



# CAPILANO BRIDGE REPLACEMENT

## ...a successful bridge sliding feat

The overall achievement on this project can be summarized as this: replacing an old bridge with a much better one, while continuing to carry over 25,000 vehicles per day, plus many pedestrians and cyclists over and under the bridge, in a period of half the normal time, with almost no impact on travelers, while protecting the environment and living peacefully with the neighbours.

The Ministry and Buckland & Taylor Ltd. studied the feasibility of sliding the existing bridge upstream during a brief closure to become a construction detour. With this idea accepted, B&T managed the design of the new bridge, and roadway improvements, and then became the designer for the new Marine Drive Overpass nearby.

The result was a very successful bridge sliding feat, videos of which became popular on YouTube© (<http://bit.ly/capbridgeslide>)

The Capilano Bridge Replacement yielded an attractive, durable, low-maintenance new bridge delivered at a low cost, with many site improvements, all while protecting the sensitive river environment and maintaining traffic without interruption.



### TheChallenge

Replacing an old bridge with a much better one, while continuing to carry vehicles and cyclists over and under the bridge, in half the normal time, with almost no impact on travelers, while protecting the environment and living peacefully with the neighbours.



### TheSchedule

Within this short period were significant schedule constraints: environmental protection requirements that limited work in the river to just two 2-month long “fish windows”; and the 2010 Winter Olympic and Paralympic Games.



### ThePlanning

Advanced planning and early construction of key elements affecting construction schedule, environmental agencies and obtaining advance environmental permitting ensured design would allow a very tight construction schedule for the new bridge.



### TheMove

The pre-built detour approaches were set to match the elevation of the bridge deck once it was set on sliders, so that once the bridge was in its new position, no vertical jacking was required; it was left on the sliding shoes for the life of the detour.



### TheResult

The solution of sliding the old bridge laterally to become the detour proved significant cost savings, in addition to environmental benefits and schedule savings.

**Client: BCMOT**

**Other Consultants Involved:**

- EBA Engineering Consultants Ltd.
- PBA Engineering Ltd.
- McElhanney Consulting Services Ltd.
- Northwest Hydraulic Consultants Ltd.

**BUCKLAND  
& TAYLOR**

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## PROJECT INFORMATION

### Project Information

#### Project Name

Capilano River Bridge Replacement Project

#### Location

West Vancouver, BC, Canada

#### Year Completed

2011

#### Category

B. Transportation

#### Entering Firms

Buckland & Taylor

101 - 788 Harbourside Drive, North Vancouver, BC, V7P 3R7

#### Role of Entering Firm

Prime Consultant

#### Project Leaders

Murray Johnson, P.Eng. - Project Manager

Darryl Matson, P.Eng. - Project Principal

#### Three Contact Names

Kristine Majlath - Communications/Marketing/Public Relations  
and Management/Administration

Murray Johnson, P.Eng. - Project Principal (Engineering Inquires)



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## PROJECT OUTLINE

### Executive Summary

The BC Ministry of Transportation and Infrastructure was in need of replacing a narrow old truss with a wide modern bridge on the original alignment while maintaining traffic.

Buckland & Taylor engineered and managed this multidisciplinary project. The old bridge was slid sideways and the traffic detoured making room for the new bridge. The new crossing is low cost, attractive, durable with many site improvements, achieved while protecting the sensitive river environment and maintaining traffic without interruption.







# PROJECT HIGHLIGHTS

## Innovation

Sliding bridges sideways is not new, but to slide multiple truss spans simultaneously in a single night closure traffic ready by next morning is rare. The design of the actual sliding scheme was included in the tender documents, for several reasons: the need to pre-construct temporary work, thereby locking in certain parameters; the very limited time available between contract award and the date the bridge had to be slid; and the crucial nature of the bridge to the Ministry. All aspects of the sliding were carefully studied and provisions made to virtually eliminate risk of such a bold approach. The pre-built detour approaches matched the deck of the old bridge in its detour position. The bridge remained on its sliding shoes for the life of the detour eliminating time delays associated with vertical jacking.

## New Alignment

A symmetrical arrangement was chosen to best fit existing site constraints, to make steelwork fabrication repetitive, to minimize obstruction to river flow, and for aesthetic reasons.

## Integral Abutments

Integral abutments eliminate costly expansion joints and make for quiet and smooth riding surface and reduce future maintenance costs. They participate in resisting horizontal seismic demands in a highly seismic and liquefiable soil zone.

## Unique Materials

To avoid paving season delays and enhancing durability, the deck has stainless steel reinforcement and a concrete running surface instead of a standard concrete deck with epoxy coated reinforcement topped with a waterproofing membrane and asphalt overlay.

## Internal Resources, Experience and Expertise

The project drew upon Buckland & Taylor's 90 experienced bridge engineers with expertise in state-of-the-art steel and concrete design, integral abutments, construction engineering including bridge moving, and management of multi-disciplinary design teams to deliver the project smoothly and to the clients' satisfaction.

