A jack-in-the-pulpit growing in a wild area along the Doan Brook. Photograph by L. C. Gooch.

Our conservation must be not just the classic conservation of production and development, but a creative conservation of restoration and innovation. Its concern is not with nature alone, but with the total relations between man and the world around him. Its object is not just man's welfare but the dignity of man's spirit.

— Lyndon B. Johnson

Message to Congress, February 8, 1965

8 What Can We Do? Doan Brook Restoration

The last several chapters have outlined a sometimes disturbing picture of the problems of Doan Brook. In a nutshell, the brook now runs through a heavily urban area, and it suffers from all of the maladies that can be expected in an urban stream. It has too much water during floods and too little during droughts; its waters are polluted by the city around it; it is buried and confined; its aquatic community is poor. Unlike many similar urban streams, though, much of the brook still runs through a relatively undisturbed riparian corridor that hosts a wide variety of birds and animals and preserves some of the stream's native beauty. What avenues can we now take to make the most of the brook's assets and minimize its defects? How can we preserve the Shaker Lakes, the gorge, and Rockefeller Park for future generations? What is already being done? In this chapter we will explore the physical measures that might be taken to restore the brook. The political and social process of making restoration a reality is the subject of Chapter 9.

8.1 Simplifying the Problem: Getting a Handle on What Doan Brook Needs

The array of problems that confronts Doan Brook can be bewildering. How can the problems be organized so that we can begin to formulate solutions? In order to avoid being overwhelmed as we sort through alternatives for Doan Brook restoration, it is useful to keep the following three categories of problems in mind:

- **Problems of Hydrology** — Flooding, too little water during dry periods, undersized existing channels and culverts, and the condition of the Shaker Lake dams.
- **Problems of Water Quality** — Contamination in the brook and the Shaker Lakes.
- **Problems of Habitat** — Physical and chemical conditions in the brook and its surroundings that are detrimental to healthy aquatic and riparian ecosystems.

Issues associated with Doan Brook hydrology, water quality, and habitat are detailed in Chapters 7, 6, and 4, respectively. Table 8-1 presents a working summary of Doan Brook's problems sorted into these three categories. As the table shows, the three categories interact with each other. For example, hydrologic problems and poor water quality contribute to poor habitat; elevated sediment levels created by hydrologic problems cause poor water quality. We will use the three categories as a framework for evaluating Doan Brook restoration measures, keeping in mind the interactions among different kinds of problems and the likelihood that a restoration measure that helps in one area may also help in another.

8.2 What Are We Trying to Accomplish? The Target of Restoration

Before we plunge into a discussion of the many options for restoring Doan Brook, it is useful to consider briefly what it is that we are trying to accomplish. What exactly do we mean by stream restoration?

In a general sense, stream restoration means returning a stream to the condition it was in before humans settled in its watershed.

Table 8-1	Summary of Doan Brook's Problems							
Problem	**Source of the Problem**							
	Hydrology						Water Quality	
	Giddings Brook Div.	Increased Runoff	Lakes	Stream Modifications	Culverts	Decreased Infiltration	CSOs	Contaminated Runoff
Hydrologic Problems:								
Damaging Floods	○	○	+	○	○			
Dam Safety		●	+					
Inadequate Channel or Culvert Capacity	○	○	+	○	○			
Stream Channel and Bank Erosion	○	○	+	○				
Low Dry Weather Flows						●		
Poor Water Quality:								
High Bacteria Levels							○	○
High Nutrient Levels							○	○
Elevated Salt Levels								●
Elevated Sediment Levels	○	○	+					○
Trace Contamination							○	○
Increased Temperature			○	○				
Degraded Habitat:								
Low Species Diversity	○	○		○	○	○	○	○
Lake Eutrophication							○	○
Poor Physical Habitat	○	○		○	○	○		
Blocked Migration Pathways			○	○	○			

● Entire Source
○ Partial Source
+ Helps the Problem

However, it is unrealistic to think that a stream in a heavily urban watershed like Doan Brook's can be completely restored through human efforts. Such a complete restoration would require drastic reduction of the number of people in the watershed and destruction of the buildings and streets we've created, followed by a period of many years during which the natural ecosystem could reestablish itself. So, when we talk about restoring Doan Brook we are talking about moving the stream back toward its original condition without expecting ever to achieve a stream that could be mistaken for the undisturbed brook.

As we begin, we must decide what aspects of the brook's character we will try to restore. Do we want flows in the stream to return to pre-development levels? Or do we want to make a more moderate reduction in flow and, at the same time, adjust the stream channel so that it can both carry the flow and accommodate a healthy ecosystem? Do we want to prevent any reasonable possibility of flooding that will have impact on humans, or do we want to live with some flooding? Do we want lakes that are aesthetically pleasing and that continue to be so for the next generation? Do we want a stream in which we can safely wade and fish? Do we want a self-sustaining ecosystem so that there will be fish to be caught? How much can we afford to do?

Figure 8-1 Canoeing on the Lower Shaker Lake — ca. 1900. Postcard from the collection of the Shaker Historical Society, Nord Library, Shaker Heights, Ohio.

