

Web-enabled Geospatial Environmental Monitoring Tool for the Sea-to-Sky Highway

***URISA BC –
Environmental Decision Making with GIS***

ENVIRONMENT SPECIALISTS



About Me



- ▶ Computer Engineer (UVic)
- ▶ Previously worked in “Community Informatics”
 - Bhutan, Fiji, Coquitlam, Port Moody
- ▶ Now: Environmental Information Systems
 - User needs analysis, training & capacity building;
 - Environmental Data Management:
 - Web based project management systems:
 - Remote sensing product delivery, visualization and analysis tools;
 - Geographic information systems (GIS):
 - Spatial data analysis and modeling;
 - Web based GIS visualization and analysis (internet map services); and
 - Spatial database design, customization, and implementation
 - Data logger data management, alerting and reporting;
 - Content development

About Hatfield



- ▶ Since 1974, Hatfield has provided expert environmental services to industry and government
- ▶ Our key markets are Canada, Southeast Asia, Africa and South America
- ▶ Head office in Vancouver, B.C. / Second Canadian office in Fort McMurray, Alberta
- ▶ Joint venture offices in Chile ('85), Indonesia ('90) and Thailand ('95)
- ▶ 60 professional staff
- ▶ Over 1000 projects completed

Our Clients (1)



Multi-national, private sector resource companies:

- Mining (Canada/Indonesia/Chile/Peru/Congo)
- Pulp and Paper (Canada/Indonesia)
- Oil & Gas (Canada/Indonesia/China/Viet Nam)
- Hydroelectricity (Canada/Lao PDR)
- Linear Developments (Canada, Bangladesh, Uruguay, Indonesia, China)
- Aquaculture (Canada, Chile, Thailand, Indonesia)



Our Clients (2)



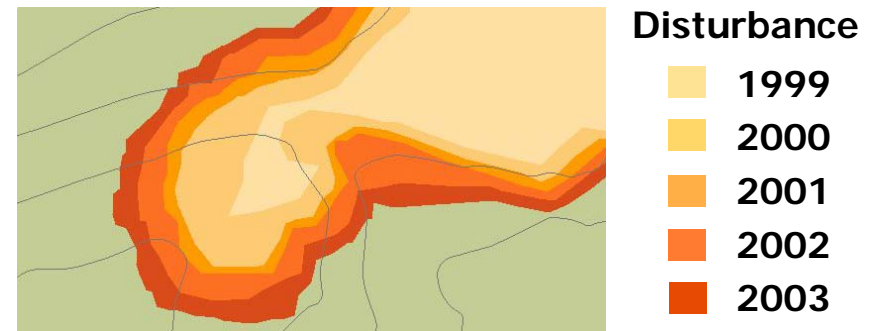
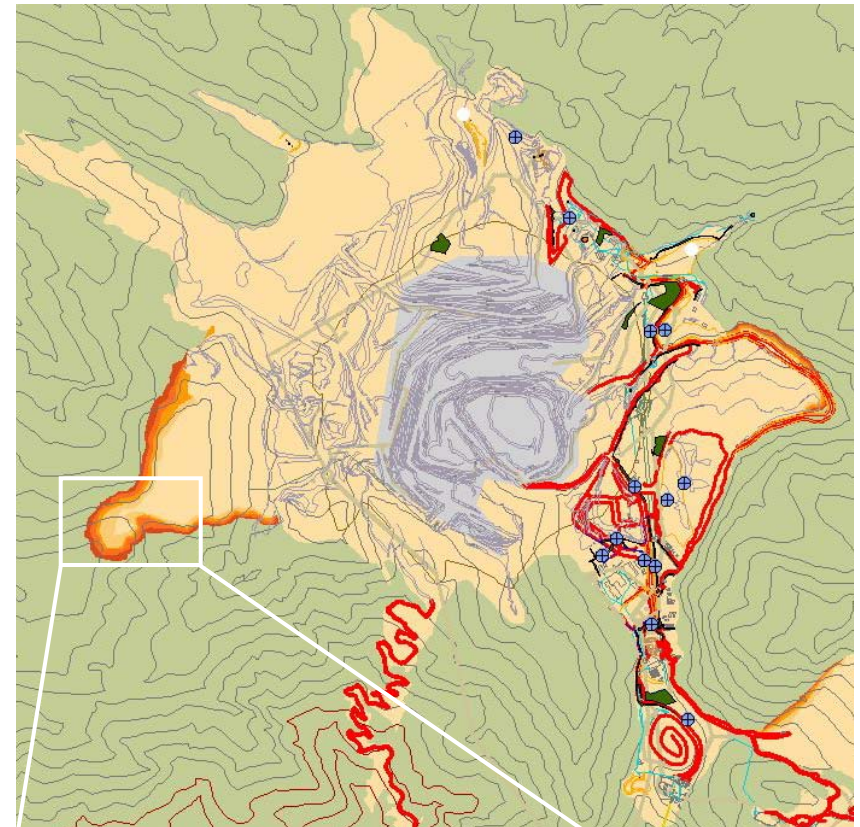
Development agencies and IFI's:

