StatoilHydro

July 23, 2008

ALBERTA ENERGY RESOURCES CONSERVATION BOARD
640 – 5th Avenue S.W.
Calgary, AB T2P 3G4

Attention: **Mr. Ken Schuldhaus, P.Eng.**

RE: **Supplemental Information Request for Application No. 1523635 (the Application)**
Kai Kos Dehseh Project – Athabasca Oil Sands Area

In support of the Application, StatoilHydro Canada Ltd. (StatoilHydro) has completed the responses to the Supplemental Information Request dated June 27, 2008 for the Kai Kos Dehseh Project (the Project).

North American Oil Sands Corporation (North American), now StatoilHydro Canada Ltd. (by way of amalgamation) had applied to the Energy Resources Conservation Board (ERCB) and Alberta Environment (AENV) for approval to construct and operate the Kai Kos Dehseh In Situ Oil Sands Project. StatoilHydro has assumed North American's role as the Application's proponent.

As outlined in the Application, the Project involves four development areas: Leismer, Corner, Thornbury and Hangingstone and the Application addresses StatoilHydro's overall development plan for the Project. The Project development plan is based on the Leismer and Corner development areas being developed first followed by the other two development areas. With this in mind, and with respect to the Project Environmental Impact Assessment (EIA), StatoilHydro wishes to again highlight the EIA's unique nature. To facilitate more openness and transparency of the overall Project development plan in the local communities, StatoilHydro has completed a broader regional EIA that fully outlines the proposed commercial development plan for the overall Project within the approximately 12 townships of oil sands leases now held by StatoilHydro.

This regional EIA approach was developed in full consultation with various regulatory agencies, including the ERCB (Energy Resources Conservation Board), AENV (Alberta Environment) and ASRD (Alberta Sustainable Resource Development). Support in principle was received and as result it was agreed that StatoilHydro would apply for overall Project approval based on one regional EIA. To the extent that detailed information for each development area was required, that information would be included, as applicable, in either the Application or any future amendment applications (instead of using separate stand-alone EIAs for each development area).

StatoilHydro believes this regional EIA approach has provided the stakeholders with transparency of its planned implementation for overall Project development and this transparency is in the public interest. The EIA is based on regional data and a conceptual engineering and execution plan. Several of the EIA programs, such as the wildlife monitoring for caribou, moose and wolf, were tailored to actively engage the local stakeholders and address their specific issues. The wildlife monitoring program is scientifically based and is focused on moose (based on First Nations concerns), caribou (based on endangered species concerns) and wolf (based on the predator/prey relationship between them).

As overall Project development progresses, subsequent approval amendment applications for each of Thornbury and Hangingstone development areas will be submitted. StatoilHydro acknowledges that if significant changes in the region occur, AENV may request additional environmental studies to

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supplement the existing EIA. All future amendment applications will contain the required level of information for each applicable development area and will be based on the acquisition of additional geological, reservoir and engineering information.

StatoilHydro is committed to updating the air and groundwater effects assessments (including cumulative effects assessment) as well as incorporating learnings from the previous development areas into future applications. Furthermore, as engineering design progresses, StatoilHydro will conduct additional detailed soil surveys (e.g., Survey Intensity Level One) as part of the Pre-Disturbance Assessment (PDA) process. StatoilHydro also commits to additional wildlife and vegetation monitoring that expands the existing spatial and temporal information.

We trust that you will find the attached responses to your information requests in order.

Yours truly.

STATOILHYDRO CANADA LTD.

for Marty Proctor, P.Eng.
Sr. Vice President, Upstream

cc:
Laura Hickman – ERCB
Corinne Kristensen – AENV
Craig Popoff, P.Eng – Director Regulatory Affairs, StatoilHydro Canada Ltd.

StatoilHydro

Title:

APPLICATION FOR APPROVAL OF
KAI KOS DEHSEH PROJECT
SUPPLEMENTAL INFORMATION REQUEST ROUND 1

Date:

JULY 2008

Submitted to:

ALBERTA ENVIRONMENT
AND ENERGY RESOURCES CONSERVATION BOARD

Submitted by:

StatoilHydro Canada Ltd.

Energy Resources Conservation Board Information Requests

Alberta Environment Information Requests

StatoilHydro Canada Ltd
Kai Kos Dehseh Project
Application No. 1523635
Supplemental Information Request Round 1

A. GENERAL (INCLUDES APPENDICES A, B, AND C)

1	Perform a review of all wells drilled within the three hub application area to determine if the wells have been drilled and cased or drilled and abandoned in a manner compatible with the proposed thermal recovery process. Provide a summary of all wells reviewed and their current status.

Response

StatoilHydro has completed a review of all the wells drilled within the Application area. The wells and their current status have been provided in the Table below. None of the cased or abandoned wells within the three Hub Application areas were deemed to be incompatible with StatoilHydro's proposed thermal recovery process.

Table 1-1 Summary and Status of Wells in the Project Area

Well ID	Well Name	RR Date	TD (m)	Status	Type	Surface Casing (m)	Additional Casing (m)	Thermal Cement
AA/03-14-078-10W400	SHCL LEISMER 3-14-78-10	3/4/2008	440	Abandoned	OSE	188.5		Yes
AA/04-14-078-10W400	NAOSC LEISMER 4-14-78-10	1/31/2008	445	Abandoned	OSE	173.5		Yes
00/05-14-078-10W400	PARA ET AL LEISMER 5-14-78-10	1/31/1997	444	Abandoned-RecCertified	OSE	151.6		Yes
AA/13-14-078-10W400	NAOSC LEISMER 13-14-78-10	2/8/2008	443	Abandoned	OSE	214.3		Yes
AA/01-15-078-10W400	NAOSC LEISMER 1-15-78-10	2/5/2007	442	Abandoned-Unreclaimed	OSE	178.5		Yes
AA/03-15-078-10W400	NAOSC LEISMER 3-15-78-10	2/4/2005	443	Abandoned-Unreclaimed	OSE	180		Yes
AA/07-15-078-10W400	NAOSC LEISMER 7-15-78-10	2/21/2008	452	Abandoned	OSE	217		Yes
00/08-15-078-10W400	PARA LEISMER 8-15-78-10	1/4/2000	450	Drilled & cased	Gas	154.8	450	Yes
AA/13-15-078-10W400	NAOSC LEISMER 13-15-78-10	2/20/2007	444	Abandoned-Unreclaimed	OSE	210		Yes
AA/14-15-078-10W400	NAOSC LEISMER 14-15-78-10	2/8/2007	444	Abandoned-Unreclaimed	OSE	183		Yes
AA/15-15-	NAOSC LEISMER 15-	2/4/2007	441	Abandoned-	OSE	215		Yes

Table 1-1 Summary and Status of Wells in the Project Area

Well ID	Well Name	RR Date	TD (m)	Status	Type	Surface Casing (m)	Additional Casing (m)	Thermal Cement
078-10W400	15-78-10			Unreclaimed				
AA/16-15-078-10W400	NAOSC LEISMER 16-15-78-10	3/4/2007	442	Abandoned-Unreclaimed	OSE	195		Yes
AA/07-21-078-10W400	NAOSC LEISMER 7-21-78-10	2/3/2008	461.5	Abandoned	OSE	197.4		Yes
AA/08-21-078-10W400	NAOSC LEISMER 8-21-78-10	3/9/2007	453	Abandoned-Unreclaimed	OSE	222		Yes
AA/15-21-078-10W400	SHCL LEISMER 15-21-78-10	3/4/2008	472.5	Abandoned	OSE	216		Yes
F1/16-21-078-10W400	NAOSC / PARA WSW LEISMER 16-21-78-10	2/13/2006	456	Drilled & cased	Water Source	173	454.4	Yes
AA/05-22-078-10W400	NAOSC LEISMER 5-22-78-10	2/27/2007	453	Abandoned-Unreclaimed	OSE	155		Yes
AA/06-22-078-10W400	NAOSC / PARA LEISMER 6-22-78-10	2/11/2007	446	Abandoned-Unreclaimed	OSE	183		Yes
00/07-22-078-10W400	PARA ET AL LEISMER 7-22-78-10	1/26/1994	445	Drilled & cased	Gas	168.4	442	Yes
AA/08-22-078-10W400	NAOSC / PARA LEISMER 8-22-78-10	3/5/2007	442	Abandoned-Unreclaimed	OSE	195		Yes
AA/10-22-078-10W400	NAOSC / PARA LEISMER 10-22-78-10	3/2/2007	448	Abandoned-Unreclaimed	OSE	195		Yes
AA/12-22-078-10W400	NAOSC / PARA LEISMER 12-22-78-10	2/25/2007	449	Abandoned-Unreclaimed	OSE	195		Yes
F1/13-22-078-10W400	NAOSC / PARA WSW LEISMER 13-22-78-10	2/18/2006	456	Drilled & cased	Water Source	169	456	Yes
AA/14-22-078-10W400	NAOSC / PARA LEISMER 14-22-78-10	3/9/2006	457	Abandoned	OSE	174		Yes
AA/15-22-078-10W400	NAOSC LEISMER 15-22-78-10	2/27/2008	453	Abandoned	OSE	213.1		Yes
00/03-27-078-10W400	NAOSC LEISMER 3-27-78-10	2/22/2007	441	Drilled & cased	Observation	181	441	Yes
AA/03-27-078-10W400	NAOSC / PARA LEISMER 3-27-78-10	2/24/2006	451	Abandoned	OSE	174.5		yes
00/04-27-078-10W400	KOCH LEISMER 4-27-78-10	1/25/2000	459.6	Abandoned-Unreclaimed	OSE	203	459	Yes
02/04-27-078-10W400	NAOSC LEISMER 4-27-78-10	1/28/2008	464	Drilled & cased	Observation	207	457.5	Yes
AB/05-27-078-10W400	NAOSC /PARA 5D LEISMER 5-27-78-10	3/5/2006	449	Abandoned-Unreclaimed	OSE	164.5		Yes
AC/05-27-078-10W400	NAOSC LEISMER 5-27-78-10	2/2/2008	450	Drilled & cased	Observation	181.5	446.4	Yes
AC/06-27-078-10W400	NAOSC LEISMER 6-27-78-10	2/12/2007	441	Abandoned-Unreclaimed	OSE	182		Yes
00/07-27-078-10W400	KOCH LEISMER 7-27-78-10	2/9/2000	458	Abandoned-Unreclaimed	OSE	196.3	458	Yes
AA/10-27-078-10W400	NAOSC / PARA LEISMER 10-27-78-10	3/6/2006	442.4	Abandoned-Unreclaimed	OSE	164		Yes
00/12-27-078-10W400	PARA ET AL LEISMER 12-27-78-10	1/14/1991	441	Abandoned-RecCertified	OSE	179		Yes

Table 1-1 Summary and Status of Wells in the Project Area

Well ID	Well Name	RR Date	TD (m)	Status	Type	Surface Casing (m)	Additional Casing (m)	Thermal Cement
02/12-27-078-10W400	KOCH LEISMER 12-27-78-10	1/21/2000	457	Abandoned-Unreclaimed	Gas	171	457	Yes
AD/12-27-078-10W400	NAOSC / PARA LEISMER 12-27-78-10	2/18/2006	447.7	Abandoned-Unreclaimed	OSE	184		Yes
00/13-27-078-10W400	NAOSC LEISMER 13-27-78-10	2/16/2007	447	Drilled & cased	Observation	185	447	Yes
00/14-27-078-10W400	NAOSC LEISMER 14-27-78-10	3/6/2007	444	Drilled & cased	Observation	183	444	Yes
AA/14-27-078-10W400	NAOSC / PARA LEISMER 14-27-78-10	3/12/2006	446	Abandoned-Unreclaimed	OSE	202.6		Yes
00/01-28-078-10W400	NAOSC / PARA INJ LEISMER 1-28-78-10	2/24/2006	471	Drilled & cased	Water Disposal	174	471	Yes
02/01-28-078-10W400	NAOSC LEISMER 1-28-78-10	2/23/2007	465	Drilled & cased	Observation	184	465	Yes
00/07-28-078-10W400	KOCH LEISMER 7-28-78-10	2/5/2000	473	Abandoned-Unreclaimed	OSE	202	473	Yes
00/08-28-078-10W400	NAOSC LEISMER 8-28-78-10	3/5/2007	460	Drilled & cased	Observation	176	460	Yes
00/09-28-078-10W400	NAOSC LEISMER 9-28-78-10	3/11/2007	454	Drilled & cased	Observation	188	454	Yes
AA/09-28-078-10W400	NAOSC / PARA LEISMER 9-28-78-10	3/4/2006	457.9	Drilled & cased	OSE	202	456	Yes
00/15-28-078-10W400	NAOSC LEISMER 15-28-78-10	2/4/2008	478	Drilled & cased	Observation	203	475.2	Yes
00/16-28-078-10W400	NAOSC LEISMER 16-28-78-10	2/18/2007	457	Drilled & cased	Observation	182	457	Yes
00/16-28-078-10W400	NAOSC LEISMER 16-28-78-10	2/18/2007	462	Drilled & cased	Observation	182	458	Yes
AA/01-33-078-10W400	NAOSC / PARA LEISMER 1-33-78-10	3/4/2006	460	Abandoned	OSE	172		Yes
00/08-33-078-10W400	KOCH LEISMER 8-33-78-10	1/31/2000	470	Abandoned-Unreclaimed	OSE	201	470	Yes
AA/09-33-078-10W400	SHCL LEISMER 9-33-78-10	3/13/2008	494	Abandoned	OSE	182		Yes
00/16-33-078-10W400	KOCH LEISMER 16-33-78-10	2/14/2000	484	Abandoned-Unreclaimed	OSE	195	483	Yes
AA/16-33-078-10W400	NAOSC LEISMER 16-33-78-10	2/28/2007	479	Abandoned-Unreclaimed	OSE	186		Yes
AA/02-34-078-10W400	NAOSC / PARA LEISMER 2-34-78-10	2/18/2006	447.5	Abandoned-Unreclaimed	OSE	164		Yes
AB/03-34-078-10W400	NAOSC / PARA LEISMER 3-34-78-10	3/1/2006	451	Abandoned-Unreclaimed	OSE	164.8		Yes
AF/04-34-078-10W400	NAOSC / PARA LEISMER 4-34-78-10	2/22/2006	443	Abandoned-Unreclaimed	OSE	164.8		Yes
AA/05-34-078-10W400	NAOSC / PARA LEISMER 5-34-78-10	3/15/2006	448	Abandoned-Unreclaimed	OSE	201		Yes
AB/05-34-078-10W400	NAOSC LEISMER 5-34-78-10	2/15/2007	467	Abandoned-Unreclaimed	OSE	155		Yes
00/06-34-	PARA ET AL LEISMER	3/11/1995	448	Drilled &	Gas	170	448	Yes

Table 1-1 Summary and Status of Wells in the Project Area

Well ID	Well Name	RR Date	TD (m)	Status	Type	Surface Casing (m)	Additional Casing (m)	Thermal Cement
078-10W400	6-34-78-10			cased				
00/10-34-078-10W400	KOCH LEISMER 10-34-78-10	2/20/2000	463	Abandoned-Unreclaimed	OSE	190	463	Yes
AA/10-34-078-10W400	NAOSC / PARA LEISMER 10-34-78-10	3/8/2006	448	Abandoned-Unreclaimed	OSE	165.5		Yes
AA/11-34-078-10W400	NAOSC / PARA LEISMER 11-34-78-10	3/10/2006	458	Abandoned-Unreclaimed	OSE	149		Yes
AA/12-34-078-10W400	NAOSC / PARA LEISMER 12-34-78-10	2/17/2006	465	Abandoned-Unreclaimed	OSE	152.1		Yes
AA/13-34-078-10W400	NAOSC LEISMER 13-34-78-10	3/11/2007	469	Abandoned-Unreclaimed	OSE	164		Yes
AA/01-03-079-10W400	NAOSC / PARA LEISMER 1-3-79-10	2/21/2006	455.9	Abandoned-Unreclaimed	OSE	164		Yes
AA/02-03-079-10W400	NAOSC / PARA LEISMER 2-3-79-10	2/24/2006	472.5	Abandoned-Unreclaimed	OSE	165		Yes
AA/03-03-079-10W400	NAOSC LEISMER 3-3-79-10	3/6/2005	480.1	Abandoned-Unreclaimed	OSE	169		Yes
AA/04-03-079-10W400	SHCL LEISMER 4-3-79-10	2/29/2008	484	Abandoned	OSE	197		Yes
AA/11-03-079-10W400	NAOSC LEISMER 11-3-79-10	3/9/2007	475	Abandoned-Unreclaimed	OSE	163.5		Yes
00/12-03-079-10W400	PARA ET AL CORNER 12-3-79-10	1/8/1999	475.5	Drilled & cased	Gas	176.5	475.5	Yes
AA/08-04-079-10W400	SHCL LEISMER 8-4-79-10	3/3/2008	477	Abandoned	OSE	200		Yes
AA/09-04-079-10W400	NAOSC / PARA LEISMER 9-4-79-10	2/20/2006	474.5	Abandoned-Unreclaimed	OSE	156.5		Yes
AA/16-04-079-10W400	NAOSC / PARA LEISMER 16-4-79-10	2/15/2006	479	Abandoned-Unreclaimed	OSE	153.5		Yes
F1/16-04-079-10W400	NAOSC LEISMER 16-4-79-10	3/7/2008	343	Drilled & cased	Water Source	196	342.6	Yes
00/05-31-080-08W400	DEVON CORNER 5-31-80-8	1/20/1998	496	Drilled & cased	Suspended Gas	128	495	Yes
AA/11-31-080-08W400	NAOSC CORNER 11-31-80-8	2/25/2008	514	Drilled & cased	OSE	233	380	Yes
00/16-31-080-08W400	NAOSC CORNER 16-31-80-8	2/29/2008	514	Drilled & cased	Observation	197	512.5	Yes
F1/14-32-080-08W400	NAOSC CORNER 14-32-80-8	2/16/2008	503	Drilled & cased	Water Source	261	376	Yes
AA/16-32-080-08W400	NAOSC CORNER 16-32-80-8	1/31/2008	500	Abandoned	OSE	228		Yes
F1/12-33-080-08W400	NAOSC WSW LEISMER 12-33-80-8	1/29/2007	488	Drilled & cased	Water Source	327.7	328	Yes
00/11-35-080-09W400	AEC CORNER 11-35-80-9	12/21/1995	489	Drilled & cased	Suspended Gas	197	489	Yes
00/10-36-080-09W400	AECOG (E) CORNER 10-36-80-9	1/9/1999	502	Abandoned-Unreclaimed	OSE	90		Yes
AA/13-36-080-09W400	NAOSC CORNER 13-36-80-9	1/11/2007	498	Abandoned	OSE	221		Yes

Table 1-1 Summary and Status of Wells in the Project Area

Well ID	Well Name	RR Date	TD (m)	Status	Type	Surface Casing (m)	Additional Casing (m)	Thermal Cement
00/01-04-081-08W400	PEOC HANGSTN 1-4-81-8	2/18/1995	500	Drilled & cased	Gas	165.6	500	Yes
AA/04-04-081-08W400	NAOSC / PARA HANGST 4-4-81-8	2/9/2006	505	Abandoned-Unreclaimed	OSE	171		Yes
AA/05-04-081-08W400	NAOSC HANGSTN 5-4-81-8	1/16/2008	510	Abandoned	OSE	213		Yes
AA/10-04-081-08W400	NAOSC / PARA HANGST 10-4-81-8	3/10/2006	509	Abandoned-Unreclaimed	OSE	147.4		Yes
AA/11-04-081-08W400	NAOSC HANGSTN 11-4-81-8	1/24/2008	506	Abandoned	OSE	204		Yes
AA/12-04-081-08W400	NAOSC / PARA HANGST 12-4-81-8	3/14/2006	521	Abandoned-Unreclaimed	OSE	150		Yes
00/13-04-081-08W400	NAOSC HANGSTN 13-4-81-8	2/11/2008	514	Drilled & cased	Observation	196	512.5	Yes
AA/14-04-081-08W400	NAOSC / PARA HANGST 14-4-81-8	1/20/2006	507.5	Abandoned-Unreclaimed	OSE	152.5		Yes
AA/15-04-081-08W400	STATOILHYDROHYDRO HANGSTN 15-4-81-8	2/27/2008	510	Abandoned	OSE	240		Yes
AA/16-04-081-08W400	NAOSC / PARA HANGSTN 16-4-81-8	3/20/2006	510	Abandoned-Unreclaimed	OSE	219		Yes
AA/02-05-081-08W400	NAOSC HANGSTN 2-5-81-8	1/23/2007	510	Abandoned-Unreclaimed	OSE	221		Yes
AA/04-05-081-08W400	NAOSC / PARA HANGST 4-5-81-8	1/29/2006	508	Abandoned-Unreclaimed	OSE	189.5		Yes
00/06-05-081-08W400	DEVON HANGST 6-5-81-8	2/25/1994	512	Drilled & cased	Suspended Gas	176.4	510.8	Yes
00/07-05-081-08W400	NAOSC HANGSTN 7-5-81-8	1/22/2008	516	Drilled & cased	Observation	197	515.1	Yes
AA/08-05-081-08W400	NAOSC / PARA HANGSTN 8-5-81-8	3/19/2006	511	Abandoned-Unreclaimed	OSE	165		Yes
AA/10-05-081-08W400	NAOSC / PARA HANGST 10-5-81-8	3/11/2006	530	Abandoned-Unreclaimed	OSE	155		Yes
AA/12-05-081-08W400	NAOSC / PARA HANGST 12-5-81-8	3/17/2006	522	Abandoned-Unreclaimed	OSE	177.4		Yes
AA/14-05-081-08W400	NAOSC / PARA HANGST 14-5-81-8	2/14/2006	520	Abandoned-Unreclaimed	OSE	177		Yes
AA/15-05-081-08W400	NAOSC HANGSTN 15-5-81-8	1/15/2008	515	Abandoned	OSE	193		Yes
AA/16-05-081-08W400	NAOSC / PARA HANGSTN 16-5-81-8	3/22/2006	521	Abandoned-Unreclaimed	OSE	177		Yes
AA/03-06-081-08W400	NAOSC / PARA CORNER 3-6-81-8	1/29/2006	503	Abandoned-Unreclaimed	OSE	211		Yes
AA/04-06-081-08W400	SHCL CORNER 4-6-81-8	3/10/2008	506	Abandoned	OSE	178.5		Yes
00/05-06-081-08W400	DEVON CORNER 5-6-81-8	2/3/1996	520	Drilled & cased	Suspended Gas	126	520	Yes
AA/07-06-081-08W400	NAOSC / PARA CORNER 7-6-81-8	1/25/2006	507	Abandoned-Unreclaimed	OSE	162		Yes
AA/08-06-	NAOSC / PARA	2/1/2005	511	Abandoned-	OSE	150		Yes

Table 1-1 Summary and Status of Wells in the Project Area

Well ID	Well Name	RR Date	TD (m)	Status	Type	Surface Casing (m)	Additional Casing (m)	Thermal Cement
081-08W400	CORNER 8-6-81-8			Unreclaimed				
00/09-06-081-08W400	NAOSC CORNER 9-6-81-8	2/4/2008	521	Drilled & cased	Observation	197	521	Yes
AA/11-06-081-08W400	NAOSC / PARA CORNER 11-6-81-8	1/27/2006	512	Abandoned-Unreclaimed	OSE	155		Yes
AA/13-06-081-08W400	NAOSC / PARA CORNER 13-6-81-8	1/22/2006	511	Abandoned-Unreclaimed	OSE	177		Yes
AA/15-06-081-08W400	NAOSC / PARA CORNER 15-6-81-8	1/23/2006	518	Abandoned-Unreclaimed	OSE	175		Yes
AA/16-06-081-08W400	NAOSC CORNER 16-6-81-8	1/31/2007	520	Abandoned-Unreclaimed	OSE	221		Yes
AA/01-07-081-08W400	NAOSC / PARA HANGST 1-7-81-8	2/3/2005	517	Abandoned-Unreclaimed	OSE	157		Yes
AA/01-08-081-08W400	NAOSC HANGSTN 1-8-81-8	2/4/2005	512	Abandoned-Unreclaimed	OSE	155		Yes
00/06-08-081-08W400	R O CORP ET AL CORNER LK 6-8-81-8	1/16/1958	1012.5	Abandoned-RecExempt		82		Unknown
AA/02-09-081-08W400	NAOSC / PARA HANGST 2-9-81-8	3/12/2006	514	Abandoned-Unreclaimed	OSE	152		Yes
AA/04-09-081-08W400	NAOSC / PARA HANGST 4-9-81-8	3/19/2006	515	Abandoned-Unreclaimed	OSE	153.5		Yes
00/06-09-081-08W400	PEOC HANGSTN 6-9-81-8	1/11/1991	522	Drilled & cased	Gas	121	521	Yes
AA/07-09-081-08W400	NAOSC HANGSTN 7-9-81-8	2/17/2008	519	Abandoned	OSE	213		Yes
AA/08-09-081-08W400	NAOSC / PARA HANGST 8-9-81-8	1/18/2006	515	Abandoned-Unreclaimed	OSE	193		Yes
AA/10-09-081-08W400	NAOSC / PARA HANGST 10-9-81-8	3/16/2006	530	Abandoned-Unreclaimed	OSE	153.5		Yes
AA/11-09-081-08W400	NAOSC HANGSTN 11-9-81-8	1/21/2008	517	Abandoned	OSE	212		Yes
AA/12-09-081-08W400	NAOSC / PARA HANGST 12-9-81-8	3/25/2006	518	Abandoned-Unreclaimed	OSE	153		Yes
AA/14-09-081-08W400	NAOSC / PARA HANGST 14-9-81-8	1/21/2006	523	Abandoned-Unreclaimed	OSE	176.6		Yes
AA/01-01-081-09W400	NAOSC / PARA CORNER 1-1-81-9	2/6/2006	360	Abandoned-Unreclaimed	OSE	152		Yes
AA/02-01-081-09W400	STATOILHYDROHYDRO CORNER 2-1-81-9	2/14/2008	503	Abandoned	OSE	203		Yes
AA/03-01-081-09W400	NAOSC / PARA CORNER 3-1-81-9	1/11/2006	496	Abandoned-Unreclaimed	OSE	155		Yes
00/05-01-081-09W400	PARA CORNER 5-1-81-9	12/13/2002	497	Drilled & cased	Gas	188	497	Yes
AA/06-01-081-09W400	STATOILHYDROHYDRO CORNER 6-1-81-9	2/9/2008	500	Abandoned	OSE	204		Yes
AA/07-01-081-09W400	NAOSC / PARA CORNER 7-1-81-9	1/16/2006	505	Abandoned-Unreclaimed	OSE	155		Yes
00/08-01-081-09W400	NAOSC CORNER 8-1-81-9	1/13/2008	509	Drilled & cased	Observation	194.5	506.9	Yes

Table 1-1 Summary and Status of Wells in the Project Area

Well ID	Well Name	RR Date	TD (m)	Status	Type	Surface Casing (m)	Additional Casing (m)	Thermal Cement
AA/09-01-081-09W400	NAOSC / PARA CORNER 9-1-81-9	1/23/2006	499	Abandoned-Unreclaimed	OSE	170.4		Yes
AA/11-01-081-09W400	NAOSC / PARA CORNER 11-1-81-9	2/9/2006	354	Abandoned-Unreclaimed	OSE	173.6		Yes
AB/11-01-081-09W400	NAOSC 1B CORNER 11-1-81-9	1/5/2007	502	Abandoned-Unreclaimed	OSE	201		Yes
AA/13-01-081-09W400	NAOSC / PARA CORNER 13-1-81-9	3/17/2006	504	Abandoned-Unreclaimed	OSE	215		Yes
AA/15-01-081-09W400	NAOSC / PARA CORNER 15-1-81-9	1/27/2006	510	Abandoned-Unreclaimed	OSE	152		Yes
AA/01-02-081-09W400	NAOSC / PARA CORNER 1-2-81-9	1/30/2006	494	Abandoned-Unreclaimed	OSE	162		Yes
AA/03-02-081-09W400	NAOSC CORNER 3-2-81-9	2/6/2007	495	Abandoned-Unreclaimed	OSE	173.3		Yes
AA/05-02-081-09W400	NAOSC CORNER 5-2-81-9	2/7/2008	493	Abandoned	OSE	245		Yes
AA/07-02-081-09W400	NAOSC / PARA CORNER 7-2-81-9	1/26/2006	491.1	Abandoned-Unreclaimed	OSE	153.8		Yes
AA/09-02-081-09W400	NAOSC / PARA CORNER 9-2-81-9	2/16/2005	495.5	Abandoned-Unreclaimed	OSE	158		Yes
00/10-02-081-09W400	NAOSC CORNER 10-2-81-9	1/28/2008	496	Drilled & cased	Observation	185.5	495	Yes
AA/11-02-081-09W400	NAOSC / PARA CORNER 11-2-81-9	3/21/2006	494	Abandoned-Unreclaimed	OSE	160.7		Yes
AA/13-02-081-09W400	NAOSC / PARA CORNER 13-2-81-9	3/18/2006	500	Abandoned-Unreclaimed	OSE	162		Yes
AA/15-02-081-09W400	NAOSC / PARA CORNER 15-2-81-9	3/20/2006	497.8	Abandoned-Unreclaimed	OSE	160.7		Yes
AA/01-11-081-09W400	NAOSC / PARA CORNER 1-11-81-9	1/24/2006	495	Abandoned-Unreclaimed	OSE	177		Yes
AA/03-11-081-09W400	NAOSC / PARA CORNER 3-11-81-9	1/15/2006	512	Abandoned-Unreclaimed	OSE	211		Yes
AA/05-11-081-09W400	NAOSC / PARA CORNER 5-11-81-9	3/17/2006	498	Abandoned-Unreclaimed	OSE	160.7		Yes
AA/07-11-081-09W400	NAOSC / PARA CORNER 7-11-81-9	1/15/2006	515	Abandoned-Unreclaimed	OSE	173		Yes
AA/09-11-081-09W400	NAOSC CORNER 9-11-81-9	3/9/2007	508.5	Abandoned-Unreclaimed	OSE	195.9		Yes
AA/03-12-081-09W400	NAOSC / PARA CORNER 3-12-81-9	2/12/2005	504	Abandoned-Unreclaimed	OSE	124		Yes
AA/05-12-081-09W400	NAOSC CORNER 5-12-81-9	2/4/2007	504	Abandoned-Unreclaimed	OSE	222		Yes

Status: EUB Abandoned Well List dated Jan 10th 2008

2	Provide an update on the status of Statoil Hydro's stakeholder (public and industry) consultation process including: a. a discussion on any concerns or objections respecting the subject application and Statoil Hydro's efforts to resolve these;

Response

StatoilHydro continues to engage local communities in close proximity to its Project and are presently involved in several initiatives, which provide opportunities to discuss and address questions and concerns. These initiatives include general consultation as documented in the attached Community Engagement Matrix, a Social Economic Assessment which is contained in the Kai Kos Dehseh (KKD) EIA and Traditional Land Use Studies and work which StatoilHydro is conducting with several local communities. The Traditional Land Use Studies are forthcoming and expected to be completed in late 2008.

StatoilHydro's main opportunity for engagement/consultation with local communities has been through meetings with Elders and the Traditional Knowledge Studies.

The following are questions and concerns that have been brought forward by local communities, and the actions taken by StatoilHydro towards resolution:

- StatoilHydro has heard consistently from local communities that they want business and employment opportunities. StatoilHydro has, and continues to put much effort into conducting business with local people. In the last three years, StatoilHydro has done over $107 million in business with people from local communities.

- Concerns regarding land, plants and animals are being addressed through StatoilHydro's innovative and highly effective Canine Wildlife Studies Program which involves the assessment of local wolf, moose and caribou populations. The information collected provides valuable baseline knowledge to use as a reference if StatoilHydro's activities affect these species, and for developing mitigation measures if required.

- StatoilHydro will be making a special presentation to the Fort McMurray First Nation Elders, who have requested that StatoilHydro share information regarding the findings of the animal, plant and water studies. These Elders indicated that such a presentation would be a first for them.

- StatoilHydro has provided information to the local communities on proposed water sources and use for the project.

- In the past year, the Conklin Community Association has requested more information regarding noise levels from aircraft operating at the Leismer Airdrome. The Leismer Airdrome Ltd. is a company in which StatoilHydro is the majority shareholder. A noise study has been completed. As a result of the study, aircraft are required to use landing approach route to the north of Conklin to minimize noise. During the winter of 2007/08, StatoilHydro had 100+ aircraft land and take off at the Leismer Airdrome. This information was shared at a Conklin Community Association meeting on July 7 2008. Community members in attendance indicated they did not hear any noise from these aircraft during the winter.

- Conklin Metis Local #193 (CML) has identified the need to conduct a Traditional Land Use Study and asked for support from StatoilHydro. This has led to an opportunity to use StatoilHydro's Traditional Knowledge Study work for the Kai Kos Dehseh EIA in support of the CML study. StatoilHydro has also provided media interview and GIS training along with equipment and administrative support so that the local people can build capacity do conduct the Traditional Knowledge Study work themselves.

Table 2-1 provides a summary of StatoilHydro's on-going stakeholder consultation efforts.

Table 2-1 Summary of StatoilHydro's Stakeholder Consultation

DATE	MEETING/EVENT	COMMUNITY PARTICIPANTS	OUTCOMES	FOLLOW-UP
Heart Lake First Nation (HLFN)				
Sept. 21, 2007	ConocoPhillips Office, Calgary	HLFNCO, Director and Regulatory Advisor meeting with all Industry representatives	Update to Industry on new direction of the HLFNCO. They are requesting financial support from collective Industry partners to operate the HLFNCO for the rest of the 07 year and all 08 year.	Industry reps collectively asked the HLFNCO to give more direction/definition as to the Office's role and what is expected from Industry and what Industry can expect as well. Then at the next collective meeting – each company would be able to respond/commit.
Nov. 2007	Phone calls	HLFN consultation Office (HLFNCO), Director	StatoilHydro has made a number of phone calls in attempts to set up a meeting with the HLFNCO Director. At the Nov 8 Southern Athabasca Oilsands Producer's Open House in HLFN, the HLFNCO Director committed to meeting with StatoilHydro about project updates and receiving its EIA.	Several phone calls have been made to the HLFNCO Director since Nov 8, no response.
Dec. 3, 2007	Meeting in Edmonton	HLFN IRC Environment Director	StatoilHydro representative shared with HLFN about project updates and hand-delivered the Kai Kos Dehseh EIA. HLFN shared about their IRC organization and progress.	Both parties agreed to organize further meetings to move forward.
Mar. 5, 2008	Meeting in Calgary at StatoilHydro Office	HLFN Chief, HLFN IRC Director, HLFN IRC Environment Coordinator and HLFN Business Manager	HLFN shared about the development of their IRC Office and how they would like to work with us. StatoilHydro committed to the overall process, and is invited to an Elder's meeting in mid March	Both parties agreed to organize further meetings to move forward.

DATE	MEETING/EVENT	COMMUNITY PARTICIPANTS	OUTCOMES	FOLLOW-UP
Mar. 19, 2008	Meeting in Heart Lake First Nation	HLFN IRC Director	Meeting with Elders and opportunity for StatoilHydro to share updates on development, including proposed pipeline plans. They want to understand more about how StatoilHydro will be using water. StatoilHydro offered to bring in water specialist to explore more. StatoilHydro also offered the opportunity for Elders to visit development areas. StatoilHydro finished meeting with continued commitment to work with the community.	Follow-up by both parties for further engagement.
Chipewyan Prairie Dene First Nation (CPDFN) & Janvier/Chard				
Sept. 12, 2007	Calgary Chamber of Commerce	CPDFN Chief and Council, Elder Representatives and business partners	Discussion about how StatoilHydro and CPDFN can do business together. CPDFN requested that the IRC agreement being negotiated by previous Chief and Council be continued.	StatoilHydro committed to sending the latest draft of IRC agreement to IRC Director. Commitment from both parties to move toward a final draft to be signed in the near future.
Oct. 22, 2007	Mtg in Lac La Biche	CPDFN Business Manager	StatoilHydro's representative met with Businesses Manager to share information on current and upcoming business with CPDFN. StatoilHydro's representative stated that it would still like to sign the business agreement with CPDFN. CPDFN Business Manager committed to getting the CPDFN business agreement to be signed, to StatoilHydro.	StatoilHydro's representative called CPDFN Business Manager in early November to obtain the latest draft of business agreement, it was not available. Business Manager said she would get the staff in her office to work on the agreement and get it to StatoilHydro. In late November, StatoilHydro's representative then stopped at CPDFN business office in LLB to gain the agreement from the office staff – the agreement was not available.
Nov. 2, 2007	Conference Call	CPDFN Chief	StatoilHydro's representative made a conference call with the Chief about next steps. Chief asked for geotechnical information from StatoilHydro, the Chief said he would call back on Monday to get the geotechnical information. Discussion also about getting the three IRC agreements signed with StatoilHydro.	StatoilHydro will have geotechnical information available as of Nov. 4. CPDFN Chief has yet to call back.
Nov. 9, 2007	CPDFN IRC Office	CPDFN IRC Environment Coordinator	StatoilHydro hand-delivered Kai Kos Dehseh EIA to the CPDFN IRC Environment Coordinator.	None required.

DATE	MEETING/EVENT	COMMUNITY PARTICIPANTS	OUTCOMES	FOLLOW-UP
Nov. 26, 2007	Meeting in Calgary at the Hyatt	CPDFN IRC Director and IRC Environment Coordinator	Updating discussions between both parties. CPDFN committed to respond to StatoilHydro's Executive VP letter dated in early October to Chief Janvier. They also committed to talking with Chief Janvier to move on all other commitments including the signing of agreements and Traditional Knowledge Studies.	CPDFN IRC to respond to StatoilHydro's letter and respond to StatoilHydro with next steps on the agreement signings and Traditional Knowledge Study.
Jan. 3, 2008	Phone meeting	CPDFN Chief	Discussions about next steps and a commitment by both parties to have a meeting on January 8^{th} in Fort McMurray	StatoilHydro to make meeting arrangement for Jan 8.
Jan. 8, 2008	Sawridge Hotel, Ft. McMurray	CPDFN Chief & Council, Elders, CPDFN IRC Director	StatoilHydro President & CEO, Executive and other representative met with Chief and Council to discuss next steps in moving forward in relationship/partnership building. Agreement by both parties to draft, agree on and sign a working agreement.	CPDFN to deliver first draft agreement to StatoilHydro.
Jan. 23, 2008	Sawridge Hotel, Ft. McMurray	CPDFN IRC Director, CPDFN IRC Environment Coordinator, CPDFN IRC Regulatory Coordinator and Advisors	CPDFN IRC presented an MOU agreement to StatoilHydro. Discussions about moving forward in a consultation process. StatoilHydro to review MOU and respond in an upcoming meeting. StatoilHydro provided an update on infrastructure with proposed pipelines and powerlines.	StatoilHydro to review MOU and responded, coordinate date of next meeting with CPDFN IRC.
Feb. 25, 2008	Sawridge Hotel, Fort McMurray	CPDFN IRC Director, CPDFN IRC Environment Coordinator, CPDFN Regulatory Coordinator and Councilors	Discussion about next steps in developing and signing IRC Agreement with StatoilHydro. CPDFN IRC Director committed to getting a next draft agreement to StatoilHydro.	CPDFN IRC to get next agreement draft to StatoilHydro.
Ft. McMurray First Nation (FMFN)				
Aug. 29, 2007	Meeting at Community Health Centre, FMFN	Twenty Elders, IRC Elder's Coordinator	Traditional Knowledge Study – helicopter tour with FMFN Elders of North American lease areas and then follow-up meetings with Elders groups. Discussions about Elder's concerns and questions.	Report will be written and follow-up to Elders on questions and concerns. A group of Elders would like to do some interviews and field tour in late winter.

DATE	MEETING/EVENT	COMMUNITY PARTICIPANTS	OUTCOMES	FOLLOW-UP
Nov. 8, 2007	Meeting at StatoilHydro/North American in Calgary	FMFN Chief, Business Manager and IRC Director	Discussions about StatoilHydro's EIA Traditional Knowledge progress with FMFN Elders – delivered a draft report to IRC Director and ask for next steps in completing the study with the Elders. StatoilHydro President and Vice Presidents shared information with the Chief about StatoilHydro's current project both for the Winter 07/08 programs and long term development.	IRC Director committed to communicating with Elder group and getting back to StatoilHydro with next steps.
Dec. 2007 /Jan.2008	Phone call	FMFN IRC Director/Former IRC Director (IRC Director Resigned Dec 17th). FMFN business arm and Chief meeting regarding StatoilHydro camp opportunities.	StatoilHydro kept in touch with FMFN IRC to see when and how StatoilHydro could continue working with the Elders. FMFN IRC was unable to respond.	StatoilHydro will continue to keep in contact with the FMFN IRC for next steps.
Mar. 13, 2008	Sawridge Hotel, Fort McMurray	FMFN IRC Director, FMFN IRC Environment Coordinator, FMFN IRC Elder's Coordinator	StatoilHydro representatives met with FMFN IRC to share about proposed pipeline project. They shared about ensuring minimum impacts to plants and wildlife. They ask about overall opportunities for employment and training opportunities for community members. They wanted to know more about what StatoilHydro is doing environmentally. StatoilHydro reps committed to a meeting with them, Chief and Council and StatoilHydro Executive to share this information.	StatoilHydro is open to meeting with FMFN, the leadership was unavailable in late March and April due to the end of April election.
Mar. 18, 2008	Anzac Community Hall	FMFN Elder's Coordinator and Elders Community	Meeting with Elders in completing Traditional Knowledge Study work for the Kai Kos Dehseh Project. Elder shared concerns around accumulative impacts.	StatoilHydro committed to sharing about employment and training opportunities in the local high school. A field tour to a special location in Hangingstone lease to be arranged with several Elders. StatoilHydro will also arrange to bring specialist who completed the environment studies to present about studies to the Elders.
Conklin				
Aug. 27/28, 2007	Conklin Community Centre	Conklin TLUS Project Coordinator and team	StatoilHydro completed two days of media training with the Conklin TLUS Project team – so they have capacity to conduct Elder's interviews.	Project Coordinator continues to provide updates that interview are progressing.

DATE	MEETING/EVENT	COMMUNITY PARTICIPANTS	OUTCOMES	FOLLOW-UP
Sept. 10, 2007	Conklin Community Centre – meeting	Annual Community Meeting and Dinner	StatoilHydro shared information about current and upcoming development plans, regarding drilling, seismic, facilities construction, airport development and study plans.	StatoilHydro to follow-up on contract and employment opportunities for winter work with local people.
Oct. – Nov. 2007	Conklin Métis Local	Conklin Métis Local President and TLU Project Team	Continual partnership with the Conklin Métis Local in completing the Traditional Knowledge Study for the Kia Kos Dehseh EIA.	Continual communication between both parties.
Nov. 8, 2007	Conklin Community Centre	Conklin Municipal Community Liaison	Hand Delivery of the Kai Kos Dehseh EIA to the Conklin Community Association.	
Dec. 16, 2007	Meeting at Ramada Inn, Edmonton	Conklin Métis Local(CML) Board of Directors	StatoilHydro and CML reviewed working partnership to date. StatoilHydro has contributed to the Conklin Métis communities' capacity building in supporting the CML Traditional Land Use Study which will support the StatoilHydro EIA Traditional Knowledge Study. Next steps will be for StatoilHydro to provide a first draft work plan to the CML.	StatoilHydro provided a first draft workplan to the CML in early January.
Jan, 19-20, 2008	Meeting at St. Louise, Edmonton CHATEAU LOUIS	Conklin Métis Local (CML) and Conklin Community Association (CCA)	Industry meeting with CML about how the CML and CCA have formed a joint committee to engage with different companies.	StatoilHydro has agreed to be part of the process.
Feb.-Mar. 2008	Phone/email discussions	Conklin Métis Local(CML) representatives	Ongoing discussions toward Spring Traditional Knowledge Study work, developing a work plan.	Continue discussions.
Beaver Lake Cree Nation (BLCN)				
Sept 27, 2007	BLCN Office, Lac La Biche	BLCN Business & Intergovernmental Representatives	Initial introduction of StatoilHydro to BLCN. BLCN asked for project and company information.	StatoilHydro commits to make EIA information available to BLCN.
Nov 2, 2007	BLCN Office, Lac La Biche	BLCN Business & Intergovernmental Representatives	Hand-delivered and discussed StatoilHydro's project information for 07/08 winter program and information about StatoilHydro including project schedules, public disclosure documents and Kai Kos Dehseh EIA. BLCN committed to reviewing information and would let StatoilHydro know next steps.	StatoilHydro to deliver the Leismer Demo Application next.
Nov 16, 2007	BLCN Office, Lac La Biche	BLCN Business & Intergovernmental Representatives	Hand-delivered more information, Leismer Demonstration Application. BLCN requested to meet with StatoilHydro representatives	Meeting date to be determined by both parties.

Date	Meeting/Event	Community Participants	Outcomes	Follow-up
Nov 20, 2007	Phone Call	BLCN Business Representative	StatoilHydro representative called BLCN to arrange a meeting date. They are not sure when they would like to meet with StatoilHydro .	
Nov 21, 2007	BLCN Office, Lac La Biche	BLCN Business & Intergovernmental Representatives	Hand delivery of StatoilHydro 's winter 07/08 drilling/seismic operations map and winter sump disposition #072601MSL and LOC 071778.	
Dec. 21, 2007	BLCN Office, Lac la Biche	BLCN Office	Hand-delivered utilities corridor (powerline, pipeline and access road) and well pad site information to BLCN office.	None required.
Jan. 17, 2008	BLCN Office, Lac La Biche	BLCN Intergovernmental Representatives & BLCN Chief and one Councilor	Meeting to discuss a working relationship. StatoilHydro shared about the Kai Kos Dehseh Project, and upcoming developments. StatoilHydro committed to a next steps working process including an upcoming Elders and Chief & Council mtg. To implement this consultation process StatoilHydro committed to a proposed $30 000.00 fee to be fully agreed to once StatoilHydro received in writing an itemized break-down of the $30 000.00 budget.	BLCN committed to providing itemized budget to StatoilHydro.
Week of Feb 11, 2008	BLCN Office, LLB		Follow-up visit to answer questions and schedule meeting for further discussions.	
Mar. 14, 2008			Registered letter sent to BLCN requesting meeting.	
Lac La Biche				
Oct. 25, 2007	Lac La Biche County Offices	Lac La Biche County Mayor, Peter Kirylchuk	StatoilHydro President, CFO and Executive VP met with the new Mayor – introductions and sharing of information. StatoilHydro was invited to present to the Lac La Biche County Council at an upcoming Council meeting.	StatoilHydro will present to the Lac La Biche County Council on Jan 8, 2008.
Oct. 25, 2007	McArthur Place, Lac La Biche	Lac La Biche County reps, local business people and communities members	StatoilHydro's Open House in Lac La Biche for all communities in the Lac La Biche County. Information was shared about winter 07/08 programs in the lease areas and longer term development plans and activities.	Follow-up with some local contractors about upcoming business opportunities.

DATE	MEETING/EVENT	COMMUNITY PARTICIPANTS	OUTCOMES	FOLLOW-UP
Jan. 8, 2008	Lac La Biche County Offices	Lac La Biche County Council Members	StatoilHydro was invited to present to the Lac La Biche County Council as the StatoilHydro Open House in Lac La Biche in Oct 07. StatoilHydro President & CEO, Senior Executive VP and other Executive presented. Presentation and resulting discussions with Council very well received by both parties.	StatoilHydro will continue to inform the Lac La Biche County of further developments and updates.

- StatoilHydro is committed to consulting with communities which are within a 30 km radius of our lease areas, including: Anzac, Ft. McMurray First Nation, Chipewyan Prairie Dene First Nation and Conklin. StatoilHydro is open and committed to developing business working relationships with local communities outside of this 30 km radius, including: Heart Lake First Nation, Lac La Biche, Kikkanno Métis Settlement, Buffalo Lake Métis Settlement, Beaver Lake Cree Nation and Ft. McMurray.

- StatoilHydro is actively consulting and involving a number of Aboriginal communities and First Nations in NE Alberta. StatoilHydro has an active program of consultation, local training, business engagement – StatoilHydro also has a dedicated staff, regular community meetings and annual community reporting of our progress and challenges. StatoilHydro is concentrating on communities nearest its operations – they are Chard, CPDFN, Conklin, Fort McMurray First Nation and Anzac. StatoilHydro is planning to stage much of its operations out of Lac La Biche and, as such, has opened an operations office in the community. For Aboriginal communities outside of the immediate region (eg. Heart Lake First Nation and Beaver Lake), StatoilHydro is working towards providing business opportunities to members of these communities.

2	b. confirmation that notification of the application has been given to the P&NG leaseholders and the freehold mineral owners of any unleased lands in the area of the application and off-setting sections as required by ERCB *Directive ID 99-1*; and

Response

P&NG Leaseholders and Freehold mineral owners in the area of the Application are indicated on the land maps in Volume 1 Figures 2.3-2a, 2.3-2b, 2.3-2c, A1.1-2, B1.2-1, C1.2-2. StatoilHydro confirms that all of these leaseholders and mineral rights owners have been notified of the Application in accordance with ERCB *Directive ID 99-1*.

2	c. a complete listing of all stakeholders (public and industry) that have received notification of the subject application.

Response

The following stakeholders have received notification of the Kai Kos Dehseh Application:

- Conklin – Conklin Community Association and Conklin Métis Local
- Janvier Municipal Office
- Chipewyan Prairie Firsts Nation IRC Office
- Fort McMurray First Nation IRC Office
- Fort McMurray Chamber of Commerce
- Fort McMurray Municipal Library
- Heart Lake First Nation Consultation Office
- Lac La Biche Chamber of Commerce
- Lac La Biche Library
- Beaver Lake Cree Nation Consultation Office.
- Athabasca Chipewyan First Nation
- Ft. McKay First Nation
- Mikisew Cree First Nation
- 297917 AB Ltd
- Alberta-Pacific Forest Industries Inc.
- Alta Gas Ltd
- Altalink Management
- Arthur Layman
- Atco Electric Ltd.
- Avenir Operating Corp.
- Barnwell of Canada
- Bounty Developments Ltd.
- BP Canada
- BP Canada Energy Company
- Burlington Resources Canada Ltd.
- Canadian Coastal Resources
- Canadian Forest Oil Ltd.
- Canadian Natural Resources Limited
- Cavalier Land Ltd.
- Chair Resources Inc.
- Compton Petroleum Corporation
- Connacher Oil and Gas
- ConocoPhillips Canada
- Consun Contracting Ltd.
- County of Lakeland

- Devon Canada Corporation
- Edmonton Office - Public Lands
- Enbridge Pipelines (Athabasca) Inc.
- EnCana
- Fortis Alberta Inc.
- Husky Oil Operations Ltd.
- Imperial Oil Resources
- Alberta Infrastructure & Transportation
- JACOS
- Koch Exploration Canada Corp
- Lac La Biche - Land Use
- Lac La Biche Regional Community Development Corporation
- Laricina Energy
- MD Wood Buffalo
- MEG
- Meridian Land Services Ltd.
- Millar Western Forest Products
- NAL Resource Management Ltd.
- Nexen Inc.
- Northrock Resources Ltd.
- Northstar Energy Corp.
- Nova Gas Transmissions Ltd.
- OPTI Canada Inc.
- Paramount Energy Trust
- Paramount Resources
- Petrobank Energy and Resource Ltd.
- Petro-Canada
- Petroland Services Ltd.
- Primewest Energy Corp.
- Provident Acquisitions Inc.
- Regional Municipality of Wood Buffalo
- Saskatoon Assets Ltd.
- Scott Land and Lease Ltd.
- Stone Valley Contracting Ltd.
- Stylus Energy Inc.
- Suncor
- Superman Resources
- Superman Resources Inc
- Talisman Energy Inc.
- Telus Communications
- Total E&P Canada Ltd. (Dome Tower)
- Town of Lac La Biche
- Vault Energy Inc
- Whitesands Insitu

3	The ERCB expects that thermal operations will be conducted in a manner that will not compromise cap rock seal integrity. Provide the following information for each of the three hubs within the application: a. The maximum steam chamber pressure proposed for each of the hubs including the methodology for measuring and monitoring this pressure.

Response

The maximum bottomhole circulation pressure during start-up operations is 6,000 kPag.
The maximum steam chamber pressure proposed for each of the hubs is 6,000 kPag. Steam chamber pressures will be monitored in real time by a gas blanket in the intermediate casing annulus space. For this type of measurement, the casing head pressure is directly measured and the corresponding steam chamber pressure is determined by adding the gas blanket hydrostatic pressure. The gas hydrostatic correction is small relative to the direct measurement (i.e. less than 80 kPa for a 6,000 kPa steam chamber at 425m TVD).

Due to the possibility of thief zones, and late-life heat management of the SAGD process, it is likely the operating pressure will be lower than the maximum during much of the life of a well pair. The pressures are more likely to be lower after the steam chamber has reached the top of the reservoir.

3	b. The maximum bottomhole circulation pressure during start-up operations.

Response

The maximum bottomhole circulation pressure during start-up operations is 6,000 kPag.

3	c. Demonstration of the thickness and areal extent of the caprock in the project area by comparing logs and cores over the caprock interval. Provide an annotated isopach map of the caprock in the project area.

Response

As stated in AENV SIR Response 2, StatoilHydro believes the A2 Mudstone in the McMurray Formation is the uppermost McMurray caprock. However, where it thins, the Wabiskaw Member of the Clearwater Formation would act as the absolute caprock to any uphole fluid migration. See attached Figure 3-1 “Leismer Kai Kos Dehseh Project Wabiskaw Caprock

Isopach Map" and Figure 3-2 "Corner Wabiskaw Isopach Map." The A2 regional shale isopachs were included in the original Application and are identified as Figures A4.1-19 (for the Leismer Initial Development Area), B4.1-19 (for the Leismer Expansion Area), and C 4.1-19 (for the Corner Initial Development Area).

3	d. Demonstration of the competency of the caprock by providing the following analysis of cores across the caprock interval: i. Composition (i.e., percentage of silt, shale and mud).

Response

No compositional analysis of the A2 caprock has currently been completed by StatoilHydro. G. Wong from the University of Alberta conducted studies as part of a MSc. Study, which categorized the Clearwater Shales overall as silty clay material. 45 to 95% of fines material passing size #200 (75 µm) and from 5 to 55% clay particles passing 2 µm size.

3	ii. Compressive strength.

Response

There have been no geomechanical tests performed on cores within the McMurray Formation in the Kai Kos Dehseh study area. However geomechanical properties were derived from the mini-frac data described in ERCB SIR Response 3 e below. There were also no geomechancial tests performed on the Wabiskaw Member in the Kai Kos Dehseh study area. However, compressive strength can be calculated from general properties for the Clearwater in the discussion that follows.

Compressive strength for sedimentary rocks, such as Clearwater Shale, is controlled by friction, and thus depends on the prevailing stress condition. Definition on the compressive strength may be different.

The most fundamental and accepted one is based on Mohr-Coulomb strength criterion. It states that the compressive strength is determined by the applied normal (σ, effective) and shear (τ) stresses via material properties: cohesion (c) and internal friction angle (□):

$$\tau = \sigma \tan(\phi) + c$$

Therefore, compressive strength is defined by two parameters: cohesion and friction angle. This is the most comprehensive strength measure for geomaterials that should be used universally.

In geomechanics, a special term, called uniaxial (or unconfined) compressive strength (UCS), specifically refers to the compressive strength when the material has no lateral support and is subject to the axial compression alone. UCS can be measured by an uniaxial compression test, or calculated from the basic Mohr-Coulomb strength properties as follows:

$$\text{UCS} = \frac{2\,c\cos(\phi)}{1-\sin(\phi)}$$

Using UCS is a convenient way to compare compressive strengths of different materials.

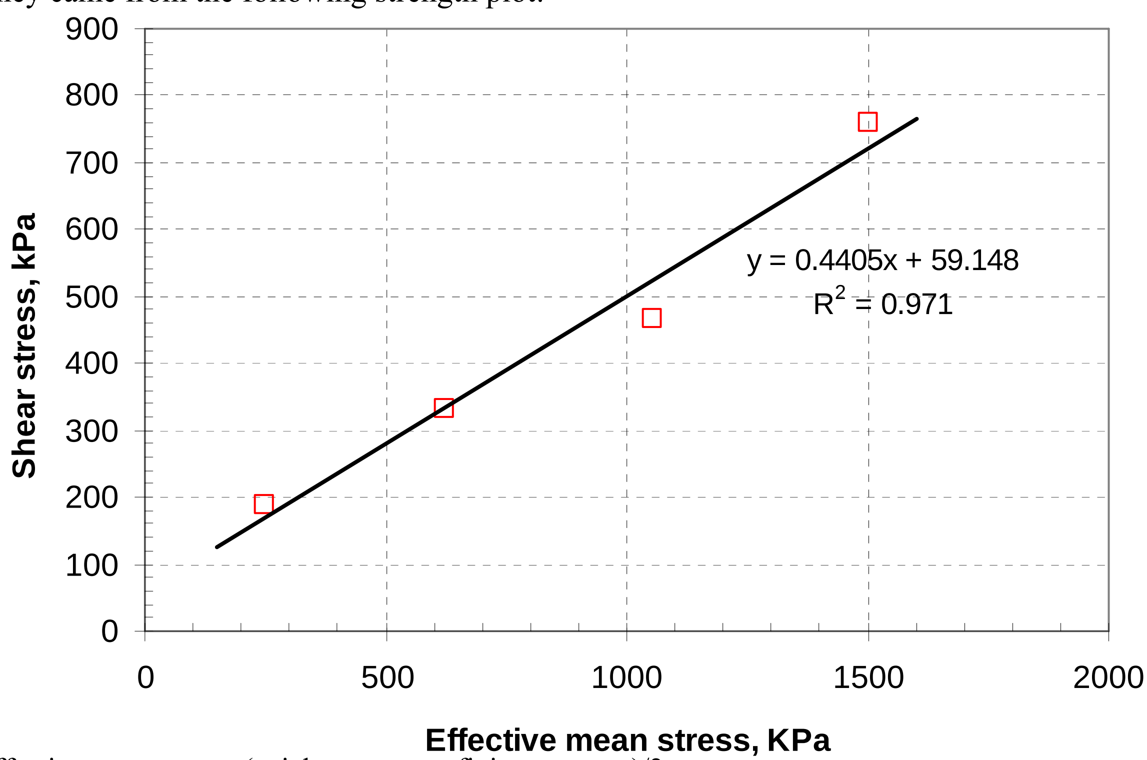
Few data studies have been published regarding the Clearwater Shale's strength properties. The most applicable examples were the following two sets of laboratory measurements on intact samples of Clearwater Shale:

1. Gulf Canada Resources Ltd.'s submission for the ERCB Gas-Over-Bitumen Hearing in 1999.

   Analysis on the test results gives the following peak strength parameters:

   Cohesion (c) =66 kPa
   (Internal) Friction angle (□) =26°
   UCS=211 kPa (calculated).

   They came from the following strength plot:



   Effective mean stress=(axial stress + confining pressure)/2-pore pressure
   Shear stress=(axial stress - confining pressure)/2

The same Submission gave the residual strength parameters on a sheared Clearwater Shale surface as follows:

Cohesion (c) =0 kPa
(Internal) Friction angle (□) =15°
UCS=0 kPa (calculated)

2. M.Sc. thesis by H. Wong at University of Alberta

For peak strength:

Cohesion (c) =300 kPa
(Internal) Friction angle (□) =32°
UCS=1082 kPa (calculated) or 683 to 2867 kPa (measured directly).

And for residual strength,

Cohesion (c) =0 kPa
(Internal) Friction angle (□) =20°
UCS=0 kPa (calculated)

The following table further summarizes the above results:

Table 3-1: Compressive strength parameters for Clearwater Formation clay shale

Source	**Peak strength**			**Residual strength**		
	Cohesion, kPa	**Friction angle, deg**	**UCS, kPa**	**Cohesion, kPa**	**Friction angle, deg**	**UCS, kPa**
Surmont hearing	66	26	211 (calculated)	0	15	0 (calculated)
M.Sc. thesis	300	32	1082 (calculated) Or 683-2867 (measured)	0	20	0 (calculated)

REFERENCES:

Kosar, K.M., 1989, *Geotechnical Properties of Oil Sands and Related Strata*. Ph.D. thesis, Dept. of Civil Eng., Univ. of Alberta, Canada.

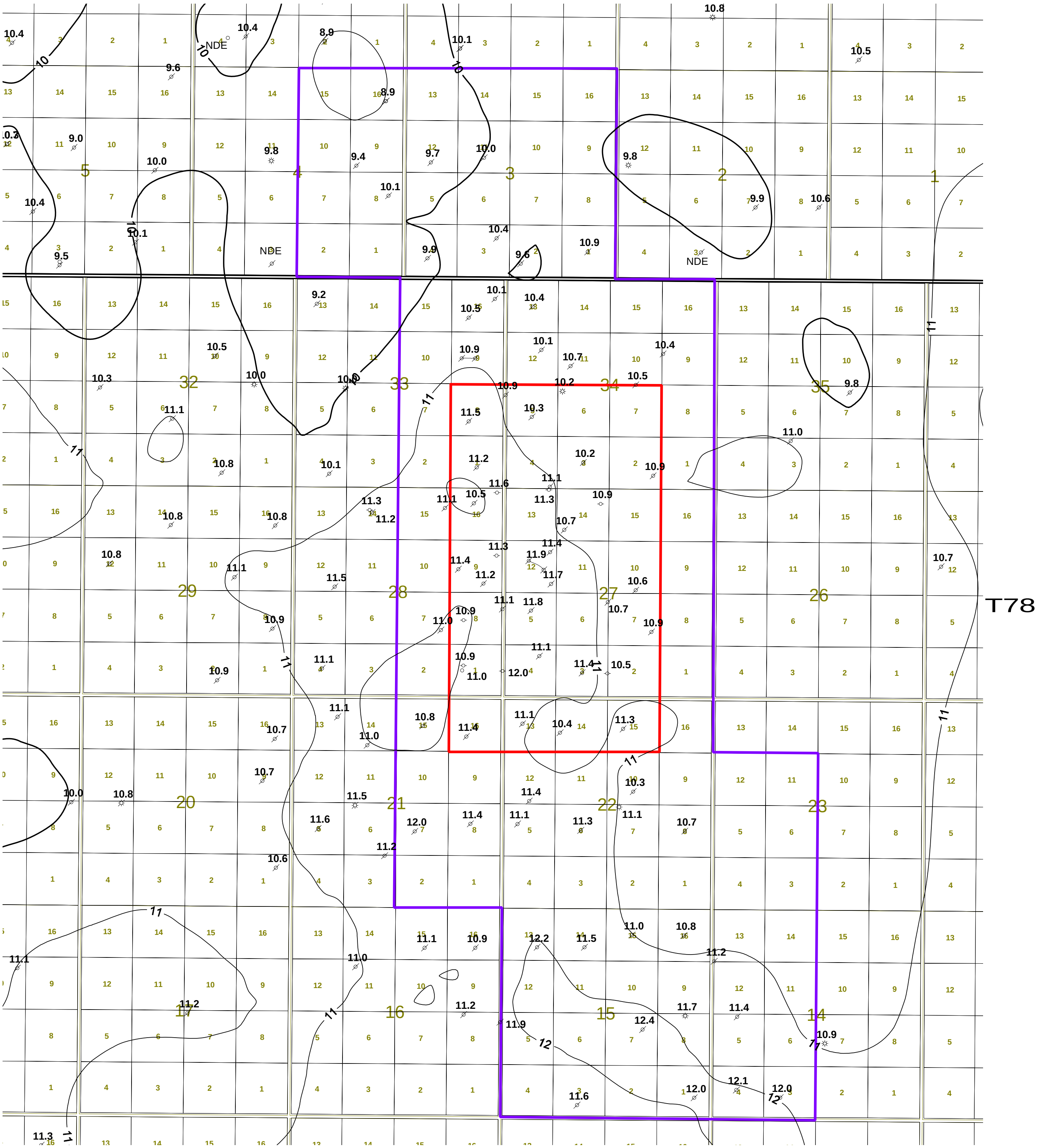
Chalaturnyk Rick, “Technical Appendices: Characteristics of Cretaceous Clay Shales in Surmont Area, Proceeding no. 960952 Surmount Area, Gulf Canada Resurces Limited”

Gilbert Wong, Unpublished M Eng Report, “Geomechanical Characterization for Clearwater Formation Clay Shale”, University of Alberta

3	iii. Evidence of fractures, faults and karsting.

Response

No evidence of fractures, faults or karsting has been observed from the analysis of cores from the Wabiskaw Member caprock interval in the Kai Kos Dehseh study area.



Leismer Expansion Project Area

Leismer Demonstration Project Area

11.4 Wabiskaw- McMurray Isopach

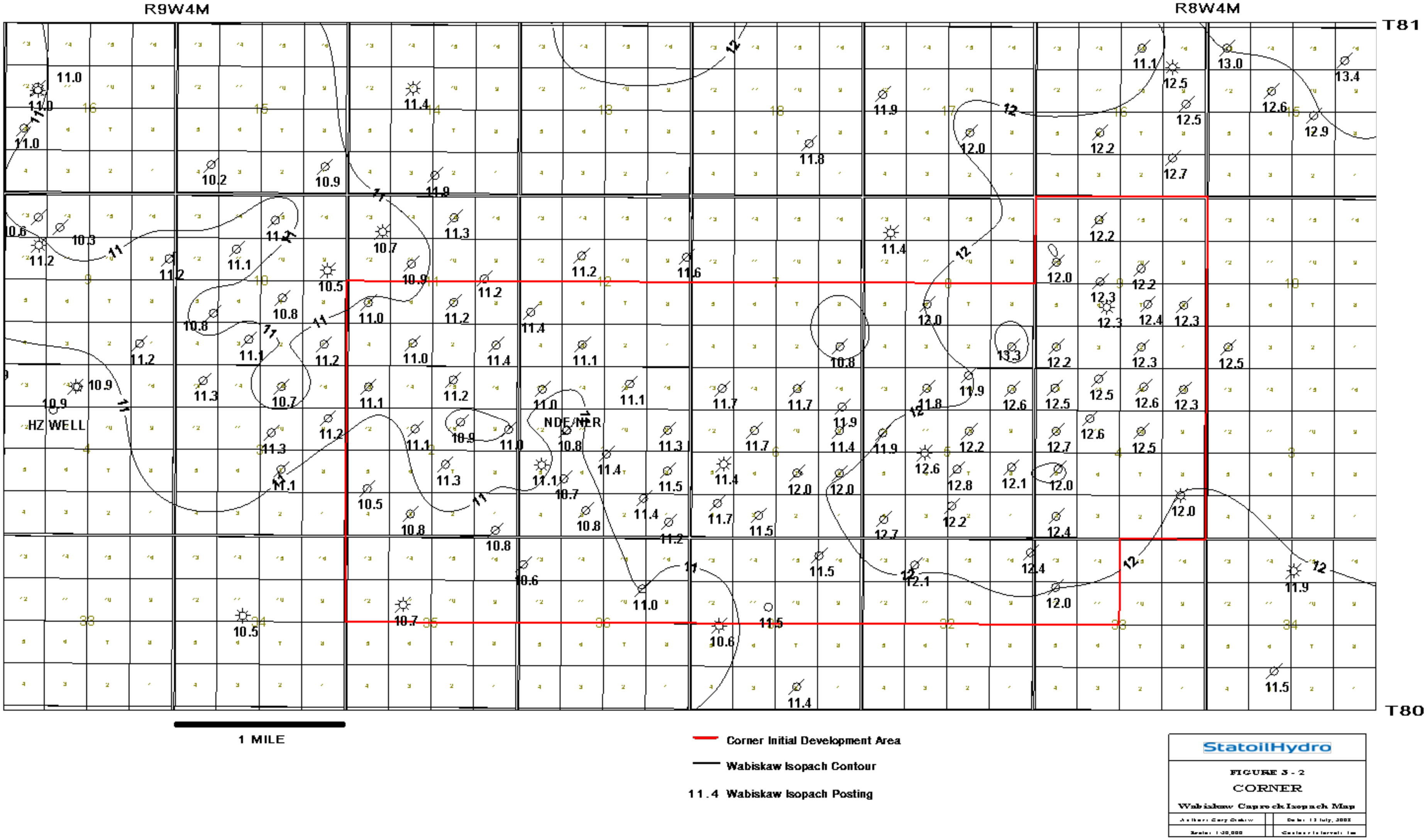
R10W4M

1mile

StatoilHydro

Figure 3-1
Leismer KKD Project
Wabiskaw Caprock Isopach Map

Author: G. Anderson		Date: 15 July, 2008
CI=1m	Scale: 1: 20,000	


R9W4M
R8W4M
T81
T80
HZ WELL
1 MILE
Corner Initial Development Area
Wabiskaw Isopach Contour
11.4 Wabiskaw Isopach Posting
StatoilHydro
FIGURE 3 - 2
CORNER
Wabiskaw Caprock Isopach Map
Scale: 1:30,000

3	e. The reservoir and caprock fracture pressure including supporting data, tests and analysis (i.e., mini fracture test, step rate injectivity test).

Response

Hydraulic fracturing stress tests were conducted at the following two Leismer Hub area wells. StatoilHydro feels that these wells are representative of the reservoir fracture conditions in the three Hub area.

Well	Facies	Depth
00/04-27-078-10W4M	oil sand	420 m KB
02/12-27-078-10W4M	regional mudstone	399 m KB

The measured downhole breakdown pressures ranged from 10 to 15 MPa. This is much higher than the maximum proposed injection pressure of 6 MPa. The Instantaneous Shut-In Pressure (ISIP) was measured after the wells were shut-in and the pressure falls due to disappearing friction were measured from 9.5 to 11 MPa. Again, this is much higher than the maximum proposed injection pressure of 6 MPa.

The hydraulic fracturing stress test for 02/12-27-078-10W4M mentioned above, was performed in a regional mudstone sequence within the Upper McMurray Formation, which forms a potential caprock for the SAGD process in this area. Other regional McMurray Formation mudstones are expected to prevent communication with potential Upper McMurray thief zones. The regionally extensive shales of the Wabiskaw Member of the Clearwater Formation would form an absolute caprock to any uphole fluid migration. Thermal stresses can also play a role in caprock integrity. Since there is typically significant vertical separation between the top of SAGD and the bottom of the Wabiskaw caprock, and even more distance to the top of the Wabiskaw Member, it is unlikely that the caprock would be breached. In general, caprock integrity is of less concern at the Kai Kos Dehseh Project than in many of the shallower SAGD projects in the region.

No hydraulic fracturing tests were specifically performed on the Wabiskaw Member. However, it would be expected that the in-situ stress gradients in the Wabiskaw would at least as high as that in the McMurray Formation.

3	f. Monitoring that will be conducted to ensure caprock integrity has not been compromised during the life of the project. This must include a measurement and alarm system for detecting sudden pressure drops and/or injection rate increases and criteria for shutting down operations.

Response

Monitoring will be conducted to ensure caprock integrity has not been compromised during the life of the Project. The monitoring will focus primarily on thermal well operational parameters. Steam injection wellhead pressures, casing gas injection pressures, and individual steam injection rates will all be measured and monitored in real time. Appropriate control system alarms will be applied to each of the measurements. First level alarming (high and low) will audibly warn of “minor” deviations of steam rates and associated injection pressures in the order of 10%. Second level alarming (high-high and low-low) will audibly warn of “major” deviations of steam rates and associated injection pressures in the order of 25%. A high-high or low-low alarm would trigger a shutdown sequence and begin ramping down steam and casing gas injection operations at the offending well pair.

In some instances, the outlined percentages would be superseded by hard engineering requirements or regulatory standards, such as tubing steam velocity limitations, or ERCB mandated maximum wellhead injection pressures.

Caprock integrity will also be assessed through production monitoring and surveillance of the installed piezometer and temperature observation well network. Unexpected deviations in the above parameters will warrant a thorough investigation.

3	g. Analysis of the potential consequences of loss of steam containment should the caprock be breached.

Response

In the unlikely situation of a caprock failure, the barriers within the Upper McMurray Formation would probably be breached first. Since there are often top thief zones within the McMurray Formation, steps would need to be taken to minimize heat losses by lowering the operating pressure of the steam chamber. Movement above the Clearwater Formation is not likely. Type Log Figures A4.1-9 and B4.1-9 in the original Application, indicate a shale Clearwater section that has additional regional marine shales from 331.5 to 335 m and 368 to 371 m, as well as the Wabiskaw Member shale from 373.5 to 379 m. Should the Wabiskaw interval be breached, the additional two shales above would contain any upward fluid movement.

In the Type Log from Corner Hub, Figure C4.1-9, the intervals from 415 to 418 m and 442 to 445 m indicate additional regional marine shales in the Clearwater Formation, as well as in the Wabiskaw Member shale from 447 to 452 m. Should the Wabiskaw caprock be breached, the additional two shales would contain any upward fluid movement.

The potential consequences of loss of steam containment, should the caprock be breached, would include the following:

- depressurization of the steam chamber
- steam / condensed steam migration into zones of less pressure (Upper McMurray and Clearwater)
- movement of heated bitumen into upper zones (the spread would be limited due to a loss in mobility as the fluids cool)
- inflow of higher pressure water zones into depressurizing steam chambers
- inflow of higher pressure gas zones into depressurizing steam chambers
- hydration of the caprock

4	The ERCB expects applicants to be familiar with all ERCB requirements respecting their proposed in situ oil sands scheme. Please provide a summary of the following information for any waivers or variances being requested as part of the subject application: a. The waiver or variance requested.

Response

StatoilHydro will be considering Blow-Out Preventer (BOP) reduction waivers and petrophysical logging waivers for its SAGD development wells under ERCB Directive 036: *Drilling Blowout Prevention Requirements and Procedures* and ERCB Directive 056: *Energy Development Applications and Schedules*. Based on the current and projected density of oil sands evaluation (OSE) wells in the Project area, there would be abundant formation pressure and geological information available. Therefore, the reduced BOP equipment stacks and reduced downhole logging equipment requirements resulting from these waivers would promote greater operational efficiency and safer work conditions on the SAGD well sites.

StatoilHydro will also be considering applications to obtain the necessary waivers from Alberta Energy under the *Mines and Minerals Act* for wellbores that terminate or will be placed on production from road allowances. Currently, StatoilHydro is investigating the required information and has not yet determined through Directive requirements, if it is eligible for these waivers at this time.

4	b. The ERCB regulation or directive that stipulates the requirement requested to be waived or varied.

Response

Refer to ERCB SIR Response 4 a.

4	c. The reason(s) for the requested waiver or variance including any supporting material.

Response

Refer to ERCB SIR Response 4 a.

5	**Volume 1, Page 4, Section 1, Figure 1.2, Introduction.** This Figure illustrates project development areas and hub locations. a. Which hub is associated with the facility located in the northeast corner of the Leismer Development Area?

Response

The facility illustrated in the northeast corner of the Leismer Development Area in Volume 1 Figure 1.2 is a potential steam generation site associated with the Leismer Expansion Hub which may be required as part of an extended gathering system in a later phase of the Leismer Project.

6	**Volume 1, Page 64, Section 4.2.3.2, Well Pair Placement.** Statoil Hydro states, "*In reservoir areas with no bottom water or lower transition zones it is North American's intention to place the SAGD production well as close to the base of the clean porous sand as possible, generally within 1m to 3m of the reservoir base*". Statoil Hydro further states, "*…numerical model sensitivity studies show recoveries will be better with a slightly higher well placement*", and "*In all areas, SAGD production wells will be allowed to deviate a few meters up and down to maximize resources recovery wherever possible*". a. Provide a discussion on remedial actions that may be undertaken during the drilling of the horizontal portion of a well if non-bitumen pay rock is encountered that could have a detrimental impact on productivity, including the criteria for implementing such remedial action.

Response

The primary remedial action that can be undertaken while drilling would be the adjustment of the well trajectory with the intention of re-encountering bitumen pay rock.

The criteria for implementing such remedial action would primarily be a function of well length or percentage of well length drilled in non-bitumen pay rock and each case would be well-specific. If only short, intermittent intervals (intervals less than 50 m and totaling less than 25% of the total well length) of non-bitumen pay rock were encountered, drilling would likely continue to the planned termination point and would be deemed a success.

If a well were drilled with a significant portion in non-bitumen pay rock (over 25% of the total well length), it would be likely that some portion of the well would be sidetracked in an attempt to encounter a larger percentage of bitumen pay rock. If sidetracking operations were unsuccessful, drilling would be suspended pending a full geophysical, geological and reservoir engineering review, which would include the prospect of completing only a portion of the reservoir section, or complete well abandonment.

6	b. Provide a discussion on when a well may have blank pipe instead of slotted liner run in a portion of the horizontal interval, including the criteria for doing this and the potential effect on resource recovery.

Response

Blank pipe may be run for a number of reasons related to drilling, well completions, well costs and process optimization. It will be run to reduce steam contact with critical well components and to ensure the first slotted liner joint is placed at some distance outside the production casing shoe or intermediate casing point. It may be run to coincide with planned steam injection tubing discharge points to reduce erosion potential of the slotted liner. Blank pipe may be periodically placed between extended slotted liner lengths to reduce well costs, primarily on steam injection wells where 100% slotting is not required for thorough steam distribution into the reservoir.

Blank pipe may be run through non-bitumen pay rock intervals to mitigate the risk of fines/solids production and associated performance issues related to excessive fines/solids production. It may be utilized when the production well intersects significant bottom water. It may also be run through intervals where the vertical separation between injection and production wells is thin (less than 4 m) to reduce the potential for steam short-circuits.

It is expected that the application of blank pipe will be quite short relative to the total slotted well length, and therefore have a negligible effect on resource recovery. The use of blank pipe may in fact improve reservoir recovery by reducing SOR and extending economic well life by minimizing the amount of steam directed at non-reservoir areas.