Obviously, there are many possible targets for restoration. Setting goals for Doan Brook will need to involve many people so that different perspectives and interests are considered. The necessary goal setting is part of the watershed planning process discussed in Chapter 9.

8.3 What Methods Are Available? The Universe of Restoration Techniques

The list of actions that could be taken to preserve and restore Doan Brook — that is, to improve its hydrology, water quality, or habitat — is long. Restoration projects may be large, aiming to make a substantial change with one action and requiring strong political backing and significant financial resources. They may be small, seeking to make a slight improvement or to address the problems of a small part of the watershed and requiring less political unanimity and more modest financing. Or, they may muster the efforts of many individual citizens of the watershed and seek to improve the condition of the brook by the cumulative effect of many very small actions.

Any given restoration project, whether large, small, or the cumulative result of citizen action, can improve the brook by one of several mechanisms:

- It can reduce or eliminate the source of a problem **(source reduction)**. For example, reducing fertilizer use reduces a source of nutrients to the brook.
- It can treat existing contamination by diverting it from the watershed for treatment elsewhere, by treating it before it reaches the brook, or by treating it within the brook itself **(treatment)**. Diversion of sanitary sewage from the brook to the wastewater treatment plant is the major treatment approach now used for Doan Brook. Treatment techniques such as the construction of treatment wetlands[1] could be used within the watershed.
- It can divert or delay flow in the brook **(flow control)**. The Shaker Lake dams and the Martin Luther King, Jr., Boulevard (MLK) detention basin are examples of flow control projects.
- It can improve the condition of the stream channel **(channel restoration)**. The biorestoration[2] of some of the stream banks downstream from the University Circle culvert is an example of channel restoration.
- It can maintain existing features that are critical to the stream **(maintenance)**. Preservation of the Shaker Lakes is an example of maintenance.

The following three sections look at some of the restoration techniques that would have significant impact on problems of hydrology, water quality, and habitat, respectively. Many methods appear in more than one section, since many approaches to restoration address more than one kind of problem. A technique that helps solve more than one problem is discussed in each appropriate section. The final section of this chapter summarizes all of the restoration methods and offers a first attempt at an evaluation of the different approaches. The list of techniques presented here is not complete. Other approaches that deserve consideration will arise as work on the Doan Brook watershed management plan goes forward.

Because there are so many possible approaches to Doan Brook restoration, it is difficult to summarize them effectively. Brief descriptions of the more significant restoration methods are given in the text, with a more thorough discussion of

1 Wetlands provide a natural filter for contaminated water, causing some contamination to settle out and absorbing other contamination (particularly nutrients) into their vegetation. Properly designed and maintained wetlands can effectively treat non-toxic contamination.

2 Stream channel biorestoration involves using plantings, tree stumps, and other natural materials to stabilize eroded channel banks and beds. Channels are designed to mimic natural channel shapes, and the restoration is intended to create both a stable channel and good habitat in the stream. The Holden Parks Trust has installed biorestoration pilot projects on Doan Brook just downstream from the University Circle culvert outlet and west of the Rockefeller Park Lagoon.

Table 8-2	Measures for Hydrologic Restoration of Doan Brook			
Measure	**Project Type**	**Impact**	**Practical?**	**Cost**
Redirect Giddings Brook	large	significant	no	$$$$
Large New Stormwater Detention	large	significant	difficult-no	$$
Parallel Stormwater Culvert	large	significant	difficult-no	$$$$
Enlarge Rockefeller Park Culverts	large	significant	fairly	$$$
*[4] Reinforce Dams Against Failure	small	significant	yes-fairly	$$–$$$
Stormwater Retrofits	small	med.- signif.	yes-fairly	$–$$$
Daylight Brook in University Circle	large	medium	difficult	$$$–$$$$
Enlarge University Circle Culvert	large	medium	fairly	$$$
Keep University Circle Culvert Clear of Debris[5]	large	medium	yes	$$
Enlarge Cedar Glen Sewer	large	medium	fairly	$$$
Enlarge Rockefeller Park Channels	large	medium	fairly	$$
Revise City Codes to Require BMPs[6]	small	medium	yes	$
Redesign MLK Detention Basin Outlet	small	medium	yes	$
Stream Channel Restoration	small	medium	fairly-difficult	$$–$$$
Improve Golf Course Maintenance	small	minor	yes	$–$$
Downspout Disconnects	citizen	minor	fairly-no	$
Rain Barrel Use	citizen	minor	yes	$
Alternative Landscaping	citizen	minor	fairly	$

Practicality: yes = highly practical – easy to implement; fairly = practical – not easily implemented; difficult = may be practical, but will be very difficult to implement; no = not practical.

Cost: $ = inexpensive; $$ = expensive; $$$ = very expensive; $$$$ = prohibitively expensive.

each technique included in Appendix J. The text also explores the advantages and disadvantages of key techniques. Those who wish to have a thorough understanding of methods that might be used to restore Doan Brook will need to consult the appendix as well as the text and tables.

