Charting a new direction for wastewater treatment in the Canadian north

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Cryofront
Cool Ideas

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The Canadian north is big… really BIG

Alaska 1.72 million km2 Northern Canada 3.92 million km2

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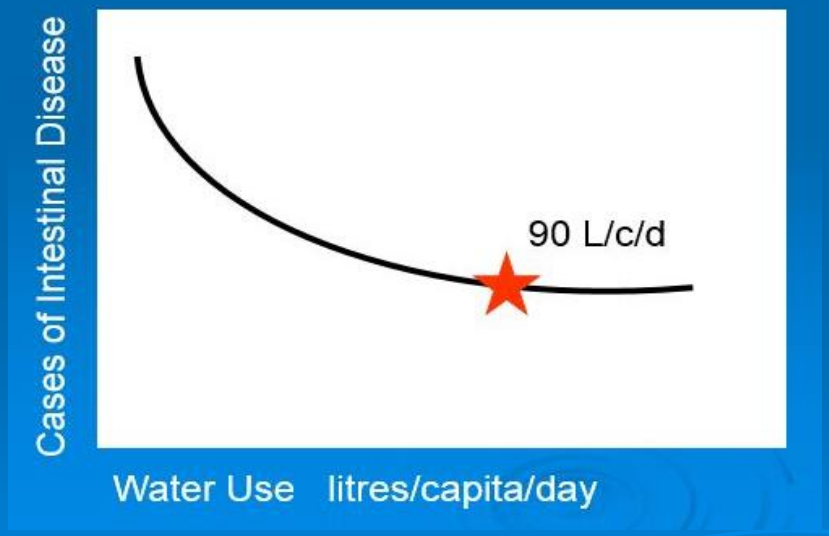
Standards and Criteria

Based upon 1980's research, a water and sewer policy was developed and implemented based upon public health of a minimum water use of **90 litres/capita/day.** This became the design standard for trucked water supply and all of the associated infrastructure.



A water and sewer subsidy began with the baseline being the cost of water in Yellowknife which was 0.2 cents per litre – subsidies were provided for residential use in all communities for all operation and maintenance costs above the Yellowknife benchmark.

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Cost of Water and Sewer in Canadian North

Grise Fiord, Nunavut - Operation and Maintenance

Year	Water $	Sewer$	Total$
2001	234,391	100,200	334,591
2002	255,959	109,696	365,655

