The NWT Granular Users Forum

Summary Report

September 27 & 28, 2006
Yellowknife, NT

Submitted to:
Indian and Northern Affairs Canada

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1.0 INTRODUCTION

1.1 Background

Indian and Northern Affairs Canada (INAC) hosted a workshop in Yellowknife, September 27-28, 2006 entitled "*The NWT Granular Users Forum."* Participants included representatives from Aboriginal organizations, government, regulators, industry, resource management bodies, consultants and others with responsibilities for land use planning, screening and environmental impact assessment, and other aspects of environmental management. The forum included presentations on relevant examples of granular resource management from both the Northwest Territories and other Canadian jurisdictions. Presentations were also given on information systems, both existing and proposed. The forum also provided the opportunity for participants to become engaged in three separate expert panels, and two break-out brainstorming sessions. The discussion was not project-specific, but focused on potential actions for improving the quality and quantity of information on NWT granular resources, and also possible management planning techniques to ensure the sustainability of the resource.

Because of its demand in the north for past, current and future industrial and public projects, it is essential that sufficient information exist on granular resources in the NWT to integrate into future land use decisions.

The need for better information on the identification, development and use of granular resources in the NWT is implied in questions raised with respect to development in the North: 'Who owns the granular resources?', 'How are the granular resources managed?', 'What are the benefits, risks and challenges associated with the development of granular resource management plans?', and 'What is done, by users, to ensure that the information on granular demands is made available to others who may require this information?' Granular resources are vital for the construction of essential logistical requirements such as roads, airports, and building structures.

1.2 Forum Purpose & Objectives

The purpose of the forum was to provide an opportunity for interested parties to meet in an open forum to discuss issues related to accessing information on the identification, development and use of granular resources in the NWT.

The three specific forum objectives were to:

1. Discuss potential actions for improving the quality and quantity of information on NWT granular resources;

2. Discuss potential actions for improving access to available information on NWT granular resources; and,

3. To discuss management planning techniques to ensure the sustainability of the granular resource.

1.3 Forum Agenda

The agenda for the NWT Granular Users Forum covered the following over the course of the two days:

- On Day 1, representatives from various organizations made presentations outlining their interests and relevant initiatives with respect to granular resource management, GIS technology, and existing granular resource information systems. Two moderated panel discussions were held, the first panel provided an NWT overview of granular resource management, and the second focused on granular management plans, the day concluded with a "hands-on" demonstration of the existing granular resource information systems;
- On Day 2, further presentations were given regarding geotechnical data standards, and an NWT example of a possible cumulative effects GIS system. The workshop concluded with participants engaged in facilitated break out groups with discussion focused on the subjects of information improvements and access to information in regards to NWT granular resources.

The complete agenda is included in *Appendix A.*

1.4 Forum Participants

The forum attendees included representatives from Aboriginal organizations, government, regulators, industry, resource management bodies, consultants, and others with responsibilities for land use planning, screening and environmental impact assessment, and other aspects of environmental management. There were approximately 35 participants (*See Appendix B)*.

1.5 Forum Presentations

A list of presentations is provided in the agenda, found in *Appendix A.* Copies of the presentations made at the forum can be found in *Appendix D.*

2.0 GRANULAR RESOURCE MANAGEMENT ISSUES AND INFORMATION SYSTEMS

2.1 Introduction

Bob Gowan (Manager of Land Programs, INAC) welcomed all participants, and provided some opening remarks. B. Gowan referred to an earlier workshop that was held in Yellowknife in 1993. Sponsored by the Northern Oil and Gas Action Program (NOGAP), this previous workshop was convened to identify granular resource requirements or development constraints in the Mackenzie Valley and Delta regions, and identify any future research requirements or outstanding granular resource management issues.

The previous workshop identified that there was a considerable amount of information on granular resource management in the NWT, but that it was widely unknown where and how to access the data. It was also identified that a major project was necessary to "kick-start," the work on improving the quality and quantity of information on NWT granular resources. Mr. Gowan noted that the Mackenzie Gas Project (MGP), subject to environmental and regulatory approvals could be the kind of project that would be able to do so.

The purpose of the 2006 NWT Granular Forum was to provide participants an opportunity to meet and discuss current issues related to accessing information on the identification, development and use of granular resources in the NWT. The forum also sought to gauge whether the needs and priorities of those involved with granular resources has changed over the past 13 years. The forum was also designed to showcase recent advances in information technology that could benefit the gathering, and analysis of NWT granular resources.

At the outset of Day 1, participants heard three presentations that gave an overview of granular resource management in Canada. The remaining workshop presentations over the course of days 1 and 2 were dedicated to examples of information systems. These included:

- GIS Systems Presentation: NWT Examples
- Mackenzie Valley Granular Data Management: WWW Site
- Geotechnical Data: Review of Existing Software and Standards
- Possible Cumulative Effects GIS: Inuvialuit Land Administration

A summary of Day 1 and 2 discussions follows. The content of the presentations themselves is only briefly summarized, as they are provided in *Appendix D* of this report. The questions/answers and discussions are also noted.

2.2 Granular Resource Management – An Overview of Canadian Examples

To set the context for the rest of the forum's discussions, an overview presentation focusing on Canadian examples of granular resource management was given by Doug Vanderveer of AggMapR Inc. Mr. Vanderveer provided a cross jurisdiction overview of granular resource

management based on his recent experience reviewing Canadian Geological Surveys. This review determined the style and where possible, the details of the various surficial and aggregate related information sources. This information would then provide information on the location and quality of granular/aggregate resource materials. The presentation briefly reviewed the legislative basis, (if there is a legislative responsibility) and the style of mapping conducted in each Canadian province and territory. It was noted that, while most provinces have legislation governing extraction of granular materials, the terminology varies by jurisdiction.

Mr. Vanderveer provided an overview of provincial governmental websites, with the objective of showing the diversity of terminology and availability of data. Using the word "geology" in any search for granular resource information was identified as a common element to all the websites identified.

The presentation was useful as a visual teaching aid for those who were interested in accessing granular information in other Canadian jurisdictions because it reviewed five different provincial websites that have substantial sources of granular information. The provinces included in this interactive review were as follows:

- Alberta;
- British Columbia;
- New Brunswick;
- Newfoundland; and,
- Ontario.

The presentation concluded by providing participants a sense of how the different Canadian provinces and territories compare in terms of sand and gravel production. This was accomplished by providing a series of bar graphs that denoted the Canadian jurisdictions production levels from a ten year period, 1995-2005. This portion of the presentation also provided statistics for sand and gravel production for the NWT.

Mr. Vanderveer's presentation slides can be found in *Appendix D.*

2.3 Role of Geotechnical Consultants in Granular Resource Evaluation and Development

Ed Hoeve of EBA Engineering Consultants provided a presentation on the role of geotechnical consultants in granular resource evaluation and development. The presentation provided a number of specific northern examples and challenges to the evaluation and development of the granular resource. Most of the challenges that geotechnical consultants face when determining granular resources are environmental, such as the harsh northern climate, and the problems that are encountered in a permafrost environment. He indicated that logistics can also be challenging for evaluating granular resources in the north, as many of the sources require air transportation to the site.

The presentation outlined the various components associated with granular resource evaluation. These components included:

- Identification - review of available information;

- Investigation - site investigation;
- Aggregate characterization – suitability, and durability: laboratory testing; and,
- Volume estimates for different applications.

The identification of the granular resource employs a number of different techniques such as the usage of topographical and surficial geological maps, historical air photos, and recently, satellite imagery. Climate data is also used in the north to identify potential problems in developing sources. Once a "target" is identified a site investigation is required to confirm the suitability of the source material. In the north, geotechnical consultants have to determine the permafrost distribution and characteristics when performing a site investigation.

Site investigations are excavations either performed by hand or by machine. Due to the fact that many of northern areas are only accessible by air, hand excavations are prevalent. By excavating a "test pit", it can showcase the variability of the granular resource, and it gives a good idea where the water table is as well. If at all possible in the north, a front end loader will be used to excavate a test pit. In other northern regions, such as Nunavut, "air track drills" are used. Although effective in locating a resource, these drills tend to pulverize the ground, thus underestimating the size of the granular resource. Depending on the budget of any site evaluation specialized equipment may be used.

Geophysical techniques such as "ground penetrating radar," are also used to fill in the gaps during a basic site investigation, but are not intended to be used in place of an excavation.

Many tests are performed in the laboratory to test the aggregate suitability and durability. Some tests that are performed include:

- Particle size distribution;
- Color Plate;
- Specific gravity; and,
- Petrographic analysis.

As mentioned early in Mr. Hoeve's presentation, permafrost can pose a major problem to a granular resource. It increases the cost of granular resource development, and it can be problematic in terms of excavation. Permafrost creates problems for granular resource extraction that would not be experience in the majority of Canada.

If the granular resource proves to be suitable, it could then be developed. Geotechnical consultants, because of their familiarity with the regulatory process also become involved with granular pit planning and development. This includes planning and design, permitting, operations, and reclamation. In the NWT, the local government would have their own permitting requirements that would need to be addressed. If the granular source is close to a body of water, quite a lot of permitting is required.

Geotechnical consultants can also assist in the monitoring and quality assurance of a designated pit. This could entail the monitoring of the suitability and quality of the source, ground ice, water management, and the impact of pit/quarry operations on the environment. The presentation also concluded that geotechnical consultants can assist with reclamation of pits and quarries by providing advice on clean up, re-contouring and final slopes, drainage and erosion control, and re-vegetation.

E. Hoeve's presentation slides can be found in *Appendix D.*

3.0 GRANULAR RESOURCE MANAGEMENT: EXPERT PANELS

3.1 Expert Panel 1: NWT Overview

During the first day of the forum, two expert panels were held. The first of these expert panels focused on the subject: Granular Resource Management – An NWT Overview. A panel with a range of perspectives and experiences discussed a number of topics that provided forum participants with a sense of how the granular resource is managed in the NWT. The six questions that were posed by the facilitator were:

1. Who owns the granular resources in the NWT?
2. How are granular resources managed?
3. How is information on inventories and demand forecasts made available to the general public?
4. Why do we need to manage the resource and what can we do to ensure the sustainability of granular resources in the NWT?
5. Does your organization take a proactive approach in identifying potential sources of granular material and direct applicants to those sources or does it rely on users identifying and evaluating the sources they wish to use?
6. How does the process of authorizing and monitoring of pit and quarry operations on your lands compare and contrast with the information provided as part of the forum package?

The four panel members included:

- Todd Romaine (Inuvialuit Land Administration, ILA)
- Dan Elliott (Indian and Northern Affairs Canada, INAC)
- Mardy Semmler (Gwich'in Tribal Council, GTC)
- Fred Collins (GNWT – Public Works and Services, PWS)

Panel participants were asked to briefly introduce themselves before the discussions began. Each of the six discussion questions were posed by the facilitator, after the question was asked each panel member was given an opportunity to respond. The discussion was then opened to all forum participants for their questions and input. The suggestions made from those on the panel and participants are summarized in the following tables.

Table 1: Who "owns" the granular resources in the NWT?	
Todd Romaine (ILA)	• In terms of the Inuvialuit Settlement Region (ISR), the Inuvialuit Final Agreement granted 91,000 kilometers of land to the Inuvialuit. The ILA has ultimate use and disposition of the granular resources on all private lands in the ISR.
Dan Elliott (INAC)	• INAC owns the resource on federal crown lands that are under the jurisdiction of the federal government. INAC controls this resource on crown lands on behalf of the citizens of Canada and the NWT.
Mardy Semmler (GTC)	• In terms of lands in the Gwich'in Settlement Region, the Gwich'in Comprehensive Land Claim Agreement identified sand and gravel as being managed and owned on private lands by the Gwich'in Tribal Council.
Fred Collins (GNWT)	• The GNWT manages the granular resource on Commissioner's Lands in the NWT, ultimately these lands account to 1% of the total NWT land area. However, the bigger picture is that the GNWT is also interested in the sustainability of the resource throughout the territory. • The GNWT is also cognizant of the association between high building costs and the lack of granular materials. This is another reason to ensure the sustainability of the resource, so that building costs are kept at a minimum.

Table 2: How are the granular resources managed?	
Todd Romaine (ILA)	• In the ISR, there is an application process to secure the right to develop. An application is submitted by a proponent, which is forwarded to the hunters and trappers associations. It also goes to the public consultation phase. Based on the support from the public the application will then move to the environmental screening committee and/or possibly the environmental impact review board. • If the application is approved an Inuvialuit environmental monitor will be assigned so to ensure that the proponent is acting accordingly, and their quantity taken from a selected pit or quarry is reflected in their daily intake. • The granular resource is very limited in the ISR; the ILA essentially counts the number of trucks of gravel going in and out of pits to ensure the numbers are correct.

Table 2: How are the granular resources managed?	
Dan Elliott (INAC)	• In terms of crown lands, INAC has a formal and informal management plan. • The formal process is the application process, land use permits are given with respect to federal lands in the ISR from the Inuvik office. In other settlement regions along the Mackenzie Valley the Land and Water Boards provide the land use permits. • Informally, INAC does not have a large scale management plan. When a proponent applies for a quarry permit, a Land Use Permit (LUPermit) is also applied for; activities on quarry sites are covered under LUPermit's. A quarry permit does not have operating conditions because they are also covered in the LUP • INAC employs environmental inspectors who make assessments on a frequent basis.
Mardy Semmler (GTC)	• In terms of management of the Gwich'in private lands the Gwich'in operate and manage the granular sources. There are two operating granular sources. The first is along the Dempster Highway, the second is close to the Willow River area near Aklavik. • There have been two other plans that have approved to develop gravel pits in the Frog Creek and Willow River areas. A third plan is in the geotechnical phase. • In terms of the application process, a quarry permit would have to be authorized by the Gwich'in Land Administration. • A permit would be needed from the Gwich'in Land and Water Board to go through the regulatory process. A type A LUPermit would be required for the development of a new granular pit or quarry.
Fred Collins (GNWT)	• The GNWT is only a regulatory authority for Commissioner's Lands. The formal process comes under the authority of the Department of Municipal and Community Affairs (MACA), which is based on the Commissioner's Land Act and regulations. • Informally, management of granular resources is required because of its essential use for NWT communities and ongoing construction operations. The Department of Public Works and Services (PWS) is required to coordinate between the communities and the GNWT in terms of their needs for granular resources. • The GNWT, in terms of management, is more involved with the forecasting of the supply and demand of the granular resource. An internal GNWT program has been developed to do this forecasting for NWT communities. • The Department of PWS works with impacted Land Claim Groups.

Table 3: How is information on inventories and demand forecasts made available to the general public?	
Todd Romaine (ILA)	• ILA administration office provides information to the public. In terms of specific demand forecasts, this information is sent out as required. • One of the long term objectives of the ILA is to develop an ISR wide granular resource management plan. INAC is a big player in this process, with support also coming from MACA and the municipal hamlets.
Dan Elliott (INAC)	• INAC has field officers in most communities, such as Inuvik, Hay River, Yellowknife, and Fort Smith. These officers possess a wealth of knowledge from working in the field. • Public inquiries are addressed in the local offices • Information on demand forecasts is also accessible through the Aurora Institute and internal INAC databases.
Mardy Semmler (GTC)	• The Gwich'in Tribal Council has granular pit management plans on CD's, and they are provided to construction agencies, industry and regulatory authorities in the region. • A resource inventory for future granular demands has not been developed yet. • For the general public there is a GTC website but granular information on the site is still in the development stage. It is hoped that in the future, management plans will be placed on this website.
Fred Collins (GNWT)	• The Department of PWS provides demand reports to each NWT community. These are done in separate 5 and 20 year assessments. • The resource base can change very quickly in 3-5 years, thus the 5 year reporting. A five year forecast for a certain community provides "ballpark" figures, and they can be accessed on the Department PWS website. • The GNWT Capital Plan is also referred to when forecasting. The Plan lists GNWT capital projects that are related to certain resources such as granular. • The Department of Transportation (DOT) is another large user of granular resources due to their involvement with transportation infrastructure in the NWT. They have their own separate demand forecast data. • The Department of PWS does not have a GIS website, which would be helpful.
Additional questions / comments from forum participants:	
How do the various agencies coordinate or support each other with the various projects?	• T. Romaine (ILA): The ILA has a joint management plan with INAC and a lot of baseline data has been recorded in the past, this data needs to be implemented. • M. Semmler (GTC): The GTC has a good working relationship with INAC and the various Land and Water Boards. We try to work with all of them cooperatively

Table 3: How is information on inventories and demand forecasts made available to the general public?	
How is the depletion of the resource tracked / managed?	• M. Semmler (GTC): Depletion is tracked through our land use authorizations; the holder supplies the information to the GTC, so that it can be determined how much volume is being extracted. The tracking is done in house. • D. Elliott (INAC): Tracking is accomplished through "quarry returns," which the proponent is required to complete per gravel quarry. • T. Romaine (ILA): This is done through the work of Inuvialuit environmental monitors. A lot of this tracking work is also done by consultants on ISR private lands.
Are there volume inventories done by consultants?	• T. Romaine (ILA): Yes, it seems like a lot of this is done through the work of consultants • M. Semmler (GTC): Volume inventories for the pit along the Dempster Highway are done through consultants • F. Collins (GNWT): This work is done in house; Land Use Permits are issued and tracked in house as well. • B. Gowan (INAC): It must be noted that there is an additional requirement under the Mackenzie Valley Resource Management Act that states that resource tracking is shared with claimant groups and dispersed on a quarterly basis so this provides further information tracking.

Table 4: Why do we need to manage the resource and what can we do to ensure the sustainability of the granular resources in the NWT?	
Todd Romaine (ILA)	• The resource absolutely needs to be managed. Granular resources in the NWT are the most undervalued and over utilized in the territory. Monitoring and enforcement is costly, but what we are doing on Inuvialuit private land is cutting edge. • In the context of the NWT, management plans need to be integrated on local, regional and territorial levels. • Granular management needs to be viewed as an entire process, right up to the pit abandonment stage.
Dan Elliott (INAC)	• INAC recognizes that granular materials are a scarce resource in the NWT, that's why it requires proper management. • In terms of how that should be done, it should be ensured that the scarce resource is used efficiently. For instance, class 1 granular materials should not be used for a sub fill. • There has to be a better understanding of the demands for the granular resource, this information has to be better shared. • As a result of the MGP hearings, INAC has a better idea of the granular requirements of the proponents, although this dialogue has to continue.

Table 4: Why do we need to manage the resource and what can we do to ensure the sustainability of the granular resources in the NWT?	
Mardy Semmler (GTC)	• It is a limited resource and thus needs to be properly managed. It needs to be ensured that everyone is getting the quality resource that they paid for. • The GTC looks at it as an economic source, the collection of its royalties are part of the management strategy. • We have to ensure that footprint sizes of pits/quarries are kept to a minimum. • Proper management and development plans should be put in place to ensure the sustainability of the granular resource. ○ When asking the proponents for the MGP about their granular demands in our region, they indicated that some of their marked sources are off the Dempster Highway; this means that they will have to develop new sources. Proper management plans will have to be put in place for each new source.
Fred Collins (GNWT)	• There needs to be sustainable development of the granular resource so that there is enough for future generations of the NWT, this is why we need to manage effectively. • The resource also needs to be managed effectively because if it isn't readily available it can seriously affect construction costs in the NWT. Managing the resource stabilizes this cost. • The increase of access to granular information, which this forum will be exploring, will be an asset for the sustainable development of the granular resource.
Additional questions / comments from forum participants:	
What is the role or mandate of the Department of Environment and Natural Resources (GNWT) in the sustainability of the granular resource?	• F. Collins (GNWT): The Department of Environment and Natural Resources (ENR) role is mostly to provide information; they are not involved in the managing of the resource. ○ The Department of Transportation (GNWT) has a larger role of managing the granular resource
Is government identifying specific granular sources for specific future uses?	• D. Elliott (INAC): In terms of identifying sources for different qualities of the resource, we have not, at the Operations level, done much inventory work in the past. We are however, starting to hire new staff that are going out to the field to complete inventories for new and existing areas that will be set aside for specific purposes. • M. Semmler (GTC): The GTC has not looked at sources for specific usage. • T. Romaine (ILA): We have not gone through the tech reports to see the various types.

Table 4: Why do we need to manage the resource and what can we do to ensure the sustainability of the granular resources in the NWT?	
Is it possible to be granted leases on quarries/pits?	• D. Elliott (INAC): INAC does not issue leases for quarries because the resource is so scarce and we don't want to limit leases to one company. i.e. restrict the access to a limited resource to one company/operator. • T. Romaine (ILA): We do have concession agreements that allow for a proponent to enter into a long term exclusive use of the source; however, we ultimately prefer short term non-exclusive uses of Inuvialuit private lands.
Could the GNWT please highlight the regions in the NWT that are lacking a substantial granular resource?	• F. Collins (GNWT): From the GNWT perspective, the further north you go, the scarcer the resource becomes. Communities such as Fort Liard and Deline have an abundance of the resource. • In the Sahtu region the gravel pits only have seasonal access. Colville Lake and especially Tulita have difficulty accessing the resource year round. • In the Delta, Tuktoyaktuk and Aklavik both have challenges due to their geography. The closest pit to Tuk is twenty kilometres to the south, and only accessed by winter road. • It has been the same communities who have had access challenges over the course of the past twenty years. • The other issue is the scale of the demand for the resource. Quarries are feasible around Norman Wells, Inuvik, and Yellowknife. But many of the other smaller communities do not require a quarry.
Have granular users looked at bedrock resources for possible development?	• F. Collins (GNWT): One must take into account that to develop a bedrock source a geo-blasting operation must be used to get it out of the ground. • This option has been looked at but is extremely costly. This is because explosives would need to be flown in and a mobile crusher would need to be used. ○ This has been done in the past; Wekweeti used this option when they built their access road to the airport. This option has also been employed in the east arctic. • It was noted by a participant that this option might be expensive if you look at it from a project by project basis, but in terms of long term it could possibly beneficial to bring in a mobile crusher every ten years. • F. Collins (GNWT): We will be looking into this next year in Lutsel'ke.

Table 5: Does your organization take a proactive approach in identifying potential sources of granular material and direct applicants to those sources or does it rely on users identifying and evaluating the sources they wish to use?	
Todd Romaine (ILA)	• The ILA does both, we have compiled a lot of historical data since the 1980's. The MGP has also done certain geotechnical assessments. • In terms of other information sources, the ILA hires consultants to provide services suited to the particular communities. • We are proactive and reactive at the same time. For large scale projects for instance, proponents will usually identify they sources they require.
Dan Elliott (INAC)	• In the past, the proponents have identified sources on crown lands. This is not the way that INAC would have wanted sources to be identified, but the Department did not have the resources to do it in house. • Now, because of extra funding we will have environmental officers in the field to identify potential resources.
Mardy Semmler (GTC)	• In terms of the Gwich'in Settlement Region we have identified two sources along the Dempster Highway where proponents are directed to use. • For the MGP, the proponents have identified their own sources, and they have done the geotechnical work to make sure that the source will meet their needs. • DOT also has two of their own operating sources along the Dempster highway, and Aklavik is hauling crushed from Inuvik to upgrade their roads.
Fred Collins (GNWT)	• The GNWT used to do a lot of aggregate mapping in the past. The GNWT would identify the source through air photos, and it would be interpreted. • In terms of our sources in Hay River, they are depleting, and we have to go further and further out of town to get new sources • The GNWT tends to be proactive and also relies to a certain extent on the user and GIS websites. • Resource information does change quickly, and this can be a problem.
Additional questions / comments from forum participants:	
How sources are identified by the MGP – Arnold Martinson	• Mr. Martinson from Imperial Oil Resources spoke about how the MGP identifies their preferred sources of granular material. They are proactive in the identification of possible sources. Imperial Oil takes demand into account and where the source can be found.

Table 6: How does the process of authorizing and monitoring of pit and quarry operations on your lands compare and contrast with the information provided as part of the forum package?	
NOTE: The context of this question is in terms of a document that was passed to forum participants entitled: "The Granular Resources Directory." It is a ten year old publication that the panel was asked to comment on whether the information is still valid and usable.	
Todd Romaine (ILA)	• Had not viewed it in the past, but would read it to provide comments.
Dan Elliott (INAC)	• It requires updating
Mardy Semmler (GTC)	• The information in this booklet is outdated. The processes and application phase can definitely be elaborated on.
Additional questions / comments from forum participants:	
Does the government require that a proponent has past experience with pits?	• F. Collins (GNWT): Normally that is site specific, and is up to the regulatory group to decide.
There is a lot of value for having historical information on existing pits	• F. Collins (GNWT): Corporate information can be found in regards to existing gravel pits. • Corporate information can also be found and accessed in terms of capital projects • The land use regulations are not as extreme through the use of an existing pit than they would be if a new pit was developed.
A regulatory system should be put in place to manage the resource in the NWT	• It was noted that there is a lot of geographic and political reasons that make the management of the granular resource in the NWT difficult. o Hamlets and communities do not have the funding to do a proper environmental assessment. o Because of the vastness of the NWT it is hard to enforce and monitor. • Thus, the creation of a regulatory system should be put in place to manage the resource in the NWT.