7	**Volume 1, Page 64, Section 4.2.3.3, Reservoir Modeling.** a. Provide a discussion on the following items and include input and output data files, and a tabulated summary of subsequent results from sensitivity studies that were used to predict: i. The optimal well pair spacing, producer elevation, and horizontal length;

Response

Well pair spacing for most of the Kai Kos Dehseh Project will be planned at 120 m. Using a single well pair block model (previously described in Section 4.2, Supplemental Information-Leismer Demonstration Project ERCB Application No. 1461870), sensitivity runs were made where only the distance to the model boundary was adjusted. This simulated varying well pair spacing assuming a repeating symmetry element.

Avg model parameters are as follows:

pay (m)	28
porosity (frac)	0.35
oil saturation (frac)	0.87
permeability (Pa.s)	12

A summary of the results are tabulated below;

Table 7-1 Sensitivity Study of Well Spacing and Cumulative Oil Recovery

Well Pair Spacing (m)	CSOR	RF (%OBIP)	Life (Yrs)	Avg Oil (bbl/d)	Cum Oil (MMbbl)
100	2.76	44	5.7	870	1.80
120	2.81	45	6.4	945	2.22
150	2.86	45	7.4	1028	2.78
200	2.98	44	9.3	1065	3.61

For consistency, the well pair life will be assumed to end when the instantaneous steam oil ratio reaches 4.0. The recovery factor was essentially the same for each case. The cumulative steam oil ratio was higher for higher well pair spacing due to increased overburden heat losses resulting from the longer operating life required to drain a larger area. This is offset by higher cumulative oil production per well pair. An economic optimum was chosen at a well pair spacing of 120 m. This analysis seems in line with the conclusions of other industry operators as their well pair spacing mostly ranges from 100 to 150 m. Since the Kai Kos Dehseh Project will be phased in over time, the well pair spacing and lengths can be changed in subsequent phases and projects, if further optimization were required.

SAGD producers will be placed as close to the base of the clean porous sand as possible, which will be generally within 1 m to 3 m of the reservoir base. Producer elevations will have be adjusted locally depending upon on the structure of the bottom and local reservoir quality issues. This should maximize recovery and no general sensitivity cases were run. In reservoirs with thicker bottom water (>5 m), the producer position may be adjusted upwards to approximately 3 to 5 m above the oil/water contact. The higher placement will limit the amount of heat lost to the bottom water and reduces the amount of bitumen draining and lost in the water zone. Since bitumen is heavier than water, the heated bitumen, once mobilized, will sink into the bottom water until it cools enough to again lose mobility. With a higher well placement the heated zone will not extend as far into the bottom water, so the losses will be reduced and the overall recovery is higher.

Except for the initial Leismer Demonstration Project, where a shorter, more conservative, well length is planned, typical SAGD well pairs will have an initial length of 1,000 m. The actual length of each well pair will be a function of pad geometry and local reservoir geology with consideration given to surface access limitations. The 1,000 m long wells will be designed to minimize pressure drops along the wells, which should allow for the maximum effective wellbore length. The length of the well pairs will fall within a range comparable to that seen at other commercial SAGD projects. Performance will be monitored and well lengths will be adjusted in future phases accordingly.

7	ii. The impact of thief zones and bottom water on the recovery efficiency of the SAGD process in relevant areas. Discuss specifically **Figure C4.1-23, Page C-74,** which shows an areal extent of associated McMurray gas greater than that encountered in the Leismer area. How does Statoil Hydro propose to mitigate any negative impact?

Response

As described in ERCB SIR Response 7 a i above, bottom water will affect the recovery efficiency of the SAGD process. The effect will be relatively minor with shale interbeds between the producer and the bottom water, or in areas with thin bottom water (< 2-3 m). This is prevalent over much of the Corner Hub initial development area. Adverse effects increase with bottom water thickness. The potential impact can be mitigated by optimizing the placement of the well pairs above the oil/water contact, as described above. The steam chamber must also be operated at a pressure slightly higher than the aquifer pressure to prevent water from coning into the producer, but low enough to not force steam into the bottom water.

Thief zones at the top of the reservoir typically consist of an associated net lean zone, sometimes overlain with associated gas. The net lean zones are mostly water-saturated. The steam chamber must be operated at a pressure slightly higher than the top thief zones. This will minimize water drainage from the top lean zone, while minimizing heat losses into the top thief zone. Based on the pressure data collected from elective formation tests, the associated thief zones appear to be in equilibrium with the bitumen zone so the issue of operating at low or unbalanced pressures does not appear to exist at the initial development area at the Corner Hub.

8	**Volume 1, Page 80, Section 4.4.1, Source Water and Disposal Principles and Concepts.** Statoil Hydro recognizes that the push-pull plan has the potential to impact bitumen recovery. a. What monitoring mechanism will be put in place to ensure a timely detection of changes to the Basal McMurray pressure?

Response

StatoilHydro has already installed an observation well network that includes pressure monitoring of the Basal McMurray Formation. Currently, the observation well network is focused on the Project area for the Leismer Demonstration Project, but StatoilHydro intends to expand the network into future development areas.

8	b. Provide the criteria that will be used to determine the location of source and disposal wells.

Response

The criteria used to locate water source wells will be:

- Minimization of surface disturbance (using existing clearings wherever possible);
- Avoidance (where possible) of potential impact on water courses and water bodies;
- Reduction of pressure impacts affecting resource recovery due to the brackish source water withdrawal;
- Well sparing;
- Aquifer thickness, expected deliverability, avoidance of gas-over-water (if known), observation wells. etc.;
- Proximity to the plant site;
- Spacing to account for inter-well interference and cumulative effects; and
- Transport time from the disposal well to the brackish source well.

The criteria used to locate disposal wells will be:

- Avoidance, where possible, of potential impact on water courses and water bodies;
- Avoidance of contamination to other geological formations;
- Minimization of pressure impacts of the disposal process on the resource recovery;
- Breakthrough of disposal water from the disposal well to the brackish source well;
- Proximity to plant site;
- Aquifer thickness;
- Connectivity of the disposal zone to a large aquifer; and
- Well sparing;

8	c. How were the source and disposal well locations relative to SAGD drainage patterns established?

Response

Multiple source and disposal well locations were initially selected where the Basal McMurray Formation was thick and extensive enough to support StatoilHydro's planned water injection and water production operations. These locations were then numerically modeled to determine if Basal McMurray operations would have any impact on the offsetting SAGD operations. If water operations imposed unacceptable pressure deviations onto StatoilHydro's SAGD operations, the locations were dismissed. The analysis resulted in a number of viable Basal McMurray source and disposal locations.

8	d. How could the push-pull plan affect Statoil Hydro's commitment to comply with the ERCB 90% recycle rate, considering that the recycle rate is likely to occur with less water going to disposal?

Response

The question is unclear.

The push-pull plan does not impact upon the 90% recycle rate, and StatoilHydro intends to meet the recycle requirements regardless of the push-pull.

8	b. How is Statoil Hydro prepared to address operational challenges that would compromise the push-pull plan such that more or less water is directed to disposal than anticipated?

Response

The disposal water will be OTSG blowdown. The make-up from the McMurray Formation will be balanced with the disposal flow. There may be short-term imbalances of over-disposal or over-make-up production (days), however, the plan will be to hydraulically balance the disposal and Basal McMurray make-up flows. This will be critical to the successful recovery of the resource.

There is no plan to dispose of produced water, at this time. The plan will be to manage the produced water returning to production if there is bottom or top water. Normally, it is expected that the production emulsion will be within the design range of water-to-oil ratio. If there is more produced water returning, then the non-saline make-up water will be reduced up to the point of the minimum required for VRU cooling and utility water needs. If the produced water continues to increase, then the production from high water cut wells will be reduced or diverted to another Central Processing Facility (CPF). If the converse occurs, where less water returns than planned, then the make-up water will be increased, production from high-water cut wells will be encouraged, or produced water will be transferred from another CPF with excess water.

8	c. In Appendix B, Page B-34, Section B2.4.6, Statoil Hydro states, "*If it* (the push-pull strategy) *causes bitumen production issues it will be modified or discontinued*". i. Elaborate on the types of bitumen production issues that may occur as a result of the push-pull plan.

Response

The types of bitumen production issues that may occur will be high or low bottom water pressures and breakthrough of disposal to production. The outcome of low bottom water pressure (over withdrawal from source well) will be the loss of steam or bitumen to the water leg. The outcome of high bottom water pressure (disposal exceeds source withdrawal) will be movement of water into production or quenching of the steam chamber.

8	ii. Discuss the criteria or triggers Statoil Hydro will use to decide whether to modify or discontinue the push-pull plan.

Response

Potential triggers that would cause StatoilHydro to decide to modify or discontinue the push-pull plan would be negative impacts on bitumen or to the steam-oil ratio.

8	iii. Provide an alternative plan should the push/pull plan be modified or discontinued.

Response

Alternative plans could potentially include:

a) disposing into a water-wet zone not connected to the resource being recovered, such as the Keg River Formation, or east Basal McMurray Formation, and sourcing the maximum amount of brackish water from Clearwater Formation aquifers;
b) installing a Zero Liquid Discharge system similar to that of the Petro-Canada McKay River Project;
c) altering the operating pressure of the SAGD steam chamber to reduce the impact on the aquifer; or
d) selecting alternate locations targeting aquifers in the McMurray Formation.

9	**Volume 1, Page 82, Section 4.4.4, Quaternary Water Usage.** Statoil Hydro states, "*Quaternary water would only be used for domestic, camp and utility water use*". Further, in Appendix B, Section B2.4.3, Page B-32, Statoil Hydro states, "*The Quaternary water supply for the Leismer Demonstration/Commercial Hub will be adequate for the Leismer Expansion*". It is unclear what the Quaternary water usage volumes are for the Leismer, Commercial, and Corner hubs. a. Provide a table clearly stating incremental Quaternary water usage for each hub.

Response

As part of the integrated plan of the Kai Kos Dehseh Project, construction and operations relating to the Corner Hub are planned to use same camps as that of the Leismer Hubs and will take advantage of the same water supply wells drawn from Quaternary-aged aquifers. The water from the Quaternary aquifers will be used for the camp domestic potable water supply. As stated in Appendix B, Section B2.4.2, page 31, the construction camp and the utilities supplied to the camp will be adequate for the Leismer Demonstration Project, Leismer Commercial Hub, Leismer Expansion Hub and Corner Hub. The construction camp potable water will be extracted from Quaternary-aged aquifers.

Potable water for each of these three CPFs will be trucked in by a commercial supplier, as noted in Appendix B, Section B2.4.3, Page 32.

Utility water for each of these three Hubs will be drawn from the Grand Rapid Formation, which is part of the Cretaceous Mannville Group, and not of Quaternary age.

Table 9-1 Quaternary Water Use for Leismer Demonstration/Commercial and Leismer Expansion

Use	Units	Leismer Demonstration/Commercial	Leismer Expansion	Corner
Camp potable	m^3/d av/peak	235/420	235/420	235/420
CPF potable	m^3/d av/peak	0/0	0/0	0/0
Utility water	m^3/d av/peak	0/0	0/0	0/0

10	**Volume 1, Page 85, Section 4.5, Water Reuse Alternatives.** Statoil Hydro states, "*The conventional warm lime process was selected based on capital cost and the concern over treatment and disposal of the concentrated evaporator brine*," and further comments, "*The decision to use proven OTSGs was made independent of the reuse treatment system, based on the fact that utility boilers, once fouled are very difficult to clean*". a. Provide any information Statoil Hydro has regarding the fouling of conventional boilers in these operations. Provide the data used to reach these conclusions.

Response

The designed steam generation pressure for the StatoilHydro SAGD facilities will be greater than 7 MPa. The pressure will be dictated by the hydraulic delivery losses and injection pressure needed to penetrate the reservoir. There are no commercial SAGD facilities operating utility boilers, even on evaporator distillate, at these pressures. The higher the steam pressure, the higher the boiling point and the more stringent the Boiler Feed Water (BFW) required.

Utility boilers operating at high steam pressures will require very stringent BFW quality. Any variations in BFW treatment such as evaporator foaming events, will result in off-specification BFW quality. Off-specification BFW will result in fouling and scaling in the utility boilers. Once fouled or scaled, the only cleaning option available for the utility boilers is treatment with chemicals. This has not been done so far for high-pressure SAGD operations.

The OTSG's, on the other hand, will be able to handle higher levels of dissolved solids and will be designed for mechanical cleaning by "pigging". While StatoilHydro does not have any direct experience in this application with utility boilers, it has recognized this as a risk, and has chosen to proceed with proven OTSG technology for steam generation.

11	**Volume 1, Page 85, Section 4.5, Water Reuse Alternatives.** Statoil Hydro states, "*…in order to conserve water resources, a minimum 90% recycle rate is strongly suggested by the* (ERCB)*, as well as the use of saline make-up water*". a. Confirm that Statoil Hydro is aware that the ERCB currently <u>requires</u> 90% water recycle for thermal in situ oil sands schemes.

Response

StatoilHydro is aware that the ERCB currently requires a 90% water recycle rate, and StatoilHydro will comply with current regulations regarding water use and recycling.

12	**Volume 1, Page 99, Section 5.2.4, Produced Water Handling and Treatment.** This section outlines the process where, after deoiling, produced water proceeds to the water treatment system. a. Are all tanks associated with this system equipped with nitrogen blankets?

Response

Skim Tank and the Deoiled Water Tank are equipped with fuel gas blanketing, at 0.2 kPag pressure. A vapor recovery system will recover the tank vapors for use as fuel in the steam generator.

12	b. Are some tanks to be vented to the atmosphere?

Response

The Warm Lime Softener, Overflow Tank and the Regeneration Waste Tank will be vented to the atmosphere, however, the water entering these units, will have gone through blanketed tanks.

13	**Volume 1, Page 99, Section 5.2.5, Startup and Operating Water Demand.** Statoil Hydro states, "*Once produced water is recycled, the demand for make-up water will decrease*". a. Provide the water use requirements on a yearly basis, including sources and volumes, for all the applied for Leismer and Corner hubs over the life of the project.

Response

The following two tables are provided from the original Kai Kos Dehseh Application. The dates shown on these tables are in alignment with original schedule, but need to be considered in light of change to schedule - 2009 should be considered as "Year One" of production for the Leismer Hub and 2012 should be considered as "Year One" of production for the Corner Hub.

Table 13-1 (Tables A2.3-2 and B2.4-2 Revised) Annual Source Water Consumption (m^3/y) for the Leismer Hub

Year	Grand Rapids Formation	Basal McMurray Formation	Bitumen Production ** (bbl/d)
2009	543,850*		5,000
2010	700,435*		12,500
2011	714,670	694,230	40,000
2012	714,670	694,230	40,000
2013	714,670	694,230	40,000
2014	714,670	694,230	40,000
2015	714,670	694,230	40,000
2016	714,670	694,230	40,000
2017	714,670	694,230	40,000
2018	714,670	694,230	40,000
2019	714,670	694,230	40,000
2020	714,670	694,230	40,000
2021	714,670	694,230	40,000
2022	714,670	694,230	40,000
2023	714,670	694,230	40,000
2024	714,670	694,230	40,000
2025	714,670	694,230	40,000
2026	714,670	694,230	40,000
2027	714,670	694,230	40,000
2028	714,670	694,230	40,000
2029	714,670	694,230	40,000

* Increased water demand due to higher retention during start-up phase
** Stream day Bitumen production reported for 2009, 2010. Calendar day rates reported from 2011 – 2029.

Table 13-2 (Table C2.4-2 Revised) Annual Source Water Consumption (m^3/y) for the Corner Hub

Year	Grand Rapids Formation	Basal McMurray Formation	Bitumen Production **(bbl/d)
2012	1,087,700*		10,000
2013	1,400,505*		25,000
2014	714,670	694,230	40,000
2015	714,670	694,230	40,000
2016	714,670	694,230	40,000
2017	714,670	694,230	40,000
2018	714,670	694,230	40,000
2019	714,670	694,230	40,000
2020	714,670	694,230	40,000
2021	714,670	694,230	40,000
2022	714,670	694,230	40,000
2023	714,670	694,230	40,000
2024	714,670	694,230	40,000
2025	714,670	694,230	40,000
2026	714,670	694,230	40,000
2027	714,670	694,230	40,000
2028	714,670	694,230	40,000
2029	714,670	694,230	40,000
2030	714,670	694,230	40,000
2031	714,670	694,230	40,000
2032	714,670	694,230	40,000
2033	714,670	694,230	40,000
2034	714,670	694,230	40,000
2035	714,670	694,230	40,000
2036	714,670	694,230	40,000
2037	714,670	694,230	40,000

* Increased water demand due to higher retention during start-up phase
** Stream day Bitumen production reported for 2012, 2013. Calendar day rates reported from 2014 – 2037.

14	**Volume 1, Page 101, Section 5.2.9, Flare Systems.** Statoil Hydro states, "*Operating experience in SAGD facilities has shown that the frequency of emergency pressure relief events from the FWKO and treaters can be reasonably expected to be less than once every two years*". a. Provide the protocol or methodology for determining estimated and measured flaring compositions and flows.

Response

Any flared volumes will be reported daily, and will be estimated and measured consistently with the methodologies and protocols contained within: the ERCB-approved Measurement Accounting and Reporting Plan (MARP) for the Leismer Commercial Demonstration Plant – Phase 1; the provisions of ERCB Directive 017: *Measurement Requirements for Upstream Oil and Gas Operations*; and other applicable regulatory standards and accepted industry practices. Plant instrumentation and automation systems will include adequate flow, pressure and temperature metering and redundancy to establish the flared volumes. Routine sampling as required for composition analyses will be performed once the Central Processing Facility (CPF) is in operation and with be consistent with the standards contained in Directive 017.

14	b. What is the expected flaring that would could occur per day or per hour during: i. normal plant operations, ii. plant upset (i.e. VRU outage, wet gas compressor outage) iii. a typical shut down, and iv. a typical start up?

Response

These volumes are referenced for a typical hub and will be further detailed specifically for each plant during detailed engineering as part of the process described under ERCB SIR Response 14 a.

i. normal plant operations:

During normal plant operation only pilot gas will be expected to be flared.

ii. plant upset (i.e., VRU outage, wet gas compressor outage):

A VRU outage will trigger continuous flaring of low pressure gas of 800 Sm^3/h for the duration of the outage. The VRU will be designed for an uptime of 99.9%.
Wet gas compressor outage does not normally trigger any flaring.

iii. a typical shut down:

There are a number of “typical” plant shut-down scenarios. In most cases, there would be no flaring required. In other cases the vapour contents of one or more hydrocarbon bearing vessels would be directed to flare. It should be noted that in a SAGD operation most vessels will have minimal vapour space, with the majority of the vessels being filled with liquid, hence the flared volume would be small and flaring would be accomplished in minutes of operation. In rare cases (such as a full-plant turnaround), the vapour contents of all hydrocarbon bearing vessels and piping would have to be flared, however this again would be accomplished in short period of time, and would involve minimal volumes.

iv. a typical start up?

No flaring will be expected during a typical start-up.

14	c. The ERCB expects that no venting of gas should occur at this facility, as all gas should be recovered in the VRU for normal operation conditions or sent to flare during upset. If there is to be some venting associated with operations, provide expected volumes and sources.

Response

StatoilHydro concurs with the ERCB position. It does not expect any venting of hydrocarbon gases during normal operations.

15	**Volume 1, Page 101, Section 5.2.10, Sulphur Removal.** Statoil Hydro states, "*The maximum sulphur inlet for each individual hub is in the 1-3t/d range*". a. Outline Statoil Hydro's plan to operate in compliance in a scenario where sulphur intake levels exceed 1t/d prior to the Leismer sulphur plant becoming operational.

Response

StatoilHydro will be operating in compliance with the 1 t/d sulphur limit, as well as the ambient air quality requirements. If necessary, StatoilHydro will constrain production to ensure the 1 t/d sulphur limit will not be exceeded.

15	b. Provide additional detail on sulphur recovery technology to be used in this project. Include plant, instrumentation, and simplified process flow diagrams.

Response

As part of detailed engineering, StatoilHydro will be assessing suitable technologies and design the sulphur recovery facilities. Currently the following systems are being considered:

- Claus Process
- Shell-Paques Process
- Xergy Process
- Lo-Cat Process
- (Sulphur Experts Ltd. expertise to offer any other practical options)

15	c. Provide a facility sulphur balance for the Leismer hub. Include the sulphur content for each of the major process streams where Sulphur In = Sulphur Out: i. In: sulphur in bitumen feed, produced gas, produced water, diluent feed (if applicable). ii. Out: elemental sulphur production, sulphur emissions from sulphur plant, flare, venting, fuel gas system, sulphur remaining in product (dilbit), and residual sulphur in produced water sent to disposal.

Response

Leismer Hub sulphur balance based on a bitumen production of 40,000 bbl/d:

i. Sulphur in bitumen feed: 4.8 % weight 309 t/d
Sulphur in produced gas: 1.75 % mole 1.2 t/d
Sulphur in produced water: traces only (due to high temperatures)
Sulphur in diluent: negligible

ii. Elemental sulphur production: 1.1 t/d
Sulphur emissions from combustion
(of produced gas and sales gas): 0.1 t/d
Sulphur remaining in dilbit product: 309 t/d
Sulphur in disposal water: negligible
(based on Induced Gas Floatation process performance)
Venting 0 t/d

16	**Volume 1, Page 102, Section 5.2.13, Stormwater and Secondary Containment.** Statoil Hydro states, "*Water collected in the storm water retention pond can also be returned to the process if it does not meet applicable limits for surface discharge*". a. What volumes are expected to be used from the pond?

Response

Runoff collected in the stormwater retention pond will only be returned to the process if it does not meet applicable limits for surface discharge. StatoilHydro expects that only on rare occasions (if at all) will the runoff collected in the stormwater retention ponds not meet applicable discharge limits, and therefore expects negligible usage of collected stormwater runoff.

16	b. How could this diversion potentially affect source water usage requirements?

Response

Due to the very infrequent nature of this diversion, source water usage will not be impacted significantly.

17	**Volume 1, Page 106, Section 5.2.15.2.** Statoil Hydro describes the waste management procedure for the project and indicates that small quantities of Class I waste may be produced and "*handled, stored and disposed of as per appropriate regulations*". Further, Statoil Hydro states that temporary waste storage sites will be located at or near the CPFs. a. Confirm that these wastes and waste storage sites will be managed in compliance with ERCB waste regulations such as Directives 50, 55 and 58.

Response

StatoilHydro confirms they will comply with all ERCB waste regulations, including Directives 50, 55 and 58.

17	b. Elaborate and identify possible Class I waste compounds, as well as proposed handling, storage and disposal procedures, and identify any other relevant regulations.

Response

Disposal of Class 1 and other waste will be based on waste volumes, storage and disposal options such as disposal wells, off-site third-party landfills and or on-site waste disposal.

The following are limited waste types that may be generated. The drilling waste management plan is provided below.

Drilling fluid and cutting waste management:

- SAGD wells will be drilled in three sections:– surface hole (using water-based gel-chem); the diversion section and production section, both drilled with polymer-based mud. The gel-chem section waste fluids and cuttings will be separated and the fluids re-used, pumped-off, landspread, or disposed of by mix, bury and cover. The polymer fluids will be recycled. The non-oil sand cuttings (non-reservoir section of well) disposed of by mix, bury and cover. The oil-saturated cuttings would be disposed of at an approved Class 2 waste facility, subject to environmental testing and requirements.

Class 1 waste compounds:

- Injection and disposal well wastes may be classified as Class 1a, 1b, II, III and IV.
- StatoilHydro intends to handle Class 1a liquid waste streams by a licensed third-party contractor.
- Class 1b liquid wastes must meet criteria for Dangerous Oilfield Waste as outlined in ERCB Directive 58: *Oilfield Waste Management Requirements for the Upstream Petroleum Industry*, Class 1b liquid wastes including boiler blowdown will be disposed of in a Class 1b disposal well.
- Class 1a and 1b solids must meet criteria for Dangerous Oilfield Waste as outlined in ERCB Directive 58: *Oilfield Waste Management Requirements for the Upstream Petroleum Industry*, Section 15.8. These products include filters, batteries, contaminated soils, process sludge etc. Based on the waste characteristics, they will be tested and disposed of according to regulation.

18	**Volume 1, Page 110, Figure 5.2-4, Water Treatment System.** This Figure shows that WAC regen waste will be directed to the lime sludge pond and that all source make-up water feeds directly to the WLS. a. What water source is to be used for the dilution of HCL, caustic and other process chemicals?

Response

Boiler feedwater will be the source for dilution of HCL and caustic for the regeneration of weak acid cation exchange resins. Utility water will be used for dilution of flocculant injected to the Warm Lime Softener. No fresh water dilution is planned for coagulant, filter aid and oxygen scavenging.

18	b. The approved Leismer demonstration project's MARP states that the source make-up water will be added to the deoiled water tank. Confirm where source water enters the water treatment system.

Response

StatoilHydro confirms that the source water is introduced to the water treatment system at the Deoiled Water Tank.

19	**Volume 1, Page 112, Figure 5.2-6, Vapour Recovery System.** This Figure shows that the VRU suction cooler uses cold water as the cooling mechanism. a. Provide the projected volume requirements for this cooling load and specify whether saline or non saline water will be used.

Response

Non-saline water at a rate of 170 m^3/d is projected for cooling load to the VRU. Water requirement will vary based on the VRU load. This water will be directed to the skim tank and reused in the process after heat exchange.

19	b. Provide the locations of any other cooling streams that will require the use of cold water and the associated volumes of saline and non saline water required.

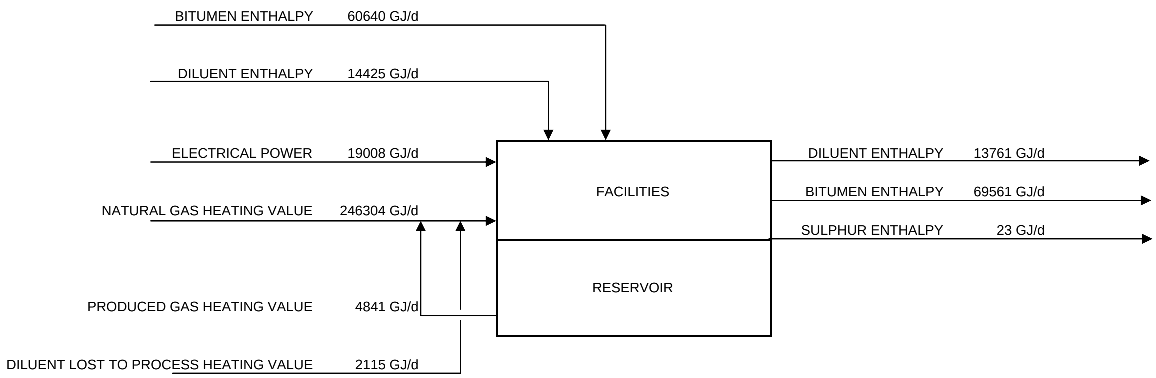
Response

Non-saline cooling water at an average flow of 7 m^3/h will be used as the cooling medium in treating gas trim cooler. Upon heat exchange, the water will be sent to the Deoiled Water Tank via the Raw Water Glycol Exchanger for process make-up water. Non-saline water will be used for utility water application. Water consumption for pump seal flush applications is envisaged at 284 m^3/d. The seal flush water enters the process stream and will be effectively reused.

20	**Volume 1, Figures 5.2-10, A2.2-4, B2.1-4 and C2.1-4, Energy Balances.** The energy balances provided do not take diluent usage into account. According to the following formula, the ERCB requires the diluent component (volumes and liquid heat value) in order to determine the energy efficiency of the project. Energy Efficiency = (Total Energy OUT / Total Energy IN) * 100 = Total Energy in Dilbit Product OUT / Total Energy in Feed and Purchased Off Lease = [(Energy of Diluent + Bitumen Product + Sulphur) / (Energy of Diluent + Bitumen Feed + Purchased NG + Electrical + Produced Gas + Electrical)] * 100 Where Diluent Product = Diluent Feed – Losses to fuel gas system and any other losses during processing Bitumen Product = Bitumen Feed (no losses) Include: heating value of diluent used

Response

The energy balances Figure 20-1, 20-2, 20-3, 20-4 **(**Figures 5.2.-10, A2.2-4, B2.1-4 and C2.1-4 Revised, respectively) have been corrected and revised.

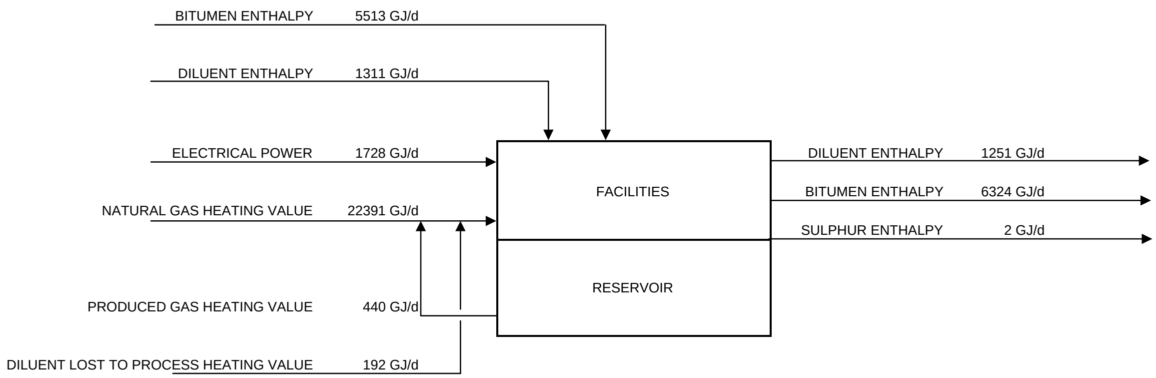


Inlet Diluent Temp.	10 °C
Inlet Bitumen Temp.	191 °C
Outlet Diluent Temp.	50 °C
Outlet Bitumen Temp.	50 °C
Sulphur Temp.	150 °C

StatoilHydro

ENERGY EFFICIENCY BALANCE
BITUMEN PRODUCTION 34980 m3/d (220,000 bpd)
SOR = 3, RR = 10%

SCALE	SIZE	DRAWING NUMBER	REV
NONE	B	FIGURE 20-1	B

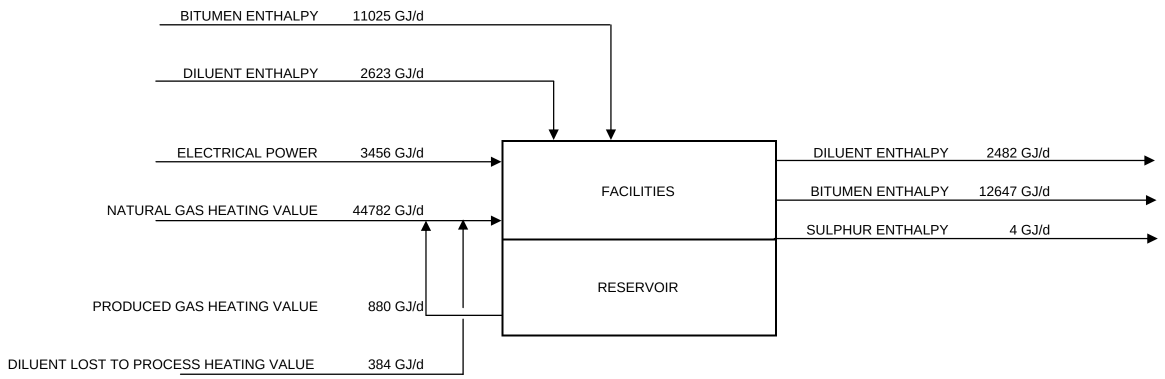


Inlet Diluent Temp.	10 °C
Inlet Bitumen Temp.	191 °C
Outlet Diluent Temp.	50 °C
Outlet Bitumen Temp.	50 °C
Sulphur Temp.	150 °C

StatoilHydro

ENERGY EFFICIENCY BALANCE
BITUMEN PRODUCTION 3180 m3/d (20,000 bpd)
SOR = 3, RR = 10%

SCALE	SIZE	DRAWING NUMBER	REV
NONE	B	FIGURE 20-2	B

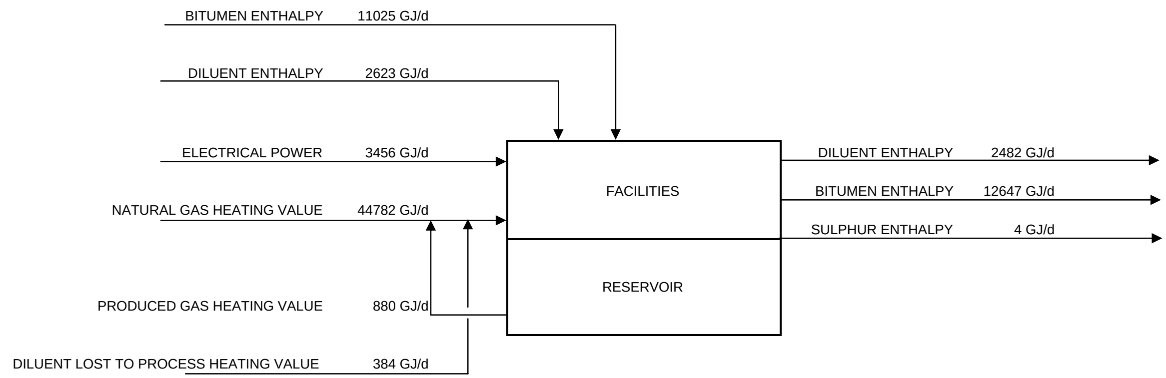


Inlet Diluent Temp.	10 °C
Inlet Bitumen Temp.	191 °C
Outlet Diluent Temp.	50 °C
Outlet Bitumen Temp.	50 °C
Sulphur Temp.	150 °C

StatoilHydro

ENERGY EFFICIENCY BALANCE
BITUMEN PRODUCTION 6360 m3/d (40,000 bpd)
SOR = 3, RR = 10%

SCALE	SIZE	DRAWING NUMBER	REV
NONE	B	FIGURE 20-3	B



Inlet Diluent Temp.	10 °C
Inlet Bitumen Temp.	191 °C
Outlet Diluent Temp.	50 °C
Outlet Bitumen Temp.	50 °C
Sulphur Temp.	150 °C

StatoilHydro

ENERGY EFFICIENCY BALANCE
BITUMEN PRODUCTION 6360 m3/d (40,000 bpd)
SOR = 3, RR = 10%

SCALE	SIZE	DRAWING NUMBER	REV
NONE	B	FIGURE 20-4	B

B. GEOLOGY

21	Provide the gross SAGD pay volume and the inputs used in its calculation for the Leismer Initial Development Area, Leismer Expansion Area, and Corner Development Area.

Response

See Figures 21-1 to 21-3, as well as Table 21-1: "McMurray Channel Resource In-Place Estimates Gross SAGD Volume."

22	There has been no drilling in section 32-080-08W4 or the northern half of section 31-080-08W4. a. What data has Statoil Hydro used to determine the extent of bitumen resources in these sections?

Response

At the time of submission, seismic data was the only data used to determine the extent of the bitumen**.** Sections 31 and 32 were not considered part of the SAGD area, however, they were included as part of the development area. The Central Processing Facility site was to be constructed on section 31. Section 32, because of a necessary buffer around some surface waters, was to accommodate the surface facilities for Pad C06.

22	b. Discuss any plans for additional delineation well drilling in the Corner Development Area.

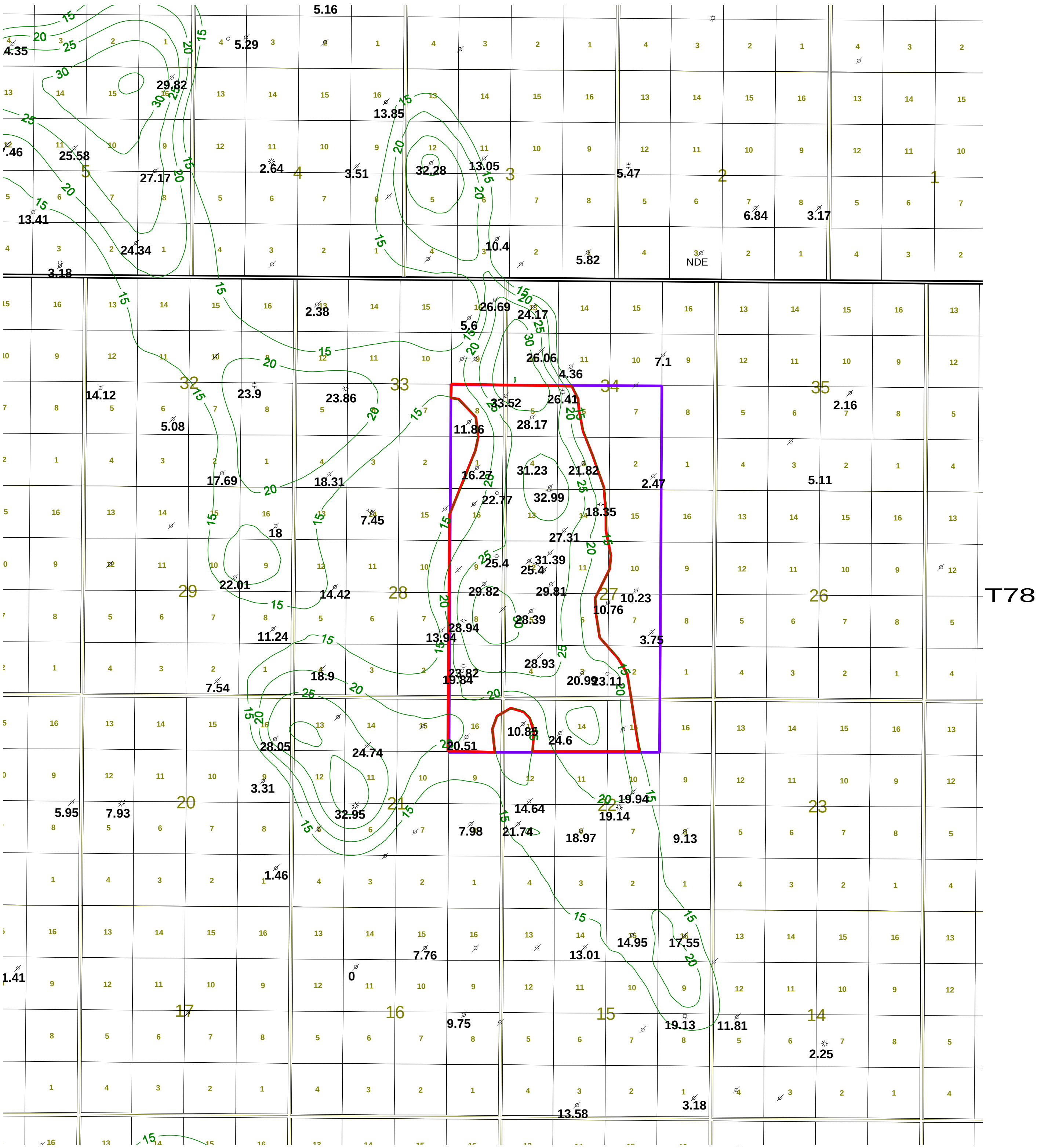
Response

4 wells were drilled in 2008 in Sections 31 and 32:

1F1/11-31-80-8 W4M, which encountered less than 15 m of SAGD pay
100/16-31-80-8 W4M, which encountered greater than 15m of SAGD pay
1F1/14-32-80-8 W4M, which encountered greater than 15m of SAGD pay
100/16-32-80-8 W4M, which encountered greater than 15m of SAGD pay

Additional wells are planned for 2009

The original Application relied solely on seismic within sections 31 and 32. Therefore, it was the intention of StatoilHydro to drill 4 new wells in 2008 to support the original interpretation.



R10W4M

Leismer Demonstration Project Area

15m SAGD Pay Cutoff

25.4 McMurray Gross SAGD Pay

1mile

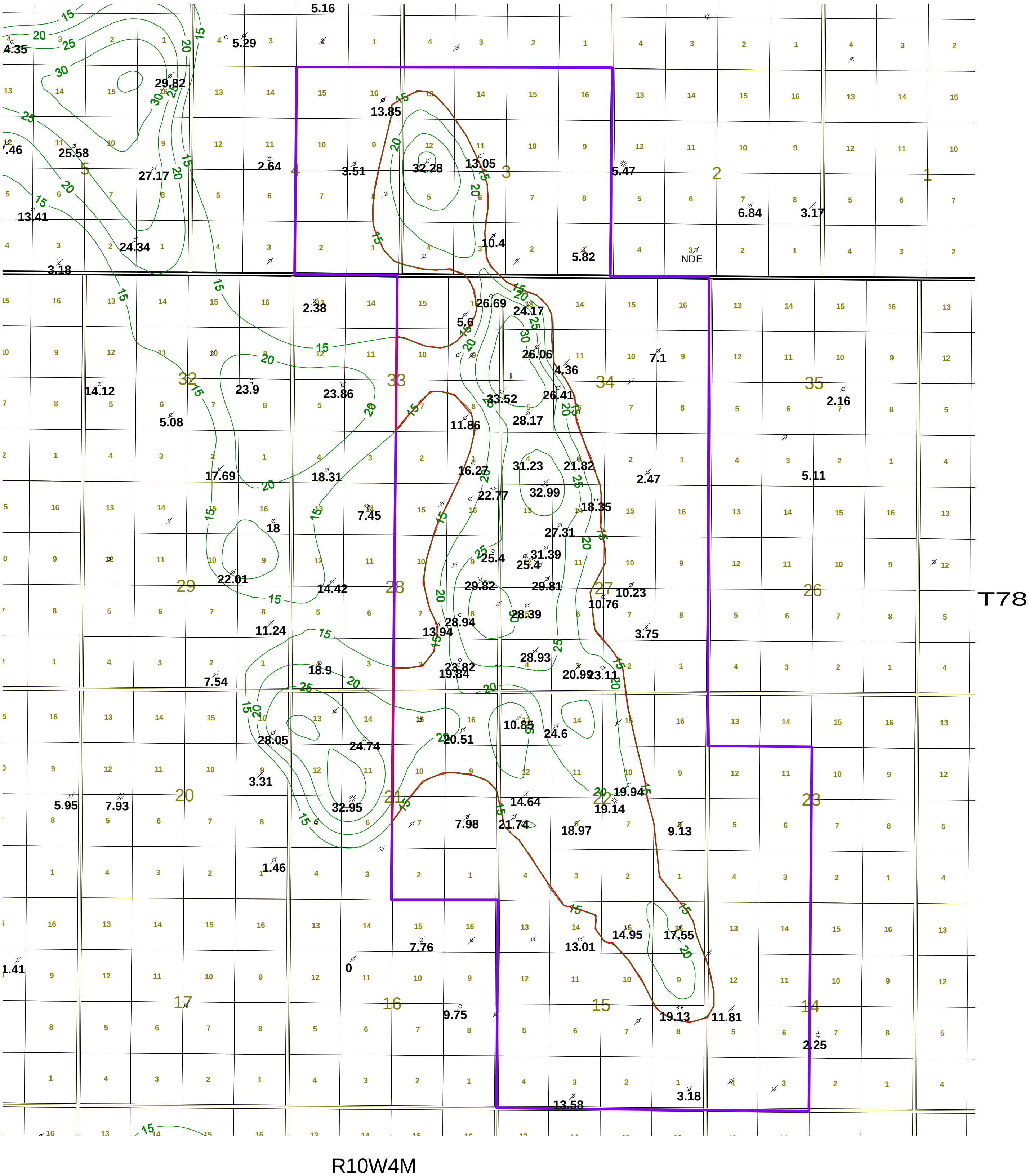
StatoilHydro

FIGURE 21-1

LEISMER DEMONSTRATION PROJECT

McMURRAY GROSS SAGD PAY VOLUME MAP

Author: J. Lobsinger, P.GEOL.	Date: 15 July, 2008
Scale: 1:20,000	Contour Interval: 5m



Leismer Expansion Project Area

15m SAGD Pay Cutoff

25.4 McMurray Gross SAGD Pay

1mile

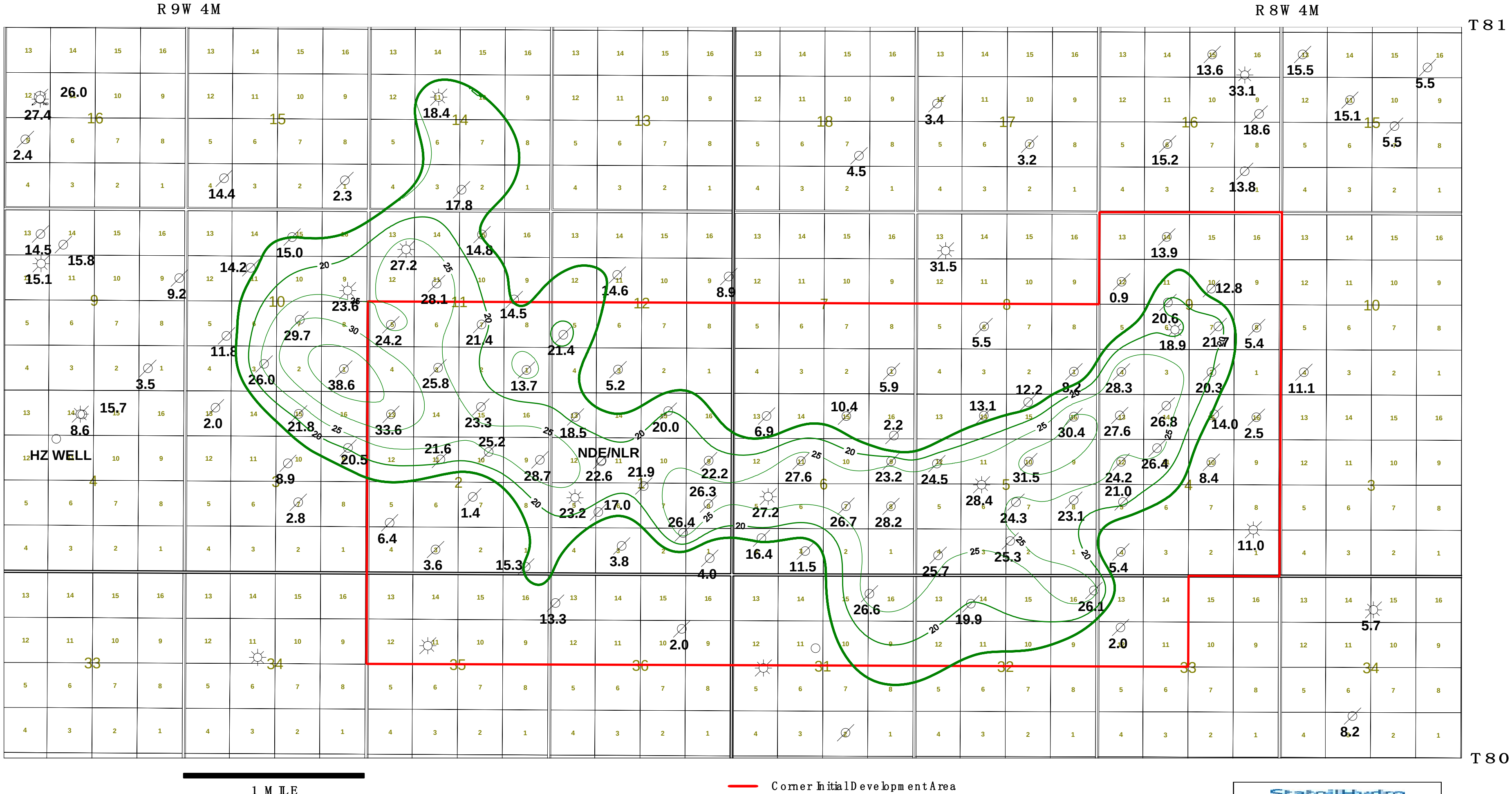
StatoilHydro

FIGURE 21-2

LEISMER EXPANSION PROJECT

McMURRAY GROSS SAGD PAY VOLUME MAP

Author: J. Lobsinger, P.GEOL.	Date: 15 July, 2008
Scale: 1:20,000	Contour Interval: 5m



Corner Initial Development Area

15m Gross SAGD Pay Contour

28.4 Gross SAGD Pay Posting

StatoilHydro

FIGURE 21 - 3

CORNER

McMurray Gross SAGD Pay Volume Map

Author: Gary Diakiw	Date: 15 July, 2008
Scale: 1:20,000	Contour Interval: 5m

Table 21-1: McMurray Channel Resource In-Place Estimates
Gross SAGD Volume

Drainage Pad Name	Total Area (A) (ha)	Average Pay 15m Gross SAGD Pay Cutoff (B) (m)	Average Bitumen Saturation (C) (frac)	Average Porosity (D) (frac)	Rock Volume AH 15m Gross SAGD Pay Cutoff (A*B) (e6m3)	Resource In-Place (A*B*C*D) (e6m3)
Leismer Demonstration Area	459	16.8	0.82	0.32	77.0	20.2
Leismer Expansion Area	2069	21.5	0.82	0.32	444.9	116.7
* additional to Demo Area						
Corner Development Area	2703	22.3	0.82	0.32	602.8	158.2

C. ENVIRONMENT

23	**Volume 1, Page B-99, Section B.5.5.1 and Page C-97, Section C.5.5.1.** Statoil Hydro states, "*Future PDAs on the Leismer Expansion facility areas will provide additional detailed information on soil depths for soil salvage.*" In addition, on **Page C-97**, Statoil Hydro states, "*Future PDAs on the Corner Initial Development facility areas will provide additional detailed information on soil depths for salvage.*" a. Provide findings and resulting mitigations from additional site-specific soil assessments of the Leismer Expansion, Leismer Commercial and Corner Commercial Project Development Areas (Volume 1, Appendices A, B, and C) as well as for any infrastructure required to support the initial development of these hubs. b. Describe any changes to the proposed project that result from detailed site assessments such as volumes of soil salvage or area required to store salvaged soil.

Response

As described in Volume 1 Section 5.1, environmental factors were considered when situating the infrastructure for the Kai Kos Dehseh Project. Based on available drilling results plus interpreted seismic data, Statoil Hydro carried out an extensive review of the options for infrastructure placement to:

- Maximize resource recovery;
- Minimize well pad footprint;
- Work with topographic features;
- Utilize existing surface disturbances;
- Avoid open water bodies; and
- Avoid defined water course channels (i.e., having defined bed and bank material).

Statoil Hydro has combined the knowledge acquired from the soils and vegetation surveys, with the Alberta Vegetation Inventory/Ecological Land Classification mapping, survey imagery (i.e., still photography images, aerial video, line scans and high resolution LIDAR (Fli-Map®), including topography), and combined with the geological data to select infrastructure locations.

Site-specific soil sampling and rare plant surveys were completed for the Leismer Demonstration CPF and SAGD pads and this information was submitted during the permitting process for the Demonstration Project. The Leismer Expansion phase will utilize the same four SAGD pads and CPF as the Leismer Demonstration and as such no additional soil or rare plant surveys are warranted for the Expansion phase. Additional soil sampling and rare plant surveys will be completed for the Leismer Commercial and Corner Commercial phases and this sampling will be conducted, and PDAs produced, as part of the ongoing regulatory process.

Again, as described in Volume 1 Section 5.1, the SAGD pad placement is primarily driven by the location and access to the bitumen resource with consideration given to surface features and environmental constraints. Preliminary field scouting and surveying is used identify surface features and environmental constraints that would necessitate large scale pad relocations. PDA level assessments are then completed on the final pad location to determine appropriate soil stripping, handling and storage requirements. Rare plant surveys are also conducted during the PDAs and are used to document the existence of rare plants and to identify potential mitigation (i.e., transplanting or pad relocation). To date the PDAs have resulted in some pads having to be resized to accommodate the predicted volumes of salvaged materials.

24	**Volume 1, Page 180, Section 8.6.5.14; Volume 4, Page 9-2, Section 9.3.1 and Volume 4, Page 10-2, Section 10.2.1.1.** Statoil Hydro states, "*PDAs will be undertaken prior to facility construction, and assessment of reclamation needs for each site will be conducted to guide reclamation procedures*." Further, **Page 9-2** states, "*the evolution of the Project footprint, following completion of the field programs, has resulted in small portions of the Project footprint occurring outside of the soils and terrain LSA boundary…In addition, it is anticipated that the overall Project footprint will be further refined, based on additional geological, biophysical and construction/reclamation information. Prior to construction, pre-disturbance assessments will be conducted on the hub areas and SAGD pads to evaluate potential impacts and develop C & R plans for each site*". **Page 10-2** states, "*the evolution of the Project footprint, following completion of the field programs has resulted in small portions of the Project footprint occurring outside of the vegetation LSA boundary…Prior to construction, Pre-development assessments (PDAs) will be conducted on the hub areas and SAGD pads to evaluate potential impacts and to develop C & R plans for each site.*" a. Provide maps that clearly show the locations of vegetation and wildlife sampling locations relative to the Leismer Expansion, Leismer Commercial and Corner Commercial Project Development Areas and associated project footprints (Volume 1, Appendices A, B, and C) as well as for any infrastructure required to support the initial development of these hubs. b. Provide findings and resulting mitigations from additional site-specific vegetation and wildlife assessments. c. Describe changes to the proposed project layout that result from detailed site assessments.

Response

Refer to ERCB SIR Response 23.

25	**Volume 1, Volume 3, Page 5-45, Section 5.5.5, Table 5.5-10, Local Water Users**. Statoil Hydro has listed all known In-Situ Oil Sands project in the vicinity of the Kai Kos Dehseh project. a. Provide a list of all P&NG and oil sands operators within the vicinity of the project and discuss whether groundwater withdrawal from the Grand Rapids or Clearwater has the potential to impact these operations.

Response

P&NG Leaseholders and any Freehold mineral owners in the area of the Application are indicated on the land maps in Volume 1 Figures 2.3-2a, 2.3-2b, 2.3-2c, A1.1-2, B1.2-1, C1.2-2 – see also ERCB SIR Response 2 b.

Oil sands leaseholders are indicated on the land map in Figure 2.3-1 in the Application.

Potential Impact to Oil Sands Rights Holders

StatoilHydro does not expect that the proposed Grand Rapids and Clearwater A and B source water production operations will have a detectable impact on offsetting oil sands rights holders in the McMurray Formation. The Grand Rapids and Clearwater aquifers are separated from the bitumen reservoir by thick aquitards. Of these three aquifers, the Clearwater B is stratigraphically the closest aquifer to the bitumen resource and it is separated by approximately 30 to 40 m of low permeability sediments (Volume 1 Figure 5.4-1).

Potential Impacts to P&NG Rights Holders;

Units within the Grand Rapids and Clearwater formations are active gas production zones for some P&NG rights holders in the Application area. The operation of the Project many have the potential to impact these operations through decreased pressure resulting from sourcing water from the zones. Volume 3, Section 5.6.3.3 describes the predicted drawdown (pressure decrease) in the Grand Rapids and Clearwater aquifers for the Application Case due to groundwater withdrawal by the Project and adjacent existing/approved projects. Pressure decreases in units overlying and underlying the Grand Rapids and Clearwater aquifers will be less than that predicted in the aquifers themselves, because of intervening fine-grained low permeability sediments that will act to buffer these pressure effects.

StatoilHydro has, and will continue, to drill only those Grand Rapids and Clearwater targets that have a low risk for impacting natural gas production operations.

In addition, StatoilHydro will implement the following measures to address any potential impacts on natural gas production:

- measure (or thermodynamically infer if too small to measure) and document all produced natural gas (free or solution gas);
- conduct pressure monitoring of sourced aquifers; and

- continue ongoing communication and collaboration with P&NG rights holders in the vicinity of the Project.

D. APPENDIX A – LEISMER COMMERCIAL HUB

26	**Volume 1, Page A-7, Section A2.2, CPF and Services.** Statoil Hydro indicates that a saline heat exchanger will be added to the Leismer Demonstration Project's CPF. a. Where is the saline water introduced to the processing facility and how is it treated?

Response

Saline water is introduced to the Deoiled Water Tank after preheating to 80°C in a Brackish Water Heater.

27	**Volume 1, Page A-9, Figure A2.2-2. Material Balance.** This Figure shows a diluent usage of 795m^3/d, which equates to a 20% blend volume. a. Confirm that Statoil Hydro will be able to meet pipeline specifications using this volume of diluent.

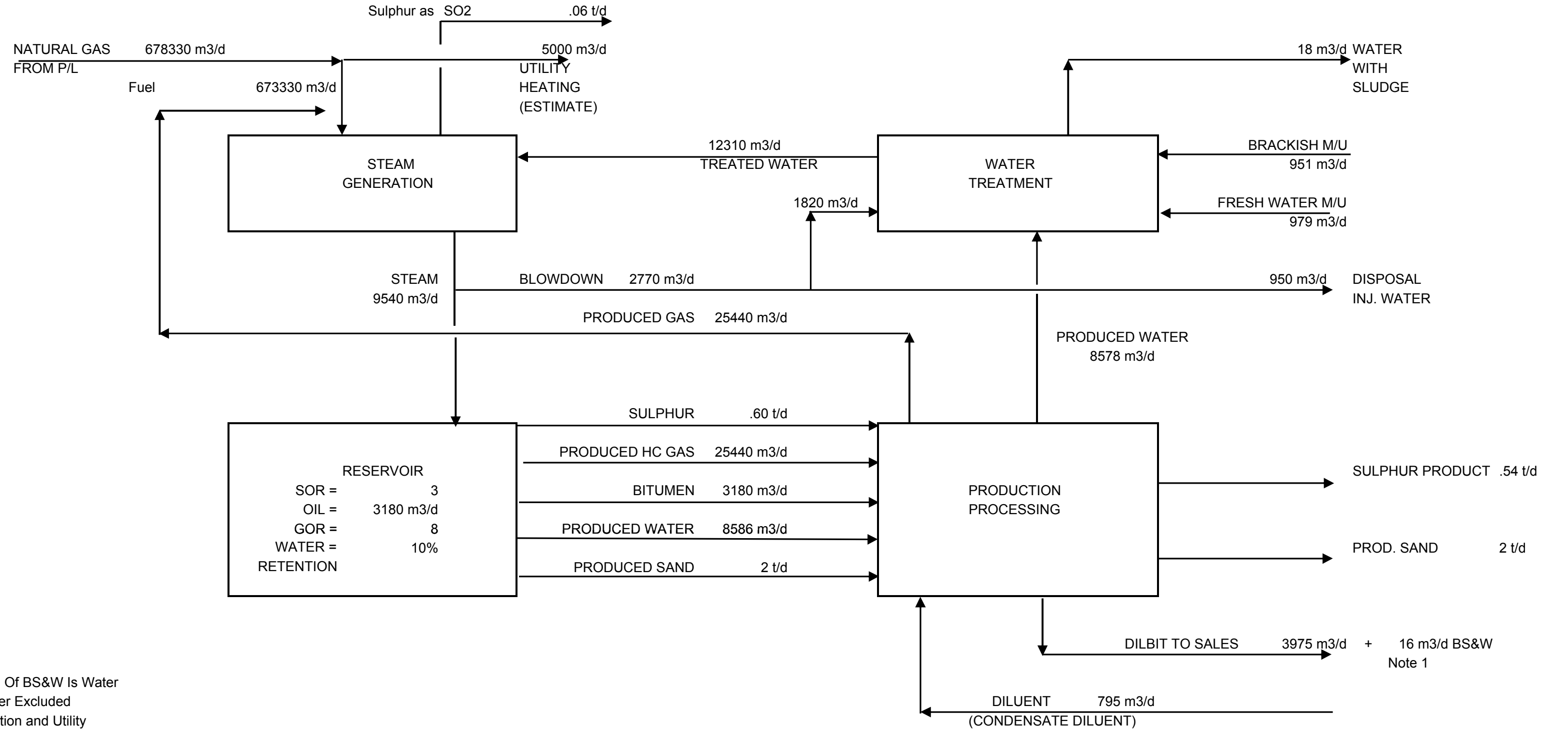
Response

StatoilHydro confirms that it will be able to meet pipeline specifications at all times. The diluent blend ratio required to meet the pipeline specifications depends on the diluent composition, bitumen composition, pressure and temperature conditions and pipeline specifications. If required, trim blending will be performed. See Figure 27-1 (Figure A2.2-2 Revised)

28	**Volume 1, Page A-10, Figure A2.2-3, Simplified Water Balance.** This Figure shows that no saline water inventory will be kept on site. Page A-7, Section A2.2 states that one saline water tank is to be added to the facility. a. Clarify whether saline water inventory will be kept on site and if so, adjust the Figure accordingly.

Response

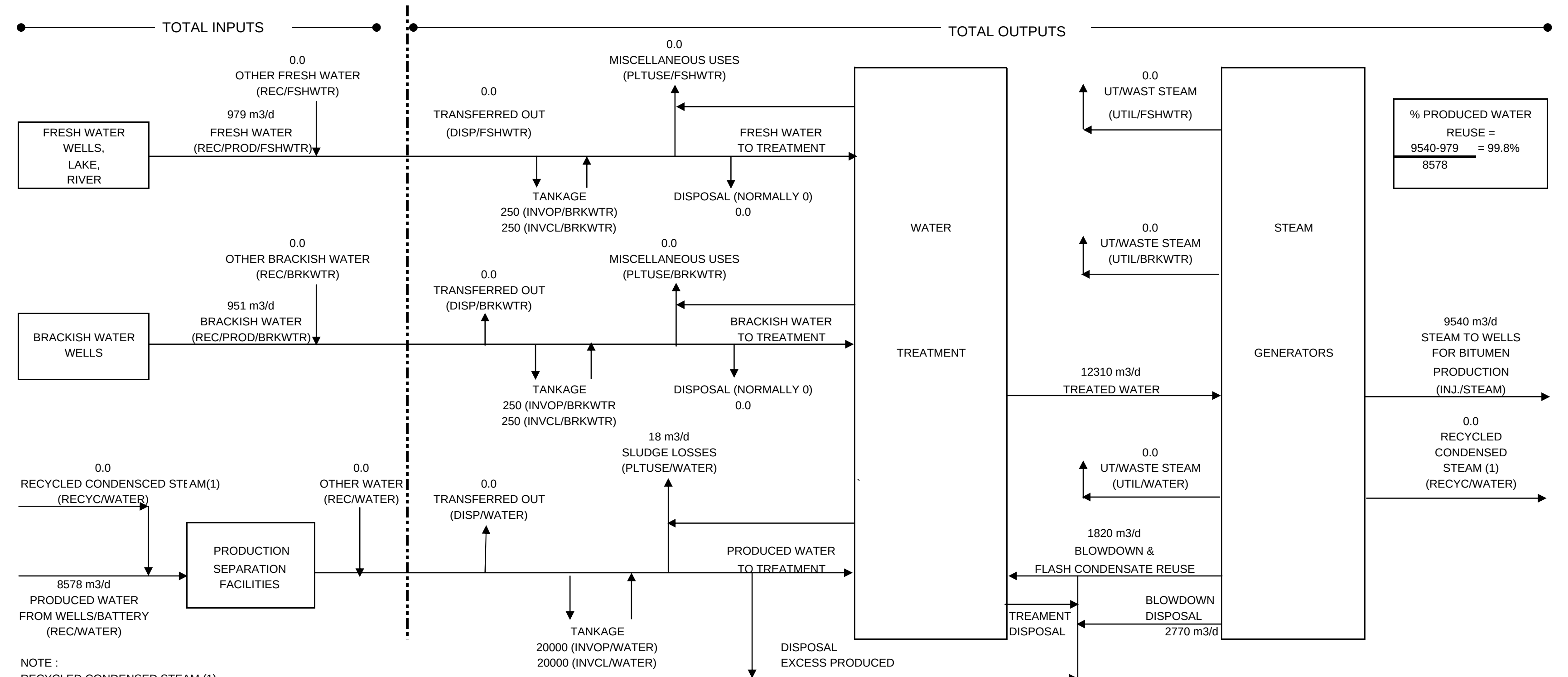
Saline water inventory will be kept on site and the water balance is adjusted to reflect this. See Figure 28-1 (Figure A2.2-3 Revised).



Notes:
1.) Assumes 50% Of BS&W Is Water
2.) Domestic Water Excluded
3.) Pond Evaporation and Utility Losses Excluded
4.) GOR is 12. Produced Hydrocarbon gas from reservoir is 8
Approximate Stream Rates

NOTE: CALENDAR DAY

StatoilHydro	MATERIAL BALANCE BITUMEN PRODUCTION 3180 m3/d (20,000 bpd) SOR = 3, RR = 10%			
	SCALE	SIZE	DRAWING NUMBER	REV
	NONE	B	FIGURE 27-1	C



NOTE :
RECYCLED CONDENSED STEAM (1)
(RECY/WATER) RECYCLED CONDENSED UTILITY STEAM THAT ENTERS THE PROCUCED WATER STREAM COMING BACK INTO THE FACILITY
DISPOSAL (2)
(INJ/WATER) DISPOSAL OF FRESH+BRACKISH+PRODUCED WATER
DISPOSAL FRESH PORTION IS CALCULATED FROM TOTAL FRESH IN - OTHER FRESH WATER USES +/- TANKAGE - FRESH WATER INJECTED. NORMALLY 0
DISPOSAL BRACKISH PORTION IS CALCULATED FROM TOTAL BRACKISH IN - OTHER BRACKISH WATER USES +/- TANKAGE - BRACKISH WATER INJECTED NORMALLY
DISPOSAL PRODUCED PORTION IS CALCULATED FROM TOTAL DISPOSAL - DISPOSAL PRESH - DISPOSAL BRACKISH

StatoilHydro

SIMPLIFIED WATER BALANCE FLOW DIAGRAM
BITUMEN PRODUCTION 3180 m3/d (20,000 bpd)
- CONTINUOUS PLANT OPERATIONS
AFTER STARTUP (RECYCLE OPERATING)

SCALE	SIZE	DRAWING NUMBER	REV
NONE	B	FIGURE 28-1	B

29	**Volume 1, Page A-27, Section A4.1.5.2, Reservoir Characteristics.** Statoil Hydro states, "*The combined zone of McMurray associated net top lean and top water is from 0.5 to 13.6m thick…SFT pressure tests in the development area confirm no depletion has occurred*". Statoil Hydro Canada further states, "*Thin bitumen legs occur with the non-associated gas and can be up to 8m thick but are typically around 3m*". a. Given the piezometers and thermocouples that will be installed to monitor these zones, would Statoil Hydro consider recovery of this bitumen by primary method following SAGD recovery of the bitumen beneath if there is indication that these zones have benefited from the SAGD energy?

Response

It may be possible that non-associated bitumen close to the SAGD interval could be heated enough through conduction (>80-100 ºC) to mobilize the bitumen. StatoilHydro is aware of a similar situation in a competitors Saskatchewan thermal heavy oil field where this was tested. Under appropriate conditions, StatoilHydro would consider such a test, assuming surface access, suitable economic potential and ability to obtain the necessary approvals.

E. APPENDIX B – LEISMER EXPANSION HUB

30	**Volume 1, Page B-11, Figure B2.1-1, Leismer Expansion Hub CPF Layout.** The Figure depicts an identical facility with a 20 000bbl/d production capacity will be constructed parallel to the existing Leismer Demonstration and applied for Commercial facility. a. What integration is expected between the two sections of the hub (i.e. gas, water, production, etc)?

Response

The objective is to maximize the integration of the Leismer Demonstration / Commercial / Expansion facilities and operate all sections as a single plant.

30	b. Clarify why steam generation capacity is not shown on the Expansion (right hand side) of the diagram.

Response

These process flow diagrams are currently under development as part of detailed engineering for the Leismer Hub and will be provided once completed. Since the facilities will be fully integrated, the process flow diagrams will be very similar to those of the Leismer Demonstration Hub.

30	c. Provide complete process flow diagrams for the entire Leismer hub.

Response

These process flow diagrams are currently under development as part of detailed engineering for the Leismer Hub. Since the facilities will be fully integrated, the process flow diagrams will be very similar to those of the Leismer Demonstration Hub.

31	**Volume 1, Page B-33, Table B2.4-1, Section B2.4.5, Water Management Plan.** This Table summarizes the estimated water make-up and disposal requirements. It is unclear why the McMurray disposal volume is higher when reservoir retention is 10%. a. Clarify the apparent discrepancy.

Response

There is no discrepancy. The Basal McMurray Formation saline make-up (TDS of about 14,000 mg/L) is approximately four times higher in TDS than the estimated produced water quality (TDS of about 3,500 mg/L). When the reservoir retention increases, more make-up is required to compensate for the condensed steam, which doesn't return as produced water. Assuming the ratio of saline to non-saline make-up water is maintained at the same level, and the BFW TDS limit is the same, the amount of TDS entering the system increases, and the disposal rate, which is the only purge of salts from the system, must be increased to compensate.

32	**Volume 1, Page B-58, Figure B4.1-8, Well Placement.** The Figure appears to show wells with concentrated spacing for the first third of the well on four of the proposed pads. a. Comment on the rationale for this reduced spacing and well placements.

Response

There is no concentrated or reduced spacing. Interfingered well pads, Figure 32-1, have been positioned facing each other with the pads and well bores offset to minimize the chance of well bore collision while drilling. Similarly configured existing pads can be found at MEG Hardy (16-077-05W4M), Devon Jackfish (32-075-06W4M) and Nexen Opti Long Lake (30-085-06W4M.) As shown, it is the build sections that are overlapping not the horizontal sections.

The pad layout is designed to minimize interpad undrained areas in the heel region of the wellbores, while reducing tie-in costs and concentrating facilities.

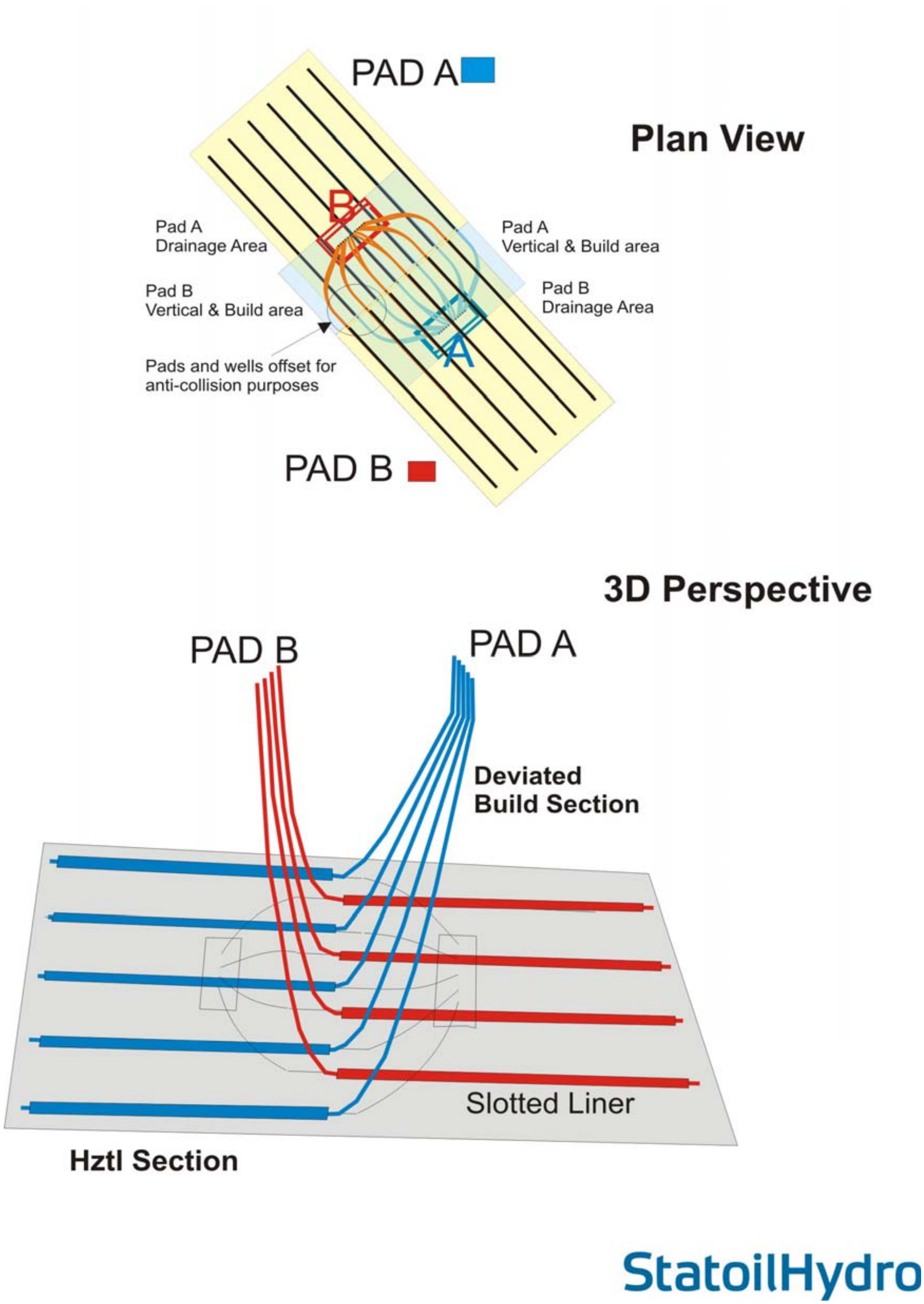


Figure 32-1 Interfingered Pad Layout Design

33	**Volume 1, Page B-72, Figure B4.1-20, SAGD Structure.** This Figure displays Statoil Hydro's 6% wt resource and 15m SAGD boundary. There are bitumen resources within the Leismer Expansion Area exceeding Statoil Hydro's minimum cutoffs for SAGD pay, which Statoil Hydro has not proposed to develop. a. Discuss Statoil Hydro's future plans to develop these resources.

Response

StatoilHydro is aware that some bitumen resources, which exceed the 15 m net SAGD pay cutoff, are present outside of the current horizontal well drainage layout pattern for the Leismer Project. With a few exceptions, these regions are primarily located to the north, west and south part of the Leismer Field. StatoilHydro intends to develop all economically recoverable bitumen resources via SAGD technology; or in the alternative, utilize any field-proven and economically viable form of in-situ recovery technology that facilitates an orderly and efficient recovery of the bitumen resources at Leismer. These >15m SAGD resources are not covered by the current development plan filed with the ERCB because full field delineation and exploration efforts are still in progress. In the winter of 2007-2008, StatoilHydro drilled 42 wells and collected 22.90 km^2 of 3D seismic to the south. Both the well and seismic data are presently being analyzed. Further work may follow in the succeeding winter drilling seasons. StatoilHydro plans to fully incorporate the information from the exploration and delineation efforts into the plan for developing the Leismer Field.

33	b. Provide a map showing how future drainage areas fit with currently planned drainage areas and how they correlate to developable net pay.

Response

A map of how future drainage areas will fit with currently planned drainage areas is not available because these future drainage areas have yet to be defined through exploration and delineation drilling – see ERCB SIR Response 33 a.

34	**Volume 1, Seismic cross section Leismer 05-L05-P2 and Leismer 06-L05-P1.** Significant portions of the horizontal section of each of these two wells appear to be drilled in poor reservoir, as defined by Statoil Hydro. a. Confirm these trajectories.

Response

Yes, StatoilHydro confirms that the given trajectories for producer wells 05-L05-P2 and 06-L05-P1 are correct.

34	b. Explain why these wells are proposed to be drilled in reservoir of lesser quality, with specific reference to Page 63, Section 4.2.1, "*Areas with pay less than 15m are being evaluated for future development…*"

Response

Both of these well pairs are part of a NE trending 6 well pair pad. Wells 05-L05-P2 and 06-L05-P1 constitute the two eastern-most wells on Leismer Expansion Hub area Pad 5. The pay thickness problems associated with both of these wells were established by drilling the 1AA020307910W400 vertical well. 1AA0203 contains 10 m of pay in a shallow, younger channel. This channel sand lies entirely above both the producer and injector horizontal wells, and as such is not accessible.

Currently, StatoilHydro's best estimate is that 60% of 05-L05-P2 lies in pay in excess of 15 m thick and only 35 percent of 06-L05-P1 lies in pay in excess of 15 m thick. A 600 m well pair in pay >= 15 m, such as 05-L05-P1, is a viable well pair and meets StatoilHydro's stated goal of developing resource >= 15 m gross pay thickness, assuming a potential 1000 m total productive length. Well pair 06-L-5-P1 is not considered viable at this time with only 350 m of horizontal well pair in pay >= 15 m thick.

Future evaluation drilling on the east edge of this well pad will confirm the pay extent and the viability of drilling 05-L05-P2 with an effective pay zone longer than 600 m (i.e. isolating the shallow pay-bearing channel at 1AA0203 and increasing the main, deeper, pay section). For well 06-L05-P1 it will be necessary to prove the existence of sufficient pay at the toe (SE corner of LSD 6-03-79-10W4M) to justify drilling this horizontal at all. As such, Pad 5 may eventually become a 5 pair pad instead of the currently planned 6 well pairs.

F. APPENDIX C – CORNER HUB

35	**Volume 1, Page C-4, Figure C1-2, Corner Hub.** The Figure appears to show that the first LACT unit will be located at the Corner hub. a. Will production from Leismer be brought to the Corner LACT unit when it is commissioned?

Response

The Kai Kos Dehseh Project has been designed as an integrated 220,000 bpd project with one integrated LACT unit. The Corner and Leismer Hubs will have pumping stations and individual metering for ERCB accounting purposes.

35	b. Clarify where Leismer production will be sent until the construction of this LACT unit is complete.

Response

Initial production from Leismer will be metered through an on-site temporary LACT unit and sent to a nearby receiving terminal. Commercial terms and agreements to receive this production have not yet been finalized. Refer to ERCB SIR Response 35 a.

35	c. Why is there not a LACT unit associated with the Leismer hub?

Response

Refer to ERCB SIR Response 35 a.

