



RETURN BIDS TO:

RETOURNER LES SOUMISSIONS À:

Travaux publics et Services gouvernementaux
Canada

Place Bonaventure,

800 rue de la Gauchetière Ouest

Voir aux présentes - See herein

Montréal

Québec

H5A 1L6

FAX pour soumissions: (514) 496-3822

REQUEST FOR PROPOSAL

DEMANDE DE PROPOSITION

**Proposal To: Public Works and Government
Services Canada**

We hereby offer to sell to Her Majesty the Queen in right of Canada, in accordance with the terms and conditions set out herein, referred to herein or attached hereto, the goods, services, and construction listed herein and on any attached sheets at the price(s) set out therefor.

**Proposition aux: Travaux Publics et Services
Gouvernementaux Canada**

Nous offrons par la présente de vendre à Sa Majesté la Reine du chef du Canada, aux conditions énoncées ou incluses par référence dans la présente et aux annexes ci-jointes, les biens, services et construction énumérés ici sur toute feuille ci-annexée, au(x) prix indiqué(s).

Comments - Commentaires

Vendor/Firm Name and Address

Raison sociale et adresse du

fournisseur/de l'entrepreneur

Issuing Office - Bureau de distribution

Travaux publics et Services gouvernementaux Canada

Place Bonaventure, portail Sud-Oue

800, rue de La Gauchetière Ouest

7e étage, suite 7300

Montréal

Québec

H5A 1L6

Title - Sujet EOSC - Pre-concept Studies	
Solicitation No. - N° de l'invitation 9F044-190081/A	Date 2020-02-06
Client Reference No. - N° de référence du client 9F044-190081	
GETS Reference No. - N° de référence de SEAG PW-\$MTB-550-15642	
File No. - N° de dossier MTB-9-42040 (550)	CCC No./N° CCC - FMS No./N° VME
Solicitation Closes - L'invitation prend fin at - à 02:00 PM on - le 2020-03-20	Time Zone Fuseau horaire Heure Normale du l'Est HNE
F.O.B. - F.A.B. Plant-Usine: <input type="checkbox"/> Destination: <input type="checkbox"/> Other-Autre: <input type="checkbox"/>	
Address Enquiries to: - Adresser toutes questions à: Mirfatahi, Kaveh	Buyer Id - Id de l'acheteur mtb550
Telephone No. - N° de téléphone (514) 260-4106 ()	FAX No. - N° de FAX (514) 496-3822
Destination - of Goods, Services, and Construction: Destination - des biens, services et construction: AGENCE SPATIALE CANADIENNE 6767 ROUTE DE L AEROPORT ST HUBERT Québec J3Y8Y9 Canada	

Instructions: See Herein

Instructions: Voir aux présentes

Delivery Required - Livraison exigée Voir doc.	Delivery Offered - Livraison proposée
Vendor/Firm Name and Address Raison sociale et adresse du fournisseur/de l'entrepreneur	
Telephone No. - N° de téléphone Facsimile No. - N° de télécopieur	
Name and title of person authorized to sign on behalf of Vendor/Firm (type or print) Nom et titre de la personne autorisée à signer au nom du fournisseur/ de l'entrepreneur (taper ou écrire en caractères d'imprimerie)	
Signature	Date

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9F044-190081/A
Client Ref. No. - N° de réf. du client
9F044-190081

Amd. No. - N° de la modif.
File No. - N° du dossier
MTB-9-42040

Buyer ID - Id de l'acheteur
mtb550
CCC No./N° CCC - FMS No./N° VME

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PART 1 - GENERAL INFORMATION

1.1 Introduction

The bid solicitation is divided into seven parts plus attachments and annexes, as follows:

- Part 1 General Information: provides a general description of the requirement;
- Part 2 Bidder Instructions: provides the instructions, clauses and conditions applicable to the bid solicitation;
- Part 3 Bid Preparation Instructions: provides Bidders with instructions on how to prepare their bid;
- Part 4 Evaluation Procedures and Basis of Selection: indicates how the evaluation will be conducted, the evaluation criteria that must be addressed in the bid, and the basis of selection;
- Part 5 Certifications and Additional Information: includes the certifications and additional information to be provided; and
- Part 6 Security, Financial and Other Requirements: includes specific requirements that must be addressed by Bidders; and
- Part 7 Resulting Contract Clauses: includes the clauses and conditions that will apply to any resulting contract

The following Annexes:

Annex A Statement of Work
Annex B Basis of Payment
Annex C Task Authorization Form

The following Attachments:

Attachment 1 to Part 3 Electronic Payment Instructions
Attachment 1 to Part 4 Point Rated Evaluation Criteria

1.2 Summary

Project Title

Concept Studies for Earth Observation for Service Continuity

Description

Public Works and Government Services Canada (PWGSC) on behalf of Canadian Space Agency (CSA) located in St-Hubert, (Quebec), is seeking bids for Concept Studies for Earth Observation for Service Continuity.

Security Requirements

There are no security requirements associated with this requirements.

Period of Contract

The period of contract will be from the date of issue for a period of approximately twenty four (24) months.

Actual Available Budget

The maximum funding available for each contract resulting from the bid solicitation for this stream is **\$1,000,000.00 per contract** (Applicable Taxes extra, as appropriate). Annex A (Statement of Work)

includes a description of the work required. Bids valued in excess of this amount will be considered non-responsive. This disclosure does not commit Canada to pay the maximum funding available.

In this RFP, up to five (5) contracts are expected to be awarded. For additional information, please refer to Part 2, section 2.8 – Maximum Funding, of the bid solicitation.

Intellectual property

The intellectual property will vest with the Contractor.

Trade Agreements

This requirements is not subject to the trade agreements.

Canadian Content

This requirement is limited to Canadian services

Bidders' Conference

There is an optional bidders' conference associated with this requirement. Consult Part 2 – Bidder Instructions.

Electronic Bidding

This bid solicitation allows bidders to use the epost Connect service provided by Canada Post Corporation to transmit their bid electronically. Bidders must refer to Part 2 entitled Bidder Instructions, and Part 3 entitled Bid Preparation Instructions, of the bid solicitation, for further information.

1.3 Debriefings

Bidders may request a debriefing on the results of the bid solicitation process. Bidders should make the request to the Contracting Authority within 15 working days from receipt of the results of the bid solicitation process. The debriefing may be in writing, by telephone or in person.

PART 2 - BIDDER INSTRUCTIONS

2.1 Standard Instructions, Clauses and Conditions

All instructions, clauses and conditions identified in the bid solicitation by number, date and title are set out in the [Standard Acquisition Clauses and Conditions Manual](https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual) (<https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual>) issued by Public Works and Government Services Canada.

Bidders who submit a bid agree to be bound by the instructions, clauses and conditions of the bid solicitation and accept the clauses and conditions of the resulting contract.

The [2003](#) (2019-03-04) Standard Instructions - Goods or Services - Competitive Requirements, are incorporated by reference into and form part of the bid solicitation.

Subsection 5.4 of [2003](#), Standard Instructions - Goods or Services - Competitive Requirements, is amended as follows:

Delete: 60 days

Insert: 180 days

2.2 Submission of Bids

Bids must be submitted only to the Public Works and Government Services Canada (PWGSC) Bid Receiving Unit specified below by the date and time indicated on page 1 of the bid solicitation:

By mail or in person, at the following address:

Public Services and Procurement Canada
Acquisitions Directorate - Quebec Region
800, rue de la Gauchetière Ouest, Portal South-west, Suite 7300
Montréal, Quebec H5A 1L6

Bids may also be submitted using the epost Connect service as detailed in the 2003 Standard Instructions.

The following PWGSC Regional Bid Receiving Unit e-mail address is to be used for epost Connect services:

TPSGC.RQReceptionSoumissions-QRSupplyTendersReception.PWGSC@tpsgc-pwgsc.gc.ca

Note: Bids will not be accepted if emailed directly to this email address. This email address is to be used to open an epost Connect conversation, as detailed in Standard Instructions [2003](#), or to send bids through an epost Connect message if the bidder is using its own licensing agreement for epost Connect.

Due to the nature of the bid solicitation, bids transmitted by facsimile to PWGSC will not be accepted.

2.3 Former Public Servant

Contracts awarded to former public servants (FPS) in receipt of a pension or of a lump sum payment must bear the closest public scrutiny, and reflect fairness in the spending of public funds. In order to comply with Treasury Board policies and directives on contracts awarded to FPSs, bidders must provide the information required below before contract award. If the answer to the questions and, as applicable the information required have not been received by the time the evaluation of bids is completed, Canada will inform the Bidder of a time frame within which to provide the information. Failure to comply with Canada's request and meet the requirement within the prescribed time frame will render the bid non-responsive.

Definitions

For the purposes of this clause, "former public servant" is any former member of a department as defined in the *Financial Administration Act*, R.S., 1985, c. F-11, a former member of the Canadian Armed Forces or a former member of the Royal Canadian Mounted Police. A former public servant may be:

- a. an individual;
- b. an individual who has incorporated;
- c. a partnership made of former public servants; or
- d. a sole proprietorship or entity where the affected individual has a controlling or major interest in the entity.

"lump sum payment period" means the period measured in weeks of salary, for which payment has been made to facilitate the transition to retirement or to other employment as a result of the

implementation of various programs to reduce the size of the Public Service. The lump sum payment period does not include the period of severance pay, which is measured in a like manner.

"pension" means a pension or annual allowance paid under the Public Service Superannuation Act (PSSA), R.S., 1985, c. P-36, and any increases paid pursuant to the Supplementary Retirement Benefits Act, R.S., 1985, c. S-24 as it affects the PSSA. It does not include pensions payable pursuant to the Canadian Forces Superannuation Act, R.S., 1985, c. C-17, the Defence Services Pension Continuation Act, 1970, c. D-3, the Royal Canadian Mounted Police Pension Continuation Act, 1970, c. R-10, and the Royal Canadian Mounted Police Superannuation Act, R.S., 1985, c. R-11, the Members of Parliament Retiring Allowances Act, R.S. 1985, c. M-5, and that portion of pension payable to the Canada Pension Plan Act, R.S., 1985, c. C-8.

Former Public Servant in Receipt of a Pension

As per the above definitions, is the Bidder a FPS in receipt of a pension? **Yes () No ()**

If so, the Bidder must provide the following information, for all FPSs in receipt of a pension, as applicable:

- a. name of former public servant;
- b. date of termination of employment or retirement from the Public Service.

By providing this information, Bidders agree that the successful Bidder's status, with respect to being a former public servant in receipt of a pension, will be reported on departmental websites as part of the published proactive disclosure reports in accordance with Contracting Policy Notice: 2012-2 and the Guidelines on the Proactive Disclosure of Contracts.

Work Force Adjustment Directive

Is the Bidder a FPS who received a lump sum payment pursuant to the terms of the Work Force Adjustment Directive? **Yes () No ()**

If so, the Bidder must provide the following information:

- a. name of former public servant;
- b. conditions of the lump sum payment incentive;
- c. date of termination of employment;
- d. amount of lump sum payment;
- e. rate of pay on which lump sum payment is based;
- f. period of lump sum payment including start date, end date and number of weeks;
- g. number and amount (professional fees) of other contracts subject to the restrictions of a work force adjustment program.

For all contracts awarded during the lump sum payment period, the total amount of fees that may be paid to a FPS who received a lump sum payment is \$5,000, including Applicable Taxes.

2.4 Enquiries - Bid Solicitation

All enquiries must be submitted in writing to the Contracting Authority no later than ten (10) calendar days before the bid closing date. Enquiries received after that time may not be answered.

Bidders should reference as accurately as possible the numbered item of the bid solicitation to which the enquiry relates. Care should be taken by Bidders to explain each question in sufficient detail in order to enable Canada to provide an accurate answer. Technical enquiries that are of a proprietary nature must be clearly marked "proprietary" at each relevant item. Items identified as "proprietary" will be treated as such except where Canada determines that the enquiry is not of a proprietary nature. Canada may edit the question(s) or may request that the Bidder do so, so that the proprietary nature of the question(s) is eliminated and the enquiry can be answered to all Bidders. Enquiries not submitted in a form that can be distributed to all Bidders may not be answered by Canada.

2.5 Applicable Laws

Any resulting contract must be interpreted and governed, and the relations between the parties determined, by the laws in force in Quebec.

Bidders may, at their discretion, substitute the applicable laws of a Canadian province or territory of their choice without affecting the validity of their bid, by deleting the name of the Canadian province or territory specified and inserting the name of the Canadian province or territory of their choice. If no change is made, it acknowledges that the applicable laws specified are acceptable to the Bidders.

2.6 Improvement of Requirement during Solicitation Period

Should bidders consider that the specifications or Statement of Work contained in the bid solicitation could be improved technically or technologically, bidders are invited to make suggestions, in writing, to the Contracting Authority named in the bid solicitation. Bidders must clearly outline the suggested improvement as well as the reason for the suggestion. Suggestions that do not restrict the level of competition nor favour a particular bidder will be given consideration provided they are submitted to the Contracting Authority at least ten (10) days before the bid closing date. Canada will have the right to accept or reject any or all suggestions.

2.7 Bidders' Conference

A Bidders' conference will be held at 6767 Route de l'Aéroport, St-Hubert, Qc, J3Y 8Y9 on **March 4, 2020**. The conference will begin at 1:00 PM EST. The scope of the requirement outlined in the bid solicitation will be reviewed during the conference and questions will be answered. It is recommended that bidders who intend to submit a bid attend or send a representative.

Bidders should provide, in writing, to the Contracting Authority, the name(s) of the person(s) who will be attending and a list of issues or questions they wish to table no later than **March 2, 2020** at 10:00 AM EST.

For any foreign national Bidder's representative(s), the bidder **must** provide to the Contracting Authority the full name of the foreign person(s) attending, passport number and date of birth no later than **February 21, 2020** at 1:00 PM EST.

Any clarifications or changes to the bid solicitation resulting from the bidders' conference will be included as an amendment to the bid solicitation. Bidders who do not attend will not be precluded from submitting a bid.

2.8 Maximum Funding

The maximum funding available for each contract resulting from the bid solicitation, for this stream, is **\$1,000,000.00** (Applicable Taxes extra, as appropriate). The breakdown is as follows (A Firm-Fixed Price of **\$350,000** for the work described in Annex A SOW sections 3.2.1 and 3.2.6, **\$150,000.00** for the Task Authorization part described in Annex A SOW section 3.2.2 and **\$500,000.00** for the Optional Service part of the work described in sections 3.2.3, 3.2.4 and 3.2.5. Bids valued in excess of this amount will be considered non-responsive. This disclosure does not commit Canada to pay the maximum funding available. A maximum of 5 contracts* are expected to be awarded.

*Note: A maximum of 5 contracts are expected to be awarded under this RFP. For additional information, please refer to Part 4 - Evaluation Procedures and Basis of Selection.

PART 3 - BID PREPARATION INSTRUCTIONS

3.1 Bid Preparation Instructions

If the Bidder chooses to submit its bid electronically, Canada requests that the Bidder submits its bid in accordance with section 08 of the 2003 standard instructions. Bidders must provide their bid in a single transmission. The epost Connect service has the capacity to receive multiple documents, up to 1GB per individual attachment.

The bid must be gathered per section and separated as follows:

Section I: Technical and Management Bid
Section II: Financial Bid
Section III: Certifications

If the Bidder chooses to submit its bid in hard copies, Canada requests that the Bidder submits its bid in separately bound sections as follows:

Section I: Technical and Management Bid (2 hard copies and 1 soft copy on USB)

Section II: Financial Bid (2 hard copies and 1 soft copy on USB)

Section III: Certifications (2 hard copies and 1 soft copy on USB)

If there is a discrepancy between the wording of the soft copy on electronic media and the hard copy, the wording of the hard copy will have priority over the wording of the soft copy.

If the Bidder is simultaneously providing copies of its bid using multiple acceptable delivery methods, and if there is a discrepancy between the wording of any of these copies and the electronic copy provided through epost Connect service, the wording of the electronic copy provided through epost Connect service will have priority over the wording of the other copies.

Due to the nature of the bid solicitation, bids transmitted by facsimile will not be accepted.

Prices must appear in the financial bid only. No prices must be indicated in any other section of the bid.

Canada requests that bidders follow the format instructions described below in the preparation of hard copy of their bid:

- (a) use 8.5 x 11 inch (216 mm x 279 mm) paper;
- (b) use a numbering system that corresponds to the bid solicitation.

In April 2006, Canada issued a policy directing federal departments and agencies to take the necessary steps to incorporate environmental considerations into the procurement process [Policy on Green Procurement](https://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=32573) (<https://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=32573>). To assist Canada in reaching its objectives, bidders should:

- 1) use 8.5 x 11 inch (216 mm x 279 mm) paper containing fibre certified as originating from a sustainably-managed forest and containing minimum 30% recycled content; and
- 2) use an environmentally-preferable format including black and white printing instead of colour printing, printing double sided/duplex, using staples or clips instead of cerlox, duotangs or binders.

Section I: Technical and Management Bid

In their technical bid, Bidders should demonstrate their understanding of the requirements contained in the bid solicitation and explain how they will meet these requirements. Bidders should demonstrate their capability and describe their approach in a thorough, concise and clear manner for carrying out the work.

The technical bid should address clearly and in sufficient depth the points that are subject to the evaluation criteria against which the bid will be evaluated. Simply repeating the statement contained in the bid solicitation is not sufficient. In order to facilitate the evaluation of the bid, Canada requests that Bidders address and present topics in the order of the evaluation criteria under the same headings. To avoid duplication, Bidders may refer to different sections of their bids by identifying the specific paragraph and page number where the subject topic has already been addressed.

In their management bid, Bidders must describe their capability and experience, the project management team and provide client contact(s).

Section II: Financial Bid

3.1.1 Bidders must submit their financial bid in accordance with the Pricing Schedule detailed in the Basis of Payment in Annex B.

3.1.2 Electronic Payment of Invoices – Bid

If you are willing to accept payment of invoices by Electronic Payment Instruments, complete Attachment 1 to Part 3 – Electronic Payment Instruments, to identify which ones are accepted.

If Attachment 1 to Part 3 – Electronic Payment Instruments is not completed, it will be considered as if Electronic Payment Instruments are not being accepted for payment of invoices.

Acceptance of Electronic Payment Instruments will not be considered as an evaluation criterion.

Price must be in Canadian funds, Applicable Taxes excluded and Canadian customs duties and excise taxes included.

3.1.3 Price Breakdown

Bidders are requested to detail the following elements for expenses in the performance of each task, milestone or phase of the Work, as applicable:

- (a) Labour: For each individual and (or) labour category to be assigned to the Work, indicate: i) the hourly rate, inclusive of overhead and profit; and ii) the estimated number of hours.

- (b) Equipment: Specify each item required to complete the Work and provide the pricing basis of each one, Canadian customs duty and excise taxes included, as applicable.
- (c) Materials and Supplies: Identify each category of materials and supplies required to complete the Work and provide the pricing basis.
- (d) Travel and Living Expenses: Indicate the number of trips and the number of days for each trip, the cost, destination and purpose of each journey, together with the basis of these costs which must not exceed the limits of the National Joint Council (NJC). With respect to the NJC's Directive, only the meal, private vehicle allowances specified in Appendices B, C and D of the Directive <http://www.njc-cnm.gc.ca/directive/travelvoyage/index-eng.php>, and the other provisions of the Directive referring to "travellers", rather than those referring to "employees", are applicable. The Treasury Board Secretariat's Special Travel Authorities, http://www.tbssct.gc.ca/pubs_pol/hrpubs/tbm_113/statb-eng.asp, also apply.
- (e) Subcontracts: Identify any proposed subcontractor and provide for each one the same price breakdown information as contained in this article.
- (f) Other Direct Charges: Identify any other direct charges anticipated, such as long distance communications and rentals, and provide the pricing basis.
- (g) Applicable Taxes: Identify any Applicable Taxes separately.

3.1.4 Exchange Rate Fluctuation

C3011T (2013-11-06) Exchange Rate Fluctuation

Section III: Certifications

Bidders must submit the certifications and additional information required under Part 5.

PART 4 - EVALUATION PROCEDURES AND BASIS OF SELECTION

4.1 Evaluation Procedures

- (a) Bids will be assessed in accordance with the entire requirement of the bid solicitation including the technical, management and financial evaluation criteria.
- (b) An evaluation team composed of representatives of Canada will evaluate the bids.

4.1.1 Technical and Management Evaluation

Mandatory and point rated technical evaluation criteria are included in Attachment 1 to Part 4.

4.1.2 Financial Evaluation

4.1.2.1 Mandatory Financial Criteria

The maximum funding available for each contract resulting from the bid solicitation, for this stream, is **\$1,000,000.00** (Applicable Taxes extra, as appropriate). The breakdown is as follows: A Firm-Fixed Price of **\$350,000** for the work described in Annex A SOW sections 3.2.1 and 3.2.6, **\$150,000.00** for the Task Authorization part described in Annex A SOW section 3.2.2 and **\$500,000.00** for the Optional Service part of the work described in sections 3.2.3, 3.2.4 and 3.2.5.

Bids valued in excess of this amount will be considered non-responsive. This disclosure does not commit Canada to pay the maximum funding available.

4.1.2.2 Evaluation of Price

The price of the bid will be evaluated in Canadian dollars, Applicable Taxes excluded, FOB destination, Canadian customs duties and excise taxes included.

4.2 Basis of Selection

4.2.1 Basis of Selection – Highest Rated Within Budget

1. To be declared responsive, each bid must:
 - a) meet all mandatory evaluation criteria
 - b) obtain the required minimum of 80 points, on a scale of 120 points, for the overall Evaluation of the bid.
2. Bids not meeting (a) or (b) will be declared non-responsive.
3. Responsive Bids will be ranked according to their overall score. Bids will be ranked starting from the Bid with the highest score down to the lowest score resulting in a Responsive Bid List.
4. In the event that more than one responsive bid have the same score, these responsive bids will be further ranked based on the highest score of the "Methodology" criteria.
5. Up to 5 Contracts will be awarded by ranking order of the Responsive Bid List or until allocation of funds for this RFP is exhausted.

PART 5 – CERTIFICATIONS AND ADDITIONAL INFORMATION

Bidders must provide the required certifications and additional information to be awarded a contract.

The certifications provided by Bidders to Canada are subject to verification by Canada at all times. Unless specified otherwise, Canada will declare a bid non-responsive, or will declare a contractor in default if any certification made by the Bidder is found to be untrue, whether made knowingly or unknowingly, during the bid evaluation period or during the contract period.

The Contracting Authority will have the right to ask for additional information to verify the Bidder's certifications. Failure to comply and to cooperate with any request or requirement imposed by the Contracting Authority will render the bid non-responsive or constitute a default under the Contract.

5.1 Certifications Required with the Bid

Bidders must submit the following duly completed certifications as part of their bid.

5.1.1 Integrity Provisions - Declaration of Convicted Offences

In accordance with the Integrity Provisions of the Standard Instructions, all bidders must provide with their bid, **if applicable**, the Integrity declaration form available on the [Forms for the Integrity Regime](http://www.tpsgc-pwgsc.gc.ca/ci-if/declaration-eng.html) website (<http://www.tpsgc-pwgsc.gc.ca/ci-if/declaration-eng.html>), to be given further consideration in the procurement process.

5.2 Certifications Precedent to Contract Award and Additional Information

The certifications and additional information listed below should be submitted with the bid but may be submitted afterwards. If any of these required certifications or additional information is not completed and submitted as requested, the Contracting Authority will inform the Bidder of a time frame within which to provide the information. Failure to provide the certifications or the additional information listed below within the time frame specified will render the bid non-responsive.

5.2.1 Integrity Provisions – Required Documentation

In accordance with the section titled Information to be provided when bidding, contracting or entering into a real property agreement of the [Ineligibility and Suspension Policy](http://www.tpsgc-pwgsc.gc.ca/ci-if/politique-policy-eng.html) (<http://www.tpsgc-pwgsc.gc.ca/ci-if/politique-policy-eng.html>), the Bidder must provide the required documentation, as applicable, to be given further consideration in the procurement process.

