RECREATION AND THE FLOODPLAIN

DESIGN AND PLANNING FOR UPPER MIDWEST RIVER BASINS

LANDSCAPE STUDIES CENTER

DEPARTMENT OF LANDSCAPE ARCHITECTURE, COLLEGE OF ARCHITECTURE & LANDSCAPE ARCHITECTURE UNIVERSITY OF MINNESOTA

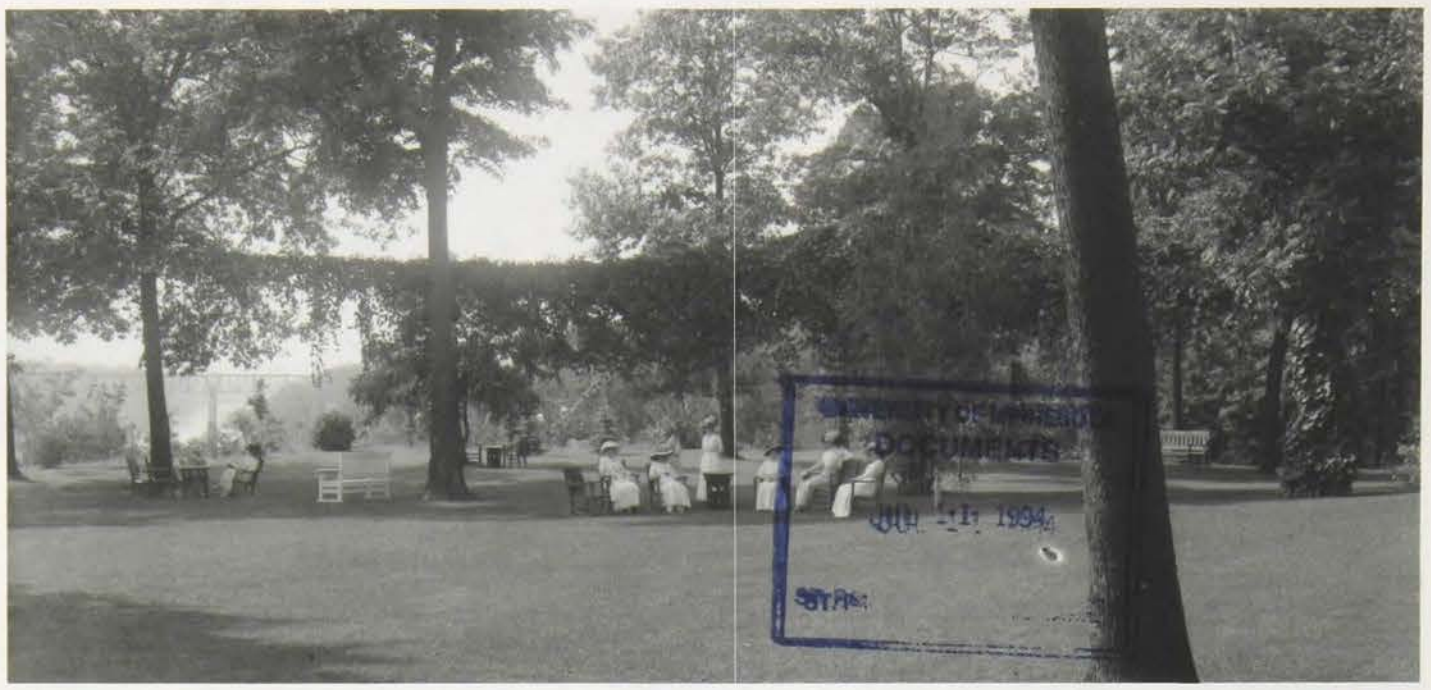
DO YOU REMEMBER?

Do you remember when Sunday afternoon meant picnics at the local park with family and friends? For some of us those were lounging days, days with a blanket and a good book, days beneath a giant cottonwood, or days just listening to the band playing in the waterside pavilion, while watching a friendly fisherman and his grandchildren down at the river's edge. The children were always curious of course, and that curiosity sent them wading along the water's edge, though never too far from grandpa's watchful eye, searching the shoreline for that perfect stick or stone to throw, or the ideal frog to take home to mom.

Recall though, that those were summer days. For many of us, anxious to get out after a long cold winter and roused by spring fever, there was also that adventure-filled springtime wait, that period after the ice went out and the floodwaters finally moved back into the river . We fussed and fretted on our springtime walks, hoping for the soils to dry out, for green grass to appear, and for the damp, musty smell to go so we could return to our favorite riverside haunts. We waited for an end to the mud.

Both times of year were special, but perhaps floodwater time was talking to us too, telling us to rethink where we build certain places for recreation and suggesting better locations for large gatherings of people.

We who live here in the Northland are lucky because we experience four, distinct seasons. Spring is especially important to us as time for rejuvenation, a time to break out of our homes and meet our neighbors again. It's a time to gather with others at local festivals, art shows, concerts, or softball games.



Harriet Island, St. Paul, MN circa 1915. (As it was) M.H.S.

Many of these social activities can and do take place in city parks. But a park built along the river's edge loses its festival appeal when walking means a thick layer of mud, if, in fact, one can walk in that park at all.

So why *did* we build along the river's edge?

SETTLEMENT AT THE RIVER'S EDGE

Historically, people have been drawn to the edges of rivers. Moving west, our ancestors came upon great forests and prairies. The rivers and streams that drained these lands offered wood along their banks for home-building. The river provided water for drinking, cooking and cleansing and it encouraged settlement.

As time passed and more pioneers arrived, scattered homesteads grew into small communities. The rivers gave energy to help mill flour and power to run saw mills. For convenience and efficiency, mills and granaries were built at the river's edge. Soon, the railroads came and tracks were built along the river terraces. Then with the milling operation and the railroads came more people as well. To quickly serve the needs of those arrivals, the commercial district often grew on the same river terrace.

Increasing settlement and transportation demands on the riverways like those of the Upper Midwest River Basins soon transformed flood plains into recreational and industrial grounds.

FLOODING AND THE FUTURE

In recent years, we have heard the rising river's ominous message and now we designate a certain amount of land as flood plain and flood fringe. Today we've marked out the area that may be periodically flooded and we have expressed concern for the future.

Development in flood plains and flood fringes is increasingly governed by a planning process called zoning. Under zoning, certain development types, especially recreational space developments, have been judged compatible with the flood plain landscape.

But while it is true that recreation is sometimes compatible with this landscape, it is also true that we need to redefine our idea of recreation, to bring it within an ecological context. We need to better understand the character and function of recreation in community building and assess recreation's best relationship to the natural systems of the riverine landscape, including flooding in that context.

PUBLICATION FRAMEWORK

The approaches presented in the following pages give voice to a set of design principles for a new, multifunctioning, linear recreational system, based on sound social, economic and ecological principles.

This publication offers alternative approaches to recreation and public space planning and design within the framework of *river terrace* landscapes. Three terraces are identified: the upland, the middle and the flood plain. Each terrace is first defined in terms of its own physical and functional characteristics. Its relationship to the other two terraces is then discussed from the perspective of land use, flood control and associated recreational opportunities.

SO ..... DOES THIS WORK? PLEASE READ ON.

Harriet Island, St. Paul, MN 1991. (As it is now)

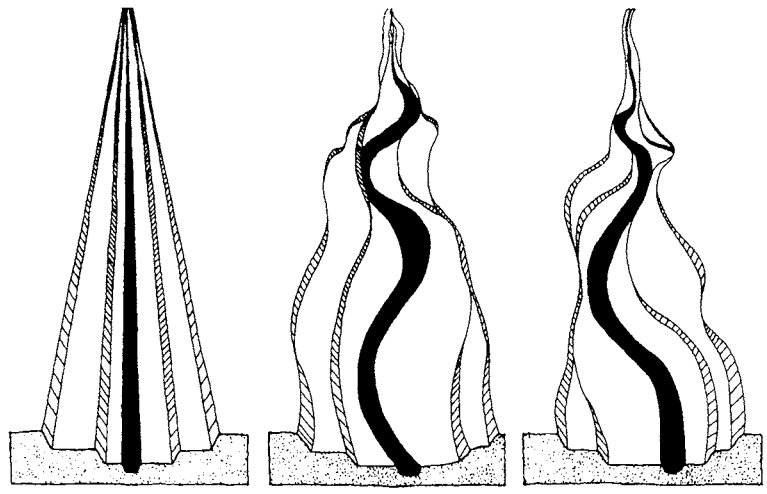
TERRACES

WHAT ARE TERRACES?