35	d. Provide the protocol or methodology for determining dilbit and actual bitumen production down the pipeline, include the following components:

Response

At Volume 1, page 96, Section 5.2.2 of the Kai Kos Dehseh Application it is stated: "*The Measurement, Accounting and Reporting plan (MARP) has been prepared for the Leismer Demonstration Project as per EUB Directive 042. It is complete and will be submitted* *separately from this application. Standards of accuracy, calibration and proving presented in the document will be stewarded throughout the various development areas of the Kai Kos Dehseh Project."*

It is StatoilHydro's intention to use the protocols and methodologies contained within the ERCB approved MARP for the Leismer Commercial Demonstration Plant – Phase 1 whenever they are appropriate for determining dilbit and actual bitumen production down the pipeline for the entire Kai Kos Dehseh Project. In addition, StatoilHydro intends to use the principles laid out in ERCB Directive 017: *Measurement Requirements for Upstream Oil and Gas Operations* - particularly the section on "Heavy Oil and Crude Bitumen Production Measurement," which is currently under development.

35	i. What is the accuracy of the flowmeter for dilbit being sent down the pipeline?

Response

All measurement procedures are to be conducted in accordance with API/ASTM standards. The stated accuracy of the flow meters for dilbit being sent down the pipeline is + - .25 %. In addition, StatoilHydro will comply with the protocols and methodologies contained within ERCB Directive 017 when determining the accuracy of all of its flow meters.

35	ii. How is dilbit sampled (e.g. grab vs. automatic flow proportion) and sub-sampled to verify that a representative sample is obtained?

Response

StatoilHydro intends to follow the sampling protocols contained within ERCB Directive 017 as they apply to automatic flow proportion sampling of the dilbit.

35	iii. If adjustments are made to the dilbit to obtain actual bitumen production due to naturally occurring light ends flashing into the fuel gas system, provide the protocol or methodology to determine the amount of light ends used or lost. Discuss whether these used or lost ends are measured using other plant gas measurements or if a factor is used. If a factor is used, include the source of data to develop the factor.

Response

Whenever appropriate (taking into account the unique characteristics of particular facilities) the actual bitumen production for the various CPFs contained within the Kai Kos Dehseh Project will be calculated in accordance with the ERCB-approved MARP for the Leismer Demonstration Project – particularly relating to how the shrinkage of diluent (due to light ends flashing) and bitumen volume is determined.

35	iv. How is the bitumen content in the dilbit determined? What assays are done in order to obtain the diluent/bitumen split? What analytical technique is used and its accuracy? What assumptions are used, if any, to arrive at bitumen content?

Response

Whenever appropriate (taking into account the unique characteristics of particular facilities) the actual bitumen production for the various CPFs contained within the Kai Kos Dehseh Project will be calculated in accordance with the ERCB-approved MARP for the Leismer Demonstration Project.

Bitumen production will be calculated (in part) by determining diluent fraction in the sales dilbit. The diluent fraction calculation requires a separate determination of diluent, bitumen and dilbit gravity. The diluent and dilbit gravity can be measured with routine sampling and either local or contract laboratory services. The bitumen gravity is harder to assess on a routine basis, but can be estimated by aggregate and average density test results obtained from routine laboratory analysis of wellhead grab samples. StatoilHydro has not set down the frequency or protocol of sampling and testing any of wellhead samples, diluent receipts, or sales dilbit.

StatoilHydro will also comply with the standards contained within ERCB Directive 017 when calculating actual bitumen production.

36	**Volume 1, Page C-19, Section C2.2.9, Well Performance Monitoring.** Statoil Hydro states, "*Injection wells will also be monitored closely for steam injection rate and pressure*". Page C-22, Figure C2.2-3 shows a typical well completion, circulation phase. a. Describe the type of instrumentations that will be used to monitor downhole pressure and temperature.

Response

For producer wells, downhole thermocouples in the horizontal section of the wellbore will provide temperature readings along the well. A downhole bubble tube ported near the heel section of the well and purged with methane gas will supply downhole pressure readings.

Injector wells will have methane blanket gas supplied from surface that will insulate the injector annulus and provide downhole pressure readings when the pressure is depth-converted for the hydraulic head of the gas. Temperature will be inferred through pressure as the steam will be on the saturation curve. Select vertical observation wells will be equiped with a thermocouple string that will provide a means to measure steam chamber growth and provide additional correlating temperature data for the injectors.

37	**Volume 1, Page C-34, Section C2.4.6, Water Balance and Contingency Operating Conditions.** Statoil Hydro states, "*In Corner, with bottom and top water in the reservoir, some production of reservoir water, in addition to the condensed steam, is expected*". Statoil Hydro further states within the first bullet on the page, "*Produced water reuse will be practiced within days of getting produced water returns at the Corner Hub or the produced water will be directed to Leismer in place of make-up water there*". a. If excess water is expected to be produced due to bottom and top water, why does the water demand on Page C-33, Table C2.4-1 reflect reservoir retention rates of 7 and 10%?

Response

The top and bottom waters associated with the resource being recovered, are not found everywhere. The general trend from the operating SAGD facilities is a loss of water condensed from the steam injected, and not a net gain. StatoilHydro believes that its experience in the Kai Kos Dehseh Project will likely be similar.

A modest amount of bottom or top water being recovered (10% of the steam rate) with the production will reduce the make-up requirements. High rates of bottom or top water production will require increases to the reservoir operating pressure to better balance the steam chamber pressure with the associated water pressure. Pipeline connections between hubs will be evaluated as part of detailed engineering. Refer to ERCB SIR Response 8 e.

37	b. What are the proposed pipeline connections between hubs (e.g., gas, water, production, dilbit, etc) and how will this affect the energy efficiency of each facility?

Response

The integrated nature of the Kai Kos Dehseh Project will create synergies, flexible and increased product movement between the various Hubs. Interconnecting pipelines include water, fuel gas, produced gas, diluent and production which will create more options for the efficient use of energy in the Project and more effective use of its resources. For example, treating produced sour gas at a larger hub may be more energy-efficient than treating it at a smaller hub. Not all hub interconnections will include the same number or types of pipelines. The final selection of pipelines and product sharing will be assessed during detailed engineering.

38	**Volume 1, Page C-74, Figure C4.1-23, Location of Pads and Horizontal Wells with Base of SAGD Structure.** This Figure displays Statoil Hydro's 6% wt resource and 15m SAGD boundary. There are bitumen resources within the Corner Hub Development Area exceeding Statoil Hydro's minimum cutoffs for SAGD pay, which Statoil Hydro has not proposed to develop. a. Discuss Statoil Hydro's future plans to develop these resources.

Response

StatoilHydro is aware that some bitumen resources, which exceed the 15 m net SAGD pay cutoff, are present outside of the current horizontal well drainage layout pattern for the Corner Project. With a few exceptions, these regions are primarily located in the northwest, east, and south part of the Corner Field. StatoilHydro intends to develop all economically recoverable bitumen resources via SAGD technology; or in the alternative, utilize any field-proven and economically viable form of in-situ recovery technology that facilitates an orderly and efficient recovery of the bitumen resources at Corner. These > 15 m SAGD pay resources are not covered by the development plan currently filed with the ERCB because full-field delineation and exploration efforts are still in progress. In the winter of 2007-2008, StatoilHydro drilled 26 delineation wells, collected 38.59 km^2 of 3D seismic in the northwest, 13.80 km^2 3D seismic in the east, and 10.5 km of 2D seismic data from the field. Both the delineation well and seismic data are currently being analysed. Further work may follow in the succeeding winter drilling seasons. StatoilHydro plans to incorporate the information from the exploration and delineation efforts into the plan for developing the Corner Field.

38	b. Provide a map showing how future drainage areas will fit with currently planned drainage areas, and how they correlate to developable net pay.

Response

A map of how future drainage areas will fit with currently planned drainage areas is not available because these future drainage areas have yet to be defined through exploration and delineation drilling – see ERCB SIR Response 38a.

G. ERRATA

39	**Volume 1, Page 114, Figure 5.2-8, Material Balance.** This Figure shows that a volume of 69 960m^3/d diluent is to be used for separation and blending with an associated bitumen projection volume of 34 980m^3/d. a. Clarify the apparent discrepancy.

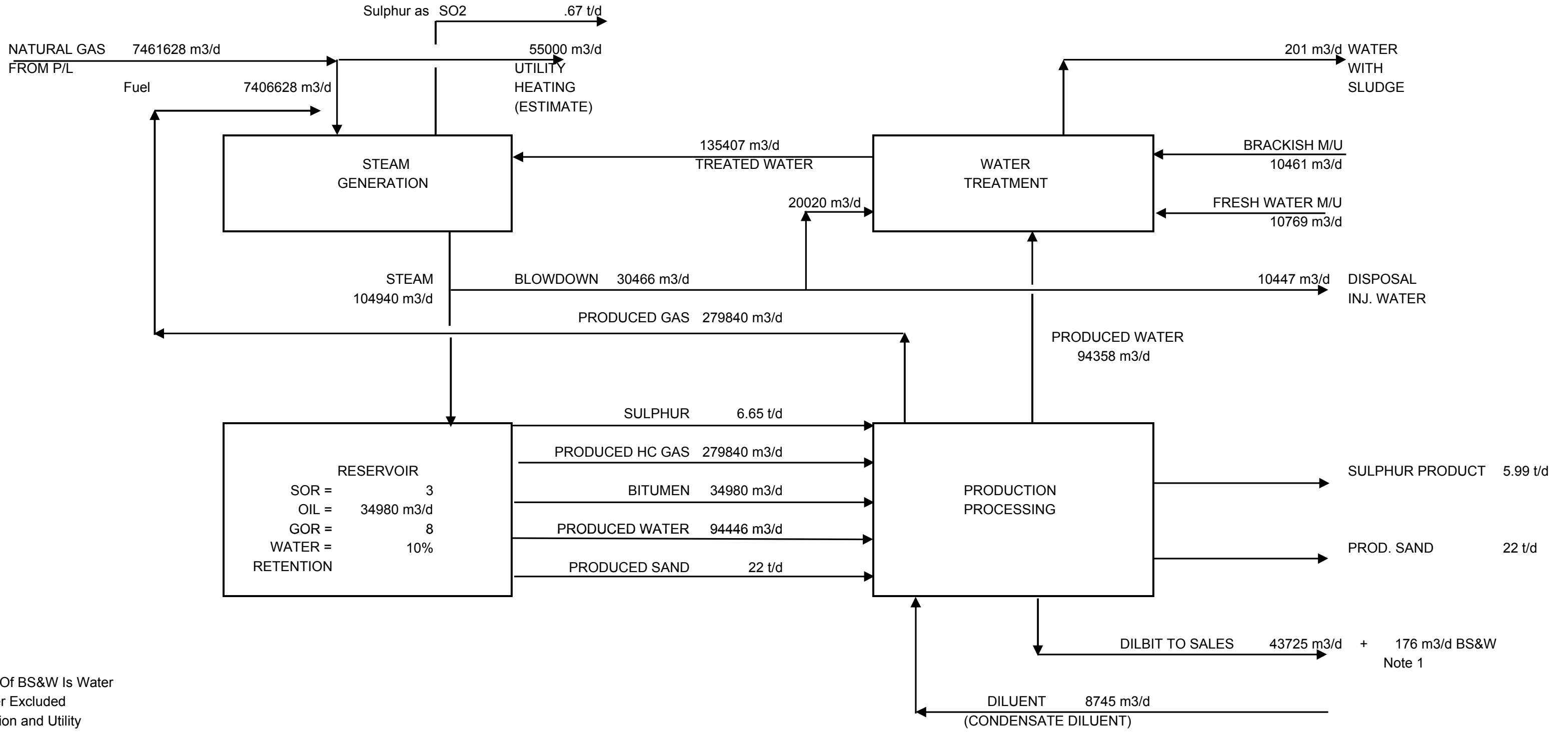
Response

The volume of 69,960 m^3/d is indeed incorrect. For a bitumen rate of 34,980 m^3/d the correct diluent volume rate is 8,745 m^3/d. See Figure 39-1 (Figure 5.2.-8 Revised).

40	**Volume 1, Page 114, Figure 5.2-8, Material Balance.** The notes associated with this Figure assume 50% water content in the sediment and water component. Assessment of this Figure shows that balance is achieved when 100% S&W water content is utilized. a. Clarify the composition of the S&W.

Response

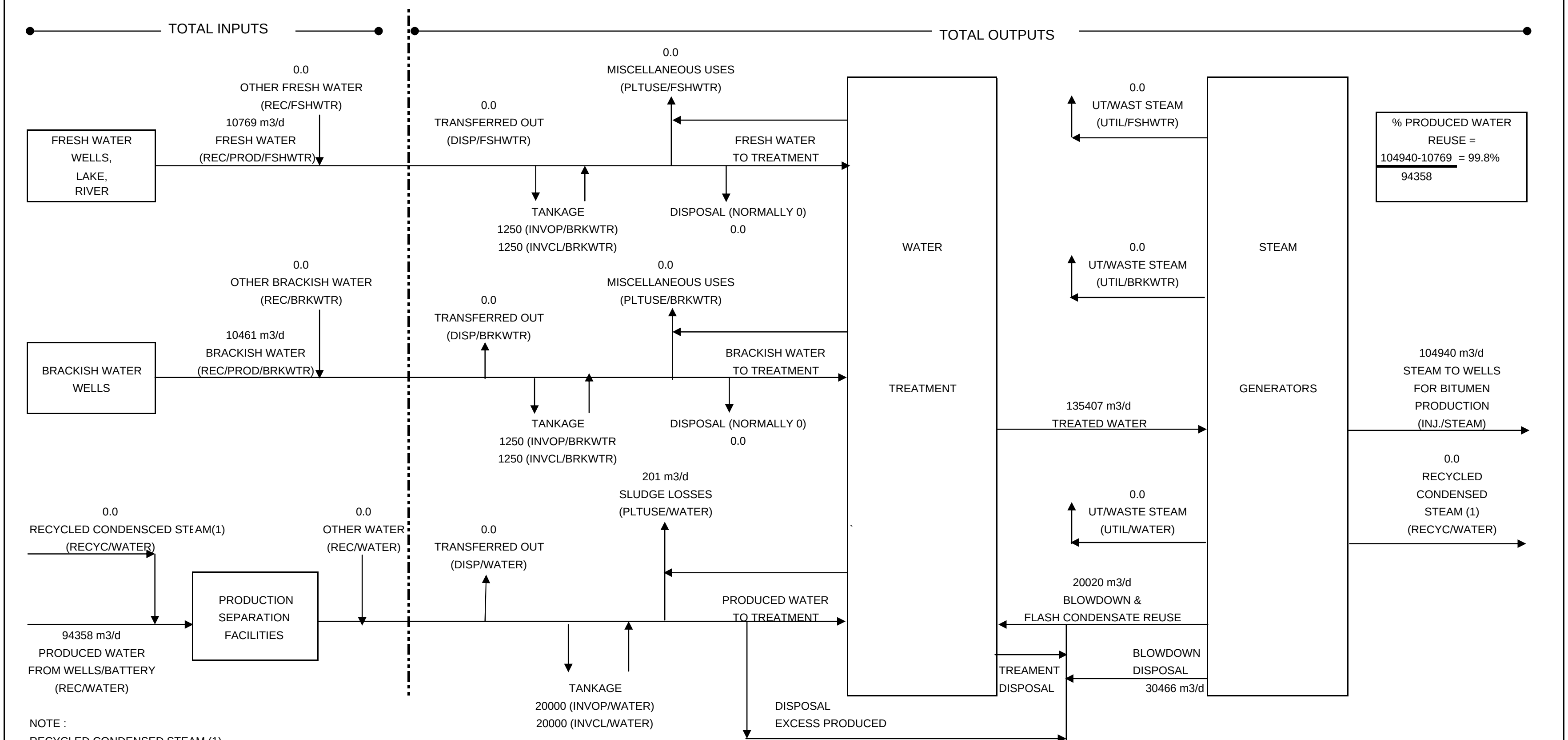
The balance did assume a 100% water content in the BS&W. This was in error to the note that states, “Assumes 50% of BS&W is Water”. The composition of Basic Sediment & Water shall be 50% water. The material balance sheet has been modified to reflect the same. See Figure 39-1 and 40-1 (Figure 5.2-9 Revised).



Notes:
1.) Assumes 50% Of BS&W Is Water
2.) Domestic Water Excluded
3.) Pond Evaporation and Utility
Losses Excluded
4.) GOR is 12. Produced Hydrocarbon gas from reservoir is 8
Approximate Stream Rates

NOTE: CALENDAR DAY

StatoilHydro	MATERIAL BALANCE BITUMEN PRODUCTION 34980 m3/d (220,000 bpd) SOR = 3, RR = 10%			
	SCALE	SIZE	DRAWING NUMBER	REV
	NONE	B	FIGURE 39-1	C



NOTE :

RECYCLED CONDENSED STEAM (1)

(RECY/WATER) RECYCLED CONDENSED UTILITY STEAM THAT ENTERS THE PROCUCED WATER STREAM COMING BACK INTO THE FACILITY

DISPOSAL (2)

(INJ/WATER) DISPOSAL OF FRESH+BRACKISH+PRODUCED WATER

DISPOSAL FRESH PORTION IS CALCULATED FROM TOTAL FRESH IN - OTHER FRESH WATER USES +/- TANKAGE - FRESH WATER INJECTED. NORMALLY 0

DISPOSAL BRACKISH PORTION IS CALCULATED FROM TOTAL BRACKISH IN - OTHER BRACKISH WATER USES +/- TANKAGE - BRACKISH WATER INJECTED NORMALLY

DISPOSAL PRODUCED PORTION IS CALCULATED FROM TOTAL DISPOSAL - DISPOSAL PRESH - DISPOSAL BRACKISH

StatoilHydro

SIMPLIFIED WATER BALANCE FLOW DIAGRAM
BITUMEN PRODUCTION 34980 m3/d (220,000 bpd)
- CONTINUOUS PLANT OPERATIONS
AFTER STARTUP (RECYCLE OPERATING)

SCALE	SIZE	DRAWING NUMBER	REV
NONE	B	FIGURE 40-1	B

ENVIRONMENTAL IMPACT ASSESSMENT

A. GENERAL

1	**Volume 1, Section 2.1, Page 5** a) Include a spreadsheet summarizing all of the commitments made in this Environmental Impact Assessment (EIA).

Response

Table 1-1 includes the commitments made in the joint Application and EIA documentation.

2	**Volume 1, Appendix A, Section A4.1.5.2, Figure A4.1-19, Page A-25** The basal A2 mudstone barrier forms the main caprock for the Steam Assisted Gravity Drainage (SAGD) operation. However its thickness can be as low as 0.4 m (Figure A4.1-19). a) Discuss if this is sufficient caprock thickness to avoid steam blowout to the surface, as has already occurred in Athabasca, and any mitigation and monitoring measures.

Response

Although the A2 mudstone in the McMurray Formation may be thin in some places in the Project area, the regionally extensive shales of the Wabiskaw Member of the Clearwater Formation are approximately 10 m thick and overly the McMurray Formation to form an absolute caprock to any uphole fluid migration.

Steam blowout to the surface can result from exceeding the fracture pressure at shallow depths. None of these conditions are expected at the Kai Kos Dehseh Project. The Kai Kos Dehseh reservoirs are at much greater depths (approximately 400 m) than some of the SAGD projects of competitors in the area. The maximum steam chamber pressure proposed for the project (5.0 MPag) is much less than the fracture pressure measured at Leismer (approximately 10.0 MPag).

Caprock integrity monitoring will be accomplished through steam chamber pressure monitoring, production monitoring and surveillance of the installed piezometer and temperature observation well network. Unexpected deviations in the above parameters will warrant a thorough investigation in which caprock integrity will be considered.

TABLE 1.1 StatoilHydro Kai Kos Dehseh Project Commitments

Volume	Section	Page	Commitment
Vol 1	Section 1	Page 1	North American's goal is to develop the Kai Kos Dehseh Project, ultimately producing approximately 35,000 m^3/d (220,000 barrels per day) of bitumen through steam assisted gravity drainage (SAGD) technology.
Vol 1	Section 1	Page 1	The Kai Kos Dehseh Project will be developed in 10 hubs, which are distributed over oil sands leases situated in four development areas - Leismer, Corner, Thornbury and Hangingstone (Table 1-1 and Figure 1-2).
Vol 1	Section 1	Page 1	Each hub is comprised of a central processing facility (CPF) (which may include steam generation, water treatment, emulsion gathering and treating, and sulphur removal) and field facilities (which includes well pads, connecting roads and utilities).
Vol 1	Section 2.1	Page 5	An agreement was made, in principle, that North American would apply for the overall Project in one regional EIA followed by detailed Applications instead of phasing five stand alone EIAs over the life of the development.
Vol 1	Section 2.1	Page 5	As engineerying design progresses, North American is committed to conducting even more detailed soil surveys (e.g., Survey Intensity Level One) as part of the pre-disturbance assessment (PDA) process.
Vol 1	Section 2.1	Page 6	North American agreed to provide more specific data and a higher data density for the initial hubs and to provide subsequent enhanced amendment applications for future hubs.
Vol 1	Section 2.1	Page 6	The intent of the future applications is to provide the standard level of application detail for each hub as their requisite geology and engineering progresses.
Vol 1	Section 2.1	Page 6	North American also committed to including updated air and groundwater effects assessment (including cumulative effects assessment) as well as incorporating learnings (continuous improvement arrow) from previous hubs into future hub applications.
Vol 1	Section 2.1	Page 6	North American is committed to preparing annual reports to the community that will chart the progress of the company's environmental stewardship and community engagement (Appendix D). These reports will be incorporated into all regulatory filings to ensure the community is actively involved in the regulatory process.
Vol 1	Section 2.2	Page 10	Integrated geological and geophysical mapping for each development area will be supplied in future submissions.
Vol 1	Section 2.7	Page 22	The phased construction means that a construction workforce of approximately 300 will be in the area continuously for approximately 12 years during the same time that operations will be starting up at most hubs.
Vol 1	Section 2.7	Page 22	Construction related traffic on Highway 881 due to the project will remain steady over approximately 12 years, rather than peaking in a short timeframe.
Vol 1	Section 2.7	Page 23	North American anticipates drawing labour from all possible sources, and will provide for transportation to the camp, where possible. This includes anticipated flights to the nearest regional airstrip, provided it is upgraded to sufficient capacity. Local bussing of construction and operations personnel is also being considered.
Vol 1	Section 2.8	Page 23	The company is committed to the following principles: - Stewardship of the environment; - Strategic planning for sustainability in business; - Meeting social expectations of stakeholders; - Engaging local aboriginal communities and businesses; - Managing key public policy and government issues; - Transferring technology for new sustainable business opportunities; and - Training and knowledge transfer related to sustainable development.
Vol 1	Section 2.8	Page 23	North American has a corporate Sustainable Development Group that addresses the sustainability challenges of the oil sands business. Such action is essential to ensure that principles of sustainable development are being applied in the design process, including, but not limited to: - Efficient equipment utilization; - Energy conservation application; - Effluent streams being re-used, recycled or re-processed; - Water use management; and - Development footprints minimization.
Vol 1	Section 2.9.1	Page 24	North American is committed to applying new technologies as they emerge, if appropriate, to proposed and future developments to improve overall environmental stewardship, reserve recovery, and cost efficiencies.
Vol 1	Section 4.4.1	Page 80	On an annual average basis, greater than 90% produced water recycle will be achieved after the start-up phase. Interconnecting pipelines between the CPFs are planned to balance water needs amongst the facilities and minimize disposal.

TABLE 1.1 StatoilHydro Kai Kos Dehseh Project Commitments

Volume	Section	Page	Commitment
Vol 1	Section 4.4.1	Page 80	Water will be supplied from the McMurray, Clearwater and Grand Rapids Formations.
Vol 1	Section 4.4.1	Page 80	Water disposal will be into the Basal McMurray Aquifer. The concept is based on balanced push-pull into/from the Basal McMurray Aquifer without impacting resource recovery.
Vol 1	Section 4.4.1	Page 80	Water treatment process is warm lime softening followed by two stage weak acid cation exchange. Alternative technologies such as evaporators and membrane processes will be monitored and assessed for potential application in future CPFs.
Vol 1	Section 4.4.1	Page 80	Compliance with the Water Conservation and Allocation Guideline 2006 for Oilfield Injection.
Vol 1	Section 5.1	Page 88	Additional constraints that will be considered during the detailed well pad location selection process are as follows: • High resolution LIDAR (Fli-Map®) Fli-Map® (Fast Laser Imaging Mapping and Profiling) is a proprietary image capture process that combines low level high quality, high resolution LiDAR data with digital video and high resolution still imagery. The multiple sources of imagery data integrated with precise GPS data allow detailed assessment of ground conditions, elevation changes, and vegetation identification. • Site soil conditions (i.e., to maximize the extent of mineral soils and minimize the extent of organic soils for each site); • Archaeological, traditional ecological knowledge and traditional use; • Topography (i.e., minimizing changes in elevation to limit need for cut and fill); • Sufficient area for soil stockpiles; and • Rare plants.
Vol 1	Section 5.1	Page 88	North American is committed to berming well pads and will meet the requirements of Directive 055 with regard to acceptable measures for on-site containment to prevent release of contaminants.
Vol 1	Section 5.1	Page 88	Disposal of all drilling fluids (fresh water based drilling fluids) will be according to EUB Directive 050.
Vol 1	Section 5.2	Page 94	North American has carried out an extensive review of the options for CPF placement to: • Locate on stable upland landform; • Minimize impact to resource recovery; • Minimize footprint; • Work with topographic features; • Avoid open water bodies; and • Avoid defined water course channels (i.e., having defined bed and bank material). North American has examined each development area to determine the best CPF placement to deliver steam to each pad site.
Vol 1	Section 5.2	Page 94	These CPF locations will be further refined detailed engineering in conjunction with constraints mapping.
Vol 1	Section 5.2.2	Page 96	Standards of accuracy, calibration and proving presented in the document will be stewarded throughout the various development areas of the Kai Kos Dehseh Project. As such the MARP will be updated to reflect the specific orientation and tagging of subsequent central processing facilities then resubmitted prior to their construction.
Vol 1	Section 5.2.10	Page 101	The maximum sulphur inlet for each individual hub is in the 1-3 t/d range and, as such, based on EUB Interim Directive 2001-3, requires 70% sulphur recovery. In its entirety, the Project will have an overall inlet sulphur rate greater than 10 t/d, and, as such, North American has designed each sulphur removal package to meet the 90% removal rate.
Vol 1	Section 5.2.11.1	Page 101	Two main camps are proposed. One will be located in the Leismer Development area to service Leismer and Corner and the other at Mariana Lake to service Thornbury and Hangingstone.
Vol 1	Section 5.2.13	Page 102	Water collected in the sludge pond will be recovered for reuse.
Vol 1	Section 5.3.3	Page 118	North American will work with industry operators, the county and the government to develop a comprehensive, coordinated fire response strategy and to ensure access into the area for emergency crews.
Vol 1	Section 6	Page 131	North American is committed to developing and maintaining constructive dialogue with all relevant stakeholders associated with the Project.

TABLE 1.1 StatoilHydro Kai Kos Dehseh Project Commitments

Volume	Section	Page	Commitment
Vol 1	Section 6.4.8	Page 137	North American will continue to report to the EUB by regularly submitting Community Consultation Matrixes, Newsletters and Reports to the Communities.
Vol 1	Section 8.2.2	Page 148	Progressive reclamation will be undertaken on facilities as they are decommissioned and abandoned throughout the life of the Project; examples are temporary camps, production pads and associated facilities that have finished production and are no longer needed.
Vol 1	Section 8.3.2	Page 151	North American will liaise with AENV and ASRD (as well as Al-Pac) for the duration of the Project regarding closure reclamation objectives and the target end land uses for disturbed sites.
Vol 1	Section 8.3.5	Page 153	North American will conduct business in a manner that benefits and engages local and Aboriginal communities, and consultation will continue throughout the life of the Project.
Vol 1	Section 8.6.3.2	Page 164	Wildlife crossings will be constructed where required for aboveground pipelines.
Vol 1	Section 8.6.3.2	Page 164	Tree and brush clearing will be conducted between August 30 and April 1 to protect birds and their nests, and to ensure compliance with Alberta's Wildlife Act (ASRD, 2000), and the federal Migratory Birds Convention Act (Government of Canada, 1994).
Vol 1	Section 8.6.3.2	Page 164	If clearing is required within the restricted time period, the area will be surveyed by a biologist to determine presence of nesting birds, including raptors and owls.
Vol 1	Section 8.6.3.2	Page 164	North American has a caribou protection plan for the area in good standing, which will be updated annually, or as required.
Vol 1	Section 8.6.3.3	Page 165	If artifacts of cultural or historical significance are encountered, work will be suspended in the area, Alberta Community Development will be contacted and a permit holder will investigate the site.
Vol 1	Section 8.6.3.3	Page 165	The AENV codes of practice for water course crossings (AENV, 2000a) and pipelines and telecommunications lines crossing waterbodies (AENV, 2000c), and applicable DFO Operational Statements will be followed.
Vol 1	Section 8.6.5.1	Page 172	For upland well sites and access roads, the salvaged soil will be stored and replaced on individual facility sites with the soil handling conservation measures outlined in Section 8.6.3.4; the replaced soil depth at these sites is expected to be similar to, or slightly less than, pre-disturbance conditions.
Vol 1	Section 8.6.5.2	Page 172	The central areas of well pads on peatland will be reclaimed to upland areas while the outer portions of the pads will be reclaimed to a surface peat area which is transitional to the undisturbed peatland (Figures 8.6-3 and 8.6-4).
Vol 1	Section 8.6.5.2	Page 172	Experience gained through the initial pad reclamations as well as through reclamation monitoring, will be used in an adaptive management strategy to revise the procedures as required.
Vol 1	Section 8.6.5.2	Page 173	Weed control measures will be undertaken to control weeds as required by the Alberta Weed Control Act (AAFRD, 2001).
Vol 1	Section 8.6.5.4	Page 174	Any gravel pit exploration, excavation, operations and reclamation done by North American will follow the appropriate regulatory guidelines including a guide to surface material resource extraction on public land (ASRD, 2001d).
Vol 1	Section 8.6.5.14	Page 180	Environmental monitoring will include a number of programs, for example: • Soil, air and groundwater monitoring will be carried out in accordance with the AENV Approval.
Vol 1	Section 8.6.5.14	Page 180	• PDAs will be undertaken prior to facility construction, and assessment of reclamation needs for each site will be conducted to guide reclamation procedures.
Vol 1	Section 8.6.5.14	Page 180	• Environmental monitors will be onsite during the construction phase of the Project to ensure the environmental protection measures are followed.
Vol 1	Section 8.6.5.14	Page 180	• Results of environmental monitoring will be reported to AENV as directed.
Vol 1	Section 8.6.5.14	Page 181	• Fish and fish habitat post-construction monitoring (e.g., road/bridge stream crossings) where required by DFO and AENV regulations.
Vol 2	Section 2.1.1	Page 1	The Project will include a vapour recovery unit as well as a leak detection and repair (LDAR) program, and therefore, fugitive emissions are expected to be negligible.

TABLE 1.1 StatoilHydro Kai Kos Dehseh Project Commitments

Volume	Section	Page	Commitment
Vol 2	Section 2.6.1.1	Page 40	The following design features were used to reduce combustion emissions from the proposed Project: • The steam boilers will use low NOx burner technology; and • To reduce GHG emissions, produced gas will be captured and used as a fuel gas instead of being flared. Since the effect of these mitigation measures were included in the emission estimates for the Project, the assessment of the Project effects is equivalent to a residual effects assessment
Vol 2	Section 2.8.1	Page 84	Monitoring is part of North American's adaptive management program identifying and responding to environmental concerns that may arise over the lifetime of the Project. Monitoring also allows North American to verify the prediction of impacts.
Vol 2	Section 2.8.2	Page 84	North American will conduct source monitoring to confirm the emissions from the steam boilers. The produced gas flow rates and H_2S contents will be measured and reported on a routine basis. Also, continuous emissions monitoring systems may be set up on representative exhaust stacks.
Vol 2	Section 2.8.3	Page 84	North American will participate in regional monitoring programs conducted in the southern oil sands area.
Vol 2	Section 2.8.3	Page 84	In addition, North American's ambient air monitoring data will be made available to all regional monitoring organizations in the southern oil sands area
Vol 2	Section 3.6.2.2	Page 10	-Advise nearby residents of significant noise-causing activities and schedule these to create the least disruption to neighbours.
Vol 2	Section 3.6.2.3	Page 10	Large dimensional heavy loads requiring specific traffic control measures will be limited to nighttime (01:00 – 5:00) and will be announced to the community.
Vol 3	Section 5.8.1	Page 68	Groundwater monitoring well networks, for each individual CPF and select well pads, will focus on the shallowest groundwater-bearing zone and therefore target the most vulnerable hydrostratigraphic unit with respect to potential impacts associated with CPF operations. Monitoring wells will be installed on-site and adjacent to areas exposed to potential sources of accidental releases
Vol 3	Section 6.12.1	Page 66	Well pads will be set back at least 100 m from waterbodies, where possible, to minimize potential disturbance to riparian conditions and impacts on local flow patterns. This will also provide an area for dispersion of stormwater releases from pads prior to discharging water to any natural waterbodies.
Vol 3	Section 6.12.2	Page 67	Culvert installations at road crossings will be monitored, on a regular basis, during or following high runoff periods and at spring break-up. Any constricting sediment or debris accumulation or excessive ice build-up will be removed to maintain the flow capacity of the culvert. Any excessive settlement of a culvert will be corrected to maintain flow patterns. Screens may be added to culvert inlets to prevent blockage in areas of potential beaver activity.
Vol 3	Section 6.12.2	Page 67	In wetland areas, water levels on either side of access roads will be monitored to ensure that they remain equal. If required, larger or additional culverts or rock drains will be installed.
Vol 3	Section 7.6.1.2	Page 69	Where applicable, DFO operational statements will be observed (DFO, 2006a - e) and the Alberta codes of practice for pipeline (AENV, 2003a) and road crossings (AENV, 2003b), and Alberta Transportation and Utilities guidelines for stream crossings (AT&U, 2001) will be implemented during construction of watercourse crossings.

TABLE 1.1 StatoilHydro Kai Kos Dehseh Project Commitments

Volume	Section	Page	Commitment
Vol 3	Section 7.6.4.2	Page 73	Road crossings will be designed and constructed to minimize flow restrictions and potential erosion. Recommended mitigation strategies include using AENV (2003a) Code of Practice, AT&U (2001) and DFO (2006 a - e) Operational Statements which are covered in Volume 3, Section 6.
Vol 4	Section 9.4.1	Page 9-8	Pre-disturbance site assessments (PDAs) at SIL1 (1 inspection/1-5 ha) will be conducted once the final layout is confirmed.
Vol 4	Section 10.6.3.1	Page 10-72	Timber removal will be coordinated under an Integrated Land Management Plan with Al-Pac.
Vol 4	Section 10.8	Page 10-103	North American is supportive of the Alberta Biodiversity Monitoring Program and will facilitate monitoring under this program within the Project area.
Vol 4	Section 10.8	Page 10-103	As much of the project area is located on wetland ecosite phases, North American will also work with other developers, local stakeholders and the government on developing wetland initiatives.
Vol 4	Section 11.3.3	Page 11-6	Hunting by Project personnel during any phase of the Project will be discouraged, and North American employees and contractors will be prohibited from carrying firearms when working on Project sites.
Vol 4	Section 11.7	Page 11-131	North American has initiated and funded a scat detection monitoring program in association with the University of Washington to assess changes in the abundance, distribution and physiological health of caribou, wolf, and moose in the region. North American plans to continue the scat detection monitoring program in collaboration with ASRD and other regional stakeholders in the area.
Vol 5	Section 13.8.2.1	Page 40	North American will follow the relevant FireSmart guidelines (Partners in Protection, 2003) including having appropriate setbacks from forest and surface vegetation and firefighting equipment.
Vol 5	Section 14.9.15	Page 66	• Communicating the Project schedule and projected workforce size with health services providers in the NLHR and Aspen Health Region, so that they can plan for coming years; and
Vol 5	Section 14.9.15	Page 66	• Providing workers with access to an employee assistance plan, to help workers with addictions counselling or those who are in distress.
Vol 5	Section 14.9.15	Page 66	• Develop a skills inventory for the communities in the LSA including information on residents' education, skills, work experience and interests. These profiles will be matched against a Job Opportunities List to identify qualified local candidates;
Vol 5	Section 14.9.15	Page 66	• Continue to communicate upcoming employment and contract business opportunities for local communities using Open Houses, newsletters, and timeline documents detailing long term employment/contract scopes in North American operations;
Vol 5	Section 15.10.1	Page 32	Pre-Disturbance Assessments and either Historic Resources Overviews or HRIAs will be required in order to request Historical Resources Act clearance.
Vol 5	Section 16.1	Page 1	North American is committed to a transparent, long-term and regional approach that actively supports the meaningful involvement of identified Aboriginal groups in the planning and decision-making process and responds to concerns as they arise.
Vol 5	Section 16.6.2.1	Page 12	Conklin and North American have agreed to work collaboratively in designing TEK and TU studies that will satisfy the regulatory process and assist the Conklin Métis Traditional Use and Occupancy Study.
Vol 5	Section 16.7	Page 14	The TEK and TU study reports will be submitted to the regulatory authorities upon completion

To mitigate the risk of a steam blowout, StatoilHydro will be establishing thermal well operations guidelines and process alarm ranges that will be designed to recognize and notify personnel of unexpected reservoir responses from its SAGD operations. StatoilHydro will apply for maximum injection pressures that do not exceed downhole fracture conditions and will abide by the pressures ultimately assigned by the ERCB itself. Operations staff will monitor injection wellhead pressures and corresponding steam chamber pressures in real time. In addition to thermal well data streams, StatoilHydro will continue expanding its existing pressure observation well network into new operating areas. This observation well network will allow for independent pressure measurements within, and surrounding, a number of StatoilHydro SAGD locations.

3	**Volume 1, Section 5.1, page 88** StatoilHydro indicates that the disposal of all drilling fluids will be according to ERCB Directive 50. a) Clarify how all drilling fluids and cuttings will be stored on-site and what containment systems will be used.

Response

The drilling fluids will be stored on-site in mud tanks. The oil sands and bitumen cuttings will be stored in 3-sided open-ended tanks that will be used to mix the cuttings with sawdust and then transported to an approved Class II landfill location for disposal. All other cuttings will be environmentally tested and approved for mix, bury, and cover.

4	**Volume 1, Section 2.1 and 5.1, Pages 5 and 88** The TOR concordance table (Volume 1, p. 34) indicates that Sections 2.1 and 5.1 contain information on the list of site facilities to be determined later (TOR 3.1e). However, Section 2.1 discusses the Regulatory Approach and Section 5.1 only states that *These initial well pad locations will be further refined by using a constraints mapping approach*. a) Provide a list of site facilities to be determined later as per TOR 3.1e).

Response

To ensure openness and transparency with the community, StatoilHydro has undertaken a regional EIA that fully discloses the commercial development within the approximately 12 townships of bitumen leases held by StatoilHydro. The facilities included in the Project footprint (Volume 1, Figure 1-2) include sufficient CPFs and well pads for the entire Project life. Also included are interconnecting pipelines, roads, powerlines, and operations camps. The precise location of the facilities and infrastructure will be further refined as additional geological and geophysical information and site specific environmental and engineering data are collected. The purpose of providing the overall Project footprint was to assess the environmental and social impacts of the entire Project. Some infrastructure not on the footprint include steam chamber observations wells, and future oil sands exploration programs. The majority of these facilities will be much smaller in size, have not been mapped or planned and typically will have a much shorter active life, then those of SAGD pads and CPFs, and as such have not been included as part of the Project footprint. Potential borrow pit locations were not included in the original footprint, however, subsequent planning has identified target borrow locations, see AENV SIR Response 80 for further details on borrow areas.

5	**Volume 1, Section 8.6.4.2, Page 170 and Section 5.3.2, Page 117** It is stated that under the umbrella of the Health, Safety and Environment (HS&E) Management Plan is a Facility Emergency Response Plan, which will include fire control management, environmental monitoring and spill response information and procedures. a) Provide information on the training StatoilHydro employees and contractors will receive on spill response procedures? b) Will all vehicles on site and facilities have spill response kits?

Response

A pool of StatoilHydro employees and contractors will be identified and will receive training on spill response procedures. Training will cover both spills on land and in waterways. The responder pool will be created to cover all aspects of the operations, from construction, through drilling and operations. An assessment is being conducted to assess the composition and best locations for spill equipment. Likely scenarios will be the establishment of a spill control trailer that will be stored and maintained at a central location. Additionally, StatoilHydro is a member of the Western Canadian Spill Services (WCSS) and will be able to access the oil spill co-op through this membership.

B. AIR

6	**Volume 1, Section 5.2.1, page 95** A sulphur balance for the Project was not provided. a) Provide a sulphur balance for the Project.

Response

Kai Kos Dehseh Sulphur Balance

i.	Sulphur in bitumen feed: 4.8 % weight;	1,700 t/d
	Sulphur in produced gas: 1.75 % mol	6.7 t/d
	Sulphur in produced water: traces only (due to high temperatures)	
	Sulphur in diluent:	negligible
ii.	Elemental sulphur production:	6.0 t/d
	Sulphur emissions from burning and incineration of produced gas and sales gas	0.7 t/d
	Sulphur remaining in dilbit product:	1,700 t/d
	Sulphur in disposal water: (based on Induced Gas Floatation process performance)	negligible
	Venting	0 t/d

6	b) Explain any disparity in the sulphur dioxide (SO_2) emissions used in the air quality assessment and the sulphur emissions in the sulphur balance.

Response

The sulphur concentrations used for the air modelling were conservative as they were based on the bitumen capacity of 240,000 bpd (i.e. including South Leismer producing at the same time as the rest of the Projects production) as well being based on preliminary and conservative engineering estimates for sulphur. Engineering refinements were incorporated into the Project description in Volume 1 however as the air modelling was conservative the EIA did not require updating. See AENV SIR Response 7d for further discussion.

7	**Volume 1, Section 5.2.8, Page 100,** **Volume 1, Figure 5.2-8, Page 114** **Volume 1, Appendix B., Figure B. 2.1-2** **Volume 1, Appendix C., Figure C. 2.1-2** **Volume 2, Section 2, Table 2.6-1** a) Provide data (calculations, gas analysis, historical records) supporting the expectation of maximum sulphur content of 1.75% (Volume/Volume) hydrogen sulphide (H_2S) in produced gas (Section 5.2.8, p.101).

Response

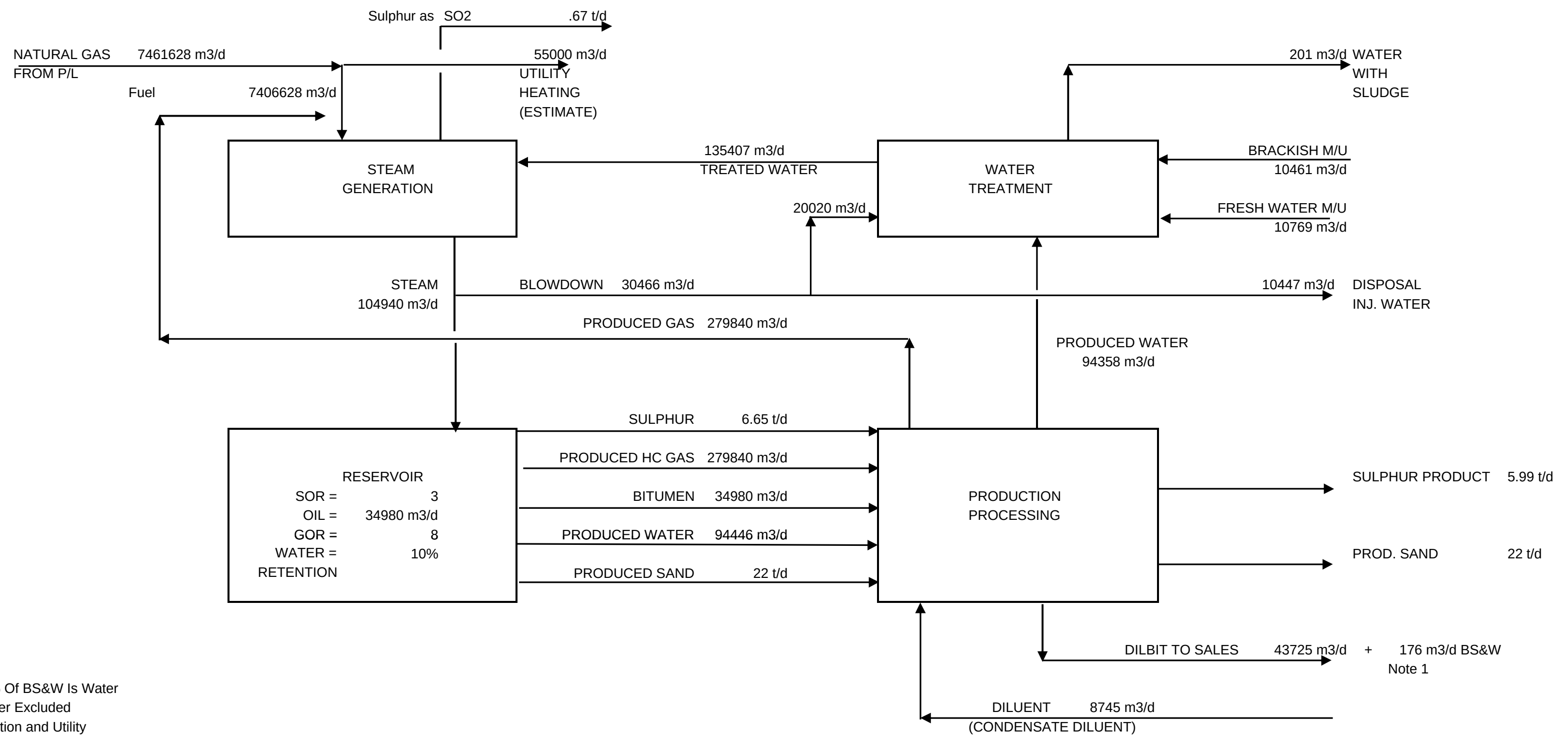
The expected maximum sulphur concentration of 1.75% v/v is based on discussions with other SAGD operators and industry experience, and laboratory solution gas measurements when adding methane to dead oil at reservoir conditions.

The corrected numbers are as follows in Figures 7-1 – 7-4 (Figures 5.2-8, A2.2-2, B2.1-2 and C2.1-2 Revised) (based on a hydrocarbon GOR of 8 m^3/m^3 and a related H_2S concentration of 1.75% volume. (Note: If CO_2 is included, the GOR is 12 m^3/m^3.)

7	b) Volume 2, Section 2.6.1.4 indicates that produced gas upstream of sulphur recovery contains 0.05% H_2S. Clarify this difference with respect to a) above.

Response

The value of 0.05% H_2S arose from a hypothetical upset scenario of blocked flow from the Free Water Knock-Out (FWKO) vessel causing a PSV relief event into the HP flare knockout drum. When the entire feed (bitumen, natural gas, water) is diverted and flashed in the flare knockout vessel, the resulting vapour contains 0.05% v/v H_2S. Since approximately 85% v/v of the remaining vapour is water, the flare would be extinguished. This upset scenario is highly unlikely based on the fact that an inlet emergency shut-down valve closes the feed at high liquid level in the FWKO.



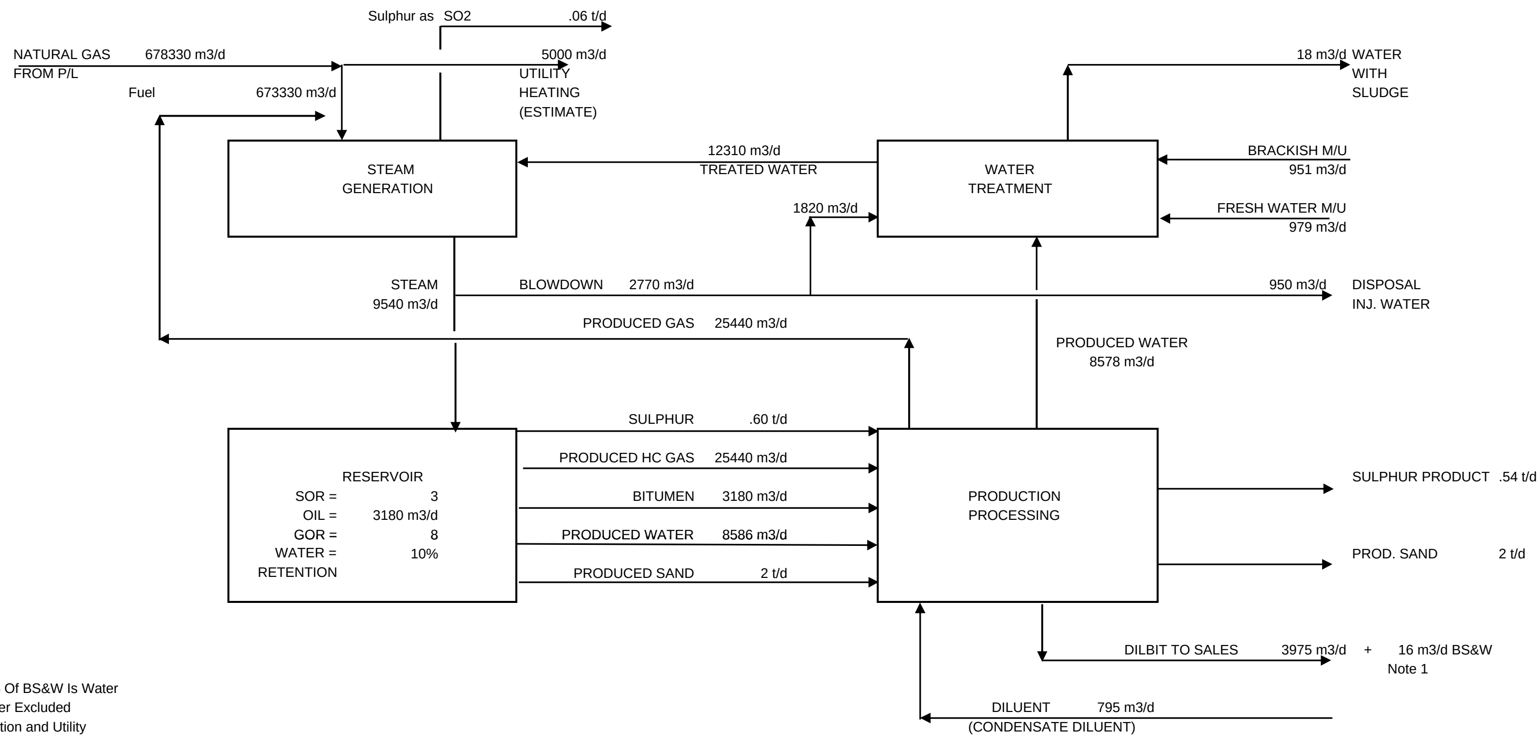
Notes:
1.) Assumes 50% Of BS&W Is Water
2.) Domestic Water Excluded
3.) Pond Evaporation and Utility Losses Excluded
4.) GOR is 12. Produced Hydrocarbon gas from reservoir is 8
Approximate Stream Rates

NOTE: CALENDAR DAY

StatoilHydro

MATERIAL BALANCE
BITUMEN PRODUCTION 34980 m3/d (220,000 bpd)
SOR = 3, RR = 10%

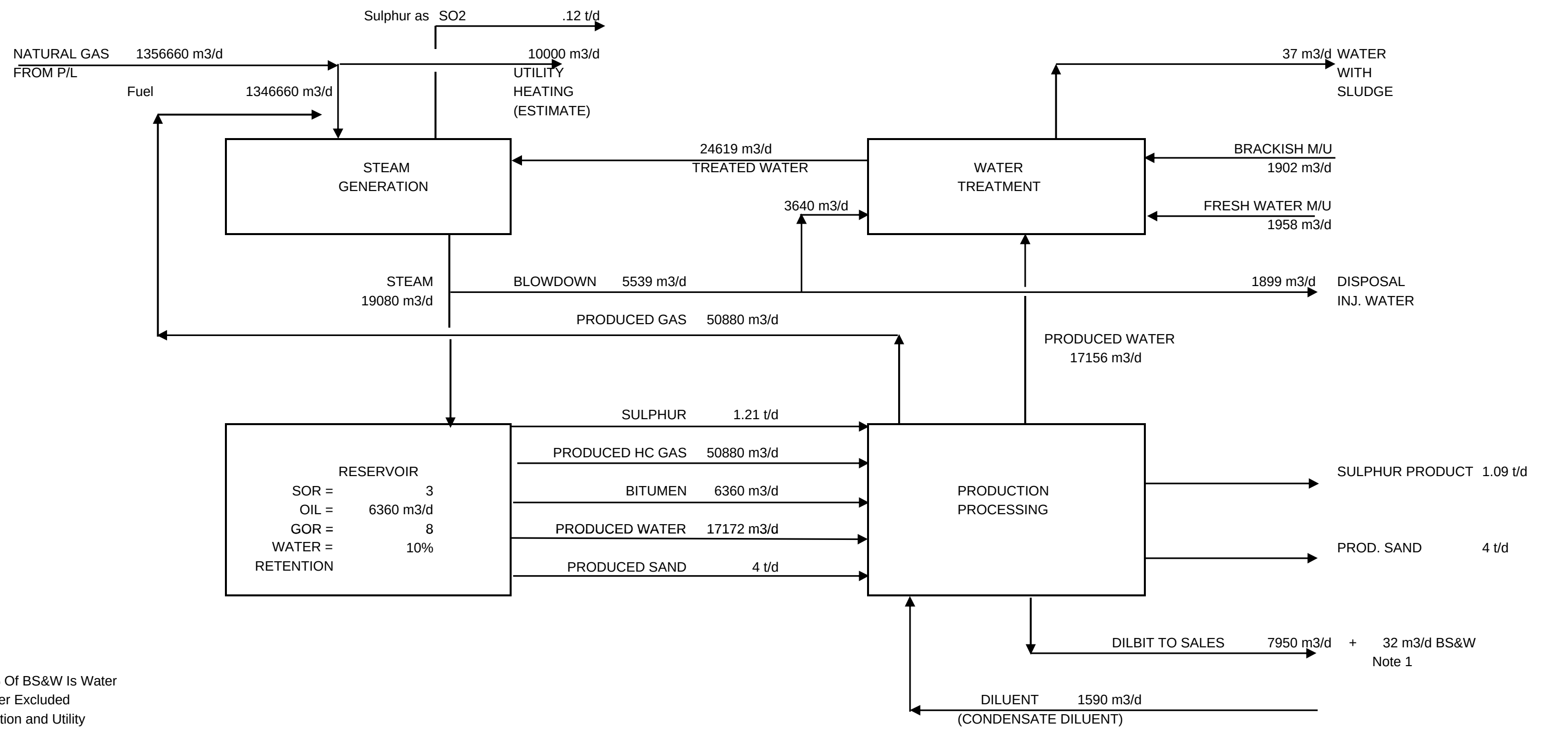
SCALE	SIZE	DRAWING NUMBER	REV
NONE	B	FIGURE 7 - 1	C



Notes:
1.) Assumes 50% Of BS&W Is Water
2.) Domestic Water Excluded
3.) Pond Evaporation and Utility Losses Excluded
4.) GOR is 12. Produced Hydrocarbon gas from reservoir is 8
Approximate Stream Rates

NOTE: CALENDAR DAY

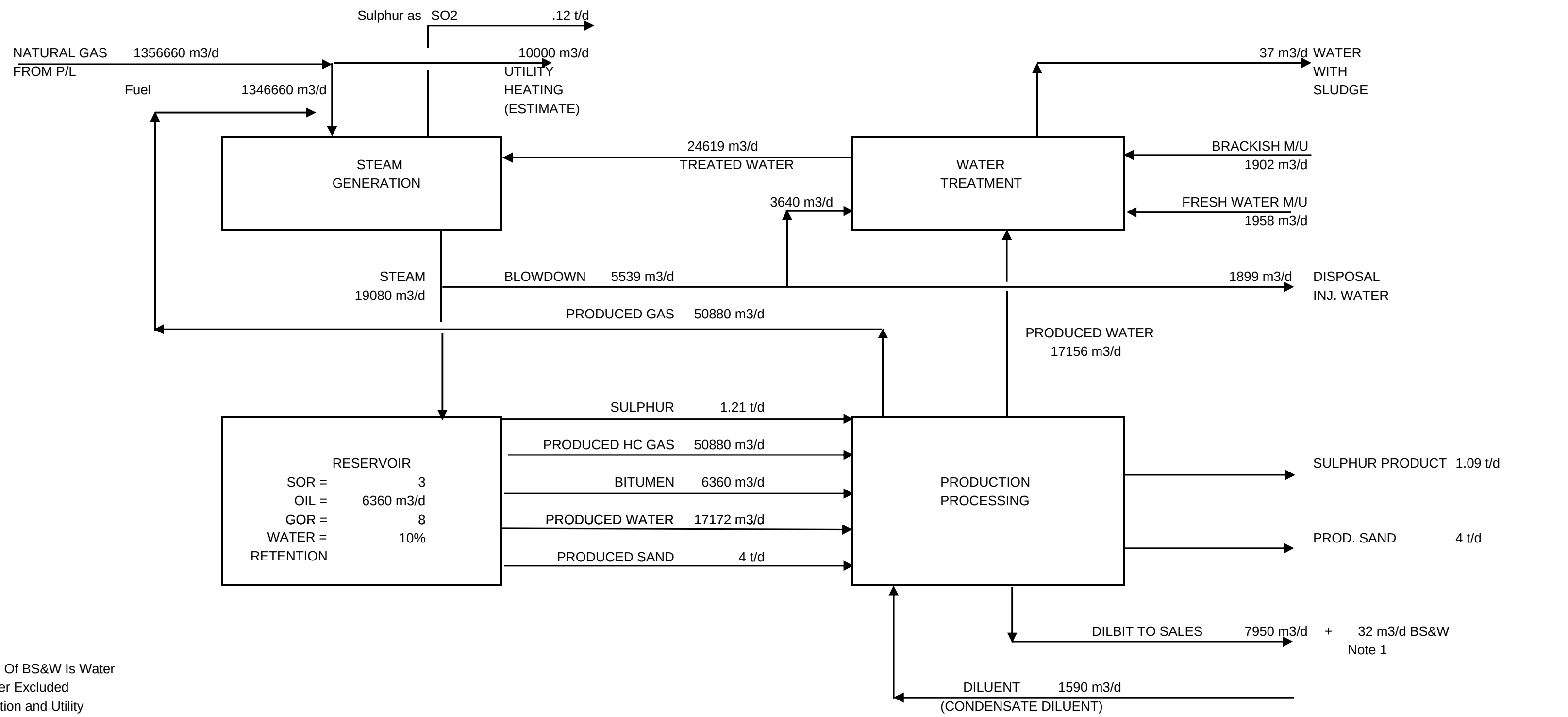
StatoilHydro	MATERIAL BALANCE BITUMEN PRODUCTION 3180 m3/d (20,000 bpd) SOR = 3, RR = 10%			
	SCALE	SIZE	DRAWING NUMBER	REV
	NONE	B	FIGURE 7 - 2	C



Notes:
1.) Assumes 50% Of BS&W Is Water
2.) Domestic Water Excluded
3.) Pond Evaporation and Utility Losses Excluded
4.) GOR is 12. Produced Hydrocarbon gas from reservoir is 8
Approximate Stream Rates

NOTE: CALENDAR DAY

StatoilHydro	MATERIAL BALANCE BITUMEN PRODUCTION 6360 m3/d (40,000 bpd) SOR = 3, RR = 10%			
	SCALE	SIZE	DRAWING NUMBER	REV
	NONE	B	FIGURE 7 - 3	C



Notes:
1.) Assumes 50% Of BS&W Is Water
2.) Domestic Water Excluded
3.) Pond Evaporation and Utility Losses Excluded
4.) GOR is 12. Produced Hydrocarbon gas from reservoir is 8
Approximate Stream Rates

NOTE: CALENDAR DAY

StatoilHydro

MATERIAL BALANCE
BITUMEN PRODUCTION 6360 m3/d (40,000 bpd)
SOR = 3, RR = 10%

SCALE	SIZE	DRAWING NUMBER	REV
NONE	B	FIGURE 7 - 4	C

7	c) Volume 1, Figure 5.2-8 indicates a sulphur production of 8 t/day at a bitumen production of 34,980 m^3/day, which calculates 0.23 kg sulphur (S) per m^3 of bitumen. However, Figure B.2.1-2 in Volume 1, Appendix B, indicates a sulphur production of 2 t/day for bitumen production of 6,360 m^3/day, which calculates 0.31 kg S per m^3 of bitumen. Clarify this difference.

Response

In Figure 7-1 (Figure 5.2-8 Revised) – for a bitumen production of 34,980 m^3/d the sulphur production is 5.99 t/d relating to 0.19 kg S per m^3 bitumen.

In Figure 7-3 (Figure B.2.1-2 Revised) - For a bitumen production of 6,360 m^3/d the sulphur production is 1.2 t/d relating to 0.19 kg S per m^3 bitumen

7	d) Volume 2, Section 2, Table 2.6-1 indicates that SO_2 emissions from the Project will be 2.86 t/day. With sulphur removal efficiency at 90%, this back calculates to 12.9 t/day of sulphur production. Provide supporting calculations and reconciliation with the numbers for sulphur production in c) above.

Response

Based on a 90% sulphur recovery, only 0.67 t/d of sulphur will be burnt to SO_2 resulting in 1.33 t/d of SO_2 emissions. Table 2.6.-1 utilizes 2.86 t/d (instead of 1.33 t/d), which reflects a much more conservative approach to air emission modelling and a higher production rate (240,000 bpd rather than the peak Kai Kos Dehseh rate of 220,000 bpd). See AENV SIR Response 6b for further discussion.

8	**Volume 1, Section 5.2.9, Page 101** a) Provide details of the flare systems including continuous/noncontinuous operation; electronic ignition; flare tip diameters to ensure combustion efficiencies; prevention of odours (i.e., poor combustion efficiency).

Response

For the purpose of the Application and typical upset conditions Volume 1, section 5.2.7-9 explains the type of flares expected and the nature of the operation of the flares. Volume 2, 2A2.3 explains the upset conditions which went into the calculations for the flare sizing, resulting in Table 2A2-4, which sizes each of the upset conditions.

The flare system will include a high pressure and a low pressure flare stack. The flares are intended to be used in upset conditions only. Both flares will be equipped with two retractable pilot assemblies, each of which will include electronic spark-type ignitors. An ignition monitoring system will be included which will incorporate a thermocouple to trigger automatic re-ignition. The flare tip diameters are approximately 0.45 cm (low pressure flare) and 0.40 cm (high pressure flare).

The flare system design is part of the process facilities engineering and as such will be developed in detail for each individual plant during the design engineering phase of the project. StatoilHydro will comply with all applicable standards, codes and regulations – including ERCB Directive 060: *Upstream Petroleum Industry Flaring, Incinerating and Venting*.

9	**Volume 1, Section 5.2.10, Page 101 and Volume 2, Appendix 2A, Section 2A2.1, Table 2A2-1** StatoilHydro states in Volume 1 that *in its entirety, the Project will have an overall inlet sulphur rate greater than 10 t/d, and, as such, StatoilHydro has designed each sulphur removal package to meet the 90% removal rate.* Table 2A2-1 indicates the total SO_2 emissions used in the dispersion modelling as 2.86 t/d for the entire Project. a) Provide the sulphur recovery calculations for the Project and confirm that the correct emission rate was used in the modelling.

Response

Correction:
The corrected numbers are shown in Figures 7-1, 7-2, 7-3, 7-4 (based on a hydrocarbon GOR of 8 m^3/m^3 and a related H_2S concentration of 1.75% volume (Note: If CO_2 is included the GOR is 12 m^3/m^3):

A conservative approach to emission modelling was taken by using 2.86 t/d of SO_2 instead of 1.33 t/d. Refer to AENV SIR Response 7 d above.

10	**Volume 1, Section 5.2.15.2, page 105** StatoilHydro states that *sour gas will be treated at Leismer, Thornbury, and Corner hubs*. Table 2A2-1, Volume 2, Appendix A, Page 2A-7 indicates that Hangingstone will also have sulphur recovery. a) Clarify which central processing facilities will have sulphur recovery.

Response

All central processing plants will either have sulphur recovery facilities or – depending on operational, safety and environmental considerations – will be linked to a sulphur recovery facility in an adjacent Central Processing Facility in accordance with the integrated philosophy of the Kai Kos Dehseh Application.

10	b) It appears that not all central processing facilities will have the capability of sweetening the produced gas. Explain logistically how the produced gas will be gathered from the extraction process, sent to a sweetening unit and then sent to a central facility to be used as fuel in the Once Through Steam Generators (OTSGs).

Response

Within a processing facility Volume 1, Sections 5.2.3, 5.2.8, 5.2.10 explain the logistics of gas handling as follows:

5.2.3: Gas separated and produced from the FWKO and treaters is mixed and sent to the mixed fuel gas separator.

5.2.8: The produced gas from the SAGD process typically contains carbon dioxide (CO_2) and hydrogen sulphide (H_2S) A small volume of produced gas from the SAGD process will be collected and used to supplement the purchased fuel gas.

5.2.10: Sulphur will be removed from the produced gas prior to mixing the produced gas with natural gas for combustion in the steam generators. The sulphur recovery unit will be a small skid mounted, package unit capable of capturing a minimum of 90% of the sulphur as elemental sulphur of suitable quality for sale. This unit will operate similarly to the larger scale Claus type units where H_2S is oxidized to elemental sulphur over a fixed bed catalytic reactor. The gas phase process will maintain the sulphur in the gas phase until it is recovered in the sulphur condenser. The treated gas leaves the process for the fuel gas mixed drum prior to being consumed as fuel in the steam generators.

The preferred case is to install sulphur recovery facilities in all central processing plants. Where, based on operational, safety and environmental considerations, sour gas will be sweetened in a neighbouring plant, design, logistics and operations will be developed during the detailed engineering phase of each plant.

10	c) Provide the expected service factor of the sulphur recovery units.

Response

The expected long-term service factor for the sulphur recovery unit is greater than 98%.

10	d) Explain what will happen when sulphur recovery units go down and the produced gas cannot be sweetened. Will the unsweetened gas continue be used as fuel? If so, evaluate the air quality impacts of this scenario.

Response

In case of an unexpected shut-down of the sweetening unit, operations will continue, but eventually will be reduced to the minimum required to avoid any reservoir damage. Unsweetened gas will continued to be utilized as fuel gas. Gas volumes and sulphur rates will be closely monitored to ensure that regulatory limits for sulphur emissions are not exceeded.

11	**Volume 1, Figure 5.2-1, Page 107** **Volume 1, Appendix B, Figure B2.1-1** **Volume 1, Appendix C, Figure C2.1-1** a) Provide a plot plan for a 4-OTSG hub, an 8-OTSG hub, and/or other configurations as appropriate. Identify on the plot plans the location of the exhaust stack locations and buildings.

Response

Figure 5.2 – 1 Page 107, of Volume 1, provides the plot plan for a 4-OTSG hub including buildings and Figure B2.1-1 & C2.1-1 a plot plan for an 8 OTSG hub including buildings. The exhaust stacks for the OTSG's are located directly adjacent to the OTSG's.

The individual layouts will be developed during design engineering for each plant taking into consideration site specific geotechnical, safety, operational and environmental factors.

12	**Volume 1, Section 5.2.1, Figures 5.2-8 & 5.2-10, Pages 114 & 116** From the material and energy balance provided in Figures 5.2-8 and 5.2-10, the resulting heating value of natural gas is about 29 MJ/m^3. a) Provide an estimated gas composition of the fuel used in the OTSGs and its associated heating value.

Response

The material balance has been revised as per ERCB SIR Question 40 a.

The fuel gas used in the OTSG's will be a blend of mainly imported natural gas (≈ 90%) and produced gas as well as vapours boiled off from diluent. The composition is in Table 12-1 below, reflecting a Lower Heating Value (LHV) of approximately 35 MJ/Sm^3.

Note: The value of 29 MJ/m^3 was calculated by the ERCB based on original data. This data has been updated to reflect new information and the resulting heating value of natural gas is approximately 35 MJ/m^3 as in the following Table.

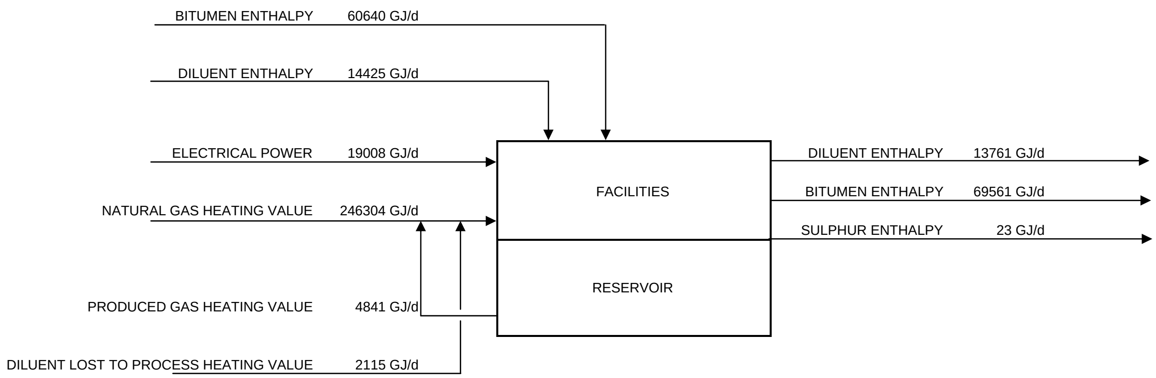
Table 12-1 Composition of Fuel Gas

Component	Mol %
N_2	2.06
CO_2	3.53
H_2O	0.18
H_2	0.018
He	0.018
Methane	91.37
Ethane	0.056
Propane	0.134
Butane	0.915
Pentane	1.319
C6+	0.4

12	b) Explain any disparity in the calculations in the material balance and energy balances.

Response

The material and energy balances Figure 7-1 and Figure 12-1(Figure 5.2-10 Revised) have now been corrected and there are no more disparities.



Inlet Diluent Temp.	10 °C
Inlet Bitumen Temp.	191 °C
Outlet Diluent Temp.	50 °C
Outlet Bitumen Temp.	50 °C
Sulphur Temp.	150 °C

StatoilHydro

ENERGY EFFICIENCY BALANCE
BITUMEN PRODUCTION 34980 m3/d (220,000 bpd)
SOR = 3, RR = 10%

SCALE	SIZE	DRAWING NUMBER	REV
NONE	B	FIGURE 12-1	B

13	**Volume 1, Section 5.3.5, page 121** StatoilHydro states that *as part of the detailed engineering phase, StatoilHydro will select steam generator manufacturers that can supply energy-efficient units with a low nitrogen oxides (NO_x) burner that comply with the Canadian Council of Ministers of the Environment (CCME) National Emissions Guidelines for Stationary Combustion Turbines and CCME National Emissions Guideline for Commercial/Industrial Boilers and Heaters, and applicable provincial guidelines*. It is noted that the OTSGs will be rated at 75.41 MW and it is estimated that each unit will emit 0.334 t/d of NO_x. a) Provide a calculation to show the CCME guidelines or other applicable provincial guidelines will be met from the OTSGs at the proposed NO_x emission rate.

Response

The original estimate of 0.334 t/d of NO_x from OTSGs was incorrect. Boiler suppliers, including OTSG manufacturers, are following the provincial codes and CCME guidelines (i.e. maximum NO_x emissions of 40 g/GJ); emission levels achieved in practice often are 15 – 20% lower than required by the Code.

13	b) Discuss if StatoilHydro has included flexibility in the design to incorporate further NO_x reduction technologies should they be required in the future.

Response

Flexibility for potentially stricter NO_x emission regulations will be considered during detailed engineering of each facility as part of the equipment specifications. Potential future limits are expected to be met through "Ultra Low NO_x Burners", or "Selective Catalytic Reduction" (SCR) technology.

14	**Volume 1, Section 5.3.7, Page 124** In Section 5.3.6 the Greenhouse Gas (GHG) emissions for the Project are listed. In Section 5.3.7 a discussion is provided regarding the Provincial and Federal legislation on climate change but does not include a discussion of StatoilHydro's Response in terms of their emissions reduction strategy. a) With regard to Table 5.3-1 (Page 122), discuss StatoilHydro's plans regarding its GHG emissions to meet the proposed Provincial and Federal legislation pertaining to climate change.

Response

StatoilHydro understands that it will need to meet the Provincial regulations as outlined in the "Specified Gas Emitters Regulation". Under this Regulation, new facilities that emit over 100,000 tonnes of carbon dioxide equivalencies (CO_2E) per year are required to reduce their emissions intensity by 2% per year after the three year baseline calculation period. It is StatoilHydro's intention to meet this emissions intensity target using a combination of the three compliance mechanisms outlined in the Regulation:

- making operational improvement to reduce emissions, and/or
- purchasing Alberta-based credits, and/or
- contributing to the Climate Change and Emissions Management Fund.

StatoilHydro Canada has been tracking the development of the Federal Government's GHG regulation. The most recent regulatory framework is "Turning the Corner: Regulatory Framework for Industrial Greenhouse Gas Emissions". As this is not yet a regulation, but rather a regulatory framework, compliance mechanisms have not yet been finalized. As such, StatoilHydro plans to continue tracking the development of the Federal regulation and develop a compliance plan once the regulation has been finalized.

15	**Volume 1, Section 7.2, Page 140** StatoilHydro states that *new exceedances of SO_2 objectives are predicted*. a) Describe where these exceedances are predicted to occur.

Response

The new exceedances of the SO_2 objectives are predicted to occur in the northeast portion of the LSA (see inset boxes of Figures 2.7-1 and 2.7-2, Volume 2, Section 2.7.2).

15	b) Indicate which emission source(s) are causing the exceedances.

Response

The area of predicted exceedances are not related to the Project; rather the exceedances are related to emissions from the existing ConocoPhillips Surmont and the planned ConocoPhillips Surmont Phase 2.

16	**Volume 2, Section 2.1.1, Page 2-1** StatoilHydro states that *the Project will include a vapour recovery unit as well as a leak detection and repair (LDAR) program, and therefore, fugitive emissions are expected to be negligible. As a result, typical fugitive emissions, including hydrogen sulphide (H_2S), total reduced sulphur (TRS) and total hydrocarbons (THC), were not assessed. These compounds are the main odorants associated with oil and gas activities. Since emissions of these compounds are expected to be negligible, odours associated with the Project are also expected to be negligible, and therefore, were not assessed.* a) Indicate whether StatoilHydro commits to no off-site odours during routine or normal operation of the facility.

Response

StatoilHydro is able to commit to eliminating the sources of off-site odours promptly should they occur. This will be accomplished primarily through the leak detection and repair (LDAR) program.

16	b) What are the effects on air quality if the Vapour Recovery Unit (VRU) fails?

Response

AENV SIR Response 20 provides additional air modelling discussion of this upset scenario.

16	c) What measures does StatoilHydro have to mitigate or reduce emissions when the Vapour Recovery Unit (VRU) is down?

Response

A key mitigation strategy would be the design of a high reliability system with appropriate redundancy to minimize downtime. StatoilHydro's design target for system reliability is 99.9% for the VRU. There are no other measures in place to mitigate a VRU shut-down apart from routing the inlet stream to flare.

17	**Volume 2, Section 2.1.1, Page 2-1** In paragraph 5, the emissions during construction have been noted as *localized, short-term, and much smaller than the emissions during operations*. a) Provide a list of the types of emissions likely to occur during construction.

Response

Emissions from construction equipment were not considered in the air assessment as the maximum air quality impacts are associated with normal operation emissions. Furthermore, construction emissions are transient in nature and are very difficult to quantify for dispersion modelling purposes. To demonstrate the magnitude of construction emissions relative to operation emissions, an assessment was conducted as shown in Table 17-1.

During the construction phase, emissions will be derived primarily from construction equipment including; earth moving equipment, excavators, trucks, side booms, graders, cranes, packers and other miscellaneous construction equipment. In addition to construction equipment, generators are used on-site to provide power. The major emissions are due to diesel fuel combustion and include SO_2, NO_x, CO, $PM_{2.5}$ and VOCs.

17	b) Provide a relative estimate of these emissions in comparison to regular operations.

Response

Table 17-1 provides a comparison of the construction and operation phases of the Corner 1 and Corner 2 facilities. The construction emission estimates are based on emissions factors and assumes that all pieces of equipment will be operating concurrently for 10h/d. This method was used to estimate construction emissions as it takes into account a high level of conservatism and represents a worst-case construction emission scenario. It should also be noted that construction emissions tend to be very localized and that not all equipment will be operated concurrently in the same vicinity.

The ratio of construction emissions to operations emissions shows that construction emissions are considerably less relative to operations emissions. As such, a detailed HHRA of construction emissions was not required for this assessment.

Table 17-1 Comparison of Construction Phase Emissions during Construction of the Corner 1 and 2 Facilities to Operations Phase

Contaminant	Construction Phase Emission Rate (t/d)	Operations Phase Emission Rate (t/d)	Ratio of Construction to Operation
SO_2	0.02	0.72	0.06
NO_x	0.29	4.04	0.07
CO	0.29	2.43	0.12
$PM_{2.5}$	0.02	0.23	0.09
VOC	0.04	0.31	0.13

18

Volume 2, Section 2.4.2, Table 2.4-4, Page 2-12

Regarding the $PM_{2.5}$ endpoint used in the assessment, effective 1 Feb 2007, the ambient air quality objectives for Alberta for $PM_{2.5}$ include: one-hour average 80 µg/m³ and annual average 30 µg/m³. The assessment (submitted August 2007) has only presented the Canada-Wide Standards (CWS) of 30 µg/m³ for the 98th percentile value. The Alberta objectives are more stringent. In particular, the one-hour $PM_{2.5}$ assessment endpoint is new and may be an issue for community or public areas.

a) Update the air quality assessment to include these assessment endpoints.
b) Provide $PM_{2.5}$ predictions within the LSA in comparison to the Alberta Ambient Air Quality Objectives (AAAQO) for $PM_{2.5}$ 1-h and 24-h averages.

