



ALBERTA SCIENCE AND RESEARCH AUTHORITY

Setting Research Priorities

for Alberta

A Background Report

Introduction

The Alberta Science and Research Authority (ASRA) is mandated by legislation to recommend priorities for provincially funded science and research investments. The purpose of this initiative is to identify those areas of science and research that will bring the greatest feasible economic and social benefits to all Albertans. This requires a decision-making framework which:

- is effective (will yield the best results)
- is credible to all stakeholders
- is inclusive
- operates at a macro level so that project selection, project management and day-to-day implementation decisions are left in the hands of “operational funders” and “performers.”

Based on a comprehensive review of the literature and discussions at the Natural Sciences and Engineering Research Council conference on “Research Measurement” (Ottawa, 1995), an ASRA internal task force identified the CSIRO Model¹ as a good basis for our priority-setting process. ASRA is using this assessment framework for this consultation process.

¹ *Australian Science, Australia's Future*, CSIRO Priority Determination 1990, Methodology and Results Overview, CSIRO Corporate Planning Office, January 1991

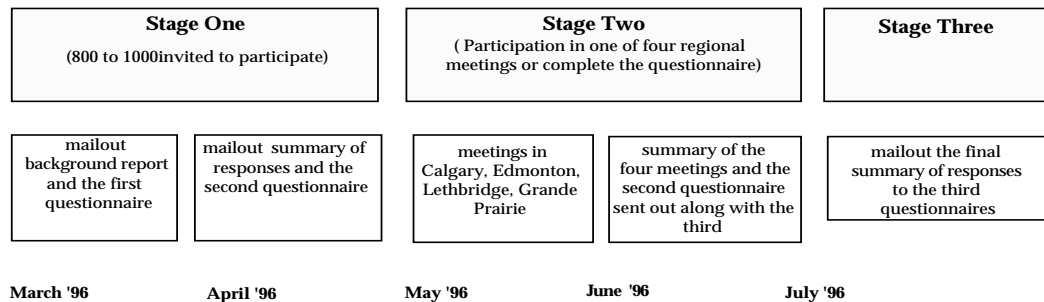
The Staged Process

A SRA is initiating a three stage process to assist in developing research priorities (Figure 1) and is inviting you and 800 to 1000 other individuals and organizations to participate. In addition, ASRA is opening the process to any other interested parties. The **first stage** will focus on refining a broad list of Research Application Areas (RAAs) and obtaining input to the assessment framework. Input will be obtained through the questionnaire accompanying this background report and can be returned by fax or mail.

The **second stage** will see participants providing input to prioritize the RAAs. Four regional, one-day workshops will ask selected participants from a wide range of economic and social areas and from geographic regions of Alberta to meet to discuss the prioritization. Participants will hear each other's views and develop a basis for prioritizing the RAAs. Those who are unable to attend these workshops will be provided with an opportunity to participate through a questionnaire. The same prioritization process undertaken in the workshops will occur in this second questionnaire.

The **third stage** will see all participants review the outcome of this priority-setting process. A final "What You Told Us" summary will be mailed to all participants in July 1996.

Figure 1
Study Process



The outcome of this process will provide macro-level priorities (at the level of the RAAs) for science and research in Alberta. The results will be provided to the public-at-large and communicated to government departments and agencies to help guide their future planning.

Introduction to the background report and first questionnaire

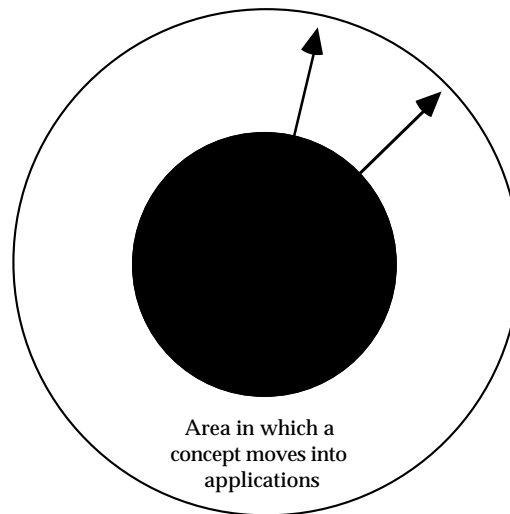
This report presents background information followed by a series of questions which are to be answered **in the accompanying faxback questionnaire**. The questionnaire is perforated along the left hand side so that you can separate the pages for ease of faxing. Please write your last name on the bottom of each page of the questionnaire so that we will not confuse any of the pages or your fax with others.