## Engineer's Role in Society

Demand for innovative ways to replace bridges with greater speed, less cost, and minimal disruption to traffic is increasing. Lessons learned on Capilano are now used on the Milton Madison Bridge over the Ohio River between Kentucky and Indiana, where a new bridge superstructure six times the length and 12 times the weight of Capilano will be slid into place during a short closure early in 2014, reducing the total closure time for this bridge from one year to 10 days! Time-lapse video clips of the sliding of made it into the public domain via YouTube®, and captured the attention of hundreds of thousands, including many teenagers - potential future engineers!

### CAPILANO RIVER BRIDGE MID-SLIDE

The image on the left shows the bridge mid-slide, in between the existing alignment on the left and the new alignment on the right.



## Complexity

B&T's scope on this project encompassed several assignments, which left us with challenges that needed to be overcome. When the Ministry first began to look at the possibility of fast-tracking this project to qualify for funding, B&T was engaged to study the feasibility of sliding the existing bridge upstream during a brief traffic closure to become the construction detour for the bridge. When this concept was accepted by the Ministry, a design for a temporary pier in the river was quickly needed in order to have it built during an upcoming environmental "window", and B&T was tasked to design this pier.

B&T was then successful in the competition to design the new bridge, including the sliding, demolition, management of other consultant disciplines, and provision of services during construction. Finally, when the replacement of the Marine Drive Overpass on the east approach to the bridge was added to the overall project, B&T became the sub-consultant for the design of the new overpass structure. Through every one of these assignments during the project, B&T met all project schedule milestones and budgets.

## Social and/or Economic Benefits

Several social and economic benefits resulted from the project. The design for the new Capilano River Bridge itself provided an additional traffic lane and greatly improved traffic flow into West Vancouver, reducing wasted time as well as exhaust from vehicles sitting in traffic jams. The many transit buses using the bridge daily especially benefit from the extra lane as well as queue jump improvements. Pedestrian and bicycle traffic has a new shared path across the bridge much wider, more pleasant, and safer than the original and well-connected to the improved paths around the site. Safety benefits result from the addition of wider lanes with shoulders, upgraded lighting, and safer railings. The clean lines of the new bridge, on a lowered vertical alignment, vastly improve the aesthetics of the area, and the new structure will require far less maintenance than the old bridge.

This solution of sliding the old bridge laterally to become the construction detour proved significant cost savings, estimated at approximately \$500,000, in addition to environmental benefits from less construction in the river and schedule savings that helped secure the federal funding.

### SHARED PATHWAY

Pedestrian and bicycle traffic has a new shared path across the bridge much wider, more pleasant, and safer than the original and well-connected to the improved paths around the site.







## Environmental Benefits

The old Capilano River bridge was effectively recycled twice - first by moving it over to become the traffic detour, then when it was demolished and the bridge steel and concrete were recycled. The detour roadway itself was built of modular concrete blocks and granular fill, both fully reclaimed after the new bridge opened and hauled away to be re-used elsewhere. The new structure is designed for longevity, including weathering steel requiring no painting, integral abutments without bearings or deck joints, and stainless steel reinforcing in high-quality concrete in the deck. The design includes provisions to accommodate future widening to replace the eastbound bridge downstream when that structure reaches the end of its useful life.

A major challenge of the project was to minimize the environmental impact on the river, which is home to several species of salmon for much of the year. In-water work in the river is limited to a short period each year, from about mid-June to mid-September. The solution was to use the existing two-span bridge for the detour with a single temporary pier in the river, eliminating two temporary piers needed for the alternative modular bridge detour. We then designed the new bridge as two spans, with a single pier aligned with a pier of the eastbound bridge, ensuring that the new design can be built within the limited river access periods.

### RESPECTING THE ENVIRONMENTAL 'WINDOW'

B&T designed the temporary piers, pictured to the left, which were quickly needed in order to have them built during the environmental 'window'.







## Meeting the Client's Needs

In 2009, the westbound Capilano River Bridge, a 79-year old steel truss structure with two narrow lanes, no shoulders, and a narrow sidewalk, was a frequent bottleneck to traffic, including many transit buses crossing daily.

With rehabilitation of the functionally obsolete bridge not practical, and recognizing that a new three-lane bridge was needed, the BC Ministry of Transportation and Infrastructure advanced long-term plans to replace the bridge when the federal government offered stimulus funds for the project, if it could be completed by March 31, 2011. This tight schedule also included minimal working periods in the river and a two-month site shutdown during the 2010 Winter Olympics.

The Ministry engaged Buckland & Taylor for several assignments, with the goal of replacing the bridge without disrupting traffic during construction. This included studying the feasibility of sliding the existing bridge upstream during a brief closure to become a construction detour. With this idea accepted, B&T quickly designed a temporary pier in the river to be built during an upcoming "fish window". B&T was then hired to design the new bridge, including managing other disciplines, and then became the designer for the new Marine Drive Overpass nearby. Through each of these assignments, B&T met all project schedule milestones and budgets. The result was a very successful bridge sliding feat, videos of which became popular on YouTube®, an attractive, durable, low-maintenance new bridge delivered at a low cost, and many site improvements, all while protecting the sensitive river environment and maintaining traffic without interruption.

### THE END RESULT

The Capilano Bridge Replacement yielded an attractive, durable, low maintenance new bridge delivered at a low cost, with many site improvements, all while protecting the sensitive river environment and maintaining traffic without interruption.