



McElhanney



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CLEARBROOK INTERCHANGE IMPROVEMENT PROJECT

ABBOTSFORD, BC

CANADIAN CONSULTING ENGINEERING AWARDS 2012
CATEGORY B | TRANSPORTATION



CLEARBROOK INTERCHANGE IMPROVEMENT PROJECT



CCE AWARDS 2012
CATEGORY B: TRANSPORTATION

Clearbrook Interchange Improvement Project

SUBMITTED BY | MCELHANNEY CONSULTING SERVICES LTD.

75-WORD PROJECT SUMMARY

The original interchange at Highway 1 and Clearbrook Road was severely over capacity due to Abbotsford's increasing population. McElhanney's multi-disciplinary design team completed a six-lane underpass, two-lane roundabout, three signalized intersections, and 6 km of roadworks and utilities, complete with roadway lighting, landscaping, stormwater infiltration ponds, and rain gardens. Completed on time and well below budget, additional roadway and utility improvements to adjacent roadways valued at \$9.8M were also delivered to enhance the new interchange.

Clearbrook Interchange Improvement Project

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PROJECT HIGHLIGHTS

The Clearbrook Interchange connects the Trans-Canada Highway (Highway 1) and Clearbrook Road in Abbotsford, BC. The original interchange was constructed in 1960 to service a population of 20,000. Dramatic population growth has resulted in 25,000 vehicles using the interchange each day, far exceeding the capacity of the original two-lane structure. The road geometry also presented a serious safety concern and did not meet current design standards. The City of Abbotsford identified the Clearbrook Interchange as a priority upgrade in its 2007 Transportation Master Plan. The Clearbrook Interchange Improvement Project is a joint initiative of the City of Abbotsford, BC Ministry of Transportation and Infrastructure, and the Government of Canada, funded under the federal Infrastructure Stimulus Fund.

PROJECT TEAM

McElhanney was initially approached to develop conceptual design options for the interchange and present a business case for the recommended solution. Upon acceptance of the proposed design, the City of Abbotsford retained McElhanney to provide detailed design and Engineer-of-Record services, develop a project implementation plan, and recommend a viable project delivery method. A hybrid methodology was developed, combining day labour with the Design-Tender-Construct model.

As engineering lead, McElhanney completed highway design, stormwater management plans, environmental assessments, and topographical and legal surveys, all using in-house expertise. Additional design and inspection components were also awarded for subsequent phases of work on Clearbrook Road and Marshall Road. Proposals were requested for structural, electrical, geotechnical, and landscaping components, and the lead proponent of each discipline was invited to join the project team as McElhanney's subconsultant.

CONSTRAINTS AND COMPLEXITY

Due to stipulations of the Infrastructure Stimulus Fund, the Clearbrook Interchange Improvement Project was required to be fully completed by March 31, 2011, within the approved funding limit of \$25M. With no conceptual design, project delivery method, or project manager in place, McElhanney was tasked with completing the interchange in only 17 months.

McElhanney determined that a very aggressive schedule was required to meet the completion deadline. Design and construction often took place concurrently, and the construction activities that would have jeopardized the overall delivery of the project were fast tracked. Significant emphasis was placed on project site management, as multiple contractors shared the worksite. Precise scheduling and good working relationships were paramount to the project's success.

To reduce costs and increase productivity, efforts were made to efficiently use and re-use site materials. Construction cost estimates were constantly updated and refined based on the latest construction tender data. As a result, the interchange was delivered at a total construction cost of



\$10.2M, well below the initial funding budget of \$25M, which allowed for additional improvements to adjacent roadways valued at \$9.8M.

An additional requirement was for both Highway 1 and Clearbrook Road to be fully functional during construction. A successful detour plan was developed that employed permanent components of the design, and very few lane closures were needed. The highway detour was designed and constructed first, during which time McElhanney completed the remaining design components and contract documents for the final tendered works contract.

DESIGN OBJECTIVES AND SOLUTIONS

The Clearbrook Interchange Improvement Project was intended to improve safety, accommodate higher traffic volumes, and provide better access to industrial areas and key amenities. The City of Abbotsford initially specified a four-lane underpass with the provision for a future extension to six lanes; however, McElhanney determined that sufficient budget existed to construct a six-lane configuration within the current project.