Once you have completed this questionnaire, please fax it to one of the numbers listed on the cover page of the questionnaire. This process is on a very tight schedule so we would appreciate **receiving your input by April 19th, 1996** so that we can incorporate your responses into the analysis.

Any knowledge application whether it is in the physical, life, or social sciences begins with an idea or concept which must then be explored through fundamental or basic research, further developed through applied research, and finally prototyped and tested before it can be applied. This is rarely a linear process. Many ideas or concepts are never explored. Often ideas that are explored do not lead to practical applications. Concepts may be explored by one individual or research team, developed further by another individual or team, perhaps in a different city or country, then languish for a while before being carried into application by yet another researcher. Most applications of knowledge require unique combinations of a variety of ideas.

Figure 2 is a simplistic representation of this science/knowledge continuum. Any radius in the circle represents the continuum from basic idea/concept at the centre to practical application of that idea at the perimeter. The outer ring of the circle represents the various domains or areas where research can be applied to produce economic and social benefits for Albertans. In this initiative, we have initially classified this outer ring into Research Application Areas (RAAs), each of which will be described later in this document. The core of the circle represents the basic science or knowledge disciplines that support any or all of these RAAs.

Figure 2
The Basic – Applied Research Continuum



As stated, the purpose of this prioritization process is to identify those RAAs that will bring the greatest feasible economic and social benefits to all Albertans. The questionnaire will also ask respondents to identify the key basic science or knowledge disciplines that support the RAAs with which they are familiar. ASRA staff and board members have identified sixteen major RAAs in a preliminary round of meetings and discussions with key people in the science and research community. The result is the first classification of these RAAs, which we would like you to comment on.

Following is the list of RAAs along with the major components within each area. At the end of this background report, you will find more detailed descriptions of each RAA.

Research Application Areas

Research Application Areas (in alphabetical order)	Major Components of the Research Application Areas
1. Agriculture and Related Products	<ul style="list-style-type: none"> - food products - soils, water and agricultural waste management - crop development - livestock development and animal nutrition - processing equipment and development - non-food products
2. Arts and Culture	<ul style="list-style-type: none"> - visual arts - performing arts - literary arts - cultural industries
3. Biotechnology	<ul style="list-style-type: none"> - medical applications - agriculture applications - environmental applications
4. Community Services	<ul style="list-style-type: none"> - public security, policing, fire and ambulance - recreation - justice - social welfare - consumer and occupational health and safety - public transportation
5. Construction	<ul style="list-style-type: none"> - building design - facility management - building programming - site location - restoration and renovation - highways, roads and bridges
6. Education	<ul style="list-style-type: none"> - design and delivery of programs - apprenticeship and other training services - educational products - human resource development
7. Energy Production	<ul style="list-style-type: none"> - conventional and non-conventional oil - coal - natural gas - electricity generation - renewable energy

8. Energy Products	<ul style="list-style-type: none"> - oil and gas production services - fluids separation - value added processes - petrochemicals - natural gas utilization
9. Environment	<ul style="list-style-type: none"> - weather and air quality - soil and water conservation - sustainable development - energy conservation - education and regulatory instruments - remote sensing
10. Forestry and Forestry Products	<ul style="list-style-type: none"> - pulp and paper - wood and panel board - value-added wood and non-wood building products - machinery, equipment, supplies and service
11. Health	<ul style="list-style-type: none"> - biomedical - health services - mental health - medical devices - health care products - pharmaceuticals
12. Information and Communications	<ul style="list-style-type: none"> - information and interactive services - software and applications - computer hardware and electronic devices - information processing and storage - communications networks and equipment
13. Manufacturing	<ul style="list-style-type: none"> - materials - machinery - product development and control systems - recycling, emission control and waste reduction - new manufacturing processes
14. Mineral Production and Products	<ul style="list-style-type: none"> - geoscience evaluations - extraction technologies - economic analyses - market opportunities
15. Tourism	<ul style="list-style-type: none"> - parks and recreation - hospitality - museums, galleries and concert halls - festivals
16. Transportation	<ul style="list-style-type: none"> - on- and off-road vehicles - road, rail, water and air systems - commercial transport operations - disaster readiness/emergency preparedness - aeronautics