3.2 Granular Resource Management Plan for the Inuvialuit Settlement Region

Before the second expert panel began, a brief presentation was given by Phil Chidgzey of Alpha Corporation on the granular resource management plan for the Inuvialuit Settlement Region. The presentation provided an example of a possible granular resource management plan that could been used in the NWT. The presentation was also to provide additional insight for discussion in the second expert panel on granular management plans.

In terms of the management plan there is a memorandum of understanding between the two land owners in the Inuvialuit Settlement Region (INAC and the Inuvialuit Regional Corporation).

The objectives of the granular resource management plan for the Inuvialuit Settlement Region (ISR) were to:

- Conserve aggregates for the most appropriate use;
- Focus planning on areas where granular shortages exist or significant future needs are identified; and to
- Adhere to "priorities" in the Inuvialuit Final Agreement.

The plan would provide a number of benefits including the logical and orderly development of the resource, a means of streamlining land administration processes, minimizing supply and demand conflicts and also ensuring that restoration and rehabilitation takes place on a continuing basis.

There were also significant challenges that came with the management plan. The biggest challenge is that granular deposits are limited in occurrence and essentially non-renewable, so they have to be managed effectively. Additional challenges included the adequacy and accuracy of existing granular inventories of supply and forecasts of demand, the remoteness of sources from established communities, and the reconciling of conflicting uses between industry and community users.

The purpose of the joint management was to have a coordinated and systematic approach to granular resource management in the ISR. It would also be beneficial to have the gathering and utilization of all existing info through the sharing of research and project data, the avoidance of duplication of effort, and a commitment to joint planning, action and resource allocation.

Some of the work done on the management plan to date includes the memorandum of understanding on the planning framework and work plan, initial consultations with the Gwich'in, Industry, Environmental Impact Screening Committee, and community site evaluations. There has been additional work completed through the a web map feasibility study and prototype, selective field reconnaissance, and a topographic survey of the "YaYa Lake Deposit."

There is a considerable amount of work left to be done on the management plan. This includes putting the final management plan together and also the assessment of the complete granular demand of the ISR communities, and public and private projects. The plan when finished is to be web based and dynamic, and will have resource extraction guidelines. Before finalized the plan will go through a public consultation phase, and once completed will be monitored and revised when required.

The Alpha Corporation's presentation slides can be found in *Appendix D.*

3.3 Expert Panel 2: Planning

The second expert panel was held during the afternoon of day one of the forum. This particular panel focused on the subject of granular management plans in the NWT. The four questions that were posed by the facilitator were:

1. What groups have main responsibility for granular resource management in the NWT?

2. What efforts have individual organizations or groups made to develop local, regional or territorial granular management plans?
3. What are the benefits, risks and challenges associated with the development of granular resource management plans?
4. What information requirements are involved in developing and communicating such plans?

The five panel members included:

- Todd Romaine (Inuvialuit Land Administration, ILA)
- Bob Gowan (Indian and Northern Affairs Canada, INAC)
- Mardy Semmler (Gwich'in Tribal Council, GTC)
- Susan Chaytor (Alpha Corporation)
- Phil Chidgzey (Alpha Corporation)

Panel participants were asked to briefly introduce themselves before the discussions began. Each of the five discussion questions were posed by the facilitator, after the question was asked each panel member was given an opportunity to respond. The discussion was then opened to all forum participants for their questions and input. The suggestions made from those on the panel and participants are summarized in the following tables.

Table 7: What groups have main responsibility for granular resource management in the NWT?

Todd Romaine (ILA)	• From our standpoint the responsibility rests with the Inuvialuit Land Administration
Mardy Semmler (GTC)	• The Gwich'in Land Administration has the responsibility for management; INAC is responsible for crown lands.
Bob Gowan (INAC)	• INAC has responsibility for managing crown land and its resources. • It makes economic sense to work cooperatively with other land owners when it comes to large projects that cross segments of both private and crown lands. • INAC is also interested in working together with other NWT land owners on cooperation plans, similar to the one with the ISR. All of these have to be negotiated, and have to be beneficial to all parties involved.

Table 8: What efforts have individual organizations or groups made to develop local, regional or territorial granular management plans?	
Todd Romaine (ILA)	• In terms of the ISR region, one of our concerns is to work with the GNWT to ensure capital projects account for gravel costs within adjacent Inuvialuit private lands. • We would also like to work with the GNWT in regards to public infrastructure.
Mardy Semmler (GTC)	• The GTC has to approve plans for granular sources in the Gwich'in Settlement Region. There are two main sources that are used, one on the Dempster Highway, the other near Aklavik. These have management plans for their usage. • Other sources along the Dempster Highway have not been accessed due to quality and proximity to communities.
Bob Gowan (INAC)	• As mentioned during the last question period, INAC is certainly interested in hearing from folks here from other settlement areas to see if they are willing and interested to follow the same sort of framework as was followed with the ISR. There is also the possibility to create a new arrangement for a management plan.
Additional questions / comments from forum participants:	
How does the Department of Transportation (GNWT) fit into the management of the granular resource?	• It was noted that DOT is indeed a major user, and a big player in terms of granular demand. • M. Semmler (GTC): DOT is a major user in the Gwich'in area as well.
The role of the GNWT in terms of granular management needs to be clearly defined	• It was noted that this is further complicated by the GNWT's "New Deal." The New Deal complicates other GNWT actions in terms of municipal responsibilities. The New Deal commences in April 2007.
What else would participants like to see from DOT in terms of granular management?	• M. Semmler (GTC): We would like to see DOT adhere to our granular management plans. In four years, DOT will have to begin paying royalties to the GTC.
The Use of Regional Land Use Plans for the Granular Resource	• Granular management plans should fit into regional land use plans. • For the Gwich'in area, a policy is being developed that any new gravel pits will have to have a Land Use Plan. Regulatory agencies will not be able to give a license without adhering to the Land Use Plan. • Once there has been a granular resource plan developed by land owners, it could make recommendations and policies a little more enforceable. • Land managers need to make the next step to create regional granular resource management plans. The planning would be long term for its use, what kind of resources, and also how to get the most out of each pit.

Table 9: What are the benefits, risks and challenges associated with the development of granular resource management plans?	

Todd Romaine (ILA)	• It is important to start with the economic criteria, that the management plan meets the economic conditions of a particular organization.
	• You want to have an authority that has permitting and enforcement powers, it is a challenge to implement both of these powers.
	  o The ILA has environmental monitors on site, and they transmit data on a regular basis.
	  o It is a challenge for us to get out and enforce certain sources without the capacity to do so
	• There needs to be a prioritization of needs by the management regime. In our context the priority is the land claim terms, there has to be local input from the ISR communities. This is very important because they are living near the resource, and they can determine what is being extracted. Once a management plan is developed it is essential to have the communities support.
	• Monitoring has to be done throughout the implementation of the management plan. The plan also has to be flexible to changing conditions.

Mardy Semmler (GTC)	• The benefits of a management plan are that it allows for the better management of the source. • There are risks associated with safety issues and access. • In terms of information requirements, it can be costly to get geotechnical information. Alternative sources need to be relied on such as public information and user groups, which can pose a whole set of new challenges.
Susan Chaytor (Alpha Corporation)	• There is a benefit to the operators and proponents, those who want to use the gravel. If correct information is provided to them and if it is streamlined it can be beneficial and cost saving. • Overall the benefit is felt by everyone because we are all tax payers. If the resource becomes more costly we all feel it.
Bob Gowan (INAC)	• The risk involved with developing a management plan is how do to know if it is succeeding. • If buy in from potential partners is not secured it is difficult to determine if a plan is working
Additional questions / comments from forum participants:	
Needs to be a Territorial Wide Approach to Granular Management Plans	• It was noted that there needs to be a territorial wide approach to granular management plans to get all the respective parties around the table. • It is also useful to demonstrate an end point where we want to be in the next few years. • When a plan is in place it needs to be flexible. The benchmark should be the survivability of communities who do not have an economic base to support themselves.

Table 10: What information requirements are involved in developing and communicating such plans?	
Todd Romaine (ILA)	• The key is communication. To show that it is an open process it needs to be decentralized and enforced by the communities. • The communities need to enforce the plan.
Susan Chaytor (Alpha Corporation)	• It is essential that you have good accurate information. Good decisions are made on accurate information.

4.0 EXISTING INFORMATION SYSTEMS

4.1 Geographic Information Systems – Some NWT Examples

A presentation was given by Bob Gowan of INAC on geographic information systems (GIS). The presentation provided an overview of GIS systems and how they relate to granular resource management in the NWT. The presentation also provided relevant examples of GIS technology that is being used in the NWT currently.

It was noted the GNWT contributed a significant amount of effort to coerce data partners to put the relevant GIS information together for mineral development areas in the late 1990's. Examples of this include: the Coronation Gulf Mineral Development Area (CGMDA), and the Beaufort-Mackenzie Mineral Development Area (BMMDA). Recently, GIS technologies in the NWT have been used in promoting hydro-carbon potential and hydroelectric potential. The presentation indicated that through the NWT geosciences' office there have been geological resources identified in the Deh Cho region. These GIS techniques that the NWT geosciences' office employs can help to locate potential sources of granular materials. INAC, the Department of Fisheries and Oceans, and the Mackenzie Valley Land and Water Board all have GIS initiatives that may help us locate and evaluate potential sources of granular materials in the NWT. GIS technology is so advanced in the use of multimedia devices, that a user could take a "virtual tour" of the proposed Mackenzie Gas Pipeline route.

A participant inquired on how available the raw data was for all of these GIS systems. It was indicated that some of the raw data is proprietary, accessible on the web but not to be downloaded. From the private operators perspective, they have invested in the costly information that is integrated in the GIS systems and don't want it to be publicly available. This is an argument that has been ongoing since the creation of GIS systems. The presenter noted that government has come along way to make the data freely available.

The presentation also provided an overview of some existing granular resource information systems. The Northern Granular Resources Bibliography (http://www.aina.ucalgary.ca/ngr) contains citations and abstracts to over 1600 reports on granular resources in Canada's three territories and adjacent waters. The website provides the scope of the project, a simple search

page, a key publications page, and contact information for anyone interested in submitting reports

The second existing granular resource information system is the Granular Demands Calculator (http://www.grancalc.ca). Developed by a civil engineer, this web page uses simple geometry to develop granular demand forecasts. It was emphasized that these estimates should only be used for preliminary calculations; a professional engineer should be hired to provide final calculations. The program allows the user to create and edit projects such as roads, runways and pipeline right of ways. The Granular Demands Calculator will then compute estimates for the required amount of granular material for the project.

A forum participant inquired on the computer hardware requirements for the progam and if it was a fee service. It was noted that the system is used in a computer web browser, so no extra hardware would be necessary. In terms of its usage, it is a free educational service. There was a small cost associated with hosting the service, and if needed it will be renewed. It is open to the public.

Mr. Gowan's presentation slides can be found in *Appendix D.*

4.2 The Mackenzie Valley Granular Data Management Internet Site

A presentation on the Mackenzie Valley Granular Data Management site was given by Ward Kilby of Cal Data, Ltd. Participants were given 3D glasses to gain a stimulating perspective on certain GIS information and map displays that have been developed for the purposes of this site.

The Mackenzie Valley Granular Data Management site provides map-based information displays and access to granular resource information along the proposed route of the Mackenzie Valley Pipeline (MGP), and was launched in 2002. The site is engineered around the MapGuide web-mapping software that had a proven track record of reliability and excellent characteristics for the site's requirements. The map interface provides users with a portal to the information hosted on the site as well as related information hosted on other linked MapGuide sites. The website requires relatively low bandwidths for data delivery making it available over a phone line web connection.

The purpose of the site was to provide web access to all granular related information along the proposed pipeline route, and to allow folks in communities along the pipeline corridor the opportunity to view interactive maps that demonstrate certain features of the landscape. The presentation provided participants the opportunity to view first hand how to use the website and its interactive maps as Mr. Kilby went through the various tools and functions. A specific example was taken from the Mackenzie Delta region. The presenter demonstrated the various map layers that were available for the Parson's Lake area by locating bore holes and different resource areas. The user of this system through using GIS technology would be able to pinpoint specific bore holes along the Mackenzie Valley, he or she would also be able to pull up a report that would detail the findings for the specific hole. A number of the map index layers have been developed to provide easy access to reports in PDF format from the website's server. Some layers provide access to complete PDF reports while other dynamically generate reports

from selected report pages that are related only to a particular borrow site or borehole. It was noted that this feature greatly increases the research efficiency of the user.

The website encompasses a variety of different scale airborne and satellite imagery to provide the best possible reference framework. The entire area covered by the site has Landsat 14.5 metre coverage, and most of the pipeline route is also covered by 15 metre ASTER multispectral data. There is additional very high resolution airborne imagery available in selected areas. The website also offers an NWT air photo link, a map index with web links to individual photos that were taken up and down the Mackenzie Valley in the summer of 2006.

The website also uses digital elevation data to generate hill shaded images to enhance surface features. The website also makes use of ASTER images, 3D anaglyph images, virtual reality worlds, and streaming video to produce additional visualization options to the user. In the summer of 2005 the Google Earth viewer became available, and some information from the site has been made available in KML format for viewing with Google Earth. Google Earth has significantly affected all web-based spatial data distribution efforts. It allows highly technical GIS displays to become increasingly user friendly. Google Earth's offline capabilities also provide a tool that is truly amazing and of significant potential value in granular resource fieldwork.

Some of the future directions for the site include a MapGuide – Google combination, an ASTER imagery analysis, increased data content, and a link to other granular tools. Mr. Kilby's presentation slides can be located in *Appendix D.*

4.3 Possible Cumulative Effects Geographic Information System – ILA

A representative from the Inuvialuit Land Administration, Mike Harlow, provided a brief overview of a GIS system that the ILA has been thinking about implementing. A brief history of the ILA was given: after the Inuvialuit Final Agreement (IFA) was signed in 1984, the Inuvialuit were granted title to some 56,000 km^2 of land. The ILA's mandate was to issue various rights and permits for land use in the region. The land usage varies, from simple research projects, complex industrial operations to traditional Inuvialuit pursuits. The three guiding principles of the ILA are as follows:

1. To preserve Inuvialuit cultural identity and values within a changing northern society;
2. To enable Inuvialuit to be equal and meaningful participants in the northern and national economy and society; and
3. To protect and preserve the arctic wildlife, environment and biological productivity.

Mr. Harlow indicated that some of the challenges that the ILA face includes not having a current land use map. He also indicated that ILA staff need to have an idea of what is happening on the ground, both while development is occurring and over time, this is compounded by not having the capacity to monitor effectively. The ILA staff would like to pursue cumulative effects monitoring. If this is initiated, it would make it easier to manage current land usage. Cumulative effects are defined by the Canadian Environmental Assessment Agency as: "changes to the environment that are caused by an action in combination with other past, present or future human actions." Cumulative effects are usually measured through wildlife monitoring.

Mr. Harlow indicated another challenge facing the ILA is the absence of a land use plan. Land use policy rules and regulations require thresholds for administration and enforcement purposes, this is difficult to accomplish without a land use plan and land use designations.

The presentation also gave an overview of GIS technology. It is a system that organizes data that can be geographic or tabular, it can be layered and/or combined with other data to help with analysis. In terms of a possible ILA cumulative effects GIS model there are some initial assumptions. The ground feature information is very important, which includes vegetation and terrain that would be 'weighted' based on its susceptibility to damage from development. This would be determined by ILA staff. The GIS system would also include development information: fuel, equipment, time of year, size of operation, etc. This would also be weighted based on the impact to the land.

An ILA cumulative effects GIS system would be created through incorporating a GIS grid of Inuvialuit owned lands, the size of the grid squares would depend on the computing power. The grid squares would be assigned a value based on weights. Changes to the value of grid squares would occur as changes to the ground occur. This would require GIS programming to incorporate the new information into existing maps and databases. Some of the challenges associated with this include obtaining the raw data and ground feature information. The major obstacle of obtaining the required data are time and money, the ILA is short staffed, and it does not have the funding.

An ILA GIS system would allow for the analysis of many types of information, and would provide a tool for land administrators to show the 'on the ground' situation. The project phases of creating such a system would be as follows:

1. Data gathering;
2. Model creation; and
3. Technology acquisition and creation.

It was noted that the data gathering stage would be the most time intensive, 75% of the work to develop a GIS system would go into getting good and accurate data. It was thought that it might take a full time staff person 1 year to collect all the required data. The model creation could take place concurrently with the data gathering. Once the data has been compiled and the model has been created, the technology can be obtained to execute the system. This would require specialized computer programming, and possibly the enlistment of outside consultants.

The system would allow for a more efficient land administration, and provide for a useful tool in land use policy creation and rule implementation. The GIS system could also help to manage the impacts of large scale projects such as the Mackenzie Gas Project. The ILA is continually looking to improve its land management capabilities, but it is faced with the challenge of managing a large territory with limited human resources. Innovative technology such as a GIS system could help the ILA meet that challenge.

A participant wondered if the GIS system would truly be a beneficial tool. It was noted that the trick to maintaining its usefulness is by having excellent baseline information. For example, the

ISR has witnessed some recent seismic activity recently, in 5 years these effects on the land will be gone, thus it is important to collect great baseline information to measure cumulative effects. A parameter of the ILA GIS model would be to have it updated yearly.

Mr. Harlow's presentation slides can be found in *Appendix D.*

4.4 Live Demonstration of Existing Systems

Forum participants were invited back to the conference room during the evening of the first day. A number of laptops were set up to allow participants to view and use the existing systems that were presented earlier in the day. Bob Gowan (INAC), and Ward Kilby (Cal Data Ltd.) were present to instruct participants on how to use the information systems. The Mackenzie Valley Granular Data Management Website was popular with the participants as they were able to view first hand how encompassing the program was.

5.0 NWT GRANULAR RESOURCES: EXPERT PANEL

5.1 Expert Panel 3: Supply and Demand Information

On the morning of the second day of the forum, the final expert panel was held. This panel focused on NWT granular resources in terms of supply and demand information. The five questions that were posed to the panel members by the facilitator were:

1. What is done by granular resource users to balance granular demands with existing granular supplies?
2. What is done, by users, to ensure that the information on granular demands is made available to others who may require this information?
3. Who has the responsibility for undertaking granular demand forecasts and monitoring granular material usage to ensure the sustainability of granular resources?
4. What roles do other stakeholders have in ensuring information on granular demands is made available to those who may require this information?
5. Do you consider quality of material in forecasts?

The five panel members included:

- Jack Rowe (Rowe's Construction)
- Bruce Doble (NWT Construction Ltd.)
- Fred Collins (GNWT – Public Works and Services, PWS)
- Arthur Mills (Town of Norman Wells)
- Arnold Martinson (Imperial Oil Resources, Mackenzie Gas Project)

Panel participants were asked to briefly introduce themselves before the discussions began. Each of the five discussion questions were posed by the facilitator, after the question was asked each panel member was given an opportunity to respond. The discussion was then opened to

all forum participants for their questions and input. The suggestions made from those on the panel and participants are summarized in the following tables.

Table 11: What is done by granular resource users to balance granular demands with existing granular supplies?

Jack Rowe (Rowe's Cnst.)	• From our standpoint as a business, the majority of our work is in the South Mackenzie area on through to Inuvik. A lot of the balancing of granular demands is dependent on the granular supply available. This can be difficult as some resources are only accessed on a seasonal basis • A lot of our clientele are only one time users; therefore it is hard to do a lot of forecasting for these types of clients. • We try to eliminate the shortfall of supply be stockpiling the resource. • In short – our demands are balanced by our clients needs, and what we project the demands might be
Bruce Doble (NWT Cnst.)	• NWT Construction in Yellowknife balances granular demands by observing historical usage. How much we used last year becomes our forecast for the following year. • When using mobile plants we search for available pits close to where we are doing the work • In summary we use historical data to forecast for permanent sites, and for new jobs we forecast as a project by project basis.
Fred Collins (GNWT)	• In terms of the GNWT as a user, we would like to ensure sustainability as much as possible with the resource. Especially for capital GNWT projects, we want to ensure that there is enough granular resources left for the community. • The GNWT uses granular demand models as a planning tool. • The GNWT's main priority to balance demands is to ensure that we have the optimum operation, that it doesn't have a negative impact on the supply for the community. • Overall, granular management comes first, we have to ensure that we have all the relevant information for supply and demand.
Arthur Mills (Town Of Norman Wells)	• We are fortunate in Norman Wells that our quarry has been established for 30 years. There are 32 Km of good roads around the town, and the town is the main users of the source. • We produce 10 different materials in our quarry • This current quarry will be sustainable for another 5 to 10 years.

Table 11: What is done by granular resource users to balance granular demands with existing granular supplies?	
Arnold Martinson (Imperial Oil, MGP)	• The MGP is still expecting to be a user, we are in the engineering phase to determine what our demands will be. • The pipeline, backfills, facility requirements and construction infrastructure will all require granular resources. • The pipeline will be 25% of our demand for granular resources. For embankments are looking to use class 3, 4 or 5 quality granular materials. We look to minimize the use of the good quality, 1 and 2 categories. • Facilities will be 25% of our demand, and infrastructure will take the last 50% of granular demands. • The big pads for facilities will be main users, they are meant to be temporary so categories 5 to 2 of granular materials would be adequate for these. • The MGP is investigating numerous borrow sources down the entire Valley to confirm supply potential to then balance supply/demand requirements. • We have also spoken to other major users such as the Department of Transportation, and have adjusted some of our pit locations based on those conversations.

Table 12: What is done, by users, to ensure that the information on granular demands is made available to others who may require this information?	
Arnold Martinson (Imperial Oil, MGP)	• We are now investigating 120 borrow locations. There have been field investigations in cooperation with the Sahtu, Gwich'in, Inuvialuit. The results of these investigations have and will be provided to Bob Gowan at INAC to feed into their internal database. One central location for this information is the best option.

Table 12: What is done, by users, to ensure that the information on granular demands is made available to others who may require this information?	

Jack Rowe (Rowe's Cnst.)	• There needs to be a little more cooperation for this so that information is available to others.
	• There needs to be longer tenures for quarries, and government cost sharing.
	• Our business is governed by supply and demand. We work fairly closely with INAC because they have people in our major areas of operation. They work with us to identify quarry sites.
	• The difficulty with this process is that we cannot develop a one off quarry if it takes a lengthy road to get to it, you will not see a return on your investment. The proximity of granular material is key, if it requires a long haul to get granular resources to a job it will require a substantial investment.
	  o An option to alleviate this difficulty is to have government underwrite the cost of the road.
	  o Tulita for example, is restricted by seasonal access to their granular resource
	• What do these communities do if they need gravel in the middle of the summer? It is beneficial to work with our partners, such as INAC on this.

Bruce Doble (NWT Cnst.)	• The level of demand is governed by the number of projects, whether private, or public. There is no way to speculate. • The tendering stage is so close, you have to wait until you get the project. • Demand is dictated by the number of projects we have.
Fred Collins (GNWT)	• The Department of Public Works has developed a program for granular needs assessments, providing a demand report for all of the NWT communities. • This program forecasts demand and available supply. We do not have a GIS system but it is on hard CD copy or on PDF format. It is available to all stakeholders and communities. • By forecasting demand we will see where we can coordinate with specific communities.

Table 13: Who has the responsibility for undertaking granular demand forecasts and monitoring granular material usage to ensure the sustainability of granular resources?	
Fred Collins (GNWT)	• Each department has a person or group who is doing this on a project by project basis. Overall, the Department of Public Works and Services has responsibility.