The highway on and off ramps were also identified as a priority, in particular the westbound off ramp, with a very tight turning radius and a design speed of only 30 km/hr. McElhanney's solution was to realign the westbound highway lanes through the existing median, to achieve a design speed of 50 km/hr for the off ramp. The ramp terminus intersections were also upgraded due to severe congestion and safety concerns. A two-lane roundabout was constructed at the south intersection and a signalized intersection at the north intersection.

At the completion of the project, McElhanney had led a multi-disciplinary design team to complete a six-lane underpass, two-lane roundabout, three signalized intersections, and 6 km of roadworks and utilities, complete with roadway lighting, landscaping, stormwater infiltration ponds, and rain gardens.

ENVIRONMENTAL, SOCIAL, AND ECONOMIC BENEFITS

Environmental consciousness was employed and demonstrated throughout the project, including efficient use and re-use of existing site materials and beneficial stormwater treatments such as infiltration ponds and rain gardens. Environmentally sensitive areas were identified, with mitigation measures put in place. The project also promotes a reduction in fuel consumption and greenhouse gas emissions from reduced idling and the promotion of alternate modes of transportation.

Residents have benefitted from more efficient travel, increased safety, and better access to key local amenities. Support for the project was attained by encouraging community involvement through all stages and the installation of a public art project: a unique raspberry sculpture that has become a signature piece for residents. The project has a positive economic effect due to improved transportation of people and goods, as well as improved access to a future industrial park. Regional connectivity has also been improved, a welcome relief to commuters to and from Metro Vancouver.

Through sound project management and a true team effort from all involved, the Clearbrook Interchange Improvement Project was delivered ahead of schedule and under budget, having over achieved the project goals. The project was executed seamlessly due to strong project management, partnership, and teamwork.

Clearbrook Interchange Improvement Project

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1 INTRODUCTION

The Clearbrook Interchange was built as part of the original Trans-Canada Highway (Highway 1) construction in 1960, at the intersection of Highway 1 and Clearbrook Road in Abbotsford, BC. The two-lane underpass was designed to service a local population of 20,000 and featured on and off ramps for both eastbound and westbound traffic. Since that time, Abbotsford has grown to become the fifth largest municipality in BC, with a seven-fold increase in population since 1960. This dramatic growth has resulted in congestion and safety concerns on several major transportation routes, prompting the City of Abbotsford to develop a Transportation Master Plan in 2007. The Clearbrook Interchange was identified as a priority upgrade.

The interchange, now host to 25,000 vehicles daily, had become a major transportation bottleneck, causing excessive delays and congestion. Additional concerns were presented due to unsafe road geometry, which did not meet current design standards, and constrained economic development. Abbotsford's Transportation Master Plan specified a new, four-lane underpass structure, with provision for future expansion to six lanes. Additional capacity improvements were also recommended at the ramp terminus intersections to improve overall traffic flow and safety.



CONGESTION ON
CLEARBROOK ROAD
INTERCHANGE APPROACH



2 PROJECT OVERVIEW

The Clearbrook Interchange Improvement Project provided much-needed upgrades to the existing Clearbrook Interchange, a vital connector between Clearbrook Road and the Trans-Canada Highway. This included widening the underpass from two lanes to six, improving the on and off ramps, and upgrading or reconstructing the adjacent intersections. Cost-saving measures also allowed for an extension of the project scope to include road and utility upgrades to both Clearbrook Road and Marshall Road. The project was fast tracked to meet funding requirements of the Infrastructure Stimulus Fund, part of Canada's Economic Action Plan.

2.1 MCELHANNEY'S ROLE

The City of Abbotsford initially approached McElhanney to develop conceptual design options and to prepare a business case for the chosen alternative. In less than three weeks, McElhanney submitted four different conceptual designs with associated cost estimates, traffic volume projections, and performance analyses. A matrix evaluation of all four options was presented, along with a recommendation for the preferred option. McElhanney then completed a business case for this option using a Multiple Accounts Evaluation methodology. The analysis pointed toward significant savings in both travel time (\$28.17M) and collision reduction (\$7.28M).