Questions Related to RAAs

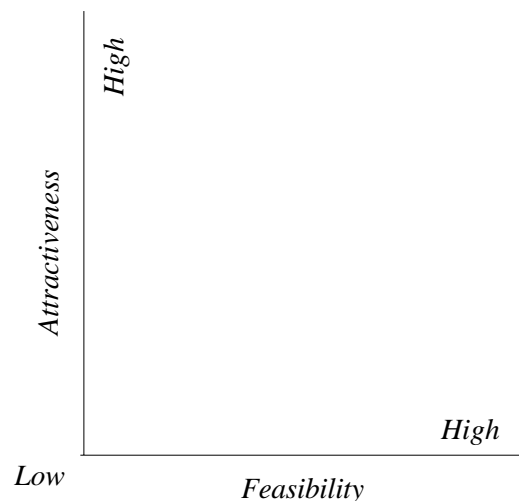
Please complete your responses in the accompanying questionnaire.

1. Please indicate the three RAAs that you “relate most closely with” in your work or research. Please list the actual number of the RAA (1 - 16) in order of priority.
2. Please review the sixteen RAAs and their description in the background report. If you find the description either *too broadly or too narrowly defined*, please indicate this and your reasons.
3. If you have suggestions for any deletions, additions or changes to the description of each RAA, please indicate these.
4. For those RAAs with which you are familiar, what are the knowledge disciplines that support each of them?
5. Please list any RAAs that were not included or that should be separated from within the previous list. Please indicate your reason(s).
6. From your perspective, which RAAs do you believe could provide the most positive future economic and social benefits to all Albertans? Why? (*please note: this is not a rating question*)
7. In any of the RAAs, are there emerging ideas, concepts and technologies that may potentially create large socio-economic impacts? Please identify any emerging ideas, concepts, and technologies that you think are important and the RAAs in which these may find their most significant applications.

Assessment and Priorization Framework

Proposed RAAs will be screened through a review process which is based on assessing both **attractiveness** and **feasibility** (Figure 3).

Figure 3
Attractiveness and Feasibility



Attractiveness is the product of potential benefits and the ability or probability of Alberta to capture them. Benefits include economic, environmental and social returns flowing to Alberta. The potential to capture benefits is a measure of the ability of Alberta companies and organizations to convert knowledge advances into commercial and other returns.

Feasibility is the product of the potential research to application development coupled with Alberta's available infrastructure and capability to realize those potential applications.

Attractiveness	<ul style="list-style-type: none"> • Potential socio-economic returns to Alberta from technical and knowledge advances • Potential for Alberta to capture benefits and convert these into socio-economic returns
Feasibility	<ul style="list-style-type: none"> • Science and research potential, especially determining whether this is a young or mature technology • Alberta's ability to realize this potential through capacity, skills and infrastructure

Indicators for Determining Attractiveness

Indicators of Potential Benefits

- Size of market
- Projected market growth
- Contribution to productivity
- Export potential
- Import replacement potential
- Health and safety improvement
- Avoided damage
- Social enhancement

Indicators of Alberta's Ability to Capture Benefits

- Can locals compete?
- Is technology "acceptable?"
- Can locals exploit this potential?
- Is it uniquely Albertan?
- Linkages with other RAAs?
- Adequate skills?
- Adequate investment?
- Access to marketing networks?
- Risk of leakage to others?
- Probability of creating new enterprises?

Indicators for Determining Feasibility

Indicators of Research and Development Potential

- Fertility of research area
- Location on an "S" curve
- Proximity to realizable potential

Indicators of Research and Development Capacity

- Is Alberta's science and research internationally competitive?
- Is Alberta's science and research nationally competitive?
- Should work be done in Alberta?
- Does a critical mass exist?
- What is Alberta's capacity (skills, facilities, investment)?
- What is Alberta's time frame for effective application?

Please complete your responses in the accompanying questionnaire.

8. Do you have any comments or suggestions about this framework ?
9. From the list of indicators presented in the background report, from your perspective, please list those which are the most important. Also, please add *any others* that you believe are important.
10. What are the issues or concerns in Alberta that would benefit from specific research activity?
11. Do you have any other thoughts or comments that you would like to share with us?

