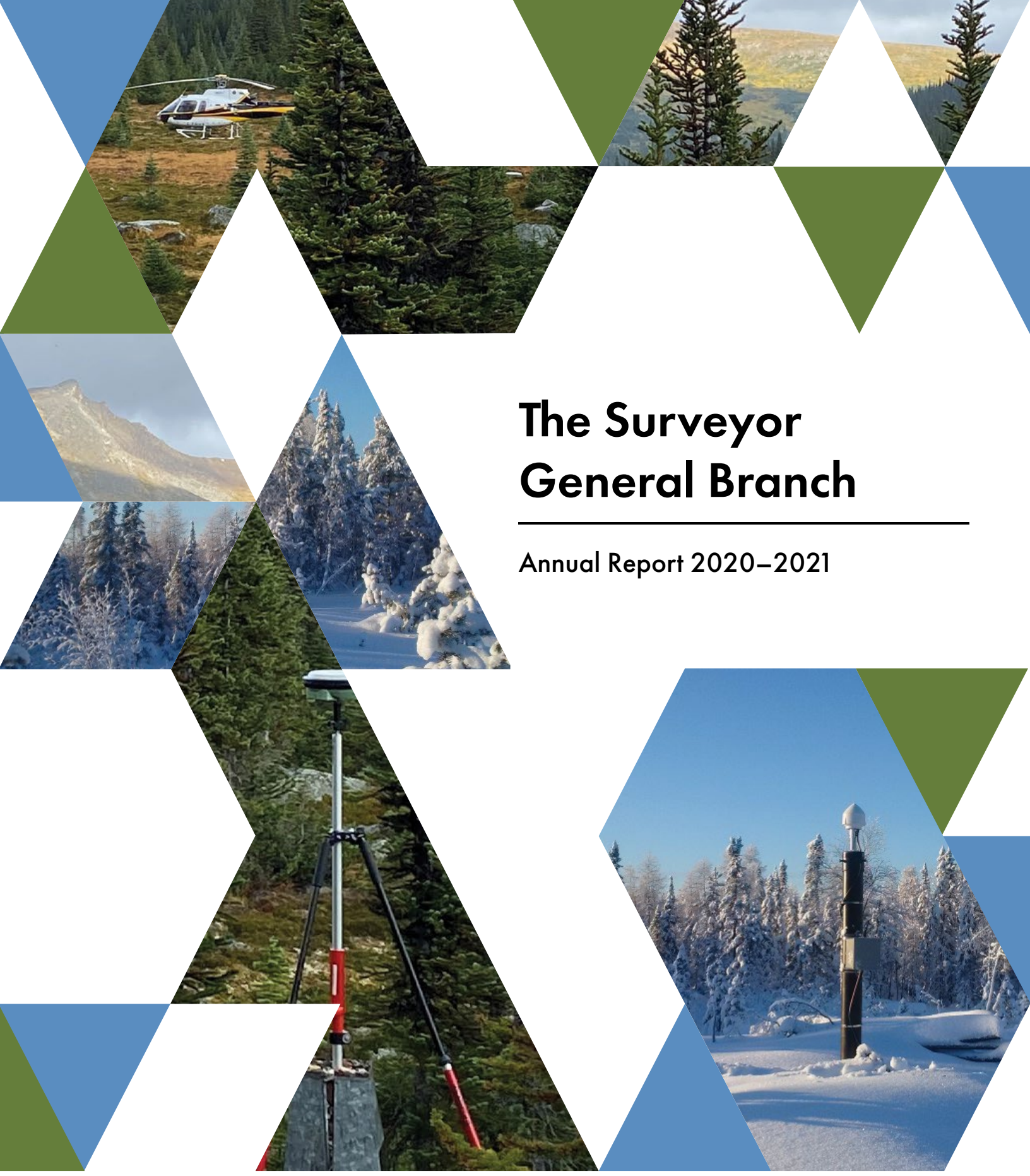

# The Surveyor General Branch

## Annual Report 2020–2021

Natural Resources Canada
Ressources naturelles Canada

Canada

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## Message from the Surveyor General

It is with great pleasure that I present the Surveyor General Branch's (SGB) annual report for the 2020–2021 fiscal year. This report is the eleventh in a series of reviews that report on our achievements, projects and publications (see Annex 4). The review also presents the SGB's progress on addressing the recommendations of the 2019 audit of the Canada Lands Survey System. It sets out metrics showcasing the volume of work undertaken by our staff in 2020–2021. Finally, it demonstrates the progress made this past year toward our four strategic priorities:

- Indigenous peoples' control of their lands
- spatially enabling Canada for the digital economy
- northern property rights
- protection of Canada's oceans

The SGB continues to play an integral part of Natural Resources Canada's (NRCan) Lands and Minerals sector. As a science and technology (S&T) organization within NRCan, the SGB responds to NRCan's S&T priority issues through innovation in services to enhance competitiveness and contributions to sound stewardship, both onshore and offshore.

Although the SGB enjoyed many accomplishments and successes throughout 2020–2021, the COVID-19 pandemic has undeniably forced us to adapt to significant challenges. The pandemic affected the delivery of some activities in most of our programs, notably the Canadian Geodetic Survey (CGS) and the International Boundary Commission (IBC). However, the Canadian Lands Survey System (CLSS) was not affected as much because surveys were considered essential throughout the pandemic.

Nevertheless, the SGB remained resilient in the face of frequently changing federal and provincial health guidelines and adapted its daily work to accommodate the new protocols. We will continue to deliver on our responsibilities and serve the many Canadians and industries that rely on our work. As well, the SGC will collaborate with others across the department to overcome the challenges presented by COVID-19.

As always, I invite you to review and provide comments on the report. I look forward to your continued engagement and, hopefully, to seeing all of you in person in the near future.

Jean Gagnon

Surveyor General of Canada Lands
Canadian Commissioner, International Boundary Commission
Director General, Surveyor General Branch

## The Surveyor General Branch: Who we are

The SGB turned 150 years old in 2021. For a century and a half, our continuous mission has been to ensure that Canadians have access to secure and reliable land survey systems, clearly defined boundaries, and accurate positioning information to meet Canada's economic, social, and environmental needs. The SGB also contributes to the science and infrastructure that Canada needs to succeed in the global economy.

In 2020–2021, the SGB had:

- a budget of $23,132,482
- 168 employees, including survey engineers, geodetic engineers, survey technicians and support staff
- 10 regional offices across Canada and 1 office in the National Capital Region
- a dynamic workforce comprised of full-time and part-time staff, students and seasonal staff

## Our programs

The SGB's three programs align with several government priorities and commitments. Our work contributes to NRCan's core responsibilities related to natural resource science and risk mitigation by providing important information about Canada's lands and supporting vital land management tools and practices.