Table 13: Who has the responsibility for undertaking granular demand forecasts and monitoring granular material usage to ensure the sustainability of granular resources?	
Bruce Doble (NWT Cnst.)	• Granular forecasts would be the owner or supplier's responsibility. They have to ensure that there is enough supply for the user. It is the responsibility of government to make sure that there is enough of the resource in a particular quarry or pit. • Forecasts can allow the owner or supplier to know how much is left in a pit, and work back the amount of years left to use it.
Jack Rowe (Rowe's Cnst.)	• Currently I don't think anyone has the responsibility. In market economies, private companies do the supply and demand forecasts. • For other communities in the NWT, the responsibility to forecast rests with the GNWT. • The GNWT has the largest reserves in the NWT; they should take on a lot of the responsibility.
Arthur Mills (Town of Norman Wells)	• In Norman Wells, we are the user and owner of the resource, therefore we manage our quarry. The responsibility for forecasting lies with the Public Works Manager.
Arnold Martinson (Imperial Oil, MGP)	• The owner of the source should be responsible for forecasting and monitoring of the resource.
Additional questions / comments from forum participants:	
Have your Forecasts Been Accurate over the Years?	• Bruce Doble (NWT Cnst.): In a controlled environment like Yellowknife, our forecasting has been accurate; in remote areas we have found discrepancies in the forecasts. • Fred Collins (GNWT): The GNWT tries to provide accurate forecasts, but unexpected forecasts could come up in the communities that skew figures. Generally the GNWT is accurate, but resource development projects can upset supply and demand issues. • Jack Rowe (Rowe's Cnst.): Forecasts are generally short-term, this results in ad hoc development of quarries. This is not efficient.
Can the Owner Ensure Accountability; if so are there Mechanisms to do so?	• Fred Collins (GNWT): This gets into site specific issues, and can be addressed in the land permitting issue. If there are concerns on sustainability, constraints can be put into the quarry permit. This forces accountability on the user. • Bruce Doble (NWT Cnst.): Different deposits, whether they be glacial or quarry, have to be approached differently, a site specific approach.

Table 14: What roles do other stakeholders have in ensuring information on granular demands is made available to those who may require this information?	
Fred Collins (GNWT)	• The role is a matter of coordination, a joint venture between the user and other stakeholders that ensures there is a method or planning strategy. • Information should be forwarded in a timely manner, and it should be available in the tender. • Stakeholders are responsible for forward planning.
Bruce Doble (NWT Cnst.)	• There is a need to get supply and demand information to the groups who need this information to bid on a tender/job. The quality of this information is critical
Jack Rowe (Rowe's Cnst.)	• Seasonal and timely access makes this issue critical.
Arnold Martinson (Imperial Oil, MGP)	• The users have to receive the supply information

Table 15: Do you consider quality of material in forecasts?	
Fred Collins (GNWT)	• Absolutely, for GNWT projects specific grades of materials is taken into account especially if you are including concrete, airports, and other specifics for certain projects.
Bruce Doble (NWT Cnst.)	• This is a key consideration for our business. Quality of a material has an impact on cost effectiveness. Some 16mm materials can be dirty and not effective, which can lead to problems with asphalt quality. We ensure that we have the best quality materials, because if we didn't' we wouldn't be in business. • When we do pit investigations we sample the materials. We consciously blend substandard materials to ensure a longer pit life.
Jack Rowe (Rowe's Cnst.)	• Most of our pits are glacial deposits, and quality factors into our forecasts and pit materials. Some pits near Hay River are for different uses such as sand, and gravel. A forecasts is done based on the demand for the specific material. • We use good quality aggregates for quality fills.
Arnold Martinson (Imperial Oil, MGP)	• With the Mackenzie Gas Project, we will work towards using the lowest level of quality needs. We only require high quality granular for topping on one 5-6 km permanent road. • We will work towards using the lowest grade to make sure that high grade remains in the pits.

Table 15: Do you consider quality of material in forecasts?	
Arthur Mills (Town of Norman Wells)	• We have 10 different types of material in our quarry. We try to keep our quarry stocked with quality material and made accessible.
Additional questions / comments from forum participants:	
Does the Panel have any Thoughts on the Establishment of a Central Information Hub, What Information Should be Kept, How should it be Accessed?	• Bruce Doble (NWT Cnst.): Public information is crucial. In other parts of Canada, contractors are provided with information that demonstrates the gradation of certain pits. Information also will demonstrate the historical usage of a particular pit. If information was given to a possible user in the early stages, it could save time in the tendering process. • Jack Rowe (Rowe's Cnst.): The GNWT is the biggest user of quarry materials; it would be beneficial if the Department of Transportation's information inventories were posted so that a possible user would have a sense of what could be extracted from a particular source.
Would a Web Based Demand Model be of any use to Panel Members?	• Bruce Doble (NWT Cnst.): If a user knew where in a pit would give you different types of materials, this could allow for better forecasting. This information would come from bore hole logs. • Arnold Martinson (Imperial Oil, MGP): Any source of information that is easily available has to be an improvement in terms of granular supply issues to engineers. • Jack Rowe (Rowe's Cnst.): Any information on granular supply and demand would be useful.

6.0 GEOTECHNICAL DATA STANDARDS

6.1 Geotechnical Data: Review of Existing Software and Standards

An overview presentation was given by Dr. Murray Fredlund, from Soil Vision Inc. on the various geotechnical data standards in Canada and the NWT and how they relate to granular resources.

The collection of geotechnical data in a digital format has proceeded since the popularization of personal computers in the late 1980's. Unfortunately the software utilized and the data format selected varied significantly between organizations. This difference resulted in chaos when consultants, universities, or governmental organizations tried to exchange geotechnical data. The standardization of geotechnical and geoenvironmental data formats would represent a significant improvement in the practice of geotechnical engineering. Data could be more easily exchanged within and across national boundaries. The standardization would also allow data to be made available and searchable through "web servers" anywhere in the world. Since the setup of the Association of Geotechnical and Geoenvironmental Specialists (AGS) in 1991 there has been a steady effort worldwide to move towards established standards for the exchange of geotechnical data. The first published AGS standard appeared in 1992. The presentation

provided a summary of existing data standards and software support for these formats for the exchange of geotechnical data.

Recently there has been an exchange of data over the web, and a popularization of the XML data format. This new data exchange tool has initiated a revisitation of geotechnical data standards. Soil Vision Systems was retained in February 2006 by INAC to review existing efforts that have been made towards the standardization of the geotechnical data dictionary, to review the status of software programs, and to review the current INAC efforts. There has also been a push recently to update the AGS format to an XML format, this has led to a new standard called AGSML. It is anticipated that the first draft of this AGSML report will be made sometime in 2006.

In the United States there has been a relatively new geotechnical standard developed called the DIGGS standard, this project currently has $643,000 (US) in funding to combine existing American geotechnical data standards. The first version of the DIGGS standard It is due to be published sometime in 2007 and is likely to become the primary international data standard.

The creation of a geotechnical data standard is not an easy task, it requires a significant investment from a number of different organizations as well as reasonable endorsement from the software industry. The presentation provided a plethora of different geological file formats, geotechnical file formats, and GIS mapping file formats. They can be found on the Geotechnical and Geoenvironmental Software Directory (GGSD) at www.ggsd.com.
It was noted that there is a wide range of existing file formats for geotechnical soil data, but the XML standard offers particular benefits in the development of a worldwide geotechnical data standard. This is because it is platform-independent, widely supported and adopted, self describing, and verifiable. If one software application receives an XML file, the file is run through a filter that allows the data to be processed appropriately, it provides a format for general data exchange.

The future for geotechnical data standards might be the DIGGSML, the concept of a global standard has always been desirable. This DIGGSML format has the support from many US governmental organizations and will likely become the new world standard when it is published in 2007. It was noted that the development of a data standard is highly beneficial for software systems. Two case studies were provided from the US Department of Transportation and the California Department of Transportation. The use of geotechnical data for both organizations could better manage their paper records in their massive archives.

There are many similarities between current INAC efforts and existing efforts by other governmental organizations in other countries. It is recommended that consideration should be given to supporting the DIGGS exchange format in the current database design. The DIGGS XML format should provide reasonable avenues for easy submission of new data, and validation of new and existing data. It might be reasonable to review the design of existing INAC databases for borehole data, in situ and laboratory test results in light of the DIGGS format.

A participant noted that in geological mapping, it is difficult to make a standard applicable world wide. The presenter noted that there are issues between geological and geotechnical communities in the use of the term “strata definitions,” and this can prove difficult. It was also

noted that the XML format is self defining, certainly something to keep in mind as we move forward with this technology.

7.0 FACILITATED BRAINSTORMING SESSIONS – GRANULAR INFORMATION ISSUES

Towards the end of the second day of the forum two facilitated brainstorming sessions were held. Forum participants were split up into three facilitated break-out groups to address two main issues. The first brainstorming session focused on information improvements in regards to the NWT granular resource. The second brainstorming session attempted to determine gaps and solutions in accessing granular resource information in the NWT. The suggestions that were formulated were then reported back to the full group and discussed in plenary.

7.1 Brainstorming Session #1 – Information Improvements

Participants, in their break-out groups, were asked to address the three following areas by determining information gaps and potential solutions in the following areas:

- Type of information;
- Quality of information; and
- Geotechnical data standards

The following tables summarize the findings presented by forum participants during the first brainstorming session.

Table 16: Types of Information – Gaps:

Quality of Information	• Data is old, so are the techniques for gathering data. • There is no data standards in the NWT
Inaccurate Information	• Information is inaccurate because depletion records are not compiled or accessible • There are lots of areas where there are no information • There are inaccurate granular demand forecasts. • There should be a compilation of all existing data source – e.g. borehole data
Project specific	• Some data is only collected on a project-specific basis,
Not knowing Users Needs	• There is a gap in not understanding what type of information should be collected, what users need. • Defining information needs for users, i.e. what information do you want suppliers to provide to make life easier for you? ○ This should be uploaded to INAC websites (types, specs, borehole information, etc.)
No Regulatory Coordination	• There is no regulatory coordination between/amongst land owners

Table 16: Types of Information – Gaps:	
No specific Policy	• There is no specific granular resource policy for the NWT
Needs to be a key contact for Granular Resources	• Folks interested in granular resources need a key contact in the GNWT, possibly with the Department of Transportation
Land Tenure / Land Ownership	• There is a lack of clarity in terms of who has land tenure / ownership. Whether it is owned by the municipality, MACA, crown, private, etc. • This should be accurately mapped on a website.
Guidelines for Granular Management Plans	• Guidelines need to be written to describe how Granular Management Plans are created. These should include examples.
No Central Database	• There needs to be a central database that compiles all the relevant information and data • Different users have different systems, a standardized system is required. • Inventory should include quality and quantity • There needs to be buy-in from key players to this database, this should include data users and providers. • It should be user friendly. • List "most up to date" information on website to minimize confusion between sources/standards
Types of Information – Solutions:	
Creation of a Database	• Database needs to be inclusive to private/old data • It doesn't need to be redone, use existing database if possible. • Important to know if a specific deposit has a delineation or not. Deposits should be geo-referenced on a map. • Database should indicate the different options for access to a deposit • Should include historical information on specific sources
Territory-Wide Inventory	• A territory wide inventory should be created including (private/crown/commissioner's land) • Community needs should be taken into account • Should include any large scale project ○ Proposed borrow sites need to be fully assessed • There should be a MOU to enable information to be shared • The inventory should show environmental areas, archaeological site feedback with land use planning to make sure it is integrated. • Inventory should be updated frequently.
Information Sharing	• Land owners to produce their own reports and share with other land owners by using recognized standards.

Table 16: Types of Information – Gaps:	
Joint Ventures	• Joint ventures should be created between contractors, owners and suppliers to increase information awareness in regards to the granular resources. • The creation of an NWT Sand and Gravel Association with annular meetings to brainstorm solutions to major aggregate issues.

Table 17: Quality of Information – Gaps:	
Interpretation of the Data	• There is a critical gap in how specific information is interpreted and the calculations that are used. • This is a matter of quality assurance and quality control. • Confusion over the volumes that are being used.
Lack of Clarity	• There is a lack of clarity in terms of land ownership, rights, priorities, community access, and the community right to develop granular resources for their usage. • Not clearly known who is responsible for the quality of information.
Original Source Data is Inaccurate	• The original source data for granular resources in the NWT is sometimes inaccurate, and can be inconsistent with maps.
Quality of Information – Solutions:	
Creation of Standards	• There should be acceptable standards created for providers and users to increase the quality of information • Probable, proven, and potential degrees of confidence for different criteria.
Accountability	• The land owner should check and confirm the data provided by the proponent
Pit Assessments	• To ensure the quality of information each pit should be assessed, this can be done by looking at historical records.
Gather Known Information	• All known information on granular resources in the NWT should be collected and sent to INAC • Data needs to be refined so that the quality is assured, system needs to be user friendly.
Creation of an NWT Sand and Gravel Association with Website	• An NWT wide Sand and Gravel Association should be created to consult on information issues related to the granular resource. By having a website, the Association could provide helpful information to users
Long Term Forecasting	• There should be a move away from project-driven management to a long term management of the granular resource.
Development Plans for Borrow Sites	• Although costly, a proper development plan should be created for each borrow site vicinity, and someone there to monitor.

Table 18: Geotechnical Data Standards – Gaps:	
Data is in Old Format	• There is an issue for transferring old data, as long as it is accessible, into new standards/format. • Should it be started from scratch? • Is this an ineffective use of funds?
Lack of Coordination	• There is a lack of coordination between agencies in terms of geotechnical data and its format.
Difficulty Accessing INAC Central Repository	• There is a definite gap in geotechnical data standards because not many know how to access the INAC Central Repository
Geotechnical Data Standards – Solutions:	
Format Should be Useful to all Stakeholders	• The format for geotechnical data standards should be in a useful format for all stakeholders • Possibly XML • This will increase reliability an minimize confusion
Require Historical Information	• Historical information for geotechnical data is required for it to be effective.
Quality and Quantity	• The emphasis for geotechnical data should be on both quality and quantity.
Geotechnical Consultants Working with Government	• There needs to be an effective methodology for geotechnical consultants to work with government.
Useable / Functional Data	• It isn't so much of an issue on what kind of standard is used; it just needs to be a standard that is useable/functional and flexible. Data and technology is constantly changing.
Stored in Central Location	• The geotechnical data and standards should be housed in a central location • Data going into a GIS database should have meta-data provided e.g. old boreholes data. This gives the user a 'heads-up'.

7.2 Brainstorming Session #2 – Access to Information

In the second facilitated break-out group, participants were asked to identify the existing systems, and also to determine gaps and correlating solutions in accessing both the INAC existing systems, and other information systems related to granular resource information in the NWT. Participants were given forty-five minutes to discuss these issues in their group. The results from the three break-out groups were then presented in plenary.

The following tables summarize the findings presented by forum participants during the second brainstorming session.

Table 19: Access to Information, Existing Systems – Gaps:	
Existing Systems Include	• The Granular Resource Management Website (Cal Data Inc.) • The Northern Granular Resources Bibliography
No Land Use Planning Information	• It needs to be ensured that the systems will be functional for a long period of time. The systems need to be upgradeable, dynamic and can easily evolve to changing technology and information • Needs to be linkages from the systems to past reports specific to depletion records.
Existing Systems are Deficient of Certain Types of Information	• The systems do not make use of the GNWT Department of Transportation information. • Particle sizes on the systems are not digitized • Legacy data is not digitized • Only some borehole data is included, borehole data from the Mackenzie Valley is not included. • There is a lack of volume data for existing pits/quarries • Systems need to mention upfront if there is a cost associated for usage.
Information on Systems is Dated	• The existing systems need to be updated regularly.
The Northern Granular Resources Bibliography – Hard Copies Only	• The Northern Granular Resources Bibliography, maintained at the University of Calgary is limited because of some of its information is in hard copy only. • There needs to be a searchable PDF database
Systems are not user friendly	• It was noted that the systems are not user friendly, there should be 'keyword searches' on these systems.
Global Warming	• The systems need to take into account the effects of global warming and its impact on granular resources in the NWT.
Translating INAC Systems to French	• The translation of the INAC systems to French hold up the updating of the sites. It should be done faster.
Archaeological Sites	• Needs to be a layer on the systems that gives the location of known archaeological and culturally sensitive sites.

Table 19: Access to Information, Existing Systems – Gaps: Access to Information, Existing Systems – Solutions:	
Easily and Publicly Accessible	• The systems should be publicly available, and web based. • They need to be user-friendly. Too many choices effects usability. • The systems need to be accessible in remote communities, thus, the systems should be designed with low-band width, so that they can be accessed from a dial-up connection. • The systems should act as a central repository of information for those who are interested in granular resource information in the NWT. • The Arctic Institute at the University of Calgary might be a suitable host for these systems. • There should be different levels of access for the different types of users. For instance, some users would have 'upload' capabilities. • Should include an interface that allows users to search for different grade types of the granular resource in the NWT. • Links on the INAC systems need to be articulate and accurate.
Reliable and Consistent Information	• The systems needs to present reliable and consistent information. • Information on granular resources in the NWT is only functional if it is being regularly updated. • The systems should provide external links to further information, such as reports and information on permafrost conditions. • The systems should have information on the regulatory and permitting processes. • It needs to have 3D models of borrow sites so that land managers could have a better idea on where to direct users.
The Existing Systems Should Include Information on the Following	• They should show active granular pit/quarry permits. The systems should also demonstrate the status of the permits, with links to the Land and Water boards. • Systems should include granular forecasting reports. • Information on best practices for: granular exploration, extraction, application for permitting. • They should include the various requirements for granular usage in the different regions of the NWT. • Should make use of 'themed' maps. • If there is legal permission, Mackenzie Valley borehole information should be retrieved from the Geological Survey of Canada
Public Awareness	• Not many know about the INAC systems, there should be increased public awareness, especially with granular users, developer, etc. • Use of a newsletter with monthly updates could be used to increase awareness. This could communicate to folks the use and existence of these systems. • INAC should also follow-up with those in the NWT who are interested in granular resource information when their 'proto-type' system is complete.
Downloads from Systems	• Users should be able to export or download the raw data from these systems.

Table 19: Access to Information, Existing Systems – Gaps:	
Reporting and Data Standards	• Standards for reporting should be implemented to assure consistency. • Data submission to these systems should also be standardized, and in web form. • NWT Stakeholders with an interest in granular resource information should work together to coordinate the data that is submitted.
Make Use of Air-photo Surveys	• The INAC systems should make use of air-photo surveys to track the quantity of depletion of pits and quarries. • This will also allow INAC to track what sources have been used recently.

Table 20: Access to Information, Other Systems – Gaps:	
Existing Systems Include	• The GNWT Data Warehouse • The NWT Cumulative Effects Assessment and Management Database • The GNWT Department of Transportation Land Use Data • Aurora College Database • Historical knowledge of NWT consultants. • One-on-one interviews with inspectors, land managers, community members • Hunters and Trappers Associations • Municipal Government contacts • MACA capital project information.
INAC to Take the Lead in Coordinating Granular Information	• It was noted that INAC should take the leadership and champion role in holding and/or coordinating the granular resource information in the NWT.
Little Public Awareness of the Location of 'Other Systems'	• It was noted that if there are other systems, they are not easy to find, or they are not advertised adequately. • The INAC systems should provide external links to other systems.
The GNWT Department of Transportation's Information	• DOT is a significant source of information in terms of granular resources in the NWT. • It should be explored on how to make their database information shared with existing INAC systems.
Use of Hard Copies	• A lot of the 'other systems' make use of hard copy reports and information. This creates a problem for users to access the information remotely.
Logging In to Other Systems	• Remember passwords to log into the other systems is tedious, there are too many to remember. There should be true freedom in accessing the information.

Table 20: Access to Information, Other Systems – Gaps:	
Hard to Print and Access Maps	• In terms of the other systems, it is hard to access and print off reliable maps to help workers in the field determine where granular resources are situated. • When requesting hard copy maps from these other systems, they take too long to arrive, they need to be received in 2-3 business days.
Access to Information, Other Existing Systems – Solutions:	
Easily and Publicly Accessible	• The systems should be publicly available, and web based. • The systems should act as a central repository of information for those who are interested in granular resource information in the NWT.
Reliable and Consistent Information	• The systems needs to present reliable and consistent information. • Information on granular resources in the NWT is only functional if it is being regularly updated. • The systems should provide external links to further information, such as reports and information on permafrost conditions. • The systems should have information on the regulatory and permitting processes. • It needs to have 3D models of borrow sites so that land managers could have a better idea on where to direct users.
The Existing Systems Should Include Information on the Following	• They should show active granular pit/quarry permits. The systems should also demonstrate the status of the permits, with links to the Land and Water boards. • Systems should include granular forecasting reports. • Information on best practices for: granular exploration, extraction, application for permitting. • They should include the various requirements for granular usage in the different regions of the NWT.
	• Joint ventures should be created between contractors, owners and suppliers to increase information awareness in regards to the granular resources. • The creation of an NWT Sand and Gravel Association with annual meetings to brainstorm solutions to major aggregate issues.

8.0 NEXT STEPS AND A WAY FORWARD

To conclude the NWT Granular Users Forum a facilitated discussion on next steps and a way forward was held. Participants were asked to provide their recommendations for a future strategic direction in terms of what is needed to improve the current NWT granular resource information, and also to improve the access to this information.

Based on these discussions, it is possible to identify a number of key strategic directions or themes, for future improvements to the current state of NWT granular resource information, and the accessibility to this information.

1) The Development of an Aggregate Users Association

- This association should include representatives from all groups in the NWT that deal with the granular resources these could include, but not limited to: the contracting and private spheres, government, consultants and granular users.
- The membership for such an Association could possibly be the invitees to the NWT Granular Users Forum (2006).
- Commitment would be needed from representatives
- The Association could designate the criteria to determine the data and reporting formats used for granular information in the NWT (e.g. DIGGS, XML). The Association could get direction on this initiative from the University of Florida as the University has created these criteria for data and reporting formats in the past.

2) Creation of an Aggregate Users Association Sub-Committee to Locate Existing NWT Granular Resource Information

- The sub-committee would initiate a review process to locate all existing NWT granular resource information.

3) Creation of a Website that acts as a "Clearing House" for Granular Information

- The website should be functional and user friendly.
- This clearing house style website should include NWT granular information from all the various sources.
- Information from the Arctic Institute at the University of Calgary should be included in this website.
- Website should offer a chat room and/or a blog for granular users, and interested organizations.
- One function of the Website could be the use of a tracking system to monitor the use of the granular resource in the NWT. The system could also track where the royalties from the granular resources are going.

4) Development of a Course or Program at Aurora College Dealing with Granular Management

- From a long term perspective, it would be beneficial to have a course or program at Aurora College that dealt with granular management.
- It should be a component of the Lands Management Program at Aurora College.

5) Creation of Guidelines and Criteria for Obtaining Granular Resources in the NWT

- Guidelines should be created that provide boundaries for the use of the granular resources in the NWT.
- The guidelines could address pit reclamation plans and fees, and access fees that would be specific to the NWT.
- There needs to be a 'cradle to the grave' process to manage the granular resource.

6) Evaluate Scope and Cost of Digitizing Legacy Data

- The first step would be to have the legacy data put into PDF format
- The second step would be to assess how much of the data is in non-depleted areas. This assessment would provide specific digitized locations in the NWT.
- It would need to be specified whether the particular data was 'digital' (spatial) or PDF format (reproduction).

APPENDIX A: WORKSHOP PURPOSE/OBJECTIVES AND AGENDA

INDIAN AND NORTHERN AFFAIRS CANADA

NWT GRANULAR USERS FORUM

Date: September 27 and 28, 2006
YELLOWKNIFE, Katimavik A Explorer Hotel

DRAFT AGENDA OUTLINE

Purpose: To provide an opportunity for interested parties to meet in an open forum to discuss issues related to accessing information on the identification, development and use of granular resources in the NWT.