Descriptions of Research Application Areas

1. Agriculture and Related Products

- food products
- soils, water and agricultural waste management
- crop development
- livestock development and animal nutrition
- processing equipment and development
- non-food products

The productivity, sustainability and competitiveness of the agricultural and food industries and stewardship of the natural resource depends on, and involves research into soil quality, water quality and water use efficiency, and agricultural management. The development and testing of new crop varieties, the improvement of crop production and storage, economic viability, market opportunities, product quality and information required for regulatory functions are under investigation. Feed grain and forage studies support the livestock industry. Livestock research studies include animal nutrition, animal health and productivity, animal breeding and management and livestock diversification. Quality assurance, safety and packaging studies and new products research in the food processing sector, ensure quality food products as well as non-food products used for medicinal, and industrial purposes. Agricultural machinery research is also part of this application area.

2. Art and Culture

- visual arts
- performing arts
- literary arts
- cultural industries

The arts and culture sector includes the fine arts, independent film, video, television and sound recording, book and magazine production and distribution, and the field of entertainment. Research leads to creative growth and to the development and application of diverse cultural products. Of particular note is the technological revolution that creates opportunities for electronic development and transmittal of information rich products which are changing many aspects of our lives. Computers, compact disc players and CD-ROMs and the Internet are providing opportunities for artists to create and market their products world wide. This requires research into the impact of multimedia presentations in the home and the ready access to off-shore arts and culture products.

3. Biotechnology

- medical applications
- agriculture applications
- environmental applications

Biotechnology is used in diverse research areas. Medical biotechnology involves the development of pharmaceuticals and various diagnostic tools. Biotechnology applied to agriculture has resulted in advances in plant biotechnology, biopesticides and bioherbicides, animal health and food processing. New pest, disease and herbicide resistant plant varieties are being developed. Animal biotechnology involves embryo transplant technology, animal genetics and animal vaccines. Environmental biotechnology focuses on waste management, biomass, remediation, recycling and materials re-use.

4. Community Services

- public security, policing, fire and ambulance
- recreation
- justice
- social welfare
- consumer and occupational health and safety
- public transportation

Research in the area of community services has been limited even though this is a major employment area as well as a major consumer of public funds. The opportunities for small and medium-sized business to create jobs, coupled with the possibility of working from one's home suggests that community services will likely change and play a different role in our lives. The Department of Justice ensures equality and fairness in the administration of justice in the areas of criminology and law. Maintaining law and order, conducting criminal and civil proceedings, carrying out the sentences of the courts, provision of legal services and access to legal aid and research related to the operations of correctional institutional institutes are components of this application area. Family and social services, child welfare and care for the handicapped and disadvantaged members of society are also part of this area.

5. Construction

- building design
- facility management
- building programming
- site location
- restoration and renovation
- highways, roads and bridges

This sector is involved in the planning, design, construction and project management of residential, commercial, industrial, institutional, health care and medical, educational, recreational, sport, cultural, religious and hospitality buildings and facilities. Transportation projects, hydroelectric power projects, power line and cable installations and municipal infrastructure are also served by this sector. Generally private firms are licensed by the province to provide design and consulting services to the public. Research is carried out in support of firms and specialized trades people in the building, renovation repair and demolition of structures and in the alteration of natural topography. Public infrastructure projects also benefit from research through more economical design and improved performance and service life. Cold weather construction technologies are very important to the industry and these have considerable export potential.

6. Education

- design and delivery of programs
- apprentice and other training services
- educational products
- human resource development

Education services and products are delivered by education and training institutions and private companies. The design, production and delivery of programs and materials cover a wide range of subjects. Academic and training courses are delivered in the classroom, the workplace and at home. Education programs provide opportunities for secondary and post-secondary students to obtain employment credentials. Human resource development programs, job-related training and skills upgrading is provided for business, industry and public service clients. Preschool and public school education programs are being designed to prepare students for living and working in a rapidly changing technological world. As the population ages, continuing education for older adults will take on greater importance and prevent their world from growing smaller. Of course, institutes of advanced education generate much of the basic research necessary for the improvement of all application areas.

