June 2006

Advancing the Regeneration of the Cuyahoga Valley

a report to the Cuyahoga County Planning Commission

by Rocky Mountain Institute

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The Joyce Foundation

www.joycefdn.org

The Joyce Foundation supports efforts to protect the natural environment of the Great Lakes, to reduce poverty and violence in the region, and to ensure that its people have access to good schools, decent jobs, and a diverse and thriving culture.

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The Cleveland Foundation's mission is to enhance the lives of all residents of Greater Cleveland, now and for generations to come, by building community endowment, addressing needs through grantmaking, and providing leadership on key community issues.

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The George Gund Foundation aims to improve human well-being and the progress of society through the support of the arts, civic affairs, economic development, education, environment and human services, primarily in Greater Cleveland and Ohio.

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For over half a century, CPC has provided land use, zoning, development, and other planning services for the county's cities, villages, and townships; the Board of County Commissioners; and other governmental and not-for-profit organizations.

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RMI is an entrepreneurial non-profit that fosters the efficient and restorative use of natural, human and other capital to make the world more secure, just, prosperous, and life-sustaining by inspiring business, civil society, and government to design integrative solutions that create true wealth.

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Please send corrections and comments to Michael Kinsley (kinsley@rmi.org).

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First Edition

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Executive Summary

Community Success & Environmental Restoration

Environmental restoration is no longer an option for American cities; it's an imperative. Though many people regard efforts to rebuild environmental assets as burdensome to a local economy, environmental restoration, when pursued intelligently, is in reality both a minimum requirement for, and a path to, a strong economic future. As described in this report, the Cuyahoga Regeneration Project focused on specific projects that simultaneously restore natural systems and strengthen economic development along the Cuyahoga River ship channel.

Only a generation ago, cities built their economies while ignoring environmental protection. Many celebrated the fact that industries could operate in their area with few environmental constraints. But that time has long passed. Now, quite to the contrary, cities that want to remain competitive must not only protect their remaining environmental assets, but they must also reverse the environmental damage that is the legacy of generations that operated by the old rules.

The new rules are emerging rapidly. Cities at the forefront of the momentum toward restoration and sustainability will be the winners.

Nationwide, there are many signs of this momentum. For example, a rapidly increasing number of major corporations are adopting strong environmental policies, reducing greenhouse gas emissions and waste, requiring their suppliers to provide green products, and, increasingly, choosing locations for their operations based on the city's quality of life. They do all this because it's more profitable, strengthens their reputations, and helps them recruit and retain bright, creative employees who feel better about the places where they live and work. Cities that lag behind in efforts to green themselves will fall off the list of prospective sites for successful companies of the future. As a recent Gallup survey of twenty American metropolitan areas discovered, the number one issue that makes people feel satisfied with their city is the quality of place—that is,"its overall aesthetic and physical beauty, air and water quality, great open space, and authentic neighborhoods."[1]

Another sign of this change is the increasing use of environmental performance indices. In the past, outsiders may have had some vague sense of the quality of a city where they were thinking about holding a conference or relocating their family or business. But now, they can refer to readily available indices of livability, quality of life, environmental performance, and sustainability. Examples include:

- The Federal Reserve Bank of St. Louis issues a"rational index"of the"ten most-livable and least-livable large metro areas."

- SustainLane issued its second annual index of U.S. cities' sustainability performance based on fifteen economic and quality-of-life categories, including air quality, housing affordability, land use policy, and transportation capabilities. Cleveland ranked 28th out of 50 cities.

- The Environmental Defense Pollution Prevention Alliance is currently developing an environmental livability index that will "…track environmental progress on issues contributing to urban quality of life…" Its pilot version will focus on Cleveland, Dayton, and Milwaukee.

Some of these indices are new and some are still under development. Their criteria and assessments will probably be controversial, at least at first. Currently, there is no way to predict which particular

1. Florida, Richard. "The Keys to the City." *The Philadelphia Inquirer* 22 Jan. 2006.

Mittal Steel is located at the upstream end of the Cuyahoga River ship channel.

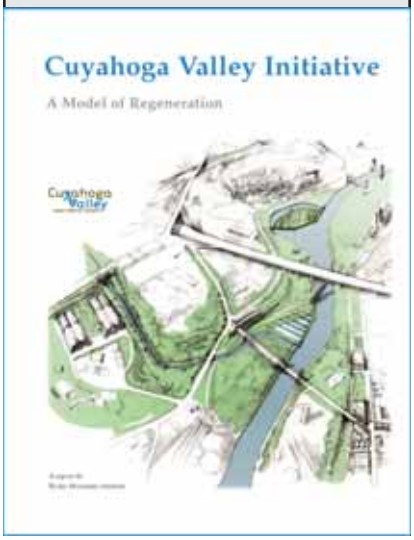
index or set of criteria will be most widely accepted. But what is predictable is that, over time, these kinds of indices will improve and gain widespread attention and credibility.

Like smart companies, smart cities are getting ahead by moving toward restoration and sustainability. Green city leaders regard restoration and sustainable development not as costs, but as essential investments with short- and long-term returns. The value of restorative development is explored at length in the 2002 book, *The Restoration Economy*.[2]

The primary factor that will make Cleveland a better place to live and do business and position Cleveland high on environmental-performance indices will be the decision of every community leader to include environmental performance in his or her own job description.

2. Cunningham, Storm. *The Restoration Economy*. San Francisco: Berrett-Koehler, 2002.

Cover of the 2004 RMI report, "Cuyahoga Valley Initiative: a Model of Regeneration."



The Cuyahoga Valley Initiative & Rocky Mountain Institute

The goal of the Cuyahoga Valley Initiative (CVI) is to "revitalize the Valley and make it once again an economic force, environmental treasure, and unifying element for the region." The Cuyahoga County Planning Commission's (CPC) mission is to provide the tools necessary to achieve this vision.

In 2003 and 2004, a team from Rocky Mountain Institute (RMI) worked with CPC and its circle of advisors to develop recommendations for regeneration of the environment, economy, and community of the Cuyahoga River Valley. Those recommendations are described in the April 2004 report "Cuyahoga Valley Initiative: A Model of Regeneration," available on RMI's website (www.rmi.org/sitepages/pid1087.php). This report will not repeat the important background information contained in the 2004 report.

In 2005 and 2006, RMI again worked with CPC, this time to move several of its earlier recommendations toward implementation. Called the Cuyahoga Regeneration Project, this stage of RMI's work, like the first stage, is a subset of the larger CVI. It especially focused on environmental

Not far downstream from Mittal is the mouth of Kingsbury Run, which, with a little work, could become a jewel of a park.

restoration and economic development along the Cuyahoga River ship channel.

Economic & Environmental Restoration in Cleveland

Most of this report focuses on the particular ways in which the Cuyahoga Valley is beginning the process of economic and environmental restoration, and the specific steps necessary for success.

But first, it's well worth prefacing those important details with a vision of what the Cuyahoga ship channel can become. Let's start with what it is. For just a moment, picture some segment of the ship channel as you know it today. There's a good chance that your picture is in shades of gray: barren gray ground and gray steel walls holding the land back from gray river water.

If you're lucky, you've also seen the green gems along the river, many of them hidden from all but a very few Clevelanders: the mouth of Kingsbury Run, a pocket of vegetation here, a tenacious heron there. Pristine these jewels are not. But they are testaments to the extraordinary resilience and tenacity of nature. Give her a chance and she'll make a comeback.

Though located in a tarnished setting, these isolated gems can help us create a picture of the ship channel in the future. We could fantasize about a vast park, but that's not very likely in this generation, and it's certainly not attractive to those working along the river. However, we can conjure a realistic vision of the future by weaving green ecological threads with gray industrial threads into an unusual, perhaps unique, fabric. Imagine a pocket park along the Towpath Trail and next to a concrete batch plant or a steel mill. It's big enough for several mature trees and there's a wetland that enhances the river. It does this by way of a new kind of bulkhead, one that protects the ship channel yet allows water to flow through it and into the wetlands, where fish thrive and herons hunt.

The 5.5 miles of the ship channel include many places for these green gems. These restored areas could thrive in the immediate vicinity of heavy industry without interfering with their operations. It's not difficult to imagine truck drivers, bookkeepers, and other industrial workers, as well as area residents, using these open spaces for lunch.

These pockets of natural refuge together create genuine habitat for fish and other wildlife, and, as a bonus, they help clean the water as it moves slowly to a grateful Lake Erie. This picture is within reach of the people of Cleveland. The activities described in this report can lead Cleveland in that direction.

Economy & Environment in Partnership

Though this report lists economic development and environmental restoration separately, the two are actually integrated, and part of a larger whole. Each drives the other. For example, green bulkheads are included in environmental restoration. But the design and implementation of these innovative solutions will create new jobs and business opportunities, while simultaneously improving river water quality and habitat. All this will provide the Cleveland community the opportunity to offer other cities not only a model of restoration, but also billable services.

Another example is low impact development (LID) for stormwater solutions. Essential for improved river water quality, these solutions also can create significant new business and job opportunities for heavy-equipment operators, landscapers, laborers, designers, contractors, and others recreating the ways in which the community deals with stormwater. And because LID is usually relatively small in scale, its projects are readily accessible to smaller businesses with limited bonding capacity.

Worldwide demand for restoration services is growing rapidly. Cities that develop technologies and techniques to solve local problems early will be positioned to sell their services elsewhere. Cities late in their restoration efforts will be the clienteles in that market.

Another exciting and concrete economic development opportunity driven by the ideas of restoration is an unusual effort with a curious name: Waste = Revenue. This initiative takes industrial waste, the stuff of environmental problems and business liability, and turns it into a business asset by finding markets for it. Though it has already generated business opportunities, the initiative described in this report just scratches the surface of what's possible. When Cleveland digs deeper into this prospect, it will find a wide range of opportunities seldom found by more conventional economic development—self-generated opportunities created where none seem to exist, and that don't depend on new business entering the community.

Report Contents

The core of this executive summary is an action plan for implementing projects that will support environmental restoration and economic development. The report then details the background, progress, and future commitments of each of the projects in the plan. These sections are a snapshot of a longer process. Also included are indicators of progress that, when monitored, will help capture future successes in each of the project areas and progress toward CVI's goals. These are accompanied by suggestions for stories that may be documented to help publicize innovative projects as they progress. Lastly, letters of support from various organizations affirm their public commitment to continue work on these projects once RMI's role concludes.

As part of its CVI work, RMI commissioned two studies,"Designing a Regeneration Zone for the Cuyahoga River Valley: Ecological Restoration"and"Review of the Doan Brook Watershed Study Report."Their executive summaries start on p. 77; the full reports are in the CD Appendix,"RMI Reports"folder. Supplemental materials on each of the projects can be found on the CD Appendix.

Action Plan for Regenerating the Cuyahoga River Valley

Cuyahoga Valley Initiative (CVI) Organization

Project description: Establish an organization to champion the vision, coordinate the activities, and implement the projects of the CVI.

Sources of financial support: George Gund Foundation (GGF) and Cuyahoga County Planning Commission (CPC) have committed to fund the organization.

Technical requirements: Currere, Inc. of Cleveland to design and establish the organization, supported by a grant from GGF and under CPC supervision.

Organizational requirements: To be defined by Currere's work. This new entity is an organizational requirement for each of the projects below.

Marketing ideas: To be defined by Currere's work.

Task requirements: Complete Currere's work, which is expected to occur in the summer of 2007. Then, secure explicit support from a wide range of stakeholders, especially local government leadership. Fortunately, because CPC already hired Alison Ball to be responsible for CVI-related work until the new organization is operational, much of the coordinating work required of this organization is now underway.

Budget estimate: $500,000

Forms of commitment: Grant proposal to GGF (see CD Appendix,"CVI Organization"folder), and GGF's proposal acceptance letter (see p. 64). CPC will be responsible for CVI-related work until the new organization is operational.

Dredging

Project description: Determine cost-effective modes of freight transportation on the Cuyahoga River that support the industrial sector while improving river ecology, water quality, and community development.

Sources of financial support: CPC has issued an RFP for the"Cleveland Lakefront/Cuyahoga River Maritime Facilities Study"(a.k.a. the Port Study), which may complete a whole-system analysis of this problem.

Technical requirements: The Port Study, authorized by the Board of County Commissioners and directed by CPC, is to include a whole-system analysis of freight transportation in the Cuyahoga River ship channel. The study will consider economic trends, optimal locations for the port, transportation modes, community development plans, and environmental aspirations.

Task requirements: Award contract to the winning firm and complete the Port Study.

Budget estimate: $200,000

Form of commitment: RFP issued by CPC (see CD Appendix,"Dredging" folder).

Stormwater

Project description: Reduce the volume and contamination of stormwater runoff in Cleveland by amending the City of Cleveland's stormwater policy, forming stormwater agencies that can charge stormwater fees, and educating agency staff and communities on stormwater best management practices (BMP).

Sources of support: Ed Rybka (City Department of Building and Housing, BH), Frances DiDonato (City Law Department), Andrew Watterson (City Sustainability Programs Manager), Jan Rybka (Soil and Water Conservation District, SWCD), Betsy Yingling (Northeast Ohio Regional Sewer District, NEORSD), Chris Alvarado (CPC), and Jim White (Cuyahoga River Remedial Action Plan, RAP).

Technical requirements: Conduct a stormwater retrofit analysis for a

neighborhood using GIS land cover images, and considering land use, building stock, and localized rain data. Determine the volume of runoff that would be captured by a comprehensive retrofit of distributed stormwater technologies in the community, whether such endeavors would be cost-effective, and what policies might produce such results.

Organizational requirements: Form a Stormwater Steering Committee, led by Cleveland city government. Secure a court order authorizing NEORSD and the Self-Funded Watershed Management Organization to be stormwater agencies for Northeast Ohio.

Marketing ideas: Issue stormwater BMP manuals, conduct education sessions for communities and developers, and familiarize the leadership of various municipalities with the function of stormwater agencies and policies.

Task requirements: Review existing stormwater policies and adopt additional policies to mandate and incentivize stormwater BMPs in Cleveland. Design the purpose and function of each of the stormwater agencies and market the idea in appropriate communities.

Forms of commitment:

1. Letter from Betsy Yingling affirming NEORSD's intent to become a stormwater agency (see p. 66).
2. Letter from Jan Rybka (SWCD) affirming continued commitment to produce educational materials on stormwater BMPs and to foster BMP adoption in the City of Cleveland (see p. 68).

Aquatic Habitat Restoration

Project description: Develop structures to restore aquatic habitat in the Cuyahoga River ship channel, including use of pocket wetlands, green bulkheads, fish shelves, and tributary restoration.

Sources of support: Jim White (RAP), Chris Alvarado (CPC), Richard Zavoda (Mittal Steel), George Cantor (City Planning Commission), Tracey Nichols (Cuyahoga County Brownfields Redevelopment Division).

Technical requirements: Conduct workshop series with diverse professionals to transform the concept of a green bulkhead into actual design parameters that will result in a patented design held in the public domain. Design parameters for the pocket wetland pilots. Assess brownfield contamination and mitigation requirements of restoration sites.

Organizational requirements: Establish a property-title-retaining entity with the financial capability to oversee the sites' maintenance.

Marketing ideas: Streamline the restoration process so that it becomes attractive and easily usable by interested landowners.

Task requirements: Conduct the design workshop series; transfer property from Mittal Steel to the City for potential use as a pocket wetland pilot site; issue design parameters for pocket wetlands; promote the siting of mitigation-credit-funded restoration in the channel; conduct brownfield site assessments and remediation as needed.

Budget estimate: $1.8 million for green bulkhead concept development; $2.6 million requested from the federal Senate Budgetary Appropriations for tributary restoration; mitigation credit funding.

Forms of commitment:

1. Letter from Jim White (RAP) detailing intent and method of pursuing a green bulkhead design (see p. 70).
2. Letter from Jim White (RAP) affirming that RAP will continue to champion the establishment of a pilot pocket wetland on the Cuyahoga River ship channel (see p. 72).
3. Letter from Paul Alsenas (CPC) affirming that the County submitted a Senate Budgetary Appropriations application for funding to purchase and restore tributary mouths in the ship channel (see p. 74), and the actual funding application (see CD Appendix, "Habitat Restoration" folder).

Industrial Cleanup

Project description: Remediate brownfield sites in the Cuyahoga River ship channel area, especially with respect to habitat restoration sites.

Sources of support: Tracey Nichols (Cuyahoga County Brownfields Redevelopment Division, BRD).

Technical requirements: Assess and remediate brownfield sites where habitat restoration will either permit contact between soil and water or between people and soil.

Task requirements: Transfer property title from a private landowner to the title-holding entity for restoration sites; apply for BRD site assessment grants; issue permission for BRD to conduct the assessments.

Budget estimate: Projects approved by BRD receive up to $6,000 for Phase I assessment and up to $35,000 for Phase II assessment.

Green Building for Industries

Project description: Establish a green building standard for Cleveland's Industrial Land Bank (ILB).

Sources of support: Andrew Watterson (City Sustainability Programs Manager), Michael Hoag (WIRE-NET), City Department of Economic Development (ED).

Technical requirements: Conduct a workshop with ED, WIRE-NET, local builders, developers, industries, regulatory agencies, and green building experts to determine the structure and function of the green industrial-building standard.

Organizational requirements: Establish design guidelines and review accreditation system.

Marketing ideas: Brand green building standards as a cost-saving and improved worker productivity approach.

Task requirements: Review of the concept of a green building standard for the ILB by the ED director; ED to conduct the policy designworkshop.

Waste = Revenue

Project description: Create a network of industries (primarily in or near the Cuyahoga Valley) that trade waste byproducts as useful resources. This can proceed with or without technical support.

Sources of support: Holly Harlan (E4S), CPC, and such industries as Alcoa, Aleris, GEM, Metaloy, Mittal, Rosby, and Zaclon.

Technical support (optional): Analysis by material and chemical engineers of business waste streams.

Organizational requirements: Continue with E4S as the organizing entity. Eventually the network may be self-sustaining, or administered by a separate non-profit organization.

Marketing ideas: Increase interest by word of mouth among industries; newspaper stories of new business opportunities may also increase participation.

Task requirements: Expand current network by recruiting new businesses and waste experts; cement current relationships and follow through on conceptual Waste = Revenue ideas.

Budget estimate: $10–20,000 for organizational support; further funding needed for research and development.

Forms of commitment: MOU signed by Holly Harlan and a group of business leaders affirming their commitment to nascent Waste = Revenue partnerships and to pursue new partnerships (see p. 73).

Cuyahoga Valley Initiative Organization

The Cuyahoga Valley Initiative (CVI) requires action on many fronts, including the projects described in this report. Though each of these projects has a champion (that is, an organization or individual committed to achieving the goals of the project), the CVI will not succeed if each champion proceeds in isolation. That may be the path to individual success, but it's also the path to community failure. Regeneration of the Cuyahoga Valley requires champions committed to the success of the larger CVI effort.

CVI success also depends on the creation of an organization whose mission is the overall success of the CVI. Many organizations and people are necessary ingredients of CVI, but each has a wide range of responsibilities beyond CVI. Success requires that one organization be the primary CVI driver.

Thanks to the foresight of the Cuyahoga County Planning Commission (CPC), the design of that organization is now underway, with the guidance of a local organizational development consulting firm, Currere, which has been funded by both the county government and a substantial grant from the George Gund Foundation (December 15, 2005). An early draft of the organization's structure may be available by mid-July 2006. The design of the organization should be complete by the summer of 2007. In addition, to keep the CVI effort going until the new organization is created, CPC has hired a temporary Cuyahoga Valley Organization Coordinator with support from the same grant.

Given Currere's long track record, RMI is confident that the design process will be a model of collaborative decision-making. Though RMI will not have a hand in designing the organization, we have two recommendations we hope will be considered:

1. Though the board of directors should include people with a variety of experiences and skills, the directors of the new organization should not formally represent particular groups. Representatives are often hamstrung by the obligation to bring only their group's inflexible position to the table, possibly to the exclusion or detriment of other points of view. Instead, "elders" come to the table with their groups' underlying interests and ideas. Representatives tend to argue, while elders discuss. (Elders are wise but not necessarily old.)

2. The scope of issues to be addressed by the new organization should be clearly defined and not too wide. For example, if the scope includes the entire breadth of environmental restoration and protection, community health, and economic development issues for the watershed, the effort will become diluted—just another layer on all the existing economic, social and environmental efforts (public, nonprofit, and for-profit) already underway.

Paul Alsenas (CPC Director), Michael Kinsley (RMI), Carla Regener (CPC), and David Beach (EcoCity Cleveland) catch up at RMI's final presentation to Cleveland at the Hausheer Building.

For draft descriptions of the future CVI organization design process, purpose, and capabilities, please refer to the CD Appendix, "CVI Organization" folder.

Healing the Cuyahoga River

All water draining the Cuyahoga watershed into Lake Erie and all larval fish swimming up the river from the lake (an indicator of the health of the next generation of fish) must pass through the Cuyahoga River ship channel. Therefore, the quality of water in that last stretch of river is central to the health of the Cuyahoga River.

To this end, RMI contracted Ohio State University biologist Dr. Bill Mitsch to identify significant causes of poor water quality in the river and to determine the best solutions for restoration in the ship channel. The report "Designing a Regeneration Zone for the Cuyahoga River Valley, Project Component: Ecological Restoration" notes that, until dredging stops and combined sewer overflows decrease in frequency and volume, the dissolved oxygen levels in the ship channel will continue to occasionally "reach levels that severely affect the viability of fish and macroinvertebrates."[3] Furthermore, the lack of aquatic habitat in the ship channel imperils larval fish health. In addition, habitat restoration along the ship channel will most likely require brownfield assessment and remediation in order to not exacerbate river water quality problems.

Healing the water quality and ecology of the Cuyahoga River will benefit not only the fish, but also human well being and prosperity. A healthy river with living stream banks improves the aesthetic quality of the river. This in turn enhances the property value and also strengthens economic development. The creation of restoration services provides new Cleveland-based jobs.