- Asian Development Bank (ADB)
- Mekong River Commission (Lao PDR, Cambodia)
- Canadian Space Agency (CSA)
- European Space Agency (ESA)
- World Bank (WB)
- Canadian International Development Agency (CIDA)
- DANIDA (Denmark)
- SIDA (Sweden)
- Ford Foundation (Viet Nam)

Remote Sensing and GIS



PT Freeport Grasberg Mine:
Ortho photos with logistical
data layers



Sea-to-Sky Highway Improvement Project - Overview

- ▶ 13,700 vehicles per day (Horseshoe Bay to Squamish)
- ▶ 7,700 vehicles per day (Squamish to Whistler)
- ▶ 300 crashes on the highway each year, substantially higher than the provincial average for comparable roads.
- ▶ 65 km of road improvements between Horseshoe Bay and Whistler in preparation of the 2010 Winter Olympics
- ▶ Provincial investment of \$600million

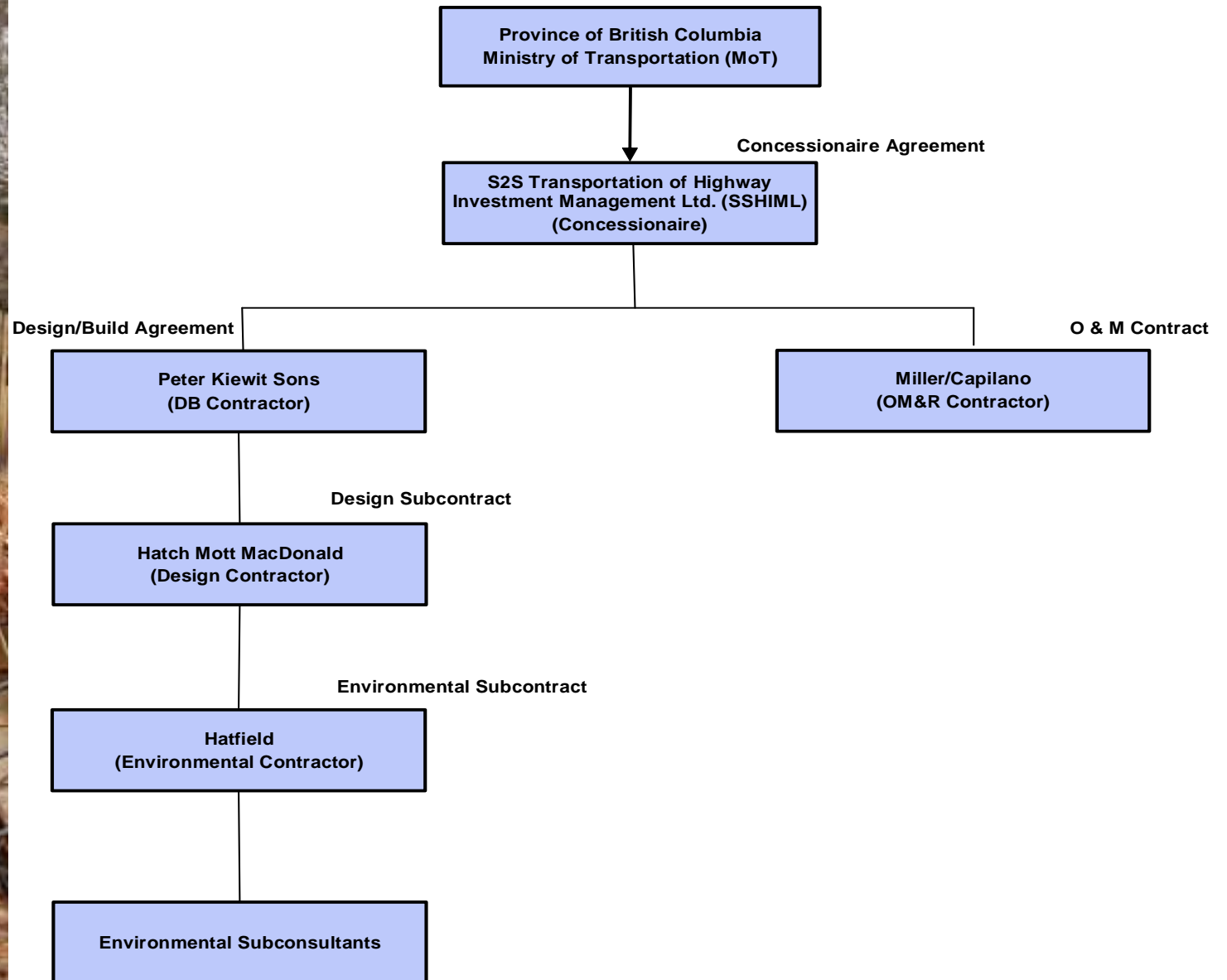


Sea-to-Sky Highway Improvement Project - Overview

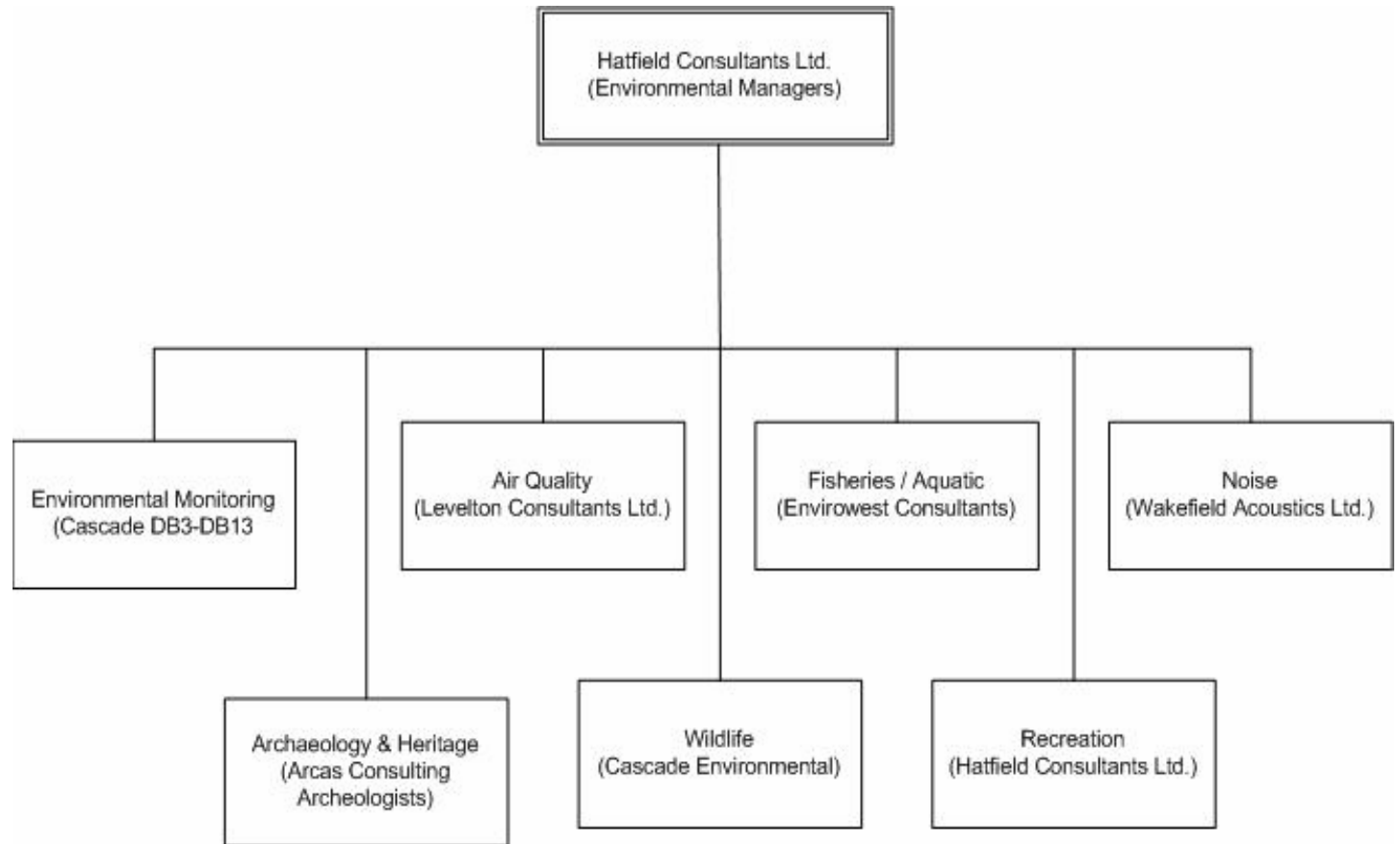


- ▶ The Ministry of Transportation (MoT) and S2S Transportation Group (S2STG) signed an agreement in June 2005 to design, build, finance, and operate the Sea-to-Sky Highway Improvement Project
- ▶ Highway has very high environmental profile
- ▶ Extensive environmental management needed due to water resources, red and blue listed species, and fisheries concerns

S2S Clients and Implementation Team



S2S Clients and Implementation Team



Environmental Management Activities



- ▶ Prepare environmental management plans (EMPs) to address natural resource issues
- ▶ Review designs for environmental requirements
- ▶ Prepare Environmental Certificates for designs prior to construction
- ▶ Assist with permit applications
- ▶ Coordinate sub-consultants for fisheries, wildlife, archaeology, air, noise, recreation and ongoing monitoring
- ▶ Communicate and liaise with multiple stakeholders and agency personnel
- ▶ Conduct ISO9001/14001 quality audits and surveillances related to environmental issues

Environmental Information Management



- ▶ A major challenge for the Project is the management of all documents related to environmental activities: EMPs, permits, monitoring data and reports, agency comments, discipline specialists reports, ...
- ▶ The production and acquisition of the documents must fit in the overall design and construction schedule
- ▶ Timely and effective management of documents reduces risk of delays due to lengthy regulatory agency review, permit acquisition and Project activities in and around environmentally sensitive areas

Environmental Information Management System



- ▶ A Web-based environmental information portal has been developed for the life of the Project with the features and functionalities described hereafter.
- ▶ The portal provides access to over 1,550 reports, 1,500 permits, 200 environmental features and 12,200 water quality measurements through an interactive database and specialized search engines.

