Road Drainage -

Securing Public Safety, Economic Competitiveness and Enhancing Environmental Sustainability

When the hydraulics of the system are not well understood, a road drainage system can be "over-designed" - going beyond what is needed to function effectively and economically. This is costly to construct and maintain, and may prove harmful to the environment.

Effective road drainage is vital to road safety. Canadian drivers and the Canadian transportation industry rely on it. When road drainage systems do not function well, problems occur, for example:

- **too much water ponding on the surface, encroaching into driving lanes and endangering traffic safety;**
- **cold weather icing problems;**
- **erosion of drainage ditches;**
- **frost heaving of pavement slabs;**
- **risk of structural damage or failure of bridge decks;**
- **damage to the aquatic environment from contaminants washing off the road; and**
- **high costs of maintenance.**

Designing a good road drainage system depends on understanding the hydraulic operation of the system as a whole, including the role played by paved surfaces, gutters, median drains and various types of drainage inlets.

Over-designed elements can accelerate runoff, washing contaminants from the road surface and contributing to high and fast flows in drainage ditches susceptible to erosion.

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NWRI and Road Drainage

In the early 1980s, NWRI joined with the Province of Ontario in a cost-recovery arrangement to develop a new design procedure for road and bridge deck drainage systems in Ontario.

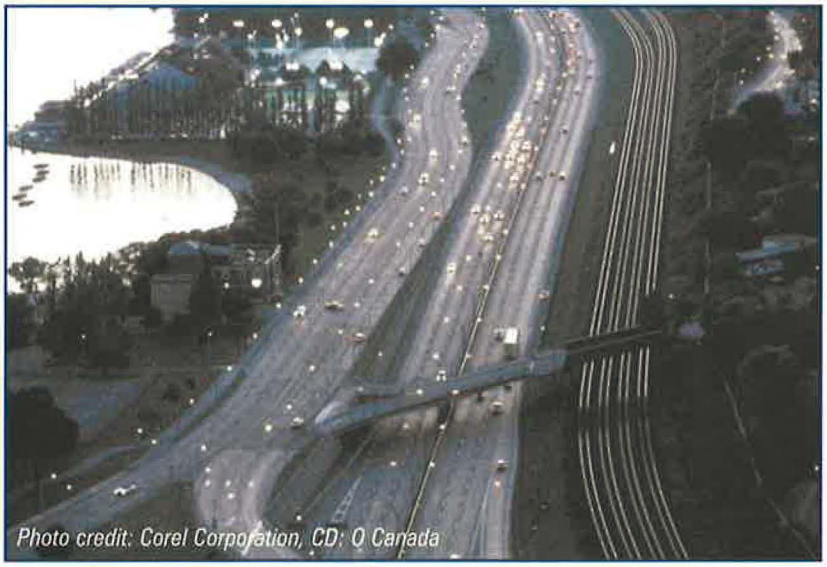
NWRI could undertake this challenging task because of a unique blend of scientific and technical expertise in hydraulics/drainage and a specialized experimental facility in which a road section was constructed, then subjected to various drainage flows in a laboratory setting.

Researchers tested a full range of drainage design parameters, including road slopes, inlet locations, inlet grate arrangements (e.g., curb-parallel bars, diagonal bars, round grates, etc.), depressed and non-depressed inlet installations, and blockage conditions - all according to existing provincial and municipal design standards.

Their findings resulted in development of a new design procedure for road and bridge deck drainage, detailed in a Ministry of Transportation report.

Based on the wealth of new scientific information gathered from NWRI research, innovative concepts that reduced costs of road drainage were introduced, including:

- eliminating storm sewers (drains) on both sides of the peak of the road (where drainage is conveyed in surface gutters);
- increasing the spacing of inlet structures and manholes on a grade;
- recognizing that the grate inlet capacity was largely controlled by the gutter flow and no tangible benefits would be obtained by attempting to develop new grate designs; and
- providing a safer design for twin inlets. It had previously been thought that twin inlet capacities could be up to three times larger than those of single inlets. In NWRI tests, twin inlet capacities never exceeded those of single inlets by more than 70%.



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Impacts of NWRI Research on Decision Making

The original hydraulic information produced by NWRI has remained the basis/standard of provincial road design since the early 1980s, and it is the core information in all drainage manuals produced by the Ministry of Transportation (MTO) since then.

NWRI is a member of the project team currently working on the latest update of the manual, with emphasis on environmental protection. Use of the manual is mandatory in all Ministry projects and in municipal projects involving MTO funding.

Building on the original project, NWRI research has moved on to address urban stormwater and highway runoff quality, impacts on receiving waters, and methods and technologies to lessen such impacts. Environment Canada has become a nationally and internationally recognized leader in this field.

Benefits to Canadians

The Ministry of Transportation of the Province of Ontario compared costs of road drainage design using the new NWRI procedure with costs using earlier methods and noted that the new procedure saved about $30,000 per kilometre of a four-lane road.

In a test year in the early 1980s, savings from use of the new procedure on all MTO projects amounted to more than $2 million.

For the last 20 years, provincial roads have been safer for vehicular travel, have had a reduced negative environmental impact on nearby aquatic ecosystems, and have cost taxpayers less - in large part thanks to the NWRI research that improved drainage design.

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