MEMORANDUM

To: Members of Committee of the Whole

From: Erin Mahoney, M. Eng.
                Commissioner of Public Works

Date: March 24, 2023

Re: 2022 Research and Innovation Update

This memo updates Council on research activities undertaken by Public Works in 2022. In previous years, this update has focused on water, wastewater, waste management, forestry, and energy conservation programs. With the integration of Transportation and Environmental Services, it now includes highlights of research completed by all service areas in Public Works.

Public Works' Research and Innovation program addresses business needs and drives efficiencies

Public Works' research activities provide direct benefits by:

- Addressing operational challenges and business needs

- Continually improving processes and services and driving efficiencies

- Supporting corporate and departmental long-term goals, including York Region's Strategic Plan priority areas

- Anticipating and influencing future trends that may impact Public Works

Strong partnerships help drive research and innovation

In 2022, York Region leveraged partnerships with the Water Research Foundation, the University of Toronto's Drinking Water Research Group, University of Waterloo, Trent University, McGill University, Mitacs (a non-profit national research organization), Sustainable Development Technology Canada, Natural Sciences and Engineering Research Council of Canada, PRESTO, CityRover, INIT-Innovation in Public Transit and Denso Corporation (an

automotive technology company). All research is driven by business needs to address challenges relating to cost, quality, time and service delivery. Public Works is committed to ensuring that dollars spent on research are used effectively and efficiently.

Partnerships leading to innovation in wastewater monitoring improve insights into the health of the Region's communities

In partnership with the University of Waterloo, York Region leveraged Provincial funding for COVID-19 wastewater surveillance research in 2022 to better understand the prevalence of variants of concern in York Region. Community and Health Services and Public Works are building on this experience by partnering with the University of Ottawa, Public Health Ontario, and the Ministry of Environment, Conservation and Parks to use similar wastewater surveillance techniques to study influenza and other viruses. The Region supported a successful proposal in which the Natural Sciences and Engineering Research Council of Canada committed $750,000 to fund this emerging area of research, matching the Province's contribution for a total funding amount of $1.5 million.

Inter-municipal partnerships are an important aspect of research and innovation. In 2022, York Region and its partners in Durham Region explored technology to further reduce phosphorus outputs from the Duffin Creek Plant. The project piloted unique diffusers to reduce phosphorus outputs, which are now being implemented plant wide. This and other innovations have been included in a Phosphorus Reduction Action Plan.

Research aims to minimize travel delays and make roads safer for drivers and pedestrians

Pedestrian and driver safety consistently ranks as one of the most important issues for York Region residents. Drivers, cyclists and pedestrians want to see increased safety and travel delays minimized. Outcomes of recent research include implementing a snowplow signal system to improve snow removal efficiency, a pedestrian and cycling intersection safety pilot and a collision avoidance and pedestrian warning system for York Region Transit drivers

With a replacement value of $2.46 billion, pavement is one of the highest value transportation assets owned by the Region. Seeking opportunities to sustain long-term fiscal sustainability by continually improving asset management practices is a priority. Through data-driven decision making, recent innovative techniques in pavement microsurfacing and thin overlay treatment have helped extend the life of York Region's pavement assets.

Research helping to advance York Region's strategic priorities

Outcomes of Public Works' research and innovation program align with York Region's strategic priorities. Through research, staff are exploring measures to protect the Region's assets through use of laser imaging, detection and ranging technology (LiDAR), to enhance flood-risk assessments as storm events increase in duration and intensity, and to effectively integrate electric buses into Transit operations. LiDAR technology combined with high resolution satellite

imagery has been used to improve the accuracy of tree canopy cover assessments. Staff-led research is also advancing circular economy concepts across Public Works operations to identify opportunities to reduce waste.

Research and innovation help Public Works address current and future challenges

York Region engages in partnerships with academics, industry experts, conservation authorities, industry associations and other utilities to pursue implementation of innovative solutions to improve delivery of our services. Through strong partnerships, the Region is able to reduce early-adoption risk and leverage a greater pool of funds and expertise to achieve more meaningful research outcomes.

