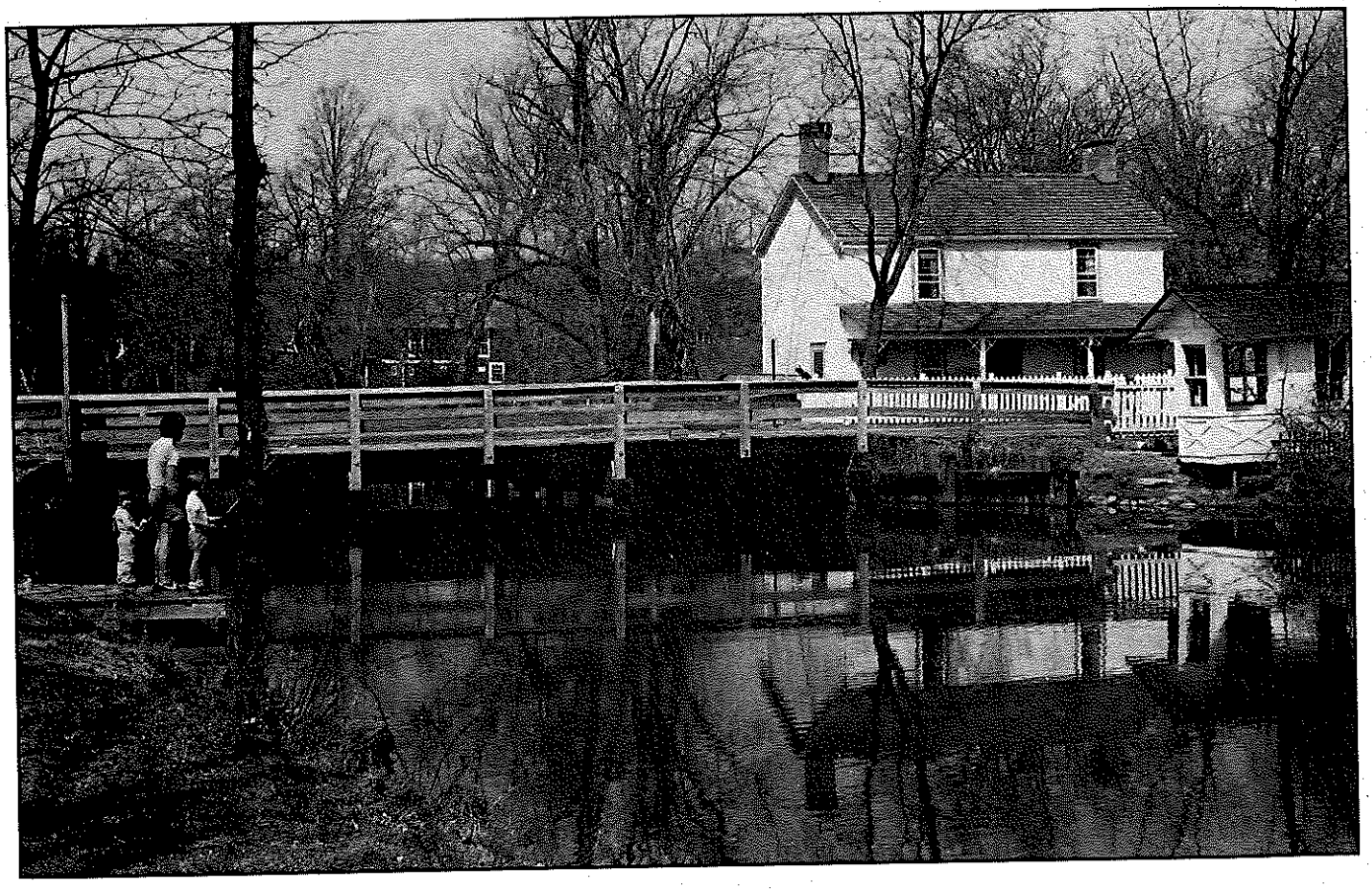
DELAWARE AND RARITAN CANAL SAFETY ISSUES

FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS



Prepared By:

Delaware & Raritan Canal Transportation Safety Study Commission

April 1996

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For Submission To:

Governor Christine Todd Whitman
Honorable Donald DiFrancesco, New Jersey Senate President
Honorable Jack Collins, New Jersey Assembly Speaker

April 1996

Acknowledgements

I would like to thank all members of the Delaware & Raritan Canal Transportation Safety Study Commission for their tremendous commitment and gratis contributions. The background research and writing were carried out almost exclusively by Commission members themselves. Moreover, it was through them that others were recruited to offer their specialized knowledge.

In this last regard, the designees of State agencies who served as Commission members are due extra thanks for being as forthcoming as they were with the information, technical resources, and staff assistance necessary to identify and evaluate transportation and other safety concerns related to the Delaware and Raritan Canal.

Legislators appointed to the Commission and their aides who sat in for them provided their backing for the Commission's efforts throughout the study process. They impelled the Commission to develop concrete and realistic budget requests to fund the report's recommendations. They also helped the Commission pay its own costs through active support of its requests for administrative funding and in-kind state agency assistance.

Public members are recognized for their tremendous civic spirit and their role in producing open discussion within the Commission. The dedication, leadership and countless hours of labor they contributed toward the Commission's work is here noticed. Furthermore, their efforts were instrumental in expediting the organization of the Commission.

Finally, special thanks are due to interested residents, and members and managers of organizations and public agencies who contributed their insights and comments and who so willingly accommodated the Commission's requests for information.

-Caroline Swartz, Chair
Delaware and Raritan Canal Transportation Safety Study Commission

Delaware & Raritan Canal Safety Issues: Findings, Conclusions, and Recommendations

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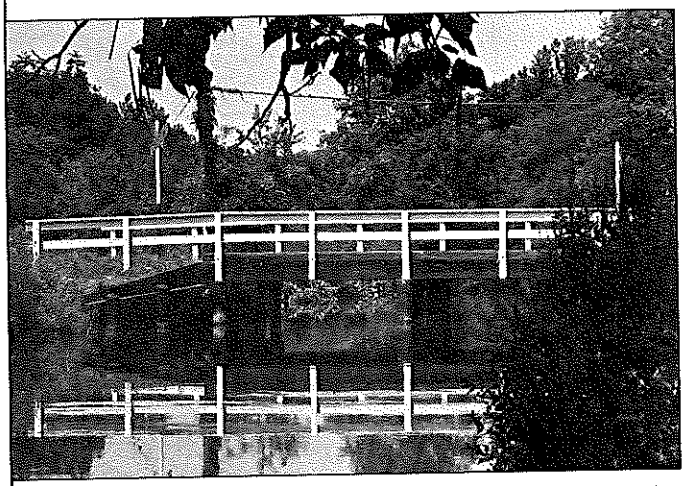
THE DELAWARE & RARITAN CANAL TRANSPORTATION SAFETY STUDY COMMISSION

Executive Summary

Background

The Delaware & Raritan Canal State Park is a widely used and valued resource.

Continued public enjoyment of the Park demands, among many considerations,



Courtesy of Delaware & Raritan Canal Commission

that an acceptable measure of safety be provided to those using it and traveling nearby. At the same time, efforts to reduce safety concerns and to minimize potential accidents must be accomplished in ways that protect its recreational, ecological, historic and aesthetic resources, the very attributes which draw thousands of visitors each day.

During the 1980s, three fatal accidents involving motor vehicles occurred in and near the Delaware & Raritan Canal State Park. In June of 1988, a meeting was convened between state agency representatives and legislators to discuss the nature of the accidents and to determine what could be done to minimize future traffic safety hazards, both at bridge crossings and on roads that run parallel to the Canal. It was determined at this meeting that the following items would require legislative action:

- the need to conduct a more detailed study of safety hazards
- the need to clearly spell out governmental jurisdiction for vehicle safety on and adjacent to the Canal
- the need to develop a funding base to implement a transportation safety program

In 1990, the State Legislature took action on these issues. Noting that the benefits associated with the Canal have been threatened by public safety concerns, especially related to bridge crossings and parallel roads, the Legislature introduced a bill which established the Delaware & Raritan Canal Transportation Safety Study Commission. The bill was signed into law in 1992 (P.L. 1991, ch. 344; codified at N.J.S.A. 13:13-12.8 and N.J.S.A. 13:13-3.1 to 3.4).

The Study Commission was directed "to study transportation, recreational, and other safety hazards associated with the Delaware & Raritan Canal, and to inquire into the ways in which these hazards might be reduced." In addition, the Commission was directed to address "intergovernmental and jurisdictional questions concerning bridges that traverse the canal, the condition of barriers, guardrails, and fences along the canal,

maintaining the historic and aesthetic integrity of the canal, and the costs associated with the construction and maintenance of these structures."

At the same time that the Legislature created the Study Commission, it also expanded the powers and responsibilities of the New Jersey Department of Transportation with respect to canal-related projects, while removing certain approval responsibilities from the New Jersey Department of Environmental Protection and Delaware & Raritan Canal Commission. However, in so doing, the Legislature acknowledged that this alteration was intended to be an interim measure only, while the Study Commission investigated and reported on relevant public safety issues and recommendations.

The Commission first convened on April 2, 1993. Bylaws were adopted on June 4, 1993 and meetings were held monthly. The following goals were formulated by the Study Commission to help guide the transportation safety study process:

Goal #1: Address jurisdictional issues regarding safety concerns associated with the Canal.

Goal #2: Investigate transportation, recreational and other safety concerns associated with the Delaware & Raritan Canal and recommend ways in which these may be reduced while maintaining the integrity of the Canal Park as a recreational, aesthetic, historic and ecological resource and as a public water supply.

Goal #3: Provide opportunities for public education and involvement during the study process.

In accord with P.L. 1991, c. 344, the Commission is now reporting its findings, conclusions and recommendations to the Governor and the Legislature.

Summary of Study Commission Recommendations

The recommendations presented in this report were developed after careful analysis and consultation with experts in the fields of transportation safety, parks and recreation, water supply and historic resources, and after public input. The recommendations call for legislative actions, gubernatorial actions and state agency actions to provide needed funding, jurisdictional allocations, infrastructure improvements and park maintenance needs. Report recommendations also include county and local initiatives.

The following is a summary of key recommendations. A detailed discussion on these and additional recommendations is contained in Chapter IV.

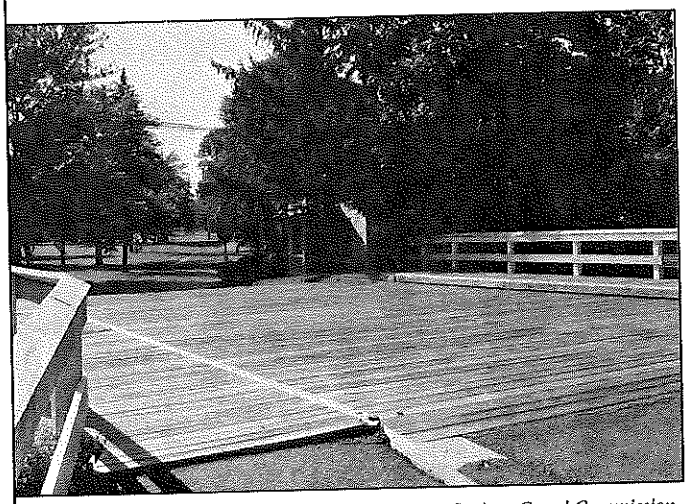
Jurisdictional and Intergovernmental Responsibilities:

The Study Commission recommends that the Department of Environmental Protection and Delaware & Raritan Canal Commission approval authorities, which were temporarily suspended as a result of N.J.S.A. 13:13-3.1 et seq., be returned. This will require legislative action.