Upon acceptance of the proposed conceptual design, the City of Abbotsford retained McElhanney to provide detailed design and Engineer-of-Record services. McElhanney was also tasked with developing a project implementation plan and recommending a viable project delivery method. Multiple delivery methods were considered, including conventional Design-Tender-Construct, Design-Build, and Early Contractor Involvement. Ultimately, the project moved forward using a hybrid approach, combining day labour with the Design-Tender-Construct model.

As engineering lead, McElhanney completed highway design, stormwater management plans, environmental assessments, and topographical and legal surveys, all using in-house expertise. Additional design and inspection components were awarded for subsequent phases of work on Clearbrook Road and Marshall Road. McElhanney also managed multiple engineering subconsultants and coordinated with utility agencies to provide designs and inspections. At the completion of the project, McElhanney had led a multi-disciplinary design team to complete a six-lane underpass, two-lane roundabout, three signalized intersections, and 6 km of roadworks and utilities, complete with roadway lighting, landscaping, stormwater infiltration ponds, and rain gardens.



2.2 DEVELOPMENT OF PROJECT TEAM

As time was of the essence, a unique process was established for development and selection of the project team. CMS Focus and JG Singer Consulting were retained for construction management and project management services, respectively. CMS Focus was instrumental in managing multiple day-labour contracts and coordinating field issues with the design team; JG Singer Consulting coordinated activities of and communication between the various project stakeholders.

Proposals were requested for structural, electrical, geotechnical, and landscaping components; these were jointly reviewed and evaluated by the Ministry of Transportation and Infrastructure, the City of Abbotsford, McElhanney, and a fairness advisor. The lead proponent of each discipline was invited to join the project team as McElhanney's subconsultant. McElhanney's project manager was tasked with leading this new multi-disciplinary team, which included some firms with whom there was no previous working relationship. Through motivation, sincere appreciation, and strong leadership, the design team worked together to issue early-works construction packages within three weeks of being assembled.

2.3 FUNDING AND ASSOCIATED PROJECT REQUIREMENTS

The Clearbrook Interchange Improvement Project is a joint initiative of the City of Abbotsford, BC Ministry of Transportation and Infrastructure, and the Government of Canada, funded under the federal Infrastructure Stimulus Fund. Funding approval was announced on September 24, 2009, with the City of Abbotsford assigned to deliver the project on behalf of the project Owner, the Ministry of Transportation and Infrastructure. In delivering the project, the City of Abbotsford agreed to four critical project requirements:

1. The Clearbrook Interchange Improvement Project was to be fully completed by March 31, 2011. This included completion of all construction works, release of holdback monies, and completion of as-constructed drawings. Under the Infrastructure Stimulus Fund agreement, reimbursement would not be provided to the City for project costs beyond this date.
2. The total project cost, including design, construction, contingencies, and project administration, was not to exceed the approved funding amount of \$25M. The federal and provincial governments' funding was capped at \$16.66M, and the City did not wish to increase its liability beyond its budgeted portion of \$8.33M.
3. Highway 1 and Clearbrook Road are major transportation corridors and were required to be fully functional, with no interruptions, throughout construction. Proposed design solutions needed to consider the constructability of detours, on and off ramps, and superstructure.



4. Land acquisition was not an eligible project cost, and the project schedule could not accommodate the timelines associated with property negotiations. All proposed options would need to be confined to existing Ministry of Transportation and Infrastructure and City of Abbotsford property and rights-of-way.

3 PROJECT CONSTRAINTS AND COMPLEXITY

The Clearbrook Interchange Improvement Project was very complex due to a short timeline for design and construction, a limited budget, and project management requirements.

3.1 ACCELERATED DESIGN AND CONSTRUCTION SCHEDULE

At the time funding was announced, there was no conceptual design, project delivery method, or project manager in place. The City of Abbotsford was required to deliver a completed \$25M interchange in only 17 months. Literally starting from scratch, McElhanney was tasked with completing conceptual and detailed design, construction of the interchange and associated roadworks, and utility relocations within this timeframe.