Seeking progress in these areas—dredging, stormwater, aquatic habitat, and brownfield remediation—RMI examined alternatives that would cost-effectively decrease the dredged depth, decrease the volume of stormwater entering the sewer system, and increase and restore native habitat in the ship channel. The following sections address each of these issues.

3. Mitsch, et al. "Designing a Regeneration Zone for the Cuyahoga River Valley, Project Component: Ecological Restoration." Aug. 2005, p. 6. See CD Appendix, "Habitat Restoration" folder. Also, OEPA. "Cuyahoga River Ship Channel Water Quality Modeling Analysis." Apr. 1993, p. 7–8.

Dredging the Cuyahoga

Scoop by scoop, Cuyahoga River sediment is dredged and removed on a barge.

According to the Mitsch report (see CD Appendix,"RMI Reports"folder), the ship channel suffers from poor water quality primarily due to dredging and combined sewer overflows (CSOs).[4] However, staff at the Ohio Environmental Protection Agency (OEPA) consider dredging to be the most entrenched of the two water quality issues because:

1) Overflows occur during times of high rain, when the river flows faster and sewage is pushed quickly into the lake; therefore, decomposing sewage is less likely a cause of oxygen depletion in the channel;

2) The lack of oxygen and habitat is crucial to aquatic ecosystems; and

3) The sewer district already has plans to eliminate CSOs.

The 5.5-mile Cuyahoga River ship channel reduces the health of the river in two key ways. First, the sudden change in river depth from a natural 5 feet to the dredged channel's 23–28 feet causes the river's flow rate to drop from 4.5 miles per hour upstream to 0.024 miles per hour in the channel.[5] This slower water turnover rate contributes to the depletion of dissolved oxygen levels in the channel. While a healthy river contains at least 5 milligrams per liter of dissolved oxygen, the Cuyahoga's levels drop from 8 milligrams per liter above the channel to as low as 1.5 milligrams per liter at the river's mouth.[6] Dissolved oxygen is lowest in the summer and fall, when higher temperatures and lower rainfall deplete the oxygen and severely restrict aquatic life in the river. The OEPA writes,"The physical habitat of the channel and the prevailing background dissolved oxygen regime are insufficient to support any resemblance of the warm-water habitat aquatic life use designation."[7] For this reason, the OEPA classifies the ship channel as a Limited Resource Waterway, with a standard of 1.5 milligrams per liter of dissolved oxygen from June to January.[8]

The second way in which the ship channel reduces river health is that the channel is almost entirely bulkheaded with concrete or steel to provide structural support to the riverbanks, virtually eliminating larval and migrating fish habitat. While the Index of Biological Integrity and the Invertebrate Community Index[9] have both improved since the 1970s, these measures continued to drop noticeably in the last few miles of the river.[10] Despite the increase in types and numbers of fish found in the channel over the years, the most dominant species in the channel remain the common carp (non-native), gizzard shad, and emerald shiner, all tolerant of degraded habitat and poor water quality.[11] The Army Corps of Engineers has also conducted studies on the sharp declines of larval fish communities in the ship channel, and concludes that declines are due to annual dredging, lack of habitat, and low dissolved oxygen.[12]

The navigation channel is an expensive and heavily subsidized transporta-

4. Earlier sewer systems combined both rainwater runoff and household sanitary sewage in one set of underground pipes. In larger storm events, the system will overload and get directed to overflow outfalls, causing untreated wastewater to enter waterbodies. These combined sewer overflows will be discussed in greater detail in the following section.

5. RAP. "Cuyahoga River Bulkhead Habitats" Factsheet.

6. Mitsch, et al, p. 6.

7. OEPA-2. "Water Quality Standards Use Designations – OAC 3745-26, Cuyahoga River." Effective July, 2002. Available online at: www.epa.state.oh.us/dsw/rules/01-26.pdf.

8. Ibid.

tion route. The yearly removal of about 350,000 cubic yards of sediment by the Army Corps of Engineers costs about $2 million.[13] Because sediments dredged from the river are too contaminated to be dumped in Lake Erie, they must be placed in a confined disposal facility (CDF). The disposal of the dredged sediment costs about $82,000 each year.[14] These costs are paid by federal budget allocations to the U.S. Army Corps of Engineers. Unexpectedly, the current Cleveland CDF is filled to capacity and will close by the end of 2006; a new CDF will last 15–20 years and cost approximately $30–40 million.[15] The federal government will pay about two-thirds of this cost, while the local government pays one-third. Thus, the cost of dredging is about $3.7–$4.9 million per year.

These costs do not include bulkhead replacement expenses. Built in the New Deal era, many sections of the bulkheads are more than fifty years old and need to be replaced. Eighty-five percent of the 5.6-mile river is bulkheaded, which means there are 50,266 linear feet of bulkheads on both sides of the river. At an estimated $3,750 per linear foot, the complete replacement of the river's bulkheads—over time—will cost at least $188 million.[16] Timely replacement of the shoreline structures is the responsibility of landowners, some of whom receive no income from shipping.

Given the ecological consequences and high cost of dredging, RMI explored alternatives to the current navigation system. As shown above, RMI's calculations find that discontinuing dredging would save $8–9 million a year. Thus, if federal funds were fungible (which they are not[17]), the cost of some possible alternative transport system must not exceed $8–9 million a year in order to match the costs of the current transportation system.

According to one Army Corps study, shipping iron ore and limestone materials to harbors 30 miles from Cleveland and moving them the rest of the way by rail would increase the delivery costs of these products to users at Cleveland Harbor. Over a twenty-year period, these costs could increase by $31.6 million.[18] Since each 600-foot ship hauls the equivalent carried by some 200 rail cars, a shift to rail also presents both traffic and energy-efficiency concerns.

Alternatively, switching from the use of deep-draft ships to 12-foot-draft barges would double dissolved levels, but would also quadruple ship traffic, increase delivery times, and require drastic capital investments that may not be feasible, especially given the uncertain longevity of key industries on the ship channel.

With these factors in mind, it appears, at least through cursory review, that the current mode of conveyance for industries on the ship channel, while heavily subsidized by the public and private sectors, may be the least expensive form of transport available. Despite its ecological significance, dredging may continue for some time due to the lack of cost-effective alternatives.

Additionally, there are practical and political reasons for maintaining the ship channel as it is. Traditionally, Cleveland has been an industrial city and the industries located along the ship channel remain important to the city's economy. Furthermore, many of these industries are located in Cleveland due, in large part, to the inexpensive transportation offered by the channel. The City of Cleveland and Cuyahoga County are committed to retaining these industries and to preserving much of the ship-channel area for industrial uses. Thus, local elected officials are unlikely to speak out against dredging, and local political support is crucial to implementation of

The ship channel is authorized to be dredged to at least 23 feet deep throughout. This means about 350,000 cubic yards of sediment is removed yearly from the river floor.

9. The IBI and ICI synthesize biological metrics that reflect the impact of human actions on biological attributes to depict the overall health of a waterway; the IBI includes fish, while the ICI is limited to macro-invertebrate species.

10. Mitsch, p. 42-43.

11. Ibid, p. 9.

12. U.S. Army Corps of Engineers – Buffalo District. "Conceptual Designs for the Improvement of Larval Fish Populations." September, 2004.

13. U.S. Army Corps of Engineers, 2004.

14. "Dredging Evaluation, Cleveland Harbor, Ohio." U.S. Army Corps of Engineers, Buffalo District, Buffalo, New York. March, 2003.

15. White, Jim. Personal communication: July 13, 2005.

16. Cuyahoga County Planning Commission. "Cuyahoga Valley Initiative Idea Package Summary - Working River." April, 2003, Draft, p. 4.

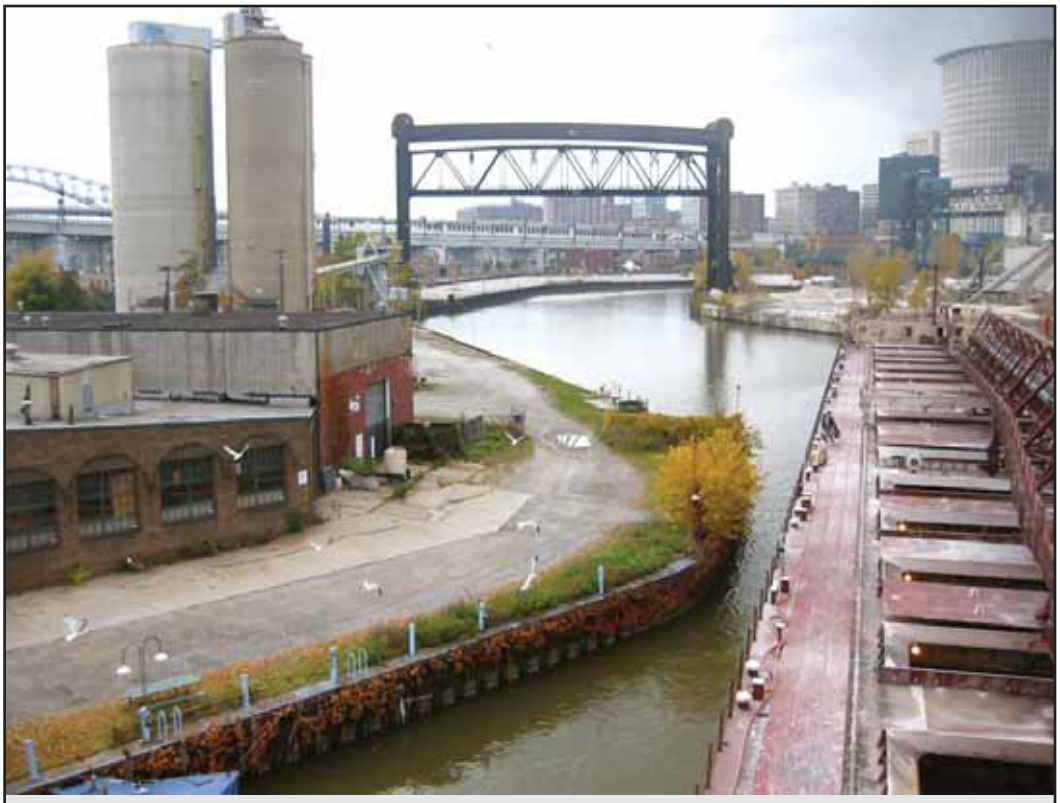
17. Federal funds tend to be allocated based on the historical expenditures of a certain agency, rather than by solutions for certain problems; thus, funding cannot readily be shifted to a different solution.

18. "Dredging Evaluation, Cleveland Harbor, Ohio."

19. Gerdel, Thomas W. "Undredged Channels Are Limiting Shipping." *The Plain Dealer* 14 Apr. 2006: C1.

20. Snyder, Matthew, Army Corps of Engineers, Cleveland Office; personal communication, March 16, 2006.

21. U.S. Army Corps of Engineers, Great Lakes and Ohio River Division. "Dredging Trends", PowerPoint presentation, June 2005. Available online at: http://operations.usace.army.mil/nav/05junndc/Trends-LRD.pdf.



The 600-foot-long *Earl W. Oglebay* makes its way through tight bends in the Cuyahoga River.

alternative strategies by the Army Corps of Engineers.

Despite the fact that the existing system is deeply rooted, significant infrastructure costs are reducing the cost-benefit ratio of dredging and may one day compel a re-examination of alternatives. A 2006 *Plain Dealer* article explored the growing dredging deficit in the Great Lakes. For instance, the Saginaw River in Michigan is authorized to be dredged to a depth of 22 feet, a depth that has not been attained since the 1980s; parts of the river are now 12 to 13 feet deep. Jim Weakley, president of Lake Carriers' Association, estimates that $200 million is necessary to restore authorized depths around the Great Lakes. The Army Corps' Great Lakes budget for 2007 is $86 million.[19]

As an engineer in the Cleveland office of the Army Corps of Engineers noted, Cleveland will only receive enough funding in 2006 to dredge 40 percent of the necessary volume to maintain the shipping channel. While the office has been allotted additional funds for 2007, these will still be insufficient to dredge the full volume, much less the backlogged sediment.[20] All of this means that, in the short term, ships would have to reduce loads to cut draft depth. In the long-term, if current levels of federal funding become the norm or even decline further, use of the channel for shipping may become uncertain.

As for Cleveland's CDF, where dredged material is deposited, there are interim plans for disposal sites until 2013 when, if requested funding comes through, hopefully a new CDF will be built. The ratio of funding for CDFs, two-third federal to one-third local, will likely change in the future as the Army Corps' budget shrinks, while demand for new infrastructure increases. Currently, CDFs on the Great Lakes are 70 percent full.[21]

High Risk or Whole Systems

While Cleveland's leadership will certainly continue to support sufficient dredging subsidies, relying on federal money is a high-risk strategy. It would be unwise for the community to assume

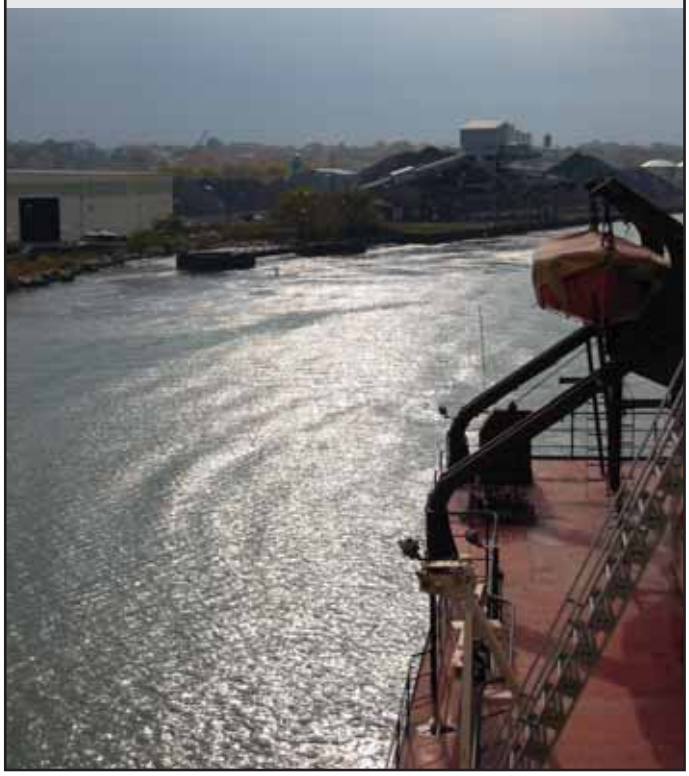
that the subsidies will always be available. A host of factors conspire to present the community with an uncertain future regarding the ship channel. Maintenance is being deferred in other cities. Future Army Corps budgets may not be adequate. The effects of large-scale disasters elsewhere may continue to capture federal resources in the future. Key industries on the ship channel may not be able to depend on access by large ships.

To avoid being caught napping, as so many other cities have, Cleveland would be well advised to consider how it can best respond to more than one scenario for its ship channel. It should pursue a whole-system analysis that considers the cost and benefits to industry, the environment, the community, the economy, and the full range of options for transporting materials from their sources to points of use.

Fortunately, the Board of County Commissioners (BOCC) has tasked CPC with directing a "Cleveland Lakefront/ Cuyahoga River Maritime Facilities Study" (a.k.a. the "Port Study"). This study will provide the information, analysis, and public feedback to assist the BOCC in making decisions about the location, extent, and type of maritime shipping operations in Cleveland and Northeast Ohio. The qualifying firm will: conduct an economic assessment and market forecast of the region and various maritime industries; identify how changes to the port's location will affect environmental aspirations and community development plans; and determine if the economy, community development, and environmental aspirations would all be optimized by moving the port to a different location or by transporting materials via an alternative system. The responses to the request for proposals were due in late June 2006, and the subsequent yearlong study will provide answers to many of the questions cited in this section. RMI sees the Port Study as a hopeful sign that a pragmatic whole-system solution to the dredging issue may be found.

Fundamental changes to the river's dredging regime will depend on time, federal funding, and the marketplace. For the time being, efforts to improve river and lake water quality must assume continued dredging. And, while a dredged channel will never be a pristine river environment, its water quality may be strengthened enough to prevent further damage to Lake Erie and to allow more fish species to survive their journey through the ship channel. Therefore, the water quality action plan focuses on habitat restoration to boost aquatic health and stormwater management to improve water quality and levels of dissolved oxygen.

The *Earl W. Oglebay* leaves Cleveland Harbor and heads for Mittal Steel some six miles upriver.



Stormwater

Impermeable surfaces like this parking lot in downtown Cleveland create stormwater runoff that can subsequently pollute waterways.

Stormwater is a major contributor to water quality degradation in the Cuyahoga River. It sometimes travels in the form of surface runoff, which gathers pollutants and erodes soil before entering a water body. It can also enter storm drains and separate stormwater sewers that empty directly into the nearest waterway without treatment. Finally, it can enter combined sewers in which sanitary sewage and stormwater mix and are treated at the wastewater treatment plant. During storm events, however, combined sewers can overload and empty without treatment directly into waterways; these events are dubbed combined sewer overflows (CSOs). Cleveland has all three forms of stormwater pollution, which degrade both the Cuyahoga River and Lake Erie.

As the following section will show, though Cleveland may be complying with regulatory requirements to improve the quality and decrease the quantity of stormwater, there is much more the community can do to prevent future stormwater pollution while improving river and lake water quality, as well as the overall urban environment. In short, compliance is not enough to clean up the river or the lake.

Encouragingly, stormwater management in Cleveland has been progressing rapidly during the past year. The Northeast Ohio Regional Sewer District (NEORSD) is moving toward becoming a stormwater agency. A separate group is working toward the creation of a Self-Funded Watershed Management Organization that will serve as a stormwater agency in areas of northeast Ohio not served by NEORSD. The City of Cleveland will soon establish a new Stormwater Management Steering Committee that will re-examine the existing stormwater runoff ordinance and related policies. The Soil and Water Conservation District (SWCD) serves as a consistent champion for progressive policies that will make northeast Ohio a

stormwater management leader. These initiatives would be strengthened if an additional study were conducted to analyze all the effects of distributed stormwater solutions, potentially pointing to cost-effective solutions that are not now being fully considered. With these shifts in policy and institutional development, Cleveland is well on its way to establishing a far-reaching stormwater management regime that will address a daunting national water quality problem.

Cleveland's Stormwater Story

The relative success of water pollution control from point-sources (e.g., factories) since the 1970s has highlighted the enormous impact that non-point sources of water pollution (e.g. stormwater and agricultural runoff) have on water quality. Indeed, about 30 percent of surface water pollution nationally is attributable to stormwater runoff.[22]

The importance of non-point source pollution led Congress to amend the Clean Water Act to include industries and construction sites more than one acre in size, municipalities, and sewer districts as point-source polluters. These entities are required to obtain National Pollution Discharge Elimination System (NPDES) permits. Under a NPDES permit, the regulated entity must establish a stormwater management plan using best management practices (BMPs), stormwater pollution prevention plans, or satisfy nine minimum control measures. Participants must prevent pollution from entering runoff and decrease total runoff volume. By 2008, all participants should be in compliance or have management plans underway.

Industries required to comply with NPDES include manufacturing plants, facilities with effluent limitations, mineral, metal, oil and gas, recycling facilities, hazardous-waste treatment or disposal facilities, as well as those involved in construction-related activities. Companies must issue a stormwater pollution prevention plan to the state environmental agency. However, the lack of enforcement capacity on the part of state agencies often results in limited knowledge and compliance in many industries.

The municipal NPDES permit plan must satisfy six BMPs issued by the Environmental Protection Agency. These include: public education and outreach, public involvement and participation, illicit discharge detection and elimination, construction site stormwater runoff control, post-construction stormwater management, and pollution prevention or "good housekeeping." However, municipalities need only satisfy these requirements for sites draining into municipal separate storm-sewer systems (MS4). For an older city like Cleveland, MS4s represent only 10 percent of the overall sewer system. Thus, while Cleveland promulgated the ordinance "Chapter 3116: Construction and Post-Construction Site Runoff Control to Municipal Separate Storm Sewer System," construction on 90 percent of land within city limits is not governed by any stormwater regulations. This is a significant limitation because, as Cleveland redevelops, current levels of pollution and the runoff volume of stormwater will remain at the same levels or even increase.

One effective way to tackle stormwater is to find ways in which certain stormwater

Certain industries are responsible for ensuring that runoff from their properties attains specific water quality standards.

22. Copeland, Claudia. "Stormwater Permits: Status of EPA's Regulatory Program." CRS Report for Congress, June 1998. Available online at: http://cnie.org/NLE/CRSreports/water/h2o-26.cfm.

Turfed lawns, with their short leaves and even shorter root systems, actually retain very little rainwater.

solutions will serve the community in other ways, too. For example, landscaping can be designed to capture stormwater at little or no additional cost. Unfortunately, Chapter 352 of the Zoning Code—"Landscaping and Screening"—requires certain landscaping and screening in redevelopment projects, but it does not require that the design accommodate stormwater, even though its language is similar to that describing stormwater BMPs.

Because mitigation of CSOs is important to improving water quality, sewer districts are also required to obtain NPDES permits. In Cleveland, 41 percent of CSOs that would otherwise have been treated at the Southerly Waste Treatment Facility flow into the Cuyahoga River.[23] In many older cities, such as Cleveland, the combined sewer system is too extensive to separate into stormwater and sanitary sewer systems. The solution in such cities is invariably to build large tunnels or retention tanks with enough capacity to prevent almost all CSOs. The retained volume is then slowly released to treatment plants over ensuing dry weather days. Building this new infrastructure requires multi-billion-dollar investments over multiple decades. In Cleveland, NEORSD is planning to construct a series of tunnels over twenty to thirty years. The estimated total cost is $1.6 billion.[24]

Despite this weighty responsibility, NEORSD is not a stormwater agency, and therefore cannot issue stormwater fees on water bills or require certain standards in development designs, which would reduce demand on its stormwater system.