The approval authorities over state agency projects that both the Department of Environmental Protection and Delaware & Raritan Canal Commission maintained prior to enactment of N.J.S.A. 13:13-3.1 et seq. did not in themselves obstruct needed safety improvements to canal crossings. These approval authorities provided valuable assurance that the Canal Park's cultural, aesthetic and recreational values will be preserved.

The absence of needed interagency coordination and communication slowed the process in the past.

Therefore, to address the need for better coordination among state agencies, especially on technical and planning issues, the Commission recommends an



Courtesy of Delaware & Raritan Canal Commission

Executive Order to formalize the existing Delaware & Raritan Canal State Park Interagency Task Force as the coordinating group for all transportation and safety issues related to the Delaware & Raritan Canal State Park, and, that said Task Force be expanded to include participation by the New Jersey Department of Transportation.

Such an Executive Order will provide a means to reduce or eliminate project review delays and facilitate communication between affected state agencies. With regard to safety, the inclusion of the New Jersey Department of Transportation will assure that projects the Department proposes will be presented and discussed early-on with other key state agencies so that their respective requirements and priorities will be satisfactorily addressed.

Bridge and Rail Safety:

The Study Commission recommends that prototype designs for bridges and railing systems be developed by the New Jersey Department of Transportation with input from the state agencies comprising the Interagency Task Force. The design and crash testing of timber bridge railing systems that the New Jersey Department of Transportation is currently undertaking with federal funds should become part of the prototype design program.

Infrastructure Needs:

The Commission has identified the need for guiderails along parallel roads to protect vehicles from driving off the road into the Canal. It also recommends detailed studies by the New Jersey Department of Transportation, with input from the Interagency Task Force, to determine infrastructure needs on roadways that approach and tie into canal crossings. This includes road realignments and improved signage.

Funding:

The New Jersey Department of Transportation has obtained $444,936 in

federal dollars, primarily through the Intermodal Surface Transportation Efficiency Act (ISTEA), to develop timber prototype railings both for wooden bridges and other Delaware & Raritan Canal bridges.

The Department has also planned for an accelerated program to upgrade Delaware & Raritan Canal bridge railings and has budgeted $4.4 million in State funding during the next three years (FY 96-98) to complete safety improvements of the existing railing systems. This accelerated upgrading of bridge railings over the next three years is intended as an improvement to correct existing safety concerns related to bridge railings.

At this time, it is uncertain whether, or to what extent, the results of the federally-funded project will be used, since its completion is not expected to occur until well after construction of the railing safety improvements begin. However, the prototype timber bridge railing designs that are being developed through the federally-funded project will be used in the future when bridges are up for replacement.

In addition, an estimated $9 million should be appropriated to the New Jersey Department of Transportation to provide for canal bridge repairs, primarily of decks and substructures. The New Jersey Department of Transportation has identified 25 bridges which need such rehabilitation.

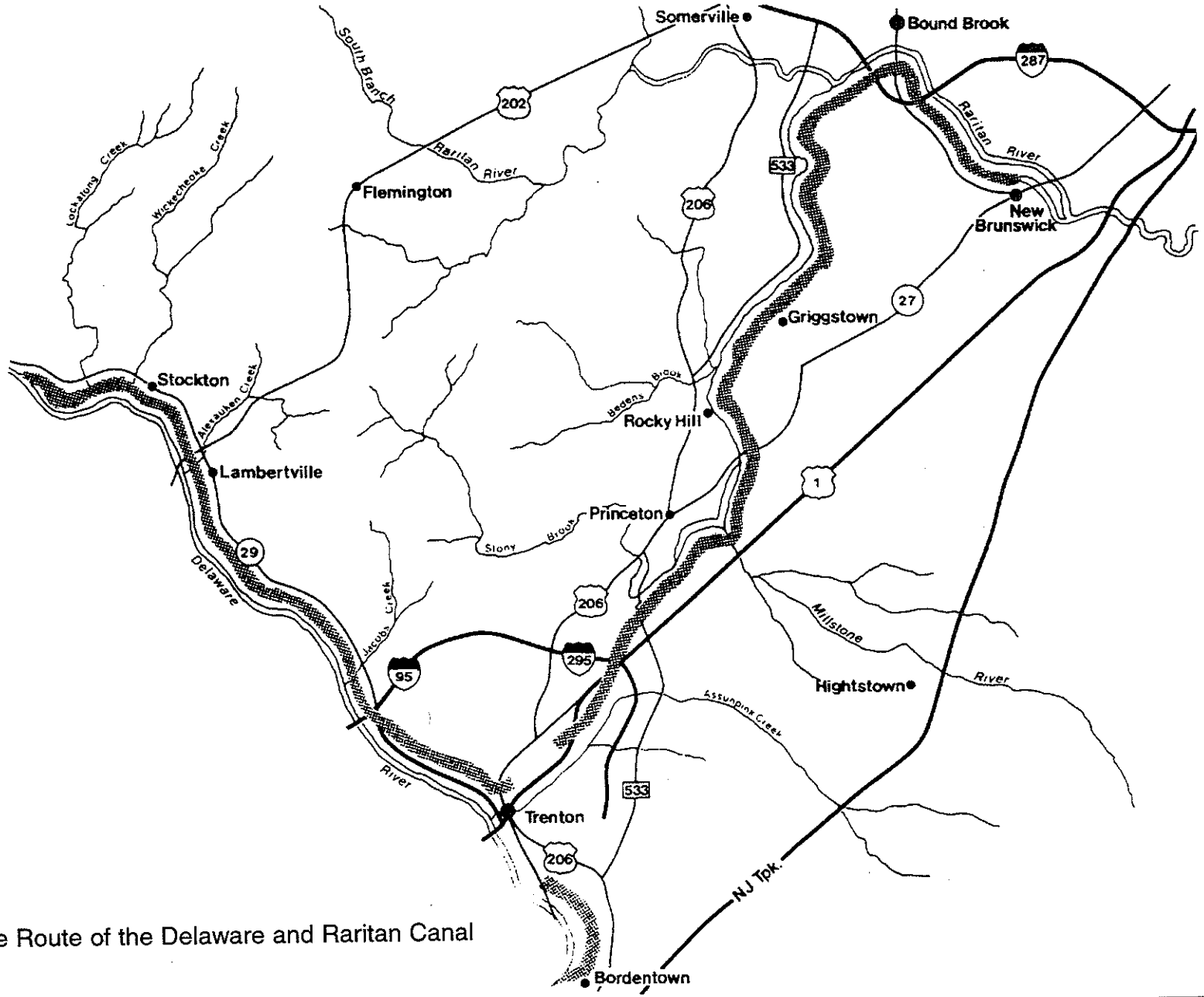
Two million dollars should be appropriated to provide for parallel roadside barriers.

One million dollars annually, additional to the current level of funding, is recommended to be appropriated to the New Jersey Department of Environmental Protection, Division of Parks and Forestry, for continued operation, public information and maintenance of the Delaware and Raritan Canal State Park.

This Park is the third most heavily visited in New Jersey with attendance increasing from some 447,000 in 1985 to over 681,700 in 1995. Since 1985, over 25 miles of trails have also been developed and open to the public, mainly in the Park's most densely populated and heavily used urban areas requiring extraordinary resources to maintain and provide a safe, enjoyable experience to its patrons.

Over the last five years, staffing levels at the Park have decreased by 19%, from 21 in FY90 to 17 today. In addition, current staffing levels are only 50% of the core level staffing established by the Office of Management and Budget in 1988 for the maintenance and operation of this unique Park. With existing resources of approximately $840,000 for its operation, the Division of Parks and Forestry estimates its needs of over $1,840,000 to efficiently and effectively manage this valuable resource and to implement the specific recommendations contained elsewhere in this report.

Figure 1



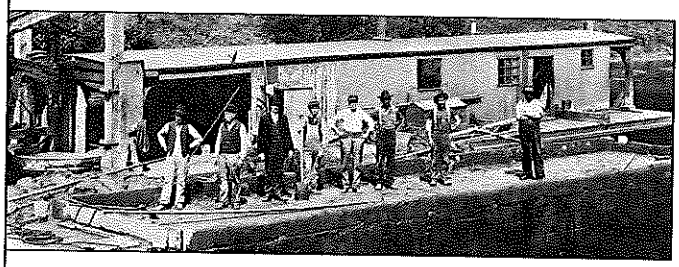
The Route of the Delaware and Raritan Canal

CHAPTER I

INTRODUCTION — THE DELAWARE & RARITAN CANAL

History of the Delaware & Raritan Canal

Pre-1940



Courtesy of Delaware & Raritan Canal Commission

The Delaware & Raritan Canal was originally conceived by William Penn in 1676 as an inland waterway to move goods and people between Philadelphia and New York. This idea lay dormant for over 100 years. In 1830, the New Jersey State Legislature finally granted a charter to a canal company to traverse central New Jersey. The first section of the Canal from Trenton to Kingston opened in September of 1833. The official Canal opening took place June 25, 1834.

The Canal's path is a large meandering "Y." The main canal connects the Delaware River at Bordentown with the Raritan River in New Brunswick. Trenton is the highest point of elevation on this 44-mile-long waterway. A 22-mile-long feeder canal was built to supply water to the main canal. The feeder draws water from the Delaware River at Raven Rock (between Frenchtown and Lambertville) and runs next to the Delaware River all the way to Trenton, where it joins the main canal.

The Canal operated for 99 years and was an important element in the prosperity of Central New Jersey in the latter half of the nineteenth century. Its connections with New York and Philadelphia meant markets for New Jersey products and trade to provide the needs of New Jersey's citizens. During the Canal's busiest years, coal accounted for 80% of the total tonnage. In its busiest year, 1871, the Delaware & Raritan Canal had more traffic than the more famous Erie Canal.

In 1871, with the acquisition of a 999-year lease of the Canal by the Pennsylvania Railroad Co. (PRR), the Canal's impact and usage began to decline. The Canal could not effectively compete with the ever-advancing rail network. Some believe that the PRR's acquisition was intentional to reduce the economic viability of the Canal. Repairs became infrequent and rates were increased.

In the spring of 1933, the Canal failed to reopen after its customary winter closing. The 1830 charter required forfeiture to the State for failure to operate for three consecutive years. Initiated as a federal Works Progress Administration (WPA) project in 1936, a part of the Canal in Trenton was filled, leaving the portion in Hamilton Township cut off and abandoned.

In 1937, the PRR turned the Canal over to the State with 933 years left on its lease.

The Canal, as a navigable commercial waterway, had lasted 99 years before becoming obsolete. Now the Canal would become important as a source of water to the industries and towns growing in the Canal region.

Post-1940

In 1944, rehabilitation began on the rest of the Canal to enable it to serve as a water conduit under the direction of the State's Division of Water Resources, now part of the New Jersey Department of Environmental Protection. Responsibility for the Canal as a water supply was turned over to New Jersey Water Supply Authority, which has been the Canal's official guardian for over thirteen years, providing for the sale of approximately 70.4 million gallons of water per day with an annual income of about $5,500,000.

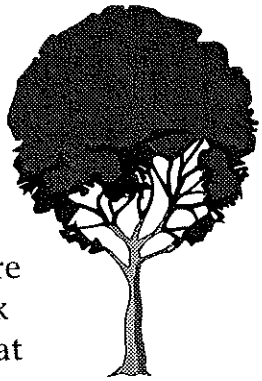
In 1973, the Delaware & Raritan Canal and seventeen related structures were made part of the National Register of Historic Places. In 1974, the New Jersey State Legislature established the Delaware & Raritan Canal State Park and the Delaware & Raritan Canal Commission.

