

## ROUTE 18 RECONSTRUCTION ANALYSIS

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### 1. Abstract

The existing conditions of Route 18 Highway, section 2F, 7E and 11H, were analyzed, observed, and compared to the proposed solutions created by Gannett Fleming. Problems in traffic flow and pedestrian movement in the existing roadway were determined. Major movements on the roadway were also discussed. Alternative solutions based on the needs of the community and the commuters were established. All aspects of this project, from the design to the actual construction were taken into consideration. Problems in staging and scheduling included lane closure, construction and demolition schedule, completion dates, and traffic control. Aesthetics of the project were analyzed, including sound barriers and the bridge decks, in order to make the city of New Brunswick, especially Boyd Park, more attractive and appealing.

The existing problems with the pedestrian flow and the implemented solutions were studied. These solutions were devised to improve the efficiency and capabilities of the current systems. Among these new facilities were bridges, wider walkways, and safer crosswalks. To further enhance pedestrian experiences, Boyd Park became one of the largest engineering ventures that the designers, builders, and contractors had to execute. Many steps were taken to fulfill the capabilities of the park and complement the reconstruction already taking place along Route 18.

### 2. Introduction

Route 18 is a state highway in New Jersey that stretches from Route 138 in Wall Township until "Hoes" Lane on the Rutgers Campus in Piscataway. It serves the regional

and local transportation needs for more than 85,000 vehicles per day. It is also one of the primary thoroughfares in the region and provides access to downtown New Brunswick, Rutgers University, many hospitals, major corporations, local businesses, and neighborhoods, including an entrance to the Raritan River and Boyd Park. It is currently undergoing long awaited major reconstruction and related pedestrian improvements, which have been planned over the past decade. The \$200 million dollar reconstruction plan will begin at Route 1 and extend north to the Amtrak Northeast corridor rail bridge. The main purpose of reconstruction is to enhance the safety and operations of the selected section of Route 18 corridor traffic operations. This will be done by removing substandard roadway geometric features, managing access to and from New Brunswick, and enhancing access and mobility for pedestrians, bicyclists, and transit users.

This project consists of the reconstruction of a two-mile stretch of the Route 18 Corridor. This section of the road includes five major intersections including Paulus Boulevard, George Street, Commercial Avenue, New Street, and Albany Avenue as well as numerous smaller entrances onto the highway.

### History of Route 18

The Tri-State Transportation Commission acquired rights as well as specific plans for the construction of NJ Route 18 in 1962. The purpose of this project was to link New Brunswick with the shore area, Bound Brook. The goal of this forty-four million dollar project was to improve access to New Brunswick, create a new bridge over the Raritan River, and connect Route 18 to I-287, I-95, and

NJ 28. The cost of the construction of thirty miles of roadway (the NJ18 and the NJ35) was estimated to be fifty million dollars. In 1973, the forty-eight mile long section of the newly opened NJ 35 was re-designated as NJ 18. This north-south route stretched from Brielle to Bound Brook, and intersected NJ 34, NJ 35 and NJ 70. Construction of several sections was hindered due to environmental regulations and funding limitations.

In order to increase practicality of this main artery of Route 18, The State Highway Commission proposed a new north-west segment, which began in New Brunswick, ran parallel to the Raritan River, crossing it as well as I-287, and continuing north to intersect US 22 in Bound Brook. The construction of the 2.3 mile long section of NJ 18 linking New Street in New Brunswick and River Road in Piscataway, began in 1977 after New Jersey Department Of Transportation (NJDOT) obtained Federal permission to start work on this area. In 1979, the section between exit 15 and exit 30 was completed, and in 1987, the one-mile stretch linking exit 11 and exit 12 was opened to the public. By 1991, the sections between exits 12 and 15, as well as the Eatontown interchange at exit 13, were completed. The Route 18 extension of 2A Piscataway was proposed in 2001 and completed in 2004. The reconstructed Route 18 is the primary source of transportation to Rutgers University. The Route 18 Widening Committee developed plans to lessen traffic congestion and facilitate the commute of thousands of Rutgers students.

Hurricane Floyd, which occurred in 1999, devastated Route 18, especially the New Brunswick section. In order to prevent this from happening again, local lanes were raised twenty feet and the road surface was covered with open grade gravel, thus allowing the free flow and escape of surface water.

A four lane freeway was opened in 1983. Consequently, the Raritan River Bridge and a part of Boyd Park were built shortly after. The Route 18 extension of Section 2A in Piscataway was proposed by NJDOT in 2001. Work on this eighty-five million dollar project was initiated in June 2002, and was completed two years later. The construction of section 3A began soon after.

A new construction plan began in 1999 to establish and redevelop the New Brunswick section of Route 18. This project is separated into eight major sections and is planned to last 50 months and cost \$145 million dollars. The design

of Route 18 has come a long way since the beginning of its construction, and it is a gateway to the heart of New Brunswick and Rutgers University. The final result will lessen traffic congestion and improve the commute of a constantly increasing number of drivers who travel this route on a daily basis.