Response

The new Alberta Ambient Air Quality Objectives for $PM_{2.5}$ perform two separate functions. The 1-h objective of 80 µg/m³ was designed for ambient monitoring and reporting purposes only, and was not meant for use in regulatory assessments (Fu, L., Pers. Comm., 2008). As such, for updating the air quality assessment for $PM_{2.5}$ only the new 24-h objective of 30 µg/m³ will be re-assessed. Instead of using the 98th percentile value of 24-h $PM_{2.5}$, the absolute maximum is presented in the following Table 18-1 for Baseline, Application and Cumulative Scenarios. In addition updated $PM_{2.5}$ Figures 18-1, 18-2, 18-3 (Figures 2.5-9, 2.6-7 and 2.7-7 Revised, respectively) are presented to reflect the new 24-hour $PM_{2.5}$ AAAQO.

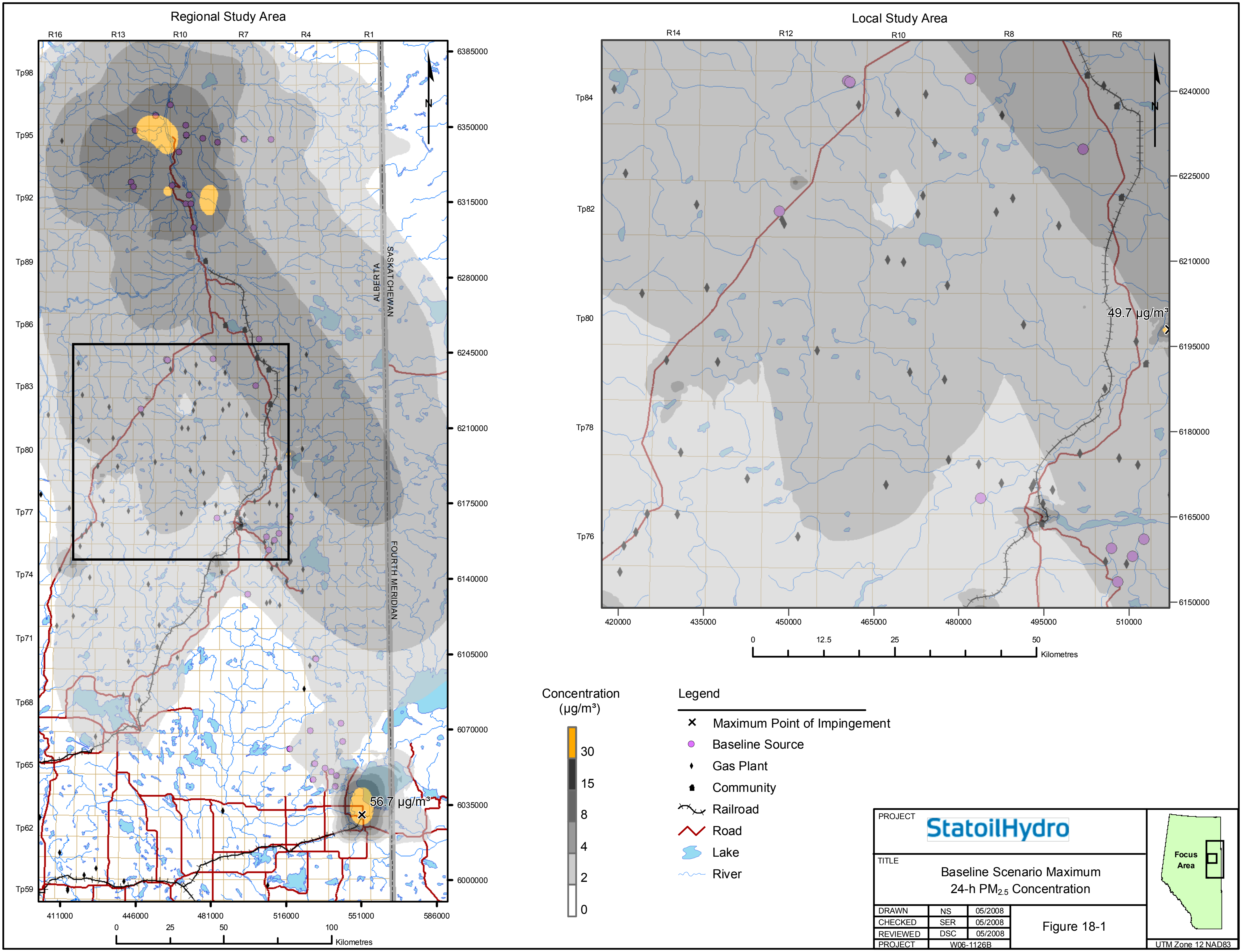
Table 18-1 Maximum Predicted 24-hour $PM_{2.5}$ Concentrations for Baseline, Application and Cumulative Scenarios

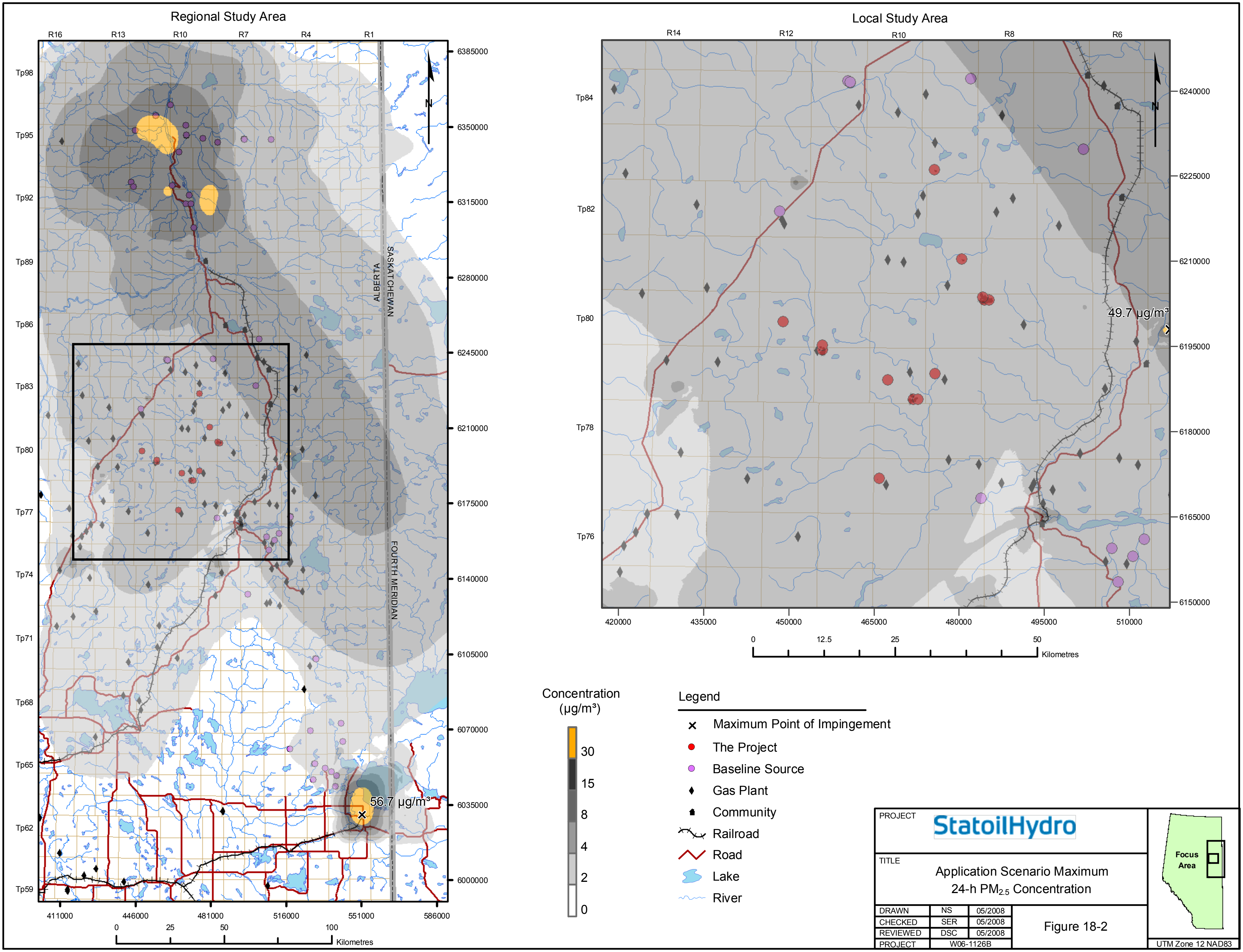
Maximum Predicted $PM_{2.5}$ Concentrations	Maximum Air RSA	Maximum Air LSA	AAAQO
Baseline 24-h concentration (µg/m^3)	56.7	49.7	30
Application 24-h concentration (µg/m^3)	56.7	47.7	30
Cumulative 24-h concentration (µg/m^3)	56.7	49.9	30

As a result of using the new 24-h AAAQO for $PM_{2.5}$, and relative to the original values, the maximum predicted concentrations have increased and now exceed this new objective. The number of exceedances in the RSA is 5 days for the Baseline, Application and Cumulative scenarios and 2 days in the LSA for the Baseline, Application and Cumulative.

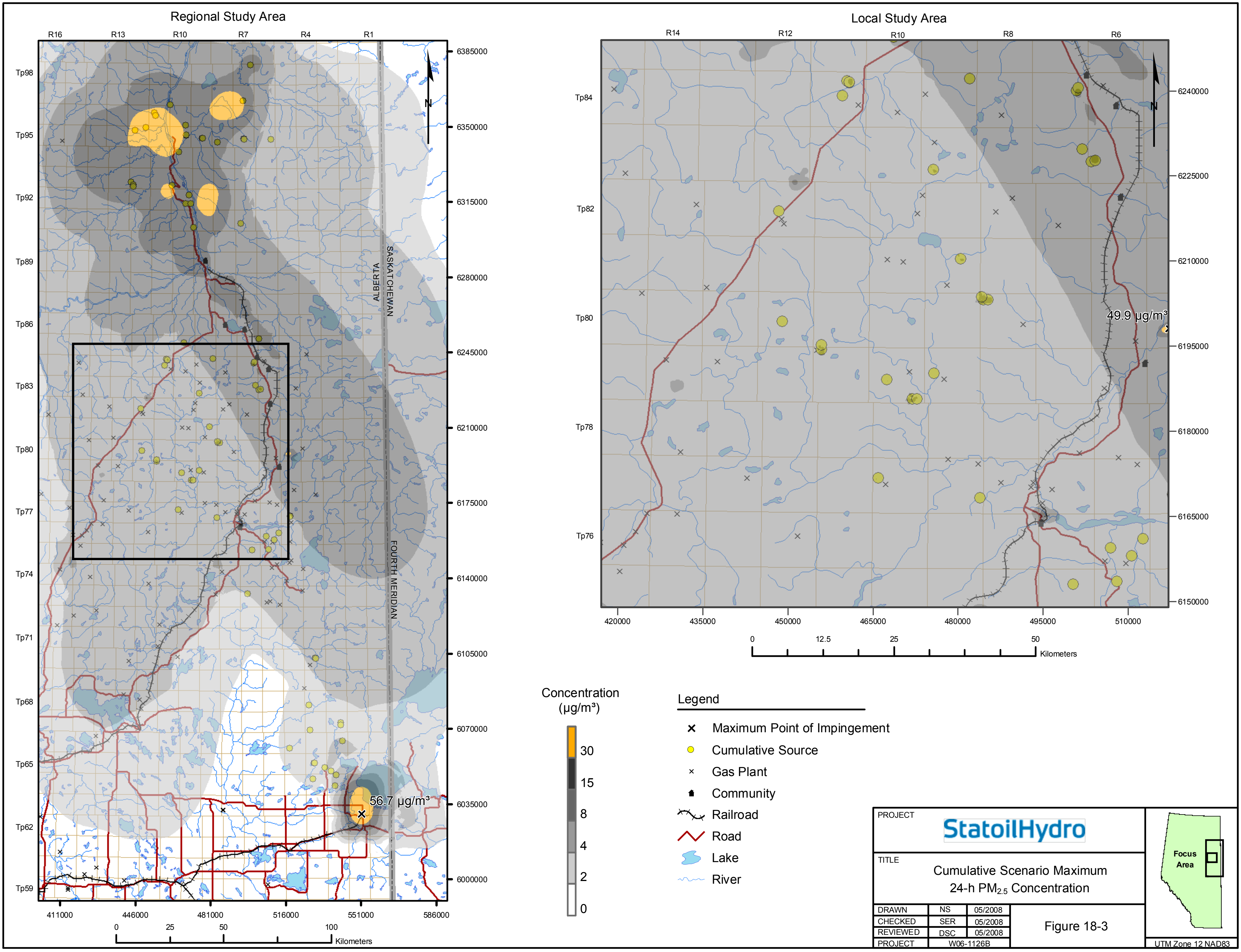
REFERENCE

Fu, Long, 2008. Personal Communication between Martin Gauthier (RWDI AIR) and Dr. Long Fu (Alberta Environment). March 2008.


Regional Study Area
R16
R13
R10
R7
R4
R1
Tp98
Tp95
Tp92
Tp89
Tp86
Tp83
Tp80
Tp77
Tp74
Tp71
Tp68
Tp65
Tp62
Tp59
ALBERTA
SASKATCHEWAN
FOURTH MERIDIAN
56.7 µg/m³
6385000
6350000
6315000
6280000
6245000
6210000
6175000
6140000
6105000
6070000
6035000
6000000
411000
446000
481000
516000
551000
586000
0
25
50
100
Kilometres
Local Study Area
R14
R12
R10
R8
R6
Tp84
Tp82
Tp80
Tp78
Tp76
49.7 µg/m³
6240000
6225000
6210000
6195000
6180000
6165000
6150000
420000
435000
450000
465000
480000
495000
510000
0
12.5
25
50
Kilometres
Concentration (µg/m³)
30
15
8
4
2
0
Legend
Maximum Point of Impingement
Baseline Source
Gas Plant
Community
Railroad
Road
Lake
River
PROJECT
StatoilHydro
TITLE
Baseline Scenario Maximum 24-h PM2.5 Concentration
DRAWN NS 05/2008
CHECKED SER 05/2008
REVIEWED DSC 05/2008
PROJECT W06-1126B
Figure 18-1
Focus Area
UTM Zone 12 NAD83



Regional Study Area
R16
R13
R10
R7
R4
R1
Tp98
Tp95
Tp92
Tp89
Tp86
Tp83
Tp80
Tp77
Tp74
Tp71
Tp68
Tp65
Tp62
Tp59
6385000
6350000
6315000
6280000
6245000
6210000
6175000
6140000
6105000
6070000
6035000
6000000
411000
446000
481000
516000
551000
586000
ALBERTA
SASKATCHEWAN
FOURTH MERIDIAN
N
56.7 µg/m³
0
25
50
100
Kilometres
Local Study Area
R14
R12
R10
R8
R6
Tp84
Tp82
Tp80
Tp78
Tp76
6240000
6225000
6210000
6195000
6180000
6165000
6150000
420000
435000
450000
465000
480000
495000
510000
49.7 µg/m³
0
12.5
25
50
Kilometres
Concentration (µg/m³)
30
15
8
4
2
0
Legend
Maximum Point of Impingement
The Project
Baseline Source
Gas Plant
Community
Railroad
Road
Lake
River
PROJECT
StatoilHydro
TITLE
Application Scenario Maximum 24-h PM2.5 Concentration
DRAWN NS 05/2008
CHECKED SER 05/2008
REVIEWED DSC 05/2008
PROJECT W06-1126B
Figure 18-2
Focus Area
UTM Zone 12 NAD83



Cumulative Scenario Maximum 24-h $PM_{2.5}$ Concentration

Figure 18-3

Table 18-2 Maximum RQ Value for Receptor

	Residential			First Nations		
	Baseline	Application	CEA	Baseline	Application	CEA
$PM_{2.5}$ (24-h max)	2.9E+00	2.9E+00	3.0E+00	6.4E-01	6.4E-01	6.6E-01

* Bold values represent an exceedance of the exposure limit

Table 18-3 Maximum RQ Value for Receptor

	Commercial			Recreational		
	Baseline	Application	CEA	Baseline	Application	CEA
$PM_{2.5}$ (24-h max)	1.8E-01	1.9E-01	2.4E-01	1.2E+00	1.2E+00	1.2E+00

* Bold values represent an exceedance of the exposure limit

Some exceedances of the AAAQO of 30 µg/m^3 were observed for the residential and recreational receptor groups. However, for both groups, baseline sources appear to contribute the most risk given the equivalence of the RQ values. For all receptors, there is a negligible change in the RQ between the baseline and application cases, indicating that the contributions from the Project are minimal. Refer to Table 4.6-20 in the original HHRA for a summary of background $PM_{2.5}$ concentrations in various regions and the discussion of conservatism.

REFERENCES

Fu, Long. 2008. Personal Communication. Email from Dr. Long Fu, Manager Environmental Science, Alberta Environment to Martin Gauthier, RWDI Air Inc.

18	c) Confirm that background $PM_{2.5}$ was not included in the predictions.

Response

Background $PM_{2.5}$ was not added to the modeled predictions in the original analysis in Volume 2, Section 2.4.2 nor in the new results in Table 18-1.

18	d) If only industrial sources of $PM_{2.5}$ are included in the modelling predictions, compare the predictions to baseline monitoring and comment on the proportion of $PM_{2.5}$ that can be attributed to natural background.

Response

Based on baseline monitoring, the proportion of $PM_{2.5}$ attributable to natural sources is approximately 1- 2 µg/m³. By comparing the 24-h $PM_{2.5}$ average for monitored and predicted values it can be seen that industrial sources comprise most of the measured concentrations. As such, the level of natural background $PM_{2.5}$ is very small.

18	e) If the natural background $PM_{2.5}$ concentrations discussed in c) were to be applied as an offset to the $PM_{2.5}$ modelling results, discuss any changes to the conclusions of air quality impacts.

Response

By applying the estimated natural background $PM_{2.5}$ concentrations to the predicted modelling results, the conclusions of the $PM_{2.5}$ assessment does not change as the predicted concentrations are dominated by industrial emissions. By adding the estimated natural background of 2 µg/m³ to the modeled results, the number of exceedances in the RSA increases from 5 days to 7 days, and in the LSA, it increases from 2 days to 3 days. Using the impact assessment rating description definitions as summarized in Volume 2, Table 2.4-6, the frequency of these exceedances of the new 24-h AAAQO (with background) remains less than 2% of the time. Therefore, the final rating for $PM_{2.5}$ remains low.

19	**Volume 2, Section 2.5.6, Page 2-24** The Baseline Prediction modelling in the air quality assessment serves two important purposes: it verifies the model predictions in comparison to monitoring; and, it forms the basis for the Application Prediction. In Section 2.5.6, the Baseline Predictions are presented for later comparison to the Application Prediction without verifying the predictions at the same locations. a) Using the Baseline Predictions at the Baseline Monitoring locations, compare the air quality using frequency diagrams and summary statistics.

Response

Baseline modelling was conducted for WBEA monitoring sites that measured SO_2, NO_2, and $PM_{2.5}$ to compare the predictive ability of the model to actual measured data for the year 2002. WBEA monitoring sites in the oil sands region of the RSA were selected as there were no monitoring sites near the Project in the LSA that measured these species for the Year 2002. Tables 19-1 through 19-6 illustrate the statistics of measured data in comparison to predicted values for 1-h and 24-h averaging periods for SO_2, NO_2 and $PM_{2.5}$. Frequency diagrams were not included, as the number of figures would be large and would be repetitive of what can be concluded from the statistics in the tables. As evident from the tables, the measured and monitored values are comparable. As expected, there are some discrepancies with maximum values as there are likely other influences that will influence the measured levels on a short-term basis.

Table 19-1 Statistical Comparison of Measured and Predicted SO_2 (1-hour averaging period, $\mu g/m^3$)

Station		Maximum	99.9th percentile	99th percentile	95th percentile	80th percentile	Average
Fort McMurray-Athabasca Valley	Measured	220	87	42	16	3	3
	Modelled	50	42	28	14	6	4
Fort McKay	Measured	167	86	42	13	3	3
	Modelled	130	85	45	20	7	5
Mildred Lake	Measured	1,000	256	102	34	8	7
	Modelled	436	211	82	35	8	7
Buffalo Viewpoint	Measured	565	200	79	21	3	5
	Modelled	272	124	56	25	6	5
Mannix	Measured	366	173	71	29	5	7
	Modelled	458	273	134	49	11	10
Fort McMurray-Patricia McInnes	Measured	170	117	52	18	3	4
	Modelled	95	66	42	19	6	4
Albian Mine Site	Measured	442	222	55	21	3	4
	Modelled	116	60	38	20	8	5
Lower Camp	Measured	544	157	65	24	5	5
	Modelled	649	348	107	33	5	7
Millennium	Measured	754	148	55	18	3	3
	Modelled	90	76	58	29	4	5
Syncrude UE1	Measured	170	80	37	8	3	2
	Modelled	144	78	45	18	5	4

Table 19-2 Statistical Comparison of Measured and Predicted SO_2 (24-hour averaging period, µg/m^3)

Station		Maximum	99.9th percentile	99th percentile	95th percentile	80th percentile	Average
Fort McMurray-Athabasca Valley	Measured	40	35	24	14	5	3
	Modelled	15	15	14	10	6	4
Fort McKay	Measured	22	21	18	13	5	3
	Modelled	32	31	26	16	7	5
Mildred Lake	Measured	119	110	43	25	11	7
	Modelled	52	52	42	25	11	7
Buffalo Viewpoint	Measured	82	73	35	20	6	5
	Modelled	49	44	27	19	8	5
Mannix	Measured	53	49	31	20	11	7
	Modelled	70	68	56	36	16	10
Fort McMurray-Patricia McInnes	Measured	45	43	25	16	5	4
	Modelled	24	24	22	13	7	4
Albian Mine Site	Measured	163	121	32	19	6	4
	Modelled	26	26	22	13	8	5
Lower Camp	Measured	51	47	28	16	9	5
	Modelled	74	73	56	28	10	7
Millennium	Measured	56	52	28	13	6	3
	Modelled	51	47	29	18	9	5
Syncrude UE1	Measured	23	22	16	9	3	2
	Modelled	32	31	27	15	6	4

Table 19-3 Statistical Comparison of Measured and Predicted NO_2 (1-hour averaging period, µg/m^3)

Station		Maximum	99.9th percentile	99th percentile	95th percentile	80th percentile	Average
Fort McMurray-Athabasca Valley	Measured	105	93	68	45	28	18
	Modelled	89	81	62	46	29	19
Fort McKay	Measured	66	58	49	38	19	12
	Modelled	186	137	101	71	39	21
Fort McMurray-Patricia McInnes	Measured	70	62	47	32	15	9
	Modelled	86	75	59	41	21	11
Albian Mine Site	Measured	134	94	66	47	26	14
	Modelled	288	193	115	80	44	25
Millennium	Measured	85	68	53	32	11	7
	Modelled	119	103	84	65	36	18
Syncrude UE1	Measured	56	51	41	32	19	9
	Modelled	151	110	87	61	34	18

Table 19-4 Statistical Comparison of Measured and Predicted NO_2 (24-hour averaging period, µg/m^3)

Station		Maximum	99.9th percentile	99th percentile	95th percentile	80th percentile	Average
Fort McMurray-Athabasca Valley	Measured	59	56	46	36	27	18
	Modelled	46	44	38	34	25	19
Fort McKay	Measured	41	41	38	31	18	12
	Modelled	72	70	61	52	35	21
Fort McMurray-Patricia McInnes	Measured	47	44	31	21	14	9
	Modelled	41	39	35	28	18	11
Albian Mine Site	Measured	55	52	44	36	23	14
	Modelled	75	73	65	50	37	25
Millennium	Measured	40	38	31	23	11	7
	Modelled	67	66	57	48	30	18
Syncrude UE1	Measured	36	36	34	29	16	9
	Modelled	56	56	52	42	29	18

Table 19-5 Statistical Comparison of Measured and Predicted $PM_{2.5}$ (1-hour averaging period, µg/m^3)

Station		Maximum	99.9th percentile	99th percentile	95th percentile	90th percentile	Average
Fort McMurray-Athabasca Valley	Measured	239	106	30	13	9	4
	Modelled	133	76	39	22	15	7
Fort McKay	Measured	204	115	32	15	11	5
	Modelled	275	218	139	63	40	14
Fort McMurray-Patricia McInnes	Measured	274	113	30	13	9	5
	Modelled	66	51	26	13	9	3
Albian Mine Site	Measured	186	99	34	15	11	5
	Modelled	133	73	43	22	13	5
Millennium	Measured	176	125	32	12	9	4
	Modelled	108	55	30	16	11	4
Syncrude UE1	Measured	29	24	16	9	7	3
	Modelled	115	75	41	21	14	5

Table 19-6 Statistical Comparison of Measured and Predicted $PM_{2.5}$ (24-hour averaging period, $\mu g/m^3$)

Station		Maximum	99.9th percentile	99th percentile	95th percentile	90th percentile	Average
Fort McMurray-Athabasca Valley	Measured	74	62	37	11	8	5
	Modelled	28	26	20	15	13	7
Fort McKay	Measured	78	66	26	12	10	5
	Modelled	110	101	64	42	35	14
Fort McMurray-Patricia McInnes	Measured	72	62	36	10	9	5
	Modelled	16	16	13	10	8	3
Albian Mine Site	Measured	65	59	29	11	9	5
	Modelled	27	27	23	13	10	5
Millennium	Measured	53	51	30	10	7	4
	Modelled	18	18	17	13	9	4
Syncrude UE1	Measured	15	14	11	6	5	3
	Modelled	28	26	21	16	11	5

19	b) Discuss the ability of the model to predict baseline conditions.

Response

The model predictions are comparable to the measured values. The largest discrepancies are found in maximum and high percentile values. Discrepancies are more likely in these statistics as measured values may contain unexpected variations in emissions of the actual sources. Such variations may include; facility upset conditions with higher than normal emissions, facility downtime, and other natural emission sources such as forest fires (which influences $PM_{2.5}$ particularly). The best measure for comparison is the 95th percentile and below, so that any unforeseen emissions can be eliminated and a direct comparison can be made to average emissions used in modelling. In general, the model provides a conservative estimate of predicted concentrations at percentile levels at and below 95% and on average.

19	c) Discuss the significance of the differences in regards to the assessment conclusions.

Response

As the difference between measured and modeled values can be attributed to varying or additional emissions that are not accounted for in modelling, the assessment conclusions remain the same as modeled predictions are comparable or exceed the measured values particularly at the 95th percentile level and below.

20	**Volume 2, Section 2.6.1.4, Page 2-40** Three upset conditions scenarios were evaluated in the EIA including: high pressure flare relief upstream and downstream of the sulphur recovery facility as well as low pressure flare relief due to the loss of the VRU compressor for tank vapours. StatoilHydro states *it was assumed that one central processing facility (CPF) at a time would be under upset conditions*. a) Provide dispersion modelling results assessing the air quality impacts related to failure of the sulphur recovery unit (SRU) at the CPF.

Response

Dispersion modelling was conducted assessing the failure of the SRU at the CPF of the proposed Leismer Demo/Commercial facility. During an SRU failure, unsweetened produced gas will be directed to the mixed fuel drum where it will be mixed with fuel gas. During SRU failure, the mixed fuel gas will still be sent to the operating OTSGs for combustion. The modelling included two scenarios; only Leismer sources and Leismer sources plus baseline sources. Table 20-1 presents the results of modelling of both scenarios during SRU failure, at the Leismer facility, in the LSA.

Table 20-1 Maximum Predicted Concentrations Associated with SRU Failure at the Leismer Facility

Scenario	Averaging Period	Predicted SO_2 Concentration
Leismer Only	9th Highest 1-h	81
	Maximum 24-h	28
Baseline + Leismer	9th Highest 1-h	284
	Maximum 24-h	104

20	b) Provide details on the flare stack and emission parameters used to model the SRU down upset scenario.

Response

During SRU failure, gas will not be automatically directed to flare. As mentioned previously, the gas will be directed to the mixed fuel gas drum to be mixed with fuel gas and then sent to the OTSGs for combustion.

21	
	Volume 2, Section 2.6.2.2, Page 2-43 The SO_2 upset/emergency flaring cases assessed used emission rates 1600 m³/h of 0.05% H_2S (0.05 t/d SO_2). This corresponds to approximately the SO_2 emissions for a single OTSG, rather than four –OTSG's for the module. The SO_2 emissions appear to correspond to diverted sour gas to flare and not the described upstream flaring of the entire sour gas stream. a) Provide calculations, gas analysis, modelling to support the emergency/upset flaring of produced gas.

Response

Please refer to AENV SIR Response 7 b above, which explains the H_2S concentration of 0.05%. Since this would be an unlikely event, the following table provides compositions and flowrates (based on a 20,000 bpd capacity plant) for two flaring scenarios:

i. OTSG's are shut-down and plant including VRU still operational
3,000 Sm^3/h flare rate (MW 32.3)

ii. VRU shut-down and plant still operational
2,100 Sm^3/h max flare rate (MW 22.2)

Table 21-1 Gas Compositions used in Flare Modelling

Composition	OTSG sh/d Mole Fraction	VRU sh/d Mole Fraction
Nitrogen	0.0068	0.0192
CO2	0.1819	0.0533
H2S	**0.0066**	**0.0036**
Methane	0.5752	0.8375
Ethane	0.0024	0.0009
Propane	0.0094	0.0029
i-Butane	0.0106	0.0025
n-Butane	0.0606	0.0116
i-Pentane	0.0607	0.0109
n-Pentane	0.0458	0.0084
H2O	0.0145	0.0402
n-Hexane	0.0000	0.0000
n-Heptane	0.0000	0.0000
Benzene	0.0000	0.0000
NBP[2]60*	0.0004	0.0001
NBP[2]106*	0.0001	0.0000
NBP[2]154*	0.0000	0.0000
NBP[2]200*	0.0000	0.0000
NBP[2]235*	0.0000	0.0000
NBP[2]277*	0.0000	0.0000
NBP[2]319*	0.0000	0.0000
NBP[2]362*	0.0000	0.0000
NBP[2]404*	0.0000	0.0000
NBP[2]445*	0.0000	0.0000

Composition	OTSG sh/d Mole Fraction	VRU sh/d Mole Fraction
NBP[4]61*	0.0195	0.0050
NBP[4]90*	0.0042	0.0021
NBP[4]116*	0.0010	0.0010
NBP[4]144*	0.0002	0.0003
NBP[4]172*	0.0000	0.0001
NBP[4]201*	0.0000	0.0000
NBP[4]230*	0.0000	0.0000
NBP[4]261*	0.0000	0.0000
NBP[4]288*	0.0000	0.0000
NBP[4]311*	0.0000	0.0000
NBP – Normal Boiling Point		

22	**Volume 2, Section 2.7.2.5, Table 2.7-6, Page 2-67** Table 2.7-6 indicates that predicted potential acid input (PAI) deposition is greater than the moderate and sensitive receptor target loads for all cases (baseline, application, cumulative) within the local study area. a) What is StatoilHydro's future plan to act on this management trigger?

Response

Mitigative measures for acid deposition are outlined in the "Application of Critical, Target, and Monitoring Loads for the Evaluation and Management of Acid Deposition" and "Recommendations for the Acid Deposition Management Framework for the Oil Sand Region of North-Eastern Alberta." The application of the Acid Deposition Management Framework is primarily intended for the management of acidifying emissions and acid deposition on a larger scale than an individual project, and is not intended for regulatory purposes on a local level. Predictions of acid deposition greater than management benchmarks (i.e., critical loads) at the local scale are meant to prompt an assessment of local issues regarding acid deposition. The Management Framework does not place the responsibility of developing a strategy to mitigate potential effects of acid deposition on one project. Rather it stipulates all stakeholders in the area participate in a regional plan.

REFERENCES

Cumulative Environmental Management Association, 2004. "Recommendations for the Acid Deposition Management Framework for the Oil Sand Region of North-Eastern Alberta."

Alberta Environment and Clean Air Strategic Alliance, 1999. "Application of Critical, Target, and Monitoring Loads for the Evaluation and Management of Acid Deposition"

23	**Volume 2, Section 7.6.5, Page 7-73** a) Clarify and describe the assessment methods for determining acidification to surface water bodies; specifically, do acidification impacts to surface water bodies include direct deposition to the water body and accumulated deposition to the water shed (thus seepage, runoff, and snowpack)?

Response

The lake was assessed as an endpoint for both sources of acid deposition and was measured as the rate of acid deposition across the watershed. It is expressed as the amount of acid deposition per hectare for a year. The critical load was provided as a rate at which the watershed can assimilate acidity on an average hectare per year basis. Therefore, acid deposition and the capacity to assimilate acidity were compared by using PAI and Critical Load Limit with the same units (keg h+/ha/y).

24	**Volume 2, Appendix 2A, Section 2A2, pg 2A-3** a) Provide a list of emission factors used for the estimation of the Kai Kos Dehseh Project emissions. Compare the NO_x emission factors to the Canadian Council of Ministers of the Environment (CCME) and Clean Air Strategic Alliance (CASA) NO_x emissions limits.

Response

See AENV SIR Response 13 a.

25	**Volume 2, Appendix 2A, Section 2A-1, Table 2A1-2, Page 2A-5** a) Provide the reference for each emission factor and total Volatile Organic Compounds (VOC) emissions listed in the Table 2A1-2.

Response

Table 25-1 provides the references for the emission factors cited for each VOC emission as listed in the original Table 2A1-2 in Volume 1.

Table 25-1 (Table 2A1-2 Revised) Summary of Emission Factors Used to Estimate VOC Species for the Project and other Point Sources in the RSA

		Emission Factors (lb/MMscf)							
	VOC Species	Heaters, Boilers and Steam Generators	Reference	Flares	Reference	Turbine Engines	Reference	Reciprocating Engines	Reference
1	2-Methylnaphthalene	0.000024	AP-42 (1)	0.0164	CATEF	0.0000063	CATEF	–	–
2	3-Methylchoranthrene	0.0000018	AP-42 (1)	–	–	–	–	–	–
3	7,12-Dimethylbenz(a)anthracene	0.000016	AP-42 (1)	–	–	–	–	–	–
4	Acenaphthene	0.0000018	AP-42 (1)	0.056	CATEF	0.000122	CATEF	0.00339	CATEF
5	Acenaphthylene	0.0000323	CATEF	0.056	CATEF	0.0000825	CATEF	0.0162	CATEF
6	Acetaldehyde	0.05	CATEF	0.653	CATEF	0.511	CATEF	2.8458	AP-42 (3)
7	Acrolein	0.0222	CATEF	0.0933	CATEF	0.0693	CATEF	2.6826	AP-42 (3)
8	Anthracene	0.0000024	AP-42 (1)	0.056	CATEF	0.000153	CATEF	0.00226	CATEF
9	Benzaldehyde	0.0272	CATEF	–	–	–	–	–	–
10	Benzene	0.04	CATEF	0.859	CATEF	0.099	CATEF	10.2	CATEF
11	Benzo(a)anthracene	0.00000285	CATEF	0.056	CATEF	0.000134	CATEF	0.000339	CATEF
12	Benzo(a)pyrene	0.0000012	AP-42 (1)	0.056	CATEF	0.0000916	CATEF	0.000151	CATEF
13	Benzo(b)fluoranthene	0.0000018	AP-42 (1)	0.056	CATEF	0.0000672	CATEF	0.000301	CATEF
14	Benzo(e)pyrene	–	–	0.0000748	CATEF	0.000000733	CATEF	–	–
15	Benzo(g,h,i)perylene	0.00000142	CATEF	0.056	CATEF	0.0000825	CATEF	0.000245	CATEF
16	Benzo(k)fluoranthene	0.0000018	AP-42 (1)	0.056	CATEF	0.0000672	CATEF	0.000117	CATEF
17	Chrysene	0.00000183	CATEF	0.056	CATEF	0.00015	CATEF	0.000395	CATEF
18	Dibenz(a,h)anthracene	0.0000012	AP-42 (1)	0.056	CATEF	0.000134	CATEF	0.0000145	CATEF
19	Dichlorobenzene	0.0012	AP-42 (1)	–	–	–	–	–	–
20	Ethylbenzene	0.00225	CATEF	–	–	0.057	CATEF	0.025296	AP-42 (3)
21	Fluoranthene	0.0000179	CATEF	0.056	CATEF	0.000305	CATEF	0.0012	CATEF
22	Fluorene	0.00000582	CATEF	0.056	CATEF	0.000458	CATEF	0.0094	CATEF
23	Formaldehyde	0.672	CATEF	67.4	CATEF	6.87	CATEF	20.91	AP-42 (3)
24	Hexane	1.8	AP-42 (1)	–	–	0.382	CATEF	–	–
25	Indeno(1,2,3-cd)pyrene	0.0000018	AP-42 (1)	0.056	CATEF	0.000134	CATEF	0.000207	CATEF
26	Naphthalene	0.00247	CATEF	35.4	CATEF	0.00788	CATEF	0.099042	AP-42 (3)
27	Pentane	2.6	AP-42 (1)	–	–	–	–	–	–
28	Perylene	–	–	0.0000748	CATEF	0.000000968	CATEF	–	–
29	Phenanthrene	0.0000474	CATEF	0.056	CATEF	0.00235	CATEF	0.00885	CATEF
30	Pyrene	0.0000116	CATEF	0.056	CATEF	0.000127	CATEF	0.00264	CATEF
31	Toluene	0.0747	CATEF	109	CATEF	0.168	CATEF	2.62	CATEF
32	Xylenes	0.0297	CATEF	0.796	CATEF	0.06528	AP-42 (2)	0.1989	AP-42 (3)
	Total VOCs	**5.5**		**215.1**		**8.3**		**40.3**	

Note: CATEF – California Air Toxics Emissions Factors
AP-42 (1) – U.S. EPA AP-42 Emission Factors Section 1.4 External Combustion Sources
AP-42 (2) – U.S. EPA AP-42 Emission Factors Section
AP-42 (3) – U.S. EPA AP-42 Emission Factors Section 3.2 Stationary Internal Combustion Sources

25	b) Page 2A-3, paragraph 8, StatoilHydro indicates that the maximum of California Air Resources Board (CARB) or U.S. Environmental Protection Agency (EPA) values were used to complete the table. Confirm that the maximum of CARB or EPA values were used for each CARB and EPA list and describe the differences.

Response

Tables 25-2, 25-3 and 25-4 illustrate the emission factors of each VOC species for the various source types for both CATEF and U.S. EPA references. The flare emissions are not presented here as all emissions from flares were obtained from CATEF as U.S. EPA AP-42 does not contain emission factors for SAGD facility flares.

Table 25-2 Emission Factors for Heaters, Boilers and Steam Generators (lb/10^6 scf)

VOC Species		Heaters, Boilers and Steam Generators		
		CATEF	AP-42	Difference
1	2-Methylnaphthalene	–	**0.000024**	–
2	3-Methylchoranthrene	–	**0.0000018**	–
3	7,12-Dimethylbenz(a)anthracene	–	**0.000016**	–
4	Acenaphthene	0.0000010	**0.0000018**	0.0000008
5	Acenaphthylene	**0.0000323**	0.0000018	0.0000305
6	Acetaldehyde	**0.05**	–	–
7	Acrolein	**0.0222**	–	–
8	Anthracene	0.0000021	**0.0000024**	0.0000003
9	Benzaldehyde	**0.0272**	–	–
10	Benzene	**0.04**	0.0021	0.0379
11	Benzo(a)anthracene	**0.00000285**	0.0000018	0.00000105
12	Benzo(a)pyrene	0.0000007	**0.0000012**	0.0000005
13	Benzo(b)fluoranthene	0.000002	**0.000002**	0
14	Benzo(e)pyrene	–	–	–
15	Benzo(g,h,i)perylene	**0.00000142**	0.0000012	0.00000022
16	Benzo(k)fluoranthene	0.0000008	**0.0000018**	0.000001
17	Chrysene	**0.00000183**	0.0000018	0.00000003
18	Dibenz(a,h)anthracene	0.0000005	**0.0000012**	0.0000007
19	Dichlorobenzene	–	**0.0012**	–
20	Ethylbenzene	**0.00225**	–	–
21	Fluoranthene	**0.0000179**	0.000003	0.0000149
22	Fluorene	**0.00000582**	0.0000028	0.00000302
23	Formaldehyde	**0.672**	0.075	0.597
24	Hexane	–	**1.8**	–
25	Indeno(1,2,3-cd)pyrene	0.0000005	**0.0000018**	0.0000013
26	Naphthalene	**0.00247**	0.00061	0.00186
27	Pentane	–	**2.6**	–
28	Perylene	–	–	–
29	Phenanthrene	**0.0000474**	0.000017	0.0000304
30	Pyrene	**0.0000116**	0.000005	0.0000066
31	Toluene	**0.0747**	0.0034	0.0713
32	Xylenes	**0.0297**	–	–
Total VOCs			**5.50**	

Note: '-' represents no emission factor is available
Bolded values represent emission factors used in assessment

Table 25-3 Emissions for Turbines (lb/10^6 scf)

VOC Species		Turbines		
		CATEF	AP-42	Difference
1	2-Methylnaphthalene	**0.0000063**	–	–
2	3-Methylchoranthrene	–	–	–
3	7,12-Dimethylbenz(a)anthracene	–	–	–
4	Acenaphthene	**0.000122**	–	–
5	Acenaphthylene	**0.0000825**	–	–
6	Acetaldehyde	**0.511**	0.0408	0.4702
7	Acrolein	**0.0693**	0.00653	0.06277
8	Anthracene	**0.000153**	–	–
9	Benzaldehyde	–	–	–
10	Benzene	**0.099**	0.01224	0.08676
11	Benzo(a)anthracene	**0.000134**	–	–
12	Benzo(a)pyrene	**0.0000916**	–	–
13	Benzo(b)fluoranthene	**0.0000672**	–	–
14	Benzo(e)pyrene	**0.000000733**	–	–
15	Benzo(g,h,i)perylene	**0.0000825**	–	–
16	Benzo(k)fluoranthene	**0.0000672**	–	–
17	Chrysene	**0.00015**	–	–
18	Dibenz(a,h)anthracene	**0.000134**	–	–
19	Dichlorobenzene	–	–	–
20	Ethylbenzene	**0.057**	0.03264	0.02436
21	Fluoranthene	**0.000305**	–	–
22	Fluorene	**0.000458**	–	–
23	Formaldehyde	**6.87**	0.7242	6.1458
24	Hexane	**0.382**	–	–
25	Indeno(1,2,3-cd)pyrene	**0.000134**	–	–
26	Naphthalene	**0.00788**	0.001326	0.006554
27	Pentane	–	–	–
28	Perylene	**0.000000968**	–	–
29	Phenanthrene	**0.00235**	–	–
30	Pyrene	**0.000127**	–	–
31	Toluene	**0.168**	0.1326	0.0354
32	Xylenes	0.0261	**0.06528**	0.03918
Total VOCs		**8.30**		

Note: '-' represents no emission factor is available
Bolded values represent emission factors used in assessment

Table 25-4 Emission Factors for Reciprocating Engines (lb/10^6 scf)

VOC Species		Reciprocating Engines		
		CATEF	AP-42	Difference
1	2-Methylnaphthalene	–	–	–
2	3-Methylchoranthrene	–	–	–
3	7,12-Dimethylbenz(a)anthracene	–	–	–
4	Acenaphthene	**0.00339**	–	–
5	Acenaphthylene	**0.0162**	–	–
6	Acetaldehyde	0.831	**2.8458**	2.0148
7	Acrolein	0.547	**2.6826**	2.1356
8	Anthracene	**0.00226**	–	–
9	Benzaldehyde	–	–	–
10	Benzene	**10.2**	1.6116	8.5884
11	Benzo(a)anthracene	**0.000339**	–	–
12	Benzo(a)pyrene	**0.000151**	–	–
13	Benzo(b)fluoranthene	**0.000301**	–	–
14	Benzo(e)pyrene	–	–	–
15	Benzo(g,h,i)perylene	**0.000245**	–	–
16	Benzo(k)fluoranthene	**0.000117**	–	–
17	Chrysene	**0.000395**	–	–
18	Dibenz(a,h)anthracene	**0.0000145**	–	–
19	Dichlorobenzene	–	–	–
20	Ethylbenzene	0.0116	**0.025296**	0.013696
21	Fluoranthene	**0.0012**	–	–
22	Fluorene	**0.0094**	–	–
23	Formaldehyde	2.35	**20.91**	18.56
24	Hexane	–	–	–
25	Indeno(1,2,3-cd)pyrene	**0.000207**	–	–
26	Naphthalene	0.0765	**0.099042**	0.022542
27	Pentane	–	–	–
28	Perylene	–	–	–
29	Phenanthrene	**0.00885**	–	–
30	Pyrene	**0.00264**	–	–
31	Toluene	**2.62**	0.56916	2.05084
32	Xylenes	**0.0602**	0.1989	0.1387
Total VOCs		**40.3**		

Note: '-' represents no emission factor is available
Bolded values represent emission factors used in assessment

25	c) The list in Table 2A1-2 is incomplete compared to the EPA general reference provided. Provide an explanation for each VOC speciation provided by EPA that has not been listed for each source.

Response

There are several species included in the U.S. EPA AP-42 emission factors for boilers, steam generators, heaters, turbines and reciprocating engines that were not included as part of this assessment. They include:

- 1,1,2,2-Tetrachloroethane
- 1,1,2-Trichloroethane
- 1,1-Dichloroethane
- 1,2-Dichloroethane
- 1,2-Dichloropropane
- 1,3-Butadiene
- 1,3-Dichloropropene
- Butyr/Isobutyraldehyde
- Carbon Tetrachloride
- Chlorobenzene
- Chloroform
- Ethane
- Ethylene Dibromide
- Methanol
- Methylene Chloride
- Styrene
- Vinyl Chloride
- Propylene Oxide
- Butane
- Propane

Most of these species were not included in the assessment as the emission factors for these species are very small therefore, combustion of natural gas will not contribute significant quantities of emissions of these species. As such, ambient levels of these compounds will not cause negative effects on the environment or human health. Species such as butane, ethane, and propane have larger emission factors but were not included as there are no published AAAQOs for these species.

26	**Volume 2, Appendix 2A, Section 2A2.1, Table 2A2-1, Pages 2A-7 to 2A-11** Table 2A2-1 indicates a NO_x emission rate of 0.334 t/d for the 48 (75.41 MW) once-through steam generators. a) Demonstrate with calculations how the proposed emission rate complies with the *CCME National Emission Guideline for Commercial/Industrial Boilers and Heaters*.

Response

See AENV SIR Response 13 a.

27	
	Volume 2, Appendix 2A, Section 2A2.1, Table 2A2-2, Page 2A-12 Table 2A2-2 shows the Project flare stack and emission parameters under normal operating conditions, however, the gas composition that was used to calculate the parameters is not provided. a) Provide the gas composition under normal operating conditions that was used to calculate the flare stack parameters.

Response

The Table below provides the sweet gas composition of the flare operating under normal conditions was used to calculate the flare stack parameters.

Table 27-1 Gas Composition of Flare during Normal Operating Conditions (in percent)

Species	Molar Fraction
H_2	**0.02**
He	**0.02**
H_2O	**0.00**
N_2	**2.26**
CO_2	**2.45**
H_2S	**0.00**
C_1	**95.16**
C_2	**0.03**
C_3	**0.02**
iC_4	**0.04**
nC_4	**0.00**
iC_5	**0.00**
nC_5	**0.00**
C_6	**0.00**
C_7+	**0.00**
Total	**100.00**

28	
	Volume 2, Appendix 2A, Section 2A2.3, Page 2A-13 The assessment for upset conditions appears to indicate that a Central Processing Facility (CPF) site such as Corner 1 with eight Once Through Steam Generators (OTSG's) compared to a CPF site with only four-OTSG's will produce identical emergency/upset flaring emissions even though the production rates would naturally differ. a) Clarify if the modularization of the central processing facilities includes sulphur recovery and sour gas handling.

Response

Sour gas handling and Sulphur recovery facilities will be installed with the first train of an 8 OTSG plant as per Appendix B Figure B2.1-1. These units will be sized for the whole plant.

28	b) Provide details and calculations on the flare sizing (height and diameter) for each CPF being designed to the 4-OTSG, the 8-OTSG standard or another standard.

Response

Volume 2 Appendix A Tables 2A2-2 and 2A2-4 provide details of flare sizing, while Table 2A2-1 provides emission parameters. For upset conditions – which form the flare design basis - flare sizes and parameters will not change whether building a 4 OTSG or 8 OTSG (in two trains) plant.

28	c) Provide emergency/upset modelling for the emission and flowrates for each CPF design.

Response

The flares are designed to the 4-OTSG standard, and as such, the upset modelling is based on 4-OTSGs, not 8-OTSGs. For the 8-OTSG facilities, there are two HP flares and two LP flares.

Modelling for two upset scenarios was reassessed to update flaring scenarios for the 4-OTSG design only, which is the standard configuration. For facilities with two 4-OTSG configurations, upset modelling was conducted only for one of the two being offline at a time. The first upset scenario reassessed was for produced gas directed to the HP flare during OTSG downtime. During this upset condition, the OTSGs are down but the remainder of the facility is operational. The second scenario is for a vapour gas stream directed to the LP flare during VRU shutdown. During the VRU shutdown, the rest of the facility is operational. Table 28-1 presents the gas composition of the flared gas for the HP and LP flares. For the HP and LP upset scenarios, the modeled maximum flow rates were 3,042.5 sm^3/h and 2,125.4 sm^3/h, respectively.

Table 28-1 Gas Compositions used in Modelling of Upset Scenarios (percent)

Species	HP Upset	LP Upset
H_2	0.000	0.017
He	0.000	0.017
H_2O	1.450	4.018
N_2	0.680	1.924
CO_2	18.190	5.327
H_2S	0.660	0.363
C_1	57.520	83.750
C_2	0.240	0.087
C_3	0.940	0.290
iC_4	1.060	0.248
nC_4	6.060	1.158
iC_5	6.070	1.094
nC_5	4.580	0.839
C_6	0.000	0.001
C_7+	0.000	0.001
NBP[2]60*	0.041	0.007
NBP[2]106*	0.006	0.004
NBP[2]154*	0.001	0.003
NBP[2]200*	0.000	0.001
NBP[2]235*	0.000	0.001
NBP[2]277*	0.000	0.000
NBP[2]319*	0.000	0.000
NBP[2]362*	0.000	0.000
NBP[2]404*	0.000	0.000
NBP[2]445*	0.000	0.000
NBP[4]61*	1.947	0.497
NBP[4]90*	0.417	0.212
NBP[4]116*	0.099	0.102
NBP[4]144*	0.018	0.030
NBP[4]172*	0.004	0.008
NBP[4]201*	0.001	0.002
NBP[4]230*	0.000	0.000
NBP[4]261*	0.000	0.000
NBP[4]288*	0.000	0.000
NBP[4]311*	0.000	0.000
Total	100.0	100.0

Modelling was conducted for the Leismer facility, as it will be the first facility to be built for the Project. The upset scenarios included the flares as well as all other StatoilHydro Kai Kos Dehseh sources that could be operational at the same time. Table 28-2 presents the 9^{th} highest 1-h model predictions for the upset scenarios for both the Project alone and also including baseline sources. For all scenarios, the 1-h AAAQO for SO_2 is not exceeded.

Table 28-2 Reassessed Model Predictions for 4-OTSG Upset Conditions (in µg/m^3)

	99.9th Percentile	
Scenario	**HP Upset**	**LP Upset**
Baseline	284	
Project Only Normal	108.36	
Project Only Upset	224.93	194.52
Baseline plus Upset	285.56	285.25

29	**Volume 2, Appendix 2A, Section 2A25, Page 2A-106** a) Provide a list of USEPA AP-42 emission factors used for the estimation of emissions from Gas Production Facilities.

Response

The methodology used for estimating emissions from gas production facilities (primarily compressor stations) is based on NO_x emissions from their respective approval documents plus AP-42 emission factors for natural gas-fired reciprocating engines (AP-42 Section 3.2). For some gas production facilities, boilers and generators were also present and were included in emission estimates. Table 29-1 below presents emission factors for CO, total VOCs and $PM_{2.5}$ used for estimating emissions from gas production facilities.

Table 29-1 Emission Factors used in Estimating Emissions from Gas Production Facilities

	Emission Factors (lb/10^6 scf)			
Species	**Heaters, Boilers and Steam Generators**	**Reference**	**Compressors**	**Reference**
$PM_{2.5}$	7.6	AP-42 (1)	39.2	AP-42 (2)
CO	84	AP-42 (1)	397.2	AP-42 (2)
Total VOCs	5.5	AP-42 (1)	122.4	AP-42 (2)

Notes: AP-42 (1) – U.S. EPA AP-42 Section 1.4 External Combustion Sources
AP-42 (2) – U.S. EPA AP-42 Section 3.2 Stationary Internal Combustion Sources
Emission Factors converted to lb/10^6 scf from lb/MMBtu by multiplying by a heating value of 1020 MMBtu/10^6 scf of natural gas.

30	
	Volume 2, Appendix 2A a) Provide a table listing the emissions basis (i.e., licensed rates or average rates) for each of the sources used in the Local Study Area (LSA) and Regional Study Area (RSA) (e.g., consider updating Table 2A27-1 and Table 2A27-3, Volume 2, Appendix 2A).

Response

Tables 30-1 and 30-2 are revised versions of Table 2A27-1 and Table 2A27-3 to include the basis of emissions (i.e. whether the emissions are maximums or average values). The Project was modelled at maximum (licensed) rates. The purpose of using maximum rates for the Project is to demonstrate the maximum potential air quality impacts associated with the Project. Existing background industrial sources were modelled at normal (average) rates. Approved background industrial sources were modelled at normal rates as provided in their corresponding regulatory application. Proposed background industrial sources were modelled at normal rates as provided by the operator.

Table 30-1 (Table 2A27-1 Revised) Summary of Baseline Air Emissions, LSA and RSA

Operator	SO_2 (t/d)	NO_X (t/d)	CO (t/d)	VOC (t/d)	$PM_{2.5}$ (t/d)	Emission Basis
Albian Sands Energy Inc.	0.61	31.68	27.05	26.83	1.63	Average
Birch Mountain Resources Ltd.	0.02	0.18	0.23	0.00	0.09	Average
Canadian Natural Resources Ltd.	19.11	58.62	40.40	157.36	2.93	Average
Connacher Oil and Gas Limited	0.08	0.45	0.27	0.02	0.04	Average
ConocoPhillips Canada Resources Corp.	3.01	4.07	2.04	0.08	0.27	Average
Deer Creek Energy Limited	0.74	0.51	0.48	0.03	0.05	Average
Devon ARL Corporation	2.00	2.00	1.39	0.09	0.13	Average
EnCana Corporation	8.64	8.16	12.08	0.31	0.57	Average
Husky Energy Inc.	2.15	7.95	20.98	0.56	0.49	Average
Imperial Oil Resources Ventures Limited	10.19	12.47	10.87	0.72	1.55	Average
Japan Canada Oil Sands Limited	0.80	0.60	0.53	0.04	0.04	Average
MEG Energy Corporation	2.00	1.62	1.33	0.11	0.16	Average
Nexen Inc./OPTI Canada Inc.	18.42	10.71	8.96	0.48	0.74	Average
Northlands Forest Products Ltd.	0.02	0.19	25.00	1.71	0.19	Average
Petro-Canada	4.69	36.66	15.31	15.76	1.40	Average
Shell Canada Limited	1.12	19.60	13.01	18.13	0.98	Average
Suncor Energy Inc.	79.00	106.85	67.33	216.26	8.48	Average
Syncrude Canada Ltd.	101.99	89.44	87.53	88.55	7.46	Average
Whitesands In-situ Ltd.	0.08	0.04	9.23	0.00	0.00	Average
Williams Energy (Canada), Inc.	0.00	0.02	0.02	0.24	0.00	Average
Gas Production Facilities	0.00	46.93	24.49	0.36	0.10	Average
Communities and Highways	2.04	8.64	25.75	2.03	3.34	Average
Baseline Totals [a]	**256.7**	**447.4**	**394.3**	**529.7**	**30.6**	

Table 30-2 (Table 2A27-3 Revised) Summary of CEA Air Emissions, LSA and RSA

Operator	SO_2 (t/d)	NO_X (t/d)	CO (t/d)	VOC (t/d)	$PM_{2.5}$ (t/d)	Emission Basis
Albian Sands Energy Inc.	0.61	31.68	27.05	26.83	1.63	Average
Birch Mountain Resources Ltd.	0.02	0.18	0.23	0.00	0.09	Average
Canadian Natural Resources Ltd.	21.75	71.33	42.55	157.48	4.23	Average
Connacher Oil and Gas Limited	0.08	0.45	0.27	0.02	0.04	Average
ConocoPhillips Canada Resources Corp.	6.63	3.26	5.11	0.13	0.45	Average
Deer Creek Energy Limited	1.80	13.45	11.04	46.91	0.56	Average
Devon ARL Corporation	4.00	3.99	2.78	0.18	0.25	Average
EnCana Corporation	8.64	8.16	12.08	0.31	0.57	Average
Husky Energy Inc.	2.15	7.95	20.98	0.56	0.49	Average
Imperial Oil Resources Ventures Limited	10.84	55.16	39.46	157.30	3.52	Average
Japan Canada Oil Sands Limited	3.93	4.49	4.75	1.00	0.30	Average
MEG Energy Corporation	2.00	1.62	1.33	0.11	0.16	Average
Nexen Inc./OPTI Canada Inc.	25.66	24.09	20.34	1.46	1.61	Average
StatoilHydro Oil Sands Corporation	**2.86**	**16.19**	**9.73**	**0.91**	**1.23**	**Maximum**
Northern Lights Partnership	0.39	15.72	11.40	64.93	0.76	Average
Northlands Forest Products Ltd.	0.02	0.19	25.00	1.71	0.19	Average
Petro-Canada	8.42	55.34	27.84	16.35	2.57	Average
Shell Canada Limited	1.23	28.83	19.32	27.14	1.43	Average
Suncor Energy Inc.	79.00	106.85	67.33	216.26	8.48	Average
Syncrude Canada Ltd.	101.99	89.44	87.53	88.55	7.46	Average
Whitesands In-situ Ltd.	0.08	0.04	9.23	0.00	0.00	Average
Williams Energy (Canada), Inc.	0.00	0.02	0.02	0.24	0.00	Average
Gas Production Facilities	0.00	46.93	24.49	0.36	0.10	Average
Communities and Highways	2.04	8.64	25.75	2.03	3.34	Average
CEA Totals [a]	**284.1**	**594.0**	**495.6**	**810.8**	**39.5**	

31	**Volume 2, Appendix 2B, Section 2B2, Page 2B-4** StatoilHydro states *there are few ambient monitoring stations located in the vicinity of the Project. The closest station was located in Conklin and was established for monitoring purposes for EnCana for 2001-2002. Most continuous monitoring occurs in the Athabasca oil sands region and the Cold Lake region.* a) Comment on the adequacy of the existing ambient air monitoring program, given the gaps in ambient monitoring in the vicinity of the Project.

Response

Currently, there are limited monitoring stations established in the region located between Fort McMurray and Cold Lake. There have been some monitoring efforts, such as those of Conklin, which have been operating on a short-term basis. In 2006, WBEA established monitoring efforts in Anzac to measure SO_2, TRS, NO, NO_2, NO_x, THC, O_3, and $PM_{2.5}$.

32	**Volume 2, Appendix 2D, Section 2D3.5, Page 2D-11** The Ozone Limiting Method (OLM) approach was used for chemistry conversion of NO_x to NO_2 using ozone data for Fort McMurray for 2002. Hourly ozone concentrations may lead to significant bias in the predicted NO_2 if the hourly values are nominally higher or lower than typical, especially when only a single year of meteorological data is used in the assessment of air quality. a) Provide a statistical and graphical summary of the 2002 ozone data used in the OLM chemistry.

Response

The OLM approach was used for chemical conversion of NO_x to NO_2 using 2002 ozone data from the Athabasca Valley – Fort McMurray monitoring station. Table 32-1 provides a statistical summary of this dataset.

Table 32-1 Statistical Summary of 2002 Ozone Data from the Athabasca Valley – Fort McMurray Monitoring Station

1-Hour Average Statistic	Ozone (ppb)
Maximum	71.0
99.9th Percentile	60.0
99th Percentile	51.0
95th Percentile	44.0
90th Percentile	38.8
Average	19.1

Figure 32-1 illustrates the 1-h average throughout the course of the year 2002. As evident from the graphic, measured ozone levels are highest during the spring and summer and lowest during autumn and winter.

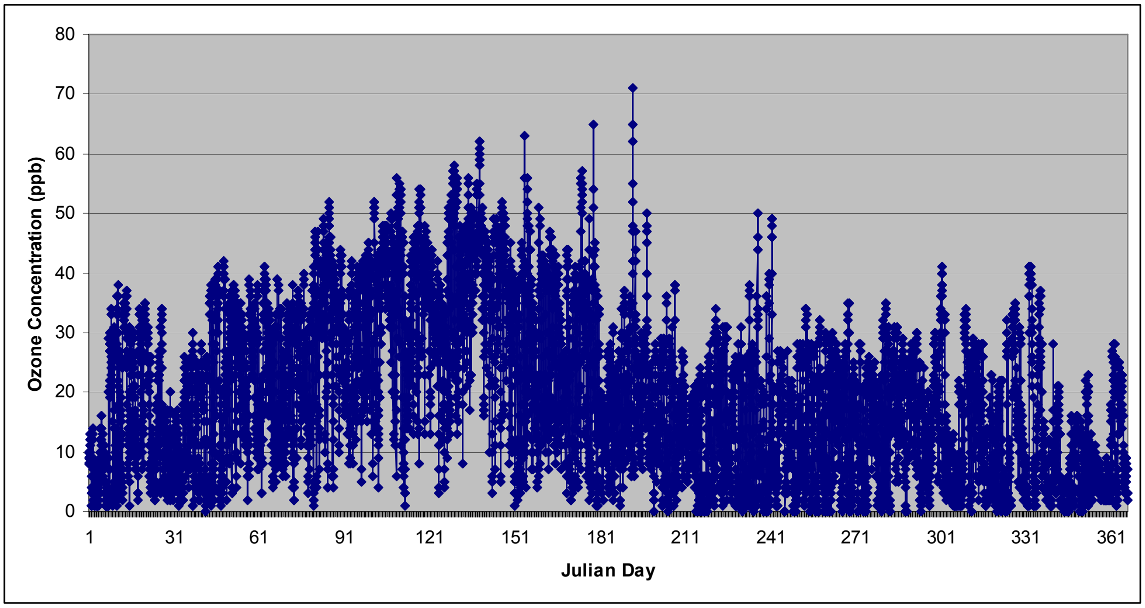


Figure 32-1 1-Hour Ozone Concentrations for the Year 2002 as Measured at the Athabasca Valley Monitoring Station

32	b) Compare the 2002 ozone data to ozone data for 2000-2005. Provide a discussion on the predicted NO_2 concentrations and assessment conclusions in regards to using the 2002 compared to a statistically larger sample of 2000-2005 ozone data.

Response

As 2002 meteorological data was used for air dispersion modelling, 2002 ozone data was needed to correlate to the meteorological data. As such, a comparison of 2002 ozone data measured at the Athabasca Valley monitoring station was compared to records from the years 2000 – 2005 to illustrate its representativeness.

Table 32-2 compares the 2002 and 2000 – 2005 data sets. As evident of the statistical data, the 2002 data is representative of the period as a whole. In fact, the 2002 ozone measurements are slightly higher than the average for the 2000 – 2005 period which makes the 2002 data set more conservative in terms of predicted NO_2 as ozone is less limiting.

Figure 32-2 illustrates the hourly ambient ozone measurements for 2002 as compared to the average hourly measurements for the period of 2000 – 2005. The 2002 data is representative of ozone trends throughout the year, with higher values in the spring and summer, and lower values in autumn and winter. As evident from the graph and noted earlier, measured ambient ozone levels in 2002 are generally higher than the average of the period from 2000 – 2005.

Table 32-2 Statistical Comparison of the Athabasca Valley 2002 and 2000 – 2005 Ozone Measurements.

1-Hour Average Statistic	2002 Ozone (ppb)	2000 – 2005 Ozone (ppb)
Maximum	71.0	71.0
99.9th Percentile	60.0	57.0
99th Percentile	51.0	49.0
95th Percentile	44.0	42.0
90th Percentile	38.8	37.0
Average	19.1	18.8

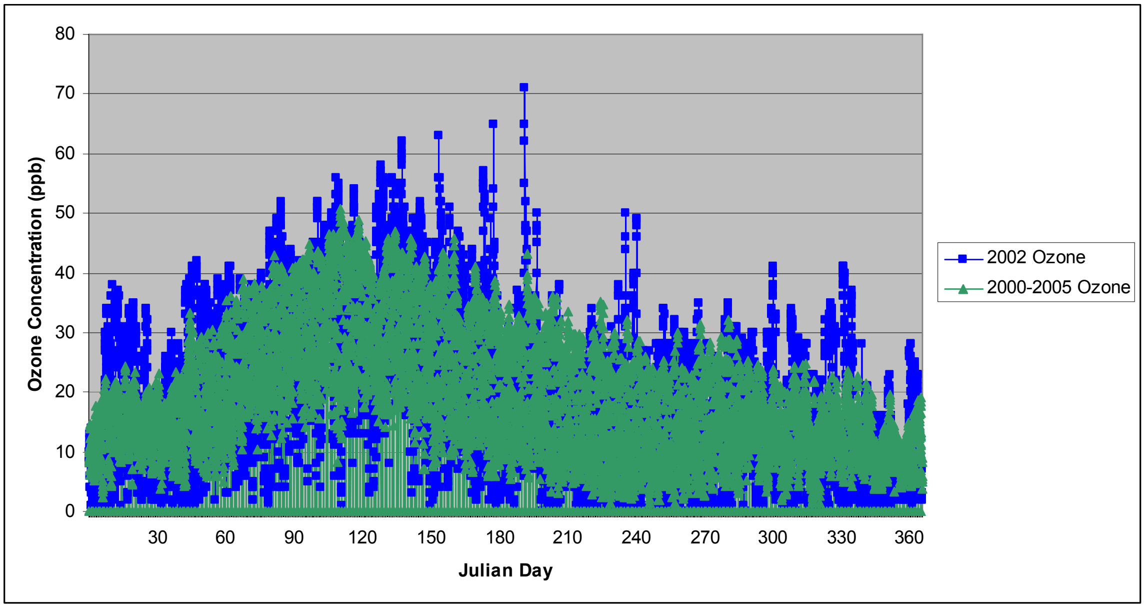


Figure 32-2 Graphical Comparison of 2002 and 2000 – 2005 Ozone Measurements from the Athabasca Valley Monitoring Site

32	c) Compare the statistical summary of the ozone data for Anzac and Foster Creek to the Fort McMurray data. Provide a discussion why the Fort McMurray data was used when other monitoring locations were closer to the LSA.

Response

The Fort McMurray (Athabasca Valley) station was selected for ozone measurements as the closer Anzac and Foster Creek stations did not have a complete year of ozone data for the year 2002, and as such, could not be used in the assessment.

33	**Volume 2, Appendix 2D, Section 2D4, Page 2D-16** StatoilHydro states that because *the upset scenarios are unlikely to occur at more than one facility at a time, the Leismer Expansion Facility was used as the representative facility*. Terrain heights can have a significant impact on the predicted air quality concentrations in the near-field modelling. a) Discuss terrain height influences in regards to selecting a single site to generalize upset SO_2 modelling.

Response

Terrain influences can have major impacts on the predicted concentrations in that large terrain features can produce high concentrations when the plume impacts directly on the terrain.

The Leismer Expansion Facility was used as a representative facility for upset modelling for two reasons:

(1) The Leismer Expansion Facility is the first facility scheduled to be built. The other StatoilHydro facilities will have upset scenarios modelled as individual assessments as conducted throughout the course of facility construction.

(2) The Leismer Expansion Facility has the lowest elevation of the proposed facilities. As such, it provides a conservative estimate of upset SO_2 concentrations as the plume is more likely to impact higher terrain due to the lower elevation of the emission sources.

C. WATER

General

34	**Volume 1, Section 2.1, Figure 2.1-3, Page 9** StatoilHydro Oil Sands Corporation states that *innovative monitoring approaches will be taken.* a) What “innovative monitoring approaches” will be taken?

Response

StatoilHydro has chosen a unique and less invasive way to study wolf, caribou and moose. Rather than utilizing common methods, such as collaring or aerial surveys, StatoilHydro uses specially trained dogs that can accurately detect scat from targeted species at distances over 500 m away. Dogs trained in the same way are used to detect drugs at international airports around the world. Scat is the most available animal product in the wilderness, and detection dogs provide a highly effective means of locating those samples. This scat collection approach has been used successfully around the world to show animal health and populations. For example, in Western Canada the program has been used to track black bears and brown bears. Scat detection avoids direct impacts upon the wildlife being studied whilst giving accurate information about the range of the species. Analysis of the scat provides information about the gender, diet, stress and health of individuals, and DNA analysis can identify individuals within a herd, if that level of detail is required.

35	**Volume 1, Section 2.4, Table 2.4-2, Page 21** a) Why is South Leismer Hub, which is planned for development in 2034, not included?

Response

The South Leismer Hub is not included in Volume 1, Table 2.4-2 because it is a replacement project for the Leismer Hub once its reserves are recovered. The start date for South Leismer production is estimated as 2034. The application process is estimated to start in 2031.

Hydrogeology

36	**Volume 1, Figure 4.3-9, Page 77** Figure 4.3-9 shows the Total Dissolved Solids (TDS) of the Clearwater B aquifer to range between 4,079-7,500 mg/L. a) Discuss the feasibility of StatoilHydro using only saline groundwater from the Clearwater B as a make up source for the Leismer Commercial and Expansion hubs.

Response

StatoilHydro has drilled and tested another Clearwater B Aquifer well in the winter of 2008 with marginal success. The drilling and test program was designed to minimize the impact of swelling clay in the Formation and gas saturation, however testing results were inconclusive and did not lead StatoilHydro to expect high deliverability from this Aquifer using conventional wells.

StatoilHydro is planning a horizontal well program for this Aquifer in the next drilling season. At this time, StatoilHydro does not consider it prudent or feasible to expect the Clearwater B Aquifer to deliver the total make-up for the Leismer Commercial Hub and Leismer Expansion Hub. If the horizontal test results support adequate deliverability and reliability, then the Aquifer will be considered as a more substantial complement of the Leismer complex water make-up

36	b) Explain if StatoilHydro is aware of the Clearwater B aquifer being in communication with any non-saline groundwater sources (less than 4,000 mg/L TDS) and if there is a potential for StatoilHydro to withdraw non-saline groundwater from the Clearwater B over the lifespan of the Project.

Response

As shown on Figure 5.5-28 Volume 3, Section 5, the TDS of the Clearwater B Aquifer in Twp 76, Rng 6 W4M is believed to be close to 4,000 mg/L TDS. This is an area where the Christina Channel erodes into the Lower Grand Rapids Aquifer. Given the locations of proposed source wells on Figure 5.6-3 Volume 3, Section 5 (~40 km from non-saline data), StatoilHydro does not anticipate withdrawing non-saline groundwater from the Clearwater B Aquifer over the life of the Project.

36	c) Discuss how StatoilHydro will monitor groundwater chemistry of sourced water from the Clearwater B over the life of the Project to verify that this source remains saline. What is StatoilHydro's mitigation plan should non-saline groundwater be produced from the Clearwater B?

Response

Water from the Clearwater B Aquifer will be monitored using an in-line conductivity meter calibrated to TDS as measured by a third-party laboratory. Based on water test quality from Clearwater B Aquifer, the TDS of the Aquifer in the area of interest is greater than 6,000 mg/L. In the unlikely event that non-saline groundwater be produced from the Clearwater B Aquifer, StatoilHydro would evaluate other saline options. If no other viable saline options are identified, StatoilHydro would submit a groundwater diversion application in accordance with the *Water Conservation and Allocation Guideline for Oilfield Injection* (AENV, 2006).

37	**Volume 1, Section 4.4.2, Table 4.4-1, Page 81** **Volume 3, Section 5.6.3.1, Table 5.6-4, Page 5-51** Until 2014, or possibly 2017, non-saline water (as defined by Alberta Environment) will be the major source of make-up water. Because the non-saline Clearwater A aquifer is combined with the saline Clearwater B aquifer, non-saline groundwater consumption is not clear. a) Update Tables 4.4-1 and Table 5.6-4 to show Clearwater A and Clearwater B groundwater volumes (m^3/d) separately for each of the development areas.

Response

Tables 37-1 and 37-2 are updated versions of Volume 1, Table 4.4-1 and Volume 3, Table 5.6-4, respectively.

Table 37-1 (Revised Table 4.4-1) Long-term Make-Up and Disposal Requirements - Balanced Push-Pull

			WLS + WAC Process					
			Source				Disposal	
	Size Kbpd	Start Date	Grand Rapids m^3/d	Clearwater A m^3/d	Clearwater B m^3/d	Basal McMurray m^3/d	Basal McMurray m^3/d	End Date
Leismer (Demonstration and Commercial)	20*	2009/2010	980			950	950	2029
Leismer Expansion	20	2011	980			950	950	2029
Corner	40	2012	1,960			1,900	1,900	2037
Thornbury	40	2013	1,960			1,900	1,900	2038
Corner Expansion	40	2014			1,960	1,900	1,900	2039
Hangingstone	20	2016		980		950	950	2041
Thornbury Expansion	20	2017	980			950	950	2042
Northwest Leismer	20	2018			980	950	950	2043
South Leismer	20	2029			980	950	950	2054
Total*	220**		6,860**	980	2,940**	10,450**	10,450**	

Notes:

* Includes 10,000 bpd Leismer Demonstration Hub requirements.

** Totals do not include the South Leismer Hub.

Table 37-2 (Table 5.6-4 Revised) Kai Kos Dehseh Project Water Demand

			WLS + WAC Process					
Based on 10% RR and 3.0 SOR			**Source**				**Disposal**	
	Size Kbpd	**Start Date**	**Grand Rapids m^3/d**	**Clearwater A m^3/d**	**Clearwater B m^3/d**	**McMurray m^3/d**	**McMurray m^3/d**	**End**
Leismer Commercial	20	2010	980			950	950	2029
Leismer Expansion	20	2011	980			950	950	2029
Corner	40	2012	1,960			1,900	1,900	2037
Thornbury	40	2013	1,960			1,900	1,900	2038
Corner Expansion	40	2014			1,960	1,900	1,900	2039
Hangingstone	20	2016		980		950	950	2041
Thornbury Expansion	20	2017	980			950	950	2042
Northwest Leismer	20	2018			980	950	950	2043
South Leismer	20	2029			980	950	950	2054
Totals	240		6,860	980	3,920	11,400	11,400	

38	**Volume 1, Appendix A, Section A4.3, Page A-61** **Volume 1, Appendix B, Section B4.3.4 and B4.3.5, Page B-86 & B86** **Volume 1, Appendix C, Section C4.3.4 and C4.3.5, Page C-83** a) For the Leismer Commercial, Leismer Expansion and Corner Hubs, provide additional testing and data obtained for these areas for all non-saline groundwater sources (i.e., hydraulic head values, hydraulic conductivity, coefficient of storativity, sustainable yield calculations as well as baseline chemical data). b) If additional testing has not been done, why are additional data not needed?

Response

StatoilHydro is conducting on-going groundwater exploration and testing at the Project. At the time of the EIA submission, three wells had been drilled and tested as discussed in Volume 3, Section 5.5.3 and in the *Application for Approval of the Leismer Demonstration Project* submitted by StatoilHydro, May 2006. Since the EIA submission, 8 water wells were drilled and tested in 2007 and 11 water wells were drilled and tested in 2008 (see Tables 38-1, 38-2, 38-3, 38-4, 38-5 and 38-6). Tables 38-1, 38-2 and 38-3 summarize hydraulic parameters based on well testing for the Lower Grand Rapids, Clearwater B and Basal McMurray aquifers, respectively. Tables 38-5, 38-6 and 38-7 summarize the groundwater chemistry for the Lower Grand Rapids, Clearwater B and Basal McMurray aquifers, respectively.

Collection of additional field data is on-going as StatoilHydro continues to assess groundwater resources and initiates groundwater monitoring. All data necessary to satisfy the *Groundwater Evaluation Guideline* and the *Water Conservation and Allocation Guideline for Oilfield Injection* will be obtained as part of future groundwater diversion license applications.

