

**CANADIAN SPACE AGENCY  
2010-2011 REPORT ON PLANS AND PRIORITIES**

**ANNEXES**

- Annexe 1: [Details on Transfer Payment Programs \(TPPs\)](#)
- Annexe 2: [Internal Audits and Evaluations](#)
- Annexe 3: [Sources of Respendable and Non-Respendable Revenue](#)
- Annexe 4: [Status Report on Major Crown Projects \(MCPs\)](#)
- Annexe 5: [Summary of Capital Spending by Program Activity](#)
- Annexe 6: [User Fees](#)

## Annexe 1 – Details on Transfer Payment Programs (TPPs)

### Contribution under the Canada/ESA Cooperation Agreement

#### Strategic Outcome:

Canada's presence in space meets the needs of Canadians for scientific knowledge, space technology and information.

#### Program Activities:

Space Based Earth Observation (EO), Space Science and Exploration (SE), Satellite Communications (SC) and Generic Technological Activities (GTA) in support of EO, SE, and SC.

**Name of Transfer Payment Program:** Contributions under the Canada/European Space Agency (ESA) Cooperation Agreement.

**Start Date:** January 1<sup>st</sup>, 2000

**End Date:** December 31, 2010

**Description:** Enhance Canadian industry's technological base and provide access to European markets for value added products and services in the fields of Earth Observation (EO), Telecommunications, and Generic Technological Activities; foster the participation of Canadian academia and the demonstration of Canadian space technologies in European Science and Exploration missions. This is achieved through a financial contribution by the CSA to ESA optional programs.

#### Expected Results (Program Activity Level)

- 1. Space Based Earth Observation:** The benefits of activities involved in Earth Observation from space serve Canadian users in the fields of environment, resource and land-use management, and, security and sovereignty.
- 2. Space Science and Exploration:** Participation in Canadian and international missions expands the scientific knowledge base made available to Canadian academia and R&D communities in the areas of astronomy, space exploration and solar-terrestrial relations, as well as in physics and life sciences.
- 3. Satellite Communications:** State-of-the-art systems and applications are developed to satisfy the needs of the Canadian government and population in order to ensure that Canada remains a world leader in satellite communications.
- 4. Generic Technological Activities in support of EO, SE, and SC:** Canada's industrial technological capabilities can meet the needs of future space missions and activities.

### Expected Results (Transfer Payment Program Level)

Successful development and demonstration of advanced technologies, systems, components, and studies provided for in the contracts awarded by ESA to Canadian firms under the following ESA EO programs: EOEP (Earth Observation Envelop Program), GMES (Global Monitoring for Environment and Security) Service Element, and GMES Space Component.

Successful development and demonstration of advanced technologies, systems, components, or studies provided for in the contracts awarded by ESA to Canadian firms under the following ESA Telecommunications and Navigation programs: ARTES 1, 3-4, 5, 8 and GalileoSat.

Successful development and demonstration of advanced technologies, systems, components, or studies provided for in the contracts awarded by ESA to Canadian firms under Europe's space exploration program Aurora, under the European Transportation and Human Exploration Preparatory Activities program and under the European Physical and Life Science program ELIPS.

Growing utilization of data obtained from ESA on markets and Earth observation and Telecommunications technologies as strategic information for government departments, agencies and industries in Canada.

Because of our participation in Europe's satellite communication, Earth observation and science and space exploration programs, more demonstration of space-qualified technologies and products developed by Canadian firms for the space markets take place.

Development of new alliances and/or strengthening of established alliances between Canadian and European companies, to diversify Canada's international space partnerships and complement its long-standing relationship with the U.S.

<b>Program Activity</b> (\$ in millions)	<b>Forecast Spending</b> <b>2009-2010</b>	<b>Planned Spending</b> <b>2010-2011</b>	<b>Planned Spending</b> <b>2011-2012</b>	<b>Planned Spending</b> <b>2012-2013</b>
Space Based Earth Observation (EO)	6.0	<b>9.3</b>	11.3	10.5
Space Science and Exploration (SE)	8.8	<b>9.9</b>	9.7	6.4
Satellite Communications (SC)	7.6	<b>8.3</b>	10.1	8.5
Generic Technological Activities (GTA) in support of EO, SE, and SC	8.0	<b>10.4</b>	10.7	11.4
Total Contributions	30.4	<b>37.8</b>	41.7	36.8
Total Transfer Payments	30.4	<b>37.8</b>	41.7	36.8

**Note:** 1. This table details contribution programs with funding in excess of \$5 million per annum.  
2. Due to rounding, decimals may not add up to totals shown.

