



NORTHWEST TERRITORIES GEOLOGICAL SURVEY STRATEGIC PLAN 2017-2022

Plan stratégique de la Commission géologique des Territoires du Nord-Ouest

Le présent document contient la traduction française du sommaire.

2017-2022

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Acknowledgement

The development of this Strategic Plan was guided by Dr. Murray Duke, who began his career as a research scientist at the Geological Survey of Canada in 1976, became Director of Mineral Resources in 1988, and was appointed Director General in 1995. Since retiring from the federal public service in 2006, he has been widely consulted about the role of geological surveys within public government and their contributions to society. Clients have included the Prospectors and Developers Association of Canada, the Government of Newfoundland and Labrador, the Government of Saskatchewan, the Government of Northwest Territories, and several federal departments. He has received numerous invitations to speak about the public policy rationale and impact of geological surveys in Canada and abroad. In 2013, Dr. Duke was one of three members of the Stakeholders Engagement Panel that toured the Northwest Territories to gather the views of residents about mineral development. The Panel's report significantly informed the Northwest Territories Mineral Development Strategy. He also led development of the first strategic plan of the Northwest Territories Geoscience Office (2011-2016), which in 2015, was renamed the Northwest Territories Geological Survey.

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EXECUTIVE SUMMARY

The Northwest Territories Geological Survey (NTGS) is a division of the Department of Industry, Tourism and Investment, Government of Northwest Territories. Its mission is to provide geoscience information about the Northwest Territories (NWT) to inform decisions by governments, industry, and the public concerning the responsible development of mineral and energy resources, use of the land, and environmental stewardship. The NTGS also plays an important role in delivering geoscience education and outreach services. Other than strategic advice provided to the Minister, geoscience information provided by the NTGS is freely available to all. It is in the vanguard of the Open Data movement.

This Strategic Plan builds on the vision set out in 2011 in the first NTGS five-year plan, while taking account of significant changes in operating environment. In particular, the devolution of jurisdiction over land and resources has meant that the NTGS is now called upon to address a broader range of issues than in the past. The division is implementing key elements of the NWT Mineral Development Strategy, and similar contributions are anticipated in support of the forthcoming Oil and Gas Strategy. Geoscience also has an important role to play in the Land Use and Sustainability Framework, and the NTGS research on permafrost disturbance will make significant contributions to the Climate Change Strategic Framework currently under development.





This new strategic plan outlines the mandate of the Minister and the Department, defines the NTGS mission, vision, and values, and seeks to ensure that the NTGS scientific program is aligned with mandate priorities of the 18th Legislative Assembly. The scientific program is presented under six goals that reflect these priorities:

Goal 1:

Ensure the availability of framework geoscience knowledge about the NWT in support of natural resource management, environmental stewardship, and sustainable communities.

Goal 2:

Promote the discovery of mineral resources in the NWT by characterizing resource potential, generating regional and thematic geoscience knowledge to underpin successful exploration, and providing scientific advice to inform policy and regulatory decisions.

Goal 3:

Promote development of energy resources in the NWT by evaluating resource potential, generating regional and thematic geoscience knowledge to underpin successful exploration, and providing scientific advice to inform policy and regulatory decisions.

Goal 4:

Inform decisions affecting use of the land, environmental stewardship, and infrastructure security.

Goal 5:

Ensure excellence in information management, discovery, and dissemination.

Goal 6:

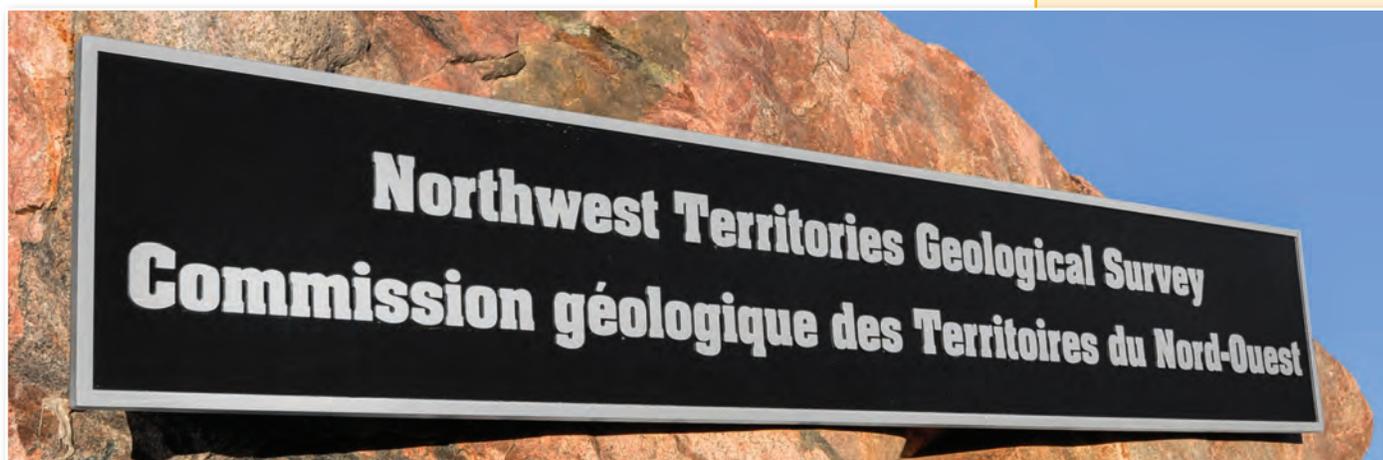
Position the NTGS to achieve its vision as the principal source of public geoscience knowledge about the NWT.

The value of NTGS public geoscience information can be broadly measured in terms of helping to sustain or grow the NWT economy, enabling decisions that are informed by scientific evidence, and enhancing knowledge of geoscience-related issues and opportunities. As this five-year Strategic Plan comes into effect, the provision of modern, comprehensive geoscience information will be particularly important in addressing the current low levels of mineral and energy exploration, and in understanding and responding to the effects of climate change.