$2240 per capita per year in 2002 or 6.4 cents per litre

Water use - 5,678,500 litres per year or 95 litres per capita per day

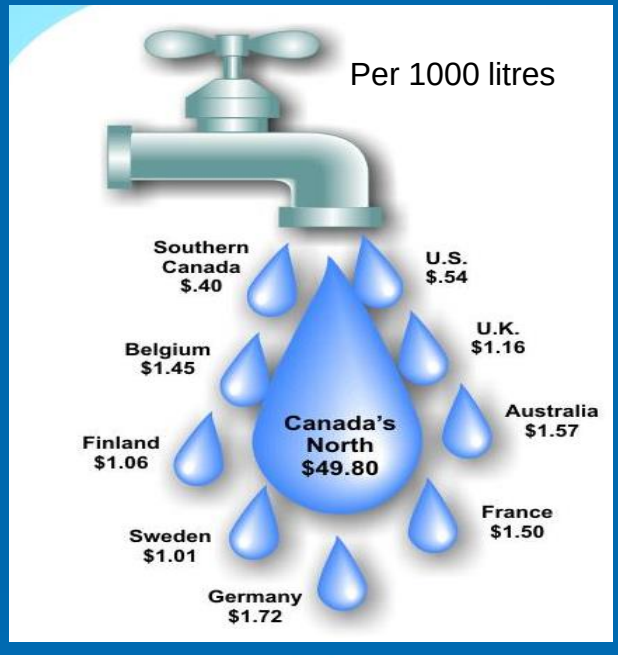
Whati, NT - Operation and Maintenance

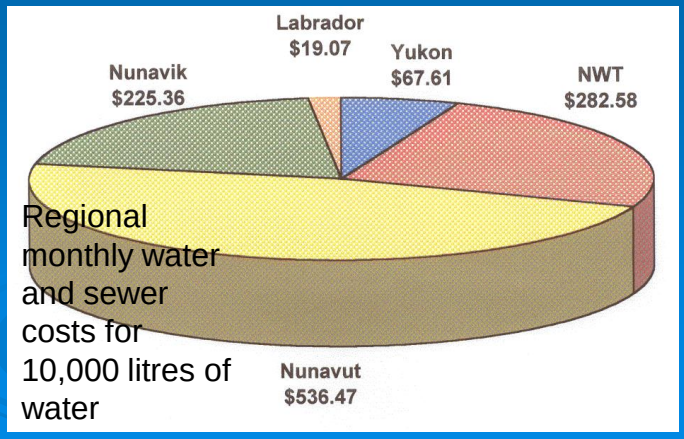
Year	Water$	Sewer$	Total$
2001	167,800	71,900	239,700
2002	184600	79,100	263,700

$580 per capita per year in 2002 or 2.3 cents per litre

Water use: 11.5 million litres per year or 70 litres per capita per day

0.12 cents per litre in Edmonton, Alberta





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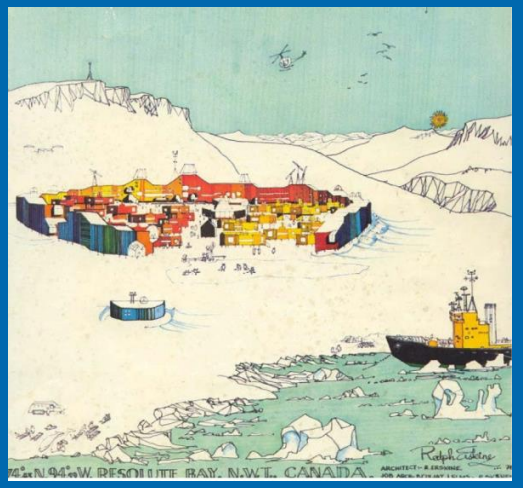
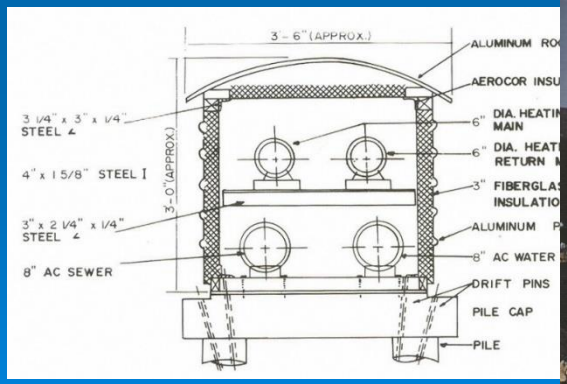
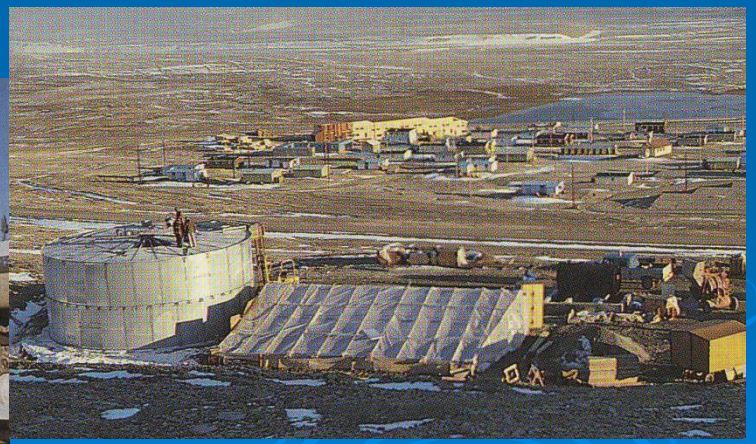
Innovation History

1960 Inuvik utilidor

1975 Resolute buried water and sewer







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Innovation History

1985 Iqaluit buried water and sewer system

1995 Wetland wastewater treatment systems

Buried water and
sewer system in Iqaluit

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Innovation History

1998 On site water reuse in the north
1998 Iqaluit wastewater treatment facility
2006 Bundled water treatment project
2010 Dawson WWTP or WTF