Table 38-1 Lower Grand Rapids Aquifer Testing

Pumped Well	Static Water Level (masl)	Available Drawdown to Top of Screen (m)	Aquifer Thickness (m)	Hydraulic Conductivity (m/s)
Grand Rapids Test Water Wells (TWW) - 2006 and 2007				
TWW 09-21-81-09 [1]	462.4	91.3	41	8.2×10^{-6}
TWW 03-02-79-10	468.9	105.3	28	1.7×10^{-5}
TWW 12-33-80-08	464.6	84.7	14	1.1×10^{-5}
TWW 13-22-78-10 [1,2]	469.1	108.0	24	1.1×10^{-5}
Grand Rapids Water Source Wells (WSW) - 2006 and 2008				
WSW 07-10-79-10	467.9	92.6	41	3.2×10^{-5}
WSW 03-04-79-10	468.1	89.4	43	2.3×10^{-5}
WSW 04-09-79-10	466.4	90.1	43	2.6×10^{-5}
WSW 14-32-80-08	464.6	76.7	27	4.4×10^{-5}
WSW 11-31-80-08	463.2	73.4	35	3.3×10^{-5}
WSW 16-09-79-10	466.5	91.7	39	3.0×10^{-5}
WSW 16-04-79-10	465.6	91.3	40	3.4×10^{-5}

Notes:
1 - Available drawdown measured to top of perforated casing interval
2 - Tested in 2006

Table 38-2 Clearwater B Aquifer Testing
Clearwater Wells - 2008 and Historical Program

Pumped Well	Static Water Level (masl)	Available Drawdown to Top of Perforations (m)	Aquifer Thickness (m)	Hydraulic Conductivity (m/s)
Clearwater Test Water Wells (TWW) - 2006 and 2007				
TWW 12-02-78-10	436.9	124.4	32	1.7×10^{-6}
TWW 10-35-77-10 [2]	411.3	115.4	15	NA
Clearwater Water Source Wells (WSW) - 2008				
WSW 11-19-77-10	468.2	171.9	30	1.7×10^{-6}

Notes:
2 - Tested in 2006

Table 38-3 Basal McMurray Aquifer Testing
McMurray Formation Wells - 2008 and Historical Program

Pumped Well	Static Water Level (masl)	Available Drawdown to Top of Perforations (m)	Aquifer Thickness (m)	Hydraulic Conductivity (m/s)
McMurray Test Disposal Wells (TDW) - 2006 and 2007				
TDW 09-02-78-10	443.4	233.7	11	2.1×10^{-5}
TDW 07-03-81-09	445.5	216.4	11	5.5×10^{-5}
TDW 13-33-78-10	425.5	220.0	16	2.0×10^{-5}
TDW 01-28-78-10 [2]	434.3	230.4	10	5.2×10^{-5}
McMurray Water Disposal Wells (WDW) - 2008				
WDW 14-28-78-10	435.8	230.5	18	4.7×10^{-5}
WDW 13-21-78-10	435.5	235.3	12	3.4×10^{-5}
WDW 06-09-78-10	433.5	225.3	5	2.2×10^{-5}

Notes:
2 - Tested in 2006

Table 38-4 Lower Grand Rapids Aquifer Chemistry

Parameter	Units	GCDWQ	09-21-81-08W4M 13-Jan-07 15:00	12-33-80-08W4M 28-Jan-07 17:10	03-02-79-10W4M 21-Mar-07 16:40	16-04-79-10W4M 15-Mar-08 11:00	16-09-79-10W4M 09-Mar-08 4:20	11-31-80-08W4M 03-Mar-08 19:00	04-09-79-10W4M 23-Feb-08 14:20	14-32-80-08W4M 26-Feb-08 3:00	03-04-79-10W4M 17-Feb-08 13:20	07-10-79-10W4 06-Feb-08 3:30
Ion Balance	%		102	107	112	85.4	106	107	99.0	110	103	95
pH	-	6.5-8.5 [2]	**8.8**	**8.7**	**9**	**8.91**	**8.8**	**8.8**	**8.9**	**8.8**	8.9	**8.8**
Conductivity	µS/cm		2,520	2,320	2,220	2,440	2,440	2,510	2,370	2,380	2,390	2,300
TDS (Calculated)	mg/L	500 [2]	**1,470**	**1,460**	**1,390**	**1,360**	**1,370**	**1,410**	**1,370**	**1,360**	**1,380**	**1,300**
Alkalinity (PP as $CaCO_3$)	mg/L		49	37	76	62	62	58	79	58	69	62
Alkalinity (Total as $CaCO_3$)	mg/L		844	940	850	933	871	856	876	864	859	804
Hardness ($CaCO_3$)	mg/L		10	34	9	7	3	4	<1	3	10	5
Turbidity	NTU	1 [1]	5.9	4,040	23.9	**2.3**	**4.9**	**3.8**	**1.8**	**2.1**	**1.1**	**1**
Silica (as SiO_2)	mg/L		4.2	10.8	6.5	7.5	7.1	7.8	7.3	7.6	10.3	4.1
Total Suspended Solids	mg/L		61	11,200	39	3	6	<3	<3	3	<3	<3
True Color	mg/L		319	171	1600	242	460	220	480	260	490	390
Major Cations												
Dissolved Calcium (Ca)	mg/L		2.1	2.3	2.3	1.69	0.9	1.0	<0.5	1.2	1.9	1.8
Dissolved Magnesium (Mg)	mg/L		1.2	6.9	0.9	0.69	0.3	0.3	<0.1	<0.1	1.2	0.1
Dissolved Potassium (K)	mg/L		3.7	13.6	2.9	2.26	1.7	1.6	1.6	3.0	2.1	1.7
Dissolved Sodium (Na)	mg/L	200 [2]	**611**	**617**	**614**	**517**	**561**	**583**	**573**	**566**	**585**	**525**
Major Anions												
Carbonate (CO_3^{2-})	mg/L		58	44	91	74	<5	<5	95	<5	85	92
Bicarbonate (HCO_3^-)	mg/L		910	1,060	852	987	911	902	876	913	875	792
Dissoved Sulphate (SO_4^{2-})	mg/L	500 [2]	2.2	0.7	<0.5	<1	0.6	1.1	2.9	5.2	0.6	2.7
Dissolved Chloride (Cl^-)	mg/L	250 [2]	**338**	**255**	**253**	**279**	**284**	**310**	**263**	**263**	**273**	**282**
Hydroxide (OH^-)	mg/L		<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Fluoride (F^-)	mg/L	1.5 [1]	**3.09**	**3.4**	**2.8**	**3.0**	**3.49**	**3.89**	**3.88**	**3.79**	**3.75**	**3.36**
Sulphide (S)	mg/L		<0.003	0.008	0.005							
Nutrients												
Dissolved Nitrate (N)	mg/L	10 [1]	0.1	0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dissolved Nitrite (N)	mg/L	3.2 [1]	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrite plus Nitrate (N)	mg/L		0.1	<0.07	<0.07	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ammonia (N)	mg/L		2.09	1.37	1.93	1.31	1.31	1.29	1.42	1.35	1.35	0.67
Orthophosphate (P)	mg/L		0.34	0.55	0.62	0.58	14:24	0.84	0.53	0.82	0.99	0.64
Total Phosphate (P)	mg/L		0.41		0.61	0.615	0.622	0.930	0.597	0.906	1.10	0.643
Organics												
Total Organic Carbon	mg/L		21	9	14	5	21	16	22	17	23	19
Dissolved Organic Carbon	mg/L		17	7	14	5	9	11	8	16	11	8
Phenols (4AAP)	mg/L	0.004 [3]	---	---	---	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.001
Naphthenic Acids	mg/L		<1	1	<1	<1	1	<1	<1	<1	<1	<1
Oil and Grease			<1	-	---	---	---	---	---	---	---	---
F1 (C_6-C_{10})	mg/L	4.6 [4]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
F2 (C_{10}-C_{16})	mg/L	2.1 [4]	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05
Benzene Purgeable	mg/L	0.005 [1]	0.0013	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Toluene Purgeable	mg/L	0.024 [2]	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Ethylbenzene Purgeable	mg/L	0.0024 [2]	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Xylenes (Total) Purgeable	mg/L	0.3 [2]	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
F1-BTEX			<0.1	<0.1	<0.1	---	---	---	---	---	---	---

Notes:

Bold - concentration equals or exceeds selected water quality guidelines.
1 - Maximum Allowable Concentration (Health Canada, 2007)
2 - Aesthetic Objective (Health Canada, 2007)
3 - Surface Water Quality Guidelines for Use in Alberta (AENV, 1999)
4 - Alberta Tier 1 Soil and Groundwater Remediation Guidelines (AENV, 2007)

Table 38-4 (Continued) Lower Grand Rapids Aquifer Chemistry

			09-21-81-08W4M		12-33-80-08W4M		03-02-79-10W4M		16-04-79-10W4M		16-09-79-10W4M		11-31-80-08W4M		04-09-79-10W4M		14-32-80-08W4M		03-04-79-10W4M		07-10-79-10W4M	
			13-Jan-07		28-Jan-07		21-Mar-07		15-Mar-08		09-Mar-08		03-Mar-08		23-Feb-08		26-Feb-08		17-Feb-08		06-Feb-08	
			15:00		17:10		16:40		11:00		4:20		19:00		14:20		03:00		13:20		3:30	
Parameter	Units	GCDWQ	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
Aluminum (Al)	mg/L	0.1 [3]	0.02	0.67	0.01	96.6	0.02	0.81	<0.025	0.029	<0.01	0.03	<0.01	0.05	0.02	0.08	0.02	0.05	0.05	0.07	0.02	0.07
Antimony (Sb)	mg/L	0.006 [1]	0.0011	0.0011	0.0006	0.0009	0.0005	0.0005	<0.00050	<0.00050	<0.0004	0.0006	<0.0004	<0.0004	0.0008	0.0008	0.0009	0.0008	<0.0004	<0.0004	0.0004	0.0005
Arsenic (As)	mg/L	0.010 [1]	0.0044	0.004	0.0038	**0.0159**	0.0022	0.0014	<0.00050	<0.00050	0.0028	0.0021	0.0021	0.0027	0.0028	0.0033	0.0069	0.0068	0.0022	0.0015	0.0023	0.0025
Barium (Ba)	mg/L	1 [1]	0.0511	0.0611	0.065	0.705	0.0117	0.0792	0.0428	0.0703	0.067	0.085	0.068	0.077	0.068	0.080	0.071	0.073	0.033	0.042	0.070	0.091
Beryllium (Be)	mg/L		<0.0005	<0.001	<0.0005	0.005	<0.0005	<0.001	<0.0025	<0.0025	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bismuth (Bi)	mg/L		<0.00005	<0.0001	<0.00005	0.0011	<0.00005	<0.0001	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Boron (B)	mg/L	5 [1]	**5.52**	**5.19**	**5.76**	**5.61**	**5.72**	**6.73**	4.11	4.34	3.93	**5.67**	**6.92**	**5.81**	**5.45**	**6.46**	**6.00**	**5.68**	**6.81**	**6.18**	**5.69**	**5.38**
Cadmium (Cd)	mg/L	0.005 [1]	<0.0001	<0.0002	<0.0001	0.0014	<0.0001	<0.0002	<0.00025	<0.00025	<0.0001	<0.0002	<0.0001	<0.0002	<0.0001	<0.0002	<0.0001	<0.0002	<0.0001	<0.0002	<0.0001	<0.0002
Calcium (Ca)	mg/L		---	2.6	---	12.5	---	1.7	1.69	1.59	0.9	1.8	1.0	1.7	<0.5	1.4	1.2	1.5	1.9	1.8	1.8	2.8
Chromium (Cr)	mg/L	0.05 [1]	0.0005	<0.005	0.014	0.124	<0.005	0.0073	<0.0025	<0.0025	<0.005	<0.005	0.008	0.012	<0.005	0.006	<0.005	<0.005	0.017	<0.005	0.011	0.011
Cobalt (Co)	mg/L		0.0005	0.0009	0.0002	0.0816	0.0004	0.0009	<0.00050	<0.00050	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Copper (Cu)	mg/L	1 [2]	0.0048	0.04	0.0014	0.138	0.0088	0.033	0.00195	0.00055	<0.001	0.002	0.004	0.004	0.003	0.003	0.001	0.006	0.002	0.002	<0.001	0.007
Iron (Fe)	mg/L	0.3 [2]	**0.319**	**1.59**	0.08	**110**	0.03	**1.84**	0.065	0.289	0.030	0.281	0.126	**0.525**	0.108	0.149	**0.389**	**0.501**	0.122	**0.343**	0.035	**1.79**
Lead (Pb)	mg/L	0.01 [1]	0.0019	0.0034	<0.0001	**0.0805**	<0.0001	**0.0166**	<0.00050	0.00087	<0.0001	0.0005	0.0002	**0.0032**	**0.0023**	**0.0030**	**0.0018**	**0.0088**	0.0010	0.0020	0.0002	**1.74**
Lithium (Li)	mg/L		0.112	0.108	0.14	0.289	0.0999	0.103	0.087	0.089	0.115	0.11	0.121	0.11	0.101	0.11	0.105	0.10	0.114	0.1	0.104	0.1
Magnesium (Mg)	mg/L		---	1.7	---	21.4	---	1	0.69	0.68	0.3	0.9	0.3	0.9	<0.1	1.0	<0.1	0.8	1.2	0.8	0.1	1.1
Manganese (Mn)	mg/L	0.05 [2]	0.007	0.014	0.016	3.26	0.03	0.044	0.00237	0.00482	0.002	0.004	0.006	0.010	0.006	0.006	0.008	0.008	0.006	0.009	0.004	0.015
Mercury (Hg)	mg/L	0.001 [1]	---	---	---	---	---	---	<0.000050	<0.000050	<0.0001	<0.0002	<0.0001	<0.0002	<0.0001	<0.0002	<0.0001	<0.0002	<0.0001	<0.0002	<0.0001	<0.0002
Molybdenum (Mo)	mg/L		0.0127	0.0135	0.0076	0.0085	0.0035	0.0039	0.00107	0.00201	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel (Ni)	mg/L		0.0049	0.0237	0.0007	0.148	0.0019	0.0601	<0.0025	<0.0025	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.007
Potassium (K)	mg/L		---	3.9	---	16	---	1.9	2.26	2.12	1.7	2.3	1.6	2.0	1.6	2.3	3.0	2.0	2.1	1.8	1.7	2.0
Selenium (Se)	mg/L	0.01 [1]	<0.0004	0.0039	0.0024	0.0051	0.0005	0.0005	<0.0050	<0.0050	0.0017	0.0056	0.0015	0.003	0.0007	0.0012	0.0012	0.0041	0.0012	0.0019	0.0010	0.0019
Silicon (Si)	mg/L		1.8	3.2	3.3	64.6	2.9	5	3.11	3.44	2.8	3.1	3.5	3.4	3.2	3.4	3.2	3.1	4.7	4.4	3.4	3.3
Silver (Ag)	mg/L		---	<0.0004	---	<0.0004	---	<0.0004	<0.000050	<0.000050	<0.0001	<0.0004	<0.0001	<0.0004	<0.0001	<0.0004	<0.0001	<0.0004	<0.0001	<0.0004	<0.0001	<0.0004
Sodium (Na)	mg/L	200 [2]	---	**590**	---	**490**	---	**499**	**517**	**584**	**561**	**536**	**583**	**523**	**573**	**565**	**566**	**512**	**585**	**508**	**525**	**489**
Strontium (Sr)	mg/L		0.165	0.174	0.145	0.777	0.0861	0.163	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sulphide	mg/L	0.05 [2]	---						-	0.015	-	0.015	-	0.010	-	0.012	-	0.005	-	0.003	-	0.012
Sulphur (S)	mg/L		0.6	1.3	<0.5	2.1	0.5	<0.5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	4.3	0.6	0.6	0.5	1.6	0.6	1.5	1.4
Thallium (Tl)	mg/L		<0.00005	0.0002	<0.00005	0.0008	<0.00005	0.0001	<0.00050	<0.00050	0.0002	<0.0001	0.0002	0.0003	0.0002	0.0003	<0.0001	0.0005	<0.0001	0.0007	<0.0001	0.0004
Tin (Sn)	mg/L		<0.0002	<0.0004	<0.0002	<0.0004	<0.0002	<0.0004	<0.00050	<0.00050	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Titanium (Ti)	mg/L		0.051	0.062	0.0014	0.323	0.0021	0.123	<0.0050	0.0503	0.002	0.078	0.002	0.051	0.003	0.084	0.005	0.054	0.004	0.076	0.002	0.067
Uranium (U)	mg/L	0.02 [1]	0.0041	0.0037	0.0002	0.0128	0.0001	0.0002	<0.000050	0.000108	<0.0001	0.0001	<0.0001	0.0001	0.0007	0.0008	0.0006	0.0008	0.0001	0.0002	<0.0001	0.0001
Vanadium (V)	mg/L		0.0162	0.0186	0.0049	0.137	0.006	0.0248	<0.0050	0.0103	0.007	0.014	0.002	0.01	0.008	0.016	0.006	0.007	0.005	0.017	0.004	0.016
Zinc (Zn)	mg/L	5 [2]	0.041	0.063	0.008	0.366	0.007	0.042	<0.025	<0.025	0.003	0.023	0.005	0.017	0.137	0.108	0.101	0.102	0.061	0.129	0.015	0.164

Notes:

Bold - concentration equals or exceeds selected water quality guidelines.
1 - Maximum Allowable Concentration (Health Canada, 2007)
2 - Aesthetic Objective (Health Canada, 2007)
3 - guideline applies only to drinking water treatment plants

Table 38-5 Clearwater B Aquifer Chemistry

Parameter	Units	GCDWQ	10-35-77-10W4M 16-Jan-07 14:15	12-02-78-10W4M 26-Feb-07 09:58	11-19-77-10W4M 06-Feb-08 0:00
Ion Balance	%		91.5	108	96.0
pH	-	6.5-8.5 [2]	6.7	8.1	8.5
Conductivity	µS/cm		13,000	11,300	9,720
TDS (Calculated)	mg/L	500 [2]	**7,290**	**6,600**	**5,790**
Alkalinity (PP as $CaCO_3$)	mg/L		<5	<5	27
Alkalinity (Total as $CaCO_3$)	mg/L		66	792	691
Hardness ($CaCO_3$)	mg/L		201	70	88
Turbidity	NTU	1 [1]	2,600	50.9	**900**
Silica (as SiO_2)	mg/L		64.5	8.3	7.3
Total Suspended Solids	mg/L		1630	79	1670
True Color	mg/L		105	8	14
Major Cations					
Dissolved Calcium (Ca)	mg/L		47.7	11.4	15.4
Dissolved Magnesium (Mg)	mg/L		20	176	12.0
Dissolved Potassium (K)	mg/L		22.3	10	9.5
Dissolved Sodium (Na)	mg/L	200 [2]	**2,560**	**2,580**	**2,200**
Major Anions					
Carbonate (CO_3^{2-})	mg/L		<5	<5	33
Bicarbonate (HCO_3^-)	mg/L		80	967	775
Dissoved Sulphate (SO_4^{2-})	mg/L	500 [2]	24.9	2	10.1
Dissolved Chloride (Cl^-)	mg/L	250 [2]	**4,540**	**3,340**	**3,130**
Hydroxide (OH^-)	mg/L		<5	<5	<5
Fluoride (F^-)	mg/L	1.5 [1]	**37.2**	**0.7**	1.24
Sulphide (S)	mg/L		<0.02	0.012	
Nutrients					
Dissolved Nitrate (N)	mg/L	10 [1]	<0.1	<0.1	<0.1
Dissolved Nitrite (N)	mg/L	3.2 [1]	<0.05	<0.1	<0.05
Nitrite plus Nitrate (N)	mg/L		<0.1	<0.1	<0.1
Ammonia (N)	mg/L		65.1	4.82	8.53
Orthophosphate (P)	mg/L		3.83	<0.01	<0.01
Total Phosphate (P)	mg/L		165	0.08	1.15
Organics					
Total Organic Carbon	mg/L		675	<1	29
Dissolved Organic Carbon	mg/L		713	<1	29
Phenols (4AAP)	mg/L	0.004 [3]	---	---	**0.026**
Naphthenic Acids	mg/L		3	<1	<1
Oil and Grease			-	---	---
F1 (C_6-C_{10})	mg/L	4.6 [4]	0.1	<0.1	0.2
F2 (C_{10}-C_{16})	mg/L	2.1 [4]	1.4	<0.05	0.62
Benzene Purgeable	mg/L	0.005 [1]	<0.005	<0.0005	**0.118**
Toluene Purgeable	mg/L	0.024 [2]	<0.005	<0.0005	**0.0250**
Ethylbenzene Purgeable	mg/L	0.0024 [2]	**0.015**	<0.0005	0.00149
Xylenes (Total) Purgeable	mg/L	0.3 [2]	0.085	<0.0005	0.00265
F1-BTEX			<0.1	<0.1	---

Notes:

Bold - concentration equals or exceeds selected water quality guidelines.
1 - Maximum Allowable Concentration (Health Canada, 2007)
2 - Aesthetic Objective (Health Canada, 2007)
3 - Surface Water Quality Guidelines for Use in Alberta (AENV, 1999)
4 - Alberta Tier 1 Soil and Groundwater Remediation Guidelines (AENV, 2007)

Table 38-5 (continued). Clearwater B Aquifer Chemistry

Parameter	Units	GCDWQ	10-35-77-10W4M 16-Jan-07 14:15		12-02-78-10W4M 26-Feb-07 09:58		11-19-77-10W4M 06-Feb-08 00:00:00	
			Dissolved	Total	Dissolved	Total	Dissolved	Total
Aluminum (Al)	mg/L	0.1[3]	2.07	19.4	0.02	1.09	**0.17**	**63.2**
Antimony (Sb)	mg/L	0.006[1]	**0.01**	**0.0135**	0.001	0.0004	0.0065	0.0166
Arsenic (As)	mg/L	0.010[1]	**0.0635**	**0.0779**	0.0154	**0.014**	0.0081	**0.0258**
Barium (Ba)	mg/L	1[1]	0.102	**1.65**	**1.31**	**1.33**	0.740	**1.68**
Beryllium (Be)	mg/L		0.0012	0.001	<0.0005	<0.001	<0.001	<0.001
Bismuth (Bi)	mg/L		0.00022	0.0004	0.0001	0.0005	---	---
Boron (B)	mg/L	5[1]	**5.38**	4.63	**5.69**	**5.51**	4.98	**5.47**
Cadmium (Cd)	mg/L	0.005[1]	0.0003	0.001	0.0001	**<0.0002**	0.0003	**0.0090**
Calcium (Ca)	mg/L		---	69.9	---	19.7	15.4	28.6
Chromium (Cr)	mg/L	0.05[1]	0.181	0.181	<0.005	0.009	0.043	0.307
Cobalt (Co)	mg/L		0.004	0.0332	0.0004	0.0014	<0.002	0.026
Copper (Cu)	mg/L	1[2]	0.0454	0.617	0.0155	0.22	1.55	14.8
Iron (Fe)	mg/L	0.3[2]	**7.73**	**133**	**3.85**	**7.87**	**2.53**	**125**
Lead (Pb)	mg/L	0.01[1]	0.0039	**0.45**	**0.014**	**1.87**	**0.103**	**5.9**
Lithium (Li)	mg/L		0.735	0.683	0.582	0.624	0.465	0.55
Magnesium (Mg)	mg/L		---	52.4	---	14.3	12.0	32.6
Manganese (Mn)	mg/L	0.05[2]	**0.247**	**1.4**	**0.129**	**0.176**	0.167	1.13
Mercury (Hg)	mg/L	0.001[1]	**---**	**---**	**---**	**---**	0.0002	**0.0022**
Molybdenum (Mo)	mg/L		0.142	0.194	0.0091	0.0078	0.148	6.16
Nickel (Ni)	mg/L		0.0524	0.18	0.0052	0.0786	0.009	0.108
Potassium (K)	mg/L		---	**31.4**	**---**	**177**	9.5	18.3
Selenium (Se)	mg/L	0.01[1]	<0.0004	0.001	0.0029	<0.0004	0.0081	**0.0192**
Silicon (Si)	mg/L		18.8	47.3	4	7	3.7	135
Silver (Ag)	mg/L		---	<0.0004	---	<0.0004	<0.0001	<0.0004
Sodium (Na)	mg/L	200[2]	---	**2,660**	---	**2,350**	**2,200**	**1,870**
Strontium (Sr)	mg/L		1.27	2.6	2.67	2.64	---	---
Sulphide	mg/L	0.05[2]					-	<0.002
Sulphur (S)	mg/L		6.6	12.4	1	0.8	4.1	6.5
Thallium (Tl)	mg/L		0.00136	0.0023	0.0006	0.0002	<0.0001	0.0071
Tin (Sn)	mg/L		0.0008	0.0043	0.0002	0.0068	<0.05	<0.05
Titanium (Ti)	mg/L		0.594	0.946	<0.0003	0.041	0.002	0.939
Uranium (U)	mg/L	0.02[1]	0.0019	0.0024	0.0002	0.0002	0.0028	0.0049
Vanadium (V)	mg/L		0.0867	0.131	<0.001	---	0.014	0.293
Zinc (Zn)	mg/L	5[2]	0.124	0.567	0.89	1.61	0.115	2.21

Notes:

Bold - concentration equals or exceeds selected water quality guidelines.
1 - Maximum Allowable Concentration (Health Canada, 2007)
2 - Aesthetic Objective (Health Canada, 2007)
3 - guideline applies only to drinking water treatment plants

Table 38-6. Basal McMurray Aquifer Chemistry

Parameter	Units	GCDWQ	07-03-81-09W4M 13-Feb-07 14:45	09-02-78-10W4M 07-Feb-07 13:45	13-33-78-10W4M 04-Mar-07	14-28-78-10W4M 18-Jan-08 14:00	13-21-78-10W4M 29-Jan-08 12:00	06-09-78-10W4M 13-Mar-08 3:10
Ion Balance	%		97.2	95.6	92.5	92.2	92.5	81.4
pH	-	6.5-8.5 [2]	7.8	7.5	7.9	8.3	8.1	8.0
Conductivity	µS/cm		17,800	22,500	20,400	21,700	21,900	20,800
TDS (Calculated)	mg/L	500 [2]	**10,800**	**13,200**	**13,100**	**13,300**	**12,800**	**13,400**
Alkalinity (PP as $CaCO_3$)	mg/L		0		<5	12	<5	<5
Alkalinity (Total as $CaCO_3$)	mg/L		1400	1050	1270	1250	1990	1050
Hardness ($CaCO_3$)	mg/L		304	441	395	522	418	403
Turbidity	NTU	1 [1]	730		50	**45**	**37**	**120**
Silica (as SiO_2)	mg/L		5.4	7.2	7.1	7.0	7.5	7.2
Total Suspended Solids	mg/L		1790	17	102	459	711	552
True Color	mg/L		3		<2	<2	<2	<2
Major Cations								
Dissolved Calcium (Ca)	mg/L		41.2	68.2	52.1	77.6	62.9	57.9
Dissolved Magnesium (Mg)	mg/L		48.8	65.8	64.3	79.6	63.3	62.7
Dissolved Potassium (K)	mg/L		30	33.7	40	25.5	44.6	39.9
Dissolved Sodium (Na)	mg/L	200 [2]	**4,070**	**4,870**	**4,780**	**4,790**	**4,690**	**4,480**
Major Anions								
Carbonate (CO_3^{2-})	mg/L		<5	<5	<5	15	<5	<5
Bicarbonate (HCO_3^-)	mg/L		1710	1280	1540	1490	2430	1290
Dissoved Sulphate (SO_4^{2-})	mg/L	500 [2]	1	8.1	<0.5	<0.5	1.6	2.1
Dissolved Chloride (Cl^-)	mg/L	250 [2]	**5,720**	**7,490**	**7,440**	**7,570**	**6,770**	**8,130**
Hydroxide (OH^-)	mg/L		<5	<5	<5	<5	<5	<5
Fluoride (F^-)	mg/L	1.5 [1]	1.4		**1.5**	1.46	**1.81**	**2.03**
Sulphide (S)	mg/L		<0.003	<0.003	<0.003			
Nutrients								
Dissolved Nitrate (N)	mg/L	10 [1]	1.11	<0.3	<0.1	<0.1	<0.1	<0.1
Dissolved Nitrite (N)	mg/L	3.2 [1]	<0.1	<0.3	<0.05	<0.05	<0.05	<0.05
Nitrite plus Nitrate (N)	mg/L		1.1	<0.4	<0.1	<0.1	<0.1	<0.1
Ammonia (N)	mg/L		5.73	10.2	8.81	7.95	11.0	7.72
Orthophosphate (P)	mg/L		<0.01		0.01	<0.01	<0.01	<0.01
Total Phosphate (P)	mg/L		0.25		0.03	0.02	0.0224	0.0491
Organics								
Total Organic Carbon	mg/L		<1	<1	14	11	10	11
Dissolved Organic Carbon	mg/L		<1	<1	12	13	11	10
Phenols (4AAP)	mg/L	0.004 [3]	---	---	---	**0.011**	**0.009**	**0.009**
Naphthenic Acids	mg/L		10	5	8	11	10	9
Oil and Grease			---	---	---	---	---	---
F1 (C_6-C_{10})	mg/L	4.6 [4]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
F2 (C_{10}-C_{16})	mg/L	2.1 [4]	1.9	<0.05	0.09	<0.05	0.07	0.18
Benzene Purgeable	mg/L	0.005 [1]	<0.0005	0.0009	<0.0005	<0.00050	<0.00050	<0.00050
Toluene Purgeable	mg/L	0.024 [2]	<0.0005	<0.0005	0.0006	<0.00050	<0.00050	<0.00050
Ethylbenzene Purgeable	mg/L	0.0024 [2]	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050
Xylenes (Total) Purgeable	mg/L	0.3 [2]	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050
F1-BTEX			<0.1	<0.1	<0.1	---	---	---

Notes:

Bold - concentration equals or exceeds selected water quality guidelines.
1 - Maximum Allowable Concentration (Health Canada, 2007)
2 - Aesthetic Objective (Health Canada, 2007)
3 - Surface Water Quality Guidelines for Use in Alberta (AENV, 1999)
4 - Alberta Tier 1 Soil and Groundwater Remediation Guidelines (AENV, 2007)

Table 38-6 (continued). Basal McMurray Aquifer Chemistry

Parameter	Units	GCDWQ	07-03-81-09W4M		09-02-78-10W4M		13-33-78-10W4M		14-28-78-10W4M		13-21-78-10W4M		06-09-78-10W4M	
			13-Feb-07		07-Feb-07		04-Mar-07		18-Jan-08		28-Jan-08		13-Mar-08	
			14:45		13:45				14:00		12:00		3:10	
			Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
Aluminum (Al)	mg/L	0.1 [3]	<0.1	11.2	<0.1	<0.2	<0.01	0.5	<0.01	**0.77**	<0.01	**0.66**	<0.01	**5.41**
Antimony (Sb)	mg/L	0.006 [1]	**0.0070**	**0.007**	<0.004	<0.004	0.0005	<0.008	<0.0004	0.0007	<0.0004	0.0004	0.0062	0.0064
Arsenic (As)	mg/L	0.010 [1]	**0.026**	**0.041**	<0.0004	<0.004	<0.0004	**0.048**	0.0062	<0.0004	<0.0004	<0.0004	0.0080	0.0100
Barium (Ba)	mg/L	1 [1]	**9.14**	**13.7**	**1.82**	**1.89**	**3.5**	**4.1**	0.895	**3.57**	**2.85**	**2.83**	**1.78**	**1.77**
Beryllium (Be)	mg/L		<0.005	<0.01	0.002	<0.01	<0.0005	<0.02	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bismuth (Bi)	mg/L		0.0010	<0.001	0.0001	<0.001	0.00096	<0.002	---	---	---	---	---	---
Boron (B)	mg/L	5 [1]	**6.96**	**7.4**	**7.59**	**7.3**	**7.17**	**8.6**	**7.81**	**9.84**	**8.28**	**8.70**	**5.79**	**7.71**
Cadmium (Cd)	mg/L	0.005 [1]	<0.001	<0.002	<0.001	<0.002	0.0005	<0.004	<0.0001	<0.0002	<0.0001	0.0003	0.0006	<0.0002
Calcium (Ca)	mg/L		---	47.5	---	84.7	---	71.5	77.6	68.3	62.9	73.2	57.9	75.5
Chromium (Cr)	mg/L	0.05 [1]	<0.005	0.093	<0.004	<0.008	<0.005	0.43	<0.005	0.040	<0.005	0.045	<0.005	0.043
Cobalt (Co)	mg/L		0.007	0.030	<0.001	<0.002	0.0006	<0.004	<0.002	<0.002	<0.002	<0.002	0.072	0.078
Copper (Cu)	mg/L	1 [2]	0.020	**2.9**	<0.006	0.03	0.0128	0.06	0.005	0.032	0.003	0.027	0.002	0.055
Iron (Fe)	mg/L	0.3 [2]	0.016	**205**	**2.23**	**3.73**	0.009	**3.7**	**2.30**	**3.09**	**1.67**	**2.39**	**2.39**	**6.38**
Lead (Pb)	mg/L	0.01 [1]	0.001	**1.07**	<0.001	**0.011**	0.0003	**0.033**	0.0002	0.0071	0.0003	**0.0045**	**0.0093**	**0.0131**
Lithium (Li)	mg/L		1.14	1.23	2.48	1.59	2.49	1.6	1.55	1.95	1.55	1.58	1.39	1.16
Magnesium (Mg)	mg/L		---	46.2	---	76.6	---	70	79.6	68.4	63.3	73.1	62.7	68.1
Manganese (Mn)	mg/L	0.05 [2]	0.239	2.26	0.054	0.055	0.047	0.07	0.034	0.049	0.028	0.038	0.083	0.212
Mercury (Hg)	mg/L	0.001 [1]	---	---	---	---	---	---	<0.0001	0.0004	<0.0001	<0.0002	<0.0001	0.0003
Molybdenum (Mo)	mg/L		0.017	0.033	0.002	<0.001	<0.0001	<0.002	0.008	0.009	<0.005	<0.005	0.010	0.014
Nickel (Ni)	mg/L		0.036	0.149	0.005	0.04	0.0477	0.1	0.006	0.020	0.003	0.026	0.181	0.205
Potassium (K)	mg/L		---	31.2	---	33.2	---	36.9	25.5	34.4	44.6	29.9	39.9	32.8
Selenium (Se)	mg/L	0.01 [1]	<0.004	<0.004	<0.004	**0.03**	<0.0004	**0.068**	<0.0004	<0.0004	<0.0004	0.0004	0.0010	0.0013
Silicon (Si)	mg/L		3.0	20.0	---	---	3.6	4.7	3.4	4.5	3.6	4.4	3.6	11.2
Silver (Ag)	mg/L		---	<0.004	---	<0.004	---	<0.008	<0.0001	<0.0004	<0.0001	<0.0004	<0.0001	<0.0004
Sodium (Na)	mg/L	200 [2]	---	**4,010**	---	**4,740**	---	**4,750**	**4,790**	**5,410**	**4,690**	**4,590**	**4,480**	**4,940**
Strontium (Sr)	mg/L		6.90	7.22	11	11.1	9.51	10	---	---	---	---	---	---
Sulphide	mg/L	0.05 [2]							-	0.007	-	0.007	-	0.003
Sulphur (S)	mg/L		1.0	3.2	---	---	<0.5	0.9	115	1.1	1.4	1.7	2.3	2.7
Thallium (Tl)	mg/L		0.0012	0.002	0.0025	<0.001	0.00068	<0.002	<0.0001	0.0013	0.0002	0.0004	0.0006	0.0006
Tin (Sn)	mg/L		<0.002	<0.004	<0.002	<0.004	0.0002	0.001	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Titanium (Ti)	mg/L		<0.003	0.13	<0.003	<0.05	<0.0003	<0.1	0.009	0.025	0.003	0.018	<0.001	0.065
Uranium (U)	mg/L	0.02 [1]	0.002	0.002	<0.001	<0.001	<0.0001	<0.002	<0.0001	0.0001	<0.0001	<0.0001	0.0021	0.0028
Vanadium (V)	mg/L		<0.001	0.026	0.001	0.002	<0.001	0.119	<0.001	<0.001	<0.001	<0.001	<0.001	0.014
Zinc (Zn)	mg/L	5 [2]	0.05	1.13	0.13	0.09	0.091	0.15	0.599	0.148	0.048	0.101	0.096	0.134

Notes:

Bold - concentration equals or exceeds selected water quality guidelines.
1 - Maximum Allowable Concentration (Health Canada, 2007)
2 - Aesthetic Objective (Health Canada, 2007)
3 - guideline applies only to drinking water treatment plants

39	**Volume 1, Appendix B, Section B4.2.5, Page B-32** **Volume 1, Appendix C, Section C2.4.5, Page C-32** **Volume 3, Section 5.6.3.1, Page 5-50** StatoilHydro states *saline water make up from the Basal McMurray and reduced Grand Rapids make up starting the second year of operation…*Table 4.4.-1 (p. 81) in Volume 1 shows higher water withdrawal from Grand Rapids than from McMurray aquifer. In Section 5.6.3.1, StatoilHydro states that the *Basal McMurray Aquifer was chosen as the primary groundwater source for make-up water because the Basal McMurray Aquifer was interpreted to have the lowest potential for adverse environmental effects of the candidate aquifers due to the depth and saline nature of the aquifer.* a) Why is the Basal McMurray Aquifer called the primary groundwater source for make-up water if it will supply at any time less than 50% of make up water for the Project?

Response

The Basal McMurray Aquifer is called the primary groundwater source for the Project because the saline Basal McMurray Aquifer will be the largest water supply source for the Project when compared to other potential water supply sources.

The breakdown (per aquifer) of withdrawal rates compared to the total Project-related withdrawal rate is as follows:

- 49% - Basal McMurray Aquifer (Saline)
- 29% - Lower Grand Rapids Aquifer (Non-Saline)
- 18% - Clearwater B Aquifer (Saline)
- 4% - Clearwater A Aquifer (Non-Saline)

In terms of groundwater quality, 67% of the cumulative groundwater proposed for the Project is considered saline (Basal McMurray and Clearwater B) as opposed to 33% non-saline groundwater (Lower Grand Rapids and Clearwater A).

40	**Volume 1, Appendix A, B and C, Tables A2.3-1, B2.4-1 and C2.4-1, pages A-13, B-32/33 and C-34** All three tables show the anticipated make up volumes for the Leismer Commercial/Expansion and Corner Hubs. StatoilHydro states that the volumes provided in the tables are based on produced water with a total dissolved solid (TDS) concentration of 3,500 mg/l, however actual TDS of the produced water is expected to be less. a) Provide the expected range of TDS for produced water for each hub.

Response

The produced water TDS experienced by other operators in the region have been typically lower than 3,500 mg/L. At a produced water TDS concentration of 3,500 mg/L, StatoilHydro's water balance is conservative. If the produced water TDS is lower than this number which is likely, make-up water requirement will be lower. This will also reflect in a higher recycle rate.

40	b) Update each table to show how sourced water volumes from the Grand Rapids and Basal McMurray will vary based on the TDS of the produced water.

Response

Tables 40-1(a-c) are revised versions of Table A2.3-1, Volume 1 (Leismer Commercial appendix) to portray produced water TDS of 3,000 mg/L, 2,500 mg/L and 2,000 mg/L, respectively. The reduction in produced water TDS results in higher blowdown recycle, hence reducing the blowdown to disposal. Blowdown quantity for the Leismer commercial shall reduce from 950 m^3/d at produced water TDS of 3,500 mg/L to 599 m^3/d at produced water TDS of 2,000 mg/L .

Table 40-1a (Table A2.3-1 Revised) Water Demand for Produced Water TDS = 3,000 mg/L

Water Demand	10% Reservoir Retention Long Term Push-Pull (m^3/cd)	7% Reservoir Retention Long Term Push-Pull (m^3/cd)
Initial Makeup (Lower Grand Rapids Aquifer)	3,850	3,850
Normal Disposal (Basal McMurray Aquifer)	839	839
Maximum Disposal (Basal McMurray Aquifer)	2,100	1,950
Normal Make-up (Lower Grand Rapids Aquifer)	984	720
Maximum Make-up (Lower Grand Rapids Aquifer)	1,823	1,559
Normal - Make up (Basal McMurray Aquifer)	839	839

Table 40-1b (Table A2.3-1 Revised) Water Demand for Produced Water TDS = 2,500 mg/L

Water Demand	10% Reservoir Retention Long Term Push-Pull (m^3/cd)	7% Reservoir Retention Long Term Push-Pull (m^3/cd)
Initial Makeup (Lower Grand Rapids Aquifer)	3,850	3,850
Normal Disposal (Basal McMurray Aquifer)	719	719
Maximum Disposal (Basal McMurray Aquifer)	2,100	1,950
Normal Make-up (Lower Grand Rapids Aquifer)	984	720
Maximum Make-up (Lower Grand Rapids Aquifer)	1,703	1,439
Normal Make-up (Basal McMurray Aquifer)	719	719

Table 40-1c (Table A2.3-1 Revised) Water Demand for Produced Water TDS = 2,000 mg/L

Water Demand	10% Reservoir Retention Long Term Push-Pull (m^3/cd)	7% Reservoir Retention Long Term Push-Pull (m^3/cd)
Initial Makeup (Lower Grand Rapids Aquifer)	3,850	3,850
Normal Disposal (Basal McMurray Aquifer)	599	599
Maximum Disposal (Basal McMurray Aquifer)	2,100	1,950
Normal Make-up (Lower Grand Rapids Aquifer)	985	720
Maximum Make-up (Lower Grand Rapids Aquifer)	1,584	1,319
Normal Make-up (Basal McMurray Aquifer)	599	599

Tables 40-2 (a-c) are revised versions of Table B2.4-1 that portray produced water TDS of 3,000 mg/L, 2,500 mg/L and 2,000 mg/L, respectively. The reduction in produced water TDS results in higher blowdown recycle, hence reducing the blowdown to disposal. Blowdown quantity for the Leismer expansion shall reduce from 1,900 m^3/d at produced water TDS of 3,500 mg/L to 1,179 m^3/d at produced water TDS of 2,000 mg/L.

Table 40-2a (Table B2.4-1 Revised) Water Demand for Produced Water TDS = 3,000 mg/L

Water Demand	10% Reservoir Retention Long Term Push-Pull (m^3/cd)	7% Reservoir Retention Long Term Push-Pull (m^3/cd)
Initial Makeup (Lower Grand Rapids Aquifer)	3,850	3,850
Normal Disposal (Basal McMurray Aquifer)	1,678	1,678
Maximum Disposal (Basal McMurray Aquifer)	4,210	3,930
Normal Make-up (Lower Grand Rapids Aquifer)	1,733	1,189
Maximum Make-up (Lower Grand Rapids Aquifer)	3,411	2,867
Normal Make-up (Basal McMurray Aquifer)	1,678	1,678

Table 40-2b (Table B2.4-1 Revised) Water Demand for Produced Water TDS = 2,500 mg/L

Water Demand	10% Reservoir Retention Long Term Push-Pull (m^3/cd)	7% Reservoir Retention Long Term Push-Pull (m^3/cd)
Initial Makeup (Lower Grand Rapids Aquifer)	3,850	3,850
Normal Disposal (Basal McMurray Aquifer)	1,419	1,419
Maximum Disposal (Basal McMurray Aquifer)	4,210	3,930
Normal Make-up (Lower Grand Rapids Aquifer)	1,733	1,189
Maximum Make-up (Lower Grand Rapids Aquifer)	3,152	2,608
Normal Make-up (Basal McMurray Aquifer)	1,419	1,419

Table 40-2c (Table B2.4-1 Revised) Water Demand for Produced Water TDS = 2,000 mg/L

Water Demand	10% Reservoir Retention Long Term Push-Pull (m^3/cd)	7% Reservoir Retention Long Term Push-Pull (m^3/cd)
Initial Makeup (Lower Grand Rapids Aquifer)	3,850	3,850
Normal Disposal (Basal McMurray Aquifer)	1,179	1,179
Maximum Disposal (Basal McMurray Aquifer)	2,100	1,950
Normal Make-up (Lower Grand Rapids Aquifer)	1,733	1,189
Maximum Make-up (Lower Grand Rapids Aquifer)	2,912	2,368
Normal Make-up (Basal McMurray Aquifer)	1,179	1,179

Tables 40-3 (a-c) are revised versions of Table C2.4-1 that portray produced water TDS of 3,000 mg/L, 2,500 mg/L and 2,000 mg/L, respectively. The reduction in produced water TDS results in higher blowdown recycle, hence reducing the blowdown to disposal. Blowdown quantity for the Corner shall reduce from 1,900 m^3/d at produced water TDS of 3,500 mg/L to 1,179 m^3/d at produced water TDS of 2,000 mg/L.

Table 40-3a (Table C2.4-1 Revised) Water Demand for Produced Water TDS = 3,000 mg/L

Water Demand	10% Reservoir Retention Long Term Push-Pull (m^3/cd)	7% Reservoir Retention Long Term Push-Pull (m^3/cd)
Initial Makeup (Lower Grand Rapids Aquifer)	3,850	3,850
Normal Disposal (Basal McMurray Aquifer)	1,678	1,678
Maximum Disposal (Basal McMurray Aquifer)	4,210	3,930
Normal Make-up (Lower Grand Rapids Aquifer)	1,733	1,189
Maximum Make-up (Lower Grand Rapids Aquifer)	3,411	2,867
Normal Make-up (Basal McMurray Aquifer)	1,678	1,678

Table 40-3b (Table C2.4-1 Revised) Water Demand for Produced Water TDS = 2,500 mg/L

Water Demand	10% Reservoir Retention Long Term Push-Pull (m^3/cd)	7% Reservoir Retention Long Term Push-Pull (m^3/cd)
Initial Makeup (Lower Grand Rapids Aquifer)	3,850	3,850
Normal Disposal (Basal McMurray Aquifer)	1,419	1,419
Maximum Disposal (Basal McMurray Aquifer)	4,210	3,930
Normal Make-up (Lower Grand Rapids Aquifer)	1,733	1,189
Maximum Make-up (Lower Grand Rapids Aquifer)	3,152	2,608
Normal Make-up (Basal McMurray Aquifer)	1,419	1,419

Table 40-3c (Table C2.4-1 Revised) Water Demand for Produced Water TDS = 2,000 mg/L

Water Demand	10% Reservoir Retention Long Term Push-Pull (m^3/cd)	7% Reservoir Retention Long Term Push-Pull (m^3/cd)
Initial Makeup (Lower Grand Rapids Aquifer)	3,850	3,850
Normal Disposal (Basal McMurray Aquifer)	1,179	1,179
Maximum Disposal (Basal McMurray Aquifer)	2,100	1,950
Normal Make-up (Lower Grand Rapids Aquifer)	1,733	1,189
Maximum Make-up (Lower Grand Rapids Aquifer)	2,912	2,368
Normal Make-up (Basal McMurray Aquifer)	1,179	1,179

40	c) Provide anticipated water source volumes that would result from the lowest and highest expected TDS of the produced water.

Response

Tables provided in the previous sections indicate a trend in the variation of source volumes as a function of produced water TDS. With balanced push-pull to the Basal McMurray Formation, the blowdown quantity sent to disposal lowers with a reduction in produced water TDS. An overall reduction in source water consumption is noted and the trends are summarized in the following Table.

Table 40-4a Source Water Consumption (m^3/d) at varying produced water TDS (RR - 10%)

Produced Water TDS (mg/L)	Leismer Commercial (20 kbbl/cd)	Leismer Expansion (40 kbbl/cd)	Corner (40 kbbl/cd)
3,500	1,930	3,860	3,860
3,000	1,823	3,411	3,411
2,500	1,683	3,152	3,152
2,000	1,584	2,912	2,912

Table 40-4b Source Water Consumption (m^3/d) at varying produced water TDS (RR - 7%)

Produced Water TDS (mg/L)	Leismer Commercial (20 kbbl/cd)	Leismer Expansion (40 kbbl/cd)	Corner (40 kbbl/cd)
3,500	1,635	3,070	3,070
3,000	1,559	2,867	2,867
2,500	1,439	2,608	2,608
2,000	1,319	2,368	2,368

41	
	Volume 1, Appendix B, Section B2.4.6, page B-35 & B-36 For the Leismer Commercial Project, StatoilHydro proposes mixing source water from the non-saline Grand Rapids aquifer with saline Basal McMurray source water for the Leismer Commercial Project. However, for the Leismer Expansion Project, StatoilHydro proposes mixing non-saline groundwater from the Grand Rapids aquifer with saline groundwater from the Clearwater B aquifer. Mixing groundwater from the Grand Rapids and Clearwater B aquifers would result in a reduction of non-saline groundwater volumes needed from the Grand Rapids aquifer. Further testing was planned for the Clearwater B to confirm its feasibility as a long term saline groundwater source. a) Explain why the option for using the Clearwater B aquifer wasn't discussed the Leismer Commercial application.

Response

StatoilHydro is still investigating certain aspects relating to the development of the Clearwater B Aquifer, including:

- gas-over-water;
- viable rates of production that have yet to be demonstrated;
- reservoir clay content that can affect both short-term and long-term production capability; and
- proximity of identified sources to the Leismer Commercial Hub.

Because of these aspects, development of the Clearwater B Aquifer will take more time than is available for the Leismer Commercial Hub application. Refer to AENV SIR Response 36 a which describes ongoing testing of the Clearwater B Aquifer.

41	
	b) Provide an update on StatoilHydro's feasibility test for mixing of non-saline Grand Rapids groundwater with saline Clearwater B groundwater for the Leismer Commercial and Expansion hubs.

Response

Refer to AENV SIR Response 36 a, which describes ongoing testing of the Clearwater B Aquifer.

41	c) Should it be feasible to use the Clearwater B as a saline groundwater source, provide the revised water volumes that would be sourced from the Grand Rapids and Basal McMurray aquifers.

Response

Should it become feasible in future to use the Clearwater B Aquifer as a saline groundwater source, the following provides an approximation of revised water volumes based upon the current data. To maintain balanced push-pull to and from the Basal McMurray Formation, and considering the limitation on boiler feed water TDS, the effect would be an increase overall make-up water consumption. The increase in salinity of the make-up water would result in an increased blowdown quantity. For Leismer Commercial, 984 m^3/d of make- up water from Clearwater B, blended with 197 m^3/d of Lower Grand Rapids non-saline water and 1,139 m^3/d of Basal McMurray Formation saline water is required. This indicates an increase in total make-up water volume from 1,930 m^3/d to 2,320 m^3/d. Consumption on non-saline Grand Rapids water would be lowered by 783 m^3/d. The blowdown disposal quantity would increase to 1,139 m^3/d from 950 m^3/d.

42	**Volume 1, Appendix D, TOR, Section 4.7.1.1, Page 20 of 37** The Terms of Reference requirements include: *"…. Identify, describe and discuss the following:* *ii) the hydraulic head, hydraulic gradients and groundwater flow directions and velocities* *iii) the chemistry of groundwater including background concentrations of major ions, metals and hydrocarbon indicators* *vi) the recharge potential for Quaternary aquifers* *vii) the potential hydraulic connection between bitumen production zones, disposal formations and other aquifers."* a) Explain how the TOR requirements will be met without specific field data.

Response

The Project Application includes a description of the regional hydrogeology consistent with the TOR requirements and previous applications submitted by numerous other operators within the

RSA. The regional hydrogeology has been characterized using a combination of regional and local scale data. Additional data has been gathered subsequent to the filing of the Application and StatoilHydro plans on-going groundwater exploration and testing. With respect to the reference TOR requirements:

ii) The hydraulic head distribution within the region is described in Volume 3, Section 5 (specific details are included in Table 5.5-7 and Appendix 5B). This discussion includes the hydraulic head distribution for the undifferentiated overburden, Empress Terrace, Empress Channel, Grand Rapids, Clearwater, McMurray and Grosmont units. Groundwater flow direction, hydraulic gradients and velocities are spatially variable and can all be deduced from the hydraulic head distribution. Specific field data collected by StatoilHydro are summarized in Section 5.5.3 and are also provided in the *Application for Approval of the Leismer Demonstration Project* submitted by StatoilHydro, May 2006 (Attachment C and D). Specific field data collected by StatoilHydro since the submission of the EIA are summarized in Tables 38-1, 38-2 and 38-3 from AENV SIR 38a.

iii) Groundwater chemistry is discussed in Volume 3, Section 5 (specific details are included in Table 5.5-8 and Appendix 5C). This discussion focuses on the salinity (i.e.: TDS concentrations) of various aquifers. Representative groundwater chemistry results from publicly available water analyses are presented in Table 50-1 (AENV SIR 50). Specific field data collected by StatoilHydro are summarized in Section 5.5.3 Volume 5 and are also provided in the *Application for Approval of the Leismer Demonstration Project* submitted by StatoilHydro, May 2006 (Tables 7 and 8 and Attachments C and D). Specific field data collected by StatoilHydro since the submission of the EIA are summarized in Tables 38-4, 38-5 and 38-6 (AENV SIR 38a).

vi) A description of spatially variable recharge for Quaternary Aquifers is discussed in Volume 3, Section 5.5.3 (Figure 5.5-21) and the recharge potential is discussed in more detail in Appendix 5D, Section 5D1.4.1.2. This section discusses estimated recharge rates for overburden and bedrock aquifers and outlines the recharge calibration targets for the StatoilHydro numerical groundwater model (1 to 5 mm/y to upper bedrock units). After calibration, the StatoilHydro model simulated a recharge rate of 1.2 mm/y. A recharge rate of 1.2 mm/y is considered a conservative rate in terms of estimating aquifer drawdown.

ii) Hydraulic connectivity between geologic units is discussed in Volume 3, Section 5. This section includes discussions on aquifer and aquitard thickness and extent, hydraulic head distribution and aquifer salinity. Analysis of the above data can provide a conceptual understanding of the potential connectivity of different units. For example, if two thick and laterally extensive aquifers are separated by an aquitard and the aquifers exhibit a large discrepancy in salinity and hydraulic head, then this may be evidence to support the conclusion that the intervening aquitard is an effective barrier to groundwater flow. Furthermore, Appendix 5D outlines the numerical groundwater model calibration to the observed hydraulic head distribution (Appendix

5B). The reasonable calibration of the model to observed steady state heads supports StatoilHydro's conceptual understanding of hydraulic connection between units.

43	**Volume 3, Section 5.5.2.1 , Page 5-14** a) Provide a characterization of the Viking Formation.

Response

Geologic characterization of the Viking Formation is discussed in Volume 3, Section 5.5.2.1 page 5-14 and the hydrogeologic characterization of the Viking Aquifer is discussed in Volume 3, Section 5.5.3.1 page 5-26.

44	**Volume 3, Section 5 , Table 5.5-1, Page 5-18** There is very limited information for Joli Fou Formation, which is the only isolator (aquitard) between Viking Aquifer and Grand Rapids Aquifer. a) Explain why more information has not been obtained on this formation, considering possible connection between Empress Channel and Viking Aquifer, and significant groundwater/make up water withdrawal from Grand Rapids Formation?

Response

Sufficient hydrogeological data existed for StatoilHydro to characterize the Joli Fou Aquitard for the purposes of this Application. StatoilHydro understands that the Joli Fou Formation plays an important role in the hydrogeological regime of the depositional basin south of Fort McMurray. Numerous regional reports and environmental impact assessments in the region have identified the Joli Fou Formation as a significant barrier to groundwater flow. The effectiveness of the Joli Fou Formation as an aquitard is further evidenced by large pressure decreases that occur across the unit. Hydrogeological characteristics of this unit that make it an effective aquitard are its thickness, extent and vertical hydraulic conductivity. StatoilHydro has conducted detailed mapping of this unit to confirm formation thickness and extent for this Project and in their *Application for Approval of the Leismer Demonstration Project* submitted by StatoilHydro, May 2006. Within the LSA, the Joli Fou Aquitard ranges in thickness from 20 to 35 m and is laterally extensive. In addition, the Basin Analysis Group has estimated the vertical hydraulic gradient of the Joli Fou Aquitard at 5×10^{-14} m/s (Volume 3, Table 5.5-2 page 5-19).

StatoilHydro has identified that the Joli Fou Aquitard thins in the Christina Channel and that there is evidence that this unit is not present in the thalweg of the channel incision. As such, a design consideration and mitigative measure of the proposed StatoilHydro Lower Grand Rapids well network was to place wells as far away from the channel incision as practicable. The closest proposed Lower Grand Rapids well is located approximately 10 km away from the edge of the Christina Channel.

StatoilHydro is committed to groundwater monitoring for this Project. Groundwater monitoring of various aquifers in the region will confirm the effectiveness of the Joli Fou Formation as an aquitard.

44	b) What additional field data will be obtained and when?

Response

Collection of additional field data is on-going as StatoilHydro continues to assess groundwater resources and initiates groundwater monitoring.

45	**Volume 3, Section 5.5.3.1, Page 5-26 to 27** StatoilHydro states that hydraulic head values for the Joli Fou Aquitard are currently not available for the LSA but groundwater flow is expected to be predominantly vertical and downward. Where the Joli Fou aquitard is thinned or absent, increased recharge from the Empress Channel Aquifer to the Upper Grand Rapids Aquifer is expected to occur. StatoilHydro further states that *hydraulic head values specific to the Lower Grand Rapids Aquifer are sporadic.* a) Explain why groundwater/make-up water withdrawal from the Lower Grand Rapids Formation will not impact the Empress Channel formation production.

Response

StatoilHydro understands the important role the Joli Fou Aquitard plays in minimizing pressure decreases in the Lower Grand Rapids Aquifer, due to pumping, from propagating upward to the Empress Channel Aquifer. As such, StatoilHydro has designed its Lower Grand Rapids well network to be located as far away as practicable from the Joli Fou Aquitard zero edge. Volume 3, Figure 5.6-23 compares the predicted impact of the Project's demands to the baseline demands from Lower Grand Rapids, Clearwater A, Clearwater B and Basal McMurray aquifers on the Empress Channel Aquifer. StatoilHydro's calibrated numerical groundwater model, which incorporates the interpreted geologic geometry, including the direct contact between the Empress Channel Aquifer and the Upper Grand Rapids Aquifer in the LSA (i.e.: no Joli Fou Aquitard) predicts a negligible incremental impact of less than 20 cm of drawdown within the Empress Channel Aquifer.

46	**Volume 3, Section 5, Table 5.5-4, Page 5-21 and Section 5.5.3.1, Page 5-28** **Volume 3, Section 5.6.3.3, Page 5-59** StatoilHydro states that *hydraulic conductivity values specific to the Clearwater A Aquifer are not available. Hydraulic head values specific to the Clearwater A Aquifer are not available.* The Clearwater A unit, which will be used for make-up water withdrawal, is considered a non-saline aquifer. a) Why wasn't more information (aquifer characterization) obtained specifically for the Clearwater A unit?

Response

Sufficient hydrogeologic data existed for StatoilHydro to characterize the Clearwater A Aquifer for the purposes of this Application. In terms of hydraulic head, Appendix 5B discusses regional hydraulic heads and hydraulic heads interpreted from drillstem tests (DSTs). It is true no hydraulic heads specific to the Clearwater A existed at the time of submission (Volume 3, Table 5B-3), but numerous hydraulic heads interpreted from DSTs existed for the Clearwater A Aquifer (Volume 3, Table 5B-6). In terms of hydraulic conductivity, Section 5 of Volume 3 discusses the hydraulic conductivity of both the Clearwater A and B aquifers. It is true no specific hydraulic conductivities specific to the Clearwater A existed at the time of submission (Volume 3, Table 5.5-4), but petrophysical well log analysis suggests the Clearwater A and B aquifers should have similar hydraulic conductivities. For the purposes of the Application, it was assumed that the Clearwater A had similar horizontal hydraulic characteristics to the Clearwater B Aquifer. Horizontal hydraulic conductivity of the Clearwater B Aquifer has been estimated by 6 tests (3 at EnCana Christina Lake and 3 by StatoilHydro, Volume 3, Section 5.5.5, Table 5.5-4 and Table 38-2). Hydraulic conductivity estimated from these tests suggested values ranging from 2×10^{-6} to 7×10^{-5} m/s. An estimate of horizontal hydraulic conductivity of 1.7×10^{-5} m/s was applied to the Clearwater A Aquifer in StatoilHydro's calibrated numerical groundwater model.

46	b) If the Clearwater A is considered to be a non-saline aquifer, why wasn't a simulated drawdown done separately for Clearwater A and B?

Response

Simulated drawdown for the Clearwater A and B aquifers was done separately in this assessment. Numerical groundwater modelling incorporated the pumping schedule outlined in Volume 3, Table 5.6-4 on page 5-51 (more specific details are provided on Tables 5.6-5 and 5.6-6).

46	c) What additional field work will be undertaken to obtain more information and when?

Response

Project water demand from the Clearwater A Aquifer is scheduled for 2016, which allows eight years to collect specific data from the Clearwater A Aquifer. Collection of additional field data is on-going as StatoilHydro continues to assess groundwater resources and initiates groundwater monitoring. All data necessary to satisfy the *Groundwater Evaluation Guideline* and the *Water Conservation and Allocation Guideline for Oilfield Injection* will be obtained as part of future applications for groundwater diversion.

47	**Volume 3, Section 5, Figure 5.5.16, 5.5.17 and 5.5.22, Page 5-94 to 95** The Figures do not outline the Project Area. a) Show the Project Areas so that the Empress Channel and Empress Terrace location are visible with respect to the subject area.

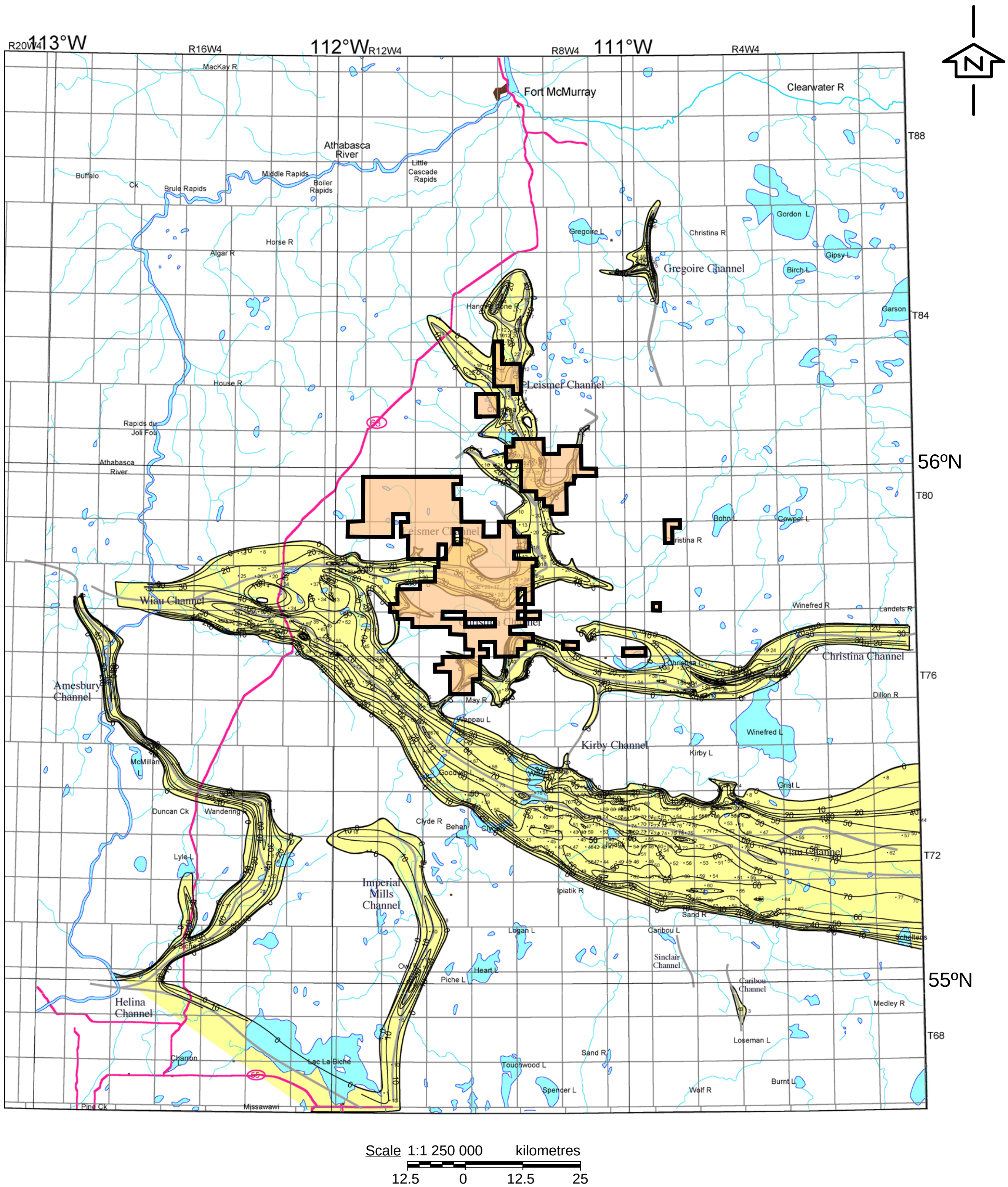
Response

Figures 47-1, 47-2 and 47-3 are updated versions of Volume 3, Figures 5.5-16, 5.5-17 and 5.5-22, respectively.

48	**Volume 3, Section 5, Figure 5.5.20, Page 5-98** Cross-section indicates possible hydraulic connection between Empress Terrace, Empress Channel, Viking aquifers and Upper & Lower Grand Rapids Aquifer. a) Explain why more information has not been obtained on this formation, considering possible and significant groundwater/make up water withdrawal from Grand Rapids Formation?

Response

Sufficient hydrogeologic data existed for StatoilHydro to characterize the interaction between the Empress and Grand Rapids formations for the purposes of this Application. Extensive detailed and regional mapping was conducted to understand interaction between these units. StatoilHydro also understands the important role the Joli Fou Aquitard plays in minimizing pressure decreases in the Lower Grand Rapids Aquifer, due to pumping, from fluids propagating upward to the Empress Channel Aquifer. As such, StatoilHydro has designed its Lower Grand Rapids well network to be located as far away from the Joli Fou Aquitard zero edge as practicable. In Volume 3, Figure 5.6-23 compares the predicted impact of the Project's demands to the baseline demands from Lower Grand Rapids, Clearwater A, Clearwater B and Basal McMurray aquifers on the Empress Channel Aquifer. StatoilHydro's calibrated numerical groundwater model, which incorporates the interpreted geologic geometry, including the direct contact between the Empress Channel Aquifer and the Upper Grand Rapids Aquifer in the LSA (i.e., no Joli Fou Aquitard) predicts a negligible incremental impact of less than 20 cm of drawdown within the Empress Channel Aquifer.



Data Legend

- ● 20 Thickness (in m) equal to value shown
- ○ 20 Thickness (in m) less than value shown
- □ 20 Thickness (in m) greater than value shown
- Channel thalweg
- Distribution of Empress Formation channel deposits (undifferentiated and combined Units 1, 2 and 3)
- Kai Kos Dehseh Project

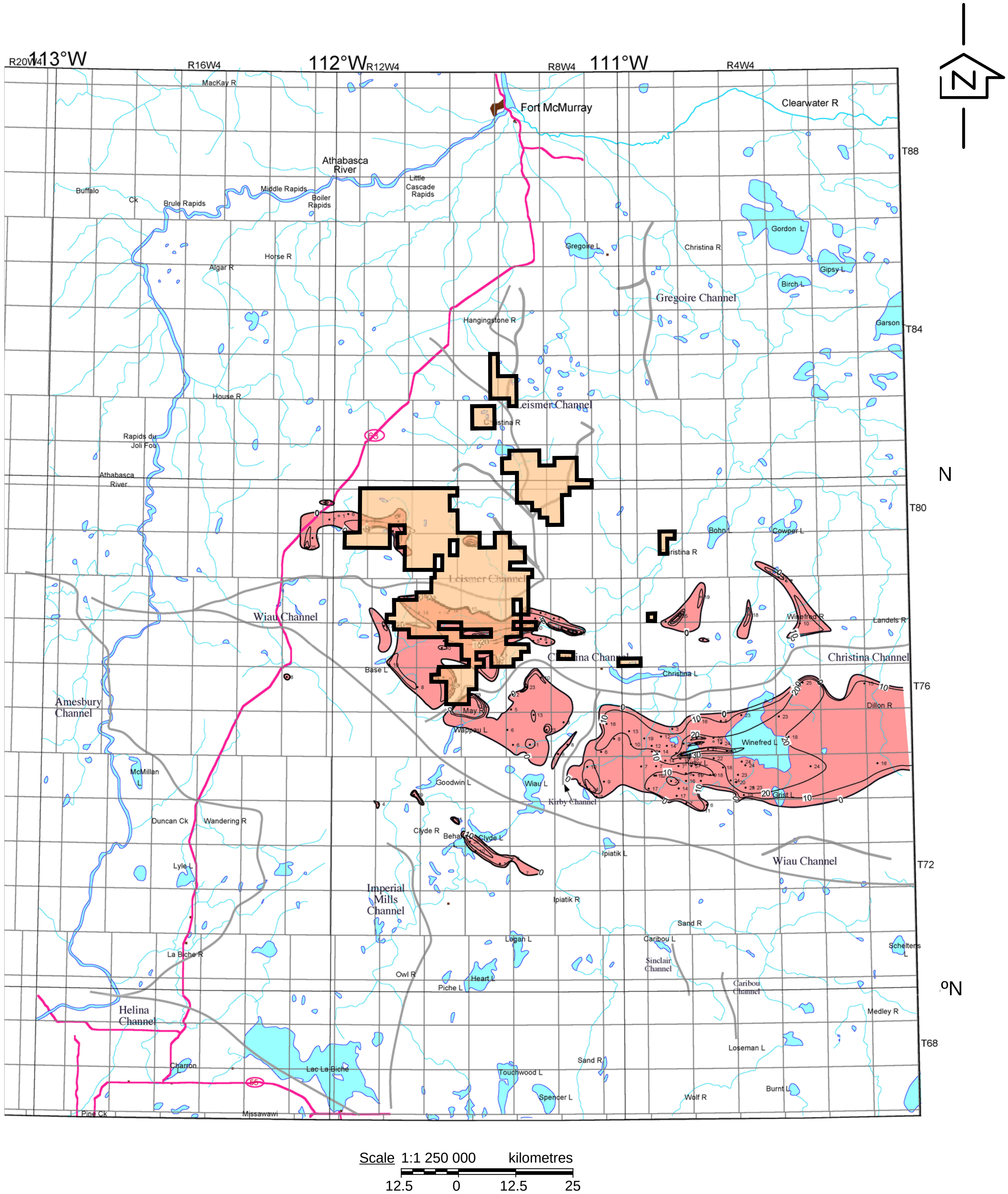
SOURCE: EUB/AGS Earth Sciences Report 2002-03, *"Quaternary Geological Setting of the Athabasca Oil Sands (In Situ) Area, Northeast Alberta"*.

Title:

EMPRESS CHANNEL SAND ISOPACH

StatoilHydro

Approved:	RP	Revision Date:	07/05/22
File:	4455-Empress-07.cdr		
Drawn by: GDE	Checked: BW	Fig. No.: **47-1**	



Data Legend

- ● 20 Thickness (in m) equal to value shown
- ○ 20 Thickness (in m) less than value shown
- □ 20 Thickness (in m) greater than value shown
- Channel thalweg
- Distribution of Empress Formation interfluve terrace sand and gravel
- Kai Kos Dehseh Project

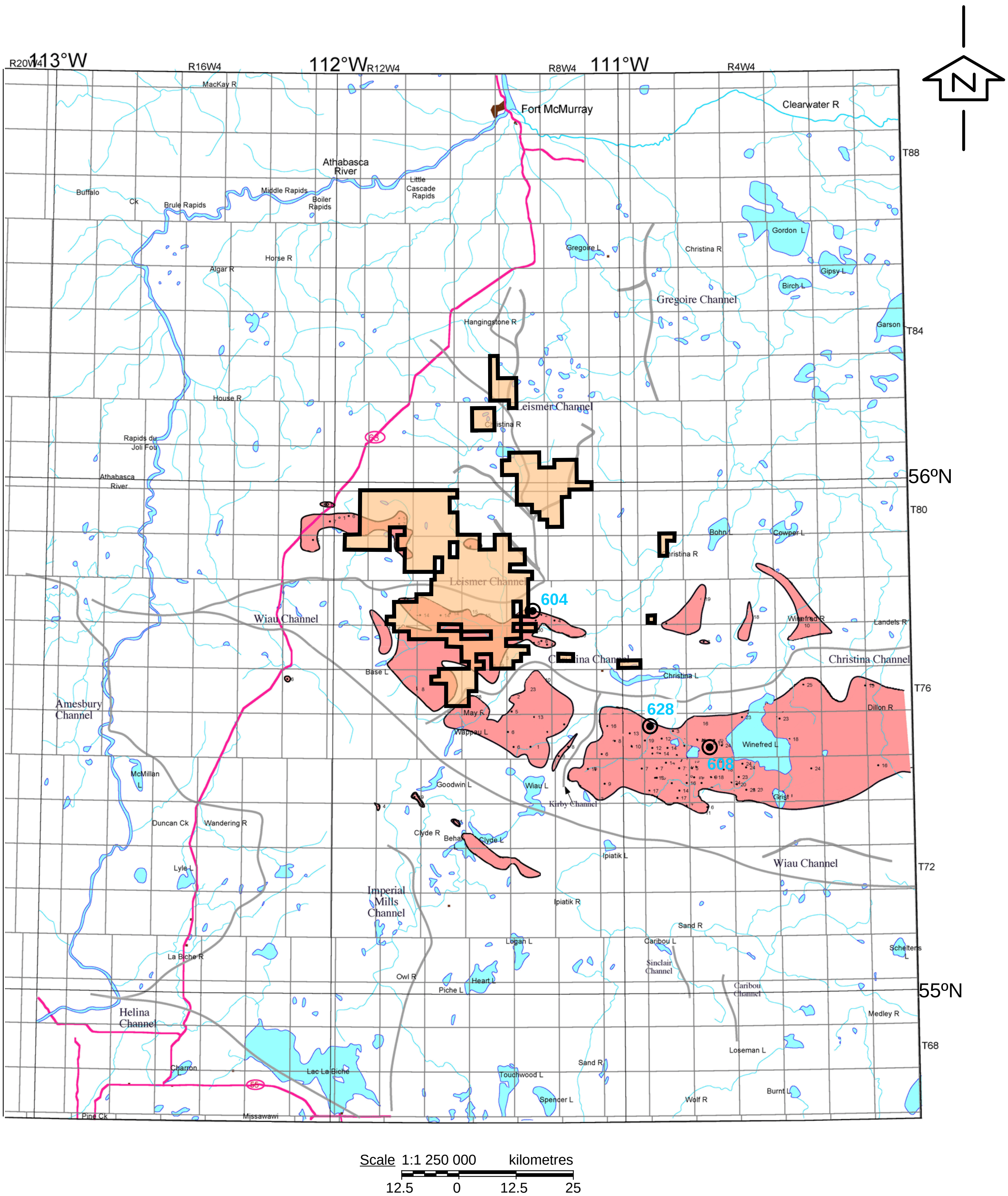
SOURCE: EUB/AGS Earth Sciences Report 2002-03, *"Quaternary Geological Setting of the Athabasca Oil Sands (In Situ) Area, Northeast Alberta"*.

Title:

EMPRESS TERRACE SAND ISOPACH

StatoilHydro

Approved: RP	Revision Date: 07/05/22	
File: 4455-Empress-07.cdr		
Drawn by: GDE	Checked: BW	Fig. No.: **47-2**



Data Legend

- ● 20 Thickness (in m) equal to value shown
- ○ 20 Thickness (in m) less than value shown
- □ 20 Thickness (in m) greater than value shown
- Channel thalweg
- Distribution of Empress Formation interfluve terrace sand and gravel
- Kai Kos Dehseh Project

SOURCE: EUB/AGS Earth Sciences Report 2002-03, *"Quaternary Geological Setting of the Athabasca Oil Sands (In Situ) Area, Northeast Alberta"*.

Title:

EMPRESS TERRACE AQUIFER HYDRAULIC HEADS

StatoilHydro

Approved: RP	Revision Date: 07/05/22	
File: 4455-Empress-07.cdr		
Drawn by: GDE	Checked: BW	Fig. No.: **47-3**

48	b) What additional field data will be obtained and when?

Response

StatoilHydro is committed to monitoring make-up water withdrawal and water levels for the duration of the Project (Volume 3, Section 5.8.3 page 5-69). StatoilHydro will monitor select aquifers in the vicinity of groundwater source wells which will include Empress Formation aquifers. In addition, any additional water wells completed in the Empress Formation aquifers by StatoilHydro for utility or potable water supply purposes will be tested for deliverability and quality.

49	**Volume 3, Appendix 5B, Table 5B-1, 5B-2 & 5B-3** The tables show very limited amount of actual hydraulic head data for the Project Area. For example, there is only one piece of data for Clearwater, which is outside the Project Area. Also, there is no distinction whether this value was obtained for Clearwater A or B. a) Confirm what field data be obtained for each phase of development.

Response

For each phase of development, the appropriate level of information necessary will be collected to apply for a groundwater diversion license (if necessary) as outlined in the *Water Conservation and Allocation Guideline for Oilfield Injection* (2006) and the *Groundwater Evaluation Guidelines* (2003). StatoilHydro will conduct pump testing appropriate to the anticipated pumping rate, install observation wells, collect groundwater samples, field-verify adjacent water wells, conduct a technical evaluation of saline sources, conduct an economic evaluation of saline sources, perform a cumulative effects assessment and evaluate environmental impacts. In addition, StatoilHydro is committed to on-going groundwater quality and quantity monitoring.

49	b) Clarify whether the values in Table 5B-3 are for the Clearwater A or B aquifer?

Response

The value in Table 5B-3 is a measurement from the Clearwater Formation where StatoilHydro does not interpret the existence of either the Clearwater A or B aquifers. This measurement, performed by Hackbarth and Nastasa (1979) indicates the hydraulic head in the Clearwater Formation at Fort McMurray to be below 298 masl (similar to the elevation of the Clearwater and Athabasca rivers in this area) and suggests groundwater discharges from the Clearwater Formation to the Clearwater and Athabasca rivers.

Furthermore, Table 5B-3 is complemented by Table 5B-6. Table 5B-6 summarizes numerous Clearwater Formation hydraulic heads from drill stem tests in the ERCB database. Drillstem tests are typically performed on the sand units of the Clearwater Formation which, hydrostratigraphically speaking, are the Clearwater A, B and C aquifers. The values from Table 5B-3 and Table 5B-6 are plotted on Figure 5.5-26. Values from Table 5B-6 are plotted with blue circles and the value from Table 5B-3 is plotted with a red triangle.

50	**Volume 3, Appendix 5C, Table 5C-1** Very limited data are provided on measured TDS values for each aquifer. No groundwater chemistry (for example anions/cations, heavy metals, redox, etc.) is provided for any of the aquifers to establish baseline conditions. a) Describe the field work program to be undertaken to provide baseline groundwater chemistry.

Response

The TDS data presented in Volume 3 Section 5 Appendix 5C originates from the Geofluids database (IHS, 2007). The remainder of the publicly available representative chemistry data was not included in the EIA, but is summarized at Table 50-1. At the time of submission, three wells had been drilled and tested, which are discussed in Section 5.5.3 and also provided in the *Application for Approval of the Leismer Demonstration Project* submitted by StatoilHydro, in May, 2006. Groundwater exploration is on-going and hydrogeologic data has been collected since submission. In 2007 and 2008, 8 and 11 wells were drilled and tested by StatoilHydro, respectively (see Tables 37-1 and 37-2, AENV SIR Response 37 a).