SOMMAIRE

La Commission géologique des Territoires du Nord-Ouest (CGTNO) est une division du ministère de l'Industrie, du Tourisme et de l'Investissement, au sein du gouvernement des Territoires du Nord-Ouest. Sa mission est d'offrir de l'information géoscientifique sur les Territoires du Nord-Ouest afin d'éclairer les décisions prises par les gouvernements, l'industrie et le public en ce qui concerne l'exploitation responsable des ressources minérales et énergétiques, l'utilisation des terres et la gérance environnementale. La CGTNO joue également un rôle important dans la prestation de services de sensibilisation et d'information géoscientifiques. Mis à part les conseils stratégiques qu'elle fournit au ministre, la CGTNO produit de l'information géoscientifique librement accessible à tous. Elle est à l'avant-garde du mouvement des données ouvertes.

Ce plan stratégique s'inspire de la vision énoncée dans le premier plan quinquennal de la CGTNO publié en 2011, tout en tenant compte des changements importants qui ont eu lieu dans l'environnement opérationnel. Plus précisément, le transfert des responsabilités liées aux terres et aux ressources fait en sorte que la CGTNO est désormais appelée à s'occuper d'un éventail plus vaste de questions qu'auparavant. La division met en œuvre des éléments clés de la Stratégie d'exploitation des minéraux des Territoires du Nord-Ouest, et des contributions semblables sont attendues à l'appui de la Stratégie pétrolière et gazière à venir. Les données géoscientifiques occupent une place importante dans le Cadre d'utilisation des terres et de durabilité et les recherches menées par la CGTNO sur la perturbation du pergélisol apporteront des contributions significatives au Cadre stratégique sur le changement climatique en cours d'élaboration.





Ce nouveau plan stratégique présente un aperçu du mandat du ministre et du Ministère; définit la mission, la vision et les valeurs de la CGTNO, et vise à faire en sorte que le programme scientifique de la CGTNO cadre avec les priorités du mandat de la 18^e Assemblée législative. Le programme scientifique est présenté sous six objectifs qui représentent ces priorités :

Objectif 1 :

Assurer la disponibilité des connaissances géoscientifiques du cadre au sujet des Territoires du Nord-Ouest à l'appui de la gestion des ressources naturelles, de la gérance environnementale et des collectivités durables.

Objectif 2 :

Promouvoir la découverte des ressources minérales dans les Territoires du Nord-Ouest, en caractérisant le potentiel des ressources, en produisant des connaissances géoscientifiques thématiques et régionales pour soutenir l'exploration réussie, et en offrant des conseils scientifiques afin d'éclairer les politiques et la prise de décisions réglementaires.

Objectif 3 :

Promouvoir l'exploitation des ressources minérales dans les Territoires du Nord-Ouest, en évaluant le potentiel des ressources, en produisant des connaissances géoscientifiques thématiques et régionales pour soutenir l'exploration réussie, et en offrant des conseils scientifiques afin d'éclairer les politiques et la prise de décisions réglementaires.

Objectif 4 :

Éclairer la prise de décisions ayant une incidence sur l'utilisation des terres, la gérance environnementale et la sécurité des infrastructures.

Objectif 5 :

Assurer l'excellence dans la gestion, la découverte et la diffusion de l'information.

Objectif 6 :

Veiller à ce que la CGTNO soit en mesure de concrétiser sa vision en tant que principale source de connaissances géoscientifiques au sujet des Territoires du Nord-Ouest.

La valeur de l'information géoscientifique publique de la CGTNO peut être évaluée de façon plus générale en fonction de la façon dont elle appuie ou stimule l'économie des Territoires du Nord-Ouest, permettant la prise de décisions éclairées par des preuves scientifiques et approfondissant la connaissance des enjeux et des possibilités géoscientifiques. Au moment de l'entrée en vigueur de ce plan stratégique, la fourniture d'information géoscientifique moderne et complète sera particulièrement importante pour régler la situation actuelle du faible niveau d'exploration des ressources minérales et énergétiques, et comprendre les effets des changements climatiques et y réagir.

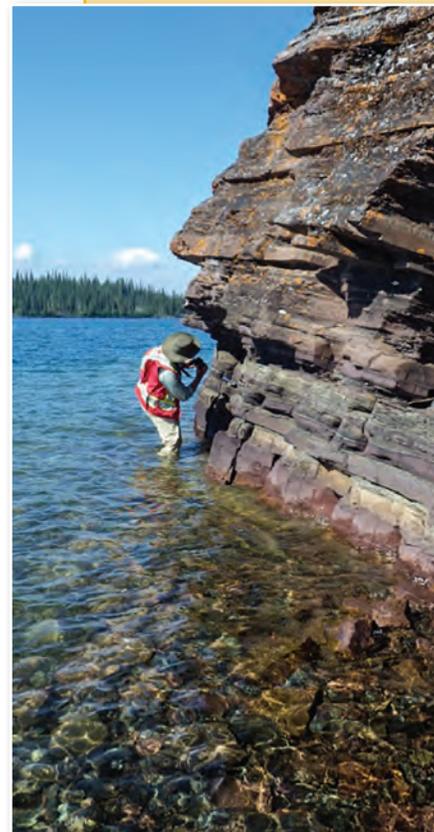
INTRODUCTION

Governments around the world have found that geological information is required to support policy development and to inform decision-making in industry, civil society, and the general public on matters ranging from mineral and energy resources and natural hazards to environmental stewardship and land use. In almost every jurisdiction – national, state, provincial, or territorial – this information is provided by a geological survey organization, within either a ministerial department or a statutory agency.

One reason that governments have chosen to consolidate geoscience expertise in-house is to ensure that information is available when required, whether by government or external users. Developing regional geological knowledge is strategic science: that is, it occurs over a long time frame and benefits from stable funding, continuity of expertise, and a systematic approach. Moreover, with careful stewardship this information will remain useful for many years. The value lies not only in digital and paper records and sample materials, but also in the tacit knowledge of experienced staff. The preservation and dissemination of this information is a core function of virtually every geological survey organization.

The geological survey function of the Government of Northwest Territories (GNWT) is delivered by the Northwest Territories Geological Survey (NTGS), a division of the Department of Industry, Tourism and Investment (ITI). The role of the NTGS is to provide comprehensive geoscience information pertaining to the territorial landmass. This information comes from various sources. Some results from ongoing NTGS research, while other components are generated by external groups, including the federal Geological Survey of Canada, academia, and the private sector. The NTGS synthesizes this information in forms that meet the needs of its stakeholders, including advice to Ministers, technical reports and maps for users in industry and civil society, and material suitable for the non-specialist. The NTGS is often called upon to provide unbiased scientific advice about issues where stakeholders' opinions diverge: its role is to be an honest broker of geoscience information.