### Summary of CSA three-year Plan:

<http://www.asc-csa.gc.ca/eng/publications/default.asp#parliament>

**Class Grant and Contribution Program to support Research, Awareness and Learning in Space Science and Technology**

**Strategic Outcome:**

Canada's presence in space meets the needs of Canadians for scientific knowledge, space technology and information.

**Program Activities:**

Space Based Earth Observation (EO), Space Science and Exploration (SE), Generic Technological Activities (GTA) in support of EO, SE and SC, and Space Awareness and Learning (AL).

**Name of Transfer Payment Program:** Class Grant and Contribution Program to support Research, Awareness and Learning in Space Science and Technology.

**Start Date:** October 1<sup>st</sup>, 2009

**End Date:** N/A – Ongoing Program

**Description:** This program supports knowledge development and innovation in areas of priorities to the Canadian Space Agency while increasing the awareness and participation of Canadians in space-related disciplines and activities.

**Expected Results (Program Activity Level)**

- 1. Space Based Earth Observation:** The benefits of activities involved in Earth Observation from space serve Canadian users in the fields of environment, resource and land-use management, and, security and sovereignty.
- 2. Space Science and Exploration:** Participation in Canadian and international missions expands the scientific knowledge base made available to Canadian academia and R&D communities in the areas of astronomy, space exploration and solar-terrestrial relations, as well as in physics and life sciences.
- 3. Generic Technological Activities in support of EO, SE, and SC:** Canada's industrial technological capabilities can meet the needs of future space missions and activities.
- 4. Space Awareness and Learning:** Targeted level of awareness of space among Canadians is reached.

## Expected Results (Transfer Payment Program Level)

### Immediate Results

- Increased knowledge from research projects in priority space science and technology areas.
- Maintained and/or increased space focus in universities, post-secondary institutions, and not-for profit organizations.
- Partnerships established and maintained.
- Leveraged partner contributions.
- Access to international collaboration for Canadian organizations.
- Increased knowledge and skills in space-related disciplines among target audience.
- Increased availability and use of space theme in learning opportunities and materials related to science and technology.

### Intermediate Results

- Increased availability of space-related knowledge and information in priority areas.
- Increased space-related science and technology capacity in targeted areas.
- Increased multi-disciplinary and/or institutional collaborations.
- Sustained interest in space-related disciplines among target audience.
- Increased Canadian Highly Qualified Personnel active in space-related disciplines.
- Target audience is reached through learning activities and materials related to science and technology.

<b>Program Activity</b> (\$ in millions)	<b>Forecast Spending</b> <b>2009-2010</b>	<b>Planned Spending</b> <b>2010-2011</b>	<b>Planned Spending</b> <b>2011-2012</b>	<b>Planned Spending</b> <b>2012-2013</b>
Space Based Earth Observation (EO)	0.5	<b>0.8</b>	2.8	3.6
Space Science and Exploration (SE)	3.9	<b>4.6</b>	4.0	3.2
Space Awareness and Learning (AL)	0.9	<b>1.3</b>	1.3	1.3
Generic Technological Activities (GTA) in support of EO, SE, and SC	0.4	<b>1.0</b>	1.0	3.0
Total Grants and Contributions	5.8	<b>7.7</b>	9.2	11.2
Total Transfer Payments	5.8	<b>7.7</b>	9.2	11.2

**Note:** 1. This table details grants and contribution program with funding in excess of \$5 million per annum.  
2. Due to rounding, decimals may not add up to totals shown.

### **Summary of CSA three-year Plan:**

<http://www.asc-csa.gc.ca/eng/publications/default.asp#parliament>

## Annexe 2 – Internal Audits and Evaluations

### Audits

Name of Internal Audit	Type	Status	Completion Date	Electronic Link to Report
Audit of the Values and Ethics Framework	Management Framework	In progress	2010-03-31	N/A
Audit of the IT Dependency	Management Framework	In progress	2010-03-31	N/A
Audit of the IT Planning and Development	Management Framework	In progress	2010-03-31	N/A
Audit of the Data and Systems Security	Management Framework	In progress	2010-03-31	N/A
Audit of the Monitoring of access to controlled goods pursuant to ITAR enforcement	Management Framework	Projected	2010-03-31	N/A
Audit of the Proactive Disclosure process	Management Framework	In progress	2010-03-31	N/A
Audit of the Management Framework of the Official Languages practices	Management Framework	Projected	2010-03-31	N/A
Audit of the Test Facilities Management	Management Framework	Projected	2010-03-31	N/A
Audit of Records Management	Management Framework	Projected	2011-03-31	N/A
Audit of Contracting and acquisitions practices	Management Framework	Projected	2011-03-31	N/A
Audit of Skills Management	Management Framework	Projected	2011-03-31	N/A
Audit of Personnel Retention Programs	Management Framework	Projected	2011-03-31	N/A
Audit of Business Case for Major Investments	Horizontal Audit	Projected	2011-03-31	N/A
Audit of Real Property Life Cycle Management	Horizontal Audit	Projected	2011-03-31	N/A
Audit of Strategic Planning, Business Plans, Monitoring and Review of Priorities	Management Framework	Projected	2011-03-31	N/A