The American Heritage Dictionary defines a terrace as, "a porch or balcony". In the context of landform, such as river valleys and flood plains, it is defined as "a raised bank of earth with vertical or sloping sides and a flat top". We all may have an image of, or know how to construct, a porch or balcony; but how are terraces of earth created?

G.H. Drury, in *Rivers and River Terraces* , presents nine different possibilities for the origins of terraces. Within the geologic history of Minnesota, six are still visible today. For example, the terraces of glacial lake Agassiz can be seen as, "shorelines of former spasmodically trapped lakes". And the creation of steep terraces, as in southeastern Minnesota, can be seen as "relics of former monstrous floods", floods that occurred when glaciers up to 500 feet high melted. Most of the landscape features we see today in Minnesota are the result of those glaciers and their melt waters.

The rivers and streams of today follow the glacial patterns, further downcutting the land and depositing sediment. This process of erosion and deposition is not confined to the immediate channels of rivers, extending instead over flood plains that are inscribed with terraces of alluvial deposits and stabilized by vegetation. These terraces record the history of the river's height and width.



Development of river terraces from a straight channel.

The river records its changing disasters as it sculpts the land. Rivers and streams wind their way through the landscape, collecting material either from banks and bottoms during a flood or at spots where the water has a high velocity. Water then spreads into the flood plain where the material that it has collected drops out to form terraces.

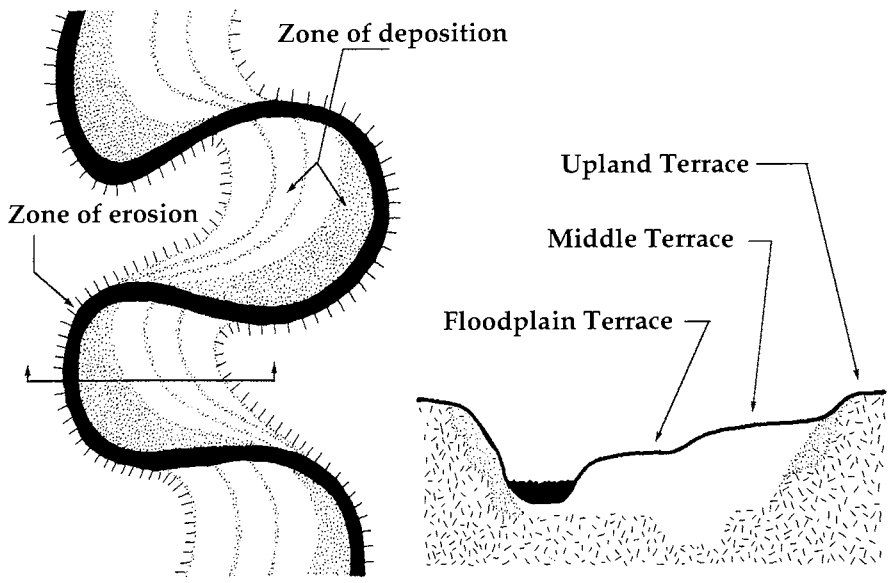
WHY ARE TERRACES IMPORTANT?

River terrace landscapes are the structural representations of hydrological processes. They provide a distinct armature for ecological and cultural relationships in a river valley.

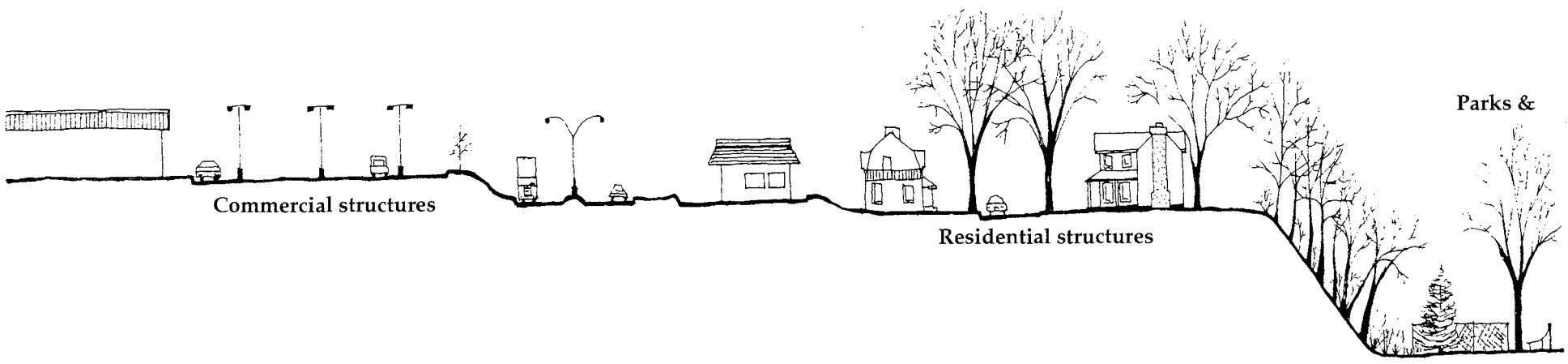
As a river carves through a flat or gently rolling landscape, its effect is to deposit soil on the inside curve of its turns and oxbows. On these inside curve landscapes, there are often discernible at least three terraces which tell the story of the river in space and time: the *upper terrace*, with its farms, subdivisions, towns, and cities; the *middle terrace*, more deposited than carved in many landscapes, and often similarly farmed or urbanized; and, lying well below the middle terrace, the *flood plain*, the most transitory landscape.

This publication stresses the importance of looking at each of the terraces as a planning and design opportunity in the control of flooding. The gathering of recreational uses in the flood plain suggests an opportunity to bring in a new language to the recreational landscape, a language that, in fact, addresses causes of flooding, rising from the flood plain to the middle, and even the upper, terrace.

With that awareness as a guide, we have adopted the three-terrace, integrated strategy presented in these pages, seeing it as a model for recreational and water management design in flood-prone communities of the upper Midwest. Although each community that considers the strategy will need to adapt it to suit its unique conditions, the general attitude defined in these pages can and should apply.

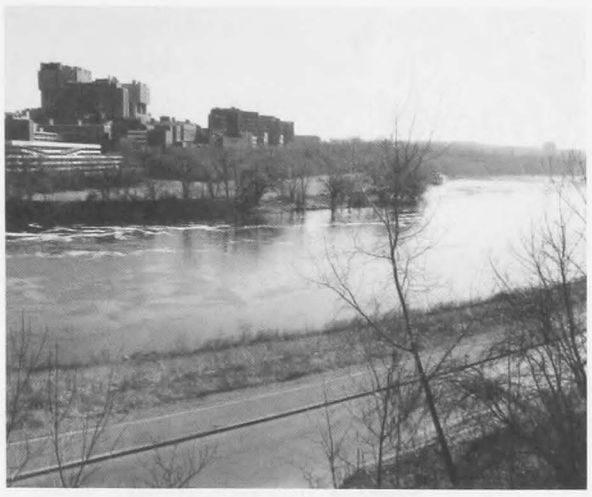


Zones of erosion and deposition within the three terrace framework.



UPLAND TERRACE — MIDDLE

TERRACES



THE UPLAND TERRACE

Today, the upland terrace often houses the structures that people have built for those residential, commerical, industrial and civic uses that make community life possible.

In addition, vast acres of farmland and pastures co-exist with and often compete for, dominance of the upland terrace. Both patterns of landuse are intended by people to insure the viability of a community. Not surprisingly, the upland terrace is usually the zone of the highest economic value. It is often the location of the highest value homes, the major shopping centers, and the civic functions.

Parks are also built on this terrace, but they often sit independent of one another and, in most cases, they are not linked together with recreational spaces or corridors.

