COMMUNITIES OF TOMORROW
Innovation For Real Life

Completed Projects

Infrastructure Evaluation
(Monitoring and modelling of infrastructure operations, condition, deterioration and effects of climate extremes, soil-structure interaction, etc.)

1. Smart Vehicle for Inspection of Pressurized Water Mains

Principal Investigators: Dr. Raman Paranjape, Electrical Systems Engineering and Dr. Mehran Mehrandezh, Industrial Systems Engineering, U of R Faculty of Engineering and Dr. Zheng Lui, Dr. Homayoun Najjaran and Dr. Balvant Rajani, NRC-IRC-UI Ottawa

Objective:
Design and development of a robotic system that will provide an effective approach to condition assessments of in-service large water mains and cost-effective rehabilitation. A pipe crawler has been designed at the U of R (called Regina Pipe Crawler, RPC). It can move inside pipes with 6 inches of diameter. A real-time controller working in a Virtual Reality (VR) simulation environment has been designed through which a user can control the motion of the robot when subjected to flow disturbances in a human-in-the-loop fashion.

2. Intelligent Video Processing Systems for Sewer Inspection

Principal Investigator: Dr. Nima Sarshar and Mahmoud Halfawy, U of R

Objective:
Systematic inspection and maintenance of sewer networks is key to efficient management of these valuable assets. Closed Circuit Television (CCTV) is, by far, the most common technology for inspecting sewer pipelines. The main objective of this project was to assess the feasibility of developing a computer system that can automatically analyze, annotate and interpret these video archives without the need for tedious manual processing.

3. Network Sensors for Real-Time Monitoring

Principal Investigator: Dr. Mohammed El-Darieby, U of R

Objective:
Monitoring of infrastructure systems (IS) is of major importance to municipalities. Existing technologies, e.g., SCADA systems, have well-known limitations. Recent advances in wireless and sensor technologies enable IS monitoring in a more economical and efficient manner. This project investigated aspects of large-scale deployment of a Network of Wireless Sensor (NWS) for IS monitoring.

4. Structural Asset Management Assessment

Principal Investigator: Pavement Scientific International Inc. (PSI)

Objective:
The primary purpose of this project was to develop an asset management system that is pragmatic for use by design engineers and road managers. The system will have the ability to mechanistically evaluate alternate road strengthening systems across specific project level field state conditions. The sub-models formulated within the Mechanistic Pavement Structural Analysis and Structural Asset Management System will be integrated within an overall software architecture to enable materials engineers to

pragmatically employ the system and assess alternate road strengthening systems on a project level basis.

5. Installation of Online monitoring Sensors in Small Water Distribution Systems

Principal Investigator: Dr. Dunling Wang, NRC-CSIR

Objective:
This project will engage two towns (Assiniboia and Lumsden) to serve as “living labs” to participate in the operation, and demonstrate of the benefits of online continuous monitoring of water quality in drinking water distribution systems. This will be part of NRC-CSIR’s strategic project on online monitoring of water quality to identify contaminants in drinking water systems with sensor technologies. This concept is particularly beneficial for small water utilities that do not have sufficient technical and financial supports to conducts extensive testing of treated water.

Water Infrastructure
(Wastewater, water treatment, water quality, water recycling, etc)

1. Evaluation of the Biofouling Risks in Asbestos-Cement Water Pipelines

Principal Investigator: Dr. Roy Cullimore, Droycon Bioconcepts Inc.

Objective:
This project addressed microbially influenced fouling of AC pipelines, and the potential use of DBI BART testers and systems.

2. RD-BART System for Remote Water Sample Collection

Principal Investigator: Dr. Roy Cullimore, Droycon Bioconcepts Inc.

Objective:
The purpose of this project was to develop a fully functional and validated RDX-BART system for the effective transportation from remote locations of water samples for total coliform testing in certified microbiological analytical laboratories.

3. Risk Management for Natural and Human-Induced Water Safety

Principal Investigator: Dr. Gordon Huang, U of R

Objective:
The proposed research was to develop a multi-dimensional vulnerability analysis and risk management system for monitoring, assessing, preventing and mitigating natural and human-induced water safety problems. The related research included the development of innovative hardware and software related to system characterization, simulation, assessment and optimization, as well as their applications to Regina..

