DILLON CONSULTING

Ottawa

Terry Fox Drive, March Road to Kanata Avenue

Environmental Achievement Award Submission

Transportation Association of Canada

1.0 Executive Summary

The 5.4 kilometre extension of Terry Fox Drive was designed and constructed as a four-lane modified urban cross-sectional roadway with signalized intersections including a two-lane portion of the ultimate four-lane cross-section through virgin forest, connecting two arterial roadways, which replaced the aging two-lane roadway. The extension passes through the rocky ridges of the South March Highlands, creating a new gateway to northern Kanata, Ontario ***(Photo 1)***. This road was long planned for, and was intended to replace the rapidly failing and inadequate Goulbourn Forced Road, which many commuters use daily.

The fast-tracked project, shared by three tiers of government to stimulate the local economy, the much needed extension to Terry Fox Drive improves the ability of commuters, including pedestrians and cyclists, to safely reach their destinations, while respecting the ecological sensitivities of the forests, creeks and wetlands along the way. Significant engineering and environmental challenges were met with innovative cost-effective solutions, several of which are 'firsts' in Ontario.

Reducing the impact of the road through provincially significant wetlands involved exchanging four stormwater ponds with advanced swirl separation chambers built into the roadbed, effectively narrowing the roadbed and overall impact of the road on the ecosystem. Bisecting the wildlife corridors presented a significant risk to Species at Risk, notably the wild American Ginseng plant and Blanding's turtle. Through the use of a wildlife guide system of culverts and fencing within the road design, this risk was eliminated. With this innovation and cutting-edge road ecology research, Dillon's design was able to protect the ecosystems around the road, and ensure the safety of the travelling public and wildlife. A significant benefit to altering the road profile, managing the ecosystem, and building out the ultimate footprint, allowed the City to effectively manage the risk of future expansions.

Despite the terrain, the project was complete and the road opened to traffic by July 21, 2011, just 30 months after receiving the assignment.

> *It's a beautiful road that goes through some very pretty area."*
> ***Marianne Wilkinson*** *(City Councilor)*

2.0 Organizations Nominated

The City of Ottawa; Construction Services Division

Dillon Consulting Limited; Ottawa & Oakville Offices

3.0 Environmental Protection/Enhancement

The Terry Fox Drive roadway is aligned through rocky, rolling terrain covered by undisturbed, old growth forests and several provincially significant wetlands (PSW) that make up an Area of Natural and Scientific Interest (ANSI) that is heavily used for hiking and mountain biking by Ottawa residents. Five Species at Risk were found in the area, including wild American Ginseng and Blanding's Turtle ***(Photo 2)***. Reducing the environmental impacts was a challenge because of the extensive wetlands, forests and floodplains. Being that the potential cumulative impacts of the project were significant, Dillon's road ecologist and engineers implemented the radical approach of integrating animal needs into the first principles of roadway design. City staff have followed up with three years of research studies to prove the validity of the ecosystem-first strategy, and they've already proven it works.

Dillon's advanced hydraulic modelling was able to rationalize the location of the roadbed within the Carp River floodplain, a very flat river known for extensive flooding that restricts Ottawa' growth. A significant challenge was overcome by incremental modelling of the offset cut on the opposite side of the river and by allowing for flood protection within the road infrastructure. Dillon on-site supervision was needed to ensure the regulators that the right amount of cut had been taken, without sacrificing the protection of public properties.

During the design and approvals phase, additional effort was required to reduce the footprint of the road on the environment. Four stormwater ponds included in the preliminary design were eliminated in favour of swirl separator chambers built into the roadbed. The vertical profile was altered by steepening the side slopes, accepting steeper gradients up to 3.4%, and strictly defining the tree-clearing areas with fencing to reduce the horizontal width on the ground. To further reduce the footprint and environmental impact, a planned rail line fly-over consuming a large amount of the wetlands was changed in favour of a level crossing. As a unique, cost and impact saving mechanism to minimize the long-term residual impacts and demonstrate sustainability, the roadbed was built out to the four-lane ultimate, yet just two lanes were surfaced, paved and put into service. Intersections, culverts, fill slopes, pole lines and an at-grade level rail crossing were all built to the four-lane objective. This will save the City time, money and manage risk of additional approvals

when all four lanes are needed to meet future traffic growth expectations. In addition, the peripheries will have time to recover ecologically, so that when the final two lanes are built, minimal to zero additional environmental impacts will be necessary. This will address public concerns and traffic accommodations for the next ten years. This innovation also provided space for planned watermains, sanitary and storm sewers and utilities to meet future growth needs while impacting the environment just once. In the future there will be no need to close the road, or go outside the existing footprint while these services are installed.