8.3.1 Hydrologic Restoration

Table 8-2 summarizes some of the measures that might be used to improve hydrologic conditions in Doan Brook. In broad terms, the brook's hydrology could be improved by decreasing the size of periodic high flows, by providing more channel capacity, and by increasing dry weather flow. The more significant specific approaches to improving the hydrology of the brook are:

- **Source Reduction** — Reducing excess runoff, the main source of the brook's hydrologic problems, involves either reducing the impervious area of the watershed or providing specific mechanisms that encourage rainfall to infiltrate into the ground. Relatively few restoration techniques involve true hydrologic source reduction. Some stormwater retrofits[3] may reduce runoff either by replacing a previously impervious surface (like a conventional parking lot) with a more pervious one (like a parking lot with pervious pavers) or by trapping runoff in a pond, sand filter, or wetland and allowing it to infiltrate over time. Some citizen actions, such as rain barrel use, downspout disconnects, and alternative landscaping will encourage infiltration and decrease runoff from private property. The cumulative impact of stormwater retrofits and citizen action over the entire watershed could be significant. However, the low permeability soils of the Doan Brook watershed (especially of the upper watershed) make source reduction more difficult here than it is in many places. Because of the soil's low permeability, water will run off of a turf lawn quickly, especially where the soil has been compacted by heavy equipment during building construction.
- **Flow Control** — Flow control, coupled with channel restoration, is the approach to hydrologic restoration that is most likely to make a significant difference in destructive flooding along Doan Brook. There are two main approaches to flow control: *diversion* and *detention followed by slow release*.

  Diversion involves simply directing flow away from the main channel of the brook either into another watershed or into storm sewers that bypass the brook. Examples of diversion include:

  - Redirecting the flow from the Giddings Brook watershed away from Doan Brook. Although this may seem like an appealing idea, the Giddings Brook watershed is as urban as the Doan Brook watershed,

3 Stormwater retrofits are generally small stormwater management facilities that are added to a developed watershed. Examples of stormwater retrofits include a small detention pond or wetland at a tributary culvert outlet, a detention pond and infiltration area in a roadway median, and a sand filter that catches runoff from a parking lot. Generally, each stormwater retrofit is intended to improve water quality or decrease peak outflow from a small subwatershed.

4 *Projects that are in progress are marked with an asterisk.

5 The culvert is now cleaned at irregular intervals.

6 BMPs are best management practices that are the most effective and practical approaches to meeting environmental quality goals.

and it is very unlikely that it would be possible and feasible to build a re-diversion that did not create more problems than it solved.

- Diverting high flows into a storm sewer that runs parallel to the brook. This could be considered for the lower brook; however, because flood flows are large, it would be extremely costly to build a parallel storm sewer large enough to have much impact on a flood of any size. This approach might, however, be feasible if the brook could be "daylighted"[7] in the University Circle area, where the existing University Circle culvert could then be used to carry high flows.

Stormwater detention (followed by slow release) involves building some form of either above-ground or underground storage for stormwater. The Shaker Lakes are existing examples of stormwater detention, and they play a critical role in reducing flooding along Doan Brook. The MLK detention basin was also intended as a stormwater detention facility, but it is generally ineffective in its current configuration (see Chapter 7).

Examples of new stormwater detention facilities that might be built in the Doan Brook watershed include large above-ground basins, underground storage, modification of the MLK detention basin outlet to increase the basin's efficacy, and stormwater retrofits such as small wetlands or ponds and rooftop runoff storage areas for buildings. As is discussed in Chapter 7, it would be very difficult to find space for large new above-ground or underground storage facilities in the watershed. Stormwater retrofits are therefore likely to be the most effective approach. Modification of the MLK detention basin outlet would also provide some additional stormwater detention at very low cost.

- **Channel Restoration** — Culvert enlargement and channel restoration could, if coupled with source reduction and flow control measures, decrease the damage to the brook channel and surroundings that is caused by excess flows. Increasing the capacity of the University Circle culvert, shorter culverts in Rockefeller Park, and feeder storm sewers would likely decrease flooding in the areas around the culverts, but it would not provide much benefit to the stream. Modification of channels in Rockefeller Park to achieve a more natural channel configuration or "daylighting" the brook in University Circle could be done in a way that decreases flooding, strengthens eroded areas, and improves channel habitat.
- **Maintenance** — Maintenance of the Shaker Lakes and their dams is critical to preventing Doan Brook flooding from becoming much worse. Proper maintenance of the University Circle culvert to keep it clear of debris would reduce the frequency of flooding in University Circle.

Some reduction of peak floods in the brook or some adjustment of the channel and culverts so that they are better suited for the flows they now receive is needed if the brook is to maintain a healthy ecosystem. Some would argue that better flood control is also needed so that the brook will cause less damage and inconvenience, particularly in University Circle and Rockefeller Park. No single restoration method will bring Doan Brook back into harmony with the volume of water that it now receives from the watershed. Instead, a combination of techniques that reduce the flow volume and increase the stream capacity may restore some balance to the brook's hydrology.