Appendix a presents highlights of research undertaken and demonstrates how Public Works' priorities align with areas of focus in York Region's Strategic Plan. Appendix B provides a detailed list of projects currently underway or recently completed. In addition to driving operational and capital construction efficiencies, these research projects help promote a workplace culture of innovation and evidence-based decision-making.
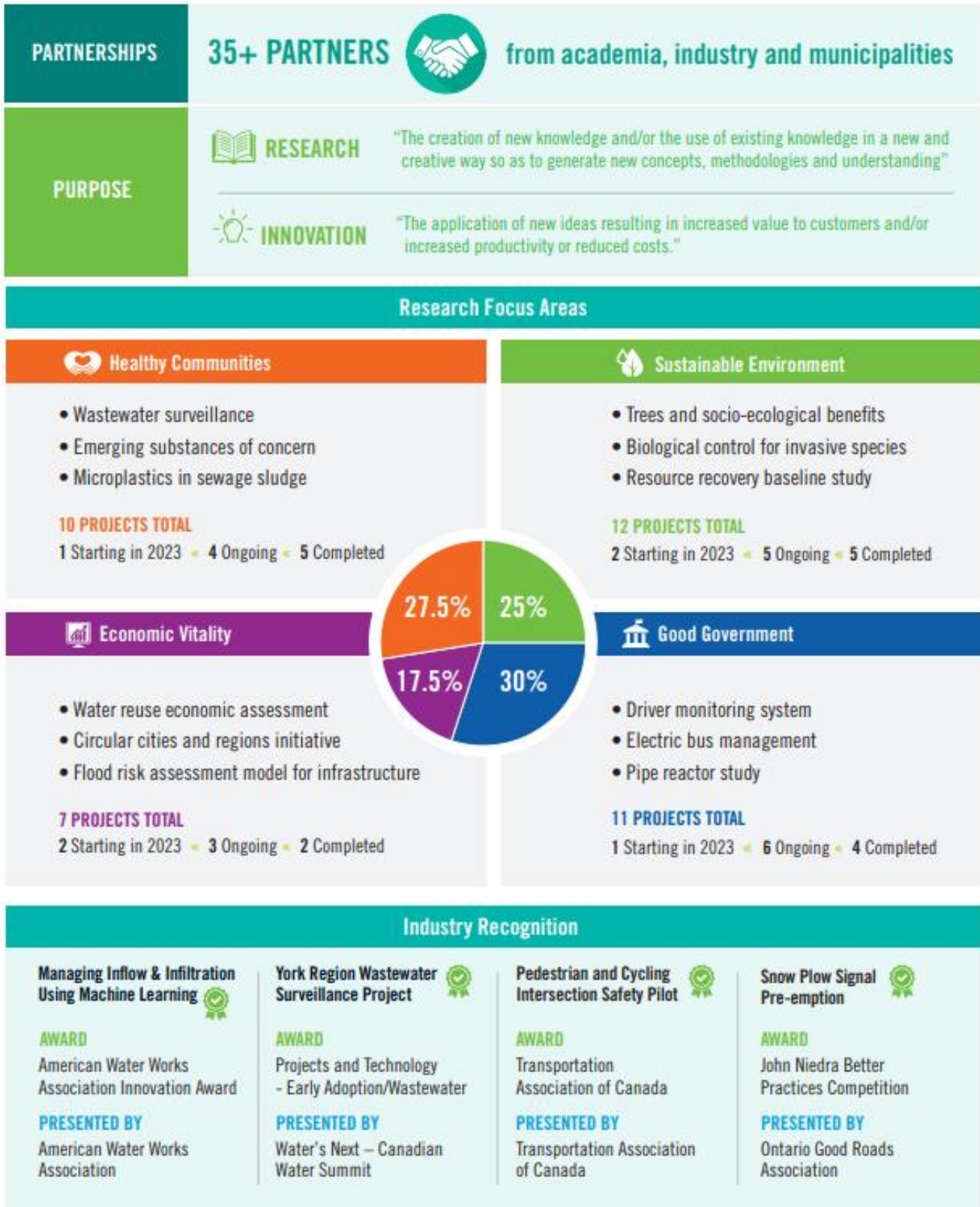

Erin Mahoney, M. Eng.
Commissioner of Public Works

Bruce Macgregor
Chief Administrative Officer

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Appendix a – 2022 Research and Innovation Highlights
Appendix B – 2022 Research and Innovation Projects List

2022 Research and Innovation Highlights

PARTNERSHIPS	35+ PARTNERS from academia, industry and municipalities

PURPOSE

📖 **RESEARCH** — "The creation of new knowledge and/or the use of existing knowledge in a new and creative way so as to generate new concepts, methodologies and understanding"

💡 **INNOVATION** — "The application of new ideas resulting in increased value to customers and/or increased productivity or reduced costs."