- The Canada Lands Survey System (CLSS) helps to define, demarcate, and describe property boundaries and the extent of property rights for Canada Lands – the North, First Nations reserve lands, national parks, and offshore. With boundary certainty and a well-maintained property rights system, stakeholders can focus on community well-being and economic growth. A strong land survey system is especially significant to support Indigenous self- governance.
- The Canadian Geodetic Survey (CGS) provides the foundational positioning infrastructure, that is, a framework that facilitates the accurate measurement of latitude, longitude, elevation, and gravity in Canada. Such measurements are important not only for boundaries, but for anything for which the location matters, including all economic activities in Canada and a wide array of scientific studies and applications.
- The Canadian Section of the International Boundary Commission (IBC), in co-operation with its United States counterpart, preserves and maintains a clear and visible boundary between Canada and the United States. This work includes maintaining the boundary monuments and open vistas through forested areas, as well as regulating construction and work within 3 metres of the 8,891-kilometre boundary. Having a clear Canada-United States boundary is essential to support law enforcement agencies in ensuring the security of Canadians and preserving our sovereignty. The Canadian Section of the IBC operates under a separate reporting structure, tracking its accomplishments and year-end metrics in its own annual report (see annexes 1 and 2). This report is submitted to the United States Secretary of State and the Canadian Minister of Foreign Affairs and is also available on the IBC website.

### Program evaluation

To ensure that we are delivering on our commitments effectively and are providing high-quality products and services to our clients, the SGB regularly reports on and assesses the performance of its programs. For example, we track the progress and results of key projects that support our strategic priorities, as well as projects that help improve our daily operations. These projects are monitored through an evergreen dashboard that is updated every two months and shared with SGB management (see Annex 1).

In 2020, the SGB conducted the Client Satisfaction Survey with stakeholder groups: Canada Lands Surveyors, other government land approvers, and Indigenous end users and organizations. Overall satisfaction levels with the SGB's services and digital tools were high regardless of audience. However, respondents did identify some points for improvement. The SGB will be reviewing these items and preparing an action plan to target improvements.

In addition to the internal reporting, the SGB undergoes audits at the departmental level (except in 2020 because of the COVID-19 pandemic). The last audit on the Canada Lands Survey System (CLSS) was in 2019. We are still working to address the remaining recommendations of this audit, a few of which are described in this section, along with some of the steps taken in 2020–2021.

Following the audit's recommendations, the SGB reinstated the user feedback surveys that measure customer satisfaction with the clients' experiences with the CLSS. Reinstating the surveys is important to gather input on the effectiveness of services and tools from the perspective of key stakeholders. The research findings will be used to enhance client satisfaction with CLSS products and services and to improve the relationship with key stakeholders. The findings will provide a better understanding of how and why different client groups use these services, tools and data. The research will also be helpful in identifying priority areas for future improvements.

Furthermore, the SGB finalized and implemented the Land Surveyor Development Program (LSDP), which is an initiative that addresses NRCan's current and future needs for licensed land surveyors. The main goals are to recruit, develop and retain a diverse and inclusive workforce with the required land surveying competencies to address succession planning. The LSDP will help the SGB with succession planning and recruiting by hiring and training new graduates in land surveying for many years to come. This program also helps these graduates to obtain the work experience needed to become certified surveyors, with a focus on providing opportunities to Indigenous participants. Since 2017, the SGB has been helping staff acquire their commission and a licence to practise. Of the 15 participants in this initiative, 9 have obtained their full licence, 5 have obtained their commission and are working toward getting the field experience to be fully licensed, and 1 has left the department. Notably, 10 of the 15 participants were women.

## Strategic priorities and highlight

### Priority 1: Indigenous peoples' control of their lands

One priority that has continuously been at the centre of the SGB's work is supporting reconciliation initiatives with Indigenous communities. One way the SGB contributes to Indigenous reconciliation is through the Surveying Capacity Development program, whose purpose is to:

- increase awareness and understanding of land surveying
- provide mentoring and tools to Indigenous communities to enable better participation in surveys on First Nation lands
- encourage land surveying as a career option for Indigenous Canadians

The 2018 program's purpose is to provide hands-on, in-community training in land surveying to Indigenous Canadians. It builds upon the success of a First Nation-led project in 2015, which was a survey capacity pilot project with the Wiikwemkoong First Nation in Ontario.

Despite the impacts COVID-19 had on travel, the SGB continued to make progress on this initiative in 2020–2021. SGB staff helped to deliver 4 in-community training sessions to 4 First Nation communities, with a total of 35

participants. The SGB also delivered 67 virtual training sessions to 8 communities during the year. From these communities, two participants have completed the full 12 weeks of training as of March 31, 2021.

Given the nature of virtual training, the number of participants was not recorded. Virtual training sessions were advertised and disseminated to as broad an audience as possible. Some sessions were attended by a small number while others were attended by a larger audience with people dropping in and out during the session. In some sessions, audience participation was uncertain because cameras were off, and there was no audio participation. Consequently, no firm number of participants was tracked.

In 2020–2021, the SGB also consulted externally with a variety of groups to ensure that the program structure and training materials were developed in a way that was practical and responded to the needs of the First Nations participants.

The Ontario Regional office worked closely with the Ontario Aboriginal Lands Association to deliver survey capacity training to its members in Ontario. This collaboration included:

- engagement with the geomatics departments of the British Columbia Institute of Technology and York University
- communications with the Aboriginal Awareness committee of the Association of Canada Lands Surveyors (ACLS)
- a presentation and panel discussion at the CANDO (Council for the Advancement of Native Development Officers) annual general meeting
- a multi-day presentation about surveying, in the field, alongside Wiikwemkoong technical staff, for First Nations Land department personnel

Across the country, SGB's staff also continue to research and develop cost-effective and culturally inclusive ways to resolve boundary disputes on First Nations lands. The Boundary Dispute Resolution Unit (BDRU) is leading these efforts.

Formed in October 2018, the BDRU works with Indigenous organizations and communities to identify existing boundary issues as well as effective dispute resolution practices. In 2020–2021, the BDRU published findings on options to resolve boundary disputes and on best practices collected from international, domestic and Indigenous research and engagement. The BDRU also created a Boundary Dispute Resolution panel of senior SGB surveyors to help advance resolving long-standing boundary and tenure issues that can pose a barrier to the governance of First Nation lands.

This panel met six times in 2020–2021, hearing submissions on four natural boundary issues and reviewing case law related to official survey documents. The panel provided advice and guidance to SGB surveyors and continues to support the work on resolving several challenging issues.

The SGB also supports Canada's efforts to reinforce Indigenous peoples' authority over the land through the First Nations Land Management Framework Agreement (FNLMFA), which recognizes First Nations' right to self-govern their lands. The SGB continued to support Canada's recognition of Indigenous peoples' right of self-determination by supporting implementation of the FNLMFA.

In 2020–2021, the SGB started working with 13 First Nations that have 80 reserves, supporting the developmental phase of the community's consideration for adopting a land code under the FNLMFA. The SGB conducts

comprehensive historical research and analysis of the boundaries of reserve lands to provide a clear and unambiguous description of lands that will fall under a community's land code. As well, the SGB works with the First Nations, the First Nations Land Management Resource Centre and Indigenous Services Canada to explain and resolve legacy issues involving land and boundaries, to provide this certainty.

During the same period, the SGB also completed comprehensive research reports on the survey history of 72 reserves and completed 47 legal land descriptions for lands covered by a First Nation land code. The results were that 59 of those descriptions were approved and recorded in the Canada Lands Survey Registry (CLSR). This work is important because it helps to provide certainty over the extent of the lands a First Nation administers through the FNLMFA.

