formerly an industrial rail line, now home to a new neighborhood of mixed-use development that is predominately residential. Under the direction of a Redevelopment Plan, the city was able to acquire Tax Incremental Financing (TIF) to fund the environmental cleanup of the area and begin work on removing the rail lines and excavating contaminated soils. New infrastructure such as streets, utilities, bridges, staircases, and public parks were built along with more than 1,000 feet of river walk (MKEDCD, 2008). After infrastructure improvements were in place, private development began largely with adaptive reuse of warehouses into residential and mixed-use projects.

Since its conception, downtown development has flocked to the river with a mix of high-end residential, commercial and recreational uses. Residents and visitors enjoy waterway access including water taxis, art displays, and festivals at the new Riverwalk Park.

.

MGP REMEDIATION

Conventional techniques for Manufacture Gas Plant remediation include chemical fixation, soil washing, in-situ thermal treatment, incineration of excavated soil, disposal in landfills, and biodegradation. A new technique was developed to combine biological and chemical treatments to clean sites more completely. The process involves injecting oxidizing agents into the soil thereby breaking down the contaminants into harmless component chemicals that can be further degraded by biological treatments, ultimately eliminating the need for excavation, transportation and offsite disposal of contaminated soil (SCE, 2008).

In Long Beach, California, ozone treatment is being used to clean groundwater contamination from an former MGP. Conventional methods of remediation such as soil excavation and groundwater pumping were not possible due to surrounding urban development and the incorporated infrastructure.

SCE partnered with IT Corp. to build the remediation system. Engineers sank 31 sparging points throughout the plume six feet beneath the water table. On the surface, IT Corp. engineers installed two ozone generators to generate a total of 52 pounds of ozone daily which is delivered through the sparging points into the ground (Valenti, 1999). In addition to ozone injection, the process involved a soil vapor extraction process that captures un-reacted ozone gas and hydrocarbon vapors that might seep from the ground which could lead to an explosive reaction.

The ozone treatment system has reduced dissolved hydrocarbons in the groundwater by 80 to 90 percent, and reduced the presence of benzopyrene to undetectable levels. Additionally, soil contaminants have migrated into the monitoring wells leading the team to believe the ozone system will continue to strip the contaminants from the soil into the groundwater, where they can be treated by ozonation (Valenti, 1999).
Source: SCE, 2008, Valenti, 1999

LEED

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System is a third party certification program using universally understood tools and performance data to encourage and accelerate global adoption of sustainable green building and development practices. LEED promotes a whole-building approach to sustainability by recognizing performance in: sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality.

Source: USGBC, 2008

SUSTAINABLE SITES INITIATIVE

A cooperative effort to provide standards and guidelines, a rating system, and pilot project opportunities to protect and enhance the ability of landscapes to provide ecological services. These services include climate regulation, clean air and water, and improved quality of life and the Sustainable Sites Initiative can apply to sites with or without buildings.
Source: SSI, 2007

Site Plan of Argo Reach

A Riverside Drive

B Wetland Courtyards

Argo Reach

a. It is determined that the contamination at the DTE site is widespread and the cost of removing contaminated soil is prohibitive. Consequently, the DTE property is completely capped and isolated from ground water flow to isolate this contamination. The capping strategy builds up most of the property a few feet, raising the land out of the flood plain.

b. Below the redesigned rapids at the former dam site, the metal armoring along the DTE property is replaced with a bioengineered solution that creates habitat while still minimizing erosion along the banks. This solution also creates terraced access points for people to get closer to the water.

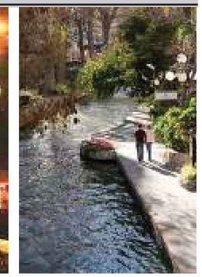
c. The Allen's Creek outlet on the Huron River is similar to existing conditions; however, a City-owned property on the west of North Main Street is repurposed as a constructed stormwater wetland facility. This facility exposes the Allen's Creek drain before the outlet on the Huron River, slowing the water and allowing some of the sediment, debris and pollutants to settle before it is released into the Huron River.

d. The DTE property becomes the site for a new commercial and business development. Commercial space, including eateries and bars can take advantage of the riverfront location. These businesses contribute to a dynamic entertainment corridor from Main Street, through Kerrytown, across the Huron River, and into Lower Town. The development also incorporates additional office space and green industry, building off the existing land uses along North Main Street, Depot Street, and Maiden Lane. The physical design of the development relies heavily on LEED Design Standards and the Sustainable Sites Initiative to create a-cutting edge sustainable development. Access into the development is provided off the Broadway Bridge. The riverfront land is built-out from the brownfield cap and planted with a series of wet prairie patches that help connect habitat through a series of small patches along the development site.

e. A specific design feature, which becomes a unique feature in Ann Arbor's landscape, is a new bike and pedestrian bridge network located near North Main Street and the railroad bridge. In part, using the structural foundation of the existing raised railroad trestle, it connects people over Main Street and the ground level railroad tracks to the DTE site. In addition, it offers the option to cross over the Huron River to the new amenities on the north and east sides banks. This bridge, was selected in a national design contest as the best solution to highlight the new idea of a balance and connection between urbanity and naturalism.

f. The enhanced mill race becomes part of a highly accessible public park. The lower water levels lead to exposed land which provides an opportunity for wet meadow areas merging into the existing mesic woodlands. A new pedestrian bridge across the Huron River connects this area to the new development on the south side of the river at the former DTE site.

SAN ANTONIO'S STRUGGLE AND RENAISSANCE



Night and day activity along the San Antonio Riverwalk.
Source: http://en.wikipedia.org/wiki/San_Antonio_River_Walk

River Walk in San Antonio, Texas, has been named a Great Public Place by PPS (Project for Public Spaces). Although it has not always been successful , a history of 'seediness' has given way to an opportunity of revitalization. Like many riverfront projects, it has acted as a catalyst for waterway revitalization as well as the revitalization of the community. However, what makes this River Walk a success and truly unique from other riverfront development projects is its capabilities of creating spaces for everyone. The waterway is home to twenty-one bridges, each unique to their surrounding space, a multi-level walk, and 31 stone stairways of native rock connecting the river to downtown streets; the varied landscape provides opportunities for people to jog, people watch, eat, shop and enjoy the cultural atmosphere (PPS 2008). Although heavily channelized, the waterway is almost reminiscent of Venice, Italy. The extensive plantings of trees, frequent day and night boat rides, combined with an impressive night light show makes for an intimate, yet highly active space.

.

AN URBAN STORMWATER MANAGEMENT DEMONSTRATIONPARK

As water makes its way through a series of constructed wetlands, visitors can view and interact with cleaning process.
Source: Keepers of the Waters, 2007

The Living Water Garden, located in the city of Chengdu in Sichuan Province, China, is a 5.9-acre public park located along a river system that has been under urban distress. Betsy Damon, an environmental artist and the designer of the Living Water Garden, created a fully functional water treatment plant, a powerful symbol to the Chinese culture, a living environmental education center, a refuge for wildlife and plants, and a wonderful place for people (Keepers of the Waters, 2007).

Process:

Each day, nearly 7,063 cubic feet of polluted river water move through the treatment system including an aeration system, wetland plants, fish, and filters until the water is clean enough to drink. This amount is not nearly enough to affect the river water quality as a whole; rather it is used as a tool to teach the importance of water quality and habitat.

Site Plan of Bandemer Reach

A Rooftop view of Dynamic Spaces

B Mosaic Wetlands + Civic Space

g. At the east end of the mill race, a new gondola boat launch facility is constructed. The gondolas are small oar-powered boats that can be rented for short trips up the mill race and into the flatter water sections of the main Huron River channel. The gondolas are intended to become an enticing nightlife attraction, where people of all ages can enjoy the illuminated riverfront and skyline.

h. With the dam redesign and an intact mill race, hydroelectric power is once again a viable option. Rather than reinstating the large scale hydroelectric plant, it is readapted into a micro-turbine system. While only generating enough power for a portion of the new development, the micro-turbines are a more economical solution, and can be designed as a vivid visual element in the landscape. In addition, the rapid and micro-turbines do not completely disrupt the movement of aquatic organisms and sediment as the former dam had done.

i. The existing canoe livery site is redeveloped into a multi-function city building. A key use of this building is to provide space for business retreats. Renting the facility generates revenue for the City of Ann Arbor and allows business groups to meet at a scenic location along the river while at the same time being within short walking distances to engaging river-based activities and leisure opportunities.

Bandemer Reach

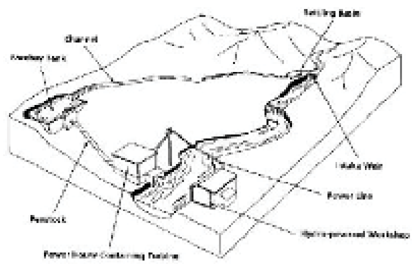
a. With the river channel aligned roughly along the center of the old Argo Pond, exposed land on the west bank allows a small service drive to be created with wide sidewalks for pedestrian and bike traffic, as well as occasional car traffic. This street connects a new development project in Bandemer to the DTE development.

b. The existing entrance into Bandemer off North Main is maintained and becomes a key entranceway into the new Argo Riverfront Site. A sensor activated stoplight is installed at this junction to allow entry and create a traffic calming devise on North Main Street.

c. The property in Bandemer immediately adjacent to the railroad line is developed into a new compact live/work district. The green buildings provide all of their own energy and water treatment needs. As live/work units, the buildings consist of apartments or lofts with attached studio, work, or office space. This new development plays off the existing land uses along the North Main Street Corridor, which are gradually targeted for adaptive reuse and eventually become another prominent green live/work district. Bridges connect buildings above the railroad tracks, creating a more porous pedestrian experience. New development is integrated with the reused buildings on North Main.

d. The North Main Street streetscape is completely redesigned as a visually engaging city entrance. New bike and pedestrian lanes are constructed. Given the city's focus on the Renewable Energy Challenge, aesthetically appealing windmills are designed to capture wind along M-14 and North Main Street. The wind powered generators provide additional power for the new development.

MICROTURBINES AT WORK IN PERU



A micro-hydro system
Source: TVE, 1999

The rural population in Peru is eight million and is spread over 1.2 million square kilometers. Much of this rural area lies in the Andean mountains and is cut off from electricity. In 1996, only 4% of the rural population had access to electricity.

Rural Peru is on its way to hope. Tapping into its natural resources, power is being generated through the use of water. It is estimated that 75,000 Megawatts of power could be harnessed for power, serving more than 20 million people through the use of micro-hydro, where each unit has a maximum capacity of up to three hundred kilowatts. Micro-hydro does not interfere with river flow nor is it harmful to the environment.

A micro-hydro system starts operating at an intake weir, where water is diverted from the river. The water then reaches the turbine through a pressure pipe. The amount of power produced by the turbine will depend on the distance of the fall, the speed of the flow, and the water flow speed through the system. The initial cost of a micro-hydro system is approximately $1200-$1500 per kilowatt of installed power and lasts for approximately 20 years.

Site Plan of Barton Reach

e. The majority of Bandemer Park is converted into a large, water cleaning wetland system. A small run of constructed rapids under the M-14 overpass, constricts the water flow and maintains the existing water level and shore line along Barton Park. Backing up this water allows another small channel to divert water from the main stem of the Huron River into the new constructed wetland area. The treatment wetland will need to rely on carefully selected wetland plants and will be engineered to ensure a constant year round flow of water, slowly moving through the wetlands, such that emergent marsh communities can thrive.

f. A small amount of the Huron River water is siphoned off to demonstrate through a sequence of wetlands how water can be cleaned using natural processes. After moving through this wetland system, a large public square and fountain at the south end of the new development reveals the cleaned water in an interactive installation. A series of engaging boardwalks and public gathering spaces crisscross this wetland system, giving people access to the riverfront and to smaller docks where people can land their evening gondolas.

g. The east bank of the river is maintained for higher quality habitat value. In-stream habitat improvement techniques are applied throughout the dam removal process to enhance habitat as much as possible.

h. The north side of the Bandemer Reach is maintained and enhanced as a riparian buffer extending into the Barton Reach.