Environmental Information Management System



- ▶ Access is limited to users with appropriate authorizations (environmental team, Design/Build contractors, regulatory agencies)

The screenshot shows the user interface of the Environmental Information Management System. At the top, a banner image of a mountain range contains the text "Sea-to-Sky Highway Improvement Project" and "Environmental Information Management System". Below the banner is a navigation menu with buttons for "Home", "Disciplines", "Permit Tracking", "Feedback", "Administration", and "logout". The main content area has a breadcrumb trail "You are here: Home > Login" and a heading "Login". A green message bar states "You have been logged out". Below this are input fields for "Username:" and "Password:", followed by a "Login" button.

Sea-to-Sky Highway Improvement Project
Environmental Information Management System

Home Disciplines Permit Tracking Feedback Administration logout

You are here: Home > Login

Login

You have been logged out

Username:

Password:

Login

Environmental Information Management System



- ▶ Data is organized, searched for and retrieved based on key parameters such as location, category and key-word.

Sea-to-Sky Highway Improvement Project
Environmental Information Management System

Home Disciplines Permit Tracking Feedback Administration logoff

You are here: Home > Search

Advanced Search

Search for Environmental Data, Documents, Reports, and Permits

by DB Sections => All DB Sections

- DB01
- DB03
- DB04
- DB05
- DB06
- DB07
- DB08
- DB12
- DB13

by Project Segments

by Crossing Name

custom station range

=> Start Station:

=> End Station:

In Disciplines:

- All Disciplines
 - Water Quality
 - Air Quality
 - Archeology
 - Recreation
 - Fish & Aquatics
 - Vegetation
 - Noise
 - Wildlife
- Document & Report Types
 - Monitoring Reports
 - Incident Reports
 - Environmental Management Plans
 - Photos
 - Environmental Design Certificates

Filter documents & reports:

- do not filter by keyword
- containing keywords:

Search

Environmental Information Management System



- ▶ Environmental Disciplines:
 - Water Quality
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Environmental Information Management System



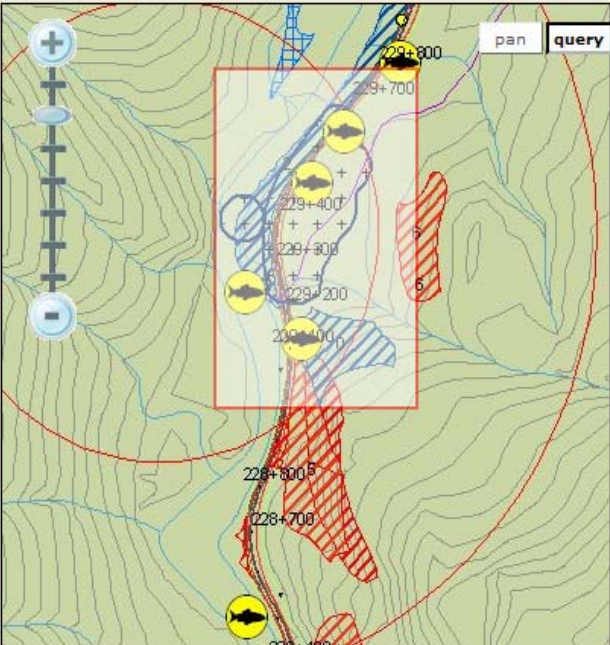
- ▶ Document & Report Types:
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 - Incident Reports
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 - Photos
 - Environmental Design Certificates

Environmental Information Management System

Sea-to-Sky Highway Improvement Project
Environmental Information Management System

Home | Disciplines | Permit Tracking | Feedback | Administration | logoff

You are here: Home



Environmental Information between stations 229+000 and 229+700
stations shown are for S2S design

Environmental Data

DB	Station	Feature	Discipline	
DB12	228+840 - 229+090	Red-listed Polygon 356	Vegetation	details edit
DB12	229+090 - 229+150	Blue-listed Polygon 358	Vegetation	details edit
DB12	229+100	Cheakamus River Tributary	Fish & Aquatics	details edit
DB12	229+180 - 230+220	Blue-listed Polygon 364	Vegetation	details edit
DB12	229+200 - 229+670	CMTs	Archeology	details edit

Showing 5 of 10 environmental data points. [see all data](#)

Documents & Reports

DB	Station	Title	Discipline	
DB05 - DB13	126+701 - 250+300	Weekly Monitoring Report #45 (Seg 3&4)	Monitoring Reports	details edit
DB01 - DB13	98+500 - 250+300	EMP, Early Construction Works (Rev 1)	Environmental Management Plans	details edit
DB02 - DB13	110+600 - 250+300	Weekly Monitoring Report #1	Monitoring Reports	details edit
DB02 - DB13	110+600 - 250+300	Weekly Monitoring Report #2	Monitoring Reports	details edit
DB02 - DB13	110+600 - 250+300	Weekly Monitoring Report #3	Monitoring Reports	details edit