The SGB also supports the mapping of parcels that are excluded from a First Nation's Land Code under FNLMFA. Communities have the right to exclude uncertain lands from their land code. As more and more communities adopt land codes under the FNLMFA, more excluded parcels of land are created.

To provide more information about these excluded parcels, the SGB developed a method to track and display them on a unique layer on the branch's Parcel Map browser.

In Phase 1, meta-data provided by the First Nations Land Management Resource Centre was used to map all of the excluded parcels that were identified in the recorded land descriptions. In the current phase, Phase 2, the lands managed under the FNLMFA were distinguished from those managed under the Indian Act. This work was complete as of August 2021.

This mapping project has been demonstrated to Indigenous Services Canada Headquarters (ISC HQ) and the regions. Further development of the business processes regarding this project are underway between ISC HQ, the SGB and the First Nations Land Management Resource Centre and need to be fully defined. The First Nations Land Management Resource Centre is a national Indigenous organization that supports First Nations that wish to adopt land codes under the FNLMFA.

As part of our commitment to support Indigenous communities' control over their lands, the SGB continues to support Canada's negotiation and implementation of a settlement agreement for flooding damages over reserve lands. The agreement is intended to help resolve a long-standing specific claim by Indigenous peoples in Treaty 3. The settlement agreement involves 12 First Nations and surveys of flooded lands over 35 reserves in northwestern Ontario and southeastern Manitoba. These surveys involve several challenging complexities involving water boundaries and reserve creation.

## Priority 2: Spatially enabling Canada for the digital economy

Another key program at the SGB is the CGS. This program is working to improve several important systems and services that Canadians rely on, while contributing to the scientific understanding of Earth.

The CGS supports the Canadian Spatial Reference System (CSRS), which is the foundation of positioning in Canada. In 2020–2021, there were a variety of service improvements in the area of geodesy, including to our main positioning service.

The previous CSRS, Version 7, was released in 2019, providing enhanced position information and a new velocity model for epoch transformations that is sufficiently accurate for use in northern Canada. This velocity model is significant because it describes the deformation of the Earth's surface, which, over time, affects the coordinates of positions surveyed. The CSRS Version 7 also includes a new error model that enables clients and government agencies to better understand the accuracy of coordinates that have been transformed between epochs.

The CGS also provides clients with essential positioning information through the CSRS precise point positioning (CSRS-PPP) service. This service has important applications across a wide range of fields, including professional surveying and engineering, construction, glaciology, geodynamics, and marine science. In late 2020, the CSRS-PPP service was modernized with a significant new release. This service now incorporates a new capability to resolve global navigation satellite system (GNSS) signal ambiguities. Many clients will be able to obtain the required position accuracy with less data collection in the field, leading to increased efficiency and reduced costs. The CGS had to develop processes to routinely generate the necessary data products to enable this capability.

The next release of the CSRS-PPP service is in development and is expected to be released in late 2022. This release will seek to take advantage of information about the ionosphere available from nearby GNSS stations that are operated continuously. We expect that the benefits will be substantial, but will be limited to clients working mainly in southern Canada where such stations are more common.

The delivery and improvement of these products and services align with the United Nations General Assembly Resolution 69/266 (2015). The resolution emphasizes the importance of implementing "open geodetic data-sharing mechanisms for the benefit of realizing, improving and accessing the global geodetic reference frame at the national, regional and global levels." This resolution applies to nearly all of what the CGS seeks to accomplish.

**2020–2021 initiatives**

In the last year, the SGB has been involved in many initiatives, working collaboratively with numerous academic and scientific partners to improve and circulate our products and services.

In such initiatives, the CGS:

- modernized the CSRC reference system to remain consistent with the United States
- modernized a reference system involving a full redefinition of the defining characteristics of the reference frame. The definition of a reference system involves complex geoscience modelling as well as a clear understanding of client needs.
- prepared a new reference system for North America in partnership with the United States National Geodetic Survey (NGS). The CGS is working with the NGS to develop a new North American geoid model that involves extensive data exchange, knowledge transfer and regular communications. Experimental geoid models produced are now in a higher resolution than previously in Canada (i.e. one arcminute by one arcminute). Because of various constraints, the United States now expects reference system modernization (in the U.S.) to occur in the 2024–2025 timeframe. Canada will seek to align with these timelines.
- worked toward a much-needed update for the specialized reference system used for management of the Great Lakes waters. While we address issues of the CSRS and North American reference system modernization, this reference system is the International Great Lakes Datum and has historically been updated on a 25-year cycle. The current version is now over 35 years old, from 1985. It is outdated technologically and is inaccurate because of geophysical movements over the past 35+ years.

The CGS has also continued to support a range of engineering and geoscience collaborations, which includes the following:

- working with member agencies of the Canadian Geodetic Reference System Committee to deliver the CSRS to Canadians
- engaging with scientific colleagues through the Canadian Geodetic Science and Applications Committee to share important information and advance collective initiatives
- collaborating with geoscience colleagues within NRCan and with other agencies (Fisheries and Oceans Canada [DFO], ECCC) on scientific or operational issues of shared interest (such as Great Lakes water management)
- continuing to support the Canadian contribution to an international space weather consortium of Australia, Canada, France and Japan. This consortium provides space weather information to a new space weather service for civil aviation launched by the United Nations International Civil Aviation Organization.
- advancing our work with NRCan partners and Oceans Network Canada to integrate GNSS position information with seismic data for warning systems
- supporting Transport Canada's working group related to positioning needs for advanced vehicles. The CGS is participating and providing expert support.

Our strategy to spatially enable Canada involves not only assessing the benefits of the services we currently provide, but also considering future services that could be delivered.

NRCan received the final report in the summer of 2021 from an assessment conducted by an independent contractor on how precision GNSS services in Canada contribute to national competitiveness in select economic sectors.

The 2021 study builds on a study completed in 2020 that considered the benefit of a proposed free- to-user national broadcast of a GNSS augmentation signal. It also considered the incremental benefits of the federal government providing another service in addition to what is currently available from all providers (governments, academia, the private sector).

The analysis indicates that investing in such services could generate economic value of $3.3 billion (present value over 20 years) in certain economic sectors. The report also indicates that this investment will result in several scientific and social benefits. The benefits include improved water management systems; enabling safety, process controls and real-time data collection; enhanced road transport; and creating smart infrastructure and autonomous driving technologies. This study is important for the CGS because it will provide a basis for discussions and planning of future geodetic infrastructure and services.

As well, the CGS and the Government of Denmark both made virtual presentations in early 2021. This relationship is important because of the very lengthy international border between Canada and Denmark, including a disputed section. Denmark's presentation in February was entitled "GNSS infrastructure in Denmark and Greenland," and the CGS presentation in March was entitled "Canadian Geodetic/GNSS activities in the north." This event led to Denmark's increased participation in studying the evolution of the North American Plate, and we expect it will lead to improved collaboration between the countries.

## Priority 3: Northern property rights

Through the CLSS, the SGB provides the system of land surveys for the three territories. This system is the foundation and an essential component of property rights in the North and is mandated through both federal and territorial legislation.