### **Traffic Flow**

Major movements along the studied Route 18 Highway include the exit off of Route 18 northbound onto New Street. Part of the reason for this movement is that this is the only exit off of Route 18 onto New Street; there is no movement from Route 18 southbound onto New Street. Another movement is from Commercial Avenue onto Route 18 northbound, a left-turn at a traffic signal controlled intersection. While there are two left turn lanes, one exclusive left turn and the other a through and left-turn lane, there is not enough time to make the turn and there ends up being approximately a 575 second delay per vehicle. The section of Route 18 that experiences the most traffic flow is on Route 18 northbound between Paulus Boulevard and George Street. Paulus Boulevard is a typical jug handle, allowing cars traveling on Route 18 southbound to access Route 18 northbound and the exits onto New Street and Commercial Avenue. While this jug handle is important, the existing conditions cause a lot of traffic buildup because the exit ramp off of Route 18 southbound onto Paulus Boulevard intersects 50 meters south of the intersection and traffic builds up easily. Another problem with this intersection is that the pedestrian walk and clear time is longer than the time needed for the cars on Paulus Boulevard to make their turn and thus the planned solution is to lengthen the exit ramp and have it intersect Paulus Boulevard further south.

There are numerous movements missing from the existing conditions of Route 18. These include an offramp from Route 18 southbound onto New Street, an offramp from Route 18 southbound to George Street, and an onramp from George Street to Route 18 northbound. The only movement not created in the proposed plans was an offramp from Route 18 northbound onto George Street. Not enough vehicles wanted to make this movement in order to justify creating this ramp. In order to create an offramp from Route 18 southbound onto George Street a George Street overpass was created. Local lanes going Northbound were separated from the express lanes, thus creating a Collector Distributor (CD) Road. The offramp from Route

18 southbound to New Street would intersect at New Street just before Neilson Street. The George Street and Route 18 northbound CD would be controlled by a partial signalized intersection with the lane configuration consisting of one northbound left-turn lane, and one eastbound left-turn lane. The two northbound CD through lanes would stop only for a pedestrian actuation.

The planned construction for the Route 18 Project includes, but is not limited to, the intersections with the highway itself. Changes are also being made to surrounding intersections. The New Street and Neilson Avenue intersection was widened and a right turn lane was added from New Street onto Neilson as well as a left turn lane from New Street, eastbound and westbound, onto Neilson. In order to eliminate the number of entrances onto Route 18, the Phelps Avenue and Newell Avenue intersections were merged into one, Connector Road.

Perhaps the major change being made in this project is the addition of a local and express lane along the highway. This will allow cars to exit if needed, but also be able to travel straight through avoiding all signaled intersections thus causing traffic to flow more easily.

The areas of highest traffic flow in 1999 occurred on Route 18 northbound between Carpenter Road and Boathouse Drive. This stretch of the highway has the most traffic in the morning peak hour and also on average. The stretch of Route 18 northbound between Route 1 and Paulus Boulevard is the busiest in the evening peak hours and is the second busiest area in the morning. This area was also the busiest during the construction year of 2005. Either with or without construction, the area of Route 18 northbound between Carpenter Road and Boathouse Drive will receive the most traffic.

By studying the predicted effect of the preferred alternative for construction, it is clear that the construction would significantly improve most of the intersections on Route 18. Each intersecting street was evaluated in 1999 and given two grades, one for the AM peak hour and one for the PM peak hour. The grades ranged "A" through "F," with "A" being the best and "F" being the worst grade. There are also predicted grades for the intersections in the year 2021. The "no-build" grade predicts the condition of the intersection if no construction is undertaken, and the IPA grade determines how the road will be if the preferred alternative is taken. Paulus Boulevard would drop one grade in

the morning and remain the same in the evening without construction, but it would improve one grade in both the morning and evening if the construction is done. George Street northbound would drop one grade in the morning and evening without construction. Without construction, the grade would remain the same in the morning and improve one grade in the evening. George Street southbound is currently one of the best intersections, with a grade of "B" in the morning and a "C" in the evening. Without construction, it would stay the same in the morning and improve one grade in the evening. Commercial Avenue and New Street would benefit the most from the construction. Commercial Avenue would improve its evening grade from an "F" to a "C," and New Street's morning grade of "F" would improve to a "C" as well. The exit ramp to Route 27 southbound would improve two grades in both the morning and evening with construction, but it would drop a grade without construction.

It is clear that construction would substantially benefit most of the intersections. The improvements would be due to many factors, one of which is the proposed Collector/Distributor highway design. This design creates express and local lanes. Express lanes have very few exits and are intended to keep traffic flowing quickly without the distraction and danger of constant exit and entrance ramps. This allows drivers on the express lane to drive continuously without looking out for merging traffic and exiting cars. Instead, the local lanes, located to the outside (right) of the express lanes, would have all of the exit and entrance ramps. Any car needing to get on or off the highway would stay in the local lanes and could easily enter or exit the highway. This simple idea eliminates a lot of the traffic that was present before construction began.