Showing 5 of 163 most recent reports. [see all reports](#)

Permit Checklists

DB	Station	Name	Est. Construction Start	Status	
...	98+450	S2S Corridor	...	no	view permit

[view map legend](#) | [reset map](#)

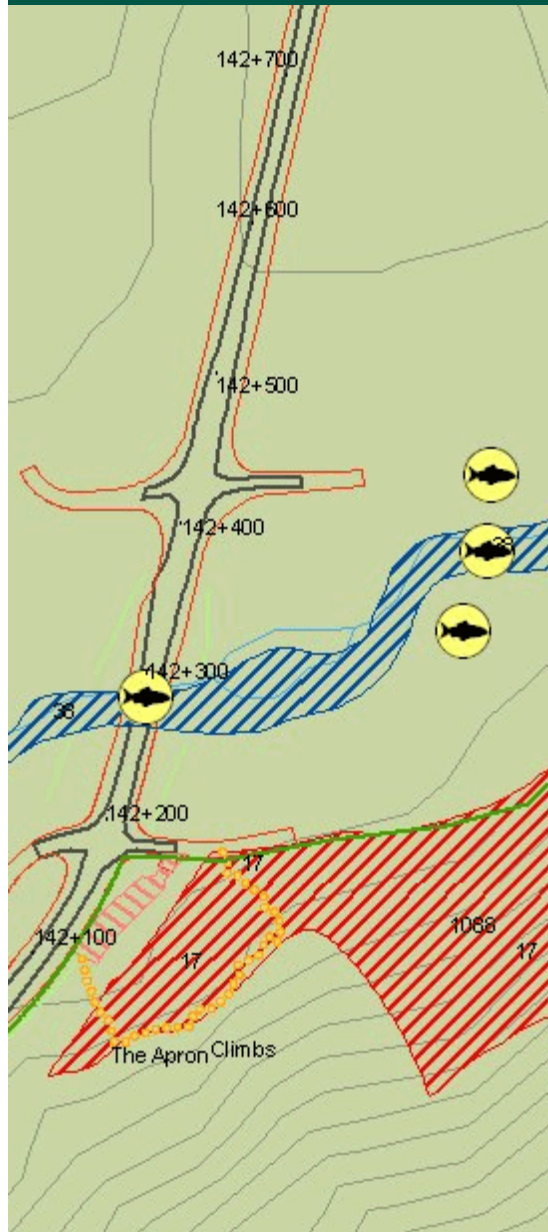
- ▶ A seamless panning and querying Internet map viewer enables users to explore the detailed highway development plans and search documents based on the area they relate to.
- ▶ Spatial relations are very important for Sea-to-Sky corridor
- ▶ In general, Linear Development uses CAD and local units which are not useful for Environmental Monitoring.

Technologies

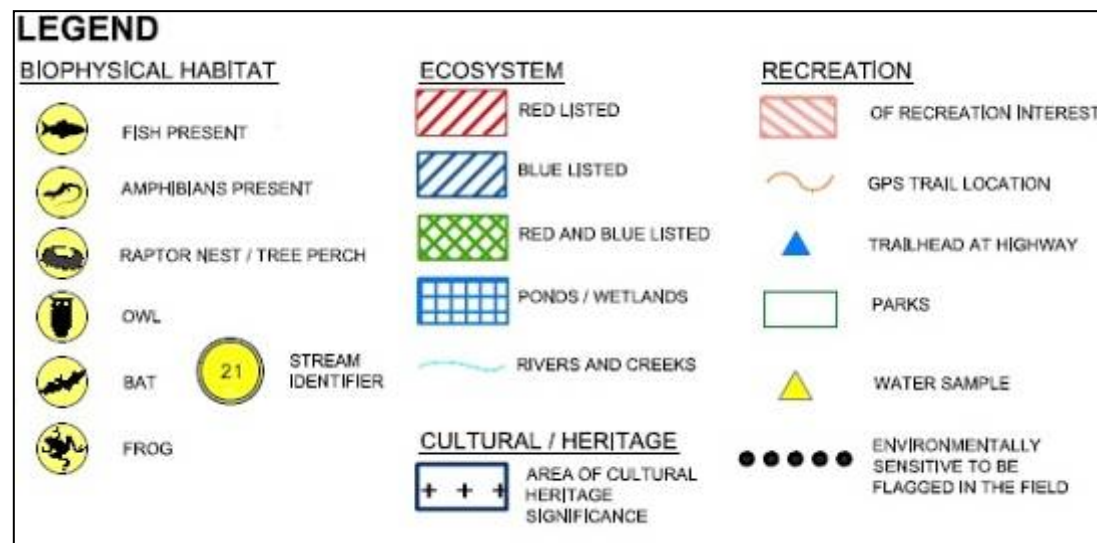


- ▶ Base Internet Map Service:
 - ArcIMS 9.1
- ▶ Web Application:
 - ASP.Net
- ▶ Seamless, tiling, fixed-zoom level, interactive querying web-map viewer:
 - custom built JavaScript libraries,
 - custom built ASP.Net libraries for tile generation, tile caching and querying
 - All libraries now superseded by ArcIMS 9.2
- ▶ Databases:
 - MXD file (spatial)
 - MySQL