To meet the vertical profile through a rock cut, blasting was required around sensitive wetlands and vernal pools that supports habitat of Western Chorus Frog and Blue Spotted Salamander ***(Photo 3)***. Dillon wrote in reduced blasting specifications to protect certain areas from subterranean rock fracture which may have caused water loss and collapse of important ecosystem features; only 40 m away. To offset floodplain impacts to the Carp River by the new roadbed, a large grading cut was finished off as 8 ha of constructed wetlands ***(Photo 4)***, that indirectly also offset the loss of 1 ha of PSW. Built as a series of unconnected swamps, they targeted frogs and turtles, some of the most vulnerable species in Ontario. It is anticipated as they mature, that aquatic birds will use them regularly. Adjacent to the watercourse on otherwise vacant land, a 2.5 ha plot was reforested with over 6,000 trees to compensate for the loss of forest land ***(Photo 5)***. These trees will serve as a windbreak to reduce snow loads, a future recreational area, a wildlife migration corridor, and as carbon sink offsets.

Where possible, changes made to support the environment have been multi-use. The floodplain cuts were necessary compensation to avoid flooding impacts, but the constructed wetlands used to finish them were also used by animals as refuge and habitat. They ameliorated water quality in the Carp River by creating deposition zones, and over the long-term, will be part of a larger meta-corridor along the River. Following the concepts of reduce, reuse and recycle, all materials used in the constructed wetlands (e.g., boulders, roots, organic soils, seed bank) came from the roadway clearing. No imported building materials were necessary for their construction other than new shrubs and aquatic plants.

During the construction phase, all site personnel, including equipment operators, coffee truck vendors and municipal visitors were required to undergo environmental awareness training, focusing on the local species at risk. Dump-truck drivers, heavy-equipment operators and labourers were regularly reporting on turtle activity and sightings of wildlife, of which action could then be taken to protect them. The workers took ownership of their responsibilities to the environment, resulting in no wildlife losses over the course of the 18-month construction period.

Dewatering required pumping into defined, temporary treatment cells in wetlands, where a tight wall of straw bales surrounded a silt sack on a rubber liner to create a high-volume filter. When the dewatering pads were decommissioned, the sensitive wetland plants quickly grew back as the soils had not been disturbed. Daily testing of water turbidity, compared against background threshold levels, allowed a quick response to avoid the release of silt-laden water to the delicate wetlands and watercourses. 19 small American Ginseng plants were carefully removed, and sent for propagation at the Ontario Ginseng Innovation & Research Consortium (OGIRC) at Western University, with the plan to replace 100 seedlings to offset the impacts. Clearing 129 Butternut trees was offset with 630 disease-free seedlings transplanted into nearby woodlots.

As a separate, yet integrated piece of the environmental infrastructure, a three-part wildlife guide system ensures animals can still migrate between habitats without the risk of being killed on the road. In addition to the six culverts passing creeks; four purpose-built dry terrestrial culverts were installed beneath the roadway, with flanking guide walls and custom fencing covering both sides of the 2.4 km roadway section through the forests and wetlands. The fence and walls direct wildlife to the culverts, which are lined with stone, topsoil and logs to provide cover from predators. Three modified catchbasins, sitting above each culvert, act as skylights, to stimulate passage and avoid the tunnel effects of small passages.

Over a four-year period, as part of the permit requirements, a Blanding's Turtle population estimate, range and distribution study was conducted, which helps guide the conservation of the endangered species as new urban development infills the lands made accessible by the Terry Fox Drive extension. There is visual confirmation that Blanding's turtle now migrate through the wildlife guide system passages regularly. Likewise, Butternut offsets and American Ginseng replanting plan is being monitored for their effectiveness at mitigating the long-term effects of the roadway construction.

Following the opening of the road in July 2011, the effectiveness of the impact reduction strategies was monitored to address a number of science-based questions. Infrared trail cameras mounted in the ten culverts for three years have captured 6,033 images of 24 species of animals (e.g., frogs, snakes, fishers, porcupines, beavers and Blanding's turtle) moving through the passages, proving the effectiveness of the wildlife guide system at protecting migrating animals ***(Table 1)***.

Year	Hours Monitored (Effort)	Observations	observations per Effort
2011	7,182	783	0.11
2012	15,711	2,391	0.15
2013	19,906	2,859	0.14

TABLE 1: INTER-YEAR OBSERVATIONS PER EFFORT

The observations have been linked to time-of-day travel to understand the movement patterns of the various wildlife groups and which culverts performed the best so we can learn from and disseminate the lessons' learned to other road ecology practitioners ***(Chart 1)***. Dillon has proven that given the right configuration and little choice, many species of wildlife will use the 1.8 metre wide by 0.9 metre high box culverts, and that the ecological impacts of roads need not be significant with forethought, innovative planning and engineering. After these three years of monitoring, the overall wildlife statistics see significantly decreased mortalities compared with nearby roads.