McElhanney determined that a very aggressive schedule was required to meet the completion deadline of March 31, 2011. Four conceptual design options were developed and presented in less than three weeks, with site work beginning only three weeks after completion of the business case and implementation strategy. McElhanney continued to rapidly submit design deliverables on time or ahead of schedule, with minimal revisions required. Design and construction often took place concurrently, and the construction activities that would have jeopardized the overall delivery of the project were fast tracked. The highway detour was designed and constructed first, during which time McElhanney completed the remaining design components and contract documents for the final tendered works contract.

To accelerate construction, the median pier and abutment walls were tendered and awarded independently to three experienced bridge contractors and completed under day-labour contracts. Construction of these substructure elements was carefully coordinated with preparatory work for realignment of the highway and off ramps. As a time-saving measure, the abutments were designed in cast-in-place concrete, rather than using a more conventional, proprietary MSE retaining wall system. This eliminated the procurement time associated with the design and manufacture of MSE wall system components, and the abutment walls were completed and backfilled prior to mobilization of the general contractor.

Over 50 day-labour contracts were employed to complete the highway relocation and detour, median pier and bridge abutments, procurement of bridge girders, relocation and installation of utilities, and earthworks for the new bridge approaches, all prior to the award of the main



construction contract. The City of Abbotsford's Hired Equipment List, Invitations to Quote, and the BC Bid procurement system were all used to fast track the day-labour works for this project. The 28 precast box girders specified for the superstructure were also designed and tendered in advance to eliminate procurement and delivery delays. This ensured that all required material would be available to the general contractor at the time of award.



CONSTRUCTION OF NEW SOUTH ABUTMENT WALL UNDER EXISTING BRIDGE

As a result of meticulous scheduling, the interchange was opened to traffic on November 5, 2010, and was substantially completed on schedule. Due to an increase in the project scope to include two additional phases of work, the original deadline of March 31, 2011, was extended to October 31, 2011, with all funded work completed before this date. Cumulatively, the three project phases were very complex, as each phase of construction was subject to an almost unachievable completion schedule. Each phase required the issuance of an early-works contract so that utility relocations and installation could commence within weeks of the project award. The more complicated road construction packages were issued shortly thereafter.

3.2 CAPPED PROJECT BUDGET

Another constraint of the project was the capped budget of \$25 million. To reduce costs and increase productivity, efforts were made to efficiently use and re-use site materials. All suitable excavated material from the existing highway and ramps was used on site. The existing westbound highway pavement was reclaimed and utilized as select granular sub-base, for additional cost savings to the project. An additional detention pond was created inside the westbound off ramp loop, and the suitable pit run was utilized for on-site road construction and as embankment fill. Unsuitable material was disposed of on site, used to flatten out slope embankments and create berms where practical. Concrete from the demolished underpass was



crushed and recycled, and the steel rebar was separated and recycled. Realigning the highway also resulted in reducing the superstructure length by 50%, providing a considerable savings in material costs.

McElhanney also constantly updated and refined construction cost estimates, from conceptual design through detailed design, based on the latest construction tender data. CMS Focus diligently tracked and forecasted day-labour construction costs. As a result, the interchange was delivered at a total construction cost of \$10.2M, well below budget, which allowed for additional improvements to adjacent roadways valued at \$9.8M.

3.3 SITE MANAGEMENT

With design and construction schedules both accelerated, a significant emphasis was placed on project site management, as multiple contractors were required to share the worksite. CMS Focus was the prime contractor during day-labour construction works, and numerous contractors worked together to keep the project on schedule. It was typical for five to ten different contractors to occupy the construction site at the same time; precise scheduling and good working relationships were paramount to the project's success. All subcontractors were professional and worked to deliver a quality product. Contract documents were carefully worded to ensure there was no site confusion as to workplace safety or the determination of the prime contractors.

3.4 DETOURS AND TRAFFIC MANAGEMENT

The project team was required to maintain uninterrupted traffic flow along the Trans-Canada Highway as well as on Clearbrook Road, an area in which the design and construction methodology excelled. Very few lane closures were required to facilitate construction of the interchange, and a successful detour plan was developed that employed permanent components of the design. Portable changeable message sign (PCMS) boards, Drive BC notifications, the media, and other communications strategies were employed to minimize the impact to motorists.

