



2023 Canadian Consulting Engineering Awards

IQALUIT WATER CRISIS

Water Resources



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Iqaluit water crisis: State of emergency declared as city receives 1st water shipment

The Nunavut government has declared a 14-day state of emergency in Iqaluit after water in the capital was deemed undrinkable and potentially tainted with petroleum.

By Emma Tranter · The Canadian Press

Posted October 14, 2021 6:43 pm · Updated October 14, 2021 6:53 pm



Iqaluit hospital limits surgeries as city water tests show 'exceedingly high concentrations' of fuel

No major health concerns for those who drank the water, says Nunavut's chief public health officer

Amy Tucker · CBC News · Posted: Oct 15, 2021 1:08 PM CT | Last Updated: October 16, 2021



Figure 1: Media coverage of the Iqaluit Water Crisis in October 2021

BACKGROUND

In early October of 2021, residents of the Iqaluit made water quality complaints regarding a fuel-like smell coming from their tap water. On October 12th, visible fuel-like contamination was discovered on the surface of one of the below ground treated water tanks at the water treatment plant. The Territory's Chief Public Health Officer issued a *Do Not Consume* water quality advisory for the population of 9,000 Iqalumiut in the Capital City. The order placed tremendous stress on consumers for access to potable water and on the ability of the hospital to sterilize equipment, as well as adding to logistical complications arising from the Covid-19 pandemic (**Figure 1**).

WSP field investigation personnel were flown to Iqaluit and performed a holistic and detailed inspection of the water treatment plant. During the investigation, WSP discovered a sub-surface cavity below the water treatment plant (known as The Void) and a deteriorated underground fuel storage tank. WSP was able to identify the contamination pathway into the system and sever the pathway, and the water quality was soon restored.

However, in January of 2021, another round of consumer complaints about a fuel-like smell shocked the City. WSP field investigation personnel and concrete materials subject matter experts were flown back to Iqaluit to assess every inch of all below-ground tanks.

NorthMart denies price gouging of bottled water; says charges are being lowered

Iqaluit residents have been buying all of the available water in local stores in light of fuel being detected in municipal drinking water.

Trevor Wright | Published October 14, 2021



Ready-to-drink baby formula en route to Iqaluit

Ottawa volunteer and Arctic Co-op team up to send 35 cases of formula on a flight Friday

HEALTH OCT 14, 2021 – 3:20 PM EDT By [Madalyn Howitt](#)



Figure 2: Local challenges exacerbated by Iqaluit water crisis

MAJOR CHALLENGES

The *Do Not Consume* (DNC) water quality advisory prompted a coordinated city-wide bottled water distribution program, bottled water supply assistance from the Government of Nunavut, and installation of a temporary water purification system by the Canadian Armed Forces. The DNC advisory placed tremendous stress on consumers for access to potable water and on the ability of the hospital to sterilize equipment, and further complicated logistics for dealing with the Covid-19 pandemic. **(Figure 2)**. WSP assisted with the design and implementation of many critical supplemental / temporary water treatment systems including the Canadian Armed Forces water purification, the Government of Nunavut portable water treatment system, and the Water Treatment Plant Bypass System. At the same time, WSP field investigation personnel investigated the multiple sources of petroleum hydrocarbon-based contamination and actively implemented measures to mitigate and eliminate the risk to consumers and the public water supply system.

Iqaluit's remote location was a major challenge. The crisis occurred in October, and during the winter months the City is accessible only by air. Transporting bottled water, essential goods, and equipment is a costly and time-consuming endeavor. Getting laboratory results for petroleum hydrocarbon testing required a lengthy travel and transportation process, so results were not available until a minimum of one week after sampling. Innovatively, WSP installed and calibrated a novel spectrophotometer to detect petroleum hydrocarbons in real-time. The installation played a pivotal role in the investigation.

Another major challenge in Iqaluit is the climate. In such a far north location, Iqaluit experiences harsh winters. The impending extreme cold in December / January placed immense stress on the City and WSP to find alternatives to bottled water distribution and outdoor temporary water treatment units.