Research Focus Areas

❤ Healthy Communities

- Wastewater surveillance
- Emerging substances of concern
- Microplastics in sewage sludge

10 PROJECTS TOTAL
1 Starting in 2023 • 4 Ongoing • 5 Completed

🍃 Sustainable Environment

- Trees and socio-ecological benefits
- Biological control for invasive species
- Resource recovery baseline study

12 PROJECTS TOTAL
2 Starting in 2023 • 5 Ongoing • 5 Completed

Pie chart: 27.5% | 25% | 17.5% | 30%

📊 Economic Vitality

- Water reuse economic assessment
- Circular cities and regions initiative
- Flood risk assessment model for infrastructure

7 PROJECTS TOTAL
2 Starting in 2023 • 3 Ongoing • 2 Completed

🏛 Good Government

- Driver monitoring system
- Electric bus management
- Pipe reactor study

11 PROJECTS TOTAL
1 Starting in 2023 • 6 Ongoing • 4 Completed

Industry Recognition

Managing Inflow & Infiltration Using Machine Learning 🏅

AWARD
American Water Works Association Innovation Award

PRESENTED BY
American Water Works Association

York Region Wastewater Surveillance Project 🏅

AWARD
Projects and Technology - Early Adoption/Wastewater

PRESENTED BY
Water's Next – Canadian Water Summit

Pedestrian and Cycling Intersection Safety Pilot 🏅

AWARD
Transportation Association of Canada

PRESENTED BY
Transportation Association of Canada

Snow Plow Signal Pre-emption 🏅

AWARD
John Niedra Better Practices Competition

PRESENTED BY
Ontario Good Roads Association

2022 Research and Innovation Projects List

COMPLETED RESEARCH

Economic Vitality	Healthy Communities	Sustainable Environment	Good Government

AREA OF FOCUS	RESEARCH PROJECT	PARTNER(S)	RESEARCH BENEFIT
(Economic Vitality icon)	Snow Plow Signal Pre-Emption	Internal project and equipment	Improved traffic flow for plow operators and motorists by enabling Regional plows to clear roadways more efficiently and maintain safe winter driving conditions
(Economic Vitality icon)	PRESTO Contactless Payments	PRESTO	PRESTO contactless payments allow customers pay for their fare with a tap of a credit card, including those cards on a phone or watch. This improves convenience and travel experience for customers
(Healthy Communities icon)	Emerging substances of concern passive sampling program	McGill University	Conduct emerging substances of concern passive sampling program at select drinking water and wastewater facilities within the Region to improve understanding of baseline conditions
(Healthy Communities icon)	Feasibility of using granular activated carbon to treat wastewater	Drinking Water Research Group, Environment Canada	Bench scale testing to assess viability of use of granular activated carbon for 'forever chemicals' perfluoroalkyl, polyfluoroalkyl, and perfluorooctanoic acid, commonly known as PFAS and PFOA chemicals, with partial removal. Implementation costs were determined to be cost prohibitive
(Healthy Communities icon)	Duffin Creek Phosphorus Reduction Action Plan Upgrades	Internal project	Field testing of new innovative diffusers which optimize plant processes and further reduce phosphorus within effluent

AREA OF FOCUS	RESEARCH PROJECT	PARTNER(S)	RESEARCH BENEFIT
	Pedestrian and Cycling Intersection Safety Pilot	Internal project	Analyzed pedestrian and cyclist-related collisions within the Region that identified improvements to improve safety for vulnerable road users. At the piloted intersections, operational changes helped decrease conflicts by up to 100% and collisions by more than 60%
	Collision Avoidance and Pedestrian Warning System	Internal project	This system monitors road signs, lane departure control, speed among other data. Data systems analyze safety-triggered events and how they correlate with vehicle operator driving responses (harsh breaking, acceleration, sharp turning, etc.) Critical alerts are mapped to identify higher risk locations using big data to enable the Region to make better business decisions
	Biological controls for Emerald Ash Borer	Natural Resources Canada	Tested biological control options informing management of Emerald Ash Borer populations, which will help with the future recovery of ash species
	Tree Species Migration Trial Design	Vineland Research and Innovation Centre	Resulted in the development of a species migration trial including background research, climatic mapping, and site soil sampling specific to York Region
	Automation of woodland cover re-assessment	Ecopia Ltd.	Results support monitoring of Regional Official Plan target and demonstrated the ability to automate some components of woodland re-assessment
	LiDAR to Improve Canopy Cover Mapping	Toronto Region Conservation Authority University of Vermont	LiDAR improved the accuracy of the assessment of canopy cover, setting a reliable baseline to measure progress towards the Region's canopy cover goal.