8.3.2 Water Quality Restoration

Table 8-3 summarizes techniques that might be used to improve water quality in Doan Brook. In general, water quality in the brook can be improved by diversion and treatment of contaminated flow, by in-stream treatment, or by reduction of contamination sources within the watershed. Some approaches to water quality restoration for Doan Brook are:

- **Source Reduction** — There is no effective way to reduce the sources of contaminants that flow to Doan Brook through the sanitary sewer system. Sanitary sewer flows can be controlled, diverted and treated in a variety of ways (see below), but there are few ways to reduce the amount of wastes that we put into the sewers in the first place.[8]

  Contaminant sources in stormwater runoff, unlike those in sanitary sewage, can be effectively reduced. For example, cities in the watershed can decrease the amount of salt that reaches the stream by using alternative deicers or simply by using less salt. They can reduce bacteria by instituting programs that encourage pet owners to pick up pet waste and discourage nuisance waterfowl around the stream.[9] They can also dredge the lakes on a regular basis. Lake dredging eliminates contaminants that may otherwise re-enter the aquatic ecosystem when sediments are disturbed. This kind of contaminant recirculation can be a significant source of nutrients. While the other approaches discussed

7 "Daylighting" refers to re-building an above-ground channel for the brook where it is currently confined to a culvert. The Case Western Reserve University Master Plan calls for the restoration of Doan Brook to an above-ground park in the area adjacent to the university campus.

8 One important source of phosphorus (a nutrient) that entered the brook mostly through the sanitary sewer system was greatly reduced when phosphate detergents were banned in the 1980s.

9 Geese can be discouraged by eliminating lawn area at the water's edge and allowing taller vegetation to grow adjacent to the lakes. Appropriately chosen vegetation can provide good habitat for other wildlife as well as discouraging geese.

Table 8-3	Measures for Water Quality Restoration of Doan Brook			
Measure	**Project Type**	**Impact**	**Practical?**	**Cost**
*[4] Heights/Hilltop Interceptor	large	significant	fairly	$$$
High Flow CSO Storage	large	significant	fairly	$$$
High Flow CSO Treatment	large	significant	fairly	$$$
Stormwater Retrofits	small	significant	yes-fairly	$–$$$
Lake or Stream Biofiltration	small	significant?	yes-difficult	$–$$$
Improve Golf Course Maintenance	small	significant	yes	$–$$
Protect Riparian Corridor	small	significant	yes	$
* Cleaning Pet Waste[10]	citizen	significant	yes	$
* Optimize the Existing Sewer System	large	medium	yes	$
Revise City Codes to Require BMPs	small	medium	yes	$
* Channel Stabilization	small	medium	fairly	$$–$$$
* Stormwater Outfall Monitoring	small	medium	yes	$
* Sanitary Sewer Maintenance	small	medium	yes	$$
* Lake Dredging	small	medium	fairly	$$$
Alternative Road Deicing	small	medium	yes	$$
Discourage Nuisance Waterfowl	small	medium	yes-fairly	$
Increase Riparian Vegetation	small	medium	yes	$
Erosion Control During Construction	small	medium	yes	$
Alternative Landscaping	citizen	medium	fairly	$
* Proper Auto Waste Handling	citizen	medium	yes	$
Proper Car Wash Practices	citizen	medium	yes	$
Reduce Lawn Fertilizer, Pesticides and Herbicides	citizen	medium	yes	$
* Proper Yard Waste Disposal[10]	citizen	medium	yes	$
* Reinforce Dams Against Failure	small	med.-neg.	yes-fairly	$$–$$$
Aquatic Plant Management	small	medium	fairly	$
* Lake Aeration	small	minor	yes	$
* Street Litter and Debris Cleanup	small	minor	yes	$
Catch Basin Inspection and Cleaning	small	minor	yes	$
Downspout Disconnects	citizen	minor	fairly-no	$
Rain Barrel Use	citizen	minor	yes	$
* Household Hazardous Waste Disposal[10]	citizen	minor	yes	$

Practicality: yes = highly practical – easy to implement; fairly = practical – not easily implemented; difficult = may be practical, but will be very difficult to implement; no = not practical.

Cost: $ = inexpensive; $$ = expensive; $$$ = very expensive; $$$$ = prohibitively expensive.

10 At least one of the cities in the watershed has an existing program requiring or encouraging appropriate action on this measure.

could be implemented by the cities without great cost,[11] lake dredging can be expensive.

Golf courses in the watershed could contribute to source reduction by using less fertilizer, using low phosphorus fertilizers,[12] and reducing pesticide and herbicide use. Given that two golf courses make up much of the land along the south branch of Doan Brook, the contribution of good golf course maintenance to the health of the brook could be significant. Homeowners throughout the watershed could have similar impacts on nutrients, pesticides, and herbicides by reducing or eliminating the use of fertilizers and other chemicals on their lawns and by planting alternative forms of vegetation.