The NTGS traces its origin to the Northwest Territories (NWT) Geology Program of the then federal Department of Indian and Northern Affairs (INAC), which operated much like a provincial geological survey, focusing primarily on mineral development and administration of the Canada Mining Regulations. In 1988, with funding from the Canada-Northwest Territories Economic Development Agreement (EDA), the GNWT Department of Energy, Mines and Petroleum Resources established the Mineral Development Office, which became the Mineral Initiatives Office in 1991. When the EDA ended in 1996, the office became part of the newly created GNWT Department of Resources, Wildlife and Economic Development (RWED) and, in the following year, the bedrock mapping





activities of RWED and INAC were combined in a single, jointly-managed program. The work of the two governments was more fully integrated in 1999 with the establishment of the C.S. Lord Geoscience Centre, and the mission was expanded in 2000 to include oil and gas geoscience. Responsibility for non-renewable resources within the GNWT was transferred to ITI in 2004, and the name was changed to the Northwest Territories Geoscience Office to better reflect its role. In 2014, jurisdiction over land and resources was devolved from the federal to the territorial government. The GNWT assumed full responsibility for the Geoscience Office, which shortly thereafter became the Northwest Territories Geological Survey.

The NTGS has accomplished most of the objectives set out in its first Strategic Plan (2011-2016). However, the operating environment has evolved significantly in the meantime. In particular, the GNWT is capitalizing on the opportunities afforded by devolution to promote the sustainable development of non-renewable resources. A new Mineral Development Strategy is already being implemented and an Oil and Gas Strategy is in preparation. Similarly, the Land Use and Sustainability Framework and Climate Change Strategic Framework provide policy guidance for the exercise of the GNWT responsibilities for land and water resources. Implementing each of these policy initiatives will require geoscience information.



MANDATE, MISSION, VISION, AND VALUES

Mandate

The term *mandate* has two meanings in the governmental context. The first refers to the authorities and responsibilities given to a Minister by legislation or equivalent. The mandate of ITI is defined in the Industry, Tourism and Investment Establishment Policy as follows:

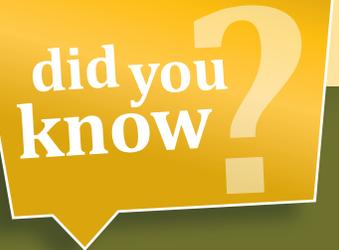
The mandate of the Minister and the Department of Industry, Tourism and Investment is to promote economic self-sufficiency through the responsible development of the Northwest Territories mineral and petroleum resources; the development of the natural resource industries, including agriculture, commercial fishing and the traditional economy; the promotion and support of tourism, trade and investment, business, and manufacturing and secondary industries, to create a prosperous, diverse and sustainable economy for the benefit of all Northwest Territories residents.

As in most Canadian jurisdictions, the formal mandate is very general and does not specify how the Minister should organize the Department to discharge his or her responsibilities. Thus, neither geological surveying in general nor the NTGS in particular are specifically referenced in the policy. However, the rationale for the NTGS is implicit in two clauses under section 6 (2):

The Minister shall develop and carry out programs and services in the Department as may be appropriate to fulfill the mandate of the Minister and the Department. The Minister shall have charge of and be responsible for...

- (f) Providing timely, relevant and accessible information and programs to support economic development, including the exploration and development of mineral and petroleum resources in the Northwest Territories.*
- (g) Promoting and supporting the use of scientific research, traditional knowledge and public education to support decision-making and increase the understanding of sustainable development of natural resources in the Northwest Territories.*

The Minister also has responsibilities under several other statutes, regulations, and policies, several of which are under revision and are not detailed here. In its second meaning, mandate refers to a government's authority to act by virtue of an election. Following each general election, the GNWT establishes short and medium-term priorities for the period of the electoral mandate. The priorities of the 18th Legislative Assembly provide essential guidance for this Strategic Plan and are described below.



In its first two years, the NTGS-run Mining Incentive Program awarded grants totalling more than \$750,000 to eight prospector and 11 small company projects, resulting in more than \$4 million in private-sector exploration spending.

The responsibilities mandated by policy or legislation collectively define the ongoing mission of the Department. For its part, the NTGS has adopted the following mission statement to more precisely define its purpose within the Department.

Mission Statement

Our mission is to provide geoscience information about the landmass of the Northwest Territories to inform decisions by governments, industry, and the public concerning the responsible development of mineral and energy resources, use of the land, and environmental stewardship.

While the mission of the NTGS remains firmly focused on mineral and petroleum resources, it has experienced a growing demand for geoscience information to address issues of land management, infrastructure development, environmental stewardship, and adapting to climate change. This trend is likely to continue and, with a modest increase in capacity, the Survey would be well-positioned to meet this need.

Vision

The NTGS will be recognized as the principal source of public geoscience knowledge about the Northwest Territories.

Values

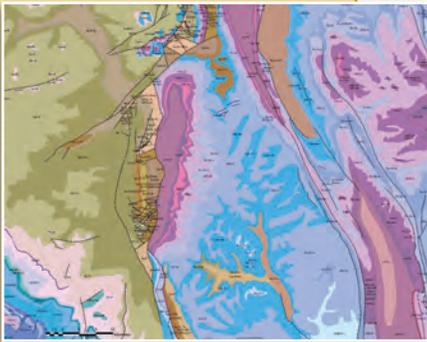
We will serve the public interest in an impartial manner, maintaining the highest ethical and professional standards. We seek to inform decisions without advocating for a particular result.

We strive for scientific excellence by conducting rigorous research that is relevant to the needs of the people of the Northwest Territories, and making the results accessible in a timely, equitable, and understandable way.

As honest brokers of geoscience knowledge, we will accurately represent the degree of uncertainty in our findings as well as opposing views where scientific consensus is lacking.

We understand that collaborative approaches are essential to maintaining a high level of achievement.

We value a diverse, safe, and innovative work environment where leadership is a shared responsibility.



STAKEHOLDERS – CLIENTS, USERS, AND PARTNERS

The ultimate beneficiaries of the work of the NTGS are the people of the NWT. However, in shaping a program that best serves the public interest, the Survey must address the needs and priorities of a broad range of stakeholders – clients, primary and indirect users, partners, and suppliers.