In 2020–2021, the SGB could not work with the territorial governments to survey territorial parks because of COVID-19 health measures, including travel restrictions. Our key stakeholders had to adapt their focus to protected areas. Consequently, no territorial parks or protected areas were surveyed.

Parks, protected areas and marine protected areas provide ecological and culturally significant protection of land for northern citizens and for all Canadians. In addition to advancing Canada's environmental commitment to protect land and marine space, these efforts support reconciliation initiatives for co-management of protected areas. This work will resume when it is safe to do so.

The SGB's northern offices continue to support to territorial municipalities and territorial government departments. In 2020–2021, this support included collaborating with municipal planning authorities on survey project approvals and efficiencies.

In the Northwest Territories (N.W.T.), our regional office worked with the territorial office of the mining recorder to provide feedback and advice as they investigate options for online map staking. The territorial office of the mining recorder is responsible for regulating mining activities in their jurisdiction. They also issue prospecting permits; track and regulate mandatory regulations; and deliver mining licences and leases.

Another ongoing project that made significant advancements in the last year is the modernization of the Yukon Land Titles Office. The Yukon government released the new procedures for the Yukon Land Titles Registry in late 2019, and, in this past fiscal year, focused on system troubleshooting and refinement in preparation for the next phase – a public-facing portal.

The SGB and the Yukon Land Titles office collaborated on identifying and correcting problems while the registry system was in service. This work helps the SGB's Yukon office integrate its functions with the Yukon Land Title office, thereby reducing duplication and providing greater efficiency.

In 2020–2021, the SGB's Northwest Territory and Nunavut offices also continued their important work on collaborating with Indigenous and government partners to advance active land claim agreements.

Significant progress was made over the year on two sets of Nunavut regulations. The first event was the *Nunavut Mining Regulations* being amended. In 2020–2021, the process of staking mineral claims in Nunavut changed from a ground-based system to an online map-based system. To coincide with the amended *Nunavut Mining Regulations*, the SGB published a new chapter in the National Standards for the Survey of Canada Lands entitled Mining Surveys – Nunavut.

The second event was the signing of a devolution agreement in principle in 2019, with a final agreement anticipated in 2024. Devolution is the transfer of responsibilities from the federal government to territorial governments. The SGB supports NRCan and other government departments as they compile active land parcels. Negotiations are ongoing for the devolution of lands and resources from the Government of Canada to the Government of Nunavut.

Working with comprehensive land claim projects is tremendously important for the SGB because this facilitates building relationships with Indigenous groups, territorial governments, and other government departments such as Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC). It is also essential for northern Canadians because it ensures boundary certainty for Indigenous groups and territorial governments and helps prevent future boundary-related conflict on federal lands.

The SGB contributed to the following comprehensive land claim projects in 2020–2021:

- Funding for the Gwich'in five-year land survey program was approved in support of the Gwich'in Comprehensive Land Claim Agreement. The program will run from 2021 to 2026.
- Ghotelnene K'odtineh Dene (formerly Manitoba Denesuline)/Athabasca Denesuline Land Claim registered in the land titles office: There is a signed agreement in principle, and work is starting on a final agreement. The SGB provided support on land boundaries during the negotiation.
- The SGB supported the implementation of the Eeyou Marine Region Land Claims Agreement with legal surveys, land descriptions and advice.

## Priority 4: Protection of Canada's oceans

The SGB plays an important role by providing foundational tools and services, such as cadastral and geodetic systems, to support marine spatial management for the governance of Canada's offshore.

This year, the protection of Canada's oceans gained momentum through the federal Blue Economy Strategy (BES) launched in February 2021 by DFO. Canada recognized that "growing a sustainable blue economy requires a strategy to create jobs in coastal communities while ensuring our oceans remain healthy."

Numerous informal conversations with various federal departments have indicated that there is a need for a more comprehensive, integrated and inclusive approach to administer Canada's ocean space.

The SGB's vision is to collaborate with federal departments to build a sense of the current challenges related to administering rights, restrictions and responsibilities in the marine environment. As well, the SGB wants to develop a consensus for integrated, marine spatial governance. This model would lead to a current and complete view of the spatial extent of relationships in Canada's ocean space. The resulting regulatory clarity would reduce barriers to investment and economic development while protecting ocean ecosystems.

Furthermore, the SGB's efforts would be aligned with the recommendation of the 2019 Program Audit of the Canada Lands Surveys System (AU1905). The audit recommended creating a comprehensive strategy to assess the impacts of various modernization trends on our program and to assess whether there is a need to update key legislative instruments. This provides the impetus to support the BES and would include informally exploring the changes that would be required to the *Canada Lands Surveys Act* to advance a marine cadastre for Canada's ocean space.

The SGB also participated in developing the following standards:

- IHO S-121 Maritime Limits and Boundaries
- ISO 19152-1 Geographic information – Land Administration Domain Model (LADM) – Part 1: Fundamentals

The SGB participated in the development of a standard for international maritime limits and boundaries. This new International Hydrographic Organization (IHO) standard, IHO S-121, is used by coastal states to publish their maritime limits and boundaries. It was finalized in September 2019 and is now at the testing phase.

When the Open Geospatial Consortium (OGC) issued a call for sponsors for a maritime limits and boundaries (MLB) pilot project, the SGB and other government partners including DFO, Geoscience Australia and the UK Hydrographic Office joined in. The pilot project will research how to operationalize the IHO S-121 standard and

assess its potential in creating a marine cadastre. This OGC pilot project, completed in March 2020, helped to advance the architecture, implementation model and prototypes for sharing MLBs, while adhering to the requirements of the United Nations Convention on the Law of the Sea.

IHO and ISO standards provide conceptual models and frameworks to represent and structure the concepts related to the maritime limits and boundaries (IHO S-121) and land administration (ISO 19152-1). These standards also provide technical solutions needed to structure databases, integrate information systems and develop exchange formats.

## Responding to future challenges

In addition to delivering on its commitments and providing access to reliable survey systems, the SGB works to identify current and future challenges and their solutions.

Although the COVID-19 pandemic monopolized most of the world's and Canada's attention, the year 2021 has also been the time to reflect on Canada's heritage and legacy toward Indigenous peoples.

Other challenges include operational challenges such as rapidly evolving technology that requires vigilant monitoring of our systems, processes and standards. The SGB prioritizes this in its every day operations to stay aligned with the continuously evolving demands of industry and clients.

Furthermore, many First Nations are moving toward self-government and regaining management and control over their lands. The SGB supports these goals through initiatives such as the First Nations Land Management program and by contributing to implementing self-government agreements. We recognize that increasingly, First Nations communities need effective land management options and tools.

One of SGB's overarching goals is to support reconciliation with Indigenous peoples and make the CLSS the system of choice for First Nations. The CLSS is a reliable and robust survey system that has the flexibility to accommodate various registries and adapt to Indigenous governance requirements. The SGB must ensure that this system continues to support the needs and self-government capacity of First Nations communities across Canada.