Objectives:

- To discuss potential actions for improving the quality and quantity of information on NWT granular resources;
- To discuss potential actions for improving access to available information on NWT granular resources; and,
- To discuss management planning techniques to ensure the sustainability of the granular resource

Day One – Granular Resource Management Issues and Information Systems		
Time	**Agenda Item**	**Lead**
8:00 – 8:30 a.m.	***Registration/Morning Refreshments***	
8:30 – 8:45 a.m.	***1. Opening Remarks*** • *Welcome and introductions* • Review purpose and objectives of forum • Review agenda	**B. Gowan, INAC Terriplan**
8:45 – 10:00 a.m.	***2. Granular Resource Management – Canadian Examples*** Who "owns" the granular resources? How are granular resources managed? How is information on inventories and demand forecasts made available to the general public?	**Doug Vanderveer (AggMapR Inc.)**
10:00 – 10:15 a.m.	***Health Break***	
10:15 – 11:00 p.m.	***3. Geotechnical Consultants and Granular Resource Management*** A presentation on the role of geotechnical consultants in granular resource identification, exploration and evaluation	**Ed Hoeve, EBA Engineering Consultants**

Day One – Granular Resource Management Issues and Information Systems		
Time	**Agenda Item**	**Lead**
11:00 - 12:00 p.m.	***4. Granular Resource Management – NWT Overview*** Who "owns" the granular resources? How are granular resources managed? How is information on inventories and demand forecasts made available to the general public? Why do we need to manage the resource? What can we do to ensure sustainability of granular resources?	**Expert Panel**
12:00 – 1:00 p.m.	***Catered Lunch***	
1:00 – 2:15 p.m.	***5. Granular Resource Management – Planning*** What groups have main responsibility for granular resources management in the NWT? What efforts have individual organizations or groups made to develop local, regional or territorial granular management plans? What are the benefits, risks and challenges associated with the development of granular resource management plans? What information requirements are involved in developing and communicating such plans? Resource document to be distributed to participants detailing the various NWT regulators and their role.	**Expert Panel**
2:15 – 2: 45 p.m.	6. GIS Systems Presentation • An overview of GIS systems and how they relate to granular resource management in the NWT.	**B. Gowan (INAC)**
2:45 – 3:00 p.m.	Health Break	
3:00 – 4:00 p.m.	***7. Granular Resource Information – Existing Systems*** Overview of existing systems	**B. Gowan (INAC)** **Ward Kilby (Cal Data Ltd.) and others**
4:00 – 4:45 p.m.	***8. Hospitality Suite / Live Demo of Existing Systems*** Presentation of several working systems	**B. Gowan (INAC)** **Ward Kilby (Cal Data Ltd.) and others**
4:45 – 5:00 p.m.	***9. Wrap-up*** • Summary of the first day • Overview of day 2	**B. Gowan (INAC)** **Terriplan**

Day One – Granular Resource Management Issues and Information Systems		
Time	**Agenda Item**	**Lead**
6:30 – 8:00 p.m.	***10. "Hands-on" Demo of Existing Systems*** Opportunity for Forum participants to test the demonstration systems presented earlier	**All**

Day Two – Improving Granular Resource Information and Systems		
Time	**Agenda Item**	**Lead**
8:30 – 9:00 a.m.	***11. Opening Comments*** Recap of Day 1 proceedings Review of Day 2 agenda	**B. Gowan (INAC)** **Terriplan**
9:00 – 10:00 a.m.	***12. NWT Granular Resources – Supply and Demand Information*** • What is done by granular resource users to balance granular demands with existing granular supplies? • What is done, by users, to ensure that the information on granular demands is made available to others who may require this information? • Who has responsibility for undertaking granular demand forecasts and monitoring granular material usage to ensure the sustainability of granular resources? • What roles do other stakeholders have in ensuring information on granular demands is made available to those who may require this information?	**Expert Panel**
10:00 – 10:15 a.m.	***Health Break***	
10:15 - 11:00 a.m.	***13. Geotechnical Data Standards*** An overview presentation on the various geotechnical data standards in Canada and the NWT and how they relate to granular resources	**Dr. Murray Fredlund (Soil Vision Inc.)**
11:00 – 12:00 a.m.	***14. NWT Granular Resources – Information Improvements*** Breakout brainstorming sessions to determine Information gaps and potential solutions in the following areas; Type of information Quality of information Geotechnical data standards	**All**
12:00 – 12:15 p.m.	***15. Report Back in Plenary*** Results from the brainstorming session on information gaps and potential solutions will be reported back to the larger group.	**All**
12:15 – 1:15 p.m.	***Catered Lunch***	
1:15 – 2:15 p.m.	***16. NWT Granular Resources – Access to Information*** Breakout brainstorming sessions to determine gaps and solutions in accessing: INAC existing systems Other systems Participants will breakout into small groups to brainstorm	**All**

Day Two – Improving Granular Resource Information and Systems		
Time	**Agenda Item**	**Lead**
	ideas regarding access to information improvements; results will then be presented in plenary	
2:15 – 2:45 p.m.	17. Report Back in Plenary • Results from the brainstorming session on gaps and solutions to accessing INAC existing systems and others will be reported back to the larger group.	**All**
2:45 – 3:00 p.m.	Health Break	
3:00 – 4:00 p.m.	***18. Next Steps*** Participants to determine where to go from here, specifically: What next steps are needed to begin creating improvements to the information available; and, What next steps are needed to begin creating improvements in accessing information	**All**

APPENDIX B: LIST OF FORUM PARTICIPANTS

Name		Affiliation	Phone	E-mail
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APPENDIX C: FLIP CHART NOTES

Breakout Group #1
Shena Shaw

Types of Information

Gaps
- Quality (data is old), techniques from original notes, they looked at different things
- Accuracy is off because depletion records are not compiled/accessible
- Lots of areas where there is no information
- Data is collected on project-specific
- Gap in understanding what type of information (what users need)
- Accurate Granular demand forecast

Solutions
- Database – B. Gowan
  - Needs to be inclusive of private/old data
  - Don't need to redo it
- Problem is funding $$
- Territory-wide inventory (private/crown/commissioner)
  - Community needs
  - Any large scale project
    - Proposed borrow sites need to be fully assessed
  - MOU
    - Enables information to be shared
  - Database
    - Show enviro areas, archaeology site feedback with LU Planning to make sure there is discussion so it is integrated
    - Database needs to be updated a conditions change

Quality of Data

Gaps

(1) Interpretation of data
- Calculations that are used – QA/QC

Solution
- Someone (land owner) should check/confirm the data provided by the prop
- Proper development plan for each borrow Site Vicinity someone would need to be there - *ideal $$$
- Probable, proven, potential degrees of confidence for different criteria
- Assess each pit (past records – no grades, just volume)
- Depends o the size of need
- Forecasting – long-term

    - Economic predictions
        - What is coming up next

- Transects
- Satellite imagery
- Ground truthing
- Classifying materials

being done but now project-driven

Move away from project-driven to management of the resource

Geotech Data Standards

Gaps

- Not useful unless the boreholes are there
- Standard site description forms
- Review of existing information
- Make sure the format is useful for all stakeholders – XML
- What will it cost??? $$$
    - How will we all conform if it is expensive
- Templates
    - Could be as simple as excel
- Issue of transferring to old (as long as it is accessible) format to the new standards
    - Do we start from scratch
    - Ineffective use of funds?

Breakout Group #1
Joe Sterritt

Types of Information

Gaps

- No central database
- No regulatory coordination between/amongst land owners
- No specific Granular Resource Policy for NWT
- Need for Sand and Gravel Association in the NWT; with annual meetings
    - To brainstorm solutions in terms of aggregate issues in major projects
- Not data standards

Solutions

- Have to know if the deposit has a delineation or not, of some sort. Geo-referenced on a map
- Need to know land location of deposits, and access – different options for access
    - Is it winter access, etc, systemic line information
- Need to know exploration data
- Need to have historical information on specific sources
- Land owners to produce their own reports, and share with other land owners by using recognized standards
- Joint ventures between contractor, owner and supplier

Quality of Information

Gaps
- Need to have a vision for communities
- No one knows what is being used
- Lack of clarity in terms of ownership, rights, priorities, community access, community rights to develop for their use
    - Rights of individuals within the community to develop a business operation
- Who is responsible?
- History of use
- Confusion over volumes that are being used
- Project cycle information

Solutions
- NWT Sand and Gravel Association with website

Geotechnical Data Standards

Gaps
- Coordination between agencies
- Need historic information
- Emphasis should be on quality, and quantity
- Methodology for Geo-tech Consultants to work with Government

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Breakout Group #1
Joe Pittari

Types of Information

Gaps
- Who is GNWT contact when in need of information? (e.g. key contact in DOJ)
- Go back to GNWT for this
- Different users with different systems - need standardized system – allows you to pull the data you need
- Issue of buy-in from key players. (Data providers – data + users) Make site user friendly
- Guidelines for creating Granular Management Plans with examples – completed one format
- Defining information needs for users "i.e. what information do you want suppliers to provide to make life easier for you?" – upload to INAC website (types, specs, borehole information, etc.)
- Need accurate granular information
    - Compilation of all existing data sources – accurate logs, e.g. Boreholes
- Inventory containing quality and quantity
- List "most up to date" information on website to minimize confusion between sources/standards
- Land tenure/land ownership
    - Lack of clarity currently (municipality, MACA, Crown, private) – increases clarity

- Accurate map on website

Quality of Information

Gaps/Solutions

- Acceptable standards for providers and users
- Consistency and certainty to assist with planning efforts
- Step #1 – gather known information but who do we send it to?
  - DIAND website with disclaimer
- Original source data is not consistent sometimes with maps
- Old data should also be submitted to DIAND website
- Data needs to be refined by all udders – intent is to make it better for everyone – system needs to be user friendly

Geotechnical Data Standards

What are the Gaps/Solutions?

- Access to website – DIAND – central repository
- Don't care what standard is – we need a standard that is useable/functional and flexible – data and technology is always changing
- Central location – easy access
- Standards for data collection to increase reliability and minimize confusion (e.g. location of Boreholes)
  - Getting better – new ones are OK – 1960's and 70's stuff is not so good
- Data going into a GIS/database should have meta-data provided – e.g. old Boreholes data
  - Gives user a "heads up"

Breakout Group #2
Shena Shaw

Access to Information

(1) INAC existing

Gaps – no Land Use Planning information

- Ensuring that the system is going to be around – upgradable can evolve
  - Dynamic
- EC layer – linkages, to report?
  - Specific to depletion (dynamic)
- Global warming
  - Will it impact granular resource
- Archaeological sites
- Layers – sensitive sites

INAC Existing

- Web based
- Central place for someone to go if there are problems downloading

- CD made of index/Table of Contents
- Accessible to everyone
- Central repository
- Arctic Institute may be a good host
- Different level of access for different types of users
- Some people would have "upload" capabilities
    - Open your system
- 3D models of borrow sites so land managers can tell people where to take from
- All systems need to be consistent
- Information is only good if people are updating
- Links for further information – i.e. permafrost
- Regulatory information permitting process

INAC Systems

- Show active permits
- Status of permits – links to LWBs
- Forecasting reports should be on the website
- Joint application
- Best practices
- Requirements for the area
- User interface
    - Put in what grade and where and the matching sites pop-up
- Updating is key

Other Systems

- GNWT Data Warehouse CEAM
    - (DOT) deals with land use data
    - Potential source of information
    - needs to be investigated
- One-on-one interviews with inspectors, land mangers, community members
- HTCs (hunters/trappers)
- Community corps
    - Municipal government contacts
- MACA capital projects
- Information should be in the Site

Breakout Group #2
Joe Sterrit

Access to Information
INAC Existing Systems
Gaps/Solutions

Existing

- NGRB
- Granular Resource Management website (Cal Data)

Gaps
- DOT information not totally represented on INAC website
- Particle sizes not digitized
- Only some borehole data is included on website
- Digitization of legacy data
- Lack of volume data for existing pits
- Survey, air-photos, quantity/depletion
- Problem of getting information into the system
- System should have "themed" maps
- Too many choices, effects usability
- Accessibility in remote communities, internet speed, etc. band width limitations

Solutions
- The system should be more user friendly, themed maps
- Minimizing the options of the database, keep it simple
- Level of reporting
- Implement standards for reporting
- Mackenzie Valley. Borehole data is not included
- If there is legal permission, retrieve Mackenzie Valley information from GSC
- Data exporting, downloading the data
- Capability of downloading raw data
- To have all stakeholders together to coordinate the data
- Data submission should be standardized, web form
- To be able to determine what source has been used
    - DIAND gets recent air photos

Information Database
Other Systems
- Possibly: Aurora College, GNWT libraries, historical knowledge of consultants

Gaps
- They are hard copy reports, no indexing
- These are no other systems
- Look at Mackenzie Valley Land and Water Board website for ideas

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Breakout Group #2
Joe Pittari

Access to Information
INAC Existing Systems
Gaps/Solutions

Arctic Institute stuff is all hard copy
- Working towards searchable PDF database of hardcopy files
- Need for Awareness with Developers
    - Newsletter? (electronic) monthly updates

- One pager as part of application process that communicates use/existence of INAC system – includes identification of land type (private, commissioner's,. crown)
- Not user friendly
    - Define keywords for searches
- If cost associated – say this upfront
- Issue of dated information
    - Need to update regularly
- Difficult to critique without testing it
    - Tell INAC of other site that provide useful data, format, etc.
- Follow-up with group when proto-type is complete – pilot test

Other Systems

Gaps/Solutions

- Not sure where they are?
    - Advertise their existence
    - Link from INAC site
- Hard to print maps to take into field
    - Geological survey has some solutions – "Go and Print here when in Norman Well"
- Issue of timing when requesting information/maps – only have 30 days
    - Identify locations for printing, or mail-out but must be received within 2-3 business days
- Log-in/Log-out – too many IDs and Passwords to remember
    - True freedom of access to information
- "Look & Feel" – Government is restricted here – use links BUP
    - Links need to be articulate and accurate
- Timing for translation into French – this holds up "updating of site"
    - Do it faster Bob
- Make sure it is stereo air photos are still required
    - Landsat has not replaced
    - Best is _____superimposed on stereo our photos

Other Stuff

(1) Index of where data is available – no need to update it
    - Minimize replication of effort and money

(2) Ease of access

(3) Regular updates of information (availability of electronic versions of old hard copy files)

(4) INAC to take a leadership role and champion the holding/coordination of information

Next Steps

(1) Create a "Group" of aggregate users with people from all sides – government, contractors, private, consultants
    - See invite list – this is Group – need for commitment

(2) Set up a website "clearing house" for people to use

(3) Continue to integrate Arctic Institute information

(4) Longer term – work with Aurora College to create a Granular Lands Management Education
(5) Chat room/BLOG for users/group
    - sub-committee
(6) Standardize Data and Reporting Systems/Templates – need to establish criteria or decide on a format to use, e.g. DIGGS, XML
(7) Build in a review process to evaluate where existing data is at
    - sub-committee
(8) Determine a way to track "use" – link to established data standards/templates
(9) Guidelines, criteria for obtaining gravel?
    - Where are royalties going – part of tracking mechanism (e.g. AB, ON)
    - Reclamation fees, access fees – specific to NWT
    - Most pits require reclamation plan
        - Need for compliance – need a "cradle to grave" process to manage resource
(10) Evaluate scope and cost of digitizing legacy data
    - Step 1 – pdf and searchable
    - Step 2 – which are part of depleted areas – location focus
    - Specify whether "digital data" (spatial) and "electronic information" – pdf format (reproduction)
(11) Research – recycling after a project

APPENDIX D: FORUM PRESENTATIONS

Northern Granular Resources Information Users' Forum

Welcome from
Indian and Northern Affairs Canada

Robert J. (Bob) Gowan
Manager, Land Programs
Land and Water Management Directorate
Indian and Northern Affairs Canada
Gatineau, QC
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Background

- NOGAP Workshop – 1993
  - Already lots of information
  - Limited accessibility to information
  - "what we need is a project"

The Interim

- Has anything changed ?
- What has been done ?
- Who is doing what ?
- Have needs and priorities changed?

Why are we here today?

- We have a project !!
  - Subject to environmental & regulatory approvals
- Examples of co-operation
- Advances in information technologies

Welcome,

and thanks for your participation

Indian and Northern Affairs Canada | Affaires indiennes et du Nord Canada

Granular Resource Management in Canada

AN OVERVIEW OF GRANULAR RESOURCE MANAGEMENT IN CANADIAN PROVINCES

By

Doug Vanderveer and Tim Hayward
AggMapR Inc.

Sept. 27, 2006

Granular Resource Management in Canada

Presentation Overview

1. What are Aggregates
   - Legislation
   - Terminology
   - Commonly used Terms
   - Sampling of Legislation
2. Geological Mapping of Aggregates
3. Aggregate Production
4. Websites

Granular Resource Management in Canada

Provinces and Territories of Canada

Granular Resource Management in Canada

WHAT ARE AGGREGATES

- Terminology is derived from:
  - Legislation (Legal Definitions)
  - Geological and Mapping
  - Statistical Summaries
- Other Commonly Used Terms

Granular Resource Management in Canada

WHAT ARE AGGREGATES

- Terminology Used in Legislation
  - Mineral Aggregates
  - Quarry Materials
  - Quarriable Substances
  - Quarry Mineral
  - Beach Materials
  - Sand, Gravel and Rock

Granular Resource Management in Canada

WHAT ARE AGGREGATES

- Terminology Used in Mapping
  - Sand, Gravel, Clay etc.
  - Fluvial, Glaciofluvial, Outwash, Lacustrine, Beach strand
  - Bedrock (limestone, shale etc.)
  - Aggregates / Aggregate Materials
  - Granular Resources

WHAT ARE AGGREGATES

- Terminology Used in Statistic Updates
- In Federal Compilations (Stats Can.)
  - Construction Materials
    - Sand and gravel
    - Stone (limestone, shale)
    - Cement

Granular Resource Management in Canada

WHAT ARE AGGREGATES

- Most commonly used terms:
  - Aggregate or Aggregates
  - Beach Material / Beach Aggregate
  - Granular Resource
  - Mineral Aggregate
  - Sand and Gravel / Bedrock Resource

List in Alphabetical order

Granular Resource Management in Canada

Sampling of Legislation Definitions

Newfoundland:

Extraction of Mineral Aggregates are administered under the Quarry Materials Act

"Quarry Material" means: a substance used in its natural form for civil construction or agricultural purposes and includes clay, sand, gravel, rock, soil, peat and slag

But does not include slate, marble, granite and similar stone used as dimension stone

Where :

(a) slate, marble, granite or other similar stone used as dimension stone; and

(b) dolomite, limestone, silica and other similar product

is mined or quarried under a lease issued under the Mineral Act.

In Labrador quarry material includes: a mineral rock or stone capable of being cut or polished for use as an ornament, personal adornment or decoration.

Granular Resource Management in Canada

Sampling of Legislation Definitions

Nova Scotia

Mineral" means a natural solid inorganic or fossilized organic substance and a substance prescribed to be a mineral, but does not include:

- (i) ordinary stone, building stone or construction stone,
- (ii) sand, gravel, peat, peat moss or ordinary soil,
- (iii) gypsum,
- (iv) limestone, except that which is vested in the Crown, and
- (v) oil or natural gas

Mineral Resources Act: All Minerals are deemed reserved to the Crown in all grants post April 1910

A few deposits of the latter commodity have specifically been declared a mineral under the Act.

Otherwise the rights to most gypsum and limestone and all stone, sand, gravel, peat and soil are attached to the ownership of the surface (private or Crown) and are administered under other statutes.

Granular Resource Management in Canada

Sampling of Legislation Definitions

Nova Scotia

Crown Lands - Inland Aggregate Removal Permits:

1. Less than 5,000 cubic metres, or 7,000 metric tonnes:
   Anyone who wants to remove, for commercial sale , inland aggregate (fill, gravel, class 'A' gravel, sand, riprap stone, armour stone and marble chips) requires a permit
2. More than 5,000 cubic metres, or 7,000 metric tonnes:
   Anyone who wants to remove, for commercial sale, more than 5,000 cubic metres, or 7,000 metric tonnes, of inland aggregate (fill, gravel, class 'A' gravel, sand, riprap stone, armour stone, and marble ships) from Crown Lands in Nova Scotia.

Beach Aggregate Permit:

3. Anyone who wants to remove not more than 10 cubic yards (7.6 cubic metres) of aggregate (gravel, sand, armour stone, and riprap stone) from a beach.

Granular Resource Management in Canada

Sampling of Legislation Definitions

Prince Edward Island

Mineral Act:

- "Mineral" means any natural solid inorganic or fossilized organic substance and such other substance as is declared to be a mineral under section 3, but does not include:
  (i) ordinary stone, building or construction stone,
  (ii) sand, gravel, peat, peat moss or ordinary soil,
  (iii) gypsum or limestone,
  (iv) oil or natural gas, or
  (v) bituminous shale, oil shale or intimately associated products or substances derived therefrom;

Environmental Protection Act: Excavation Pit Regulations

- A system for tracking & regulating the establishment and operation of excavation pits to obtain sand, gravel, stone, shale, etc.
- It is necessary to submit an application to open or operate an excavation pit.

Granular Resource Management in Canada

Sampling of Legislation Definitions

New Brunswick

Quarry Substances Act:

- **"Quarriable substance" means ordinary stone, building or construction stone, sand, gravel, peat, clay and soil;**
- **"Quarry" means a pit or excavation in the ground created by the removal or taking of a "quarriable substance" from it and includes the works, machinery, plant, buildings and premises located below and above ground used in connection with the quarry**
- **The Lieutenant-Governor in Council may, by regulation, designate a shore area lying outside Crown Lands to be subject to this Act.**
- **No person shall remove or take a "quarriable substance" from a shore area designated under subsection (1) unless the person has been issued a quarry permit.**

***Mineral Act*: does not include:**

(a) **sand, gravel, ordinary stone, clay or soil unless it is to be used for its chemical or special physical properties, or both, or where it is taken for contained minerals,**

(b) **ordinary stone used for building or construction,**

(c) **peat, peat moss, bituminous materials, oil or natural gas etc.**

Granular Resource Management in Canada

Sampling of Legislation Definitions

Quebec

***Mining Act*:**

"minerals" or "mineral substances" mean: all natural solid, liquid or gaseous mineral substances, and all fossilized organic matter

"mine": any opening or excavation made for the purpose of discovering or obtaining any mineral substance … or of any industrial product or residue, including a quarry, a sand-pit or a well …and the ways, works, machinery, mills, buildings and furnaces below or above the surface of lands which form part of a mining operation;

- **After the 1st of January 1921, all minerals shall belong to the Crown under the soil of land which, on the 24th of July 1880, had not yet been patented except for on land that all the conditions of the location ticket land had been fulfilled on the 24th of July 1880.**
- **On lands granted or alienated by the Crown after the 1st of January 1966, otherwise than by mining concession or mining lease, mineral rights other than those of the tilth are reserved to the Crown.**

Granular Resource Management in Canada

Sampling of Legislation Definitions

Ontario:

The Aggregate Resources Act and its regulations apply to the excavation of:

- **All aggregate and topsoil on Crown land and all Crown-owned aggregate;**
- **All aggregate from land under natural water bodies; and**
- **All aggregate on private land in designated areas of the province.**

'Aggregate' is defined as: gravel, sand, clay, earth, shale, stone, limestone, dolostone, sandstone, marble, granite, and rock .

'Rock' does not include metallic ores, andalusite, asbestos, barite, coal, diamond, graphite, gypsum, kaolin, kyanite, lepidolite, magnesite, mica, nepheline syenite, petalite, phosphate rock, salt, sillimanite, spodumene, talc, or wollastonite.

Mining Act: Underground aggregate mining and materials are exempted from the definition of 'rock' and are regulated by the Ministry of Northern Development and Mines under the Mining Act.

Granular Resource Management in Canada

Sampling of Legislation Definitions

Manitoba:

The Mines and Minerals Act

- **"aggregate" means a quarry mineral that is used solely for construction purposes or as a constituent of concrete other than in the manufacture of cement and includes sand, gravel, clay, crushed stone and crushed rock**
- **"aggregate quarry" means a quarry from which aggregate is produced**
- **"quarry mineral" means a mineral, other than a diamond, ruby, sapphire or emerald, that is obtained from a quarry, and includes:**
  - **(a) sand, gravel, clay, shale, kaolin, bentonite, gypsum, salt, peat, peat moss, coal and amber,**
  - **(b) rock or stone that is used for a purpose other than as a source of metal, metalloid or asbestos, and**
  - **(c) a mineral that is prescribed as a quarry mineral.**
- **"mineral access rights" means, in respect of a lease or mineral disposition, the right to enter, use and occupy the surface of land to prospect or explore for or develop, mine and produce minerals, but does not include surface rights**

Granular Resource Management in Canada

Sampling of Legislation Definitions

Saskatchewan:

Sand and Gravel Ownership: The owner of the surface of any land is and shall be deemed to have always been the owner of and entitled to all sand and gravel on the surface of the land and all sand and gravel obtainable by stripping off the overburden, excavating from the surface or other surface operation.

The Quarrying Regulations, 1957

- **Regulations under *The Mineral Resources Act* that Govern the disposal of quarriable substances on Crown Property**
- **These regulations shall be construed with reference to the terms and**
- **interpretation of The Mineral Resources Act and The Sand and Gravel Act as they are amended from time to time.**

"Quarriable Substance" means any mineral substance, the property of the Crown in the right of Saskatchewan, which is capable of being quarried and includes bentonite, building stone, clay, granite, gravel, gypsum, limestone, marble, marl, sand, slate, volcanic ash, and any other substance which may from time to time be declared by the Lieutenant Governor in Council to be a "quarriable substance" within the meaning of these regulations.