The design specified realignment of the westbound lanes of Highway 1, with the new lanes also designed to double as a construction detour and site access road. The detour phase was designed and constructed first, with traffic subsequently detoured onto the new westbound lanes to facilitate the second phase of works. This design innovation permitted construction of the median pier and north abutment wall with no lane closures, which also improved worker safety. The south abutment wall was designed to allow for a new eastbound deceleration lane where one did not previously exist. This allowed for its construction with no impact to highway traffic and easy access via municipal roadways.



The new underpass was constructed adjacent to the existing bridge and designed to act as its detour. The new structure was completed with top lift asphalt prior to diverting traffic and demolishing the old underpass. This process also resulted in minimal disruption to traffic on Clearbrook Road during construction.



CONCRETE POUR
FOR NEW BRIDGE DECK

3.5 UTILITY COORDINATION

The project roadworks crossed two high-pressure, large-diameter gas transmission mains in four separate locations, requiring significant liaison with Terasen Gas (now FortisBC). Split casings were installed at all the crossings locations, with phased work and temporary detours to facilitate the installations. No work was permitted in these four locations without a Terasen Gas representative on site. A significant portion of project management effort was dedicated to mitigating the impacts of roadworks and negotiating compensation for the installation of new casing pipes on the transmission mains.



INSTALLATION OF
SPLIT CASING AT
EASTBOUND OFF RAMP

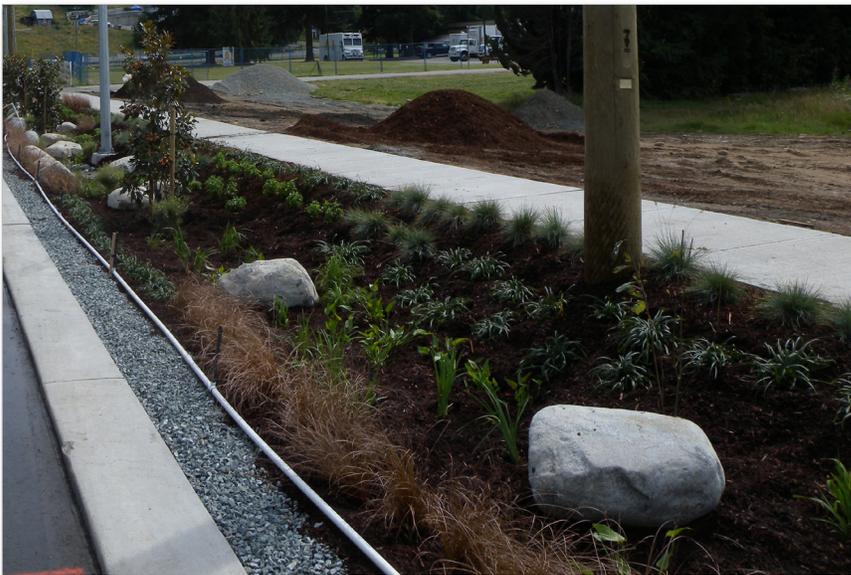


Additional coordination was required with BC Hydro, Telus, and Shaw, who all had works within the project area. Construction schedules were adjusted to accommodate the installation of new underground and overhead utilities, splicing, and pole relocations.

3.6 STORMWATER MANAGEMENT

Drainage presented an additional challenge, as all stormwater within the current project site was self-contained, with no outlet to a water course or storm sewer connection. A geotechnical investigation revealed that the area generally consisted of well-drained, sub-surface soils, and the decision was made to combine existing drainage patterns with additional infiltration measures. New low-lying retention and infiltration areas were constructed to improve runoff quality and retain and infiltrate stormwater.

McElhanney's stormwater management design resulted in 100% infiltration of runoff within the original interchange project area. This has additional benefits for residents, as the City of Abbotsford has a limited water supply, and a portion of the City's drinking water is drawn from an aquifer. Similar efforts were undertaken on subsequent phases of the project, with the majority of runoff being infiltrated. Stormwater within the Clearbrook Road project area is treated through flush concrete curbs, bioswales, and rain gardens; runoff within the Marshall Road project area is directed to a community pond for biofiltration and detention. The treated stormwater is then infiltrated into the aquifer.