5.2.2 Federal Contractors Program for Employment Equity - Bid Certification

By submitting a bid, the Bidder certifies that the Bidder, and any of the Bidder's members if the Bidder is a Joint Venture, is not named on the Federal Contractors Program (FCP) for employment equity "FCP Limited Eligibility to Bid" list available at the bottom of the page of the [Employment and Social Development Canada \(ESDC\) - Labour's](https://www.canada.ca/en/employment-social-development/programs/employment-equity/federal-contractor-program.html#) website (<https://www.canada.ca/en/employment-social-development/programs/employment-equity/federal-contractor-program.html#>).

Canada will have the right to declare a bid non-responsive if the Bidder, or any member of the Bidder if the Bidder is a Joint Venture, appears on the "FCP Limited Eligibility to Bid list at the time of contract award.

5.2.3 Additional Certifications Precedent to Contract Award

5.2.3.1 Canadian Content Certification

SACC Manual clause [A3050T](#) (2018-12-06) Canadian Content Definition

5.2.3.2 Status and Availability of Resources

SACC Manual clause [A3005T](#) (2010-08-16) Status and Availability of Resources

5.2.3.3 Education and Experience

SACC Manual clause [A3010T](#) (2010-08-16) Education and Experience

Part 6: FINANCIAL AND OTHER REQUIREMENTS

6.1 Financial Capability

SACC Manual clause [A9033T](#) (2012-07-16) Financial Capability

PART 7 - RESULTING CONTRACT CLAUSES

The following clauses and conditions apply to and form part of any contract resulting from the bid solicitation.

7.1 Statement of Work

The Contractor must perform the Work in accordance with the Statement of Work at Annex A and the Contractor's technical bid entitled _____, dated _____.

7.1.1 Optional Goods and/or Services

The Contractor grants to Canada the irrevocable option to acquire the goods, services or both described in the SOW under sections 3.2.3, 3.2.4 and 3.2.5) Requirement Developments (Optional Work) of the Contract under the same conditions and at the prices and/or rates stated in the Contract. The option may only be exercised by the Contracting Authority and will be evidenced, for administrative purposes only, through a contract amendment.

The Contracting Authority may exercise the option at any time before the expiry of the Contract by sending a written notice to the Contractor.

7.1.2 Task Authorization

The Task Authorization portion of the Work (refer to Annex A: Statement of Work under section 3.2.2 Additional Task Authorizations) to be performed under the Contract will be on an "as and when requested basis" using a Task Authorization (TA). The Work described in the TA must be in accordance with the scope of the Contract.

7.1.2.1 Task Authorization Process

1. The Project authority will provide the Contractor with a description of the task using the "Task Authorization" form specified in Annex E.
2. The Task Authorization (TA) will contain the details of the activities to be performed, a description of the deliverables, and a schedule indicating completion dates for the major activities or submission dates for the deliverables. The TA will also include the applicable basis (bases) and methods of payment as specified in the Contract.
3. The Contractor must provide the Project authority, within 14 calendar days of its receipt, the proposed total estimated cost for performing the task and a breakdown of that cost, established in accordance with the Basis of Payment specified in the Contract.
4. The Contractor must not commence work until a TA authorized by the Project authority has been received by the Contractor. The Contractor acknowledges that any work performed before a TA has been received will be done at the Contractor's own risk.

7.1.2.2 Task Authorization Limit

The Project authority may authorize individual task authorizations up to a limit of **\$60,000.00**, Applicable Taxes included, inclusive of any revisions.

Any task authorization to be issued in excess of that limit must be authorized by the Project authority and Contracting Authority before issuance.

7.1.2.3 Canada's Obligation - Portion of the Work - Task Authorizations

Canada's obligation with respect to the portion of the Work under the Contract that is performed through task authorizations is limited to the total amount of the actual tasks performed by the Contractor.

7.1.2.4 Periodic Usage Reports - Contracts with Task Authorizations

The Contractor must compile and maintain records on its provision of services to the federal government under authorized Task Authorizations issued under the Contract.

The Contractor must provide this data in accordance with the reporting requirements detailed below. If some data is not available, the reason must be indicated. If services are not provided during a given period, the Contractor must still provide a "nil" report.

The data must be submitted on a quarterly basis to the Contracting Authority.

The quarterly periods are defined as follows:

1st quarter: April 1 to June 30;

2nd quarter: July 1 to September 30;

3rd quarter: October 1 to December 31; and

4th quarter: January 1 to March 31.

The data must be submitted to the Contracting Authority no later than 15 calendar days after the end of the reporting period.

Reporting Requirement - Details

A detailed and current record of all authorized tasks must be kept for each contract with a task authorization process. This record must contain:

For each authorized task:

- i. the authorized task number or task revision number(s);
- ii. a title or a brief description of each authorized task;
- iii. the total estimated cost specified in the authorized Task Authorization (TA) of each task, exclusive of Applicable Taxes;
- iv. the total amount, exclusive of Applicable Taxes, expended to date against each authorized task;
- v. the start and completion date for each authorized task; and
- vi. the active status of each authorized task, as applicable.

For all authorized tasks:

- i. the amount (exclusive of Applicable Taxes) specified in the contract (as last amended, as applicable) as Canada's total liability to the contractor for all authorized TAs; and
- ii. the total amount, exclusive of Applicable Taxes, expended to date against all authorized TAs.

7.2 Standard Clauses and Conditions

All clauses and conditions identified in the Contract by number, date and title are set out in the [Standard Acquisition Clauses and Conditions Manual](https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual) (<https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual>) issued by Public Works and Government Services Canada.

7.2.1 General Conditions

2040 (2018-06-21), General Conditions - Research & Development, apply to and form part of the Contract.

7.3 Term of Contract

7.3.1 Period of the Contract

The period of the Contract is from date of Contract to _____ inclusive (*fill in end date of the period*).

7.4 Authorities

7.4.1 Contracting Authority

The Contracting Authority for the Contract is:

Kaveh Mirfatahi
Supply Specialist
Public Works and Government Services Canada
Acquisitions Branch, Quebec Region
Place Bonaventure
800 de la Gauchetière Ouest
Suite 7300, Portail Sud-Ouest, Montréal, Québec H5A 1L6

Telephone: 514-260-4106
Facsimile: 514-496-3822
E-mail address: kaveh.mirfatahi@pwgsc-tpsgc.gc.ca

The Contracting Authority is responsible for the management of the Contract and any changes to the Contract must be authorized in writing by the Contracting Authority. The Contractor must not perform work in excess of or outside the scope of the Contract based on verbal or written requests or instructions from anybody other than the Contracting Authority.

7.4.2 Project Authority

The Project Authority for the Contract is:

Name: _____
Title: _____
Organization: _____
Address: _____

Telephone: ____-____-_____
Facsimile: ____-____-_____
E-mail address: _____

7.4.3 Contractor's Representative (*Contractor to fill in*)

Name: _____
Title: _____
Organization: _____
Address: _____

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File No. - N° du dossier
MTB-9-42040

Buyer ID - Id de l'acheteur
mtb550
CCC No./N° CCC - FMS No./N° VME

Telephone: ____ - ____ - ____
Facsimile: ____ - ____ - ____
E-mail address: _____

7.5 Proactive Disclosure of Contracts with Former Public Servants (*if applicable*)

By providing information on its status, with respect to being a former public servant in receipt of a [Public Service Superannuation Act](#) (PSSA) pension, the Contractor has agreed that this information will be reported on departmental websites as part of the published proactive disclosure reports, in accordance with [Contracting Policy Notice: 2012-2](#) of the Treasury Board Secretariat of Canada.

7.6 Payment

7.6.1 Basis of Payment (*to be completed at contract award*)

7.6.1.1 A – Basis of Payment – Firm price as described in SOW Sections 3.2.1 and 3.2.6

For the Work described in Sections 3.2.1 and 3.2.6 of the Statement of Work in Annex A in Annex A:

In consideration of the Contractor satisfactorily completing all of its obligations under the Contract, the Contractor will be paid a firm price, as specified in Annex B – Basis of Payment (A) for a cost of \$ _____. Customs duties are included and Applicable Taxes are extra.

Canada will not pay the Contractor for any design changes, modifications or interpretations of the Work, unless they have been approved, in writing, by the Contracting Authority before their incorporation into the Work.

7.6.1.2 B – Basis of Payment under Task Authorization as described in the SOW per section 3.2.2

The following type of basis of payment will form part of the approved Task Authorization (TA). The task price must be determined in accordance with the Basis of Payment at Annex B.

Basis of Payment- Ceiling Price - Task Authorizations

The Contractor will be reimbursed for the costs reasonably and properly incurred in the performance of the Work, as determined in accordance with the Task Authorization (TA), to a ceiling price of \$ _____. Customs duties are included and Goods and Services Tax or Harmonized Sales Tax is extra, if applicable.

The ceiling price is subject to downward adjustment so as not to exceed the actual cost reasonably incurred in the performance of the Work and computed in accordance with the Task Authorization (TA).

7.6.1.3 C – For the Optional work described in the SOW under sections 3.2.3, 3.2.4 and 3.2.5

Basis of Payment - Ceiling Price (*to be exercised by a contract amendment*)

The Contractor will be reimbursed for the costs reasonably and properly incurred in the performance of the Work, as determined in accordance with the Basis of Payment in Annex B, to a ceiling price of \$ _____. Customs duties are included and Goods and Services Tax or Harmonized Sales Tax is extra, if applicable.

The ceiling price is subject to downward adjustment so as not to exceed the actual cost reasonably incurred in the performance of the Work and computed in accordance with the Basis of Payment.

7.6.1.4 Total Estimated Contract Price: \$ _____ (A+B+C: *when the optional service will be exercised*)

7.6.2 Method of Payment

7.6.2.1 A – Milestone Payments - Firm Price

Canada will make milestone payments in accordance with the Schedule of Milestones detailed in Annex B - Basis of Payment and the payment provisions of the Contract if:

- (a) an accurate and complete claim for payment using form PWGSC-TPSGC 1111 (<http://www.tpsgc-pwgsc.gc.ca/app-acq/forms/documents/1111.pdf>) and any other document required by the Contract have been submitted in accordance with the invoicing instructions provided in the Contract;
- (b) all the certificates appearing on form PWGSC-TPSGC 1111 have been signed by the respective authorized representatives;
- (c) all work associated with the milestone and as applicable any deliverable required has been completed and accepted by Canada.

7.6.2.1.1 Schedule of Milestones

The schedule of milestones for which payments will be made in accordance with the Contract is detailed in Annex B.

And

7.6.2.2 B and C Progress Payments - Ceiling Price

1. Canada will make progress payments in accordance with the payment provisions of the Contract, no more than once a month, for cost incurred in the performance of the Work up to 90 percent of the amount claimed and approved by Canada if:

- (a) an accurate and complete claim for payment using form PWGSC-TPSGC 1111 (<http://www.tpsgc-pwgsc.gc.ca/app-acq/forms/documents/1111.pdf>) and any other document required by the Contract have been submitted in accordance with the invoicing instructions provided in the Contract;
- (b) the amount claimed is in accordance with the Annex B: Basis of Payment;
- (c) the total amount for all progress payments paid by Canada does not exceed 90 percent of the total amount to be paid under the Contract;
- (d) all certificates appearing on form PWGSC-TPSGC 1111 have been signed by the respective authorized representatives.

2. The balance of the amount payable will be paid in accordance with the payment provisions of the Contract upon completion and delivery of all work required under the Contract if the Work has been accepted by Canada and a final claim for the payment is submitted.

3. Progress payments are interim payments only. Canada may conduct a government audit and interim time and cost verifications and reserves the right to make adjustments to the Contract from time to time during the performance of the Work. Any overpayment resulting from progress payments or otherwise must be refunded promptly to Canada.

7.6.3 T1204 – Direct Request by Customer Department

SACC Manual clause [A9117C](#) (2007-11-30), T1204 – Direct Request by Customer Department

7.6.4 Electronic Payment of Invoices – Contract

The Contractor accepts to be paid using any of the following Electronic Payment Instrument(s):

- a. Visa Acquisition Card;
- b. MasterCard Acquisition Card;
- c. Direct Deposit (Domestic and International);
- d. Electronic Data Interchange (EDI);

7.7 Invoicing Instructions

1. The Contractor must submit a claim for payment using form [PWGSC-TPSGC 1111](#), Claim for Progress Payment.

Each claim must show:

- a. all information required on form [PWGSC-TPSGC 1111](#);
- b. all applicable information detailed under the section entitled "Invoice Submission" of the general conditions;
- c. a list of all expenses;
- d. expenditures plus pro-rated profit or fee;
- e. the description and value of the milestone claimed as detailed in the Contract.

Each claim must be supported by:

- a. a copy of time sheets to support the time claimed;
 - b. a copy of the invoices, receipts, vouchers for all direct expenses, travel and living expenses;
 - c. a copy of the monthly progress report.
2. Applicable Taxes must be calculated on the total amount of the claim before the holdback is applied. At the time the holdback is claimed, there will be no Applicable Taxes payable as it was claimed and payable under the previous claims for progress payments.
 3. Invoices must be distributed as follows:
 - i. Send one PDF copy of the invoice by e-mail to the Contracting and Technical Authorities as identified under sub-articles 7.4.1 and 7.4.2 of the contract with copy to the following CSA e-mail address: asc.facturation-invoicing.csa@canada.ca; **OR**

- ii. If mailed, the Contractor must prepare and certify **one original and two (2) copies** of the invoice, and forward it to CSA's Financial Services using the address shown on page 1 of the Contract under "Invoices" (Financial Services Section)
4. The CSA's Financial Services Section will then forward **the original and one (1) copy** of the claim to the Contracting Authority for certification and onward submission to the Payment Office for the remaining certification and payment action.
5. The Contractor must not submit claims until all work identified in the claim is completed.

7.8 Certifications and Additional Information

7.8.1 Compliance

Unless specified otherwise, the continuous compliance with the certifications provided by the Contractor in its bid or precedent to contract award, and the ongoing cooperation in providing additional information are conditions of the Contract and failure to comply will constitute the Contractor in default. Certifications are subject to verification by Canada during the entire period of the Contract.

Federal Contractors Program for Employment Equity – Default by the Contractor

7.8.2 Canadian Content Certification

SACC Manual clause [A3060C](#) (2008-05-12), Canadian Content Certification

7.9 Applicable Laws

The Contract must be interpreted and governed, and the relations between the parties determined, by the laws in force in _____ *(to be inserted at contract award)*

7.10 Priority of Documents

If there is a discrepancy between the wording of any documents that appear on the list, the wording of the document that first appears on the list has priority over the wording of any document that subsequently appears on the list.

- (a) the Articles of Agreement;
- (b) the general conditions [2040](#) (2018-06-21), Research & Development;
- (c) Annex A, Statement of Work;
- (d) Annex B, Basis of Payment;
- (e) the signed Task Authorizations (including all of its annexes, if any); and
- (f) the Contractor's bid dated _____.

7.11 Foreign Nationals (Canadian Contractor)

SACC Manual clause [A2000C](#) (2006-06-16) Foreign Nationals (Canadian Contractor)

7.12 Insurance

SACC Manual clause [G1005C](#) (2016-01-28) Insurance

7.13 Directive on Communications with the Media

1. Definitions

"Communication Activity(ies)" includes: public information and recognition, the planning, development, production and delivery or publication, and any other type or form of dissemination of marketing, promotional or information activities, initiatives, reports, summaries or other products or materials, whether in print or electronic format that pertain to the present agreement, all communications, public relations events, press releases, social media releases, or any other communication directed to the general public in whatever form or media it may be in, including but without limiting the generality of the preceding done through any company web site.

2. Communication Activities Format

The Contractor must coordinate early on with the Canadian Space Agency (CSA) all Communication Activities that pertain to the present contract.

Subject to review and approval by the CSA, the Contractor may mention and/or indicate visually, without any additional costs to the CSA, the CSA's participation in the contract through at least one of the following methods at the complete discretion of the CSA:

- a. By clearly and prominently labelling publications, advertising and promotional products and any form of material and products sponsored or funded by the CSA, as follows, in the appropriate official language:

"This program/project/activity is undertaken with the financial support of the Canadian Space Agency."

"Ce programme/projet/activité est réalisé(e) avec l'appui financier de l'Agence spatiale canadienne."

- b. By affixing CSA's corporate logo on print or electronic publications, advertising and promotional products and on any other form of material, products or displays sponsored or funded by the Canadian Space Agency.

Any and all mention or reference to the Canadian Space Agency in addition to those specified above in (a) and (b) must be specifically accepted by the CSA prior to publication.

The Contractor must obtain and use a high resolution printed or electronic copy of the CSA's corporate identity logo and seek advice on its application, by contacting the project authority as mentioned in Paragraph 6.4.2 of this contract.

3. Communication Activity Coordination Process

The contractor must coordinate with the CSA's Directorate of Communications and Public Affairs all Communication Activities pertaining to the present contract. To this end, the contractor must:

- a. As soon as the Contractor intends to organize a Communication Activity, send a Notice to the CSA's Directorate of Communications and Public Affairs. The Communications Notice must include a complete description of the proposed Communication Activity. The Notice must be in writing in accordance with the clause Notice included in the general conditions applicable to the contract. The Communications Notice must include a copy or example of the proposed Communication Activity.
- b. The contractor must provide to the CSA any and all additional document in any appropriate format, example or information that the CSA deems necessary, at its entire discretion to correctly and efficiently coordinate the proposed Communication Activity. The Contractor agrees to only proceed with the proposed Communication Activity after receiving a written confirmation of coordination of the Communication Activity from the CSA's Directorate of Communications and Public Affairs.

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9F044-190081/A
Client Ref. No. - N° de réf. du client
9F044-190081

Amd. No. - N° de la modif.
File No. - N° du dossier
MTB-9-42040

Buyer ID - Id de l'acheteur
mtb550
CCC No./N° CCC - FMS No./N° VME

The Contractor must receive beforehand the authorization, approval and written confirmation from the CSA's Directorate of Communications and Public Affairs before organizing, proceeding or hosting a communication activity

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9F044-190081/A
Client Ref. No. - N° de réf. du client
9F044-190081

Amd. No. - N° de la modif.
File No. - N° du dossier
MTB-9-42040

Buyer ID - Id de l'acheteur
mtb550
CCC No./N° CCC - FMS No./N° VME

ANNEX A

STATEMENT OF WORK

The Statement of Work is hereby attached.

Canadian Space Agency

ANNEX A

Option Analysis Studies for Earth Observation Service Continuity

Statement of Work (SOW)

Date: Jan 22th, 2020

FOR CANADIAN SPACE AGENCY USE ONLY

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1 INTRODUCTION

1.1 SCOPE

This Statement of Work (SoW) provides information on the activities to be performed to define feasible implementation options addressing Government of Canada (GoC) Earth Observation (EO) needs for **maritime/marine and terrestrial applications**, from 2026 until 2041.

1.2 BACKGROUND

1.2.1 *Government of Canada Space Based Earth Observation Objectives*

As noted in Canada's newest *Space Strategy, Exploration, Imagination, Innovation*, the GoC is committed to ensuring that its federal departments relying on space-based EO data to deliver on their core programs and services, particularly RADARSAT Constellation Mission (RCM) data, are provided continued access to critical data beyond the design life of RCM.

Based on its experience in developing and launching three iterations of the RADARSAT family of Synthetic Aperture Radar (SAR) satellites, and through extensive consultation with partner departments across the federal government, the Canadian Space Agency (CSA) has developed a more thorough understanding of all of the elements that are needed to ensure it is able to capture, store and disseminate useful EO data over Canada and other areas of interest to the GoC and industry. In particular, the CSA is focused on identifying a suitable end-to-end solution – that includes a space segment, ground infrastructure, and data exploitation- that is able to provide a centralized access to user-friendly data products and applications meeting GoC needs while also helping to support growth and competitiveness across Canada's EO Industry.

Given this evolved understanding of what the GoC's future space-based EO system aspires to be, the following opportunities have to be taken into consideration, as key objectives of a RCM follow-on system. It should be noted, however, that these considerations are, in addition to the primary focus on the continuity of the services enabled by the RCM:

- Efficient leveraging of another country or region's space infrastructure to complement Canadian space infrastructure;
- Commitments and agreements to ensure Canada's continued access to international data sets;
- Artificial Intelligence (AI) enabled system capable of exploiting and efficiently analyzing big data sets;
- Data storage platform that is able to combine Space Based Earth Observation data with existing ground observations and archived data sets;

- Coordinated world class ground stations to collect data from Canadian and International satellites;
- Centralized access to user-friendly applications, products and services; and
- Platform services that leverage high performance computing to offer users unparalleled analysis and visuals.

While these considerations are key to most federal government departments, DND and the Canadian Armed Force's (CAF) requirements differ, largely based on the need for higher levels of security and resiliency in a next-generation system. By and large, the need for heightened security and resiliency on a RCM follow-on system is not shared by other GC departments and agencies. It is for this reason that both DND and the CSA are issuing concept studies to collect detailed information on what a next-generation system could look like. Following the completion of all studies, however, both organizations will work together to review concepts and to determine where there is interdependencies or overlap between them.

1.2.2 *RADARSAT Satellites and Options Analysis*

Since the mid-1990s, Canada has relied on the RADARSAT Program, a remote sensing satellite program to meet many of its EO needs. The RADARSAT program provides the GoC with critical capabilities in maritime surveillance, disaster management, environmental monitoring, resource management and mapping. At the heart of the RADARSAT program is a SAR, an advanced radar sensor, which utilizes radar frequencies to capture and generate high-resolution images, regardless of time of day or atmospheric conditions.

Since its inception, the RADARSAT program has launched three satellite projects, namely RADARSAT-1, RADARSAT-2, and the RCM which have established Canada as the world leader in SAR technology. The most recent iteration, the RCM, is comprised of three satellites that work in formation to enhance coverage and change detection capabilities. RCM will provide continuity of service as RADARSAT-2 has passed its eleventh year of operation. Launched in 2019, the RCM will provide at least average daily coverage of Canada's maritime approaches and frequent coverage of its vast territory. The RCM design life is 7 years, and is expected to reach the end of its design life cycle in 2026.

The CSA is currently working on identifying possible options to ensure the GoC continues to have consistent, reliable and timely access to the data and information that would ensure the continuity of the services enabled by the RCM.

The CSA has developed a preliminary list of SAR data needs based on consultations with federal users of RADARSAT data, including Agriculture and Agri-food Canada (AAFC), Environment and Climate Change Canada (ECCC), Natural Resources Canada (NRCan) and Fisheries and Oceans Canada (DFO). The list of needs is captured in the Harmonized User Needs (HUN) document (AD-1), and is available to the bidders. The DND/CAF specific needs are captured in: Department of National Defence and Canadian Armed Forces Space-Based Surveillance Requirements (RD-2). The HUN and the Department of National Defence and Canadian Armed

Forces Space-Based Surveillance Requirements summarizes the needs of the GC to be considered under the EOSC study. The HUN document contains mainly SAR related needs. Other EO needs identified have a focus on the information that could complement the SAR data. This broader EO needs list is preliminary, but could provide key insight in identifying complementary sources of data that, once combined with SAR data, could augment EO capabilities available to the GoC.

The GoC's reliance on EO data for its operations means that it needs to plan for a longer horizon than a single mission lifecycle (i.e. longer than RCM's seven year design life). To this end, the GoC is stepping away from its historic approach of a single space mission and is now focusing on ensuring continuity of the services currently enabled by SAR data over a longer horizon. In this case, the CSA is aiming to identify options over the 15-year time horizon from 2026 to 2041. It is expected that new GoC EO-based applications will reach an operational level of maturity within the timeframe of 15 years investigated in this study. This will raise new challenges on how to introduce improvement in the solution to properly respond to these new operational needs without impacting the operations of the existing SAR data users.