## Evaluations

<b>Name of Evaluation</b>	<b>Program Activity</b>	<b>Type</b>	<b>Status</b>	<b>Completion Date</b>	<b>Electronic Link to Report</b>
Evaluation of the RADARSAT-2 Major Crown Project	EO	Summative	Completed	2009-09-30	<a href="http://www.asc-csa.gc.ca/pdf/mcp-5702-7823.pdf">http://www.asc-csa.gc.ca/pdf/mcp-5702-7823.pdf</a>
Evaluation of the 2000-2009 Canada/ESA Cooperation Agreement	EO, SE, SC and GTA	Summative	In Progress	2010-03-31	N/A
Evaluation of the Space Technology Development Program (STDP)	GTA	Summative	In Progress	2010-03-31	N/A

### Annexe 3 – Sources of Respendable and Non-Respendable

#### Respendable Revenue (\$ in millions)

	Forecast Revenue 2009-2010	Planned Revenue 2010-2011	Planned Revenue 2011-2012	Planned Revenue 2012-2013
Respendable Revenue	0.0	0.0	0.0	0.0
<b>Total Respendable Revenue</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>

#### Non-Respendable Revenue (\$ in millions)

Program Activity	Forecast Revenue 2009-2010	Planned Revenue 2010-2011	Planned Revenue 2011-2012	Planned Revenue 2012-2013
<b>Space Based Earth Observation</b>				
Royalties from activities related to the RADARSAT program	0.7	0.7	0.7	0.1
<b>Generic Technological Activities (GTA) in support of EO, SE, and SC</b>				
Testing facilities and services of the David Florida Laboratory (DFL)	1.0	2.3	2.0	1.5
<b>Satellite Communications</b>				
Revenue of royalties from intellectual property	0.0	0.0	0.0	0.0
<b>Internal Services</b>				
Revenue of royalties from intellectual property	0.0	0.0	0.0	0.0
<b>Total Non-Respendable Revenue</b>	<b>1.8</b>	<b>3.1</b>	<b>2.8</b>	<b>1.6</b>
<b>Total Respendable and Non-Respendable Revenue</b>	<b>1.8</b>	<b>3.1</b>	<b>2.8</b>	<b>1.6</b>

Note: Due to rounding, figures may not add up to totals shown.



## **Annexe 4 – Status Report on Major Crown Projects (MCPs)**

### **RADARSAT-2**

#### **Description**

RADARSAT-2 is the next generation synthetic aperture radar (SAR) Canadian Earth Observation satellite. Launched in December 2007, RADARSAT-2 provides all-weather, day-and-night coverage of the entire globe to support fishing, shipping, oil and gas exploration, offshore drilling, mapping and ocean research. Equipped with a C-band radar system, it is the first fully commercial SAR satellite to offer multi-polarization, an important aid in identifying a wide variety of surface features and targets. It also has the capability to image both the right and left with a resolution down to three metres and to access an area of 800 kilometres on either side. This translates into a new range of products and services, which contributes valuable new information on natural resources and the global environment.

The RADARSAT-2 Major Crown Project, in partnership with MacDonald, Dettwiler and Associates (MDA), carried out the design, development, testing, deployment and operations of a space-borne SAR satellite to provide global coverage of terrestrial phenomena as a follow-up to RADARSAT-1. The current estimated total cost from CSA's budget is \$418.1 million.

RADARSAT-2's design and construction improves upon RADARSAT-1, with new capabilities to ensure Canada's continued leadership in the satellite remote sensing global marketplace and to create a commercial industrial satellite remote sensing industry in Canada.