Clients or customers are those that pay for a service. The NTGS currently receives most of its funding from two principal sources: the GNWT and the federal government, the latter through the Canadian Northern Economic Development Agency (CanNor). The NTGS will seek funding from other sources where appropriate and consistent with its mission.

Primary users are those that directly access the geoscience expertise and information provided by the NTGS. In approximate order of frequency of use, these include: the mining industry; petroleum industry; geoscience service industry; federal, territorial, and Aboriginal government departments, boards and agencies; communities; and the general public. Departments within the GNWT that rely on NTGS information, in addition to ITI, include Lands, Infrastructure, and Environment and Natural Resources. The Department of Lands requires geoscience expertise for both regional land-use planning and operational decisions related to permitting, reclamation, and similar functions. It also coordinates the environmental review and impact assessment processes for the GNWT. The Department of Infrastructure needs to understand geological constraints on infrastructure development, particularly those related to permafrost. Environment and Natural Resources is responsible for the Cumulative Impacts Monitoring Program (CIMP) as well as the NWT State of the Environment Report.

Indirect users avail themselves of NTGS information through an intermediary such as a private consultant or another government agency. It is sometimes difficult to know the identity and needs of these users, but they are an important constituency.

did you
know?

The CanNor-funded Slave Province Surficial Materials and Permafrost Study (2014-2016) not only produced a wealth of knowledge to stimulate diamond exploration (including surficial geology maps, indicator mineral and till geochemistry data, and 3D indicator mineral transport models) over a 1,500 km² area, but also characterized permafrost conditions that may inform future resource and infrastructure development.

Partners noticeably enhance the NTGS's ability to deliver its mission. These are organizations or individuals with which the Survey collaborates to achieve common or complementary scientific objectives. Partnerships may entail financial considerations, as for example when the NTGS supports a student research project through a contribution agreement, but more commonly involve in-kind support or sharing logistical costs. The most important benefit, however, results from bringing more diverse scientific expertise to bear on a research objective or other activity. The ability of the NTGS to "punch above its weight" derives in no small part from its ability to successfully engage other organizations and implement appropriate partnerships. Current partners include other geological surveys (e.g. Canada, British Columbia, Yukon), several GNWT departments and Aboriginal government agencies, more than 20 universities, and a like number of private companies.



PLANNING ENVIRONMENT

This Strategic Plan seeks to ensure that the NTGS program is aligned with government priorities. The 18th Legislative Assembly has defined five priority areas for the period 2016-2019: (1) Governance; (2) Cost-of-living; (3) Education, Training, and Youth Development; (4) Community Wellness and Safety; and (5) Economy, Environment, and Climate Change. Further, a series of commitments and legislative initiatives has been identified in each of these areas, along with specific Ministerial accountabilities.

Most commitments for which ITI is accountable fall under Economy, Environment, and Climate Change, but there are several in other areas as well. Indeed, many deliverables address more than one priority. For example, assessing geothermal energy opportunities relates to both climate change and cost-of-living. The Department has assigned the NTGS either a leading or supporting role in numerous specific deliverables, which are accommodated under *Goals and Strategies* in the final section of this Plan. However, by virtue of being the territory's principal repository of geoscience knowledge, the NTGS is also expected to support other departments in meeting their commitments.

Economy

Non-renewable resources are the principal drivers of economic prosperity in the NWT, accounting for about 25 percent of the Gross Domestic Product (GDP). The value of mineral production amounted to \$1.8 billion in 2015, while oil and gas production was valued at \$229 million. These amounts have declined somewhat in the last few years due to a cyclical low in commodity prices, but should rebound in the medium term.

The mining industry is the largest private sector contributor to both GDP and employment in the NWT. Several factors put the ongoing contribution of mining to the NWT economy at risk. The fact that diamonds account for 99 percent of mineral production raises two key concerns. First, according to current projections, diamond production will begin to decline by the end of the decade and in order to sustain diamond production into the future, it will be necessary to identify new reserves. Second, without diversified mineral production, the economy is sensitive to the market conditions of a single commodity. Fortunately, there are positive indicators on both fronts. Several projects in the advanced exploration and development stages will likely result in new reserves, not only of diamonds, but of other commodities as well. However, in and of themselves, these advanced projects would not offset the expected decline in diamond production.



did you know?

The Liard Basin Hydrocarbon Project, undertaken in 2012-2015 by the NTGS in collaboration with the federal, Yukon, and British Columbia governments, resulted in a fourfold increase in natural gas resource estimates.

Another concern is that despite the excellent geological potential for new discoveries, the NWT has for many years lagged behind other Canadian jurisdictions in the intensity of grassroots mineral exploration. This reflects the negative perceptions of the investment climate, resulting mainly from uncertainty in the regulatory regime, unsettled land claims and land access as well as gaps in infrastructure and high operating costs. Increasing the amount of grassroots exploration by the private sector will be an important step towards sustaining mineral production into the future.

The availability of public geoscience information is a key determinant of the investment climate for exploration, especially at the grassroots stage. It increases economic efficiency because industry does not have to duplicate broad-scale precompetitive surveys. By allowing companies to focus their efforts on areas of highest potential, it not only lowers costs, but also reduces the “footprint” of exploration.

The GNWT seized the opportunity afforded by the Land and Resources Devolution Agreement in 2014 to adopt a new Mineral Development Strategy (MDS), the implementation of which is a key mandate priority. The first goal of the MDS recognizes the importance of public geoscience in promoting an attractive investment climate:

Goal 1.1: World-class geoscience information is publicly available and contributes to enhancing exploration and development activity in the NWT.

Other explicit deliverables assigned to the NTGS include implementation of the Mining Incentive Program, which was initiated in 2014, and ongoing support to mineral tenure rights administration.