1.2.3 Specific issues raised during the consultation process

In the preparatory work to this activity, several consultations have been performed. The main one was the National Forum on Earth Observation from Space held at the CSA on November 20-22, 2018. Out of these consultations, several issues have been brought forward and have to be addressed.

- 1) There is a strong interest to maximize the uptake and the value of the EO data collected by the GoC. Through the open data directive and global trends in making EO data freely available, there is an interest in providing free and open data. On the other hand, Canadian regulations (i.e., the Remote Sensing Space Systems Act) and security consideration impose limits on the distribution of these data. The sharing of the data may have a direct impact on the cost and the viability of certain *Business Model for EOSC*. RCM has established a data policy (RD-3) that seeks to balance these various considerations. Therefore, during this initial phase of the EO service continuity assessment work, a trade-off analysis is needed to clearly understand the impact of providing free and open data on the viable *Business Model* and on the creation of value for Canada.
- 2) There is a challenge to use EO data efficiently. SAR data in particular is difficult to access and interpret and there is a shortage of personnel that can efficiently use this data. Image analysis software is costly. How can the accessibility of the data and derived information products be improved? How can the synergy of EO data with existing ground observations be improved? What role can cloud technology, artificial intelligence, analysis ready data, data analytic play in improving the use of the EO data?
- 3) The importance of accessing other SAR frequency bands has been highlighted. This is in conflict with the need for increased temporal and spatial coverage. Even if an antenna enabling the simultaneous use of multiple frequencies becomes operational, the imaging time while using the multiples frequencies may be reduced compared to a single frequency

system of the same complexity. What is the optimum mix of temporal/spatial diversity versus the frequency diversity? What is the optimal way to improve access to multiple frequency band for the end users?

- 4) This study focusses on the operational needs of the GoC. However, there is also strong use of EO data for scientific purposes and to address evolving challenges such as climate changes. Furthermore, the GOC's EO data needs will likely evolve during the 2026 to 2041 timeframe. How and when should new functionalities and technologies be introduced in an operational solution to respond to evolving policy needs and scientific advances?
- 5) Maritime and terrestrial applications are often in conflict requiring different beam modes, especially in the areas close to the coast. There is a need to either consider an improved beam mode meeting the needs of both types of applications, or to consider if separate systems would be a better solution.
- 6) There is a conflicting need to perform ad hoc tasking a satellite for a specific purpose with, for example, a high resolution mode, but at the same time having a predictable, repeatable, and consistent mode coverage that is required for other applications. How to best accommodate/balance these two competing needs?

1.3 DOCUMENT CONVENTIONS

A number of the sections in this document describe controlled requirements and specifications and therefore the following verbs are used in the specific sense indicated below:

- a) "Shall" or "Must" is used to indicate a mandatory requirement;
- b) "Should" indicates a goal or preferred alternative. Such goals or alternatives must be treated as requirements on a best efforts basis, and verified as for other requirements. The actual performance achieved must be included in the appropriate verification report, whether or not the goal performance is achieved;
- c) "May" indicates an option; and,
- d) "Will" indicates a statement of intention or fact, as does the use of present indicative active verbs.

In the following, the term 'Contractor' is used to describe the team that will conduct the study, which could be a mixed team drawn from Industry, University or Research Institutes.

1.4 DOCUMENT DEFINITIONS

For the purpose of this SoW:

"Business Model": Refers to the formal descriptions of the arrangements and building blocks making up a proposed solution. For example, a *Business Model* may include but is not limited to, the following building blocks

- **Value proposition;** collection of products and services proposed to meet the needs of its customers, it is what distinguishes it from its competing offering.
- **Customer Segments;** customer base and their different needs and attributes.
- **Channels:** means to efficiently promote and deliver the value proposition
- **Customer Relationships:** Describe the interactions and roles/responsibilities between the Contractor/data provider and the customer.
- **Delivery options:** from design/build/finance/operate/maintain to leasing to data provision services.
- **Cost Structure:** This describes the monetary characteristics such as classes cost drivers and structures (e.g., fixed costs, variable costs, scaling effects).
- **Value Streams:** The way the solutions creates value for each stakeholder. (Governments, industry, value-added sector, academia).

“*Information Product*”: Refers to EO data or value-added products that are used to satisfy the user needs expressed in the HUN document (AD-1).

“*Solution*”: Refers to the set of elements such as space systems, ground systems, purchase of data, use of commercial data used to provide the *Information Product* required to satisfy the user needs. Although the meaning is similar to Mission or System, the term *Solution* is being used as more neutral term to reflect the fact that alternative scenarios to a traditional space/ground system procurement are being considered.

2 DOCUMENTS

2.1 APPLICABLE DOCUMENTS (AD)

RD No.	Document Number	Document Title	Rev. No.	Date
AD-1		Harmonized User Needs Document	D	

2.2 REFERENCE DOCUMENTS (RD)

The following documents provide additional information or guidelines that either may clarify the contents or are pertinent to the history of this document.

Table2.2-1: Reference Documents

RD No.	Document Number	Document Title	Rev. No.	Date
RD-1.	CSA-ST-GDL-0001	CSA Technology Readiness and Risk Assessment Guidelines ftp://ftp.asc-csa.gc.ca/users/TRP/pub/TRRA/	Rev. D	March 2019
RD-2.		Department of National Defence and Canadian Armed Forces Space-Based Surveillance Requirements	Rev. 2.0	
RD-3.		RADARSAT Constellation Mission Synthetic Aperture Radar Data Policy https://www.asc-csa.gc.ca/eng/publications/rcm-sar-data-policy.asp	IR	August 2019
RD-4.	CSA-RC-RD-0002	RADARSAT Constellation: Mission Requirements Document	H	July 2019

3 REQUIREMENTS

3.1 GENERAL

The Contractor must provide the management, technical leadership and support necessary to ensure effective and efficient performance of all efforts and activities.

This study is expected to be as much as possible independent of both the technology and the *Business Model*. However, some of the detailed tasks in this SoW may not be fully aligned with all potential *Solutions/Business Models* and may require deliverables that are irrelevant to a particular *Solution*. For example, the cost breakdown for a government owned system versus the purchase of commercial data can be very different. In such case, the Contractor must flag as early as possible (i.e., as part of the proposal) the deliverables that are not applicable to the proposed *Solution*. The Contractor must then propose an appropriate equivalent level of information and have it approved by the Technical Authority (TA).

Although the approach taken must be as much as possible technology agnostic(i.e.: no direct requirement to use a specific frequency band or a specific type of instrument), several of the operational needs rely on a long history of expertise and an infrastructure already in place. If changes are proposed to the existing infrastructure, the Contractor must characterize their impacts in terms of cost and schedule with the same level of accuracy as requested for the overall *Solution* cost and schedule. User Group Meetings are planned to answer the Contractor's questions on the user needs and the operational use of the *Information Product* , and to discuss alternative ways of meeting the user needs.

3.2 DETAILED TASKS

The following figures summarizes the main activities of this study with their associated review meetings.

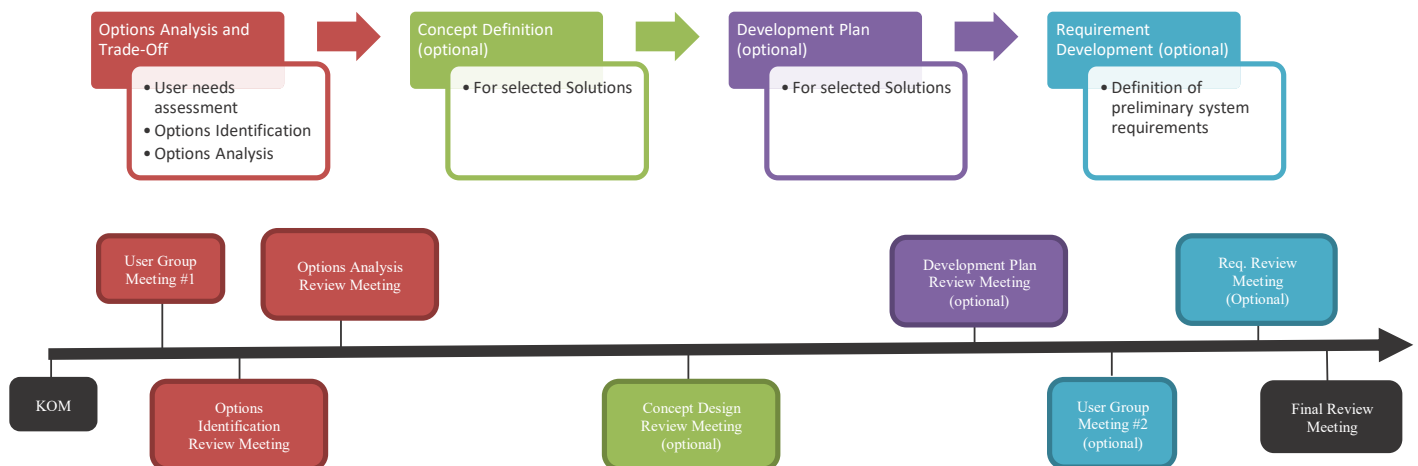


FIGURE 1 MAIN ACTIVITIES AND REVIEW MEETINGS

3.2.1 Options Analysis and Trade-offs

3.2.1.1 User Needs Assessment and Driving Needs Identification

The Contractor must first review the HUN document [AD-1] and flag any inconsistencies or missing information that may require clarification. The document provides both the Needed Measurement(s) (e.g., sea ice type and extent) and also the expected Measurement Performance (e.g., resolution, NESZ, etc.). In some cases, the Measurement Performance is stated in terms of the actual Instruments Performance (such as the NESZ). These Instruments Performance metrics must be interpreted as a guideline as long as the information required to meet the Needed Measurements can be provided by the proposed *Solution*.

The Contractor must identify those requirements that are driving the complexity and cost of the solution and provide a preliminary assessment of their impact on the overall *Solution*.

The Contractor must provide an analysis method to compare the different *Solution* options in terms of compliance to the HUN, overall cost, technical/programmatic/schedule risks and key considerations outlined in Section 1.2.3.

The Contractor must provide the results of this initial investigation, including a complete list of all the sources of data/information considered one month after contract award in an Options Analysis Document. It is understood that this information will be preliminary and will need to be refined in the subsequent project phases.

The User Group Meeting #1 will be held approximately 1.5 months after contract award. This meeting will include representatives from the GoC departments and representatives from all industrial teams that have been awarded a contract based on this SoW. Information on some of the current government infrastructure (receiving station, processing and archiving facilities, etc.) will be provided to the Contractors at this meeting.

The Contractor may also review the Department of National Defence and Canadian Armed Forces Space-Based Surveillance Requirements (RD-2) during this user needs assessment phase. Questions on those requirements may be asked at the User Group Meeting #1.

3.2.1.2 Solution Options Identification

Following the clarifications provided at the User Group Meeting #1, the Contractor must develop several *Solution* options targeting different level of compliance to the user needs defined in the HUN document (AD-1) to ensure that the GoC is provided with a clear understanding of the impact (e.g., feasibility, cost to GoC, schedule, risks) of meeting different levels of compliance. The choice of options must be such that major cost drivers and the major steps in performance are clearly highlighted. The Contractor must provide a high level compliance indication of the *Solution* options with the HUN. The Contractor must also provide clear information about the level of maturity of the proposed *Solution* options (including maturity of the cost estimate, risk analysis and schedule). The *Solution* options identified must encompass the complete end to end *Solution* and include different combinations of the following elements:

- Data exploitation to efficiently combine all sources of data (space based and ground based observation) to provide the end-user with centralized access to user-friendly applications, products and services required to meet their needs.
- Use of free and open data
- Use of commercial data (not limited to space based observation)
- Potential of international cooperation
- Government capabilities (government ground and space infrastructure)
- Data reception, processing, storage and distribution
- Others elements identified by the Contractor

The level of performance refers to either the number of needs that can be satisfied or if a specific need is satisfied at the Threshold or Goal level as defined in the HUN document (AD-1). At least one *Solution* option must address to the greatest extent possible the complete list of user needs listed in the HUN document, as early as possible while ensuring that the proposed *Solutions* remain cost efficient and implementable. For each *Solution* option, the Contractor must clearly explain how and when the capabilities could be injected throughout the planned timeframe of 2026 to 2041.

The Contractor should provide *Solution* options enabling a seamless transition with no loss of capabilities with respect to the RCM mission requirements (RD-4) after the end of the RCM design life in 2026. It is understood that some of the requirements listed in RD-4 are RCM specific and may be ignored by the Contractor as long as the coverage, revisit and quality can be maintained to sustain the users operations. If the Contractor is unable to provide a *Solution* option enabling such a seamless transition with no loss of capabilities, the Contractor must describe the considered *Solution* options and explain why they can't enable this seamless transition.

For each proposed *Solution* option, the Contractor must describe each of the aspects of the *Business Models* as defined in Section 1.4 Document Definitions. The Contractor may choose to provide more than one *Business Model* for the same technical *Solution* option.

The Contractor must document the identified *Solution* options in the Options Analysis Document.

The Contractor must hold an Options Identification Review Meeting to present the *Solution* options analysis results.

3.2.1.3 Options Analysis

The Contractor must document in the Options Analysis Document the following items:

- Update to the *Solution* option(s) to maximize the compliance to the DND/CAF requirements expressed in RD-2 particularly in the timeframe between 2026 and 2034.
- A trade-off analysis to identify the requirements from the Department of National Defence and Canadian Armed Forces Space-Based Surveillance Requirements (RD-2) that could be more efficiently implemented in a common *Solution* rather than in a separate system.

- A compliance matrix indicating which user need listed in the HUN and in the Department of National Defence and Canadian Armed Forces Space-Based Surveillance Requirements document will be satisfied by the various *Solution* options and, in the case of a gradual introduction of capabilities, when each need/requirement will be fully satisfied.
 - o The Contractor must support the claimed compliance by preliminary analysis.
 - o The Contractor must take into account the free and open data from various sensors currently available or planned (Sentinel, Landsat, etc.) in the analysis of options. The Contractor must consider the quality of the data available but also other factors such as the reliability of the source of data and latency.
- A description of how each *Solution* option could help address the elements described in Section 1.2.3 and an overall trade-off analysis and recommendations for each items of Section 1.2.3.
- Ranking of the *Solution* options based on the methodology established prior to the User Group Meeting #1.
- An analysis of the *Business Model* considered including the advantages and disadvantages of each model considered
- A cost estimate to the GoC for each of the *Solution* options. At this stage, there is no prescribed accuracy or methodology to derive the cost estimate. However, the Contractor must describe for each cost estimate:
 - o The assumptions;
 - o The methodology used and the supporting information sources;
 - o An estimate of the cost uncertainty and/or a cost range (minimum, mean, maximum cost) and their justification; and,
 - o Specific risks or considerations that may have a significant impact on the reported cost estimate to the GoC.
- A major milestone schedule for overall implementation for each *Solution options*.

The Contractor must hold an Options Analysis Review Meeting to present the *Solution* options analysis details reported in the Options Analysis Document.

3.2.2 Additional Task Authorizations

CSA may request additional work to be performed following the issuance of a Task Authorization to perform additional unplanned analysis and tradeoffs analysis.

In particular, the CSA may investigate potential collaborations with other government agencies in parallel to these studies. The CSA may provide information on both the capabilities of the external system and levy additional requirements on the proposed *Solutions*. The Contractor must be able, following the issuance of a Task Authorization, to properly analyze the impact of the additional

capability and additional requirements, and to provide a comparison of the initial options with options incorporating the collaboration.

3.2.3 Concept Definition (Optional Services)

Upon a contract amendment to exercise the Optional Services, the TA will communicate to the Contractor, approximately two weeks after the Option Analysis Review meeting, which of the *Solution* option(s) presented are the most promising and will be explored in more details through a concept definition study. A minimum of two *Solution* options will be carried for further study. The TA will also communicate to the Contractor which DND/CAF requirements in RD-2 must be carried forward in the Concept Definition phase. The combination of the needs listed in the HUN document (AD-1) and the subset of the DND/CAF requirements will be referred to as the *Consolidated User Needs*.

After the identification of the carried out *Solution* options, the Contractor must perform a design analysis to define the details of the proposed *Solution(s)* in a Conceptual Design Document.

The Contractor must ensure that the *Solution* definition is complete and provide credible evidence to the CSA that the *Solution* can be realized and will deliver the continuity of services after the design life of RCM. As such, the Conceptual Design Document must contain enough details to address the following dimensions irrespective of the *Business Models* proposed:

- *Solution* Description: The Contractor must include a full description of all assets/systems involved in the *Solution* including the space and ground segment but also the systems required to deliver the *Information Product*. The main interfaces between these assets/systems must be described.
- Compliance to the *Consolidated User Needs*: The Contractor must include a compliance matrix showing the compliance of the *Solution* options with the *Consolidated User Needs*. The Contractor must provide a quantitative estimate of the compliance percentage on the main parameters as defined by the Contractor and agreed with the TA. In order to establish the compliance to the *Consolidated User Needs*, the Contractor must perform all required analysis to validate that the performance of the instrument(s) or the delivered data products, meet the *Consolidated User Needs*. The Contractor must use models and analysis techniques documented in the literature. If the Contractor decides to use a custom model, they must present the validation activities performed to confirm the accuracy of the model.
- Concept of Operations: The Contractor must include a concept of operations demonstrating that the operation of the *Solution(s)* will satisfy the *Consolidated User Needs*. The Contractor must demonstrate clearly how the latency and the need for fast tasking and interoperability expressed in the *Consolidated User Needs*. will be met. The Contractor must also explain the maintenance of the *Solution(s)* after the initial capabilities has been implemented.
- *Business Model*: The Contractor must fully describe the proposed *Business Model*.

- **Impact of Legacy Systems and Services:** The Contractor must include a description of the impact the concept might have on currently used SAR data sets, archives, and data processing systems.

The Contractor must update the impact analysis of the *Solution* options with respect to the elements mentioned in Section 1.2.3.

The Contractor must hold a Concept Design Review meeting presenting the results of the analysis performed. The Contractor must include in the Conceptual Design Document an executive summary of the two developed *Solution* options.

3.2.4 *Development Plan (Optional Services)*

The Contractor must produce a Development Plan Document that will convey all aspects of the development required to realize the selected *Solution* option(s).

It is expected that the activities scheduled to happen closer in time (around 2026) will be provided with a greater level of details than the activities needed to satisfy the *Solution* options implemented towards the end of the investigated period (around 2041).

The Development Plan Document must include, for each *Solution*, at a minimum, the following elements:

- Technology Readiness and Risk Assessment (TRRA) in accordance with the requirements of the CSA Technology Readiness and Risk Assessment Guidelines (RD-1) to formally document the technology status.
- For each identified Critical Technology, provide:
 - Details on the technology development efforts and why technology development is required
 - Performance characteristics/objective of technology development. Details on what advancements beyond the current state-of-the-art is required, including metric where known/applicable
 - Schedule for the development activities.
 - Cost estimate and the type of analysis (analogous, bottom-up, etc.) performed, as well as assumptions made along with an estimate of the uncertainty margin.
 - Identify if the technology can be developed in Canada
- Preliminary prototyping approach and model philosophy
- Considerations for the Product Assurance Requirements, Verification and Validation Plan, Integration Plan, Operation Plan and Manufacturing and Engineering capacity that might impact the project cost and schedule.
- A Schedule showing the main phases/major milestones, key decision points and indicating any dependencies in the project or with external initiatives.

- A description of the risks associated with the proposed *Solutions* including for each risk:
 - o Likelihood the risk will be realized
 - o Impact of the risk (schedule and cost)
 - o Mitigation measures
- Recommendations regarding additional data processing applications development or science development that might bridge the gaps regarding any needs that are difficult to meet by the selected *Solution* options or new/emerging needs for which the proposed *Solution* options may provide significant benefits. These recommendations must include the following elements:
 - o Description of the application/science gap
 - o Identification of the main steps required to develop the application/science/sensor technologies along with the expected schedule.
 - o Preliminary identification of the impact on the investigated options (additional data, improved performance, etc.)
- Recommended activities for a follow-up phase supported by a detailed Work Breakdown Structure (WBS).

The Contractor must produce a Detailed Lifecycle Cost Estimate to the GoC for all phases, including the definition, development, implementation, operation and disposal of the proposed options as well as the cost for an Applications/Science/Technologies development plan. The Contractor must provide a bottom up cost estimate for the follow-up phase based on the WBS provided in the Development Plan.

The Contractor must present the details of the Development Plan Document and the Detailed Lifecycle Cost Estimate to the GoC at the Development Plan Review meeting.

3.2.5 Requirement Developments (Optional Services)

One month after the Development Plan Review Meeting, an Initial Requirements Document will be produced by the CSA and provided to the Contractor. The Initial Requirement Document will be derived from the *Consolidated User Needs* and will incorporate the knowledge gained on the feasibility studies and opportunities identified in the previous phases of this contract. The Contractor must first review the Initial Requirement Document and flag any inconsistencies or missing information that may require clarification. The User Group Meeting #2 will be held to answer any questions on the Initial Requirement Document and provide clarification to all the Contractors in a single meeting.

At this point, the CSA will select a single *Solution* to be studied in more details. That selected *Solution* could be a viable *Solution* for a subset of the Initial Requirements Document and there will be no expectation that a complete redesign of the selected *Solution* will be performed.

The Contractor must explore potential updates as appropriate to the selected *Solution* to either reduce cost or improve compliance in response to the delivery of the Initial Requirements Document. The Contractor must update the documentation for the Concept Definition (Section 3.2.3), i.e. the Conceptual Design Document.

The Contractor must produce a Preliminary System Requirements (or equivalent level of requirements) for each of the elements of the proposed *Solution*. The format is left to the Contractor but the document must be sufficiently detailed to enable a credible cost exercise. The Contractor must produce a traceability matrix between the requirements expressed in the Preliminary System Requirements and the Initial Requirements Document. For any system requirements not linked to Initial Requirement(s), the Contractor must provide a rationale for their inclusion in the document.

The Contractor must update the Detailed Lifecycle Cost Estimate to the GoC. The Contractor should improve the quality of the cost estimate to reduce the cost uncertainty.

The Contractor must revise the Development Plan to ensure it is in line with the requirements expressed in the Preliminary System Requirements, and update it as needed.

The Contractor must present the details of the Preliminary System Requirements and the Detailed Lifecycle Cost Estimate to the GoC at the Requirement Review Meeting.

3.2.6 *Final Meeting*

The Contractor must hold a Final Review Meeting presenting the complete work performed during the study.

3.3 DELIVERABLES

The deliverables for the activity are listed in Table 3.4-1.

Table 3.4-1 Deliverables

Documents	Due Date
Reports/Analysis	
Options Analysis Document	Draft: Contract Award + 1 month Initial Release: Options Identification Review Meeting – 1 week Final: Options Analysis Review Meeting – 1 week Update as required: Final Review Meeting – 1 week
Conceptual Design Document (Optional)	Initial Release: Concept Design Review – 1 week Update: Development Plan Review Meeting – 1 week Final: Requirement Review Meeting – 1 week Update as required: Final Review Meeting – 1 week
Development Plan (Optional)	Initial Release: Development Plan Review Meeting – 1 week Final: Requirements Review Meeting – 1 week Update as required: Final Review Meeting – 1 week
Preliminary System Requirements and Traceability Matrix (Optional)	Initial Release: Requirement Review Meeting – 1 week Update as required: Final Review Meeting – 1 week
Detailed Lifecycle Cost Estimate to the GoC (Optional)	Initial Release: Development Plan Review Meeting – Week Final: Requirement Review Meeting – 1 week Update as required: Final Review Meeting – 1 week
Technical Notes	As required.
Minutes/ Presentations	
Kick-off Meeting Agenda and Presentation	Meeting Date – 1 week
Option Analysis Review Agenda and Presentation	Meeting Date – 1 week
Concept Design Review Agenda and Presentation (Optional)	Meeting Date – 1 week
Development Plan Review Agenda and Presentation (Optional)	Meeting Date – 1 week
Requirement Review Meeting Agenda and Presentation (Optional)	Meeting Date – 1 week
Final Review Meeting Agenda and Presentation	Meeting Date – 1 week
Minutes of Meetings	Meeting Date + 1 week
Action Item Log for Reviews and Teleconference	Meeting Date + 1 day
Final Data Package	

Final Version of all documents	2 weeks before Contract End Date
Executive Report	2 weeks before Contract End Date
BIP and FIP Disclosure Report	2 weeks before Contract End Date
Software models used for performance analysis when developed for this contract	2 weeks before Contract End Date

3.4 SCHEDULE

Table 3.8-1 lists the meetings planned for this activity.