While stormwater management plans that mandate infrastructure projects such as storage tunnels and treatment plants are typical of most urban stormwater management plans, such cities as Seattle, Portland, and Chicago are recognizing the effectiveness of vegetation as a supplemental solution. In nature, where there is no waste, rainwater is a resource that restores groundwater, replenishes waterways, and nourishes the vegetation that then produces fresh air, habitat, and cooling for the immediate area. Current trends in stormwater management show an increased willingness to implement low impact development (LID) that treats stormwater as a resource, not a waste product.

Best practices in developments include policies like smart growth guidelines and zoning for riparian corridors and open space, and structural LID technologies like vegetated strips, bioswales, permeable pavement, green roofs, and the use of native vegetation (see p. 32). The leaves, stems, and roots of these plants filter and retain rainwater before it percolates through the soil. Plants also offer many other benefits, such as urban heat-island effect mitigation, energy savings, and wildlife habitat. However, developers and local governments are often hesitant to employ new technologies, fearing a price premium. But a report compiled by the Conservation Research Institute[25] demonstrates that, for example, installation costs for natural landscaping can be $4,400 to $8,850 cheaper per acre than turf grass, and that maintenance costs range from $3,950 to $4,583 cheaper per acre per year over ten years. In addition, while porous pavement is more expensive than its conventional cousin, it can reduce total development costs by as much as 30 percent by reducing the scale of pipes and drains. Similarly, bioswales can be 80

23. Northeast Ohio Sewer District. "Southerly CSO Phase II Facilities Plan" Chapter 7, p. 6.

24. Northeast Ohio Areawide Coordinating Agency. "2004 State of the Region Report" p. 16. Available online at: http://www.noaca.org/04SOR.pdf.

percent cheaper than sewer systems by reducing the need to convey and detain stormwater.

Stormwater Workshop

Having conducted this background sleuthing, RMI sensed that much more could be done to strengthen stormwater management in Cleveland. We found that there is limited public support for LID in new development; there is no financial incentive for developers to take greater care in site design or for owners to retrofit existing seas of impermeable surfaces; and existing regulations do not connect urban beautification with vegetation that absorbs stormwater.

Therefore, RMI focused on galvanizing consensus and action around a stormwater ordinance that would require LID for all developments in the City, and on promoting financial incentives for retrofits at existing sites. As a first step, RMI convened a workshop in November 2005 to discuss these ideas with Cleveland's key regulatory, non-profit and private sector players in water quality management.

Workshop Agenda

The workshop began with a presentation by Linda Shi (RMI) on the costs and lost opportunities of the current system, and the net benefits to ecology, sewer operation and maintenance costs, property values, and aesthetics that lay in enhancing the City's stormwater policies. The presentation (see CD appendix,"Stormwater" folder) covered the natural and developed hydrologic cycles, and the technologies and policies that can restore natural hydrology in developed landscapes.

On behalf of Joe Deal (City of Chicago, Special Assistant to the Mayor), Ms. Shi also delivered a presentation (see CD appendix,"Stormwater"folder) on Chicago's proposed stormwater ordinance, which is based on performance standards. Michael Kinsley (RMI) facilitated the workshop. In addition, RMI brought in Daniel Medina (CH2M Hill), a senior stormwater expert, to provide technical guidance throughout the session.

Discussion and Results

The discussions following the presentations were both lively and productive, demonstrating the power of collaborative problem-solving when knowledgeable people are in the room. When concerns were raised around potential actions, there was usually someone who could supply a knowledgeable response. Others pointed to specific problems in the existing stormwater system that were new to the group and helped underscore the urgency of the issue.

The group listed sixteen desired outcomes from a stormwater management policy. Then, attendees listed actions that would lead to the outcomes, and grouped them into six categories: establish baselines, develop model ordinances, create standards,

25. Conservation Research Institute. "Changing Cost Perceptions: an Analysis of Conservation Development." February 2005, p. iii. Report prepared for the Illinois Conservation Foundation and Chicago Wilderness.

Case Study 1: Ford River Rouge Stormwater Retrofit

The common solution for industrial compliance is constructing bigger treatment facilities and pipes. A notable exception is Ford Motor Company's Truck Assembly Plant in Dearborn, Mich., an industrial plant that fell under Phase I NPDES regulations. Instead of building a stormwater treatment facility that would have cost $50 million, Ford's massive renovation of the over 90-year-old site includes the world's largest green roof (as of 2004: 10.4 acres), the world's largest porous pavement lot (16 acres), as well as bioswales. All told, these installations are expected to absorb 85 percent of its rainwater, while costing less than a third of the proposed treatment facility and providing multiple other services. The green roof not only absorbed 50 percent of rainwater, but it also provided 25 percent of the productive habitat of an undisturbed natural site. It was also expected to improve air quality above the roof by 40 percent.

review procedures, develop market-based strategies, and establish institutional frameworks.

Of twenty-one suggested actions, eight were deemed achievable within the next six months. These included: issuing riparian, wetland, stormwater, and post-construction regulations; highlighting local stormwater examples and business opportunities; and developing standards manuals, among others. A team volunteered to champion each of these actions, with RMI's coordination.
The workshop helped build a shared sense of importance around stormwater, cement collaborative relationships, and establish agreed-upon goals.

Participants included members from:
City Planning Commission, CPC, Division of Water Pollution Control (WPC), City Department of Building and Housing (DBH), SWCD, City Law Department, City Sustainability Programs Manager, NEORSD, Northeast Ohio Areawide Coordinating Agency (NOACA), OEPA, RAP, Entrepreneurs for Sustainability, Chagrin River Watershed Partners, Inc., Parsons Brinckerhoff, and CH2M Hill.

Regulatory Action

The elections in November 2005 delayed progress on the development of a new stormwater policy. Nevertheless, Cleveland Mayor Frank G. Jackson has stated that he wants the city to go beyond minimum compliance with state regulations.[26] Since 2006, DBH, Department of Law, City Planning, Department of Public Utilities, Division of Water Pollution Control (WPC), and SWCD have each attended at least one of three meetings to discuss how the City of Cleveland can have an equitable and thorough stormwater management policy. These conversations have shed new light on the stormwater management situation in the City of Cleveland, as well as the steps needed to proceed.

In 2003, the Stormwater Management Steering Committee issued a Stormwater Management Plan[28] (SWMP) in compliance with the requirements of a MS4 permit. Included in the SWMP was a mandate to adopt a set of construction and post-construction stormwater ordinances that were, at the time, being developed by the Euclid Creek Watershed and NOACA. Though NOACA's model ordinances were completed in 2004 and have been audited

Case Study 2: Seattle's Street Alternatives (SEA Streets)[27]

In 2000, Seattle Public Utility (SPU) constructed its first alternative drainage and street design project to examine more ecological options for streets in need of new infrastructure. The 2nd Avenue NW project redesigned a 660-foot paved street to absorb runoff from the street and homes. The redesigned street replaced curbs, sidewalks, and gutters with swales of native vegetation, structural grass lattices for street-side parking, and traditional drainage infrastructure.

The result? In the first three years, the improvements reduced 100 percent of dry-weather flow and 98 percent of wet-weather flow from the catchment basin. The new landscaping also helps slow traffic and creates a safer environment for bicyclists and pedestrians.

Today, the walkability and garden-like environment on the street creates a sense of place that engages the care, pride, and community of local residents. Of the 100-plus trees and 1100 shrubs planted, almost 100 percent have survived due to the residents' maintenance efforts. The project has also created a local awareness among residents of their place in the larger watershed. In addition, students and design professionals visit the street for education purposes. As SPU notes, SEA Streets evokes "stewardship by design."

The project cost $850,000 due to extensive consultation in designing the pilot and communicating with residents. SPU estimates that future projects will cost less than traditional street improvements.

26. Rybka, Ed. Personal communication: 2 Feb. 2006.

27. For a virtual tour of SEA Streets and more information on other SPU projects, see http://www.ci.seattle.wa.us/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/index.asp.

and approved by OEPA, the Euclid Creek ordinances were never completed.

However, after NOACA's ordinances were finalized, the City of Cleveland promulgated Chapter 3116 (see above) instead. While this ordinance appears at first to satisfy the MS4 permit requirement that cities issue policies on stormwater best practices, it is more limited in scope. Also, it's difficult for developers to implement and officials to enforce. For example, this construction- and post-construction-runoff ordinance covers only MS4 areas and does not provide the guidance, best management practice detail, or enforcement capabilities of NOACA's ordinances. Also, Chapter 3116 is an ordinance by reference; for the meat of the regulatory language, the ordinance only refers to the MS4 permit. The permit's language translates poorly into building and development codes, thereby adding to the difficulty of using it.[29]

From the informal dialogues among the various departments, the group appears to agree on two points: first, that additional policies are necessary to both comply with the MS4 permit and to attain local best practice; and second, that a stormwater policy should apply to the entire city for both ease of implementation and fairness.

The crucial next step is to form a Stormwater Management Steering Committee with the authority to review the SWMP, determine if NOACA's ordinances should be adopted, and issue additional stormwater policies. At the time of this report, the Law Department had been in conversation with the Mayor's office and expected that a Steering Committee would soon be established. From speaking with various parties who have been involved in these stormwater conversations, RMI has a sense that positive, comprehensive policies will likely be enacted by the current administration.

Financial Incentives Action

As noted previously, there is no fee directly related to stormwater impact in northeast Ohio. Funding for the CSO mitigation project will come entirely from increased water user fees, which are based on water usage and are unrelated to stormwater impact. This presents an unfair system whereby land users with vast impermeable spaces contribute little or nothing toward the CSO mitigation project.

NEORSD is actively pursuing regional stormwater management authority, which would entail collecting fees for impermeability, as well as providing stormwater management services. The total revenue from rate charges would not change. Instead, it would be charged more equitably according to types of land uses. While this idea is new to Cleveland, it is by no means uncharted territory. According to Green City Blue Lake, an online community workspace hosted by EcoCity Cleveland, there are currently some 230 stormwater agencies in the country, most of which charge a stormwater fee based on impermeability.[30]

Gaining this authority will require a change to the court order that established NEORSD, which, in turn, will require the approval of NEORSD's sixty member communities. The process will likely require two years, beginning with a marketing and education campaign in member communities to further understanding and collaboration. More information can be found in NEORSD's letter of support (p. 66).
Following RMI's workshop, a group of lawyers, watershed-related organizations, staff of CPC, NEORSD, and Metroparks, and others began meeting to discuss the creation of a Self-Funded Watershed Management Organization (SFWMO). If established, the SFWMO would provide a source of local funding for important federal watershed restoration grants that require a local match. It would also serve as a stormwater and watershed manage-

28. The "Cleveland Stormwater Report 2003" is available on the main page of the Division of Water Pollution Control's website: www.clevelandwpc.com.

29. Houser, Todd. Personal communication: 17 May 2006.

30. Green City Blue Lake. "Paying for Stormwater." 15 May 2006. Available online at: http://www.gcbl.org/water/water-issues/paying-for-stormwater.

Debris and oil often seen along the Cuyahoga could be reduced by LID technologies.

ment organization in areas of Northeast Ohio that are not within NEORSD's jurisdiction.

As of May 2006, the American Heritage Rivers Initiative, led by Jim White, is facilitating monthly meetings with a growing group of partners to discuss needs, governance structures, and revenue mechanisms of the SFWMO. Under one scenario, the organization could charge a stormwater fee and use the revenue to conduct watershed preservation and restoration projects. The organizing group has no legal authority, but is working with county and city officials and others to get to a point where the SFWMO may become a legal entity.

Small Solutions for a Big Problem?

Around the country, small-scale implementation of distributed stormwater technologies have proven cost-effective in decreasing runoff volumes and contamination levels, in addition to enhancing neighborhood aesthetics, local ecology, and property values. To capture these values, some land developers have favored gravel trails, bioswales, and native vegetation over conventional underground pipe systems; many cities have adopted ordinances to encourage the adoption of these technologies in redevelopment; and some utilities have redesigned streets to absorb runoff from roofs and streets (see Case Study 2, p. 26).

RMI wondered if Cleveland was taking full advantage of these innovations and decided to examine if these distributed solutions could be implemented at a large-enough scale to make a large-enough difference in the local watershed's hydrology. In particular, RMI commissioned E-Design Dynamics (EDD) to review the Doan Brook Watershed Study (DBWS). (See p. 80 for the executive summary from EDD's review. The entire EDD and DBWS reports are on the CD Appendix, "Reports" folder.)

RMI's goal in commissioning this study was not to fault existing analyses but rather to determine if the full range of innovative solutions had been fully considered. A study on the efficacy of LID in the Cleveland area—based on local impermeability, soil type, building type, and cost data—would help everyone in the building and stormwater-management sectors understand the extent to which they can rely on swales, retention tanks, and stormwater tunnels (a.k.a. interceptors).

RMI selected the DBWS for review because it is the most thorough watershed management plan completed to date in the Greater Cleveland area. It is also the only study in the region that compared centralized and decentralized solutions at the scale of the watershed.

Led by NEORSD in 2001, the report evaluated all of the impacts on Doan Brook's stream ecology and encompassed biotic, channel and floodplain, stormwater, and wastewater management plans. It was funded in part by the U.S. EPA and engaged the participation of a variety of local stakeholders, as well as the consultation of the Center for Watershed Protection and EcoCity Cleveland. Today, NEORSD is carrying out the wastewater and CSO recommendations, while the Doan Brook Watershed Partnership is implementing some of the other proposals.

The DBWS notes that,"a sustained effort to implement numerous small retrofit practices over a long period of time may have a significant cumulative impact on stormwater."[31] However, the report concludes that runoff reduction measures are not technically feasible, cost-effective, easily implemented, or reliable.

The central finding of EDD's review of DBWS stands in sharp contrast to this conclusion. It indicates that DBWS did not fully explore the effects of widespread implementation of LID and that, therefore, the DBWS cannot conclude whether centralized solutions, LID, or some mix of technologies would be most cost-effective. Furthermore, EDD recommends a definitive, scientific assessment of this question before final management decisions are made. In particular EDD suggests that the optimal mix of strategies be identified through the use of an independent cost-effectiveness and land-cover model.

There is no question that a management plan that incorporates LID requires a different management model and implementation strategy, both of which may require more work (e.g., working with landowners to redesign streets). However, the important question for Cleveland's leaders is whether the long-term benefits of LID outweigh the costs. Such an analysis would be particularly timely as NEORSD considers watershed-wide stormwater management strategies and becoming a stormwater agency, and as city officials decide on comprehensive stormwater management regulations and policies.

Crisis as Danger and Opportunity

Non-point source pollution endangers the health of water bodies across the country. To avert this crisis, the U.S. EPA has issued regulations that are aimed at

31. NEORSD. *Doan Brook Watershed Study Report*, 2001, p. 5-26.

32. See the CD Appendix, "Stormwater" folder, "PhiladelphiaCH2M-HillStudy.pdf" for more comprehensive data.

Case Study 3: LID Effectively Reduce CSOs[32]

CH2M Hill studied a 28-acre area in Philadelphia to analyze the efficacy of LID (green roofs, bioretention cells, pervious pavement, and impervious pavement replacement) in reducing CSOs. The area, which is 65 percent impervious, created an average of twelve overflows per year, totaling about 2.3 million gallons. Land uses were primarily residential, with a few big box stores, institutions, and parking lots. The housing and other infrastructure was about 75 years old.

In the study's model, each building and land use was allotted certain retrofitted features, (e.g., bioretention cells for roof leaders on front yards with slopes of 2 percent or less). The cumulative result of widely implemented LID was a reduction in annual runoff volume of 37 percent, reduction in the number of overflow events by 46 percent, and an increase of 38 percent in the threshold of rainfall needed to create an overflow event. While no cost data were provided for this study, it is striking that these technologies had the potential to reduce overflow events by 46 percent—almost as much as the reduction promised by the planned infrastructure project in Doan Brook.

Downtown Cleveland seen from a nook along the river.

the symptoms of that danger: CSO overflows. Under this strategy, sewer districts like NEORSD comply with their CSO permits by eliminating almost all CSOs within as short a time as possible (e.g., twenty years) for as little cost as possible. Hamstrung by this framework of expectations and threatened by fines in the thousands per day if they fail to meet these deadlines, NEORSD is in a challenging position. Understandably, it is relying on centralized solutions that it can control. In conversation with staff at NEORSD, we've heard their frustration at being cornered into interceptor-based solutions that they know will satisfy the CSO permits but will not, in the end, solve the problem.

Yet, it is also within cities' grasp to turn this crisis into an opportunity, one that can reshape the form and function of a city. An urban-design model[33] of a 35-block area in Portland, Ore. found that under pre-development conditions, 30 percent of precipitation in the area became runoff, 20 percent evapotranspired, and 50 percent recharged the groundwater. Under 2004 urban conditions, 88 percent of precipitation became runoff, 13 percent evapotranspired, and no groundwater was recharged. Ironically for a rain-rich region, all of the water used on site was piped in; 90 percent of it left as wastewater.

Responding to these compelling numbers, designs for the redevelopment of the area include rainwater collection tanks on roofs, curbs that direct street runoff into street-side bioswales, underground tanks that gather overflow from bioswales, and a small runoff treatment system that returns collected rainwater to the area for irrigation and plumbing. Models show that rainwater harvesting for the area would reduce potable water consumption by 62 percent, which, when combined with incremental implementation of an area-wide stormwater treatment system, would reduce the costs of using and treating water by 89 percent. Though improvements to buildings and sites would cost $17.8 million, they would pay back the investment in five years through avoided water-utility costs. From then on, the avoided costs would all be booked as savings. Over 45 years, the site would accrue $22.4 million dollars in savings. Currently, four blocks in downtown Portland are being redeveloped according to this design as an experiment.

Unfortunately, few cities have seriously examined how small-scale solutions—e.g., redesigning streets, redesigning curbs, and upgrading plumbing stocks—can be retrofitted into existing communities to reduce the stormwater problem. Therefore, it would be risky for NEORSD, which is not yet even a stormwater agency, to disrupt streets to install LIDs. Accordingly, NEORSD's current approach relies on building interceptors as the primary solution, and regards widespread LID as infeasible to implement in a reasonable timeframe. For instance in the Doan Brook Watershed, the Heights/Hilltop Interceptor, a sanitary sewer line that is being completed, removes enough

33. Mithun. "Lloyd Crossing: Sustainable Urban Design Plan & Catalyst." 1 Jul. 2004. Available online at: http://www.mithun.com/expertise/LloydSustainableDesignPlan.pdf.

sanitary waste to cut CSOs to Doan Brook by half. For the remaining half of the CSOs, the DBWS encourages the use of LIDs in the long-term, but ultimately recommends that NEORSD construct the Easterly Interceptors with enough capacity to accept the Doan Brook Watershed's CSOs.

But imagine this: NEORSD working in conjunction with the Department of Public Service (Division of Streets), the Department of Building and Housing, the Department of Economic Development, the Department of Parks, Recreation and Properties, and community development organizations to redesign the form and function of lawns, streets, and medians in existing neighborhoods. In areas undergoing redevelopment, such design changes may be relatively easy to incorporate into future plans. In neighborhoods with little or no development activity, these investments could improve property values, create jobs, and infuse the area with new hope and prospects.

This alternative approach would identify and commit to the optimum whole-system mix of technologies for each neighborhood. In many areas, existing interceptor construction would continue as a necessary retention and filtration system for large storms. In other areas, renovated streetscapes that absorb rainwater could reduce or even avoid the need for segments of interceptors. As a bonus, they would enhance community pride, create jobs, and engage neighborhoods in maintenance and care.

The participation of multiple departments and community groups would enable projects to leverage not only NEORSD's funds, but also community development grants, regular funding for road repairs, and housing development funds. This approach transforms the stormwater problem into an economic opportunity.

The hydrologic cycle is a complex system and involves one of the most fundamental resources to society. Resolving the current misuse of rainwater must therefore be a multi-agency and multi-jurisdictional task, with solutions that address the fundamental purposes of rainwater. Adopting numerous small-scale solutions and depending upon multiple partners can be risky and time-consuming, and requires an entirely different framework from that of centralized solutions. Also, it requires additional negotiations with the EPA for a court order, which is still to be decided.

These recommendations are not easy to implement. However, the potential benefits merit not only the study EDD suggests, but also collaboration among various departments to determine how to best resolve, from a whole-system perspective, the crisis of stormwater.

A little boy points to a dollar bill on a country road. "Grandpa!" he says. "There's a dollar on the ground!"

"No, that can't be true," replies the grandpa, a retired economist. "If there were a dollar on the ground, someone would already have picked it up."

Examples of Low Impact Development Technologies

Green Roofs

Green roofs, or vegetated roofs, are waterproofed roofs, covered by drainage systems, soil, and plants. Studies have shown that green roofs absorb 60–80 percent of the rainfall, and that 40–50 percent of urban surfaces are rooftops.[34] As an example of the effect of these figures, if 80 percent of the rooftops in Washington DC were covered by green roofs, the Capitol's stormwater discharges would be halved.[35]

In addition to absorbing stormwater, green roofs provide natural habitat and mitigate the urban heat island effect, which saves building cooling energy. Of the sun's rays, green roofs reflect 27 percent, absorb 60 percent, and transmit only 13 percent into the soil, while also evapotranspiring to actively cool the roof.[36] Chicago City Hall's green roof measured 100°F on the hottest day in the summer of 2001, 65°F cooler than the blacktop roof next door. Indeed, roof gardens have been demonstrated to reduced interior temperatures by as much as 6–8°F.[38] For every 1°F drop in cooling needs, as much as 8 percent less energy is needed in air conditioning.[39] Cooling bills are also lowered since mechanical equipment working in 95°F conditions (standard operating temperature) requires much less energy and maintenance than those working at 165°F. These same characteristics protect the roof from changes in temperature (by as much as 94 percent), UV rays, and weather; thus, green roofs last two to three times as long as standard asphalt roofs.