RAIN GARDEN ON
CLEARBROOK ROAD



4 DESIGN OBJECTIVES AND SOLUTIONS

The Clearbrook Interchange Improvement Project was intended to improve safety, accommodate higher traffic volumes, and provide better access to industrial areas and key amenities. The City of Abbotsford prioritized the project's design objectives as follows:

1. Improve capacity of the interchange by constructing a four-lane underpass, with provision to accommodate a future six-lane section.
2. Improve safety and capacity of the on and off ramps.
3. Improve safety and capacity of the intersections directly north and south of Highway 1.
4. Create a direct connection from the interchange to Marshall Road south of North Poplar School.

4.1 UNDERPASS SUPERSTRUCTURE

The original Terms of Reference specified a four-lane underpass that could be expanded to six lanes in the future. Through an iterative design process and refinement of cost estimates, McElhanney determined that sufficient budget existed to widen the underpass beyond four lanes within the scope of the current project. Three different design options were proposed:

1. A five-lane configuration with no allowance for future widening.
2. A five-lane configuration with provision for a future sixth lane.
3. An initial six-lane configuration.

Associated Engineering, the project's structural subconsultant, was tasked with evaluating these options to determine their respective costs and identify any design constraints. An initial six-lane configuration was determined to have the lowest net present value, with additional benefits to the community. The facility would be complete when delivered, with no unusual features that may be required to accommodate future expansion, such as a protruding pier cap. Residents would also not have to endure a second construction project—and its associated risks—for further modifications. Controlled traffic conditions in close proximity to construction work can result in increased collisions, and a travel cost premium and inconvenience would be imposed on the community from reduced speeds and detours. Instead of providing a four-lane underpass, the project team was able to deliver a six-lane superstructure—below the project budget.

4.2 ON AND OFF RAMPS

The existing Highway 1 on and off ramps did not meet current design standards, with a few particularly troublesome features. The eastbound off ramp did not include a deceleration lane, and the westbound off ramp had a very tight turning radius, with an unpractical design speed of only 30 km/hr.



The challenge was to construct a more modern interchange to improve safety and traffic capacity within the available funding limit and existing property rights-of-way. Under these constraints, the design team quickly realized that it would not be feasible to meet interchange design standards for a rural divided highway. Instead, a solution was recommended based on urban divided highway standards, with additional mitigation elements to address safety concerns.



REALIGNMENT OF WESTBOUND LANES

To address the limitations of the previous westbound off ramp, McElhanney took advantage of the six existing highway lanes and a generous, 30m-wide median. The westbound traffic lanes were realigned through the median, resulting in an increase of the off-ramp turning radius to accommodate a design speed of 50 km/hr. Overall, McElhanney's solution improved exit ramp geometry, provided surplus deceleration lanes, and enhanced operational safety, while maintaining sufficient median width to accommodate two additional lanes on Highway 1 in the future.



CONSTRUCTION OF NEW WESTBOUND LANES



4.3 ADJACENT INTERSECTIONS

The intersections immediately north and south of Highway 1 were both problematic, with excessive delays and high collision frequencies. Severe congestion was typical during both morning and afternoon rush-hour periods. Collision rates were high (greater than 50 annual collisions) at both intersections, with many collisions resulting in injuries or fatalities.

The south intersection was of particular concern, as afternoon traffic volumes could result in backups along the Highway 1 off ramp. As there was no deceleration lane on the highway to provide vehicle storage, the safety issue was very serious. McElhanney has completely addressed this concern by designing a large-diameter, two-lane roundabout. It is designed to allow large commercial vehicles to circulate the roundabout alongside passenger vehicles. A free-flow slip lane has also been provided, allowing off-ramp traffic to bypass the roundabout into a dedicated northbound lane. The roundabout now functions at the highest intersection performance level; it controls travel speed and accommodates multi-directional traffic, pedestrians, and cyclists.



ROUNDABOUT AT
SOUTH INTERSECTION

The north, signalized intersection has also been significantly improved over its previous condition and operates at the highest intersection performance level. Traffic from the westbound highway off ramp is provided with free-flow access to southbound lanes of the underpass. The project team also determined that performance could be significantly improved with a minor amount of property acquisition and was able to quickly negotiate amicable agreements to acquire property from two owners. In one instance, surplus highway right-of-way was exchanged; in the other, minor off-site improvements were made for the property owner. Through the cooperation of the Abbotsford School District, a small amount of property acquisition allowed for the installation of a dedicated right-turn lane and the full, six-lane use of the superstructure.