REFERENCE

IHS Energy, 2007. Rakhit GeoFluids. Copyright 2006. Calgary, Alberta.

50	b) Determine the long term impact of operations on groundwater quality in all aquifers.

Response

As discussed in Volume 3 Section 5.6, StatoilHydro has assessed the long-term impacts of Project operations on groundwater quality in all aquifers.

Table 50-1 Publicly Available Groundwater Chemistry

Unique Well Identifier	Aquifer	pH	Na	K	Ca	Mg	Ba	Sr	Fe	Cl	HCO_3	SO_4	CO_3	OH	TDS Calculated
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
102/07-16-076-06W4/00	Basal McMurray	8.1	4,090	18	61	60	18	7.1	-	6,320.3	1,433.5	7	0	0	12,015
100/10-30-076-14W4/00	Basal McMurray	7.5	4,597	-	124	90	-	-	-	6,450	1,799	103	-	-	13,163
100/10-04-077-14W4/00	Basal McMurray	8.1	4,370	33	88	164	-	-	-	6,500	1,940	17	-	-	13,114
100/07-09-077-14W4/00	Basal McMurray	8.2	3,750	67	45	54	-	-	-	5,478.4	1,977.6	83	0	0	11,455
100/06-28-078-13W4/00	Basal McMurray	8.2	4,461	47	123	75	-	-	-	6,750	956	74	-	-	12,486
100/15-02-076-06W4/00	Clearwater B	8.8	1,774	11	24	20	-	-	Trace	2,155	1,000	43	66	-	5,093
100/11-14-076-06W4/00	Clearwater B	8.3	1,450	-	15	7	-	-	Present	1,830	771	6	-	-	4,079
100/06-26-076-06W4/00	Clearwater B	8.5	1,355	-	47	33	-	-	Present	1,626	839	195	10	-	4,105
100/06-05-076-07W4/00	Clearwater B	8.3	1,500	7.9	13.6	9.7	-	-	-	1,800	854	28.9	<0.1	0	4,210
100/10-32-076-08W4/00	Clearwater B	8.4	2,143	-	24	14	-	-	Trace	2,992	635	12	14	-	5,834
100/06-16-077-06W4/00	Clearwater B	8	1,822	-	14	10	-	-	Trace	2,401	791	-	-	-	5,038
100/10-20-077-08W4/00	Clearwater B	8.4	2,105	-	20	9	-	-	Present	2,912	625	37	5	-	5,713
100/11-06-077-09W4/00	Clearwater B	8.8	1,734	-	8	6	-	-	Present	2,354	527	27	22	-	4,678
100/06-11-077-09W4/00	Clearwater B	8.7	2,454	-	17	12	-	-	Present	3,350	781	20	26	-	6,660
100/02-25-077-10W4/00	Clearwater B	8.7	2,440	12	20	16	1	3	-	3,400	370	12	150	-	6,434
100/10-09-078-09W4/00	Clearwater B	8.1	2,690	-	25	17	-	-	Present	3,670	918	54	-	-	7,374
100/09-02-078-10W4/00	Clearwater B	8.3	2,370	8.3	20	15	-	-	-	3,327	1,040	11	0	0	6,791
100/10-11-078-10W4/00	Clearwater B	8.5	1,983	-	24	13	-	-	-	2,500	1,018	23	25	-	5,586
100/06-16-078-07W4/00	Clearwater A	8.6	1,301	-	15	5	-	-	Present	1,678	547	23	29	-	3,598
102/08-34-081-07W4/00	Clearwater A	7.9	877	14	5.8	2.2	-	-	-	738.6	1,014.5	294	0	0	2,947
100/06-18-076-13W4/00	Lower Grand Rapids	8	876	7	16	5	-	-	-	616	1,212	107	-	-	2,839
100/10-20-077-08W4/00	Lower Grand Rapids	8.6	460	-	6	5	-	-	Present	153	691	163	50	-	1,528
100/06-16-078-07W4/00	Lower Grand Rapids	9	356	-	2	1	-	-	Present	72	705	31	43	-	1,210
100/07-09-078-10W4/00	Lower Grand Rapids	8.2	538	-	8	1	-	-	-	284	962	4	-	-	1,797
100/07-21-079-10W4/00	Lower Grand Rapids	8.6	557	-	63	3	-	-	-	260	1,040	156	-	-	2,079
100/14-30-079-14W4/00	Lower Grand Rapids	8	993	15.5	7.5	3.1	-	-	-	755	1,210	50	-	-	3,035
100/09-01-080-08W4/00	Lower Grand Rapids	9	615	-	26	5	-	-	-	280	1,100	121	-	-	2,147
100/10-08-082-10W4/00	Lower Grand Rapids	9	578	-	9	5	-	-	-	250	1,000	123	-	-	1,965
1AA/05-27-083-06W4/00	Lower Grand Rapids	8.3	550	5.4	9	2.3	-	-	-	368.3	884.7	26	0	0	1,846

Source: (IHS, 2007)

Water Supply

51	**Volume 1, Section 7.5, Page 142** **Volume 3, Section 5.6.3.3, Page 5-62** When discussing impacts from non-saline groundwater withdraws from the Lower Grand Rapids, StatoilHydro states that a *predicted 70% change in aquifer productivity would occur for an area encompassing the OPTI/Nexen Long Lake, ConocoPhillips Surmont and Petro-Canada Meadow Creek Projects.* StatoilHydro further states that *the Project has a relatively small incremental impact on baseline conditions.* a) Discuss how the predicted change in aquifer productivity of greater then 70% will result in an incremental impact on baseline conditions.

Response

The Kai Kos Dehseh Project will have a small incremental impact on the Lower Grand Rapids Aquifer productivity in the OPTI/Nexen Long Lake and ConocoPhillips Surmont region. Refer to Volume 3, Section 5, Figures 5.6-19 to 5.6-22. As indicated in Figure 5.6-19, the StatoilHydro numerical groundwater model predicts about 58 m of drawdown for the Baseline Case at the ConocoPhillips observation well. In other words, 58 m of drawdown is predicted in the Lower Grand Rapids Aquifer at this location due to operations other than the Kai Kos Dehseh Project. When the Kai Kos Dehseh Project is included in the simulation (i.e.: the Application Case) StatoilHydro predicts approximately 62 m of drawdown at the ConocoPhillips observation well. Therefore, StatoilHydro will incrementally add 4 m of drawdown or about 6% of the total drawdown.

51	b) How can a decrease in aquifer productivity of 30% to 70% be considered moderate for a non-saline aquifer in view of the *Water Conservation and Allocation Guideline for Oilfield Injection (2006)*?

Response

The Application Case decrease in Lower Grand Rapids Aquifer productivity is shown in Volume 3, Figure 5.6-22. The 30% contour includes all of the Corner Development Area and the 70% contour does not exist in any development area within the Application. The 50% contour (not shown) would cover portions of the Corner Development Area. A reduction in aquifer productivity ranging from 30% to 50% is considered high magnitude but was assigned a final impact rating of low because aquifer utilization within this range would be acceptable according to the *Water Conservation and Allocation Guideline for Oilfield Injection* (2006). Since the numerical groundwater modelling suggests there may be slightly more than a 50% reduction in aquifer productivity in some areas of the Corner Development Area, StatoilHydro has assigned a final impact rating for the Lower Grand Rapids Aquifer of moderate. A moderate final impact rating indicates that StatoilHydro will likely be able to source the necessary groundwater, but will require additional aquifer characterization to effectively mitigate drawdown through optimization of the water well network and will require monitoring of the Lower Grand Rapids Aquifer to ensure compliance with the *Water Conservation and Allocation Guideline for Oilfield Injection* (2006).

52	**Volume 1, Appendix B, Section B2.4.3, Page B-32** StatoilHydro states *the Quaternary water supply for the Leismer Demonstration/Commercial Hub will be adequate for the Leismer Expansion. Potable water (bottled) is planned to be provided by a commercial supplier.* a) Why is the potable water supply needed if the proposed Quaternary water well is deemed satisfactory for the construction and operation camp?

Response

Operation/construction camp(s) are located some distance from the CPF(s). At each CPF, bottled water will be supplied for drinking water purposes. Well water from Quaternary-aged aquifers will be used to supply the water requirements for the construction and operation camp.

53	**Volume 1, Appendix D, TOR, Section 3.4.1, Page 10 of 37** The Terms of Reference include a requirement to *describe the water supply requirements for the Project, including, but not limited to, the following:* • *compliance with the Water Conservation and Allocation Guideline 2006 for Oilfield Injection.* • *an evaluation of alternative water sources and include a description of the criteria and rationale for selecting the preferred source(s) and identify the volume of water to be withdrawn from each source while considering plans for wastewater reuse and the locations of any water wells.* • *contingency plans for water supply including the potential effects of extended periods of droughts on the proposed water supply.* • *options for using saline groundwater including the criteria used to assess the feasibility of its use.* a) Confirm whether or not StatoilHydro will comply with the *Water Conservation and Allocation Guideline for Oilfield Injection (2006).* Comment on the need for a Tier 2 evaluation.

Response

Yes, StatoilHydro will comply with the *Water Conservation and Allocation Guideline for Oilfield Injection* (2006) as well as *Groundwater Evaluation Guidelines* (2003). StatoilHydro is cognizant of the need for tiered evaluation for all wells sourcing groundwater from the non-saline Lower Grand Rapids and Clearwater A aquifers. StatoilHydro will conduct pump testing appropriate to the anticipated pumping rate, install observation wells, collect groundwater samples, field-verify adjacent water wells, conduct a technical evaluation of saline sources, conduct an economic evaluation of saline sources, perform a cumulative effects assessment and evaluate environmental impacts. In addition, StatoilHydro is committed to on-going groundwater quality and quantity monitoring.

53	b) Provide an evaluation of alternative water sources including criteria and rationale for selection.

Response

All tiered groundwater diversion applications submitted by StatoilHydro will include a technical and economic evaluation of alternative water sources in compliance with the *Water Conservation and Allocation Guideline for Oilfield Injection* (2006).

With respect to this Application, StatoilHydro has assessed all possible groundwater sources for the Project and made it a priority to minimize the use of non-saline water.

StatoilHydro's first priority was to source groundwater from the deepest saline source. Within the Project lease boundary, no Paleozoic aged aquifers were identified, therefore the Basal McMurray Aquifer was the deepest feasible saline water source for this Project. The Basal McMurray Aquifer is thin and discontinuous in the Project area. StatoilHydro attempted to maximize the amount of saline groundwater they could source from this aquifer by implementing a balanced push-pull strategy. Using a balanced push-pull technique, StatoilHydro proposed that 49% of the required make-up water for the Project could be sourced from the Basal McMurray Aquifer. StatoilHydro's second priority was to maximize the use of all other viable saline aquifers. The Clearwater B Aquifer is the only other source of saline water within the Project lease and it is only present in the southern portion of the lease area. StatoilHydro attempted to optimize the use of this Aquifer where it was feasible to do so, and proposed that 18% of the required make-up water for the Project could be sourced from the Clearwater B Aquifer. In total, StatoilHydro proposed that saline water constitutes 67% of the required water for the Project.

StatoilHydro's third priority was to obtain the remaining 33% of the required make-up water volume from the deepest non-saline source. The Clearwater A Aquifer is the deepest non-saline source of groundwater in the Project area and it is only present in the northern portion of the lease area. StatoilHydro attempted to optimize the use of this aquifer where it was feasible to do so, and proposed that only 4% of the required make-up water for the Project could be sourced from the Clearwater A Aquifer. Finally, StatoilHydro proposed that all remaining water requirements (29%) be sourced from the Lower Grand Rapids Aquifer (the next deepest non-saline source). The Lower Grand Rapids Aquifer is laterally extensive and present in all Project development areas.

StatoilHydro's plan to use groundwater from the Basal McMurray, Clearwater B, Clearwater A and Lower Grand Rapids aquifers for make-up water requirements allowed StatoilHydro to avoid the use of potentially shallower potable sources, such as, the Empress Channel Aquifer, Empress Terrace Aquifer, overburden aquifers or surface water.

53	c) Comment on whether or not extended periods of drought could impact the groundwater supply and if there are any contingency plans.

Response

StatoilHydro does not believe extended periods of drought would impact groundwater supply given the proposed length of Project, the depth of proposed source aquifers and the presence of thick aquitards above source aquifers. Extended periods of drought (i.e.: decreased recharge), may impact surface water levels and the hydraulic head in shallow aquifers. A detectable change in water levels in aquifers located several hundred metres below ground surface and overlain by thick aquitards would require a drought on a scale of decades to centuries before detectable reductions in water levels are realized. Given the Project length is estimated to be less than 50 years, aquifer productivity is not believed to be at risk with respect to drought.

53	d) What criteria have been used to assess the feasibility of using saline groundwater in the process?

Response

StatoilHydro's criteria for assessment of feasibility in using saline groundwater is explained in Volume 1, Section 4.4.4., Table 4.4-1 in Volume 1 quantifies the estimated use of saline water through the SAGD development.

54	**Volume 3, Section 5.6.2, Page 5-47** The *Alberta Private Sewage Systems Standard of Practice 1999* considers 225 litres per person per day for a construction camp. a) Why is the potable water supply need for the construction, drilling and operation camps estimated at only 70 to 90 litres per person per day?

Response

There is an apparent error in reporting the potable water supply requirements in this Section. Potable water requirements for the construction camps have been described in Appendix A, Section A2.3.1, Page A-12. The camp water requirement is estimated at 225 L per person per camp day.

55	**Volume 3, Section 5.6.3.2, Page 5-62** With reference to the *Water Conservation and Allocation Guideline for Oilfield Injection (2006)*: a) Explain why the 52% of simulated drawdown at the Corner observation well, as well as the 50% increase in size (from the baseline) for 50 m drawdown contour within Lower Grand Rapids aquifer, are not considered significant.

Response

The discussion on page 5-62 refers to the percentage change in drawdown comparing the application case to the baseline case with respect to both magnitude (52% increase) and areal extent (50% increase). Put another way, the 52% discussed for the Corner observation well refers to 52% of the expected drawdown not 52% of the available head and the change in 50 m drawdown contour interval is simply a description of how the drawdown cone changes from the baseline to application. The *Water Conservation and Allocation Guideline for Oilfield Injection (2006)*, on the other hand, describes maximum allowable drawdown as a percentage of the available head. Furthermore, StatoilHydro does not state that drawdown cone size and magnitude in this region are insignificant. On page 5-62, under the heading *Application Impact Assessment*, StatoilHydro states, "The magnitude of make-up water withdrawal is medium to high impact in the vicinity of the Project because the change in aquifer productivity is greater than 15% and exceeds 30% in areas (Volume 3, Figure 5.6-22).

56	**Volume 3, Section 5.6.4.1, Page 5-66** StatoilHydro states that *the thermal plume is predicted to extend 25 m from the well bore in the Undifferentiated Overburden Aquifer/Aquitard, 125 m in the Empress Terrace Aquifer, and 175 m in the Empress Channel Aquifer as a result of 8 years of steam injection…The final impact rating is considered low because there are only three wells (all completed in the Undifferentiated Overburden/Aquitard) located near Project well pads. The closest water well to a SAGD well pad is much greater than 25 m away.* a) Explain whether potable water well may be present in the future within the Empress Terrace and Channel aquifers within 125 m and 175 m of the Project well pads and if so, how the thermal plume impacts to the Empress Terrace and Channel aquifers will be mitigated.

Response

Yes, it is possible that a potable water well, completed in the Empress Terrace and Channel aquifers, could be installed in the future, most likely by an industrial user. StatoilHydro is committed to monitoring representative Project well pads in order to monitor and understand possible impacts to groundwater quality as a result of thermal plumes. StatoilHydro will work closely with all potable water users in the Project area to ensure the protection of potable aquifers and implement appropriate mitigation measures that may be required.

57	**Volume 3, Figure 5.6-3, Page 5-112** Figure 5.6-3 shows two source wells that are not located on StatoilHydro's leases. a) Provide further details including baseline chemical data and any additional testing done on these wells.

Response

Volume 3, Figure 5.6-3, Page 5-112 illustrates the proposed Clearwater Formation wells for the Application Case scenario. These wells do not currently exist, so accordingly no chemical or testing data exists. StatoilHydro will test these wells for deliverability and groundwater quality once these wells are drilled. The well located in Twp 082, Rng 08 W4M is a proposed Clearwater A well to be put in service in 2016 (Volume 3, Tables 5.6-5 and 5.6-6). The well located in Twp 076, Rng 11 W4M is a proposed Clearwater B well to be put in service in 2014 (Volume 3, Tables 5.6-5 and 5.6-6).

57	b) Which development areas will these wells be used for?

Response

The proposed Clearwater A well in Twp 082, Rng 08 W4M is designated to be used for the Hangingstone development. The proposed Clearwater B well in Twp 076, Rng 11 W4M is designated to be used for the Corner expansion, Northwest Leismer and South Leismer development areas. Please refer to Volume 3, Tables 5.6-4, 5.6-5 and 5.6-6, pages 5-51, 5-53 and 5-54.

57	c) Confirm that these wells have been accounted for in the application and cumulative effects assessments. If not, update the assessment to include these wells.

Response

Yes, these two wells were included in the Application and cumulative effects assessments. Please see Tables 5.6-5 and 5.6-6.

Surface Water Management

58	**Volume 1, Section 5.2.13 and 5.3.4, Pages 102 & 119** **Volume 3, Section 6.11.4.1, Page 6-63** StatoilHydro states that water retained in the storm water ponds will be tested and, if acceptable, will be released to watercourses. Retention ponds will be designed to fully retain the 1:25 year, 24-hour storm event. StatoilHydro also states that water retained in the storm water ponds will be tested and, if acceptable, released. Section 6.11.4.1 explains how retention ponds are not directly hydraulically connected to waterbodies; rather, pond release is dispersed over an open, low gradient slope. StatoilHydro continues on by saying that in wet years, there may be slightly more runoff with more frequent releases and less opportunity for downstream losses due to saturated ground conditions, thus, more direct local flow paths to streams may develop. a) What testing protocol will be followed to determine if retained stormwater should be released to the environment?

Response

A testing protocol will be developed that is consistent with applicable guidelines, directives and approval conditions.

58	b) What design characteristics will be used for the stormwater release facilities, e.g., slopes, containment liners, erosion and sedimentation protection, distances from watercourses, etc.?

Response

A dispersion hose or hoses will be laid out along an open, low gradient slope to diffuse the pumped discharge of water. Where possible, the dispersion hose will be located at least 100 m away from any watercourse. For extreme precipitation events in excess of the 1:25 year rainfall, an emergency overflow outlet will release excess water build-up. The outlet will consist of a cobble-armored weir and a downstream swale with a minimum depth of 0.3 m and a base width of 1m. If discharge points need to be closer than 100 m to a watercourse, StatoilHydro will consult with the local ASRD officer and AENV, and obtain any approvals necessary prior to commencing discharge. Potential for down slope erosion due to releases will be monitored and corrective action taken if any erosion develops. This may include the use of local armouring, protective filter fabric, exfiltration ditches or pipes to disperse the flow. The most effective and least disruptive control measures will be selected according to site specific conditions.

58	c) Discuss the potential for increased erosion and increased sedimentation in waterbodies due to the release of stormwater in wet years and the resulting potential for direct flow into nearby streams and lakes.

Response

Compared to dry years, there is a higher potential for increased erosion and sedimentation in waterbodies due to the release of stormwater in wet years. Compared to dry years, there is a greater potential for local flow paths to develop to nearby streams and lakes. StatoilHydro will undertake the following measures to avoid erosion or sedimentation, and reduce potential for direct flow paths into nearby streams or lakes;

- Using dispersion hoses to discharge stormwater which will reduce the volume and intensity of discharge at any particular location, hence reducing potential for erosion and sedimentation;
- Monitoring the potential for down slope erosion due to releases and taking corrective action if any erosion develops; and
- Directing industrial runoff from process areas within the CPFs to the sludge pond, and using water collected in the sludge pond, in the SAGD process.

58	d) Confirm what approvals will be obtained to release surface runoff from facilities into nearby watercourses.

Response

StatoilHydro will review potential discharges from each well pad and CPF with AENV and determine if an approval is required. StatoilHydro will also obtain authorization from ASRD to discharge stormwater off it's leases onto Crown Land. StatoilHydro understands that the EPEA approval may regulate discharge from stormwater ponds.

59	**Volume 1, Section 5.2.13 (p. 102) and 5.3.4.1 (p. 119), Figure 5.1-5 (p. 93)** **Volume 3, Section 6.11.4.1, Page 6-63** Section 5.2.13 indicates that surface water runoff will be directed to the storm water retention pond on each CPF. Section 5.3.4.1 indicates that surface water runoff will be collected for both CPF and production pads. Figure 5.1-5, Typical Well Pad Layout During Drilling Operations, does not show a storm water retention pond. a) Confirm that there will be a stormwater retention pond on each well pad during drilling operations.

Response

Each well pad will have a stormwater retention area located at a well pad corner, which will collect surface runoff within the each well pad by general site grading.

59	b) Confirm the release of stormwater via dispersion over an open, low gradient slope applies to both the well pads and CPF retention ponds.

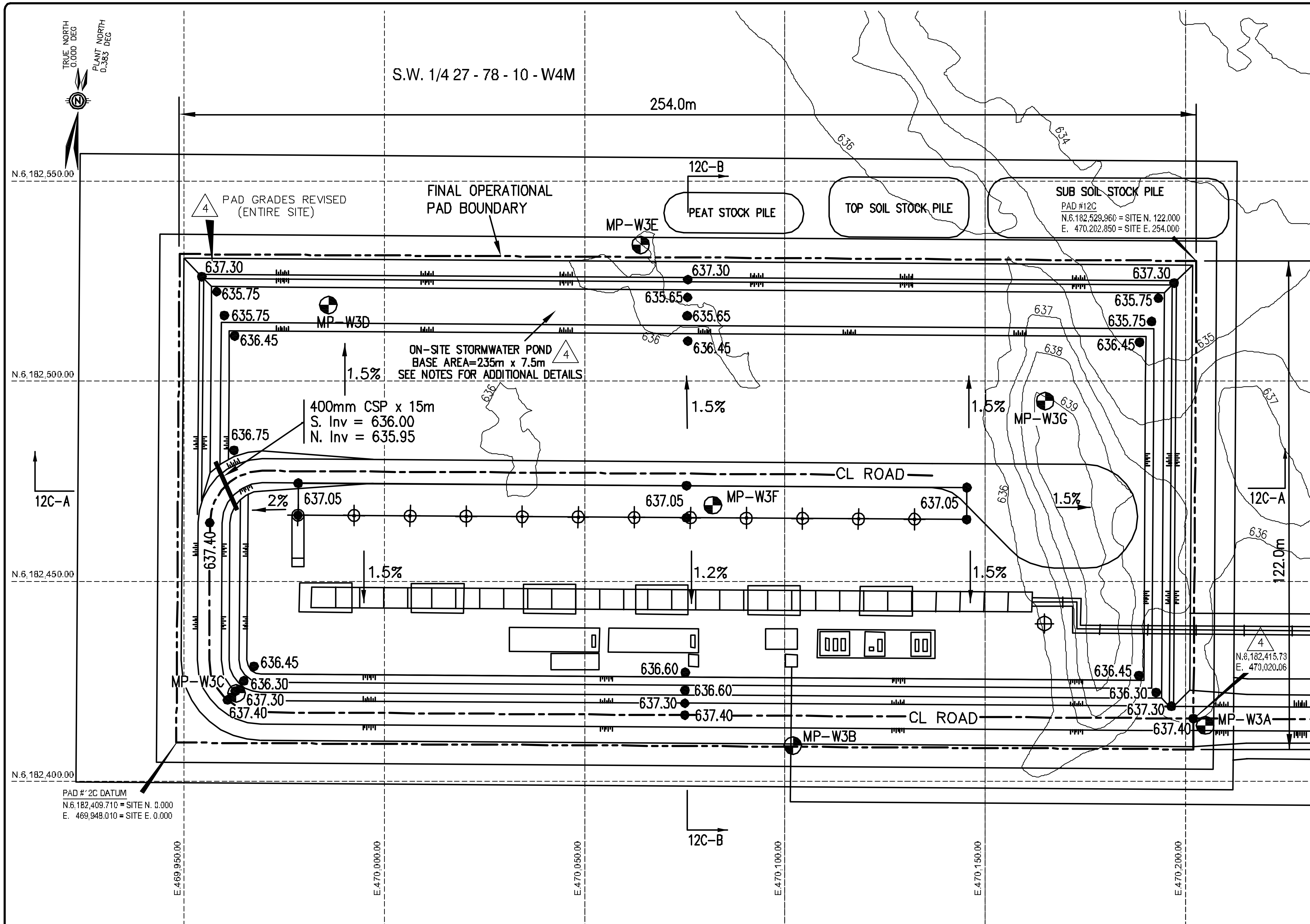
Response

The principle of stormwater discharge via dispersion hoses over an open, low gradient slope applies to the well pads and the CPF retention ponds. It is foreseeable that in some circumstances this may not be possible to achieve, in which case StatoilHydro will consult with AENV and ASRD.

59	c) What are the design characteristics of the stormwater retention ponds found on the well pads?

Response

The stormwater retention ponds on the well pads are designed with impermeable clay liners (see example Figures 59-1 and 59-2). Once sampled and approved for discharge, clean stormwater will be pumped off the pad over an open, low gradient slope through a dispersion hose. It is foreseeable that in some circumstances this may not be possible to achieve, in which case StatoilHydro will consult with AENV and ASRD.



GENERAL NOTES:

1. TOPOGRAPHIC DATA FOR DESIGN HAS BEEN PROVIDED BY THE CLIENT (NAOSC), BASED ON LIDAR DATA COLLECTED BY A THIRD PARTY (FUGRO SESL). AMEC IS NOT RESPONSIBLE FOR ANY ERRORS DUE TO THE ACCEPTANCE OF THIS DATA.
2. MUSKEG LOCATIONS ARE BASED ON VISUAL OBSERVATIONS ONLY. ACTUAL FIELD CONDITIONS TO BE VERIFIED AT TIME OF CONSTRUCTION.
3. GEOTECHNICAL INVESTIGATION CONDUCTED BY THURBER ENGINEERING LTD. 'LEISMER DEMONSTRATION PLANT HUB 1' REPORT, DATED APRIL 16, 2007 CONTAINING BOREHOLE LOGS TH07-5 & TH07-6, WERE REVIEWED AND USED IN THE PAD DESIGN. COMPACTED CLAY LINER RECOMMENDATIONS TO BE FOLLOWED DURING CONSTRUCTION OF STORMWATER POND. LINER TO BE MINIMUM 500mm THICK, COMPACTED TO MINIMUM 95% OF STANDARD PROCTOR MAXIMUM DRY DENSITY AND BE 0 TO 2% ABOVE OPTIMUM MOISTURE CONTENT. HYDRAULIC CONDUCTIVITY OF CLAY LINER MATERIAL IS NOT TO EXCEED 1 x 10^{-7}cm/s.
4. SURFACE DRAINAGE REQUIREMENTS FOLLOW RECOMMENDATIONS AS INDICATED IN THE 'DRILLING PAD DRAINAGE ASSESSMENT' PREPARED BY MATRIX SOLUTIONS INC. ON OCTOBER 30, 2007. STORMWATER POND TO MEET MINIMUM CAPACITY OF 1,500m^3. (AVERAGE DIMENSIONS: 235m x 9m x 0.75m) PERIMETER SITE DRAINAGE TO BE MONITORED DURING & POST CONSTRUCTION. DITCHING TO BE CONSTRUCTED AS RECOMMENDED BY THE ENGINEER/OWNER OR THEIR REPRESENTATIVES.
5. 'SOIL SALVAGE PLAN – PAD 3' PREPARED BY MATRIX SOLUTIONS INC. ON OCTOBER 16, 2007 IS TO BE FOLLOWED DURING SOIL EXCAVATION & STOCKPILING OPERATIONS. STRIPPING DEPTHS TO BE CONFIRMED IN THE FIELD BY NAOSC ENVIRONMENTAL REPRESENTATIVE.
6. CONTRACTOR SHALL MONITOR MUSKEG SETTLEMENT RATE AND TAKE APPROPRIATE MEASURES DURING CONSTRUCTION.
7. CONTRACTOR SHALL FOLLOW ACCEPTED INDUSTRY PRACTICES WHEN CONSTRUCTING OVER MUSKEG.
8. AMEC SHALL BE NOTIFIED IMMEDIATELY IF CONSTRUCTION DEVIATES FROM ORIGINAL DESIGN.
9. SEE SHEET 7 FOR PAD 12C CROSS SECTIONS
10. ALL UNITS ARE IN METRIC, UNLESS NOTED OTHERWISE
11. COORDINATE SYSTEM IS UTM, NAD83

MUSKEG/SOIL PROBE (MP) DATA

1. PROBE LOCATIONS BASED ON HANDHELD GPS. UTM, NAD83 LOCATIONS ARE +/- 10m
2. PROBED IN JULY 2006, BY AMEC INFRASTRUCTURE LTD.
3.

MP No.	NORTHING	EASTING	DEPTH	NOTES
W3A	6182414	470205	N/A	0.3m DUFF
W3B	6182409	470102	N/A	0.3m DUFF
W3C	6182422	469963	N/A	0.3m DUFF
W3D	6182519	469986	N/A	0.5m DUFF
W3E	6182534	470064	N/A	0.4m DUFF
W3F	6182469	470082	N/A	0.4m DUFF
W3G	6182495	470165	N/A	HIGH RIDGE

NO.	REVISIONS	BY	DATE	APPR.
4	Revised & Additional 'General Notes', Revised Well Pad Grades and Addition of 'Stormwater Pond' reference	BC	DEC 18, 2007	TC

NO.	DESIGN LEVEL	DATE
7		
6		
5		
4	Well Pad 12C-Re-Issue for Construction	Dec 18, 2007
3	Well Pad 12C-Issued for Construction	Sept. 21, 2007
2	Well Pad 12C-Layout-for Review	April 27, 2007
1	Issued for Conceptual Purposes	July 28, 2006

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ORIGINAL DRAWING SIGNED AND STAMPED BY THOMAS Y. CHANG AND P.ENG. REGISTRATION NUMBER M37825 ON SEPTEMBER 21, 2007 WITH AMEC INFRASTRUCTURE LIMITED APEGGA PERMIT No. P211 AND SIGNED BY KEN KOZAKEWICH ON SEPTEMBER 21, 2007

SCALE 1:1,000 (0m 10 20 30 40)

DRAWN B.A.C. DATE April 27, 2007
DESIGNED B.A.C./G.R. DATE April 2007
CHECKED G.R. DATE May 3, 2007

CLIENT StatoilHydro

PROJECT STATOILHYDRO KAI KOS DEHSEH PROJECT

LOCATION

TITLE GRADING DESIGN - PAD LAYOUT

PROJECT No. EDT06-0024

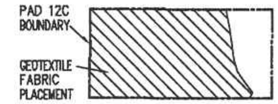
DESIGN LEVEL

SHEET 6 OF 12

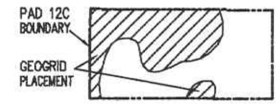
Figure 59-1

CONSTRUCTION NOTES:

1. WOVEN GEOTEXTILE MATERIAL PLACEMENT:
WOVEN GEOTEXTILE MATERIAL TO BE PLACED AT ALL MUSKEG LOCATIONS OR AS DIRECTED BY THE ENGINEER / FIELD REPRESENTATIVE. ALSO TO BE PLACED UNDER ALL ROADWAY AREAS. ESTIMATED QUANTITY = 31,500 SQ.M.

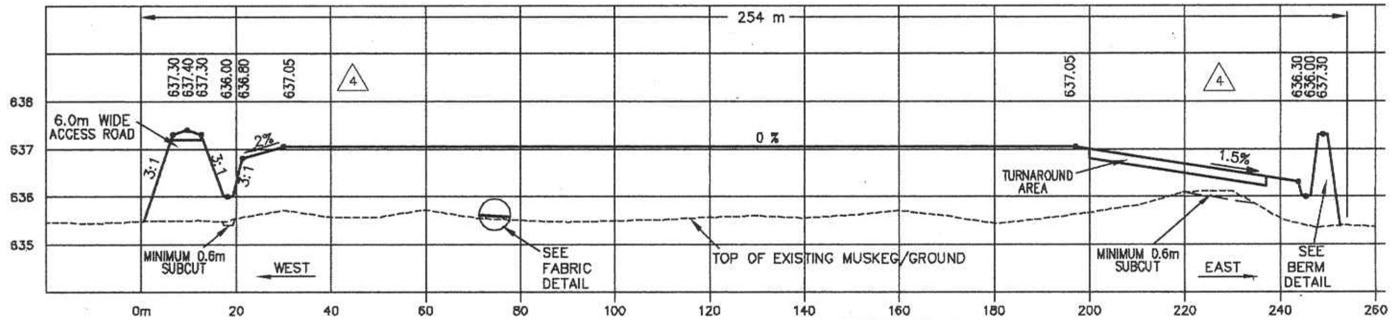


2. GEOGRID MATERIAL & SWD DRAIN PLACEMENT:
GEOGRID MATERIAL TO BE PLACED IF MUSKEG CONDITIONS ARE LOCATED, OR GROUND IS AT ELEVATION 635.70, OR LOWER, AS DIRECTED BY THE ENGINEER / FIELD REP. ESTIMATED QUANTITY = 14,100 SQ.M.



3. ROADWAY & PAD SURFACING GRAVEL:
ROADWAY GRAVEL TO BE SPREAD AT 0.15m (6") THICKNESS FOR ALL DRIVING AREAS ESTIMATED AMOUNT FOR ROADS = 575 cu.m. REMAINDER OF PAD SURFACE TO BE COVERED WITH 0.10m (4") THICKNESS OF GRAVEL ESTIMATED AMOUNT FOR PADS = 1800 cu.m.

4. TOPSOIL & SUBSOIL STRIPPING PILES TO BE SEPARATED BY A MINIMUM OF 5m FROM EACH OTHER AND FROM TREE CLEARING LIMITS. TOPSOIL / SUBSOIL PILES SHALL BE PLACED ON NATIVE TOPSOIL / SUBSOIL, OR AREAS PREPARED WITH GEOTEXTILE TO ENSURE SOIL SEPARATION. PILES SHALL NOT BE STOCKPILED TO AN UNSAFE HEIGHT.



SECTION 12C-A
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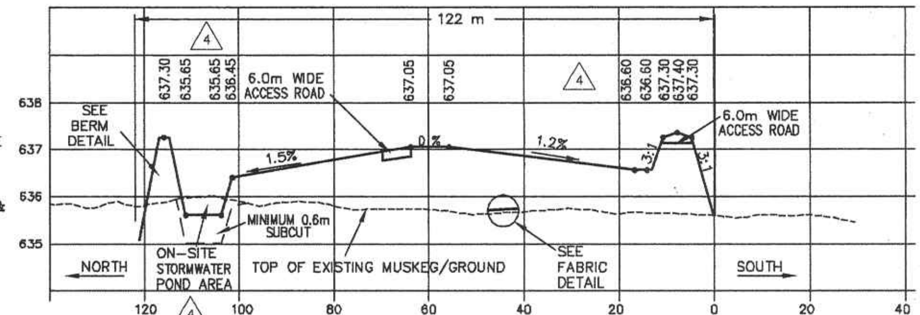
V 1:100



SECTION 12C-B
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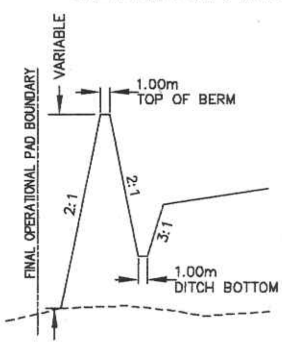
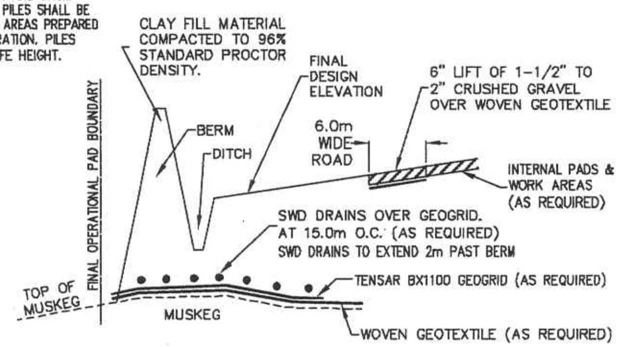
V 1:100



BERM DETAIL
N.T.S.



FABRIC DETAIL
N.T.S.

NOTE: ALL GEOTEXTILE FABRIC, GEOGRID AND SWD DRAIN PLACEMENT TO BE CONFIRMED BY THE ENGINEER OR REPRESENTATIVE AT THE TIME OF CONSTRUCTION.

NO.	REVISIONS	BY	DATE	APPR.
4	Revised & Additional 'Construction Notes', Revised Well Pad Grades and Addition of 'Stormwater Pond' reference	BC	DEC 18, 2007	TC

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ORIGINAL DRAWING SIGNED AND STAMPED BY THOMAS Y. CHANG AND P.ENG. REGISTRATION NUMBER M39235 ON SEPTEMBER 21, 2007 WITH AMEC INFRASTRUCTURE LIMITED APEGGA PERMIT No. P211 AND SIGNED BY KEN KOZAKEWICH ON SEPTEMBER 21, 2007

SCALE: AS SHOWN
DRAWN: B.A.C. DATE: April 27, 2007
DESIGNED: B.A.C./G.R. DATE: April 2007
CHECKED: G.R. DATE: May 3, 2007

CLIENT: StatoilHydro
PROJECT: STATOILHYDRO KAI KOS DEHSEH PROJECT
TITLE: GRADING DESIGN - CROSS SECTIONS
PROJECT No. EDT06-0024
SHEET 7 OF 12

Figure 59-2

60	**Volume 3, Section 6.11.2, Page 6-62** StatoilHydro states that *Surface water use for the Project will be minimal and restricted to short-term tanker truck withdrawals for construction, drilling and dust control. These uses will be individually reviewed and permitted.* a) Confirm what water sources will be used for each of the activities listed above and give an estimate of quantities of surface water that are needed for these activities and the timing (seasonal use).

Response

Water sources for drilling, construction and dust control will be sourced from larger streams or lakes in the area. The concept for selection of streams or lakes for water withdrawal will be to utilize larger streams or lakes, where possible, so that the impact of water withdrawal is minimized. The Table 60-1 below provides an estimate of water volumes that will be required for construction, drilling and dust control, and identifies potential stream and lake locations for each hub. It must be noted that climate variability may have an impact upon the volume of water required for construction, drilling and dust control, and therefore the volumes required during the Project may differ substantially from the figures presented in the Table. Construction and dust control activities will use water in summer only, whereas drilling operations will have a potential year-round need for water, when drilling is taking place. Recycling of drilling fluids will measurably reduce volumes required as well.

Table 60-1 Water Volume Estimates

Hub	Construction volume (m^3)*	Drilling volume (m^3)*	Dust control volume (m^3/yr)
Leismer Demonstration	24,000	12,500	3,000
Leismer Commercial	24,000	0	3,000
Leismer Expansion	24,000	86,500	6,000
South Leismer	24,000	24,500	6,000
Northwest Leismer	24,000	40,500	6,000
Northeast Leismer	24,000	Unspecified	6,000
Corner	24,000	42,250	6,000
Corner Expansion	24,000	42,250	6,000
Hangingstone	24,000	29,500	6,000
Thornbury	24,000	45,250	3,000
Thornbury expansion	24,000	45,250	9,000

* These volumes are for the duration of the construction or drilling program at each hub (not m^3/y)

60	b) If road or pad freezing is required in the winter, confirm where this water will come from and the quantity.

Response

Work to freeze roads or pads would be very infrequent and it would be speculative to attempt to identify locations and volumes of water used.

61	**Volume 3, Section 6.11.4.2, Page 6-65** StatoilHydro indicates that other plant facilities such as camps, offices, laydown areas, and parking lots will have increased run-off, which will be contained and tested before release. a) Provide a map depicting these other plant facilities and describe the run-off containment system.

Response

As a point of correction, surface facilities outside of the industrial process areas such as parking lots, camps and laydown yards will be assessed on a case-by-case basis to determine if stormwater containment and release facilities will be installed.

62	**Volume 3, Section 6.12.1, Page 6-66** StatoilHydro states that well pads will be set back at least 100 m from water bodies where possible to minimize potential disturbance to riparian conditions and impacts on local flow patterns. a) Clarify if this setback will also apply to the CPFs.

Response

As part of the CPF site selection criteria the 100 m setback was incorporated for open water courses and as such, where possible, the setback applies for the CPFs.

62	b) Clarify the conditions where a setback will be less than 100 m and describe the mitigation measures that will be used for these situations.

Response

There may be isolated cases where a well pad cannot be located outside of the 100 m setback due to drilling and or other environmental constraints. In these cases, the well pads would include an appropriate level of mitigation to reduce risks to the nearby watercourses. These measures could include, but not be limited to, increased secondary containment, remote process monitoring, on-site spill response equipment or increased site visits by operations staff.

Wastewater Management

63	**Volume 1, Appendix A, Table A2.3-1 (p. A-13) and Figure A2.2-2 (p. A-9)** **Volume 1, Appendix B, Figure B2.1-2 (p. B-12) and Table B2.4-1 (p. B-33)** **Volume 1, Appendix C., Table C2.4-1 (p.C-33) and Figure C2.1-2 (p. C-12)** Volume 1, Appendix A, Table A2.3-1 indicates Maximum Disposal to the Basal McMurray Aquifer at the Leismer Commercial Hub of 2,100 m^3 per calendar day while Figure A2.2-2 indicates a blowdown rate of 2,770 m^3/d. Volume 1, Appendix B, Table B2.4-1 indicates Maximum Disposal to the Basal McMurray Aquifer at the Leismer Expansion Hub of 4,210 m^3 per calendar day while Figure B2.1-2 indicates a blowdown rate of 5,539 m^3/d. Volume 1, Appendix C, Table C2.4-1 indicates Maximum Disposal to the Basal McMurray Aquifer at the Corner Hub of 4,210 m^3 per calendar day while Figure C2.1-2 indicates a blowdown rate of 5,539 m^3/d. a) For each of the hubs, explain how the blowdown rate can be greater than the Maximum Disposal rate.

Response

Leismer Commercial Hub:
The Maximum Disposal shown on Table A2.3-1 is the disposal flow after the blowdown is flashed. The flashed steam is used in the process and the condensate is recovered to the water reuse system. The blowdown rate shown in the schematic Figure A2.2-2 is at the steam temperature and pressure, and before flash.

Leismer Expansion Hub:
The Maximum Disposal shown on Table B2.4-1 is the disposal flow after the blowdown is flashed. The flashed steam is used in the process and the condensate is recovered to the water reuse system. The blowdown rate shown in the schematic Figure B2.1-2 is at the steam temperature and pressure, and before flash.

Corner Hub:
The Maximum Disposal shown on Table C2.4-1 is the disposal flow after the blowdown is flashed. The flashed steam is used in the process and the condensate is recovered to the water reuse system. The blowdown rate shown in the schematic Figure C2.1-2 is at the steam temperature and pressure, and before flash.

64	**Volume 3, Section 5.6.3.2, Page 5-51** a) Why will wastewater injection into the Basal McMurray Aquifer increase water levels if there is a balanced push-pull approach (i.e., groundwater withdrawal will equal wastewater disposal at any year during the production)?

Response

On a regional scale, there is a balanced push/pull from the Basal McMurray Aquifer (i.e., the wastewater injected equals the source water removed). Wastewater will be injected in disposal wells and source water will be pumped from source wells (Volume 3, Figure 5.6-2, page 5-111). In the vicinity of each disposal well there will be a localized increase in water levels.

Aquatics

65	**Volume 3, Section 8.1, Page 8-1** StatoilHydro states that *field assessments were completed to determine presence or absence of fish species in the region.* Sampling was carried out within the LSA; regional sampling was not conducted. In addition, all sampling was conducted within a single year timeframe which cannot account for the nature of fish distributions (extent and population size) that would fluctuate both due to natural local environmental variables as well as anthropogenic factors. Therefore, the current work done is not sufficient to demonstrate the absence of fish species. a) Comment on the applicability of the data on a regional level given that information was only collected within the LSA. b) Provide additional information on studies to be done to determine the absence of fish.

Response

The StatoilHydro regional approach to aquatic sampling focused on aquatic resources located within close proximity of planned Project developments. Information collected during seasonal sampling was supplemented with information collected for other projects in the region (i.e. other EIA's and RAMP), where available. Studies focused fish habitat quality and fish presence/absence at the time of sampling. The absence of fish present at the time of sampling was not considered an indication of fish absence within the LSA, for this reason habitat quality was the primary focus of the assessments.

As a component of regional study approach, StatoilHydro has committed to conducting site specific aquatic monitoring and adhering to best management practices in areas associated with planned infrastructure development (i.e. roads, pipeline, well pads). The best management practices utilized for the Project will ensure that impacts to aquatic resources are minimized.

66	**Volume 3, Section 8.4.3.4, Page 8-16** Section 8.4.3.4 states that backpack electrofishing was employed for sampling (it is understood that minnow traps and angling were also used for selected sites). Given the size of the watercourses sampled (width, depth, flow) float shocking would have been expected. a) Verify that no other types of electrofishing were conducted. b) If no other types of electrofishing were conducted, comment on the level of confidence StatoilHydro has in the data collected.

Response

Float shocking was conducted on the Christina River (WCL7, WCL10, WCL11, WCL12) during the Fall 2006 baseline sampling program in locations where access to the Christina River was possible. Accessibility was the primary reason float shocking was not conducted at other locations in the LSA and RSA as the majority of sampling sites were only accessible by helicopter or all terrain vehicles.

The data collection conducted during the assessment of fish and fish habitat associated with the Project was collected at a level consistent with other projects in the region. StatoilHydro has committed to conducting additional aquatics surveys at watercourse and waterbody locations as part of the watercourse crossing design and permit process.

67	**Volume 3, Section 8.4.3.6, Page 8-18, 8-19** For habitat ratings (nil, low, medium, high) it is not clear how the classifications were determined. For example, would a single one of these conditions (bullets) result in a particular classification (e.g., low winter habitat potential) or was the overall site classification based on the balance of conditions? a) Provide additional information on how the classifications were determined.

Response

The habitat classifications characteristics provided in Section 8.4.3.6 outline the habitat characteristics that may be present at a watercourse or waterbody at the time of survey. The overall classification of a study location is based on overall observations, which may include but are not limited to channel type, flow characteristics, habitat quality and quantity, water quality and quantity and fish presence/absence at the specific study locations over multiple seasons of observation. Circumstances where no water is present or no channel exists are specific instances where a single condition may be used to determine a study reach's habitat classification.

68	**Volume 3, Section 8.5.1, Page 8-22** There are a series of surveys for fish in the upper Christina River that were not referenced in the Historical Surveys (conducted by FRM Environmental Consulting between 1996 and 2000). This information has since been supplied to Matrix Solutions (Trina James) and should be reviewed for reassessment of potential impacts of the Project. In particular, additional consideration should be given to impacts on Arctic grayling as these surveys demonstrated much more extensive grayling distribution in the RSA. a) Update the assessment as required.

Response

Following the original submission of the StatoilHydro Application and EIA, communications with ASRD (pers. com. C. Davis, ASRD) have resulted in securing additional historical fisheries data within the Project RSA. The following section and the accompanying Figure 68-1 provide an update to Volume 3 Section 8.1.1 and Table 8.1-1. Historic field data sites are depicted as numbers on Figure 68-1

A number of fish species have been identified within the RSA and LSA, including Arctic grayling. The mitigation measures outlined in Sections 8.6.3 and 8.6.4 are designed to minimize the impact to the fish and fish habitat associated with Project activities. StatoilHydro will assess site-specific impacts and if necessary, develop additional mitigative measures, as required by DFO and AENV.

Lower Christina River and Tributaries - Number denotes historic field data sites

- 9 through 15 (Christina River) – A fish inventory was conducted on this stretch of the Christina River in the spring, summer and fall of 1998. Walleye, longnose sucker, white sucker and trout-perch were captured in all three seasons. Northen pike were captured in summer and fall. Goldeye were only captured in summer and lake chub and spottail shiner were only captured during fall sampling.
- 7 (Christina River) – A fish survey was undertaken in the summer and fall of 1996 as part of the fish inventory and monitoring program in Alberta Pacific (Al-Pac) Forest Management Agreement Area (FMA) in northeastern Alberta. Walleye were captured at this site in the spring.
- 21 and 22 (Christina River) – A fish inventory was conducted on the Christina River in the fall of 2004 in conjunction with the RAMP program. Longnose sucker, white sucker, trout-perch and longnose dace were captured in this reach.
- 1 (Christina River) – A fish survey was conducted in the fall of 1993 and spring of 1994 to inventory fish species and distribution in Al-Pac's FMA in northeastern Alberta. Walleye and northern pike were captured at this site.
- 4 (Christina River) – A fish survey was undertaken in the summer and fall of 1996 as part of the Al-Pac fish inventory program within their FMA in northeastern Alberta. Goldeye were captured at this site during summer sampling.
- 5 (Christina River) – A fish survey was undertaken in the summer and fall of 1996 as part of the Al-Pac fish inventory program within thier FMA in northeastern Alberta. Goldeye were captured at this site during summer sampling.
- 51 (Christina River) – A fish survey was conducted in 1998 and 2000 in conjunction with ongoing Al-Pac monitoring within their FMA in northeastern Alberta. Walleye and northern pike were captured at this site during spring sampling.
- 50 (Jackfish River) – A fish survey was conducted in the summer of 1995 as part of the Al-Pac fish inventory program within their FMA in northeastern Alberta. Longnose sucker were captured at this site.

Upper Christina River and Tributaries - Number denotes historic field data sites

- 6 (Christina River) – A fish survey was undertaken in the summer and fall of 1996 as part of the Al-Pac fish inventory program within their FMA in northeastern Alberta. Burbot were captured at this site during summer sampling.
- 2 (Christina River) – A fish survey was undertaken in the summer of 1994 as part of the Al-Pac fish inventory program within their FMA in northeastern Alberta. Walleye and lake chub were captured at this site.
- 3 (Christina River) – A fish survey was conducted in the summer of 1995 as part of the Al-Pac fish inventory program within their FMA in northeastern Alberta. Longnose sucker were captured at this site.
- 29 (Christina River) – Fish surveys were conducted in the summer of 1994 and spring of 1995 as part of the Al-Pac fish inventory and monitoring program within their FMA in northeastern Alberta. Lake chub, longnose sucker, Arctic grayling, white sucker, triout-perch, spottail shiner and pearl dace were captured during summer sampling. Longnose sucker, Arctic grayling and white sucker were captured in the spring.
- 24, 26, 27 (Christina River) – Fish surveys were conducted in the summers of 1997, 1998 and 1999 as part of the Al-Pac fish inventory and monitoring program within their FMA in northeastern Alberta. Northen pike and Arctic grayling were captured at this site.
- 8 (Christina River) – A fish survey was conducted in the summer of 1997 as part of the Al-Pac fish inventory and monitoring program within their FMA in northeastern Alberta. Arctic grayling were captured at this site.
- 24 (unnamed (Goose) River) – A fish survey was conducted in the summer of 1997 as part of the Al-Pac fish inventory and monitoring program within their FMA in northeastern Alberta. Arctic grayling were captured at this site.
- 25 (unnamed (Goose) River) – A fish survey was conducted in the summer of 1997 as part of the Al-Pac fish inventory and monitoring program within their FMA in northeastern Alberta. Arctic grayling were captured at this site.
- 57 (unnamed stream) – A fish survey was conducted in the summer of 2003 within Al-Pac's FMA. Brook stickleback were the only species captured at this site.
- 54 (unnamed stream) – A fish survey was conducted in the summer of 1993 as part of the Al-Pac fish inventory and monitoring program within their FMA in northeastern Alberta. Brook stickleback were captured at this site.
- 53 (unnamed stream) – A fish survey was conducted in the summer of 1993 as part of the Al-Pac fish inventory and monitoring program within their FMA in northeastern Alberta. Longnose sucker, lake chub, white sucker, trout-perch, slimy sculpin and brook stickleback were captured at this site.
- 32 (May River) – A fish survey was conducted in the summer of 1995 as part of the Al-Pac fish inventory program within their FMA in northeastern Alberta. Arctic grayling were captured at this site.
- 43 (May River) - A fish survey was conducted in the summer of 1998 to set up baseline monitoring for high priority watersheds of the Al-Pac FMA. Focus was placed upon sport fish species, particularly Arctic grayling. Northern pike were captured at this site.
- 28, 31, 34, 38, 45 (May River) – Fish surveys were conducted in the summers of 1994, 1995, 1996, 1998 and 1999 as part of ongoing Al-Pac fish inventories and monitoring within their FMA in northeastern Alberta. Effort was focused on sport fish species,

particularly Arctic grayling. Northern pike and Arctic grayling were captured in this reach.

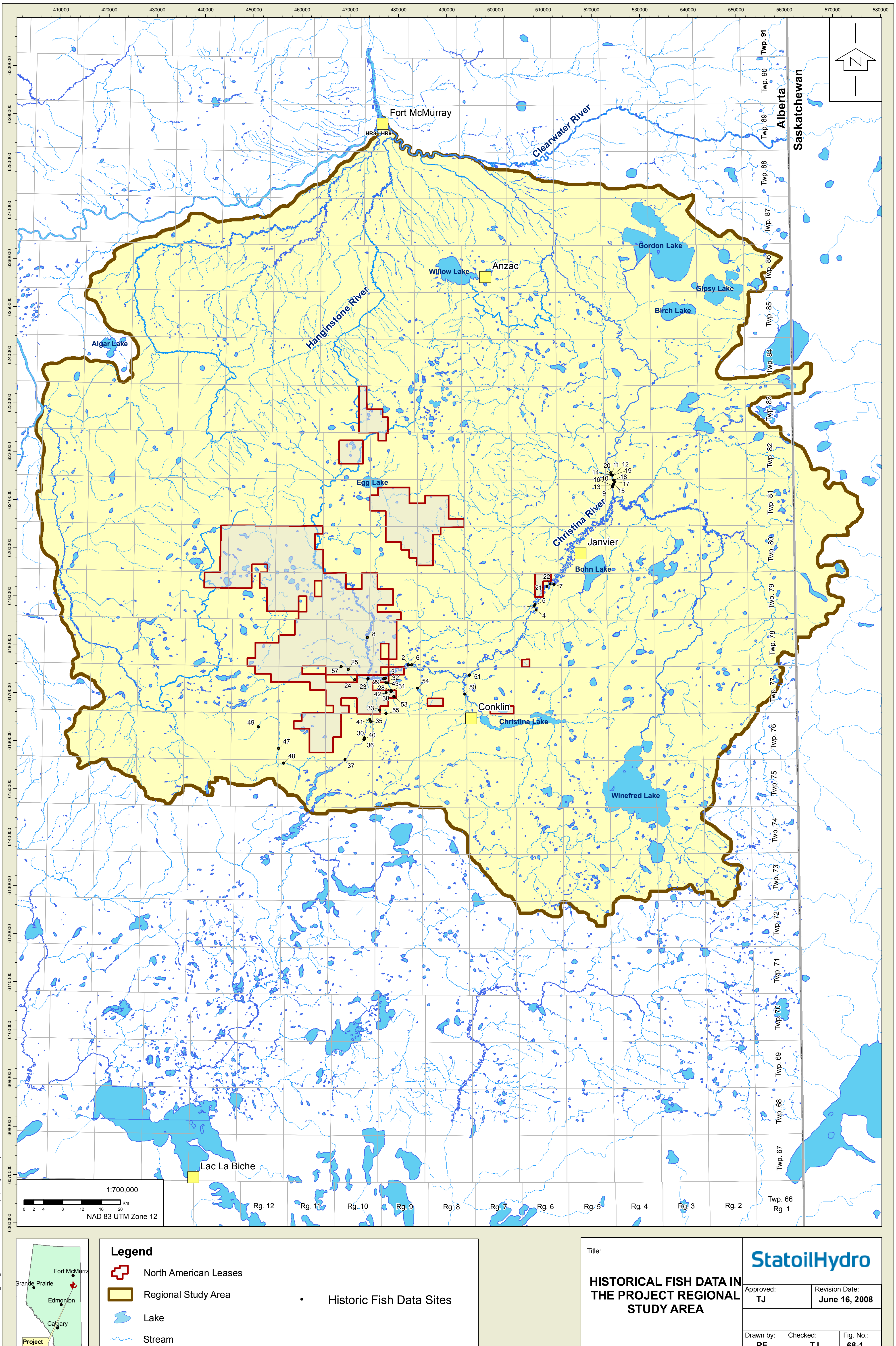
- 42 (May River) – Fish surveys were conducted in the summers of 1998 and 2000 as part of ongoing Al-Pac fish inventories and monitoring within their FMA in northeastern Alberta. Effort was focused on sport fish species, particularly Arctic grayling. Northern pike and Arctic grayling were captured at this site.
- 33 (May River) – Fish surveys were conducted in the summers of 1996, 1998 and 1999 as part of ongoing Al-Pac fish inventories and monitoring within their FMA in northeastern Alberta. Effort was focused on sport fish species, particularly Arctic grayling. Northern pike and Arctic grayling were captured at this site.
- 55 (unnamed stream) – A fish survey was conducted in the summer of 1993 as part of the Al-Pac fish inventory and monitoring program within their FMA in northeastern Alberta. Brook stickleback were captured at this site.
- 41 (May River) – A fish survey was conducted in the summer of 1998 as part of ongoing Al-Pac fish inventories and monitoring within their FMA in northeastern Alberta. Effort was focused on sport fish species, particularly Arctic grayling. Arctic grayling were captured at this site.
- 35 (May River) – A fish survey was conducted in the summer of 1998 as part of ongoing Al-Pac fish inventories and monitoring within their FMA in northeastern Alberta. Effort was focused on sport fish species, particularly Arctic grayling. Arctic grayling were captured at this site.
- 30 (May River) – A fish survey was conducted in the spring of 1995 as part of the Al-Pac fish inventory program within their FMA in northeastern Alberta. Northen pike and white sucker were captured at this site.
- 36 (May River) – Fish surveys were conducted in the summers of 1996, 1998 and 1999 as part of ongoing Al-Pac fish inventories and monitoring within their FMA in northeastern Alberta. Effort was focused on sport fish species, particularly Arctic grayling. Arctic grayling were captured at this site.
- 37 (May River) - A fish survey was conducted in the summer of 1996 as part of the Al-Pac fish inventory program within their FMA in northeastern Alberta. Northen Pike were captured at this site.
- 48 (May River) – A fish survey was conducted in the fall of 2007 as part of a baseline assessment. White sucker were captured at this site.
- 47 (May River) – A fish survey was conducted in the fall of 2007 as part of a baseline assessment. White sucker were captured at this site.
- 49 (May River) – A fish survey was conducted in the fall of 2007 as part of a baseline assessment. Brook stickleback were captured at this site.

Table 68-1 (Table 8.1-1Revised) Fish Species Documented During the Present and Previous Studies in the StatoilHydro Kai Kos Dehseh Project LSA and RSA

Common Name	Scientific Name	Species Code	Occurrence Reported In		Found in Current Study
			LSA	RSA	
longnose sucker	*Catostomus catostomus*	LNSC	√	√	√
white sucker	*Catostomus commersoni*	WHSC	√	√	√
spoonhead sculpin	*Cottus ricei*	SPSC		√	
slimy sculpin	*Cottus cognatus*	SLSC	√	√	
longnose dace	*Rhinichthys cataractae*	LNDC	√*	√	
flathead chub	*Platygobio gracilis*	FLCH		√	
lake chub	*Couesius plumbeus*	LKCH	√	√	√
pearl dace	*Semotilus margarita*	PRDC	√	√	√
finescale dace	*Phoxinus neogaeus*	FNDC		√	
spottail shiner	*Notropis hudsonius*	SPSH	√	√	√
fathead minnow	*Pimephales promelas*	FTMN		√	√
emerald shiner	*Notropis atherinoides*	EMSH		√	
northern pike	*Esox lucius*	NRPK	√	√	√
burbot	*Lola lota*	BURB	√*	√	√
brook stickleback	*Culea inconstans*	BRST	√	√	√
goldeye	*Hiodon alosoides*	GOLD	√*	√	√
walleye	*Stizostedion vitreum*	WALL	√	√	
yellow perch	*Perca flavescens*	YLPR		√	
trout-perch	*Percopsis omiscomaycus*	TRPR	√*	√	√
Arctic grayling	*Thymallus arcticus*	ARGR	√	√	√
cisco, lake herring	*Coregenus artedii*	CISC		√	
lake whitefish	*Coregonus clupeaformis*	LKWH		√	
mountain whitefish	*Prosopium williamsoni*	MNWH		√	
lake trout	*Salvelinus namaycush*	LKTR		√	
rainbow trout	*Oncorhynchus mykiss*	RNTR		√	

√* Updated June 13, 2008

Source(s): MEG Energy Corp. (2005), Devon (2003), Gulf Canada (2001), RAMP (2005), JACOS (2002), OPTI (2000), Nexen/OPTI (2006), Petro-Canada (2001), FMIS (Fisheries Management Information System) database, as of November 16, 2006 (pers. com. L. Rhude, Alberta Sustainable Resource Development) and as of June 13, 2008 (pers. com. C. Davis, Alberta Sustainable Resource Development).



Title:

HISTORICAL FISH DATA IN THE PROJECT REGIONAL STUDY AREA

StatoilHydro

Approved:	Revision Date:	
TJ	June 16, 2008	
Drawn by:	Checked:	Fig. No.:
RF	TJ	68-1

69	**Volume 3, Section 8.6.1, Page 8-45, 8-46** The fish species indicators are not the most appropriate tool for the evaluation of potential impacts. StatoilHydro states that *Specific indicators are chosen because they are able to signal environmental changes that may be caused by certain Project-related activities.* Since the main potential impacts come from sedimentation, water levels and flows, benthic macroinvertebrate changes, and increased access (fish harvest), more appropriate indicators would have been species that are more sensitive to these impacts. Species that would be more appropriate and were also found during the field work associated with sampling for this Project are: slimy sculpin, longnose sucker, and Arctic grayling. Though some species are listed as indicators (brook stickleback, white sucker, northern pike), StatoilHydro notes that *Generalists tend to do better than specialists when environmental changes affect food sources.* There is also no elaboration on how the selected species would be used as indicators. a) Substitute the more appropriate and sensitive indicator species, elaborate on the use of indicator species for assessment of potential impacts, and provide proposals for appropriate monitoring to detect impacts of the Project.

Response

The indicator species selected for this assessment are consistent with other assessments conducted in the region. The species selected as indicators were chosen because they are commonly found throughout the region. The selection of other more sensitive species such as Arctic grayling for long term study may result in adverse affects on the population over an extended period of time. StatoilHydro is committed to working with the appropriate regulators to develop monitoring programs as part of the Operating Approval.

70	**Volume 3, Section 8.6.3.1, Page 8-47** **Volume 3, Section 6.11.4.2, Page 6-64** StatoilHydro explains that surface flow changes due to roads will be highly localized, and based on the Project footprint, there will be numerous watercourse or wetland/ephemeral draw crossing locations to provide access to well pads. a) List and map all watercourse crossings (road, pipeline), give locations and type of crossing planned (eg. bridge, direct drill).

Response

The locations of the proposed watercourse crossings and pad placements in the vicinity of watercourses associated with the StatoilHydro Project are presented in Figure 70-1. A total of 106 road crossings, 17 pipeline crossings and 2 well pads in the vicinity of watercourses are being proposed. Individual crossing techniques (e.g. bridge, direct drill) will be determined prior to construction during the approval process following detailed surveys of the crossing locations.

70	b) Describe reclamation materials and provide a typical design plan for a crossing.

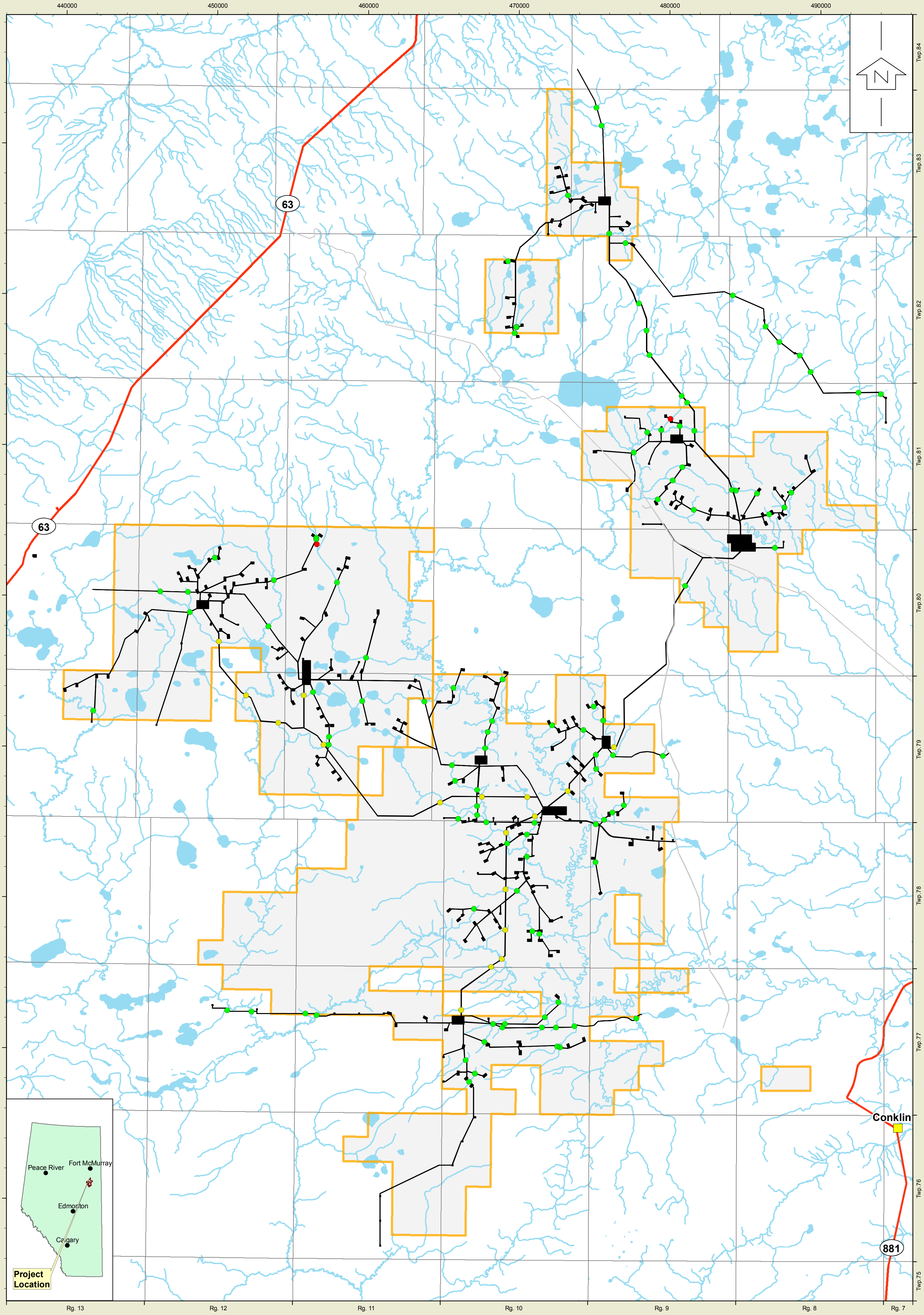
Response

Prior to constructing roads and pipeline crossings, StatoilHydro will provide detailed reclamation and design plans for each individual crossing. StatoilHydro will ensure that all crossings receive the appropriate regulatory authorization (e.g., AENV and DFO) prior to construction, and will ensure that crossing methods employ the most appropriate best management practices required to mitigate potential impacts to aquatic resources.

70	c) There is no description of monitoring for sedimentation at watercourse crossings. Provide a plan to monitor some selected locations to determine if mitigation for impacts of watercourse crossings are being met.

Response

StatoilHydro will provide detailed monitoring plans for watercourse crossings which will be determined prior to construction activities commencing as a component of the approvals process. Individual monitoring plans will be determined based on the types of crossing proposed and the detailed characteristics of the watercourses (e.g. hydrology, substrate composition and bed and bank characteristics).



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LEGEND

- PROPOSED PROJECT FOOTPRINT
- STATOIL LEASE BOUNDARY
- TOWNS
- HIGHWAYS
- ACCESS OUTLINE
- LAKE
- STREAMS

WATERCOURSE CROSSINGS

- ACCESS ROAD (106)
- PIPELINE (17)
- SAGD-PAD (2)

1:250,000

0 1.5 3 6 9 12 15 km

NAD 83 UTM Zone 12

Title:

PROPOSED PROJECT WATERCOURSE CROSSINGS

StatoilHydro

Approved:	Revision Date:
CS/GI	May 23, 2008

File: PROPOSED WATERCOURSE CROSSINGS

Drawn by:	Checked:	Fig. No.:
RF	JA	70-1

71	**Volume 3, Section 8.6.3.2, Page 8-50** Clearing of trees for pads and roadways and hardening of surfaces will alter both the magnitude and timing of runoff. a) Discuss the nature of this impact. In particular, describe stream flows and impacts on spring spawning fish and their rearing habitats, especially Arctic grayling.

Response

The clearing of trees for pads and roadways could potentially result in the alteration of surface flows during periods of elevated runoff. Pads and watercourse crossings associated with the Project will be engineered to ensure that runoff patterns are maintained at natural levels. StatoilHydro will implement the appropriate sediment and erosion control (mitigation) measures to ensure that elevated levels of sedimentation do not enter watercourses during periods of project construction and operation. StatoilHydro will provide detailed engineering designs and proposed mitigation measures to AENV (*Water Act* notifications) and Fisheries and Oceans Canada (*Fisheries Act* authorizations) during the approvals process required for each individual crossing where necessary.

72	**Volume 3, Section 8.6.4.3, Page 8-57** StatoilHydro states *Sport fisheries within the LSA are not considered locally significant.* There is no reference provided to support this statement. While pressure may be low, the population of Arctic grayling in the upper Christina River is extremely important. This is the core population that currently feeds the unnamed tributary to the west (locally known as Goose River) that originates at Base Lake, and the May River. It is also the last remaining population from what used to be an extensive range for grayling that included sub-populations in the Jackfish River, Sunday Creek, and Birch Creek. a) Clarify how the significance of this fishery was determined.

Response

The sport fisheries in the StatoilHydro LSA were not considered locally significant because of the limited access to the majority of watercourses and waterbodies in the area. The significance ranking does not reflect the potential fish and fish habitat present in the LSA; rather it is related to the level of sport fishing pressure the area is currently subject to.

73	**Volume 3, Section 8.6.4.3, Page 8-57** The House River is not named as a watershed within the LSA (or RSA) on Page 8-57 but it does fall within the LSA boundaries. a) Clarify why this river has not been included.

Response

StatoilHydro acknowledges that the House River is located within both the LSA and RSA boundaries. Sampling of the House River drainage was conducted (WCL3 and LL3) during the gathering of baseline data as shown in Volume 3, Figure 8.2-2.

74	**Volume 3, Section 8.6.4.3, Page 8-57** The conclusion that access development will not have a large magnitude impact on fish populations does not seem well supported by the information provided. StatoilHydro states that *even a small increase in angling pressure has the potential to impact local fish populations.* The location of the Leismer Study Area and the proposed main access point to this facility cross the Christina River at a location previously devoid of access by automobile. StatoilHydro also acknowledges that *the main fishing areas within the RSA are all readily accessible (i.e., by automobile)...* This is not because roads created fish populations, but because roads provide people with access to the fishery. The same will be true for the fish currently residing or spending some part of their life-cycle in the vicinity of any of the new access points proposed to be developed for the Project. Studies within Alberta (Ripley et al. 2005) have demonstrated a significant inverse relationship between access development and fish population density (i.e., as access improves the fish population declines). In the immediate vicinity of the proposed Project, access development and the associated increase in fishing pressure has resulted in declines in Arctic grayling population from much of their historic range when there were good fisheries in the Jackfish and May rivers and small but sustainable populations in Birch and Sunday creeks. This is an effect that is well understood and yet is not cited by StatoilHydro while StatoilHydro does state that *StatoilHydro has limited authority to prevent access (considered public land).* The Project proposes adding new access to areas currently very difficult to reach and will therefore provide opportunity for increased angler harvest – both legal and illegal. a) Rather than generalize fish populations (as many fish species are not impacted directly by angling), discuss, in particular, the expected impacts on the Arctic grayling population. b) What sampling (analogous to the pH monitoring proposed) is planned to monitor the fish populations and detect impacts? c) What metrics would be used as measuring tools? d) What mitigation is planned in the event of adverse impacts? e) How is angler fishing pressure and harvest due to the new access development going to be monitored?

Responses

The data collected to support the EIA was not intended to be a fisheries population census for the region, but rather to provide adequate data to assess the potential impacts of the Project and to aid in overall Project planning. As such, the EIA focused on collecting habitat data and not fish population data. Detailed fisheries assessments have been and will be conducted at the locations of potential road and pipeline crossings. The detailed assessments will provide an indication of localized fish populations at the time of survey. StatoilHydro will adhere to best management practices aimed at preventing adverse impacts to watercourses and waterbodies in the Project area. Site specific mitigation plans, if required, will be designed for construction and operational activities associated with watercourse and waterbodies within the Project area. During construction and when appropriate, watercourse crossings will be monitored to ensure mitigation measures are effective.

StatoilHydro staff and contractors are required to adhere to all applicable fishing regulations administered by the Province of Alberta. StatoilHydro acknowledges the concern regarding increased access into the region and the potential implication it may have as a result of both legal and illegal fishing. There are two obvious solutions to mitigate against increased angling pressures; limit access by controlling roads and control fishing pressures through fishing licenses and enforcement. StatoilHydro, like all other operators that construct private roads on Crown land, has limited authority to restrict access to public lands. StatoilHydro is also not in a position to regulate or enforce fishing regulations within Alberta. As such, StatoilHydro does not intend on monitoring fish populations or fishing practices in the region, however StatoilHydro is more than willing, and required by regulations, to provide fisheries data collected during detailed design and watercourse crossing monitoring so that appropriate fisheries management decisions can be made by the Province.

75	**Volume 3, Section 8.9, Table 8.9-1, Page 8-59** The impact to sportfish populations is expected to include the entire population within the upper Christina River watershed. Larger species such as Arctic grayling and longnose sucker use the headwaters of this system for spawning and early rearing, the middle reaches (near the proposed Leismer area) for mid-summer adult foraging habitat and the lower reaches for overwintering. Any activities along this entire course would therefore have the potential to negatively impact the population of these wide-ranging larger species and since the effect would often be manifested at the population as well as the individual level, one would anticipate that the extent of the impact should be considered at least regional. As the grayling population is currently at a lower level than historically reported – both in range and in number, this species is at particular risk. To effectively determine potential impacts of the Project, details about what life history stages are utilizing each river reach is needed. a) How did the age and size distribution of Arctic grayling and other large-bodied fish species vary along the major river systems within the RSA (Christina, Hangingstone, and House)?

Response

The data collected to support the EIA was not intended to be a fisheries population survey for the region but rather to provide adequate data to assess the potential impacts of the Project and to aid in overall Project planning. As such, the data collected for the StatoilHydro EIA focused on fish habitat and fish presence and non-presence. The determination of the age and size distribution of Arctic graying and other large-bodied fish species within the RSA is outside the scope of the current assessment.

75	b) Where is the summer range for sportfish species within the RSA (particularly pike and grayling) and how does this relate to existing and proposed access developments?

Response

Based on the absence of known barriers to fish migration in the larger river systems (e.g. Hangingstone, House and the Christina Rivers) in the StatoilHydro RSA, it is assumed that sportfish such as Arctic grayling and northern pike will be present throughout these systems. StatoilHydro has committed to conducting detailed assessments of the fish and fish habitat at proposed infrastructure locations (e.g. watercourse crossings, pad locations) that will aid in determining the distribution of sportfish as they relate to proposed developments.

D. TERRESTRIAL

Project Development/Footprint

76	**Volume 1, Figure 1-2, Page 4** **Volume 1, Section 2.2; Page 10** **Volume 1, Table 8.2-1, Page 148** **Volume 2, Table 1.5-1, Page 1-16** Section 2.2 indicates that pad access roads are associated with field facilities, and that access roads are associated with interconnecting access roads. Figure 1-2 shows roads going between the hubs on the Regional Study Area (RSA). a) Comment on whether or not the roads linking the hubs shown in Figure 1-2 are existing or future roads.

Response

Within the Project area, roads linking hubs are predominantly winter access roads, which may be upgraded to all-season roads. One notable existing all-season road is the Waddel Road, which provides a substantial part of the proposed access between the Leismer and Corner hubs.

76	b) Table 8.2-1 presents a disturbed area for roads of 439 ha. Clarify if the 439 ha disturbance applies to disturbance in the Local Study Area (LSA) only.

Response

The disturbed area for roads of 439 ha applies to the disturbance within the Project footprint which includes lands in both the LSA and RSA.

76	c) There is no mention in Table 1.5-1 of additional roads disturbance as part of the projects being considered in the cumulative effects assessment. Clarify if there is an additional disturbance value for roads (and possibly utility corridors) linking the different hubs that run through the RSA that was used in the cumulative effects assessment.

Response

No, all roads connecting the hubs are included as part of the footprint.

77	**Volume 1, Figure 1-2, Page 4** **Volume 1, Section 2.2, Page 10-11** **Volume 4, Figure 10.2-1, Page 10-4** It is noted that some project infrastructure is located outside of the development areas and the terrestrial LSA. The services not included in the application (i.e., fuel gas pipeline, main diluent supply pipeline, main diluted bitumen sales line; and electrical power transmission line) could all potentially cause extensive surface disturbance (along with other potential impacts) within the LSA and RSA. a) Describe how these areas were considered in the EIA.

Response

Commercial arrangements regarding this infrastructure had not been finalized at the time of submission. Potential routing of infrastructure is subject to negotiation of terms and conditions with third-party service providers. Consistent with other EIA applications in the general area, this information was not included in the Application. Separate applications for this infrastructure will be made either by StatoilHydro, or by appropriate third-parties and approval requirements will be met at that time.