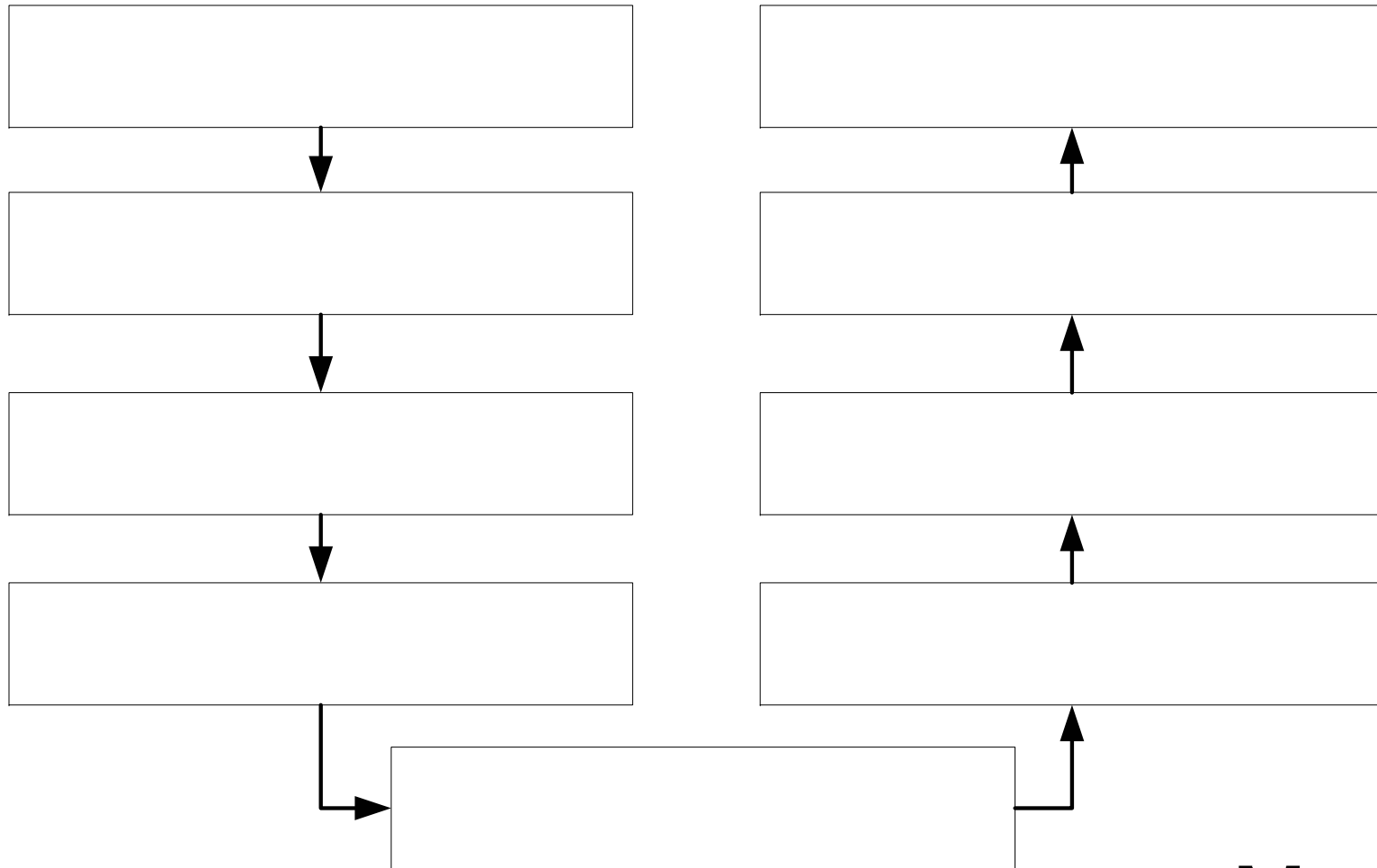
Spatial Data



- ▶ Highway Features:
 - CAD files converted to SHP using FME
- ▶ Environmental Features (bird nests, hiking trails, etc)
 - CAD files converted to SHP using FME
- ▶ Elevation, coastline, waterbodies, rivers, roads, etc
 - TRIM (1:20,000)