Commercial production of oil in the NWT began in 1920 with discovery of the Norman Wells field. In addition to Norman Wells, hydrocarbons have been produced at Cameron Hills in the south-central NWT and from the Liard Basin in southwestern NWT. There has also been natural gas production from wells near Inuvik for local consumption. Although the contribution of petroleum production to the economy lags well behind that of mining, there is great potential for significant growth. In 2014, the National Energy Board estimated that NWT contains 37 percent of Canada’s marketable resources of light crude oil and 35 percent of the gas. Production from the significant resources in the Mackenzie-Beaufort seems less likely now than it did a few years ago due to

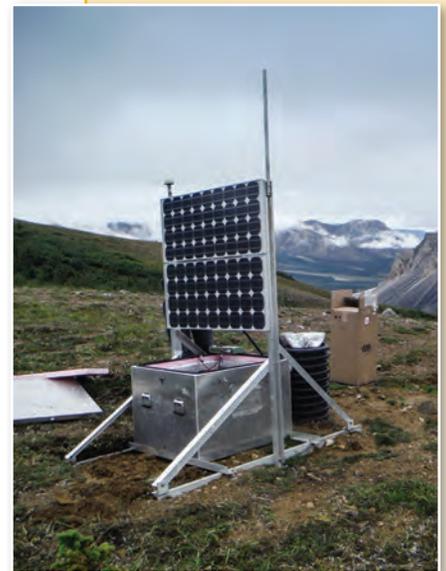
current economic conditions, but new recovery technologies have generated interest in the Canol and Bluefish shale plays in the Central Mackenzie Valley as well as in shale gas potential of the Liard Basin. Development of these resources faces similar challenges to mining, including limited infrastructure, regulatory uncertainty, and high operating costs.

As in the case of minerals, the GNWT will seek to mitigate these challenges through a new Oil and Gas Strategy. The place of geoscience in petroleum resource assessment and exploration is already well understood. For example, the Liard Basin Hydrocarbon Project undertaken by the NTGS in 2012-2015, in collaboration with the federal, Yukon, and British Columbia governments, resulted in a fourfold increase in natural gas resource estimates. Ongoing studies will characterize the Canol and Bluefish shales beyond the Mackenzie Plain. Going forward, the NTGS will produce a web-based NWT geological petroleum atlas that will simplify petroleum-related data searches by industry, governments, and the public.

Environment

The land is important to Northerners. It not only sustains the traditional lifestyle, but also offers the promise of future economic prosperity. The GNWT has embraced the concept of sustainable development, which requires that use of the land and its resources does not compromise the ability of future generations to meet their needs. The Land Use and Sustainability Framework sets out the vision and principles that will guide the GNWT in land-use and land management decision-making.

Regional land-use plans underpin government decisions about where certain activities can take place. These legally-binding plans are mandated by the *Mackenzie Valley Resource Management Act* throughout the NWT, except in the Inuvialuit Settlement Region, where the need is addressed by community conservation plans. Plans have been approved for the Gwich'in and Sahtù Settlement Areas and Tłı̄chǫ lands. A draft interim plan for the Dehcho area was completed in 2016. Completion of remaining land-use plans is a priority of the 18th Legislative Assembly. Although the responsibility for coordinating land-use planning rests with the Minister of Lands, ITI is one of the core departments having explicit roles in developing and implementing regional plans.



did you know?

Ongoing NTGS research on permafrost thaw slumps has directly contributed to Department of Infrastructure mitigation planning along the Dempster Highway as well as submissions to the environmental impact assessment for the Inuvik-Tuktoyaktuk highway. This work has also influenced the Department's climate change and adaptation policy.

Geoscience informs the planning process by defining areas with elevated mineral and petroleum resource potential as well as identifying geological constraints on land use. It is also a factor in land use and quarry permitting and leasing as well as in the environmental assessment and environmental impact review process.

Other mandate priorities related to the environment include implementation of the Cumulative Impact Monitoring Program Action Plan (2016-2020) and finalization of existing candidate protected areas through the Conservation Action Plan. Previously, the NTGS led a project to map permafrost disturbance and impacts to aquatic systems across the northern NWT. In another, survey scientists collaborated in a CIMP study of arsenic concentrations in lake waters in the Yellowknife area. Currently, the NTGS is monitoring seismic activity in the Norman Wells area in order to establish baseline conditions in the event of future development of unconventional petroleum resources.

Climate Change

The impacts of climate change are already noticeable in the North. The cryosphere is particularly sensitive as indicated by the reduced extent and thickness of sea, lake, and river ice, which may necessitate shorter ice road seasons and lower weight limits. Permafrost degradation can trigger slope failure and terrain subsidence, and accelerate erosion of river and stream banks with potentially severe consequences for all types of infrastructure. Rising sea levels will promote coastal erosion and more frequent flooding of low-lying communities. These changes have the potential to profoundly affect Northerners' way of life and economic prosperity, and it is clear that society will need to understand and adapt to them.

The GNWT is developing a Climate Change Strategic Framework that will rest on three pillars: knowledge; resilience and adaptation; and economy, innovation, and emissions. Geoscience knowledge will be essential to understanding and adapting to the impact of the changing climate, and the NTGS already has work ongoing. For example, one project is mapping permafrost disturbance and impacts to aquatic systems across the northern NWT. Characterizing the physical and thermal conditions of permafrost and assessing the distribution of terrain disturbances along the Dempster and Inuvik-Tuktoyaktuk highway infrastructure corridors is a focus of current research.

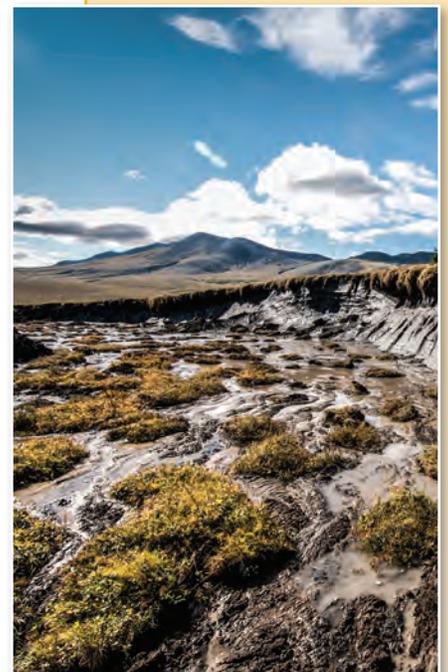
A second initiative, launched in 2015, is compiling, archiving, and distributing ground temperature data collected in the NWT by various research, environmental monitoring, resource, and infrastructure development projects. This database will provide important baseline information for planning future infrastructure projects and assessing the effects of climate change on permafrost conditions. This project is complemented by the collection of new baseline information on ground ice and ground temperature conditions as part of the Slave Province Surficial Materials and Permafrost Study.