7. Energy production

- conventional and non-conventional oil
- coal
- natural gas
- electricity generation
- renewable energy

Energy production covers the range from exploration, resource confirmation, drilling and a wide range of recovery processes and production. The oil sands resource of Alberta is unique to the country. Research occurs in both in-situ oil sands and oil sands mining and extraction. Reservoir process development and operations, environmental aspects of recovery and bitumen and heavy oil upgrading are related research fields. Conventional oil research is directed toward the discovery and delineation of the resource, reservoir access and fluid handling. Horizontal well drilling and completion, formation damage control, and enhanced oil recovery processes are also part of this research application area. Natural gas recovery research is studying low permeability, low pressure reservoirs and the potential of coal bed methane recovery. Coal studies are designed to ensure coal remains an environmentally acceptable, low cost option for power generation. Hydrogen research is directed at the use of hydrogen feed stock for the upgrading of heavy oil and bitumen. Renewable energy studies include wind, solar and ethanol from grains.

8. Energy Products

- oil and gas production services
- fluids separation
- value added processes
- petrochemicals
- natural gas utilization

The design, manufacture and servicing of resource extraction equipment as well as the development and sale of energy production equipment and services is included in this research application area. Refined petroleum products include fuels, heating oils, asphalt, and lubricants. In addition, organic and specialty chemicals such as paints and varnishes, soaps and cleaning compounds, rust inhibitors and catalysts are produced. Metallurgical, coking and thermal coals have export potential. Research into new uses for sulphur in the fertilizer and chemical industries has potential for developing new markets for this resource. Reliable electrical power is necessary for Alberta's industries.

9. Environment

- weather and air quality
- soil and water conservation
- sustainable development
- energy conservation
- education and regulatory instruments
- remote sensing

Research is playing a major role in this sector. Science and technology is reducing the environmental impact of the resource based industries and energy conservation practices are reducing the environmental effects of the use of fossil fuels. An increased awareness of the importance of biodiversity is laying the foundation for ecobased management systems. In the agricultural sector, more sustainable farming practices and being undertaken and the chemical industry has introduced better disposal and storage methods. Improving recycle and composting practices is reducing the use of land-fill sites. Wild lands tourism is recognized as a wealth provider for the province. A good scientific basis for environmental protection and for the related regulatory instruments will ensure the good stewardship of the environmental application area.

10. Forestry and Forest Products

- pulp and paper
- wood and panelboard
- value-added wood and non-wood building products
- machinery, equipment, supplies and services

Forestry and forest products address utilizing the resource efficiently and the production of value added products from the resource. The activities include improved forest harvesting equipment, timber process conversion to new products, improving utilization of wood residues and improvement of a wide range of new and old products. Pulp and paper producers are expanding their capacity and moving into value added products. Research in this area allows the industry to maintain competitiveness and respond to growing environmental awareness. Production capabilities in windows, doors, molding, etc. are continuing to increase. Research is occurring in value-added manufacturing of timber resources and in the utilization of wood residues in products like particle board, and oriented strand board or medium density fibre board. Alberta's fibre mix gives researchers unique challenges. The sustainability of forest management practices, the use of recycle fibre and concerns over effluent emissions are all receiving research attention.

11. Health

- biomedical
- health services
- mental health
- medical devices
- health care products
- pharmaceuticals

All Albertans desire a long and healthy life. Timely, reliable information from research is used by government regional health authorities, health service providers, industry and the public to make informed decisions on health and health services. Basic and clinical research as well as the research of allied health professionals in care-giving institutions are contributing to the development of new medical devices, pharmaceuticals and health care products. Opportunities for improvements in health informatics, biomedical engineering, environmental health, health care services and long term and community care are being actively pursued. Health research is funded by the Alberta Heritage Foundation for Medical Research and the cancer program is supported by the Heritage Fund.

12. Information and Communications

- information and interactive services
- software and applications
- computer hardware and electronic devices
- information processing and storage
- communications networks and equipment

The information and communications application area demonstrates dramatic industrial and consumer growth. Broad band communications systems and applications, including intelligent communications networks are under investigation. Interactive multimedia information services and educational products have considerable market potential. Data storage visualization, management, analysis and transmission systems are under study as are wireless communication systems and applications. Artificial intelligence applications are contributing to the growth of this area and virtual reality applications will become increasingly important. In short the changes in software engineering practices, and integrated voice, text and data imaging make this an exciting research application area.