The Paulus intersection, in 1999, had five of the six possible turns experiencing delays of forty seconds or more. The only intersection that passed based on the delay times was the Southbound Thru, but it is estimated to have at most ten to fifteen cars per hour on the route. This intersection is currently classified as a "Type A" jug-handle, thus, traffic from Rt. 18 will use the intersection for turns. Due to this fact, over 1700 cars per day are estimated to use this turn coming from 18 SB. In addition to these, over 3000 cars a day come from Paulus Blvd. West towards the intersection. Furthermore, over 1500 cars per day enter Paulus from 18 NB, as well as over 1800 cars from

Paulus Blvd. East. Consequently, traffic times and delay times grow.

To alleviate the problem, the proposed modifications will expand Route 18 at the intersection, providing for more access onto the road. Furthermore, the jug-handle function for the NB side will be eliminated, helping to alleviate some of the traffic and wait time there. The plans significantly reduced the delay times for many of the turns, helping to improve letter grades on 3 of the turns. However, it still has its flaws, for many of the turns also predicted an increased wait time and a drop in letter grade, including the Southbound Thru dropping from a “B” to a “D” during the PM hours. Still, it was the best alternative presented considering the improvements to the overall condition.

The only other alternative that was studied in respect to the intersection called for an overpass for Route 18 over Paulus Blvd. However, it would take away direct access from Phelps Avenue and Dewey Drive. This would create more problems and increased traffic on other roads leading up to Route 18, resulting in the dropping of this alternative from consideration.

The second intersection, and the worse of the two, was the Commercial Avenue intersection. When viewing the volume to capacity ratio of the intersection, there are four instances where it exceeds the maximum capacity the route can handle efficiently, twice on the Commercial Avenue left turn approach. This inefficiency is further reflected in the delay times experienced by the vehicles, where in these four instances, the wait surpasses three minutes, going as high as twelve minute delay per vehicle. This intersection, like the Paulus intersection is also a jug-handle, except it is a “Type B” rather than “Type A.” To solve the problem, however, planners decided to separate the intersection entirely from Route 18.

Instead, there is a diamond intersection connecting first to Burnet Street, then a overpass to connect onto Route 18 NB (C-D). From this, the traffic was able to be alleviated, especially for left turns, and the intersection itself was significantly reduced in size. Through the alternative of separating the traffic depending on destination, the Commercial Avenue intersection was able to be greatly improved, and the intersection onto 18 NB had no delay times over 25 seconds. The trouble spot at the intersection is now predicted to be fine, though the data for the Burnet Street and Commercial Avenue intersection was not present, causing some

concern to be raised over whether or not this new intersection would become a trouble spot in itself.

Three other plans were proposed, and studied in depth, to improve this intersection, two involving U-turn provisions and the last one based on the idea of a “Type B” jug-handle. The first alternative called for a median U-turn to be created before the intersection, hopefully resulting in less of a strain on the left turn part of the intersection. By providing a method for cars traveling on 18 SB to turn onto 18 NB without using the Commercial Ave. intersection would then effectively reduce delay times and traffic volume at the intersection. However, when examining the predicted delay times, it still saw long delays for the left turns, as well as the 18 SB side turns.

The second alternative was almost identical to the first, except the U-turn would not be a median turn, rather, a signalized one. Cars would still be able to make the U-turn from 18 SB to NB without use of the intersection, however, it still called for more signals preceding and following the intersection. As a result, the delay times were slightly increased from the first alternative, thus, it was not chosen. The final alternative maintained the existing configuration, though with slight modifications. However, through the use of traffic analyzing software, the delay times were only slightly improved from current conditions, so it too was not chosen as the preferred alternative.

Outside of these two intersections, the preferred alternative for the Route 18 reconstruction continued to show predicted improvements based on the traffic analyzing software predicting conditions in 2021. Whether the improvements were large or small, there were visible improvements including numerous increases in letter grades for many of the intersections and trouble spots identified in the first study. However, at the same time, one must consider that in order to alleviate traffic from one area of the road, new intersections and more redirections were employed, creating the possibility of more trouble spots and less maneuverability on the road. Also, in the case of some intersections receiving more access onto Route 18, more traffic signals must be added, resulting in more inconvenience for drivers.

For example, Burnet Street, which is expanded to help take some of the traffic from Route 18 SB, may become another trouble spot because of the increased burden for the road. The entirety of the Commercial Avenue intersection

was placed on Burnet Street, creating another troublesome intersection which planners must deal with. Still, it does help improve traffic on Route 18, which is the primary goal of the reconstruction project. In light of this fact, the preferred alternative can be viewed as a satisfactory solution to the current traffic situation, at least in respect to short term goals. Whether it will be successful 25 years from now will be another issue to be observed and studied.