The WSP team worked closely with the City to find the source of the contamination and address it in less than one week, allowing life in the City to return to normal.



Figure 3: Sub-surface cavity beneath the Iqaluit WTP known as the Void (left) and a 60-year old abandoned underground fuel storage tank (right)

STAYING SAFE IN “THE VOID”

During the investigation, WSP discovered a sub-surface cavity below the WTP (which became known as “The Void”). The Void is essentially the air space between the concrete water treatment plant structure and the surrounding bedrock. Navigating it was a challenge. Not only was it flooded with contaminated water, but there were also several very narrow corridors and sections with limited head room. In the deepest reaches of the Void, WSP personnel discovered a severely rusted underground fuel storage tank with remnants of congealed oil hanging from its bottom, and pooled oil directly beneath the tank (**Figure 3**). Through a series of in-depth theories and consultations with several professional chemists and subject matter experts, the WSP team identified the pathway and was successfully able to bypass the contamination entry point. Within one week, the pristine glacier-like water quality was restored.

The large, subsurface, cavern-like space below the WTP is, by every definition, a confined space. WSP led all safety tailgates, provided oversight for all confined space entries and provided innovative approaches (automation, alarms, databasing, and drawings) to mitigate the necessity for operations staff to enter the space. While occupying all confined spaces, WSP ensured all persons were equipped with air quality monitoring devices, wore appropriate PPE (hard hat, steel toe boots, hi-vis vests, nitrile gloves, and respirators, where applicable), and had a defined entry plan. Prior to all entries, the local fire department was notified of who, when, and where confined spaced entries were to occur to mitigate emergency response time.

WSP is proud to report that no incidents occurred and no persons were injured, required medical attention, or lost time at work during the investigation or at any point during the remediation efforts.



Figure 4: Novel real-time hydrocarbon monitoring system.

NOVEL APPROACH TO HYDROCARBON TESTING

In addition to the challenges already described, third-party lab results for petroleum hydrocarbons were taking longer than one week to get back; this meant that critical decisions were being made on week old data, and the City couldn't inform consumers of the risks associated with water quality "today". In response, WSP worked with an equipment supplier to install a spectrophotometer device known as the S::CAN (**Figure 4**). This technology was relatively new to Canada and was the first of its kind in Canada's Northern Territories. WSP professional chemists performed a unique calibration of the device to measure petroleum hydrocarbons. The system could collect and analyze results in "real-time", which was a vast improvement to the one-week lead time on third-party results. Additionally, the system is capable of running grab samples, so operations staff could collect results from any point in the water treatment and distribution systems and obtain immediate results. When a water complaint was received by the City, public works staff would collect a sample from the complainant's tap and provide the consumer with the results on the same day. The system also produces a spectrophotometric "fingerprint", which can be used to compare the likeness between different samples. This device played a pivotal role in the investigation.

Providing evidence that the historic fuel tank was the sole source of the contamination was no easy task and involved disproving all *other* potential sources of contamination. WSP inspected every inch of the water treatment plant's heating fuel supply system and all pumps for lubrication leaks, and even went so far as to work with the City on a Phase II Environmental Site Assessment reviewing the soil conditions around the building. The real backbone of the investigation was the chemical fingerprint analysis from the S::CAN. WSP personnel collected samples of all liquids and potential contaminants found in the Void, in the water treatment plant, and around the site. The fingerprints provided overwhelming evidence that all contamination linked back to the historic underground fuel storage tank. The results from the chemical fingerprinting also further validated the pathway of the contamination into the system: the smaller and more volatile compounds were able to penetrate the concrete and contaminate the treated water tanks, but the heavier compounds did not readily pass into the treated water tanks and instead remained as a thick, black liquid at the bottom of the Void.

The S::CAN played a pivotal role in the investigation and allowed WSP to provide overwhelming evidence that the leaking historic underground fuel storage tank was the sole source of the contamination.