- **Treatment and Flow Control** — Diversion and treatment of sanitary sewage is the single action that can most improve Doan Brook water quality. The water quality in the stream already benefits greatly from the diversion of the bulk of the watershed's sanitary sewage for treatment at the Easterly Wastewater Treatment Center. The Heights/ Hilltop Interceptor (HHI), when in service,[13] will divert even more sanitary sewage for treatment.

  Substantial periodic overflows from the combined sanitary and storm sewer system in the lower watershed will continue even after the HHI is complete. The primary purpose of NEORSD's Doan Brook watershed study was to evaluate the best means of further reducing these combined sewer overflows. Alternatives under consideration include construction of a tunnel in the lower watershed to temporarily store some CSOs and divert them to the Easterly Wastewater Treatment Center, installation of several small treatment facilities in the lower watershed to treat combined sewage before it is discharged to the stream, and construction of a number of CSO storage facilities in the lower watershed.[14]

  Although the HHI and additional CSO controls will significantly improve water quality in the lower watershed, they will not address contamination from stormwater runoff in the upper watershed. Treatment methods that could restore water quality in the upper watershed include in-stream treatment (by lake aeration, biofiltration, stormwater retrofits, or aquatic plant removal), runoff filtration before it reaches the brook (by increasing riparian vegetation or installing filtering wetlands or runoff traps), regular street sweeping, frequent inspection and cleaning of storm sewer catch basins, and collection of various yard and household wastes for treatment or other disposal before they reach the brook. Finally, bacteria discharges to the brook can be substantially reduced by a coordinated program that detects and corrects illicit sanitary sewer connections that now discharge directly to the storm sewers.

- **Channel Restoration** — Channel stabilization can improve water quality in the brook by reducing erosion of the bed and banks and thus reducing the sediment load in the stream.

- **Maintenance** — Maintenance of existing facilities that contribute to good water quality in the brook is an important part of improving water quality. Proper monitoring and maintenance of the sanitary sewer system is particularly critical. NEORSD currently has a monitoring program in place, and NEORSD and the cities repair the sewers when a problem is detected. In addition, NEORSD plans to optimize the existing sewer system to make maximum use of its storage and diversion capacity.

Attention to sewer monitoring and maintenance and the elimination of phosphate detergents have already left Doan Brook with much better water quality than it had in the 1960s and 1970s. A recent system analysis and further repairs by NEORSD resulted in still more improvement. Ohio EPA clean water regulations require that NEORSD control CSOs to the extent feasible, and further reduction in CSOs will be accomplished first by the completion of the HHI and then by additional CSO controls in the lower watershed. These large projects will go a long way toward improving the brook's water quality, but they will not be sufficient to achieve a genuinely healthy stream. Restoring water quality sufficiently so that the stream can support a healthy ecosystem will depend on small projects and citizen actions spread throughout the watershed.

8.3.3 Habitat Restoration

Habitat restoration in Doan Brook depends heavily upon reducing flooding, redesigning the channel to accommodate larger flows, and improving water quality. As long as aquatic organisms are damaged by dirty water and swept away by high flows, the stream habitat will remain fair at best. Methods of decreasing flooding, restoring the channel, and improving water quality are discussed in the two previous sections. A few more measures that can be taken to improve habitat in other ways are discussed below. All approaches to habitat restoration are summarized in Table 8-4.

- **Flow Control** — Some flow control measures, such as stormwater retrofits and enlargement of the Rockefeller Park chan-

11 Deicer cost may vary and switching to an alternative to salt could be fairly costly.

12 Shaker Heights Country Club currently uses low phosphorus fertilizer.

13 The HHI in the Doan Brook watershed should be partially in service by the end of 2001 and complete by 2005.

14 The most likely alternative is the construction of a large-diameter CSO storage and diversion tunnel in the lower watershed.