**Scheduling/Staging**

The Route 18 project was primarily designed to minimize traffic and create an effective form of transportation. A schedule was designed to ensure the most efficient traffic management. Also, complications such as holidays and times of especially heavy traffic were addressed and considered in planning. Another major point in the staging and scheduling aspect of Route 18 is the construction sequence. The construction sequence is given to the contractor to provide a feasible approach to the project and it also addresses allowable construction zones, traffic movements and project constraints.

A major aspect of the planning stage in the Route 18 project is schedule limitations, including lane closure restrictions. A certain number of lanes must be open at specific times. For example, all lanes of Route 18 must remain open during periods of high traffic. These hours include Monday through Friday 6am-9pm, Saturday 8am-8pm, and Sunday 9am-8pm. Other major roads also have strategically planned lane closure schedules to minimize traffic backups and maintain a steady flow of vehicles. At certain times, all lanes may be closed for a maximum of 15 minutes during 11pm-5am. Construction work will not be allowed on days interfering with graduation, football games and sports events held at Rutgers. Access to certain buildings such as the Douglass Developmental and Disabilities Center can not be blocked Monday thru Friday from 8:30-10:00am and 2-4pm. Pedestrian access must also be allowed at all times on Route 27. Access to New Brunswick is maintained at all times by preventing the closure of adjacent interchanges simultaneously.

The second part of the staging and scheduling is the actual phases of the project. The entire project is divided into eight stages. Each stage of the project defines what must be accomplished to allow construction to progress. First, road closures are defined. Certain roads and lanes must be closed to allow for

construction to take place. Detours will be

<b>If Holiday Falls On</b>	<b>No Lane Closures Permitted</b>
Sunday or Monday	6:00 AM Friday until Noon Tuesday
Tuesday	6:00 AM Friday until Noon Wednesday
Wednesday	6:00 AM Tuesday until Noon Thursday
Thursday	6:00 AM Wednesday until Noon Monday
Friday or Saturday	6:00 AM Thursday until Noon Monday

created to maintain traffic flow through the New Brunswick area. After road closures have taken place, following stages require the opening of these roads. Also, the construction protocol must be defined. Each stage includes descriptions of what structures need to be built such as lanes, bridges and overpasses. Lastly, nighttime closures must be defined to allow for major traffic impeding construction.

Each stage defines specific tasks starting from Stage 1 requiring project mobilization, temporary pavement, and miscellaneous improvements. Stage 2 involves the reconstruction on New Street Interchange and construction on Route 18 south bound. Construction on Commercial Avenue Interchange (part 1 of 2) and reconstruction of Route 27 (Albany Street) Interchange (part 1 of 3) is done in Stage 3. Stage 4 requires construction on Commercial Avenue Interchange (part 2 of 2), reconstruction on Route 27 (Albany Street) Interchange (part 2 of 3) and construction on Route 18 north bound B. Stage 5 includes reconstruction on George Street Interchange (part 1 of 2), reconstruction of Route 27 (Albany Street) Interchange (part 3 of 3) and reconstruction on Mainline Route 18 (part 1 of 3). Stage 6 deals with reconstruction on George Street Interchange (part 2 of 2) and stage 7 involves the reconstruction on Mainline Route 18 (part 2 of 3). The last phase, Stage 8, requires the reconstruction on Mainline Route 18 (part 3 of 3) and final paving, stripping and landscaping.

In order to keep the project on schedule or ahead of schedule, the city provides the contractor with incentives. If the contractor completes the project ahead of schedule, a limited monetary value is awarded. However, certain restrictions on early completion apply. If

the project falls behind schedule, the contractor must pay additional fees. Also, violations of the lane closure restrictions result in fines. The incentives plan ensures the timely completion of the project.

To successfully complete the Route 18 project, schedule and staging must be addressed. Everything must be taken into consideration in order to provide the best possible situation for the public. Good organization and planning results in a successful outcome. For these reasons, staging and scheduling is a vital part of highway construction.

### **Pedestrian Flow/Parks**

Among the improvements to Route 18 are the repairs of existing pedestrian flow. The current capabilities for pedestrians were very poor. Worn paths could be seen along the sides of the road where pedestrians had to resort to walk. The need for sidewalks was so great that sidewalks will be built along the entirety of Route 18. These improved pedestrian facilities will be built alongside the widened roadway. Pedestrian crossings will be improved with traffic signals. These include the crossings at Paulus Boulevard, George Street, and Commercial Avenue.

Bridges will also be built along Route 18 for pedestrian crossing. The goal of these pedestrian overpasses is to reduce the number of intersections the paths of pedestrians have with vehicles traveling along Route 18. By limiting the contact vehicles have with pedestrian crossings, the risk of accidents involving the two is reduced. It will also improve the efficiency of the highway by eliminating stops at each pedestrian crossings. The pedestrian overpasses are all wheelchair-accessible. They will be built at Route 18's intersections with Carpender Place, Commercial Avenue, and Richmond Street. The overpass at New Street is being improved.