Figure 5: Performing a Phase II Environmental Site Assessment.

REMEDIATION

Following the October contamination events, WSP worked with the City to implement the following risk-reduction upgrades and tasks:

- Installation & calibration of a two real-time hydrocarbon detection systems (**Figure 5**);
- Installation of a WTP bypass system that bypasses all below-ground treated water tanks;
- Removal of the leaking historic underground fuel storage tank (**Figure 6**);
- Cleaning of the Void and all below-ground treated water tanks (**Figure 6**);
- Completion of a Phase II Environmental Site Assessment (ESA) to further validate that all contaminants had been effectively removed;
- Development of a field sampling plan and monitoring & reporting plan; and
- Development of standard operating procedures for consumer complaints, contamination investigations, and operation of the WTP bypass system.



Figure 6: Removal of the historic underground fuel storage tank (left) and the Void after cleaning (right)..



Figure 7: Iqaluit Water Treatment Plant below-ground tank inspections and black tar-like substance

RE-EMERGENCE OF CONTAMINATION

In January of 2022, another round of consumer complaints about a fuel-like smell shocked the City. WSP Field Investigation personnel and subject matter experts were flown in from across Canada, including British Columbia (concrete materials), Manitoba (chemical interaction), Ontario (structural), and Quebec (environmental remediation). The team took a multi-faceted approach to identify all possible contamination entry points and swiftly develop remediation measures for protecting the public water supply system.

The team of water treatment, materials, and structural engineers performed a detailed re-inspection of all below-ground tanks and noticed immediately that something had changed from the previous inspection. Several portions of some of the tank walls had spalled off, revealing a black tar-like substance within (**Figure 7**). A sample of the unknown substance was run through the S::CAN, and the fingerprint was confirmed as a match for the contaminant in the water. Through the team's review of historical data and documentation, they were able to identify it as a waterstop product that contained petroleum hydrocarbons as a compositional ingredient.

In light of the concerns for the waterstop product, WSP worked with the City to remove all remaining waterstop product from the concrete tanks, and applied both a protective concrete coating and secondary waterproofing coating to all treated water tanks. The structural and materials subject matter experts confirmed that the now 61-year-old water treatment plant in the Canadian Arctic remains in excellent condition, and will be fit for service for many years to come.

WSP professional chemists devised a novel onsite experiment using a calibrated field spectrophotometer to determine the composition of the black, tar-like substance and assess its risk to the public water supply.

FURTHER REMEDIATION

Following the crisis, many upgrades were successfully performed on the water treatment system to both mitigate the risk of recontamination and improve the robustness of the water treatment plant. These activities included:

- Upgrades to the onsite fuel storage as well as handling & management procedures;
- Waterproofing & protective concrete reinstatement material to the below-ground treated water tanks;
- Enhancements to the chlorine gas system;
- Construction of an emergency water treatment plant bypass system;
- Development of standard operating procedures for critical water treatment plant components; and
- Updates to the City's monitoring and reporting plans.

As of November of 2022, all upgrades were successfully implemented, and a return-to-service plan was developed and executed. Since the system had been offline for over a year, it was imperative that all valves, controls and automation, and general operation of the facility remained intact. WSP was on site throughout the entire re-commissioning to ensure a smooth transition for the City and its residents.

A critical component of the Project was restoring the severely eroded consumer confidence. Consumers were informed not only of one fuel contamination, but also of a second completely separate fuel contamination event only a few months later. On top of that, consumers had to endure almost two full months under the *Do Not Consume* advisory. WSP delivered several simplified technical presentations to the Mayor, City Council, and national news media outlets, as well as drafting public service announcements. The City posted water quality information on their website on a regular basis, and provided residents with access to a water quality hotline and an abundance of additional resources on health risks and the public water system. Successes in restoring consumer confidence were realized through frequent engagement with local public health officials and Health Canada.