Barton Reach

a. The upstream portion of Barton is preserved and enhanced as a place of higher habitat value. In particular, the existing emergent marsh, a rare community type at the Argo Riverfront, is protected. The city canoe livery is moved near the Barton Dam, and canoeists can have an uninterrupted run from Barton to Gallup Park. The two sections of rapids, at the M-14 overpass and near the Argo Dam site provide a challenge, comparable to the Delhi rapids further upstream. Portaging opportunities are provided at both rapids for the less daring.

b. Improvements are made to existing trails in Barton Park, in particular removing some of the access points to the shore in favor of a boardwalk that minimizes habitat disturbance.

Site Plan of Riverside Reach

A Health and Wellness Garden

Riverside Reach

a. Broadway Park is redesigned as a higher use civic space. A large terraced amphitheater is constructed into the hill. This performance venue provides a viable alternative to West Park's aging band shell, given the lack of residential properties immediately adjacent to the park and the venues distinctly urban context. The river edge again highlights bioengineering solutions that enhance habitat while requiring little space.

b. New pedestrian bridges cross into Riverside Park. A land swap with DTE, and subsequent public-private partnerships has resulted in Riverside Park being redeveloped into a new Health and Wellness Park. New facilities along Canal Street provide hospitality suites for families visiting patients at the University of Michigan Hospital. Recreation and rehabilitation facilities are integrated into the park design. The green-design of these facilities focuses again on health and wellness, showcasing safer product alternatives, maximizing natural light in the built spaces, and making strong connections between indoor and outdoor spaces.

c. The landscape design for the Health and Wellness Center incorporates healing gardens as well as rehabilitation courses. The healing gardens are quiet, contemplative spaces that use plants with therapeutic, aromatic, or other engaging features. Enabling gardens featuring raised beds and highly accessible areas, allow people with disabilities to have hands-on interaction with the gardens. The rehabilitation courses offer a sequence of walkways designed with different materials, slopes and ramps and other "obstacles", designed to encourage outdoor physical therapy, and to create obstacles that one may encounter upon release from the hospital. The space becomes structured into the University of Michigan Hospital is programming as the institution becomes a leader of incorporating patient care philosophy research, on the benefits of outdoor exposure and physical activity, into patient recovery.

d. The spatial design of the new Health and Wellness Center builds off the existing Lower Town Redevelopment plans, becoming a seamless integrated urban space. Wet prairie and wet meadow plantings weave together to shape the healing garden landscape.

Site Plan of Fuller Reach


A Contemplative Spaces


B Restoration Fountain

Fuller Reach

a. Recognizing the impacts of large lawn areas as generally detrimental to river health, Fuller Park, which contains many soccer fields intensively used by the city, is renovated to incorporate stormwater management systems and an expanded riparian buffer. The south bank of the river, which already contains some small off-channel wetlands, is converted into a much larger contiguous wetland system, managed for enhanced habitat biodiversity. The restored floodplain forests are nurtured on the Fuller side to enhance the species diversity and foster the old growth that was once noted and slated for preservation in the original O.C. Simonds master plan.

b. Cedar Bend and Island Park are slated for historic restoration based on the original O.C.Simond's Master Plan.

Other Design + Programming Features

a. As part of the adaptive reuse program for underutilized structures, Michigan brownfield law is leveraged where applicable for financing and development incentives.

MICHIGAN BROWNFIELD REDEVELOPMENT LAWS AT WORK

For nearly a century, the American Seating Company made event, transportation, and office seating out of a three-building complex in downtown Grand Rapids, Michigan. In the late 1990s, its manufacturing operations relocated leaving a vacancy in an already impoverished part of town. However, the company's president, with the assistance of state brownfield redevelopment tax credits and Grand Rapid's tax-free Renaissance Zone designation, transformed the 8.22-acre site into a mixed use development that has given hope to the neighborhood.

The Michigan Economic Development Corporation (MEDC) offered American Seating a state brownfield redevelopment credit worth 10% of the eligible investment, up to $2.8 million (MEDC, 2004a). The MEDC and the city of Grand Rapids also endowed the site with a state Renaissance Zone designation. This allowed any company located in the Renaissance Zone as well as residents living in the development's lofts and apartments, to operate or live state, local, and personal property tax free until Year 2011.

Located adjacent to Broadway Street, the new development consists of four main buildings. Building 51, the Off-Broadway Apartments, is a 130,000 sq. ft., four-story, building comprised of 67 three- and four-bedroom apartments, marketed to students of a local University, with a 100% occupation rate (MEDC, 2004a). Building 52 is a 175,000 sq. ft., four-story, mixed use building; comprising the commercial office, corporate headquarters for the American Seating Company, and luxury apartments. The two remaining buildings in the complex are still being used for manufacturing, but are viewed as future potential brownfield redevelopments. The grounds provide space for recreation and entertainment including an outdoor amphitheater.

Michigan's brownfield redevelopment program helps investors by reforming cleanup laws and offering tax credits and low-interest loans to communities (MEDC, 2004a). Since its inception, the program has grown from 10 projects a year to more than 100 projects per year, resulting in $4 billion in new private investment in brownfield redevelopments and the continuing use of the public infrastructures built to serve these sites, says Don Jakeway, President and CEO of the Michigan Economic Development Corporation (MEDC, 2004a). By expanding the definition of brownfields to include blighted and functionally obsolete buildings, sites containing abandoned buildings with no contamination are also eligible for brownfields single business tax credits (MEDC, 2004a).
Source: MEDC, 2004a

.

Chapter 6 – Anticipated Outcomes

Using the futures, relative trade-offs can be made, performance estimated, and anticipated outcomes described. The evaluation criteria for this project are qualitative or rely on land area calculations for comparing the different scenarios

Ecology

The ecology variable first considers total area of different cover types, including shrub/herbaceous, stormwater wetland, woodland, and other vegetated areas of lower habitat value (turf, native decorative plantings, etc.). The Biodiversity + Heritage Corridor scenario, results in the highest proportion of shrub/herbaceous vegetation, which includes restored floodplain wetlands and other natural communities. Furthermore, these habitat patches are the most interconnected along the Argo Riverfront. Combined with the backyard habitat programs, it is anticipated that wildlife can move more easily both along the river corridor and from the river to outlying upland areas. The Rainwater Adventure Park scenario, relies on converting much of the reclaimed land into large stormwater treatment wetlands at the discharge points of the stormwater pipes. The cost and effort to maintain these wetlands for habitat value will be high, as high levels of nutrients entering the wetland from the storm system will encourage invasive species over a diverse native community. Overtime the plant community may change to a community dominated by a few plant species best suited to the fluctuations and nutrient loading of stormwater discharges. While the lower biodiversity on these treatment wetlands may not provide excellent core habitat, it can still provide some cover and food habitat. Restored riparian areas surround these wetlands and can be managed for their habitat functions. The Sustainable Live/Work Community scenario, relies on creating smaller patches of habitat, primarily riparian and wooded, throughout the project site, creating "stepping stones" that facilitate movement between core habitat patches.

In terms of aquatic habitat, all three scenarios improve ecological conditions in the river. Removing the dam eliminates a major barrier to organism mobility and also allows sediment, nutrients, and woody debris to move naturally downstream. The expected performance of the aquatic ecosystem was estimated qualitatively based on the design intention of each scenario. The Biodiversity + Heritage Corridor scenario relies on allowing the river channel to stabilize on its own. Riverbed dredging and re-grading is minimized. This will result in mild rapids condition near the Argo Dam. The form of the river itself is the direct result of the river morphology model. After dam removal, water will move faster, collect more oxygen, have a cooler temperature, and become better habitat for a diverse native river fish population. The Rainwater Adventure Park scenario relies on removing the dam but carefully modifying the river bed near the Argo Dam and the M-14 Bridge to create two gradual sections of riffles. These riffles back up the water at those two points, creating an alternating pool and riffle effect, but also allow a side channel to divert water for the kayak runs. Cold-water releases upstream create better habitat conditions for stocked game species. The Sustainable Live/Work Community scenario creates a larger riffle section along the

Argo Dam space, maintaining higher water levels for the mill race. The end result is partway between dam removal and the existing impoundment conditions where organisms and materials can move freely up or downstream.

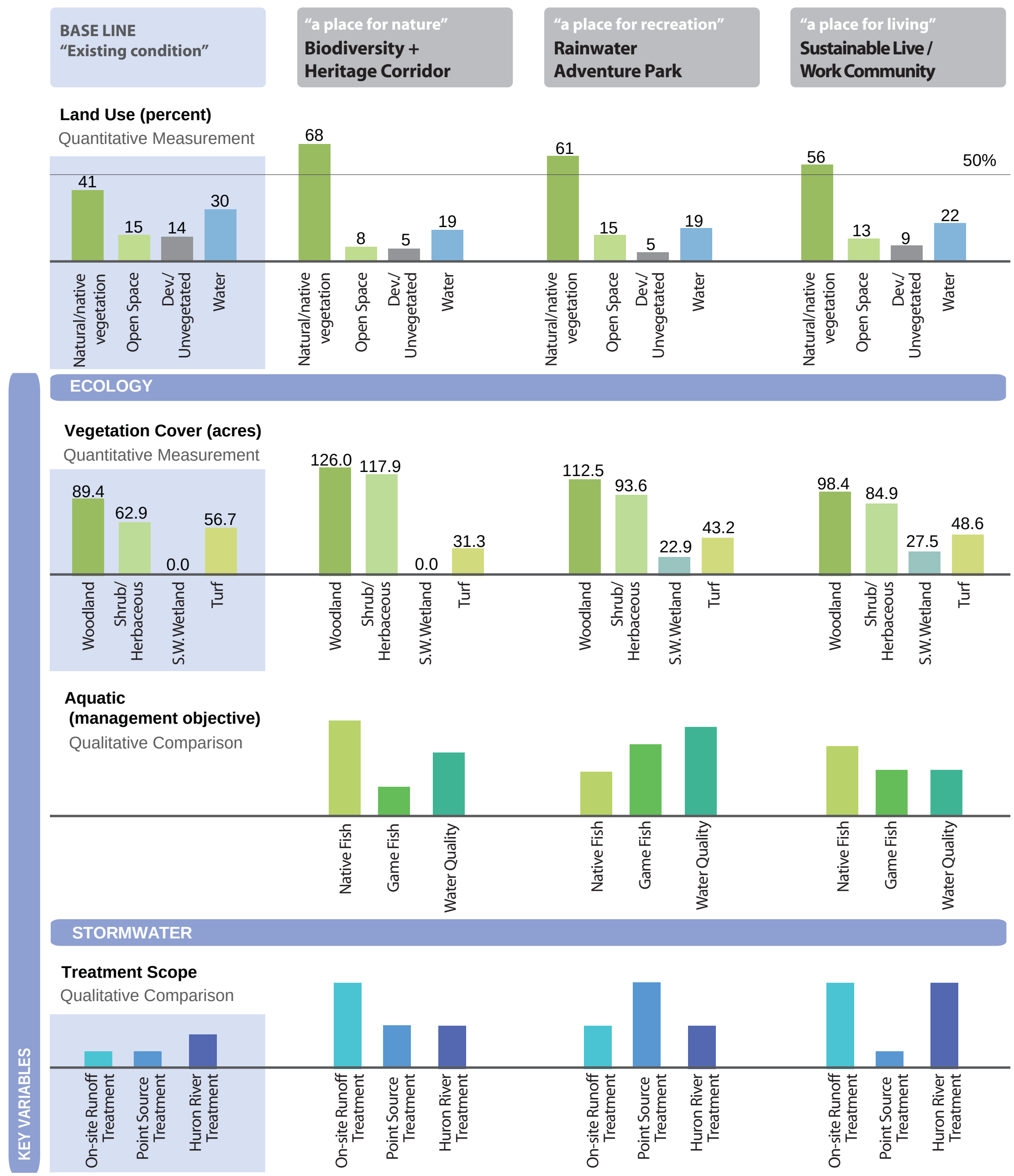
Stormwater

Stormwater and water management were considered in one of the three ways: (1) on-site runoff treatment, (2) point source treatment, collecting and treating stormwater at discharge point of stormwater pipes, and (3) cleaning or management of water in the Huron River itself. All three scenarios are expected to manage on-site runoff, either infiltrating or filtering runoff through wide riparian buffers, as in the Biodiversity + Heritage Corridor scenario, or via created rain gardens throughout the redevelopment, exemplified in the Sustainable Live/Work Community scenario. The Rainwater Adventure Park scenario emphasizes cleaning off-site stormwater directly through constructed off-channel wetlands. Combined with large scale stormwater systems in the adjoining creeksheds, it is anticipated that the "bounce" resulting from stormwater surges will be highly minimized and that the outlet-point hydrographs will reflect pre-development patterns. The Biodiversity + Heritage Corridor scenario relies on widespread BMP programs to gradually reduce dependence on stormwater infrastructure, eliminating the need for stormwater management of off-site flows at the Argo Riverfront. Both the Biodiversity + Heritage Corridor scenario and the Rainwater Adventure Park scenario treat stormwater discharge from Allen's Creek at the DTE site.