The upland terrace is typically unaffected by flood conditions and as a result, its role in contributing to downstream flooding is often overlooked. Herein lies an opportunity to embrace an array of land uses, ranging from agricultural runoff impoundments to ball fields to greenways, with each use functioning ecologically to help control flooding.

THE MIDDLE TERRACE

The middle terrace typically presents the best opportunities to provide connections between the people and the activities of the upper terrace and the recreational and industrial uses of the flood plain. While this middle landscape links people to their river-based past, it also offers them an ideal place to reposition themselves and their communities for the future.

The middle terrace is the land between top and bottom; it is also the place for surface water to flow through on its way to the flood plain. This is true whether the water is visible in a swale or ravine or unseen in a pipe. This intermediate landscape may be partly occupied; but because it is too steep or inaccessible, it is normally less built-up than the upland terrace.

This middle terrace constitutes an opportunity for new types of interventions designed to provide additional recreational uses while also helping with stormwater management.

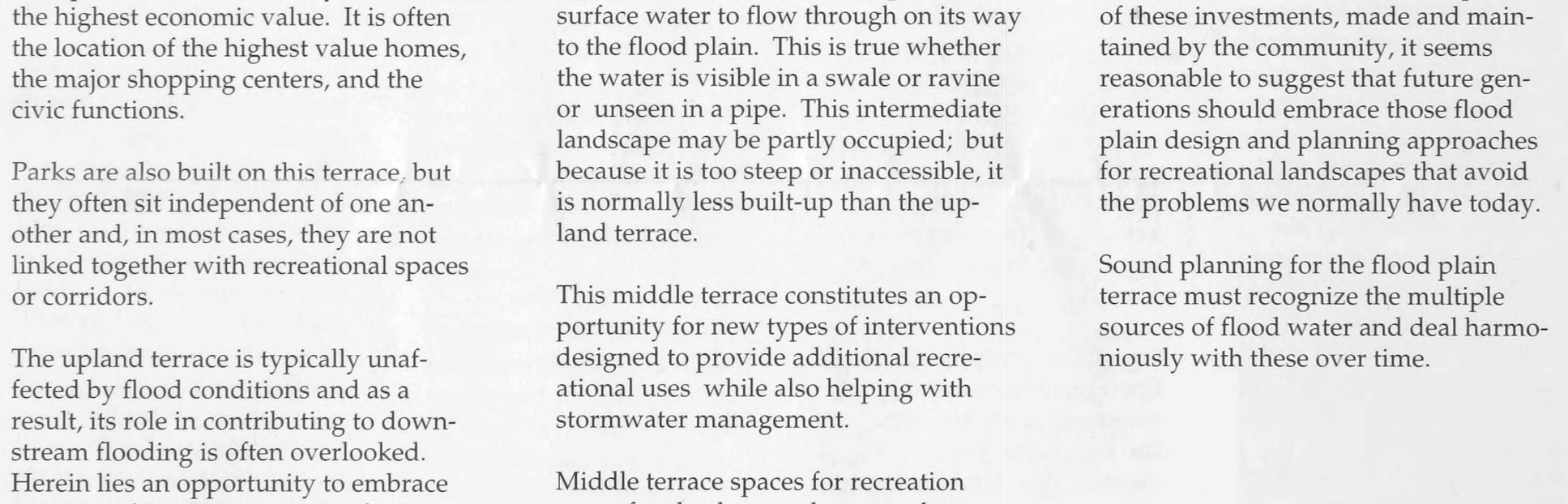
Middle terrace spaces for recreation may often be long and narrow, but simultaneously they can be a unique water management zone, and can serve as a remarkable, linear, recreational asset.

THE FLOOD PLAIN TERRACE

The flood plain terrace is the land adjacent to rivers and streams. It is dominated by a fluid and unpredictable edge and is the zone most affected by seasonal changes.

Strong principles are needed to guide development in flood plains, because these are the places where the recurring whims of nature regularly encounter significant human investments whenever there is a flood. Recognizing that recreation is one of the more important of these investments, made and maintained by the community, it seems reasonable to suggest that future generations should embrace those flood plain design and planning approaches for recreational landscapes that avoid the problems we normally have today.

Sound planning for the flood plain terrace must recognize the multiple sources of flood water and deal harmoniously with these over time.



THE UPLAND TERRACE

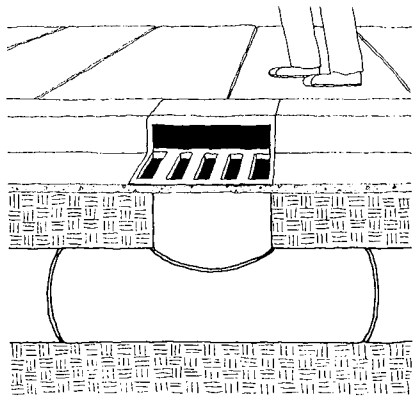
WHAT IS THE UPLAND TERRACE?

The upland terrace is where a community's best, civic and private structures are normally located. It begins at the bluff line of a river valley and extends away from the edge to the surrounding agricultural land. It is the terrace which experiences the growing pains of an expanding community by accommodating new growth and development at the edge of town.

It is also the terrace which affords great views of the river and its valley while providing security from the sporadic and sometimes catastrophic movement of water in the flood plain.

The community watershed, defined as an "area drained by, or contributing to, a stream, lake or other body of water", (Tourbier and Westmacott, 1992), has its beginnings in the upland terrace. In developed areas, the watershed is made up of two types of surfaces: surfaces which permit infiltration of water into the soil, and impervious surfaces, such as pavement and rooftops, which do not.

When it rains, the impervious areas rapidly transport rain as runoff, greatly enhancing the water's force and volume in the lower terraces. Thus, the runoff-increasing investments of the upper terrace impact the environmental quality of the lower terraces in a very negative way by



Buried pipe & culvert.

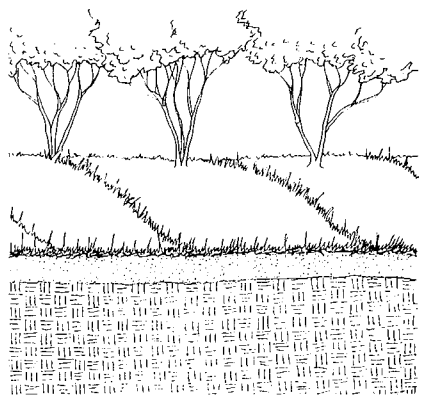
contributing high velocities and volumes of water, sediments and nutrients, whenever it rains.

Buried pipes and culverts function to reduce "the time required for surface runoff from the most remote part of a drainage basin to reach the basin's outlet", (Tourbier and Westmacott, 1992). This is known as the time of concentration, or TOC. For example, if one were to pour water down a concrete pipe with a 3% slope and a 1 foot radius, the water would travel at 16 feet per second. Given the same slope conditions, but with the water traveling down a vegetated channel, the velocity of the water would be reduced to just 4 feet per second.

Significant protection of the flood plain from a deluge of water and nutrients often can be achieved by implementing new land management practices designed to modify stormwater runoff.

BEST MANAGEMENT PRACTICES

Best Management Practices (BMPs), are defined as "structural devices that



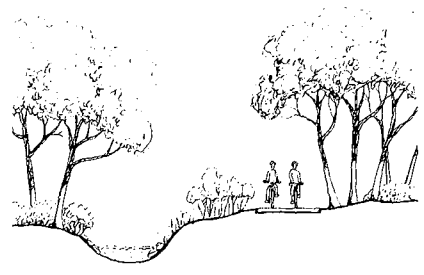
Shrub and grass filter strip.

temporarily store or treat urban stormwater runoff to reduce flooding, remove pollutants, and provide other amenities", (Schueler, 1992). BMP's are used to protect existing levels of water quality from further deterioration and to correct existing water quality problems, (Brach, 1991).

BMP's relevant to the discussion of stormwater treatment and associated amenities on the upper terrace include: filter strips, vegetated swales and stormwater wetlands. If designed properly, these Best Management Practices will reduce erosion and diminish the amounts of de-icing salts, nitrates, phosphates and other pollutants entering water bodies and systems.