#### **Leading and Participating Departments and Agencies**

Sponsoring Agency: Canadian Space Agency

Contracting Authority for the  
CSA/MDA Master Agreement: Canadian Space Agency

Participating Departments:

- Natural Resources Canada (Canada Centre for Remote Sensing)
- Environment Canada
- Industry Canada
- Fisheries and Oceans
- National Defence
- Foreign Affairs
- International Trade
- Agriculture Canada

### Prime and Major Sub-Contractors

Prime Contractor:  - MacDonald, Dettwiler, and Associates (MDA)	- Richmond, British Columbia
Major Sub-Contractors:  - EMS Technologies (now MacDonald, Dettwiler, and Associates) - Alenia Aerospazio - AEC Able Engineering Co. - RADARSAT international (RSI) (now MacDonald, Dettwiler and Associates) - STARSEM	- Ste.-Anne-de-Bellevue, Quebec - Rome, Italy - Goletta, California - Richmond, British Columbia  - Baikonur, Kazakhstan

### Major Milestones

The major milestones on Major Crown Project, by phase, were the following:

Phase	Major Milestones	Date
A and B	Requirement Definition	June 1999
C	System Design	May 2002
D	Sub-system Construction Integration and Testing Pre-launch Preparations Launch/Commissioning complete	September 2005 January 2007 July 2007 December 2007 April 2008
E	Operations	2008 to 2015

### Progress Report and Explanation of Variances

In June 1994, the government directed the CSA to develop an arrangement with the private sector for the development and operation of a RADARSAT follow-on program to maintain continuity of data following RADARSAT-1. In February 1998, following a formal Request for Proposal, MDA was selected to construct and operate RADARSAT-2.

The CSA and MDA signed a Master Agreement in December 1998 for the RADARSAT-2 mission, under a firm price agreement in which the government contribution was \$225 million, in exchange for data. MDA was to invest \$80 million. The Master Agreement between the CSA and MDA was updated in January 2000 to reflect changes in the schedule and the latest cost estimates. The company (MDA) is responsible for spacecraft operations and business development, while the CSA is responsible for arranging the launch and maintaining the long-term national archive of RADARSAT-2 data. The CSA will also provide an additional "in-kind" contribution of certain assets, plus the services of its David Florida Laboratory (DFL) and the NRC Institute of Aerospace Research Laboratory for spacecraft integration and testing.

In November 1998, Treasury Board (TB) approved the RADARSAT-2 Major Crown Project with a funding envelope of \$242.2 million. In March 2000, Treasury Board approved an increase of \$47.1 million to cover the cost of changing bus suppliers, required by U.S. government restrictions imposed on the U.S. bus supplier at that time, and an increase of \$12.3 million for upgrades to existing satellite ground station infrastructures. In June 2000, Treasury Board approved an increase of \$108 million to cover the cost of procuring a commercial launch as a result of NASA withdrawing from the agreement to provide launch for RADARSAT-2 in exchange for data, as it did for RADARSAT-1. In June 2001, Treasury Board approved an increase of \$6 million to cover the cost of critical modifications to be made to the RADARSAT-2 spacecraft in order to accommodate a potential future tandem mission with RADARSAT-3.

The development of the RADARSAT-2 satellite was completed at a slower pace than planned. Delays encountered by the main contractor and sub-contractors in the production of some of the satellite components have resulted in a significant delay in the assembly, integration and testing of the spacecraft. The Extendible Support Structure (ESS), one of the primary spacecraft sub-systems, was delivered to the Assembly, Integration and Test (AI&T) site at the DFL in October 2003. The Solar Arrays and the Bus were delivered to DFL in April and May 2004, respectively. The SAR antenna was delivered in September 2005. The assembly, integration and test of the RADARSAT-2 spacecraft at the DFL, along with the operations-preparations activities at the CSA in St-Hubert were successfully completed in September 2007. RADARSAT-2 was launched on December 14, 2007 and associated commissioning activities were completed by the end of April 2008. As a result, the necessary procedures and tools were developed to provide fully operational order desk services to the Government of Canada (GoC) clients with regard to order handling, data acquisition planning, data archiving and web-based reporting on the client usage of the RADARSAT-2 SAR payload.

The additional costs to complete the construction and launch of RADARSAT-2 were at the main contractor's expense. However, these additional delays required that the CSA RADARSAT-2 project office remained operational to cover the remaining activities until project close-out. The necessary funding to cover all additional expenditures for the CSA is from within the project risk funding envelope and associated project authorities. With RADARSAT-2 being fully operational and the government departments making regular use of the data, the CSA is preparing the closure of the RADARSAT-2 Major Crown Project with the objective to submit the closure report to Treasury Board in January 2010.

### **Industrial Benefits**

Significant industrial benefits in the space and Earth observation sectors are expected from this next-generation satellite system. The RADARSAT-2 program will generate employment growth in the Canadian knowledge-based economy, mostly from export sales, and spur the growth of small- and medium-sized businesses as the Canadian infrastructure and services industry continues to grow.