4. Solar Aquatics™ Wastewater Treatment System Feasibility Study

Principal Investigator: Jim Ireland, Eco-Industrial Solutions; Erin Consulting

Objective:
This project evaluated the technical feasibility of using a Solar Aquatics™ wastewater treatment system (SAS) in a prairie environment with temperature extremes. Solar Aquatics™ is an existing technology from the United States that had not been demonstrated in a cold environment. The feasibility study evaluated the SAS technology for use in cold conditions and establish how the technology must be modified for such a use.

5. Greywater Reclamation and Reuse System Market Assessment

Principal Investigator: Victor Thomas

Objective:
This project focused on three areas of research: Identify pending water shortages throughout North America; What other technologies exist; and What is the performance of competing technologies?

6. Market Research on Regina Pipe Crawler

Principal Investigator: U of R Centre for Management Development

Objective:
The objective was to determine the market potential for the Regina Pipe Crawler. The first objective for the research was to identify any competing products and/or technologies for inspecting (leakage, integrity of the pipe) and testing fresh water pipes of different diameters. The second objective was to identify what approaches municipalities in Canada, United States and Europe use to inspect and test fresh water pipes of different diameters. The third objective of the project was to identify possible market opportunities and potential customers for the pipe crawler product as currently designed.

7. Grey Water Treatment Using Glauconite

Principal Investigator: Dr. Malcolm Wilson, U of R

Objective:
The purpose of this research was to undertake some preliminary tests on the efficiency of glauconite to treat greywater in buildings for reuse in irrigation, toilets or other uses not requiring potable water. Glauconite (or greensand, a mix of silica and glauconite) is a clay mineral well-known for its ion-exchange capacity and historically, has been used for water softening.

8. Market Assessment and GeoTech Study relating to Small Scale, Chemical-Free Treatment of Arsenic Impacted Potable Ground Water Resources in Rural Saskatchewan

Principal Investigator: Victor Thomas and Brett Moldovan

Objective:
The market assessment will identify market demand, potential customers, competitor information, and trends. The GeoTech report will evaluate the scientific foundation relating to Small Scale, Chemical-Free Treatment of Arsenic Impacted Potable Ground Water Resources in Rural Saskatchewan.

9. Assessment of the Market Potential of the Watercycles Heat Exchanger for Urban Infrastructure Applications

Principal Investigator: Andre Cayer, Watercycles Energy Recovery Inc.

Objective:
This project investigated market opportunities for energy recovery technology from municipal sources of heated water using Regina as a test case. The project also inspected Regina's potential heat recovery locations, and developed a data analysis tool to determine efficiencies and cost recovery for each type of municipal application. Then it used a data analysis tool to assess the suitability of a Watercycles heat exchanger at each potential location in Regina, installing one or more Watercycles demo units at one location in the City of Regina.

10. Green Roof Pilot

Principal Investigator: Drs. G. Huang, D. McMartin, U of R; Dr. Darryl Dormuth, NRC-CSIR

Objective:
Green roof technology incorporates a layer of vegetation and soil on a roof top to improve water recycling and retention, extended roof lifecycle (requiring fewer construction inputs and waste) and energy conservation over conventional roofing technologies. Green roofs produce a microclimate in which moisture is retained and reused and the layer of vegetation and soil acts as insulation to reduce heating costs in winter and cooling costs in summer. The extra retention of stormwater runoff by green roofs provides an important means of reducing the loading on stormwater collection and distribution systems, especially in areas with high concentrations of buildings.

11. Saskatchewan Water Industry Profile Development

Principal Investigator: Kathleen Livingston, SEIMA

Objective:
Many of SEIMA's members work in water treatment, purification, filtration, infrastructure development and repair. The full range of the educational institutions, provincial and federal agencies, and private sector companies involved in this area in Saskatchewan was not known; nor was there a clear understanding of the availability of technology and services. CT's plan to develop a "water theme" as one element of focus for cluster development was a strategic fit with SEIMA's mandate and direction. To fully develop the Water Quality Roundtable in a strategic manner, SEIMA identified, and provided an overview of the Saskatchewan research, educational institutions, federal and provincial agencies and environmental industry capabilities in the areas of water treatment, purification, filtration, infrastructure development and repair.

12. Biodegradable Substitute for a Petrochemical Wastewater Treatment Media

Principal Investigators: Martin Sellar Voll, Blazewest Utilities Inc.