Filter Strips

Overland flow of water is encouraged by using filter strips on the upper terrace. Filter strips "consist of grass or other close-growing vegetation designed to receive overland flow", (Brach, 1991). Their function is to slow stormwater



Stormwater recreation trail.

runoff and to trap sediment. They can be mowed or managed as natural areas.

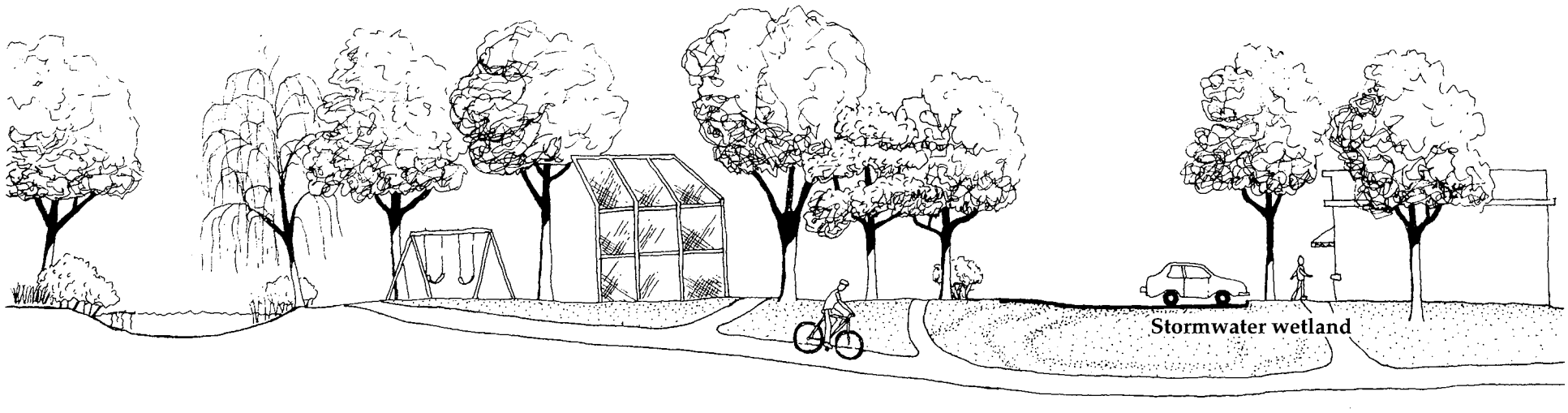
Vegetated Swales

Vegetated swales are "broad channels, with a stand of dense vegetation established in them, that are designed to promote infiltration and traps pollutants", (Brach, 1991). They can be used in place of curb and gutter along roads, reducing the volume and velocity of stormwater runoff.

Filter strips and vegetated swales are most effective as stormwater management practices when used in conjunction with other BMPs, such as stormwater wetlands. They should be included in land use planning and design, i.e. in commercial/institutional, residential and recreational uses on the upper terrace.

Stormwater Wetlands

Since the majority of new development takes place at the outer edges of a community on the upland terrace, away from the mouth of a watershed, it is important to



PARKS AND PLAYGROUNDS — COMMERCIAL STRUCTURES

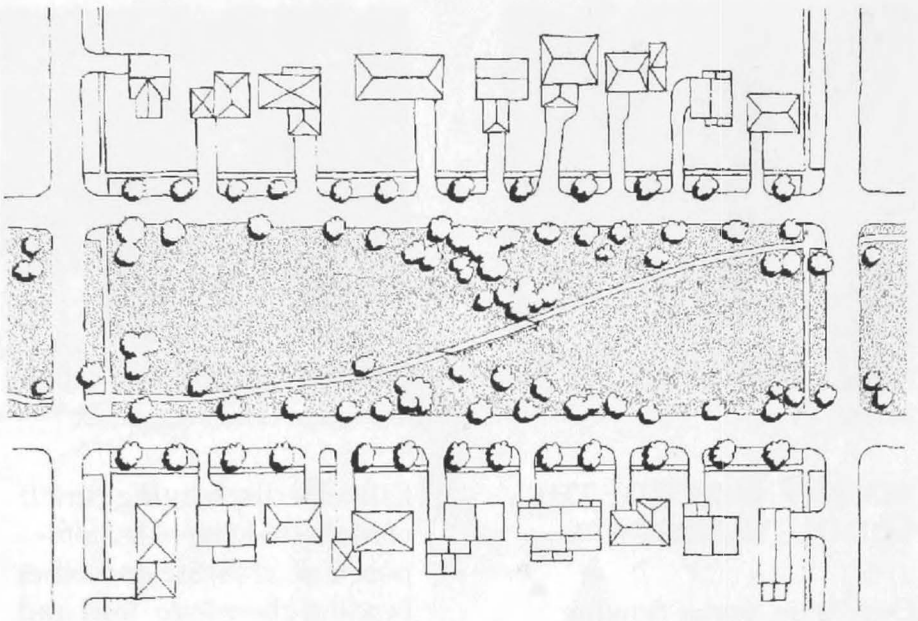
THE UPLAND TERRACE

implement good site planning on and near the construction site *before* the runoff reaches the lower terraces. Good site planning should include the use of a stormwater wetland system.

A stormwater wetland is defined as a "shallow pool that creates... conditions suitable for the growth of marsh plants...designed to maximize pollutant removal by wetland uptake, retention, and settling", (Schueler, 1992).

This type of wetland is a stormwater management device, dependent on rainfall and the impervious surface area of the watershed. Its purpose is to reduce water flow velocity and treat discharge, using wetland vegetation and soil as a natural filtering device.

Stormwater wetlands should be constructed to collect runoff from more than one site. Although onsite storage is a common practice using simple detention basins, such basins tend not to be as effective as those constructed to collect runoff from larger drainage areas. Also, small basins are often designed solely as functional devices with little regard for ecology or aesthetics. Consequently, they often appear as "mud holes" with little recreational or wildlife value.



Vegetated swale and recreation trail within a residential setting

STORMWATER SUSTAINED RECREATIONAL SPACES

Stormwater runoff interventions can have an array of ecological and recreationally compatible possibilities. For example, water that previously had been whisked away by pipes can now be used to help maintain stormwater wetlands and corridors, while creating recreational linkages between the upland, the middle and the flood plain terraces.

Well-conceived, stormwater sustained landscapes should attract and enhance habitat for wildlife in direct proportion to the size and configuration of the wetlands and corridors.

These landscapes can provide recreationists with an opportunity to observe the wildlife as they walk, jog or bike along the adjacent path or trail. These paths also can provide an opportunity for residents of new developments to meet residents of the older established neighborhoods.

INCREASED PROPERTY VALUES

The image of nature and recreation attracts people to live in and visit an area, thereby building and enhancing a community that values the place. For example, the private homes adjacent to the Minneapolis chain of lakes, i.e. Lakes Harriet, Calhoun and Isles, are separated from water by a parkway. Yet, these properties have more than maintained their value, simply through their location. This fact is also true for the land adjacent to Minnehaha Parkway.