TABLE 3.8-1 MEETINGS

Meeting	Date	Location
Kick-off Meeting	CA + 2 weeks	Contractor
User Group Meeting #1	CA + 1.5 months	Gatineau (CSA office)
Options Identification Review Meeting	CA + 3 months	Gatineau (CSA office)
Options Analysis Review Meeting	CA + 5 months	Saint-Hubert (CSA headquarters)
Concept Design Review Meeting (Optional)	CA + 8 months	Gatineau (CSA office)
Development Plan Review Meeting (Optional)	CA + 11 months	Saint-Hubert (CSA headquarters)
User Group Meeting #2 (Optional)	CA + 12 months	Gatineau (CSA office)
Requirement Review Meeting (Optional)	CA + 15 months	Saint-Hubert (CSA office)
Final Review Meeting	1 month after last Review Meeting	Saint-Hubert (CSA office)

3.5 DOCUMENTATION AND NAMING CONVENTION

Documentation, reporting and other deliverables must be produced according to instructions provided in Appendix B of this SoW, which also provides naming convention. Documents provided in Adobe PDF format must not be protected against copy of text and figures.

Documents must be delivered in the original software application format. One electronic copy of each deliverable document must be transferred to the CSA to the address and in the format specified in DID-0000, Appendix B. No paper copy is to be delivered.

3.6 PROJECT MANAGEMENT REQUIREMENTS

The Contractor is responsible for establishing and maintaining a project management control system necessary to meet the requirements provided in the next sub-sections.

3.6.1 *Communications and Access*

The Contractor must establish and maintain a close management and technical interface with CSA technical and project authorities to assure a coordinated program effort and monitoring of the total program cost, schedule and performance.

The Contractor must provide access to its installation and personnel, at mutually agreeable dates, by representatives of CSA or other organizations nominated by the CSA, for review of program status.

The Contractor must provide temporary accommodation and other facilities for the use of the CSA representatives (and the nominated attendees) visiting the Contractor's premises for reviews, meetings, audits, liaison, etc.

The accommodation must be adequate for the purposes of the visit and the facilities provided must include telephone and Internet access.

All documentation and data generated by the Contractor for the project must be accessible to the TA for review.

3.6.2 *Project Meetings*

The Contractor must hold the meetings described in Section 3.4. Some or all of these meetings may be attended by representatives of the CSA, and/or other organizations nominated by the CSA. GoC reserves the right to invite additional knowledgeable people (Public Servants or others under Non-Disclosure Agreements (NDAs)) to this meeting.

All meetings will be held between the Contractor and the TA at a mutually agreeable time. The Contractor must provide formal notification of the proposed meeting date to the TA no less than 10 working days before the meeting (with the exception of the KoM where the Contractor must provide formal notification no less than 5 working days before the meeting).

For meetings held at government venues, the Contractor must inform the TA of the names of Contractor and Subcontractor attendees no less than 10 working days before each meeting.

Additional teleconferences and face-to-face review meetings may be held if necessary when mutually agreed to by the Contractor and the CSA project manager.

3.6.2.1 *Kick-off Meeting (KOM)*

Within two weeks of the contract award (or at a date mutually agreeable to by the TA and the Contractor) a Kick-Off Meeting must be scheduled by the Contractor. The Contractor should provide the meeting agenda at least five working days before the meeting. The presentation must include the following content:

- Review of contract deliverables;
- Work requirements;
- Foreground Intellectual Property (FIP) and Background Intellectual Property (BIP);

- Licensing issues if any;
- Project's funding and expected cash-flow;
- Presentation to include the required copyrights and intellectual property disclosure;
- Other items as deemed appropriate.

This meeting will be held at Contractor Facilities or via teleconference.

All key participants under the contract, including at least one representative from each subcontractor, must attend this meeting. Work may start immediately after the award of the Contract and should not wait until the KoM is held.

3.6.2.2 Review Meetings

During the contract, various meetings will be necessary to evaluate progress of the work. The meetings are intended to provide an opportunity for the Contractor, CSA, government partners, and other invited attendees to review and discuss the following in detail, as necessary:

- The contents of the contract deliverables;
- The technical work of each task;
- Discuss project management issues;
- Presentation to include the required copyrights and intellectual property disclosure;
- Other items as deemed appropriate.

The Contractor's project manager, the systems engineer and all key Contractor participants, including at least one representative from each Subcontractor, must attend all Review meetings.

3.6.2.3 User Group Meetings

These meetings will be mostly used to communicate information to all the industrial performer in a consistent and coordinated fashion. The meeting will be chaired by the CSA and attended by representatives of the GoC departments and by all involved Contractors.

No deliverable will be required by the Contractor specific to these meetings. However, they will be critical to the success of the activities as answers to questions raised on the HUN document and (AD-1) and the Department of National Defence and Canadian Armed Forces Space-Based Surveillance Requirements (RD-2) will be provided.

3.6.2.4 Final Review Meeting

The Final Review Meeting will be held at the SA at the end of the contract. The specific intent of this meeting will be to discuss in detail the results obtained and the proposed follow-on activities. The Final Review Meeting is intended to provide an opportunity for the Contractor, CSA, Users group and other invited attendees to review and discuss the project.

- Contract deliverables;
- Foreground Intellectual Property (FIP) and Background Intellectual Property (BIP);
- Licensing issues if any;
- Final Funding and cash-flow;
- Discuss project management issues;
- Presentation to include the required copyrights and intellectual property disclosure;
- Other items as deemed appropriate

3.6.3 *Agendas, Minutes and Action Item Log*

The Contractor must provide a Meeting Agenda for all reviews and meetings including teleconferences and must deliver these to the TA no less than 5 working days before the meeting and must have it approved by the TA.

The Contractor must produce the minutes for all reviews and meetings including teleconferences and must deliver these to CSA no more than 5 working days after the meeting.

The Contractor must maintain a detailed Action Item Log (AIL) throughout the project to track actions resulting from all reviews and meetings including teleconferences.

The Contractor must submit Monthly Progress Reports.

3.6.4 *Project Reporting*

3.6.5 *Documents Deliverables*

The Contractor must deliver all documentation listed in the CDRL tables (Appendix A) as a minimum. The format and content of the deliverables must be in accordance with the requirements specified in the Data Item Descriptions (DIDs) (Appendix B), both the specific DID identified in the CDRL and the General Preparation Instructions, DID-0000.

Except for the documents that will remain CSA documents, the Contractor may propose documents in a Contractor's format provided the purpose, scope and content equal or exceed the DID requirements. Subject to CSA approval, the content of the Contractor's document will replace the content of the document specified in the DID.

3.6.6 *Subcontract Management*

The Contractor must be fully responsible for implementation and execution of all tasks, including those subcontracted to others. Whenever a subcontract is used, the Contractor must prepare and maintain subcontract Statements of Work, technical requirements documents, etc., necessary to effectively manage the subcontractors' work. At the request of the TA, copies of subcontractor documentation must be delivered to the TA.

The Contractor must ensure that all of the relevant requirements of this SoW are flowed down to the subcontract Statements of Work.

3.6.7 *Product Assurance*

There are no applicable product assurance requirements in this study.

3.7 INTELLECTUAL PROPERTY

The Contractor must prepare Background and Foreground Intellectual Property (BIP and FIP) Report, identifying the BIP and FIP that will be generated in this study.

4 GOVERNMENT FURNISHED EQUIPMENT AND INFORMATION

No Government Furnished Equipment will be provided under this Contract.

The Government will furnish the information stated in this SoW (e.g. Initial Requirements Document).

APPENDICES

APPENDIX A CONTRACT DATA REQUIREMENTS LIST (CDRL)

This Appendix defines the documentation to be delivered by the Contractor.

LEGEND:

A = Approval (in the Approval Category)

R = Review (in the Approval Category)

CF = Contractor's format

X = Ad-hoc, as and when requested

D: Draft

I.R. = Initial Release

U: Updated

F: Final

TABLE A-1: CDRL

Title	DID No.	Monthly	Kick Off Meeting	Solution Options Identification Review	Options Analysis Review	Concept Design Review (optional)	Development Plan Review Meeting (optional)	Requirements Review (optional)	Final Review Meeting	Approval Category
Meeting Agenda	0004		I.R.	I.R.	I.R.	I.R.	I.R.	I.R.	I.R.	A
Minutes of Meetings	0005		I.R.	I.R.	I.R.	I.R.	I.R.	I.R.	I.R.	A
Action Items Log (AIL)	0006		I.R.	U	U	U	U	U	F	A
Monthly Progress Report	0007	I.R.								R
Options Analysis Document	0200		Draft	I.R.	F				X	A
Conceptual Design Document ¹	CF					I.R.	U	F	X	A
Development Plan ¹	CF						I.R.	F	X	A
BIP and FIP Disclosure Report	0240		I.R.						F	A

¹ Document is required only if the Contractor is selected for the Optional Services.

Title	DID No.	Monthly	Kick Off Meeting	Solution Options Identification Review	Options Analysis Review	Concept Design Review (optional)	Development Plan Review Meeting (optional)	Requirements Review (optional)	Final Review Meeting	Approval Category
Executive Report	0250								F	A
System Requirements and Traceability Matrix ¹	CF							I.R	X	A
Detailed Lifecycle Cost Estimate to the GoC ¹	0260						I.R.	F	X	A
Technical Notes	CF		X		X	X	X	X	X	R
Meeting Presentations	CF		I.R.		I.R.	I.R.	I.R.	I.R.	I.R.	R
Software models used for performance analysis when developed for this contract	CF								F	R

APPENDIX B DATA ITEMS DESCRIPTIONS (DIDs)

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DID-0004 – MEETING AGENDA	31
DID-0005 – MINUTES OF MEETINGS	32
DID-0006 – ACTION ITEMS LOG	33
DID-0007 – PROGRESS REPORT	34
DID-0200 – OPTIONS ANALYSIS	35
DID-0240 – FIP AND BIP DISCLOSURE REPORT	37
DID-0250 – EXECUTIVE REPORT	39
DID-0260 – DETAILED COST ESTIMATE TO THE GoC	40

DID-0000 - General Preparation Instructions

PURPOSE:

This DID describes the standard format for the preparation of deliverable project documentation. All documentation must be written in English and must be delivered in electronic format. Documentation must be prepared in the Contractor's format, however it must meet the requirements of this DID.

PREPARATION INSTRUCTIONS:

1. GENERAL INSTRUCTIONS

1.1. Electronic Copies

Electronic documents must be prepared using the most appropriate tool (Microsoft Word, Excel, MS Project, etc.); released versions must be delivered in electronic format. Documents whose native format is not a common office program must be delivered in PDF (without security or pwd protection) in addition to the native format.

The electronic file name and the identification number written on the document itself must have the following format:

CDRL-NUM CIE Document Title (WXYZ) revA_sent2013-12-31 where:

CDRL-NUM:	The CDRL Identifier, for example: PM-100;
CIE:	Name of the Company originating the document (no space, no hyphen), for example: NDG;
Document Title:	Document title, for example: CAMS Optical Design Document;
(WXYZ)	Contractor's document number, in brackets, this is optional;
revA_sent 2013-12-31:	Revision number and Date Tracking Number with "sent" or "appd". For the initial release the Contractor can use "rev0", "revNC", or "revIR".

Note the absence of underscores or hyphens, except at CDRL.

Electronic documents or notifications of their availability on Contractor repositories must be sent to the Project Manager or its designated representative.

Emails are to contain the project/program acronym or equivalent identifier in the "Subject" line and include the CDRL identifier under which deliverable documents are being submitted. Hard copy and media deliverables are to be addressed to:

Attention: Eric Dubuc
Canadian Space Agency
6767, Route de l'Aéroport
Longueuil, QC, J3Y 8Y9
CANADA

2. DOCUMENT STRUCTURE AND CONTENT

2.1. Overall

Except as otherwise specified, all documents must have the overall structure as follows:

- a) Cover/Title Page;
- b) Table of Contents;
- c) Scope;
- d) Applicable and Reference Documents;
- e) Body of Document; and
- f) Appendices
- g) The following property notice of all internal pages: *Use, duplication or disclosure of this document or any of the information contained herein is subject to the Proprietary Notice at the front of this document.*

2.2. Cover/Title Page

The title page must contain the following information:

- Document Number and date: Volume x of y (if multivolume)
- Rev. indicator / date of Rev.
- Document Title
- Project Name
- Contract No.
- CDRL Item No. or Nos., if one document responds to more than one CDRL, subject to prior approval from the TA.
- Prepared for: Canadian Space Agency
- Prepared by: Contractor name, CAGE Code, address, and phone number
- © HER MAJESTY THE QUEEN IN RIGHT OF CANADA [YEAR]
- The following proprietary notice: *This document is a deliverable under contract no. _____. It contains information proprietary to the Crown, or to a third party to which the Crown may have legal obligation to protect such information from unauthorized disclosure, use or duplication. Any disclosure, use or duplication of this document or of any of the information contained herein for other than the specific purpose for which it was disclosed is expressly prohibited outside the Government of Canada except as the Crown may otherwise agree to in writing.*

3. DOCUMENT REVISIONS

Changes in revised documents must be identified by a sidebar.

DID-0004 – Meeting Agenda

PURPOSE:

To clarify the purpose, content and timings of a meeting.

PREPARATION INSTRUCTIONS:

The meeting agendas must contain the following information, as a minimum.

1) DOCUMENT HEADER:

- a) Title;
- b) Type of meeting;
- c) Project title, project number, and contract number;
- d) Date, time, and place;
- e) Chairperson; and
- f) Expected duration.

2) DOCUMENT BODY:

- a) Introduction;
- b) Opening Remarks: CSA;
- c) Opening Remarks: Contractor;
- d) Review of previous minutes and all open action items;
- e) Project technical issues;
- f) Project management issues;
- g) Other topics;
- h) Review of any action items as a result of the current meeting and
- i) Set or confirm dates of future meetings.

DID-0005 – Minutes of Meetings

PURPOSE:

The minutes of reviews or meetings provide a record of decisions and agreements reached during reviews/meetings.

PREPARATION INSTRUCTIONS:

Minutes of meeting must be prepared for each formal review or meeting and must include the following information, as a minimum:

- 1) Title page containing the following:
 - a) Title, type of meeting and date,
 - b) Project title, project number, and contract number,
 - c) Space for signatures of the designated representatives of the Contractor and the CSA,
 - d) Name and address of the Contractor;
- 2) Purpose and objective of the meeting;
- 3) Location;
- 4) Agenda;
- 5) Summary of the discussions, assumptions, decisions and agreements reached;
- 6) List of the attendees by name, position, phone numbers and e-mail addresses as appropriate;
- 7) Listing of open action items and responsibility for each action to be implemented as a result of the review;
- 8) Other data and information as mutually agreed; and
- 9) The minutes must include the following statement:

“All parties involved in contractual obligations concerning the project acknowledge that minutes of a review/meeting do not modify, subtract from, or add to the obligations of the parties, as defined in the contract.”

The list of action items must include the following information:

- 1) the action item number;
- 2) a description of the action required;
- 3) the date the action item was opened;
- 4) the person responsible for ensuring that the action is carried out;
- 5) the due date for the action;
- 6) the status of the action (open or closed); and
- 7) any comments or remarks relevant to the action.

Once an action item is closed, the action item list must also indicate the date the action was complete.

DID-0006 – Action Items Log

PURPOSE:

The Action Item Log (AIL) lists, in chronological order, all items on which some action is required, allows tracking of the action, and in the end provides a permanent record of those Action Items (AI).

PREPARATION INSTRUCTIONS:

The AIL must be in a tabular form, with the following headings in this order:

- 1) Item Number;
- 2) Red, yellow, green stoplight
- 3) Item Title;
- 4) Open Date;
- 5) Source of AI (e.g. MCR meeting, RID, etc.);
- 6) Originator;
- 7) Office of Prime Interest;
- 8) Person responsible (for taking action);
- 9) Target/Actual Date of Resolution;
- 10) Status (Open or Closed);
- 11) Remarks; and
- 12) Chart of graphical representation of open, closed, and total action items.

The date in column 9 will be the target date as long as the item is open, and the actual date once the item is closed.

DID-0007 – Progress Report

PURPOSE:

The Progress Report records the status of the work in progress during the previous calendar period. The Progress Report is used by the Government to assess the Contractor's progress in performance of the work.

PREPARATION INSTRUCTIONS:

The Monthly Progress Report must include status data and information summarizing project management, technical and schedule progress and accomplishment for each element of the Contractor's Work Breakdown Structure (CWBS). The report must address the major activities of the reporting period and must emphasize major achievements and events of special significance. Difficulties and/or problems that have affected the work progress, proposed corrective actions, and project impact expected, must also be reported.

Each progress report must answer the following three questions:

- 1) Is the project on schedule?
- 2) Is the project within budget?
- 3) Is the project free of any areas of concern in which the assistance or guidance of the CSA may be required?

Each negative response must be supported with an explanation.

The Progress Report must include the following information, as a minimum:

- 1) Summary outlook, including technical performance, work performed, schedule and cost status, and areas of concerns;
- 2) Status of the work in progress, specifically the work performed in the previous calendar period;
- 3) The work projected for the next period;
- 4) Detailed project schedule status including percent of completion;
- 5) Financial status including actual and forecasted expenditures, by month, as compared to the original monthly planned expenditure profile;
- 6) Cost and schedule variances from the plan, including deviations from schedule and proposed corrective actions for significant variances;
- 7) Description of trips connected with the Contract during the period of the report;
- 8) Status of all action items from previous review(s) and meeting(s).

DID-0200 – Options Analysis

PURPOSE:

To identify options to meet observation requirements, perform trade-off on those options and identify promising options.

PREPARATION INSTRUCTIONS:

The document must include as a minimum:

- 1) An introduction including the scope, the purpose and a list of assumptions (if any);

The Draft version needs to have these elements:

- 2) An analysis method to compare the different *Solution* options in terms of compliance to the HUN, overall cost, technical/programmatic/schedule risks and key questions of Section 1.2.3.
- 3) A complete list of all the sources of *Information Product* that will be considered in the trade-off.

The Initial Release version must add these elements:

- 4) A description of the proposed options and their compliance to the expressed needs
- 5) An estimate of the cost to the GoC/schedule/risks for the overall option from the early planning up to the end of the operating period. It is understood that at this early stage the cost estimate will present a large uncertainty. The Contractor must provide along with the cost estimate an associated uncertainty.
- 6) A complete description of the *Business Model* considered including but not limited to:
 - a) **Value proposition**
 - b) **Customer Segments**
 - c) **Channels**
 - d) **Customer Relationships**
 - e) **Delivery options**
 - f) **Cost Structure**
 - g) **Value Streams:** Some of the items to be considered under this section are:
 - i) Technologies

- (1) Identify any technologies, processes, innovations of the proposed options that would create jobs and new industrial capabilities, while leveraging established industries.
- ii) Fostering a culture of innovation and entrepreneurship
 - (1) Identify opportunities to foster innovation in Canada EO's industry.
 - (2) Illustrate how the proposed options will foster science excellence in Canada .
- iii) Companies
 - (1) Explain how the proposed options will maximize industrial benefits to Canada (retain and increase number of space-based Earth Observation firms in Canada across the entire value chain).
 - (2) Maintain the industrial capacity in Canada to produce space-based Earth Observation assets.

The Final Release must add these elements:

- 7) Update to the *Solution* option(s) to maximize the compliance to the DND/CAF requirements expressed in RD-2.
- 8) A trade-off analysis to identify the requirements from the Department of National Defence and Canadian Armed Forces Space-Based Surveillance Requirements (RD-2) that could be more efficiently implemented in a common *Solution* rather than in a separate system.
- 9) Trade-off analysis and recommendation related to the elements mentioned in Section 1.2.3.
- 10) An analysis of the *Business Model* considered including the advantages and disadvantages of each model considered.
- 11) A cost estimate to the GoC for each of the *Solution* options. At this stage, there is no prescribed accuracy or methodology to derive the cost estimate. However, the Contractor must describe for each cost estimate:
 - a) The assumptions
 - b) The methodology used and the supporting information sources
 - c) An estimate of the cost uncertainty and/or a cost range (minimum, mean, maximum cost) and the rationale for the value presented.
 - d) Specific risks or considerations that may have a significant impact on the reported cost estimate to the GoC.
- 12) A major milestone schedule for overall implementation for each *Solution options*
- 13) Ranking of the options based on the methodology established prior to the first User Group Meeting.

DID-0240 – FIP and BIP Disclosure Report

PURPOSE:

To fully disclose all FIP and BIP resulting from the study.

PREPARATION INSTRUCTIONS:

General Instructions for completing the “BIP” and “FIP” tables:

- Tables must be structured according to the CSA IP forms.
- Each IP element must have a unique ID# in order to easily link the elements of the different tables.
- Titles of the IP elements must be descriptive enough for the project stakeholders to get a general idea of the nature of the IP.
- Numbers and complete titles of reference documents must be included.

The CSA Technical Authority is responsible to review and approve the Tables before the closing of the Contract.

DISCLOSURE OF BACKGROUND INTELLECTUAL PROPERTY (BIP) BROUGHT TO THE PROJECT BY THE CONTRACTOR (if applicable)

1 BIP ID#	2 Project Element	3 Title of the BIP	4 Type of IP	5 Type of access to the BIP required to use/improve the FIP	6 Description of the BIP	7 Reference Documentation	8 Origin of the BIP	9 Owner of the BIP
<i>Provide ID# specific to each BIP element brought to the project e.g. BIP-CON-99</i> <i>Where “CON” is the contract acronym.</i>	<i>Describe the system or sub system in which BIP is integrated (e.g. camera, control unit, etc.).</i>	<i>Use a title that is descriptive of the BIP element integrated to the Work.</i>	<i>Is the BIP in the form of an invention, trade secret, copyright, design, patent?</i>	<i>Describe how the BIP will be available for Canada to use the FIP (e.g. BIP information will be incorporated in deliverables documents, software will be in object code, etc.).</i>	<i>Describe briefly the nature of the BIP (e.g. mechanical design, algorithm, software, method, etc.).</i>	<i>Provide the number and fill title of the reference documents where the BIP is fully described. The reference document must be available to Canada. Provide patent # for Canada if BIP is patented.</i>	<i>Describe circumstances of the creation of the BIP. Was it developed from internal research or through a contract with Canada? If so, provide contract number.</i>	<i>Name the organization that owns the BIP. Provide the name of the subContractor if not owned by the prime Contractor.</i>

DISCLOSURE OF THE FOREGROUND INTELLECTUAL PROPERTY (FIP) DEVELOPED UNDER THE CONTRACT

1 FIP ID#	2 Project Element	3 Title of the FIP	4 Type of FIP	5 Description of the FIP	6 Reference documenta tion	7 BIP used to generate the FIP	8 Owner of the FIP
<p><i>Provide ID# specific to each FIP element brought to the project e.g. BIP-CON-99</i></p> <p><i>Where "CON" is the contract acronym.</i></p>	<p><i>Describe the system or sub system in which FIP is integrated (e.g. camera, control unit, etc.).</i></p>	<p><i>Use a title that is descriptive of the FIP element.</i></p>	<p><i>Specify the form of the FIP e.g. invention, trade secret, copyright, industrial design, patent?</i></p>	<p><i>Specify the nature of the FIP e.g. software, design, algorithm, etc.</i></p>	<p><i>Provide the full title and number of the reference document where the FIP is fully described. The reference document must be available to Canada.</i></p>	<p><i>BIP referenced in Table 1 e.g. BIP-CON-2, 15.</i></p>	<p><i>Specify which organization owns the FIP e.g. Contractor or SubContractor.</i></p> <p><i>Provide the name of the subContractor if not owned by the prime Contractor.</i></p> <p><i>Provide reference to contract clauses that support FIP ownership.</i></p> <p><i>Provide reference to WPDs (Work Package Descriptions) under which the technical Work has been performed.</i></p>

DID-0250 – Executive Report

PURPOSE:

To provide a summary of the work accomplished during the contract.