Human Engagement

Human engagement is considered in terms of education opportunities, recreation and leisure activities, connectivity of trail and road networks, and site access. For education, all of the scenarios have abundant opportunities to demonstrate ecological processes in action. For the Biodiversity + Heritage Corridor scenario, the monitoring and observation programs are geared around watching habitat use and interact with the landscape. Scenario A also emphasizes stewardship and hands-on opportunities. Nearly all of the "facilities" remaining in the Argo Riverfront area are geared towards accommodating education and outreach objectives, providing the facilities and materials for citizens to become actively engaged with the landscape. Community gardens further reinforce this landscape engagement aspect. The Rainwater Adventure Park scenario demonstrates and vivifies innovative approaches to stormwater management on a large scale, while the Sustainable Live/Work Community scenario exhibits renewable energy use, green building techniques, and alternative wastewater and stormwater management.

In terms of recreation activity, the distribution between reflective, active, and entertainment leisure activities can be compared across scenarios. he Biodiversity + Heritage Corridor scenario focuses primarily on reflective activities such as bird watching, walking/jogging, minimal levels of fishing, and similar low-impact, low-disturbance activities. The Rainwater Adventure Park scenario builds on many of the passive opportunities, but dedicates a larger portion of the Argo Riverfront to active recreation facilities. Most of these facilities are kept away from the reclaimed land areas along the river channel itself, reserving that land for stormwater management or riparian habitat functions. The Sustainable


BASE LINE
"Existing condition"
"a place for nature"
Biodiversity + Heritage Corridor
"a place for recreation"
Rainwater Adventure Park
"a place for living"
Sustainable Live / Work Community
Land Use (percent)
Quantitative Measurement
50%
41
15
14
30
68
8
5
19
61
15
5
19
56
13
9
22
Natural/native vegetation
Open Space
Dev./ Unvegetated
Water
KEY VARIABLES
ECOLOGY
Vegetation Cover (acres)
Quantitative Measurement
89.4
62.9
0.0
56.7
126.0
117.9
0.0
31.3
112.5
93.6
22.9
43.2
98.4
84.9
27.5
48.6
Woodland
Shrub/ Herbaceous
S.W.Wetland
Turf
Aquatic
(management objective)
Qualitative Comparison
Native Fish
Game Fish
Water Quality
STORMWATER
Treatment Scope
Qualitative Comparison
On-site Runoff Treatment
Point Source Treatment
Huron River Treatment

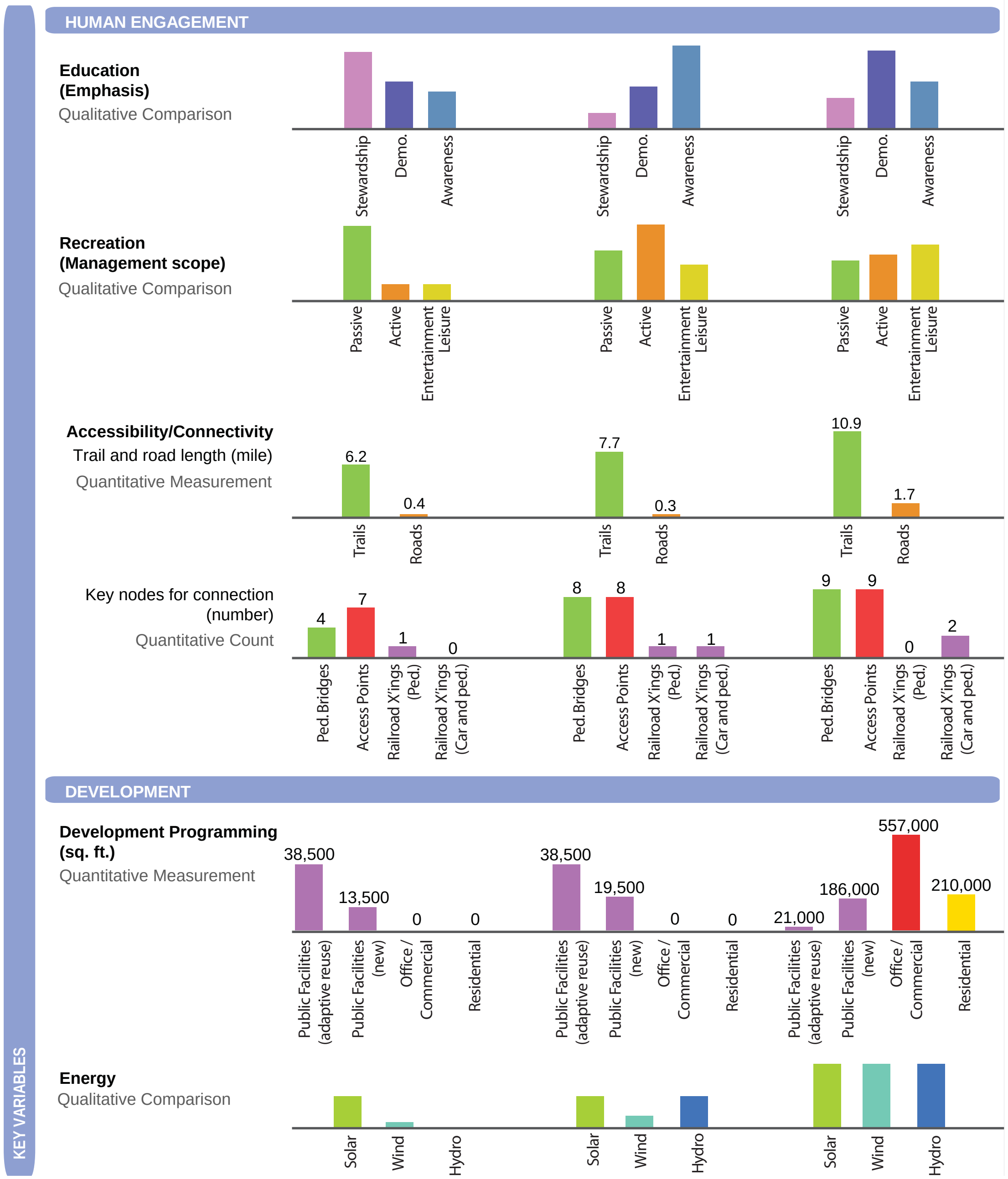


Figure 59: Performance Summary

Live/Work Community scenario reflects a more diverse range of recreation activities, incorporating some active and passive amenities as well as leisure activities, such as gondola boating, restaurants and cafés, a large performance venue, and other civic amenities. All of the scenarios reduce the capacity for rowing along this stretch of the river. (Scenario C may be flat enough to accommodate 1-2 person rowing sculls). Despite the relocation of team rowing off-site, the opportunities for other forms of recreation are increased in all scenarios.

Site access is another crucial basis for comparison. The Biodiversity + Heritage Corridor scenario results in a level of site entrances similar to the present conditions. The entrance to Bandemer along North Main Street is closed, although pedestrian access is secured over the railroad off Huron River Drive. A much needed pedestrian bridge connects over the river at the Broadway Bridge where the existing boardwalks are located. Internally, site connectivity increases. There is no change in the number of entrances because in some areas entrances are added and in other areas removed. Some pathways are removed, particularly where they pass through more sensitive ecological areas and fragment larger habitat patches. Others are added especially in areas where demonstration, education, and stewardship are the focus. The Rainwater Adventure Park scenario results in a higher level of site access and connectivity with both new entrances to the site and new pathways and crossings created within the project site. The Sustainable Live/Work Community scenario demonstrates the greatest level of site access, and relies heavily on a strong partnership with the railroad companies to negotiate crossing points. For the Rainwater Adventure Park scenario and the Sustainable Live/Work Community scenario, the anticipated outcome is that higher levels of access to the site will make the Argo Riverfront a more convenient and desirable destination for recreation activities. For the Biodiversity + Heritage Corridor scenario, entrances are tightly controlled and well articulated, still allowing access throughout the site, but enhancing the naturalistic qualities of the experience.

Development Programming

Differences in development patterns are expressed by the different uses and square footages of new building spaces, as well as the anticipated energy generation potential of the landscape. The Biodiversity + Heritage Corridor scenario minimizes new construction, only allowing existing buildings and structures to be re-adapted to serve new purposes. Additionally, efforts are made to ensure that all buildings function "off the grid" as much as possible, particularly in the case of the education center. The Rainwater Adventure Park scenario necessitates the construction of a new multi-use building near the swimming beach, but otherwise re-adapts existing buildings to new purposes. Renovated and new facilities become compelling civic amenities and focal points for residents to come together and participate in collective activities. The Sustainable Live/Work Community scenario relies on constructing extensive new sustainable buildings as well as implementing a more inclusive adaptive reuse program for aging buildings close to the Argo Riverfront. The anticipation is that the new development communities will be highly desirable places to live, work, and play, all the while generating all their energy needs on site, and potentially generating excess electricity which can be sold back into the grid.

Chapter 7 – Conclusions and Recommendations

Summary

Why the Alternative Futures Process?

The alternative futures process provides a method for stakeholders to discuss, engage, and evaluate future landscape patterns and to establish a trajectory that works towards realizing that future. The process used in the *Visions of Argo* project relies on the normative scenario approach, where desirable scenarios are explored as a means to explore what the future should be, rather than what the future is likely to be.

Furthermore, the alternative futures process allows complex spatial or landscape patterns to be proposed and evaluated in a rational yet iterative manner. Scenario drivers are identified; alternative assumptions that respond to uncertainties are stated; and guidelines are drafted for key variables or issues of concern. The process permits alternative "sets" of drivers, assumptions, and guidelines to be assembled and evaluated. In effect, the process is a mechanism for proactive planning that relies on specified drivers leading to desired outcomes rather than a reactive planning approach that responds to uncertain and varying circumstances.

Visions for the Argo Riverfront

The three alternative futures explored in this project embody plausible, distinct, and ambitious responses to the challenges and opportunities presented along the Argo Riverfront Site. The scenarios and futures are guided by three overarching goals; that (1) the Argo Riverfront Site becomes a focal point for the City of Ann Arbor, providing an increased amenity value for people; (2) the ecological quality and services of the Argo Riverfront Site, from Barton Dam to Fuller Bridge, is enhanced; and (3) sustainable design and management practices are embraced to protect the ecological health of the river. The three futures each succeed in accomplishing these goals but each in a different way, and each provides a compelling vision for the City of Ann Arbor and its residents to pursue.

Taken individually, each future depicts how the Argo Riverfront Site might be redeveloped under the chosen assumptions and drivers. However, one can easily imagine the future of a particular scenario looking quite different while nonetheless working within the same scenario. A reality of the ecological design process and the project team's aim is to provide a coherent portrayal of the normative scenarios as they might play out into the future. Each aspect of the design hinges, on and supports other proposed landscape interventions in a sustainable and unified manner. The proposed futures reflect an example of plausible and desirable outcomes, and should not be considered the solutions to the opportunities and challenges presented by the Argo Riverfront Site.

A Framework For Decision Making

Beyond the futures themselves, the process of assembling the scenario framework is perhaps the most difficult yet insightful part of the process. In particular, identifying and understanding the drivers and key variables for this project, or any alternative future project, helps prioritize specific concerns and allows holistic responses to be proposed.