Granular Resource Management in Canada

Sampling of Legislation Definitions

Alberta:

- **"mine" means any opening or excavation in, or working of, the surface or subsurface for the purpose of working, recovering, opening up or proving any mineral or mineral-bearing substance, and includes works and machinery at or below the surface belonging to or used in connection with the mine;**
- **minerals" means all naturally occurring minerals including:**

  (i) gold, silver, uranium, platinum, pitchblende, radium, precious stones, copper, iron, tin, zinc, asbestos, salts, sulphur, petroleum, oil, asphalt, bituminous sands, oil sands, natural gas, coal, anhydrite, barite, bauxite, bentonite, diatomite, dolomite, epsomite, granite, gypsum, limestone, marble, mica, mirabilite, potash, quartz rock, rock phosphate, sandstone, serpentine, shale, slate, talc, thenardite, trona, volcanic ash, sand, gravel, clay and marl, but does not include:

  (ii) sand and gravel, clay and marl that belong to the owner of the surface of land under section 57, 58 of the *Law of Property Act*, or peat on the surface of land and peat obtained by stripping off the overburden, excavating from the surface, or otherwise recovered by surface operations.

Granular Resource Management in Canada

Sampling of Legislation Definitions

British Columbia:

Mines Act

- **Pits and quarries are defined as mines and are regulated under the *Mines Act*.**
- **"mine" includes: a place where mechanical disturbance of the ground or any excavation is made to explore for or to produce coal, mineral bearing substances, placer minerals, rock, limestone, earth, clay, sand or gravel**
- **"mining activity" means any activity related to:**
  - **(a) the exploration and development of a mineral, a placer mineral, coal, sand, gravel or rock, or**
  - **(b) the production of a mineral, a placer mineral, coal, sand, gravel or rock,**
- **and includes the reclamation of a mine**

Granular Resource Management in Canada

Sampling of Legislation Definitions

Inuvialuit:

Ownership of most of the accessible granular deposits in the Western Arctic Region was transferred to the Inuvialuit, under the Inuvialuit Final Agreement [IFA], signed between the Government of Canada and the Inuvialuit in 1984.

Management of this resource is now the responsibility of the Inuvialuit Land Administration [ILA] in consultation with local groups such as the Community Corporations and Hunters and Trappers Associations.

A granular materials project designated as Task 7 - Sand and Gravel Inventories was set up by the Government of Canada to implement the requirements of the IFA and provide for more efficient development of the resource.

The objectives of this project are to determine the 20 year demands for granular material, provide an inventory of potential sources, determine the quality and quantity at the more promising deposits and form a plan for reservation and development of the granular material.

Granular Resource Management in Canada

Sampling of Legislation Definitions

Yukon

Placer Mining Act:

- **"mine" means any natural stratum or bed of earth, soil, gravel, or cement that is mined for gold or other precious minerals or stones;**
- **"mining" or "placer mining" includes every mode and method of working whatever whereby earth, soil, gravel, or cement may be removed, washed, shifted, or refined or otherwise dealt with, for the purpose of obtaining gold or other precious minerals or stones, but does not include the working of rock on the site**
- **Unclear what legislation controls other extraction activities**

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Province of Newfoundland and Labrador

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Newfoundland and Labrador:

- **Surficial Geology Mapping by the GSC late 60's - early 70's**
- **Surficial Mapping by Province began in early 1970's**
  - **Airphoto Landform Classification @1:50,000 scale,**
  - **Ground-truthing (roads, railway, forest access roads and tracks, shorelines)**
  - **Mapping of glacial transport indicators (glacial striae and landform features)**
  - **Sampling of glacial till materials**
- **Aggregate Resource Inventories @1:50,000 scale, started in 1974**
  - **Identification of potential sand and gravel related landforms from Airphoto interpretation or from previous Surficial mapping programs**
  - **Focused on 30km corridor around major urban centres and 3km corridor along all roads and highways on both the island and Labrador**
  - **Sampling of outwash (sand and gravel) and potential bedrock formations**
  - **Sampling from natural or man-made exposures, shallow hand dug or backhoe test pits**
  - **Field Screening (32, 16, 8, 4mm); Petrographic Value (modified ASTM)**
  - **Laboratory 2mm to 0.063mm**

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Newfoundland and Labrador:

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Newfoundland and Labrador:

Geological Survey of Newfoundland and Labrador

110/14

Surficial and glacial geology and gravel resource inventory of southwestern Newfoundland. By D.G. Vanderveer, 1977. 10-page report and 10 maps, including Stephenville-Port aux Basques (12B-11G), Main Gut (12B/6), Flat Bay (12B/7), Little Friars Cove (12B/3), St. Fintans (12B/2), Rose Blanche (11O/10), Port aux Basques (11O/11), and Codroy (11O/14). NFLD/0959

Aggregate Geology

Inventory of aggregate resources in Newfoundland and Labrador, by F.T. Kirby, R.J. Ricketts and D.G. Vanderveer. Scale 1:250,000. Nfld. 1287 and Lab. 602. Plus Report 83-2. Map 83-03 Port aux Basques, 11O.

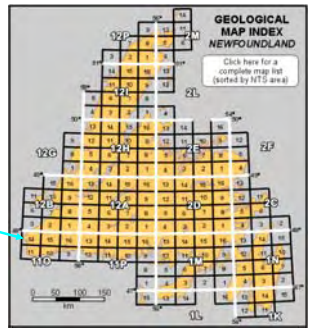
MAP 01-07 2001. Granular aggregate resource of the Codroy map sheet (NTS 11O/14), by M.J. Ricketts. Scale: 1:50 000. Newfoundland Department of Mines and Energy, Geological Survey. Open File 011O/14/0052.

CONTACTS

For publications and general information:

Norman Mercer
Geological Survey of Newfoundland and Labrador
(709) 729-6193

Index of Surficial Geology and Aggregate maps for Newfoundland



Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Newfoundland and Labrador:

Aggregate Geology

Flat Bay Aggregate Resource Map (NTS 12B/7), by M.J. Ricketts, 1992. Scale 1:50,000. Newfoundland Department of Mines and Energy. Map 90-12. 012B/0318.

Inventory of aggregate resources in Newfoundland and Labrador, by F.T. Kirby, R.J. Ricketts and D.G. Vanderveer. Scale 1:250,000. Nfld. 1287 and Lab. 602. Plus Report 83-2. Map 83-10 Stephenville, 12B.

MAP 82-168 1982. Surficial aggregates of the Flat Bay map area (NTS 12B/07), by F.T. Kirby, R.J. Ricketts and D.G. Vanderveer. Scale 1:50 000. Newfoundland Department of Mines and Energy, Mineral Development Division. Open File NFLD/1300.

MAP 87-088 1987. Shallop Cove - Flat Bay aggregate resource map (sample type and location map (NTS 12B/07 - A), by F.T. Kirby. Scale: 1:16 666. Newfoundland Department of Mines and Energy, Mineral Development Division. Open File 012B/07/0396.

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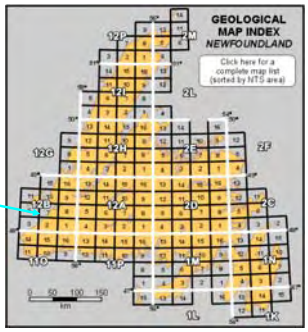
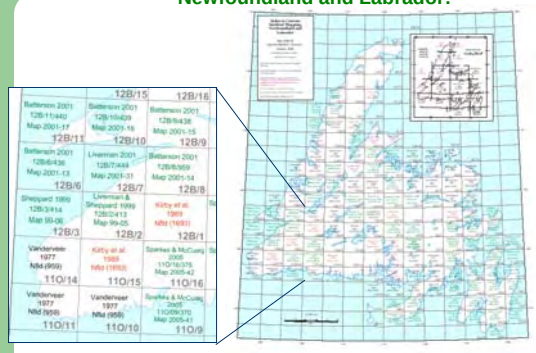


Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Newfoundland and Labrador:



Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Province of Nova Scotia

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Province of Nova Scotia

Program based on Surficial Mapping Program at various scales:

- **Provincial Scale (1:500,000 or greater)**
- **Regional Scale (1:500,000 to less than 1:100,000)**
- **Detailed Scale (less than 100,000)**

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Province of Nova Scotia

Ministry of Natural Resources

Mineral Resources Branch Maps For Sale

Table of Contents

Bedrock Geology Maps

- Provincial Scale (1:500 000 or greater)
- Regional Scale (1:100 000 to less than 1:500 000)
- Detailed Scale (less than 1:100 000)

Glacial/Surficial Geology Maps

- Provincial Scale (1:500 000 or greater)
- Regional Scale (1:100 000 to less than 1:500 000)
- Detailed Scale (less than 1:100 000)

Structure/Tectonic Maps

- Provincial Scale (1:500 000 or greater)

Mineral Deposits Maps

- Provincial Scale (1:500 000 or greater)
- Regional Scale (1:100 000 to less than 1:500 000)
- Detailed Scale (less than 1:100 000)

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY
Province of Nova Scotia

Provincial Scale Digital Maps (1:500 000 or greater)

DP ME 36, Version 2, 2006. Digital Version of Nova Scotia Department of Natural Resources Map ME 1992-3, **Surficial Geology Map of the Province of Nova Scotia**, 1:500 000, by R. R. Stea, H. Conley and Y. Brown, 1992. Digital product compiled by B. E. Fisher. (Formerly DP ME D92-03)

Format, Size and Projection Information — FREE DOWNLOAD

Detailed Scale Digital Maps (less than 1:100 000)

DP ME 59, Version 2, 2006. Digital Version of Nova Scotia Department of Natural Resources Open File Map ME 2003-1, **Surficial Geology Map of the Whycocomagh Area**, (NTS 11F/14), Inverness County, Nova Scotia, scale 1:50 000, by R. R. Stea and M. Fretham, 2003. Digital product compiled by B. E. Fisher, J. D. MacNeil and J. A. Beaumont

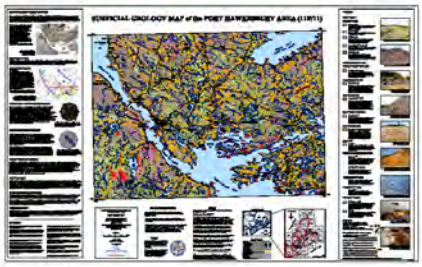
Format, Size and Projection Information — FREE DOWNLOAD

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

A Sample Image of the Surficial Geology Map of the Port Hawkesbury Area, OFM ME 2004-2

(Sample image - Click to view an enlargement from this image)



Format and Projection

Format PDF, ArcInfo Export (E00), DXF/DBF, ArcView shape files (SHP) and TXT files compressed in self-extracting EXE/ZIP files (more information on data formats)

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY
Province of Nova Scotia
Ministry of Natural Resources

NovaScan

- NovaScan is the provincial database of geoscience maps and publications for Nova Scotia, and is produced and maintained by the Mineral Resources Branch of the Nova Scotia Department of Natural Resources. It currently contains over 14,000 records.
- NovaScan contains geologically indexed records of all the geoscience documents produced by or collected by the Mineral Resources Branch (and its predecessors), such as:

  -maps (geology, geochemistry, geophysics, mineral deposits, mineral rights, etc.)
  -publications (bulletins, economic geology series, memoirs, papers, reports, etc.)
  -open files (illustrations, maps, reports)
  -university theses (B. Sc., M. Sc., Ph. D.)
  -mineral exploration assessment reports and mining property reports
- NovaScan can be searched by Title, Author/Organization, Subject, Area, Map Sheet (NTS), Map Type, Document Type, Document Number, Year and Scale.
- NovaScan is updated monthly as new geoscience maps, publications, open files, theses, mineral exploration assessment reports and mining property reports become available.
- Note that NovaScan contains only records of maps and publications produced by or collected by the Mineral Resources Branch (and its predecessors). NovaScan **does not** contain any records of Geological Survey of Canada (GSC) maps or publications. GSC records on Nova Scotia can be searched in the GEOSCAN database.

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY
Province of Nova Scotia
Ministry of Natural Resources

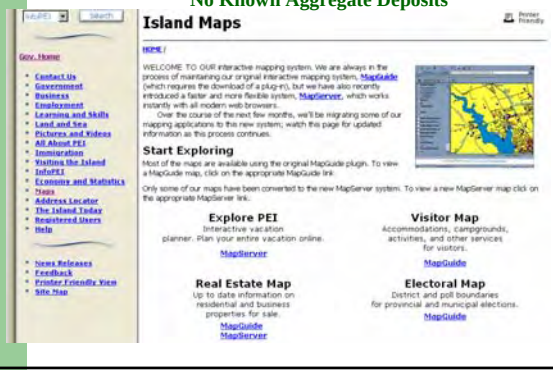
- **Mineral Deposits Map Series**
- **Provincial Scale 1:2,000,000 and 1:1,000,000O**
- **Regional Scale1:250,000**
- **Sub-Regional Scales 1:125,000 and 1:100,000**
  - **Map ME 1985-6 (Map C) Aggregate Resources Map, Northern Cape Breton Island, by W. J. Wright, 1985, scale 1:125 000.**
  - **1:100 000**
  - **OFM ME 2001-1** Map of Bedrock Aggregate Potential in the Halifax-Dartmouth Metropolitan Area Nova Scotia, by G. Prime, 2001, scale 1:100 000.
- **Detailed Mapping 1:50 000**
  - **OFM ME 1991-5 to OFM ME 1991-18** Aggregate Potential of Cumberland and Colchester Counties (14 preliminary map sheets), (11E/02, 11E/03, 11E/05, 11E/06, 11E/07, 11E/11, 11E/12, 11E/13, 11E/14, 21H/07, 21H/08, 21H/09, 21H/10, 21H/16), by G. Prime, 1991, scale 1:50 000. $3.00 per NTS Map Sheet

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY
Province of Prince Edward Island

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY
Province of Prince Edward Island
No Known Aggregate Deposits



Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY
Province of New Brunswick

Granular Resource Management in Canada

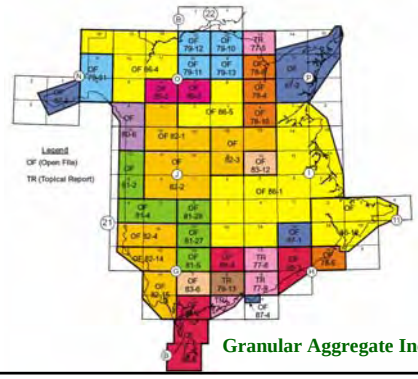
GRANULAR RESOURCE INVENTORY
Province of New Brunswick

New Brunswick:

- An extensive aggregate resources program has been developed for the province
- Near 100% coverage at one scale or another
- Most of the Surficial geological mapping has been completed to date by the Geological Survey of Canada i.e. at 1:250,000 scale or smaller
- Limited detailed Surficial geological mapping
- Bedrock Mapping much more comprehensive

Granular Resource Management in Canada

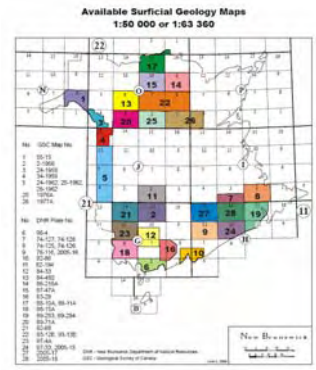
GRANULAR RESOURCE INVENTORY
Province of New Brunswick



Granular Aggregate Index Map

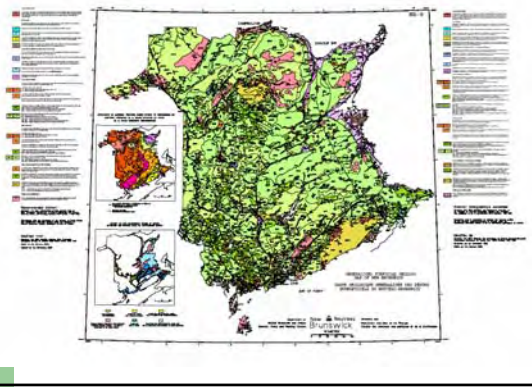
Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY
Province of New Brunswick



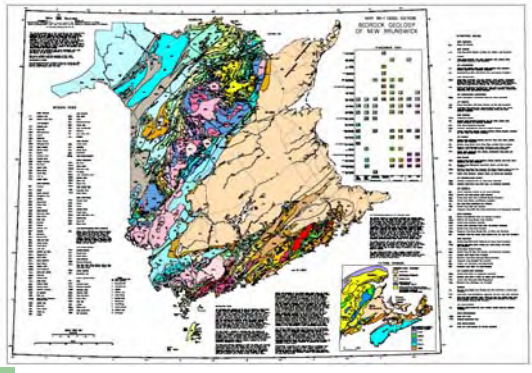
Granular Resource Management in Canada

Surficial Geology Map - New Brunswick



Granular Resource Management in Canada

Bedrock Geology Map - New Brunswick



Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY
Province of Quebec

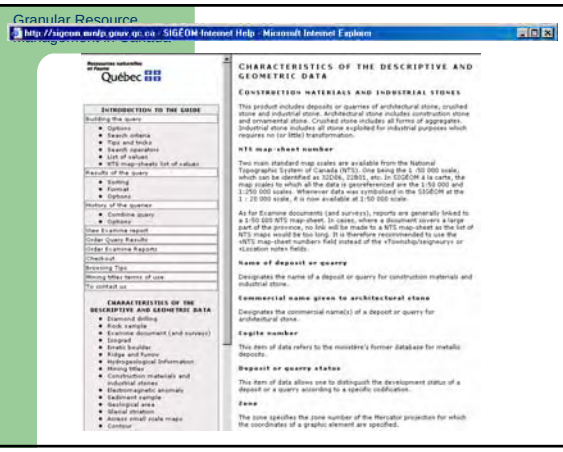
Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY
Province of Quebec

Quebec:

- Granular surveys cover 10% of Province, mainly in the south
- Work has focused on population centres (60-70% covered)
- Mapping mainly at a 1:50,000 scale
- Database (sigeom) includes coverage of construction materials and industrial stone, including architectural and ornamental stone
- Information includes location of deposits and quarries

Granular Resource



Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY
Province of Ontario

Granular Resource Management in Canada

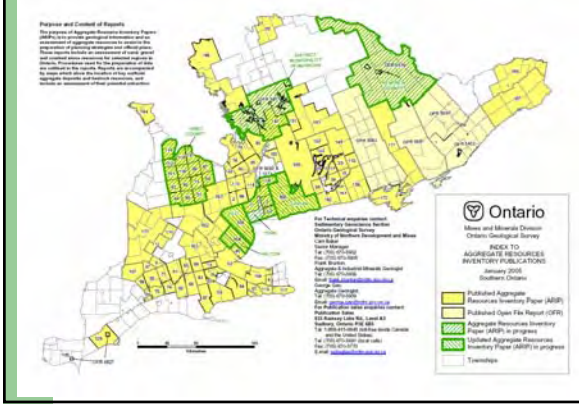
GRANULAR RESOURCE INVENTORY
Province of Ontario

Ontario:

- Responsibility of Aggregates split across 2 Ministries
- Ministry of Northern Development and Mines:
  - Ontario Geological Surve) is responsible for geological mapping (bedrock, surficial and aggregate inventories)
  - Extensive mapping program throughout S. Ontario and in populated areas of N. Ontario.
- Ministry of Natural Resources:
  - Takes on the responsibility of regulating the extraction industry in designated areas of the province and on all Crown Land under the Aggregate Resources Act.
  - MNR District offices responsible for protection of aggregate deposits as a commenting agency on land use plans (e.g. municipal plan amendments)
  - Intent to enlarge the areas designated under the Aggregate Resources Act i.e. extend the coverage of enforcement further north.

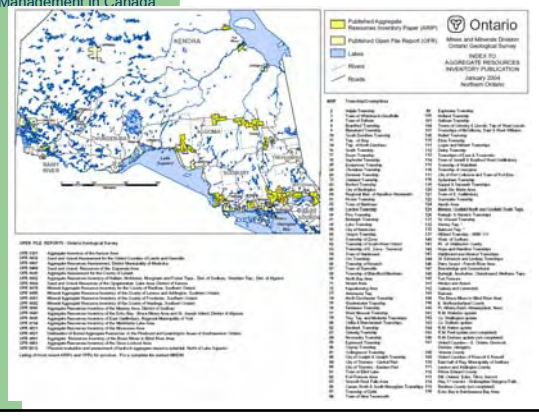
Granular Resource

Aggregate Index Map – Southern Ontario



Granular Resource Management in Canada

Aggregate Index Map – Northern Ontario



Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Province of Manitoba

Granular Resource Management in Canada

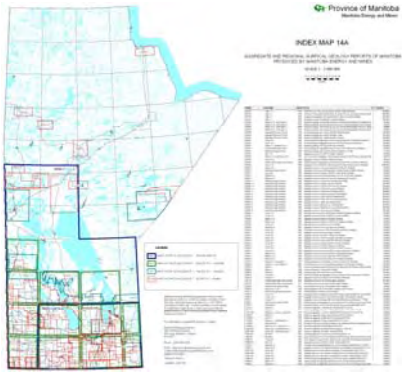
GRANULAR RESOURCE INVENTORY

Province of Manitoba

- Aggregate and Surficial Mapping concentration in the south half of the province
- An integrated map of Manitoba surficial geology has been prepared based on Geological Survey and Manitoba Geological Survey programs

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY



Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Province of Saskatchewan

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Province of Saskatchewan

Saskatchewan Research Council:

- Quaternary Geology Section (under the Research and Technology Branch conducts surficial mapping and aggregate resource evaluations

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Province of Saskatchewan

Granular Resource Management in Canada

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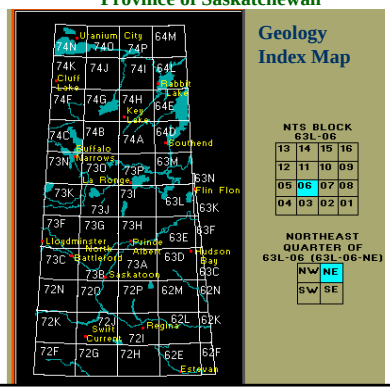
Province of Saskatchewan

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

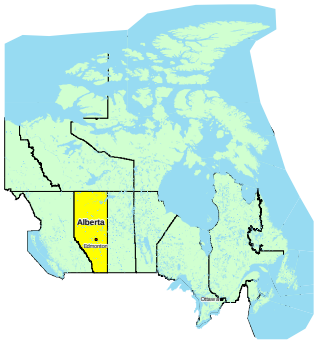
Province of Saskatchewan



Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Province of Alberta



Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Province of Alberta

- **Alberta Geological Survey responsible for Geological Mapping**
- **Mapping of sand and gravel deposit covers 50% plus of province**
- **Work in progress will increase coverage to +/- 75%**

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Province of Alberta

Alberta Energy and Utilities Board – Alberta Geological Survey

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Province of British Columbia

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Province of British Columbia

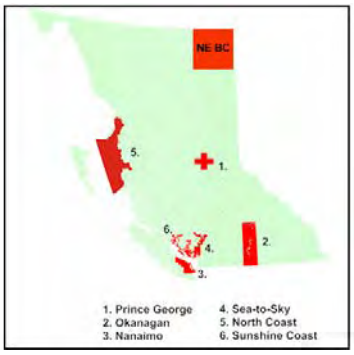
- The British Columbia Geological Survey is responsible for aggregate mapping
- In 1994 instituted the Aggregate Program with the objective of:
  - Inventory location of pits and quarries
  - Produce a series of Aggregate Potential Maps
  - Improve information transfer and data management between key provincial ministries

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Province of British Columbia

Aggregate Index Map



Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Aggregate Production Statistics

Move to separate Slide Show

Granular Resource Management in Canada

GRANULAR RESOURCE INVENTORY

Electronic Information and Websites

- Newfoundland
- New Brunswick
- Ontario
- Alberta
- British Columbia
- Others available if time permits

Role of Geotechnical Consultants in Granular Resource Evaluation and Development

Presented by:

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&
Anwar Majid, P. Eng. (amajid@eba.ca)

September, 2006

What do we mean by Granular Material?

- Materials Commonly Known as Sand and Gravel
- Include Silt, Sand, Gravel, Cobbles and Boulders
- Clay < 0.002 mm; Silt 0.002 – 0.08 mm
- Sand 0.08 – 5 mm; Gravel 5 – 75 mm
- Cobbles 75 – 200 mm; Boulders >200 mm

Why do we need Granular Material

- Highways and Associated Infrastructure
- Gas Pipe Line and Associated Infrastructure
- Mining Infrastructure – Buildings, Pads, Roads, Dikes/Dams, etc.
- Community Infrastructure – Roads, Buildings, Water and Waste Water Facilities, etc.