PREPARATION INSTRUCTIONS:

The Executive Report will be placed in the public domain (e.g. CSA's library, publication and/or website).

The report should not exceed ten (10) pages.

The Contractor should submit an electronic copy of the Executive Report in the Final Data Package. The structure for the Executive Report is as follows:

- 1) Introduction;
- 2) Project Objectives;
- 3) Approach / Project Tasks;
- 4) Accomplishments;
- 5) Science/Technology:
 - a) Innovative Aspects;
 - b) Application Fields;
- 6) Business Potential, Benefit and Impact on the organization;
- 7) Ownership of Intellectual Property; and
- 8) Publications / References.

The CSA and the Contractor, or others designated by them, have the right to unrestricted reproduction and distribution of the Executive Report. The report should include the following proprietary notice ("Owner of FIP" being either the CSA or the Contractor):

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DID-0260 – Detailed Cost Estimate to the GoC

PURPOSE:

To provide CSA with an accurate Cost Estimate to the GoC.

PREPARATION INSTRUCTIONS:

Cost Estimates

1. The estimates must be based on a Cost Work Breakdown Structure. The table below shows the expected amount of detail in the Cost Breakdown Structure. However, the exact item in the Cost Breakdown structure must be determined by the Contractor and he must have it approved by the TA,

Number	Description
1	EOSC Solution
1.1	System engineering
1.2	Project management
	...
1.3	Spacecraft #1
1.3.1	Bus
1.3.2	Payload #1
	...
1.4	Technology/Science/Applications development
1.4.1	Initiative #1
	...
1.N	Purchase of data

2. The following information must be provided for each element of the Cost Work Breakdown Structure and by major phase of the project:
 - a. Labour: In Person-Hours or Person-Days
 - b. Labour: In CAD \$K
 - c. Subcontracts: In CAD \$K
 - d. Purchased Equipment: In CAD \$K
 - e. Travel: In CAD \$K
 - f. Miscellaneous: In CAD \$K
 - g. Cost (\$K): Total CAD \$K
 - h. Markup (\$K): Total markup (i.e. contractor overhead) in CAD \$K

- i. Fee (\$K): Total fee (i.e. contractor profit) in CAD \$K
 - j. Total with Mark-up and Fee: in CAD \$K
-
- 3. For each of estimate a numbered list of assumptions must be provided including assumptions related to inflation.
 - 4. For each estimate the methodology(Bottom-up, comparison, parametric model) and the source of information (past project, standard tools or model, etc) used to derive the estimate must be provided. The estimate for the follow-up phase must be Bottom-up based on the WBS provided in the Development Plan.
 - 5. Work performed by major subcontractors must be supported by a copy of the original subcontractor cost estimate.

Cost Uncertainty and risk

- 6. Quantification of the cost uncertainty surrounding the estimate must be provided. At a minimum a minimum, expected and maximum cost must be provided.
- 7. A risk reserve shall be recommended for each phase based on the risk assessment.

APPENDIX C ACRONYMS AND ABBREVIATIONS

AAFC	Agriculture and Agri-food Canada
AD	Applicable Document
AI	Action Items
AIL	Action Items Log
BIP	Background Intellectual Property
CAF	Canadian Armed Forces
CDRL	Contract Data Requirements List
CF	Contractor's format
DFO	Fisheries and Oceans Canada
CSA	Canadian Space Agency
CWBS	Contractor's Work Breakdown Structure
DID	Data Item Description
DND	Department of National Defence
ECCC	Environment and Climate Change Canada
EO	Earth Observation
FIP	Foreground Intellectual Property
GoC	Government of Canada
HUN	Harmonized User Needs
IP	Intellectual Property
IR	Initial Release
KoM	Kick-off Meeting
NDA	Non-Disclosure Agreement
NESZ	Noise equivalent sigma zero
RCM	RADARSAT Constellation Mission
RD	Reference Document
SAR	Synthetic Aperture Radar
SoW	Statement Of Work
TA	Technical Authority
TRRA	Technology Readiness & Risk Assessment
WBS	Work Breakdown Structure
WPD	Work Package Description

Canadian Space Agency EOSC Joint Project Team

Earth Observation Service Continuity Harmonized User Needs Document

Rev D

January 24, 2020

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REVISION HISTORY

Rev.	Description	Initials	Date
Draft 0	Initial draft version of the document.	ML	March 31, 2017
Draft 0.1	Second draft version revised following individual feedback from departments and discussions at harmonization meeting (April 26).	ML	May 11, 2017
Rev A	First Release Version	ML	May 26, 2017
Rev B	Added the possibility of additional classified needs in Section 4.5 and corrected a typo in DEM posting for [LAN-910] and [LAN-920].	ML	May 31, 2017
Rev B.1	Version for public consultations. Also minor updates for MAR-320, MAR-330, MAR-340, MAR-350 and MAR-360.4.	ML	July 05, 2018
Rev C	Added the “Minimum Capability for Service Continuity” for each of the needs. Changed SDC to EOSC. Added BAQ information in [MAR-100] and [MAR-120]. Added chronic oil spills in [MAR-120]. Clarification of vessel detection performance for narrow AOIs/smaller ships in [MAR-200]. Clarifications in Section 4.5 on Other Considerations. Minor final edits to address users feedback.	ML	August 12, 2019
Rev D	Removed needs strictly related to National Defence (now addressed in a separate document): [MAR-2xx], [LAN-9xx], [DAT-020], [DAT-030], [DAT-090], [DAT-100], [SEC-030], [SEC-060], [NET-010] to [NET-040]. Added [MAR-380] and [MAR-390] that were not covered anymore when removing [MAR-200]. Removed the “Minimum Capability for Service Continuity”. Updates (mainly Coverage Frequencies) in [LAN-510] and [LAN-630.1]. Updates to [DAT-040], [DAT-50] and [DAT-070].	ML	January 24, 2020



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1 INTRODUCTION

This Harmonized User Needs Document, along with the Department of National Defence/Canadian Armed Forces (DND/CAF) Space-Based Surveillance Requirements Document (SBS-RD), summarize the Government of Canada (GC) main user needs to be considered in the context of the Earth Observation Service Continuity (EOSC) study.

1.1 PURPOSE AND SCOPE

The purpose of this document, when considered in addition to the DND/CAF SBS-RD, is to record the user needs of the Government of Canada departments for the provision of SAR information after the end of the design life of the RADARSAT Constellation Mission (RCM) in 2026. Although the focus of this document is on SAR-related needs, the document also gives an overview of some non SAR space-based Earth Observation needs that are expected, in some cases, to enhance the SAR information. This list of broader EO needs is not complete and will be the object of a future exercise outside the EOSC initiative. The scope of this document is limited to maritime/marine and terrestrial needs.

1.2 APPLICABLE AND REFERENCE DOCUMENTS

1.2.1 *Applicable Documents*

There is no applicable document.

1.2.2 *Reference Documents*

There is no reference document.

2 CONSULTATION BACKGROUND

The third generation of RADARSAT-brand satellite systems, the three-satellite RADARSAT Constellation Mission (RCM), has been launched in 2019 and is expected to operate until at least 2026. Once operational, this system will provide Canada with continued and independent access to SAR data, a critical Earth Observation capability that supports a wide range of Government operations.

Given the significant planning and financial investments required to deliver a major satellite project, the Canadian Space Agency (CSA) and key federal partners are beginning planning for the next generation of SAR Earth Observation systems in order to ensure that Canada is able to seamlessly maintain this capability and enhance the operational services beyond 2026.

To this end, the CSA have consulted key federal partners to gather inputs on Canada's future Earth Observation needs, with a focus on the SAR data needs, with the objective to provide the recommendations on the way forward to ensure EO Service Continuity for Canada.



3 SUMMARY OF GOVERNMENT OF CANADA USER NEEDS

This section provides an overview of the Government of Canada main user needs that will be described in more detail in the next section (excluding those already included in DND/CAF SBS-RD).

TABLE 3-1 – SUMMARY OF GC USER NEEDS IN THE CONTEXT OF EOSC

ID	Name	Expected Contribution from SAR			Stage of Maturity ¹		
		Mostly SAR	Benefit from SAR	Not SAR	1-Operational	2-Pre-Operational	3-Emerging
[MAR-100]	Ice Monitoring (including Sea Ice and Iceberg)	x			x		
[MAR-110]	Ice Data Assimilation	x				x	
[MAR-120]	Oil Pollution Monitoring	x			x		
[MAR-130]	Marine Winds	x			x		
[MAR-140]	Wind Data Assimilation	x				x	
[MAR-150]	Ice Dynamics	x				x	
[MAR-300]	Coastal Altimetry	x ²			x		
[MAR-310]	Marine Turbulence		x			x	
[MAR-320]	Satellite Derived Bathymetry		x		x		
[MAR-330]	Shoreline/Intertidal Zone Extraction		x		x		
[MAR-340]	Change Detection		x		x		
[MAR-350]	3 Dimensional Shoreline extraction and Depth Estimation		x			x	
[MAR-360.1]	Oceanographic monitoring and ecosystem assessment – Temperature, Salinity & Turbidity			x	x		x

¹ Stage of Maturity in the context of EOSC:

- 1- Operational: currently operational need for which the absence of data will directly impact the department capacity to deliver its mandate in 2026.
- 2- Pre-operational: need that is expected to become operational and improve the department capacity to deliver its mandate in 2026.
- 3- Emerging: need that is emerging and for which there is uncertainty on its eventual operational use by the department to deliver its mandate.

² Satellite altimetry is used (SWOT SAR interferometric altimeter will be used: non-traditional SAR).



[MAR-360.2]	Oceanographic monitoring and ecosystem assessment – Currents	x ³			x		
[MAR-360.3]	Oceanographic monitoring and ecosystem assessment - Waves	x			x		
[MAR-360.4]	Oceanographic monitoring and ecosystem assessment – Sea Ice Characterization		x		x	x	
[MAR-360.5]	Oceanographic monitoring and ecosystem assessment - Harmful Algal Bloom			x		x	
[MAR-360.6]	Oceanographic monitoring and ecosystem assessment – Ocean Color			x	x		
[MAR-360.7]	Oceanographic monitoring and ecosystem assessment - Phytoplankton			x			x
[MAR-360.8]	Oceanographic monitoring and ecosystem assessment - Bottom Type		x				x
[MAR-370]	Changes in marine / estuary fish habitat & vegetation		x			x	
[MAR-380]	Ship traffic monitoring and pattern identification			x	x		
[MAR-390]	Detection and identification of small vessels	x			x		
[LAN-100]	Lake Ice Monitoring	x			x		
[LAN-110]	Lake Ice Monitoring and Thickness		x			x	
[LAN-120]	River Ice Monitoring		x		x		
[LAN-130]	Monitoring of ice formation in the Great Lakes connecting river channels	x					x
[LAN-200]	Permafrost Landscape Characterization		x		x		x
[LAN-210]	Glaciology - Iceberg Discharge	x				x	
[LAN-220]	Glaciology - Mass Balance	x ⁴			x		
[LAN-300]	Snow water equivalent retrievals	x ⁵					x
[LAN-310]	Estimating snow cover extent			x	x		
[LAN-400]	Ecosystem Monitoring – Wetlands and coastline		x		x		
[LAN-410]	Northern Ecosystem Monitoring		x			x ⁶	
[LAN-420]	Remote Sensing of Freshwater Environments			x			x
[LAN-430]	Surface Water Mapping	x			x		
[LAN-440]	Flood Mapping and Flood Risk	x			x		
[LAN-500]	Soil Moisture Data Assimilation		x				x

³ Satellite altimetry is used (SWOT SAR interferometric altimeter will be used: non-traditional SAR).

⁴ Radar altimetry is used (Cryosat SAR interferometer: non-traditional SAR).

⁵ On-going studies to determine best approach to derive SWE. Could be SAR, but at higher frequencies than C-band (e.g. Ku/Ka).

⁶ Pre-operational for radar data, operational for optical data.



[LAN-510]	Soil Moisture for Agriculture	x ⁷				x	
[LAN-600]	Land cover / Land Use Classification		x		x		
[LAN-610.1]	Crop Condition Assessment - Vegetation biophysical monitoring		x			x ⁸	x
[LAN-610.2]	Crop Condition Assessment - Vegetation biochemical monitoring			x			x
[LAN-620.1]	Grassland and Rangeland Condition Assessment – Mapping grassland and rangeland extent		x		x		
[LAN-620.2]	Grassland and Rangeland Condition Assessment – Estimating grassland and rangeland health		x			x ⁹	
[LAN-620.3]	Grassland and Rangeland Condition Assessment – Estimating grassland and rangeland health – invasive plant		x				x
[LAN-630.1]	Land Management- Tillage and crop residue mapping		x				x
[LAN-630.2]	Land Management- Estimation of soil properties		x				x
[LAN-630.3]	Land Management- Prescription mapping for variable management of agricultural inputs and crop yield	x					x
[LAN-700]	Forest canopy height mapping and monitoring	x ¹⁰					x
[LAN-710]	Biomass mapping and monitoring		x			x	
[LAN-720]	Active wildfire mapping and fuel consumption monitoring	x ¹¹					x
[LAN-800]	Infrastructure Integrity Monitoring	x			x		
[LAN-810]	Infrastructure Damage Assessment	x				x	
[LAN-820]	Monitoring Seismically Active Areas and Volcanoes	x				x	
[LAN-830]	Rapid Earthquake Characterization	x			x		
[LAN-840]	Assessing Induced Surface Deformation	x			x		

⁷ Also done operationally at coarser resolution using passive microwave.

⁸ Operational for optical data.

⁹ Operational for optical data.

¹⁰ Single-pass tandem radar interferometry is needed (e.g. Tandem-X).

¹¹ C-band only for wetland or open forest. L-band needed for dense forest.

4 GOVERNMENT OF CANADA NEEDS

In this section, the detailed needs of the GC to be considered in the EOSC study are presented (excluding those already included in DND/CAF SBS-RD). Section 4.1 summarizes the maritime needs and Section 4.2 summarizes the land needs, including inland waters. The focus is on the measurement performance, areas of interest, revisit/coverage frequency and latencies. Section 4.3 includes needs related to data availability and continuity, data access and use and security.

4.1 GOVERNMENT OF CANADA MARITIME NEEDS

This section contains the maritime/marine needs of the Government of Canada to be considered in the EOSC study (excluding those already included in DND/CAF SBS-RD). While the term « maritime » is used in this section for simplicity, both marine (e.g. organisms, ecosystems dynamics, ocean currents, etc.) and maritime (e.g. human related activity centered on ocean resources) needs are included. Inland waters are covered in Section 4.2.

It is assumed that those needs must be met simultaneously when applicable and that compromise beam modes can only be used if they allow satisfaction of all the applicable needs. This applies also to the land needs of the following section.



TABLE 4-1 –GC MARITIME NEEDS IN THE CONTEXT OF EOSC

ID	Name	Purpose and Rationale	Stage of Maturity	Needed measurement(s)	Measurement Performance (T: Threshold; G: Goal)	Area of Interest & Revisit/Coverage Frequency (T: Threshold; G: Goal)	Data Latency ¹² & Fast-tasking (T: Threshold; G: Goal)
[MAR-100]	Ice Monitoring (including Sea Ice and Iceberg)	Operational monitoring of Canada's navigable waters to support safe and efficient maritime operations.	1 - Operational	Sea ice type and extent Ice thickness (G)	Data/image quality to enable multiple ice typing, texture and structure, floe size and shape and icebergs. Polarization: HH/HV & VV/VH dual polarization and Compact Polarimetry (T) Fully polarimetric at swath widths of 200-500 km (G) Spatial resolution: 50 m (T) 1-10 m (G) with swath widths of 500 km or greater (G). Noise floor: <-28 dB (T) <-30 dB (G) Quantization: Image quality equivalent to at least 3-bit BAQ (T), 4-bit as a goal (G). Other considerations: <ul style="list-style-type: none">Simultaneous (or near-simultaneous e.g. min) multi-frequency/wavelength data	Areas of interest: Ice Monitoring Can AOI (ref. Section 5.1) (T) North Pole (ref. Section 5.1) (G) Coverage Frequency: Ice Monitoring Can AOI: Twice daily (T) North Pole: Daily Morning acquisitions are critical. Fast-tasking: 6 hours (G) for emergency situations.	Data latency: 30 min (T) 10 min (G) On-board processing for target (ship vs iceberg detection) of interest IF false alarm rate can be minimized and detection accuracy maximized. Fast-tasking: 6 hours (G) for emergency situations.

¹² **Data Latency:** time between data acquisition and product delivery.

[MAR-110]	Ice Data Assimilation	Operational regional and global sea ice analyses in support of operations and environmental predictions.	2 – Pre-operational (while NWP data assimilation is operational, the use of SAR in this process is pre-operational)	Ice concentration, thickness and motion	<p>is highly desirable; C-band (for continuity) and longer wavelength (e.g. L-Band) would be desirable. For example, L-band SAR would be useful for better classification of ice types (first-year and multi-year) during both dry and wet periods and for improved identification of floe boundaries and ridges throughout the melt season; C- and X-Band combination not desirable as interaction with ice cover is too similar.</p> <ul style="list-style-type: none"> • High resolution optical imagery (VIS/IR) would be a complementary source of data for this application. • Ice thickness information is highly desirable and a complementary source of data for this application. 	<p>Areas of interest: Similar to Ice Monitoring and Ice Dynamics but on a <u>global domain</u> (ice on entire globe).</p> <p>Coverage Frequency: 4 times daily (6 hours) (G) Twice daily (T)</p>	Data latency: 30 min (T)
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[MAR-120]	Oil Pollution Monitoring	Monitoring to encourage compliance with Canada's laws and International Conventions that seek to minimize oil pollution.	1 – Operational	Oil spill extent over marine areas	<ul style="list-style-type: none"> An instrument on board that would be quite valuable for NWP is a GNSS receiver for radio-occultation (RO). Small instrument with significant impact on forecasts. <p>Polarization: HH/HV & VV/VH (preferred) dual polarization and Compact Polarimetry (T) Fully polarimetric at swath widths of 200-500 km (G)</p> <p>Spatial resolution: 10 m (T) 3 m (G) with swath widths of 300-500 km, or greater (G)</p> <p>Noise floor: < -28 dB (T) < -30 dB (G)</p> <p>Quantization: Image quality equivalent to at least 3-bit BAQ (T), 4-bit as a goal (G).</p> <p>In addition to large area oil pollution monitoring, there is also a need for high resolution (5m (T)) monitoring of smaller chronic oil spills regions within the larger AOI.</p> <p>Other considerations:</p> <ul style="list-style-type: none"> C-band preferred but X-band could also be used. High Resolution optical (VIS/IR) imagery would be a complementary source of data for this application. 	<p>Areas of interest: Oil Pollution Can AOI (ref. Section 5.2). Specific chronic oil spills regions at higher resolution.</p> <p>Coverage Frequency: Three times daily (G) Twice daily (T)</p> <p>Local acquisition time other than dawn/dusk would also be desirable.</p>	<p>Data latency: 15 min (T) 5 min (G)</p> <p>On-board processing for anomaly “first-guess” detection is of interest is accuracy can be maximized.</p> <p>Fast-tasking: For emergency and/or “re-look” at higher resolution (G).</p>
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[MAR-130]	Marine Winds	To support the operational marine forecasting program.	1 – Operational	Marine surface wind speed and direction	<p>Accuracy: 2 m/s at 500 m resolution (T) Better accuracy than current SAR capability (G)</p> <p>Polarization: Optimal VV-VH; Compact Polarimetry.</p> <p>Other considerations:</p> <ul style="list-style-type: none">• C-band best but X-band could also be used.• Over 85% of the data used by this application is “re-used” from primary application orders (e.g. ice, oil).	<p>Areas of interest: Greatest spatial coverage possible over marine areas. Focus on coastal areas and shared AOI with much of the ice monitoring and oil (ISTOP) needs.</p> <p>Potential “global” marine wind products in future if coverage allows – see Wind Assimilation.</p> <p>Coverage Frequency: 3-4 times daily</p>	<p>Data latency: <3 h (T) <10 min (G)</p>
[MAR-140]	Wind Data Assimilation	To support regional and global numerical weather prediction (NWP) data assimilation over oceans.	2 – Pre-operational	Marine surface wind speeds	<p>Coverage is more important than the resolution of the data. Hence, data over a 500 km swath would be required.</p> <p>Other considerations:</p> <ul style="list-style-type: none">• To complement scatterometers data providing two wind components at about 50 km horizontal resolution.• An instrument on board that would be quite valuable for NWP is a GNSS receiver for radio-occultation (RO). Small instrument with significant impact on forecasts.	<p>Global oceans</p> <p>Coverage Frequency: Global coverage 4x daily (G)</p>	<p>Data latency: 6 h (T) 0.5 - 1.5 h (G)</p>
[MAR-150]	Ice Dynamics	Ice motion products are required to assess the	2 – Pre-operational	Sea ice speed and direction	<p>Polarization: HH</p> <p>Other considerations:</p>	<p>Areas of Interest: pan-Arctic (ref. Section 5.3)</p>	



		state of the Arctic sea ice cover which supports strategic operational and policy decision making, national and international research initiatives, and infrastructure design. Ice motion information is also used to constrain estimates from seasonal forecast models.			<ul style="list-style-type: none">• L, X and Ku-band imagery could be used in addition to C-band to increase coverage. L-band could find additional utility during the melt season for determining additional vectors.• Pre-processing of imagery to ingest into the ice drift tracking algorithm would be beneficial to ease the transition to fully operational. Large data volume is an issue.	Coverage Frequency: 1-3 day Application expected to grow with increasing capabilities of SAR, including higher temporal and spatial coverage.	
[MAR-300]	Coastal Altimetry	To build satellite altimetry data for GC's long-term and operational monitoring of canadian waters.	1-Operational	Coastal Altimetry/ Sea Level	Accuracy: 0.5 cm Spatial resolution: 1 km Other considerations: <ul style="list-style-type: none">• Satellite Altimeter. This technology is currently operational and advancements are expected with the launch of SWOT (first 2-D altimeter),• The technology will grow over the coming decades.• Current satellites: Jason 2 (NASA/CNES), Sentinel-3 SARL (ESA), AltiKa (ISRO).	Area of Interest: All Canadian waters Coverage Frequency: TBD	Data latency: 11 days (I) 2-3 days (G)