A major objective of this project is the transition of the Earth observation industry from the public sector to the private sector. The intention is to build on the SAR data and value-added markets established with RADARSAT-1 to strengthen the Canadian industry's position as a supplier of SAR-related technology, systems and value-added products and services.

Specifically, manufacturing potential and competitiveness will be encouraged in Canadian industry in the areas of phased array antenna design/manufacture, high performance receiver/transmitter design and manufacture, and enhanced structure design. Moreover, opportunities will be created for the export of ground station systems. The new capabilities also make new applications possible, creating new and expanded markets for data sales and value-added products.

As of March 31, 2009, the CSA will have funded \$236.66 million worth of work to Canadian industry directly attributable to the RADARSAT-2 Major Crown Project (MCP). Direct industrial benefits from the construction of RADARSAT-2 will benefit all regions of Canada. The regional distribution of direct industrial benefits is shown in the following table.

**Regional Distribution of RADARSAT-2 Contracts to Canadian Industry  
(as of March 31, 2009)**

<b>Program</b>	<b>British Columbia</b>	<b>Prairie Provinces</b>	<b>Ontario</b>	<b>Quebec</b>	<b>Atlantic provinces</b>	<b>Total Canada</b>
RADARSAT-2	59.1%	0.3%	10.2%	29.9%	0.5%	100%

**Note:** Due to rounding, decimals may not add up to totals shown.

**Summary of Non-Recurring Expenditures (\$ in millions)  
(as of March 31, 2010)**

<b>Program</b>	<b>Current Estimated Total Expenditure</b>	<b>Forecast to March 31, 2010</b>	<b>Planned Spending 2010-2011</b>	<b>Future Years</b>
RADARSAT-2	417.7	417.7	0.0	0.0

## **RADARSAT Constellation**

### **Description**

The RADARSAT Constellation is the follow-on to RADARSAT-1 and 2. RADARSAT-1 was launched in 1995 and is still operating. RADARSAT-2, developed in partnership with the private sector, was launched in 2007 for a seven-year mission. Canada has established itself as a leading global supplier of C-band satellite radar data. The RADARSAT Constellation will enhance this leadership and position Canadian industry in technology and value-added product markets.

The RADARSAT Constellation is designed as a scalable constellation of three small satellites. The satellites will be launched in 2014, 2015 and 2016. With a constellation, the time between successive imaging of the same part of the Earth (revisit time) is significantly reduced. The creation of a three-satellite constellation will increase the frequency of available information, as well as the reliability of the system, making it better suited to operational requirements of Departments. In the event of a satellite failure, the other satellites can continue to provide a reduced level of service. The lower cost of satellites facilitates the replacement of individual satellites and makes the system scalable.

The scope of the RADARSAT Constellation MCP includes the design, development manufacture, integration, test and launch of the satellites plus the design, development, manufacture and installation of the associated ground segment. One year of operation of the 3-satellite constellation is also included as well as an applications development program.

The RADARSAT Constellation will provide all-weather day and night data in support of three main user areas: maritime surveillance, disaster management and ecosystem monitoring. The three satellite constellation provides average daily coverage of most of Canada and its surrounding waters. Coverage increases significantly in Canada's North. The constellation will provide coverage two to three times daily of the Northwest Passage.

In support of maritime surveillance requirements of Environment Canada, Department of National Defence, Department of Fisheries and Oceans, Canadian Coast Guard and Transport Canada, the RADARSAT Constellation is the principal data source envisaged for wide area surveillance of Canada's remote areas and marine approaches. Only satellite data can offer regular cost effective coverage to task ships and aircraft to intercept suspect vessels. The daily coverage of marine areas will also support fisheries monitoring, ice and iceberg monitoring, pollution monitoring and integrated ocean and coastal zone management.

In support of disaster management, both in Canada and globally, the RADARSAT Constellation can provide high resolution, all-weather (3 m) imagery of most places in the world on a daily basis. This data is critical to disaster mitigation, warning, response and recovery. Disaster types supported include flood monitoring and relief, oil spills, changes in the permafrost in northern Canada, volcano and earthquake warning and hurricane monitoring.

In support of ecosystem monitoring of Natural Resources Canada, Environment Canada, Parks Canada and Agriculture and Agri-foods Canada, the RADARSAT Constellation will be a critical source of information for agriculture, forestry and wildlife habitat. The Constellation will also provide medium resolution data for wide area change detection, supporting water quantity monitoring, wetlands mapping and coastal change monitoring.

In addition, the RADARSAT Constellation develops Canadian high technology design and manufacturing capabilities and the integration of satellite data into information products and services. Canada's space and geomatics industries will benefit from increased positioning on international markets and privileged access to data essential to many international users.