Green roofs reintegrate nature into the urban landscape in the form of gardens and views from surrounding, taller buildings. The Gap Headquarters in California has a roof garden planted with local vegetation, the colors of which change with the seasons. A green roof in Washington DC was planted by at-risk youth from Covenant House. The Fairmount Hotel in Vancouver grows herbs, flowers, and vegetables on its roof, saving the hotel's restaurant about $30,000 a year.

Cost: A conventional roof costs $4–10 per square foot, depending on its quality. A typical 4-inch thick green roof costs about $10–14 per square foot in addition to the waterproofing layer. However, this additional cost is paid for during the life of a green roof, because the owner avoids portions of energy, stormwater, and roof replacement costs.

Three major green-roofing companies in the country are located in the area: Soprema in Wadsworth, Garland Company in Cleveland, and W.P. Hickman Systems, Inc. in Solon. Therefore, green-roof renovations of current industrial facilities or redevelopment of new areas along the Cuyahoga are prime business opportunities for area industries.

Table 5: Distributed Stormwater Technology Costs[37]

	Green Roofs	Porous Pavement	Bioinfiltration/ Bioswales	Stormwater Wetlands	Rain Barrel/ Cistern
Low End	$13/gallon or $10/ft^2	$2/ft^2	$10/ft^2	$83,500 / 10 acres	$0.50/gallon
High End	$22/gallon or $14/ft^2	$3/ft^2	$40/ft^2	$289,000 / 10 acres	$2/gallon

This green roof covers the structured parking lot at the Great Lakes Science Center in downtown Cleveland.

34. Dunnett and Kingsbury. Planting Green Roofs and Living Walls. Portland, OR: Timber Press, 2004.

35. Turner, Laura. 2004. "Washington, D.C. Joins Trend of Greenroofs for a Better Environment" in Cities Weekly 27(26).

36. Eumorfopoulou and Aravantinos. 1998. "The Contribution of a Planted Roof to the Thermal Protection of Buildings in Greece" in Energy & Buildings 27(1): 29-36.

37. Stormwater Manager's Resource Center. Available online at: www.stormwatercenter.net.

38. Peck, et al. 1999. "Greenbacks from Greenroofs: Forging a New Industry in Canada." Toronto: Canada Mortgage and Housing Corp.

39. Dunnett and Kingsbury, 2004.

Porous Pavement

Porous pavement allows stormwater to permeate paved areas that are normally impervious. Rainwater is stored in gravel subpavement reservoirs before entering the subsoil. Porous pavement types include asphalt and concrete, which have coarse grains to increase perviousness, and interlocking pavers with grass growing in grid spaces. These innovative pavements absorb a storm's first flush, which is the time in which most pollutants are washed off conventional paving into waterways. As a result, they remove 95 percent of suspended solids, 65 percent of phosphorous, 82 percent of nitrogen, and 98–99 percent of metals.[40] Porous pavement also allows rain to recharge groundwater.

Heavy traffic will compress porous pavement, thereby decreasing the permeability of the soil in grass pavers or of the grains in asphalt and concrete. Thus, this new paving should only be applied on infrequently used surfaces. Also, snowplow blades may catch on the edges of grass pavers and damage them. And porous pavement cannot be sanded or salted, as the former will clog the holes and the latter will directly pollute the soil and groundwater below. Therefore, this pavement must be used where snow and ice can melt naturally. Furthermore, porous pavement requires vacuum sweeping in order to clear the air pockets of debris.

Cost: At $2–3 per square foot, porous pavement can be four-to-six times more expensive than its conventional cousin, which results in an additional cost of $45,000 to $100,000 per acre. Though these appear to be significant costs, porous pavement avoids stormwater infrastructure costs and can actually save a project money. As discussed in Case Study 1 on p. 25, Ford Motor Company installed 16 acres of porous pavement as part of its BMP stormwater renovation, which cost less than one-third of conventional technologies.

Bioinfiltration / Bioswales

These are used as islands in parking lots or on residential streets. They slow the fall of rain and capture it with their biomass. They keep rain for a considerable time on the surface and, with their roots, release moisture to the subsoil and groundwater or through evapotranspiration.

Bioinfiltration and bioswales absorb and filter out the first flush of pollution during storm events. The drainage area, usually no more than 5 acres, is graded to channel runoff into these pockets of landscaping, about 5–10 percent the size of their drainage area. Curbs are completely or partially eliminated to help direct the water.

Stormwater enters the planted area, which is graded to pond runoff to a depth of 6 inches. Once the organic materials and soil reach saturation, rainwater seeps into the groundwater or into the gravel infiltration trenches. If it goes into the trenches, the water then exfiltrates into surrounding subsoils, or into the standard stormwater drainage system once the trench is full. One study shows that bioswales remove 81 percent of suspended solids, 29 percent of phosphorous, 49 percent of nitrogen, 38 percent of nitrogen oxides, and 51–71 percent of metals.[41]

A porous pavement trail at Lakewood Park absorbs water that otherwise would run off.

40. Stormwater Manager's Resource Center. "Factsheet on Porous Pavement." Available online at: www.stormwatercenter.net.

41. Stormwater Manager's Resource Center. "Factsheet on Bioretention." Available online at: www.stormwatercenter.net.

42. One equation finds that the cost of construction, design and permitting is C = $7.30V^{0.99}$, where V is the water treated in cubic feet. See Brown and Schueler, "The Economics of Stormwater BMPs in the Mid-Atlantic Region." Ellicott City, MD: Center for Watershed Protection, 1997.

43. Evans, T. "Wetlands and Land Development" in Properties Management, Inc. Jun. 2000.

44. See Brown and Schueler, 1997. They estimate the design, permitting and construction cost of wet ponds through the equation C = $30.6V^{0.705}$, where V is the wetland volume in cubic feet needed to control a 10-year storm. By these calculations, a one-acre facility costs $71,375, a 10-acre facility costs $361,250, and a 100-acre facility costs $1,837,500.

Cost: Constructing bioswales in place of building a concrete surface is an additional cost. However, where there are landscaping and runoff regulations, bioswales can be implemented in lieu of landscaping requirements and also decrease runoff concerns with little to no additional cost.[42]

Stormwater Wetlands

Stormwater wetlands are constructed mainly to treat and store stormwater runoff. They are also used to control floods, alleviate channel erosion, and remove pollutants. Scores of studies have demonstrated the pollutant-removal ability of wetlands, which remove nitrogen and bacteria more effectively than any other system. Like many other nature-based stormwater treatment solutions, these wetlands offer additional benefits. They provide wildlife habitat, recreational and open space, and educational and aesthetic characteristics. However, though they simulate the function of a wetland, they are less biologically diverse. As a result they do not generally qualify as wetland mitigation for those seeking credit for having eliminated wetlands elsewhere.

In a typical wetland, the runoff flows into a sediment forebay (a shallow pool) that captures coarse particles. It then falls over a weir and enters a micro-pool that may be a pond with an island or a wetland. Finally, it leaves the wetland through an outfall pipe. The site is graded to capture enough runoff for water quality assurance, channel protection, overbank flood control, or extreme flood control.

There are five major variations of the stormwater wetland, which differ first in the proportion of the wetland in deep pool, high marsh, or low marsh, and second in the length of time water is detained above ground. A deeper pond or wetland requires less surface area. A wetland that runs with a hill's fall line retains water longer than an equal-sized one that crosses the fall line. Wetlands in colder areas receive fewer benefits because the wetlands sometimes freeze over, thereby capturing less runoff and fewer pollutants.

Interstate Commerce Park in Streetsboro, Ohio is a 200-acre mixed-use development that includes a 56-acre open-space amenity that"preserved 20 acres of existing wetlands and a stream corridor, enlarged existing wetlands by 12 acres, provided regional stormwater management, and donated 22 acres for a new city park."[43]The inclusion of these wetland plans was crucial in gaining the City Council's approval for the project.

Cost: Stormwater wetlands are usually 25 percent more expensive than dry retention ponds.[44] Maintenance costs range from 3–5 percent of the construction costs, and stormwater wetlands typically last more than 20 years. According to the Navy and Marine Corps, construction and maintenance costs are significantly lower than those of conventional solutions.

Scranton Peninsula from Tower City with widespread impermeable surfaces typical of the Cuyahoga valley. (Photo courtesy of Forest City Enterprises.)

Aquatic Habitat Restoration

The mouth of Kingsbury Run as it empties into the Cuyahoga River provides a hint of what the area could become.

While the Cuyahoga River water quality has greatly improved over the past several decades, riparian (streamside) habitat is one aspect of the ship channel that has seen virtually no improvement. Extensive bulkheading forces fish to swim almost six miles under low-oxygen conditions, braving ships and bow thrusters, as well as the occasional combined sewer overflow (CSO) event—all without places to rest, hunt for prey, or hide from predators, ships, and CSOs. Of particular concern in the channel are the sharp declines of larval fish populations of the endemic fish species that migrate from the Cuyahoga Valley National Park to Lake Erie and back.[45] Although changing the dredging regime and mitigating CSO events would enhance water quality, a high-quality fish population requires sufficient levels of aquatic habitat located in the right places.

Given the importance of enhancing aquatic habitat to the overall biological health of the Cuyahoga River, RMI engaged riverside landowners in the idea of riverside restoration. In this effort, RMI partnered closely with the Cuyahoga River Remedial Action Plan (RAP). RAP is a non-profit, community-based organization dedicated to restoring the environmental quality of the Cuyahoga River through remediation of existing problems, prevention of further degradation, and restoration of habitat and riparian corridors. RAP has been working on ideas for riparian habitat restoration in the channel for some time now, and supplied the technical details for restoration options, as well as a leadership presence in the community. RMI also worked with CPC, as the topic of river restoration is a central component of the CVI.

As the following details describe, RMI, RAP, and CPC worked to promote pilot projects for each of four restoration options: pocket wetlands, green bulkheads, fish shelves, and tributary restoration. These options serve a number of functions, including: aquatic and riparian habitat provision, job creation through the promulgation of new technologies, aesthetic enhancement, property value augmentation, and ecosystem services like urban runoff, erosion and sedimentation mitigation, and air and water filtration.

In August 2005, RMI met with ten landowners along the ship channel to discuss various CVI ideas. Discussions with landowners ranging from Inland Waters to Mittal Steel showed that there was significant positive interest in ecological restoration and beautification. Most indicated that civic pride motivated them to support the ideas. Many landowners had small parcels on their property that were

45. Mistch, p. 9.

underutilized, already heavily vegetated, and which could be given to the city by lease, easement, or sale. These meetings encouraged RMI to hold a workshop with local leaders and business owners to turn vague ideas into specific actions.

Shortly before the Revegetation Workshop in November 2005, Lake Carriers' Association (LCA) organized a tour of the ship channel to determine optimal sites for restoration. Representatives of Mittal Steel, LCA, RMI, RAP, and CPC toured aboard a 600-foot Oglebay Norton iron-ore ship. This was a critical step in relationship building between the shipping and steel industries and the agencies that seek river restoration. LCA's main intent was to ensure that agency representatives understood the size of ships plying the channel, how much turbulence they created in the river, and how difficult it would be for restoration sites to survive under such conditions. However, the eight-hour tour gave both sides a chance to understand each other on a more personal level. Detailed discussions of RAP's restoration designs mixed with civic duty, and the desire to beautify and restore the river resulted in genuine progress. By the following day's discussion over maps and photos, representatives of LCA and Oglebay Norton took a leadership role in suggesting specific potential restoration sites. This group selected a dozen sites along the ship channel that would be feasible for restoration from a navigation perspective (see map on facing page).

The following week RMI organized a workshop with landowners, government agencies, local business associations, design firms, and non-profit organizations to discuss restoration locations and brownfield liability issues.

Habitat Restoration Workshop

As all water in the Cuyahoga River watershed drains into the ship channel before it enters Lake Erie, it represents a bottleneck for water quality and aquatic-habitat viability. Today, the bulkheads that stabilize the riverbanks preclude almost all riparian and aquatic habitats, making especially difficult the survival of larval and native fish in the river. Bulkhead replacement is needed along much of the channel; yet, at $3750 per linear foot, replacement would offer no new habitat. This workshop focused on how Cleveland could replace bulkheads that would provide both structural support and aquatic habitat in areas not used for shipping.

Workshop Agenda

Linda Shi (RMI) and Jim White (RAP) presented on current water quality and habitat conditions of the Cuyahoga River ship channel, the costs and conditions of the current bulkheading system, and alternative, habitat-restoring shoreline options, including green bulkheads, pocket wetlands, fish shelves, and tributary restoration. Then, since brownfield sites are pervasive in the Cuyahoga Valley, Tracey Nichols (County Brownfields Redevelopment Division, BRD) presented

Paul Alsenas (CPC Director), discusses ideas for the valley with Linda Shi (RMI).

Potential pocket wetland restoration site by Lock 44, where Canal Basin Park will one day mark the northern end of the Ohio Canal.

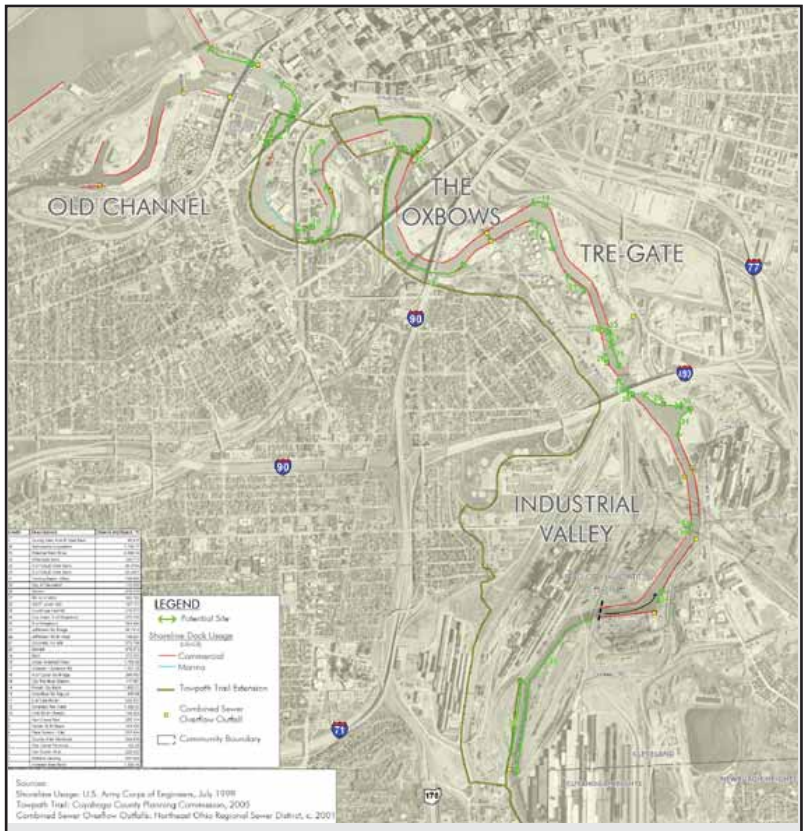
on the ownership, liability, risks and costs of restoring a site with potential contamination. She noted that owners could transfer properties to a non-profit entity, which would be able to assess contamination and retain liability, and that the BRD could assist with site assessment and work with landowners to do clean up and find matching funds.

Discussion and Results

The attendees were split into two groups: a Design Group that determined the three best sites for riparian restoration in the ship channel, and a Policy Group that discussed ownership and liability issues.

As criteria for selection, the Design Group used RAP's eleven criteria for green bulkhead sites and also recommended that sites be publicly accessible, benefit from an aesthetic upgrade, and not be considered if they have docking potential or are on the outside curve of the river. The Design Group chose the following: the site at the north end of the Ohio and Erie Canal (City-owned), the boat slip by the fire station on Scranton Peninsula (City-owned), and a parcel by the I-490 bridge on the west bank (Mittal-owned).

The Policy Group found the potential advantages (e.g., tax deduction, mitigation credits, public relations, cost savings, property value increase, etc.) and risks (e.g., remaining/future land-use limitations, brownfield liability, public access, etc.) to landowners using ecological bulkhead replacements. The group also listed



This map marks in green potential restoration sites identified by those who went on a cargo-ship tour of the Cuyahoga River ship channel (larger version available on the CD appendix, "Habitat Restoration" folder.

the organizations (Port Authority, City, non-governmental organizations, landowners through easements, or public-private partnership, etc.) that could retain title to the property. The workshop helped create a sense of goodwill between sectors and identified the sites and process through which RMI, RAP, and others would pursue pilot restoration projects.

Participants included members from: City Planning Commission, City Depart-

Much of the ship channel needs bulkhead replacement. This site could be restored as a pocket wetland.

Some sites where the bulkhead has collapsed into the ship channel can present hazards to navigation.

46. Cuyahoga River RAP. "Cuyahoga River Bulkhead Habitats." 2005, p. 1.

ment of Economic Development, City Sustainability Programs Manager, Cleveland-Cuyahoga County Port Authority, CPC, Cuyahoga County Department of Development, RAP, NEORSD, OEPA, U.S. Army Corps of Engineers, Flats Oxbow Association, LCA, Oglebay Norton, Interlake Steamship, Ohio and Erie Canalway Association, Cleveland Metroparks, Entrepreneurs for Sustainability, Schmidt Copeland Parker Stevens, Biohabitats, Parsons Brinckerhoff, and Valley landowners.

Restoration Options & Progress

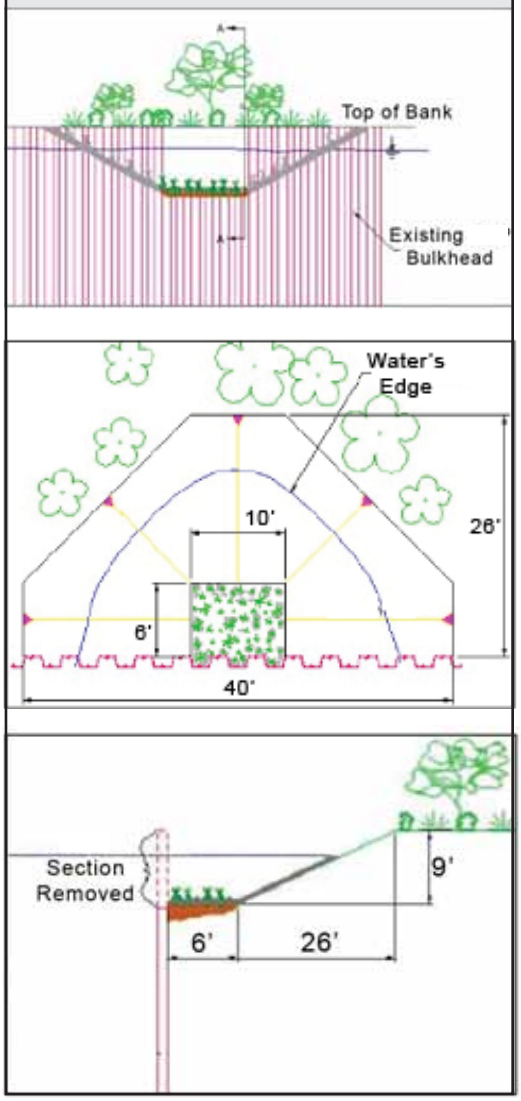
Pocket Wetlands – Jim White (RAP) has been exploring ways to create aquatic habitat in an improbable place: a steel-encased ship channel. One of his design ideas is a "pocket wetland" (see Figures 1a-c), which removes a portion of the bulkheading, scoops out the soil behind the bulkhead, grades the slopes, and replants the site with native wetland vegetation. Such sites would have to be located away from the turbulence generated by ships' bow thrusters. These pocket wetlands require about fifty feet of frontage, a thirty-to-forty-foot setback, and six feet of depth. Specific designs have not yet been rendered, but may include a small floating boom to keep out debris. The cost is estimated at $20,000–$40,000 per pocket. As with all of the following designs, pilot projects and monitoring is necessary prior to widespread implementation.

The river tour identified a dozen restoration sites, which the revegetation workshop then pared down to three top priority sites for piloting pocket wetlands. Subsequently, because two of the sites were publicly owned and would require a lengthy council-approval process, RMI pursued the parcel owned by Mittal Steel.

Mittal has signed an MOU with the City Planning Commission, promising to give them the 0.75-acre property as part of the Towpath Trail. Both Mittal and the City Planning Commission believe that an innovative restoration of the site would be an added amenity, and they have encouraged the process to continue. Nevertheless, there are issues that the City must resolve first—actually conducting the transfer of property, and amending Chapter 573 of the Harbor Code to permit such new shoreline systems as pocket wetlands and green bulkheads. We are confident that this will move forward, and RAP will continue to champion the project (see p. 72).

Green Bulkheads – RAP has been working on a green bulkhead prototype (a.k.a. high-performance shoreline edge system). It is a conceptual prototype that could functionally replace steel sheet pile bulkheads while meeting structural and navigation requirements, and simultaneously providing habitat for fish and

Figures 1a-c: Conceptual Designs of a Pocket Wetland[46]



potentially earning wetland mitigation credits. The prototype may be a series of stepped planter boxes rising from steel sheet pile bulkheads.

RAP has secured $500,000 of the $2 million federal funding request to develop green bulkheads. With this funding, RAP is proceeding with the design process. The next step is to assemble a technical committee of engineers, regulatory professionals, hydrologists, biologists, and ecologists who will together design the prototype green bulkheads. The patent will be held in the public domain. These designs will be constructed with the federal funding and physically tested in the Cuyahoga River. RAP hopes to have the first pilots in the ground before the winter of 2006.

If successful, green bulkheads could produce a new industry in Cleveland that generates the systems for ship channels in similar rivers around the Great Lakes. Because the time required to design green bulkheads is longer than the term of RMI's Regeneration Project, RMI could not establish firm commitments between landowners and RAP. Nevertheless, RMI helped accelerate progress through networking—namely RMI's meetings with landowners and the workshop on habitat restoration. See p. 70 for RAP's letter of support stating that the organization will continue to work on green bulkheads.