These design suggestions allow for smoother actions between pedestrians and vehicles. The flow of traffic and pedestrians is much more efficient. One of the main concerns of safety for pedestrians is also addressed. The reduced contact between vehicles and pedestrians lowers the number of accidents, which would further back up traffic because of arriving emergency vehicles. The design of the project is key to better action, traffic and pedestrian flow, and increased safety.

Boyd Park, located adjacent to Route 18, was also in desperate need of repair and

improvement. Acting as the "Gateway to New Brunswick", the park's aesthetics were also considered as the multi-million dollar project commenced. One of the main issues of the park was the pavilion, located near Commercial Avenue. The pavilion was now almost destitute, with handrails that obstructed views to the stage, no raised seating, and a further cumbersome and obstructing tree canopy. With the restrooms located next to the stage, activities on the stage limited access to the restroom. The location of the pavilion also hurt the flow of the park, interrupting the connectivity.

A major issue regarding the park was the noise walls placed along the highway. These noise walls were put up to reduce the highway noise right next to the park. However, the height and appearance of the walls was a problem for the city and those enjoying the park. The nature of the walls created a "tunnel effect" that basically secluded the park from the rest of the city. The design of the walls also took away from the natural look of the park.

Vehicle parking space for the park was very poor. The lack of parking lots forced visitors to park their cars in the park's open space, at the North Brunswick Police Station, or on the streets of New Brunswick. Accessibility to the park was limited as well, with not enough entrances.

There were many suggested solutions for the issues present in the park. For the pavilion, the handrail was suggested to be removed, along with the ideas of removing a section of the east side to increase open space, a large entry plaza that could serve as seating for a second ground level stage area, and a ground level amphitheater between the pavilion and the Commercial Avenue entrance.

Berms were thought to be able to minimize the visual impacts and lessen the exposed height of the remaining CD noise walls in the park. Trees were also to be planted along the walls to soften the view of the park from the city and contribute to the overall look of the city.

The problem of limited parking may be solved with a large parking lot on Boathouse Drive. Accessibility to the park may be improved by paving a dirt driveway at the park's intersection with New Street, and a pedestrian entrance located there as well.

Although not all ideas and suggestions for improvements were kept, certain ones were implemented in the final design. The amphitheater will be built, with stadium seating and stairs. Stairs will be added around the stage

for improved access. A section of the east side of the pavilion was also eventually removed. The berms and trees planted along the noise walls were eventually implemented, as well as the entranceway at Commercial Avenue, to increase access to the park by pedestrians.

Among other ideas were the public boat launch that was added and a picnic gazebo in the city dock area. The dock area was further improved with a promenade next to the river connecting the docks to the rest of the park. Graffiti proof structures were used where available, and the old police station which was no longer in use was demolished.

Because Route 18 needed to be widened along most of its length, land from Boyd Park needed to be used for the highway. For approximately a mile stretch of land, thirty feet of park land was paved over. In exchange for this land, the park asked for a trade-off. This trade-off was the improvements that were entailed within the cost of the Route 18 project. The contractor would include these costs in the project and the park commission would not have to pay for them.

### **Context Sensitive Design (Aesthetics)**

The aesthetic portion of the Route 18 reconstruction plays an important role in New Brunswick; the highway serves as a gateway to the city. Therefore, the appearance of Route 18 sets the tone for New Brunswick. Another reason for the emphasis on Route 18's design is the goal of revitalizing the formerly unappealing Boyd Park.

Recently, on our group visit to several Route 18 construction sites, we were able to get a first hand experience with the plans. The bridge on New Street was constructed with concrete, iron frames, and visually appealing gray stonework. Twin, massive pedestrian crossing structures stood on opposite sides of Route 18. Constructed with concrete and grey stones, the pedestrian crossing structures consisted of not only stairs, but also large handicap ramps. The metal frame of the pedestrian bridge was on the ground, ready to be placed across the highway. The sound barriers were made of red brick and a white border along the top. Avoiding the typical, boring straight shape of sound barriers, these walls were built in a wavy shape, which is not only functional, but pleasing to the eye. Noting the materials and classic designs of the Route 18 constructs, we began to appreciate the importance of presenting a grand "gateway" to New Brunswick.

Before planning began, questions and concerns were discussed. As with any major project, budget is one of the first concerns to be raised. The budget was not initially set when the project's planning began, rather the team decided that first determining the purpose and need of each feature and examining costs was necessary. Another question asked how much variation there would be in the design of the NJTRANSIT bus shelters and how many there would be. Bus stops at Paulus Boulevard and Commercial Avenue were definite but a Rutgers stop on George Street was in question. The design was to be standardized, although flexibility in design could be considered. Possible themes were also brought up such as historic, modern, or classic. The need for improved directional signage at key points was also expressed. Concerns regarding the noise walls included a preference for red brick with white edges and softer curves in the wall to enhance a flowing theme. Regarding vandalism of the noise walls, a suggested solution was the use of murals or motifs; the team decided that active participation by the community in the creation of the murals would further discourage graffiti. The desire to make New Brunswick a "nice college town" again was emphasized through the expressed preferences of soft curved styles, lighting and welcoming gateways.