Cost-of-living

The cost-of-living and of doing business is higher in the NWT than in most other parts of Canada. Reducing this disparity would not only enhance Northerners' quality of life, but also create new economic opportunities. Among the most significant contributing factors are high energy costs and underdeveloped transportation infrastructure. The Legislative Assembly has identified both of these issues as mandate priorities.

Geoscience information is critical in siting, designing, and building many kinds of physical infrastructure, including roads, pipelines, and hydroelectric installations. It is used to assess the structural suitability of the ground, the proximity to natural hazards, and the local availability of aggregate and other building materials. While the private sector is the appropriate source for project-specific geoscience information, this relies in turn on regional baseline information provided by government surveys. On a broader scale, knowledge of resource potential can inform decisions about locating transportation and energy infrastructure to best serve future development needs. Government geoscience expertise is also required in the environmental assessment of development projects.

The GNWT is working to secure funding for three major road-building initiatives: the Tłı̨chʼo All-Season Road, the Mackenzie Valley Highway, and the Slave Geological Province Transportation Corridor. It seems likely that the Tłı̨chʼo road will proceed first. It promises not only to greatly reduce the cost of food and other supplies in the community of Whatı̨, but is also required to bring the nearby NICO polymetallic deposit into production.





In 2016, the NTGS contracted a high-resolution airborne geophysical survey in the Chan Lake area covering 8,500 km². The surveyed area both overlaps and is adjacent to the proposed Tłı̄chǫ All-Season Road route. This information will inform both mineral exploration and land-use decisions stemming from opportunities provided by the new road.

Road access through the Slave Geological Province from Yellowknife to Nunavut would go a long way towards realizing the full potential of this resource-rich region. It would reduce operating costs of the current diamond producers and lower the development threshold of deposits that are not economic under current conditions. Results of the Slave Province Surficial Materials and Permafrost Study led by the NTGS will not only stimulate diamond and metals exploration, but will also define permafrost conditions that may impact future infrastructure development.

Shallow natural gas resources provide an opportunity in some communities to displace more expensive and polluting fuels for local power generation and space heating. The NTGS will respond to requests for the geoscience information required in exploring these resources.

The government is also committed to investigating and increasing the supply of renewable energy, including hydro and geothermal. The NTGS is specifically tasked with supporting the evaluation of geothermal opportunities.

Governance

The ongoing evolution of governance arrangements has significant implications for the delivery of public geoscience in the NWT. In particular, the devolution of jurisdiction over land and resources to the territorial government in 2014 has expanded the role of the NTGS. In addition to implementing elements of the MDS and the pending Oil and Gas Strategy, the NTGS will be expected to field requests for geoscience information with respect to land-use and environmental issues that would previously have been directed to the federal government.

On the legislative and regulatory front, mandate priorities include a new *Mineral Resources Act* as well as amendments to the Mining Regulations, the *Petroleum Resources Act*, and the *Oil and Gas Operations Act*.

Another mandate priority concerns the resolution of outstanding land, resource, and self-government agreements with regional and community governments. Comprehensive land claims agreements have been settled in the Inuvialuit (1984), Gwich'in (1992), Sahtù (1993), and Tłı̨chǫ (2003) areas, and negotiations are proceeding with the Dehcho, Akaitcho, Acho Dene Koe, and the NWT Métis Nation. Self-government negotiations are under way with the latter three as well as with the communities of Norman Wells and Tulita. Délı̨ne assumed self-governing responsibilities on September 1, 2016. Regardless of the outcome of these various negotiations, the underlying need for geoscience information in the NWT will not change. What is in play, however, is whether these needs will be met and by whom. Effective and efficient delivery of public geoscience is in the interests of all stakeholders.

The GNWT has engaged Aboriginal governments to encourage the formulation of regional mineral development strategies. In a related initiative, the NTGS is producing a series of maps to illustrate the detailed geology and resource potential of all NWT regions.

Finally, the GNWT is committed to advancing open government, which holds that government data, information, and decision-making should be accessible in a way that is responsive to the needs and expectations of NWT residents. This concept is an intrinsic part of the mission of the NTGS, which exists primarily to provide information as a public good.

Building Science Capacity

The GNWT science agenda, Building a Path for Northern Science, was approved by the Legislative Assembly in 2009. The agenda identifies the need for a systematic and long-term approach to science capacity-building in NWT. Five priorities were identified: cultural sustainability, environmental science and stewardship, health and wellness, natural resource management, and sustainable communities. The NTGS contributes significantly to elements of natural resource management, including assessment of natural resource potential, diversification of the commodity base, unconventional energy, and contributing information for land-use decisions. The Survey is also a partner in research on the effects of changing permafrost regimes on infrastructure (under sustainable communities) and in cumulative impact monitoring (under environmental science and stewardship).

did you
know?

In 2016, the NTGS published Mineral Showings, Petroleum Wells and Generalized Geology Maps for the Gwich'in, Sahtù, Dehcho, Wek'èezhìı, and Inuvialuit regions to raise awareness of the resource potential of Aboriginal-owned and adjacent lands.



For its part, in 2015 the Government of Canada established a new agency, Polar Knowledge Canada (POLAR), with a mission to conduct cutting-edge Arctic research. POLAR's current priorities (2014-2019) are alternative and renewable energy for the North, baseline information to prepare for Northern sustainability, predicting the impacts of changing ice, permafrost, and snow on shipping, infrastructure, and communities, and catalysing improved design, construction, and maintenance of Northern-built infrastructure. Its Canadian High Arctic Research Station (CHARS) at Cambridge Bay, Nunavut, will anchor a network of research infrastructure in the North and there should be opportunities for synergy with the NTGS.



The NWT is a marvelous natural laboratory for scientists to study both ancient earth history and contemporary geological processes. As the focal point of public geoscience in the territories, the NTGS plays an invaluable catalytic role. Students and faculty from more than 20 universities are partners in NTGS research projects. Conversely, NTGS staff provides advice and support-in-kind to university and government-sponsored research. The Survey collaborates with the University of Alberta in offering an annual two-week geological mapping field course for senior students. It also supports the GNWT Department of Environment and Natural Resources in delivering the Tundra Science and Culture Camp, an environmental education program for high school students.