Granular Material Types

- **Class 1** – concrete aggregate, surfacing material
  - – clean, well graded, structurally sound sand & gravel
  - – minimum processing
- **Class 2** – concrete aggregate, surfacing material
  - – well graded sand & gravel with limited silt
  - – extensive processing
- **Class 3** – base, subbase, embankment
  - – poorly graded sand and gravel with or without silt
  - – extensive processing for concrete aggregate
- **Class 4** – subbase, embankment
  - – silty, fine-grained sand, minor gravel
  - – may contain week/deleterious material
- **Class 5** – riprap, if processes, equivalent to Class 1 or any other class
  - – bedrock of fair quality

Components of Granular Resource Evaluation

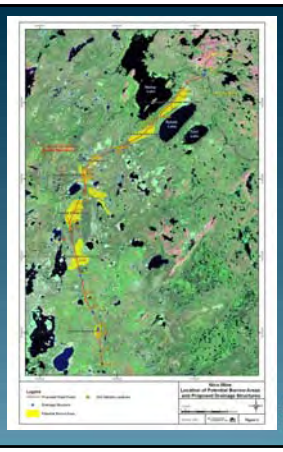
- **Identification**
  Review of Available Information
- **Investigation Phase**
  Site Investigation
- **Aggregate Characterization – Suitability, Durability**
  Laboratory Testing
- **Volume Estimates for Different Applications**

Granular Resource – Identification Phase

Review of Available Information

- Topographic Maps
- Surficial Geology Maps
- Land Use Maps
- Historical Airphotos
- Recent Satellite Imagery
- Old Reports
- Climate Data

Satellite Image
Showing Borrow Areas



What Information Do We Need From Site Investigation Program

- Confirm the Suitability of the Source Material
- Determine Permafrost Distribution and Characteristics
  - description of ground ice, etc.
- Groundwater Conditions
- Depth to Bedrock
- Determine Quantity of Material Present

Site Investigation

Challenges and Constraints

- Logistics (access for equipment)
- Weather
- Permafrost Environment

Site Investigation Methods

- **Excavations/Test pitting**
  - Hand Excavations – picks, shovels, hand augers
  - Machine Excavations – excavators, bobcats, etc.
- **Drilling**
  - Auger Drills, Airtrack Drills, Air Rotary Drills, etc.
- **Geophysical Techniques**
  - Resistivity and Conductivity Methods
  - Ground Penetrating Radars
  - Borehole Logging

Hand Excavated Testpit

Test pitting

Test Pitting – Wheeled Loader

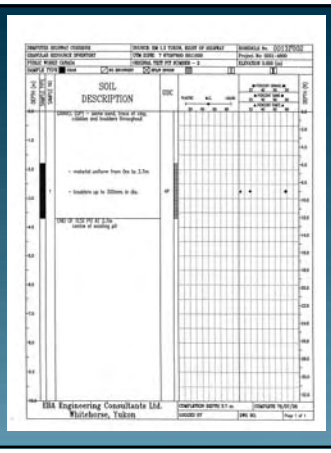
Drilling – Bobcat With Auger

Air Track Drill

Air Rotary

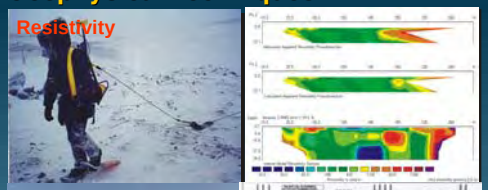
Auger

Borehole Log

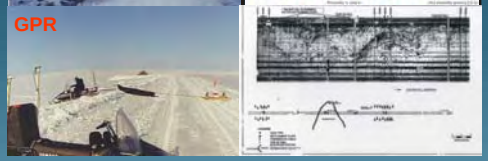


Geophysical Techniques

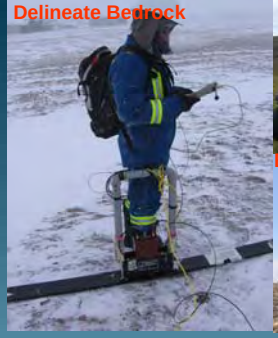
Resistivity



GPR



Pulse Ekko GPR Survey to Delineate Bedrock



Iqaluit Granular Resource Study - GPR

Borehole Logging

Aggregate Characterization

Aggregate Suitability/Durability Testing

- Particle Size Distribution
- L. A. Abrasion/Micro Deval Testing
- Color Plate
- Flat and Elongated Particles
- Specific Gravity
- Low Density Granular Material
- Material Finer Than 0.08 μm
- Clay Lumps
- Unconfined Freeze-Thaw
- Absorption
- Alkali Aggregate Reactivity
- Petrographic Analysis

Analysis
Permafrost Considerations And Volume Estimates

- **Implications of Massive Ice and Ice-Rich Permafrost**

  Increases Cost of Granular Resource Development

  Problematic for Granular Resource Development

  Terrain Instability

  Overestimation of Granular Inventories

- **Volume Estimates**
  - Proven
  - Probable
  - Potential

Pit Planning and Development

- Permits
- Planning and Design
- Pit Development
- Operations
- Reclamation

Pit Planning - Permitting

- Land Use Permit
- Quarry Permit
- Blasting Permit
- Special Permits – Riverbeds, Lakeshores, Ocean Shorelines, normally not granted unless no other alternative exists

Pit Planning - Planning and Design

- Demand for the granular resource
- Site Conditions
  - surface vegetation, geology, topography
  - environmentally/archeologically sensitive area
  - slope stability, drainage
  - groundwater and permafrost conditions
- Development Timing
  - access and transportation – winter or all weather roads
  - washing/screening – typically summer operation
  - environmental considerations – may limit operations in some season
  - user's needs – seasonal or year round
  - life span of operations (single vs multiple years)

Pit Planning - Planning and Design

- Water Management
  - divert water away from the development area
  - reduce erosion at discharge point,
  - clarify silty water prior to discharge
  - manage groundwater inflow
  - manage other sources of in-pit water such as rain/snow, thaw of ice-rich permafrost
  - identify if any permits are required to discharge water
- Pit/Quarry Development Plan
  - development plan – location of various activities over time
  - plan to monitor progress
  - restoration plan

Pit Development

- Follow plans outlined in the land use permits and conditions attached to it
- **Pit Access –** economical, least damage to environment
- **Buffer Strips –** undeveloped buffer strips (100 m wide) should be left to protect sensitive areas such as water bodies
- **Visual screening –** if possible pit and quarries should be hidden from view
- **Noise and Dust**
- **Flag Site Boundaries**
- **Clearing –** limit activities to development area
- **Topsoil and Muskeg –** save for reclamation
- **Overburden on granular source –** stockpiles should be sloped and rounded, facilities to collect silty water

Pit Development

- **Resource Extraction –** excavation method/equipment, permafrost, ice, etc.
- **Resource Processing**
  - stockpiling – stockpiles easily accessible
  - crushing and screening equipment– easily accessible, on hard ground
- **Drainage Management**
- **Security –** limit uncontrolled assess to pit/quarry site

Pit Planning - Operations

- Monitoring/Quality Assurance
  - operations should be monitored to ensure they are according to plan
  - monitor suitability and quality of source, ground ice, water management
  - impact of pit/quarry operations on environment
  - stockpile slopes, pit slopes, crushing, screening and washing operations
  - maintenance of equipment, access roads, etc.

Reclamation

- Restore all disturbed areas
- Clean up
- Re-contouring and final slopes
- Drainage and Erosion Control
- Overburden/Topsoil – use for landscaping
- Revegetation
- Protection against hazards - quarries

Granular Resource Management Plan for the Inuvialuit Settlement Region

Memorandum of Understanding between

Inuvialuit Regional Corporation

And

Department of Indian Affairs and Northern Development

PLANNING OBJECTIVES

- Conservation of aggregate for most appropriate use
- Focus planning on areas where shortages exist or significant future needs are identified
- Adhere to “priorities” in Inuvialuit Final Agreement

BENEFITS

- Logical and orderly development of resource
- A means of streamlining land administration processes
- Minimize supply/demand conflicts
- Ensure restoration and rehabilitation takes place on a continuing basis

CHALLENGES

- Deposits are limited in occurrence and essentially non-renewable
- Adequacy and accuracy of existing inventories of supply and forecasts of demand
- Sources are remote from established communities
- Reconciling conflicting uses between industry and communities equitably

JOINT MANAGEMENT PURPOSE

- Co-ordinated and systematic approach to Granular Resource Management in the Inuvialuit Settlement Region
- Gathering and utilizing all existing Info

through

- Sharing research and project data
- Avoiding duplication of effort
- A commitment to joint planning, action and resource allocation

WORK DONE TO DATE

- MOU, Planning Framework and Workplan
- Initial consultations: Gwich'in, Industry, EISC
- Web map feasibility study & prototype
- Inuvik/TUK Highway data consolidation
- Community site evaluations (Aklavik, TUK and Paulatuk)
- Selective field recon
- Topo survey of YaYa Lake Deposit
- Massive Ice Research (PERD)

MORE WORK DONE TO DATE

GRANULAR SUPPLY

- report compilation and scanning
- report catalogue (AINA – Arctic Institute of North America)
- deposit compilation and digitizing
- existing inventory (various)
- geological setting
- data review & gap analysis
- historical usage and depletion statistics

DEMAND

- Demand Forecast Model (IFA Requirement)

MORE WORK DONE TO DATE

INTERIM MANAGEMENT PLAN

- based on specific area and regional needs
- highest priority to areas where shortages exist and where a significant increase in future demand is anticipated

EVEN MORE WORK DONE TO DATE

Implementation of Best Management Practices for 2003 YaYa Lake gravel haul

- predevelopment inspection
- professional supervision
- volume control
- reclamation inspection

REMAINING WORK

TO BE DONE …….

WORK PLAN

1 – Demand

- communities
- public projects
- significant private projects

2 - Goals, Objectives, Principles

- reflect specific views of both land owners
- adhere to Inuvialuit Final Agreement or DIAND regulations

3 - Allocation Rules

- minimum quantity for development
- minimize No. of pits
- access appropriate grade for best use
- environmental/archeological impacts
- minimize haul distance

4 - Regulatory Regime

- develop integrated services to extent possible
- operating guidelines
- Inuvialuit Land Administration & DIAND

5 - The Plan

- web based and dynamic
- resource extraction guidelines

6 – Consultation

- public involvement in process

7 - Monitor and Revise as Required

- as sources get depleted
- as new sources are found
- changes in demand

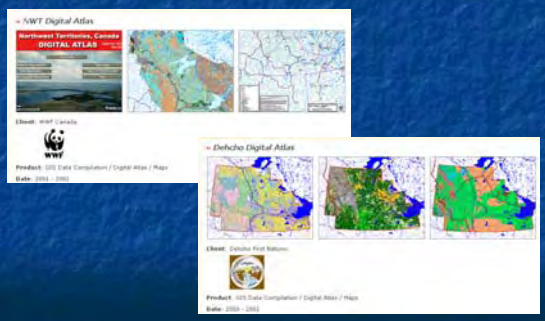
Geographic Information Systems
Some NWT Examples

VictoryPoint Showcase
- courtesy Alan Udell

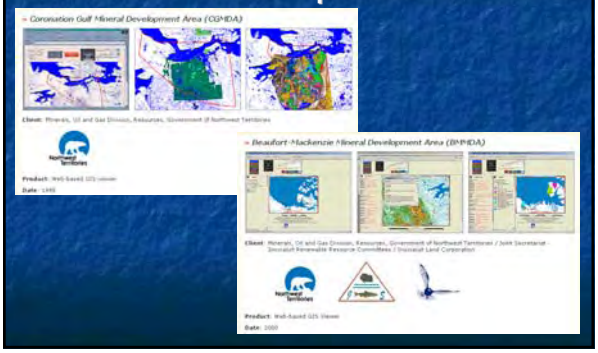
GIS in NWT

- Who is using GIS ?
- Help us identify others
- Are these relevant to granular sites ?
- Data sharing / partnership opportunities ?
- Changing technologies

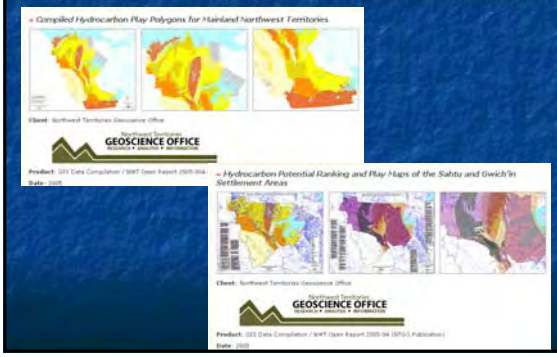
Digital Atlases



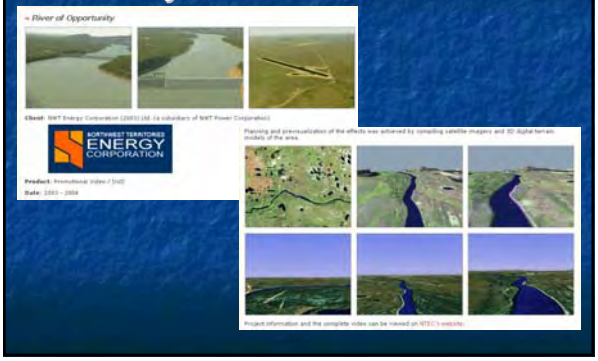
Mineral Development Areas



Hydrocarbon Potential



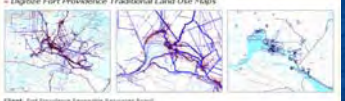
Hydroelectric Power



Land Use

- Digitize Northern Land Use Information Series Maps

- Digitize Fort Providence Traditional Land Use Maps



Deh Cho geological resources

- Dehcho Mineral Potential Map

- Evaluation of Oil and Gas Potential in the Dehcho Territory

DIAND

- NWT GeoViewer

- Hay River Reserve Mapping

DFO / Parks

- DFO GIS System Design, Implementation and Training

- Digitize Nahanni Park Boundary Expansion Maps

Mackenzie Valley

- MVLWB GIS System Design, Implementation and Training

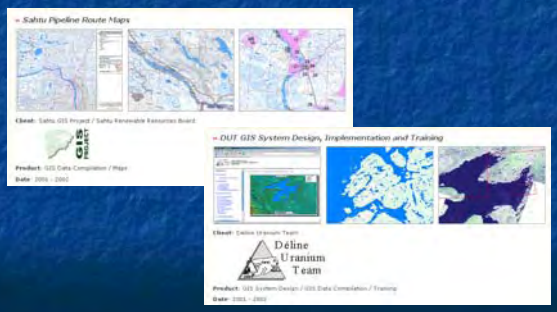
- Mackenzie Valley Mineral Potential Map

Deh Cho

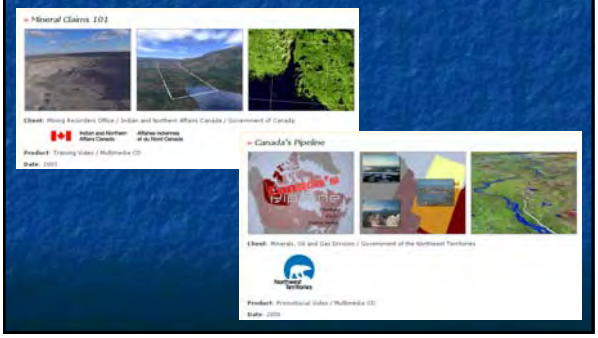
- Fort Liard Resources Directory

- Spatial Analysis of Timber Potential in the Dehcho Territory

Sahtu region



Multimedia



Any Others ?

Please let us know

-
-
-

Granular Resource Information

Some Existing Systems

Presentation approach

- Overview of selected systems
- Live demonstrations
- “Hands on” demonstrations
- Invitation to show other related sites

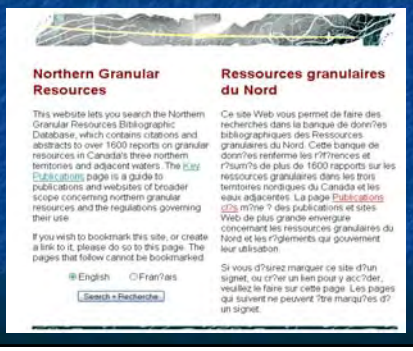
INAC Granular Program

- Northern Granular Resources Bibliography
  - *http://www.aina.ucalgary.ca/ngr*
- *Granular Resource Estimating Tool*
  - *http://www.grancalc.ca*
- Granular Resources Management Web GIS
  - Inuvialuit Settlement Region
  - Mackenzie Valley

Northern Granular Resources Bibliography

- Bibliographic citations and abstracts
- over 1600 reports
- covers territories and adjacent waters
- Key Publications page
- Many reports can be downloaded

NGRB Home Page



Northern Granular Resources

This website lets you search the Northern Granular Resources Bibliographic Database, which contains citations and abstracts to over 1600 reports on granular resources in Canada's three northern territories and adjacent waters. The Key Publications page is a guide to publications and websites of broader scope concerning northern granular resources and the regulations governing their use.

If you wish to bookmark this site, or create a link to it, please do so to this page. The pages that follow cannot be bookmarked.

◉English ○Fran?ais

Search = Recherche

Ressources granulaires du Nord

Ce site Web vous permet de faire des recherches dans la banque de donn?es bibliographiques des Ressources granulaires du Nord. Cette banque de donn?es renferme les r?f?rences et r?sum?s de plus de 1600 rapports sur les ressources granulaires dans les trois territoires nordiques du Canada et les eaux adjacentes. La page Publications cl?s m?ne ? des publications et sites Web de plus grande envergure concernant les ressources granulaires du Nord et les r?glements qui gouvernent leur utilisation.

Si vous d?sirez marquer ce site d?un signet, ou cr?er un lien pour y acc?der, veuillez le faire sur cette page. Les pages qui suivent ne peuvent ?tre marqu?es d? un signet.

Subject Scope

Northern Granular Resources

Scope

Subject Scope

This database covers all aspects of granular resources, defined as gravel, sand and crushed rock for use in construction.

Publications about the availability of granular resources are covered, including descriptions of specific sources, inventories of granular resources and the management of this resource. Methods of extracting and transporting granular resources are also covered, including the environmental and socio-economic impacts of such work and methods of mitigating these impacts. Future requirements for granular resources in all types of construction are covered, including conflicting demands for granular resources.

Geological or geotechnical surveys are included if they contain information on possible sources of granular resources. Publications about existing artificial islands and berms in the Beaufort Sea have been included if they contain information that would be helpful in the scavenging of granular resources to build future islands and berms.

Some publications in the database cover many subjects in addition to granular resources, but have been included because they do contain significant granular resources information.

Geographic Scope

Northern Granular Resources

Scope

Geographic Scope

This database covers Yukon, the Northwest Territories, Nunavut and adjacent waters. Publications that overlap into Alaska and the provinces are included, as long as they contain some information about granular resources in the Territories.

Publications that contain information about preventing or repairing the environmental impacts of granular resources extraction in arctic regions have been included even if they are not about the Territories.

Return to Search Page

Search Form

Northern Granular Resources

Simple Search

Your search will find records that satisfy **all** the conditions you specify.

Records that contain **any** of the following words in their **titles** or **abstracts**

Records that contain **all** of the following words in their **titles**

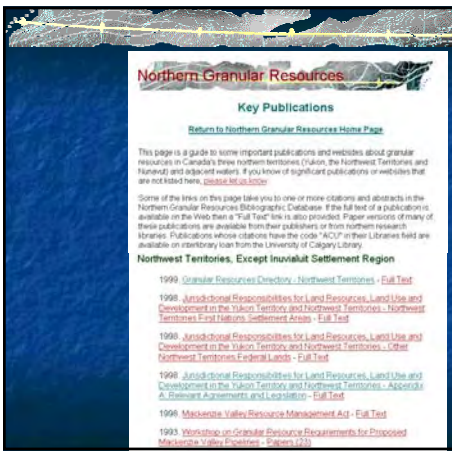
Records that have the following **author**

All Geographic Regions | Select I.S.R. Subregion

All Decades | ASTIS record

Search | Clear

Background Scope Comprehensiveness Using Simple Search
Go To Advanced Search Obtaining Publications
Acknowledgments Contact Us Home



Northern Granular Resources

Key Publications

Return to Northern Granular Resources Home Page

This page is a guide to some important publications and websites about granular resources in Canada's three northern territories (Yukon, the Northwest Territories and Nunavut) and adjacent waters. If you know of significant publications or websites that are not listed here, please let us know.

Some of the links on this page take you to one or more citations and abstracts in the Northern Granular Resources Bibliographic Database. If the full text of a publication is available on the Web then a "Full Text" link is also provided. Paper versions of many of these publications are available from their publishers or from northern research libraries. Publications whose citations have the code "ACU" in their Libraries field are available on interlibrary loan from the University of Calgary Library.

Northwest Territories, Except Inuvialuit Settlement Region

1999. Granular Resources Directory - Northwest Territories - Full Text

1998. Jurisdictional Responsibilities for Land Resources, Land Use and Development in the Yukon Territory and Northwest Territories - Northwest Territories First Nations Settlement Areas - Full Text

1998. Jurisdictional Responsibilities for Land Resources, Land Use and Development in the Yukon Territory and Northwest Territories - Other Northwest Territories Federal Lands - Full Text

1998. Jurisdictional Responsibilities for Land Resources, Land Use and Development in the Yukon Territory and Northwest Territories - Appendix A: Relevant Agreements and Legislation - Full Text

1998. Mackenzie Valley Resource Management Act - Full Text

1993. Workshop on Granular Resource Requirements for Proposed Mackenzie Valley Pipelines - Papers (23)

Contacts:


Northern Granular Resources

How to Contact Us

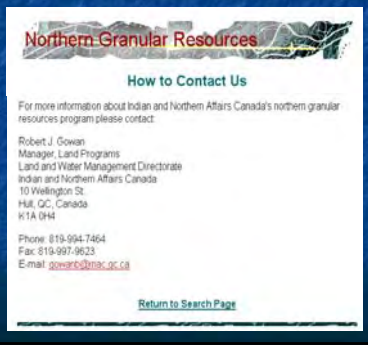
We welcome your comments about this database, as well as information about publications that were missed and additional sources that should be checked. The simplest way to have us add a publication to the database is to send a copy of it, whether permanently or on loan, to either of the following people. All donated publications will be deposited in the Arctic Institute of North America collection within the University of Calgary Library, and will be available to anyone through interlibrary loan.

For more information about the Northern Granular Resources Bibliographic Database, this website or ASTIS, please contact:

Ross Goodwin
Manager, ASTIS
Arctic Institute of North America
University of Calgary
Calgary, AB, Canada
T2N 1N4

Phone: 403-220-4036
Fax: 403-282-4609
E-mail: astis@ucalgary.ca

Contacts:


Northern Granular Resources

How to Contact Us

For more information about Indian and Northern Affairs Canada's northern granular resources program please contact:

Robert J. Gowan
Manager, Land Programs
Land and Water Management Directorate
Indian and Northern Affairs Canada
10 Wellington St.
Hull, QC, Canada
K1A 0H4

Phone: 819-994-7464
Fax: 819-997-9623
E-mail: gowanb@inac.gc.ca

Return to Search Page

Granular Demands Calculator

- For developing granular demand forecasts
- Designed for northern NWT (permafrost)
- Several types of structures included
- Considers design options
- Default values can be over-ridden
- General estimates – not engineering judgements

GranCalc Home page


Granular Resource Estimating Tool

Home
Instructions
Login/Logoff
Account Info
Projects
Contacts

Welcome!

Many exploration and construction projects depend on the availability of granular resources. In the northern regions of Canada, these resources can be scarce or difficult to find. Anticipating the region's granular needs in advance helps ensure that resources are available now and in the future.

The purpose of this tool is to help project estimators participate in developing a forecast of the granular resource needs of the northern NWT. Information collected here will help the surrounding communities plan the future of the region's resources.

Here you will find calculators for estimating the granular resource requirements for a variety of projects. They are intended for general estimating only, and do not replace engineering judgments.

Some hints on how to use this estimating tool are provided on the Instructions page below, and other tips and explanations are provided on the appropriate pages, or on linked reference pages, through each step of the estimating procedure.

Instructions

Create Account / Log In


Login/Logoff

Home
Instructions
Login/Logoff
Account Info
Projects
Contacts

Please enter your login name and password. Your login name is your email address. If you cannot remember your password it will be sent to you in an email.