Bioreactors to be retrofitted from original MBR bioreactor construction

Dawson wwtp

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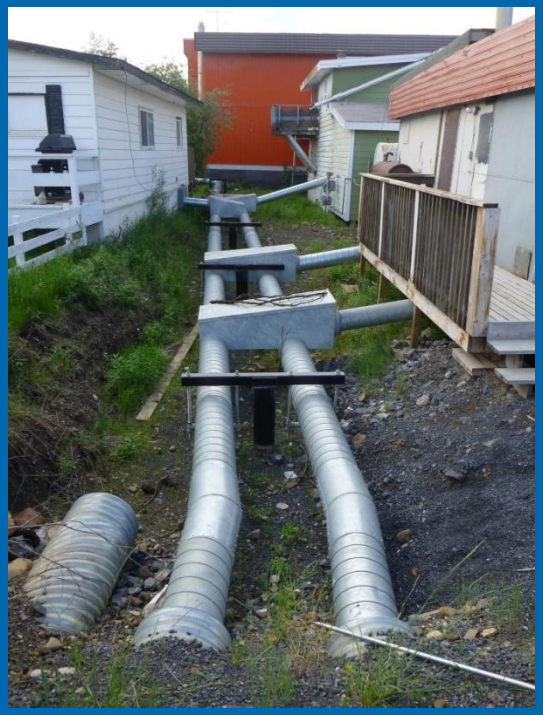
Inuvik utilidor replacement

The "utilidor" infrastructure in Inuvik is slowly being replaced with modern materials that include metal clad, insulated pipe, and steel pile systems – the cost is $8,000 per metre.



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Resolute water and sewer

A piped water and sewer system envisioned to service a community of 2500 people was built in 1975, and has ultimately served a population of only 250 – replacement of the entire piped system is costing $40 million

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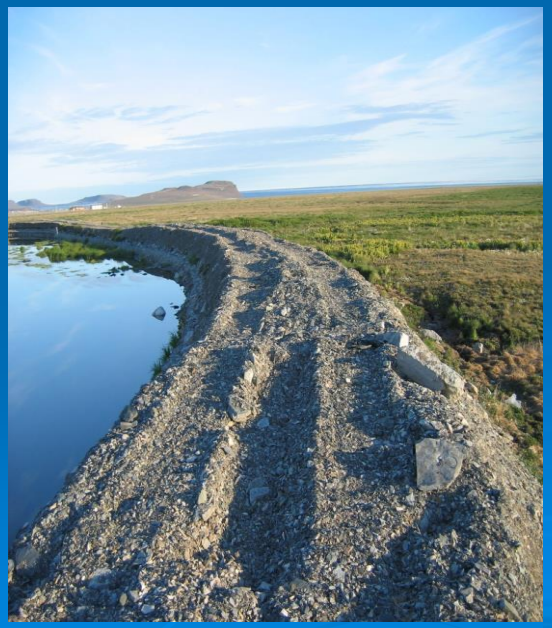
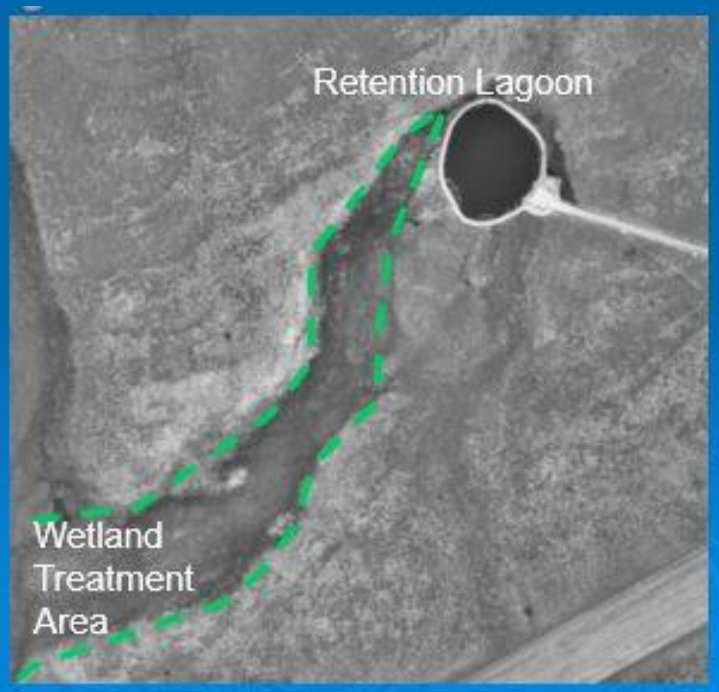
The lagoon and wetland processes

Lagoon systems remain the most common form of sewage treatment, in spite of demands for more sophisticated technologies. Improving upon the performance of lagoons is occurring with the application of wetlands for tertiary treatment.