Although the NTGS is the largest scientific research organization in NWT, its capacity is limited relative to the task of building the geoscience knowledge base for Canada's third largest jurisdiction by area (1.14 million km²). The federal geological survey traditionally assumed most of the responsibility for regional geoscience mapping, but with devolution, it is expected that the GNWT will have to take a greater role. Because the base budget of the NTGS is insufficient to fund comprehensive regional geoscience surveys, it relies on ad hoc funding opportunities from the GNWT as well as the federal government.

If the NTGS is to realize its vision as the principal source of public geoscience knowledge about the NWT, it will need to increase its capacity in a few key areas. In the near term, additional expertise in permafrost geoscience would help address growing demand for information on the impacts of climate change. Additional mineral deposits expertise would reduce the need to outsource regional mineral potential assessments in the near term and, when exploration activity returns to more robust levels, help ensure the technical and scientific integrity of reports submitted by industry to maintain exploration rights in good standing. Finally, additional geoscience information capacity would allow the NTGS to better meet demands for the delivery of community outreach services throughout the territory.

GOALS AND STRATEGIES

Goal 1: Ensure the availability of framework geoscience knowledge about the Northwest Territories in support of natural resource management, environmental stewardship, and sustainable communities.

Strategy 1.1: Increase bedrock, surficial, geophysical, and geochemical map coverage.

- Continue to work with partners to increase regional map coverage of NWT. A current regional mapping collaboration is the South Rae Mapping Project under the federal Geo-mapping for Energy and Minerals Program (2013-2020). This work aims to provide multidisciplinary geoscience knowledge about the under-explored southeast corner of the NWT.
- Undertake more detailed mapping in areas of elevated resource potential or proposed infrastructure development. For example, bedrock and surficial mapping done as part of the Slave Volcanogenic Massive Sulphide Project meets both criteria.
- Continue compilation of the digital bedrock geology map of the NWT at a scale of 1:250,000. The western mainland and southern Arctic islands regions were published in 2014 and subsequent releases will cover the southeast, central mainland, and remaining Arctic islands. The ultimate goal is to provide a comprehensive bedrock map as a base upon which geological and other data may be layered.
- While a territory-wide compilation of surficial geology is a long-term goal, the focus in the short and medium term will be detailed mapping and thematic studies in support of mineral exploration and infrastructure development. The Slave Province Surficial Materials and Permafrost Study has been one venue for this work.
- Complete stream sediment geochemical surveys in the Mackenzie Mountains as funding opportunities permit. This 270,000 km² area between the Mackenzie River and the Yukon border has excellent potential for discovery of tungsten, base, and precious metals. Regional surveys characterize natural geochemical variability that not only guides industry exploration, but also serves as a baseline for environmental monitoring. Interpretation is facilitated by a recent 1:50,000 scale watershed delineation conducted by the NTGS. In the medium term, lake sediment geochemical surveys will be initiated in appropriate areas.
- High-sensitivity airborne geophysical surveys will be carried out in priority areas as funding opportunities permit, with results incorporated in the regional geophysical compilation of NWT. Begin regional compilation of airborne gamma ray spectrometry and produce value-added products through enhanced interpretation of geophysical data provided by industry.

did you know?

Research by the NTGS and its partners is showcased in November at the annual Yellowknife Geoscience Forum, which regularly attracts more than 700 attendees.

Strategy 1.2: Undertake collaborative research with universities and other partners to address significant gaps in geological knowledge about the Northwest Territories.



- At any given time, the NTGS has collaborative work underway with about 20 universities and a similar number of private companies. Financial or in-kind support is provided to more than 50 students each year. Priority should be given to projects that best align with the NTGS mission and GNWT priorities.

Goal 2: Promote the discovery of mineral resources in the NWT by characterizing resource potential, generating regional and thematic geoscience knowledge to underpin successful exploration, and providing scientific advice to inform policy and regulatory decisions.

Strategy 2.1: Increase understanding and awareness of mineral resource potential of the NWT, with a view to stimulating exploration and sustaining the contribution of mining to the economy.

- Characterize the diamond potential of NWT regions outside of the Slave Geological Province, including, for example, the Dehcho region and Banks Island. Stimulate new exploration in prospective terranes through detailed surficial geological mapping and glacial transport studies, glacial sediment geochemistry, kimberlite indicator mineral composition, and tele-seismology. Incorporate results in web-accessible diamond exploration databases.
- Undertake metallogenic studies, with an emphasis on mineral deposit types having potential to diversify mining production (including metals, industrial minerals, aggregates, building stone, and precious stones other than diamonds). Examples include multidisciplinary studies of the Flat River-Howards Pass area, in which there are known resources of base and precious metals and tungsten.
- Contribute to regional mineral development strategies and in raising awareness of the resource potential of Aboriginal lands. For example, in 2016, the NTGS published Mineral Showings, Petroleum Wells and Generalized Geology maps for the Gwich'in, Sahtù, Dehcho, Wek'èezhì, and Inuvialuit areas.
- Assist ITI Mineral Resources Division and its contractors as required with mineral potential mapping of proposed road corridors.

Strategy 2.2: Support mineral resource management decisions and an efficient regulatory regime.

- Support the administration of the Northwest Territories Mining Regulations by reviewing the geoscience content of representation work reports submitted by industry.
- Monitor NWT exploration activity from a geoscience perspective to inform decision-making in both government and industry. Present interim reports in time for the Yellowknife Geoscience Forum in November and the Prospectors and Developers Association of Canada conference in March.

Strategy 2.3: Administer the NWT Mining Incentive Program

- Evaluate proposals from prospectors and exploration companies seeking funding for NWT exploration projects, award grants, and review progress and final reports.

Goal 3: Promote development of energy resources in the NWT by evaluating resource potential, generating regional and thematic geoscience knowledge to underpin successful exploration, and providing scientific advice to inform policy and regulatory decisions.

Strategy 3.1: Provide petroleum systems evaluation, basin analysis, and other regional geoscience information to support industry exploration for oil and gas.