Query System



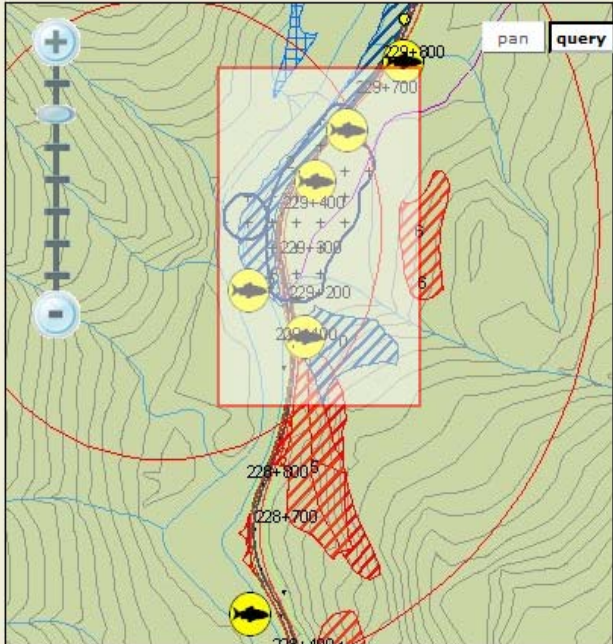
User Drags Mouse with

Query System

Sea-to-Sky Highway Improvement Project
Environmental Information Management System

Home
Disciplines
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logout

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[view map legend](#) | [reset map](#)

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Spatial Characteristics



- ▶ Link between spatial data in ArcIMS and non-spatial data in MySQL is by construction Station (eg "134+300")
- ▶ Stations are grouped together by
 - DB (Design Build) sections
 - Project Segments
- ▶ Water Crossings are very important

by DB Sections =>

by Project Segments

by Crossing Name

custom station range

S1

DB1

S2

DB3

DB4 South

DB4 North

DB5 South

S3

DB5 North

DB6 South

DB6 North

DB7 South

DB7 North

DB8

S4

DB12 South

DB12 North

DB13

Start Station:

End Station:

Environmental Information Management System



Sea-to-Sky Highway Improvement Project
Environmental Information Management System

Home | Disciplines | **Permit Tracking** | Feedback | Administration | logoff

You are here: Home > Permit Tracking > All Permit Checklists

Permit Checklists for DB08

DB Section:

DB	Station	Name	Est. Construction Start	Status	
DB01	98+450 - 250+300	S2S Corridor Wide Permits	Apr. 1 2005	no permits pending	view permit list edit
DB08	142+250 - 142+290	Stawamus River Bridge (HS108)	Aug. 2 2007	1 permit pending	view permit list edit
DB08	143+600 - 143+640	Mamquam Blind Channel Bridge (HS109)	Mar. 7 2007	no permits pending	view permit list edit
DB08	144+340 - 144+380	Mamquam Blind North Channel (HS110)	Apr. 25 2007	3 permits pending	view permit list edit
DB08	144+580 - 144+620	Mamquam Blind Side Channel (HS111)	Apr. 25 2007	3 permits pending	view permit list edit
DB08	145+020 - 145+060	Loggers Lane Creek (HS112)	Feb. 15 2006	no permits pending	view permit list edit
DB08	145+480 - 145+520	Trib. To Loggers Lane Creek (HS113)	Feb. 15 2006	no permits pending	view permit list edit
DB08	146+920 - 146+970	Mamquam River Bridge (HS114)	Aug. 14 2006	no permits pending	view permit list edit
DB08	147+260 - 147+300	Mamquam River Bridge (HS115)	Aug. 14 2006	no permits pending	view permit list edit

- ▶ The database is also a key-tool for permit tracking, with specific warnings for pending procedures.
- ▶ Training has been provided to field construction staff

Sea-to-Sky Highway Improvement Project
Environmental Information Management System

Home | Disciplines | **Permit Tracking** | Feedback | Administration | logoff

You are here: Home > Permit Tracking > Checklist Details

Checklist "Stawamus River Bridge (HS108)"

Station	Name	Sensitive Features	Estimated Construction Start Date	S2S Comments
142+250 - 142+290	Stawamus River Bridge (HS108)	Fish	August 02, 2007	IR #24 50% IDR Valid Design

Permit	Status	Comments	
DFO Review	Pending - Permit Applied for on Jun. 13 2007		edit delete
MoE Water Act Notification	Not Required		edit delete
MoE Water Act Approval	Permit Received on Apr. 23 2007 (view application) (view permit)		edit delete
MoE Tailed Frog Salvage Permit	Not Required		edit delete
MoE Small Mammals, Amphibians and Reptile Salvage Permit	Not Required		edit delete
TC Navigable Water	Permit Received on Jun. 8 2007 (view application) (view permit)		edit delete
DFO Fish Salvage	Permit Received on Mar. 14 2007 (view application) (view permit)	Collection period valid from March 13, 2007 to July 12, 2007.	edit delete
MoE Fish Salvage	Permit Received on Mar. 23 2007 (view application) (view permit)	Amended Permit. Original Rec'd: 14-Jul-06	edit delete
MoE Water Use	Permit Received on Apr. 24 2007 (view application) (view permit)	Water Use Permit Valid until May 31, 2008.	edit delete

MapView/Query System Issues



- ▶ Design drive: Google Maps
- ▶ Always give user feedback. Hide nothing
- ▶ Error Handling
 - ▶ Handle ALL error conditions
 - ▶ Data integration errors, user input errors
- ▶ Browser speed optimization
 - ▶ AJAX
 - ▶ usage of multiple hostnames
- ▶ Back button management
- ▶ Browser memory management
- ▶ Never blame the user

Why has this system been well received?