At the onset of the project, the discussion of dam removal among stakeholders and the project team was central to the scenario design process. Initially, dam removal was proposed as a scenario driver itself. However, specific decisions regarding the dam's fate were difficult to establish, as the multitude of impacts resulting from dam management decisions were far reaching and hard to assess. A broader set of drivers and objectives was needed to provide a context for which decisions about dam management could be made. This need led to the realization that dam management was not a driver. Instead, residents' desires for how the river should be used became the primary driver, and decision criteria should be based on those different perspectives.

Given diverse stakeholder concerns and interests from the project team, the four key variables of ecology, stormwater, human engagement, and development were selected. Focusing on these issues, the framework responds intelligently to the entire spectrum of choices faced by the community. Ultimately, this project moves beyond addressing specific issues of dam management, aquatic weed removal, or recreation allocation, instead it helps the city and residents explore broader visions for the future. When acted upon, these futures inform the final decision for any of the important design, management, or policy opportunities.

Lessons Learned

Throughout the process, important lessons were learned that have implications not only for the Argo Riverfront Site, but for the future of the City of Ann Arbor and the surrounding region.

- The path and form of the Huron River has changed many times in the past, and the opportunity to change it again to meet diverse ecological and cultural needs should be acted upon. Acknowledging and re-imagining the land use legacies along the Argo Riverfront Site can lead to a richer and more rewarding riverfront experience.
- The Argo Riverfront Site is positioned at the confluence of a diverse range of opportunities. (1) The regional greenways pass through the site, (2) the Allen's Creek greenway can connect much of the city to the waterfront, (3) dam removal can expose significant new land areas and opportunities, (4) redeveloping under-utilized industrial land is an opportunity to enhance recreation and ecological amenities, (5) the site is positioned between the thriving downtown and emerging Lower Town districts, (6) the site can provide alternative energy needs, and (7) the site is surrounded by an intelligent and engaged citizenry. These are only a few of the significant opportunities the city can build

on to transform the existing riverfront into a thriving and dynamic space. The redevelopment of the Argo Riverfront Site can be a catalyst for realizing other city and community plans, and ultimately, becomes an opportunity to enhance the identity and sense of place for Ann Arbor.

- Thoughtful ecological design can be incorporated throughout any and all redevelopment projects. Development does not have to imply a reduction in ecological quality or services, but can in fact build on or augment ecological conditions. For the Argo Riverfront Site, ecological and sustainable design practices are embraced in all three scenarios, building stronger connections between ecological health and human health.
- Improving the overall water quality of the Huron River is beyond the capabilities of the Argo Riverfront Site itself. However, Ann Arbor can make powerful steps towards increasing the quality of water it releases into the Huron River and act as a leader for a promoting a cleaner Huron River in the future. At the Site Scale, opportunities to take advantage of cleaner water or demonstrate ecological approaches to cleaning the water can be pursued and vivified for the entire watershed.
- The City of Ann Arbor has an abundant range of partnership opportunities with the University of Michigan, state departments, and neighboring municipalities. Capitalizing on these opportunities provides a pathway for creating a new sustainable Argo Riverfront that serves a much broader audience and provides greater benefit to society than merely the "sum of its parts."
- Finding a balance between the natural and urban land uses that exist at the Argo Riverfront is a challenging task as well as on opportunity. Natural areas have long been impacted by development pressures and will continue to be so. On the other hand, the urban landscape often lacks a strong relationship to natural spaces. The opportunity to embrace the Argo Riverfront as both a natural space and an urban space can reconnect people to their natural environment. Reconnected people make better stewards of the land, who in turn can enhance the integrity and quality of nearby ecological systems. The Argo Riverfront's revitalization is a chance for the City of Ann Arbor to rediscover the Huron River as a remarkable amenity and redefine itself as a sustainable and thriving place to live.

Future Recommendations

Future Studies and Activities

The alternative futures process is geared towards helping decision makers and the public consider complex options and work towards a desirable future. The futures are a strong visual tool for helping the pubic to conceptualize the future and consider their own preferences. The City of Ann Arbor and the Huron River Watershed Council can use the results of this project to facilitate community meetings, survey preferences, research feasibility, and evaluate future outcomes. The following recommendations describe potential next steps:

- Develop and distribute a post-design survey as a way to gauge resident's desires. The futures can be described, trade-offs between alternatives explored, and visuals presented to community members, who can then rank their preferences using a visual preference model or similar approach.
- Survey topical experts, asking them to evaluate or rank the performance of the futures in the key variable categories of: ecology, stormwater, human engagement, and development. For example, engineers and ecologists can score the hydrologic or habitat connectivity performance, while developers comment on the economic feasibility of proposed sustainable development options.
- Implement an outreach campaign, distributing information about the Argo Riverfront and its future possibilities to residents and citizens throughout the area. Placing 3-D models on Google Earth and linking the images to perspective drawings is one possible technique. Developing a brief pamphlet describing the options and/or a short video clip for local television are additional approaches.
- Pursue richer evaluation approaches to quantitatively assess scenario performance across the key variables. For instance, a GIS habitat connectivity analysis for specific organisms could be conducted based on the existing conditions and again for each of the futures. The extent to which restoration activities, backyard habitat programs, or similar landscape interventions enhance connectivity could be specifically determined. The results of such an analysis will allow for more accurate comparisons between certain aspects of the scenarios, minimizing the interpretive quality of the existing evaluation.
- Conduct additional modeling to better define the assumptions explored in the scenario framework. For instance, a HEC-HMS model, developed for Allen's Creek and Traver Creek watershed could predict runoff discharge volumes into the Huron River, which in turn could be used to set targets for city-wide Best Management Practice (BMP) programs, or be used to establish design parameters for stormwater treatment wetlands along the Argo Riverfront. Land use change models for the Upper and Middle Huron River Watershed can better predict how water quality might change in the future, pushing decision makers to pursue one scenario over another.

General Recommendations for Pursuing a Sustainable Future

Regardless of the specific scenario that might be desired (or faced) moving into the future, there are many recommendations that the City of Ann Arbor might act upon to actively make the scenarios happen. These recommendations highlight the importance of forming partnerships with private and other public entities, increasing the feasibility and successes of the scenarios. These include:

- Form partnerships with the railroad companies and property owners adjacent to the Argo Riverfront Site to enhance access points. The railroad in particular is a major limiting factor for site access, effectively severing the site from the surrounding urban grid. With the possibility of a new commuter mass-transit line coming into Ann Arbor, greater pedestrian access and visual quality can benefit both the railroad companies and the city.

- Strengthen partnerships with institutions such as the University of Michigan, and in particular the University of Michigan Hospital, to build additional programming into the revitalized Argo Riverfront and to help finance project development.
- Enhance partnerships with local schools, the Parks and Recreation Department, Natural Areas Preservation, and local non-profits can build a stronger volunteer and stewardship base, greatly increasing the feasibility of large scale restoration projects. School curriculum can be expanded to embrace new opportunities at the Argo Riverfront.
- Form partnerships between Detroit Edison Company, developers, and public entities to explore brownfield redevelopment opportunities and investigate political, legal and economic solutions. Promote the acceleration of a full investigation and the Remedial Action Plan at the DTE brownfield site so that extent and severity of contaminations can be accounted for and addressed in a holistic and cooperative fashion.
- Research and promote stormwater Best Management Practices and habitat programs in key neighborhoods. Develop specific restoration plans outlining techniques, a restoration schedule, and stewardship opportunities.
- Form partnerships with upstream municipalities to enhance the water quality of the Huron River. Leverage its location in the Middle Huron to act as a leader in initiating the organization and demonstration that this will take.
- Look for partnership opportunities between research institutions and public agencies to develop and carry out more robust ecological monitoring along the Huron River. In particular, the opportunity to research the exact long-term effects of dam removal in an urban context is a compelling and much needed research agenda.

The Argo Riverfront Site is an area where many complex issues overlap and no one decision can or should be made in isolation. *Visions of Argo* can provide a catalyst to allow stakeholders to imagine the future and begin discussing the possibilities and impacts of decisions made today. *Visions of Argo* provides one piece in an integrated web of both past and future planning, analysis, and organization. Future work should be directed, cohesive and farsighted. The alternative futures visualization process, can help in these efforts by funneling much of the work that has come before through a visual lens which allows stakeholders to revisit the "big picture" of the complex decisions before them. The research and designs presented in *Visions of Argo* serves the purpose of reframing these big picture complexities in a way that future planning, analysis, and organization remains focused on the Huron River as a natural resource, as an amenity, and most importantly as the heart of a city so reliant on its ecological health.

About the Authors

Amy M Beltemacchi has worked over 20 years in the as a designer, information architect, software engineer and project manager, as well as in strategic corporate communications. Amy is pursuing her second advanced degree in ecology based landscape architecture as a way to connect her love of nature with her expertise in communication of visual and electronic media as a way to actively participate in the betterment of our planet. The Ann Arbor Argo area project is particularly appealing since it is a unique opportunity to integrate aesthetic solutions with ecology based processes while helping a community to envisions ecologically sound solutions.

Amy Hiipakka-Squires has completed her Masters of Landscape Architecture at the School of Natural Resources and the Environment, University of Michigan. She received a Bachelor of Science degree at Michigan State University in Fisheries and Wildlife with a concentration in Wildlife Management. Amy is a southeast Michigan native but will be moving to Rochester, York. Her heart remains here in Michigan and hopes to return some day. Because of growing populations, urban areas will continue to grow. Amy would like to incorporate ecological design into these urban areas to raise awareness of sustainability as well as design ecologically healthy and socially stimulating environments.

Yasuhiro Ishihara completed his Masters of Landscape Architecture from the School of Natural Resources and Environment, University of Michigan. He received a Master of Science degree at Hokkaido University in the Environmental Management Program with a concentration in Forest Management. He worked in landscape design firm in Hokkaido, Japan for two years, where he engaged in environmental surveys, landscape planning, and workshop management for park design. He also worked at The Museum of Nature and Human Activity, Hyogo, Japan for three years, where he engaged in geo-spatial analysis for watershed management, wildlife survey, and facilitation of educational programs of geographic information system for practitioners. His research interest includes multi-scale analysis and planning, water resource management, and ecological restoration.

Oliver Kiley completed his Masters of Landscape Architecture from the School of NaturalResources and the Environment, University of Michigan. He completed his undergraduate work at the same school, obtaining a degree in environmental policy and behavior. Prior to coming back to school he worked for a Design/Build Landscape Architecture firm as a foreman, project manager, and lead residential designer. He is from Ann Arbor and intends to live in the area after graduation, solidifying his townie status. Consequently, he wants Ann Arbor to remain a vibrant and progressive town, and is excited about how this Masters Project can lead to a revitalization of the Huron River, benefiting the city's residents as well as improving the health of the river. Of particular interest to Oliver is the relationship between science and design, the integration of art into the landscape, and how this project can meet multiple sustainability goals.

Alicia LaValle is a Master of Landscape Architecture student with Bachelors degrees in Biological-Anthropology and Photography. Her background is in habitat restoration, environmental education and graphic design. She has worked for the National Park Service, National Audubon Society and other non-profits in California, Oregon, Connecticut and Maine. In the past she has worked internationally as a photographer with work appearing in books on architecture as well as human culture and society. As a native of Ann Arbor Michigan, she is enthusiastic about the opportunity for local involvement which incorporates her interest in history, ecological design and landscape ecology. She plans to pursue a career in community based design integrating stakeholder needs with more sustainable solutions towards recreation, stormwater management and urban development.

Michael Wagman is pursuing a master's degree in aquatic sciences at the University of Michigan's School of Natural Resources and Environment and a certificate in Spatial Analysis. He also holds a B.S. in Resource Ecology Management from SNRE. He was a recipient of the 2006 Dean Gorham Fellowship in Ecosystem Management. His research interests include agricultural effects on aquatic ecosystems, bio-magnifications, and stream restoration. Michael has worked at the Michigan DNR Institute for Fisheries Research, Sequoia and Kings Canyon National Park, and was a Peace Corps volunteer in El Salvador.

References

Adams, Wendy M., Cauzillo, M., Chiang, K., Deuling, S., & Tislerics, A. (2004). Investigating the Feasibility of River Restoration at Argo Pond on the Huron River, Ann Arbor, Michigan. *Master's Project, School of Natural Resources and Environment, University of Michigan.* Retrieved from http://sitemaker.umich.edu/argoproject/files/final_report_13AUG2004.pdf.