- Petroleum system evaluation will be undertaken in the Mackenzie Corridor, Liard Basin, and Trout Plain, building outward from well-studied core areas (as, for example, from the Mackenzie Plain to the Peel Plateau and Plain). Key parameters include reservoir quality, source rock potential, thermal history, cap and seal rock quality, and timing of basin deformation.
- Publish a new Petroleum Play Summary series. Each installment will overview geoscience information about the oil and gas potential of a known or proposed NWT exploration area. The first summary describes the Canol Formation and Bluefish Member shale play in the Central Mackenzie Valley and the second will deal with the Liard Basin shale gas play.
- Produce a web-based NWT petroleum geological atlas that will make the wealth of industry-generated and public geoscience information, which is currently dispersed among many sources, searchable and downloadable through a single portal. The atlas will be published in stages on an ongoing basis.

did you know?

The NTGS hosts a world-class collection of information for diamond exploration, including the Kimberlite Indicator and Diamond Database, Kimberlite Indicator Mineral Chemistry Database, and the Kimberlite Anomaly and Drillhole Database.



Strategy 3.2: Assess NWT energy resources.

- Revise the assessment of the unconventional petroleum resources of the Bluefish and Canol shales to account for the presence of gas and condensate (as well as oil) in the Canol Formation.
- Support the GNWT initiative to further evaluate geothermal energy potential.
- Provide geoscience knowledge as required to support community initiatives to develop local natural gas supplies for electricity generation.

Strategy 3.3: Provide geoscience knowledge to inform policy and regulatory decisions and support the administration of oil and gas rights.

- Provide scientific expertise in the evaluation of technical submissions pursuant to the *Petroleum Resources Act*.
- Provide data and information that supports industry and government decisions pertaining to the rights issuance process for oil and gas exploration rights in the NWT.



Goal 4: Inform decisions affecting use of the land, environmental stewardship, and infrastructure security.

Strategy 4.1: Undertake scientific research and monitoring to better understand geological constraints on land use, infrastructure and resource development, and the impacts of climate change.

- Evaluate the physical and thermal characteristics of permafrost along key infrastructure corridors and near NWT communities.
- Investigate the characteristics and mechanisms of permafrost disturbance and its impact on terrain, aquatic systems, and infrastructure. Research is already underway in the northern NWT and includes work on the Dempster-Inuvik-Tutoyaktuk Highway Corridor.
- Develop permafrost maps, at various scales, which indicate ground ice conditions, ground temperatures, and landscape change.
- Develop and populate the NWT Permafrost and Ground Temperature Database incorporating input from diverse sources. This will ensure the public availability of information in standard format and through a single portal for engineering, environmental, and regulatory applications.
- Monitor natural seismic activity in the Central Mackenzie Valley to establish baseline conditions that inform possible future development of unconventional petroleum resources.
- Seek greater integration of geotechnical knowledge in geoscience applied to land use and infrastructure issues. Work with partners to incorporate legacy and current geotechnical information collected by various agencies in a unified NWT Geotechnical Database.

Strategy 4.2: Ensure that land-use, infrastructure development, and regulatory decisions are informed by an adequate understanding of non-renewable resource potential and terrain sensitivity.

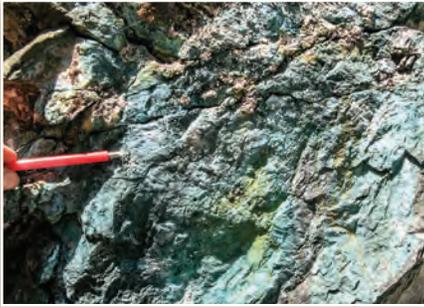
- Provide geoscience input as required to inform regional land-use planning, land-use and quarrying permitting and leasing, infrastructure development, reclamation, and environmental assessment and impact review processes.
- Engage relevant government departments, regulators, and community representatives to better understand their geoscience needs and identify opportunities to support their decision-making.

did you know?

NTGS scientists help facilitate the annual Tundra Science and Culture Camp, a multidisciplinary education program for high school students held at Daring Lake, 300 km northeast of Yellowknife.

Goal 5: Ensure excellence in information management, discovery, and dissemination.

Strategy 5.1: Ensure timely availability of high-quality geoscience data, information, and knowledge.



- Continue to establish and populate databases in a timely fashion and release research results to stakeholders. The short-term priority is to reduce the data entry backlog.
- Continue digitizing donated industry data from past exploration projects and closed mines, and make the archive accessible on-line. Users will be able to search and download material from a collection of more than 30,000 records, including field notes, maps, air photos, drill logs, geological reports, and assays.
- Provide modern web applications and services that build and improve on older web-based portals for the discovery and download of NTGS geoscience information. These should operate in tandem with other GNWT spatial data systems so that users can query and download multiple layers of up-to-date information.
- Ensure that the NTGS web service, data query, and retrieval systems remain at the leading edge of rapidly-evolving technological development and user needs.
- Continue to explore synergies with the Informatics Shared Service Centre to improve efficiency of web-based delivery.



Strategy 5.2: Ensure integrity and accessibility of physical information assets.

- Open and operate the new NTGS Geological Materials Storage Facility in a manner that allows users to examine, photograph, and analyse the extensive collection of representative drill cores, hand samples, and thin sections from NWT mineral deposits and geological mapping programs.

Strategy 5.3: Promote knowledge and understanding of the relevance of geoscience to society, with particular reference to the NWT.

- Continue to use the Yellowknife Geoscience Forum, which annually attracts about 750 registrants, as a venue to highlight the full spectrum of NTGS research. This forum also provides an opportunity to conduct public outreach.
- Continue to support the Department of Environment and Natural Resources in delivering the Tundra Science and Culture Camp, an environmental education program for high school students.
- Expand the delivery of outreach services for communities outside of Yellowknife as resources permit.
- Support Aurora College in implementing the Geoscience Field Assistant Training Program, an MDS initiative.

Goal 6: Position the NTGS to achieve its vision as the principal source of public geoscience knowledge about the Northwest Territories.

Strategy 6.1: Pursue opportunities to expand the science capacity of the NTGS.

- For priority areas of research and information support, develop business cases to demonstrate how a modest expansion in capacity would make the GNWT less reliant on non-resident and contracted geoscience expertise.
- Promote opportunities with other government departments to co-locate or co-fund additional geoscience expertise within the NTGS.
- Promote public awareness of the NTGS at community events.

did you
know?

The NTGS efforts to increase public awareness of geoscience include classroom and library visits, participation in career fairs, public “rock walks”, and short courses on prospecting, mining, and petroleum.



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