Objective:
This project investigated a more affordable and sustainable bio-filtration wastewater treatment media. The new biodegradable media would be a substitute for the costly petrochemical treatment based synthetic media currently used in an otherwise biological wastewater treatment process. The project reviewed current literature with the purpose of identifying more sustainable and improved treatment media prospects. Furthermore, this work provided a high level market assessment of the opportunity a biodegradable media would offer, as well as attempted to determine the economic development contribution of a new media for Regina and the Sustainable Infrastructure Cluster.

13. Whole House Water Recycling System

Principal Investigator: Allan Finney, Envron Environmental Ltd.

Objective:
Water treatment infrastructure is ageing and replacing municipal water treatment plants is expensive. Significant gains can be made if household water can be conserved. This would delay replacement costs and allow existing water treatment infrastructure to service more customers. This project explored the market potential for a "whole-house water recycling system." The system is an Ozone-assisted biofilter capable of recycling up to 90% of a single-family dwelling's water back into the household as either hygienic water or potable water.

14. Chemical-Free Arsenic Removal from Rural Saskatchewan Potable Water Supplies

Principal Investigator: Mainstream Solutions Inc., University of Regina

Objective:
The project relied on environmental water treatment principles while addressing the commercial and economical aspects of rural Canadian water treatment challenges. It involved a modification to the existing Mainstream Ozone-Assisted Biofiltration drinking water treatment system to increase its efficiency at removing arsenic from potable water. The objective was to develop a reliable and cost-effective arsenic removal technology.

15. Small Scale Potable Water Treatment Design

Principal Investigator: Dr. Dena McMartin, U of R Environmental Systems Engineering

Objective:
Development of a relatively simple, self-sustaining water treatment system that required minimal maintenance and operational skill and could be utilized in First Nations and other small rural communities.

16. Chemistry of Chemical-Free Arsenic Removal from Rural Saskatchewan Potable Water

Principal investigator: Ann Gottinger, Mainstream Water Solutions Inc.

Objective:
The project is a component of a larger project to investigate a simple, inexpensive and chemical-free method for removing arsenic from drinking water suitable for small-scale rural utilities. It involves a modification to the existing Mainstream BioClear water treatment system to increase its efficiency at removing arsenic from potable water. The results of the project are expected to be a determination of the best configuration of the arsenic-removal component [eg. media placement] and the effects of various qualities and compounds typically present in water [pH, phosphate, sulfate etc.] that are known to have an effect on arsenic removal by iron-based methods.

Sustainable Roads and Transportation Systems

1. Eco-Industrial Networking Opportunities for Sustainable Transportation in Ross Industrial Park

Principal Investigator: Regina Eco-Industrial Network; Jim Ireland and Rob Hughes, Erin Consulting

Objective:
The development of best practices and identification of technologies related to transportation planning, logistics and fleet management, with a case study focus on the Ross Industrial Park in Regina.

2. Development of Attachment to Facilitate Improved Road Maintenance

Principal Investigator: Tom Wiley, Battle River Asphalt Equipment Ltd.

Objective:
This project entailed the development and testing of a piece of equipment that would add a consistent QA capability to the process. The new piece of equipment would be an attachment for a skid steer loader, powered by the auxiliary hydraulic system of the same and would remove the material to an accurate depth on a level plane so compaction can be consistent. While doing this, the additive materials would be well blended with the recycled material. Finally the attachment would level the recycled material producing a “machine finish” considered to be much more desirable and of higher quality than hand finished material. The end result would be top quality predictable repairs for paved roads.

3. Mechanistic Pavement Structural Analysis

Principal Investigator: Pavement Scientific International Inc. (PSI)

Objective:
This project investigated an integrated and multidisciplinary approach to implementing a Mechanistic Pavement Structural Analysis and Structural Asset Management System specifically intended for road infrastructure renewal and management of Saskatchewan roads under Saskatchewan field state conditions. The system addressed the inherent technical limitations currently employed and aimed to help road engineers develop innovative road strengthening and surfacing systems that augment conventional empirical based road engineering and asset management methods in Saskatchewan.

4. Use of Recycled Asphalt Concrete in Road Construction

Principal Investigator: Pavement Scientific International Inc. (PSI)

Objective:
The objective of this project is to demonstrate the cost effective recycling of recycled asphalt concrete pavement for use as a black base material within a standard design and analysis framework. This project will involve the use of innovative construction recycling techniques as well as mechanistic based materials design and analysis.