Four agencies share responsibility for the administration of the Canal Park: the Delaware & Raritan Canal Commission; the Division of Parks and Forestry within the New Jersey Department of Environmental Protection; and the New Jersey Water Supply Authority. In addition, the New Jersey Department of Transportation maintains the bridges over the Canal.

Today, the Canal serves as the potable water source for about 700,000 people in Central New Jersey, while the Canal Park is the third most heavily used state park in New Jersey (after Liberty State Park and Island Beach State Park). In view of its importance, the public must be able to use the Delaware & Raritan Canal Park in a safe and environmentally sound manner.

The Delaware & Raritan Canal Commission, New Jersey Department of Environmental Protection, New Jersey Water Supply Authority and New Jersey Department of Transportation share responsibility for the administration of the Canal Park.

Park as a Public Resource



The Delaware & Raritan Canal State Park is a widely used and valued resource. The Delaware & Raritan Canal State Park Master Plan points out that the Park is a resource that attracts and holds public affection.

Continued public enjoyment of the Park demands, among many considerations, that an acceptable measure of safety be provided to those using it and traveling nearby. At the same time, efforts to reduce safety concerns and to minimize potential accidents must be accomplished in ways that protect its recreational, ecological, historic and aesthetic resources, the very attributes which draw thousands of visitors each day.

Canal Park Environment

Just as the Canal represents a barrier to vehicles traveling between two points, each vehicle crossing is an intrusion into the State Park. The Delaware & Raritan Canal Commission has adopted policies and strategies for reviewing projects that affect the Park. The Delaware & Raritan Canal State Park Master Plan offers several

principles which help guide decisions about the physical development of the Park:

"• The Canal Park is a linear park.

• The Canal Park must retain a degree of serenity and separation from the manmade world. Vehicular intrusion either from roads that enter the Park or from those that run parallel to it should be avoided.

• As a multiple use resource, each of the Canal Park's primary roles must be given equal importance. Any development of the Canal Park should accommodate the Canal's historical qualities, its function as a recreational site, its role as a water supply system and its role as a nature preserve.

• The Canal Park is a site for recreational activities.

• The Canal is a historic resource. All repair, maintenance and development work on the Canal and its associated structures should conform to the Secretary of Interior's Standards and Guidelines for Rehabilitation. The Canal Park's historic character is derived as much from the context through which the Canal flows as from the Canal's structures. That context—the area that can be seen from the Canal and its towpath—should be preserved in a manner that reflects its historic nature. The Canal Park should provide an appropriate context for nearby historic structures, landscapes and sites.

• The Canal Park is a means of enhancing urban areas. The recreational, historical and natural conservation objectives are all applicable to urban areas through which the Canal flows and should be appropriately applied there." [1]

In addition to the aforesaid principles, the Master Plan also distinguishes between areas along the Canal according to a series of "environmental types" by which they are categorized. Environmental types describe the unique surroundings immediately adjacent to the Canal Park.

They have been used as guidelines in evaluating development projects for their compatibility with a given area, although they have generally not been used in reviewing bridge projects. Environmental types are defined as follows:

• Natural: very little signs of man's influence.

• Rural: natural conditions dominate but unobtrusive signs of man's impact may be visible from the towpath.

• Suburban: open spaces dominate, although those spaces are chiefly defined by manmade structures; regularly placed houses sit adjacent to the Canal Park.

- Transportation: highways abut the Canal Park, creating the sense of a confined narrow corridor in the Park.

- Urban: dense development surrounds the Park.

- Special node: short sections of the Park, usually connected to points where roads cross the Canal, with a character unlike what is on either side or that present special development potential.

Because the Canal Park is linear in configuration and very narrow, drivers approaching a bridge may not even be aware of their entry into the Park when crossing, despite the presence of state park signs and despite the standardized design of canal bridges. Drivers are even less likely to realize they are entering a park prior to actually crossing the Canal, while traveling on the approach roadways. This is exacerbated by a lack of advance warnings on the approach roads to alert drivers that they are entering a park and prompt them to adjust speed and steering.

Historical Significance of Canal Bridges

Most of the bridges constructed after World War II are not historically significant structures, according to the New Jersey Department of Transportation records. The staff of the State Historic Preservation Office (SHPO), housed within the New Jersey Department of Environmental Protection, have confirmed that most of today's bridges postdate the Canal's era of historical significance when the Canal ceased operation as a transportation corridor. Nonetheless, historic preservation specialists consider the bridges to be one of the most significant design elements in the Park.[2]

The Canal bridges are considered to be one of the most significant historical design elements in the Canal Park.

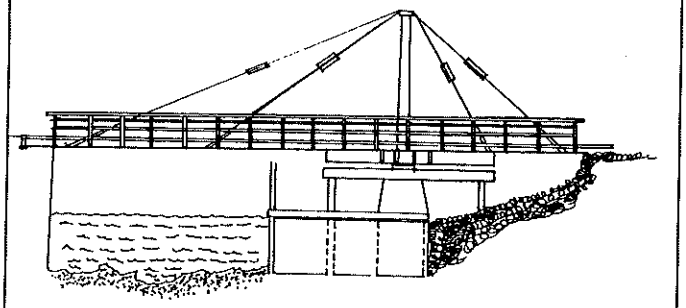
Moreover, both the Delaware & Raritan Canal State Park Master Plan and 1980 Design Guide acknowledge that they are consistent with the Park's historical ambience.

In reviewing projects affecting national and state historic register properties or structures, SHPO uses the Secretary of the Interior's Standards for the Treatment of Historic Properties (1992).[3] One of these standards which is of particular importance in reviewing canal projects states that the historic character of a property must be retained and preserved. In this regard, SHPO staff note that while the structural components of the bridges may not be historically significant themselves, bridge appearance is important in relation to the historic character of the Canal. Thus, bridges should be compatible and in character with the history of the Canal.

Historic preservation specialists suggest that in developing designs for new bridges, it is important to incorporate characteristics of existing canal bridges.[4] Present day bridges in fact retain many of the design elements of their predecessors. The earliest known bridge design was the "A" frame. Bridges of this style were timber, with simple handrails and uprights

spaced at roughly four-foot intervals. Most had a single horizontal rail which was painted white. The "A" frame bridges were replaced by the "King" post bridges between 1911 and 1913. Much like the "A" frame bridges, these were built to a typical prototype consisting of timber

Figure 2



Courtesy of Harvey Steinberg

King Post swing bridge at Kingston

materials and simple rails similar to the "A" frame predecessor. In 1932, the closing of the Canal to navigation obviated the need for movable bridges. Consequently, these bridges were largely replaced with fixed timber bridges built to a prototype in the 1940's.

Historic preservation specialists have documented that maintenance of historical bridge design, carried on through generations of prototypes, is vital to the Canal's historical integrity. Typical design elements include the flat wooden decks and open, white rails. SHPO has gone on record indicating its preference for wooden bridge railing systems. If there are no wooden bridge railings that have been crash tested and meet AASHTO (American Association of State Highway and Transportation Officials)[5] standards, then metal railings painted white would be the next best alternative.[6]

Most likely, all of the original Delaware & Raritan Canal bridges were constructed of timber. However, over time, this changed, especially in urban areas. Indeed, historical documents and photographs reveal a great deal of diversity in structure and design. Steel structures were prevalent in urban areas, while timber swing bridges dominated the rural landscape. This suggests, according to SHPO staff, that new bridge designs can similarly reflect a good deal of diversity, incorporating, for example, different design elements into bridges in rural areas from those in urban places.[7]

Natural Resources

The Delaware & Raritan Canal Park is linear, over 60 miles in length, covering 3,600 acres. It is very narrow, generally ranging in width from as little as 60 feet to 200 feet, but as wide as 2,000 feet in one section of Franklin Township, Somerset County.

The Canal Park is generally blessed by a wide variety of natural resources, characterized by the flow of canal water; 24 tributary streams; 76 drainage basins; two different physiographic provinces—Piedmont and Intercoastal; a wide variety of floodplain, marsh, and upland vegetation; animal life ranging from many species of natural game fish, turtles, and frogs to about 200 bird species, deer, and small mammals.

Recreation

The Delaware & Raritan Canal State Park offers numerous recreational opportunities. The historic towpath along the main canal offers bank run material or

crushed stone surfaces for hiking, jogging, horseback riding and biking. Canoes, kayaks and small boats can be launched at the several access points along the Canal and Delaware River. Fishing, picnicking and camping are also available to visitors to the Delaware & Raritan Canal State Park. The frequent transit of bicyclists, hikers, joggers, runners, and sometimes horseback riders between the Park and adjacent areas presents safety issues related to vehicular traffic.

Park Protection and Enhancement Programs

Since creation of the Delaware & Raritan Canal State Park in 1974, there have been numerous examples of projects and initiatives led by citizen organizations as diverse as historical societies, greenway groups, and canal societies and by municipal, county, state and federal government to enhance or preserve the integrity of the Delaware & Raritan Canal State Park. Designation in 1973 of the Canal and related structures on the National Register of Historic Places has already been noted. Other examples follow.

Federal Programs

The Delaware & Raritan Canal was included in the National Trails System in 1992. The National Trails System Act of 1968 established a policy for creating a system of recreation, scenic and historic trails that increase public access to outdoor areas and historic resources, primarily in urban areas but also in more remote locations.

State Programs

The New Jersey State Development and Redevelopment Plan identifies the Delaware & Raritan Canal as an area of critical concern that should be considered for future inclusion in the Plan.

In 1991, an intergovernmental steering committee, led by the New Jersey Department of Transportation, was created to develop a State Scenic Byways Program. This program is designed to encourage appropriate management of highways that offer visual or physical access to particularly outstanding scenic, historic, cultural, recreational, natural or archeological resources.

In order to "test" the effectiveness of the Scenic Byways Program, the State is undertaking a pilot project to designate the first scenic byway in New Jersey. Route 29, a State highway which runs next to the Delaware & Raritan Canal, has been designated as the project area. The result of this effort will be a series of recommended management measures and capital investments needed to protect the scenic, recreational, historical and other important resources within the corridor.

County Programs

The Somerset County Planning Board prepared a Scenic Corridor and Roadway Study in July of 1992. The report identifies scenic roadways and corridors in Somerset County according to the presence of valuable and unique visual resources. It then recommends alternative engineering standards for roadway design,

bridges and culverts, guiderails and other transportation facilities; landscaping and lighting; and land use and site planning strategies, all geared toward protection of scenic resources. A map of scenic corridors and roadways shows that roughly 12 miles of Somerset County and local roads bordering the Canal and crossing the Canal are designated as scenic roadways.

Local Programs

The City of Trenton and Capital City Redevelopment Corporation are currently planning improvements to create a major recreational and open space amenity along the Canal and to promote housing and economic revitalization.

Trends Affecting Park Usage and Safety

According to the Division of Parks and Forestry, the Delaware & Raritan Canal State Park is the third most heavily used State Park in New Jersey. An estimated 2,000 people visit the Park daily during the week, with many additional visitors on weekends. Attendance has increased from approximately 447,000 to over 681,700 between 1985 and 1995. Reasons for its popularity are many. Its central location in one of the most populated regions of New Jersey, coupled with its linear configuration, make the Park accessible to a large number of people. The Park and immediate areas surrounding it offer a variety of recreational opportunities. A survey conducted in 1988 by the New Jersey Department of Environmental Protection determined that bicycling, walking, jogging, fishing, canoeing and camping are among the 20 most popular outdoor recreational activities in New Jersey. The Canal Park area accommodates all of these activities.