Another challenge the SGB must adapt to is the ever-changing workplace environment. The COVID- 19 pandemic has modified the way we work, from working from home to accommodating personal and professional life. The SGB's fieldwork operations will continue to evolve in accordance with federal and provincial health guidelines. We are still in the process of implementing the return to the workplace plan while adhering to health and safety measures.

At the same time, retirements and employee scarcity are another preoccupation. As people retire, we must ensure that their knowledge and experience are effectively passed down to the next professional succession. The SGB recognizes the need to move more students into permanent positions, especially in the regions. Employee scarcity is therefore at the forefront of the SGB's priorities.

On the CGS side, identified challenges are the maintenance, modernization and replacement of critical but aging ground-based infrastructure that receives and disseminates satellite data in order to guarantee the accuracy and availability of real-time positioning, navigation and timing (PNT) information for surveying and aviation services; hazard warning monitoring systems; meteorological forecasts and climate modelling; and other geoscience applications.

The increasing need to support industry and science in expanded fields of applications has created new demands on GNSS infrastructure. It must provide higher accuracy, greater resilience to cyber attacks, improved uptime of GNSS stations to support the needs of autonomous technologies, and greater scalability of services.

Over the next few years, the CGS is planning to add at least 22 GNSS stations in key areas in Canada to begin addressing these needs. Additionally, the CGS has started modernizing its data processing environment by moving existing data to online software and services platforms, also called the "cloud." Traditional approaches of performing major infrastructure updates every decade or so are no longer sufficient. Migrating CGS data to the cloud will facilitate the necessary modernization of existing and upcoming GNSS infrastructure.

Moving forward, regular and continuous updates of infrastructure and systems through scheduled, incremental investments to avoid dependence on legacy systems will be important to maintain industry`s reliance on accurate positioning services.

One final future challenge identified by the SGB is our capacity to adapt to rapidly changing technology. We must remain up-to-date with new technology. The SGB must be agile in this complex technological era and keep innovating by operating on emerging server technologies.

However, we recognize our limited capacity in this regard. Consequently, the SGB must maintain critical physical infrastructure for operational needs. This means having adequate broadband access to deliver effectively in our new digital economy. The SGB will adapt its practices and implement new technologies to remain effective.

The SGB will continue to support the development of Canada's post-pandemic economical recovery plan and do its part to contribute positively to society. In addition to advancing reconciliation with Indigenous peoples, the SGB's priorities will include supporting partners such as CIRNAC, the Government of Nunavut, and the Government of the Northwest Territories through the devolution process.

The SGB will continue to engage with partners on a unified vision of a Canadian marine cadastre to support the administration of the sovereignty of Canada's offshore regions.

On the geodetic front, the SGB plans to pursue new strategic alliances and provide national leadership on PPP services. The CGS will also continue to improve the CSRS-PPP service and work on increasing the number of GNSS stations across Canada. The additional data from new stations will increase the accuracy and availability of real-time PNT for positioning services, meteorological forecasts, climate modelling, and other geoscience applications.

## Building human resources capacity

SGB's staff are spread out across Canada, operating out of 10 regional offices and a main office in Ottawa. By working in proximity to our clients and stakeholders, we are able to strengthen collaboration and remain cognizant of regional needs and priorities.

The SGB's work requires a high level of professional and technical expertise, which led to award recognition for some employees (see Annex 3).

In 2020–2021, our 168 employees were distributed across 13 occupational groups (see Annex 5 for a list).

Approximately 50 employees are eligible to retire within the next 5 years. In 2020–2021, nine employees retired, following nine retirements in 2019–2021 and eight in 2018–2019. In response to the increasing number of upcoming retirements, the branch has developed a Strategic Human Resources Plan to staff 34 positions from 2018 to 2022. This plan is intended to outline various employment considerations, risks, strategies and actions that can be taken to backfill important positions that may become vacant.

The LSDP was approved by NRCan Human Resources in January 2021 and presented to the SGB Management Board and unit managers. Two candidates joined the program. One person has received a Canada Lands Surveyors commission and is well on the way to getting her licence to practise, and the other person has written exams for obtaining his commission. The LSDP will be presented to the SGB employees and will be used by managers in their recruitment and retention efforts.

In recent years, the Geodetic Survey has been seeing a significant number of retirements and rapid hiring. In 2020–2021, five employees were hired. Two EN-SUR-2 employees were hired in the late summer of 2020 and two additional employees were hired at the EN-SUR-1 level in early 2021. These four new employees will eventually relocate to Ottawa, but have not yet done so because of the pandemic. An additional EN-SUR employees was hired in May 2021. These five employees constitute about 15% of the division, which is an unusually high rate of change for an organization that has experienced few changes in the past several years.

Looking forward, the main challenge in terms of geodetic capacity will be adapting to the retirement of several members of the management team. From a team of seven managers, two will leave in the summer of 2021, and others will leave in 2022 and 2023. These departures will create some disruption but also create opportunities for advancement for other members of the team.

## Annex 1. SGB projects

The following table lists the 26 ongoing projects identified in the 2020–2023 Integrated Business Plan. Much progress has been made on these files, but some will require more time than initially planned. These delays are due to a number of circumstances, including the COVID-19 pandemic. The SGB dashboard for 2020–2021 and new projects will also be managed through the SGB's upcoming 2020–2023 integrated business plan.

| # | Project | Project description |
|---|---|---|
| 1 | Modernization of the *Canada Lands Surveyors Act* | Finalize the amendments to the Canada Lands Surveyors Act (the Act) to respond to the request submitted by the ACLS and to modernize the legislative framework supporting the Canada Lands Surveyors profession. The Act has not been revised since it cameinto force in 1999. |
| 2 | Developing an MOU with the FNLM Resource Centre | Negotiate an intergovernmental Agreement with the First Nations Land Management Lands Advisory Board and Resource Centre related to the specifications for the description of lands for transactions recorded in the First Nations Lands Registry. |

| # | Project | Project description |
|---|---|---|
| 3 | Renew Framework Accord with Indigenous Services Canada (ISC) | Renewal of an interdepartmental agreement with Indigenous Services Canada, related to cooperation on legal survey projects and the specifications for the descriptions of lands for transactions recorded in the Indian Lands Registry. This will also address a recommendation from the audit report of the CLSS program. |
| 4 | Modernize the production of GNSS orbit and clock products | Current POD packages operated by the CGS are limited to GPS and/or GLONASS constellations and have reached their efficiency limits. The newly acquired software Gipsy-X will consolidate the production of all POD product lines and enable processing of emerging constellations, upholding the quality of NRCan's international contributions and supporting CGS clients acquiring signals from multiple constellations. |
| 5 | Increase the accuracy and efficiency of the CSRS-PPP service | The CSRS-PPP service allows GNSS users to collect data in the field, upload this data to NRCan, and within minutes receive an estimate of their positions, along with quality estimates and visual reports. The service is being modernized to include ambiguity resolution (PPP-AR), faster convergence using external ionospheric information, and the processing of new signals and constellations (Galileo and GPS L5). |
| 6 | Co-develop the North American 4D Spatial Reference System | Contribute to development of a North American 4D spatial reference system in collaboration with the US National Geodetic Survey (NGS) and the Mexican Instituto Nacional de Estadística y Geografía (INEGI). This work includes definition of the North American Terrestrial Reference Frame of 2022 (NATRF2022) and the North American-Pacific Geopotential Datum of 2022. (NAPGD2022). |
| 7 | Collaborate with provinces and territories toward an improved unified reference frame | Set the ground work for the provincial, territorial and federal geodetic agencies to adopt NATRF2022 across Canada at the same time as the US and maintain a unified reference frame thereafter. This will ready Canada for ubiquitous instantaneous, sub-decimetre GNSS positioning. |
| 8 | Update Canada's gravity standardization net to the International Gravity Reference System | Integrate the Canadian Gravity Standardization Net (CGSN) within the new International Gravity Reference System (IGRS) recently adopted by the International Association of Geodesy (IAG). The new standard is based on absolute gravimetry. The Canadian network was last adjusted nationally in the 1970s under the IGSN71 standard. |