Alaska Department of Fish and Game. (2008). *Streambank revegetation and Protection: A guide for Alaska Revegetation Techniques-Bundles, Fascines*. Retrieved April 3, 2008 from http://www.sf.adfg.state.ak.us/sarr/restoration/techniques/fascine.cfm.

Albert, D.A. Denton, S.R., & Barnes, B.V. (1986). *Regional landscape ecosystems of Michigan*. School of Natural Resources, University of Michigan, Ann Arbor.

Allen's Creek Watershed Group. (2001). *Allen's Creek Watershed Management Plan. Appendix L of Watershed Plan for the Huron River in the Ann Arbor – Ypsilanti Metropolitan Area (Approved by MDEQ in 2001).* Rerieved March 10, 2008 from http://acwg.org.

Almodovar A. and Nicola, G. (1999). Effects of a Small Hydropower Station Upon Brown Trout Salmo trutta L. in the River Hoz Seca (Tagus Basin, Spain) One Year After Regulation. *Regulated Rivers: Research & Management. Vol 15: 477-484.*

American Rivers and Trout Unlimited. (2002). Exploring *Dam Removal: A Decision Making Guide.* Bowman, Margaret, Higgs, S., McClain, E., Sicchio, M., Sours, A., Johnson, S., et al.

Atwell-Hicks Maps. (1887). *Folder 3 Maps of mill sites on Huron River and Broadway and Misc*. Bentley Historical Library, University of Michigan, Ann Arbor MI

Bain M.B., Finn, J.T., and Booke, H.E. (1988). Streamflow Regulation and Fish Community Structure. *Ecology. Vol 69: 382-392.*

Barnett, Jyl. (1999). Ed Noonan, the River Man, Creates a White-Water Rapids Course. *EJ News. 3(2). Fall 1999.*

Barr Engineering Co. (2002). *Argo Pond Sediment Sampling Study*. Ann Arbor, MI.

Batterman, J. (2006). *Rowing venues of Ann Arbor: A brief Analysis*. Retrieved February 22 2008 from Huron River Impoundment Management Plan, University of Michigan C-tools. Web site: https://ctools.umich.edu/access/content/group/1ab5639c-5cf9-42be-80bd-b344998db2f3/Recreation/Rowing%20-%20JB%20-%20080106final1.pdf

Bednarek, Angela T. (2001). Undamming Rivers: A Review of the Ecological Impacts of Dam Removal. *Environmental Management 27(6), 803-814.*

Bentley Historical Society. *Photgraph of City of Ann Arbor Interpretative signage on Broadway Bridge*, Ann Arbor, MI. Original image circa 1870. Photograph taken by Alicia LaValle.

Blumer, S. (2003). Taken from Adams, Wendy M., Cauzillo, M., Chiang, K., Deuling, S., & Tislerics, A. (2004). Executive Summary: Investigating the Feasibility of River Restoration at Argo Pond on the Huron River, Ann Arbor, Michigan. Master's *Project, School of Natural Resources and Environment, University of Michigan*. Retrieved March 1, 2008 from http://sitemaker.umich.edu/argoproject/files/executive_summary_13AUG2004.pdf

Brenner, A. J., Brish, L.A., Martin, J.S., Olsson, K.Y., Rentschler, P.L., & Wolf, J.K. (1999). The Huron River Watershed Council: Grassroots Organization for Holistic Watershed Management. *Water Science and Technology 39 (12), 331–337.*

Butz, C. (1974). A *History of the Huron River in Ann Arbor* (report written for NR 403, Prof. Charles Cares). Ann Arbor, MI, University of Michigan. Retrieved Feb 1, 2008 from http://www.hrwc.org/pdf/hist_annarbor.pdf.:

Canadian Parks and Wilderness Society (CPWS). (2008). *TransCanada Highway: Performance of Current Fences and Wildlife Crossing Structures*. Retrieved on April 10, 2008 from http://www.cpawscalgary.org/campaigns_nationalparks/trans_performance.php.

Carl, L.M. (1982). Social Impacts of a Stream Reclamation Project on Urban Anglers. *North American Journal of Fisheries Management. Volume 2, 164—170.*

Carlson, Erik, Personal Webpage. (1999). *The Red Cedar Rapids, an engineered whitewater project in Williamston, Michigan*. Retrieved March 21, 2008. http://homepage.mac.com/erikcarlson/web/williamston.html

City of Ann Arbor. (1999). *Along the Huron: the Natural Communities of the Huron River Corridor in Ann Arbor, Michigan. Ann Arbor, MI.* University of Michigan Press: Natural Area Preservation Division of the Parks & Recreation Dept.

City of Ann Arbor. (2005). *Parks and Recreation, 2006-2011 Parks and Recreation Open Space (PROS) Plan.*

City of Ann Arbor (2007a). *Response letter to NPDES permit MI0058169-AP for Honey Creek discharge*. Retrieved March 27, 8008 from http://www.a2gov.org/government/publicservices/systems_planning/Environment/Documents/spu_env_HoneyCreekNPDESComments.pdf

City of Ann Arbor (2007b) *Site Summary, MichCon Broadway 841 Broadway*, Ann Arbor MI.

City of Ann Arbor. (2008a). *Ann Arbor's Energy Challenge*. Retrieved on February 2008 from http://a2gov.org/government/publicservices/systems_planning/energy/energychallenge/Pages/WhatIsTheEnergyChallenge.aspx.

City of Ann Arbor (2008b) *Huron River and Impoundment Management Plan*. Retrieved March 28, 2008 from http://www.a2gov.org/government/publicservices/systems_planning/Environment/hrimp/Pages/HRIMP

City of Los Angeles. (2007). *Los Angeles River Revitalization Master Plan*. City of Los Angeles.

Clevenger, A. P. (2007). Highways through habitats: The Banff Wildlife Crossings Project. *Transportation Research News 247:14-17.*

Coleman, Cindy. (2004). Chicago Goes Green. *Interior Design October 2004*.

Cooke, G.D., Welch, E.B., Peterson, S.A., & Nichols, S.A. (2005). *Restoration and Management of Lakes and Reservoirs, 3rd ed.* Taylor & Francis Group. Boca Raton, Florida.

Cool Cities. (2008). *Background on Cool Cities*. Retrieved March 4, 2008 from http://www.coolcities.com/whatscool/Background/.

Cornell Lab of Ornithology. (2007). *All About Birds*. Retrieved March 20, 2008 from http://www.birds.cornell.edu/AllAboutBirds/.

Cushing, C.E. and Allan, J.D. (2001). *Streams: their ecology and life*. Academic Press, San Diego. Pp. 366.

Denison, D. (2004). Oden Creek Restoration – Bringing Together People and Trout. *Proceedings of the 2004 University Council on Water Resources Conference. Allocating Water: Economics and the Environment*. Portland, Oregon.

Detroit Riverfront Conservancy (DRC), The. (2005). *About the Conservancy*. Retrieved March 20, 2008 from http://www.detroitriverfront.org.

Dole, D. & Niemi, E. (2004). Future Water Allocation and In-Stream Values in the Willamette River Basin: A Basin-Wide Analysis. *Ecological Applications 14(2), 355–367.*

Edwards, David. (September 1 1987). *Michigan Department of Environmental Quality Field Photography Log Sheet* Retrieved March 28, 2008 from http://quod.lib.umich.edu/cgi/i/image/image-idx?id=S-BP1IC-X-GN09%5DCOALTAR.TIF

Eggers, S.T. & Reed, D.M. (1987). *Wetland plants and plant communities of Minnesota and Wisconsin*. US Army Corps of Engineers, St. Paul, Minnesota.

Environmental Protection Agency (EPA). (2007). *International Brownfields Case Study: Emscher Park, Germany.* Retrieved March 20, 2008 from http://epa.gov/brownfields/partners/emscher.html.

Florida Habitat. (2007). *Opening to Gopher Tortoise/Small Animal Underpass.* Retrieved on April 10, 2008 from http://www.floridahabitat.org/picture-gallery/gopher%20crossing2.JPG/view

Froese, R. and Pauly, D., et al. (2008). *FishBase*. Retrieved March 24-26, 2008 from www.fishbase.org.

Gardner, W. S. (1906). *Huron River Valley from Maps made in 1905-1906*. Consulting Engineer Ann Arbor MI.

General Land Office. (1819). Plat *Map. Township No. 2 south, Range No 6 E of Mer. Surveyed by J.Wampler*. Submitted to Surveyor Generals Office. Sept 15th.

Graber, B., Bowman, M., Carney, R.S., Doyle, M., Fisher, M., Mackey, S., et al. (2001). *21st Annual USSD Technical Issues in Small Dam Removal Engineering, The Future of Dams and Their Reservoirs*.

Grabowski, T.B. and Iseley, J.J. (2007). Effects of Flow Fluctuations on the Spawning Habitat of a Riverine Fish. *Southeastern Naturalist. Vol 6: 471-478.*

Greenways Initiative. (2005) *Grantees: City of Ann Arbor*. Retrieved Feb 16 2005 from http://greenways.cfsem.org/grantees/grantees_reader.php?pid=Ann_Arbor_City_of_land_grant.txt

Grimes, Donald R & Fulton, G.A. (2007). *A Region in Turbulence and Transition: The Economic and Demographic Outlook for Southeast Michigan Through 2035*. South East Michigan Council of Governments (SEMCOG), Detroit.

Growing Vine Street. (2005). *Growing Vine Street*. Retrieved March 21, 2008 from http://www.growingvinestreet.org/

Hager, Mary C. (2003). Low Impact Development. *Stormwater. January/February 2003.*

Hatheway, A. (2006). *Symposium of the International Association of Engineering Geology*. Geo-environmental classification of the residuals and wastes of gas manufacturing. Trent University, UK.

Heinz Center. (2002). *Dam Removal: Science and Decision Making*. Washington, DC: John Heinz III Center for Science, Economics, and the Environment.

Helfand, Adams, Cauzillo, Chiang, Deuling, Kiley, and Tislerics. (2007). "Benefits *and Costs of Dam Removal: A Case Study of Argo Dam, Ann Arbor, MI*". Working Paper. School of Natural Resources and the Environment, University of Michigan.

Hilsenhoff, W.L. (1988). Rapid field assessment of organic pollution with a family-level biotic index. *Journal of North America Benthological Society 7(1), 65-68.*

Hines, Sara.. (2007). When Science Is Child's Play. *Landscape Architecture. October 2007 Vol 97: No 10.*

Holdren, C., Jones, W., & Taggart, J. (2001). *Managing Lakes and Reservoirs. N. Am. Lake Mgt. Soc. & Terrene Inst., in cooperation with Off. Water Assess*. Watershed Prot. Div. U.S. Environ. Prot. Agency, Madison, WI.

Hulse, D., Gregory, S., & Baker, J. (2002). Pacific Northwest Ecosystem Research Consortium. *Willamette River Basin Atlas: Trajectories of Environmental and Ecological Change*.

Huron River Impoundment Management Plan Committee. (2007a). *Canoeing, Kayaking and the Ann Arbor Liveries Meeting Notes Summary*. Retrieved February 18, 2008 from http://www.a2gov.org/government/publicservices/systems_planning/Environment/hrimp/Pages/HRIMP.aspx: Saam, Cheryl.

Huron River Impoundment Management Plan Committee. (2007b). *Rowing Opportunities Meeting Notes Summary*. Retrieved February 2008 from http://www.a2gov.org/government/publicservices/systems_planning/Environment/hrimp/Pages/HRIMP.aspx :Woodman, Ron.

Huron River Watershed Council. (1996). *The Middle Huron Initiative: Phosphorus Reduction Strategy for the Middle Huron River Watershed*. Ann Arbor, MI: Brenner, A. J. & Rentshler, P.

Huron River Watershed Council. (2005). *2004 Annual Report of the Middle Huron River Watershed Initiative: Appendix B - Middle Huron Stream Nutrient Monitoring Program for 2004 and Huron River Report Article*. Retrieved January 15, 2008 from http://www.hrwc.org/plan/30_57_MHI.pdf.