The Delaware & Raritan Canal State Park is the third most heavily used State Park in New Jersey.

Courtesy of Delaware & Raritan Canal Commission

According to Park rangers, the Park draws visitors from a large geographic area. Not surprisingly, most Park users are from surrounding municipalities. However, people throughout the Central New Jersey region take advantage of its accessibility and recreational opportunities. The Park even draws visitors from Philadelphia and New York for day and weekend trips, particularly because of its campground and boat access areas.

Park rangers have observed a trend in the growing numbers of bicyclists that use the towpath and adjacent roadways. Increased park usage for bicycling and for other purposes will likely continue in the future, given anticipated population growth within the Central New Jersey

area. Between 1990 and 2010, population forecasts prepared by the five counties which the Canal travels through or adjoins suggest an overall population increase of about 16 to 18 percent in the five county region.

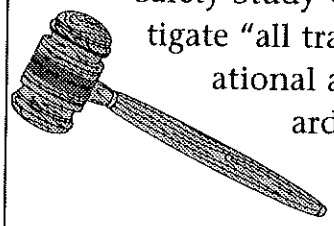
Future residential, commercial, and road development within the Central New Jersey area will have far-reaching consequences for the Canal Park and its environs. Beyond a potential increase in Park visitation, increased vehicular traffic resulting from development will have a direct bearing on safety considerations within and near the Park.

CHAPTER II

SAFETY

Introduction

The State Legislature directed the Delaware & Raritan Canal Transportation Safety Study Commission to investigate "all transportation, recreational and other safety hazards associated with the Delaware & Raritan Canal..." For the purposes of this study, the Commission adopted the following definition of "safety concern" as it pertains to the Delaware & Raritan Canal State Park:



> *Any situation or structural deficiency that poses a potential danger or hazard to people traveling in or near the Delaware & Raritan Canal State Park and people using and working in the Canal Park who are exercising responsible judgment in the conduct of their activities.*

The State of New Jersey has an obligation to provide a reasonable level of public safety with respect to the Park. Also, the public has a responsibility to act in a way that does not place people in unnecessary jeopardy.

Thus, while the Delaware & Raritan Canal, by virtue of its being a waterway, can be considered a safety concern, the level and manner of protection afforded the public must be balanced by an assumption of reasonable judgment to be exercised by park users.

The following is a discussion of safety concerns identified by the Study Commission. These are placed into one of two categories. "Vehicular safety concerns" refer to those that relate to motor vehicle users, while "other safety concerns" include potential hazards to pedestrians, bicyclists and other park users.

Vehicular Safety Concerns

Accident History at Canal Crossings

A total of four vehicular accidents have occurred approaching Canal crossings since 1984.[8] Three of these accidents resulted in fatalities, although one of two which occurred at the Wilburtha Road crossing in Ewing Township was due to the driver's heart attack.

As a result of these accidents, the Legislature concluded that there may be "deficient safety at bridges" crossing the Canal. Beyond the bridge structure itself, the Legislature further concluded that substandard or missing approach rails that tie into these bridges may contribute to safety hazards at canal crossings. In response to such declarations stated in N.J.S.A. 13:13-3.1 et seq., the Study Commission began its investigation by reviewing the structural integrity of bridges and approach railings.

It should be noted that data collection and preliminary evaluation revealed that the factors compromising safety at canal crossings went beyond structural considerations of bridges and approach railings, initially considered the primary focus of investigation. In fact, circumstances that at first appeared to some as the cause of potentially dangerous situations were sub-

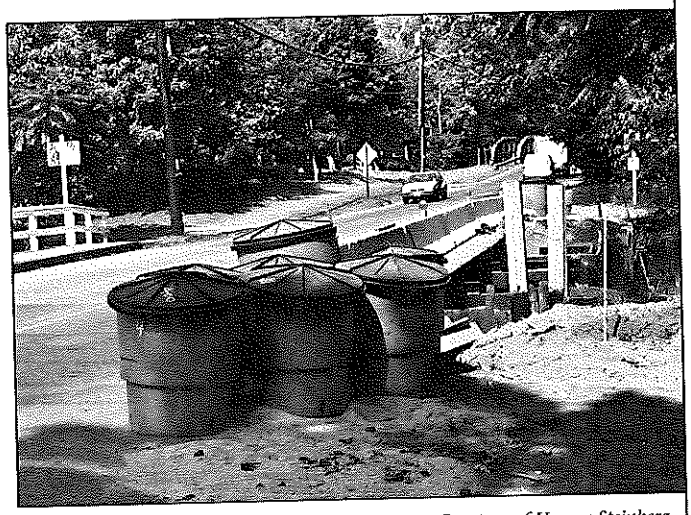
sequently deemed symptomatic of a much more complex problem. An examination of bridge safety, therefore, was broadened to include traffic and roadway conditions on roads that lead up to bridges (approach roads), aesthetic and historic standards that state agencies use to review projects, and interagency coordination in expediting bridge and roadway improvements or construction.

Of the four vehicular accidents approaching canal crossings since 1984, two incidents at the Wilburtha Road bridge in Ewing Township and the Alexander Road bridge between Princeton and West Windsor Townships resulted in fatalities; an incident at the Weston Causeway bridge in Franklin Township resulted in injury.

During the 10-year period studied, a total of 827 million vehicles crossed the Canal. This translates into an overall accident rate of one per 276 million crossings. Fatalities occurred at a rate of one per 414 million crossings. Analysis of accident rates at individual bridge locations during the year of each incident also revealed relatively low rates of one per 803,000 on Wilburtha Road, one per 1.7 million on Alexander Road and one per 1.2 million on the Weston Causeway.

In all of the accident locations, the bridges were constructed of timber and the bridge rails and approach rails failed to meet current safety standards. However, none of the accidents involved vehicles driving off the main bridge structure; rather, the automobile drivers lost control as they approached the bridges, crashing through approach structures.

All of the accidents occurred during the winter. The roads were posted at 40 mph but normally require speed reduction and steering adjustments, even in good weather, to negotiate the roadway alignments approaching the bridges.



Courtesy of Harvey Steinberg

Bridge repairs underway on Alexander Road, Princeton and West Windsor Township, 1995.

Although the three locations accommodated low daily traffic volumes (under 5,000 vehicles per day), two of the approach roads had been widened and realigned shortly before the accidents occurred, and this may have influenced the speed at which drivers approached the bridges.

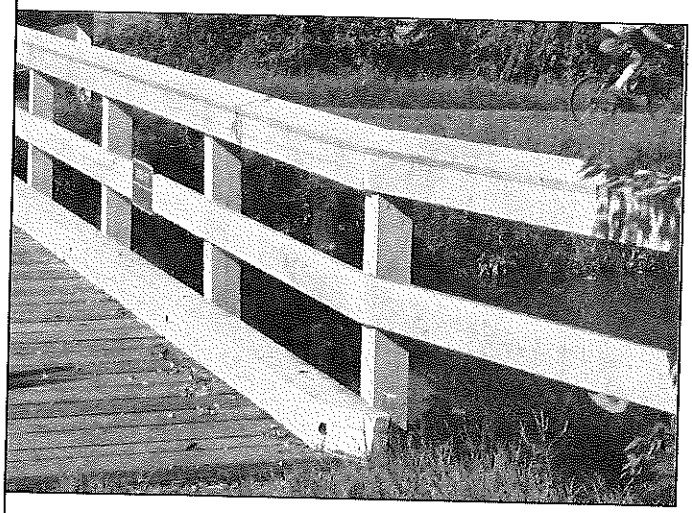
On the Weston Causeway, not long before the accident, Somerset County replaced what had been a 90-degree turn on the approach road with construction of a sweeping curve. Similarly, shortly before the Wilburtha Road accident, Ewing Township required a nearby developer to widen the approach road. Before this, the road curved abruptly on a steep decline as it approached the bridge. As a result of the improvements, the road still approached on a sharp decline, but was

widened significantly. At the Alexander Road bridge, no roadway improvements were constructed. However, a driver approaching the Canal from the east (as the accident car did) travels on a wide flat road until the point where the road turns abruptly and descends. This situation gives the driver a warning, but only at the last moment, to slow down and drive carefully.

Various factors, then, including weather, vehicle speed and approach roadway geometry, may have contributed to these hazardous situations, causing the drivers to lose control of their vehicles.

Existing Characteristics of Canal Bridges

Although a total of 57 vehicular bridges cross the Canal, the scope of this study was limited to 48 crossings which exclude federal, interstate and state bridges that



Courtesy of Delaware & Raritan Canal Commission

the U.S. Department of Transportation and the New Jersey Department of Transportation have judged meet current safety standards. Most bridges (32) that were reviewed by the Study Commission were constructed during a twelve-year period following World War II. Twelve bridges originate from the 1920's or earlier. The oldest structures are located in urban settings, while post war bridges were designed for rural settings to accommodate relatively low traffic volumes.

The majority of canal bridges (31) are made of timber, with the remaining 17 constructed of concrete, steel or a combination of materials.

The majority of canal bridges (31) are made of timber, with the remaining 17 constructed of concrete, steel or a combination of materials. Of the timber bridges, public use is prohibited in six locations and restricted or limited at an additional seven. Eighteen timber bridges are open to the public and serve as part of a local roadway network.

Twenty-three bridges have posted weight restrictions, including six which are posted at 15 tons or less. Twenty bridges have unrestricted load limits. Actual vehicular weight loads traversing canal bridges exceed posted weight limits.[9]

The 48 canal bridges under review handle approximately 226,700 daily vehicular crossings. Upon closer examination, one can observe variation in traffic volumes among the bridges. While the majority carry relatively low volumes of traffic, ten structures carry 10,000 or more vehicles per day. Of these, seven are found in urban settings and the remaining three high volume bridges are situated in suburban or rural locations. At the other extreme, some bridges carry 10 or fewer vehicles per day. (See Appendix E for bridge data.)

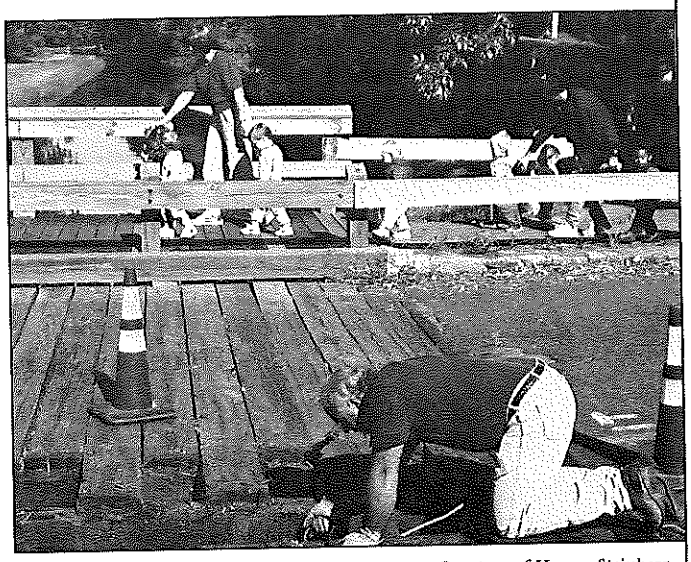
Twenty-seven bridges have a wooden deck surface. Wooden decks may retain moisture longer than impervious surfaces and, coupled with wearing over time, are considered to have more slippery driving conditions than concrete or asphalt. Wooden decks are most commonly found on bridges carrying fewer than 5,000 cars per day. Only one wooden bridge which also has a wooden deck surface carries high traffic volumes (more than 10,000 vehicles per day), namely the Route 518 crossing in Rocky Hill. Three bridges with daily traffic greater than 5,000 but less than 6,000 vehicles per day have a wooden deck. Although major accidents have occurred at three locations with wooden deck surfaces, the deck conditions were not considered to have had any bearing on the incidents.