[MAR-310]	Marine Turbulence	Marine forecast and to monitor the physical environment.	2-Pre-operational (derived from SAR data)	Surfactants crude oil natural oil seeps macroalgae on ocean surface	<p>Accuracy: 5 km/h</p> <p>Spatial resolution: 1 km</p> <p>Other considerations:</p> <ul style="list-style-type: none">• SAR backscatter (RADARSAT-2) and Ocean Color satellites are currently used.• Relate the radar signal backscatter to turbulent mixing intensity based on the hypothesis that more waves generates more backscatter as well as more turbulence.	<p>Area of Interest: All Canadian waters (EEZ)</p> <p>Coverage Frequency: 2-3 days (T) Daily (G)</p>	<p>Data latency: 1-2 days</p>
[MAR-320]	Satellite Derived Bathymetry	Derive water depths to support extension of hydrographic surveys to wider geographical areas. Increase the amount of depth information presented within shallow areas on hydrographic charts.	1-Operational (optical) 3-Emerging (radar and hyperspectral)	Water Depth	<p>Spatial resolution: 0.5-2 m (G) 30 m (optical and hyperspectral) 50 m (radar) (T)</p> <p>Other considerations:</p> <ul style="list-style-type: none">• Cloud and ice free imagery critical• Optical (e.g. DigitalGlobe, RapidEye, Sentinel-2 and Landsat) and Radar (RADARSAT-2, RCM, possibly TerraSAR-X) data can be used.• Optical gaps: recent coverage; SAR gaps: Regular high resolution coverage within coastal areas. Radar will function best in areas where optical satellite derived bathymetry is not possible (e.g. strong current areas).• Impact of technology change: optical: could impact accuracy of depth estimates; radar: could require significant modifications to depth estimation methods; hyperspectral: minimal impact as satellite methods not yet developed.• Growth expected to be greatest during the 2025-2030 timeframe for optical, and during the 2030/2035-2040 timeframe for radar.	<p>Area of Interest: Canadian coastal waters and major inland waterways (e.g. St. Lawrence River). Also the Great Lakes for optical data.</p> <p>Coverage Frequency: Monthly (T) Weekly (G)</p>	<p>Data latency: 3 days</p>



[MAR-330]	Shoreline/Intertidal Zone Extraction	Identify shorelines and intertidal zones from optical and SAR imagery for use as source data for hydrographic charts. Detailed shorelines are required for aquatic species habitat modelling. Accurate assessment of shoreline modifications requiring Fisheries Act and or Species at Risk Act permits.	1- Operational	Shoreline and intertidal zone locations	<p>Spatial resolution: 30 m (T) 1-2 m (G)</p> <p>Other considerations:</p> <ul style="list-style-type: none">• For optical, cloud free optical imagery is critical.• For SAR, multi-polarization SAR observations (e.g. HH+HV, quad pol, CP) are beneficial.• DigitalGlobe, RapidEye, Sentinel-2, Landsat and RADARSAT-2 are currently used.• Optical gaps: recent coverage; SAR gaps: Regular high resolution coverage within coastal areas.• Technological change impact medium. Methods for shoreline extraction would need to be updated.• Growth expected to be greatest during the 2025-2030 timeframe.	<p>Area of Interest: Canadian coastal waters and major inland waterways, including the Great Lakes.</p> <p>Coverage Frequency: Monthly (T) Weekly (G)</p>	<p>Data latency: 3 days</p>
[MAR-340]	Change Detection	Identify changes in Canadian coastal waters to support hydrographic chart production planning activities. Measuring and	1- Operational	Areas of change indicators (vector, raster).	<p>Spatial resolution: 10 m (T) 1-2 m (G)</p> <p>Other considerations:</p> <ul style="list-style-type: none">• Cloud free optical imagery critical.• Multi-polarization SAR observations beneficial.• DigitalGlobe, RapidEye, Sentinel-2, Landsat and RADARSAT-2 are currently used.	<p>Area of Interest: Canadian coastal waters and major inland waterways.</p> <p>Coverage Frequency: Bi-weekly (T) Weekly (G)</p>	<p>Data latency: 3 days For emergency: 1h (G) 3h (T)</p> <p>Fast-tasking: May be requested for emergency situations.</p>



		monitoring impacts of works near water.				<ul style="list-style-type: none">Optical gaps: recent coverage; SAR gaps: regular high resolution coverage within coastal areas.Technological change impact medium. Some changes to methods would be required.Growth expected to be greatest during the 2025-2030 timeframe.		
[MAR-350]	3Dimensional Shoreline Extraction and Depth Estimation	Use of stereo optical and/or SAR measurements to derive elevations of coastal areas. Allows for precise mapping of high/low water lines and intertidal zones. Can support validation of tidal predictions.	2-Pre-operational	Shoreline locations and water depths	<ul style="list-style-type: none">Spatial resolution : 10 m (T) 1-2 m (G)Other considerations:<ul style="list-style-type: none">Cloud and ice free optical imagery critical.Ice free SAR data critical.DigitalGlobe and TerraSAR-X currently used.Gap: stereo data availability over coastal waters.RCM expected to be very useful.Technological change impact may be high if data characteristics change significantly.Growth expected to be greatest during the 2030/2035-2040 timeframe.	Area of Interest: Canadian coastal waters and major inland waterways. Coverage Frequency: Weekly (G); Annual (T).	Data latency: 3 days For emergency: 1h (G) 3h (T) Fast-tasking: May be requested for emergency situations.	
[MAR-360.1]	Oceanographic monitoring and ecosystem assessment – Temperature, Salinity & Turbidity	Monitor the physical environment, detect and quantify changes that may affect the entire marine ecosystem. EO products needed to integrate and complement in situ and	1-Operational (Temp.) 3-Emerging (Salinity)	Temperature Salinity Turbidity	Accuracy: <0.1% Other considerations: <ul style="list-style-type: none">Various platforms, including ships (flow through and direct samples), autonomous vehicles (argo-floats and gliders) and moorings and satellites.Technology will grow over the coming decades, which may provide opportunities to expand the types of measurements that can be derived for EO systems. Current satellites: <i>Temperature:</i> <ul style="list-style-type: none">MODIS (NASA)	Area of Interest: All Canadian waters (EEZ) Coverage Frequency: Needed at various temporal (daily, weekly, monthly, seasonally, annually).	Data latency: 24 to 48 h	



		field-based monitoring activities in support of regional assessments of oceanographic conditions in marine areas.				<ul style="list-style-type: none">• AVHRR (NOAA/EUMETSAT)• SLSTR (ESA/EUMETSAT) <i>Salinity:</i> <ul style="list-style-type: none">• SMOS for global coverage (ESA) Ocean Colour satellite for river mouth (correlation of salinity with CDOM absorption)		
[MAR-360.2]	Oceanographic monitoring and ecosystem assessment – Currents	Monitor the physical environment, detect and quantify changes that may affect the entire physical oceanography and marine ecosystem.	1- Operational	Current velocity and direction coastal currents mesoscale / sub-mesoscale features and eddies	Accuracy: <0.1% Spatial resolution: ~1 km Other considerations: Satellite Altimeter. This technology is currently operational and advancements are expected with the launch of SWOT (first 2-D altimeter). The technology will grow over the coming decades. Current satellites: <ul style="list-style-type: none">• Jason 2 (NASA/CNES)• Sentinel-3 SARL (ESA)• AltiKa (ISRO)	Area of Interest: All Canadian waters (EEZ) Coverage Frequency: weekly (T) daily (G)	Data latency: 1 week	
[MAR-360.3]	Oceanographic monitoring and ecosystem assessment - Waves	Monitor the physical environment, detect and quantify changes that may affect the entire physical oceanography and marine ecosystem.	1- Operational	Wave height mean directions 1-d and 2-d wave spectra period swell	Accuracy: 5 cm Spatial resolution: 1 km Polarization: SAR Compact polarization offers new opportunities for retrieving wave information. Other considerations: Current satellites: RADARSAT-2, Sentinel-1. Moored, wave gliders and RCM to come. Gap: low revisiting frequency	Area of Interest: All Canadian waters (EEZ) Coverage Frequency: 2-3 days (T) daily (G)	Data latency: 1-2 days	



[MAR-360.4]	Oceanographic monitoring and ecosystem assessment – Sea Ice Characterization	Marine Forecast, marine safety, and to monitor the physical environment	1-Operational for some products and 2-Pre-operational for others (e.g., melt pond, ice type).	Sea-ice floe-size distributions concentration thickness melt ponds ice type	Spatial resolution: 100 m Other considerations: [Similar to Ice Monitoring: MAR-100] Current satellites: Radarsat-2, Ocean Colour/Visible RCM to come	Area of Interest: Arctic and subarctic waters Coverage Frequency: 2-3 days (T) daily (G)	Data latency: 1-2 days
[MAR-360.5]	Oceanographic monitoring and ecosystem assessment - Harmful Algal Bloom	Detection of Harmful algal bloom	2-Pre-operational	Cell abundance of harmful algae and bacteria	Other considerations: Use of satellite ocean color to derive biomass indices or rely on proxies. Current satellites: OLCI (ESA), MODIS and VIIRS (NASA)	Area of Interest: All Canadian waters (e.g., ocean, coastal, inland waterbodies and waterways). Coverage Frequency: 2-3 days (T) daily (G)	Data latency: 1-2 days
[MAR-360.6]	Oceanographic monitoring and ecosystem assessment – Ocean Color	Monitor the biological environment, detect and quantify changes that may affect the entire marine ecosystem.	1-Operational (2-Pre-operational and 3-Emerging for sensors that will be launch in the near future with extra spectral, temporal and spatial capacity)	Ocean Color (chl, cdom, primary production and more)	Other considerations: Various platforms, including ships, autonomous vehicles (argo floats and gliders) and moorings. Current satellites: OLCI (ESA), MODIS and VIIRS (NASA). Gap: coastal areas are not monitored, need for high resolution (< 250 m) satellite with multi- or hyperspectral capacity (COCI-type). PACE (NASA) expected to be launched in 2020, need to support effort to ingest hyperspectral data in processing chain.	Area of Interest: All Canadian waters (EEZ) Coverage Frequency: Needed at various temporal (daily, weekly, monthly, seasonally, annually).	Data Latency: 2-3 days (G)

					Technology will grow over the coming decades.			
[MAR-360.7]	Oceanographic monitoring and ecosystem assessment - Phytoplankton	Monitor the biological environment, detect and quantify changes that may affect the entire marine ecosystem.	3-Emerging	Phytoplankton vertical profile	Other considerations: Shipboard and satellite LIDAR (e.g., Calipso satellite LiDAR, 2006-current).	Area of Interest: All Canadian waters (EEZ) Coverage Frequency: 2-3 days (G) 2 weeks (T)	Data Latency: 24 – 48 h	
[MAR-360.8]	Oceanographic monitoring and ecosystem assessment - Bottom Type	Identify and monitor habitat and habitat suitability in oceans, inland, and coastal waters (e.g., Great Lakes, Lake Winnipeg), and inland waterways (e.g. St. Lawrence River).	3-Emerging	Bottom type classification of the ecosystem	Other considerations: With RCM and possibly COCI, technology will grow over the coming decades. Current Satellites: <ul style="list-style-type: none">• Landsat, Sentinel-2• Radarsat-2• OLCI, MODIS, and VIIRS	Area of Interest: All Canadian coastal waters Coverage Frequency: 2-3 days (G) 10 days (T)	Data latency: 1-2 days	
[MAR-370]	Changes in marine / estuary fish habitat & Vegetation	Identify and track changes in nearshore marine and estuary habitat & vegetation (eelgrass, kelp, etc.) that are important for fish.	2-Pre-operational	Bottom type classification	Spatial Resolution: 5 – 250 m Other considerations: <ul style="list-style-type: none">• Potentially from existing satellite imagery resources, but would require further investigation.	Area of Interest: BC coastal waters Coverage Frequency: Annually (T)	Data Latency: 6 months	



[MAR-380]	Ship traffic monitoring and pattern identification	Use of AIS data to track and monitor ship location and identify navigational patterns/trends. This information is critical for defining surveying priorities and other planning activities related to navigational safety. This information is also critical for operational delivery of marine navigation and emergency response services.	1- Operational	<ul style="list-style-type: none">• Name of Ship• Flag• IMO• Category• MMSI• Call Signal• LAT/LON• Date/time• Frequency	Other considerations: <ul style="list-style-type: none">• Technological change impact minimal as format of AIS will remain consistent.• Measurements required over entire timeframe. Growth greatest during first five years as additional data becomes available.	Area of Interest: Canada's waters Coverage Frequency: AIS measurements from satellite multiple times per day	
[MAR-390]	Detection and identification of small vessels	SAR can be used to identify small vessel targets that are not captured by regulations requiring them to transmit AIS use other	1- Operational	<ul style="list-style-type: none">• Lat/Long• Date/Time• Course/Speed• Ship identification information	Spatial Resolution: 5 m detectable ship length Other considerations: To detect small craft vessels (of 5m of length or larger) with low probability of false identification. The goal is the development of a potential low impact shipping corridors to include small craft vessels.	Area of Interest: Navigable Canadian waterways Coverage Frequency: Automatic identification of small craft	Data Latency and Fast Tasking: Delays in scheduling often result in the data not being used. Fast tasking capability would be of



		means of self-reporting. Data is needed which has high enough resolution to detect and classify ships, but must also have a large enough swath width to monitor large areas.				vessels to be provided once per month during navigation season.	incredible benefit.
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4.2 GOVERNMENT OF CANADA LAND NEEDS

This section contains the land needs of the Government of Canada to be considered in the EOSC study, including the inland waters (excluding those already included in DND/CAF SBS-RD document). It is assumed that those needs must be met simultaneously when applicable and that compromise beam modes can only be used if they allow satisfaction of all the applicable needs. This applies also to the maritime needs of the previous section.

TABLE 4-2 –GC LAND NEEDS IN THE CONTEXT OF EOSC (INCLUDING INLAND WATER)

ID	Name	Purpose and Rationale	Stage of Maturity	Needed measurement(s)	Measurement Performance (T: Threshold; G: Goal)	Area of Interest and Revisit/Coverage Frequency Threshold; (T: Threshold; G: Goal)	Data Latency & Fast-tasking (T: Threshold; G: Goal)
[LAN-100]	Lake Ice Monitoring	Monitoring of lake ice coverage for heat flux input estimates to improve weather forecast accuracy.	1 - Operational	Lake ice type and extent Lake ice vs. water extent Ice thickness (G)	Similar to Ice Monitoring [MAR-100]. Other considerations: <ul style="list-style-type: none"> High resolution optical imagery (VIS/IR) would be a complementary source of data for this application. Ice thickness information is highly desirable and a complementary source of data for this application. 	Areas of interest: National inland lakes (ref. Section 5.4) Coverage Frequency: Weekly (T) Twice weekly (G)	Data latency: 30 min (T) 10 min (G)
[LAN-110]	Lake Ice Monitoring and Thickness	Measure presence and condition of ice lakes in support of public safety (e.g. EGS) and climate change studies.	2- Pre-Operational	Ice / No Ice Ice Conditions Ice Thickness	Consistent separation of ice and rough open water Consistent separation of wet snow and flooded ice and open water Identification of cracks, ridges and ice types (e.g. snow/ice, thermal ice) Estimation of ice thickness (+/- 10 cm) Spatial Resolution:	Areas of interest: National inland lakes Coverage Frequency: Twice a week (T)	Data Latency: 24h



[LAN-120]	River Ice Monitoring	Measure presence and condition of river ice in support of public safety (e.g. EGS).	1- Operational 2- Pre-operational for Ice Thickness	Ice / No Ice Ice Roughness Ice Thickness	<p>10 m over 350 km (T) 3-5 m over 350 km (G)</p> <p>Noise floor: <-28 dB (T) <-30 dB (G)</p> <p>Other considerations:</p> <ul style="list-style-type: none">• Lake ice detection and conditions operationally possible with C-band single, multi-pole and polarimetric data (incl. compact-polarization)• Ice thickness not possible with RCM. Preferred approach is L-band sensor in a bi-static tandem mission with large baseline.• Reliable separation of ice from open water is an outstanding requirement. L-band, concurrent optical data or bistatic SAR could assist.		
					<p>Consistent separation of ice and rough open water Consistent separation of wet snow and flooded ice and open water Identification of ice types (e.g. smooth and rough-ice jams) Estimation of ice thickness (+/- 10 cm)</p> <p>Spatial Resolution: 5 m over 350 km (T) 1 m over 100 km (G)</p> <p>Noise floor: <-30 dB (T) <-35 dB (G)</p> <p>Other considerations:</p> <ul style="list-style-type: none">• River ice detection and conditions operationally today with C-band single channel HH• Ice thickness not possible with RCM. Preferred approach is L-band sensor in a	<p>Areas of interest: National scale</p> <p>Coverage Frequency: Twice daily (T)</p>	



					<p>bi-static tandem mission with large baseline.</p> <ul style="list-style-type: none">Reliable separation of ice from open water is an outstanding requirement. L-band, concurrent optical data or bistatic SAR could assist.Maximize river coverage in individual frames		
[LAN-130]	Monitoring of ice formation in the Great Lakes connecting river channels	Monitoring of river ice formation to support regulatory operations and water balance monitoring	3 - Emerging	Monitoring of ice formation in the Great Lakes connecting river channels	<p>Similar to ice monitoring [MAR-100].</p> <p>Other considerations:</p> <ul style="list-style-type: none">High resolution optical imagery (VIS/IR) would be a complementary source of data for this application.	<p>Areas of interest:</p> <p>Great Lakes connecting river channels</p> <p>Coverage Frequency:</p> <p>Daily (T)</p> <p>From December through to April.</p>	
[LAN-200]	Permafrost Landscape Characterization	Detect and map the presence and impacts of frozen soils and ground ice	1 - Operational for ground deformation 3 - Emerging for spatial distribution	3-D Ground deformation related to ice growth, melt Spatial distribution of permafrost and ground ice	<p>Spatial Resolution:</p> <p>5 m for 3D terrain displacement</p> <p>Polarization:</p> <p>Polarimetric (or compact-pol) data required to support PolInSAR methods</p> <p>Noise floor:</p> <p><-30 dB (T) <-35 dB (G)</p> <p>Other considerations:</p> <ul style="list-style-type: none">For spatial distribution: direct measurements of the presence of permafrost and other types of ground ice are required over large areas. Currently cannot observe sub-surface ice directly. Vegetation and deformation used as proxy for its presence.	<p>Area of Interest:</p> <p>Continuous and Discontinuous Permafrost Regions of Canada</p> <p>Coverage Frequency:</p> <p>Daily through summer period.</p>	

					<ul style="list-style-type: none"> For ground deformation: InSAR approach used: vertical surface deformation required (mm accuracy). 3-D deformation desirable. Research underway to assess longer wavelength polarimetric SARs (e.g. L-band, P-band) to detect ice directly Inclusion of concurrent optical data can assist through mapping of related landscape features and change. See suggestions for Infrastructure Integrity Monitoring [LAN-800]. 		
[LAN-210]	Glaciology - Iceberg Discharge	To enhance our understanding of climate change and its impacts.	2- Pre-Operational	Glacier ice motion - seasonal	<p>Spatial resolution: 5-10 m</p> <p>Other considerations:</p> <ul style="list-style-type: none"> Current data source: RADARSAT-2 L-band would improve velocity mapping capabilities in summer months Integration with optical data (May to October) would be valuable 	<p>Areas of interest: Terrestrial ice masses (150,000km²) within the Canadian Arctic Archipelago</p> <p>Coverage Frequency: 1-2 day</p>	
[LAN-220]	Glaciology - Mass Balance	To enhance our understanding of climate change and its impacts.	1- Operational	Glacier ice thickness change	<p>Spatial resolution: 5-10 m</p> <p>Other considerations:</p> <ul style="list-style-type: none"> Interferometric SAR (Ku Band) mode: current source – CryoSat-2 	<p>Areas of interest: Include land ice masses across the Canadian Arctic Archipelago and Western / Northern Cordillera of Canada</p> <p>Coverage Frequency: 1-2 day</p>	



[LAN-300]	Estimating Snow Water Equivalent	Radar retrievals of snow water equivalent are required to support land surface data assimilation for numerical weather prediction and hydrological forecasting. Coarser resolution (i.e. passive microwave) can be used for weekly mapping SWE across Canada's agricultural extent for inputs to hydrological models and bio-geochemical (yield) models.	3 - Emerging	Snow Water Equivalent (SWE)	<p>Spatial resolution: 1 km (T) 500 m (G)</p> <p>Accuracy: 30 mm (T) 10 mm (G)</p> <p>Other considerations:</p> <ul style="list-style-type: none">• C-band measurements are not appropriate for snow water equivalent retrieval - higher frequency (Ku; Ka) measurements are required.• Current concept studies and analysis of experimental data focused on identifying ideal frequency or frequencies, retrieval algorithm development, and data assimilation.• For Agriculture, best available resolution from passive microwave might be sufficient, but desirable to have high level "canned" products.	<p>Area of interest: Land regions with seasonal snow cover (Northern hemisphere (T), globally (G)).</p> <p>Agricultural Region of Canada</p> <p>Coverage Frequency: 1-3 days [weekly in fall and spring for Agriculture]</p>	<p>Data Latency: 6-12 hrs for operational data assimilation [72h for Agriculture]</p>
[LAN-310]	Estimating Snow Cover Extent	Weekly mapping snow cover extent across Canada's agricultural extent.	1. Operational (As part of CALMS)	Extent of snow cover	<p>Spatial Resolution (Sub-field level): 30 m (T) 10 m (G)</p> <p>Other considerations: Optical: NIR and SWIR critical (or "canned" product); Wide swath (AWIFS-type); Daily MODIS MOD10A1 L-2 Product currently</p>	<p>Area of Interest: Agricultural region of Canada.</p> <p>Coverage Frequency:</p>	<p>Data Latency: 72 hours (T)</p>



		Data used to map the extent of snow cover to help define start of growing season.				used (daily but coarse resolution at 250m); Gaps over cloudy regions; Dependencies on USGS LP-DAAC archive that does not ensure timely delivery (<48 h) of data. Concerns over MODIS life-span and effort to transition to new sensor.	Weekly (T) Daily (G) Limited to spring (possibly fall).	
[LAN-400]	Ecosystem Monitoring – Wetlands and Coastline	Ecosystem habitat monitoring, assessment and mapping, Arctic coastline sensitivity mapping	2 – Pre-operational	Wetland mapping, habitat monitoring, coastal mapping	<p>Polarization: Continuity of polarimetric data for wetlands (Compact-Pol and Quad-pol)</p> <p>Spatial Resolution: Higher resolution (5 m), larger swath widths towards improved operationalization</p> <p>Other considerations:</p> <ul style="list-style-type: none">• L-band would be beneficial for wetland vegetation penetration.• SAR complementary data source with other space-based EO sources and sensor types including optical data.		<p>Areas of interest: Wetland sites and coastal erosion sites (ref. Section 5.5).</p> <p>Coverage Frequency: Higher re-visit times and coherent change detection (~daily) are expected to improve ecosystem monitoring.</p>	
[LAN-410]	Northern Ecosystem Monitoring	Land-based ecosystem management decision support and monitoring. Data is needed to detect and monitor inland (lake) development, especially in the north where	1- Operational for optical data 2-Pre-Operational for radar data	Data for the analysis of the cumulative impacts of human activities (e.g. mines, dams, etc.) and natural causes are required.	<p>Spatial Resolution: High resolution (exact value not a high priority)</p> <p>Other considerations:</p> <ul style="list-style-type: none">• This data could come in the form of optical and radar data.• Current source: LANDSAT.		<p>Area of Interest: Focus on Canada’s north (inland and coastal).</p> <p>Coverage Frequency: Annual (T)</p>	