| # | Project | Project description |
|---|---|---|
| 9 | Improve real-time GNSS precise positioning services for public safety geosciences | Public safety geosciences (e.g. tsunami and earthquake early warning systems) are increasingly reliant on high precision real- time GNSS-based positioning. Current CGS real-time products are GPS only. A robust contribution to these systems requires the integration of other GNSS constellations (GLONASS, Galileo) and new system products such as optimized combined coordinate streams and regional ionosphere data products. |
| 10 | Meet ICAO requirements for space weather monitoring and ionospheric products | NRCan's Canadian Hazards Information Services (CHIS) is contributing space weather services for the International Civil Aviation Organization (ICAO). The GNSS ionospheric products needed to support ICAO and needed for the CHIS space weather webpage are provided by CGS. This project seeks to meet requirements and improve these ionospheric products by developing support for multi-GNSS constellations. |
| 11 | Analyze gaps and identify options for Canada's geodetic observing infrastructure | Develop options for national positioning services and infrastructure as part of the international geodetic infrastructure for reference systems and measuring our changing Earth. This would contribute to a larger PNT collaborative effort. |
| 12 | Expanded use of digital plans in the North | The project consists of work with the Territorial Land Registry of Yukon to allow for the adoption of digital plans. The Yukon SGB office is preparing digital plan guidelines for surveyors, which have been developed in conjunction with the Yukon Land Title Office. |
| 13 | Land knowledge capacity in CLCA areas | Collaborate with beneficiary organizations, territorial governments and other federal government departments to build a framework for enhancing local capacity to work with geospatial land information. This project will identify stakeholders, categorize common objectives and facilitate the development of a framework that can be implemented. |
| 14 | Support the modernization of Nunavut mining regulations | For Nunavut, this project is the continuation of the project Support modernization of NU and NT mining regulations from the previous integrated business plan. The SGB will continue to support Nunavut as it moves toward a map selection process for its mining regulations. |
| 15 | Support the northern land titles modernization and Integration | Each territory is at various stages of modernizing their land titles systems and how they operate with the CLSS. This project will support and contribute in the modernization and integration of each territorial land titles system, as well as enable stakeholder participation. |

| # | Project | Project description |
|---|---|---|
| 16 | Develop a Canadian marine cadastre governance framework to ensure communication and collaboration between federal agencies that have offshore responsibilities and rights | The aim of this project is to organize a workshop with various partners with an interest in the marine area to develop a governance framework and stimulate a desire among partners to contribute, via their data, to a marine cadastre. |
| 17 | Develop a plan of action to migrate ArcMap to the ArcGIS Pro environment | The main objective of this project is to develop a plan of action to be ready for the software migration from ArcMap to the Arc GIS Pro. Our current GIS environment uses the ArcMap and ArcObjects, but these are no longer enhanced by ESRI and are only maintained for fixing problems. |
| 18 | Facilitate the exchange of knowledge within the International Boundary Commission | Improve access to the IBC data from our portal (internal and external), and to the methods used for field data capture and integration into IBC files. |
| 19 | Client satisfaction questionnaire | Working with the NRCan Communications and Portfolio Sector, the SGB will reinstitute biannual user feedback surveys to seek input on the effectiveness of our services and tools and unmet user needs from key stakeholders and end users, specifically land surveyors, other government departments, Indigenous organizations, Indigenous end users, and territorial governments. |
| 20 | Communication strategy with stakeholders | The SGB will develop and implement a formal communications strategy to align with stakeholders' requests for greater person-to- person contact. The SGB supports and recognizes the benefits of in-person communications. Increased in-person liaison with stakeholders will require travel by SGB staff. This factor presents challenges that will be overcome through strategic engagement planning and participation in targeted events. The SGB will also formally track in-person communication efforts to better document efforts and to identify regional or user-group gaps. |
| 21 | Develop an impact assessment of emerging modernization trends within the Canada Lands Survey System environment | This project will develop and implement a comprehensive strategy to assess the impact of various modernization trends emerging within the CLSS environment and to assess whether there is a need to update key legislative instruments. This project will be performed in collaboration with the territories and provinces and Indigenous communities. |

| # | Project | Project description |
|---|---|---|
| 22 | Develop a plan to migrate, manage and preserve SGB digital imagery by using the NRCan EODMS | The goal of this project is to make all the digital aerial photography collected by the SGB since 2007 available to the public. The Canada Centre for Mapping and Earth Observation (CCMEO) has developed the Earth Observation Data Management System (EODMS), which makes discoverable and downloadable digital imagery, including digital aerial photography. Working with CCMEO, the SGB is organizing, structuring and uploading its digital aerial photography into this management system. |
| 23 | Modernize CLSS and CGS applications to align with the GC Application Modernization and Cloud First initiatives | To comply with the government of Canada's Application Modernization Project and Cloud First Adoption Strategy, the SGB line-of-business applications need to be migrated to suitable approved end-state environments, either in the NRCan-managed commercial cloud or in the SSC enterprise data centres. This project entails assessing the technical suitability, security and on- going costs of running the applications in the proposed end-state environments. The project also assesses transforming or replacing legacy applications and migrating the applications and data to the selected end-states with minimum interruption to services. |
| 24 | Implement a trusted digital repository | The trusted digital repository (TDR) is being modifies to focus on developing redundant digital preservation components to reduce the risk to CLSR digital records. Once this component is in place, work will focus on longer term solutions. This focus on redundant digital preservation will eliminate dependency on microfilm. To date, development of a TDR based on GCDocs has been unsuccessful despite numerous attempts. Because the GCDocs environment is currently under evaluation to determine if it will be maintained with NRCan's move to Office365, the project will stop working with this software and focus on alternative cloud-powered options. |
| 25 | Road map and implementation of CLSS IT strategies | The goal of this project is to finish migrating the CLSS applications to the Windows 2016 server platform to comply with the Windows 2008 decommissioning project. |
| 26 | Land Surveyor Development Program | The LSDP will help with succession planning and recruiting by hiring and training new graduates in land surveying. This program also aims to help the new employees obtain the work experience needed to acquire their commission and licence to practise as a Canada Lands Surveyor. |

## Annex 2. Program metrics

SGB metrics – Canada Lands Survey System

### General metrics

To maintain the Canada Lands Survey System and the land registries across Canada, the SGB conducts various important daily operations represented by the metrics in the following table. This work provides the foundation for all of the projects and programs which support the SGB's four strategic priorities.