13. Manufacturing

- materials
- machinery
- product development and control systems
- recycling, emission control and waste reduction
- new manufacturing processes

Studies in specialty metals, ceramics, polymers and composites have reduced manufacturing costs and energy consumption in the manufacturing process. Advanced materials offer new possibilities by allowing the industry to predetermine the properties for a given manufacturing application. Research in materials substitution is important to this area. As new materials are introduced that enhance strength, withstand greater heat and provide greater flexibility, opportunities for the development of new processing machinery and tooling are introduced. Computers, sensors, controllers, automated materials handling and inspection equipment are leading to the automated factory. Rapid prototyping of new products, global telecommunications, flexible business networking and recycle technologies are changing today's manufacturing industries and research in this area is extensive.

14. Mineral Production and Products

- geoscience evaluations
- extraction technologies
- economic analyses
- market opportunities

The potential exists for precious metal, base metal, rare earth and uranium deposits in Precambrian shield rocks and Phanerozoic sedimentary rocks. Minerals such as salt, lime, gypsum and clays are used by Alberta's industries. There is potential for calcium, magnesium and potassium extraction from formation waters. The construction, chemical and paper industries rely heavily on the availability and accessibility of certain industrial minerals in the province and the development of innovative technologies can improve the viability of existing operations and encourage new and diversified mineral-based enterprises.

15. Tourism

- parks and recreation
- hospitality
- museums, galleries and concert halls
- festivals

Alberta is fortunate to have several UNESCO World Heritage sites within easy access of major cities. These and world famous places of natural beauty combined with archeological, palentological and historical sites of interest to the cultural tourist attract national and foreign visitors to Alberta. Research into new ways of presenting these attractions in meaningful and informative ways will ensure a healthy tourist industry. It is important to ensure that our parks and wilderness areas remain attractive. It is also essential that our hospitality industries keep up with current trends so that visitors are well treated and want to return. Having facilities that can accept international exhibitions and attract world class performers is important to residents. Also important is the training of personnel in this application area.

16. Transportation

- on- and off-road vehicles
- road, rail, water and air systems
- commercial transport operations
- disaster emergency preparedness
- aeronautics

The research application area is aimed at improving the development, maintenance, operation and safety of the transportation facilities. Research can range from economic analysis and geometric design issues to pavement design theory to high performance concrete and crack sealer products and procedures. Topographic, aerial, hydrographic soil, traffic and accident surveys are conducted to support planning, design construction and programming activities related to the province's transportation infrastructure. The data is also used in policy and engineering decisions to establish provincial standards for infrastructure, materials, devices, products and processes. Information regarding the transport of people and goods is required by the industry so that in an emergency lives are saved.

ASRA can be contacted at:

Alberta Science and Research Authority

250 Karl Clark Road

P .O. Box 8330

Edmonton, Alberta

T6H 5X2

Phone: (430) 427-1488

(To call toll free, from outside the Edmonton
area, dial 310-0000 and ask for 427-1488)

Email: caruk@arc.ab.ca

URL: <http://www.gov.ab.ca/~sra/>

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An Invitation:

Participate in Determining Science
and Research Priorities for Alberta

The Alberta Science and Research Authority (ASRA) is undertaking a consultation process with you and other participants who will work with ASRA in developing recommended research priorities for the province. This consultation will also identify a broad range of innovative suggestions that could be considered in developing these recommendations.

Included in this package is a background paper which will provide you with information on the process. **Please retain this background paper for future stages of the process.**

Accompanying the background paper is the Stage One questionnaire. The questionnaire is also available on our internet homepage and can be accessed by others interested in participating in the process. The homepage is at <http://www.gov.ab.ca/~sra/>. We ask that you complete this questionnaire and fax it back to us by **April 19, 1996**. Alternatively, you may mail your questionnaire back to:

Alberta Science and Research Authority

250 Karl Clark Road
▶ P.O. Box 8330
Edmonton, Alberta T6H 5X2

A summary of responses from this questionnaire will be sent to you along with the Stage Two questionnaire. We will also be holding regional workshops across Alberta in conjunction with Stage Two. Participants will be selected from those people who participated in Stage One. We will try to achieve a balance of participants both regionally as well as from all areas where research is applied.

The Board of Management of ASRA hopes that you will participate in this important project. We would like to take this opportunity to thank you in advance for both your interest and assistance. We look forward to a creative and exciting process.

Sincerely,

Dr. R. J. (Bob) Fessenden
President
Alberta Science and Research Authority

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Process
Development

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