SIGNALIZED
NORTH INTERSECTION

4.4 CONNECTION TO NORTH POPLAR SCHOOL

McElhanney developed a design option to provide a requested connection from the interchange to Marshall Road, south of North Poplar School. However, upon evaluation of this option, it was determined that this would increase traffic along the frontage of school, creating a potential safety concern for students. The City of Abbotsford decided to maintain the existing traffic pattern but improve connectivity between the interchange, the school, and Marshall Road via a stairway and a multi-purpose pathway.



MULTI-PURPOSE PATHWAY
AND STAIRWAY TO SCHOOL



5 ENVIRONMENTAL IMPACT

Environmental consciousness was employed and demonstrated throughout the project, including efficient use and re-use of existing site materials and beneficial stormwater treatments such as infiltration ponds and rain gardens. Environmentally sensitive areas were identified, and proper mitigation measures were put in place. The project also promotes a reduction in fuel consumption and greenhouse gas emissions.

5.1 PROTECTION OF ENVIRONMENTALLY SENSITIVE AREAS

Following the development of conceptual design options, McElhanney conducted an environmental assessment of the entire project site, with consideration for each of the proposed design alternatives. The existing project area was found not to contain any sensitive habitat areas, rare or endangered species, or critical wildlife or aquatic resources. However, wildlife habitat features were observed in wetlands adjacent to the site, south of the Marshall Road Diversion, including birds' nests, an artificial pond, and a vegetation buffer. Options 2 and 4 were considered to be the most environmentally favourable, as their footprints did not impinge upon the wetland area.

Due to the selection of Option 2, the project would not create any habitat loss or impact fish-bearing watercourses. As such, the primary requirement was to observe provincial Best Management Practices for construction activities occurring next to the identified wetlands area. One consideration was avian species, as the BC Wildlife Act prohibits the disturbance of occupied birds' nests. To ensure compliance, a specialist was retained to conduct an Active Migratory Bird Nest Survey Program for an area extending 50 m outward from the project boundaries. Active nest sites of protected species were assigned a 30m protected buffer area. Clearing was also kept to a minimum.

5.2 REDUCTION IN FUEL CONSUMPTION AND GREENHOUSE GAS EMISSIONS

The Clearbrook Interchange Improvement Project has a positive impact on decreasing fuel consumption and greenhouse gas emissions. Improved traffic flow has reduced congestion and delays, thereby lowering vehicle idling. Better accommodation of pedestrians and cyclists has increased the appeal of alternate modes of transportation to realize additional benefits in this area. Using Synchro traffic modelling and the Urban Transportation Emissions Calculator, McElhanney estimated that fuel consumption and greenhouse gas emissions will decrease by 8M L and 19M kg, respectively, over a 25-year period.



6 SOCIAL AND ECONOMIC BENEFITS

The Clearbrook Interchange Improvement Project has been a welcome upgrade for residents of Abbotsford, Canada’s “City in the Country.” The project’s many benefits include more efficient travel, increased safety, and better connectivity, along with economic opportunities and community pride.

6.1 IMPROVED QUALITY OF LIFE FOR RESIDENTS

Abbotsford now has an interchange that is more representative of its growing population. The Clearbrook Interchange Improvement Project has accommodated higher traffic volumes and improved safety for motorists, pedestrians, and cyclists. Better access is now provided to Abbotsford’s industrial and agricultural employment centres, public institutions, key community amenities, and other local destinations.

The region is also home to the Matsqui and Kwantlen First Nations groups, with whom the project team consulted throughout each of the project phases. The environmental assessment was presented to the Kwantlen First Nations, and Matsqui First Nations members were contracted during the day-labour construction phase. Harvestable trees from clearing activities were donated to the Matsqui First Nations.