| Measured output | 2020–2021 |
|---|---|
| New parcels created in cadastral datasets | 5,876 |
| Parcels maintained | 317,691 |
| Survey instructions issued | 707 |
| Documents registered in the CLSR | 1,282 |

### Saskatchewan Treaty Land Entitlemen

Treaty Land Entitlement claims can be submitted by First Nations that did not receive all the land they were entitled to under treaties signed by the Crown. In Saskatchewan, much of this land has already been surveyed in the province's township system. The SGB is responsible for reviewing these parcels to identify and resolve any ambiguities or related issues.

| Measured output | 2020–2021 |
|---|---|
| Area of parcels described | 4,423 ha |
| Lands added to the reserve to date | 357,238 ha |

### Manitoba Treaty Land Entitlement

In Manitoba, a significant proportion of the treaty land First Nations are entitled to has yet to be surveyed. The SGB is responsible for surveying this Crown land to define land selections and ensure that Canada adheres to its treaty obligations. The progress of this work is measured by the metrics in the following table.

| Measured output | 2020–2021 |
|---|---|
| Area surveyed | 4,980 ha |
| Lands added to the reserve to date | 228,498 ha |

### FNLM metrics

These metrics represent the work carried out to help provide certainty over the extent of lands a First Nation administers through the FNLMFA.

| Measured output | 2020–2021 |
|---|---|
| Land descriptions | 62 completed<br>59 approved and recorded in the CLSR |
| Research reports completed | 72 |

**Interdepartmental letters of agreement and survey contracts to the private sector**

To support the mandate and obligations of our partners in other government departments, certain SGB activities are carried out at cost recovery. The figures in the following table are indicators of the work accomplished in this context. The majority of survey contracts issued to the private industry are a result of these interdepartmental letters of agreement.

| Measured output | 2020–2021 |
|---|---|
| **Interdepartmental letters of agreement** | |
| Letters of agreement | 30 |
| Value | $ 3,333,191 |
| **Survey contracts to the private sector** | |
| Contracts | 112 |
| Value | $ 1,837,914 |

## SGB metrics – Canadian Geodetic Survey

The following metrics are derived from the CGS Performance Indicator Profile and will serve as a key reference point for future evaluations. These indicators are used to monitor CGS' accomplishments and results from year to year. They are aligned with the division's expected immediate outcomes (providing accessible, accurate and timely geodetic information) and intermediate outcomes (georeferencing to a common Canadian reference system consistent with international standards).

| Measured output | Target | 2020–2021 |
|---|---|---|
| **Accessible, accurate and timely geodetic information** | | |
| GNSS stations for which data is distributed | ≥ 112 | 137 |
| Accuracy of GNSS orbits with respect to international standards | < 2 cm | 1.28 cm |
| Précision horizontale des produits GNSS en temps réel | <10 cm 95% of the time | 7.55 cm |

| Measured output | Target | 2020–2021 |
|---|---|---|
| GNSS stations used for reference frame and velocity computations | > 330 | 335 |
| Accuracy of the Canadian Gravity Standardization Network | < 10 micro Gals | 5 micro Gals |
| Availability of CACS daily data files (within 30 minutes after the end of the day) | > 95 % | 99,86 % |
| Availability of rapid orbit and clock products (within 12 hours after the end of the day) | ≥ 95 % | 100,00 % |
| **Georeferencing to a common Canadian reference system consistent with international standards** | | |
| Direct users of CGS data products | ≥ 7 000 | 9,464 |
| Requests for CGS products and services | 300,000 | 581,693 |
| Commercial GNSS reference stations monitored by the CGS as part of the RTK compliance program | > 500 | 704 |

## Annex 3. Awards

Awards received by SGB staff throughout 2020–2021

| Recipients | Award description |
|---|---|
| **Division awards (instant awards)** | |
| Philippe Lamothe | For exceptional work developing and implementing the modernized CSRS-PPP v3 service / GIS Team |
| Justin Farinaccio | |
| Elyes Hassen | |
| Simon Banville | |
| Rémi Ferland | For his single-handed development of two generations of SINEX software |
| Bianca D'Aoust | For outstanding work coordinating the 2020 pandemic-year LMS Charitable Campaign (over 700 employees) |

| Recipients | Award description |
|---|---|
| Kristina Yuzva-Clement | For recognition of outstanding dedication and effort in the Gwich'in Land Survey Program |
| **Department award for career achievement** | |
| Cameron Twa | For their involvement on the COVID-19 North Working Group |
| Mark Hatcher | |
| **Department award for career achievement (June 2020)** | |
| Roberta Holtner | For outstanding achievement team award for SINEWS |
| **NRCan departmental achievement award (October 2020)** | |
| Roberta Holtner | For impact award on leadership in innovation for SINEWS |

## Annex 4. Publications


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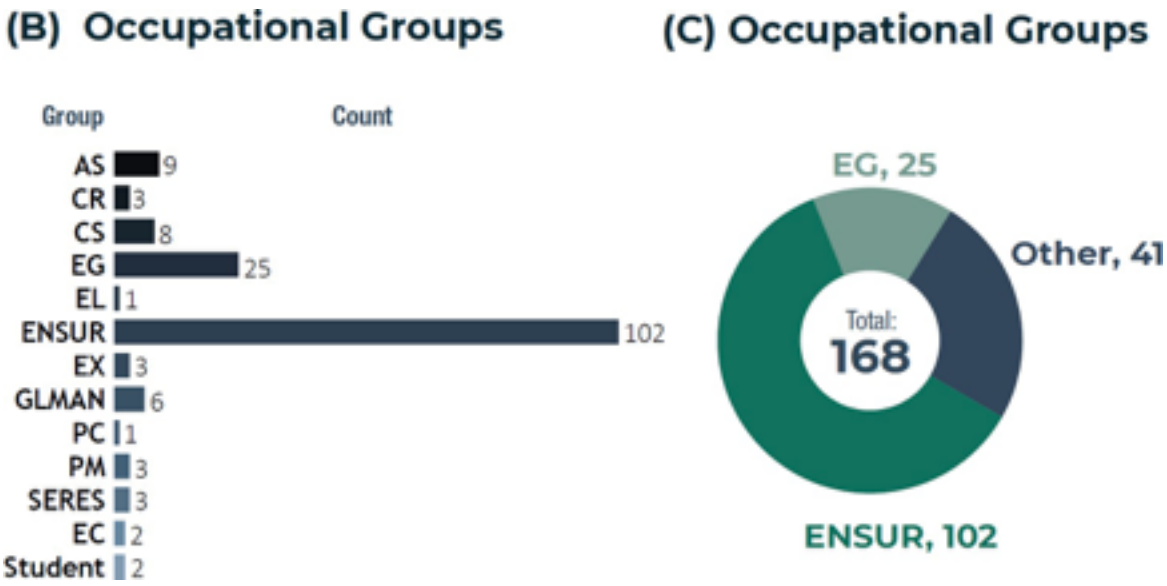
## Annex 5. Human resources data

The following table provides a breakdown of all SGB occupational groups with the number (Count) of employees in 2020–2021. Both of the following figures offer further analysis of occupational groups during the same period.