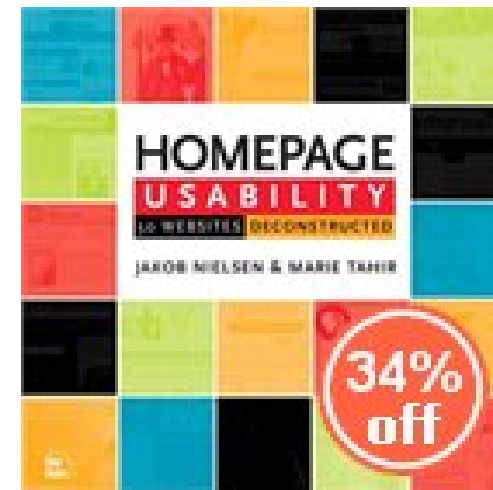
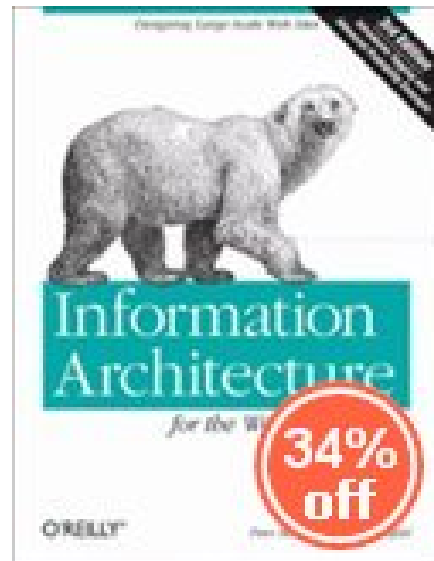
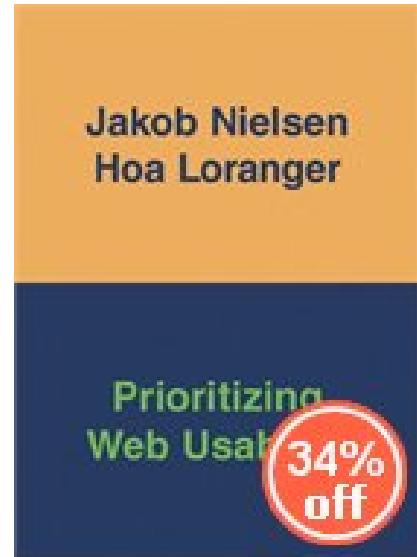
- ▶ Web-based administration system (distribution of tasks)
- ▶ User Training
- ▶ Expert data that is regularly updated
 - ▶ Data logger
- ▶ Budgeted, ongoing system improvements
(2006-2009)

Website design for spatial applications

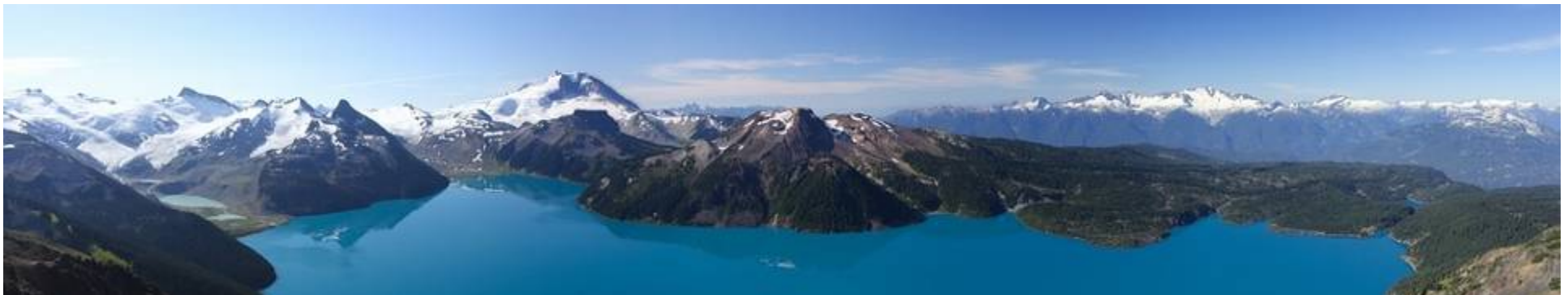


- ▶ **User Centered Design**
 - ▶ Understand how users use websites
- ▶ **Task Based**
 - ▶ Don't just list tasks that can be performed
 - ▶ Visibility
- ▶ **Web-interaction** model (sufficing, stateless)
 - ▶ Information structure & integration (visual & structural – talk to your librarian!)
 - ▶ No pop-ups!
 - ▶ Back button always works!
 - ▶ “Each user action has an equal visual representation”
 - ▶ Make things clickable
 - ▶ Mouse-hover isn't good enough
 - ▶ Avoid information overload

Books for your web development staff to read



- ▶ Next Steps
 - Further systems-level Integration
 - ArcGIS 9.2
 - Much more map data
 - Alternate Viewers (KML)
 - Highway 1/Port Mann Bridge Project?



Thank you!



- ▶ Thank you!
- ▶ Questions?

For more information, contact...

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