Table 8-4	Measures for Habitat Restoration Along Doan Brook			
Measure	**Project Type**	**Impact**	**Practical?**	**Cost**
Daylight Brook in Gordon Park	large	significant	difficult-no	$$$$
Stream Channel Restoration	small	significant	fairly-difficult	$$–$$$
Lake or Stream Biofiltration	small	significant?	yes-difficult	$–$$$
Protect Riparian Corridor	small	significant	yes	$
Parallel Stormwater Culvert	large	medium	difficult-no	$$$$
Daylight Brook in University Circle	large	medium	difficult	$$$–$$$$
Stormwater Retrofits	small	medium	yes-fairly	$–$$$
*[4] Channel Stabilization	small	medium	fairly	$$–$$$
* Lake Dredging	small	medium	fairly	$$$
* Lake Aeration	small	medium	yes	$
Enc. Native Species and Disc. Invasive Exotics	small	medium	fairly-difficult	$$
Species Reintroduction	small	medium	fairly-difficult	$
Alternative Road Deicing	small	medium	yes	$$
Improve Golf Course Maintenance	small	medium	yes	$–$$
Increase Riparian Vegetation	small	medium	yes	$
* Reinforce Dams Against Failure	small	med.-negative	yes-fairly	$$–$$$
* Heights/Hilltop Interceptor	large	minor	fairly	$$$
High Flow CSO Storage	large	minor	fairly	$$$
High Flow CSO Treatment	large	minor	fairly	$$$
Redirect Giddings Brook	large	minor	no	$$$$
Large New Stormwater Detention	large	minor	difficult-no	$$
Enlarge Rockefeller Park Channels	large	minor	fairly	$$
Revise City Codes to Require BMPs	small	minor	yes	$
* Stormwater Outfall Monitoring	small	minor	yes	$
* Sanitary Sewer Maintenance	small	minor	yes	$$
Aquatic Plant Management	small	minor	fairly	$
Discourage Nuisance Waterfowl	small	minor	yes-fairly	$
* Street Litter and Debris Cleanup	small	minor	yes	$
Catch Basin Inspection and Cleaning	small	minor	yes	$
Erosion Control During Construction	small	minor	yes	$
Flow Augmentation	small	minor	fairly	$$
Downspout Disconnects	citizen	minor	fairly-no	$
Rain Barrel Use	citizen	minor	yes	$
Alternative Landscaping	citizen	minor	fairly	$
* Proper Auto Waste Handling[10]	citizen	minor	yes	$
Proper Car Wash Practices	citizen	minor	yes	$
* Household Hazardous Waste Disposal	citizen	minor	yes	$
* Cleaning Pet Waste[10]	citizen	minor	yes	$
Reduce Lawn Fertilizer, Pest. and Herbicides	citizen	minor	yes	$
* Proper Yard Waste Disposal[10]	citizen	minor	yes	$

Practicality: yes = highly practical – easy to implement; fairly = practical – not easily implemented; difficult = may be practical, but will be very difficult to implement; no = not practical.

Cost: $ = inexpensive; $$ = expensive; $$$ = very expensive; $$$$ = prohibitively expensive.

Figure 8-2 The Site 14 dredge spoil disposal area at the mouth of Doan Brook has become outstanding migratory bird habitat. Preservation of this habitat could be part of Doan Brook restoration. Photograph by L. C. Gooch.

nels, can be done in a way that provides good aquatic habitat as well as runoff detention and treatment or increased flow capacity. Where practical, these measures should be designed to provide habitat as well as to serve their primary functions. Augmentation of stream flows during dry weather could also be used to improve in-stream habitat.[15]

- **Channel Restoration** — Improvement to the channel and the riparian corridor would, if done properly, significantly improve aquatic habitat. In particular, daylighting the brook through the Site 14 dredge spoil area in Gordon Park would reconnect the brook with Lake Erie and eliminate a major migration barrier, as well as providing additional channel habitat. Unfortunately, such reconnection would be very costly and is probably not practical.[16]

  Daylighting the brook in University Circle would also remove a major migration barrier and provide more channel habitat. Bringing the brook above ground through University Circle may be easier than daylighting it through Gordon Park, but it would still be a very difficult and costly undertaking. Restoration of the stream channel to a more natural shape through Rockefeller Park, Ambler Park, and along other channelized sections of the stream would be more practical and would reduce the impact of high flows on aquatic organisms. Maintaining and improving the riparian corridor would provide wildlife habitat and help keep stream temperatures in an appropriate range.

- **Maintenance** — Maintenance measures such as lake dredging, encouraging native species and discouraging exotic species, and possible species reintroduction could help invigorate the stream's ecosystem.

Once water quality is improved, flood peaks reduced, and stream channels redesigned to better convey high flows, the aquatic habitat in the stream will begin to restore itself, even without further human intervention. Some additional work, such as channel restoration, daylighting the brook and perhaps species reintroduction may be worthwhile to achieve a truly diverse ecosystem. Plans for habitat improvement should be made with the awareness that the brook will remain an urban stream and may be somewhat limited in its ability to support a natural habitat.

8.4 Narrowing the Choices: Sketching a Restoration Plan

Table 8-5 gathers together all of the alternatives for stream restoration that have been discussed in this chapter. It indicates whether each restoration method would improve the brook's hydrology, water quality, or habitat, and it shows what mechanism the method would use to achieve improvement. Finally, it rates each measure as to its practicality and cost.

The list shown in Table 8-5 is not exhaustive, and the assessments of practicality and cost are not definitive. Other approaches to stream restoration are possible and will undoubtedly be considered as Doan Brook watershed

15 The usual approach to flow augmentation is the release of clean (usually treated) water directly into the stream. This kind of sustained release to the Doan Brook could be quite expensive, since it would use water that was pumped from Lake Erie and treated to drinking water standards, and it would use the water during dry summer months when demand is greatest. A more practical approach to flow augmentation in Doan Brook would be to release some untreated Lake Erie water from the Baldwin Filtration Plant directly to the brook.

16 As the bird surveys discussed in Chapter 4 demonstrate, Site 14 already harbors an extraordinary variety of bird life. There is interest in preserving it as a bird and wildlife sanctuary as well as interest in developing it as a park, so that the area could provide either developed or undeveloped park land even if the brook remained underground.