5. Optimal Traffic Noise Reduction in Canadian Cities with AR Road Pavement using Crumb Rubber from Recycled Tires

Principal Investigator: Dr. Liming Dai, Industrial Systems Engineering, U of R

Objective:
Saskatchewan Highways and Transportation (SHT) completed a highway-resurfacing project on a section of four-lane highway between Findlater and Chamberlain on Provincial Highway No 11 in July 2005 using rubber asphalt concrete, asphalt concrete never before used in Saskatchewan. The project involves the establishment of a novel methodology for systematically assessing and comprehensively understanding the traffic noise for urban areas using crumb rubber from recycled tires as and additive to asphalt for road pavement.

6. Transit Tracker Market Assessment

Principal Investigator: Craig Gelowitz, TRLabs

Objective:
The Proponent proposes to develop new technology to provide accurate and timely bus location information to transit users and the general public on a continuous basis through an on-board GPS system, cellular phone technology and Web-based technology. This information will be useful for transit users as it will allow them to plan their arrival at bus stops precisely to coincide with the arrival of their bus. The system will track the movement of all the buses on several bus routes and provide both a web site interface and a cell phone interface as a mechanism for knowing the next bus' current location at all times.

Remediation Processes and Technologies

1. Environmental Bioremediation Benchmark Testing

Principal Investigator: Patrick Mah, New Wave Environmental Technologies

Objective:
New Wave proposed to create a bench scale evaluation to test and demonstrate its in-situ remediation technology platform. The creation of the bench scale test allowed New Wave to isolate and assess all variables in the remedial process. By creating an environment of all known variables New Wave was able to concretely determine the best remedial processes and combinations of materials. This journal quality data also increased New Wave's credibility.

2. Electrochemical Remediation of Salt-Contaminated Sites

Principal Investigators: Sean Frisky, Ground Effects Environmental Services & Dr. Gordon Huang, U of R

Objective:
Salt contamination in soil and groundwater is a rising environmental issue in Western Canada and throughout the world. There is currently no cost effective or feasible way to address the issue of salt contamination. The current remediation approach is an ex-situ remediation known as a "dig and dump" which relocates contaminated soil to an industry land fill. There is a defined market need for innovative solutions to more effectively deal with this issue.

Other Projects Related to Sustainable Municipal Infrastructure

1. Ochrous Plugging in Drains

Principal Investigator: Dr. Roy Cullimore, Droycon Bioconcepts Inc.

Objective:
This project addressed the development of a prediction of ochrous plugging (POP) using the BART tester systems and standard chemical tests, improvement in the design of drains to assure that drains become sustainable, development of on-site monitoring systems, and the establishment of effective treatment protocols for the rehabilitation of drains being impacted by ochrous growths.

2. Modification Methods for Regina Clay

Principal Investigator: Dr. Shahid Azam, U of R

Objective:
Expansive soils are infamous for undergoing large changes in volume when hydrated from an initial unsaturated state. Seasonal climatic changes result in cyclic swelling and compressibility in the surface layer of clayey sediments thereby leading to extensive distress in all types of civil infrastructure systems such as water supply, sewage collection, transportation systems, and urban facilities including schools and hospitals. The main objective of this project was to evaluate alternative modification methods for an improved engineering behavior of Regina clay.

3. Algae Species for Degradation of Contaminant in Cold Climate

Principal Investigator: Dr. Dena McMartin, U of R

Objective:
The project was situated in Whitehorse, Yukon where arctic stove oil and other hydrocarbon contamination issues are persistent, with groundwater / surface water interaction allowing for movement of plumes and spreading of contamination well beyond the source of contamination. Preliminary results indicatde that 3 algae species dominate the groundwater discharge area at the field site. The following were addressed through this research: which species compose the biotic mat at the site; how the composition compares to compositions in different climactic regions; at what temperature the specific mat remediates optimally; ability to identify conclusively the mechanism of degradation (oxidation via O_2 respiration, external enzymatic activity, internal metabolism); and whether the biomat can be mass-produced for commercial applications.

4. Study of the Uses for Waste Glass - City of Regina Study of Innovation in Recycling for Waste Glass

Principal investigator: Lorne Boyle, Mandate Consulting

Objective:
Review and research the business opportunities for waste (recycled) glass for the City of Regina and Communities of Tomorrow to determine what innovative, cost effective and productive alternatives can be found for the second and subsequent usage of glass containers such that a feasible for-profit venture can be established.