4.0 Cost Implications (Cost-Effective Techniques)

The elimination of four stormwater ponds (roughly $350,000 each), replaced with 10 swirl oil-grit separators ($27,500 each) saved roughly $1.1M, assuming all other storm sewer piping connections were equal. They will require about the same amount of life-span maintenance, but at a greater frequency.

The additional four culverts, wildlife guide walls and 4.8 km of fencing cost $978,000, saving the lives of countless animals, yet requiring periodic maintenance by City staff to ensure its integrity is not compromised. However, the wildlife guide system is an unqualified success and represents a significant achievement in road ecology.

Sediment and erosion controls were considerably more elaborate than conventional projects, and when coupled with the daily monitoring of turbidity levels, was a more expensive alternative. However, the systems are very effective at protecting the aquatic environment, controlling impacts to within the footprint and therefore are deemed a technical improvement over previous practices.

The plants and recycled materials for the reforestation and constructed wetlands cost an additional $647,000 to the project. While the lands are in the process of conversion from farm to urban use, restoring some of the ecological processes to areas otherwise landlocked, or planned to be vacant, makes good use of the lands for long-term benefit.

Reducing the footprint of the road reduced the impacts on the wetlands and forests, but required more rock blasting at a higher cost implication. The value to the ecosystem of saving over 1 ha of provincially significant wetlands is incalculable.

5.0 Economic, Social and Environmental Quality of Life Contribution

After 16 years of planning and design, the final 5.4 kilometre extension completes the vision of Terry Fox Drive as an arterial roadway which improves the safety of commuter's access to and from the highway and adjacent development, and improves the level of service over the old roadway systems that it replaced. The design and construction of the roadway is an engineering standout for the innovative solutions implemented towards reducing the impact on the terrain through which it travels. Not only is it a "beautiful road", but by building in wildlife passages, offsite constructed wetlands, reforestation tracts and managing storm water internally, it is contributing to reducing the road mortalities of Blanding's turtle, an important endangered species, and many other species of wildlife.

With its completion, Terry Fox Drive ensures future generations of people and wildlife can both depend on the roadway to provide safe passage for where they need to go.

Appendix A
Photos

PHOTO 1:
Terry Fox Drive, Completed

PHOTO 2:
Blanding's Turtle

PHOTO 3:
Blue Spotted Salamander

PHOTO 4:
Constructed Wetland

PHOTO 5:
Newly Planted Trees

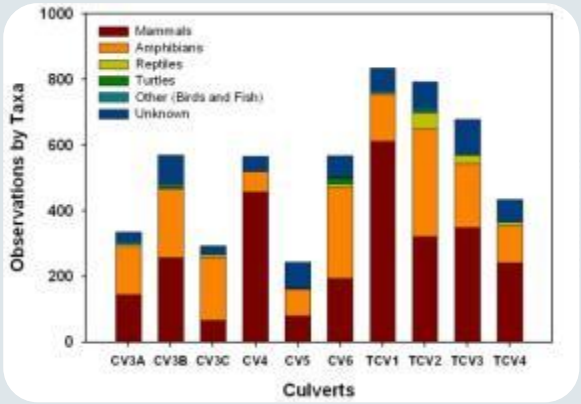

CHART 1:
Observations by Taxa for each wildlife guide culvert

PHOTO 6:
Blanding's Turtle in a Culvert

PHOTO 7:
Porcupine in a Culvert at Night

PHOTO 8
Fisher under Skylight

PHOTO 9:
Wildlife Guide System Culvert

PHOTO 10:
Dr. Caleb Hasler (Dillon) with a tagged Blanding's Turtle

PHOTO 11:
Blanding's Turtle with Transmitter Tag

PHOTO 12:
Tagged Blanding's Turtle rediscovered in Zone 2

PHOTO 13:
Dillon Field Technician surveying a wetland area

PHOTO 14:
Dillon Biologist surveying a wetland area

PHOTO 15:
Blanding's Turtle in natural habitat

PHOTO 16:
Dillon Biologist conducting environmental monitoring of a wetland area

PHOTO 17:
Terry Fox Drive toward Ginseng Hill

PHOTO 18:
Dillon Field Technicians Conducting Environmental Monitoring of the Terry Fox Drive Area

PHOTO 20:
Terry Fox Drive and Second Line

PHOTO 22:
Kevin Robinson (Dillon) with freshly planted trees

PHOTO 19:
Blanding's Turtle at Wildlife Guide System Fence

PHOTO 21:
Terry Fox Drive – Completed

PHOTO 23:
Terry Fox Drive – At Grade Railroad Crossing

PHOTO 24:
Terry Fox Drive, North east aerial view during spring construction