Ulukhaktok, Northwest Territories

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Iqaluit wastewater treatment plant

Process – membrane bioreactor (MBR)
History – abandoned by contractor in 2000, **never finished**
Construction – design / build

New design completed in 2004 for conventional treatment with only phase 1 completed – new design initiated in 2015 and construction completion anticipated in 2018


Unfinished wwtp in Iqaluit (2004)


Iqaluit wwtp discharge

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Bundled water treatment project

The NT government has completed the phase 2 of a unique project delivery approach where water treatment facilities for communities were "bundled" into groups of 5 projects and tendered as design build – the program has delivered 10 water treatment facilities costing on average $2.5 million each.

Water treatment facility in Edzo, NT

Water treatment facility for Ulukhaktok, NT – on route and in place

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Performance of northern lagoon systems

Livingston Trail Environmental Control Facility

Constituent	Water License: Max. limit for discharge of treated effluent	2003 Tests: Effluent Quality data from LTS
BOD	45 mg/L	<4
Suspended Solids	60 mg/L	<1
Oils and Grease **	5 mg/L	<1
PH	6-9	7.8
Ammonia	N/A	<0.05
Faecal Coliforms	2000 MPN/100mL	
E.Coli	2000 MPN/100mL	<1
Giardia	N/A	0
Total Phosphorus	N/A	3.32
Dissolved Oxygen	N/A	2.1
96-hour static LC_{50}	100%	100

(< symbol) less than detection limit

Capital Cost
$20 million (1996 $)
$36 million (2016 $)
O + M (per year)
$200,000 (2015 $)

Whitehorse sewage lagoon system is the largest facility of its kind in northern Canada serving a population of 24,000 and producing a very high quality effluent, which is well below the Wastewater Systems Effluent Regulations.

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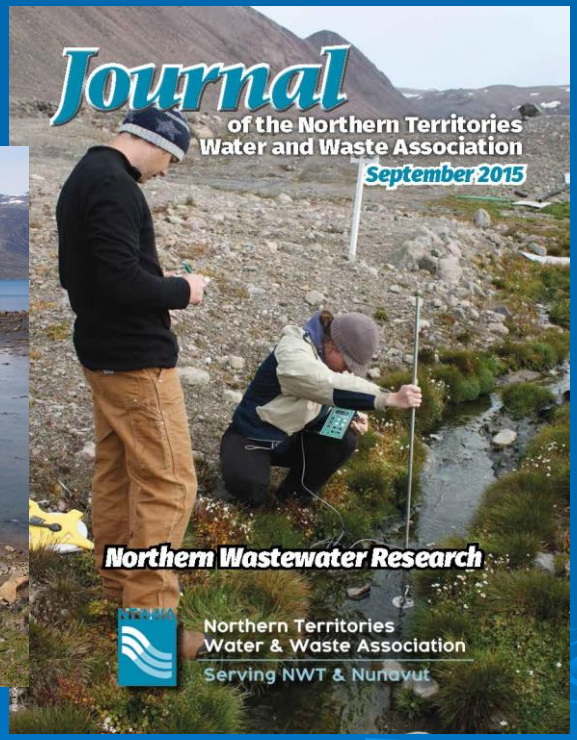
Current challenges with lagoon systems and responses



The lagoon systems in a number of communities in the Nunavut Territory have issues associated with stability and seepage – these issues and other research is demanding a rethinking of the performance of lagoons in the high arctic given the influent quality (pure sewage) and environmental impact (minimal impact).

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Back to 1st Principles

CCME MWWE Principles and apparent practices that are "rolling" out

• Be fiscally responsible and sustainable by identifying costs and taking into account other environmental issues

The capital budget for the Dawson City wastewater facility is $25 million – this is in addition to approximately $8 million previously spent on "work" that was never implemented. The operation and maintenance budget was estimated to be $300,000 per year, and reality is over $1 million per year.

Natural sewage lagoon in Tuktoyaktuk, NT

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… and in conclusion…

There is a significant gap associated with wastewater management between regulatory principles, and reasonable practices for the communities of the far north.

We are in a position to either implement solutions which are appropriate to the administrative, financial, technical, and human resource capacities of northern communities OR create legacies which will unreasonably burden the communities for a generation.

Trucked sewage collection in Repulse Bay, NU