Fish Shelves – The innovative idea of a fish shelf was first piloted on the Black River in Lorain County, just west of Cleveland. In 2002, the Lorain Port Authority created a 400-foot-long horizontal steel pier near the mouth of the 28-foot deep, channelized river. Under the mitigation requirements of Section 401 of the Clean Water Act, the Port and an OEPA representative to the Black River RAP designed a fish shelf unique in the Great Lakes area. As can be seen in Figure 2 (p. 40), the bank slopes down to a 25-foot-wide shelf located 6–8 feet below the waterline. The outer edge of the shelf then drops off steeply to the bottom of the river, and is supported by a mound of boulders in riprap. The shelf is shallow enough to gather sunlight and vegetation; the rock piles provide habitat at lower depths. The fish shelf has been astonishingly successful in attracting fish, especially bass. Indeed, the shelf was still under construction when the fishermen on the river were already shouting to the workers, "What are you doing? The fishing here is great now!" The estimated cost was about $150–$250 per linear foot.

Two sites were identified in the ship channel as appropriate for fish shelf construction—Kingsbury Run and the boat slip on Scranton Peninsula. As seen under "Tributary Restoration" below, CPC is seeking funding to acquire Kingsbury Run's mouth. Given RMI's limited time on the project, it prioritized pocket wetlands and green bulkheads for implementation. The concept and locations for fish shelves remain on the list of RAP's future work.

It does not require much imagination to envision a restored Kingsbury Run that serves as a beautiful asset.

This boat slip by the Cleveland Fire Station could be restored with a fish shelf.

47. Lorain Port Authority, URS Corporation; published in *The Plain Dealer* with graphics by James Owen.

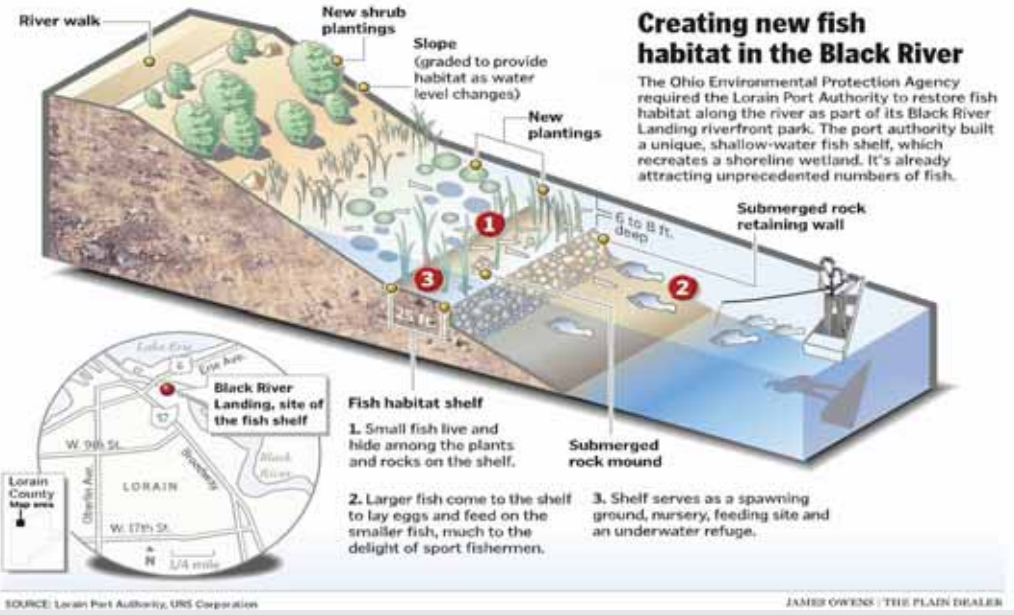


Figure 2: Black River Fish Shelf[47]

Tributary Restoration – Streams, like wetlands, were once seen as dispensable and useless. As development spread, communities buried their waterways in pipes and built roads, homes, and factories on top. Only recently have scientists and communities come to realize that streams are functionally important and economically valuable. Along the ship channel, there are two tributaries to the Cuyahoga River: Kingsbury Run and Walworth Run.

Kingsbury Run, which drains land from Shaker Heights to the Cuyahoga River, is entirely culverted except for the last few hundred feet, where the inlet is still physically intact. Walworth Run is culverted up until it discharges into the Cuyahoga River. Both are combined sewer outfalls, though the work of the sewer district will decrease the number of overflow events in the future.

Despite the alteration from their natural state, it is not difficult to imagine these places as beautiful parks, wetlands, and catalysts of restoration further upstream. Although the Kingsbury Run inlet includes a few small industrial features and its surface contains debris and petroleum slicks, its banks retain substantial vegetation and can easily be envisioned as an oasis of ecological restoration in close proximity to heavy industry. Nearby community development corporations have already developed plans to create a greenway that would restore the higher reaches of Kingsbury Run in their neighborhoods, though currently they do not have the funds necessary for such a project.

CPC submitted an appropriations application to the U.S. Senate via Ohio Senator Mike DeWine for funds to purchase and restore both tributaries. As the budgetary hearings are late in 2006, this project awaits Congressional decision. See the CD Appendix,"Habitat Restoration"folder for the application.

Brownfield Remediation

Brownfields are properties that contain or potentially contain chemical, petroleum, or other hazardous pollutants that complicate redevelopment, expansion, or reuse.[48] They are common in old, industrial cities like Cleveland. As the prevalence of brownfields can obstruct redevelopment, their remediation is crucial to rehabilitating urban properties for higher or new uses, and overall economic development.

In Cleveland, steel, oil drilling and refining, and other industries date back to the 1800s, long before environmental policies arose. Tracey Nichols, with the County Brownfields Redevelopment Division (BRD), once noted that at every location along the Cuyahoga River ship channel, some level of contamination can be found. For instance, in one 700-acre area along the ship channel there are currently forty-four RCRA, one TSD, one CERCLA, twenty UST, and twenty-seven LUST known brownfield sites.[49]

Because the City of Cleveland and Cuyahoga County have demonstrated the capacity for innovative brownfield redevelopment, RMI confined its brownfield cleanup efforts to sites along the ship channel that are targets for habitat restoration. One of the fundamental characteristics of the habitat restoration designs discussed in the previous section is the reintegration of the land with the river. However, the removal of barriers like bulkheads may inadvertently allow soil contaminants to enter the waterway. Thus, riverbank sites that are being restored must first be assessed for contaminants and then, if necessary, remediated (see "Remediation Process" box, p. 42).

Over the past year, RMI has worked with CBP and RAP to educate landowners about the need for brownfield assessments and the risks and opportunities therein. CBP has been a steadfast partner that is capable of supporting site assessments once a property is secured for restoration.

RMI had hoped to catalyze the remediation of a property in the Cuyahoga ship channel area. However, as we dug into the issue, it became evident that remediation is generally not cost-effective without a change of ownership or conversion to higher-value uses. Because the city and the county intend to keep heavy industry along the portion of the ship channel where RMI focused its attention, and because most of the ship channel's industrial operators have been there for many years and plan to remain, there appears to be little opportunity to shift to higher value uses and, therefore, little opportunity to remediate in this section of the ship channel without substantial government intervention.

Fortunately, with its history of brownfield innovation, Cleveland has found a way through this dilemma: an Industrial Land Bank that will recycle properties by remediating sites using federal grants and recruiting new industrial end-users.

This old industrial building now houses tanks of chemicals along the Cuyahoga River ship channel.

48. EPA Office of Brownfields Cleanup and Redevelopment. Available online at: http://www.epa.gov/swerosps/bf/index.html, last updated on April 3, 2006.

49. RCRA: Resource Conservation and Reclamation Act, governs the transport, storage, treatment, and disposal of hazardous waste; TSD: Transport, Storage and Disposal sites for hazardous waste; CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act, often known as Superfund, though this site is not on the National Priority List; UST – underground storage tank – soil samples must still test below such tanks to make sure they're not leaking; LUST: Leaking Underground Storage Tank, known to be leaking, and may be very expensive to clean up if contamination has reached groundwater.

The Brownfield Remediation Process

The process of remediation begins with two levels of site assessment that determine extent of contamination. Phase I involves a literature review to detail the environmental history of the site, which helps identify possible areas of contamination (a.k.a."areas of concern"), such as locations of old fuel-tanks, leaks, and spills. Then, if areas of concern are identified, a Phase II site assessment analyzes soil samples. At least three samples must be taken for each contaminant at each area of concern.

If significant contamination is found, then site assessment is followed by cleanup (a.k.a. remediation), the standards for which vary depending on the eventual use for the land. For example, residential and park standards require clean soil to a depth of twelve inches, while industrial standards call for 6–8 inches. The cost of remediation depends on the technology, the level of contamination, and the speediness of the solution. According to one study, there are three cost levels of cleanup technologies:

- Low cost – Natural attenuation, enhanced bioremediation, phytoremediation, and capping;
- Medium cost – Soil vapor extraction, bioventing, enhanced bioremediation, and encapsulation; and
- High cost – Landfarming, composting, on-site treatment, and off-site disposal.

Actual remediation costs can be surprisingly different from the costs one might estimate based on site appearance or history. Ms. Nichols notes that a site that appears exceedingly dirty can actually be relatively uncontaminated, while remediation of an old Wendy's restaurant in Cleveland will cost $3 million because it was once a gas station with leaky underground fuel tanks.

Though it's not required by federal law, a city interested in sustainable solutions could add a final site-healing step: green development (that is, ensuring that redevelopment uses resources efficiently and ensures healthful conditions for the environment and future site occupants). Sites developed with these criteria will remain a community asset instead of deteriorating into a liability as they once did. For information concerning green building standards for recycled brownfield properties, see "Green Building for Industries," p. 46.

Brooke Furio with the City Department of Economic Development is in charge of creating the nationally recognized Bank.

It became clear to RMI that a long-term effort is required to catalyze the remediation of larger industrial properties and identify opportunities for land assembly and consolidation. While RMI's short-term project is not conducive to such an effort, the Industrial Land Bank is well positioned and moving aggressively in that direction.
RMI focused its attention instead on promoting remediation as part of the habitat restoration process.

In effect, bulkheads have prevented pollutants in the brownfields around the ship channel from migrating through the soil and into the Cuyahoga River. Without remediation, pocket wetlands that remove a portion of a bulkhead could actually exacerbate water quality issues by allowing pollutants to seep into the river. Thus, site assessment and remediation are crucial first steps in the restoration process.

RMI worked with BRD, which has done award-winning work in the Cleveland area and which was a vital partner in the habitat restoration project. The program has twenty-one projects in Cuyahoga County, many of which have been fully remediated, have end-users, and, they have added 516 jobs and hundreds of thousands of dollars to the property tax base. Since 2001, the program has secured about $800,000 from the U.S. EPA to help fund site assessment. For each accepted project, it can contribute up to $6,000 for Phase I site assessment, and $35,000 for Phase II assessment. Also, the staff works with landowners to help find public funding and other resources in the remediation process.

CBP is particularly interested in remediation of sites that will be set aside for open space or restored ecologically, in part because the EPA Brownfields Program values such projects. At RMI's Habitat Restoration Workshop in November (see p. 36), Ms. Nichols spoke to landowners and agencies about how brownfield liability issues impact restoration efforts, and how liability and costs should not cripple action because assistance is available.

After the workshop, RMI worked with BRD and RAP to submit applications for county site-assessment funds for two sites: the Mittal I-490 parcel and the Lock 44 site. While BRD was willing to provide the funds and manpower for the assessments, and had also lined up potential funding from the state Department of Development for actual remediation, property ownership issues derailed completion of this work in the time frame of RMI's involvement.

Remediation of one or more sites can take place only when the City Planning Commission agrees to collaborate on a pocket wetland restoration for the Mittal I-490 site, or when other sites for restoration become available. BRD has indicated a willingness to be a partner in the remediation process.

Filtration tanks remove the petroleum in the runoff from an old BP property along the ship channel.

Building the Economy along the Cuyahoga

Volumes have been written, millions spent, and many organizations created to strengthen the economy of Northeast Ohio. Many of those organizations employ brilliant people who are doing excellent work. The Regeneration Project was intended, in part, to complement their efforts by approaching economic development from, perhaps, a different perspective.

Most economic development focuses on increasing economic "throughput," that is, increasing the flow of goods, services, and capital through an economy. Success is measured by such indicators as housing starts, tons of product, and retail sales. Particular attention is paid to finding new external sources of revenue. These efforts are important and necessary, but they miss one important fact: Virtually every local economy leaks resources and revenues.

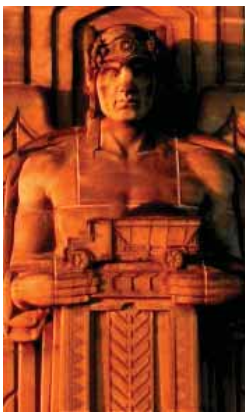
If we think of a local economy as a water bucket that is full when prosperous, we would notice that most economic development focuses on finding more hoses to fill the bucket—certainly well worth doing. But, less obvious is that the bucket is full of holes, that is, the inefficiencies that allow money to leak from the community.

The bucket is a simple metaphor; the concept shouldn't be taken to the extreme. In a modern economy, it is obviously absurd to think of plugging all the leaks, of making the locality entirely self-sufficient. The leaks are not wrong, instead they are wonderful opportunities for local creativity, innovation, and entrepreneurship. For example, any community spends many millions of dollars for electricity that is wasted through inefficient lighting, motors, roofing, windows, insulation, and many other factors. Worse, most of that wasted money is spent outside the community and results in economic leakage. The good news is that the measures required to improve efficiency create local businesses and jobs, reduce family and business costs, and are often less expensive on a unit basis that the electricity they are saving.

Though energy efficiency, as a discrete effort, is not within the scope of the Regeneration Project, RMI urges the leadership of the Cleveland metropolitan area to aggressively pursue this significant economic-development opportunity—one that doesn't depend on an upturn in the economy or decisions made by distant governments or companies. Low-risk, high-return investments in energy efficiency can be driven by local technical, financial, and political creativity. Described below, green industrial buildings are part of this project and energy efficiency is an important aspect of them.

Another form of economic leakage is industrial waste. Generally, waste creates significant costs and risks for the people who create it. Worse, when improperly disposed, it creates risks for the community. But, as Cleveland business people have clearly demonstrated in their involvement in Waste = Revenue, described below, this form of economic leakage also offers significant business opportunities. Smart business people in Cleveland are transforming waste from a liability into a working asset.

Resource productivity (of which energy efficiency is a subset) and waste-to-revenue efforts are powerful self-generated opportunities created where none seem to exist, opportunities that don't depend on new business coming to the community. For more information on these opportunities, explore RMI's book, *Natural Capitalism*, available free online at www.natcap.org.



Green Building for Industries

Buildings have an enormous impact on the environment, through not only the construction process, but also ongoing resource consumption. Buildings consume about 40 percent of this country's total energy and 60 percent of its electricity, and account for 49 percent of its sulfur dioxide emissions, 35 percent of its carbon dioxide emissions, 25 percent of its nitrous oxide emissions, and 10 percent of its particulate emissions. They also use five billion gallons of potable water daily to flush toilets.[50]

50. U.S. Green Building Council. "LEED Reference Guide for New Construction and Major Renovations, Version 2.1, 2nd Edition" May 2003, p.1.

This daylit warehouse in Utrecht, the Netherlands, belongs to Ecover, an international company that produces ecologically safe cleaners.

Yet, for little to no increase in capital cost, buildings can radically reduce operating costs by reducing the energy, water, and materials they consume, and improve the productivity and health of occupants. Green building standards may one day become part of standard building codes. Nevertheless, it is crucial to make wise decisions now about building design and efficiency because buildings become decades-long commitments to future resource use and environmental and human impact.

As part of its Regeneration Project, RMI committed to promoting efficient, ecological, and healthy buildings in the Valley. To this end, RMI worked with the Industrial Land Bank (ILB), housed within the City Department of Economic Development, to establish a green building standard for industrial properties. The ILB is an innovative program that works to clean Cleveland's brownfield properties, some of which are in the Cuyahoga Valley, and then sell these properties at below-market rates to new industries in order to entice companies back into Cleveland.

Brownfields are a legacy of the externalities and inefficiencies of the industrial revolution, which regarded natural resources as unlimited and laborers as expendable. This unsustainable and profligate model burdened today's generation with significant investments in cleanup and restoration. It is therefore particularly appropriate that redevelopment on such properties avoid repeating mistakes of the past and reduce business risk in the present.

A green building standard should demonstrate resource efficiency, energy independence, waste recovery, and a respect for worker and ecological well-being to the maximum extent feasible. The ILB could create a new, local green building standard. Alternatively, the ILB could adopt an existing standard such as the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) rating system. The LEED system has the advantage of being comprehensive, periodically updated, and widely recognized. Its stringent documentation and commissioning requirements also ensure a high level of quality in the final product. However, the process of LEED certification can be cumbersome, time-consuming, and costly. Also, as presently written, LEED standards are geared more towards commercial than industrial projects.

The city staff involved with the ILB and the developers for the first ILB project have been very supportive of the idea of establishing a green building standard for the land bank. The current thinking amongst ILB staff is to craft a local standard, drawn in part from LEED and tailored to industrial properties. The standard would focus on energy use, site design, local materials use, and water and stormwater. The actual criteria, review and certification mechanisms, incentive structures, and other policies concerning the standard would be devel-

oped in collaboration with such groups as local architects, developers, industries, regulatory agencies, and the Cleveland Green Building Coalition. This process may draw much upon the experiences of the Cleveland Housing Trust Fund's development of a residential green building standard. The residential green building standard has three approaches: "basic requirements, additional incentives to encourage a higher standard, and an aggressive pilot program to set a new standard."[51]

Despite the staff's interest, currently the ILB cannot commit to a green building standard for the Land Bank because the new director for the Department of Economic Development came onboard very recently. His opinions and assessment of the green building standard will determine whether the ILB issues a green building policy. However, given the merits of the standard, RMI is confident that there will soon be rapid progress towards a green building policy for the ILB.

Background: The LEED System

To provide a sense of what a green building standard for the ILB would entail, the following describes the LEED rating system, its applicability to industrial properties, the LEED process, and the costs related to green building.

The Applicability of LEED to Industrial Properties

The LEED rating system groups design elements into five categories: sustainable sites, water, energy and atmosphere, materials and resources, and indoor environmental quality. The more credits under each category a project wins, the more points it receives. Based on the total points earned, a project can attain a LEED Certified, Silver, Gold, or Platinum rating. LEED is also separated into different rating systems: LEED-NC for "New Construction," LEED-CS for "Core and Shell," and LEED-EB for "Existing Buildings," among others. For ILB, LEED-NC is the applicable standard.

While commercial properties dominate the list of 200-plus projects that have been LEED certified in the world, about a dozen commercial/industrial facilities have also been certified (see CD Appendix, "Green Development" folder, "LEED Industrial.doc," for a list of facilities and a case study on one project). The standard does not apply to equipment or building areas dedicated to industrial or manufacturing purposes, but would help produce an overall building that is well-insulated, uses efficient appliances for lighting (e.g., skylights and southern orientation) and water (e.g., waterless urinals and industrial wastewater recycling), uses a more efficient heating and cooling system (e.g., better chillers and more insulated refrigerators for food warehouses), and buys local materials for construction. See p. 49–50 for the LEED-NC checklist from which a new facility would be able to choose.

The Cost of Building Green

Developers across the country are building green not out of the goodness of their hearts, but because it makes financial sense. Studies of the incremental cost of making a project green demonstrate that LEED increases construction costs by little to nothing, since the cost

51. Memorandum from Andrew Watterson to Daryl Rush. "High Performance, Healthy Building Standards for the Housing Trust Fund Program." 24 Oct. 2005.

The offices in Gotz Manufacturing, Germany, are well daylighted with backup fluorescent lighting.

of such additions as high-performance glazing, chillers, and insulation are offset by down-sized heating, ventilation, and cooling systems.[52] Even the increased costs of commissioning (making sure the building works as it should)—about 1.5–3.0 percent of construction costs for an under $5 million project—are offset by the returns on decreased utility bills (5–10 percent) and increased occupant comfort. For instance, the State of Oregon Office of Energy studied the direct energy savings of two buildings after they had been commissioned. In the 110,000-square-foot building, energy savings totaled $12,276 per year, or $0.21 per square foot per year. In the 22,000-square-foot building, savings totaled $7,630 per year, or $0.35 per square foot per year.[53]

The average green building costs slightly less than 2 percent ($3–$5 per square foot) more than its conventional equivalent.[54] Beginning in 2003, the General Services Administration required all new GSA projects to meet minimum LEED criteria. In this policy, it allocated a 2.5 percent increase in building project budgets, finding that this would be sufficient for all projects to attain minimum certification and for many projects to meet LEED Silver, and for a few to achieve LEED Gold.

The biggest economic gains accrue to the building user as a result of decreased utility bills for both water and energy. The more expensive the energy and the more efficient the LEED building, the faster the efficiency measures will pay themselves back. In a 2003 study by Greg Kats, the average green building cost 2 percent more to construct, but resulted in life-cycle savings of 20 percent of total construction costs. For example, if a $5 million project were allocated $100,000 more for green components, it would accrue $1 million in savings over the lifespan of the building.[55] In the Cuyahoga River Valley, Zaclon installed a wastewater-recycling stormwater-recapture system that allowed it to decrease its draw on municipal potable water by 80 percent, with associated savings. Various simulation software programs like DOE-2 can help calculate the length of payback time for each building component.[56]

Building Green in Cleveland

Though there are only five LEED certified projects in the entire state of Ohio, green building is clearly a growing trend in the region, as it is elsewhere in the country. There are currently ten projects in Cleveland that are registered to become LEED certified and 135 LEED accredited professionals in the Greater Cleveland area.[57] This suggests that there exists a group of experts in the area who can help develop the local green building industry.