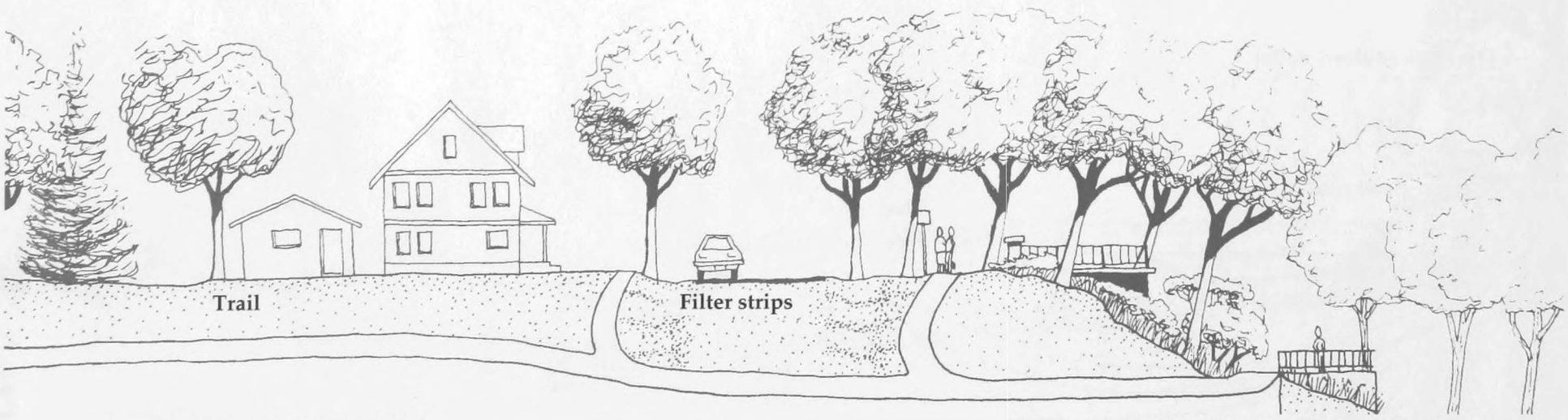
Many studies show that people are attracted to features in the landscape, especially when they include views, park-like landscapes or especially, water.

This attraction, as shown in the Minneapolis lakes, is based upon a visual connection to those lakes and does not require private shoreline ownership.

This relationship is also true of the properties along the East and West River Parkways beside the Mississippi River in Minneapolis and St. Paul. Homes and roads are set well back, far enough away from the bluff edge to allow for a ribbon parkway system that accommodates pedestrian, bicycle and vehicular circulation.

The perceived economic value associated with the natural and recreational aspects of Minneapolis chain of lakes and the Minneapolis and St. Paul Mississippi River bluff properties and their adjacent parkways is a major asset for both communities.

Looking out over the MississippiRiver in St.Paul.



RESIDENTIAL STRUCTURES — OVERLOOK TO THE MIDDLE TERRACE

THE MIDDLE TERRACE

WHAT IS THE MIDDLE TERRACE?

The middle terrace is a critical zone of mediation lying between the highly structured, and often inhabited, upland landscape and the vulnerable flood plain. This middle terrace is an ecological result of sediment deposition caused by flooding and subsequent erosion associated with the flow of the river.

Typical tree species found on the terrace include *silver* and *red maples, hackberry, elm* and *ash*, due to their tolerance of both drought and flooding conditions.

Because this landscape is generally somewhat elevated, it provides an opportunity to rest and walk above the river's edge and experience it from a safe position. It is the porch, the overlooking, shared terrace.

Walkers along the length of this terrace may notice a notch on the sidewall or slope which connects the upland to the middle terrace. This notch, swale, or ravine serves as more than a point of visual interest; it is also a natural conduit for the flow of water between the upland and the river. There may be a series of these notches along the side slopes.

Ravine.

MAINTENANCE OF THE MIDDLE LANDSCAPE

Over time, water flowing across the surface of the land can scour it enough to eliminate the middle terrace. Maintenance of that naturally formed shelf of the middle terrace can not only provide us with a place to be near the river; it can also play a critical role in slowing down erosion and in filtering the surface flow from the upland before it reaches the main river channel.

Unfortunately, most communities have not paid attention to this natural process, under the assumption that faster is better, i.e., the more quickly storm water is drained away from physical improvements, the less likely it is that they will be damaged. This view is understandable but it is also shortsighted. We can move the rain water from our yards and from our streets and into our streams by only using underground sewer systems, but our rivers and streams are not enhanced by this action. Instead, they are overfilled and badly contaminated.

Stormwater culvert & headwall.

Culverts discharging runoff contain de-icing salts composed of chloride and other binding chemicals, lead and other pollutants from the roads, plus fertilizer from lawns and golf courses, and nitrates and phosphorus from feed lots and fields. The mix can be lethal.

How, then, can we take advantage of this middle landscape in a way that meets our need for recreation and wildlife near our river's edge while providing a system that will mitigate the effects of upland stormwater runoff?

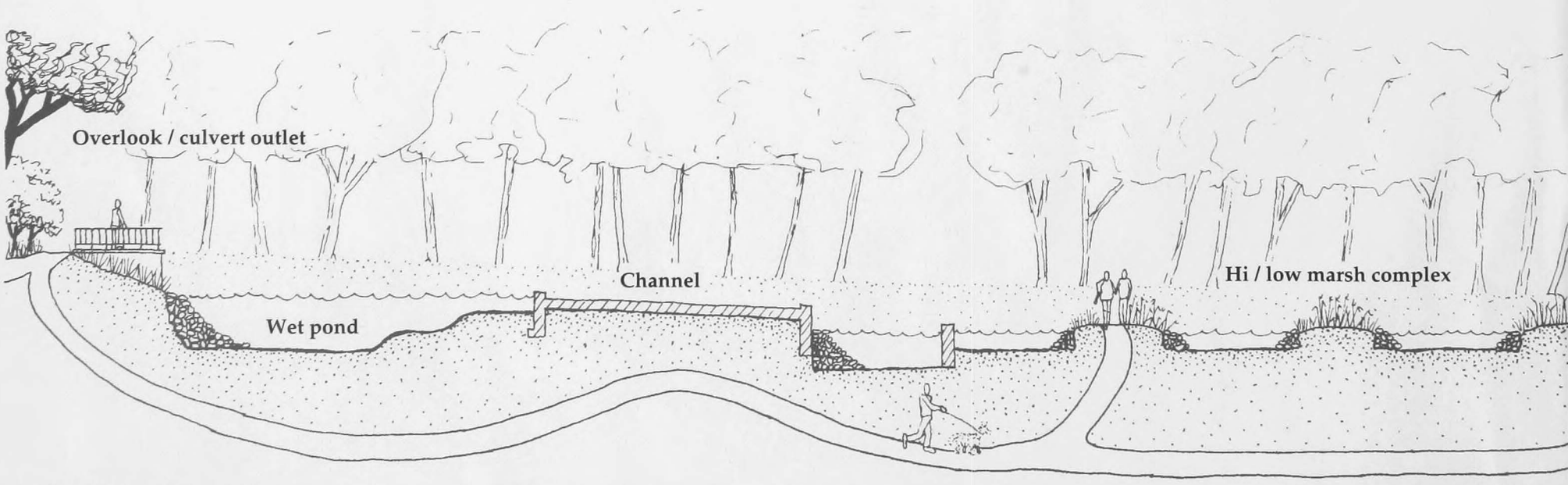
The following approach looks at the function of the middle terrace as it relates to stormwater management, recreation, wildlife habitat, and culture.

STORMWATER WETLAND DESIGN ON THE MIDDLE TERRACE

An appropriate design strategy for the middle terrace would include the creation of a series of stormwater wetland basins because these basins would provide redundant treatment techniques for runoff coming from the roads via designed culverts. The design presented on the following page is based on the use of BMPs, described by J. Brach in *Protecting Water Quality in Urban Areas*, and work done by Thomas R. Schueler and the *Anacostia Restoration Team* in Washington, D.C.