What the Law Requires: Actions by NEORSD and the Cities

NEORSD: NEORSD is responsible for reducing Doan Brook CSOs to meet the requirements of the federal Clean Water Act. The current construction of the HHI is their first response to CSO regulations. The completion of this project and the optimization of the existing sewer system will reduce CSO discharges to the brook to about half their current level. However, regulations require that NEORSD further reduce CSOs to the extent practical. To meet this requirement, they will undoubtedly move forward with additional CSO reductions. Likely measures include some combination of CSO diversion, storage, and treatment in the lower watershed, as is discussed in Section 8.3. These measures will be designed to handle storms that occur three to four times each year. They are expected to further reduce CSOs to less than half of their volume after the completion of the HHI (to about 20% of their current volume).

The Cities: U.S. EPA's Phase II Storm Water Program requires that cities like Cleveland Heights and Shaker Heights (Cleveland is largely covered under CSO regulations) take steps to reduce contamination in stormwater runoff discharged from separate storm sewer systems. Storm Water Management Programs are to be in place by 2007. "Minimum controls" that must be part of the programs include:

- Public education about steps citizens can take to reduce stormwater pollution.
- Public involvement and participation in developing and implementing a Storm Water Management Plan.
- Elimination of illicit sanitary sewage discharges to the stormwater system.
- Revision of city ordinances to require that construction site sediment runoff be controlled.
- Revision of city ordinances to require that new developments and redeveloped areas incorporate stormwater best management practices.
- Minimization of stormwater pollution from city operations such as park maintenance and city vehicle maintenance.

These required measures include many of the restoration options for Doan Brook that are discussed in Section 8.3. If the cities do a thorough job of designing and implementing their Storm Water Management Programs, Doan Brook will undoubtedly benefit. If they use the requirements of the Phase II Storm Water Program as an opportunity to focus on Doan Brook restoration, benefits will be even greater.

planning progresses. New, more thorough assessments of practicality and cost will be made. The table may nonetheless be useful as a first tool for sorting out restoration measures that may be of use for Doan Brook. The table and other information about restoration alternatives for the brook lead to a few conclusions:

- Once NEORSD and the cities have taken legally required measures to control CSOs and improve stormwater quality (see sidebar), further improvement to Doan Brook will essentially be the responsibility of the citizens and the city governments. NEORSD may take some further action and may work with the cities on other projects, but they will have fulfilled their primary responsibility for control of sanitary sewage.
- The costs of flooding along Doan Brook are not high, particularly since Case Western Reserve University has moved sensitive facilities out of harm's way. Because flood damage is not expensive, there is little motivation for building costly flood control measures. Measures that reduce flooding will therefore need to be combined with other benefits such as aesthetic improvements to the stream and habitat restoration.
- A number of measures that would benefit the brook, such as daylighting the brook through Gordon Park and University Circle and restoring the Rockefeller Park channels, would also benefit the parks and communities along the stream. Because these projects will be expensive, it will be necessary to work with all interests — advocates of the parks, advocates of the communities and institutions, and advocates of the stream — to make the projects a reality.

Table 8-5 Summary of Doan Brook Restoration Techniques

Measure	Practical and Cost Effective?	Impact of Measure			Improvement Mechanism				
		Hydrology	Water Quality	Habitat	Source Red.	Treatment	Flow Control	Chan. Improv.	Maintenance
Large Projects:									
*[4] Heights/Hilltop Interceptor	fairly/$$$	tiny	significant	minor			■		
High Flow CSO Storage	fairly/$$$	tiny	significant	minor			■		
High Flow CSO Treatment	fairly/$$$		significant	minor		■			
* Optimize the Existing Sewer System	yes/$		medium	tiny					■
Redirect Giddings Brook	no/$$$$	significant		minor			■		
Large New Stormwater Detention	difficult-no/$$	significant		minor			■		
Parallel Stormwater Culvert	difficult-no/$$$$	significant		medium			■		
Daylight Brook in University Circle	difficult/$$$-$$$$	medium		medium				■	
Daylight Brook in Gordon Park	difficult-no/$$$$	tiny		significant				■	
Enlarge University Circle Culvert	fairly/$$$	medium						■	
Keep University Circle Culvert Clear of Debris	yes/$$	medium							■
Enlarge Cedar Glen Sewer	fairly/$$$	medium						■	
Enlarge Rockefeller Park Channels	fairly/$$	medium		minor				■	
Enlarge Rockefeller Park Culverts	fairly/$$$	significant		tiny				■	
Small Projects:									
Revise City Codes to Require BMPs	yes/$	medium	medium	minor	❑	❑	❑		
Redesign MLK Detention Basin Outlet	yes/$	medium		tiny			■		
Stormwater Retrofits	yes–fairly/$-$$$	medium to signif.	significant	medium		❑	❑		
Stream Channel Restoration	fairly–difficult/$$-$$$	medium		significant			❑	❑	
* Channel Stabilization	fairly/$$-$$$		medium	medium				■	
* Stormwater Outfall Monitoring	yes/$		medium	minor					■
* Sanitary Sewer Maintenance	yes/$$		medium	minor					■
* Reinforce Dams Against Failure	yes–fairly/$$-$$$	significant	medium to negative	medium to negative		❑	❑		❑
* Lake Dredging	fairly/$$$	[17]	medium	medium	❑				❑
* Lake Aeration	yes/$		minor	medium		■			
Aquatic Plant Management	fairly/$		medium	minor		■			
Lake or Stream Biofiltration	yes–difficult/$-$$$		significant?	significant?		■			
Encourage Native Species and Discourage Invasive Exotics	fairly–difficult/$$			medium					■