The concerns regarding Carpenter Road are the location of the pedestrian overpass and the exposure of Carpenter Road to road noise and debris. The final solution was to build a barrier wall alongside the overpass ramping to the street. A suggestion made by the community was for the overpass ramping to be directed towards the bus stop. The bus stop is to be located underneath the overpass in the final design. The final design of Carpenter Road's pedestrian crossing is a bowstring archway while the Albany Street Bridge will have a similar design. These two archways will act as the two gateways into New Brunswick.

On the subject of graffiti and vandalism, graffiti-proof walls were deemed unnecessary because the board decided that this was an issue for maintenance and security. Suggestions for smaller-than-standard green traffic signs were taken into consideration. The sizes of the signs are to be reduced on local roadways however mainline roadways must have the larger signs and standard posts must be used. When discussing the lighting design, as long as the standard DOT pole was used, there was flexibility in choosing the fixture. A teardrop

fixture was the final design chosen. Even small details such as types of plants to be planted along the highway were discussed. Certain areas were not likely to receive enough sun, therefore making plantings relatively useless. Strategies to use non-people friendly plants were decided upon as well to discourage pedestrian travel along the highway and vandalism on the walls. Three different sidewalk paving types were proposed. Out of the three proposed designs, the simple design was chosen.

## **Bridges**

Structures located on Route 18 have undergone a variety of reconstruction along many main avenues of New Brunswick. The structures undergoing renovation include the bridges located on Route 18 over Albany Street, New Street, Commercial Avenue, and George Street. The design of each bridge, the chosen alternatives, the deficiencies operationally and structurally, and the existing conditions are top concerns to be analyzed.

To begin, the existing conditions of George Street consist of a roadway that carries Route 18 NB traffic onto George Street, one of the main routes for entrance into Rutgers University's Douglass College. The bridge has eight concrete approach spans with an average length of 10.7m and three steel main spans with various span lengths from 13.3m to 22.9m (60' to 75'). The bridge geometry includes a minimum vertical underclearance that is currently 15.2in at the bottom of the crossbeam at the inside edge of Route 18 NB lanes. This clearance is less than the state's 16.5 highway requirements. Therefore, this crossbeam does not meet current lead ratings. For example, the sufficiency rating is 59.0, the condition rating of the deck is 5, the superstructure is 6, and the substructure is 5. Moreover, traffic is negatively affected with congestion. Also, safety is another major issue to consider.

Bridge alternatives considered include two main avenues. The first being a new grade-separated T-intersection with bridge over Route 18 and elevated NB C-D Road extending south past George Street interchange. The second alternative includes four plans. 2A being a total replacement of George Street Bridge. The new bridge is a 5-span steel structure with a span configuration of 25m-30m-31m-31m-31m (82'-98.4'-101.7'-101.7'-101.7'). A steel box-cross girder, supported by two concrete columns, will span Route 18 NB. 2B plan dictates a total replacement of the George Street Bridge. The

new bridge is a 3-span steel structure with a span configuration of 22m-34m-31m-31m-31m (72.2'-111.5'-101.7'-101.7'-101.7'). A concrete pier would be placed in the median of Route 18 along its centerline. The preferred plan, 2C, proposes a complete renewal of George Street Bridge. The new bridge will be a 3-span structure with a span configuration of 60m-47m-46m (197'-154.2'-151'). Several improvements have been suggested: continuous horizontal curved steel multi-girder bridge supporting a composite concrete deck; semi-stub abutments with a concrete slope protection; column bent and hammerhead type piers; conventional C-I-P cantilever concrete retaining walls needed to retain approach roadway fills along the Route 18 NB roadway. The final alternative suggests an entire reconstruction of three main spans and retrofit of the remaining George Street Bridge structure with a span configuration of 25m-36m (82'-118').

Engineers must consider various issues and problems that may arise in the duration of improving the George Street Bridge transportation system. An element that must be considered is the rock cutting that will be required for a retaining wall that widens Route 18 SB. High pier bent construction due to the steep embankment along Route 18 NB roadway is also a major issue that must be taken into account. It is also required to construct a pedestrian bridge that descends from the George Street structure to Boyd Park.

Secondly, Commercial Avenue intersects Route 18 at an at-grade, signal controlled intersection. Operationally, this functions well.

The first and preferred alternative is the Commercial Avenue on structure over Route 18, which includes a single span, steel multi-girder bridge supporting a composite concrete deck; full-height abutments; and a retaining wall. The A secondary alternative proposes a Route 18 bridge over Commercial Avenue. This bridge will be a single span, steel multi-girder bridge supporting a composite concrete deck and full-height abutments. The B secondary alternative is similar to the A secondary alternative, but it also includes hammerhead type piers.