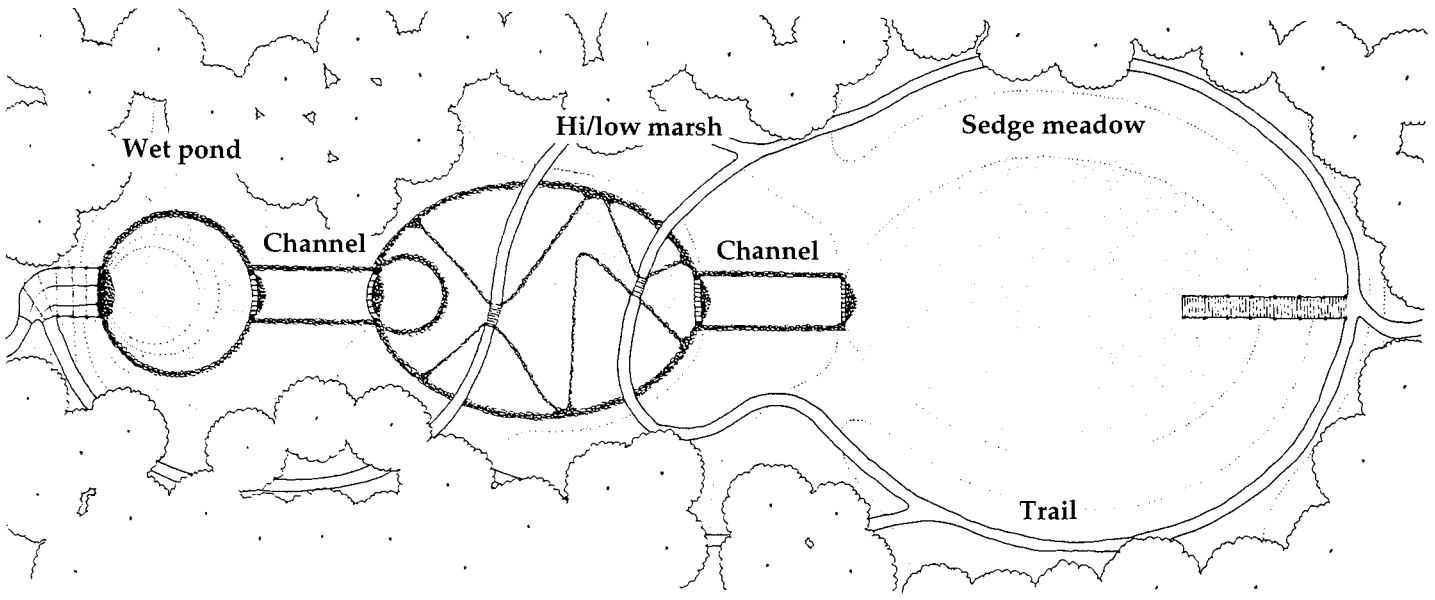
A main feature of this proposed wetland system, unlike other systems, is the incorporation of a recognizable physical form in the design of the treatment basins. The form attempts to reflect the cultural aspect of the middle terrace through the use of material and structure in a series of circular and oval basins. The design also attempts to create a landscape rich in recreational experience while respecting the need to promote wildlife habitat through the appropriate use of vegetation.

The proposed stormwater wetland system should be composed of three separate basins; the wet pond, the shallow/deep marsh complex and the sedge meadow. Each basin has a unique function in the collection and treatment of stormwater via a canal system. In addition, each provides an opportunity to experience three very distinct, yet interdependent, wetlands.



Trail from upland terrace — MIDDLE

THE MIDDLE TERRACE



Multiple pond stormwater wetland recreation trail.

The Wet Pond

The function of the wet pond is to serve as a collection point for the upland runoff and as a place to trap suspended solids and pretreat runoff by reducing flow velocity before the water enters the wetland.

The Hi /Low Marsh Complex

The function of this wetland complex is to improve water quality through a cleansing treatment accomplished by the natural filtering processes of wetland vegetation.

The treatment of stormwater is enhanced by the increased contact time of the water over the surface area of the marsh, an increase gained through the design of hi marsh wedges placed perpendicular to the flow path, (Schuler, 1992). This technique is especially useful during small storm events and dry weather conditions.

Cattails, reeds, bulrushes and other aquatic vegetation in the marsh also will provide food, cover and nesting areas for wildlife.

The Sedge Meadow

The sedge meadow, in the design of this wetland system, provides a final opportunity to "polish" the runoff during small storm events and to store greater volumes of runoff during flood conditions.

The sedges, grasses and wildflowers in the meadow also provide an excellent food source and cover for wildlife.

RECREATIONAL POTENTIALS/WILDLIFE HABITAT

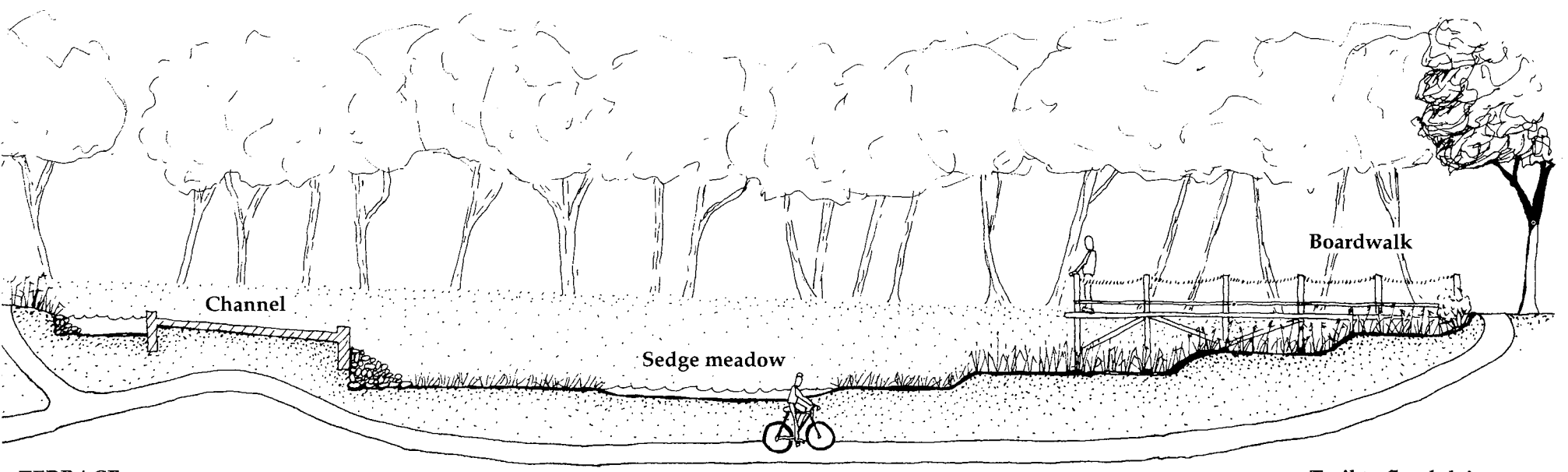
The recreational potentials provided by the design of a stormwater wetland in the middle landscape, functioning as part of a watershed, stormwater management strategy, are rich and abundant. This functional, and yet aesthetically appealing landscape will give us the opportunity to see, experience and understand the effects of runoff and the solutions to its control and treatment, and to observe the dynamic links between a functioning landscape and the wildlife habitat it provides.

Maintained paths and trails should lead us to the edges of these basins, and boardwalks take us through them. There we can look for the tadpoles which develop into "those perfect frogs" we found as children. Walks will become adventures, leading us around and into these wetlands, giving us an opportunity to listen to the playful scolding of the red-winged and yellow-headed blackbirds, and then later, bringing us back to the calling of the river's edge.

The natural levees usually found between the middle terrace and the flood plain can be expanded and reinforced to support flood-proofed recreational structures such as picnic shelters, and should be planted with vegetation native to a flood-prone landscape. These gathering areas will provide us with dry places to share our wetland walk findings, especially if we are on a treasured grade school field trip on one of those warm, sunny days in May.

FORMAL STORMWATER WETLANDS

The stormwater wetland design promotes the idea of function and aesthetics to create a wonderful opportunity for learning. It promotes a greater appreciation for human stewardship of natural processes, such as the cleansing effect of wetland vegetation, and for the attraction of birds and wildlife to these systems. The design also promotes the cultural significance of the middle terrace, by using a form that is recognizably human. Here, the circle and oval forms are used. Not readily found in nature, they are constructed forms and are appropriate for a landscape that has been highly manipulated over time, one such as the landscape of the middle terrace.



TERRACE — Trail to floodplain terrace

THE FLOOD PLAIN TERRACE

WHAT IS A FLOOD PLAIN ?

The term flood plain refers to the low-lying land next to a river or stream. It is land that has been flooded naturally throughout historic time. The flooding usually occurs periodically in late winter and early spring. Acting as an area of temporary water storage, the land also provides habitat for a variety of species. Its plants and animals have been able to adapt to the changing conditions of this specific environment.