77	b) Estimate potential upside surface disturbance values for the LSA and RSA. These appear to be planned facilities associated with the Project that should be considered in both the project-related impact assessment and cumulative effects assessment.

Response

Commercial arrangements regarding this infrastructure had not been finalized at the time of Submission. Without commercial arrangements, upside surface facilities routing is very difficult to predict, and it is speculative to provide an estimate of surface disturbance values. Consistent with other EIA applications in the general area, this information was not included in the Application. Separate applications for these services will be made under appropriate regulatory processes.

78	**Volume 1, Figure 1-2, Page 4** **Volume 4, Section 10.2.1, Page 10-1** **Volume 4, Section 11.2.1, Page 11-1** **Volume 4, Section 12.3.1, Page 12-2** The LSA encompasses StatoilHydro's Development areas as well as lands between Development areas. a) What proportion of the LSA is within StatoilHydro's Development areas? b) Provide a discussion about the dilution effect of predicted disturbances, and how this has been accounted for when determining impact assessment criteria.

Response

To ensure openness and transparency in the community, Statoil Hydro has undertaken a regional EIA that fully discloses the commercial development within the approximately 12 townships of bitumen leases held by StatoilHydro. The size of the StatoilHydro land holdings, combined with the physical separation of the leases, created challenges in the development of study areas for the EIA. For example, the Project team knew that the leases needed to be interconnected by pipelines and infrastructure however the routing of the infrastructure was not known until late in the Project design. This necessitated the interconnection of the Leismer and Corner leases with a corridor wide enough to capture the pipeline in the LSA. Had the pipeline route been know when the Terrestrial LSA was selected, the LSA would have been narrowed between the leases (see AENV SIR Response 85 for further discussion of the LSA and an analysis of a revised LSA).

The EIA team also considered the potential issue of "diluting" the impacts by creating an artificially large LSA. At the time of the LSA selection it was thought that the majority of the development would occur inside of the oil sands lease boundaries. While resource recovery can only occur with the leases there is no limitation to placing well pads and infrastructure outside of the oil sands leases as long as horizontal completions are within the lease. A close look at the footprint (Volume 1, Figure 1-2) confirms that the majority of the footprint lies within the LSA (and lease boundaries) however some pads and rights-of-way do lie outside of the LSA. The number and size of the facilities occurring outside of the LSA was not considered to affect the discipline assessments and as such the LSA was not refined in the EIA. (again, see AENV SIR Response 85 for further discussion of the LSA).

<table>
<tr><td>79</td><td>Volume 1, Section 2.4, Figure 2.4-1, Page 19
Volume 1, Section 8.2.2, Page 148

In the application StatoilHydro follows a Regional EIA approach which takes into account multiple projects at different geographical locations; Figure 2.4-1 shows the phasing of these different projects.

a) Provide an estimated schedule that shows the reclamation and development phases for each project as they overlap given the dates of developments and the expected lifespan of the well pads.</td></tr>
</table>

Response

Figure 79-1 provides an estimated schedule that indicates the reclamation and development phases for each project as they overlap.

<table>
<tr><td>80</td><td>Volume 1, Section 8.2.1, Page 148

StatoilHydro states that initial borrow excavations for the Leismer Demonstration Project are included: additional borrow excavations will be needed, but locations have not been finalized. In addition, Section 9.7.2, page 9-76 states that landscape borrows will be required to supply fill material for the construction of the Project facilities. All landscape borrow areas will be located in upland sites. To ensure sufficient fill material will be available for the construction of the Project the area of potential landscape borrow locations within the LSA was evaluated. Potential locations were defined as upland areas with mineral soils that had developed on clay textured parent material.

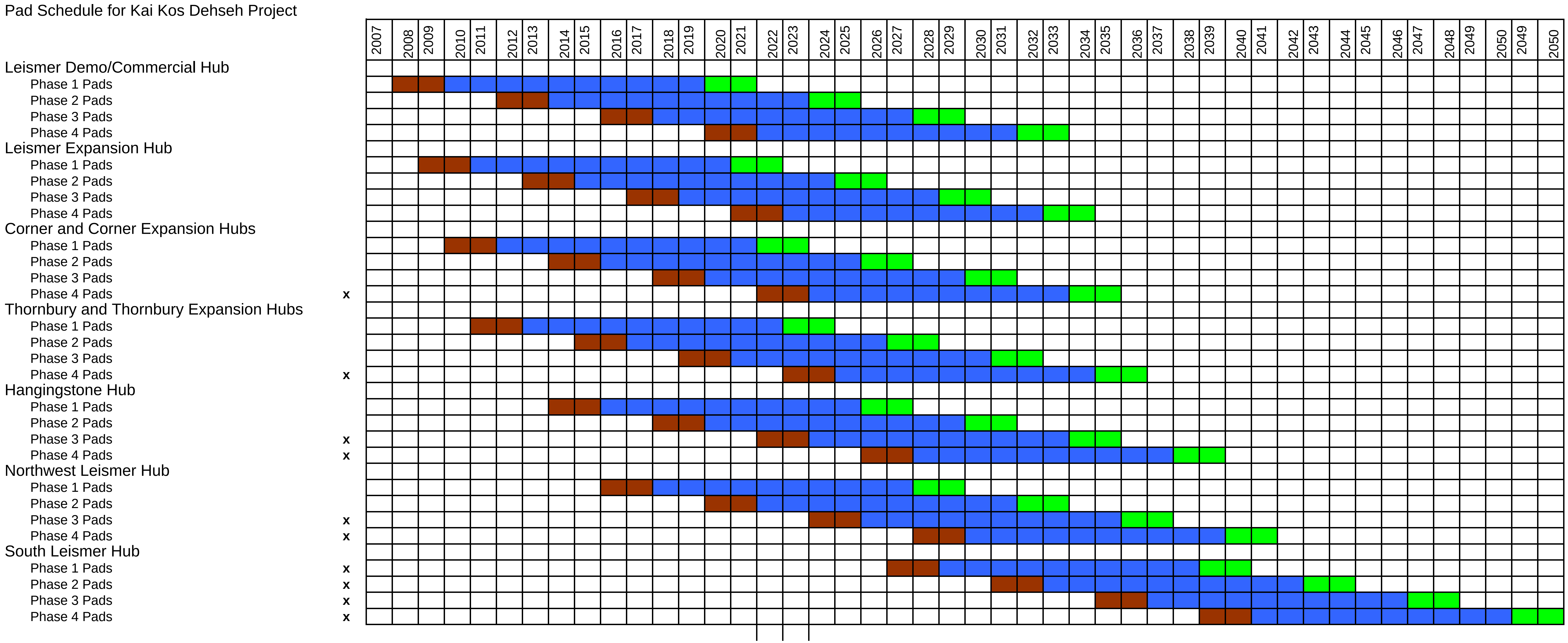
a) Confirm if StatoilHydro has included these additional borrow excavations in its Project footprint calculation. If not, identify clearly and revise.</td></tr>
</table>

Response

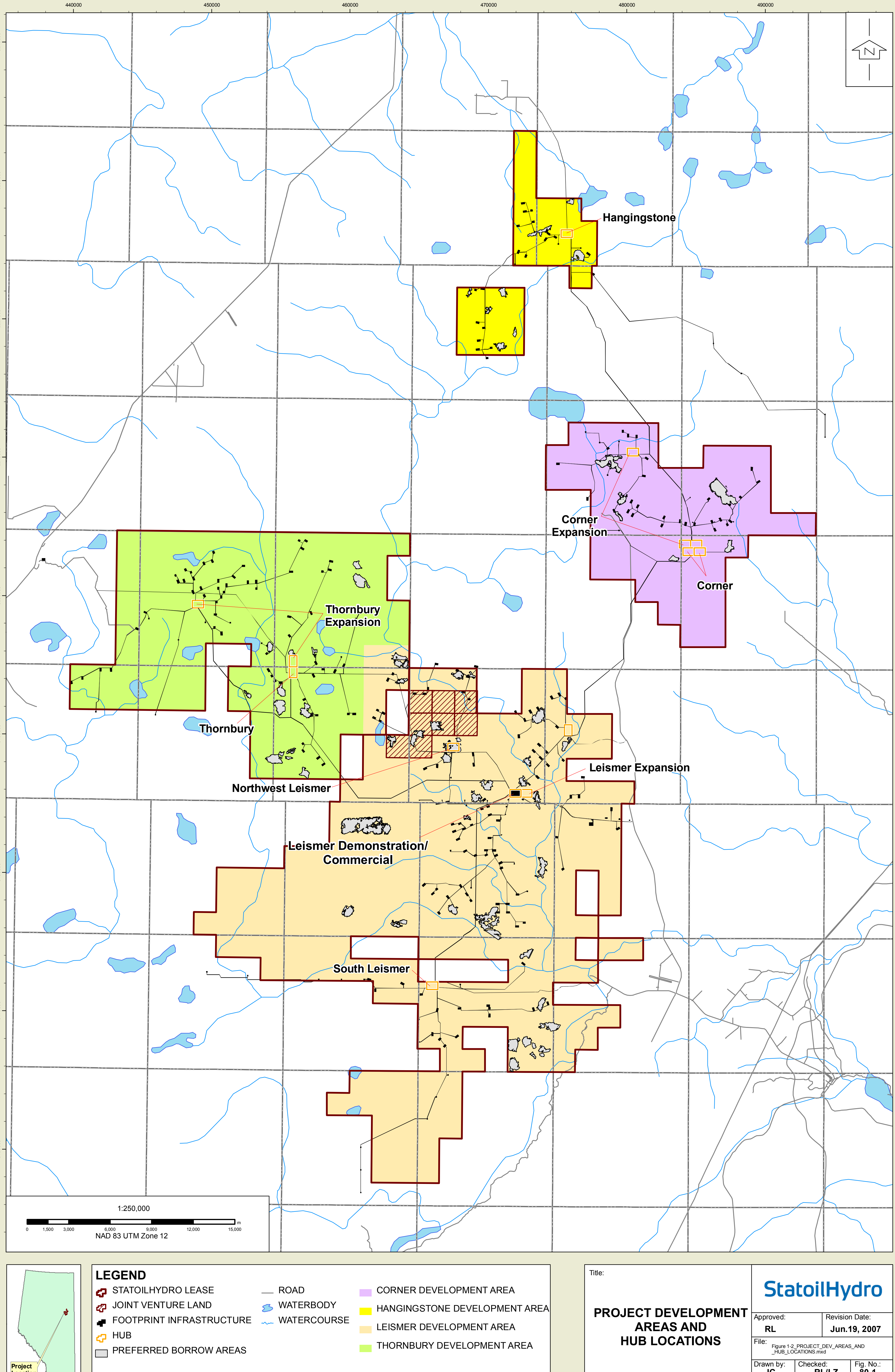
As discussed in the EIA, landscape borrows in the LSA were evaluated to assess if sufficient borrow could be obtained within a reasonable distance from the Project footprint. The landscape borrows will be opened, excavated and reclaimed within a 2 to 5 year time frame and they will not all be open at any one time. On this basis, the borrow areas were not included in the Project footprint as they have a much different temporal aspect when compared to the CPFs, pads and roads.

A planning level estimation of borrow requirements has been conducted and target borrow locations are provided on Figure 80-1. The borrows have been sized, approximately 2,600 ha, to supply adequate volume of borrow for all pads and roads while maintaining a dry upland feature for reclamation. If permitted, StatoilHydro would like to revisit the possibility of excavating deeper borrows, the deep borrows would ultimately be reclaimed as water features, as this would reduce the ultimate area of temporary landscape disturbance.

Figure 79-1 Estimated Schedule



KEY:
Construction/drilling
Operation (assumes shorter well life of 10 years)
Well abandonment/reclamation
x Wellpads constructed after another phase of wellpads have been reclaimed.



LEGEND

- STATOILHYDRO LEASE
- JOINT VENTURE LAND
- FOOTPRINT INFRASTRUCTURE
- HUB
- PREFERRED BORROW AREAS
- ROAD
- WATERBODY
- WATERCOURSE
- CORNER DEVELOPMENT AREA
- HANGINGSTONE DEVELOPMENT AREA
- LEISMER DEVELOPMENT AREA
- THORNBURY DEVELOPMENT AREA

Title:

PROJECT DEVELOPMENT AREAS AND HUB LOCATIONS

StatoilHydro

Approved: RL	Revision Date: Jun.19, 2007	
File: Figure 1-2_PROJECT_DEV_AREAS_AND_HUB_LOCATIONS.mxd		
Drawn by: JC	Checked: RL/LZ	Fig. No.: 80-1

80	b) Provide an estimate as to the quantity of the fill material required for the entire Project and discuss any potential need to import fill material from outside the LSA.

Response

StatoilHydro anticipates it will need approximately 40 million m^3 of fill material. This volume of material will be sourced from the StatoilHydro leases, however, in some cases there may be logistical and environmental benefits from sourcing material off-lease.

81	**Volume 1, Section 8.6.2.2, Page 161** StatoilHydro states that the production well pads will be clay lined to contain runoff and prevent water seepage onto the lease. The accumulated facility runoff water will be tested to determine whether it is appropriate to release. a) Provide details on any detection methods in place to determine if there are any leaks in the clay liner.

Response

The clay liner will have testing conducted after construction to verify that it meets required impermeability standards. For any pads in muskeg, water testing will be conducted annually from muskeg downstream of the pad to determine any significant change in water quality (monitoring for hydrocarbons, TDS and TSS).

82	**Volume 1, Section 8.6.3.3, Page 166** **Volume 1, Section 5.2.15.2, Page 107** StatoilHydro identifies the construction of sludge ponds and storm water retention ponds. a) Discuss the end land use and reclamation of these ponds.

Response

For sludge ponds, any contaminated material will be excavated and trucked to an appropriate landfill. Once all potentially contaminated material has been removed from the pond(s), the clay liner will be removed and the pond(s) will be reclaimed to be self-draining, and consistent with the reclamation end point for the rest of the CPF

For stormwater retention pond(s), any contaminated material will be evaluated and trucked to an appropriate landfill. Once all potentially contaminated material has been removed from the pond(s), the clay liner will be removed and the ponds will be reclaimed to be self-draining, and consistent with the reclamation end point for the rest of the CPF

82	b) It is unclear if these ponds are included in Table 8.2-1, Page 148. Confirm if StatoilHydro has included these ponds in its Project footprint calculation. If not, identify clearly on a map and revise Table 8.2-1.

Response

The stormwater and sludge ponds are considered to be part of the CPF, and are therefore accounted for in Table 8.2-1.

82	c) Identify what potential impacts ponds will have on wildlife and how wildlife will be excluded from these ponds.

Response

The process ponds at the CPFs will be fenced, and if required, bird deterrents will be utilized. These design measures will mitigate potential wildlife interactions and impacts with the ponds.

83	**Volume 1, Section 8.6.3.4, page 168** StatoilHydro states that *access roads on mineral soils will have surface duff/peat and surface mineral soil salvaged only*. a) Discuss the scientific rationale used to determine that subsoil will not be salvaged on access roads.

Response

Soil salvage aims to preserve the upper soil quality important for vegetation growth by salvaging it and storing it for replacement upon reclamation. Historically, the most severe impact to surface soil by development is arguably from contaminating the surface soil, which can affect large areas and be difficult to remediate, sometimes necessitating removal (and loss) of the soil. The potential for contamination on the access roads, taken as a whole, is relatively low compared to CPF and well pad facilities. The benefits of salvaging subsoils must be weighed against some potential impacts of the salvaging process. Recovery of the subsoil would require additional topsoil stripping (for subsoil storage), thus increasing the surface disturbance area exposed to potential impacts, and could require additional clearing required for wider access rights-of-way (or other areas) to accommodate the salvaged subsoil storage.

A potentially significant impact to subsoils on the access roads could result from compaction. On drier areas of the access road, compaction is likely to be less severe than on the wet areas, and is more easily relieved. Historically, many compacted access roads leading to well sites, have been successfully ameliorated, and have received reclamation certificates. Experience has shown that use of operations such as ripping and discing can be successful if carried out until compaction is sufficiently relieved to allow vegetation growth required for reclamation certification. In wetter areas, compaction may be harder to relieve, and de-compaction activities may need to be targeted for the driest part of the year. In the wetter areas, the salvage process itself may cause some compaction and puddling in fine-textured soils, particularly where saturated conditions exist in the subsoil.

StatoilHydro intends to carry out reclamation activities (including decompaction) as required to achieve soil and vegetation conditions that will meet the reclamation criteria of the day. It is noted that recent AENV approvals for similar projects require subsoil salvage on central processing facility sites and well pads.

<table>
<tr><td>84</td><td>Volume 1, Section 8.6.4.1, Page 170

StatoilHydro states that approximately 15 days of molten sulphur storage will be provided onsite.

a) Describe how the molten sulphur stored will be stored onsite including the containment measures to be used.</td></tr>
</table>

Response

Molten Sulphur will be stored in either of steel atmospheric tankage, or concrete pit, depending on selection of the sulphur recovery process. The storage of sulphur is not addressed in the ERCB Directive 055: *Storage Requirements for the Upstream Petroleum Industry*, however, it is covered in IL 84-11: *Approval, Monitoring and Control of Sulphur Storage Sites*. StatoilHydro has no specific design details for secondary containment at this time, however, it will review the design for environmental impact before submitting its sulphur recovery application for review.

85	
	Volume 4, Section 10, Section 11 Kai Kos Dehseh is the first project to go through the AENV approval process as a large, long-term SAGD project with many, as yet, specifically undefined phases. a) With respect to the size and location of the LSA: i. Provide a map of the area of the footprint applied for in this application (Leismer Commercial, Leismer Expansion, Corner), including ecosite types and specific locations of well pads, road access, and hub development. Also, provide a table of the amount of each ecosite type that will be lost as a result of the footprint applied for in the current application development.

Response

Maps showing the footprints being applied for in this application are provided in Volume 1 Appendix A, Figure A1.1-1; Appendix B, Figure B1.1-1; and Appendix C, Figure C1-2. An overall map showing these Hubs relative to the entire Project is found in Volume 2, Figure 1.2-1. Figures 85-1 and 85-2, provided for this response show these footprints relative to the ecosite phases that will be disturbed.
The amount of ecosite phases disturbed by each of these hubs is provided in Table 85-1.

Table 85-1: Area of Ecosite Phases Removed by the Initial Development Hubs, Corner and Leismer

Ecosite Phase	Corner Hub (ha)	Leismer Hub (ha)	Total (ha)
a1	0.8	0.6	1.4
AIH	4.1	5.5	9.5
b1	38.6	0.8	39.4
b2	11.5	2.3	13.7
b3	7.4	0.0	7.4
BU	0.0	0.3	0.3
c1	20.9	22.0	42.9
CIP	1.9	5.5	7.4
CIW	1.7	0.4	2.1
d1	25.9	71.2	97.0
d2	1.2	10.2	11.4
d3	1.7	2.4	4.1
e1	0.0	2.2	2.2
f1	0.0	1.0	1.0
g1	9.4	24.5	33.9
h1	5.0	45.4	50.4
h2	0.9	11.6	12.5
i1	18.9	8.5	27.4
i2	3.7	2.0	5.7
j1	1.9	7.4	9.3
j2	0.8	0.0	0.8
j3	0.4	0.6	1.0
NWR	0.0	0.6	0.6
Total	156.4	225.0	381.4

85	ii. The LSA is larger than the project footprint due to unknown future development at the time the EIA was conducted. Therefore the LSA includes large areas between leases where only a small strip would actually be located. It also means that the LSA includes significantly more area than that to be developed. Provide a re-analysis of vegetation and wildlife components for the LSA using a more appropriate corridor linkage size. Update the EIA according to the new LSA size.

Response
As requested, the LSA was reduced in area as indicated in Figure 85-3 for this response. See AENV SIR Response 78 for additional discussion on re-sizing the LSA. The wildlife components of the EIA that have been updated for this new LSA include habitat availability. HSI and RSF models were re-run for the wildlife indicator species within the LSA. The results of the re-assessment are provided in Appendix A of this document with a summary provided in Table 85-2.

A summary of the model results (Table 85-2) show small differences from the original LSA analysis and therefore impact ratings for most indicator species are unchanged. Changes in availability of high quality habitat for most indicator species were small in comparison to the original assessment as well. However, larger changes are predicted for the great gray owl, barred owl, black bear, and woodland caribou.

The impact rating for the great gray owl and barred owl changes from a low impact to a moderate impact. Although the change in availability of high quality habitat for black bear and caribou is higher in magnitude than predicted for the original assessment, the impact to both indicators is still considered a moderate impact.

Results of the vegetation assessment for the revised LSA is provided in Table 85-3 and do not affect the impact ratings provided in the EIA.

Table 85-2. Change in Habitat Availability within the Original and Revised LSA at Application

Indicator	Total Habitat Availability		High Quality Habitat	
	Original LSA	Revised LSA	Original LSA	Revised LSA
Canadian Toad	-2.2%	-2.7%	-2.2%	-2.6%
Northern Goshawk	-5.2%	-6.1%	-7.4%	-9.8%
Great Gray Owl	-4.0%	-6.5%	-5.2%	-10.6%
Barred Owl	-1.8%	-1.9%	-4.3%	-6.1%
Boreal Owl	-1.4%	-1.5%	-0.8%	-0.9%
Mixedwood Birds	-2.6%	-3.0%	-2.6%	-3.0%
Old Growth Birds	-1.7%	-2.0%	-1.7%	-2.0%
Beaver	-0.2%	-0.3%	-0.1%	-0.1%
Muskrat	-0.2%	-0.4%	-0.2%	-0.4%
Fisher	-2.0%	-2.4%	-2.3%	-2.6%
Lynx	-2.6%	-3.2%	-4.6%	-5.4%
Black Bear	-5.7%	-7.1%	-3.5%	-12.8%
Moose	-5.1%	-6.2%	-7.0%	-6.5%
Woodland Caribou	-3.3%	-5.6%	-10.6%	-13.3%

Table 85-3 Vegetation Resources within the Revised LSA at Baseline, Application and Closure

Ecosite Phase	Baseline	Application Scenario			Closure Scenario		
	Area (ha)	Area (ha)	Change in Area (ha)	Change in Area	Area (ha)	Change in Area (ha)	Change in Area
Central Mixedwood Subregion							
a1	10	10	0	0.0%	10	0	0.0%
b1	115	114	-1	-0.5%	115	0	0.0%
b3	27	26	-1	-2.8%	27	0	0.0%
b4	42	42	0	0.0%	42	0	0.0%
c1	57	57	0	-0.4%	57	0	0.0%
d1	498	498	0	0.0%	498	0	0.0%
d2	303	303	0	-0.1%	303	0	0.0%
d3	108	108	0	0.0%	108	0	0.0%
e1	316	315	-1	-0.3%	316	0	0.0%
e2	77	77	0	0.0%	77	0	0.0%
e3	18	18	0	0.0%	18	0	0.0%
f1	4	4	0	0.0%	4	0	0.0%
f2	8	8	0	0.0%	8	0	0.0%
f3	2	2	0	0.0%	2	0	0.0%
g1	79	79	0	0.0%	79	0	0.2%
h1	97	97	0	0.0%	97	0	0.0%
i1	550	549	0	-0.1%	550	0	0.0%
i2	36	36	0	0.0%	36	0	0.0%
j1	38	38	0	0.0%	38	0	0.0%
j2	117	116	-1	-0.4%	117	0	0.0%
k1	14	14	0	0.0%	14	0	0.0%
k2	216	216	0	-0.1%	216	0	0.0%
k3	62	62	0	0.0%	62	0	0.0%
Total	2,794	2,790	-4	-0.1%	2,794	0	0.0%

Ecosite Phase	Baseline	Application Scenario			Closure Scenario		
	Area (ha)	Area (ha)	Change in Area (ha)	Change in Area	Area (ha)	Change in Area (ha)	Change in Area
Lower Boreal Highlands Subregion							
a1	1,917	1,852	-65	-3.4%	1,923	7	0.3%
b1	3,373	3,213	-159	-4.7%	3,382	10	0.3%
b2	809	746	-63	-7.8%	813	4	0.5%
b3	481	467	-14	-3.0%	482	1	0.3%
c1	9,877	9,501	-376	-3.8%	9,903	26	0.3%
d1	7,468	7,234	-234	-3.1%	7,500	32	0.4%
d2	3,212	3,163	-49	-1.5%	3,214	2	0.1%
d3	1,090	1,081	-10	-0.9%	1,091	1	0.1%
e1	1,290	1,262	-28	-2.2%	1,292	1	0.1%
f1	79	78	-1	-1.3%	79	0	0.1%
g1	12,966	12,640	-326	-2.5%	13,162	196	1.5%
g1 / transit					650	650	
h1	34,272	33,506	-766	-2.2%	33,882	-391	-1.1%
h2	5,806	5,664	-142	-2.4%	5,725	-81	-1.4%
i1	6,575	6,415	-160	-2.4%	6,489	-86	-1.3%
i2	6,098	6,005	-93	-1.5%	6,052	-46	-0.8%
j1	8,758	8,642	-116	-1.3%	8,702	-55	-0.6%
j2	3,263	3,217	-45	-1.4%	3,241	-21	-0.6%
j3	3,009	2,960	-48	-1.6%	2,984	-25	-0.8%
Total	110,342	107,647	-2695	-2.4%	110,568	226	0.2%
Other							
BU	3,296	3,267	-29	-0.9%	3,267	-29	-0.9%
BU_CC	38	38	0	0.0%	38	0	0.0%
BU_Regen	796	777	-20	-2.5%	830	34	4.2%
Meadow	15	15	0	0.0%	15	0	0.0%
NMC	1	1	0	0.0%	1	0	0.0%
Shrubland	33	33	0	-0.3%	33	0	0.0%
Water							
NWF	276	274	-2	-0.7%	276	0	0.0%
NWL	2,119	2,119	0	0.0%	2,119	0	0.0%
NWR	380	375	-5	-1.2%	380	0	0.0%
Disturbance							
AIG	8	19	12	150.8%	8	0	0.0%
AIH	1,491	2,442	950	63.7%	1,417	-74	-5.0%
AII	22	650	629	2915.3%	21	-1	-2.8%
CC	1,424	1,401	-24	-1.7%	1,401	-23	-1.6%
CIP	1,380	1,662	282	20.4%	1,265	-115	-8.4%
CIW	253	1,160	907	357.7%	235	-18	-7.1%
CL	46	44	-2	-3.5%	46	0	0.1%
Data Unavailable	502	502			502		
Total	125,216	125,216			125,216		

*Summed totals may differ due to rounding

85	b) With respect to the size and location of RSA: i. The RSA is only 3.3 times the size of the LSA, and does not include other regional projects such as Conoco Phillips Surmont, MEG Christina Lake, EnCana Christina Lake, Connacher Great Divide, Devon Jackfish, Whitesands In Situ, JACOS Hangingstone, PetroCanada Meadow Creek, and OPTI/Nexen Long Lake. Provide a more appropriately-sized RSA taking into account and explaining criteria and decisions around regional species biology, movement and distribution, existing and announced projects, and relative RSA size in comparison with the LSA. Update the EIA according to the new RSA size.

Response

Section 4.8.3.2 of the TOR states, “Provide the selection criteria used to determine the Study Areas, including information sources and assessment methods.” There are no regulatory guidelines or recommendations to delineate regional study area boundaries. The selection criteria used is explained in Volume 4, Section 11.2. The RSA was selected based on the average home range of a moose. It is assumed that beyond this distance, the Project affects would be minimal to an individual moose. Although home ranges vary in size and shape, a home range of 11 km wide was used. Based on the literature, moose home ranges vary considerably from 1 km^2 to 90 km^2 with the average less than 50 km^2 (Petticrew and Munro 1979, Haug and Keith 1981, Mytton and Keith 1981, Doerr 1983, Leptich and Gilbert 1989, Cederlund and Sand 1994, Lawson and Rodgers 1997). A circular home range 11 km across is approximately 95 km^2 which is equivalent to the largest home range size reported.

Seasonal movements made by moose are also variable. In one study in northeast Alberta, 76% of moose made seasonal movements between summer and winter home ranges whereas others remained year round in the winter area (Haug and Keith 1981). Of those that made seasonal movements, 38% were greater than 20 km between lowland and highland terrain; however, most moved less than 6 km. At Rochester Alberta, moose that made seasonal movements varied from 7 km to 13 km depending on the sex of the moose (Mytton and Keith 1981). Movements in these areas were between different terrain types. The StatoilHydro study area has fairly consistent terrain and seasonal movements are not expected.

To address cumulative effects, the RSA selection considered other planned or announced projects in the area that were within 22 km (i.e., two moose home ranges) of the Project. Projects within that range would be included with an 11 km buffer surrounding that project. At the time of the assessment, there were no other projects proposed or announced with required project information within 22 km.

While StatoilHydro believes the study areas presented in the EIA are defensible and comply with the TOR, the wildlife LSA and RSA have been revised as requested. The rationale for the revised RSA includes a number of criteria including using one RSA for both moose and caribou. The RSA considers most of the caribou herd boundaries in the ESAR, approximately four moose home ranges (40 km), significant river features (Athabasca River, Clearwater River, Christina

River), and political boundaries (Town of Fort McMurray, Saskatchewan border, Cold Lake Air weapons range) (AENV SIR Response 85a ii, Figure 85-3). This RSA includes all the projects listed above and includes projects that were announced after the inclusion date of March 1, 2007. A rationale for the ratio between the size of the RSA and LSA is unclear and was not considered since no guidelines have been provided.

Project and cumulative impacts on habitat availability for woodland caribou and moose were assessed for the revised RSA (Appendix A). Updated resource selection models were fit from moose and caribou pellet locations for extrapolation to the extent of the revised RSA and are detailed in Appendix B. Updated models were fit because different data sources were required to extrapolate caribou and moose habitat models within the revised RSA. A summary of habitat availability and Project and cumulative impacts on habitat availability for woodland caribou and moose is provided in Table 85-4 and 85-5.

Table 85-4 Summary of Project (Application Scenario) and Cumulative Impacts on Moose Habitat Availability in the RSA

	Impacts		
	Baseline	**Application**	**Cumulative**
Habitat availability for moose in the RSA (HU)	768,460.6	765,572.9	760,353.2
Habitat availability for High Quality Habitat in the RSA (HU)	44,154.2	44,050.7	43,878.1
Change in habitat availability relative to baseline		-2,887.7 (-0.4%)	-8,107.4 -1.0%
Change to high quality habitat availability relative to baseline		-103.5 (-0.2%)	-276.1 -0.6%
Environmental impact		Negligible	Negligible

Table 85-5 Summary of Project (Application Scenario) and Cumulative Impacts on Woodland Caribou Habitat Availability in the RSA

	Impacts		
	Baseline	**Application**	**Cumulative**
Habitat availability for caribou in the RSA (HU)	810,971.5	792,108.6	784,298.9
Habitat availability for High Quality Habitat in the RSA (HU)	339,777.7	312,460.6	306,434.5
Change in habitat availability relative to baseline		-18,862.9 (-2.3%)	-26,672.6 -3.3%
Change to high quality habitat availability relative to baseline		-27,317.0 (-8.0%)	-33,343.1 -9.8%
Environmental impact		Moderate	Moderate

The impact to moose from habitat loss in the revised RSA for both the Project and cumulative impacts are considered to be negligible. Expanding the RSA to include other regional projects resulted in a lower magnitude change from the original assessment.
The regional impact to woodland caribou from habitat loss is predicted to increase from a low to a moderate impact in the revised RSA analysis. Using new data sources (e.g., AGCC data) for

the larger RSA, the Project is predicted to reduce high quality habitat by 8.0% compared to 4.8% in the original Application. However StatoilHydro has a low level confidence in the predictions from the updated models used in the revised RSA (reduced from a previously moderate to a low level of prediction confidence in the RSA analysis), given but not limited to the following reasons:

1) Stand level habitat attributes for caribou was estimated in the revised RSA from much lower resolution data than was used in the original Application (AGCC data vs. AVI data),
2) StatoilHydro has a lesser ability to identify the level of human activity and use on anthropogenic features in the revised RSA as opposed to the original Caribou RSA,
3) The effects of habitat loss on caribou are not understood.

The cumulative effect of the Project with regional projects in the revised RSA is predicted to reduce caribou habitat availability by 3.3%. However since caribou populations are suspected to be below carrying capacity in the region and since there will exist a large amount of caribou habitat (784,289.9 HUs) and high quality habitat (306,434.5 HUs) in the revised RSA, the cumulative effect of habitat loss is considered a moderate impact. Furthermore for both moose and woodland caribou, habitat loss is overestimated given how the future case data (Project and cumulative projects) available to StatoilHydro was applied in this analysis:

1) The entire StatoilHydro Project footprint was considered as a high-use human disturbance and was considered to be developed and operated in synchrony, rather than a staged development in phases over a 30-year duration as planned.
2) The footprints for several cumulative projects in the revised RSA were not available (see AENV SIR Response 88a, Table 88-1) and hence the entire lease area for these projects was used or a larger area surrounding the footprint was digitized from maps available in the public domain.
3) The entire footprint for cumulative projects (whether actual footprint or a larger area) was considered as a high-use human disturbance with no phased development.

To better understand uncertainties related to, and to better manage for woodland caribou, StatoilHydro plans on continuing to monitor caribou, moose and wolf dynamics via the scat detection study design as detailed in AENV SIR Response 85c i), 103b, 104a, 105b, 106a.

REFERENCES

Cederlund, G. and H. Sand. 1994. Home-range size in relation to age and sex in moose. Journal of Mammalogy, 75(4):1005-1012.

Doerr, J.G. 1983. Home range size, movements and habitat use in two moose, Alces alces, populations in southeastern Alaska. Canadian Field-Naturalist 97(1): 79-88.

Hauge, T.M. and L.B Keith. 1981. Dynamics of moose populations in northeastern Alberta. The Journal of Wildlife Management, 45(3): 573-597.

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Leptich, D.J. and J.R. Gilbert. 1989. Summer home range and habitat use by moose in northern Maine. The Journal of Wildlife Management, 53(4): 880-885.

Petticrew, P.S. and W.T. Munro. 1979. Preliminary moose management plan for British Columbia. Fish and Wildlife Branch. Victoria.

Mytton, W.R. and L.B. Keith. 1981. Dynamics of moose populations near Rochester, Alberta, 1975-1978.

85	ii. StatoilHydro states (Volume 4, Page 12-4) that *the perimeters of these projects have not been expanded by an additional 11 km buffer to create the StatoilHydro RSA boundary*. The meaning of the quoted statement is not clear. Provide additional explanation and clarification.

Response

The method used to delineate the RSA for this and past projects included using a conservative home range size for a moose, which is 11 km across (see AENV SIR Response 85b i). The Project is not expected to affect moose more than 11 km from the Project. This assumption is believed to be reliable since the 11 km buffer is relative to a large moose home range in this area and the buffer is applied to the lease boundary, not the project footprint. To include the cumulative effects of other projects, (planned or announced projects with required footprint information) were buffered by 11 km and where the buffers intersect, those projects plus their buffer are included in the RSA. As the Project 11 km buffer did not intersect with the 11 km buffer of other proposed or announced projects, those projects were not included in the RSA. Buffers with existing projects were not considered since those projects are included in baseline. This approach has been accepted for numerous previous EIAs that are approved or deemed complete; however, the RSA has been revised as requested in AENV SIR Response 85 b i.

85	c) With respect to the size and location of caribou RSA: i. What criteria did NAOS use to determine the size and location of the caribou RSA? What is the rationale for removal of townships that are almost entirely designated as Egg-Pony range, and the addition of townships outside the range?

Response

The caribou RSA was selected based on two criteria. First, the area should be of sufficient size and extent to encompass the effects of publicly announced future developments, which may have cumulative effects on caribou. In the case of this EIA, no other cumulative (planned) projects with appropriate assessment information (i.e., project footprint) were identified in the vicinity of the proposed Project (See the regional Air assessment which encompasses a larger area than the caribou RSA: Figure 2.7-1: volume 2, Section 2 of the Kai Kos Dehseh EIA). Since no other cumulative projects with enough detail were identified in the vicinity of the proposed Project, expansion of the RSA to a greater size was not considered necessary.

Second, the caribou RSA should be of sufficient areal extent to adequately capture the typical movement of caribou in the region. A review of the scientific literature on caribou movement and home range use in the ESAR was conducted. The following findings were revealed based on a radio telemetry tracking study of 65 adult caribou (including caribou occurring in the Project area) by Stuart-Smith *et al*. (1997):

- The average annual home range of boreal caribou in northeast Alberta is estimated at 711 km^2 (outliers not removed);
- The spatial overlap between winter and summer home ranges was estimated at 69.3%; and
- Caribou movements between adjacent caribou herd ranges (as delineated from closely neighboring caribou that were studied) occurred at a frequency of only 4.6%.

The above findings indicate that caribou typically reside in home range areas of 711 km^2 or less (given outliers) and that caribou have a high level of annual and seasonal fidelity to their home range areas. The caribou RSA is 3,608 km^2, over five-times the areal extent of an average caribou home range, and is located primarily within the extent of the Egg-Pony caribou herd range (85% overlap). Based on the above findings, the caribou RSA was deemed as sufficient in area to assess habitat conditions for caribou that might reside and continue to reside within the study area in an annual time period.

Provincial herd ranges were delineated by ASRD and the Boreal Caribou Committee using coarse telemetry data and extrapolating estimated habitat relationships (Ann Hubbs, personal communication 28 May 2008), and do not represent geographic distribution boundaries for caribou in the ESAR. The scat detection surveys indicate that caribou use high quality habitats both within, and outside of the Provincial range boundaries. Since the ranges do not represent actual population boundaries, and scat data shows that caribou and high quality habitat occur outside these ranges, the RSA was based on other criteria as noted above.

REFERENCES

Stuart-Smith, A. K., C. J. A. Bradshaw, S. Boutin, D. M. Herbert, A. B. Rippin. 1997. Woodland caribou relative to landscape patterns in northeastern Alberta. J. Wildl. Mange. 61(3): 662-633.

Hubbs, Anne. Senior Wildlife Biologist, Fish and Wildlife, Alberta Sustainable Resource Development. Telephone conversation, May 2008.

85	ii. Considering caribou are managed on a herd basis, analyze the 2 caribou herds covered by the study area separately. What consideration was put into looking at caribou at the East Side Athabasca River (Caribou Range) (ESAR) level?

Response

See AENV SIR Response 85c i). Since herd ranges do not represent geographic distribution boundaries for caribou in the ESAR, separate analysis of the Egg Pony and Waiu caribou herds separately is not warranted.

At the time of the assessment, and based on knowledge of caribou home range size and movements, Project affects were not predicted to extend beyond the Egg Pony and Waiu caribou boundaries, and therefore the entire ESAR range was not included. Caribou in northeast Alberta typically reside in home range areas of 711 km^2 or less (given outliers) and they tend to have a high level of annual and seasonal fidelity to their home range areas (Stuart-Smith *et al*. 1997). Caribou in northeast Alberta have overlapping summer and winter home ranges or make only small seasonal movements (Stuart-Smith *et al*. 1997, Ferguson and Elkie 2004). However, the RSA has been expanded to include almost all the ESAR herd as requested (see AENV SIR Response 85b i.

REFERENCES

Ferguson, S.H. and P.C. Elkie. 2004. Seasonal movement patterns of woodland caribou (Rangifer tarandus caribou). Journal of Zoology, 262: 125-134.

Stuart-Smith, A.K., C.J.A. Bradshaw, S. Boutin, D.M. Hebert and A.B. Rippin. 1997. Woodland caribou relative to landscape patterns in northeastern Alberta. The Journal of Wildlife Management, 61(3): 622-633.

85	iii. Update the Environmental Impact Assessment according to changes in size of the LSA, RSA and caribou RSA.

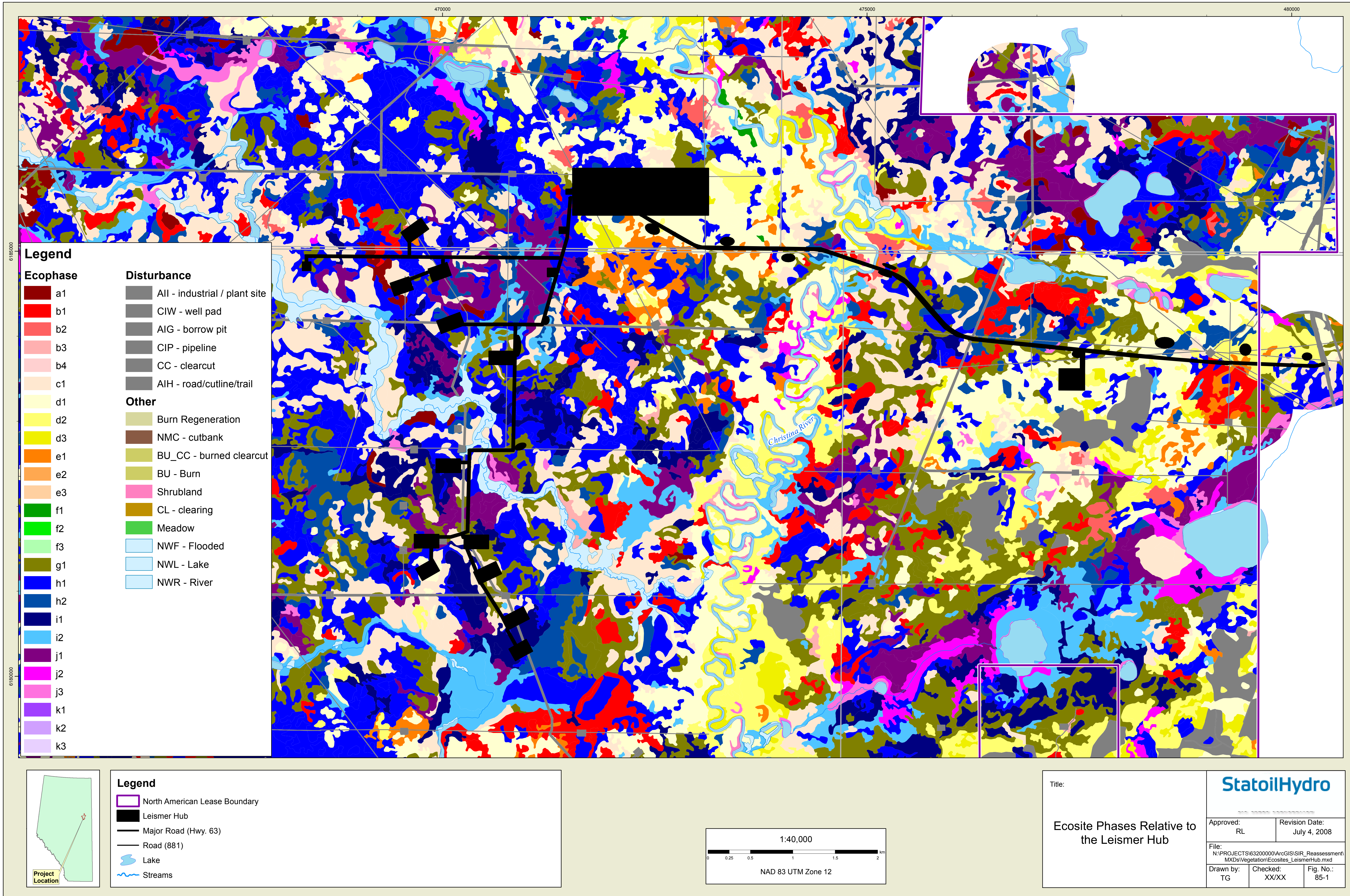
Response

The EIA is being updated as indicated in AENV SIR Response 85 a ii and b i.

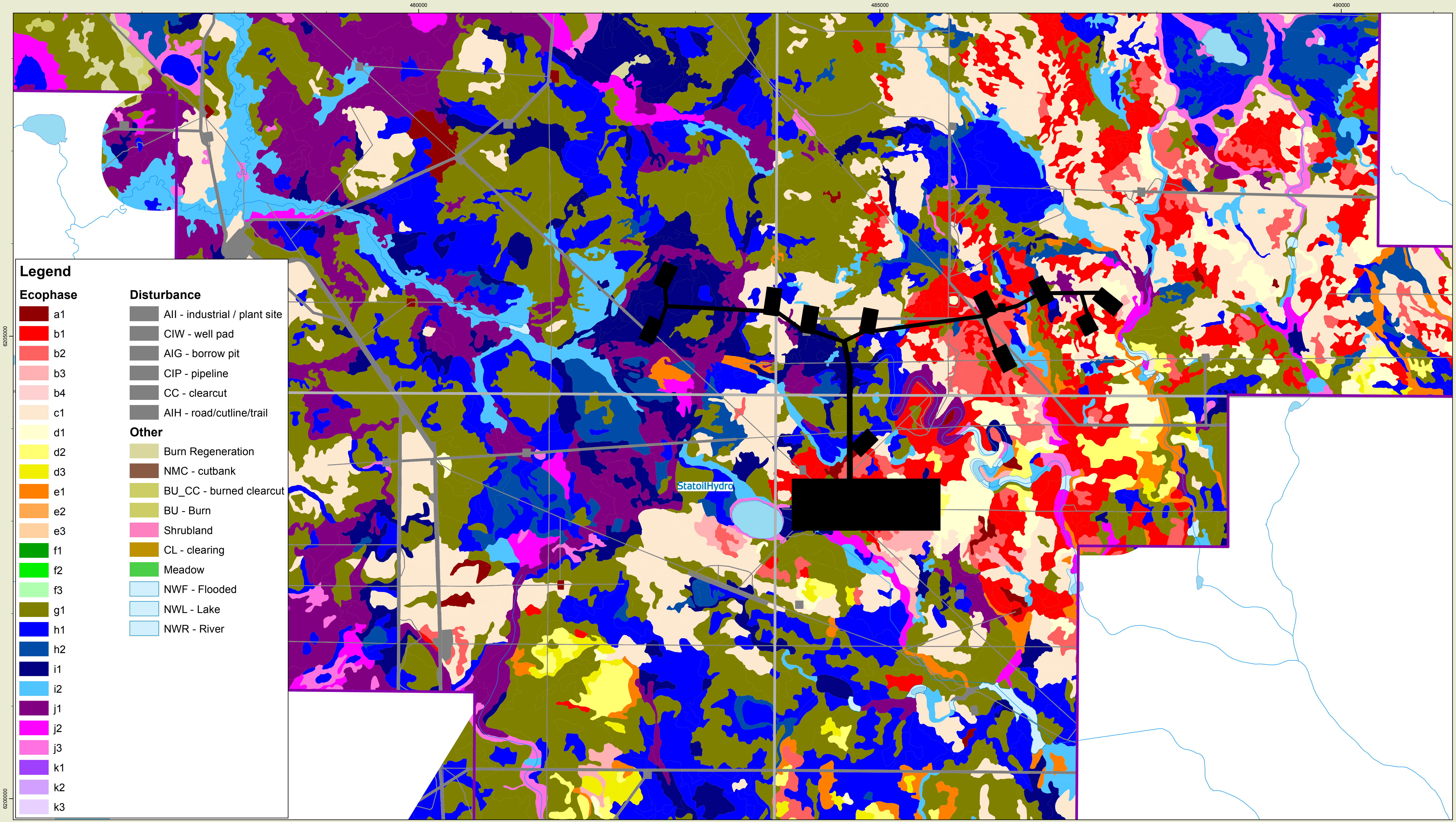
85	d) A conceptual plan was provided for the areas slated for development in future phases (Map 1-2, Volume 1, Page 3). How were impact predictions for the Project as a whole incorporated into these phases?

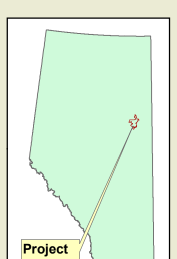
Response

Although Statoil is applying specifically for the Leismer and Corner hubs, the EIA assessed impacts for all phases combined. However, the footprint for future phases is conceptual. The assessment uses a worst case approach assuming that all parts of the Project are developed at one point in time. Hence, this overestimated the impacts on terrestrial resources at any given point in time since the projects will actually be phased over a period of over 30 years (See Volume 1, Figure 2.4-1). Some components of the Project will be reclaimed before other components are developed (see AENV SIR Response 79 a for development schedule). The impacts on wildlife, therefore, are less than predicted.



470000
475000
480000
6185000
6180000
Christina River
Legend
Ecophase
a1
b1
b2
b3
b4
c1
d1
d2
d3
e1
e2
e3
f1
f2
f3
g1
h1
h2
i1
i2
j1
j2
j3
k1
k2
k3
Disturbance
AII - industrial / plant site
CIW - well pad
AIG - borrow pit
CIP - pipeline
CC - clearcut
AIH - road/cutline/trail
Other
Burn Regeneration
NMC - cutbank
BU_CC - burned clearcut
BU - Burn
Shrubland
CL - clearing
Meadow
NWF - Flooded
NWL - Lake
NWR - River
Project Location
Legend
North American Lease Boundary
Leismer Hub
Major Road (Hwy. 63)
Road (881)
Lake
Streams
1:40,000
0 0.25 0.5 1 1.5 2 km
NAD 83 UTM Zone 12
Title:
Ecosite Phases Relative to the Leismer Hub
StatoilHydro
Approved: RL
Revision Date: July 4, 2008
File: N:\PROJECTS\63200000\ArcGIS\SIR_Reassessment\MXDs\Vegetation\Ecosites_LeismerHub.mxd
Drawn by: TG
Checked: XX/XX
Fig. No.: 85-1





Legend

- North American Lease Boundary
- Corner Hub
- Major Road (Hwy. 63)
- Road (881)
- Lake
- Streams

1:40,000

0 0.25 0.5 1 1.5 2 km

NAD 83 UTM Zone 12

Title:

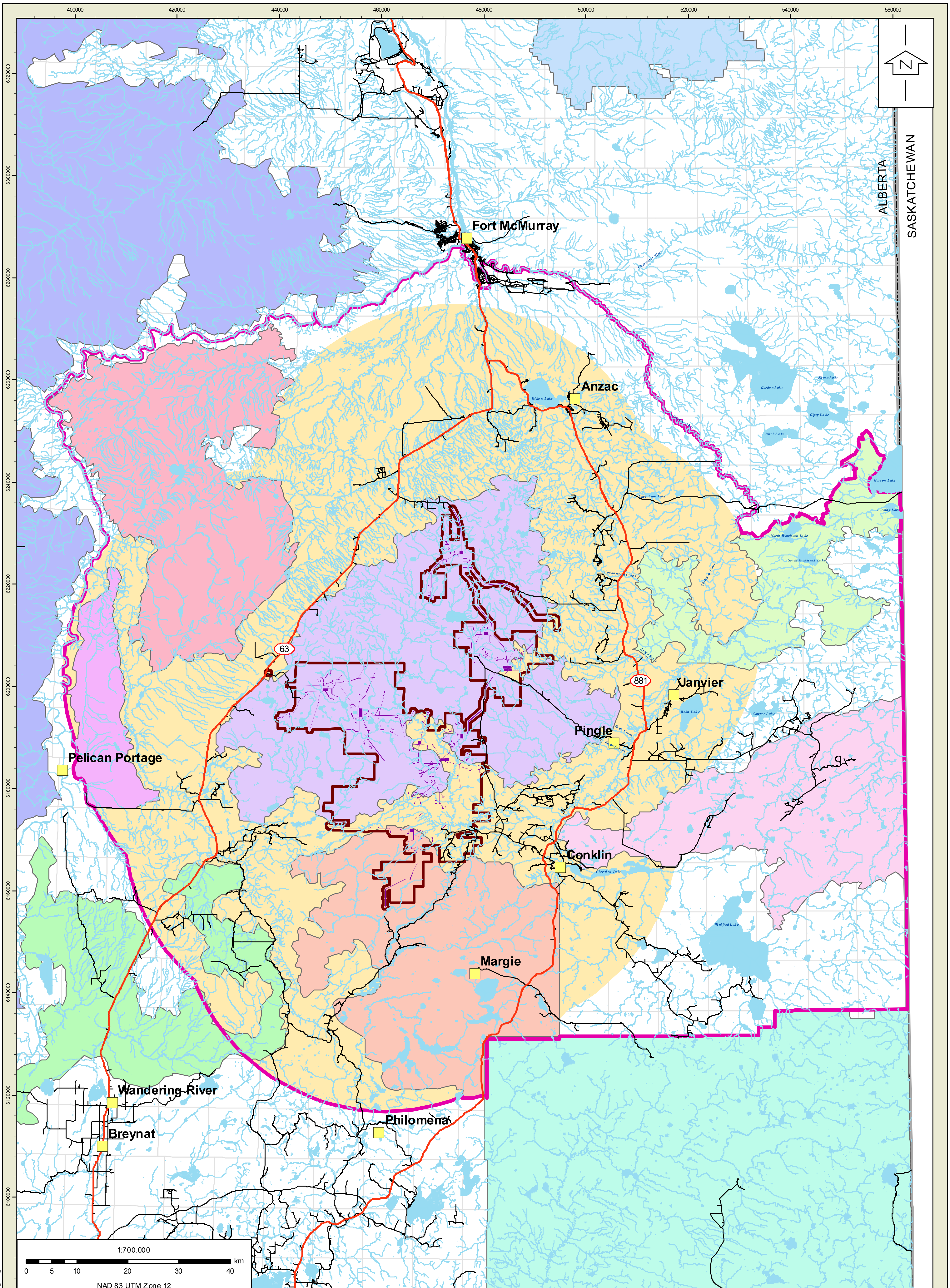
Ecosite Phases Relative to the Corner Hub

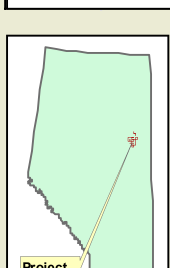
StatoilHydro

Approved: RL	Revision Date: July 4, 2008

File: N:\PROJECTS\63200000\ArcGIS\SIR_Reassessment\MXDs\Vegetation\Ecosites_CornerHub.mxd

Drawn by: TG	Checked: XX/XX	Fig. No.: 85-2





Legend

- WILDLIFE RSA
- WILDLIFE LSA
- STATOIL FOOTPRINT
- STATOIL 40Km BUFFER
- WATERBODY
- WATERCOURSE
- HIGHWAY
- ROAD
- MUNICIPALITY

CARIBOU HERD RANGE

- Agnes
- Algar
- Audet
- Bohn
- Christina
- Cold L. Air Weapons Range
- Egg-Pony
- Firebag
- Steepbank
- Wabasca-Dunkirk
- Wandering
- Wiau

Title:

REVISED WILDLIFE LSA AND RSA

StatoilHydro

Approved:	Revision Date:
RL	July 10, 2008

File: REVISED_WILDLIFE_LSA_AND_RSA.mxd

Drawn by:	Checked:	Fig. No.:
JC	JA	85-3

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86	**Volume 4, Section 10.2.1, Page 10-2 and Volume 1, Figure 1-2, Page 4** StatoilHydro states that *it is anticipated that the overall Project footprint will be further refined.* a) Discuss how confident StatoilHydro is in its environmental effects assessment in light of likely changes in the Project footprint.

Response

The Project footprint includes enough SAGD pads and CPFs to sustain full production over the life of the Project. These facility locations were selected based on current geological interpretations. If these interpretations change in future, they are likely to only change in relative shape, and as such, may see pad movements in the order of hundreds of metres, not kilometres. While some pads may move from one ecosite phase to another, the region is relatively homogenous and pads are not expected to move into significantly different habitats, and, as such, there will likely be little change.

Considering the EIA is a planning tool, a high level of confidence can be given to the overall assessment. If the Project were, in future, to propose an alternate recovery method (other than SAGD) then the assumptions and confidence would need to be revisited and the impacts reassessed. This concept was discussed with the regulators during the EIA kickoff, and both StatoilHydro and the regulators were in agreement that major Project changes could trigger a reassessment of specific impacts or a completely new EIA. Small changes are expected in every project between submission of the EIA and final project design.

86	b) Provide details on additional development anticipated within the defined Project Development Area, as identified in Figure 1-2.

Response

StatoilHydro does not expect to significantly change the amount of infrastructure development within the Project area. As additional reservoir data becomes available for development areas, there may be a need to alter the location of well pads. Should this occur, StatoilHydro will undertake an amendment process with the appropriate regulatory agencies. StatoilHydro has identified viable borrow areas, see AENV SIR Response 80 a for further discussion.

86	c) Clarify if StatoilHydro anticipates the need for additional infill pads within the initial development areas.

Response

Additional infill pads within the initial development areas are not currently required, but this will be assessed as the results from new seismic and stratigraphic well drilling programs are evaluated.

86	d) Discuss how StatoilHydro will include updated environmental baseline and assessment information as part of any Project amendment applications.

Response

StatoilHydro will incorporate an adaptive management approach when new information is received from future site specific assessments and ongoing monitoring activities. This new information will be evaluated to determine whether additional or different mitigation or changes to proposed development placement or construction plans are required. These changes and details will be highlighted in the amendment applications for future hubs.

The intent of the future amendment applications is to provide the standard level of application detail for each hub as their geological concepts and engineering processes move forward. StatoilHydro is also committed to including updated air and groundwater effects assessments (including cumulative effects assessment) as well as incorporating learnings from previous hubs into future hub applications. As engineering design progresses, StatoilHydro is committed to conducting further detailed soil surveys (e.g., Survey Intensity Level One) as part of the Pre-Disturbance Assessment (PDA) process. StatoilHydro has committed to a wildlife and vegetation monitoring program that expands upon the spatial and temporal detail of information available as the Project progresses and these data will be discussed in future amendment applications.

87	**Volume 4, Section 10.3, Page 10-6 and Section 10.7, Page 10-103** StatoilHydro states that *Project effects in the LSA with a predicted magnitude of medium or higher that could act cumulatively with other environmental pressures were included in the Cumulative Effects Assessment (CEA).* Assessment criteria for magnitude indicate that this would require a measurable change of 10% or larger. The document *Cumulative Effects Assessment in Environmental Impact Assessment Reports Required Under the Alberta Environmental Protection and Enhancement Act* (ERCB, AENV, NRCB) directs that past and current projects and activities should be considered in a cumulative effects assessment if project effects overlap those of the project under review. Any measurable effect should be included regardless of magnitude or significance. a) Provide justification for considering only effects rated as moderate or high in the cumulative effects assessment.

Response

The CEA approach was modified to include effects in the LSA with a predicted magnitude of low or higher. The word "medium" is a typo and the assessment was conducted using the correct criteria.

87	b) Indicate how existing and future disturbances within the LSA from seismic activity and oil and gas exploration (including stratigraphic and monitoring wells) have been considered. Note that these have not been included in the Baseline or Application cases in Volume 2, Table 1.5-1.

Response

The Pre-Project anthropogenic disturbances, such as existing well pads, roads, and historical seismic lines, are included in the baseline and therefore are presented as part of the Application Case. These activities are captured under the headings of, "Gas production facilities" and "Pipeline/roadway/electric transmission/other linear" in Table 1.5-1.

Forecasting future oil and gas exploration locations and activities is highly speculative. The inclusion of future oil and gas exploration into the CEA assessment is only possible in qualitative terms, as there is no regulatory requirement for operators to predict where these activities may occur and, as such, footprints for future activities are not available. For additional discussion of future seismic activity, see AENV SIR Response 101.

88	**Volume 4, Sections 10.7, 11.7, 12.3.2 and 12.7** "Baseline" data for the purpose of wildlife models does not seem to include seismic activity on the landscape. "Baseline" in terms of cumulative assessment assumes that seismic activity is on the landscape prior to development. Also, StatoilHydro did not include any other regional projects in the cumulative effects assessment as there were no publicly announced oil sands projects in the RSA. The Cumulative Effects Assessment in Environmental Impact Assessment Reports required under the Alberta Environmental Protection and Enhancement Act (2000) states that all development which is "approved, undergoing review, about to be submitted for review, officially announced by proponent, directly associated with the project under review, not directly associated but induced if the project is approved, identified in a development plan for the area" should be included in a cumulative effects assessment. Development therefore includes, but is not limited to, all oil and gas exploration, forestry, roads, towns, demonstration hubs, planned hub expansion, future hubs and well pads, and other projects. a) Provide a complete cumulative effects assessment for wildlife and vegetation using the new RSA size.

Response

As stated in Section 1.5.2 of Volume 2 of the Kai Kos Dehseh EIA, existing projects were defined as those that are approved by the ERCB and/or AENV. For the cumulative effect assessment, planned developments include projects that have been publicly disclosed (but not approved) as of March 1, 2007. The Air assessment, Section 2.4, Volume 2, has a much larger modelling domain and as such included many more projects that cover a larger study area (Table 2.4-2, Volume 2). While StatoilHydro believes the study areas presented in the EIA are defensible and comply with the TOR, the wildlife LSA and RSA have been revised based on the request to AENV SIR 85 a ii and b i.

StatoilHydro has revised the list of existing and planned developments in the revised RSA (Table 88-1). The list relative to the revised RSA includes several planned projects. Three of these projects were announced after the March 1, 2007 disclosure cut-off but StatoilHydro has included them for the purpose of answering this supplemental question. For additional information on the effects of oil and gas exploration, see AENV SIR Response 101.
The cumulative effects assessment addressed habitat availability for moose and caribou since these species have relatively large home ranges. See AENV SIR Response 85b i for the discussion on cumulative effects.

Table 88-1 (Table 1.5-1 Revised) Existing and Planned Projects in the Kai Kos Dehseh Project Revised Terrestrial Regional Study Area

Assessment	Baseline	Impact Assessment (Application)	Cumulative Effects Assessment
Description	Existing and Approved Developments	Existing and Approved Developments + Kai Kos Dehseh Project	Existing and Approved Developments + Kai Kos Dehseh Project + Planned Developments
Existing and Approved	Nexen/OPTI Long Lake SAGD/Upgraders	Nexen/OPTI Long Lake SAGD	Nexen/OPTI Long Lake SAGD
	Petro-Canada Meadow Creek	Petro-Canada Meadow Creek	Petro-Canada Meadow Creek
	ConocoPhillips Canada Resources Corp. Surmont	ConocoPhillips Canada Resources Corp. Surmont	ConocoPhillips Canada Resources Corp. Surmont
	JACOS Hangingstone Pilot	JACOS Hangingstone Pilot	JACOS Hangingstone Pilot
	MEG Energy Christina Lake Regional Project (Pilot and first phase commercial)	MEG Energy Christina Lake Regional Project (Pilot and first phase commercial)	MEG Energy Christina Lake Regional Project (Pilot and first phase commercial)
	Petrobank Whitesands Pilot	Petrobank Whitesands Pilot	Petrobank Whitesands Pilot
	Devon Jackfish SAGD	Devon Jackfish SAGD	Devon Jackfish SAGD
	EnCana Christina Lake Pilot	EnCana Christina Lake Pilot	EnCana Christina Lake Pilot
	Connacher Great Divide Pilot	Connacher Great Divide Pilot	Connacher Great Divide Pilot
	CNRL Kirby Pilot Project	CNRL Kirby Pilot Project	CNRL Kirby Pilot Project
	Gas production facilities	Gas production facilities	Gas production facilities
	Non-industrial sources	Non-Industrial Sources	Non-industrial sources
	Municipalities	Municipalities	Municipalities
	Non-industrial sources	Non-industrial sources	Non-industrial sources
	Pipeline/roadway/electric transmission/other linear	Pipeline/roadway/electric transmission/other linear	Pipeline/roadway/electric transmission/other linear
	Forest harvest	Forest harvest	Forest harvest
	Trapping and hunting	Trapping and hunting	Trapping and hunting
	Recreation	Recreation	Recreation
Kai Kos Dehseh Project		Kai Kos Dehseh Project	Kai Kos Dehseh Project
Planned			**CNRL Kirby Project**[1]
			Devon Jackfish II SAGD
			Nexen/OPTI Long Lake South SAGD
			Future oil sands exploration
			Future seismic exploration
			Other likely activities
			Forest Harvest
			MEG Energy Christina Lake Regional Project Phase Two
			MEG Energy Christina Lake Regional Project Phase Three[2]
			Connacher Algar[3]
			Possible Highway 63 and Highway 881 connector west of Conklin[4]
		Notes – Date footprint data was available **1 CRNL Kirby, Sept 2007** **2 MEG CLRP Phase 3, April 2008** **3 Connacher Algar, June 2007** **4 Footprint not available at this time**	

88	b) Describe future plans for forest harvest in the region and how StatoilHydro has incorporated these into the project footprint.

Response

Discussions have been, and are, taking place with Al-Pac to incorporate StatoilHydro's development plans into Al-Pac's harvest schedule. StatoilHydro has shared its overall 30 year development plan to indicate the areas that StatoilHydro will be in need of clearing. Now, as part of Al-Pac's integrated land management approach to harvest planning, these data can be incorporated into harvest plans.

88	c) Outline recreational trends in the RSA and describe how these have been included in the cumulative effects assessment.

Response

There are a number of recreational activities that may be present in the RSA including consumptive recreational activities (i.e. berry picking, hunting, fishing) and non-consumptive recreational activities (paddling, hiking, snowmobiling, off road vehicles, cross country skiing) as discussed in Volume 5, Section 13.7-6 to 13.7-10 of the EIA. The "Report on Mobile Workers in the Wood Buffalo Region of Alberta" (Nichols Applied Management and Economic Consultants, November 2007) found that 20% of mobile workers are involved in backcountry activities, which is equivalent to approximately 0.1 backcountry activities per year per mobile worker. The two most common backcountry activities undertaken by mobile workers are off road exploring (41%) and fishing (22%).

Section 13.8.2.3 of the EIA states that there may be an impact on recreational activities due to an increase in access into the Project area. This impact has been rated as neutral as it may be positive for some users, and negative for others. As described in Section 13.9.1 the cumulative effects on recreational activities are also neutral, as the impact may be positive for some users, and negative for others.

Vegetation

89	
	Volume 4, Figures 10.4-1,Page 10-15 and Figures 10.4-1a-c, Pages 10-16 to 10-18 These figures show clusters of vegetation sampling in the Leismer and Corner development areas, while sampling has not been conducted in other areas where project disturbances are proposed. a) Describe additional vegetation sampling, at the site and landscape levels, that will be conducted to evaluate effects of these disturbances. Include a schedule for implementation.

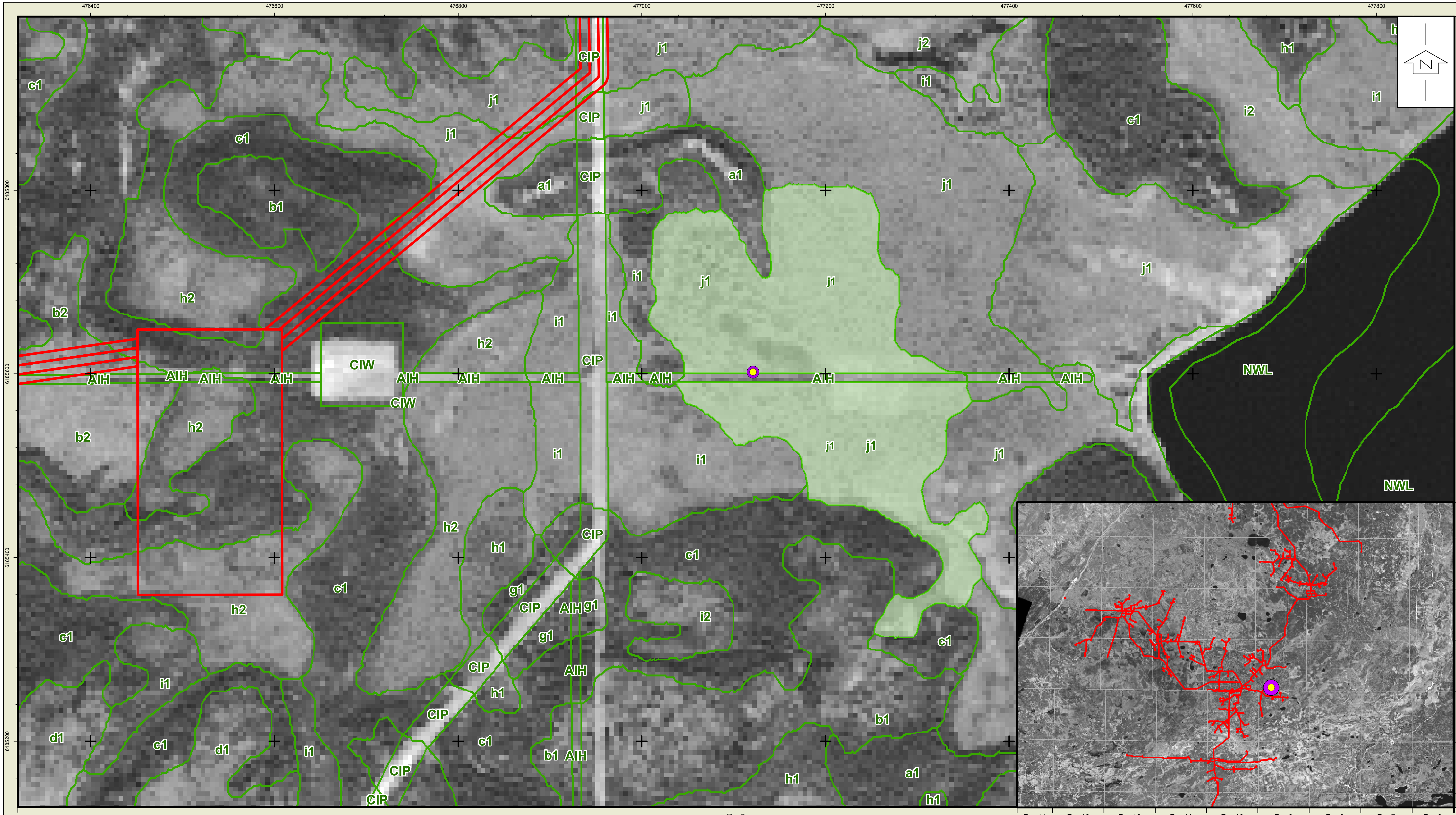
Response

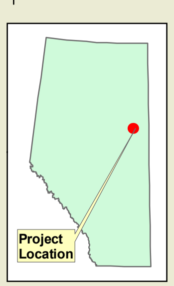
Vegetation sampling was conducted to verify the purchased AVI and ELC data. Based on the confidence of these data, the EIA adequately assesses the areas outside of the Leismer and Corner areas. While the EIA provides an adequate assessment of the impacts, additional soils and vegetation assessments are required as part of reclamation planning and to support regulatory submissions for approval amendments and surface leases. These detailed assessments will be conducted in the Pre-Disturbance Assessments (PDAs) and are required to be submitted to AENV six months prior to proposed pad construction. Based on the six-month lead-time requirement, StatoilHydro will be conducting the actual field assessments one to two years prior to development of new CPFs and pads.

90	
	Volume 4, Section 10.5.3.3, Page 10-30 One rare plant community (S1/S2) was noted in the LSA. Rare plant communities are often associated with unusual site conditions. a) Provide a figure depicting the location and extent of this community relative to the Project footprint.

Response

See Figure 90-1 – Rare plant community depicts the location of this community relative to the project footprint. The extent of the highlighted polygon (community) is 8.19 ha.





Legend

- FOOTPRINT
- AVI
- RARE ECOLOGICAL COMMUNITY POLYGON (Andromeda polifolia/Sarracenia purpurea/Sphagnum angustifolium)
- RARE ECOLOGICAL COMMUNITY OBSERVATION POINT
- RARE PLANTS (Sarracenia purpurea)

1:4,000

0 30 60 90 120 150 Metres

NAD 83 UTM ZONE 12

Title:

RARE ECOLOGICAL COMMUNITY

StatoilHydro

Approved:	Revision Date:	
LM	MAY 22, 2008	
File:		
Drawn by:	Checked:	Fig. No.:
GU	LM	90-1

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90	b) Describe the site conditions that support this rare plant community and identify any other sites matching those conditions.

Response

In Alberta, this rare plant community (rare ecological community) defined by ANHIC as Shrubland: Andromeda polifolia Group: Andromeda polifolia/Sarracenia purpurea/Sphagnum angustifolium (bog rosemary/pitcher plant/peat moss) occurs in close proximity to small lakes where it forms narrow bands or patches around the edges of the lake (Allen and Johnson, 2000). Typically, this community type occurs within rich fens adjacent to small lakes rather than in marshes. Ecosite phases that may support this rare ecological community include; (1) k1 (treed fens with a density of A or B), (2) k2 (shrubby rich fen), and (3) k3 (graminoid rich fen) in the Central Mixedwood Natural subregion. This community type also occurs in the j1 (treed rich fen with a density of A or B), j2 (shrubby rich fen), and j3 (graminoid rich fen) in the Lower Boreal Natural Subregion.

Pitcher plant is always significant for this rare ecological community; percent cover varies from 10% to 24%. Bog rosemary is also prominent with cover that ranges from 15% to 50%. Sphagnum angustifolium is the dominant moss at 45% to 60%; however, other peat moss species may be present with variable cover values (Allen and Johnson, 2000).

REFERENCE

Allen, L. and J.D. Johnson. (2000). Potentially Trackable Small Patch Communities of the Maybelle Dunes, Richardson River Dunes and Marguerite Crag and Tail Wildland Parks. Alberta Environment, Edmonton, Alberta. 32 pp.

90	c) Describe plans to monitor rare plant locations that may be indirectly affected by changes in hydrology.

Response

Hydrology in the area will be monitored in order to detect any changes in surface water levels. It is anticipated that if no changes are detected, vegetation (including rare plants) will not be affected. If changes in surface water are detected, upstream or downstream of surface infrastructure additional vegetation, including rare plant sites, may be monitored.

91	
	Volume 4, Table 10.6-1, Page 10-68 and Table 10.6-2, Page 10-70 These tables indicate that disturbances for Application, Baseline, and Closure scenarios are not applicable (N/A) for ecosite phases at the LSA level, even though overall areas and percentages have been provided for terrestrial, wetland, water, and other disturbances. a) Discuss why disturbance values are not applicable at the LSA level for these ecosite phases.

Response

The ecosite phases are totaled for each subregion, but cannot be added together for the LSA because they represent different plant community types in each subregion. For example, the ecosite phase b3 in the Central Mixedwood subregion is characterized by Aspen and White spruce as co-dominants with White birch and Jack pine sometimes present in small percentages, whereas b3 in the Lower Boreal Highlands subregion has White spruce and Jack pine as co-dominants with no Aspen or White birch (Beckingham and Archibald, 1996).

REFERENCE

Beckingham, J.D. and J.H. Archibald. (1996). Field Guide to Ecosites of Northern Alberta. Special Report 5. Natural Resources Canada, Canadian Forest Service, Northwest Region, Northern Forestry Centre, Edmonton. 516 pp.

92	
	Volume 4, Table 10.6-1, Page 10-68 Disturbances to each ecosite phase or combined terrestrial, wetland, water, and disturbed sites are calculated as a proportion of the overall LSA rather than as a proportion of each ecological land unit or aggregated type. a) Recalculate these values for each type as a proportion of the type being considered.

Response

The values have been calculated in Table 92-1 (Table 10.6-2 Revised). Comparison of Baseline and Closure Scenarios for Ecosite Phases and Disturbance Areas by Subregion is provided for the original LSA.