**Occupational groups**

| Group | Count |
|---|---|
| AS | 9 |
| CR | 3 |
| CS | 8 |
| EG | 25 |
| EL | 1 |
| ENSUR | 102 |
| EX | 3 |
| GLMAN | 6 |
| PC | 1 |
| PM | 3 |
| SERES | 3 |
| EC | 2 |
| Student | 2 |
| **Total** | **168** |

**Reference**




## Annex 6. Abbreviations

| | |
|---|---|
| ACLS | Association of Canada Lands Surveyors |
| AGM | Annual general meeting |
| BDRU | Boundary Dispute Resolution Unit |
| BES | Blue Economy Strategy |
| CANDO | Council for the Advancement of Native Development Officers |
| CGS | Canadian Geodetic Survey |
| CHIS | Canadian Hazards Information Services |
| CHS | Canadian Hydrographic Service |
| CIRNAC | Crown-Indigenous Relations and Northern Affairs Canada |
| CLSR | Canada Lands Survey Records |
| CLSS | Canada Lands Survey System |
| COVID-19 | Coronavirus disease 2019 |
| CSRS | Canadian Spatial Reference System |
| DFO | Department of Fisheries and Oceans |
| ECCC | Environment and Climate Change Canada |
| FNLM | First Nations Land Management |
| FNLMFA | First Nations Land Management Framework Agreement |
| GNSS | Global Navigation Satellite System |
| GPS | Global Positioning System |
| IBC | International Boundary Commission |
| IHO | International Hydrographic Organization |
| ISC HQ | Indigenous Services Canada, Headquarters |
| ISO | International Organization for Standardization |
| LADM | Land Administration Domain Model |
| LSDP | Land Surveyor Development Program |
| MLB | Maritime limits and boundaries |
| MSDI | Marine spatial data infrastructure |
| NGS | National Geodetic Survey |
| NRCan | Natural Resources Canada |
| N.W.T. | Northwest Territories |
| OGC | Open Geospatial Consortium |
| PNT | Positioning, navigation and timing |
| PPP | Precise point positioning |
| S&T | Science and technology |
| SGB | Surveyor General Branch |
| US | United States |

## Annex 7. Contact us

### Head Offices

**Surveyor General office**
Natural Resources Canada 2nd Floor
588 Booth Street Ottawa ON K1A 0Y7
Surveyor General: Jean Gagnon
Tel.: 343-292-6642
Fax: 613-947-1388
Email: jean.gagnon@NRCan-RNCan.gc.ca

**Northern Canada division**
Natural Resources Canada Suite 225, 2nd Floor
300 Main Street Whitehorse YT Y1A 2B5
Deputy Surveyor General: Mark Hatcher
Tel.: 867 333-3387
Fax: 867-393-6709
Email: mark.hatcher@NRCan-RNCan.gc.ca

**Eastern Canada division**
Natural Resources Canada 2nd Floor
588 Booth Street Ottawa ON K1A 0Y7
Deputy Surveyor General: Martin Gingras
Tel.: 613-899-6611
Fax: 613-947-1388
Email: martin.gingras@NRCan-RNCan.gc.ca

**Canadian Geodetic Survey**
Natural Resources Canada 2nd Floor
588 Booth Street Ottawa ON K1A 0Y7
Chief Geodesist of Canada: Dr. Calvin Klatt
Tel.: 343-292-6638
Fax: 613-947-1388
Email: calvin.klatt@NRCan-RNCan.gc.ca

**Western Canada division**
Natural Resources Canada Suite 1501, 15th Floor 1138
Melville Street Vancouver BC V6E 4S3
Deputy Surveyor General: Steve Minnie
Tel.: 604-666-3517
Fax: 604-666-0522
Email: steve.minnie@NRCan-RNCan.gc.ca

**International Boundary Commission – Canadian section**
Natural Resources Canada 2nd Floor
588 Booth Street Ottawa ON K1A 0Y7
Canadian Commissioner: Jean Gagnon
Tel.: 343-292-6642
Fax: 613-947-1388
Email: jean.gagnon@NRCan-RNCan.gc.ca

### Regional offices

**Atlantic regional office**
Natural Resources Canada Suite 100
136 Victoria Street E Amherst NS B4H 1Y1
Manager: Ronald Robichaud
Tel.: 902-661-6766
Fax: 902-661-6769
Email: ronald.robichaud@NRCan-RNCan.gc.ca

**Alberta regional office**
Natural Resources Canada 2nd Floor, Room 2081
5320 122nd Street NW Edmonton AB T6H 3S5
Manager: David Young
Telephone: 825-510-1324
Fax: 825-510-1121
Email: david.young2@NRCan-RNCan.gc.ca

**Quebec regional office**
Natural Resources Canada 2nd Floor, Room 203
320 Saint-Joseph Street E Quebec QC G1K 8G5
Manager: Eric Groulx
Tel.: 418-648-7681
Fax: 418-648-5728
Email: eric.groulx@NRCan-RNCan.gc.ca

**British Columbia regional office**
Natural Resources Canada 15th Floor, Suite 1501 1138
Melville Street Vancouver BC V6E 4S3
Manager: Cade Brown
Tel.: 604-666-2999
Fax: 604-666-0522
Email: cade.brown@NRCan-RNCan.gc.ca

**Ontario regional office**
Natural Resources Canada 300-655 Bay Street
PO BOX 15
Toronto ON M5G 2K4
Manager: Gavin Lawrence
Tel.: 416-527-9155
Fax: 416-973-1004
Email: gavin.lawrence@NRCan-RNCan.gc.ca

**Northwest Territories regional office**
Natural Resources Canada Room 2-230-4
5101 50th Avenue
PO BOX 668
Yellowknife NT X1A 2N5
Manager: Cameron Twa
Tel.: 867-445-2784
Fax: 867-766-8533
Email: cameron.twa@NRCan-RNCan.gc.ca

**Manitoba regional office**
Natural Resources Canada 2nd Floor, Room 250
365 Hargrave Street Winnipeg MB R3B 2K3
Manager: Keith Norek
Tel.: 204-983-3793
Fax: 204-983-0157
Email: keith.norek@NRCan-RNCan.gc.ca

**Nunavut regional office**
Natural Resources Canada Suite 100
1093 Governor Street
PO BOX 2380
Iqaluit NU X0A 0H0
Manager: William Crews
Tel.: 825-510-1332
Fax: 867-975-6624
Email: william.crews@NRCan-RNCan.gc.ca

**Saskatchewan regional office**
Natural Resources Canada 701-1783 Hamilton Street
Regina SK S4P 2B6
Manager: Akbarali Karsan
Tel.: 306-780-5402
Fax: 306-780-5191
Email: akbarali.karsan@NRCan-RNCan.gc.ca

**Yukon regional office**
Natural Resources Canada Suite 225, 2nd Floor
300 Main Street Whitehorse YT Y1A 2B5
Manager: Elden Pfeiffer
Tel.: 867 667-3958
Fax: 867-393-6709
Email: elden.pfeiffer@NRCan-RNCan.gc.ca