Bridge Maintenance and Repairs

Bridge replacement and repair is a continuing process, affected by at least the following factors:

- reports of traffic accidents and fatalities
- changing conditions at the crossings
- degradation of existing structures
- availability of new materials and techniques for replacement and repair
- changes in structural standards.

Structural standards which apply to a bridge are determined by the standards in effect at the time of original construction. When major rehabilitation or replacement is performed, the then-current standards come to apply. Although standards may change, such changes do not necessarily dictate immediate bridge replacement, or even repair, since new standards may simply reflect availability of newer materials and techniques without major improvement in safety.



Courtesy of Harvey Steinberg

Generally, most repairs have been accomplished by in-kind measures, that is replacement of materials with like materials in order to maintain bridges at standards applicable at the time of construction. This approach prevails until a bridge qualifies for replacement through a statewide prioritization process. Review and ranking of bridge reconstruction needs are done on an individual basis. Therefore, rather than being considered collectively, canal bridges are evaluated individually through a statewide ranking system.

This statewide prioritization process is used to identify bridge repair and replacement needs that qualify for Federal Highway Administration (FHWA) funds. The New Jersey Department of Transportation evaluates bridge structural integrity and ranks bridge repair or

replacement needs based on periodic inspections. These inspections take place at least once every two years. They cover over 115 items, primarily for bridge structures and railing systems. Specifications pertaining to approach roadway conditions and alignments are available but less comprehensive. Thus, the FHWA funding is directed more toward bridge structural needs, rather than to safety improvements related to broader traffic safety considerations at canal crossings, such as approach roadway conditions and traffic patterns. Based on the results of the inspections, the New Jersey Department of Transportation appraises bridge sufficiency according to two principles:

- structural deficiency relating to minimal structural standards.

- functional obsolescence relating to a bridge's capacity to handle current traffic demands.[10]

Together, these principles help to establish maintenance, rehabilitation, reconstruction, and replacement priorities of bridges statewide. Bridges that do not qualify for federal bridge funds may still be in need of safety improvements. Accepted safety standards, such as road geometry and bridge and approach railings, are identified in the FHWA's National Bridge Inspection Standards (NBIS). However, these items do not contribute enough weight to qualify the bridges for federal funds on their own.

Those bridges which do not qualify for federal funds may be identified where serious accidents have occurred or where the New Jersey Department of Transportation has determined that deficient bridge and approach features exist. The New Jersey Department of Transportation has identified 25 Delaware & Raritan Canal bridges in need of rehabilitation involving primarily deck and substructure repairs. This will cost an estimated $9 million in state funding.

Pre-approved Designs for Delaware & Raritan Canal Structures

At present, the New Jersey Department of Transportation is developing prototype bridge rail systems, including approach rails, for canal bridges (see pp. 22 and 24). Early interagency coordination has already occurred and will help to ensure that the various concerns of all agencies are addressed as railing designs are developed. In addition, an early railing developed by the New Jersey Department of Transportation and installed at the Wilburtha Road bridge in 1990 was intended, at the time, to be a prototype.

The New Jersey Water Supply Authority has also developed three different designs to repair canal culverts. Water Supply officials have noted that these designs have been through the reviews of relevant state agencies in the past and now have assurance of rapid approvals in the future. Besides those noted above, the Study Commission has found no other examples of prototype structures developed for canal purposes by state agencies.

Approach Roadway Characteristics

Clearly, the structural integrity of the bridges and rails plays a key role in evaluating vehicular safety at bridge crossings. Other factors of major importance include

traffic patterns and the approach roadways.[11] More specifically, a driver's ability to safely negotiate a bridge crossing will depend on:

- the speed traveled as the driver approaches the bridges.
- the driver's ability to see a reasonable distance in order to adjust speed and direction.
- the volume of traffic on the approach roads.
- the mix of vehicles on the approach roads.
- the number and location of various intersections (e.g. roadway intersections, driveways, parking lots, etc.) where additional traffic may enter or exit the approach roads. This is commonly referred to as "side friction".
- the type and condition of road surface and width.

Indeed, the driver's ability to safely cross canal bridges is compromised in many locations due to approach roadway conditions and alignments. Accepted standards attempt to limit the decisions or distracting elements confronting a driver as a means of improving traffic safety. Ideally, a free flow of traffic moving at a relatively constant speed with gradual turns and limited access can reduce external influences and decrease the potential for accidents. Yet, approach roads intersect with other roadways, driveways and private service roads at 23 bridge locations (Refer to Appendix E).

CASE STUDY: SAFETY CONCERN

Conditions at the Port Mercer bridge and its approach road demonstrate how traffic safety may be compromised. Port Mercer is a historic hamlet consisting of a tight cluster of houses and structures at the juncture of Lawrence, West Windsor and Princeton Townships. Despite the rural character of the immediate surroundings, Port Mercer is a throughway for traffic crossing Route 1, only one half mile away. The Port Mercer bridge, a modest timber structure, serves as a major canal crossing for over 12,000 vehicles daily. County Route 533 is a two-lane road that approaches the bridge. East on Route 533 is a four-lane overpass over Route 1. There is only one sign indicating a 40 mph speed limit on the County road and that is located on the Route 1 exit ramp. Notice of the bridge's 15 ton weight limit is not provided in advance of the bridge. Furthermore, two poorly visible driveways enter onto the County road within 50 feet of the bridge and no warning sign is posted.

On the western side of the bridge, Route 533 terminates at a "T" intersection with Province Line Road to the left and Quaker Road to the right, both restricted to 40 mph speed limits. However, neither road is signed for an approaching intersection or possible turning movements. The traffic flow traveling both east and west requires a 90 degree turn when crossing the bridge. A parking lot is located north of the bridge on Province Line Road. When large tractor trailers exit Route 1 and then observe the posted weight limit of the bridge, the only available option for them is to cross the bridge and turn around in the parking lot, causing additional hazardous conditions on a narrow road. Thus, a combination of abrupt changes in roadway conditions, coupled with driveway intersections, high speed limits, heavy traffic volumes and lack of adequate warning signs all contribute to a very hazardous situation.

Professionals note that a driver's line of sight and roadway geometry are also critical factors that influence traffic safety.

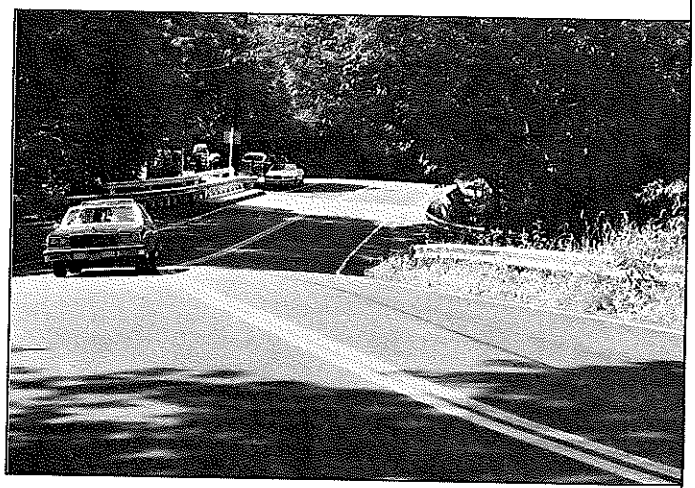
Vehicular safety at canal crossings is not dictated by the structural integrity of bridges and railings alone. Other important factors include the condition and alignment of approach roads as well as traffic patterns.

When a driver is unable to see a change in roadway width or an approach to a narrow bridge due to elevation changes or curves in the road, he may be unable to adjust steering and/or speed in adequate time. New Jersey Department of Transportation professionals have observed that roadway alignments approaching seven existing canal bridges are unsatisfactory. Most of the approach roads are under county jurisdiction and some are under municipal jurisdiction. Any improvements to them will therefore require coordination with the applicable county or local government.

Speed limits play an important role in determining traffic safety as well. The posted speed limit on most approach roads at canal crossings is 40 mph. Where roadway geometry impedes a driver's ability to see far enough ahead, a reduction in speed, below the posted limit, may be necessary.

The mix in types of vehicles using the canal bridges presents a potentially hazardous situation. Increased development during the 1980's brought additional traffic to the canal region and increased congestion on primary roads, including both cars and trucks. Cars and trucks seeking to bypass congestion on major roadways have discovered alternative routes through the Canal Park, with both increased volume and mix in types of vehicles contributing to traffic safety concerns.

Finally, the geometry of the approach roads greatly affects traffic safety. On the one hand, roadway widening and realignment to increase sight distance can improve traffic safety. Under certain conditions, however, such improvements encourage higher speeds and may attract larger vehicles. Thus, if improvements occur on a particular segment of roadway in advance of a canal crossing and are followed by abrupt narrowing immediately prior to the crossing, a driver may be unable to safely adjust his steering or speed if he is not alerted well in advance of the change in conditions. Likewise, such an improvement on the roadway segment immediately prior to the crossing creates a hazardous situation if the bridge structure itself is not correspondingly improved.



Courtesy of Harvey Steinberg

Approach to canal crossing on Wilburtha Road, Ewing Township.

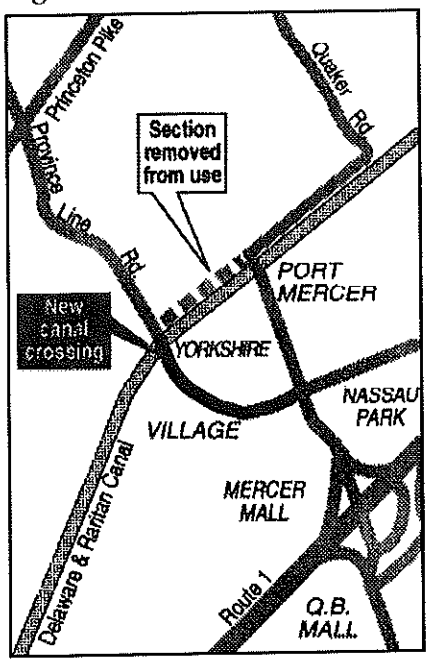
While subject to debate, there has been some suggestion that appropriate landscaping, such as the presence of street

CASE STUDY: SAFETY ENHANCEMENT

Another example of traffic considerations on the approaches to canal crossings provides insight into appropriate traffic safety enhancement measures. A proposed major commercial development and proposed residential developments in West Windsor and Lawrence Townships will require the construction of a new canal crossing on Province Line Road (see figures 3 & 4). Bridge engineers representing WalMart, the commercial developer, are working in concert with State, County and local agencies to design a bridge to cross the Canal.

The bridge will create another link to Route 1, diverting the additional traffic generated by the new development away from Port Mercer. In addition, the posted speed limit of Province Line Road will be reduced from 40 mph to 25 mph. Shoulders will be constructed to accommodate an emergency lane but will be composed of turf material rather than asphalt in order to create a sense of a narrower roadway to slow traffic down. Moreover, pedestrian safety will be enhanced at the bridge crossing, with a continuous pedestrian path under the bridge.

Figure 3



Courtesy of Tom Lederer, Lawrence Ledger

Location of new bridge under construction on Province Line Road, Lawrence Township.

trees, and other techniques to create a sense of a narrow passage can heighten safety, providing other conditions do not counteract this. These counteracting conditions include:

- high speed limits
- wide lanes at bridge approaches
- heavy traffic volumes and vehicle mix.