Huron River Watershed Council. (2006a). *About the Huron River Watershed-Natural Features: Prairies, Woodlands and Upland Areas*. Retrieved February 2008 from http://www.hrwc.org/text/woodlands.htm.

Huron River Watershed Council. (2006b). *Upper Huron Program: General Information*. Retrieved Feb 1, 2008 from http://www.hrwc.org/program/up.htm.

Huron River Watershed Coucil (HRWC). (2008). *Riparian Buffer Initiative*. Retrieved April 13, 2008 from http://www.hrwc.org/text/buffer.htm.

Huron-Clinton Metroparks. (2002). *Metro Parks History*. Retrieved February 2008 from http://www.metroparks.com/global/history.php.

Infante, D. (2005). Relationships among the landscape, stream habitat, and stream biota of the Huron and Raisin Rivers, Southeastern Michigan. *Doctoral Dissertation*, University of Michigan Press.

Keepers of the waters. (2007). *Model Projects-Living Water Garden*. Retrieved March 1, 2008. from http://www.keepersofthewaters.org.

Knighton, S. (1984). *Fluvial forms and process*. Edward Arnold Ltd, London, Great Britain.

LaBelle, Judith M. (2001). Emscher Park, Germany-expanding the definition of a "park". Crossing Boundaries in Park Management: Proceeding of the 11th Conference on Research and Resource Management in Parks and on Public Lands. *The 2001 GWS Biennial Conference. 37: 222-237.*

Latz and Partners. (2008). *Images of the Emscher Park*. Retrieved March 22, 2008 from http://www.latzundpartner.de).

Lehman, D. (2008). *Data Archive*. Retrieved March 31, 2008 from http://www.umich.edu/~hrstudy/

Limno-Tech, Inc. (2007). *Aquatic Vegetation Survey and Preliminary Management Assessment Report Barton, Argo, Geddes, and South Ponds Huron River, Michigan*. Limno-Tech, Inc. Ann Arbor, Michigan: Limno Tech.

Lyle, John T. (1999). *Design for Human Ecosystems: Landscape, Land Use, and Natural Resources*. Island Press.

Michigan Department of Environmental Quality. (1985) *Briefing Memo for Michcon Sites* – Ann Arbor, Washtenaw Co-Groundwater Quality Division. Oct, 25 1985 Retrieved February 11th 2008 from Broadway Park: Renewing Ann Arbor's Public Riverfront. Web site: http://quod.lib.umich.edu/cgi/i/image/image-idx?c=bp1ic.

Michigan Department of Environmental Quality. (2001). *Total Maximum Daily Load for Escherichia Coli in Geddes Pond, Huron River, Washtenaw County*: Surface Water Quality Division.

Michigan Department of Environmental Quality. (2004). *Executive Summary Selman Science, Inc. Unit E Aquifer Groundwater Contamination Decision Document*. Lansing, MI.

Michigan Department of Environmental Quality. (2005). *Brownfields-USTsfields Database*. Retrieved January 2008 from http://www.deq.state.mi.us/ustfields/default.asp.

Michigan Department of Environmental Quality. (2006). *Permit No. 06-81-0050-P, (DTE Energy) MI Consolidated Gas Company. Issued August 9, 2006, Expires December 31, 2007*. Signed by Mario Fusco Jr. Floodplain Subdivision Program Lands and Water Management Division.

Michigan Department of Natural Resources. (1991). *Qualitative biological and habitat survey protocols for wadeable streams and rivers*. Lansing, Michigan: Surface Water Quality Division & Great Lakes Environmental Assessment Section.

Michigan Department of Natural Resources. (1995). *Huron River Assessment. (Fisheries Division Special Report No. 16*. Ann Arbor, Michigan: Hay-Chmielewski, E.M., Seelbach, P.W., Whelan, G.E., Jester, D.B.

Michigan Department of Natural Resources. (2002). *Huron River Plan*. Lansing Michigan: Fisheries Division.

Michigan Economic Development Corporation (MEDC). (2004a). *American Seating Park in Grand Rapids: Rescue and Renewal*. Retrieved March 20, 2008. http://www.brownfields.com/Feature/Feature-10-2004-AmericanSeating.htm.: The Center for Brownfields Initiatives at the University of New Orleans.

Michigan Economic Development Corporation. (2004b). *Michigan Cool Cities Survey: Summary of Findings.* Retrieved March 4, 2008 from http://www.coolcities.com/heard/results/.

Midwest Hazardous Substance Research Center, The (MHSRC). (2004). *Overview. Michigan State University. Technical Outreach Services for Communities (MSU-TOSC*). Retrieved 2Q 2008 from http://www.egr.msu.edu/tosc/gelman/gelmanoverview.shtml.

Michigan State Housing Development Authority (MSHDA). (2008) *"Granholm Announces Brownfield Redevelopments in Ann Arbor, Grand Rapids to Create and Retain 748 Jobs"* Retrieved on 15 March 2008, from http://www.michigan.gov/mshda/0,1607,7-141-7559_9637-169885--,00.html

Miller Johnson Attorneys and Counselors. (2008). *Legislation Preserves Single Business Tax Credits for Brownfield Redevelopment*. October 20, 2006. Retrieved on 18 March 2008 from http://www.millerjohnson.com/pubs/xprPub-Detail.aspx?xpST=PubDetail&pub=1207.

Milwaukee and Department of City Development, City of (MKEDCD). (2008). *Riverfront: Project History*. Retrieved March 16, 2008 from http://www.mkedcd.org/Riverwalk/history.html

Nassauer, J., Corry, R. (2004). Using normative scenarios in Landscape Ecology. *Landscape Ecology, 19, 343-356.*

National Park Service (NPS). *Pamphlet: Giving new life to streams in rural city centers*. Seattle.: Rivers and Trails Program.

National Wildlife Federation. (2008). *Create a Certified Wildlife Habitat*. Retrieved March 16, 2008. http://www.nwf.org/backyard.

New Jersey Audubon Society. (2006). *Guide to Conservation Incentive Programs for New Jersey Landowners and Farmers*. Bernardsville, New Jersey.

Ohio Department of Natural Resources. (2005). *Ohio Stream Management Guide-Live Fascines*. Retrieved April 3, 2008 from http://www.dnr.state.oh.us/water/pubs/fs_st/stfs14/tabid/4169/Default.aspx.

Pall Corporation. (2004). *Interim Feasibility Study for the Unit E Plume*. Retrieved January 23, 2008 from http://www.egr.msu.edu/tosc/gelman/Interim_Feas_Study.pdf

Poff, Leroy N. & Hart, D. D., (2002). How Dams Vary and Why it Matters for Emerging Science of Dam Removal. *Bioscience 52(8), 659-688.*

Projects for Public Spaces (PPS). (2008). *Great Public Places: River Walk in San Antonio, Texas*. Retrieved March 20, 2008 from http://www.pps.org/great_public_spaces/one?public_place_id=22#.

Resource Center. (2007). *City Farm*. Retrived April 8, 2008 from http://www.resourcecenterchicago.org/70thfarm.html.

Sanborn Map Company, The. (2001). *Digital Sanborn Fire Insurance Maps 1867-1970*. Retrieved Feb 11, 2008 from http://sanborn.umi.com/

Schumaker, N.H., Ernst, T., White, D., Baker, J., & Haggerty, P. (2004). Projecting Wildlife Responses to Alternative Future Landscapes in Oregon's Willamette Basin. *Ecological Applications 14(2), 381–400.*

Scobey, D., Kuras, A., & Kortesoja, K. (2008). *Broadway Park: Renewing Ann Arbor's Public Riverfront University of Michigan Arts of Citizenship Program and the Ann Arbor Department of Parks and Recreation*. Retrieved March 1, 2008 from http://www.artsofcitizenship.umich.edu/broadway.

Shackman, G. (2006). *Ann Arbor Observed: Selections from Then and Now*. University of Michigan Press. Ann Arbor MI.

Shackman, Grace. (1993). *History of the Huron River and Allen's Creek in Ann Arbor*. Retrieved February 10, 2008 from http://www.hrwc.org/pdf/hist_annarborallenscreek.pdf .

Sickle, J.V., Baker, J., Herlihy, A., Bayley, P., Gregory, S., Haggert, et al. (2004). Projecting the Biological Condition of Streams under Alternative Scenarios of Human Land Use. *Ecological Applications 14(2), 368–380.*

Sommers, L.M. editor.(1977). *Atlas of Michigan*. Michigan State University Press, Lansing.

Southeast Michigan Council of Governments (SEMCOG). (2001). *2030 Regional Development Forecast for Southeast Michigan: Population, Households, and Jobs for Cities, Villages, and Townships 1990-2030*. Detroit.

Southeast Michigan Research Conservation and Development Council (SEMIRCDC). (2008). *Workshops and Demonstrations*. *Washtenaw County: Nichols Arboretum Site*. Retrieved on April 10, 2008 from http://semircd.org/buffers/workshops/na/nasiteprep1.php

Southern California Edison. (2008). *Environment Commitment-Restoration for Manufactured Gas Plants.* Retrieved March 16, 2008 from http://www.sce.com/PowerandEnvironment/EnvironmentalCommitment/Restoration/ManufacturedGasPlants.htm.

Steinitz, C., Arias, H., Bassett, S., Flaxman, M., Goode, T., Maddock. T. III, et al. (2003). *Alternative futures for changing landscapes: the Upper San Pedro River Basin in Arizona and Sonora.* Washington, D.C., Island Press.

Stormwater Managers Resource Center (SMRC). (2008). *Fact Sheets: Aquatic Buffers*. Retrieved April 13, 2008 from http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool3_Buffers/BufferZones.htm.

Sustainable Sites Initiative, The. (2007). *The Sustainable Site Initiative*. Retrieved April 6, 2008 from http://www.sustainablesites.org/.

Sweeney, N. (2005). *A stroll along the River Walk. MKE Online*. Retrieved March 20, 2008 from http://www.mkeonline.com/story.asp?id=342124.

Television Trust for the Environment (TVE). (1999). *Hands On: Only Connect-Hydro micro-Peru*. Retrieved March 27, 2008 from http://www.tve.org/ho/doc.cfm?aid=321.

United Nations. (1987). *Our Common Future*, Report of the World Commission on Environment and Development. Published as Annex to General Assembly document A/42/427, Development and International Co-operation: Environment. August 2, 1997. Retrieved March 15, 2008. from http://www.un-documents.net/wced-ocf.htm.

United States. Army Corps of Engineers (2004). *National Inventory of Dams*. Retrieved July 19, 2004 from http://crunch.tec.army.mil/nid/webpages/nid.cfm.

United States Department of Agriculture, NRCS. (2008). *The PLANTS Database*. National Plant Data Center, Baton Rouge, LA 70874-4490 USA. Retrieved March 20, 2008 from http://plants.usda.gov.

United States Department of Agriculture, NRCS-MICH. (2008) Technical Guide 391 *Riparian Forest Buffers*. Retrieved April 13, 2008 from http://www.hrwc.org/pdf/riparian_forest_buffer.pdf.

United States Forest Service (USFS) Lake Tahoe Basin Management Unit. (2008). *Taylor Creek Visitor Center: Stream Profile Chamber and Rainbow Trail*. Retrieved April 2, 2008 from http://www.fs.fed.us/r5/ltbmu/recreation/visitor-center/streampc.shtml

United States Geological Survey (USGS). (2008a). *USGS Real-time Data for USGS 04174500 Huron River at Ann Arbor, MI*. Retrieved March 29, 2008 from http://waterdata.usgs.gov/nwis/uv/?site_no=04174500&agency_cd=USGS.

United States Geological Survey (USGS). (2008b). *Surface Water Daily Data for the Nation*. Retrieved April 1, 2008 from http://waterdata.usgs.giv/nwis/dv/?referred_module=sw.

United States Green Building Council (USGBC). (2008). *LEED Rating Systems*. Retrieved April 7, 2008 from http://www.usgbc.org/DisplayPage.aspx?CategoryID=19.