Vegetation

The vegetative pattern of the flood plain responds to water flow and the duration of flooding. Moving from relatively high ground within the flood plain to the rivers edge, we can experience the following plant communities: flood plain forests, sedge meadows and wet prairies occupying the less saturated soil, and the aquatic plant communities occupying the saturated soils.

Tree species often found in the floodplain include: *cottonwood* and *black willow.* Occasionally, *American elm, river birch, silver maple, box elder, honey locust and black* and *green ash* are found to be growing.

Flood plain in Hastings.

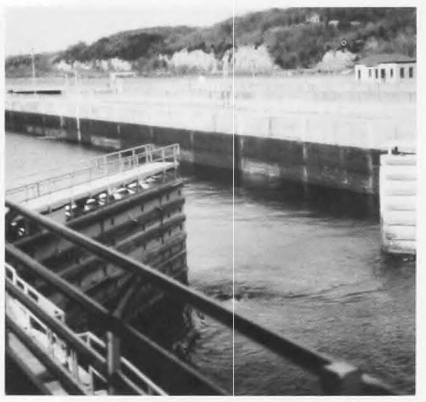
The understory is generally sparsely vegetated. However shrubs that may be found include; *red-twig dogwood* and *other dogwood species, common buckthorn and elderberry.* These are usually found in openings where light is able to penetrate the tree canopy.

The forest floor is often covered with *riverbank grape vines, virginia creeper, poison ivy, jewelweed* and *nettle.*

The pattern of trees, shrubs and ground cover migrates within the flood plain, responding to the seasonal inundation of water.

Water

Water drains into the rivers and streams, moving naturally down ravines or artificially via a culvert.



Lock & Dam #2.

Water also enters the flood plain by infiltrating the soils of the upland terrace and traveling via underground seepage to the flood plain.

In addition, water from the river or stream enters the flood plain by overflowing its banks to spread out in a number of directions.

Soil

The alluvial soils of the flood plain mainly are composed of *loams, sandy loams, and clay.* They are characteristically poorly drained and fertile. These soils have associated with them: a high water table, usually less than five feet from the surface; and topography that is flat, with less than a two percent slope. The flood plain soils are able to support a wide variety of plant communities. Most of the flood plain is woodland.

Pasture and an occasional field of corn or soybeans can be grown but usually with limited success. The periodic, soggy conditions are prohibitive to regular,

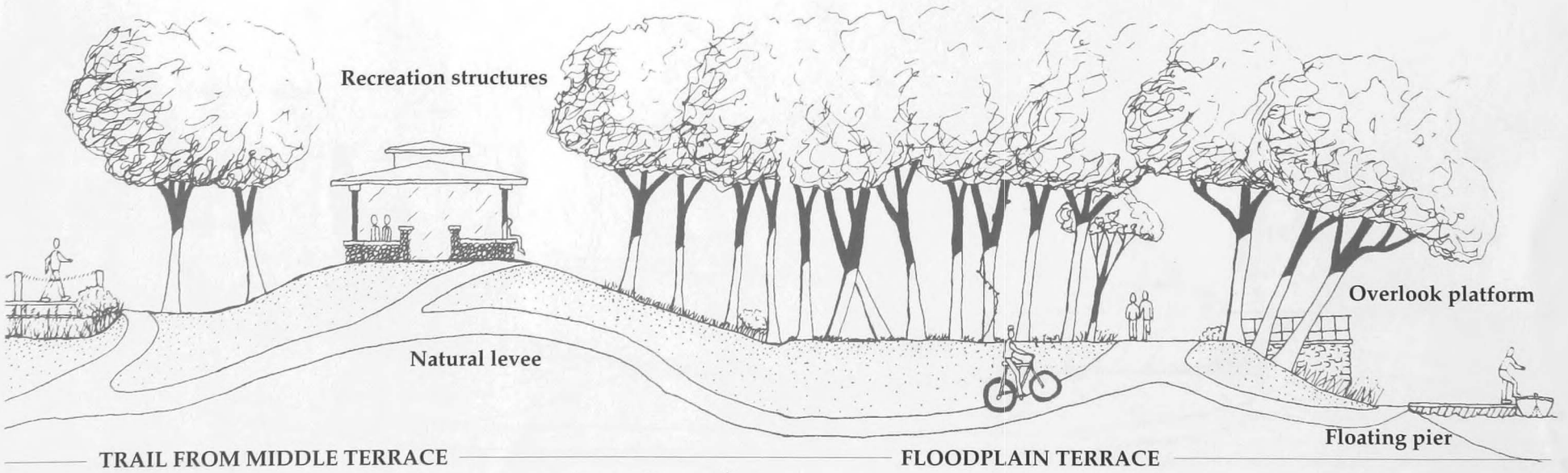
Flood plain in Stockholm.

reliable farming. The Soil Conservation Service states, "because of wetness and the hazard of flooding, most areas of this soil unit are not suitable for building sites and sanitary facilities."

Cultural Elements

Cultural elements, such as historic railroad and vehicular bridges can be viewed from the flood plain's edge. So, too, can farm structures and other buildings gracing the higher ground.

Unfortunately though, some cultural elements tarnish the sensitive character of the flood plain. Included in this negative list are inappropriately placed structures and improperly driven recreational boats on the rivers, boats navigated by those who do not respect the nature of the shoreline, and consequently promote its destruction by not adhering to the posted "no wake" or "low wake" zones.



THE FLOOD PLAIN TERRACE: NEW MODELS FOR RECREATION

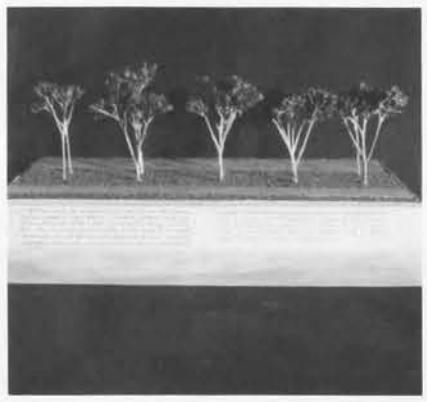
NEW MODELS FOR RECREATION

The hallmark of the flood plain is change. Recreational opportunities in the flood plain must be designed to adapt to changes which are seasonal and unpredictable. Unvegetated soils and structures are moved by floods. But floodplain plants adapt well to change, hold soil in place and often withstand flooding.

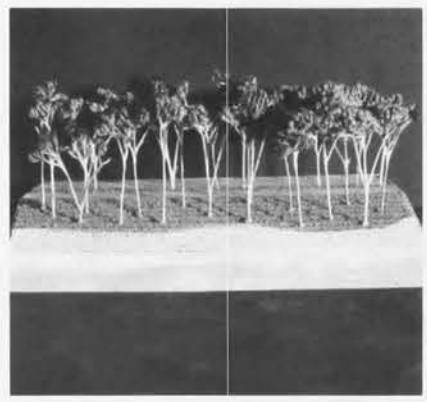
The flood plain resists conventional recreational design practices. Seasonal shifts in water levels and use patterns make the availability of many recreational zones highly unpredictable. Ballfields and tennis courts in the flood plain, for example, can present significant problems, especially in the spring and early summer when these facilities are needed. In all cases, the capriciousness of events in the flood plain demands a flexible attitude towards planned and scheduled uses.

If the challenge for recreational design in the flood plain is adaptability, or flexibility, the linear (or corridor) and edge character of these landscapes, points to a range of recreational uses, from the extremely strenuous to the most relaxing, as being best.

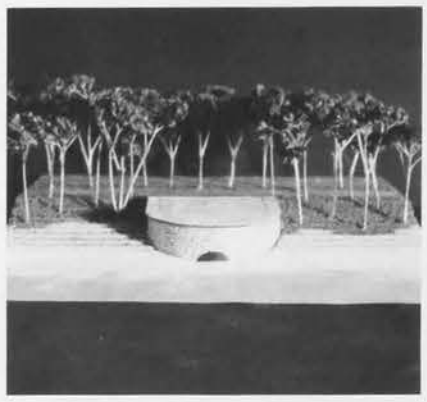
Most flood plains in this Upper Midwest River Basin are linear, or corridor-like, in form. These corridors provide great opportunities for active recreation that spans the seasons- from cross-country skiing to bicycling, in-line skating, and hiking.