The RADARSAT Constellation will provide C-band SAR data continuity to existing RADARSAT users, including the Canadian Ice Service, which relies on SAR data to support safe shipping in Canada.

**Leading and participating Departments and Agencies**

Sponsoring Agency: Canadian Space Agency

Contracting Authority: Public Works and Government Services  
Canada

Participating Departments:  
Natural Resources Canada  
Environment Canada  
National Defence  
Foreign Affairs and International Trade  
Industry Canada  
Fisheries and Oceans  
Agriculture and Agri-foods Canada  
Transport Canada  
Public Security  
Indian and Northern Affairs Canada  
Parks Canada

### Prime and Major Sub-Contractors

Prime Contractor: - MacDonald, Dettwiler and Associates (MDA)	- Richmond, British Columbia
Major Sub-Contractors: - MacDonald, Dettwiler and Associates - Magellan Aerospace, Bristol Aerospace - COMDEV Limited - MacDonald, Dettwiler and Associates	- Ste.-Anne-de-Bellevue, Quebec - Winnipeg, Manitoba - Cambridge, Ontario - Halifax, Nova Scotia

### Major Milestones

The major milestones on Major Crown Project, by phase, are the following:

Phase	Major Milestones	Date
A	Requirement Definition	March 2009
B	Preliminary Design	March 2010
C	Detailed Design	January 2012
D	Launch satellite #1 Launch satellite #2 Launch satellite #3	May 2014 August 2015 November 2016
E1	Operations (part of MCP)	to March 2018
E2	Operations (not part of MCP)	2018 to 2024

### Progress Report and Explanation of Variances

On December 13, 2004, the Domestic Affairs Committee of Cabinet granted approval-in-principle to a ten-year, \$600 million program to implement a RADARSAT Constellation aimed at addressing user needs in relation to Canadian sovereignty and marine surveillance, environmental monitoring and change detection, and disaster management. The RADARSAT Constellation is to be government-owned and operated.

In Budget 2005, the CSA was provided with an additional \$110.9 million over five years (2005-2006 to 2009-2010). Combined with a further \$89.1 million from the CSA's reference levels, a total of \$200 million was identified for CSA to work with the Canadian space industry on the development of the next generation of advanced radar remote sensing satellites. This funding covers Phases A (Initial Planning and Identification Phase) through C (Detailed Definition Phase) of the RADARSAT Constellation Project, but is insufficient for building and operating the satellites.

On June 6, 2005, Treasury Board granted Preliminary Project Approval (PPA) for the RADARSAT Constellation and expenditure authority for the Project Initial Planning and Identification Phase A at a substantive cost estimate of \$13 million (excluding GST). Phase A sought to finalize feasibility studies, define user requirements, payload and bus options for the mission, and reduce technology risks for the antenna, transmit/receive modules, and sensor electronics.

The Phase A work started in July 2005 and was completed in December 2006. Phase A was then extended to allow additional technical risk reduction activities to continue during the period prior to the Phase B contract award. This was completed in March 2008.

A revised PPA Treasury Board Submission to proceed to Phases B and C was approved in March 2007. In December 2006, Public Works and Government Services Canada (PWGSC) initiated a competitive Request for Proposal (RFP) process to identify a prime contractor for the RADARSAT Constellation project (i.e., for Phases B/C/D of the space segment and a portion of the ground segment) and negotiate a contract for Phases B and C with the winning prime contractor, MDA. The contract for Phase D would follow successful completion of Phases B and C, obtaining the necessary funding and the granting of Effective Project Approval (EPA) from Treasury Board. In September 2008, PWGSC obtained authority to enter into a contract with MDA. Negotiations for Phase B were completed in October 2008 and the contract for Phase B was awarded to MDA in November 2008. Phase B will be completed in February 2010. It is planned to amend the contract for Phase B to include the scope of Phase C which will continue to December 2011.

### **Industrial Benefits**

Significant industrial benefits in the space and Earth observation sectors are expected from the RADARSAT Constellation program. It is expected to generate employment growth in the Canadian knowledge-based economy and spur the growth of small and medium-sized businesses as the Canadian infrastructure and services industry continues to grow. As of September 30, 2008, the CSA has funded \$13 million worth of work to Canadian industry directly attributable to the RADARSAT Constellation Major Crown Project.

CSA's approach to regional distribution has been developed in consultation with Industry Canada and the Atlantic Opportunities Agency (ACOA). It is based on applying CSA's overall regional distribution targets to the project, and will require bidders to apply these targets on a "best efforts" basis. The prime contract includes a requirement for 70% Canadian content, excluding launch services. Given the past difficulty in achieving the targets in Atlantic Canada, a minimum of 3.5% benefits has been set for that region. The prime contract includes reporting obligations and performance measures as well as financial penalties for not meeting the minimum Atlantic Canada content. CSA will continue to work closely with Industry Canada and ACOA to monitor regional distribution achievements and to support the prime contractor in the delivery of the given targets.