Many issues rise when we consider the alternatives for reconstruction on this particular bridge. For example, the pedestrian bridges must connect at-grade sidewalk on Commercial Avenue and C-D road to the Commercial Avenue structure at the west approach. Additionally, a bus stop is to be included as well

as a pedestrian walkway ramping from the C-D Road to Boyd Park. The city of New Brunswick also requested the retraining walls and pedestrian bridges to be aesthetically pleasing.

Additionally, New Street must undergo some improvements. Current conditions include a bridge that carried two-way New Street traffic over Route 18 and a three-span bridge with a span configuration of 14.5m-18m-25.5m(47.7'-59'-83.5'). Note, this clearance is less than the state highway requirement of 16.5in. Unfortunately, based on the Bridge Re-evaluation Survey Report the structure is considered functionally obsolete due to the inadequate deck geometry. Subsequently, traffic is heavier on such road conditions. This bridge earned a sufficiency rating of 95.2. The condition rating of: the deck is 6, the superstructure is 7, and the substructure is 7.

There are three New Street bridge alternatives suggested. The first being a single span steel structure with span length of 64m. The second and preferred alternative proposes a two-span, continuous horizontal curved steel multi-girder bridge with a span configuration of 32m-34.5m (105'-113.2'); a full-height for west abutment and semi-stub for east abutment with concrete slope protection; and a column bent type pier in the middle of Route 18 roadway. The third alternative plans for a three-span steel structure with a span configuration of 14.5m-18m-25.5m (47.7'-59'-83.5').

Similar to the other bridges undergoing renovation, the New Street poses elements that must be included into the design. Staged construction is one of those elements which must be required if the bridge is to remain open to traffic during construction. Staged construction must also incorporate the anticipated temporary sheeting needed. If Alternative 1 were to be considered, deeper superstructures for the bridge will lead to higher retaining walls along the approach loop ramp. A pedestrian walkway/bikeway connecting the bridge's south side walkway to the Boyd Park ramp is another requirement.

Finally, the Route 18 over Route 27 has also been incorporated in the plans to renew the Route 18 highway. Current conditions include a bridge that carries Route 18 NB and SB over Route 27 (Albany Street). There is a two span bridge with span configurations of 22.4m-17.7m (74'-58'). The bridge geometry also does not meet the state requirement of having a clearance of at least 16.5in. The sufficiency rating is 89.9. The condition ratings of: the deck is 8, the

superstructure is 7, and the substructure is 7. Operationally, this whole structure slows down traffic

The preferred alternative is to: widen the structure by approximately 10.5m; modify existing deck cross slopes to accommodate the proposed Route 18 NB mainline and CD road; widen bridge with a two span continuous steel stringer and abutment and pier extensions; raise deck elevations by adding concrete overlay or providing complete deck replacement; and maintain existing underclearance. Alternative 2 plans to raise the superstructure to meet standard vertical underclearance, and it plans to deck cross-slope requirements.

Route 18 over Route 27 must consider upgrading the 4.6m (15.2') bridge underclearance to a minimum of to 5.01m (16.5'). This in turn would significantly impact existing ramps and tie-in points, thus extending work beyond the current project limits and proving costly. Constructors must also take the action of lowering the deck elevations at certain areas to accommodate the proposed roadway cross slopes. This will result in a lowering of the existing stringers, and this may affect the existing underclearance.

The bridges are interconnected in that they all improve upon the traffic system and the sanity of drivers. Using the preferred alternatives as a guide, we can determine the specific similarities and dissimilarities. All bridges are undergoing partial reconstruction, except for the George Street Bridge, which is undergoing complete and total reconstruction. The structural element that is similar in the designs of the New Street Bridge, the Route 18 over Route 27 Bridge, and the George Street Bridge are a minimum of 16.5 in for each underclearance. Only the Route 18 over Route 27 Bridge is maintaining the existing underclearance. Conversely, the other remaining bridges awaiting reconstruction are all redoing their underclearances.

In finale, through improving the major structures along Route 18, Route 18 over Route 27, New Street, Commercial Avenue, and George Street, a better and safer transportation system for the commuters of New Brunswick and New Jersey will be produced.

### **Other Considerations**

The reconstruction of Route 18, affects the access and transportation to Rutgers University. Major traffic congestion is expected due to the widening of this roadway.

Representatives of the University's communication, planning and transportation committees met with members of NJDOT on February 27 to discuss possible communication initiatives to deal with the numerous traffic congestion issues. The Route 18 widening committee is working to aid the university in operating efficiently during the several phases of construction. The committee is composed of twenty-five members including faculty, staff and student from the Rutgers campus. It was divided into three sub-groups which focus on transportation, scheduling and student and administrative services. According to Robert Spear, director of parking and transportation services, 45,000 students utilize ten bus routes each day to commute to several locations spread all over the New Brunswick/Piscataway campus. Several actions are planned to go in effect in order to more efficiently serve the student body of Rutgers University. The steps include improved transportation system, flexible construction periods and altered class schedules. The subcommittees will most likely develop new bus routes and schedules for Rutgers buses, decrease private vehicle use between campuses in order to lessen traffic and adapt convenient work hours to reduce congestion during peak hours.