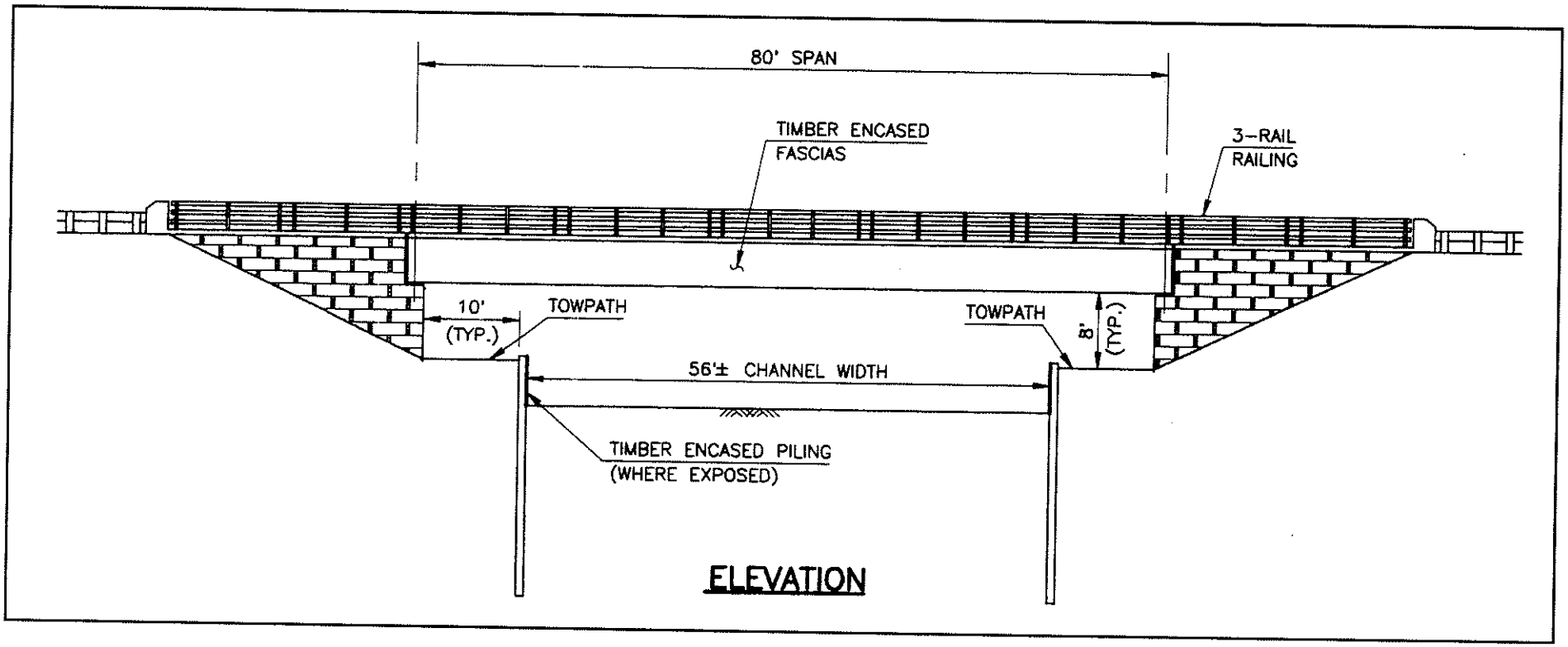
Upgrading of Railings at Canal Crossings

Bridge rails include the railing on the bridge itself (bridge rail), the rail on the road approaching the bridge (approach guiderail), the transition between the approach guiderail and the bridge rail, and the termination or anchoring of the approach rail.

Much of the attention accorded bridge safety has been focused on railing systems, more specifically, the bridge approach rails. As a result of a fatal accident in 1988 at the Wilburtha Road bridge, the New Jersey Department of Transportation developed and installed a bridge and approach guiderail system which was intended to serve as a possible prototype. This is a "W" beam constructed of steel and painted white. While the rail design did not necessarily conform to aesthetic and historic standards of all agencies involved, it was deemed the most cost-effective design and expedient solution that met then-current safety standards.

The New Jersey Department of Transportation has upgraded bridge rails to current standards at three locations: the Harrison Street bridge joining West

Figure 4



Design elements of new bridge under construction on Province Line Road, Lawrence Township

Windsor and Princeton Townships, the Whitehead Road bridge in Lawrence Township, and the Wilburtha Road bridge in Ewing Township.

The New Jersey Department of Transportation has recently initiated a program for short term safety improvements. Specifically, the program involves upgrading railing systems at all canal crossings where existing railings are deemed deficient by the New Jersey Department of Transportation. This accelerated upgrading of bridge railings over the next three years is intended as an improvement to correct existing safety problems related to bridge railings.

On a separate note, the New Jersey Department of Transportation has obtained $444,936 in Federal monies primarily through the Intermodal Surface Transportation Efficiency Act (ISTEA) to develop crash-tested designs of timber bridge and approach rail systems specifically for Delaware & Raritan Canal bridges. This provides the opportunity to improve canal bridges under one dedicated program, avoiding statewide competition on a bridge-by-bridge basis for Federal Highway Administration (FHWA) bridge improvement funds.

Aesthetics is to play a much greater role in the design of future prototype canal bridge rail systems under the ISTEA program. This is intended to result in railing systems that not only meet current standards but also are designed with sensitivity to the Canal Park's historical integrity.

The New Jersey Department of Transportation has budgeted $4.4 million in State funding during the next three years to complete construction of the railing safety improvements. At this time, it is uncertain whether, or to what extent, the results of the ISTEA-funded project will be used, since completion of the ISTEA-funded project is not expected to occur until well after construction of the railing safety improvements begins. However, the prototype timber bridge railing designs that are being developed through the ISTEA-funded project will be used in the future when bridges are up for replacement.

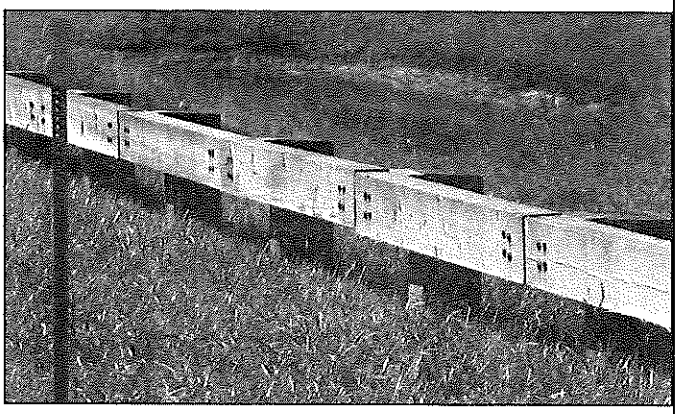
Accidents Involving Parallel Roads

Since 1984, there has been a total of seven accidents involving vehicles entering the Canal from parallel roads or dead-ends documented in New Jersey Department of Environmental Protection records.[12] In 1983, two Rider College students died when their automobile was driven from a restaurant parking lot around a steel guiderail and down an access road into the Canal in Lawrence Township. None of the other accidents resulted in fatalities. The accidents generally involved one or more of the following conditions:

- roadway conditions were icy.
- roadside barriers were deteriorated or absent.
- a vehicle tried to avoid an animal crossing the road.
- the driver fell asleep at the wheel and the vehicle rolled down the dead end into the Canal.

- one vehicle crossed into another lane while attempting to pass.

One incident occurred on Route 29 when a driver lost control of the vehicle due to icy conditions and drove into the Canal. Several other accidents occurred in icy conditions on Route 29 but did not result in vehicles entering the Canal.



Courtesy of Federal Highway Administration

Steel-backed timber guiderail

Roadside Barriers on Parallel Roads

Manmade roadside guiderails or barriers exist within 100 feet of the Canal along roughly half the length of the Park. These barriers were installed in order to prevent vehicles from running off of the road and into the Canal. The Study Commission, in conjunction with the Division of Parks and Forestry, conducted an inventory of barriers that parallel the Park to make a preliminary judgment about their structural soundness and ability to protect drivers. This inventory included an investigation of barriers on parallel roadways and those on perpendicular streets which terminate at the Canal Park (See also p. 26). The Study Commission also researched records of vehicular accidents at these locations.

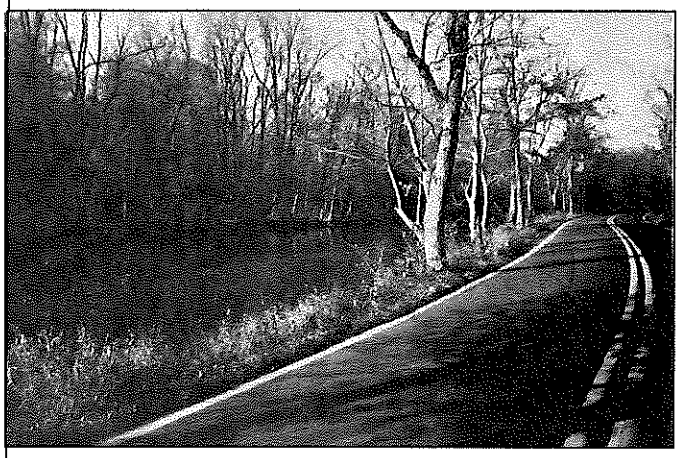
Roadside Barriers: Function and Materials

Roadside barriers, such as steel guiderails and concrete barriers, are used to protect motorists from either natural or manmade hazards located alongside roadways. According to AASHTO, roadside barriers should only be installed if fixed objects or natural features adjacent to the road are considered more hazardous than the barrier itself. In other words, barriers are warranted only if the consequence of hitting a fixed object or running off of the road is more serious than hitting the barrier itself.[13]

Several types of roadside barriers are recommended for use by AASHTO. Barriers such as "W-beam" systems, concrete barriers, stone masonry walls and steel-backed timber railing systems are just a few examples. All of these have demonstrated satisfactory field performance in terms of construction, maintenance and accident experience and have met established criteria in crash tests. Determination of appropriate types of barriers can depend upon many factors, including types and weight of vehicles using the roadways, design speeds, cost variation and aesthetic considerations.

W-beam guiderails are constructed of galvanized steel. One distinct advantage of these railing systems from a safety standpoint is that they are flexible. Thus, when a vehicle hits the guiderail, there is a lower impact force upon the vehicle.

Cor-ten guiderails are constructed of weatherized steel and have a more rustic appearance.



Canal Road, Franklin Township

The steel-backed timber alternative consists of wood rails backed with a steel plate and supported by timber posts. The steel plate provides tensile strength to the system and the wood members give a more rustic appearance than steel or concrete.

The Federal Highway Administration has developed standards for steel-backed timber barriers. These have been crash tested at 50 and 60 mph speeds. While developed for use on Federal lands, they can be used generally at locations where impacts within ranges to which they have been crash tested can be expected.[14] In New Jersey, approximately 1,160 linear feet of steel-backed timber guiderail was installed on the Weston Causeway between Manville and Franklin in the vicinity of the Millstone River Crossing.[15]

Roadside Barrier Inventory

In July of 1993, the Division of Parks and Forestry conducted an inventory of roadside barriers within 100 feet of the Delaware & Raritan Canal State Park.[16] The following observations were made:

- There are approximately 32 miles of parallel roadways within 100 feet of the Canal.

- Roughly 24 miles of parallel roadways are protected within New Jersey Department of Transportation-approved W-beam guiderail systems.

- Approximately three miles of roadway are protected with deteriorated wire rope and wooden post guiderail. These are located along Canal Road in Franklin Township, Somerset County. Roughly one half mile of roadway is protected by timber guiderail.[17]

- Approximately 4.5 miles of roadway are either bordered by natural barriers, such as drainage ditches, stands of mature trees or large stretches of open space, or abut the Canal with little or no protective barrier between the road and waterway.