Valenti, Michael, Senior Ed. (1999). *Cleaning up after industry*. Retrieved March 16, 2008 from http://www.memagazine.org/backissues/membersonly/september99/features/after/after.html

Walter, R. C., Merritts. D. J. (2008) "Natural streams and the legacy of water-powered mills." *Science: p 299(6).*

Washtenaw County. (2008). *Doyle Park Reconstruction.* Retrieved March 27, 2008 from http://www.ewashtenaw.org/government/drain_commissioner/dc_webWaterQuality/brownpark..

Wetzel, R.G. (2001). *Limnology (3rd ed)*. Academic Press, London, U.K.

Wikipedia. (2008). *San Antonio River Walk*. Retrieved March 20, 2008. from http://en.wikipedia.org/wiki/San_Antonio_River_Walk.

Wild Fish Habitat Initiative (WFHI). (2007). *Trapper Creek*. Retrieved April 2, 2008 from http://wildfish.montana.edu/Cases/methods/TrapperCreek_OR.asp?ProjectID=36.

Wittersheim, Robert. (1993). The Huron River. *Huron River Watershed Council Huron Riverfest Publication*. Retrieved January 10, 2008 from http://www.hrwc.org/pdf/hist_huronriver.pdf.

Appendix 1 – Species of Special Concern in the Argo Riverfront Site Parklands

FLORA

Species (City of Ann Arbor, 1999)	Resident Park	Species description (USDA, 2008)	Site Specific Notes (City of Ann Arbor, 1999)
Alnus glutinosa (Black alder)	Bandemer	Can be weedy/invasive. Usually occurs in poorly drained soils but is adapted to wide range of soils and is a soil improving species.	Harvester butterfly is dependent on this plant because of the pest (Woolly aphid) that feeds on the Alder.
Chelone obliqua (Purple turtlehead)	Argo	State Endangered Species-Legally protected. Perennial in floodplain forests.	Located along toe drains of the Argo Mill Race.
Coronilla varia (Crown vetch)	Barton	Largely used for bank stabilization. Provides forage for deer and cover for ground nesting birds.	Becoming invasive at this site. Needed for the Wild indigo duskywing.
Lonicera spp. (Honeysuckle)	Argo	An invasive shrub with red berries dispersed by birds and small mammals. Early to leaf out and late to lose leaves, this shrub shades out many native wildflowers.	Invasive species prevalent due to shape of park coupled with dispersal methods. Erosion gullies are ideal place for germination of invasive species.
Rhamnus spp. (Buckthorn)	Argo, Bandemer, Barton	Highly invasive shrub species with black berries that attract birds-effective dispersal method. Dense form that crowds and shades out native shrubs and herbs. Highly tolerant to a wide range of soil types.	Invasive species flourish due to shape of park coupled with dispersal methods. Erosion gullies are ideal place for germination of invasive species. Continuously managed by the Natural Area Preservation Division.

FAUNA

Species (City of Ann Arbor, 1999)	Resident Park	Species Description (City of Ann Arbor, 1999)	Site Specific Notes (City of Ann Arbor, 1999).
Erynnis baptisiae (Wild Indigo Duskywing)	Barton	Historically dependent on wild indigo (*Baptisia tinctoria*) in open woods and barrens; now occurring near highways and railroad beds where crown vetch has been introduced.	State Special concern. Not legally protected. Larval host is the highly invasive, crown vetch (*Coronilla varia*)
Feniseca tarquinius (Harvester butterfly)	Argo, Bandemer	A carnivorous species. Caterpillar host is Woolly aphids and adults feed on aphid honeydew. Lives in deciduous or mixed woodlands long streams.	Uncommon to Michigan. Feeds on the Woolly aphids, that are pests to the invasive *Alnus glutinosa.*
Petrochelidon pyrrhonota (Cliff Swallow)	Bandemer	Songbird that nests in large colonies. Forages through colony alerting and support (Cornell, 2008)	Uncommon to Southern Michigan. Nesting site located under the M-14 bridge.

Sources: (USDA, 2008). (Cornell, 2007). (City of Ann Arbor., 1999

Appendix 2 – Fish Presence in the Argo Area

Fish of the Huron River Impoundments (Argo Pond and Barton Pond) Compared to Nearby Tributaries with Higher Flow Rates and Water Quality (Mill Creek and Fleming Creek)

NP: Not Present, R: Rare (<5%), U: Uncommon (5-10%), C: Common (10-30%), D: Dominant (>30%)

Species	Fleming Creek	Mill Creek	Barton Pond	Argo Pond	Comments
Ambloplites rupestris (Rock bass)	NP	NP	U	C	Inhabits vegetated and brushy stream margins and pools of creeks and small to medium rivers, and rocky and vegetated margins of lakes
Ameiurus melas (Black bullhead)	NP	NP	NP	R	Inhabits pools, backwaters, and sluggish current over soft substrates in creeks and small to large rivers; impoundments, oxbows, and ponds.
Ameiurus natalis (Yellow bullhead)	NP	NP	R	R	Pools, backwaters, and sluggish current over soft substrate in creeks and small to large rivers; oxbows, ponds, and impoundments.
Ameiurus nebulosus (Brown bullhead)	NP	NP	U	R	Occurs in pools and sluggish runs over soft substrates in creeks and small to large rivers.
Amia calva (Bowfin)	NP	NP	R	R	Found in swampy, vegetated lakes and rivers.
Campostoma anomalum (Central stoneroller)	R	NP	NP	NP	Inhabit rocky riffles, runs, and pools of headwaters, creeks and small to large rivers.
Catostomus commersonii (White Sucker)	U	C	NP	NP	Usually occurs in small, clear, cool creeks and small to medium rivers.
Cottus bairdii (Mottled sculpin)	D	D	NP	NP	Adults occur in rubble and gravel riffles, less often in sand-gravel runs of headwaters, creeks and small rivers.
Cyprinus carpio (Common carp)	NP	NP	C	R	Invasive species. Prefers large bodies of slow or standing water and soft, vegetative sediments.
Esox lucius (Northern pike)	NP	NP	R	NP	Occurs in clear vegetated lakes, quiet pools and backwaters of creeks and small to large rivers. Valuable game fish.
Etheostoma blennioides (Greenside darter)	R	R	NP	NP	Inhabit rocky riffles of creeks and small to medium rivers, and shores of large lakes.
Etheostoma caeruleum (Rainbow darter)	R	NP	NP	NP	Found in fast moving gravel and riffles of creeks and small- to medium-sized rivers.
Etheostoma nigrum (Johnny darter)	NP	R	NP	NP	Occurs in sandy and muddy, sometimes rocky, pools of headwaters, creeks, and small to medium rivers; and in sandy shores of lakes.
Hypentelium nigricans (Northern hogsucker)	R	R	NP	NP	
Ictalurus punctatus (Channel catfish)	NP	NP	R	R	Thrives in small rivers, large rivers, reservoirs, natural lakes, and ponds.

Species	Fleming Creek	Mill Creek	Barton Pond	Argo Pond	Comments
Lampetra appendix (American brook lamprey)	R	NP	NP	NP	Occurs in gravel or sand riffles and runs of creeks and small to medium rivers with strong flow and usually clear water.
Lepisosteus osseus (Longnose gar)	NP	NP	R	R	Occurs in sluggish pools, backwaters and oxbows of medium to large rivers, and lakes.
Lepomis cyanellus (Green sunfish)	R	NP	NP	NP	Prefers vegetated areas in sluggish backwaters, lakes, and ponds.
Lepomis gibbous (Pumpkinseed)	R	NP	R	R	Pumpkinseeds prefer shallow water with some weed cover.
Lepomis gulosus (Warmouth)	NP	NP	NP	R	Inhabits the heavily vegetated, muddy-bottomed habitats typical of the sunfishes.
Lepomis macrochirus (Bluegill)	NP	R	C	D	Found frequently in lakes, ponds, reservoirs and sluggish streams.
Micropterus dolomieu (Smallmouth bass)	R	NP	R	NP	Because it is relatively intolerant of pollution, it is a good natural indicator of a healthy environment.
Micropterus salmoides (Largemouth bass)	NP	R	NP	R	Prefers quiet, clear water and over-grown banks. Popular game fish.
Moxostoma macrolepidotu (Shorthead redhorse)	NP	NP	C	R	Typically found in natural lakes and still regions in rivers.
Luxilus cornutus (Common shiner)	R	NP	NP	NP	Adults inhabit rocky pools near riffles in clear, cool creeks, small/ medium rivers.
Noturus flavus (Stonecat)	NP	NP	NP	R	Inhabits rubble and boulder riffles and runs of creeks and small to large rivers, and gravel shoals of lakes.
Perca flavescens (Yellow perch)	NP	NP	R	R	Most commonly found in clear water near vegetation.
Pimephales notatus (Bluntnose minnow)	R	NP	NP	NP	A small creek species that is intolerant of high turbidity.
Pimephales promelas (Fathead minnow)	R	NP	NP	NP	The fathead is quite tolerant of turbid, low-oxygenated water.
Pomoxis nigromaculatus (Black crappie)	NP	NP	C	U	Thrive in clear, natural lakes and reservoirs with moderate vegetation .
Rhinichthys atratulus (Blacknose dace)	D	C	NP	NP	Inhabits rocky runs and pools of headwaters, creeks and small rivers.
Sander vitreus (Walleye)	NP	NP	U	R	Prefers large, shallow lakes with high turbidity. Often raised for stocking.
Semotilus atromaculatus (Creek chub)	C	C	NP	NP	Inhabits rocky and sandy pools of headwaters, creeks and small rivers.
Umbra limi (Central mudminnow)	NP	R	NP	NP	Moderate to heavily vegetated portions of small streams, ponds, lakes, and marshes, over a bottom of mud or thick muck.

NP: Not Present, R: Rare (<5%), U: Uncommon (5-10%), C: Common (10-30%), D: Dominant (>30%)

Source for Comments: Froese, R. and D. Pauly. Editors. 2008. FishBase. www.fishbase.org

Appendix 4 – Relevent Planning Documents

Ann Arbor Energy Commission. (2007). *Renewable Energy Challenge.* http://www.a2gov.org/government/publicservices/systems_planning/energy/energychallenge/Pages/WhatIsTheEnergyChallenge.aspx

City of Ann Arbor. (1988). *North Main Street/Huron River Corridor Plan.*

City of Ann Arbor. (1995). *West Area Plan.*

City of Ann Arbor - Allen's Creek Watershed Group. (2001). *Allen's Creek Watershed Management Plan.* http://www.acwg.org/

City of Ann Arbor. (2006). *Northeast Area Plan*. http://www.a2gov.org/government/communityservices/planninganddevelopment/planning/Pages/NortheastAreaPLan.aspx

City of Ann Arbor - *Parks and Recreation. (2005). Parks, Recreation and Open Space (PROS) Plan.* http://www.a2gov.org/government/communityservices/ParksandRecreation/Documents/2006%20Parks%20Open%20Space%20Plan.pdf

City of Ann Arbor - Planning and Development Services and the Alternative Transportation Program. (2006). *City of Ann Arbor Non-Motorized Transportation Plan 2007.* http://www.greenwaycollab.com/images/AANoMo/AANoMo%20Master%20Plan%202007.pdf

City of Ann Arbor - Greenway Task Force. (2007) *The Allen Creek Greenway-Findings and Recommendations.* http://www.a2gov.org/greenway/Documents/Final%20Report_low%20res.pdf

Huron RiverWatershed Council. (1996). *The Middle Huron Initiative: Phosphorus Reduction Strategy for the Middle Huron River Watershed.*

Huron River Watershed Coucil. (2007). *Riparian Buffer Model Ordinance*. http://www.hrwc.org/pdf/riparian_model_ordinance.pdf

Michigan Department of Natural Resources. (2002). *Huron River Plan.* Lansing Michigan: Fisheries Division. http://www.michigan.gov/documents/Huron_River_Plan_23082_7.pdf

Michigan Department of Labor and Economic Growth. (2005). *Michigan's Cool Cities Initiative: A Reinvestment Strategy.* http://www.coolcities.com/cm/attach/65FCD505-DBB5-43A9-AB66-F7D84978B9A7/CCWhitePaper.pdf

Washtenaw County - Drain Commission (2000). *Mallet's Creek Restoration Project.* http://www.ewashtenaw.org/government/drain_commissioner/malletts_creek/index_html

Washtenaw County - Parks and Recreation. (2007). *County Greenways Initiative. Border to Border Trails (Huron River Greenway)*. http://www.ewashtenaw.org/government/departments/parks_recreation/greenways/pr_greenways.html

Appendix 3 – Stakeholders and Topical Experts

Dave Allan
Professor of Aquatic Sciences and Associate Dean of the School of Natural Resources and Environment. Expertise in fluvial ecosystem science and management.