### **Summary of Non-Recurring Expenditures (\$ in millions) (as of March 31, 2010)**

<b>Program</b>	<b>Current Estimated Total Expenditure</b>	<b>Forecast to March 31, 2010</b>	<b>Planned Spending 2010-2011</b>	<b>Future Years</b>
RADARSAT Constellation	145.9	64.0	39.9	41.9



## James Webb Space Telescope

### **Description**

The James Webb Space Telescope (JWST) is a joint mission of NASA, ESA, and the Canadian Space Agency. The mission concept is for a large filled-aperture telescope located 1.5 million km from Earth. Like Hubble, the JWST will be used by the astronomy community to observe targets that range from objects within our Solar System to the most remote galaxies, which are seen during their formation in the early universe. The science mission is centered on the quest to understand our origins, and specifically aimed at:

- Observing the very first generation of stars to illuminate the dark universe when it was less than a billion years old.
- Understanding the physical processes that have controlled the evolution of galaxies over cosmic time, and, in particular, identifying the processes that led to the assembly of galaxies within the first 4 billion years after the Big Bang.
- Understanding the physical processes that control the formation and early evolution of stars in our own and other nearby galaxies.
- Studying the formation and early evolution of proto-planetary disks, and characterizing the atmospheres of isolated planetary mass objects.

The JWST is scheduled for launch in 2014. JWST instruments will be designed to work primarily in the infrared range of the electromagnetic spectrum, with some capability in the visible range. JWST will have a large mirror, 6.5 meters in diameter and a sunshield the size of a tennis court that will both fold up and open once in outer space.

Canada is providing the Fine Guidance Sensor (FGS) and Tuneable Filter Imager (TFI). The FGS is integral to the attitude control system of JWST, and consists of two fully redundant cameras that will report precise pointing information of JWST. Canadian expertise in this area has been established with the successful fine error sensors for the FUSE mission. Packaged with the FGS but functionally independent, the Tuneable Filter Imager is a unique, narrow-band camera with imaging capability. For example, it will allow astronomers to search for extrasolar planets through a technique called *coronagraphy*, which means that the light from a star will be blocked out so that astronomers can see what is in the star's neighbourhood.

The JWST-FGS Major Crown Project, in partnership with COM DEV, consists of the design, development, integration and testing and integration into the spacecraft, launch and commissioning of the Fine Guidance Sensor and Tunable Filter Imager.

By participating in this leading-edge international space exploration mission, the Canadian Space Agency is actively promoting Canadian scientific expertise and innovative, advanced space technologies. The National Research Council's Herzberg Institute of Astrophysics is a key Government of Canada partner for activities related to the development of science instruments and distribution of telescope data.

In return for its overall investment in the JWST, Canada will obtain a minimum of 5% of the time on this unique space telescope. Already, the news of Canada's involvement in this international space exploration mission is inspiring youth, educators and amateur astronomers, and rallying members of Canada's world-renowned astrophysics community.

**Leading and Participating Departments and Agencies**

Sponsoring Agency: Canadian Space Agency

Contracting Authority: Public Works and Government Services  
Canada for the Canadian Space Agency

Participating Departments: NRC's Herzberg Institute of Astrophysics  
Industry Canada

**Prime and Major Sub-Contractors**

Prime Contractor: - COM DEV Canada	- Ottawa, Ontario
Major Sub-Contractors: - Teledyne - Corning Netoptix - IMP Aerospace Avionics - ABB Bomem - MDA - INO - CDA - ESTL	- U.S. - U.S. - Canada - Canada - Canada - Canada - U.S. - Europe

## Major Milestones

The major milestones, by phase, are the following:

Phase	Major Milestones	Date
A	Requirement Definition	2003-2004
B	Preliminary Design	August 2004 to May 2005
C	Detailed Design	July 2005 to September 2008
D	Manufacturing/Assembly; Integration/Testing; Pre-launch preparations, Launch/System Commissioning	May 2007 to December 2015
E	Operations	2014-2015 to 2018-2019

**Note:** The Major Crown Project terminates with the completion of Phase D.

## Progress Report and Explanation of Variances

In March 2004, Treasury Board gave Preliminary Project Approval for Phases B, C and D at an indicative cost of \$67.2 million. In December 2006, before the completion of the detailed design of the FGS, the CSA requested increased expenditure authority to complete the project. Treasury Board granted Effective Project Approval for a substantive total cost estimate of \$98.4 million in February 2007 with the condition "that the Canadian Space Agency provide reports to Treasury Board at the completion of Phases C and D of the JWST project which include up-to-date information on the project scope, costs, schedule and risks". At the same time, the project became a Major Crown Project.