- Many types of barriers exist at streets that dead end at the Canal Park. These include guiderail, tree stumps, large rocks, and wooden railings. Several streets terminate at the Canal Park with no barriers present, including some locations where the road slopes abruptly toward the Canal.

- Most parallel roads, except for Route 1 and Route 29, are municipal or county roads. Speed limits vary on these roads from 25 mph to 40 mph.

Other Safety Concerns

The inventory of "other safety concerns" described below was identified by Study Commission members based on

personal and professional knowledge. Several were reiterated by the public at Commission meetings and special public forums. It should be recognized that those concerns mentioned here may be incomplete; parties connected with Park operations should be alert to other concerns that may surface in various ways. Following is a description of findings and conclusions related to "other safety concerns."

Waterway Awareness

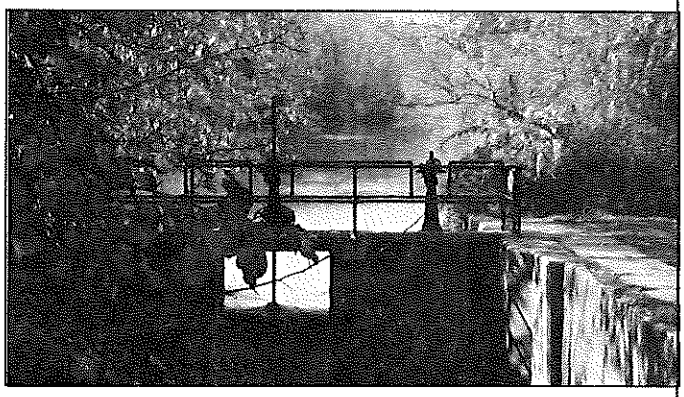
The Canal cross-section is generally trapezoidal in shape. The width of the waterway ranges from thirty feet to over a hundred feet at the water's surface. The side slopes of the Canal are relatively steep and are nearly vertical in some locations. Water depths are as much as eight feet. The depth of the Canal is not readily apparent because of murky water which can also hide submerged objects. Water velocities are in the range of two-tenths to one-half of a foot per second. A recreational user of the Canal might sense the water movement but, because of the vegetation along the Canal, would not have a feel for the depth or the fact that the Canal has near vertical side walls.

In most locations there is a towpath on one side of the Canal and in some locations there is a path on both sides of it. The Canal path is in some places immediately next to the Canal and in some places there is a separation of a hundred feet.

Although swimming is prohibited in Canal Park, there have been 11 drowning incidents dating back to the 1960's.[18] Two were determined to be suicides; the others appear to be accidental. A contributing factor in these incidents may have been a lack of awareness of the presence or depth of the Canal.

Flow Control Structures and Spillways

The Delaware & Raritan Canal waterway contains several structures related to its former use as a transportation corridor and present use for water supply purposes. Due to changes in elevation, numerous locks were constructed along the waterway. In addition, flood preventing structures were built to release excess water from the Canal during flooding conditions. To comply with Public Employees Occupational Safety and Hazards Act



Courtesy of Harvey Steinberg

(PEOSHA) regulations, railings were installed by the New Jersey Water Supply Authority at crosswalks used by its employees to access nonpublic operational areas.

There is no historical documentation of any mishaps relating to patrons being injured on canal locks. However, due to the physical characteristics of these structures, and the flow of water through them, they could pose a potential hazard to park patrons who may be unaware of their existence and possible danger.

No safety criteria have been established (state or national building codes) which require the installation of safety railings or fencing for recreational users. The provision of railings or fencing in public access and recreation areas is, therefore, a policy decision that rests with the owners of the property, namely the New Jersey Department of Environmental Protection, Division of Parks and Forestry.

Fencing, Barriers and Pedestrian Crossings

Fences and barriers can be found next to the Canal in several locations. These structures are intended to guide or bar vehicular, pedestrian and bicycle use. The nature of these structures varies greatly. For example, a steel and wooden gate located at one intersection between a road and the towpath may be followed by a barrier consisting of a gate and boulder combination at the next intersection. This lack of uniformity, where patrons are confronted with varied obstacles, can lead to confusion and potential mishaps.

Additionally, there are many towpath-roadway intersections lacking crosswalk markings, signage or traffic signals, and preceded by less than desirable approach roadway geometry. All these factors can contribute to potential safety hazards to pedestrians and bicyclists attempting to cross roadways where they intersect the towpath.

Bicycle Accidents on the Towpath

Two factors contribute to bicycle accidents on the Park towpath: the fact that it accommodates multiple uses and activities and the surface material of the towpath. The Park towpath is designated as a "mixed-use trail." As such, it accommodates hiking, jogging, strolling, bicycling and horseback riding. No motorized vehicles may use the trail except for maintenance and enforcement personnel. However, the nature and variety of allowed uses create the potential for accidents. Two recorded incidents resulted in injury when bicyclists either collided or attempted to avoid collision.

The improved surface of the towpath is constructed of either "trap rock quarry dust" or the "I-5" bank run mixture, both of which require a considerable amount of maintenance. Due to the nature of the material, it is subject to erosion, compaction and frost heaving during different times of the year. This material is also subject to vegetative intrusion of tree roots, weeds and other growth because of its loose granular composition. The Division of Parks and Forestry, in conjunction with the New Jersey Water Supply Authority, has established an annual resurfacing program for the improved sections of the Canal towpath. Unfortunately, the demand for resurfacing far exceeds the capabilities of the New Jersey Water

Courtesy of Harvey Steinberg

Supply Authority and the Division's funding resources.

Bicycle Safety Concerns on Parallel Roads

Roads parallel to the Canal are popular biking routes. Many of these roads are designated as biking routes on maps available to the public.

Biking occurs year-round, but is especially heavy in spring, summer, and fall. During these seasons, early evening biking is popular. On weekends, the volume of bicycles on Canal Road in Franklin Township and some other parallel roads is very heavy. Individual riders, riders in pairs or small groups, large clubs of riders (typically 10-20), and families with children (often with a child and parent sharing a single bicycle) use this road. These bikers reach the parallel roads by the use of Canal Park and other parking areas, and by the use of intersecting roads.

The safety problem associated with the sometimes heavy bike traffic is, of course, the fact that most parallel roads are typical rural roads — narrow, no shoulders, bends and turns with poor visibility, and varying pavements. These conditions become potentially hazardous because of the high volume of automobile and truck traffic on many parallel roads, e.g. Canal Road from Millstone to Route 518 in Rocky Hill. Speed limits are variable, not well marked, and often exceeded. Intersections with driveways and roads both through and adjacent to the Canal Park are frequent.

Although no history of bicycle accidents has been compiled, the potential for serious accidents appears to exist. This is true for runners and joggers as well, who also use the parallel roads.

Environmental Concerns

There are many easements and rights of way for utilities traversing and paralleling the Park. These easements include natural gas, gasoline, oil, electric, telephone, water and sewer lines.

Potential hazards exist for which the resultant natural resource damage could be extensive, though only one such instance directly related to these easements and rights of way is known to have occurred to date. Considerable natural resource and structural damage resulted along a one-mile section of the Park when a contractor ruptured a gasoline transmission line in West Windsor Township in 1986. The ruptured transmission line subsequently ignited. The administrative agencies responsible for granting and overseeing easements and rights of way are currently consolidating all of their records to insure that all agencies have thorough knowledge of their location and existence.

Other potential hazards which could be characterized under this heading include those related to vegetation along this corridor. Although mishaps have occurred, none have been reported to park personnel. The Division of Parks and Forestry is unable to adequately maintain the vegetation along the towpath. Trail patrons are subjected to such things as poison ivy, overgrown brush along trail shoulders, low hanging branches and dead or dying trees falling across the Canal towpath.

Each of these situations has a potential to harm or injure park patrons while walking, jogging or bicycling along the trail.

Vandalism, Crime and Special Urban Concerns

Concern over the occurrence of vandalism and crime in the Delaware & Raritan Canal State Park has been expressed primarily by residents of the City of Trenton. This section of the Park is one of the last remaining areas yet to be developed and actively maintained by the Division of Parks and Forestry. The Canal Park has been reported to function as a means of "escape" for vandals and burglars because it is undeveloped and underpopulated.

In addition, field observations of the Park in Trenton along the stretch between West Trenton and Lawrence Township revealed the following:

- garbage
- high grass and weeds
- inadequate and defective fences
- graffiti
- limited signage
- hidden structures
- deteriorated bridges
- very limited access to the Canal
- high traffic volume areas creating erosion

The Division of Parks and Forestry has received ISTEA funding to improve the towpath within the Cities of Trenton and Lambertville.[19] This funding will contribute to resurfacing and redevelopment of the Park from Lower Ferry Road to the Battle Monument. The towpath will be cleared and resurfaced, trees trimmed and bridges redecked. In addition, the City of Trenton, in cooperation with the Capital City Redevelopment Corporation, is hoping to secure state funding to assist in park improvements and housing and economic revitalization along sections of the Canal.[20]

Accident Records

There are upwards of 23 local enforcement agencies that respond to both vehicular and nonvehicular incidents in the communities surrounding the Delaware & Raritan Canal Park. When the New Jersey Department of Environmental Protection, Division of Parks and Forestry, is notified of serious accidents, crimes, suicides and other incidents within the confines of the Park, these occurrences are generally documented, with copies of police reports maintained by park personnel.

The New Jersey Department of Environmental Protection is alerted to such incidents either through first hand knowledge by Park staff, through citizen reports or through communication by local police units. However, there is no statutory requirement that police departments notify the New Jersey Department of Environmental Protection of such incidents or that they forward police reports to them.

When a motor vehicle accident occurs on any public roadway in New Jersey and the police are notified, the police officer who investigates the accident and files the report must use a standardized police report form. "Reportable accidents," those which either result in injury, death, or at least $500 damage, are subsequently filed with the Division of Motor Vehicles. DMV then forwards a copy to the New Jersey Department of Transportation Accident Records Section within the Division of Transportation Data Technology.

The Accident Records Section maintains a database and files of all reportable motor vehicle accidents on all public roadways. This includes motor vehicular accidents involving pedestrians and bicyclists as well. In order to analyze the extent and nature of accidents that have occurred on roads around the Park, hard copy files of the roadway police records would have to be pulled in order to to review the complete set of facts reported on the police accident form. Due to the size of the database and files, this could be a lengthy and complicated process. Moreover, the database and files exclude those accidents and incidents which might occur off of a public road, within and around the Canal Park. Likewise they exclude accidents that do not involve motor vehicles.

Thus, there appears to be no system of information from which one could readily retrieve all records of incidents related to the Canal Park.

SAFETY STUDY CONCLUSIONS

Bridges, Bridge Approach Rails, and Approach Roadways

1) Current New Jersey Department of Transportation practices regarding bridge inspections and maintenance are sufficient for identifying and addressing structural safety problems related to bridges and their railing systems.

Bridge inspections are conducted every two years to identify structural safety problems. Additionally, the New Jersey Department of Transportation has initiated a pilot project to develop crash-tested bridge and approach railing systems that specifically targets Delaware & Raritan Canal bridges. It has also budgeted state funding to complete timber bridge railing improvements.

Specific studies of safety issues, concerning the Delaware & Raritan Canal, by agencies with jurisdictional responsibility are very limited. As discussed elsewhere in this report, the New Jersey Department of Transportation does inspect bridges that cross the Canal to identify safety and capacity needs, and the New Jersey Department of Transportation is currently studying safe wooden bridge design under a Federal ISTEA grant. The New Jersey Water Supply Authority conducts periodic safety inspections on water supply structures relative to the State Public Employees Occupational Safety and Health Act (PEOSHA).