As of November of 2022, all upgrades were successfully implemented and a return-to-service plan was developed & executed. WSP professional chemists, NAPEG certified engineers, and trained water treatment plant operators were onsite throughout the entire re-commissioning to ensure the successful return of the water treatment plant to normal operation.



Iqaluit residents can drink tap water again, Nunavut's health department says

Health officials lifted the city's do-not-consume order on Friday afternoon

CBC News - Posted: Dec 10, 2021 3:35 PM CT | Last Updated: December 10, 2021



City recreation staff no longer assigned to water emergency

Aquatic centre, gym services restored as staff go back to aquatic centre; pool reopens Wednesday

HEALTH DEC 13, 2021 - 5:12 PM EST



Positive media coverage celebrating the resolution of the Iqaluit Water Crisis

BENEFITS TO THE COMMUNITY

WSP's ability to quickly identify and address the sources of the contamination was a major benefit to the community and the 9,000 residents of Iqaluit. The project excellence of our team was measured empirically in two ways: 1) the rapid reduction of petroleum hydrocarbons in the system immediately after WSP engagement; and, 2) the progressive restoration of consumer confidence after two unique fuel-like contamination events. The response to the City and WSP's efforts during the investigation and upon release of hydrocarbon-free water quality results has been overwhelmingly positive.

While the contamination in one of the tanks at the water treatment plant may have been substantial, it is important to note that the petroleum hydrocarbons that passed into the distribution system did not reach any concentration that would be concerning to any consumer, whether that consumer is an adult or a child. The rapid responses to both contamination events by the City and WSP likely prevented a much more serious situation.

The combined efforts of WSP and the City restored and reinstated a 60-year old WTP in the Canadian arctic into a safe and sustainable facility for years to come.

ADDITIONAL INFORMATION

For further information on the Water Crisis, its impact on the community, and the combined efforts of the WSP Team and the City, select online news articles have been selected for reference:

October 12, 2021	Don't drink the tap water, Iqaluit mayor tells residents https://www.cbc.ca/news/canada/north/igaluit-water-emergency-council-meeting-1.6208466
October 21, 2021	Iqaluit forced to medevac patients out of territory as water crisis hits hospital https://www.ctvnews.ca/canada/igaluit-forced-to-medevac-patients-out-of-territory-as-water-crisis-hits-hospital-1.5632461
October 24, 2021	Canadian military arrives in Iqaluit to assist with clean drinking water crisis https://globalnews.ca/news/8320111/military-canada-igaluit-drinking-water/
November 17, 2021	Iqaluit to build bypass at water treatment plant https://www.cbc.ca/news/canada/north/igaluit-water-bypass-1.6251306
November 18, 2021	Iqaluit's water crisis continues; City presents new information https://www.nunavutnews.com/news/igaluits-water-crisis-continues-city-presents-new-information/
November 19, 2021	Fuel storage tank adjacent to Iqaluit water treatment plant removed https://www.nunavutnews.com/news/fuel-storage-tank-adjacent-to-igaluit-water-treatment-plant-removed/
November 24, 2021	New military tent on the way to Iqaluit after wind causes damage, halts water purification operations https://www.cbc.ca/news/canada/north/igaluit-water-crisis-nunavut-canadian-armed-forces-1.6261554
December 10, 2021	Iqaluit residents can drink tap water again, Nunavut's health department says https://www.cbc.ca/news/canada/north/igaluit-water-crisis-1.6281773
January 15, 2022	Nunavut government confirms fuel found in Iqaluit water supply again https://www.cbc.ca/news/canada/north/nunavut-government-confirms-fuel-found-in-igaluit-water-supply-again-1.6316623
April 1, 2022	New Iqaluit water reservoir in the works as feds announce \$214M in funding https://www.cbc.ca/news/canada/north/federal-funding-igaluit-water-system-1.6405057
May 6, 2022	Different fuel sources caused fall, winter water contamination, say experts https://nunatsiaq.com/stories/article/different-fuel-sources-caused-fall-winter-water-contamination-say-experts/