The first Critical Design Review (CDR), held in March 2007, for the guider function of the FGS, did reveal some technical issues, which required additional effort to resolve. This Review took place after the Effective Project Approval (EPA) received in February 2007. After this first CDR, with the focus now turning toward the preparation of the system level CDR, new issues became apparent requiring additional analysis. Testing of the Tunable Filter Imager prototype also revealed technical issues that needed to be addressed.

During this transition between the completion of the detailed design phase (Phase C) and the initiation of the manufacturing phase (Phase D) the project faced the prospect of a significant cost growth and therefore required the CSA to return to Treasury Board to amend its Effective Project Approval (EPA) for the JWST Major Crown Project. The current estimated total cost for the Definition and Implementation phases is now \$134.7 million. On December 2007, Treasury Board granted a revised Effective Project Approval. Manufacturing, integration and test of the FGS will be completed during Fiscal Year 2010-2011.

Over the last period, the project has been very busy with the hardware and software development. COM DEV Canada, the prime contractor for the JWST Fine Guider Sensor (FGS) project, has been working on the FGS Engineering Test Unit (ETU) and Proto Flight Model (PFM).

On the ETU, a major achievement has been the successful completion of the cryogenic detector alignment test in August 2009 at CSA David Florida Laboratory (DFL) test facilities. This milestone paved the way towards the highly anticipated environmental test campaign where the FGS ETU is being subjected to environmental conditions replicating launch, transition to its operation site and operations. These tests have started at DFL in the fall of 2009 and should be completed before the end of fiscal year 2009-2010. The ETU will be delivered to NASA Goddard Space Flight Center in March 2010.

On the PFM side, COM DEV Canada has received most of the flight components and is proceeding with the integration steps. The PFM is planned to be delivered to NASA Goddard Space Flight Center early 2011.

### **Industrial Benefits**

As of March 31, 2009, the CSA has funded \$71.97 million worth of work to Canadian industry directly attributable to the JWST-FGS Major Crown Project. Direct industrial benefits from the construction of the JWST-FGS and TFI system will benefit central regions of Canada. Although there is no regional distribution requirement for this project, the following table provides an approximate distribution:

#### **Regional Distribution of JWST Contracts to Canadian Industry (as of March 31, 2009)**

<b>Program</b>	<b>Ontario</b>	<b>Quebec</b>	<b>Atlantic Provinces</b>	<b>Total Canada</b>
JWST-FGS and TFI	86.0%	11.6%	2.4%	100%

#### **Summary of Non-Recurring Expenditures (\$ in millions) (as of March 31, 2010)**

<b>Program</b>	<b>Current Estimated Total Expenditure</b>	<b>Forecast to March 31, 2010</b>	<b>Planned Spending 2010-2011</b>	<b>Future Years</b>
JWST-FGS and TFI	144.8	126.2	13.0	5.6

### Annexe 5 – Summary of Capital Spending by Program Activity

<b>Program Activity</b> (\$ in millions)	Forecast Spending 2009-2010	<b>Planned Spending 2010-2011</b>	Planned Spending 2011-2012	Planned Spending 2012-2013
Space Based Earth Observation (EO)	39.8	<b>44.7</b>	62.4	67.0
Space Science and Exploration (SE)	31.9	<b>26.4</b>	7.5	2.0
Satellite Communications (SC)	0.5	<b>5.5</b>	0.4	0.0
Space Awareness and Learning (AL)	0.0	<b>0.0</b>	0.0	0.0
Generic Technological Activities in support of EO, SE and SC (GTA)	1.6	<b>2.1</b>	1.6	1.4
Internal Services Program Activities	3.4	<b>2.8</b>	2.5	2.5
<b>Total Capital Spending</b>	77.1	<b>81.4</b>	74.4	72.9

**Note:** Due to rounding, decimals may not add up to totals shown.

## Annexe 6 – User Fees

Name of User Fee	Fee Type	Fee-Setting Authority	Reason for Planned Introduction or Amendment to Fee	Effective Date of Planned Change	Consultation and Review Process Planned
Fees charged for the processing of access to information requests filed under the <i>Access to Information Act</i>	Other services (O)	<i>Access to Information Act</i>	Volume change	2010-2011	The number of access requests is decreasing, therefore the total of planned User Fees are decreasing accordingly.