Despite growing awareness in the private sector about the benefits of building green, the public sector can accelerate the adoption of greener standards by mandating green building standards in projects where the government has a role. While a green building standard may be a challenge at first, such a policy will incentivize local expertise and the entire green building industry.

In a city whose long industrial history continues to trouble its prospective development, it is appropriate and inspirational for the inheritors of brownfields to refashion the image and future legacy of manufacturing, and of Cleveland. As a green-building champion, the Industrial Land Bank can play a major role in transforming the next generation of industries in Cleveland.

52. Matthiessen, L.F. and Peter M. "Costing Green: A Comprehensive Cost Database and Budgeting Methodology." July 2004, p. 23. Available online at: http://www.usgbc.org/Docs/Resources/Cost_of_Green_Full.pdf.

53. USGBC, p. 112.

54. Kats, Greg. "The Costs and Financial Benefits of Green Buildings." October, 2003, p. 14. Available online at: http://www.cap-e.com/ewebeditpro/items/O59F3259.pdf. The average premium for a LEED Certified building is one percent (sampling pool of eight buildings), a Silver building is 2.1 percent (sample pool of eighteen), and a Gold building is 1.8 percent (sample pool of six).

55. Ibid, p. ii.

56. For more information on DOE-2, see http://www.doe2.com.

57. For a list of accredited professionals in the area, see LEED AP directory at: http://www.usgbc.org/LEED/AP/ViewAll.aspx?CMSPageID=280&CategoryID=127&?CMSPageID=288&.

58. More information on LEED standards can be found in "LEED-NC, Green Building Rating System for New Construction & Major Renovations, V. 2.2," available online at: https://www.usgbc.org/ShowFile.aspx?DocumentID=1095.

The following LEED-New Construction checklist provides an idea of the kinds of building designs choices that can affect a building's efficiency and quality.[58]

Project Checklist

Sustainable Sites — 14 Possible Points

Prereq 1	**Construction Activity Pollution Prevention**	Required
Credit 1	**Site Selection**	1
Credit 2	**Development Density & Community Connectivity**	1
Credit 3	**Brownfield Redevelopment**	1
Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
Credit 4.3	**Alternative Transportation**, Low Emitting & Fuel Efficient Vehicles	1
Credit 4.4	**Alternative Transportation**, Parking Capacity	1
Credit 5.1	**Site Development**, Protect or Restore Habitat	1
Credit 5.2	**Site Development**, Maximize Open Space	1
Credit 6.1	**Stormwater Design**, Quantity Control	1
Credit 6.2	**Stormwater Design**, Quality Control	1
Credit 7.1	**Heat Island Effect**, Non-Roof	1
Credit 7.2	**Heat Island Effect**, Roof	1
Credit 8	**Light Pollution Reduction**	1

Water Efficiency — 5 Possible Points

Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
Credit 2	**Innovative Wastewater Technologies**	1
Credit 3.1	**Water Use Reduction**, 20% Reduction	1
Credit 3.2	**Water Use Reduction**, 30% Reduction	1

Energy & Atmosphere — 17 Possible Points

Prereq 1	**Fundamental Commissioning of the Building Energy Systems**	Required
Prereq 2	**Minimum Energy Performance**	Required
Prereq 3	**Fundamental Refrigerant Management**	Required
Credit 1	**Optimize Energy Performance**	1–10
Credit 2	**On-Site Renewable Energy**	1–3
Credit 3	**Enhanced Commissioning**	1
Credit 4	**Enhanced Refrigerant Management**	1
Credit 5	**Measurement & Verification**	1
Credit 6	**Green Power**	1

Materials & Resources — 13 Possible Points

Prereq 1	**Storage & Collection of Recyclables**	Required
Credit 1.1	**Building Reuse**, Maintain 75% of Existing Walls, Floors & Roof	1
Credit 1.2	**Building Reuse**, Maintain 95% of Existing Walls, Floors & Roof	1

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Credit 1.3	**Building Reuse**, Maintain 50% of Interior Non-Structural Elements	1
Credit 2.1	**Construction Waste Management**, Divert 50% from Disposal	1
Credit 2.2	**Construction Waste Management**, Divert 75% from Disposal	1
Credit 3.1	**Materials Reuse**, 5%	1
Credit 3.2	**Materials Reuse**, 10%	1
Credit 4.1	**Recycled Content**, 10% (post-consumer + 1/2 pre-consumer)	1
Credit 4.2	**Recycled Content**, 20% (post-consumer + 1/2 pre-consumer)	1
Credit 5.1	**Regional Materials**, 10% Extracted, Processed & Manufactured Regionally	1
Credit 5.2	**Regional Materials**, 20% Extracted, Processed & Manufactured Regionally	1
Credit 6	**Rapidly Renewable Materials**	1
Credit 7	**Certified Wood**	1

Indoor Environmental Quality 15 Possible Points

Prereq 1	**Minimum IAQ Performance**	Required
Prereq 2	**Environmental Tobacco Smoke (ETS) Control**	Required
Credit 1	**Outdoor Air Delivery Monitoring**	1
Credit 2	**Increased Ventilation**	1
Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
Credit 4.2	**Low-Emitting Materials**, Paints & Coatings	1
Credit 4.3	**Low-Emitting Materials**, Carpet Systems	1
Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber Products	1
Credit 5	**Indoor Chemical & Pollutant Source Control**	1
Credit 6.1	**Controllability of Systems**, Lighting	1
Credit 6.2	**Controllability of Systems**, Thermal Comfort	1
Credit 7.1	**Thermal Comfort**, Design	1
Credit 7.2	**Thermal Comfort**, Verification	1
Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1
Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1

Innovation & Design Process 5 Possible Points

Credit 1.1	**Innovation in Design**	1
Credit 1.2	**Innovation in Design**	1
Credit 1.3	**Innovation in Design**	1
Credit 1.4	**Innovation in Design**	1
Credit 2	**LEED Accredited Professional**	1

Project Totals 69 Possible Points

Certified 26–32 points Silver 33–38 points Gold 39–51 points Platinum 52–69 points

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Waste = Revenue

Industrial symbiosis, or industrial ecology, is the co-existence among industries—ranging from agricultural to chemical—in which each business benefits financially from the other to create a healthy, productive, and, ultimately, waste-free environment. In the field of industrial symbiosis, the City of Kalundborg, Denmark is the first and foremost example documented to date. Over the last few decades, businesses and the municipality have created more than twenty relationships that turn each other's "wastes" into revenue. Each relationship increased the area's economic and environmental sustainability.[59]

Two fundamental principles of nature that are insightful to industrial symbiosis come to us from the Zero Emissions Research & Initiatives (ZERI) network:

1. Wastes of one kingdom are always food and/or energy for another.

2. Toxins produced by one kingdom are always neutral or inputs for another kingdom.

Yet, due to flaws inherent in contemporary engineering, most industries are designed as isolated units that use linear flow processes: raw material in, products and unusable waste out. Consider some of the following statistics:[60]

1. Only 6 percent of material ends up in final product.

2. Over 99 percent of everything we take from the earth ends up back in the earth in six months in a form that can not be easily reused.

3. The U.S. automobile industry creates seven billion pounds of unrecycled scrap metal each year.

4. Two quarts of gasoline and one thousand quarts of water are required to produce one quart of orange juice.

All of the "wastes" from these processes could be "food" for another industry. Ignoring the value of waste can lead to significant environmental impacts on air, water, and soil, which in turn lead to considerable human health impacts. Capturing the value of waste leads to cost savings, new revenue, and job creation. Commonly overlooked values of reusing waste include: reduced disposal and disposal reporting costs; revenues from selling waste as the raw materials for other processes; and reduced raw material costs.

In Cleveland, Great Lakes Brewing (GLB) understands these principles. The company has moved from a conventional "take make waste" process to an innovative "take make remake" process. GLB uses spent brewery grains to make bread and pretzels and to grow shitake mushrooms. Spent vegetable oils are used to fuel their "Fatty Wagon," a van that delivers patrons to the nearby Jacobs Field for a ball game and returns them to the brewery afterwards. GLB is currently testing vegetable oil as fuel in one of its delivery trucks. The company has reduced its costs and found new revenue streams.

GLB owner Daniel Conway explains, "In the process of seeking ways to make our operations more environmentally friendly,

A group of business leaders at Zaclon for the first Waste = Revenue Roundtable in January, 2006.

59. For more information on the Kalundborg industrial symbiosis model, please see their website, available online at: http://www.symbiosis.dk.

60. Hawken, Paul, Amory Lovins, and L. Hunter Lovins. *Natural Capitalism.* Little, Brown and Company: New York, 1999.

Steel mills already apply many waste = revenue principles, such as recycling scrap metal. Yet, even here, there are uncharted opportunities.

we've been able to cut operating costs at the same time. It's simply a matter of taking the time and making the commitment up front to explore the technology that's out there and find a way to do it that makes environmental, financial, and social sense." His partner Patrick Conway continues, "Our objective is to make full use of the by-products created by the brewing process. By taking a 'full circle' approach, we are making the most of potential savings and income-generating opportunities as the raw materials used to produce our products are continuously transformed into a host of food-generating and energy-saving opportunities." Their ultimate goal is to mimic nature, where 100 percent of resources are used in closed-loop systems.

The Cuyahoga Valley, where many industries transform raw materials to create new products, is a natural area in which to consider how to transform waste into revenue. In RMI's effort to stimulate local industrial symbiotic relationships, we partnered with Holly Harlan, Founder and President of Entrepreneurs for Sustainability (E4S). An engineer and business specialist, she identified local business leaders and brought them together in a Waste = Revenue Roundtable.

At the time of writing, the roundtable had eight member companies, among other institutional experts, and had produced twenty project ideas, nine of which are actively under investigation. CPC has committed to financially supporting E4S's work after RMI's role concludes so that the network will continue to grow.

Waste = Revenue Roundtables

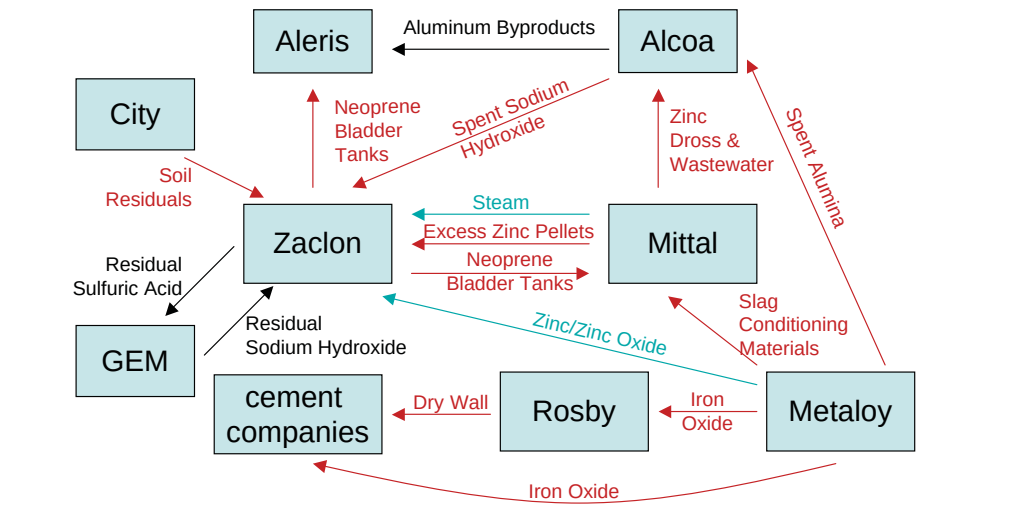
There were several ways to explore turning waste into revenue in the Cuyahoga Valley. One was to study all the industries in the Valley and identify those most likely to have common material needs. Another was to map material flows like building materials, food, recycled goods, and transportation through several of the major industries in the Valley. However, through interviews with local business leaders, we learned that they already knew the value of turning waste into revenue within their companies. What if we got those business leaders together and helped them get to know

each other's business? Would we find more opportunities between the companies? Based on more than twenty years of working with business leaders, Ms. Harlan knew that relationships are the backbone of business. Business leaders are more likely to invest in change if the projects involve partnering with people they trust. RMI had already established relationships with Alcoa, Mittal, Zaclon, GEM, and St. Mary's Cement in the interview process. E4S had relationships with Aleris and Metaloy. While these businesses were physically proximate and a few already had ongoing business relationships, most of them were unaware of what processes took place in neighboring industries.

E4S hoped to achieve the following through the Roundtable: create business opportunities from waste or byproducts; document triple bottom line benefits from these business opportunities; develop a network of business leaders who turn waste into revenues; and discuss the viability of promoting industrial ecology or industrial symbiosis as a way to bring economic, environmental, and social prosperity to the Cuyahoga Valley.
At the first Roundtable in January 2006—with Zaclon, GEM, Alcoa, Alumitech, Metaloy, St. Mary's Cement, Mittal and RMI in attendance—Ms. Harlan posed the question: "Could one company's waste be another's food?" The participants went around the room, introducing themselves and stating what waste products they could sell and what materials they needed. Within an hour, the business cards were flying across the table. As Rich Zavoda with Mittal noted, such a gathering of industry leaders had never taken place before and was a valuable way to find new business opportunities. Since then, the roundtable has met three more times, and added Rosby Resource Recovery, the City of Cleveland, and CSU to the group. St. Mary's Cement and GEM did not participate further.

To date, more than twenty projects have been discussed during the four meetings since the end of January. Three of these were existing connections, nine are under investigation, two did not work out, and seven are concepts that are waiting for partners or materials experts (see Diagram p. 53).

Diagram: Waste = Revenue Connections in the Valley



Other Possible Connections: Feldspar Shingles, Wind Energy, Tire Recycling, Equipment Sales

Waste = Revenue's Future

Given the successful conversations thus far, the Roundtable is looking to continue to develop the list of twenty projects and identify new opportunities by inviting other industries located in or near the valley to the Roundtable. Already, the group has invited materials experts in soils, minerals, chemicals, solid waste, and polymers, and it will continue to grow its partnerships with local professionals. Eventually, the group may invite national or international experts in industrial ecology for further guidance and inspiration.

The Roundtable is not limited to discussions about waste. Other business opportunities have been discussed, including wind energy, equipment, and land and infrastructure needs. Ms. Harlan is also interested in starting a food or organic materials roundtable.

To help promote communication once relationships are established, the team would like to create a materials trading website or listserv. They want a real-time way of identifying and tracking business opportunities. Asked if the website could take the place of the meetings, they all agreed that the Roundtable enabled them to get to know each other and their businesses better. This will help them find more opportunities than a simple list of materials or waste streams on a website. Such attitudes are supported by the experience of those in Kalundborg. "Today the basis of the symbiotic co-operation of Kalundborg is openness, communication, and mutual trust between the partners. The Kalundborg companies are located in a small community that has helped establish fine conditions for open and intimate working relations."

The Roundtable will seek out research funding to help business representatives learn about new opportunities for the waste streams that do not have apparent opportunities. With the assistance of the materials experts from local institutions, they hope to create experimental products to test in new markets.

The participants signed a letter of support (see p. 73). They believe that, given time, they will find win-win solutions that maximize social, environmental, and economic values for their businesses and the region. The Waste = Revenue Roundtable offers participants the time to develop relationships with each other and an understanding of each participant's business that will lead to future benefits. Could the Cuyahoga Valley Initiative create an American Kalundborg? The Waste = Revenue Roundtable is a fine start to such a goal.

As this rust stain on a concrete step shows, waste, seen in the right light, can be a beautiful thing.

Real Estate Development Workshop

The May 2005 workshop gathered ideas and discovered compelling solutions for the area around the Cuyahoga Valley ship channel from a group of senior local development professionals, all of whom are members of the Urban Land Institute (ULI).

Redevelopment, especially of brownfields, is most feasible when land will be used for high-value activities like commercial or residential development, which can generate enough revenues to cover remediation costs. Yet, given the proximity and impacts (e.g., noise, dust, odors, etc.) of heavy industry in the Valley, few developers choose to site commercial or residential projects there. The city and county are committed to keeping industry in the vicinity of the ship channel. All of the attendees felt frustrated that they had little opportunity to redevelop parts of the Flats and the river valley despite rewarding potential. They all regard the river, especially a restored ship channel, as an extraordinary real estate asset.

Workshop Agenda

The workshop began with a tour of the most heavily industrial area of the ship channel. Afterwards, the group discussed development and ecological restoration in the area. RMI introduced the idea of economic modeling to demonstrate the value of ecological restoration and opened the floor for an energetic and well-informed conversation.

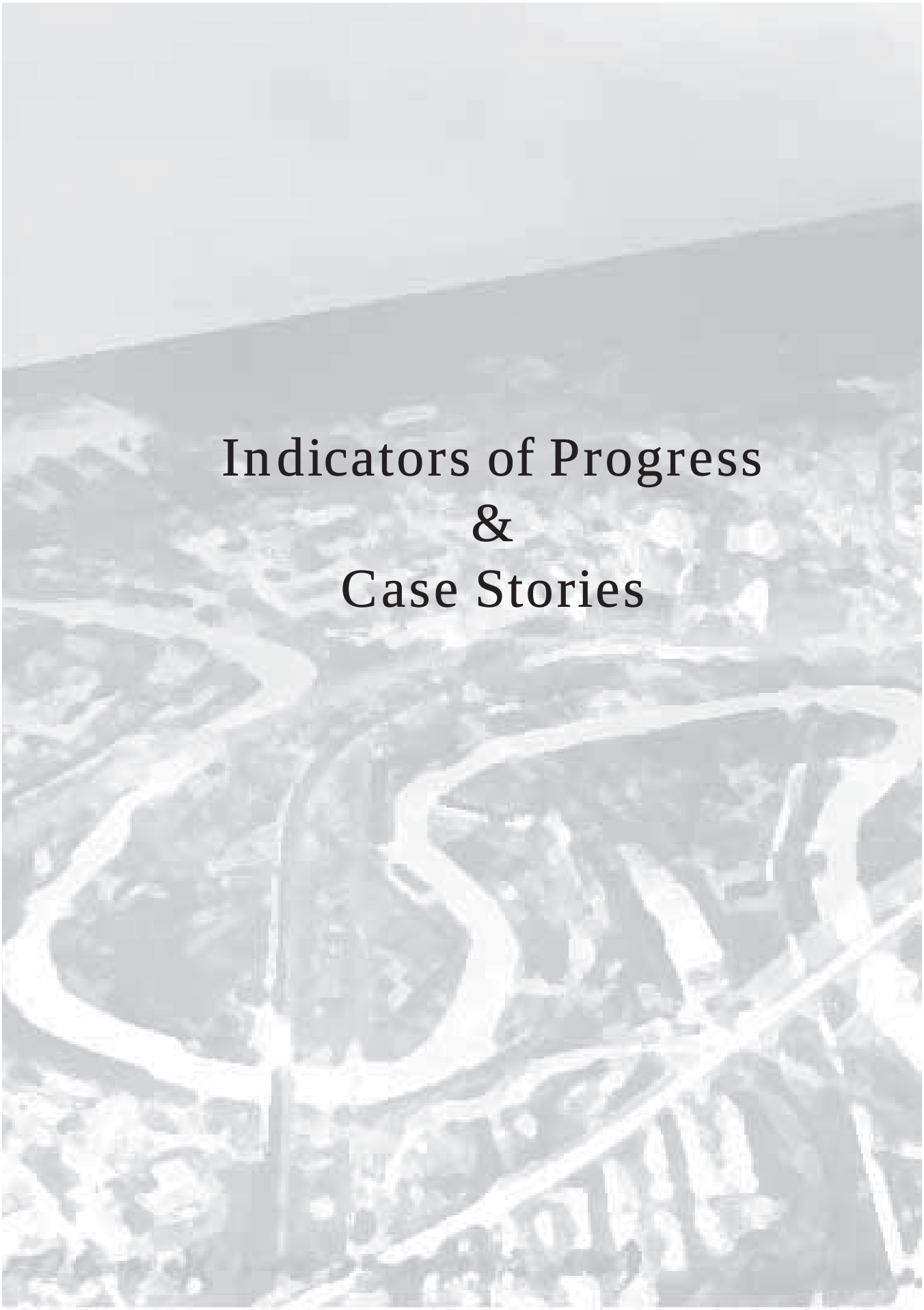
Discussion and Results

Two points of consensus emerged. First, the success of the CVI requires unequivocal public sector commitment to quality of place (i.e., use control through standards and entitlements, site control, and planning with vision) over a long period of time, as well as the political will to make the hard decisions. Political will was defined as extending beyond the politicians. Second, the ship channel would be prime development land if uses shifted from heavy industry to office, commercial, residential, and even light industrial, if the latter were clean and quiet. The primary reason for this observation is that properties along the river have an unusual and attractive position in the market. As one participant remarked, "They aren't making any more rivers."

Given that the city and county are committed to maintaining industrial uses in the upstream portion of the ship channel, but that the future of some heavy industry is uncertain, some participants suggested that the area should shift over time from heavy to light industries (e.g., fuel-cell R&D, medical products, nanotechnology, etc.). The latter would be more compatible with office, commercial, and residential uses, which might gradually come into the area if zoning allowed, and if noise, dust, and odors were mitigated.

Following the workshop, one participant e-mailed RMI to say: "I felt the most compelling concept yesterday was the 'system thinking' approach; specifically, the graph that showed that commercial and residential real estate would benefit the most from a restoration while industrial real estate would only benefit marginally. Now, to me here lies the biggest challenge. The industrial stakeholders are the ones that need to be convinced of a restoration project, but are the ones that will benefit least from it."

Participants included members from:
Hemisphere Corporation, Midland Group, Allegro Realty Advisors, Forest City Capital Corporation, Cumberland Development, Heartland Developers, Baker Hostetler, University Park Alliance–University of Akron, ULI Cleveland Executive Committee, Greater Cleveland Partnership, Cuyahoga County Department of Development, City of Shaker Heights, and E4S.