[LAN-420]		there is limited physical access to sites.	3-Emerging	Water Depth Temperature Turbidity Stream flow velocity and volume. Trophic status Riparian vegetation and stream cover vegetation characteristics.	Spatial Resolution: 5 m Other considerations: <ul style="list-style-type: none">• Potentially from satellite imagery, in situ platforms, acoustic profilers, drones.• Additional investigation of emerging technologies is required.	Area of Interest: Pacific Region (BC and Yukon) rivers, lakes and wetlands Coverage Frequency: Monthly (T) weekly (G)	Data Latency: 30 days
[LAN-430]	Surface Water Mapping	Across Canada's agricultural extent, data used to: (a) map areas of flooding; (b) excessive wetness; (c) land that is too-wet-to-seed. Surface water seen to have multiple uses with other applications (e.g. ecosystems).	I-Operational	Locations of surface standing water over agricultural land. Terrestrial water body extent, incl. ephemeral areas (e.g. wetlands), relative and absolute water levels and seasonal change detection	Spatial Resolution (Sub-field & Dugout level): 10 m (T) 5 m (G) over large as possible swaths Polarization: Polarimetric data needed for wetland (incl. peatlands) classification. Noise floor: <-28 dB (T) <-32 dB (G) Repeat pass imagery and phase preservation required for water level dynamics via coherence and InSAR methods. Other considerations:	Area of interest: Surface waters in Canada, including the entire agricultural region of Canada and all Canadian Prairies. Entire BC, MB, ON, NB, NS, PEI, NFLD&LA B at lower frequency.	Data Latency: 24 h (T)



		Map inland lakes and rivers in support of National Hydro Network.			<ul style="list-style-type: none">• C & L Band, RADARSAT-2 currently used; Gaps if confliction with OGDs, especially in spring.• L-band could assist detecting flooded vegetation• High resolution cloud-free optical imagery would be a valuable complementary source of data for this application (too-wet-to-seed maps could even be produced with optical data alone with lower classification accuracies and less reliability). Possible extension to mapping on-farm water resources (dug-outs). Would be considered an Emerging R&D priority.	Coverage Frequency: Weekly & on-demand when needed. Annually for BC, MB, ON, NB, NS, PEI, NFLD&LA B. Seasonal (March – November)	
[LAN-440]	Flood Mapping and Flood Risk	Measure inundated areas in support of emergency geomatic services and assessing flood risk	1- Operational for water extent 2- Pre-Operational for water level	Surface water extent Surface water level	Spatial Resolution: 10 m over 350 km swath (T) 5 m over 350 km swath (G) Polarization: HH/HV & CP (T) Fully Polarimetric (G) Noise floor: <-28 dB (T) <-32 dB (G) Repeat pass imagery and phase preservation required for water level estimation via coherence and InSAR methods. Other considerations: <ul style="list-style-type: none">• Consistent detection between dry land and flooded land independent of acquisition geometry and environmental conditions.• Detection of flooded areas under vegetation canopies and of flooded urban areas required.	Area of interest: Varies annually Coverage Frequency: 3-4 times daily	Data Latency: 30 min

[LAN-500]	Soil Moisture Data Assimilation	For inclusion in GC's land data assimilation system, in order to provide analyses for environmental applications including weather, hydrology, agriculture, and forest fires.	3 - Emerging	Soil moisture, numerical modeling	<ul style="list-style-type: none"> Current data sources: RADARSAT-2, Sentinel-1 Frequency: C+L or C+S: S & L-band could assist detecting flooded forests, vegetation Integration of concurrent optical data would be valuable (resolution up to 3m in a visible spectrum). <p>Other considerations:</p> <ul style="list-style-type: none"> SAR data currently a complementary source of information for assimilation into numerical weather modeling. It is not used yet operationally for soil moisture. First implementation would be with RCM, but the value of C-band active measurements would increase with increased temporal and spatial coverage. An instrument on board that would be quite valuable for NWP is a GNSS receiver for radio-occultation (RO). Small instrument with significant impact on forecasts. 	<p>Areas of Interest:</p> <p>Canada's agriculture regions (prairies, southern Ontario and southern Quebec) (T).</p> <p>Eventually national, continental, and even global coverage (G).</p> <p>Coverage Frequency:</p> <p>1-3 days</p>	<p>Data latency:</p> <p>12 h (T) 2 h (G)</p>
[LAN-510]	Soil Moisture for Agriculture	Mapping of surface soil moisture during the growing season.	2-Pre-Operational for SAR 1. Operational for Passive Microwave	Volumetric surface soil moisture content over agricultural land.	<p>Spatial Resolution for Agriculture Region of Canada: (Sub-field level): 30 m (T) 10-20 m (G) Coarser (e.g. best resolution of passive microwave) for entire Canada terrestrial landmass.</p> <p>Other considerations:</p> <ul style="list-style-type: none"> Both SAR and passive microwave are needed for this application. 	<p>Areas of interest:</p> <p>Agricultural region of Canada / Specific regions at high resolution (i.e. radar). Ref. Section 5.6.</p>	<p>Data Latency:</p> <p>24 h (T)</p>



[LAN-600]	Land Cover / Land Use Classification	The Annual Space-Based Crop Inventory (ACI) maps crop type at the field level annually across Canada's agricultural extent.	1. Operational	Agricultural and non-agricultural land use and land cover.	<ul style="list-style-type: none">SAR: C & L band, RADARSAT-2, Wide Fine Quad-Pol currently used; Gaps if confliction with OGDs.Passive Microwave: L-Band, SMAP/SMOS currently used.	Canada terrestrial landmass at lower resolution (i.e. passive microwave). Coverage Frequency: 1-3 days & on-demand when needed (May – September).	Data Latency: 1 week (T)
[LAN-610.1]	Crop Condition Assessment - Vegetation biophysical monitoring	Weekly mapping of vegetation biophysical condition using	1- Operational (Optical)	Vegetation biophysical variables over	Spatial Resolution (Sub-field level): 30 m (T) 10-20 m (G) Other considerations: <ul style="list-style-type: none">Optical: R, NIR & SWIR bands critical, Landsat-8 currently used, AwIFS-type swath; Gaps over cloudy regions;SAR: C-Band (Multi-Pol), though Multi-Frequency desired, RADARSAT-2 currently used, ScanSAR Wide-type swath; Gaps if confliction with OGDs.Without optical data ACI cannot be generated. Without SAR, the ACI could still be produced with optical data, but would lead to lower overall classification accuracies (accuracies of 5-15% less in places).	Areas of Interest: Agricultural region of Canada / Coverage Frequency: >3 overpasses per growing season (April – Nov)	Data Latency: 24 h (T)



		Canadian Ag-Land Monitoring System (CALMS). Used to identify areas of poor and high plant productivity to help target various GC programs.	3-Emerging / 2-Pre-Operational (SAR)	agricultural land.	<ul style="list-style-type: none">• Optical data is currently essential.• Optical: R, NIR & SWIR bands critical. B, G, Y bands desirable; Two bands within "red edge" preferable; TIR (critical for ET). MODIS currently used; Dependencies on USGS LP-DAAC does not ensure timely data delivery (<48 h). Effort to transition to new sensor post-MODIS.• SAR: C-band (RADARSAT-2, Fine Quad-Pol Mode currently used); Gaps if conflict with OGDs.• Needed measurements includes: NDVI; LAI; Yield; Above-ground Biomass; Evapotranspiration; Surface Temp.	Specific regions. Coverage Frequency: Weekly (March – October).	
[LAN-610.2]	Crop Condition Assessment - Vegetation biochemical monitoring	Weekly mapping of vegetation biochemical condition across Canada's agricultural extent.	3. Emerging	Vegetation Biochemical variables over agricultural land	Spatial resolution (Sub-field level): 30 m (T) 10 m (G) Other considerations: <ul style="list-style-type: none">• Optical: Definition of "red edge" critical; Two bands within "red edge" preferable.• Wide swath (AWiFS-type).• Needed measurements includes: Leaf chlorophyll; leaf N; PRI; other Photo-chemical Indices].	Areas of Interest: Agricultural region of Canada / Specific regions. Coverage Frequency: Weekly	Data Latency: 72 h (T)
[LAN-620.1]	Grassland and Rangeland Condition Assessment - Mapping grassland and rangeland extent	The Annual Space-Based Crop Inventory (ACI) maps grassland and range-land annually across Canada's ag extent. The ACI grassland and range-land extents are	1. Operational (as part of the ACI)	Extent of grassland, rangeland and pasture.	Spatial resolution (Sub-field level): 30 m (T) 10 m (G) Other considerations: <ul style="list-style-type: none">• Optical: R, NIR and SWIR; Wide swath (AWiFS-type); Landsat-8 currently used; Gaps over cloudy regions.• SAR: C-Band ScanSAR-type swaths; RADARSAT-2 Wide Mode currently used; Gaps if conflict with OGDs.• Without optical data ACI cannot be generated; without SAR, ACI would be	Areas of Interest: Agricultural region of Canada (western provs.) Coverage Frequency: Monthly, during growing	Data Latency: 1 week (T)



		used to: (a) calculate acreage under these types; (b) track spatio-temporal changes in ag-related land use; (c) create Agri-Environmental Indicators (AEIs) for reporting purposes.			produced with optical data with lower classification accuracies.	season (May – Sept).	
[LAN-620.2]	Grassland and Rangeland Condition Assessment - Estimating grassland and rangeland health	Weekly mapping of grassland condition using Canadian Ag-Land Monitoring System (CALMS). CALMS used to identify areas of poor and high plant productivity to help target various GC programs.	1. Operational (Optical, as part of CALMS) 2. Pre-Operational (SAR)	Vegetation biophysical variables over grassland, rangeland and pasture.	Spatial resolution (Sub-field level): 30 m (T), 80 m (T) for TIR 5 m (G) Other considerations: <ul style="list-style-type: none">• Optical data is currently essential.• Optical: R, NIR & SWIR bands critical. B, G, Y bands desirable; Two bands within "red edge" preferable; TIR (critical for ET); Wide swath (AWIFS-type); MODIS currently used. Dependencies on USGS LP-DAAC archive that does not ensure timely delivery (<48 h) of data. Concerns over MODIS life-span and effort to transition to new sensor. <ul style="list-style-type: none">• SAR: C-band; ScanSAR-type swaths; RADARSAT-2, Fine Quad-Pol currently used; Gaps if conflict with OGDs.• Needed measurements includes: Biomass production, Amounts of photosynthetic and non-photosynthetic vegetation, bare soil ground cover.	Areas of Interest: Agricultural region of Canada. Coverage Frequency: Weekly (March-Oct)	Data Latency: 24 h (T)



[LAN-620.3]	Grassland and Rangeland Condition Assessment - Estimating grassland and rangeland health – invasive plant	Weekly mapping of invasive plant species. Data used to identify invasive plant species, detect new infestations and quantify success of control programs.	3. Emerging	Invasive plant species in grassland, rangeland and pasture	Spatial resolution (Sub-field level): 20 m (T) 5 m (G) Other considerations: <ul style="list-style-type: none">Optical: Visible, NIR and SWIR; Wide swath (AWiFS-type).SAR: C-band.	Areas of Interest: Agricultural region of Canada (western prov.) Coverage Frequency: Weekly	Data Latency: 1 week (T)
[LAN-630.1]	Land Management- Tillage and crop residue mapping	Weekly mapping of the tillage intensity of agricultural land across Canada's ag extent. Data used to: (a) map crop residue; and (b) characterize tillage status.	3. Emerging	Tillage intensity of agricultural land.	Spatial resolution (Sub-field level): 30 m (T) 10-20 m (G) Other considerations : <ul style="list-style-type: none">Optical: R, NIR & SWIR bands critical; Wide swath (AWiFS-type); Landsat-style multispectral scanners currently used; Gaps over cloudy regions; Finer spatial resolution, more timely data may give more accurate estimates.SAR: X, C & L Band (better characterization of roughness would be helpful); ScanSAR-type swaths; RADARSAT-2 currently used; Gaps if confliction with OGDs.Needed measurements includes: crop residue cover (total and fraction of surface) and surface roughness (RMS).	Areas of Interest: Agricultural region of Canada / Specific regions. Coverage Frequency: 3-5 days, but limited to fall and spring.	Data Latency: 1 week (T)
[LAN-630.2]	Land Management- Estimation of soil properties	Weekly mapping of soil properties of agricultural land across Canada's	3. Emerging	Physico-chemical soil properties over agricultural land.	Spatial resolution (Sub-field level): 30 m (T) 10 m (G) Other considerations: <ul style="list-style-type: none">Optical : NIR and SWIR; Wide swath (AWiFS-type);	Areas of Interest: Agricultural region of Canada / Specific regions.	Data Latency: 1 week (T)



[LAN-630.3]	Land Management- Prescription for mapping for variable management of agricultural inputs and crop yield	agricultural extent. Data used to map soil physico-chemical properties. Prescription mapping for variable management of agricultural inputs and crop yield at field scale. Data used to map soil physico-chemical properties.	3. Emerging	Crop Yield	<ul style="list-style-type: none">• SAR: X, C & L Band; ScanSAR-type swaths.• Needed measurements includes: Soil texture; organic matter; drainage; P, K, M3-Al, etc. Spatial resolution (Sub-field level): 10 m (T) Other considerations: SAR: C-Band; ultrafine-type swaths; RADARSAT-2 Fine and Ultrafine modes currently used.	Coverage Frequency: Weekly, but limited to fall and spring.	Data Latency: 1 week (T)
[LAN-700]	Forest canopy height mapping and monitoring	Forest height is an important indicator of timber production and closely related to forest biomass in forestry.	3- Emerging	Forest canopy height	Spatial resolution: 10 m Noise floor Lower than RCM (e.g. RCM: <-25dB for 16m, <-19dB for 5m) Other considerations: <ul style="list-style-type: none">• Single-pass tandem radar interferometry• Current data source: single-pass dual-copol/single-pol modes of TanDEM-X radar interferometry• Tandem mission critical to avoid temporal decorrelation• Wide swath and polarimetric modes• Multi-frequency preferred• Choice of different baselines	Area of interest: Large scale managed and non-managed forests mapping in Canada Currently R&D over sites in BC, AB, NWT and ON	Coverage Frequency:



						Seasonal coverage for change detection and monitoring	
[LAN-710]	Biomass mapping and monitoring	Forest biomass along with related structural attributes (basal area, volume) and its dynamic is a key for national forest inventory (NFI), forest productivity assessment and bioenergy inventory.	2- Pre-operational	Live aboveground forest biomass	<p>Spatial resolution: 25-50 m</p> <p>Polarization: Compact-pol</p> <p>Other considerations:</p> <ul style="list-style-type: none">• C-band is more useful within forests with low biomass levels or within treed wetlands.• In general, C-band datasets mostly useful when fused with L-band SAR and optical datasets• Radar modes/temporal requirements can be largely harmonized with those needed for height mapping and wildfire mapping.• Background systematic acquisitions in proper mode needed to ensure yearly multi-seasonal national coverages.	<p>Area of interest: National coverage with emphasis on unmanaged northern boreal forests.</p> <p>Coverage Frequency: Multi-year, multi-seasonal</p>	
[LAN-720]	Active wildfire mapping and fuel consumption monitoring	Monitoring of fire extent as well as duff and peat consumption aids in wildfire spread and smoke dispersion modelling.	3-Emerging	Forest structure change and surface deformation due to forest fire	<p>Spatial resolution: 10 m</p> <p>Other considerations:</p> <ul style="list-style-type: none">• Penetration of dense forest canopy not possible with RCM C-band; L-band would provide better penetration in dense forest.• Not currently operational as RS-2 24-day repeat cycle is insufficient for InSAR approach.• RCM would provide surface deformation/ground fuel consumption only in open forest and wetlands; L-band and tandem mission would help to extend this to denser forest.	<p>Area of interest: Entire forested area of Canada</p> <p>Coverage Frequency: Multi-seasonal radar interferometry monitoring for pre-burn areas and ones for post fire conditions.</p>	<p>Data Latency: NRT delivery for post fire</p>



[LAN-800]	Infrastructure Integrity Monitoring	Monitor infrastructure and surrounding terrain to assess risk to integrity	1-Operational		3-dimensional terrain displacement Infrastructure stability Feature detection and characterization over time (e.g. debris, soil)	Spatial Resolution: 5 m for 3D terrain displacement 3 m for infrastructure stability Polarization: Polarimetric (or compact-pol) data required to support PolInSAR methods Other considerations: <ul style="list-style-type: none">• InSAR approach used for 3D terrain displacement and infrastructure stability• Highly accurate orbital vector needed (equivalent to European missions) needed for 3D terrain displacement.• Measuring change in amplitude over wide range of incidence angles on a daily basis for feature detection.• Multiple viewing geometries / look directions needed to support 3-D analysis. The displacement of some terrain cannot be measured accurately via a near-polar orbit. As such, potential value in combination of data acquired by near-polar and non-near polar orbits.• Consider platforms with multiple orbital tubes to accommodate various needs (e.g. vertical structure via tomography vs. surface displacement via traditional InSAR)• Measurements required in vegetated/forested areas – L-band needed.	Area of Interest: no standard AOIs (projects dependent). Coverage Frequency: Daily Coherent Change Detection Revisit: 4 days for C-band 6-8 days for L-band	The first post-fire should be within 3-4 days after fire (1-2 days would be ideal)	

[LAN-810]	Infrastructure Damage Assessment	Detecting change in built infrastructure integrity (e.g. roads, rail, bridges, and buildings) due to use and hazards (e.g. earthquakes).	2-Pre-Operational	Identify post-event changes in infrastructure and surrounding environment	<p>Spatial Resolution: 3 m</p> <p>Polarization: Polarimetric (or compact-pol) data required</p> <p>Other considerations:</p> <ul style="list-style-type: none"> Highly accurate orbital vector needed (equivalent to European missions) Baseline datasets over critical infrastructure and urban areas required Concurrent high resolution optical (incl. LiDAR) is strong complement Multi-frequency approach (e.g. C and L) will improve target characterization and change detection 	<p>Area of Interest: no standard AOs (projects dependent).</p> <p>Coverage Frequency: Daily</p>	<p>Data Latency: (<15 min) when responding to events.</p> <p>Fast-tasking: Required when responding to events.</p>
[LAN-820]	Monitoring Seismically Active Areas and Volcanoes	Assessment of seismicity and source mechanisms for hazard estimation.	2-Pre-Operational	Multi-dimensional surface deformation over regional areas	<p>Spatial Resolution: 5-10 m</p> <p>Polarization: Polarimetric data may improve deformation measurements through better target coherence.</p> <p>Other considerations:</p> <ul style="list-style-type: none"> InSAR approach to measure mm-scale ground deformation Highly accurate orbital vector needed (equivalent to European missions) Ascending and descending passes for 2-dimensional deformation Information informs understanding of events and improves earthquake and volcano hazard forecasts. Non-polar orbits could be useful for 3-D deformation Multi-frequency approach (e.g. C and L) will improve measurements due to better coherence and atmospheric correction (ionosphere). 	<p>Area of Interest: Targeted 50x50 km patches over Canada's actively seismic areas (1/3rd of Canada)</p> <p>Coverage Frequency: Weekly</p>	



[LAN-830]	Rapid Earthquake Characterization	Measure large scale surface deformation related to earthquakes.	1- Operational	Co-seismic surface deformation	<ul style="list-style-type: none">Concurrent estimate of water vapour within imaging path would improve InSAR measurements. <p>Spatial Resolution: 5-10 m</p> <p>Other considerations:</p> <ul style="list-style-type: none">InSAR approach to measure centimetre-scale ground deformationBaseline datasets required over seismically active areasHighly accurate orbital vector needed (equivalent to European missions)Although currently using R-2 and Sentinel-1 data, latency is a severe limitation of current approach.Seismic data can be combined with co-seismic InSAR deformations to obtain improved estimates of earthquake properties (operational in other countries)Concurrent estimate of water vapour within imaging path would improve InSAR measurements.	<p>Area of Interest: Specific regions (50 x 50 km) immediately after an earthquake</p> <p>Data Latency: <15 min when responding to events.</p> <p>Fast-tasking: Required when responding to events.</p>
[LAN-840]	Assessing Induced Surface Deformation	Assessment of ground deformation related to human activities (e.g. oil sands steam injection, CO2 injection, water withdrawal and injection).	1- Operational	Multi-dimensional surface deformation over regional areas	<p>Spatial Resolution: 3 m</p> <p>Polarization: Polarimetric data may improve deformation measurements through better target coherence.</p> <p>Other considerations:</p> <ul style="list-style-type: none">InSAR approach to measure mm-scale ground deformation measured over target areasHighly accurate orbital vector needed (equivalent to European missions)Ascending and descending passes for 2-dimensional deformationNon-polar orbits could be useful for 3-D deformation	<p>Area of Interest: no standard AOs (projects dependent).</p> <p>Coverage Frequency: Weekly</p>



					<ul style="list-style-type: none">• Multi-frequency approach (e.g. C and L) will improve measurements due to better coherence and atmospheric correction (ionosphere).• Concurrent estimate of water vapour within imaging path would improve InSAR measurements.		
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4.3 GC NEEDS RELATED TO DATA AVAILABILITY AND CONTINUITY, DATA ACCESS AND USE AND SECURITY

Data Availability and Continuity:

[DAC-010] Continuity. There is a need to ensure SAR data continuity to avoid any gap in the operational applications.

[DAC-020] Reliability. For operational applications, it is critical to have a predictable and reliable access to near-real time data.

[DAC-030] Scalability. There is a need for the system to be scalable to allow for potential growth of the demand.

Data Access and Use:

[DAT-010] Orders Override. The capability to override other orders for purposes of health and safety of the system, emergency responses, national security events, or other urgent operations (24/7 operations) is essential.

[DAT-040] Data Sharing. Data sharing with partners inside or outside the GC is essential (including other countries).

Note: Data sharing is specifically needed for ice monitoring (e.g. NAIS), oil pollution, lake and river ice monitoring (US shared transboundary water areas), Winds (e.g. NOAA), climate research applications and Agriculture applications. Data includes raw data, imagery and value-added products.

[DAT-050] Archiving. Need for an archive for the data from all sensors as well as derived information products, which can be easily and efficiently exploited.

Note: The archive should support all levels of satellite data and products, from raw instrument data to gridded derived products.

[DAT-060] Data Analysis Tools. Data analysis tools are needed to enable and simplify processing of the vast amount of information gathered by the space assets.



Note: This includes advanced processing to exploit other parameters of the data collected, to include as a minimum: Track history, Anomaly detection, Big data manipulation & product reports and Predictive analytics.

[DAT-070] Efficient Data Processing, Exploitation and Dissemination. There is a need for automated, semi-automated, and manual operations for data processing, exploitation and dissemination.

Note: This implies the capability to map raw data into a gridded field at a given projection and resolution with calibration coefficients applied. On-board processing can be explored as an option.

[DAT-080] Extended Data Access. Access to archived data and their processing, exploitation and dissemination is needed until a point in time that there remains no further relevance or operational utility to the archived data (beyond the life of the space assets).

[DAT-110] Big Data Exploitation. There is a need for the data archive to be able to receive and exploit data from other systems and archives.

Note: This includes the ability to search for data and information products within operational timelines using simple tools and interfaces, which can process and analyze large volumes of data.

[DAT-120] Data Format. There is a need for the data to be in a suitable format(s) to enable integration into other systems.

[DAT-130] Training. There is a need for training to ensure GC stakeholders understand the potential, utility and applications associated with the system.

Note: This includes tailored training for different levels (from a high level understanding of the capability, to exploitation, maintenance and upgrade of the system), as well as periodic training to account for change in personnel.

Security:

[SEC-010] Security & Protection Measures. Security and protection measures need to be in place to protect the assets from potential hostile events or accidents.

Note: This includes the capability to perform a maneuver in the event of a possible conjunction.



[SEC-020] Ground Infrastructure & Network Security. The system ground infrastructure and network connectivity is required to be protected in accordance with physical, network and cyber security policies.

[SEC-040] Jamming, Blinding, or Interference. Protective measures need to be in place to protect sensitive remote sensing components from being damaged in the event of jamming, blinding, or interference.

[SEC-050] Restricted Visibility. There is a need to be capable to restrict visibility into the data ordering system and the geospatial data archive.

4.4 CONSTRAINTS

[CON-010] Duration. The proposed solutions must ensure service continuity for a minimum duration of 15 years.

[CON-020] Compliance with GC Legislations, Directives and Policies. The proposed solution must comply with GC legislations, directives and policies, including but not limited to: Remote Sensing Space Systems Act (RSSSA), security policies and the spirit of the GC Open Data Directive (within the limitations of the applicable laws and security constraints).