Several alternations were proposed to the Rutgers class schedule by the scheduling subcommittee in response to the Route 18 construction. Widening the time between classes increased inter-campus travel time. Back to back classes on different campuses would not be permitted. Classes taking place in the mornings, evenings and on weekends are aimed to replace many of the classes starting or ending during periods of mostly congested traffic. Work is being done in to link campuses electronically in order to reduce travel between them. Finally, several campus events are being relocated to more convenient locations between each of the campuses. Inter-campus travel is also being reduced by constructing university offices in more accessible locations and by improving the electronic transport of data, as well as access to library resources. The proposals of each of the subcommittees were submitted by April 1 of this year and were reviewed and converted into a draft of the final report by late May or early June. Other suggestions aimed to lessen the impact of the construction on Rutgers University include the formation of new bus lines, construction of new parking and the development of several additional bike lanes.

In order to efficiently inform students at Rutgers University of the current conditions of Route 18, the news of the latest developments are available at [Route18update.Rutgers.edu](http://Route18update.Rutgers.edu). In addition, the NJDOT and Rutgers will use a self-subscribed email list in order to send updates on road closures, detours and other construction related details. Finally, video cameras are stationed along Route 18 in order to provide live updates available on the Rutgers television networks as well as the Rutgers website.

When designing construction improvements planed for Route 18, the project committee took into consideration the effects of Hurricane Floyd on the roadway in 1999. Several parts of the route are located in low laying regions close to the Raritan River, which are often labeled as flood zones. After the 1999 hurricane hit the area of New Brunswick, numerous parts of Route 18 were flooded. As a result, transportation of people and goods was hindered. In order to solve that issue and prevent such circumstances from occurring in the future, the new design of Route 18 includes the elevation of local lanes. Although the express lanes were only slightly raised, the local lanes were elevated twenty feet and even higher in trouble spots. Occasionally they are supported upon structures in order to maximize their elevation. Furthermore, the construction of several retaining walls along the path of the road is aimed to minimize flooding as well as land slides. Also, the type of pavement used was taken into consideration and after thorough analysis open-grade pavement was chosen to line the streets of Route 18. Although this type of pavement is less structurally sound then fine-grade pavement, which is usually used in roadways such as Route 18, it is more suitable in the fact that it allows for the free flow of surface water and makes it easier for it to escape. Such changes in the construction of the roadway are hoped to reduce any possible losses due to another similar natural disaster.

### **Future Work**

The work that was done on Route 18 has inspired future experiments that can be applied in civil engineering. Instruction on the Traffic Flow, Staging and Scheduling, Pedestrian Flow and Park, Context-Sensitive Design, Bridges, and Miscellaneous Project topics have provided a better understanding of working on reconstruction, a feature of civil engineering. The newfound experience gained can be applied to the future construction of Route 18 Section 3A.

In the future, the NJDOT is making plans to extend the width dimensions of Section 3A's Hoes Lane Extension to I-287 at Possumtown Road. This endeavor will require the consolidation of traffic signals, improvement of shoulders and sidewalks, and upgrade of drainage and utilities. These are many of the issues considered in the Route 18 Wide and Specific Issue Projects.

From the reconstruction of Route 18 Section 3A, we can expect benefits similar to those received from the renovation of the other parts of Route 18. Improvements include: safer and faster traffic flow, aesthetically pleasing highway systems, and enjoyment and access to public facilities such as Boyd Park.

### **Conclusion**

In conclusion, the research we have compiled regarding the reconstruction of Route 18 has led us to more clearly understand the concepts, ideas and expectations of this project. Provided with detailed maps, we were able to take a closer look at the detailed design of the plan changes and their effect on the surrounding communities. Our instructor, Dave Nemeth, organized a trip for us to visit the construction site. We spoke with the project manager who provided us with an outline of the work being currently done as well as plans for the future. We stopped at several locations along the route and discussed the specifics of the construction. Among the issues we gained insight into were the costs, deadlines and detailed plans that go along with a major project such as this one.

We have been exposed to the responsibilities and work of a civil engineer. As a result, many of us discovered several disciplines within this field that appeal to us. By doing hands on activities we were more able to see the work involved in such assignments and discovered that different components of this project call for different specialists within the engineering field. Each of our interest was represented in the reconstruction of Route 18 and helped us discover what aspect of the project we were interested in. This activity, as well as others, introduced to us during the entire Governor's School, has provided us with greater insight into the work of an engineer. Before participating in this program, many of us questioned our commitment to this field, but by being here we explored our interests in engineering and look forward to continuing our education in this direction as we move onto further schooling.

### **Acknowledgements**

The authors would like to thank Dave Nemeth of Gannett Fleming, Inc., Matthew Elwin, Conti Construction, and the New Jersey Governor's School of Engineering and Technology for providing an excellent learning opportunity and a foundation in the Civil Engineering Field.

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