Indicators of Progress & Case Stories

The Cuyahoga Valley Initiative (CVI) will best succeed in affecting local and regional policy and attracting investment when its proponents can clearly document success and demonstrate positive change.

Evidence of progress is most effective when substantiated by both empirical evidence (i.e., data showing change) and anecdotal evidence (i.e., stories about change). Data appeals to some people; stories influence others. Stories supported by and bringing life to data are particularly powerful.

The kinds of changes anticipated in the Regeneration Action Plan (see p. 11) require longer to take effect than the eighteen months over which the Regeneration Project has taken place. Thus, RMI presents here the foundations upon which data and case stories can be developed as CVI proceeds. RMI suggests that the future CVI organization compile and disseminate this information, possibly with the help of local government and other nonprofit organizations.

Indicators of Progress

See Table (p. 60)

Benchmarks: With the guidance of a wide range of local stakeholders, RMI focused on several projects intended to achieve the outcomes of the Regeneration Action Plan. Included in the chart below are recommended benchmarks that reflect steps required to implement each project.

Indicators: The table also suggests the kinds of indicators that will reflect progress toward environmental, social, and economic goals consistent with the original vision of the CVI (e.g., water quality, public use of new green spaces, etc.). RMI recommends that the future CVI organization review each indicator in the chart, adopt the indicators it deems most appropriate, and then derive specific measures for that indicator to be used as hard evidence of progress. For example, acreage of planted medians, roofs, and parking lots could measure changes in urban vegetated areas.

Indicators point toward longer-term goals, as contrasted to benchmarks that show shorter-term achievements toward specific projects. Benchmarks address incremental "outputs," while indicators (and their specific measures) focus on "outcomes." (Arrows in the chart suggest the positive direction for each indicator.)

Case Stories

Also below are suggestions for case stories that should be written and disseminated in order to provide anecdotal evidence to substantiate popular understanding of CVI in general and each of the projects in particular. Because all projects are works in progress, each story is still emerging. The future CVI organization should collect and share these stories as they emerge.

The case stories will be most effective when they illuminate the indicators. For example, if the indicator is water quality, possibly measured by the population of a certain species of fish, a companion story might portray the people who helped create fish habitat through green bulkheads. Indicator data, as they accrue over time, can be included in new stories.

The following are suggestions for the kinds of stories that will catch the attention of the public and influential people who can reinforce the CVI. This effort can proceed at three levels: printed, audio, and video media—each with increasing effectiveness and cost. At a minimum, the new CVI organization should produce an ongoing stream of press releases, written by people who understand the media, which colorfully portray the human side of progress toward regeneration of the Cuyahoga River Valley. Over time, as harder evidence of progress accumulates in the form of indicators, that data should be included in the stories.

The generalization that applies to all

Herons are increasingly common in the Cleveland area and the Cuyahoga River.

these projects is that the most effective stories always portray effects on individuals. Look for ways in which a project improves someone's neighborhood, creates a job or business opportunity for a particular person, is part of a person's job, or makes someone feel better about his or her city.

Dredging: Though most of the valley-regeneration stories are clearly positive, the story of dredging may be an awkward one to tell. It appears that without dredging, major industries on the river cannot operate economically (though this question may not have been thoroughly analyzed from an objective perspective). On the other hand, if dredging continues as it is practiced on the Cuyahoga today, the river cannot fully recover biologically.

While the authors of this report make no judgment, some people in Cleveland suggest that many current riverside industries will not always stay in Cleveland and that one day, changes in the global market will force a shift in the city's industrial sector and the need for the present dredging regime. At the same time, continued budgetary pressures may restrict the ability of the Army Corps of Engineers, which dredges the river, to dredge the Cuyahoga to the needed depths. These trends may converge more quickly than is imagined today.

The new CVI organization would serve the community well by developing stories that promote pragmatic discussion of these issues and that explore options in the event of future declines in the Corps' budget or changes in the mix of present industries.

Stormwater Ordinance: The principal effect of an ordinance will be to require site developers to design their projects to capture and filter significant portions of rainwater before it leaves the site. In many cases, on-site stormwater treatments are part of an attractive landscape design. An initial story about the ordinance could outline its effects on development design and provide comparative photos of developments with or without such treatments. A subsequent story could feature the people developing and executing the designs in Cleveland, and quote realtors or appraisers regarding the

Table: Benchmarks and Indicators of Progress

Activity	Project Benchmarks	Environmental Indicators	Social Indicators	Economic Indicators
Dredging	1. City or U.S. Army Corps of Engineers conducts study on alternative transportation or sediment disposal methods	1. ⇑ Dissolved oxygen levels in the ship channel 2. ⇓ Concentrations of heavy metals in the water 3. ⇑ Scores on the IBI and QHEI indices 4. ⇑ # of species and pop. of native fish species	1. Perceived support for and collaboration with industry by public sector	1. ⇑ Employment 2. ⇓ Use of public funding 3. Cost savings through reuse of resources (e.g. reuse of dredged sediments)
Stormwater Ordinance	1. City approves a new stormwater ordinance encompassing the entire city	1. Improved runoff or river water quality 2. ⇓ Volume of runoff 3. ⇓ Erosion & sedimentation in streams 4. ⇑ Urban vegetated areas (e.g., acreage of planted medians, roofs, parking lots) 5. ⇑ Habitat for birds, insects	1. ⇑ Attractiveness of vegetated stormwater treatments 2. Pride in "doing things right"—part of greening the city.	1. ⇓ Costs to developers 2. ⇓ Operation & maintenance costs to landowners 3. ⇓ NEORSD operations & maintenance costs 4. ⇓ NEORSD capital costs 5. ⇓ Urban heat-island effect and cooling costs
Stormwater Agency	1. An agency (e.g., sewer) accepts stormwater responsibility 2. Fund established for BMP retrofits & restoration 3. Economic incentive to build & retrofit with BMPs	Same as above	Same as above	Same as above
Habitat Restoration (pocket wetlands, fish shelves)	1. RAP revegetates 3 pilot sites in Ship Channel 2. Pilot sites cause more restoration 3. ⇑ Public acquisition of river frontage	1. ⇑ Aquatic habitat & fish pop. 2. ⇑ Native vegetation & wetland habitat	1. Use of small parks by neighborhood residents & industry workers 3. ⇑ Recreational use of river and riverbanks	1. ⇑ Nearby property values 2. ⇓ Private bulkhead maintenance costs
Green Bulkheads	1. Green bulkheads designs finalized 2. City approves bulkhead designs 3. Bulkheads installed	Same as above	Same as above	Same as above

Tributary Restoration	1. Senate allocates sufficient funding 2. Public acquires the land for tributary restoration	1. Feet of tributary restored 2. ⇑ In birds & aquatic wildlife on sites (e.g., larval fish pop.). 3. Improved water quality at the restored sites (e.g., dissolved O_2 levels)	1. ⇑ Public use (workers, residents) 2. Improved community health and safety 3. Improved perception of the industrial valley	1. ⇑ Nearby property values 2. CDCs expand restoration upstream (e.g., greenways)
Site Remediation	1. County to remediate riparian restoration sites	1. No pollution migration from the site's soils to river 2. Acceptable soil quality for restoration	1. ⇑ Community pride	1. ⇑ Nearby property value
Green Building for Industries	1. Industrial Land Bank adopts a green building standard 2. City adopts municipal or more encompassing green building standard	1. ⇓ Energy & water consumption 2. ⇑ Local material use 3. ⇑ Construction/demolition recycling	1. ⇑ Quality of work environment	1. ⇑ Employment 2. ⇑ Worker productivity 3. ⇓ Demand on public infrastructure/resources 4. ⇑ Nearby property values 5. New generation of greener industry
Waste = Revenue	1. Businesses trade waste products 2. Waste trading network established 3. Detailed analysis of waste trading potential in valley (aka industrial symbiosis)	1. ⇑ Resource efficiency 2. ⇓ (Hazardous) waste in landfills 3. ⇓ Waste-haul distance	1. Improved public image and relations between businesses and communities	1. ⇑ Cost savings to participating businesses 2. ⇓ Public cost of landfilling/treating waste

1. The Index of Biological Integrity (IBI) synthesizes biological metrics that reflect the impact of human actions on biological attributes to depict the overall "health" of a waterway. A score of 50 is considered "exceptional." The Qualitative Habitat Evaluation Index (QHEI) assesses the physical traits of a waterway using metrics on substrate, channel morphology, in-stream cover, etc. A score of 100 is considered "exceptional."

2. While the new tunneling system will have the capacity to store a large volume of wastewater, the operation and maintenance costs of the treatment facilities will be lower if less volume needs processing.

3. Impermeable surfaces like asphalt and concrete have lower reflectivity and emissivity rates and do not produce evapotranspiration like plants. Natural stormwater solutions will provide shading and decrease heat absorption, thereby lowering cooling costs.

4. If neither the conservancy district nor the stormwater agency is established, the city/county/region should find another means of creating a funding mechanism to cause stormwater retrofits and watershed restoration.

5. The Cuyahoga River Remedial Action Plan is working to pilot aquatic habitat retrofits into the ship channel bulkheads (pocket wetlands, fish shelves). The locations are at the northern end of the Ohio and Erie Canal, the boat slip on Scranton Peninsula, and a parcel below I-490 by Mittal Steel.

effect of the designs on property values. As these changes improve water quality and reduce combined sewer overflows, stories could include interviews with biologists, anglers, and environmental-agency personnel.

Stormwater Agency: Northeast Ohio may one day have a stormwater agency (or agencies) that will charge stormwater fees for impermeable coverage, much as the sewer agency currently charges for water usage. Through this revenue, the agency will restore watersheds and riparian corridors, and retrofit built environments. Stories regarding this project should be similar to those suggested for the stormwater ordinance.

Habitat & Tributary Restoration: Restoration of the ship channel and its tributaries offers an opportunity to design, discuss, and tell a story of ecological restoration opportunities: native vegetation, fish habitat, public spaces, and possibly access by recreational boaters. Biologists and landscape architects can discuss specific design possibilities. Staff from nearby Community Development Corporations might plan further restoration. The restoration itself will offer plenty of visual images that will make for compelling stories.

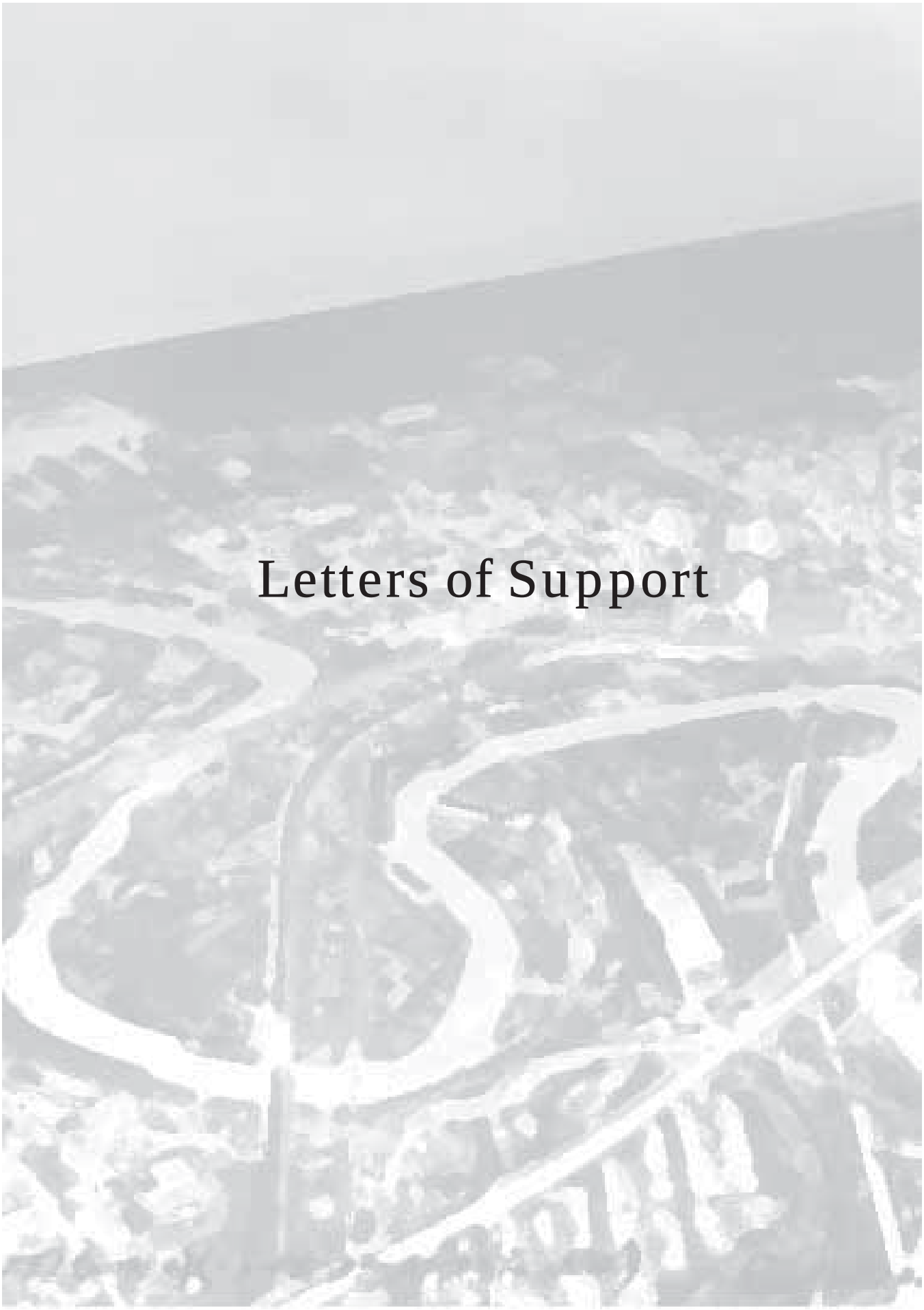
Green Bulkheads: This project may be the most interesting to the public, regardless of its direct effect on people. Converting a cold steel barrier into something that supports life is a surprising and visually interesting story. Stories may include conversations with various bulkhead designers and Jim White at RAP, and the story of the construction itself.

Site Remediation: While restoration creates new positive conditions, remediation improves a negative condition. Therefore, its story may be less interesting to the public. However, if these remediation efforts can be placed in the context of an overall river-valley recovery process, the story may prove more interesting. There might also be interest in the particular remediation techniques being employed or the collaborative institutional mechanisms that make it possible.

Green Building for Industries: This subject is well established in Cleveland. Therefore, unlike the green-bulkhead stories, novelty will produce green-development stories. The local Green Building Coalition has been a genuine innovator and may be interested in commenting on the city adopting green guidelines for the industrial river valley. The most effective story would describe the innovative features and life-cycle costs of a particular industrial building as a result of LEED certification, and what the owner thinks about those features.

Waste = Revenue: Businesses have been finding ways to use or sell waste for many years. The new feature of this project is that disinterested third parties, RMI and E4S, have brought industry people together to generate a waste-trading network. The deals that resulted point to the potential benefits of a larger-scale waste-trading effort.

Though business people are often reluctant to make public their internal workings, especially when related to waste, the business people involved in this project appreciate the value of the CVI and may be willing to discuss these efforts.



Letters of Support

216.241.3114
Fax 216.241.6560
1845 Guildhall Building
45 Prospect Avenue West
Cleveland, Ohio 44115

The George Gund Foundation

Mr. Paul A. Alsenas
Director
Cuyahoga County Planning Commission
323 Lakeside Avenue, West
Suite 400
Cleveland, OH 44113-

December 15, 2005

Dear Mr. Alsenas:

I am pleased to inform you that the Trustees of The George Gund Foundation have approved a two-year grant of $500,000 to the Cuyahoga County Planning Commission (Grant Number 05-317) for the Cuyahoga Valley Initiative organizational planning and start-up. This action has been taken in response to your letter and proposal of June 30, 2005, and is made on the terms described below.

A payment schedule for your grant will be determined when the conditions outlined below have been met. Grant payment cannot be made until the countersigned copy of this letter

It is our understanding that grant funds will be used for the Cuyahoga Valley Initiative organizational planning and start-up.

Terms and Conditions:
First payment of $250,000 will be paid to the Cuyahoga County Planning Commission for work as outlined in the proposal.
Second payment of $250,000 is committed, but payment will be subject to identification of new nonprofit as planned in proposal.

Under the laws of our Federal Government relating to the Foundation, all grants must be used solely for educational, scientific, or charitable purposes. The objective of this grant, as indicated above and described in the background material you have provided, may be modified only with the Foundation's approval.

It is our understanding that the Cuyahoga County Planning Commission has been determined to be a tax exempt instrumentality of the State of Ohio as described in Section 170 of the Internal Revenue Code. If there is any change in this status and/or classification, please let us know promptly. In event of loss of tax exempt status under Federal laws, or a change in classification, no further expenditures of grant funds are to be made and any unspent grant funds are to be returned to the Foundation.

Would you please arrange for our Foundation to receive reports on the dates indicated on the enclosed report and payment schedule forms. Please duplicate the Grant Reporting Form if more than one report is requested under the terms of this grant. Any additional correspondence should be sent to Jon M. Jensen, Senior Program Officer, and should reference the 05-317 grant number. When there are press releases, photographs, and any published material about this grant and the work it has made possible, we would appreciate receiving copies.

If this letter correctly sets forth your understanding of the terms of this grant and there has been no change in the IRS status and classification of the Cuyahoga County Planning Commission as indicated above, will you please countersign the attached copy and return it to me.

Sincerely,

David T. Abbott
Executive Director

JMJ:lr
Enclosures

Cuyahoga Soil and Water Conservation District

6100 West Canal Road • Valley View, Ohio 44125-3330 • Phone: 216/524-6580 • FAX: 216/524-6584

April 18, 2006

Mr. Michael Kinsley
Rocky Mountain Institute
1739 Snowmass Creek Road
Snowmass, CO 81654

Re: Storm water management-Cleveland collaboration

Dear Michael:

The Cuyahoga Soil and Water Conservation District (SWCD) is working with the City of Cleveland to assist in the implementation of their NPDES Phase II-MS4 Permit. As you know, a new administration is now in place and working on new initiatives.

The City and Cuyahoga SWCD have established a Memorandum of Understanding, which is a working agreement, to implement storm water initiatives. Our assistance to the City, relative to storm water management, includes:

- Training of City staff in the proper application of best management practices for new and redevelopment sites to help reduce sedimentation in local waterways and Lake Erie
- Storm water pollution plan reviews for new developments larger than one acre of part of a larger plan of development. Plan review recommendations take into account drainage and natural resource issues and recommendations are made regarding the best management practices for construction and post construction
- Develop reports to the City and developer relative to plan review recommendations
- Monthly inspections of development sites with follow up reports
- Assist the City with review and adoption of required ordinances for erosion and sediment control and post construction storm water management
- Coordination of public education and public involvement
  - Activities specific to the Euclid Creek watershed
  - Educational poster on rain gardens
  - Presentation regarding rain gardens; monthly presentations are being provided, mostly to garden clubs
  - Articles regarding bio-retention and storm water issues in the Cuyahoga SWCD newsletter
  - Article regarding bio-retention in Great Lakes Commission newsletter
  - *Plain Dealer* article regarding bio-retention
  - Interview with WKSU radio station for a storm water program, *not aired*
  - Educational literature regarding rain gardens

- Stream stewardship campaign (storm water awareness)
- Big Creek clean up on June 3, 2006
- Work with the Green Building Coalition Education Committee and building facility managers about capturing storm water
- Presentation regarding Site Planning Tools for Storm Water Management; presentations provided upon requested

Nearly every community in Cuyahoga County is required to implement a storm water management plan. As an outgrowth of the Regional Storm Water Task Force, the Cuyahoga SWCD has created the following tools for the use by each community, including the City of Cleveland. It is our opinion that a uniform approach across the county (and across county boundaries) will eliminate confusion among practitioners, thus providing a more uniform approach to resolving water quality issues, in a more timely fashion. This is especially true in the review of storm water pollution prevention plans and the implementation of best management practices, such as the ordinances for erosion and sediment control and post construction ordinances. The tools for storm water management include:

- Northeast Ohio Regional Model Ordinances for erosion and sediment control and post construction storm water management (especially for properties connected to separate storm water sewers or all properties)
- Community Riparian and Wetland Guidance
- Conservation Easements
- Storm Water Management Guidance (currently being developed by the SWCD)

The City of Cleveland is aware of its obligations and efforts are underway to tackled storm water issues. Due to the nature of high priority concerns, the City is working as quickly as possible. Ed Rybka, the Director of the Building and Housing Department, informed me that an internal meeting of the departments of Water Pollution Control, Building and Housing, Planning, and Law is scheduled for later this month. The purpose of the meeting is to move forward on the storm water issues.

I hope this is the information you need. If you need more clarification, please call.

Sincerely,

Janine Rybka
District Administrator

April 27, 2006

Michael Kinsley
Rocky Mountain Institute
1739 Snowmass Creek Road
Snowmass, CO 81654

Dear Mr. Kinsley:

Over the past year we have made significant progress on the idea of green bulkheads (also known as high performance shoreline management systems), prototypes for bulkheads that would functionally replace steel sheet pile bulkheads without sacrificing structural or navigation needs, while also providing habitat for fish. The many public and private landowners along the river who do not transport materials on the river derive no benefit from the steel sheet pile bulkheads and may be willing to pilot this new technology. Landowners who adopt green bulkheads may receive the following benefits: enhanced aesthetics, provision of aquatic habitat, opportunity to obtain stream bank restoration mitigation credits, improved public image, and increased property values.