6.2 IMPROVED ACCESS TO ALTERNATE MODES OF TRANSPORTATION

Alternate modes of transportation such as cycling and walking were not adequately addressed in the original Clearbrook Interchange. In addition to major road upgrades, the Improvement Project included the installation of over 5.5 km of bike lanes and sidewalks to accommodate cyclists and pedestrians within the project corridor. Pedestrian and cyclist connectivity to North Poplar School have been improved via new a stairway connection from the underpass and a multi-use pathway. A new student drop-off area and cul-de-sac were constructed along the school’s frontage.

6.3 ECONOMIC GROWTH

The Clearbrook Interchange Improvement Project has a positive economic effect. Improved transport of people and goods will bolster growth, stimulate economic development, and improve connectivity to the airport and other key amenities. Abbotsford’s “City in the Country” plan involves developing 920 acres into an industrial business park to potentially facilitate 2000 new jobs and spur economic growth. The new highway interchange, as well as upgrades to Clearbrook Road and Marshall Road, are key for access to this new business park.



6.4 CONTRIBUTION TO A SENSE OF COMMUNITY

The project team encouraged community involvement during all stages of the project, including conducting an open house presentation to seek public input and promote awareness of the project's benefits. Constant liaison was maintained with owners of adjacent properties and businesses, and emphasis was placed on informing the public about construction schedules and detours. These efforts garnered much support from residents, who were able to realize the positive impact the project would have on the community.

A public art installation was also included as part of the project, promoted by City Manager Frank Pizzuto as a way to “increase civic pride, promote multiculturalism and inclusiveness, and beautify the public realm.” The centre island of the roundabout on Clearbrook Road now features a unique raspberry sculpture to celebrate Abbotsford’s agricultural roots and its unofficial title of “The Raspberry Capital of Canada.” It is an acknowledgement to the agricultural industry, berry growers, and the arts community. In a Letter to the Editor of the Abbotsford News, a resident declared the statue a measure of City pride, indicating that it made the “wait, dust, and traffic” during the construction period worthwhile.



RASPBERRY STATUE
IN ROUNDABOUT
CENTRE ISLAND

6.5 IMPROVED REGIONAL CONNECTIVITY

In addition to local benefits, the Clearbrook Interchange Improvement Project has greatly enhanced regional connectivity. Almost one-quarter of all commuter trips out of Abbotsford are to Metro Vancouver, representing more than 22,000 vehicles per day. An additional 8,200 vehicles per day travel from Metro Vancouver to the Fraser Valley. Highway 1 is also an important route for commercial traffic, and efficient access is vital to Abbotsford’s agricultural sector and other industries.



7 ACHIEVEMENTS

Through sound project management and a true team effort from all involved, the Clearbrook Interchange Improvement Project was delivered ahead of schedule and under budget, having over achieved the project goals. A six-lane underpass was constructed instead of the required four-lane structure, and sufficient design and construction savings were achieved to complete two additional road and utility projects adjacent to the interchange valued at \$9.8M.

Strong project management and leadership were absolutely crucial for the successful completion of the project. Through partnership and teamwork between McElhanney, the Ministry of Transportation and Infrastructure, the City of Abbotsford, and CMS Focus, a phased day-labour and tendered works construction methodology was developed and implemented, which closely resembled a design-build philosophy. The project's success can be directly attributed to the effective communication and shared management partnership between McElhanney, completing detailed design for the tendered works packages, and CMS Focus, completing early works construction contracts.

Despite the rapid pace of both design and construction, quality control and quality assurance were never compromised. An independent quality audit and independent road safety audit resulted in zero non-conformance reports and no major design safety issues. Through strong project management and effective communication, McElhanney maintained constant liaison with the City of Abbotsford and the Ministry of Transportation and Infrastructure. Both parties were able to swiftly complete design reviews, as they were kept informed of the design process and project objectives throughout.

8 CONCLUSION

The Clearbrook Interchange Improvement Project was executed seamlessly, with significant scope expansion at a much-reduced total cost. The project success can be directly related to McElhanney, CMS Focus, and various subconsultants and contractors working together to ensure the project's success.

This project also exemplifies the expanding role of engineers in society. The engineer is not only responsible for the detailed design of a defined element, but also for developing and fostering the project through to completion, implementation, and warranty. The engineer is required to be appropriately trained in technical disciplines, but also plays an increasing role in project management, effective communication, and team leadership.