AREA OF FOCUS	RESEARCH PROJECT	PARTNER(S)	RESEARCH BENEFIT
	"The Lendery" Tool Sharing Library	Vaughan Public Libraries	The Lendery – a library of things such as household items, sporting goods and hand tools – helps foster the necessary social and cultural change that can lead to waste reduction by allowing residents to borrow infrequently used items instead of purchasing them. This is the third Lendery opened in York Region to date.
	Managing Inflow & Infiltration Using Machine Learning	York Region's Data Analytics and Transformation Technology and Data teams	Capitalizes on big data from over a decade of flow and rainfall monitoring across the Region, leading to better forecasting, faster responses, adaptation to climate change and improved system resilience. This facilitates better data-driven decision making and reduces analysis time by 78%, saving approximately $40,000/year in labour costs for Region-wide inflow and infiltration analysis
	Water User Rate Study	York Region Corporate Finance	The User Rate Study brings the Region to full cost recovery, supporting the overall health of the system for residents and businesses and not unfairly burdening future users
	E-Logbooks for Water and Wastewater Facilities	Ministry of the Environment, Conservation and Parks	Transitions hard copy logbooks required by the Province for compliance reporting to a digital format. This creates a digital record of compliance tracking that improves information sharing across the department. York Region was among the first in the province to implement this system

AREA OF FOCUS	RESEARCH PROJECT	PARTNER(S)	RESEARCH BENEFIT
	Virtual Public Engagement	Internal project	This new approach now allows staff to streamline the consultation/engagement process by leading online conversations using interactive maps and visuals prompts to promote idea sharing. Users can provide comments, show preferences using maps/pins and fill out surveys using the tool. The approach has enabled more people to participate than traditional in-person consultation

ONGOING RESEARCH IN 2023

Economic Vitality	Healthy Communities	Sustainable Environment	Good Government

AREA OF FOCUS	RESEARCH PROJECT	PARTNER(S)	RESEARCH BENEFIT
	Water Reuse/Resource Recovery from Wastewater Effluent Economic Assessment	Hatch Ltd.	Assess feasibility of developing a water reuse program from groundwater dewatering and wastewater effluent sources
	Pavement Deficiency System – Pilot for signs and pavement marking	CityRover Inc.	Uses image capture and analytics with artificial intelligence to properly identify and report issues. This system integrates with asset management systems to automatically create service requests to be actioned, removing a manual process
	Circular Cities and Regions Initiative	Federation of Canadian Municipalities, National Zero Waste Council, Recycling Council of Alberta, Recyc-Quebec and various municipalities	First phase of the research resulted in the development of a roadmap to focus the Region's work on circular economy projects, policies and research in the key areas of sustainable food systems, reuse and sharing, increasing community capacity, circular procurement and asset management and built environment. Ongoing participation will enable York Region to collaborate on common challenges and share work to encourage others
	Wastewater Surveillance	Universities of Waterloo and Ottawa, Province of Ontario, Public Health Ontario, Public Health Agency of Canada,	Provide wastewater samples and advance detection of viruses such as COVID-19 and influenza in wastewater. The program partnership enables analysis of the presence of variants of concern detected in wastewater