This spring, the Cuyahoga River Remedial Action Plan (RAP) in partnership with the Cuyahoga County secured $500,000 of the $2 million federal funding requested to develop green bulkheads. With this funding, we are ready to proceed with the prototype design process. The next step is to assemble a technical advisory committee of engineers, regulatory professionals, hydrologists, biologists, and ecologists who will establish a list of minimum criteria that designs must satisfy. We will then hold a design collaborative; the most promising designs will be constructed with federal funding and physically tested in the Cuyahoga River. The process, from committee assembly to design selection, will take about a year. Since bulkheads can have a lifecycle of fifty years, we are discussing with the Army Corps of Engineers what indicators and standards will best suggest long-term success.

We are also currently discussing with a few public agencies regarding the final ownership of these shoreline properties. Since standard bulkhead replacement costs around $4,000 to $5,000 per linear foot, bulkhead replacement can drastically undercut or even negate the value of a property. Some landowners have expressed interest in the idea of deeding – through easement or donation – riverside property to the City in return for help in replacing the bulkheads. Public ownership may also be beneficial in assuaging concerns about brown fields liability and the risk of green bulkhead failure.

If successful, green bulkheads may provide a new industry for Cleveland that could be applied to similarly channelized rivers around the Great Lakes, and perhaps beyond. The Cuyahoga County

1299 Superior Avenue ~ Cleveland, Ohio 44114 ~(216) 241-2414 Ext. 307
www.CuyahogaRiverRAP.org

Planning Commission intends for green bulkheads to be the default design except at docking sites.

We appreciate RMI's collaboration with RAP; RMI has greatly helped promote awareness, understanding, and interest in green bulkheads and other forms of riparian restoration on the Cuyahoga. RMI's meetings with individual landowners along the river, including Forest City, and its workshop on Revegetating the Cuyahoga accelerated and strengthened the formation of our network.

At RAP's recent major introduction of the green bulkhead project at the Cleveland Engineering Society, several attendees expressed knowledge of the concept as a result of RMI's workshops and conferences. The progress that we've achieved to date is heavily dependant on the effort and energy of RMI's terrific staff and its information gathering, formation of meetings, and promotion of networks.

Sincerely,

James White

Executive Director, Cuyahoga River Remedial Action Plan
River Navigator, Cuyahoga-American Heritage River Initiative

1299 Superior Avenue ~ Cleveland, Ohio 44114 ~(216) 241-2414 Ext. 307
www.CuyahogaRiverRAP.org

June 27, 2006

Michael Kinsley
Rocky Mountain Institute
1739 Snowmass Creek Road
Snowmass, CO 81654

Dear Michael:

The Cuyahoga River ship channel with its dredged depth and armored shoreline creates a harsh environment for aquatic life, especially larval fish. The Cuyahoga River Remedial Action Plan (RAP), in conjunction with the U.S. Army Corps of Engineers and other stakeholders, has developed a prototype pocket wetland design for armored shorelines that would create much needed aquatic habitat. These roughly fifty- by thirty-foot wetlands are small enough and cheap enough to be feasibly implemented in numerous locations along the ship channel. These pocket wetlands would be eligible for wetland or stream mitigation credits and funding from Ohio EPA. They would also help beautify areas along the ship channel and, when accessible, serve as educational sites for the public.

Over the past year, RMI has greatly helped RAP publicize this design concept and engage landowner interest in the implementation of pocket wetlands. As RMI concludes its work on the Cuyahoga Valley Initiative's Regeneration Project, RAP commits to advancing pilot pocket wetland projects. One site with great potential is a parcel owned by Mittal Steel that is situated along the Cuyahoga River ship channel and Interstate-490. Both Mittal Steel and the City Planning Commission have shown interest in having this parcel serve as the site for the first pocket wetland pilot. We will continue to work with Mittal Steel, the City Planning Commission, and the County Planning Commission to make sure this project goes forward. We are also working with a public agency that has certain wetland mitigation requirements to see if some of the mitigation might be sited along the ship channel in the form of pocket wetlands.

We look forward to much success for ship channel habitat and will keep you abreast of future developments. RMI activity in the project was vital to the progress we have achieved.

Sincerely,

James White

Executive Director, Cuyahoga River Remedial Action Plan
River navigator, Cuyahoga-American Heritage River Initiative

Statement of Support for the CVI/Regen Waste=Revenue Roundtable
May 23, 2006

As a participant in one or more meetings of the W=R Roundtable, I submit my support for the continuation of the Roundtable. I have already found new business opportunities or believe that I will find one if I continue to participate. I also value networking with other business leaders who know the value of turning waste products into business opportunities. I look forward to working with material scientist that may assist the participants in the roundtable with creating new opportunities. Given time this Roundtable may bring new business to the region.

Signed,

Name, Title, Company

John W. Pickens Director of Technology / Alumitech Division / Aleris International

Claude Kennard President Metal Alloy Reclaimers Inc

[illegible] ENV. MANAGER ALCOA CLEVELAND WORKS

Joseph Jasper Jr T2 Officer CSU

Andrew Watterson Sustainability Manager City of Cleveland

Scott [illegible] G.M. Rosby Companies

S Ferguson CEO Zaclon

R Zavoda Mittal Environmental

Christopher Alexander Associate Sr. Planner Cuyahoga County Planning Comm.

CUYAHOGA COUNTY
PLANNING
COMMISSION

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e-mail: cpc@planning.co.cuyahoga.oh.us / web site: planning.co.cuyahoga.oh.us / TDD: 1-800-750-0750

15 June 2006

Martha C. Pickett
Executive Director
Rocky Mountain Institute
1739 Snowmass Creek Road
Snowmass, Colorado 81654

Dear Ms. Pickett:

We at the Cuyahoga County Planning Commission are extremely grateful for the opportunity that we have had to collaborate with the Rocky Mountain Institute on the Cuyahoga Valley Initiative.

We are also pleased to provide a report on the progress that is currently underway to meet the goals that we have worked on together to bring about systemic and lasting change throughout our Cuyahoga Valley Initiative project area and the Regeneration Zone in particular.

RMI's work in Phase I that was documented in their report *Cuyahoga Valley Initiative: A Model of Regeneration* has led directly to CPC's focus on putting RMI's ideas to work throughout the Valley, with a special focus on those changes which will lead to systemic water quality improvements. CPC has also distributed three hundred CDs of the report, over five hundred downloads from the website, and promoted the whole-systems approach advocated by RMI.

The work accomplished under Phase II has led to several new initiatives that the CPC will continue to promote, facilitate, and drive far past the end of RMI's own work.

Holly Harlan, founder of Entrepreneurs for Sustainability and RMI alumna, is leading several businesses in the Cuyahoga Valley Regeneration Zone towards diverting waste away from landfills and towards other businesses to be used as inputs for new or existing industrial operations. Based on the work begun by RMI, a community of industries has formed that has already begun developing purchase and transfer agreements that will make waste trading a reality in the Cuyahoga Valley. The businesses are as large as Mittal Steel's Cleveland Works (the world's most efficient steel mill based on man-hours per ton of steel produced) and include smaller companies such as Zaclon. We are working with Entrepreneurs for Sustainability to continue this work on converting waste to revenue, and to further expand the number of collaborating businesses.

Our relationship with the business community has been fundamentally improved through our work with RMI. Prior to your work, our model for the Cuyahoga Valley Initiative was based on regulatory and statutory interventions that directed how development should take place and how businesses should minimize their negative impacts on the ecological health of the Valley. By showing us how to entice businesses to act in environmentally responsible ways that also increase profits, we see the development of a community of business leaders that see themselves as stewards of the Cuyahoga Valley and that are suggesting strategies and changing their actions in ways that create triple bottom line benefits to the Valley.

By gaining credence with the business community, we have been able to forge partnerships between government representatives, companies, neighborhood representatives, and stewards of the environment where previously adversarial relationships were the norm. It is this style of collaboration that has successfully attracted investments in the Green Bulkhead project, brought about regional initiatives for a sustainable energy strategy, and spurred green building projects throughout Northeast Ohio.

Another exciting project that may shortly come to fruition is the Cuyahoga River Valley Land Restoration Project (LRP). The goal is to acquire several properties at the mouths of the much-degraded Kingsbury Run and Walworth Run tributaries of the Cuyahoga River and to improve the aquatic and habitat health of these tributaries and the entire Cuyahoga River System, reconnect residents and workers within the Cuyahoga Valley to the River, and encourage sustainable economic development along the Kingsbury Run and Walworth Run corridors by restoring these properties to their natural state by removing pollutants, reestablishing wetlands and native vegetation, and daylighting these urban streams. This Regeneration Zone land strategy has been brought to the attention of federal officials, particularly Senator Mike DeWine's office, resulting in the submittal of an appropriations request for FY 2007 through the Coastal and Estuarine Land Conservation Program. Our discussions with the Senator's staff have drawn heavily from RMI's *Cuyahoga Valley Initiative: A Model of Regeneration*.

Local initiatives to address stormwater management in the Cuyahoga River Watershed have been improved through the work of RMI. Interactions initiated by RMI with the Northeast Ohio Regional Sewer District, the Cuyahoga River Remedial Action Plan, and the City of Cleveland are resulting in a greater understanding of how collaborative efforts can bring about water quality improvements in urbanized areas where non-point source pollution is an ever-increasing threat to the health of the Cuyahoga River and Lake Erie. We are looking forward facilitating these regional collaborations.

Finally, as a result of Phase II, RMI has contributed to introducing systemic thinking to stakeholders throughout the Cuyahoga Valley. The work on the High Performance Shoreline Management System, otherwise known as the Green Bulkheads, has been directly influenced by RMI. In cooperation with the Cuyahoga River Remedial Action Plan, the CPC is working on the design, development, and construction of a prototype Green Bulkhead that would provide a stable and secure division between dry land uses and the ship channel, promote recovery of a vegetated shoreline, provide habitat and dissolved oxygen for migrating fish, are stable enough to withstand prop wash and shore line scour from passing freighters and seasonal ice scour, and not consume additional land area that would inhibit development. Some of the most exciting work on this has come from the maritime users of the River, including businesses represented by the Lake Carriers' Association and the Flats Oxbow Association, who are assisting us in the design and location of the prototypes. This kind of collaboration between

planners, environmental advocates, and businesses has led to $500,000 in federal funding for the project, with the possibility of much more.

Systemic thinking has also informed our approach to our development of a Maritime Facilities Study for Cleveland Harbor that integrates economic development, maritime facility planning, and environmental protection in a single study that has been funded by the Board of Cuyahoga County Commissioners and that will be directed by the CPC.

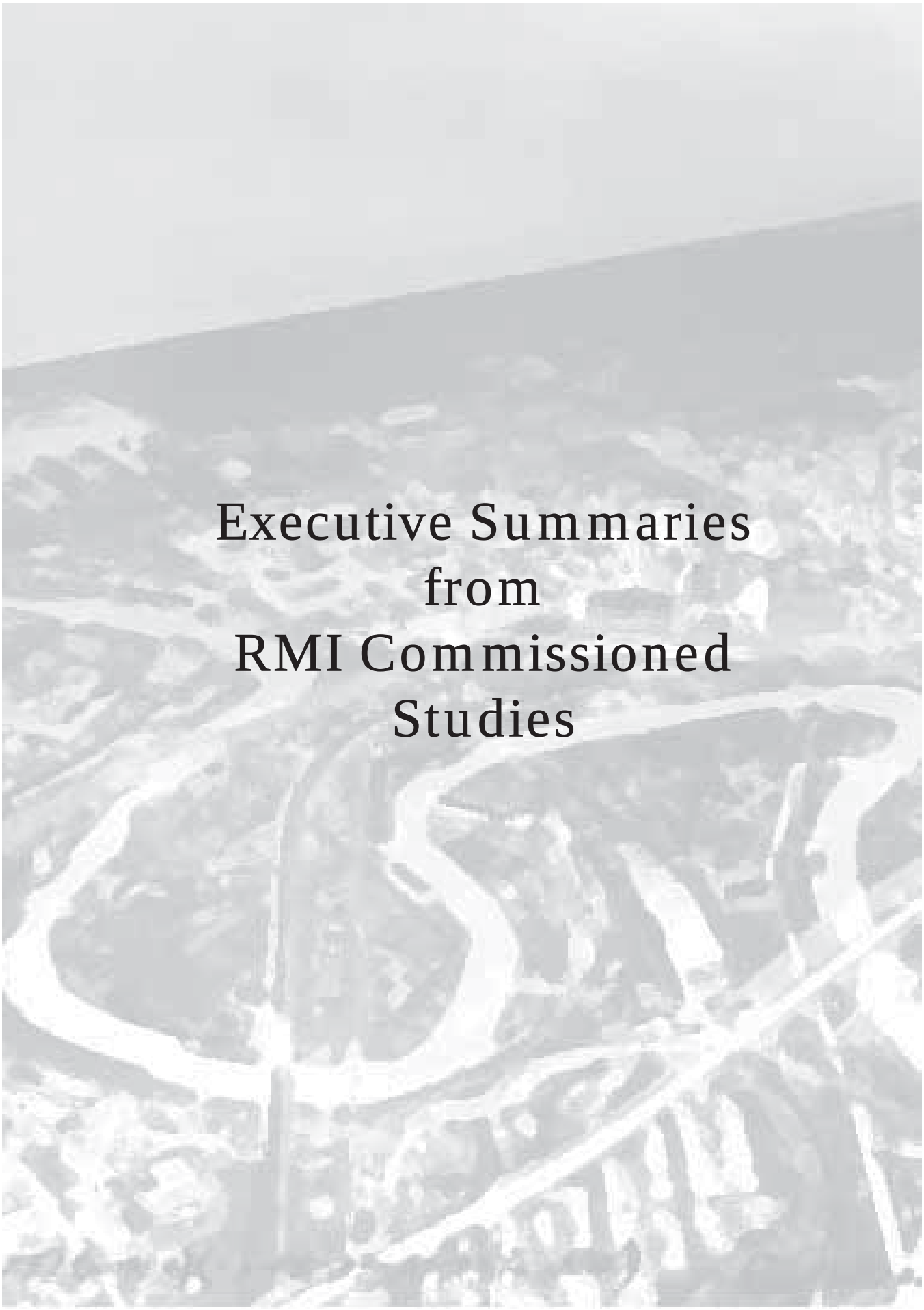
In the aggregate, these whole systems perspectives will fundamentally transform the Cuyahoga River and the Navigation Channel, which is the key to the redevelopment and restoration of the Regeneration Zone.

This legacy of sustainability and Valley transformation will continue through the work of the CPC and the recent Gund Foundation-funded development by the CPC of an organization whose purpose will be to implement these and many other measures throughout the Cuyahoga Valley. Needless to say, without the generous support of the Joyce Foundation, the George Gund Foundation, and the Cleveland Foundation, this work would not have been possible.

We hope to work again with you in the future, and we look forward to periodically providing you and the foundations updates that illustrate the positive changes made throughout the Cuyahoga Valley that have resulted from your work.

Sincerely,

Paul A. Alsenas
Director



Executive Summaries from RMI Commissioned Studies

Designing a Regeneration Zone for the Cuyahoga River Valley

Project Component: Ecological Restoration

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Summary

The potential for ecological restoration of the lower Cuyahoga River is presented as part of a planning for a Regenerative Development Zone (RDZ) in industrial/commercial land near downtown Cleveland. First, hydrology, water quality, and fish and invertebrate data and composite biological indicators are presented for this lower reach of the Cuyahoga River. While there are some signs of recent improvement in river fish richness, the biological indicators generally still indicate poor aquatic habitat. Channel dredging, large ship use, and rigid shoreline pilings limit the diversity of habitat and ensure continual resuspension of chemically contaminated river sediments. We present three general alternatives for restoration of the riverine system. One is the creation of 70 acres of oxbow wetlands on the floodplain terrace with seasonal hydrologic connections to the river but otherwise with connections to upland urban runoff. A second alternative is for the restoration of a 0.5-mile reach of a tributary stream, Kingsbury Run, to the Cuyahoga River, thus avoiding some of the problems associated with restoration of the Cuyahoga River itself while providing a significant habitat connected to the river. A third alternative considered is 5.6 miles of “pocket wetlands” along the Cuyahoga River riparian edge itself. Costs and ecological benefits of each of these options are provided. Cessation of river channel dredging and improvement in water quality in the upstream river are vital to any effective restoration techniques in the lower Cuyahoga River. Data on costs of a detailed study of the lower Cuyahoga River and of demonstration projects that would be needed as the next step are also provided.

Review of the Doan Brook Watershed Study Report

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Executive Summary

Across the nation, urban and urbanizing communities like those in the Doan Brook Watershed are faced with the need to meet increasingly stringent water, wastewater, stormwater and other environmental regulations. Historically, urban environmental problems were addressed with centralized, hard infrastructure solutions, featuring end-of-pipe treatment works. Today, low impact development (LID) is a relatively new approach to stormwater management receiving increased attention as a potentially cost effective means of reducing the impacts of development on the landscape. By seeking to minimize stormwater runoff at its source, LID technologies minimize the need for runoff mitigation infrastructure downstream in the watershed.

The purpose of this review was to assess the extent to which low impact approaches were considered in the development of the Doan Brook Watershed's various management plans. These plans were developed through a participatory process involving the Doan Brook Watershed Study Committee (WSC) and the Northeast Ohio Regional Sewer District (NEORSD), and were summarized in a document entitled the Doan Brook Watershed Study Report (DBWSR), dated August, 2001. The following review is based almost exclusively upon the data and information as presented in that approximately 450-page document.

The DBWSR describes the development of four management plans:

- The Biotic Management Plan
- The Channel and Floodplain Management Plan
- The Stormwater Management Plan
- The Wastewater Management Plan

In addition, and resulting from a decision-making process external to development of the DBWSR, the NEORSD was to construct the Heights/Hilltop Interceptor Sewer (HHI Project). The purpose of the HHI Project was to reduce the volume of combined sewage discharges to Doan Brook from 759 to approximately 439 million gallons per year. The decision to construct the HHI Project is not addressed in the DBWSR. Instead, the "baseline conditions" described in the DBWSR refer to the Doan Brook Watershed with the HHI Project already in place. Consequently, no critique of the alternatives to the HHI Project could be provided in this review.

A summary of the plans as presented in the DBWSR follows below:

The final recommended Biotic Management Plan involved both direct manipulation of plant and animal populations, and indirect management of the environs in which the organisms live. The plan sought to a) enlarge and diversify the biotic community, b) increase and diversify habitat, and c) lead to the development of a lake management plan. The plan did not specifically address the diffuse sources of the poor water quality that are responsible for the degraded biological conditions in the watershed. Rather, it assumes that these factors will be addressed by the other three plans.

The final recommended Channel and Floodplain Management Plan included a variety of practices that serve to a) stabilize degrading channel banks, b) reduce flooding, c) control trash and debris, d) improve refuge areas and habitat and e) remove fish migration barriers. Although

there was ample mention in this chapter of the DBWSR of the extent to which runoff from upstream urban development is a cause of channel instability and flooding, the final recommended practices did not include any distributed, low impact runoff capture measures in the Doan Brook watershed.

The purpose of the Stormwater Management Plan was to address the problems associated with stormwater runoff quality (heavy metals, bacteria, phosphorus, sediments, toxics, oil, road salt) and quantity (high flow velocities, low base flows). The final recommended plan includes a combination of policy actions, operational changes, and capital improvement projects, with emphasis placed on implementing the six minimum control requirements of NYPDES Phase II storm water program. The recommendations are classified as measures that a) reduce the sources of pollutants carried in stormwater, b) reduce the amount and improve the treatment of stormwater runoff. However, although several capital projects for stormwater storage and infiltration are mentioned, the final plan falls short of any significant commitment of resources towards the retrofit of distributed runoff control measures throughout the watershed.

Lastly, the purpose of the Wastewater Management Plan was to address the inability of the existing Doan Brook Interceptor to adequately convey stormwater runoff and wastewater to the treatment plant. As interpreted in the DBWSR, regulations required that either additional wet weather flow be captured, or overflows be treated and/or stored. Consequently, the framers of the DBWSR took the position that "new facilities are necessary to relieve surcharge in the existing interceptor system and to allow for the capture of additional wet weather flows." This chapter of the DBWSR also does not consider low impact runoff reduction measures. Rather, the final plan calls for the construction of a $118 million tunnel, which would reduce CSOs by proving storage of approximately 45 million gallons of wet weather flow. In addition, the plan calls for a number of additional practices that would involve a) upgrading the existing sewer system and b) adding sewer system capacity.

There appear to be several reasons why LID technologies were not seriously considered in any of the management plans. First, certain decisions appear to have been made outside of the Doan Brook Watershed Study process. The HHI project, for example is a major infrastructure investment projected to reduce CSOs in the watershed by almost 50%. Although the reduction in CSOs is significant, the decision to construct an interceptor pipe represents a large commitment of the District's financial resources. Because the planning of the HHI project was external to the watershed planning process, comparison of the benefits of this project with a distributed LID approach was not presented in the DBWSR. Ideally, these two decision making processes would have been fused.

Secondly, the framers of the DBWSR suggest throughout the report that distributed runoff reduction measures are not technically feasible, not cost effective, not easily implemented, and not reliable. Based on the information provided in the DBWSR, and on the increasing attention LID technologies are receiving nationwide, these claims appear to be unsubstantiated.

Thirdly, the framing of alternatives appears to have diverted the attention of the WSC away from consideration of the full potential of low impact runoff reduction measures in the watershed. This is perhaps most obvious in the alternatives presented in the development of the Wastewater

Management Plan, none of which include runoff reduction measures. The alternatives presented in the development of the Stormwater Management Plan also do not include a concerted effort to incentivize the retrofitting of BMPs *throughout* the various subwatersheds, at a level at which significant runoff reductions would be achieved. Further, the development of other management plans – most notably the Biotic Management Plan – forego discussions on these issues, and rely on other sections of the DBWSR for adequate coverage.

For all these reasons, it is not possible to evaluate whether a comprehensive LID approach would have been more or less cost-effective than the HHI Project, or any of the final recommended practices included in the DBWSR.

We conclude this report by recommending that the final recommended management plans be revisited after conducting an independent study into the cost effectiveness of LID as a means of achieving the goals of the four management plans.