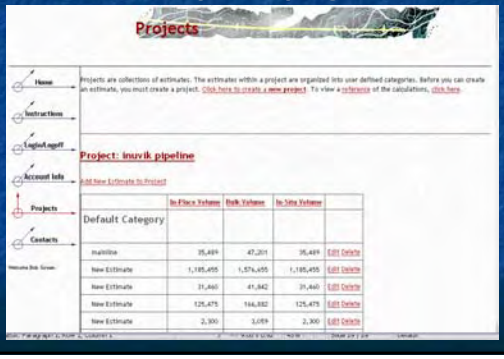
If you don't have an account, please create one

Login: gowanb@inac.gc.ca
Password:
Login

Home | Instructions | Login/Logoff | Account Info | Projects | Contacts

This page was last updated 2005-08-08

Projects page


Projects

Home
Instructions
Login/Logoff
Account Info
Projects
Contacts

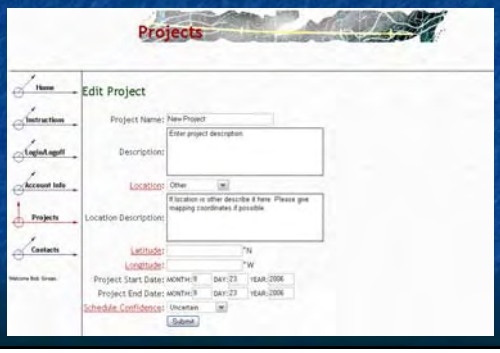
Projects are collections of estimates. The estimates within a project are organized into user defined categories. Before you can create an estimate, you must create a project. Click here to create a new project. To view a reference of the calculations, click here.

Project: Inuvik pipeline

Add New Estimate to Project

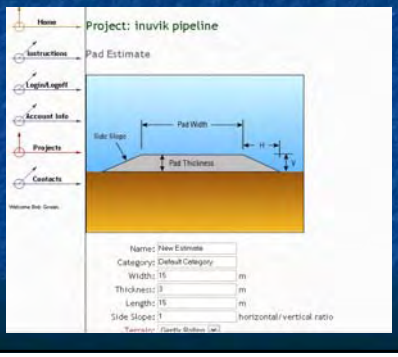
	In Place Volume	Bulk Volume	In Situ Volume	
Default Category				
mainline	35,489	47,201	35,489	Edit Delete
New Estimate	1,185,455	1,576,655	1,185,455	Edit Delete
New Estimate	31,460	41,842	31,460	Edit Delete
New Estimate	125,475	166,882	125,475	Edit Delete
New Estimate	2,300	3,059	2,300	Edit Delete

Create / Edit Project



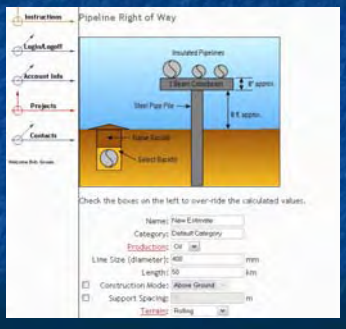
Add Estimate

Estimate: Pad

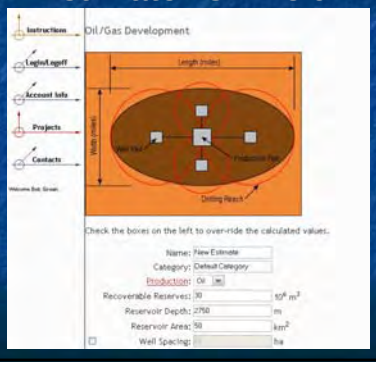


Estimate: Mine

Estimate: Pipelines



Estimate: Oil Field



Calculation References

Contacts

Granular Resources Management GIS Web Sites

Presentation by Ward Kilby, P.Geo.
Cal Data Ltd.

Granular Management Site Discussion

- Site purpose/objectives
- History
- Software
- Data
- Functionality
- Future direction?

Purpose

- Provide WEB access to all granular related information along the proposed pipeline route
- Provide WEB based data management capabilities
- Provide data visualization tools
- Collect or link to all required information

History

- 2002 ISR Feasibility Study
- 2002 O&G Tenure Feasibility Study
- 2003 ISR Prototype site
- 2003 O&G Prototype site
- 2004 Valley Prototype site
- 2004 ISR Prototype V2 site
- 2004 OGC & remote update for O&G site
- 2005 Enhancements to MV site
- 2005 Enhancements to ISR site

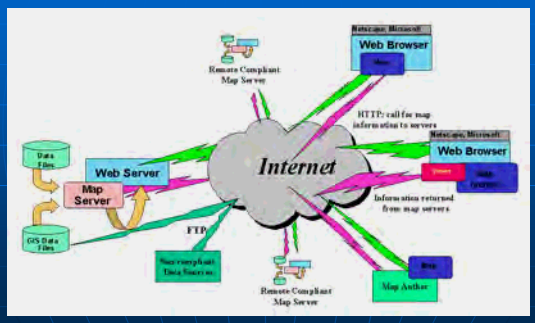
Software

- Software selection
- MapGuide architecture
- ColdFusion

Software Selection

- 2002 Feasibility Study
  - Reviewed available data
  - Reviewed client requirements
    - >41 in person interviews
    - 4 phone interviews, informed others
  - Reviewed 6 software packages
    - ArcIMS, AspMap, GeoMedia, MapGuide, MapServer, MapXtreme
  - MapGuide
    - COTS, Corporate, Ease of development, Raster & Vector, Distributed data, Remote authoring, Client side functions, Remote data entry, hardcopy quality, bandwidth requirements.

MapGuide - Internet



Site Overview

Parson Lake Example

Data

- Base map data
  - Imagery
  - Raster – maps, diagrams, dems
  - Vector
- Granular specific data
  - Vector
  - Textural – PDF and database reports
  - ASTIS link

Base Map - Imagery

- Landsat – NASA Mosaic
- ASTER – products
- TARIN – ISR site
- SPOT – 10 sites
- IKONOS - 10 sites
- Pipeline – 30K & 50K

Base Map - Imagery

New NWT Air Photo Link

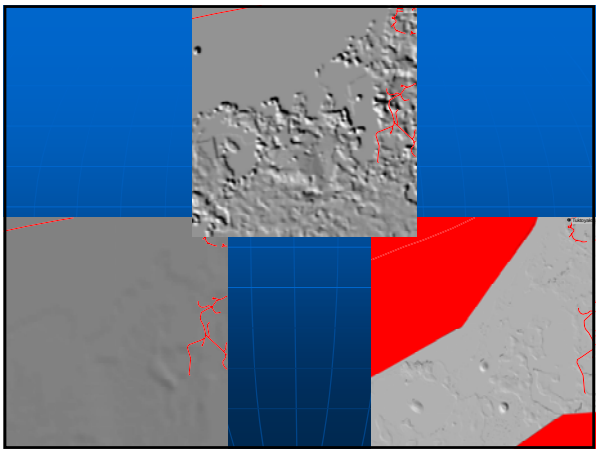
TARIN (ISR site)

Base Map - Raster

- Mackenzie highway
- Proposed Pipeline Route – PIP
- ASTER DEMS
- GTOPO 30 DEMS
- LIDAR – ISR site

Base Map - Raster

DEMs



Base Map - Vector

- Geology of Canada - 1:5M
- Canada Surficial Geology
- Permafrost
- Sensitive Areas
- NWT Mineral Occurrences and Tenure
- O&G Wells & Seismic Lines ??
- DMTI
- GeoBase
- Legal Surveys

Base Map - Vector

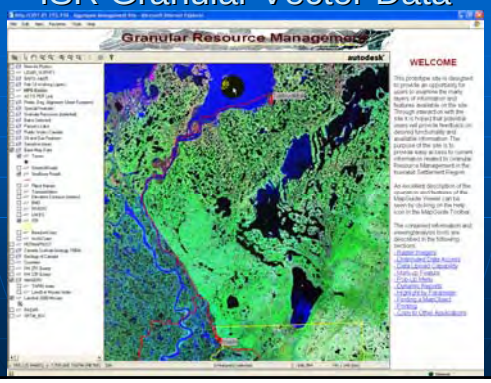
Legal Survey Parcels

Granular Specific - Vector

- ISR Resource Sites
- Geotech Boreholes
- MGP Burrow Sites
- Pipeline Terrain Unit Polygons
- Parson's Lake – ISR
- Public Works Canada – ISR
- GSC Resources - ISR

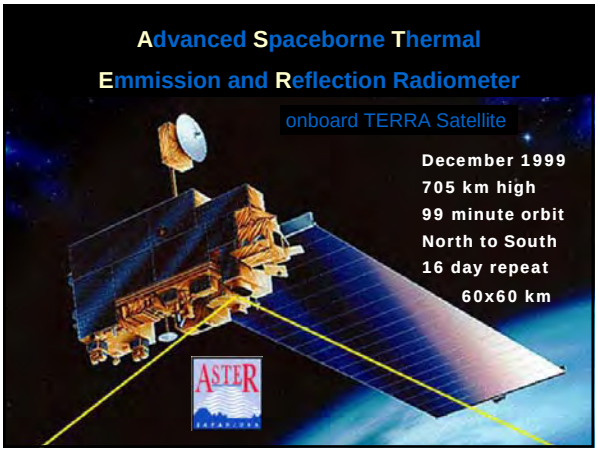
Granular Vector Data

ISR Granular Vector Data



Advanced Spaceborne Thermal Emmission and Reflection Radiometer

onboard TERRA Satellite



December 1999
705 km high
99 minute orbit
North to South
16 day repeat
60x60 km

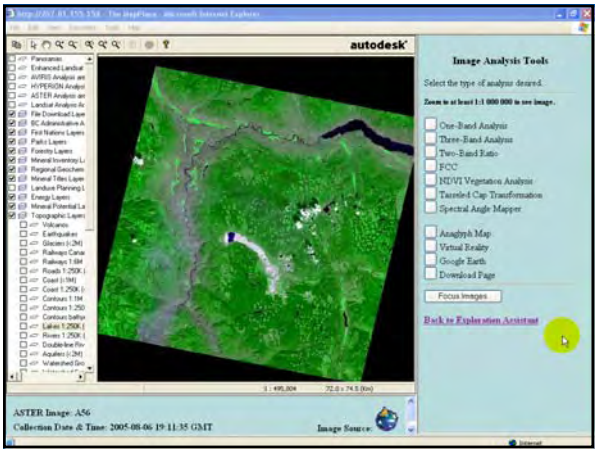
ASTER Image Products

- Streaming Video
- Virtual Reality Worlds
- Perspective Views
- Fly-by Movies
- DEMs
- Natural Colour Images
- Vegetation and Thermal Character

ASTER Products

Google Earth Display on MapPlace

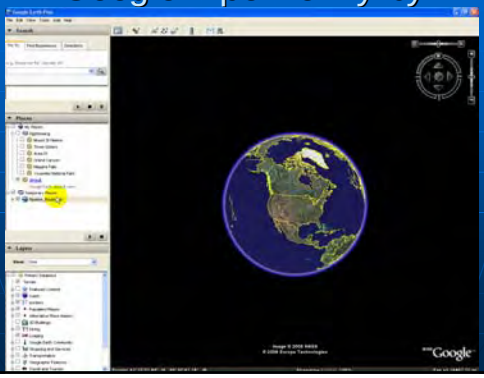
- Became available summer 2005
- January 10th Mac version
- Our additions:
  - Near-natural colour image
  - Mineral maps
  - Anaglyph map
  - Some MapPlace layers
- Excellent viewing functions
- Disruptive technology



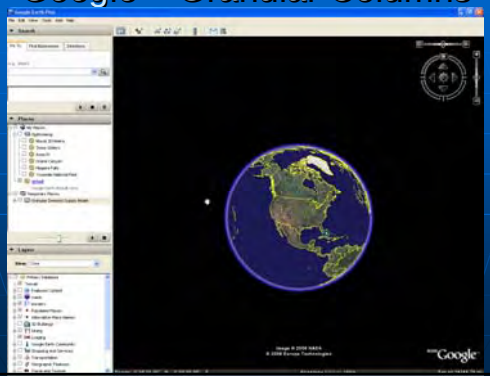
Google Earth Browser

- 3D Viewing
- Recent imagery
- Data piggy-backing
- Data input & GPS connection
- Off-line use
- Data Transfer
- GIS compatible
- Meteoric raise in acceptance

Google Pipeline Fly-by



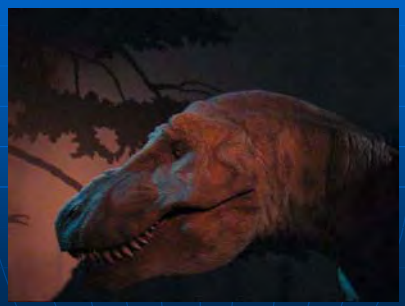
Google – Granular Columns



Future Direction

- MapGuide – Google Combination
- ASTER imagery analysis
- Increased data content
- Link to other granular tools

Going Live



Possible Cumulative Effects Geographic Information System

Inuvialuit Land Administration

Presentation Outline

Examine issues relating to Inuvialuit Land Administration (ILA) land use analysis and policy

Present background on Geographic Information System (GIS) and Cumulative Effects (CE)

Present a tool to help ILA staff address land use management and CE

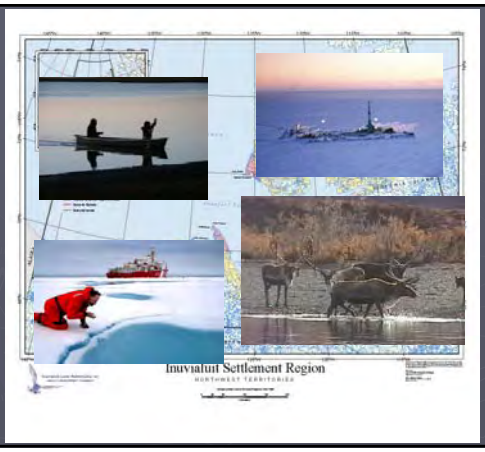
ILA - History

Inuvialuit Final Agreement (IFA) Signed 1984

Inuvialuit granted title to some 56,000 km^2 land

Inuvialuit Land Administration (ILA) – issues various "Rights" & "Permits" for land use – Inuvialuit receive compensation

Land uses vary – simple research projects, complex industrial operations and traditional Inuvialuit pursuits



ILA - History

IFA 3 Guiding Principles:

1) *To preserve Inuvialuit cultural identity and values within a changing northern society;*
2) *To enable Inuvialuit to be equal and meaningful participants in the northern and national economy and society; and*
3) *To protect and preserve the Arctic wildlife, environment and biological productivity.*

ILA - Challenges

1) Land Use Impact Analysis -

ILA staff need to have an idea of what is happening 'on the ground' – both while development is occurring and over time

Need a sense of 'cumulative effects'

Office Staff of 7 – limited resources

ILA - Challenges

2) Policy Administration -

Land Use Policy rules and regulations require thresholds for administration and enforcement purposes

Difficult to do without land use designations – i.e. Land Use Plan

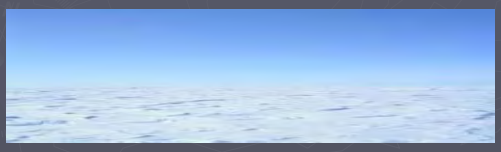
How do you decide where to draw lines on the map?

Cumulative Effects

Canadian Environmental Assessment Agency –

CE are *"…changes to the environment that are caused by an action in combination with other past, present or future human actions"*

Usually measured through wildlife monitoring



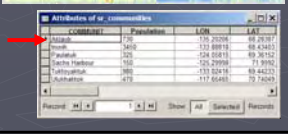
What is GIS?

Geographic Information Science or System = GIS

Way to organize data – can be geographic or tabular

Can be layered and/or combined with other data to help with analysis – i.e. maps

Early versions = paper
Now = computer



ILA CE GIS

Challenge – create a data analysis model

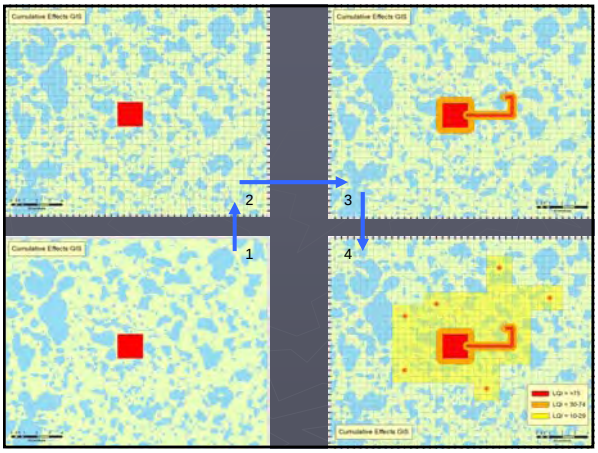
- Ground feature information
  - Important features
  - Vegetation and terrain
  - 'Weighted' based on susceptibility to damage from development – must be determined at ILA
- Development information
  - Fuel, Equipment, Time of Year, Size of operation etc.
  - 'Weighted' based on impact to the land – determined at ILA

Ground Feature 'weight' – Development 'weight' = Land Quality Index (LQI)

ILA CE GIS

How to build a CE GIS?

- Create a GIS grid of Inuvialuit owned lands – size of grid squares depends on computing power
- Assign a value to each grid square – based on 'weights'
- Change grid values as changes to ground occur
  - Would require GIS programming to incorporate new information into existing maps and databases
  - If online application system capable of storing detailed project information maps could automatically be updated



ILA CE GIS - Challenges

Obtaining information

- Ground feature information
  - ILA files – paper, RMS, LUAPS, GIS etc.
  - Satellite imagery analysis - $$$ depends on level of detail and accuracy
  - Existing studies
  - University research projects
  - Consultation with local people & local regulatory agencies – culturally/environmentally sensitive areas
  - ILA could use proponents as 'ground truth agents' to build/update databases
  - Cost sharing between various ISR regulatory agencies?

Major obstacles = Time and Money

ILA CE GIS - Challenges

Obtaining information (cont'd)

- Development information
  - Obtained from land users via application and potential other means
  - Environmental Monitors for certain developments
  - Create a model to determine 'weights' of development impact
  - How long do impacts last? – ILA to determine

ILA CE GIS - Results

A CE GIS could help ILA in meeting challenges 1 & 2:

- GIS allows for analysis of many types of information
- Possible to input information over time to highlight areas of cumulative development
- Would provide a tool for land administrators to show 'on the ground' situation
- Much required background information is currently available

ILA CE GIS – Process

Project Phases:

1. Data Gathering
2. Model Creation
3. Technology acquisition and creation

ILA CE GIS – Data Gathering

- Most time and labour intensive portion of project
- Better to focus on ILA data first – worry about satellite coverage etc. later
- Require making ILA paper land use inventory digital – reading, extracting, scanning and digitizing
- Likely require a 1 year position at ILA to do this – training in GIS and data management can be provided
- Funding available from EC&E (GNWT) and AHRDA (IRC) to help alleviate the cost
- Benefits ILA in many ways, not just CE monitoring – initiate statistical analysis of land use

ILA CE GIS – Model Creation

While Data Gathering phase is underway can also create CE monitoring model

- ILA, ILAC, HTC and Community input
- Must be able to defend any parameter to be included
- Must be flexible to change in impacts and environment
- Must have Inuvialuit content

ILA CE GIS – Technology Creation and Acquisition

Once Data has been compiled and Model has been created, technology can be obtained to execute model

- Require specialized computer programming
- May require outside help (consultants)
- May require additional software – possible web applications?
- May require additional data sources – satellite imagery, digital terrain models etc. (Ground features)
- *GeoConnections Canada* (Federal): $60M over next 5 years for GeoSpatial applications
- This project eligible for up to $150,000 (to 50% of project cost)

ILA CE GIS - Results

More Efficient Land Administration:

- Useful tool in Land Use Policy creation and rule implementation
- Different land uses allowed based on LQI:

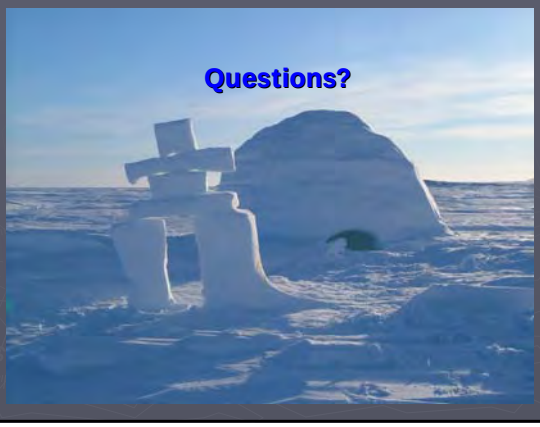
  Ex. If LQI = 0 – 100 (100 = unusable lands, 0 = non-objectionable/suitable lands) Land LQI >75 = suitable for development type *X* but not development type *Y*
- Certain areas could have LQI 'conditions' associated – i.e. Special Areas, Pipeline route etc.
- Could help manage impacts of large-scale projects: Mackenzie Gas Project

ILA CE GIS - Summary

ILA is continually looking to improve its land management capabilities

ILA is faced with the challenge of managing a large territory with limited human resources

Innovative technology use can help ILA meet that challenge



SoilVision Systems Ltd.

GEOTECHNICAL DATA: REVIEW OF EXISTING SOFTWARE AND STANDARDS

Presenter:
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Prepared for: INAC

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Overview

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Introduction

- Collection of geotechnical data in a digital format has proceeded since the popularization of personal computers in the late 1980's
- The software utilized and the data format selected varied significantly between organizations
- This difference resulted in chaos when consultants, universities, or government organizations attempted to exchange geotechnical data
- Since the setup of the Association of Geotechnical and Geoenvironmental Specialists (AGS) in 1991 there has been an ongoing effort worldwide to move towards established standards for the exchange of geotechnical data
- This report provides a summary of existing data standards and software that can be used for the exchange of geotechnical data

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OVERVIEW

- The standardization of geotechnical and geoenvironmental data format would represent a significant improvement in the practice of geotechnical engineering
- Data could be more easily exchanged within and across national boundaries
- The standardization would also allow data to be made available and searchable through "Web servers" anywhere in the world
- The need for global standardization has been recognized since 1991 with the formation of the "Association of Geotechnical and Geoenvironmental Specialists", AGS in the UK
- AGS
  - On third edition (3.1)
  - Widespread use throughout the UK, Singapore, and Hong Kong
  - Estimated usage at about 700 firms

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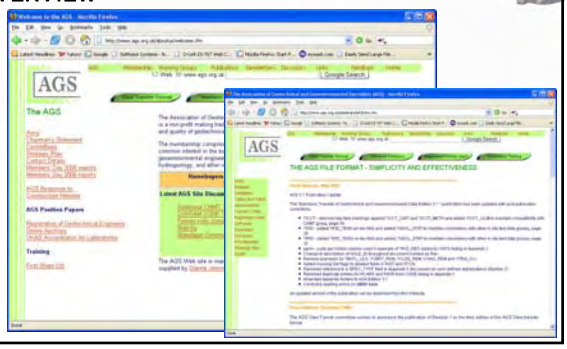
OVERVIEW



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OVERVIEW

- More recently
  - Exchange of data over the Web
  - Popularization of the XML data format
- This new data exchange tool has initiated a revisitation of geotechnical data standards
- Changing a standard is complex since it requires a "buy in" of
  - industry leaders in data management
  - software developers
  - AGS cost est. $3M
- SoilVision Systems Ltd. was retained in February, 2006 by Indian and Northern Affairs Canada (INAC)
  - Review existing efforts that have been made towards the standardization of the geotechnical data dictionary
  - Review status of software programs
  - Review current efforts of INAC

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HISTORICAL DEVELOPMENT

- Important to understand the context of its historical development
- The current status is the result of a number of significant initiatives by various organizations and individuals
- The first recognition of the need for a global geotechnical data standard - Association of Geotechnical and Geoenvironmental Specialists, AGS, in 1991 - UK
- The first published AGS standard appeared in 1992
- Second and Third editions of the AGS Format were published in 1994 and 1999, respectively
- Third edition included rules for the creation of user-defined fields
- Feature was leveraged significantly with the publication of AGS-M for monitoring data (CIRIA, 2002)

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HISTORICAL DEVELOPMENT

- AGS - it was considered important that there not be a conflict with the requirements of geotechnical and geoenvironment communities following the "National Codes of Practice or Standards"
- AGS format acceptance
  - Widespread acceptance by the geotechnical and geoenvironmental industry in the UK
  - Specified by most major clients and organizations in UK
  - Used by the British Geological Survey for the transfer of ground investigation data
  - The AGS format is used by an estimated 700 geotechnical offices in the UK and is widely used in Hong Kong, Ireland and Singapore
  - The AGS format has currently received reasonable support from about 25 compatible software programs listed on www.GGSD.com (Geotechnical and Geoenvironmental Software Directory)

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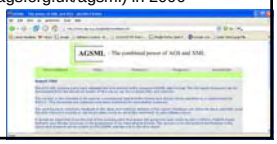
HISTORICAL DEVELOPMENT

- Recently been a push to update the AGS Format to an XML format
- XML is recommended as the W3C standard for sharing structured data over the internet
- There are significant advantages to adopting the XML format - seems to be the way of industry
- The need to incorporate XML into the AGS standard has led to a new standard called AGSML
- A "discussionary" implementation of the AGSML format has been posted on the AGSML website (www.ags.org.uk/agsml) in 2006



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HISTORICAL DEVELOPMENT

- It is anticipated that the first draft of the AGSML report will be made available sometime in the year 2006
- The AGSML group has also formed a data coalition with the COSMOS group, USA Federal Highway Administration and Florida University in order to develop an international transfer format based on the AGSML format
- It is anticipated that AGS will adopt AGSML as the basis for its new format called AGS 4 which has a tentative release date of 2007/2008
- This is Europe – what is happening in the US?