Hard edge model.



Soft edge model.



Combined edge model.

Less active recreational uses might relate best to the character of the edge. And since edges are ecologically critical, they can be most appropriate as places to observe wildlife. Depending upon their scale, they can either define a vast area of lowland cover for birds and other animals or an "ecotone," a zone of change from one soil and vegetative cover type to another. Slow-speed boating is an important recreational activity that occupies the edge. In a more urbanized area, an edge can be a great place to simply stroll, or picnic, or sit on a bench.

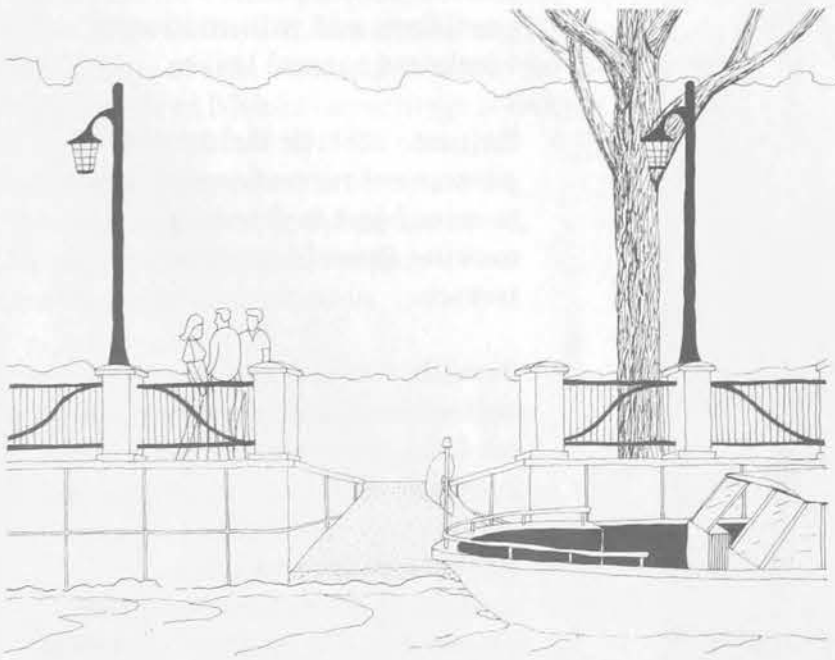
The edge of a river or stream can be designed to be flexible in at least three ways:

- hard edge -- a walled or channelized approach to the edge which assumes that not only can the schedules of activities in a flood plain be flexible to accommodate change, but that the structures, soils, and plants themselves are durable and flexible enough to withstand the flood and become usable as soon as the waters recede. In such cases, some engineered, highly pervious gravels may be needed to underlie surface soils; also wall and revetment structures (e.g., reinforced concrete, masonry or gabbion) must be designed to withstand the forces of the flood water; finally some structures can be built on piers; and plants must be able to withstand sustained inundation.

- soft edge -- an edge that essentially reflects the native condition of soils and vegetation. Vegetation can be restored if conditions have deteriorated. Structures such as pavements should be minimized and confined to upland positions. They also should be buffered by well-vegetated zones. Easily repaired and relatively flexible pavements such as bituminous concrete (asphalt) can be used in such zones. Asphaltic pavements can be specified in a wide variety of thicknesses and mixes to accommodate all kinds of traffic, and to meet barrier-free requirements.

- combined approach -- a combined approach requires the construction of some edge-specific structures (e.g., boat launches, marinas, piers, overlook platforms, etc.) in the context of an otherwise soft edge.

Specific designs will vary with local conditions, but ecologically-compatible, user-friendly concepts will always want to be employed.



Hard edge condition with access to and from the river.

Soft edge condition with linear trail following the river's margin.

KEY DESIGN PRINCIPLES

Ideally it would be best if a community could design all of its corridors from the upland to the flood plain as part of a multifunctioning, linear recreational system of corridors and edges. Safety, health, social, economic and fundamental ecological functions can be well-served by such a system. The following design principles refer to approaches on each terrace in the context of this planned totality.

THE UPLAND TERRACE

D.C.A.U.L.

- **Implement Best Management Practices (BMPs) into design and planning of new developments before water reaches the lower terraces and the stream/river.**

- **Locate old detention basins and open spaces to determine their potential in a new recreational wetland system.**

- **Provide vegetated edges or greenways along stormwater corridors for wildlife habitat and movement.**

- **Create recreational opportunites within these greenways with path and trail systems circulating between the terraces.**

THE MIDDLE TERRACE

- **Create a series of stormwater wetland basins which will store and treat stormwater runoff not treated in the upland terrace.**

- **Provide pedestrian access through and around wetland edges by using boardwalks.**

- **Provide pedestrian and bicyle trails around the perimeter of the wetlands & link the trails to the intra-terrace circulation system.**

- **Provide wildlife observation points along the trail and path system.**

THE FLOOD PLAIN TERRACE

- **Locate piered recreational structures, i.e. picnic pavillions and informational kiosks on natural levees.**

- **Relocate athletic fields and permanent recreational structures subject to flooding, moving them to an upper terrace.**

- **Provide recreational spaces suited for seasonal events, i.e. art fairs, concerts, farmer's markets, etc.**

- **Provide paths and trails, and those other structures that respond to the seasonal qualities of the flood plain.**

NEXT STEPS

WORKING TOWARD A MULTIFUNCTIONING LINEAR RECREATIONAL SYSTEM:
NEXT STEPS FOR THE COMMUNITY WITH FLOODING PROBLEMS:

The following is a list of steps you can take to help you understand how this stormwater/recreational system can work.

Step 1. Get to know your watershed.
This includes an inventory of landform (topography and slope information), landcover/land use, (vegetation and zoning information), soil types, hydrology (contributing streams and rivers, location of wells, depth of water table). Locate the 100 year, 10 year and 2 year flood plain. Locate all structural devices, such as old hydro-electric and mill pond dams which may be located on smaller streams on upper reaches of the watershed.

Step 2. Get to know your community's vision for future development and recreation planning.
Within your community's comprehensive plan, include provisions for the treatment of stormwater runoff while incorporating recreational opportunities on and between the terraces.

Step 3. Get to know your river terrace landscape.
Understand the spatial and functional relationship between the upper, middle and floodplain terraces; and the natural processes, i.e. natural drainage, types of vegetation associated with each, etc.

CONTACT AND SOURCE INFORMATION

- To obtain topographic, hydrologic, and county atlas maps for a watershed inventory, contact the U.S. Geological Survey Service in your state.
- To obtain soil map information, contact your county Soil Conservation Service (SCS).
- To obtain copies of aerial photographs, contact your state Agricultural Stabilization and Conservation Service (ASCS).
- To obtain plat maps showing zoning and property ownership, contact your county or local planning office.

GOVERNMENT AGENCIES

For additional assistance and information you may contact the following federal, state and local agencies:

Federal and State
District Office of the United States Army Corps of Engineers.
State Office of the U.S. Environmental Protection Agency (EPA).
Field Office of U.S. Fish and Wildlife Service (FWS).
Department of Natural Resources (DNR).

Region and County
Planning and Zoning Commission
Department of Public Works
County Parks Commission

Municipal/ Local
Planning and Zoning Department
Department of Public Works
Department of Economic Development
Departments of Park and Recreation

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ACKNOWLEDGEMENTS AND CREDITS

Funding for this project was provided by the Minnesota Extension Service, University of Minnesota.

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The project began as a search for sound management principles in the middle terrace landscape of Lake Rebecca Park in Hastings, Minnesota on the Mississippi River. It then expanded to become the broader study found in these pages.

Special thanks to the City of Hastings, Dakota County, Minnesota Pollution Control Agency, Minnesota Historical Society (photo p. 1), Design Center for American Urban Landscape (photo p.10), and U.S. Army Corps of Engineers.

"Each generation has its own rendezvous with the land, for despite our fee titles and claims of ownership, we are all brief tenants on this planet".

Stewart Udall (1963)

AD-FO-6445-S

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