2) Traffic and roadway conditions leading up to Canal bridges have a significant effect on overall vehicular safety at the bridges.

Accident histories and field observations both suggest that traffic patterns and roadway configurations can significantly influence vehicular safety at bridge crossings. When the New Jersey Department of Transportation evaluates needed safety enhancements at bridge crossings, it should examine not only bridge structural safety but also vehicular safety on the approach roads. Traffic safety improvements may need to include several measures such as:

- slowing traffic down – alerting drivers that they are entering a park and realigning roadways where heavy volumes, side friction and other complicating factors are present at bridge crossings.

- diverting high-volume, high-speed traffic away from more rural, unimproved canal crossings by using traffic lights, stop signs, speed limits, landscaping, and other measures that discourage high-volume, high-speed traffic.

3) The development of prototype elements for bridge railing systems would help expedite review and construction of safety improvements.

Development of prototypes can be very helpful in expediting project reviews and minimize engineering costs, particularly if

relevant agencies are involved early on in the development of the designs.

4) Bridge or roadway safety improvements should be undertaken in a way that is consistent with the aesthetic and historic character of the Delaware & Raritan Canal State Park.

The Canal Park is characterized by great variation in surrounding environments, ranging from urban to suburban to rural. In addition, the evolution of canal bridge structures reveals a good deal of diversity, again reflective of the kind of environment in which the bridges are situated. Development of prototype designs that reflect such variation will not only help to protect important aesthetic and historic qualities of the Park but can actually enhance these features. Results of the ISTEA-funded timber bridge study will be used to develop prototype designs for bridge railings that not only meet current standards but also address historic and aesthetic concerns.

Roadside Barriers

5) A combination of factors, including deficient barriers or an absence of barriers, high speed traffic, poor roadway conditions and poor judgment on the part of the driver can contribute to potentially hazardous conditions for motor vehicle traffic on roadways that parallel the Canal.

Both natural and manmade barriers can function effectively in preventing vehicles from driving off the road and into the Canal. The determination of appropriate barriers should be based not only on engineering principles such as roadway design speed, vehicle mix and vehicle weight, etc. but also on aesthetic and historic considerations and the diversity in character of areas surrounding the Park.

Pedestrians and Bicyclists

6) Pedestrians and bicyclists – the major users of the Delaware & Raritan Canal Park – face various potential safety hazards when using the towpath, when travelling on roads parallel to the Canal and at towpath-roadway intersections.

Public education as well as improved signage can help raise awareness on the part of towpath users and motor vehicle operators of the various safety concerns they may confront in and around the Park. Efforts to reduce vehicle speed at and near the Canal Park should also enhance safety for both pedestrians and bicyclists.

CHAPTER III

JURISDICTIONAL ISSUES

Several state agencies have responsibilities associated with the multifunctional aspects of the Delaware & Raritan Canal. Some of these responsibilities, however, were altered, recently, with the enactment of N.J.S.A. 13:13-3.1 et seq., which established the Delaware & Raritan Canal Transportation Safety Study Commission.

In adopting this Act, the Legislature expanded the powers and responsibilities of the New Jersey Department of Transportation, while retracting certain approval authorities of the New Jersey Department of Environmental Protection and the Delaware & Raritan Canal Commission. In doing so, the Legislature pointed out that this alteration was intended to be a temporary measure only "until further direction from the Legislature." It was intended as an interim measure while a newly created study commission investigates relevant public safety issues and reports its findings, conclusions and recommendations to the Legislature.

After reviewing the Study Commission report, the State Legislature will determine what further action will be required concerning jurisdictional issues. To provide guidance to the Legislature and governmental agencies, the Study Commission has made recommendations regarding future jurisdictional allocations of governmental entities. These are based on an analysis of responsibilities that existed both prior to and subsequent to the enactment of 13:13-3.1 et seq.

Jurisdictional Responsibilities Regarding

Canal Crossings:

New Jersey Department of Environmental Protection

In 1974, N.J.S.A. 13:13A-1, the Delaware & Raritan Canal State Park Law created the Delaware & Raritan Canal State Park. The Canal Park property is owned by the State of New Jersey. The responsible organization within the State is the New Jersey Department of Environmental Protection. Within the New Jersey Department of Environmental Protection, operational responsibility rests with the Division of Parks and Forestry.

N.J.S.A. 13:13-12.7 states that "the Department of Conservation and Development (predecessor organization to the New Jersey Department of Environmental Protection) shall in addition, improve such portions of said Canal and its appurtenances as it may deem proper to develop for recreational and park use; provided, said use shall not reasonably interfere with the efficient operation of said Canal as a source of industrial water supply."

Prior to the enactment of N.J.S.A. 13:13-3.1 et seq. in 1992, the New Jersey Department of Environmental Protection also had authority to grant or deny consent for any project which would encroach upon any site included in the New Jersey Register of Historic Places. The Delaware & Raritan Canal is on both the State and National Registers of Historic

Places. The New Jersey Department of Environmental Protection Commissioner was mandated to "solicit the advice and recommendations of the Historic Sites Council," housed within the New Jersey Department of Environmental Protection Division of Parks and Forestry, prior to granting or denying consent.

The New Jersey Department of Environmental Protection no longer has historic approval powers over the design and repair of existing bridges, guiderails and barriers on the Canal. The New Jersey Department of Transportation need only consult with the New Jersey Department of Environmental Protection not less than 30 days prior to undertaking maintenance, repair, rehabilitation and replacement of any existing vehicle bridges carrying state, county or municipal roads and any guiderails or barriers along the approaches to these vehicle bridges over the Delaware & Raritan Canal.

New Jersey Water Supply Authority (NJWSA)

The New Jersey Water Supply Authority Act of 1981 N.J.S.A. 58:1b created the New Jersey Water Supply Authority, and by N.J.S.A. 5:1B-5 all water supply facilities then owned and operated by the State were transferred to that Authority. Included in this was the Delaware & Raritan Canal Transmission Complex (comprised of the Canal and land that is part of the canal structure).

As part of this transfer of water supply facilities, the New Jersey Department of Environmental Protection, Parks and Forestry entered into a long term lease and management agreement with the New Jersey Water Supply Authority that makes Parks and Forestry responsible for the property and recreational aspects of the Canal Park, while the New Jersey Water Supply Authority is responsible for the operation of the Canal as a water supply facility.

Delaware & Raritan Canal Commission

The Delaware & Raritan Canal State Park Law of 1974 also created the Delaware & Raritan Canal Commission. The Law empowered the Canal Commission to develop a Master Plan for the development and protection of the Park and a delineated review zone within which the Commission will review public and private projects that might adversely affect the Park.

With respect to State agency projects, the Canal State Park Law granted the Canal Commission authority to:

- review and approve, reject or modify, any state project planned or state permits issued in the Park, and submit its decision to the Governor; (N.J.S.A. 13:13A-13.d.).

- approve all state actions within the review zone that impact on the Park, and ensure that these actions conform as nearly as possible to the Commission's Master Plan and relevant local plans or initiatives.

The state actions that the Canal Commission reviews include the operations of the Division of Water Resources concerning water supply and quality; the Division of Parks and Forestry in developing recreational facilities; and the activities of any other state department or agency that might affect the Park. (N.J.S.A. 13:13A-14.b.)

The above authorities were in effect before the 1991 Act. However, this Act suspends the ability of the Delaware & Raritan Canal Commission to approve New Jersey Department of Transportation actions regarding the maintenance, repair, rehabilitation and replacement of existing vehicle bridges carrying state, county or municipal roads and any guiderails or barriers along the approaches to these vehicle bridges over the Delaware & Raritan Canal. The New Jersey Department of Transportation need only consult with the Delaware & Raritan Canal Commission not less than 30 days before undertaking said actions.

New Jersey Department of Transportation

The New Jersey Department of Transportation has jurisdiction over existing canal bridges and guiderails along with the approaches to these bridges for the purposes of maintenance, repair, rehabilitation and replacement.

N.J.S.A. 13:13-12.8 entitled Bridges, Maintenance and Repair by Highway Commission states "The State Highway Commission (predecessor to the New Jersey Department of Transportation) in cooperation with the Department of Conservation and Development (predecessor to the New Jersey Department of Environmental Protection) is empowered and directed to enter upon and take possession of all of the existing vehicle bridges over said Canal and to maintain, repair and keep the same in safe condition."

N.J.S.A. 13:13-3.1 et seq. amends these provisions. In effect, it grants the New Jersey Department of Transportation additional powers and responsibilities. First, the New Jersey Department of Transportation is now responsible not only for existing vehicle bridges over the Delaware & Raritan Canal carrying public roads, but also any guardrail or barrier along the approaches to these bridges.

Second, the same law grants the New Jersey Department of Transportation control and responsibility for maintenance, repair, rehabilitation and replacement of these bridges. In order to protect the public safety, the Department of Transportation Commissioner may order the closing of public access, including roads, highways, sidewalks, tracks, paths or passageways, leading to, in, under or near any such bridge.

Third, the New Jersey Department of Transportation need only "consult" with the New Jersey Department of Environmental Protection and the Delaware & Raritan Canal Commission prior to undertaking any maintenance, repair, rehabilitation and replacement on these bridges. Said consultation must occur not less than 30 days before taking action.

Fourth, the new legislation grants the

New Jersey Department of Transportation responsibility for the design of any bridges or structures appurtenant thereto along or traversing the Canal.

Although the New Jersey Department of Transportation currently has jurisdiction over existing canal bridges and approach rails, it is not clear to what extent this jurisdiction extends to new bridges and new bridge approach rails.

Existing legislation is ambiguous regarding New Jersey Department of Transportation's jurisdiction over new canal bridges and their approach rails.

There is currently under design a new bridge over the Canal in Lawrence Township. This bridge is being designed by the County of Mercer. When constructed it appears to be the only bridge across the Canal Park not under the jurisdiction of the New Jersey Department of Transportation.

Delaware & Raritan Canal State Park Interagency Task Force

In 1986, the New Jersey Department of Environmental Protection and the New Jersey Water Supply Authority entered a property lease agreement that will remain in effect for 99 years. Among the provisions of this lease was the stipulation that the New Jersey Department of Environmental Protection and the New Jersey Water Supply Authority establish a committee, to be comprised of representatives from both agencies as well as the Delaware & Raritan Canal Commission, to coordinate implementation and performance of the agreement and to discuss proposed maintenance and construction projects affecting the Canal.

The Delaware and Raritan Canal State Park Interagency Task Force meets quarterly to review and discuss park-related projects, providing the opportunity for interagency input on a regular basis.

For the past five years, this Interagency Task Force, known as the Delaware & Raritan Canal State Park Interagency Task Force, has been meeting quarterly to carry out these mandates. Park-related projects are reviewed and discussed among Task Force members, providing opportunity for interagency input. Membership includes the New Jersey Department of Environmental Protection, Division of Parks and Forestry, and State Historic Preservation Office; New Jersey Water Supply Authority and Delaware & Raritan Canal Commission. Due to the nature of projects discussed, it is the technical staff of the various departments that generally participates in these meetings.

Since the inception of the Study Commission, the Task Force, at the Commission's request, has involved the New Jersey Department of Transportation in its quarterly meetings.

Clearly, projects undertaken by the New Jersey Department of Transportation in or near the Canal have bearing on the Park and impact on operations of all member state agencies. The inclusion of the New Jersey Department of Transportation in the Task Force is a logical step toward