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HISTORICAL DEVELOPMENT

- Geotechnical management system workshop held in Newport Beach, California in June 2004
- The event was jointly sponsored by the FHWA and COSMOS
- The intent of the meeting was to meet the state Department of Transport, DOT, geotechnical management system needs as well as presenting the work of COSMOS, UKHA, and AGS
- There was significant interest from state DOT representatives to pursue the development of standards for geotechnical management systems
  - Exchange of data!
  - A state DOT highway project could conceivably take advantage of subsurface investigation data obtained by state Environmental Protection Agencies (EPA), USGS, US Army Corps of Engineers, and others

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HISTORICAL DEVELOPMENT

- The focus of the geotechnical management system workshop became to create the DIGGS standard
- The DIGGS project currently has $643,000 (US), in funding to combine existing geotechnical data standards (AGS, UF, COSMOS)
- The first version of the DIGGS standard is due to be published in the first part of 2007 and is likely to become the primary international data standard

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HISTORICAL DEVELOPMENT

Year	Description
1991	Association of Geotechnical and Geoenvironmental Specialists (AGS) set up Working Party
1992	First edition AGS 1 released
1994	Second edition AGS 2 released
1996	NGES (National Geotechnical Experimentation Site) developed at University of New Hampshire (http://www.unh.edu/nges/)
1996	XML Working group formed by W3C
1998	XML first published (Specification 1.0)
1999	Third edition AGS 3.1 released - user defined fields added - incorporated AGS-M
2000	XML Second Edition specification published
2001	Geotech-XML format developed by Oklahoma State University
2003	Presentation of Geography Markup Language (GML) version 3.00
2004	W3C World Wide Web Consortium, http://www.w3.org/XML/
2005	DIGGS draft data dictionary proposed
2006	AGSML format published
2007	DIGGS version 1 specification released
2008	AGS 4 format release ? - incorporating XML data format

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ORGANIZATIONS/EXISTING STANDARDS

- **Creating and proposing a geotechnical data standard is not a trivial task**
- **It requires a significant investment from a number of different organizations as well as reasonable endorsement from the software industry**
- **These factors must also be considered in light of varying standards of practice throughout the world**
- **Because of the complexity of this task there have been a number of standards that have been proposed over the years**
- **Many of these have not gained significant usage**
- **So where are we now?**

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ORGANIZATIONS/EXISTING STANDARDS

- **Previously - a historical overview of the primary standardization initiatives**
- **Now will provide a comprehensive list of the formats that have been proposed along with the supporting organizations**
- **WARNING – there are a lot of formats and this may be confusing…!**
- **A comprehensive list of geoscience standards has been compiled by Tim Spink (CIRIA, 2006)**
- **Presented on the Geotechnical and Geoenvironmental Software Directory (GGSD) at www.ggsd.com**

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ORGANIZATIONS/EXISTING STANDARDS

- **GEOLOGICAL file formats**

Format name	File extension	Description	Status	Ownership	Number of programs
Datamine		Drilling information and 3-D geological modelling	In use	Proprietary	1
DGSM		Digital Geoscience Spatial Model. Geology, structural geology, landforms, stratiraphy	In use	Proprietary	0
Earthvision		3D modelling format for proprietary software	In use	Proprietary	1
eEarth	.xml	International borehole data interchange format	Active	Open source	0
episEM IS	.xml	EPIcentre Shared Earth Model. Petroleum industry focussed research project for transfering geological models.	Development	Open source	0
ESML	.xml	Earth Science Markup Language to describe the structure, semantics and content of any earth science dataset	Active	Open source	0
GeoSciML	.xml	Geology, structural geology, landforms and text	Development	Open source	0
LogPlot		Borehole information	In use	Proprietary	5
Micromine		Mining data processing software with proprietary data format.	In use	Proprietary	2
NADM	.xml	North American geological map Data Model	Development	Open source	0
RESCUE		Petroleum industry transfer of data from geomodels through the use of the Epicenter data	Active	Open source	0
Rockworks		Borehole information	In use	Proprietary	2
SBB	.xml .txt. or .xls	Shallow boreholes tranfer format for sales from The Netherlands National Geological Survey	Active	Open source	0
SEP	.mdb	Borehole information	In use	Open source	2
Surpac		Mining industry data transfer format	In use	Proprietary	1
Vulcan		Mining data and 3-D mining modelling	In use	Proprietary	4
WinCORE		Borehole information	In use	Open source	1
WinLog		Borehole information	In use	Proprietary	8
XMML	.xml	Data transfer format for Mining Industry (eXploations and Mining Markup Language)	Active	Open source	0

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ORGANIZATIONS/EXISTING STANDARDS

- **GEOTECHNICAL file formats**

Format name	File extension	Description	Status	Ownership	Number of programs
AGS	.AGS	Geotechnical field, laboratory and monitoring data transfer format.	Active	Open source	28
AGS-M	.AGS	Monitoring data transfer format. Now included in AGS 3.1	In use	Open source	1
AGSML	.xml	Geotechnical field, laboratory and monitoring transfer format. Incorporated within DIGGS	Development	Open source	0
bch	.bch	Inclinometer monitoring data file type.	Obsolete	Proprietary	1
CivilXML	.xml	Construction records - principally piling, and associated geotechnical data. Incorporated within DIGGS.	Development	Open source	0
COSMOS	.xml	California based geotechnical data transfer format for earthquake studies. Incorporated within DIGGS	Development	Open source	0
DIGGS	.xml	Data interchange for geotechnical and geoenvironmental specialists. Based on AGSML, COSMOS and CivilXML	Development	Open source	0
GEF	.gef	CPT test results	Active	Open source	3
GeoMil		CPT test results	In use	Proprietary	2
Geopoint		CPT test data format	In use	Proprietary	1
GeotechML	.xml	Geotechnical field, laboratory and monitoring transfer format	Inactive	Open source	0
Gorilla!		CPT test results	In use	Proprietary	1
NENGEO		Dutch CPT test results format.	Obsolete	Open source	1
NGES	.xml	Geotechnical data exchange format for scientific research sites	In use	Open source	0
RocProp		Database of Rock Properties	In use	Proprietary	0
RPP	.rpp	Inclinometer monitoring data	In use	Proprietary	1
SGF		CPT test results	In use	Open source	1
SlopesML	.xml	Slope stability case history format	Inactive	Open source	0

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ORGANIZATIONS/EXISTING STANDARDS

- **GIS & MAPPING file formats**

Format name	File extension	Description	Status	Ownership	Number of programs
Atlas BNA	.bna	Atlas GIS file format	Obsolete	Proprietary	7
Atlas GIS	.axf	Geographical Information System spatial data format.	Obsolete	Proprietary	3
DEM	.dem	Digital Elevation Model.	In use	Open source	14
DLG	.dlg	USGS Digital Line Graphics mapping data	In use	Open source	5
E00	.e00	Geographical Information System spatial data format. Transfer format for ArcInfo	Obsolete	Proprietary	2
ERDAS	.lan or .gis or .img	Mapping image format	In use	Proprietary	3
GeoHO		3D engineering modelling software transfer format used by MOSS/MX	In use	Proprietary	2
Geopak		3D engineering modelling software.	In use	Proprietary	1
GEOSPOT		Geographical Information System image data format for satellite imagery	In use	Proprietary	2
GML	.xml	Geography Markup Language	Active	Open source	0
GRASS		File format for Geographic Resources Analysis Support System open source GIS	In use	Open source	3
LandGML	.xml	Incorporates spatial data used by designers, contractors and surveyors using GML 3.	Active	Open source	0
LandXML	.xml	Incorporates spatial data used by designers, contractors and surveyors. Interoperability with MX	Active	Open source	0
LAS	.las	Interchange format for LiDAR data	Active	Open source	0
MIF / MID	.mif or .mid	MapInfo data transfer files	In use	Proprietary	29
MOSS		3D engineering modelling software transfer format, Now known as MX	Obsolete	Proprietary	2
SDSFIE		Spatial data standard for facilities, infrastructure and environment. US military standard, adopted for USACE geotechnical data management	In use	Open source	0
SDTS		Spatial data transfer standard. Mandatory compliance for US federal agencies	In use	Open source	0
Shape	.shp	ESRI ArcView GIS file format	Active	Proprietary	43
Surfer boundary	.bln	Surfer sector boundary file format	In use	Proprietary	5
Surfer grid	.grd	Surfer gridded data file	In use	Proprietary	3
TIGER		Topologically Integrated Geographical Encoding and Referencing Files. Line based.	In use	Open source	0
XYZG		Rockworks 3D model transfer format	Inactive	Proprietary	2

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WHY XML?

- **There is a wide range of existing file formats for geotechnical soil data**
- **The XML standard offers particular benefits in the development of a worldwide geotechnical data standard**
- **There are a host of compelling reasons to adopt the XML format for the establishment of a geotechnical data standard**
- **Since its first incarnation in 1998 the use of XML has gained worldwide acceptance and is theW3C standard for sharing structured data over the Internet**

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WHY XML?

- **Platform-independent:** A XML file can be defined on any particular software platform and exchanged with other software platforms. XML resources are widely available for both Windows and Linux platforms.
- **Widely Supported and Adopted:** XML is a standard for structured Internet data exchange as proposed by the World Wide Web Consortium (W3C) in 1998.
- **Self Describing:** an XML file format can be deciphered by software to determine what data elements are contained in the file. Tables, relationships, and data types are all defined in an XML file.
- **Variety in Supported Data Types:** It is possible to store text and numbers, graphics, multimedia objects such as towns, and active formats as Java applets or ActiveX components.

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WHY XML?

- **Verifiable:** The XML schema allows for quick and easy verification of an XML file.
- **Style Sheets:** style sheets can be used to format the data in any manner without changing the original data.
- **Internationalism:** XML supports multilingual documents through the use of the Unicode standard.
- **Distributed Data:** XML documents can consist of data stored on multiple servers located anywhere on the web.
- **Unit Conversions:** Units and coordinate-dependent data can be automatically tagged in an XML format which allows automatic conversion from one system to another.
- **Archival Advantages:** Binary file formats require specific software in order to obtain access to the data. The use of a text-based file format means the data can be stored and transformed more easily when technologies change in the future.

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WHY XML?

- The theory behind XML provides a format for general data exchange. If one software application receives an XML file, the file is run through a filter that allows the data to be processed appropriately
- An example of how this might work can be readily seen in the HTML code used in an Internet browser

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" lang="en"><!-- InstanceBegin template="/Templates/main.dwt"
      codeOutsideHTMLIsLocked="false" -->
<head>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1" />
<!-- InstanceBeginEditable name="doctitle" -->
<title>Data Interchange for Geotechnical and Geoenvironmental Specialists</title>
<!-- InstanceEndEditable --><link href="includes/main.css" rel="stylesheet" type="text/css" />
<!-- InstanceBeginEditable name="head" --><!-- InstanceEndEditable -->
</head>
<body>
<div class="box-wrap">
<div class="box-header">
<h1><a href="index.asp"><img src="images/diggs_header.gif" alt="DIGGS Logo - Go To Homepage" width="744" height="101" class="logo"
      /></a></h1>
</div>
<div class="nav-menu">
 <ul>
```

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WHY XML?

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WHY XML?

- Example – finite element model files from the SVFLUX groundwater modeling software (SoilVision Systems Ltd.)

```
<?xml version="1.0"?>
<SVSModel xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xsd="http://www.w3.org/2001/XMLSchema">
 <ApplicationName>SVFlux</ApplicationName>
 <ApplicationVersion>6.00.16</ApplicationVersion>
 <SVS_Front_End_Model>
  <Project_ID>Examples</Project_ID>
  <Model_ID>Subsidence</Model_ID>
  <System_Type>THREE_DIMMENSION</System_Type>
  <TransientProblem>false</TransientProblem>
  <Model_Bounding_Box Min_X="-5" Min_Y="-5" Min_Z="0" Max_X="110" Max_Y="110" Max_Z="10" />
  <WCSLeft>0</WCSLeft>
  <WCSBottom>0</WCSBottom>
  <WCSRight>0</WCSRight>
  <WCSTop>0</WCSTop>
  <WCSNear>0</WCSNear>
  <WCSFar>0</WCSFar>
  <Regions>
   <Region ID="1">
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     <SoilID>657556</SoilID>
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```

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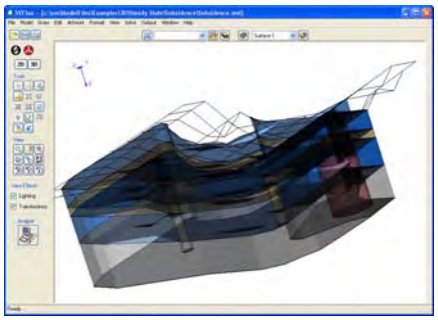
WHY XML?



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THE MOVE TOWARDS XML

- It can be seen that there has been significant endorsement of the XML standard through the following proposed formats

Geotechnical XML	(www.ejge.com/GML)
GeotechML	(http://www.dur.ac.uk/geo-engineering/geotechml/)
SlopesML	(http://www.ins.itu.edu.tr/bulent/slopesml/)
ISO	(http://isotc.iso.org/livelink/livelink?func=ll&objId=138420&objAction=browse&sort=name)
eEarth	(http://www.eearth.nl)
XMML	(https://www.seegrid.csiro.au/twiki/bin/view/Xmml)
GeolSciML	(https://www.seegrid.csiro.au/twiki/bin/view/CGIModel/GeoSciML)
COSMOS	(http://www.cosmos-eq.org/GVDC.html)
AGSML	(http://ags.org.uk/agsml/)
FDOT	(http://fdot.ce.ufl.edu/)
GADML	(http://www.hagdms.com/)
DIGGSML	(http://www.diggsml.org/)

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THE FUTURE - DIGGSML

- Given the significant number of geoscience formats currently available, it might initially appear to be a daunting task to have a single format that will eventually dominate the computer system
- The concept of a global standard has always been desirable
- The work initially done by AGS has led to a number of greater initiatives that are currently underway
- The primary new initiative, (i.e., DIGGS) has begun with the endorsement of the primary management groups worldwide at the government level
- As this new standard is published and becomes more widely used, it remains unlikely that it will replace proprietary software formats but rather provide an avenue for easy exchange of geo-data

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THE FUTURE - DIGGSML

- The DIGGS project has the support of the following organizations:
  - 12 State Department of Transportation, DOTs
  - Federal Highway Administration (FHWA)
  - US EPA (U.S. Environmental Protection Agency)
  - US Army Corps of Engineers
  - US Geological Survey
  - UF
  - AGS
  - COSMOS
  - Construction Industry Research and Information Association (CIRIA)
  - Ohio Department of Transportation (ODOT)
- Given the significant level of “buy-in” to the DIGGS project, it is quite likely to become the new world standard when it is published in 2007.

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SOFTWARE SYSTEMS

- The development of a data standard is highly beneficial for software systems
- Many software systems have used proprietary data formats in the past and it is likely they will be used in the future
- Proprietary formats generally complicate the exchange of data between agencies

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SOFTWARE SYSTEMS – AGS SUPPORT

- AGS File Manager - Data validation
- ALF - Data validation
- Contam Data System - Geoenvironmental database systems
- CPT-pro - Insitu testing
- DataSystem 7 - Laboratory testing (soil)
- GEODASY - Database systems (with log production)
- GeoSmart II - Borehole log production
- GEOVIEW - Geographical information systems
- gINT LogWRITER+ - Database systems (with log production)
- gINT Professional - Database systems (with log production)
- HoleBASE III - Database systems (with log production)
- INCLI-pro - Instrumentation
- KeyAGS - Data validation information
- KeyGeoView - Geographical systems
- KeyHOLE - Database systems (general)
- KeyLAB - Laboratory testing (soil)
- MonitoringPoint - Instrumentation
- PocketSI - Field data collection
- SID - Database systems (with log production)
- Smart Lab - Laboratory testing (soil)
- Smart-M - Instrumentation
- SOILVISION – Database system (saturated and unsaturated soils)
- TECHBASE - Database systems (with log production)

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SOFTWARE SYSTEMS – WEB BASED

- It should be noted that any proposed data standard does not necessarily provide a good database design format
- The purpose of a data standard is primarily for data exchange
- Web-based geotechnical database systems show promise for the future of managing and using geotechnical data
- Off-the-shelf commercial web-based systems are not currently available
- Governmental companies have a strong desire to manage larger amounts of information and make it public to all companies
- Web platforms offer an ideal setting for the dissemination of geotechnical data for these organizations
- Web-based systems have therefore been developed in conjunction with large initiatives where data from multiple organizations must be managed

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CASE STUDY – US DOTs

- State DOT geotechnical specialists are pursuing means to better manage geotechnical data (e.g., boring logs, lab test data), geologic hazards (e.g., landslides, rockfalls, mine subsidence), and assets (e.g., walls, reinforced slopes)
- The geotechnical investigation records for the state drilling crews are stored in a warehouse at the central DOT vehicle maintenance facilities once the projects are completed
- Multiple projects are stored in each cardboard records box and the boxes are indexed by the section of warehouse shelf where they are stored


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CASE STUDY – US DOTs

- Over 21,000 index cards are maintained to provide a reference to the project boxes
- Frequently, box location and subsequent reference numbers are changed without updating the index cards
- This makes the retrieval of information difficult and time consuming
- It currently requires 20-30 person hours per week to retrieve information for planning and preliminary design of projects


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CASE STUDY – US DOTs

- This historical information is valuable for nearly all future highway projects including rehabilitation and widening
- The information stored at the central office is valued at $½ billion
- An equivalent amount of geotechnical data is also stored at District offices
- It is estimated that the use of this information will reduce the amount of drilling for projects by 10-20% resulting in cost savings of $12-24 million per year

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CASE STUDY – US DOTs

- Subsurface investigation data and reports for consultant designed projects are placed in their respective project files residing at each District office
- This information is held in the file until several years (usually about 7 to 8 years) after the completion of the project
- Then, the project files are purged and disposed of (difficult to search in the future)
- This practice may result in the loss of geotechnical data valued at an estimated $52 million per year

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CASE STUDIES – CALTRANS

- The current archives of geotechnical information at California Department of Transportation (Caltrans) includes large volumes of paper records
- There is significant pressure to expedite project delivery and this heightens the need for more efficient data management practices as well as data collection practices

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CASE STUDIES – CALTRANS

- In order to expedite the entire workflow, Caltrans has undertaken a number of initiatives:
- **Borehole logging data:** Collaboration with the DIGGS geotechnical data management committee has resulted in efforts to develop and finalize a reasonable data dictionary – standardized borehole information
- **Field borehole logging with Tablet PC's:** Four PCs have been deployed over the course of a year in 2005. It is anticipated that the use of these units will minimize errors from multiple handling of data between field and office operations.

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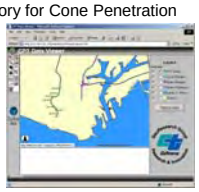
CASE STUDIES – CALTRANS

- **Laboratory Data Management Software:** Work is currently underway to develop and test an advanced soils laboratory data management system. The system is designed to replace previous laboratory processes where test data is logged on paper forms.
- **Insitu test data:** A study was undertaken 2002 to explore the feasibility of an effective web-based repository for Cone Penetration Test (CPT) data. The result of this work:



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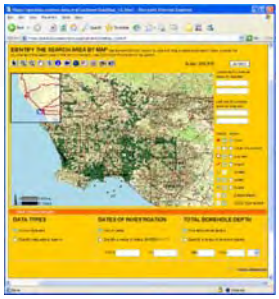
CASE STUDIES – CALTRANS

- **Partnerships: COSMOS/DIGGS**



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CASE STUDIES – Mn/DOT

- The Minnesota Department of Transportation (Mn/DOT) has advanced over 20,000 soil borings and CPT soundings in the past 46 years (Dasenbrock, 2006)
- With this significant amount of data there has been a concerted effort over the past few years to improve the methodology associated with handling the data
- A web-based interface and set of query tools was developed in 2003. A public version of this system is expected to be ready in 2006
- Mn/DOT is one of the organizations involved in the development of the new DIGGS standard and the organization is working towards compatibility

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CASE STUDIES – eEarth

- The eEarth system (http://fraga.nitg.tno.nl/dinoLks/eEarth.jsp) allows the user to browse borehole data held by six European geological surveys, representing the United Kingdom, Netherlands, Germany, Poland, Czech Republic and Lithuania
- The system incorporates a multilingual web GIS interface, and borehole information can be displayed in seven European languages: English, Dutch, German, Polish, Czech, Lithuanian and Italian

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CASE STUDIES – eEarth

- Support:
  - The Netherlands Institute of Applied GeoScience (TNO-NITG, NL)
  - The Dutch Geological Survey
  - British Geological Survey (BGS, UK)
  - German Geological Survey (Bundesanstalt fur Geowissenschaften und Rohstoffe, BGR)
  - Lithuanian Geological Survey (LTG, LT)
  - Polish Geological Institute (PGI, PL)
  - Geofond (CZ)
  - Geodan Mobile Solutions (NL)
  - Golder Associates (IT)

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CASE STUDIES – eEarth

- Initial project development took place over a span of approximately 18 months.
- A great deal of effort was invested in converting information from a various formats into a consistent standard.
- The eEarth project developed its own data standard based on the XML schema (http://eearth.nitg.tno.nl/schema/e_earth.xsd).

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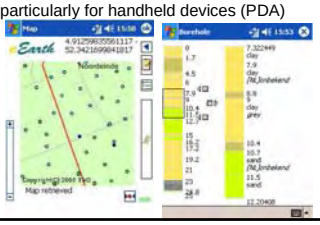
CASE STUDIES – eEarth

- The eEarth initiative has also included support for mobile handheld devices
- A mobile user is able to visualize his location as well as displaying a log of a borehole of their interest
- The borehole can be selected by a means of a GIS applications developed particularly for handheld devices (PDA)



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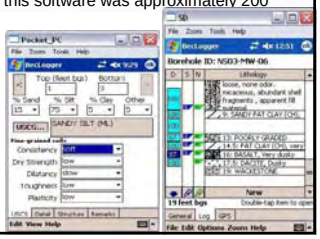
CASE STUDIES – Bechtel

- Bechtel has now attempted to improve the handling of borehole data by developing a software application known as a Personal Digital Assistant, PDA
- It is estimated that the manpower savings for logging and producing final logs for 20 boreholes using this software was approximately 200 hours
- The initiative spearheaded by Bechtel has also involved Idaho National Labs and resulted in the development of a borehole logging program called BecLogger



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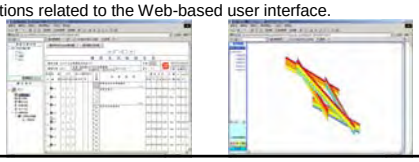
CASE STUDIES – Sinotech

- Sinotech engineering consultants in Taiwan had a need for proper management at geotechnical engineering sites
- A preliminary web-based system named GENET has been established and applied in practice (Wang, 2006)
- The system includes modules for project management, borehole log report generation, strata definition, and a geological database of 16,417 boreholes around Taiwan
- The most common complaint associated with the system has to do with limitations related to the Web-based user interface.



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APPLICATION TO INAC

- There are many similarities between current INAC efforts and existing efforts by other government organizations in other countries
  - Consideration should be given to supporting the DIGGS recommended exchange format in the current database design.
  - The DIGGS XML format should provide reasonable avenues for:
    - easy submission of new data, and,
    - validation of new and existing data.
  - It may be reasonable to review the design of existing databases for borehole data, in situ and laboratory test results in light of the DIGGS format.
  - Storage of sieve analysis data should be designed such that it conforms to the DIGGS format
  - Data reporting methodologies could benefit from the use of XML style-sheets
  - Design of the current web system could benefit from an in-depth review of related efforts

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THANK YOU...