17 Lake dredging will not increase the flood control capacity of the Shaker Lakes. See Chapter 7.

Table 8-5, continued	Summary of Doan Brook Restoration Techniques								
Measure	**Practical and Cost Effective?**	**Impact of Measure**			**Improvement Mechanism**				
		Hydrology	Water Quality	Habitat	Source Red.	Treatment	Flow Control	Chan. Improv.	Maintenance
Small Projects, continued:									
Species Reintroduction	fairly-difficult/$			medium					
Alternative Road Deicing	yes/$$		medium	medium	■				
Improve Golf Course Maintenance	yes/$-$$	minor	significant	medium	❑	❑	❑	❑	
Discourage Nuisance Waterfowl	yes–fairly/$		medium	minor	■				
Protect Riparian Corridor	yes/$		significant	significant					■
Increase Riparian Vegetation	yes/$		medium	medium		■			
* Street Litter and Debris Cleanup	yes/$		minor	minor		■			
Catch Basin Inspection and Cleaning	yes/$		minor	minor		■			
Erosion Control During Construction	yes/$		medium	minor	■				
Flow Augmentation	fairly/$$		tiny	minor			■		
Citizen Action:									
Downspout Disconnects	fairly-no/$	minor	minor	minor	❑		❑		
Rain Barrel Use	yes/$	minor	minor	minor	❑		❑		
Alternative Landscaping	fairly/$	minor	medium	minor	■				
* Proper Auto Waste Handling[10]	yes[18]/$		medium	minor		■			
Proper Car Wash Practices	yes[18]/$		medium	minor		■			
* Household Hazardous Waste Disposal[10]	yes[18]/$		minor	minor		■			
* Cleaning Pet Waste[10]	yes[18]/$		significant	minor		■			
Reduce Lawn Fertilizer, Pesticides and Herbicides	yes[18]/$		medium	minor	■				
* Proper Yard Waste Disposal[10]	yes/$		medium	minor		■			

Practicality: yes = highly practical – easy to implement; fairly = practical – not easily implemented; difficult = may be practical, but will be very difficult to implement; no = not practical.

Cost: $ = inexpensive; $$ = expensive; $$$ = very expensive; $$$$ = prohibitively expensive.

Area of Impact: Significant = measure has a significant impact on the problem; medium = measure helps the problem some; minor = measure helps the problem a little; tiny = measure has a very small but positive impact; negative = measure makes the problem worse.

Mechanism of Impact: ■ = sole mechanism; ❑ = one of several mechanisms.

18 A number of "citizen action" measures are quite easy to implement and have relatively small costs that are dispersed among the watershed's residents. Although some of these measures could have significant positive impact on the brook if they were widely embraced, obtaining compliance by a large number of people is difficult, at least over a short period of time. Very well run public education campaigns change the behavior of at most 20% of the targeted population. Time and persistent delivery of a consistent message may influence more people.

- Many of the measures that may benefit the brook involve small efforts spread over the watershed and over time. Because such dispersed efforts require fewer resources at any one time, they may be a more practical approach to Doan Brook restoration than a few large projects. However, successful execution of a long-term, dispersed effort will require not only close attention to a well-conceived watershed management plan, but also on-going monitoring to evaluate the success of each incremental effort.
- The gradual redesign of the urban Doan Brook watershed — the transformation of the way that water runs off from streets, parking lots, lawns, and rooftops — will require a combination of voluntary citizen action and modification of local building codes and ordinances. Some ordinances will need to be rewritten to allow less impervious construction; others will need to be rewritten to require changes in construction practices. The three watershed cities will need to cooperate to rewrite their ordinances to restore the health of the brook. In addition, the cities will need to be willing to explore new approaches to road construction, drainage design, bank stabilization, park maintenance, deicing, and other activities.
- Citizen education and participation will be essential.
- The combined efforts of the watershed cities, institutions, agencies, and citizens will be needed if we are to successfully restore the stream.

It should be obvious by now that the formation of a coherent watershed management plan is the first step in an on-going effort to restore Doan Brook. In 1998, NEORSD convened the Doan Brook Study Committee as part of their study of the Doan Brook watershed. The study committee was charged with creation of a watershed management plan, and the plan that they created (available through NEORSD and the Nature Center at Shaker Lakes) is an excellent starting point for restoration of the brook. The final chapter of this handbook outlines the steps that will make the plan a reality.