4.5 OTHER CONSIDERATIONS

The proposed solution should take advantage of the existing Canadian ground infrastructures developed for the RCM to the maximum extent possible, when it is cost effective to do so. This also includes considering continuity of the RCM data format to minimize the impacts on the operations.

While the favored approach is to be as much as possible technology agnostic and focus on the services, there is a significant experience and heritage with C-band SAR data in Canada that cannot be ignored. Therefore, although solutions incorporating any types of sensors meeting the needs are encouraged, the impact of the change of technology on the delivery of the required information must be taken into consideration.



5 AREAS OF INTEREST

5.1 ICE MONITORING AOIS [MAR-100]

The areas of interest for ice monitoring are season-dependent. For simplicity, the entire Ice Monitoring Canadian AOI is shown.



Figure 5-1: Entire Ice Monitoring Canadian AOI (seasonal dependency not shown).



Figure 5-2: North Pole AOI for Ice Monitoring.

5.2 OIL POLLUTION (INCL. MOST OF NATIONAL SAR WINDS) AOIS [MAR-120]



Figure 5-3: Entire Oil Pollution Canadian AOI including most part of National SAR Winds regions (seasonal dependency not shown).



5.3 ICE DYNAMICS AOIS [MAR-150]

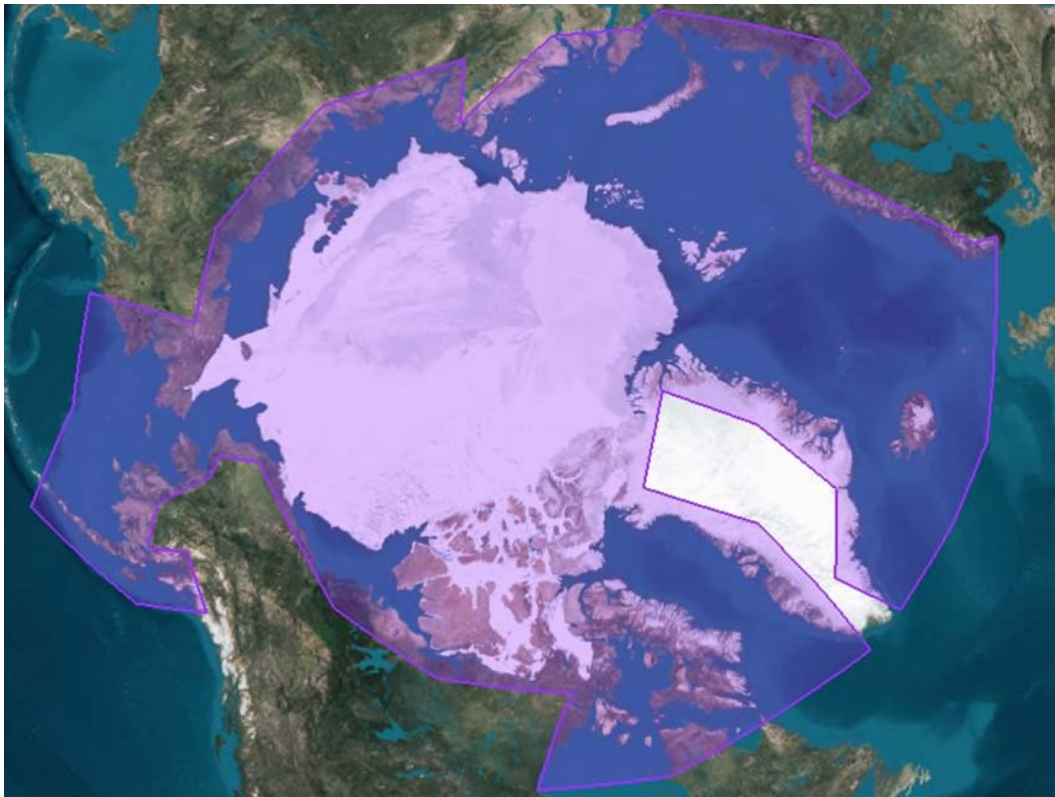


Figure 5-4: Pan-Arctic AOI for Ice Dynamics.



5.4 LAKE ICE MONITORING AOIS [LAN-100]



Figure 5-5: Lake Ice Monitoring AOIs (Jan-Feb).



Figure 5-6: Lake Ice Monitoring AOIs (March-April).



Figure 5-7: Lake Ice Monitoring AOIs (May-June).



Figure 5-8: Lake Ice Monitoring AOIs (July and Oct; none in Aug-Sep).



Figure 5-9: Lake Ice Monitoring AOIs (Nov-Dec).

5.5 ECOSYSTEM MONITORING AOIS [LAN-400]

These are the actual sites of interest. They are expected to evolve with time.

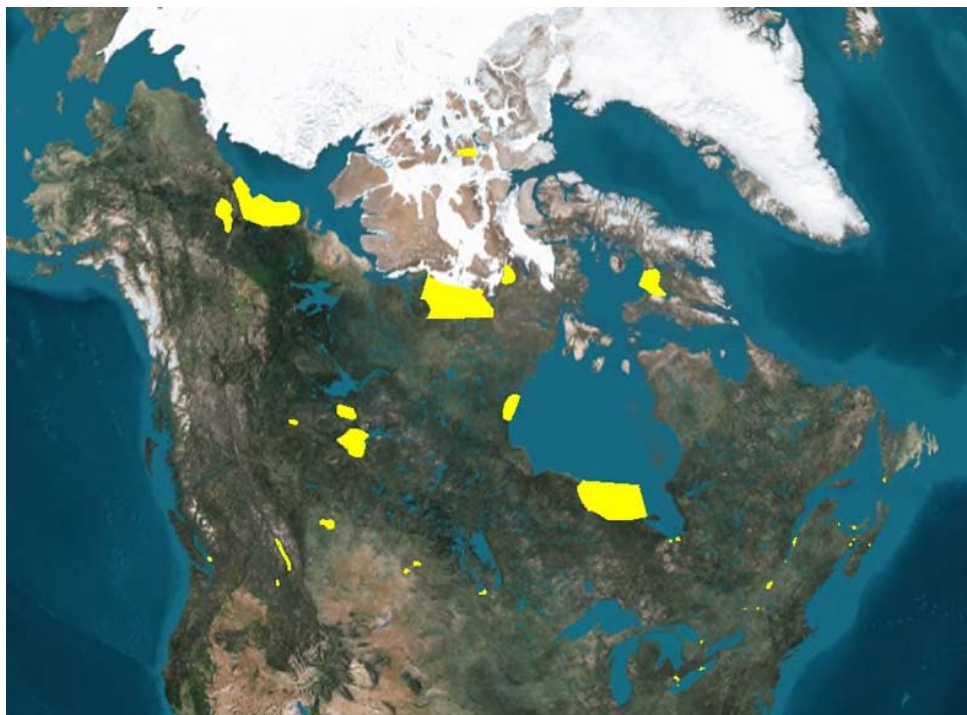


Figure 5-10: Ecosystem Monitoring actual AOIs.

5.6 SOIL MOISTURE FOR AGRICULTURE AOIS [LAN-510]



Figure 5-11: Soil Moisture AOIs.



5.7 LAND COVER AOIS [LAN-600]



Figure 5-12: Canadian Land cover AOIs.

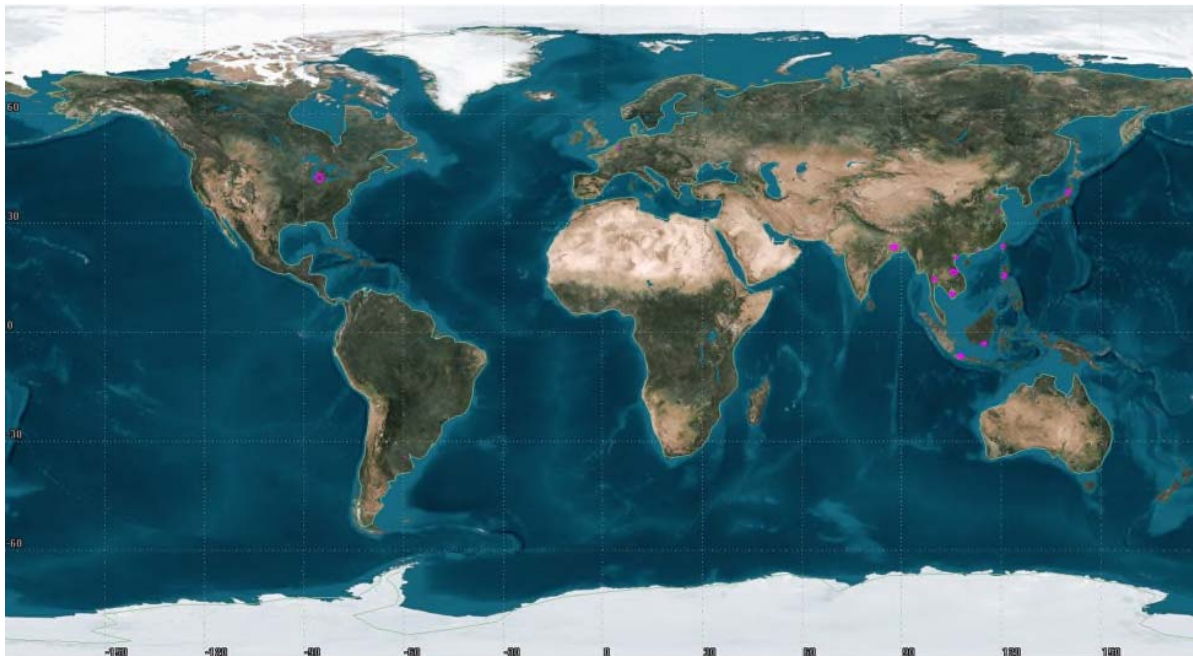


Figure 5-13: Current international land cover AOIs (JECAM).



6 ACRONYMS

The following provides a list of applicable acronyms.

Acronym	Definition
AIS	Automatic Identification System
AOI	Area of Interest
BAQ	Block Adaptive Quantization
COCI	Coastal Ocean Color Imager
CSA	Canadian Space Agency
EEZ	Exclusive Economic Zone
EO	Earth Observation
EOSC	Earth Observation Service Continuity
ESA	European Space Agency
GC	Government of Canada
GNSS	Global Navigation Satellite System
ISTOP	Integrated Satellite Tracking Of Pollution
JECAM	Joint Experiment of Crop Assessment and Monitoring
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
NWP	Numerical Weather Prediction
RCM	RADARSAT Constellation Mission
RO	Radio Occultation
RSSSA	Remote Sensing Space Systems Act
SAR	Synthetic Aperture Radar

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ANNEX B

BASIS OF PAYMENT

BASIS OF PAYMENT A

Firm Price as per sections 3.2.1 and 3.2.6 of the SOW

SCHEDULE OF MILESTONES

The schedule of milestones for which payments will be made in accordance with the Contract is as follows:

Milestone No.	Description of Deliverable	Firm Amount	Delivery Date
1	Specify		
2	Specify		
3	Specify		
Etc.			

A-Total Firm Price \$_____ **(All taxes applicable Extra)**

BASIS OF PAYMENT B

Ceiling Price under **Task Authorisation** as per section **3.2.2 Additional Task authorizations** of SOW, the bidder should provide a break down for each of the Task Authorizations.

1. **LABOUR:** at the following firm rates, excluding overhead and profit

CATEGORY (OR NAME)

FIRM HOURLY RATE

\$ _____

\$ _____
Etc.

Est.: \$ _____

2. **EQUIPMENT:** at laid down cost without markup
(Specify type of equipment.)

Est.: \$ _____

3. **RENTALS:** at actual cost without markup
(Specify what rentals.)

Est.: \$ _____

4. **MATERIALS AND SUPPLIES:** at laid down cost without
markup (Specify what categories of materials and supplies.)

Est.: \$ _____

5. **TRAVEL AND LIVING EXPENSES:**

Est.: \$ _____

The Contractor will be reimbursed its authorized travel and living expenses reasonably and properly incurred in the performance of the Work, at cost, without any allowance for profit and/or administrative overhead, in accordance with the meal and private vehicle expenses provided in Appendices B, C and D of the Treasury Board Travel Directive (<http://www.njc-cnm.gc.ca/directive/travel-voyage/index-eng.php>), and with the other provisions of the directive referring to "travellers", rather than those referring to "employees".

All travel must have prior authorization of the Project authority. All payments are subject to government audit.

6. **SUBCONTRACTS:** at actual cost without markup
(Identify subcontractors, if applicable.)

Est.: \$ _____

7. **OTHER DIRECT CHARGES:** at actual cost without markup
(Specify what categories of direct charges.)

Est.: \$ _____

8. **OVERHEAD:** at a firm rate of ___% of item ___ above

Est.: \$ _____

9. **PROFIT:** at a firm rate of ___% of item ___ above

Est.: \$ _____

B-Total of Ceiling Price under Task Authorisation: \$ _____
(Applicable Taxes extra)

BASIS OF PAYMENT C

Ceiling Price for the Optional work as per sections **3.2.3, 3.2.4 and 3.2.5** of the SOW, the bidder should provide a break down.

1. **LABOUR:** at the following firm rates

CATEGORY (OR NAME)	FIRM HOURLY RATE	
_____	\$ _____	
_____	\$ _____	
Etc.		
		Est.: \$ _____

2. **EQUIPMENT:** at laid down cost without markup
(Specify type of equipment.) Est.: \$ _____

3. **RENTALS:** at actual cost without markup
(Specify what rentals.) Est.: \$ _____

4. **MATERIALS AND SUPPLIES:** at laid down cost without
markup (Specify what categories of materials and supplies.) Est.: \$ _____

5. **TRAVEL AND LIVING EXPENSES:** Est.: \$ _____

The Contractor will be reimbursed its authorized travel and living expenses reasonably and properly incurred in the performance of the Work, at cost, without any allowance for profit and/or administrative overhead, in accordance with the meal and private vehicle expenses provided in Appendices B, C and D of the Treasury Board Travel Directive (<http://www.njc-cnm.gc.ca/directive/travel-voyage/index-eng.php>), and with the other provisions of the directive referring to "travellers", rather than those referring to "employees".

All travel must have prior authorization of the Project authority. All payments are subject to government audit.

6. **SUBCONTRACTS:** at actual cost without markup
(Identify subcontractors, if applicable.) Est.: \$ _____

7. **OTHER DIRECT CHARGES:** at actual cost without markup
(Specify what categories of direct charges.) Est.: \$ _____

8. **OVERHEAD:** at a firm rate of ____% of item ____ above Est.: \$ _____

9. **PROFIT:** at a firm rate of ____% of item ____ above Est.: \$ _____

C-Total of Ceiling Price: \$ _____
(Applicable Taxes extra)

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A + B + C = Estimated Total Contract Price: \$ _____
(Applicable Taxes extra)

With the exception of the firm rate(s) and price(s), the amounts shown in the various items specified above are estimates only. Minor changes to these estimates will be accepted for billing purposes as the Work proceeds, provided that these changes have the prior approval of the Project authority, and provided that the estimated cost does not exceed the aforementioned Ceiling Price.

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ANNEX C - TASK AUTHORIZATION FORM

Contract No: 9F044-190081	Task Authorization No:
Period covered:	Task Authorisation Revision No:
Title:	

PART 1: Request: To be completed by the Project authority:

You are requested to consider the following task or revised task and to submit, without delay, your proposal for the performance of this Work, in accordance with the provisions of the Task Authorisation clause of the above referenced Contract.

Description of the Work as follows: see attached:

Delivery and required delivery dates: as follows: see attached:

For the Project authority:

Name

Signature

Date

PART 2: Cost Breakdown- Proposal to be completed by Contractor:

(a) Labour:

Name	Category	Fixed Rate	Estimated Hours	Estimated Amount
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
Total Estimated Labour Cost:		\$		

(b) Materials and supplies - at laid down cost without markup

Specify:

Total Estimated Materials and Supplies Cost: \$_____

(c) Travel and living - The Contractor will be reimbursed its authorized travel and living expenses reasonably and properly incurred in the performance of the Work, at cost, without any allowance for profit and/or administrative overhead, in accordance with the meal and private vehicle provided in Appendices B, C and D of the Treasury Board Travel Directive (<http://www.njc-cnm.gc.ca/directive/travel-voyage/index-eng.php>), and with the other provisions of the directive referring to “travellers”, rather than those referring to “employees” are applicable.

All travel must have prior authorization of the Project Authority. All payments are subject to government audit.

Specify:

Total Estimated Travel and Living Cost: \$_____

(d) Subcontracting - at actual cost without markup

Specify:

Total Estimated Subcontracting Cost: \$_____

(e) Other direct expenses - at actual cost without markup

Specify:

Total Estimated Other Direct Expenses: \$_____

TOTAL ESTIMATED COST: Applicable taxes excluded: \$_____

For the Contractor:

Name of person authorized to sign
On behalf of Contractor

Signature

Date

PART 3: Authorization to start the work:

For the Project authority:

Name

Signature

Date

For the Contracting Authority

Name

Signature

Date

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ATTACHMENT 1 to PART 3 OF THE BID SOLICITATION

ELECTRONIC PAYMENT INSTRUMENTS

The Bidder accepts to be paid by any of the following Electronic Payment Instrument(s):

- ☐ VISA Acquisition Card;
- ☐ MasterCard Acquisition Card;
- ☐ Direct Deposit (Domestic and International);
- ☐ Electronic Data Interchange (EDI);

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ATTACHMENT 1 to PART 4 OF THE BID SOLICITATION

TECHNICAL AND MANAGEMENT EVALUATION CRITERIA

The technical and management evaluation criteria are hereby attached.



Canadian Space Agency
Agence spatiale
canadienne

1. EVALUATION CRITERIA

Evaluation Criteria	Minimum Score	Weighted Maximum Score
1) State of the art knowledge		18
2) Methodology		30
3) Earth observation concept study experience		24
4) Team Experience		24
5) Project Management		24
Total score	80	120

1. State of the art knowledge

This criterion assesses how the proposal demonstrates the bidders understanding of the state of the art in earth observation to address Canadian challenges. Element to be considered include:

- Spacecraft platform and technologies
- Measurement Technologies
- Ground segment
- Data exploitation (Cloud storage and processing, Artificial intelligence, Data analytics)
- Free and Open data availability and use
- Commercial available data

The point rated evaluation criteria:

0 points	The proposal does not contain a review of the state of the art applicable to the SoW requirements.
6 points	The proposal contains a review of the state of the art applicable to the SoW requirements.
12 points	The proposal contains a review of the state of the art applicable to the SoW requirements. The proposal identifies the relevant source of information/data (commercial system, free and open data, etc.) that would need to be considered in the study.

18 points The proposal contains a review of the state of the art applicable to the SoW requirements. The proposal identifies the relevant source of information/data (commercial system, free and open data, etc.) that would need to be considered in the study. The proposal provides a preliminary analysis of the impact of the available information sources on the compliance to the overall HUN, and how they will influence the selection of a solution. The proposal identifies emerging technologies and applications and how they could influence the proposed solution.

2. Methodology

This criterion assesses how the proposal demonstrates the bidder's methodology will be efficient to produce the deliverables within the required timeframe.

To be fully compliant with this evaluation criteria, the contractor must:

- Provide a complete description of the methodology planned for the study
- Demonstrate it has access to sufficient information to generate the required solution, Business Model, schedule and costing information within the required timeframe.
- Provide evidence to support the methodology with a preliminary description, preliminary performance analysis, preliminary costing and preliminary schedule of a potential solution/business model to be studied.
- Identify technology development roadmap and key area(s) for R&D
- Identify relevant trade-off(s) to be performed.
- Describe how the proposed methodology will lead to an unbiased solution.

The point rated evaluation criteria:

0 points	The proposal does not contain a Methodology.
10 points	The proposal contains a methodology but its ability to produce the deliverables identified in the SoW is not justified or credible. A preliminary list of key technologies to be developed is provided.
20 points	The proposal contains a methodology to produce the required deliverables identified in the SoW. The proposed methodology to produce the deliverables within the required timeline is credible and is supported by some of the elements of a preliminary solution (preliminary description, preliminary performance analysis, preliminary costing and preliminary schedule). A preliminary list of key technologies and/or developments (including development needed because of obsolescence as relevant) required is provided.
30 points	The proposal contains a methodology to produce the required deliverables identified in the SoW. Relevant trade-offs to be performed

are identified. The ability of the methodology to produce the deliverables within the required timeline is credible and is supported by all elements (description, preliminary analysis, preliminary costing and preliminary schedule) of a preliminary solution. A Technology development roadmap (including developments needed because of obsolescence as relevant) and key areas for R&D is provided. The proposal clearly highlights how the proposed methodology will lead to an unbiased solution.

3. Earth observation concept study experience

This criterion assesses the bidder's experience in undertaking concept study for Earth Observation mission of comparable complexity and scope.

The key technical fields required to perform the work include but are not limited to;

- Payload Analysis and Trade-off
- Mission Concept Design
- Mission Development Planning
- Data service delivery

The point rated evaluation criteria:

0 points	The proposal does not demonstrate the bidder's experience.
8 points	The proposal demonstrates the bidder's experience with at least one Earth Observation Concept Study in the last 10 years.
16 points	The proposal demonstrates the bidder's experience with at least two Earth Observation Concept Studies in the last 10 years. The proposal clearly demonstrates how the previous bidder's studies experience is relevant to the current study. The proposal demonstrates that these studies have been successful. The tools/software/standard practices of the bidder are clearly described.
24 points	The proposal demonstrates the bidder's experience with at least two Earth Observation Concept Studies in the last 10 years. The proposal clearly demonstrates how the previous bidder's studies experience is relevant to the current study. The proposal demonstrates that these studies have been successful. The previous concept studies must be of similar scope and complexity. The tools/software/standard practices of the bidder are clearly described and their applicability to the current work is demonstrated.

CSA may contact past clients to request written certification supporting the past experience claims. The bidder shall provide complete coordinates of a point of contact for each study used to demonstrate compliance to this criteria with the submission of the bid.

4. Team Experience

This criterion assesses the accumulation of knowledge and skills resulting from direct participation in relevant activities to this project for each of the team members.

Key technical fields necessary to perform the work are identified in criterion 3.

The point rated evaluation criteria:

0 points	The proposal does not demonstrate the team possesses the experience required to perform the work.
8 points	The proposal demonstrates the team possesses some of the experience required to perform the work.
16 points	The proposal demonstrates the team possesses all of the experience required to perform the work. The proposal states, verifiable projects and activities to support all experience claims. Role and responsibilities as well as the level of effort of each team member is clearly defined.
24 points	The proposal demonstrates the team possesses all of the experience required to perform the work. The proposal states, verifiable multiple projects and mandates performed in the last five (5) years in support of all experience claims. Role and responsibilities as well as the level of effort of each team member is clearly defined.

5. Project Management Plan

This criterion assesses the Project Management Plan (PMP) to execute what is cited in the proposal. The project management plan should be **complete, coherent** and **credible**.

Components of the PMP include, but are not limited to:

- Scope management (requirements tracking, work packs and activities, change management etc.)
- Time management (schedules, actuals, forecasts etc.)
- Cost, expenditures and added value (budget containment and control, cost breakdowns etc.)
- Quality control (benchmarks, management plan, etc)



- Human resources management (complementarity of teams members, back-ups, Resources Allocation Matrix, etc.)
- Communications and reporting (timeliness, relevancy, transparency etc.)

Complete: includes all PMP components outlined above

Coherent: orderly, logical and consistent

Credible: substantiated by factual demonstration and valid assumptions

The point rated evaluation criteria:

0 points	The proposal does not contain a PMP.
8 points	The proposal contains an incomplete PMP.
16 points	The proposal contains a complete, coherent and credible PMP.
24 points	The proposal contains a complete, coherent and credible PMP. Additionally, the proposal demonstrates the project leader/manager has been delegated all the necessary authorities to efficiently deliver the work.