AREA OF FOCUS	RESEARCH PROJECT	PARTNER(S)	RESEARCH BENEFIT
		and several Ontario municipalities	
	Granular activated Carbon Core Sample Challenge Testing	Drinking Water Research Group, WSP	Testing of granular activated carbon adsorptive capacity to remove by-products from drinking water
	Cyanotoxin control strategies in drinking water	Drinking Water Research Group, Hamilton, Union Water, Durham, and Niagara	Evaluating effectiveness of granular activated carbon and other treatment processes to remove cyanotoxins, as well as developing monitoring tools for improved response to harmful algal blooms growing in proximity to water intakes
	Microplastics in sewage sludge exploration and detection	York University (Lassonde School of Engineering)	Measuring new approaches to address microplastics and their impact on wastewater treatment systems and advance understanding of their prevalence and fate
	Monitoring and mitigation of mussel impact to treatment facilities	Drinking Water Research Group	Research on protecting water treatment infrastructure
	Trees and their socio-ecological effects	University of Toronto	Improves understanding of the social and ecological benefits of urban trees by quantifying how much social and ecological benefit is lost when trees are removed
	Biological controls for dog-strangling vine	Silv-Econ Ltd., Agriculture and Agri-Food Canada	Tests biological control informing management of the invasive species dog-strangling vine and protects York Region forests and biodiversity

AREA OF FOCUS	RESEARCH PROJECT	PARTNER(S)	RESEARCH BENEFIT
	Greening the Landscape Consortium	Vineland Research and Innovation Centre	Supports urban greening research by setting priorities reflecting industry needs and supporting economic success
	Using Algae to Reduce phosphorus in Wastewater and Stormwater Discharges	Ministry of the Environment, Conservation and Parks	Testing use of algae as a sustainable treatment technology to reduce ammonia and phosphorus levels in wastewater and stormwater effluent concentrations and stormwater discharges
	Pipe Reactor and Pipe Loop Study	Drinking Water Research Group, Town of Newmarket	Developing a bench scale pipe loop equivalent that can accurately emulate distribution system conditions including flows, sheer force, etc.
	Electric bus management (electromobility)	INIT	MOBILEcharge optimizes fleet charging based on operational requirements and has several benefits: avoids expensive peak loads, delivers predictive analytics to optimize tariffs and prolongs the battery life
	Driver Monitoring System	Denso Corporation (an automotive technology company)	York Region Transit is piloting a facial scanning technology for bus operators that can monitor and provide alerts when drivers are distracted or fatigued
	Measuring the Impact of Utility Driven Innovation Investments and Programs	Arcadis and various other North American utilities	Provides tactics for utility innovation leaders to advance innovation opportunities from staff to address business problems
	Intersection Pavement Research	University of Waterloo	Tests performance of various asphalt mixes to establish preliminary performance specifications that ensures pavement at intersections is resilient to high traffic volumes and the impacts of changing weather conditions due to climate change.

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🏛	Microsurfacing and Thin Overlay Treatment Options for Pavement Preservation	Internal project	Compares the performance of pavement preservation treatments, including microsurfacing and thin overlay. This helps the organization make data driven decisions that support investments in pavement from a long-term asset management lens. Pavement is one of the highest value transportation assets with a replacement value of $2.46 billion.

NEW STARTING IN 2023

Economic Vitality	Healthy Communities	Sustainable Environment	Good Government

AREA OF FOCUS	RESEARCH PROJECT	PARTNER(S)	RESEARCH BENEFIT
	Technology pilot to monitor and optimize irrigation of landscaping	Hortau Inc., Sustainability Development and Technology Canada	Monitors moisture levels to reduce staff time from manual validation and reporting; saves water by watering when and where required; reducing the cost of replacing dead plants; and ensure healthy growth of landscaping
	Emerging Substances of Concern Prioritization Pilot Project	McGill University	Develop and execute a pilot parameter prioritization and water sampling prioritization program to enhance York Region's knowledge of the presence of key emerging substances of concern
	Flood Risk Assessment Model Development for Infrastructure in York Region	TBD	Maps flood impacts on public and private infrastructure to assess high risk zones in the Region to be prioritized in climate change adaptation planning.
	Resource Recovery Baseline Study for select service areas	TBD	Baseline study will apply a 'circular economy' lens to determine how to reduce, reuse and recover resources generated by selected Regional lines of business
	Net Zero GHG Emissions Design for York Region's Wastewater Projects	TBD	Results will be used by Public Works to assess feasibility of net zero designs or/and retrofits of existing and new Water Resource Recovery Facilities
	Precursor to Digital Twin	TBD	Study to create a Digital Twin program of water system and gap analysis of data required