5. Last Mountain Lake Sustainable Community Development

Principal Investigator: Last Mountain Lake Joint Venture Development Team

Objective:
The project focused on a sustainable 21st century community. This project specifically focused on exploring 4 identified areas related to sustainable infrastructure: distribution systems for alternative energy; water conservation and reuse methods and technologies; watershed, land and natural habitat conservation; and sustainable community design and green infrastructure (walking/biking paths, xeriscape landscaping, community gardens/composting and recycling, water source, treatment and distribution systems and grey water recycling and black water management systems).

6. *Green, Self-Sustaining Snow & Ice Control for Bridges & Roadways*

Principal Investigator: Lyle Weichel, Chief Executive Officer WestSource Solutions Inc.

Objective:
This project included research in the following key areas: bridge and roadway surface solar thermal energy collection; underground thermal energy storage (UTES); and bridge and roadway surface snow and ice control using thermal transfer (i.e. radiant heating). This project refined what has been completed in other locations, but more importantly designed, implemented and tested in a Canadian climate. The outcome of this proposed research was it provided an understanding of whether the current technologies that have been used in other geographical areas and climates are able to be combined and used in a full scale snow and ice melt application. As well, it provided an opportunity to better evaluate the need of such a technology and system application in Regina, Saskatchewan, and Canadian cities.

7. Innovative Regional Waste Management

Principal Investigator: Harvey Linnen, HJ Linnen Associates Ltd.

Objective:

With current technological advancements and landfill design knowledge, there will be a demand for certain features in new landfill facilities, including issues related to social change. A key component to a new facility will be waste minimization. This project will examine the public policy and regulatory framework for creating community/grassroots change regarding waste management. This project will also define and develop a formal research project proposal to identify and develop recommendations and plans for commercialization and value maximization.

8. Research and Experimental Development of Two Prototype Geo-Panel Units for the Remote Generation of Electricity for use in Infrastructure Applications

Principal Investigator: Dr. Roy Cullimore, Droycon Bioconcepts Inc.

Objective:
The proponent will undertake the development of two Geo-Panel units. These would be constructed to function totally immersed in water or saturated soil up to 2 meters below grade. The project involves demonstrating that the Geo-panel concept can generate similar levels of electrical output to a solar panel but not be dependent upon solar energy. This has tremendous potential in the application of technology to

sustainable infrastructure through the local generation of electrical power without reliance on a power grid. For example the geo-panels could provide a remote source of power for desalination of waters, or the remote monitoring of water, wastewater, and other fluids and gases.

Projects Funded Under Previous CT Mandate

1. Gasification and By-Product Waste Gas Production from Local Waste Streams

Principal Investigators: Dr. Nader Mahinpey and Dr. Malcolm Wilson, Petroleum Systems Engineering and U of R Centre for Energy and Environment

Objective:
The analysis of local waste streams and development of fundamental information on the nature of waste gasification and energy production from local waste streams.

2. Biodiesel Production Using Waste Cooking Oil and Landfill Gas

Principal Investigator: Dr. Amy Veawab, U of R

Objective:
This project was aimed at converting waste cooking oil into a marketable biodiesel fuel using landfill biogas as an energy source. In addition to the use of waste cooking oil as the feedstock in biodiesel production, this project also proposed to use landfill biogas as the energy source for the biodiesel production process.

3. Factor 9 Home: A New Prairie Approach

Principal Investigator: Dr. Rob Dumont, SRC

Objective:
This project will involve the design, construction, monitoring and technology transfer for a new detached house in Regina that will use 90% less fossil fuel energy (Factor 10) and produce 90% less greenhouse gas production than a conventional house. In addition, water efficiency and other advanced environmental features will be showcased. This Factor 9 project will demonstrate a new level of energy performance and a significant advance on current technology.

4. Core Neighborhood Sustainability

Principal Investigator: Bob Bjerke, City of Regina

Objective:
This project will build a community partnership to create and implement an economically feasible sustainable neighborhood plan that respects the heritage and community diversity of the General Hospital Area, enhances neighborhood vitality and desirability and contributes to improved quality of life. The completed development will demonstrate the application of sustainability at the neighborhood level and will provide this existing neighborhood with new mixed income affordable housing, enhanced functioning of existing institutions, improved transit, transportation and parking, and increased opportunities for recreation, education and neighborhood amenities.