Sumedh Bahl
Manager of Water Services for the City of Ann Arbor. Expertise in city dam management and operations.

Dave Borneman
Manager of the City of Ann Arbor Natural Areas Preservation .Extensive experience with land management, restoration, and ecosystem communities.

Scott Dierks:
HRIMP Committee Member and a Senior Water Resource Engineer at JFNew. Extensive expertise with HEC-RAS modeling and river morphology.

Tom Edsall:
HRIMP Committee Member Committee and a retired USGS fish biologist, expertise with aquatic systems.

Dirk Fischbach
HRIMP Committee Member, local fisherman with Huron River Fly Fishing Adventures.

Paul Ganz
HRIMP Committee Member and representative of DTE (formerly MichCon).

Cathy Gendron:
HRIMP Committee Member and an engaged Ann Arbor / Barton resident, a graphic artist by trade.

Sue Gott:
HRIMP Committee Member and Head Planner for the University of Michigan.

Chris Graham:
HRIMP Committee Member and the Ann Arbor Environmental Commission. Landscape Architect with special concerns at HRIMP related to viewshed preservation.

Gloria Helfand
Associate Professor at the University of Michigan School of Natural Resources and Environment. Expertise in environmental economics

Jeff Kahan
Planner for the City of Ann Arbor. Expertise with city master plans, planning efforts, and development opportunities.

Vicki Katko
Michigan Department of Environmental Quality with expertise in remediation and reclamations of brownfields.

Amy Kuras:
City of Ann Arbor landscape architect for the Parks and Recreation Department

Dave Michner
Associate Curator for the UM Botanic Gardens and Arboretum. Assistant Research Scientist for the UM Biology Department, School of Natural Resources and Environment. Lower Town resident.

Joan Nassauer
Professor of Landscape Architecture at the School of Natural Resources and Environment. Expertise in ecological design, landscape ecology, and landscape perception.

Matthew Naud:
Environmental Coordinator for the City of Ann Arbor. Expertise in environmental consulting, management, and environmental systems. HRIMP steering committee member.

Jeffrey Plakke:
HRIMP Committee Member and Natural Areas and Collection Specialists for the University of Michigan Matthaei Botanical Gardens and Nichols Arboretum. Expertise with land management and terrestrial ecosystems.

Evan Pratt:
HRIMP Committee Member, Consultant at OHM, and a Chair of the City of Ann Arbor Planning Commission.

Elizabeth Riggs
Watershed Planner for the Huron River Watershed Council.

Steven Riley:
Aquatic biologist for the USGS Fisheries Division. Expertise in fluvial ecosystems.

Catherine Riseng: HRIMP Committee Member and Aquatic Research Associate at the School of Natural Resources and Environment.

Laura Rubin:
HRIMP Committee Member and Director of the Huron River Watershed Council (HRWC). Expertise with aquatic systems, and watershed management at a local, state, and regional, scale.

Cheryl Saam
City of Ann Arbor Canoe Liveries Supervisor. Environmental educator and expert on local water recreation activities.

David Stead:
Chair of HRIMP Committee and an Ann Arbor Environmental Commissioner. Expertise in resource recycling and environmental venture capital. David is a previous Ann Arbor City council member.

David Szczygiel:
HRIMP Committee Member and environmental educator for the Ann Arbor Public Schools. Local expert on fishing along the Huron River.

Mike Taft:
HRIMP Committee Member and an active rowing enthusiast and a member of the Ann Arbor Rowing Club as well as a coach of the Huron High School Rowing Team.

Jason Tallant:
Technical at the City of Ann Arbor Natural Areas Preservation group. Expertise in natural land management, restoration practices, and GIS.

Molly Wade:
Water Quality Manager for the City of Ann Arbor. HRIMP steering committee member.

Kevin Wehrley
Aquatic scientist at the UM Institute for Fisheries Research.

Shirley White-Black :
HRIMP Committee Member and resident of the South Pond community. An active participant in community issues along the Huron River

Julia Wondelick:
Facilitator for HRIMP Committee and Associate Professor at the School of Natural Resources. Expertise in environmental negotiations and mediation, collaborative ecosystem management, and environmental policy.

Wendy Woods:
HRIMP Committee Member and previous member of the Ann Arbor City Council.

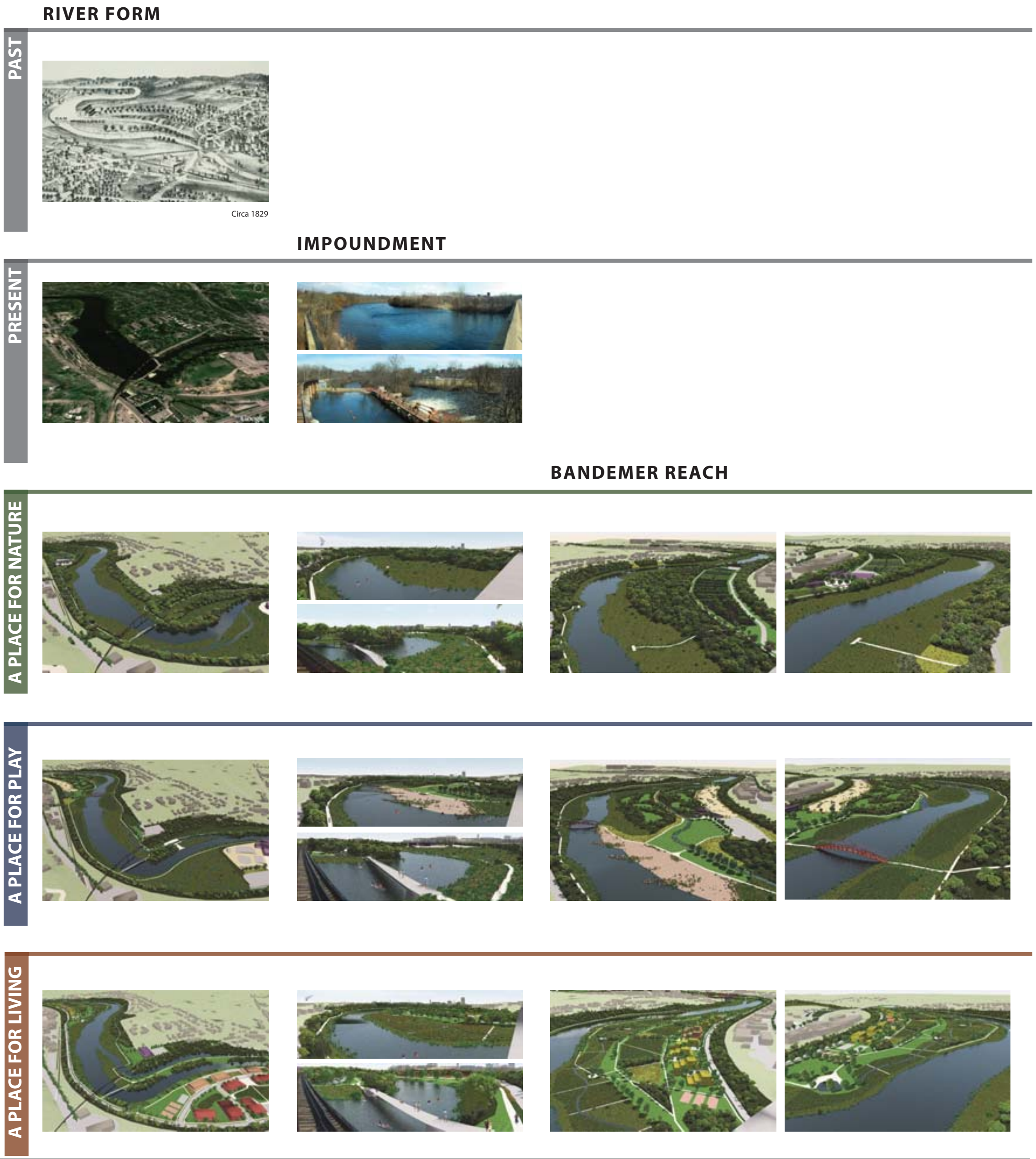
Steve Yaffee:
Facilitator of the HRIMP Committee and a professor at the UM School of Natural Resources and Environment, with expertise in ecosystem management, community organization.

Appendix 5 – GIS, Geographic Information System

Watershed Scale		
Category	**Theme**	**Source**
Hydrography	Watershed Boundary	Michigan DIT*
	Huron River	Michigan DIT
	Parks	SEMCOG**
Infrastructure	Road	SEMCOG
Land use/cover	Land use 2000	SEMCOG
	Impervious surface	USGS
Natural Resources	Natural land cover 2000	MichiganDIT
	EPT scores	HRWC***
City/Site Scale		
Category	**Theme**	**Source**
Aerial Imagery	digital orthopho 2005	City of Ann Arbor
Topography	1 foot contour	City of Ann Arbor
Hydrography	Floodplain	City of Ann Arbor
	Huron River	City of Ann Arbor
	Ann Arbor Creeksheds	City of Ann Arbor
	Sediment depth	Barr Engineering Report
Land cover/use	Land use	City of Ann Arbor
	Historic land cover	SEMCOG
Management Boundaries	City boundary	City of Ann Arbor
	Parcel	City of Ann Arbor
	Building foot print	City of Ann Arbor
Soils	SSURGO Washtenaw County	City of Ann Arbor
Infrastructure	Road	City of Ann Arbor
	Rail Road	City of Ann Arbor
	Trails	City of Ann Arbor
	Bridges	City of Ann Arbor
	Dams	City of Ann Arbor
Natural Resources	Natural area / habitat	City of Ann Arbor
	Wetland	City of Ann Arbor
	Woodland	City of Ann Arbor
Recreation	Recreation spots	City of Ann Arbor
	Parks	City of Ann Arbor
Greenway trials	Greenway	Greenway Collaboration

Michigan DIT: State of Michigan Department of Information technology
SEMCOG: Southeast Michigan Council of Governments
HRWC: Huron River Watershed Council

Appendix 6 – Image Comparison Board



PAST, PRESENT & FUTURES

DTE SITE


Circa 1930

ARGO REACH

RIVERSIDE REACH

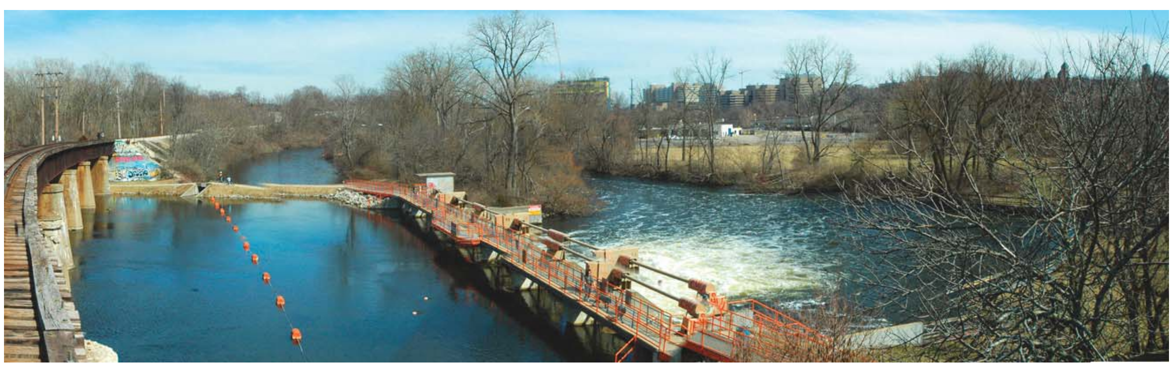
FULLER REACH









VISIONS of ARGO

Alternative Futures for Ann Arbor's Riverfront

Amy Beltemacchi
Amy Hiipakka-Squires
Yasuhiro Ishihara
Oliver Kiley
Alicia LaValle
Michael Wagman