Table 92-1 Comparison of Baseline and Closure Scenarios for Ecosite Phases and Disturbance Areas by Natural Subregion in the LSA

	Baseline Scenario						Closure Scenario										Change to Resource		
	Central Mixedwood Subregion		Lower Boreal Highlands Subregion		LSA		Central Mixedwood (CM) Subregion		Lower Boreal Highlands (LBH) Subregion		CM Difference	CM % Change to Resource	LBH Difference	LBH % Change to Resource	LSA		Central Mixedwood Subregion	Lower Boreal Highlands Subregion	LSA
Upland Ecosite Phase	**Area (ha)**	**% of LSA**	**Area (ha)**	**% of LSA**	**Area (ha)**	**% of LSA**	**Area (ha)**	**% of LSA**	**Area (ha)**	**% of LSA**					**Area (ha)**	**% of LSA**	**% Change to Resource***		
a1	9	0.0	2,477	1.7			9	0.0	2,484	1.7	0.0	0.0	6.5	0.3			0.0	0.3	
b1	109	0.1	3,994	2.7			109	0.1	4,004	2.8	0.0	0.0	9.7	0.2			0.0	0.2	
b2	0	0.0	962	0.7			0	0.0	966	0.7	0.0	0.0	3.9	0.4			N/A	0.4	
b3	27	0.0	626	0.4			27	0.0	628	0.4	0.0	0.0	1.2	0.2			0.0	0.2	
b4	24	0.0	N/A	N/A			24	0.0	N/A	N/A	0.0	0.0	N/A	N/A			0.0	N/A	
c1	58	0.0	11,540	7.9			58	0.0	11,566	8.0	0.0	0.0	26.1	0.2			0.0	0.2	
d1	477	0.3	7,852	5.4			477	0.3	7,884	5.4	0.0	0.0	32.3	0.4			0.0	0.4	
d2	287	0.2	3,185	2.2			287	0.2	3,187	2.2	0.0	0.0	2.3	0.1			0.0	0.1	
d3	111	0.1	1,142	0.8	N/A		111	0.1	1,143	0.8	0.0	0.0	0.9	0.1	N/A		0.0	0.1	N/A
e1	311	0.2	1,343	0.9			311	0.2	1,344	0.9	0.0	0.0	1.4	0.1			0.0	0.1	
e2	77	0.1	N/A	N/A			77	0.1	N/A	N/A	0.0	0.0	N/A	N/A			0.0	N/A	
e3	19	0.0	N/A	N/A			19	0.0	N/A	N/A	0.0	0.0	N/A	N/A			0.0	N/A	
f1	4	0.0	86	0.1			4	0.0	86	0.1	0.0	0.0	0.1	0.1			0.0	0.1	
f2	8	0.0	N/A	N/A			8	0.0	N/A	N/A	0.0	0.0	N/A	N/A			0.0	N/A	
f3	2	0.0	N/A	N/A			2	0.0	N/A	N/A	0.0	0.0	N/A	N/A			0.0	N/A	
g1	83	0.1	14,151	9.7			83	0.1	14,347	9.9	0.0	0.0	195.9	1.4			0.2	1.4	
g1/transition	N/A	N/A	N/A	N/A			0	0.0	650	0.4	na	N/A	N/A	N/A			N/A	N/A	
h1	96	0.1	N/A	N/A			96	0.1	N/A	N/A	0.0	0.0	N/A	N/A			0.0	N/A	
Terrestrial Subtotal	***1701***	***1.2***	***47,358***	***32.6***	***49060***	***33.8***	***1702***	***1.2***	***48,289***	***33.2***	***0.0***	***0.0***	280.4	3.5	***49991***	***34.4***	***N/A***	***N/A***	***N/A***
																			3.5
Wetland/Peatland Ecosite Phase																			
h1	N/A	N/A	37,516	25.8			N/A	N/A	37,125	25.5	N/A	N/A	-390.7	-1.0			N/A	-1.0	
h2	N/A	N/A	6,198	4.3			N/A	N/A	6,117	4.2	N/A	N/A	-81.1	-1.3			N/A	-1.3	
i1	548	0.4	7,308	5.0			548	0.4	7,222	5.0	0.0	0.0	-85.7	-1.2			0.0	-1.2	
i2	36	0.0	7,210	5.0			36	0.0	7,164	4.9	0.0	0.0	-46.1	-0.6			0.0	-0.6	
j1	41	0.0	10,688	7.4			41	0.0	10,633	7.3	0.0	0.0	-55.3	N/A			0.0	-0.5	
j2	109	0.1	4,360	3.0	N/A		109	0.1	4,339	3.0	0.0	0.0	-21.2	-0.5	N/A		0.0	-0.5	N/A
j3	N/A	N/A	3,647	2.5			N/A	N/A	3,622	2.5	N/A	N/A	-24.8	-0.7			N/A	-0.7	
k1	15	0.0	N/A	N/A			15	0.0	N/A	N/A	0.0	0.0	N/A	N/A			0.0	N/A	
k2	204	0.1	N/A	N/A			204	0.1	N/A	N/A	0.0	0.0	N/A	N/A			0.0	N/A	
k3	62	0.0	N/A	N/A			62	0.0	N/A	N/A	0.0	0.0	N/A	N/A			0.0	N/A	
l1	0	0.0	N/A	N/A			0	0.0	N/A	N/A	0.0	N/A	N/A	N/A			N/A	N/A	
Wetland Subtotal	***1015***	***0.7***	***76,927***	***52.9***	***77,942***	***53.6***	***1015***	***0.7***	***76,222***	***52.4***	***-0.1***	***0.0***	***-704.8***	***-5.3***	***77,237***	***53.1***	***N/A***	***N/A***	***N/A***
																			-5.4
Other																			
Burn	0	0.0	8,388	5.8	8,388	5.8	0	0.0	8,359	5.8	0.0	0.0	-29.0	-0.3	8,359	5.8	N/A	-0.3	-0.3
Burn Clearcut	0	0.0	38	0.0	38	0.0	0	0.0	38	0.0	N/A	N/A	0.0	0.0	38	0.0	N/A	0.0	0.0
Burn Regen	0	0.0	1,100	0.8	1,100	0.8	0	0.0	1,134	0.8	0.0	0.0	33.8	3.1	1,134	0.8	N/A	3.1	3.1
Meadow	1	0.0	35	0.0	36	0.0	1	0.0	35	0.0	0.0	0.0	0.0	0.0	36	0.0	0.0	0.0	0.0
NMC (Cutbank)	1	0.0	0	0.0	1	0.0	1	0.0	0	0.0	0.0	0.0	N/A	N/A	1	0.0	0.0	N/A	0.0
Shrubland	1	0.0	41	0.0	42	0.0	1	0.0	41	0.0	0.0	0.0	0.0	0.0	42	0.0	0.0	0.0	0.0
Other Subtotal	***2***	***0.0***	***9,602***	***6.6***	***9,604***	***6.6***	***2***	***0.0***	***9,607***	***6.6***	***0.0***	***0.0***	***4.7***	***2.7***	***9,609***	***6.6***	***N/A***	***N/A***	***N/A***
																			2.7
Water																			
NWF (Flooded)	10	0.0	276	0.2	287	0.2	10	0.0	277	0.2	0.0	0.0	0.1	0.0	287	0.2	0.0	0.0	0.0
NWL (Lake)	25	0.0	2,991	2.1	3,016	2.1	25	0.0	2,991	2.1	N/A	N/A	0.0	N/A	3,016	2.1	0.0	0.0	0.0
NWR (River)	72	0.0	320	0.2	392	0.3	72	0.0	320	0.2	0.0	0.0	0.0	0.0	392	0.3	0.0	0.0	0.0
Water Subtotal	***107***	***0.1***	***3,588***	***2.5***	***3,694***	***2.5***	***107***	***0.1***	***3,588***	***2.5***	***0.0***	***0.0***	***0.1***	***0.0***	***3,694***	***2.5***	***N/A***	***N/A***	***N/A***
																			0.0
Disturbance																			
AIG (Gravel/Borrow Pit)	26	0.0	5	0.0	31	0.0	0	0.0	5	0.0	-26.3	0.0	0.0	N/A	5	0.0	-100.0	0.0	-84.8
AIH (Roads)	0	0.0	1,608	1.1	1,608	1.1	26	0.0	1,535	1.1	N/A	N/A	-73.7	-4.6	1,561	1.1	N/A	-4.6	-3.0
AII (Industrial Sites)	0	0.0	19	0.0	19	0.0	0	0.0	18	0.0	0.0	0.0	-0.6	***-3.2***	18	0.0	N/A	-3.2	-3.2
CC (Clearcut)	392	0.3	1,149	0.8	1,541	1.1	392	0.3	1,126	0.8	0.0	N/A	-23.2	-2.0	1,518	1.0	0.0	-2.0	-1.5
CIP (Pipelines)	27	0.0	1,481	1.0	1,507	1.0	27	0.0	1,365	0.9	N/A	0.0	-115.3	***-7.8***	1,392	1.0	0.0	-7.8	-7.6
CIW (Wellsites)	9	0.0	284	0.2	293	0.2	9	0.0	266	0.2	0.0	N/A	-18.1	-6.4	275	0.2	0.0	-6.4	-6.2
CL (Clearing)	0	0.0	49	0.0	49	0.0	0	0.0	49	0.0	0.0	0.0	0.0	N/A	49	0.0	N/A	0.1	0.1
CP (Reclaimed to grass)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	N/A	N/A	0.0	N/A	0	0.0	N/A	N/A	N/A
Disturbance Subtotal	***454***	***0.3***	***4,594***	***3.2***	***5,049***	***3.5***	***454***	***0.3***	***4,364***	***3.0***	***-26.3***	***0.0***	***-230.8***	***-24.0***	***4,818***	***3.3***	***N/A***	***N/A***	***N/A***
																			-24.0
Total	**3280**	**2.3**	**142,069**	**97.7**	***145,349***	**100.0**	**3280**	**2.3**	**142,069**	**97.7**					***145,349***	**100.0**	***N/A***	***N/A***	***N/A***

*% Change to Resource = ((Area at Closure - Area at Baseline) / Area at Baseline)*100 (Not applicable to cases where baseline area is zero)
Note: Summed Totals may differ due to rounding of original GIS values in columns.
N/A - not applicable

92	b) Update any conclusions to the EIA that will change as a result of this calculation. For example, when considering disturbance to terrestrial vegetation the proportion would be 1281/49,060 ha = 2.6%. Using the criteria in Volume 2, Section 1, this is a moderate magnitude effect.

Response

No conclusions changed as a result of the calculation.

In response to the example given in the question, when evaluating an impact, mitigation is taken into consideration. The assessment of impacts as stated in Volume 2, Section 1, Page 1-17, 1.55 Effects Criteria, are "a predictive assessment based on the response of resources and/or indicators to project-specific activities… and/or multiple stresses. Furthermore, on Page 1-18 under Direction, it states Direction describes if there is a net benefit, net loss or net balance to the resource …". It is assumed with good confidence that ecosite phases can be reclaimed to a successional trajectory that will, in time, be equivalent to the original ecosite phase. The exception, of course, is for peatlands, and in these instances, they are evaluated with a lower confidence rating. It should also be noted that the overall impact rating is a combined assessment of multiple criteria and does not rely solely on magnitude.

Also, in Volume 2, Section 1, Page 1-17, 1.5.5 Effects Criteria it states "Where necessary, because of differences amongst the broad range of biophysical and social factors, the criteria are further defined within relevant sections of the EIA." Accordingly, in Volume 4, Section 10, Page 10-5, criteria has been further defined. Magnitude is as follows:

Negligible	No discernible contribution, less than 1% measurable change
Low	1% or greater but less than 10% measurable change
Medium	10% or greater but less than 20% measurable change
High	20% or greater measurable change

Therefore, a 2.6% change would fall in a low magnitude effect, not a moderate effect.

93	**Volume 4, Section 10.6.1, Page 10-69; Table 10.6-2, Page 10-70; and Section 10.6.6, Page 10-81** StatoilHydro states that *portions of disturbed wetlands will be reclaimed to equivalent wetland ecosite phases, upland ecosite phases g1, and a 'transitional g1' ecosite phase*. Roads, pads, and CPFs on peatlands will be reclaimed to a g1 or transitional g1 ecosite phase, while linear disturbances will be reclaimed to equivalent wetland (h1-j3). a) Describe StatoilHydro's commitment to complete removal of all Project facilities, including roads and pads, during Project closure.

Response

StatoilHydro is committed to meeting the reclamation policy in place at the time that sites are decommissioned. It is StatoilHydro's understanding that recent (draft) guidelines from AENV and ASRD do not require complete pad removal, instead focusing on partial removal of pads from deep peat areas. Additionally, these draft criteria provide for reclamation of peatlands to an alternative end-use, if an agreement with the landowner has been reached. With respect to road reclamation, the County, the Forestry office and other industrial stakeholders will also be consulted regarding specific roads, as they may request that some roads be left in place. See AENV SIR Response 130 for further discussion.

93	b) Describe the discussions StatoilHydro has had with AENV and ASRD regarding the conversion of wetland areas to transition-g1 ecosites/upland sites.

Response

StatoilHydro entered in to discussions in 2006 with ERCB, AENV and ASRD regarding conversions of wetland to transition/upland sites as part of the ERCB's Supplemental Information Request (SIR) process for StatoilHydro's Leismer Demonstration Application.

StatoilHydro discussed pad construction and reclamation approaches with Barb Pullishy (AENV) and Wally Peters, Lac La Biche ASRD. ASRD had expressed a desire for pad reclamation to be handled on a site-by-site basis with consideration given to the complete removal of pads constructed on top of organic soils. ASRD commented that consideration should be given to factors such as whether the pads have depressed the organic soils and if the removal of the fill material will result in open water. ASRD indicated that end land use goals for SAGD pad reclamation into open water features were not acceptable.

StatoilHydro discussed the feasibility of reclaiming pads that have depressed the organic materials by sculpting the pad edges to create an amorphous shape with transitional wetlands around the former pads edges. The materials sculpted from the pads edges would be placed around the lease creating an undulating upland feature. ASRD expressed interest in this proposed approach and would consider it on a site-by-site basis.

Based on this discussion, StatoilHydro proceeded with the transition-g1 ecosites/upland sites approach. StatoilHydro met with ASRD, AENV and EUB on April 13, 2007, to discuss soil salvage on deep peats and end land use targets for sites constructed in deep peats. At the meeting, StatoilHydro committed to removing portions of the clay fill material from the pad so that the height of the reclaimed pad is reduced from the operational height.

StatoilHydro committed to continue the dialogue with the regulators on these issues and will further address approaches in the joint Application/EIA submission. For the Leismer Demonstration Project's SAGD pads, StatoilHydro has discussed with ASRD that a final detailed approach will be addressed in the permitting process for mineral surface leases.

93	c) Provide scientific or empirical evidence to demonstrate successful reclamation of linear disturbances to equivalent peatland types.

Response

Rights-of-way for production pads include power line and above-ground pipeline facilities, which involve installation of power poles and pipe rack supports at intervals within the right-of-way. Construction on Organic soil areas is generally done in winter during frozen conditions, and surface disturbance will occur in a small area at the pole/piperack support locations. The large majority of these rights-of-way (areas between the pipeline, powerline and road, and between the poles/racks) will not have significant surface (peat) disturbance. Due to the relatively small amount of surface disturbance to the peat in these rights-of-way, it is anticipated these rights-of-way will return to peatland ecosite phases similar to pre-disturbance by natural regeneration and planting/seeding of native species as required.

For underground pipelines on wetlands, construction will also occur in winter. Surface disturbance will be limited to a fairly narrow width over the pipeline location, representing only a portion of the right-of-way. The remaining right-of-way surface will be largely undisturbed and is anticipated to return to similar peatland ecosite phases as pre-disturbance by natural regeneration and planting/seeding of native species. The narrow proportion of the right-of-way (slightly wider than trench width) at the underground pipeline location will involve salvaging peat, placing the pipeline, and replacing peat. These narrow surface disturbance areas are also anticipated to return to similar peatland ecosite phases as pre-disturbance by natural regeneration and planting/seeding of native species.

93	d) Describe how it will be determined where wetlands will be returned to equivalent wetland ecosite phases, and how this will be accomplished.

Response

Reclamation to wetland ecosite phases is the reclamation target for the powerline and pipeline rights-of-way as described in AENV SIR Response 93c.

The proposed reclamation target for the outer edges of padded facilities on peatland is to create saturated, replaced peat conditions, similar to the adjacent undisturbed peat, and establish appropriate wetland vegetation species, as described in Volume 1, Section 8.6.

In addition, removal of road culverts on peatland, will involve removal of mineral material around the culvert to the underlying peat to allow for drainage, and promote ingress and establishment of the adjacent peatland vegetation.

Reclamation research on techniques to reclaim padded facilities on peatland is currently underway through a joint academic/industry initiative. StatoilHydro will utilize successfully demonstrated techniques to reclaim these areas to peatland ecosite phases as research and other reclamation results become available over time.

93	e) Table 10.6-2 indicates that at closure, g1 and transitional g1 ecosites create an increase of 846 ha from baseline conditions, while wetlands decrease by 705 ha. Provide an explanation for this discrepancy.

Response

As stated in Volume 4, Section 10.6.1 page 10-69, "The extent of wetlands will decrease following reclamation while the extent of upland terrestrial vegetation will increase, as portions of Project components occurring on wetland sites will be reclaimed to upland g1 and to 'transitional g1' ecosite phases.

"Pipelines and power lines will be reclaimed to pre-disturbance wetland ecosite phases, whereas access roads will be reclaimed to a g1 ecosite phase. Well sites and CPFs on peatlands will have portions reclaimed to upland g1 and a 'transitional g1' ecosite phase.

Upon closure, disturbance areas will decrease 231 ha from baseline. As stated above, these areas will be reclaimed to either wetland or upland ecosites depending on the disturbance and pre-disturbance ecosite phase. Therefore these previously disturbed areas are calculated in the closure upland and wetland calculations

Table 93-1 Ecosites at Baseline and Closure

Ecosites	Baseline (ha)	Closure(ha)
Terrestrial		+931
Wetland	-705	
Disturbance		+5
Other	-231	
Total	-936	+936

94	**Volume 4, Section 10.6.1, Page 10-69 and Section 10.6.7, Page 10-82** StatoilHydro states that *terrestrial ecosite phases will be reclaimed to equivalent pre-disturbance conditions*, and that *clearcuts within the footprint will be reclaimed to a d1(aspen, low-bush cranberry) ecosite phase*. a) Clarify this apparent discrepancy.

Response

Clear cuts are not ecosite phases, they are a disturbance area delimited as a polygon in the AVI data. On occasion, a CC (clear cut) polygon is encompassed within an AVI polygon that can be interpreted and coded to an ecosite phase designation; otherwise the ecosite phase cannot be determined.

94	b) Provide a justification for reclaiming all clearcuts to a d1 ecosite phase.

Response

The Project lies within Al-Pac's FMA. Al-Pac holds quota rights to the deciduous stands in the area and uses Aspen and Balsam poplar almost exclusively in their operations. A majority of clear cuts in the area are Al-Pac clearcuts; other forestry companies hold licenses (issued by the Alberta government) for the coniferous quotas within the Al-Pac FMA. Al-Pac works in an integrative manner with other companies to ensure a healthy mix of forest types across the landscape.

The forests in the area are a mixture of both deciduous (Aspen and Balsam poplar) and coniferous (White spruce, Pine, Black spruce) tree species. Forest stands can be deciduous, mixedwood, or coniferous stands. Aspen or deciduous stands are often the first to establish after fire or disturbance (harvesting) because of their suckering abilities. While white spruce can and does establish at the same time, it grows more slowly; however, it eventually becomes the dominant canopy species by out-living the deciduous species.

Previously, coniferous stands were re-planted after harvesting, and required much site preparation and chemical control of other species to be successful. Research of Lieffers and Grover (2004) has demonstrated that conifers perform better when establishment patterns more closely reflect natural regeneration. Therefore, planting to a d1 ecosite phase (dominant Aspen/Balsam poplar, with a small proportion of White Spruce) will mimic more natural conditions across the landscape and produce a healthy mix of forest types.

REFERENCE

Lieffers, V. and B. Grover. (2004). Alternative Silviculture for Boreal Mixedwood Forests of Alberta. Sustainable Forest Management Network. Alberta Pacific Forest Industries and Department of Renewable Resources, University of Alberta, Edmonton. 20 pp.

95	**Volume 4, Section 10.6.2, Page 10-71** Ecosites of limited distribution have been identified as b2, b3, d3, e1, and f1 based on the criteria of occupying less than one percent of the LSA (Section 10.4.1.3, Page 10-9). a) Indicate why ecosite phases f2, f3, and h1 have not been included as communities of limited distribution even though they meet this criteria. b) Revise the EIA, if required.

Response

As stated in Volume 4, Section 10.6.2, page 10-71, "The LSA lies within two natural subregions: the Central Mixedwood Natural Subregion and the Lower Boreal Highlands Natural Subregion. Approximately 97.7% of the LSA falls in the Lower Boreal Highlands Subregion with 2.3% in the Central Mixedwood. The low proportionate representation of the Central Mixedwood Natural Subregion in the LSA skews data analyses for communities of limited distribution, thus only the Lower Boreal Highlands ecosite phases are considered in this assessment."

In the Lower Boreal Highlands Subregion, f2 and f3 ecosite phases do not exist. The h1 ecosite phase does not exist as an upland or terrestrial ecosite phase; it is a treed bog and is therefore listed with the wetland ecosite phases. The h1 ecosite phase is 25.8% of the LSA and hence not a communities of limited distribution.

No revision is required to the EIA.

96	**Volume 4, Section 10.6.6, Page 10-81 and Section 10.6.8, Page 10-84** This section states that the prediction confidence for impacts on wetlands and peatlands from alterations in hydrology is low. It is also noted that many of the rare plants located in the LSA are associated with wetlands or peatlands. a) Outline monitoring plans to determine actual effects on hydrology within wetlands and peatlands.

Response

To elaborate on AENV SIR Response 90 c, hydrology will be monitored by measuring water levels upstream and downstream of surface infrastructure. Monitoring will include visual observations of water levels and flows near culverts as well as the installation of surveyed measurement points. The surveyed measurement points will include both surface mounted monuments and shallow peizometers. Additional details of the monitoring will be outlined in the wetland monitoring proposal that, based on other operators in the region, will be a condition of the operating approval.

96	b) Describe how local effects, such as increasing water tables with tree removal, have been considered in this assessment.

Response

The vegetation in the LSA is controlled by a number of abiotic factors not the least of which is the hydrodynamics of the ecosystem. Volume 3, Section 6 (Hydrology) of the EIA states that increased runoff is anticipated over the road surfaces, with flows to be directed into ditches, and then into cross-drains or culverts as mitigation measures to maintain drainage patterns. As well, Volume 3, Section 6 indicated that evapotranspiration is expected to be slightly reduced from these facility disturbances, and therefore, slightly higher runoff is anticipated from the cleared areas adjacent to roads. However, the surface water receipt and flow changes as a result of roads and related facilities, is expected to be highly localized.

Volume 3, Section 5.6.3 estimated the maximum change in flux at the surface (i.e., drawdown effect of induced groundwater recharge) of 0.5 mm/y during the maximum water demand period. However, these changes are not expected to impact surface waterbodies or surface flow.

Based on the above information provided in Volume 3, Section 6 and summarized above, professional judgment was used to assess the impacts of altered hydrodynamics to be low and localized.

97	**Volume 4, Section 10.6.6, Page 10-81** a) Indicate how StatoilHydro will protect wetlands and peatlands from sedimentation during construction, operations and reclamation phases.

Response

Design:

Production well pads will have a perimeter ditch/berm system to prevent flow onsite, and contain runoff in a graded lower corner with impermeable liners. CPF design will include grading, berms, ditching and lined stormwater ponds. Access roads will be designed with gravel surfaces to reduce erosion and runoff potential.

Construction:

Construction of facilities will include berms, ditches, culverts, grading, and clay/synthetic lined collection areas/ponds needed to manage offsite and onsite surface water. Construction will generally be undertaken in winter conditions, significantly reducing the potential for sedimentation. Construction operations will be suspended if conditions have potential to cause sedimentation issues in adjacent wetlands and peatlands.

Operations:

During operations, vegetation cover will be monitored (and actively promoted if necessary) and any noxious weeds controlled. Accumulated facility runoff water will be tested to determine whether release to the environment is appropriate as per the relevant surface water quality guidelines (e.g., AENV Approval conditions, or “Surface Water Quality Guidelines for Use in Alberta” [AENV, 1999]). Water will be released in a manner preventing erosion or drainage impacts. Water not meeting the appropriate guidelines will be sent for treatment or appropriate disposal.

Reclamation:

Prior to the removal of any facilities, existing information will be reviewed from environmental reports completed during facility operation, and additional site assessments will be conducted, if required, to determine the presence and extent of any contamination. A plan for controlling erosion will be developed for each of the facility areas prior to decommissioning. Facilities will be abandoned according to applicable ERCB, AENV and ASRD standards. All watercourse crossings, culverts and berms will be removed and reclaimed pending consultation with stakeholders and government regulatory agencies.

Wildlife

98	**Volume 4, Section 3, 6 or 11** a) Provide a discussion of the effects of noise on wildlife.

Response

The response to noise can vary between species and within individuals of the same species groups. Generally, studies on the effects of noise on wildlife are lacking. However, in a few studies, wildlife such as caribou showed some apparent avoidance 300 m from a simulated noise disturbance; however, lack of a response may be because caribou don't normally perceive loud noise as a threat (McCourt et al 1974 in Burke and Lapka 2007). This may be true for other wildlife species as well. Of note here is that the distance of avoidance was relatively small indicating that wildlife are not likely to leave the area due to construction noise. In another study, caribou that were exposed to simulated petroleum exploration in northeastern Alberta moved faster and crossed more habitat boundaries than controls, but did not alter the proportion of time spent feeding (Bradshaw *et al*. 1997).

Bears are known to habituate to human disturbance. One study observed a black bear spending several nights under a trailer 20 m from an active drilling platform with noise levels reaching 99 dBA because of a small garbage dump nearby (Tietje and Ruff 1983).

The noise assessment (Volume 2, Section 3) modeled application noise for the CPFs and provided an assessment of well pad noise for AENV SIR Response 162 a. The well pads will be using electric downhole pumps which emit no noise. However, there is some noise emitting equipment, such as small pumps and air compressors, but these are located within buildings and the noise emitted is expected to be minimal. The noise levels modeled were found to be below permissible sound levels (PSLs) of 40 dBA within about 100 m of the well pad. During operations, noise may affect species such as songbirds within 100 m of a well pad; but overall affects of noise on wildlife from the well pads is predicted to be low. During construction, some species of wildlife may be temporarily displaced; however, not all well pads will be constructed at the same time therefore impacts will be of a short duration and predicted to be low in magnitude.

Noise levels from the CPF's was assessed and the models show that noise will attenuate to below permissible sound levels (PSLs) of 40 dBA within approximately 500 m. Species most affected are those that use sound as breeding/territorial displays or navigation (i.e. amphibians, birds, bats). Given the phased approach of the development, impacts from noise are predicted to be low.

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Tietje, WD, and RL Ruff. 1983. Responses of black bears to oil development in Alberta. Wildlife Soc Bull 11:99-112.

99	**Volume 4, Section 9.7.2, Page 9-77** a) Explain the impact on caribou habitat and population numbers, within the Egg-Pony caribou herd habitat, of reclaiming to the proposed ecosite phase of upland g1 Labrador tea-subhygric Black spruce-Jack pine vegetation community.

Response

The change in caribou habitat at closure in the LSA and in the caribou RSA is presented in Volume 4, Table 11.6-16, Page 11-81 based on winter habitat prediction from the resource selection model. In total, available caribou habitat in the LSA and following reclamation is estimated to decrease by 0.8% or 1,163 ha from baseline. The impact to caribou habitat in the LSA at closure was deemed to be negligible in the assessment. The impact to caribou habitat availability in the caribou RSA at closure was similarly deemed as a negligible impact at closure (-0.8% impact).

Since there is currently no satisfactory method to reclaim peatlands to their original conditions, 846 ha of wetlands will be reclaimed to the g1 ecosite phase. To address if the g1 ecosite phase provides a comparable habitat resource to caribou as do wetlands, the selection index value (Manly et al. 2002) for the g1 ecosite phase and wetlands were calculated from the scat detection data. The selection index for the g1 is 0.56 and for wetlands the selection index is 2.3. A larger selection index value for wetlands indicates that wintering caribou have a selection preference for wetlands as compared to g1 sites, based on the data.

It is important to recognize that caribou select sites given consideration of a combination of resource conditions in synchrony (not only if it is a wetland or not). Hence wetland loss, or the reclamation of wetlands to a g1 ecosite phase alone does not necessarily result in habitat loss. In the same way, selection of wetlands by caribou was found to be dependent on other factors such as terrain complexity and road proximity (See Volume 4, Appendix 11: Woodland caribou resource selection model).

The RSF for caribou is developed using actual caribou data from the caribou RSA. At closure, the RSF predicts that habitat availability for caribou will be near baseline conditions and therefore the caribou population should recover from any decreases (if they occur) as a result of the Project.

100	**Volume 4, Section 11** Several in-situ operators are participating in an industry-led group looking to address connectivity and wildlife corridor issues in the oil sands region south of Fort McMurray. a) Comment on StatoilHydro's participation in this regional initiative.

Response

StatoilHydro is a member of the Southern Athabasca Oil Sands Group, the Alberta Caribou Committee and the Regional Issues Working Group.

101	**Volume 4, Section 11** Some in-situ projects in the oil sands region are considering the use of 3D-seismic surveys repeated through time (4D-seismic) to monitor bitumen reserves through the life of the project. Seismic activity has not been mentioned in this EIA. a) If 4D-seismic is something StatoilHydro is considering for this Project, identify the following: i. Rationale, including why it is being considered given the potential expansion of impacts to wildlife and vegetation as a consequence of its use.

Response

Both 3D and 4D seismic can be integral to the efficient and timely exploration and development of oil sands leases. The ERCB requires any company owning an oil sands lease to conduct a minimum level of exploration activity as a condition of maintaining the lease. Oil sands exploration is conducted through the drilling and coring of vertical wellbores into the oils sands to physically assess the stratigraphy of the reservoir (known as "strat wells") and through seismic programs that, when tied to the strat wells, are used to map the subsurface contours of the reservoir. With the development of 3D seismic, less strat wells are needed to assess the potential of a reservoir. Once a reservoir has been adequately assessed and developed into a SAGD project, vertical monitoring wells or 4D seismic programs can be used to monitor the development and performance of the steam chamber. StatoilHydro is currently assessing which monitoring program is best suited for its steam chambers, and while a commitment has not yet been made to use 4D seismic for the Kai Kos Dehseh Project, the "rationale" for industry to utilize 4D seismic is to ensure efficient and effective resource recovery.

The following provides a discussion of the potential environmental impacts of implementing a 4D seismic program on StatoilHydro's leases. If implemented, a 4D seismic program would be designed over top of the horizontal well sections. The 4D program would most likely be a smaller, more focused, area of a 3D exploration program. The 4D program would likely require a tighter source and receiver grid (to provide a finer seismic resolution in order to see steam chamber growth) and, as such, would require additional source and receiver lines to be cleared between a portion of the existing 3D grid. The 4D source and receiver lines are cleared as "low impact" seismic lines (as are the 3D lines). This 4D line clearing would result in incremental vegetation impacts over the 3D exploration program. In subsequent years, the source and receiver lines would be reused.

In more detail, "low impact" seismic clearing is conducted during frozen conditions using a blade-up approach which prevents disturbance of the forest floor or by hand clearing. The low impact lines are typically only 1.75 m wide for receiver lines and 3 m wide for source lines and follow a meandering pattern to reduce sight lines. The blade-up and hand clearing encourages quick vegetation regeneration and rollbacks discourage entry of unauthorized vehicles. Al-Pac does not consider the low impact clearing method detrimental to forest productivity and does not charge stumpage (timber damage) for this activity.

The 4D programs are typically executed every one to two years, preferably in similar weather conditions. The programs take approximately two weeks to execute. Impacts to wildlife may occur each time the 4D program is conducted but the responses by wildlife will be dependent on the species. Scat detection surveys show that human activity impacts caribou within a short temporal window by increasing stress and decreasing nutrition. However, caribou appear to recover from these stressors once human activity abates. Caribou did not alter site selection in response to 2D seismic lines. Data are not available to analyze changes in site selection relative to denser disturbances, such as 3D seismic. None the less, our resource selection analysis suggests that site selection is influenced by detected human activity rather than the linear features themselves. At this time, we predict that it is the activities associated with seismic exploration that influences site selection.

StatoilHydro expects that similar mitigation measures would be outlined in the approved Caribou Protection Plan for future 4D programs as those in place for the 3D exploration programs. Mitigation may include scheduling of various seismic programs to ensure the programs do not temporally or spatially overlap and thus reduce temporal disturbances to caribou. StatoilHydro intends to monitor changes in caribou hormone levels, habitat use, and populations in the future, in part because of the uncertain effects of 4D seismic activity. If monitoring indicates that caribou respond negatively to 4D seismic activity, additional mitigation will be implemented and monitored.

101	ii. Whether 4-D seismic will encroach on watercourses or waterbodies

Response

If implemented, 4D programs will encroach on watercourses or water bodies in the same way as 3D or 2D programs are completed. Mitigation for 4D programs will be the same as for 3D and 2D programs (e.g. buffer zones and hand cuts, as approved by ASRD annually in each Caribou Protection Plan).

101	iii. Provide details of any plans StatoilHydro has to conduct 4D-seismic surveys during the construction and post-construction phases of the Project to monitor bitumen reserves including grid size, frequency, time of year, equipment used, and duration expected. iv. Map the proposed grid overlain on pad location and local topography. v. Provide schedule of implementation

Response

See AENV SIR Response 101 a i.

101	vi. Update all affected areas in the EIA accordingly.

Response

StatoilHydro agrees with and followed the approach used, in other EIAs recently deemed complete in the region to exclude 3D seismic from the assessment of vegetation and wildlife impacts (Nexen/OPTI Long Lake South EIA 2006). In summary, the rational for the exclusion is that the low impact 3D seismic clearing does not have the same level of impact as older 2D programs with wider clearing. While the 3D grid patterns are visible from over-flights, the meander pattern and rapid vegetation regrowth has led EIA scientists on the ground to the conclusion that the 3D program should not be assessed in the same way as the older 2D lines. It should be noted that the older 2D lines have been included in the baseline and impact assessment. These conclusions, combined with the inability to forecast where the 3D or 4D programs may be located, justify the assessment as it stands and therefore no EIA update is warranted.

102	**Volume 4, Section 11.4.1, Page 11-7; and Figure 11.4-2, Figure 11.4-3, Figure 11.4-4, Figure 11.4-5, and Figure 11.4-6, Pages 11-20 to 11-24** StatoilHydro states *Wildlife field surveys including those listed above were conducted in the Corner and Leismer areas of the wildlife LSA. Field surveys were not conducted in the South Leismer, Thornbury and Hangingstone areas of the LSA based on a decision made in consultation with ASRD for the following reasons:* • *StatoilHydro is proactively conducting a long term study to assess and monitor the effects of the Project on wolf, moose and caribou within and beyond the wildlife LSA (section 11.4.1.2); and* • *To focus other wildlife surveys within areas of the LSA that would be initially developed by StatoilHydro (the Corner and Leismer areas).* According to ASRD's records, the agreement with StatoilHydro was on which species were to be modelled, and which were to have field data collected for them. There was no recorded agreement about removing entire lease areas from data collection. a) For each type of data collected, discuss, using peer-reviewed references, what amount (distance, point counts, etc…) would need to be sampled in each habitat type to ensure a representative sample of each habitat type. Discuss in relation to search effort by habitat type (Table 11.4-1).

Response

Upon clarification with AENV (Cathy Kingdon, June 3, 2008) on the term "representative sample", we have provided a discussion on the amount of sampling required in each habitat type for a statistically relevant sample size.

The term "statistically relevant sample size" has a number of different meanings with respect to ecology and wildlife biology. It could refer to (1) the sample providing an accurate measure of the variable of interest, (2) that the samples provide enough power to detect significant differences through the appropriate statistical tests, or (3) that the variability within the samples is small or within accepted boundaries. These will be dealt with in order below.

1. Accurate estimates – The goal of any survey is to gain an accurate measure of the variable of interest. Both sample size and sample methodology are important for meeting this goal. Even with a very large sample size, if the methodology is biased or improper for the survey goals or samples the wrong population, then the values gathered will not be an accurate measure of the real values of interest (Underwood 1997, Morrison 2001, Braun 2005). The number of sample units required in community ecology and wildlife biology depends on the complexity of the community and the goals of the study (McCune and Grace 2002). For wildlife surveys that encompass a number of different species and habitats, some of which are rare on the landscape, this complexity can be very high (Braun 2005) and is most often determined by professional experience or practical limitations. For the StatoilHydro Kai Kos Dehseh project, all of the methods used are

accepted methods of performing wildlife surveys and are utilized by the Alberta Biodiversity Monitoring Institute (ABMI 2008, Internet site), the British Columbia Resource Information Standards Committee (BC RISC 2008, Internet site), are described in standard wildlife research textbooks (Bookhout 1996, Bibby et al 2000, Braun 2005) or are protocols that have been accepted and used in previous oil sands EIAs in Alberta. These methods are accepted methods to perform surveys for the various species of interest and should be relatively unbiased as compared to other possible methods.

2. Sample power to detect significant changes – Power is defined as the ability to detect statistically significant differences between two groups. Power increases as sample size increases (Underwood 1997) as well as when effect size increases (i.e., the difference between experimental groups for the variable of interest). Power relates mainly to experiments where there is a control and experimental group where a certain effect size is meant to be detected with statistical tests (i.e., ANOVAs, t-tests, etc.). The wildlife surveys for Kai Kos Dehseh, or other EIAs, are not related to a formal experimental design and there is no effect size, therefore the power of the surveys is not of issue. In addition, calculation of power and the sample size needed requires information about the variability of the population from pilot studies. In this Project, and in most EIAs, this information is not available. However, this information is available for subsequent monitoring over the life of the Project and should be incorporated into any monitoring designs.

3. Variability of the samples within accepted boundaries – If preliminary sampling data is available, and a univariate measure is being collected, there are standard statistical techniques to determine the sample size required for a given level of accuracy (Braun 2005). However, in the Kai Kos Dehseh case, there is very little preliminary data available for the area and multiple species are included in the surveys, each of which have their own level of variability and sample size required. In practice therefore, the usual methods for determining sample adequacy are not usually applicable to the typical sampling situations in ecology and wildlife biology (McCune and Grace 2002). Quite often "circumstances of a particular study are so variable that no generally agreed upon minimum sample sizes exist" (Bookhout 1996). However, there are some guideline methods in wildlife biology that can be used to estimate the number of sample units needed for a subsample that accurately represents a large sample (Morrison 2001). One that can be applied here is to seek a sample size that will yield a standard error less than or equal to 10% of the mean for that variable (McCune and Grace 2002). This rule is actually quite stringent for field biology, and often 20% limits can also give acceptable confidence bounds. For the Kai Kos Dehseh EIA, the track survey generally met this 20% requirement for more common species (i.e., grouse, red squirrel, snowshoe hare, marten, coyote, wolf, deer and moose). For species that are more difficult to detect (i.e., large home ranges such as fisher, lynx and caribou), or species that were not specifically targeted during the winter tracking survey (i.e., mink, otter, muskrat), standard errors were larger but were still generally below 50% of the mean value. For wildlife surveys where multiple species and rare species are included, it will be extremely difficult if not impossible to reduce the errors of all species to below 20%.

Based on the sampling intensity conducted within the LSA and regionally, it is believed that the sample accuracy for the Kai Kos Dehseh Project is within acceptable and practical limits. In future, StatoilHydro will be performing additional surveys for toads, owls and bats as part of the Application amendments required for the future hub developments.

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Underwood, A.J. 1997. Experiments in Ecology – Their logical design and interpretation using analysis of variance. Cambridge University Press. New York, NY.

102	b) Provide a sampling plan and schedule for implementation to reach the required sampling by representative habitat in the previous response.

Response

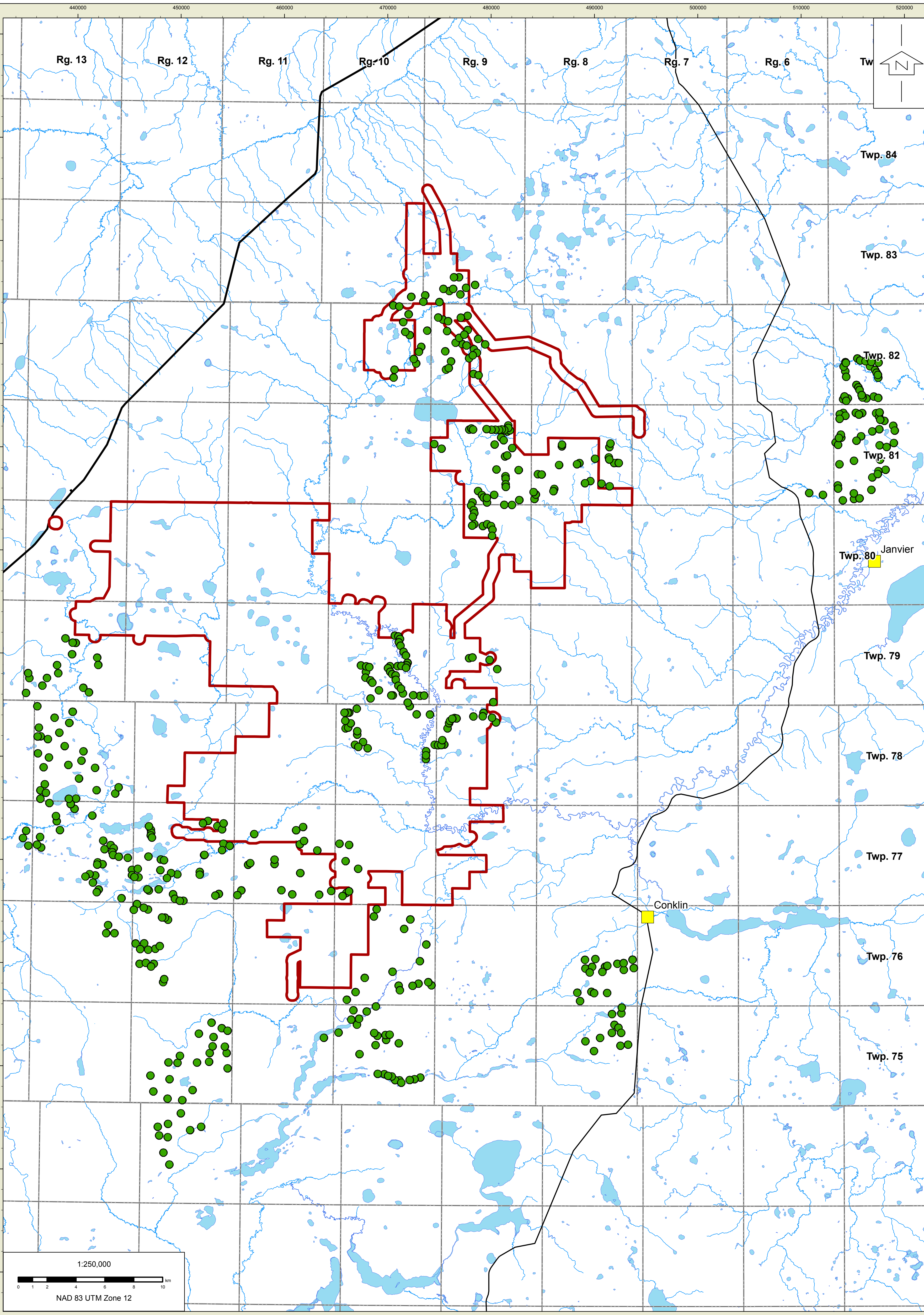
The surveys conducted focused on the two initial development areas since these are being applied for in this Application. The issue of sampling by representative habitat type pertains only to the winter tracking and songbird surveys since the owl and toad surveys are based on area covered, not the number of samples per habitat type and bat surveys focus on specific areas.

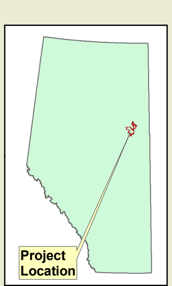
To supplement local data and support the EIA for the entire LSA, regional data was also used. Data sharing agreements with other operators were established to increase the regional knowledge of wildlife distribution and use of habitat types and to share the information provided by the scat monitoring program. The distance sampled for winter tracking and the number of breeding bird points surveyed for the Kai Kos Dehseh Project and therefore the representative sample sites within each habitat type is higher than that conducted for any other EIA in the region (Table 102-1, Figures 102-1 and 102-2). Based on this information and the response to AENV SIR 102a, StatoilHydro does not plan on conducting additional surveys specifically to support the EIA with the exception of a bat survey since sampling intensity was affected by weather. A bat survey will be conducted in the initial development areas in 2008. In addition, StatoilHydro will conduct surveys for Canadian toads, owls, and bats as part of the application amendments required for the future hub developments and plans to continue the scat monitoring program.

Table 102-1 Sampling Intensity for Winter Tracking and Breeding Bird Surveys for EIAs Conducted in Northeast Alberta

Survey	Kai Kos Dehseh	Meadow Creek[1]	Horizon[2]	Long Lake[3]	Christina Lake[4]
Winter Tracking	357[5] km	~22km	~53km	~28km	~31km
Breeding Bird	531[5] points	92 points	108 points	155 points	57 points

[1] Petro-Canada
[2] CNRL
[3] OPTI/Nexen
[4] MEG Energy (Christina Lake)
[5] Confidential baseline data gathering 2007





Legend

- North American Wildlife LSA
- Breeding Bird Survey Location
- Major Road (Hwy. 63)
- Road (881)
- Twp. Rg. Lines
- Lake
- Rivers

Title:

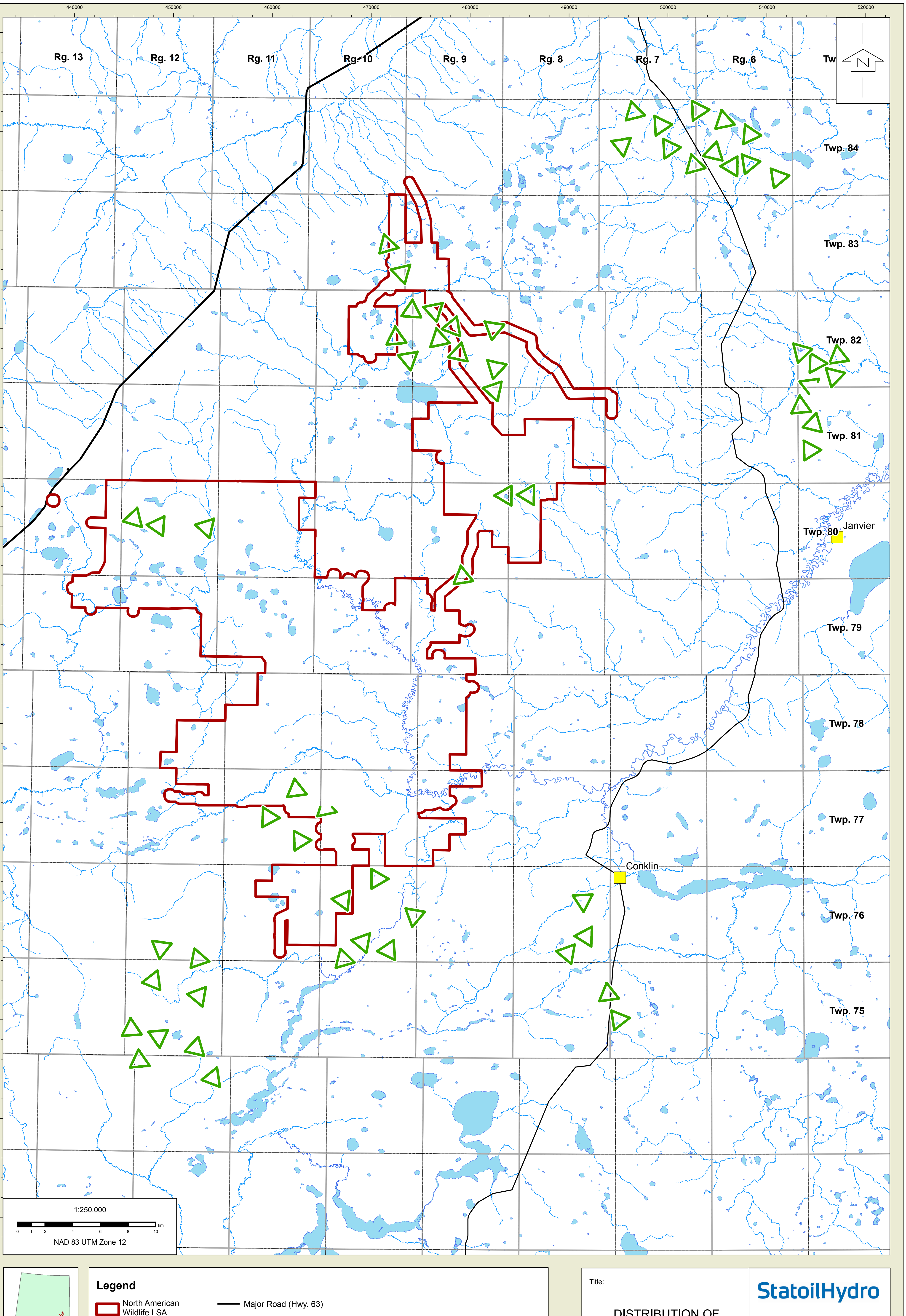
DISTRIBUTION OF BREEDING BIRD SURVEY POINTS

StatoilHydro

Approved: RL	Revision Date: July 4, 2008

File: N:\PROJECTS\63200000\ArcGIS\SIR_Reassessment\MXDs\Wildlife\BreedingBirdSurveyPts.mxd

Drawn by:	Checked:	Fig. No.:
TG	RL	102-1



Legend

- North American Wildlife LSA
- Winter Tracking Transect
- Major Road (Hwy. 63)
- Road (881)
- Twp. Rg. Lines
- Lake
- Rivers

Title:

DISTRIBUTION OF WINTER TRACKING TRANSECTS

StatoilHydro

Approved: RL	Revision Date: July 4, 2008

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Drawn by:	Checked:	Fig. No.:
TG	RL	102-2

103	**Volume 4, Section 11.2.2, Page 11-2** The RSA for caribou encompasses approximately 85% of the Egg-Pony caribou herd range and a small proportion of the Wiau caribou herd range. There is potential for caribou in these herds to interact with other regional projects as well as with the Kai Kos Dehseh Project. a) Describe other approved or announced projects that could interact with these herds.

Response

Existing and planned projects within the revised RSA are presented in AENV SIR Response 87 b. Projects specifically within the Egg Pony and Waiu caribou herd range include those listed in Table 103-1.

Table 103-1. Existing and Planned Projects within the Egg Pony and Wiau Caribou Herd Ranges

Assessment	Baseline	Impact Assessment (Application)	Cumulative Effects Assessment
Baseline	Petro-Canada Meadow Creek	Petro-Canada Meadow Creek	Petro-Canada Meadow Creek
	CNRL Kirby Pilot Project	CNRL Kirby Pilot Project	CNRL Kirby Pilot Project
	Gas production facilities	Gas production facilities	Gas production facilities
	Non-industrial sources	Non-Industrial Sources	Non-industrial sources
	Municipalities	Municipalities	Municipalities
	Non-industrial sources	Non-industrial sources	Non-industrial sources
	Pipeline/roadway/electric transmission/other linear	Pipeline/roadway/electric transmission/other linear	Pipeline/roadway/electric transmission/other linear
	Forest harvest	Forest harvest	Forest harvest
	Trapping and hunting	Trapping and hunting	Trapping and hunting
	Recreation	Recreation	Recreation
Project		Kai Kos Dehseh Project	Kai Kos Dehseh Project
Planned			**CNRL Kirby Project[1]**
			Devon Jackfish II SAGD
			Future oil sands exploration
			Future seismic exploration
			Other likely activities
			Forest Harvest
			Connacher Algar[2]
			Possible Highway 63 and Highway 881 connector west of Conklin[3]
		Notes – Date footprint data was available **1 CRNL Kirby, Sept 2007** **2 Connacher Algar, June 2007** **3 Footprint not available at this time**	

103	b) Discuss why the entire range of each of these herds was not included in the cumulative effects assessment.

Response

Provincial herd ranges were delineated using coarse telemetry data and extrapolating estimated habitat relationships (Ann Hubbs, Pers. Comm,. 28 May 2008), and do not represent geographic distribution boundaries for caribou in the ESAR. The scat detection surveys indicate that caribou use high quality habitats both within and outside of the provincial range boundaries. These range boundaries are management tools (an area for which caribou management planning and guidelines apply) and do not necessarily reflect the geographic distribution of caribou in ESAR (Ann Hubbs, Pers. Comm,. 28 May 2008). However, as requested, the RSA has been revised (See AENV SIR Response 85 b). The revised RSA incorporates Egg-Pony, Agnes, Audet, Algar, Wiau, and Bohn caribou ranges and portions of the Christina and Wandering caribou ranges.

104	**Volume 4, Section 11.4.1.1, Page 11-7 to 11-8** A scat detection survey was conducted to measure, in part, physiological health of individual animals. Monitoring of physiological factors is to allow for *a high probability of quickly detecting impacts*. a) Discuss specific thresholds or indicators that will be used to determine physiological health of caribou, and how this will be incorporated into project design and management.

Response

Physiological indicators are one of the components of the scat detection monitoring program. An important component and advantage of the scat detection study design is that it enables multiple stressors and factors, including various physiological indicators, to be monitored simultaneously.

StatoilHydro recognized that numerous uncertainties exist with respect to factors that influence caribou dynamics (health, population dynamics, habitat preferences) in the ESAR caribou ranges. Hence StatoilHydro took the initiative to conduct a monitoring program aimed at reducing these uncertainties and at hopefully identifying mitigation solutions for maintaining caribou in and surrounding their lease areas. The employed monitoring study is a non-invasive method of collecting sample data from wildlife and is a scientifically rigorous approach being conducted through the University of Washington. Several uncertainties, which currently exist and that the monitoring program is aimed at reducing include:

- Trends of wildlife population demographics and abundance; there are no current caribou population estimates within the ESAR (Ann Hubbs, Pers. Comm,. 28 May 2008)

- Responses of wildlife to anthropogenic development and activities
- Effects of habitat loss and range abandonment on wildlife populations
- Effects that predator-prey (and alternative-prey) dynamics have on wildlife populations, particularly among wolves, caribou, and moose

The objectives of the scat study are to monitor the following factors in synchrony:

- Changes in the abundance of moose, caribou, and wolves in the study area using mark-recapture analysis of individual animals (from DNA analysis of scat samples)
- Changes in the physiological health of moose, caribou and wolves in the study area using laboratory analysis of the fecal samples collected
- Changes in resource selection (habitat) by caribou, moose, and wolves
- Evaluate separate control populations, helpful for detecting and isolating impacts from the StatoilHydro lease areas more efficiently

Laboratory analysis of the collected fecal samples allows several different physiological measures, providing multiple, complementary indices that can be tied to changes in abundance over time. These different physiological measures, which are essential for partitioning the various pressures impacting these species, include:

1. Cortisol concentrations, which is an adrenal hormone secreted in response to many external stressors. Elevated cortisol metabolites in feces could reflect stress impacts, such as those resulting from increases in human activities, starvation or chemical exposure.

2. Thyroid hormone secretion, which is reduced in response to nutritional stress. Animals reduce thyroid hormone under nutritional stress to reduce metabolism, making their body more efficient at storing energy. Low thyroid hormone levels thus reflect nutritional stress, implying reduced food availability. Thyroid hormone can also provide a useful index of toxin-related endocrine disruption.

3. Reproductive hormones, testosterone in males and estrogen and progesterone in females. These hormones reflect changes in reproductive health that could be resulting from stress or toxin-related hormone disruption. If stress-related reproductive suppression is occurring, the reproductive hormones of both males and females will be lower than expected at each reproductive stage. If toxin exposure is impacting this system, the interdependencies of each of the above hormones to one another will be low, but also more erratic and coincident with equally erratic profiles in cortisol and thyroid hormones.

4. Immunoglobulins, IgA and IgG, best reflect infection from ingested bacteria, and exposure to disease, respectively. Stress-related immunosuppression is reflected by relatively low levels of IgA and IgG. However, stress-related immunosuppression will most likely be reflected by highly variable immunoglobulin patterns; some individuals will have shut down their immune system, making them more vulnerable to exposure to pathogens, whereas infected individuals should, in turn, respond with high immunoglobulins.

StatoilHydro plans to continue the scat monitoring program through the course of Project development and is discussing with other operators in the region potential to share in the implementation of this monitoring on a regional basis. Current study objectives as outlined above, and future work will help determine thresholds of physiological health of caribou, and this will be incorporated into Project design and management.

105	**Volume 4, Section 11.4.1.1, Page 11-7 to 11-8; Section 11.5.1, Page 11-25 Figure 11.4-1, Page 11-19, Figure 11.5-1, Page 11-46 and Figure 11.5-9, Page 11-52** Scat locations were used to develop an empirical habitat model for caribou. Scat locations for caribou are shown in Figure 11.5-1, however, observations in Figure 11.5-9 do not coincide. a) Describe the empirical habitat model.

Response

As indicated in Volume 4 page 11-39 Section 11.5.7.3, Figure 11.5-1 shows the results of the scat monitoring whereas Figure 11.5-9 shows observations from the winter tracking. These are two different field programs with different sampling areas and therefore the results will not coincide.

The resource selection models (RSF and RSPF models) derived from the scat location data for woodland caribou are presented in Volume 4, Appendix 11A. Included in this Appendix as part of the woodland caribou model description is: a description of the data, study area and statistical analysis; the final statistical model function selected; covariates, coefficients, and standard errors for each covariate in the final model; and an evaluation of fit for two model forms considered (exponential RSF and logistic RSPF).

The woodland caribou model was updated in order to determine impacts to caribou within the revised RSA (see AENV SIR Response 86). Since the area of analysis was greatly expanded, the use of AGCC data was required. Appendix B of this document provides a description of the updated resource selection model and analysis used to identify winter caribou habitats in the revised RSA.

105	b) Discuss limitations and the validity of assumptions around using scat locations to determine habitat use

Response

The monitoring program was designed by a research team from the Center for Conservation Biology at the University of Washington. By using a valid study design, the uncertainty and hence limitations in using scat location data to determine habitat-use and assess resource selection was reduced. This research team is internationally recognized for numerous studies on wildlife conservation that utilizes specially trained dogs to detect animal scat. The sampling design had the following advantages that eliminated several sources of uncertainty in using scat locations to determine habitat use and selection in the assessment of baseline habitat availability:

- Each dog used on this study was trained to detect and locate scat for all three indicator species (caribou, moose, and wolves). Habitat use by each of the three species was found to be different, yet selective (see Appendix B, modeling report for habitat selection analysis of caribou and moose scat); indicating that the sampling method did not appear to confuse the findings of habitat use among or between the three species considered. For example, caribou and moose were not found to select the same types of environmental resources, although the data was collected in the same approach and at the same time.
- Dog-teams (consisting of a scat detection dog and a dog handler) surveyed predetermined 8 km by 8 km grids covering the extent of the study area. Within each 8 km by 8 km grid, a smaller nested grid (5 km by 5 km) was established for sampling. Replicate surveys (1 to 3 replicates) were conducted among each grid surveyed in each year to reduce sample variability within the grids and to account for winter season temporal variation.
- The ability of the dog-teams to accurately identify animal species from scat during the surveys was evaluated by confirming the species identity from DNA in the scat samples (over half of the samples collected have been tested so far, N=1,311). The dog-teams correctly identified 95% of caribou scats, 100 % of moose scats, and 89% of wolf scats to species during the 2006 and 2007 surveys.
- The ability to determine individual identities from DNA in the scat, and hence account for individual variability.
- Resources selection was estimated using the resource selection probability function (RSPF (Lele and Keim 2006)) from scat locations for habitat use. This statistical method enabled the absolute probability of selection to be determined when only used locations are available, as is the situation with the scat locations (see Appendix B model report for a full description of the analysis).
- In the analysis of resource selection, researchers adjusted for potential surveyor (dog team) bias during transect walks by considering available habitat sites to be within the area searched by the dog teams as determined by a GPS path, rather than the entire sample grids (see Appendix B model report for a full description of the analysis).
- The detection dogs were able to efficiently collect a large sample of scat locations for the indicator species (1,262 caribou, 848 moose and 235 wolf) samples were collected during two winter seasons of sampling.

The location of each sample site where moose and caribou scat was collected is assumed representative of habitat use by caribou and moose at the time of the survey. Despite criticism (Collins and Urness 1981, 1984), this assumption is supported by research (Leopold *et al*. 1984, Loft and Kie 1988, Edge and Marcum 1989, Telfer *et al*. 2006). Provided in the following points are the findings in a review of the literature on the limitations and validity of using pellet locations to determine habitat use by cervids.

- The main criticism in the literature, and hence limitation, with using pellet locations for assessing habitat preference (tested among mule deer and elk) is the potential for bias in relative habitat preferences towards areas used for movement by animals (Collins and Urness 1981, 1984). There is some debate in this citation however, given a challenging response by Leopold *et al*. (1984) using a re-analysis of the same data.
- Previous studies on cervids have compared pellet counts to other types of data collection (telemetry or observational surveys) and found pellet survey to be a similarly comparable method of identifying habitat preferences (Neff 1968, Edge and Marcum 1989, Leopold et al. 1984, Loft and Kie 1988). This is especially relevant in the case of the scat data since several of the potentially confounding factors identified for pellet count data in these literature (missed pellet groups, individual variability in defecating rates) are accounted for in the sampling design employed.
- Cervid species are known to defecate frequently and thus the location of pellet-groups is representative of habitat-use at multiple points in time per day. For example moose have been document to defecate between 7 and 25 times per day (mean ~14 (cited in Persson *et al*. 2000)).
- The content of plant nutrients has been found to be higher under feces (McKendrick et al. 1980) and the nutrient content may be important to areas selected by animals (Hobbs 1966).

The project team acknowledges that scat locations for wolf are possibly not a representative indicator of habitat use because wolves are known to selectively choose areas to urinate and defecate as a behavioural trait for marking their territory (Zub et al. 2003, Barja *et al*. 2005). However, a site where scat was collected for wolves is representative of the location where wolves were at when defecating and possibly in marking their territories. Interpretation of the wolf data is cautioned in terms of habitat use.

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Persson, I.L., Danell, K., and Bergstrom, R. 2000. Disturbance by large herbivores in boreal forests with special reference to moose. Ann. Zool. Fennici. 37: 251-263.

Telfer, W. R., A. D. Griffiths and M. J. S. Bowman. 2006. Scats can reveal the presence and habitat use of cryptic rock-dwelling macropods. Aust. J. Zool. 54: 325-334.

Zub, K., Theuerkauf, J., Jedrzejewski, W., Jedrzejewska, B., Schmidt, K., and Kowalczyk, R. 2003. Wolf pack territory marking in the Bialowieza primeval forest (Poland). Behaviour. 140: 635-648.

105	c) Describe any seasonally critical habitats for caribou that have been identified through field surveys.

Response

The definition of “critical” habitat is not clear. Caribou select habitat based on a number of factors or types of resources. No single resource condition or location was identified as being most important for caribou within the study area. Winter habitat selection was identified from scat using resource selection analysis. High quality habitat representing the most probable types of resources to be selected by caribou within the original LSA and caribou study area is provided in Volume 4, Section 11, Figures 11.5-25 and 11.5-26. Based on the Resource selection models, wintering caribou differentially selected sites:

1. Having lower variation in elevation (meters above sea level) measured within a 140 m radius;

2. That are more distant from high-use anthropogenic disturbances (permanent roads, winter roads, active well sites and facilities);
3. That are not forestry cut blocks;
4. That are within wetland complexes; and/or
5. Sites that occur on linear features with little or no detectable human use.

105	d) Compare findings and conclusions from the scat surveys to those of the winter track surveys.

Response

To compare habitat use among scat survey data and winter tracking survey data, the resource selection probability (as derived by the resource selection model – see Appendix B) was predicted at each location that winter caribou habitat use was observed for each survey type. Both the scat survey data (2006 and 2007) and the winter tracking data (2006) were collected from within the caribou RSA. For additional rigor in the comparison, observations from a winter aerial (2008) in the nearby West Side of the Athabasca caribou range (WSAR) were included in the analysis. To compare habitat use data among the survey types, only caribou observations were considered given their apparent preface to this SIR question (105). A histogram plot was derived to depict the distribution of habitat use observations by resource selection probability (habitat type) for each of the data types (e.g., data from each of the scat detection, winter tracking, and aerial survey types). To aid interpretation, a selection probability nearer 1.0 indicates a combination of resources that have a greater probability of being selected (higher quality habitats) versus probabilities nearer 0.0 (lower quality habitats). The histogram (frequency distribution plot) depicts the percent of the total caribou observation for each survey types by selection probability (Figure 105-1).

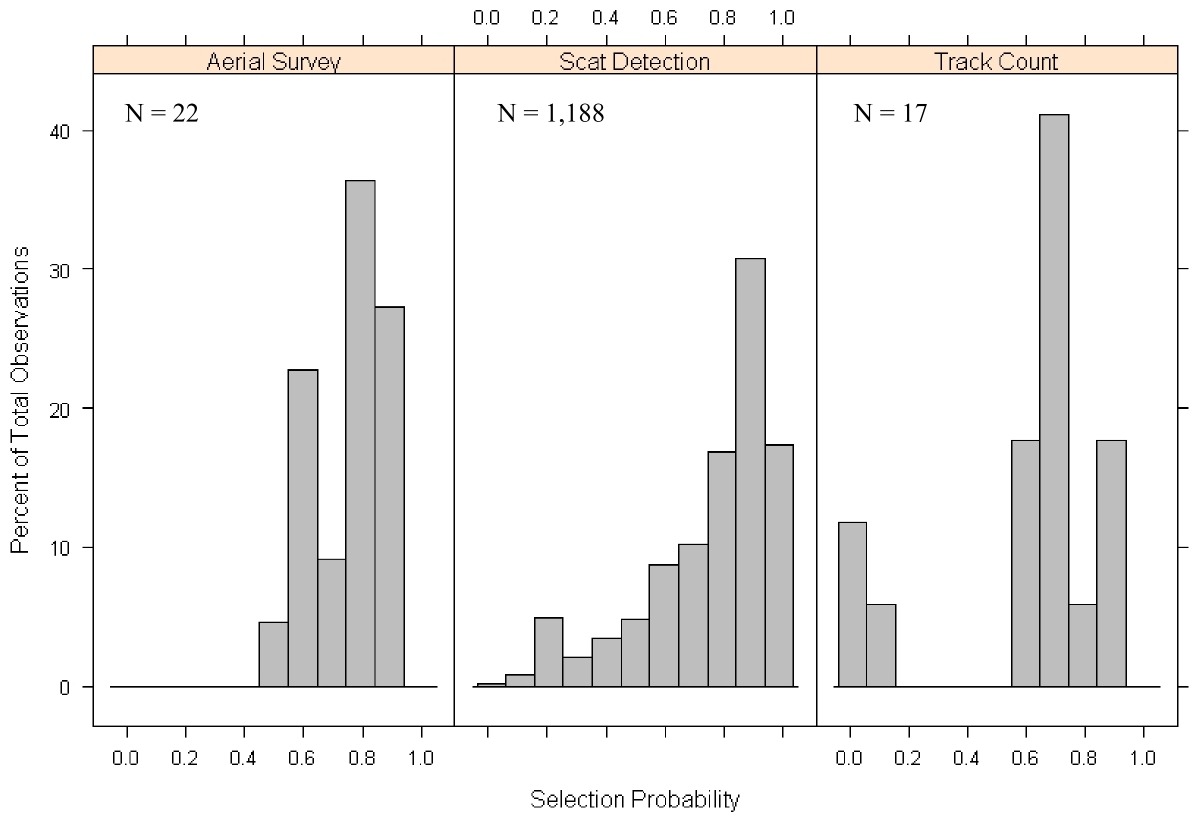

Figure 105-1- Histogram of the distribution of resource selection probability scores among three different habitat use data collected for wintering caribou: scat detection survey locations, winter tracking locations, and aerial survey locations. The frequency of observations is scaled as a percentage of the total observations for each survey type, wherein total observations equal: 22 aerial survey observations, 1,188 scat detection observations, and 17 track count observations.

The comparison of the data from the three survey types provides only a weak ability to compare the response in habitat use because the sample of data points from the winter tracking survey (N = 17) and the aerial survey (N = 22) is relatively small. There is also a potential issue with data dependence among the winter tracking data and the scat detection data since some of the tracking data was collected in the similar locations and at nearly the same time as the scat detection data. As such, a comparison of model fitting or an analysis of the variance or other statistical test was not conducted. However notably by the histogram plot is, that among all three data types, winter caribou habitat use observations predominantly occur in selection probabilities greater than 0.6 (resources predicted to have a higher quality habitats), and that all three data types provide for a similar distribution of the response: a skewed distribution towards upper resource selection probabilities (right skewed). The observations for caribou habitat use among the three survey types appear to be indicating a similar positive response with selection probability (higher quality habitats), however more aerial survey and track count observations would be needed to confirm this conclusion.

To our knowledge, adequate data from an alternative source to compare the findings of habitat use and selection from the scat detection surveys does not exist for caribou in the ESAR. Future analyses are planned to assess whether the scat detection data findings for habitat selection are similar to GPS collar data and further aerial survey locations from the WSAR.

106	**Volume 4, Section 11.4.1.1, Page 11-7 and Figure 11.4-1, Page 11-19** StatoilHydro notes that the control grid is not located in any defined caribou range, and is in the Central Mixedwood rather than the Lower Boreal Highlands Natural Sub-region. a) Describe the purpose of this control area and any sampling conducted in that area.

Response

The control area is designed to provide a separate, unexposed control population with which to detect and isolate the impact of industrial development. A control area should be unexposed to anthropogenic disturbances and ecologically similar to the lease (e.g. contain caribou, moose, and wolves). The distribution of past industrial development made it difficult to find such an unexposed region.

Scat surveys were conducted in the control area in 2007 following the methods provided in Volume 4, Section 11. Surveys detected moose and wolves within the control area, but no caribou (subsequent genetic analyses indicate that the 44 pellet groups reported in Volume 4, Section 11, Page 25 were misclassified in the field).

106	b) Discuss how the control area was selected and why StatoilHydro feels that it is comparable to areas inside a caribou range.

Response

The control area was chosen because it is ecological similar to the lease, contains low industrial exposure, and contains areas identified by the Alberta Caribou Committee as caribou herd range team planning areas. The range team planning areas represent the most current knowledge of caribou habitat (Ann Hubbs, personal communication 28 May 2008) and are believed to reflect the distribution of ESAR caribou better than the provincial range referral boundaries. Also, the scat monitoring indicates that caribou use high quality habitats both within and outside of the provincial range referral boundaries.

As indicated in AENV SIR Response 106 a, scat surveys did not detect any caribou within the control area and as a result, a new control area, with limited activity, needs to be identified.

107	**Volume 4, Section 11.4.1.4, Page 11-11 and Figure 11.4-4, Page 11-22** Barred owl surveys were conducted during May 17-25, 2006 based on advice contained in Takats et al. 2001. However, this reference recommends two surveys to be conducted between March 20 and May 2. As well, owl surveys were focused on the Corner and eastern portion of the Leismer development areas. a) Discuss the confidence StatoilHydro has in the results of these surveys.

Response

Initially, owls were not included in the required surveys and were requested by ASRD at a later date. After reviewing literature on owl survey methods (e.g., Olsen *et al*. 1999, Takats *et al*. 2001), there was no clear indication whether the timing of the survey was un-suitable. Lisa Priestley (nee Takats) was consulted to ensure the validity of the survey and she indicated that barred owls will respond but since they are nesting, the broadcast survey should only be conducted once (Lisa Priestley, pers. comm. 2006). For the purpose of obtaining presence/not detected information, we have high confidence in the results of the survey.

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Olsen, B., L. Takats, B. Beck, J. Beck, and R. Bonar. 1999. Barred Owl Reproductive Habitat. Habitat Suitability Index Model Version 3. Foothills Model Forest. 11 pg.

Takats, D.L., Francis, C.M., Holroyd, G.L., Duncan, J.R., Nazur, L.M., Cannings, R.J., Harris, W. and D. Holt. 2001. Guidelines for Nocturnal Owl Monitoring In North America. Beaverhill Bird Observatory and Bird Studies Canada, Edmonton, AB, p 32.

107	b) Outline additional pre-construction surveys that will be undertaken by StatoilHydro to detect active owl nests.

Response

StatoilHydro is committed to conducting pre-clearing nest surveys, if clearing is required between May 1 and August 15.

108	**Volume 4, Figure 11.4-3, Page 11-21, Figure 11.4-5, Page 11-23 and Figure 11.4-6, Page 11-24** It is noted that bats were surveyed in very few locations within the LSA, while toad and breeding bird survey locations are focused on the Corner and eastern portion of the Leismer development areas. a) Describe additional pre-construction surveys that will be conducted to determine habitat use by bats, toads, and breeding birds.

Response

An additional bat survey will be conducted within the Leismer and Corner leases in August 2008 since the survey conducted for the assessment was not completed due to weather. Additional bat, Canadian toad, and owl surveys will be conducted within the other development areas at a future date when amendment applications are being submitted for those Hubs.

The songbird survey conducted within the Leismer and Corner Leases and supplemented by the regional survey data is adequate to describe avian baseline conditions in the LSA and RSA. A total of 531 points (see AENV SIR Response 102 b) were surveyed which is much higher than surveys in support of other projects in the region (92 points for PetroCanada Meadow Creek, 108 points for CNRL Horizon, 155 points for Opti/Nexen Long Lake, 57 points for MEG Christina Lake). Since specific bird species are not chosen as indicators, results of additional bird surveys would not change the impact assessment. There are no plans to conduct additional songbird surveys.

109	**Volume 4, Section 11.9, Page 11-32** a) Explain the impact of the proposed time line for construction of each of the hubs on caribou movements and habitat use within the Egg-Pony range.

Response

The assessment of habitat availability and habitat connectivity used a worst case scenario assuming all phases constructed at once so future hubs were considered in the assessment (see AENV SIR Response 79 a for development schedule). The Leismer and Corner hubs will be developed first incorporating progressive reclamation. As future hubs are developed, earlier wellpads will start to be reclaimed. Therefore impacts on caribou will be less than predicted.

109	b) Describe the impact of habitat loss (250 m loss on each side of linear disturbance) as a result of the proposed final foot print.

Response

As presented in Volume 4, Appendix 11A, the effects of Project related impacts on winter caribou habitat were estimated from the baseline caribou habitat (resource selection model) in combination with a region of influence coefficient (ROI). The ROI's and disturbance coefficients that were applied to this model are provided in Table I-8 of Appendix 11A (copied below).

Table 109-1 Disturbance Types, Description of Activity, Region of Influence (ROI) and Disturbance Coefficient for Woodland Caribou

Disturbance Feature	Description of Disturbance	ROI (m)	Dist. Coef.
High-level Disturbances			
Primary and Secondary Roads	Provincial highways with high speed and high daily volumes	500	0.75
		250	0.50
Primary and Secondary industrial sites; active construction sites	Permanent facility, daily construction sites with heavy equipment activity	250	0.75
		50	0.50
Moderate Disturbances			
Resource and winter roads	3 season access, no regular road maintenance	100	0.75
Lower-level Disturbances			
Trails, abandoned roads, existing corridors (pipeline/electrical)	Various widths up to 50 m wide	N/A	N/A

The impact on caribou from habitat loss from the proposed footprint at application was rated as a moderate impact in the LSA and a low impact in the caribou RSA (Volume 4, Section 11; Table 11.9-1).

The assumption that habitat is less likely to be used within 250 m of a linear disturbance is based on Dyer et al. (2001). Recent and preliminary results from the scat data are indicating that it is the level of human activity (detectable by caribou) on anthropogenic features, rather than the footprint itself, that changes habitat selection by caribou. Human features with high levels of human use (e.g., highways, permanent access roads, winter access roads) were negatively related to resource selection by caribou, with the degree of loss also depending on other resource conditions (e.g. wetlands, terrain complexity). In contrast, the data appear to be indicating that caribou exhibit a weak positive relationship with low-use anthropogenic features (e.g. seismic lines).

REFERENCE

Dyer, S. J., J. P. O'Neill, S. M. Wasel, S. Boutin. 2001. Avoidance of industrial development by woodland caribou. J. Wildl. Mange. 65(3): 531-542.

110	**Volume 4, Section 11.5.8, Page 11-40** It is noted that suitable habitat for several terrestrial species is limited within the LSA (e.g., Figures 11.5-13 to 11.5-16). a) Discuss how habitat quality and distribution were considered during project design and if these areas were used as avoidance constraints.

Response

The use of habitat quality for constraints is problematic in that optimization of the footprint for one species will negatively affect another. However, StatoilHydro considered, for example, the caribou herd range boundaries, incorporated the use of existing disturbance, and avoided riparian areas to the extent possible in footprint development.

Impacts to the species identified in the figures listed (Volume 4, Figures 11.5-13 to 11.5-16) are considered low. Habitat may be limited in the LSA since the area has a high lowland component but these habitats are not limited in the region.

110	b) Describe how results of habitat mapping will be used to direct pre-disturbance assessments (PDAs).

Response

StatoilHydro will follow the current PDA process, which focuses on vegetation and soils assessments and reclamation planning. The reclamation plan will utilize a targeted ecosite phase, and by inference, habitat approach.

111	**Volume 4, Section 11.6.2, Pages 11-71 to 11-81; Table 11.4-3, Page 11-18 and Section 11.7, Page 11-131** The environmental impact from the Project is predicted to be low to moderate for a number of species. As shown in Table 11.4-3, Page 11-18, this indicates a measurable change. a) Describe the natural range of variability that was considered for habitat availability (Habitat Units) for each species used in the assessment.

Response

In the absence of regulatory guidelines or studies showing definite effects of projects on wildlife populations, professional judgement was used. Habitat loss may affect one species more than another and therefore specific thresholds cannot be applied.

111	b) Discuss why environmental effects on caribou habitat are considered moderate, even though there will be a greater than 10% loss of high quality habitat within the LSA during initial development.

Response

The 10% loss of high quality habitat assumes full build out of the entire Project footprint (see AENV SIR Response 79 a for the Project development schedule). The actual habitat loss will be less than predicted since some project developments will be reclaimed before others are developed. At closure, the impact to high quality habitat is 1.6% less than baseline.

Based on the impact assessment criteria (Volume 4, Section 11, Table 11.4-3), a high impact would infer that the Project threatens the long term viability of the caribou population. Based on the phased development, mitigation measures, habitat compensation, habitat availability at closure, and the less than 5% reduction regionally, StatoilHydro believes that the viability of the caribou population within the region will not be threatened. The reassessment for caribou predicts a moderate impact in the LSA.

111	c) Discuss how the expected duration of the Project was considered in determining population viability when discerning between moderate and high environmental impacts as defined in Table 11.4-3.

Response

There are no current caribou population estimates within the ESAR (Ann Hubbs, Pers. Comm., 28 May 2008) from which to estimate viability. Since the relationship between habitat and caribou population factors (growth rate, abundance, etc.) is not understood (Johnson and Seip, 2008) an estimate of population viability cannot be realistically measured from habitat. StatoilHydro is working on a scat-based mark-recapture analysis that will provide a population estimate. The mark-recapture analysis is a data intensive process that includes extensive DNA testing and is currently being conducted at the University of Washington. While the mark-recapture data is not required to assess the potential impacts of the Project, StatoilHydro is committed to funding this research as it will further the scientific understanding of caribou in this region. The information gathered from the monitoring will be used to validate the impact predictions.

REFERENCES

Johnson, C. J., and D. R. Seip. 2008. Relationship between resource selection, distribution, and abundance: a test with implications to theory and conservation. Popul. Ecol. 50: 145-157.

112	**Volume 4, Section 11.6.2.14, Page 11-81 and Table 11.9-1, Page 11-134** a) Based on StatoilHydro's modelling, habitat reduction numbers and reclamation practice (target ecosite phase), provide an approximate population number and size of core habitat available for caribou at closure. Include the impacts of 4D-seismic activity, if applicable.

Response

See AENV SIR Response 111 c.

112	b) Clarify if caribou on the landscape will be able to re-populate the reclaimed foot print at closure.

Response

As noted in the EIA, based on the resource selection model (using caribou scat data), the availability of high-quality habitat in the LSA will be reduced by 1.6% at closure and as such, suitable habitat for caribou will be available at Project closure.

112	c) Determine the effect on calf survival rates over the length of the operating period and how StatoilHydro proposes to maintain or increase calf survival rates.

Response

In northeastern Alberta, caribou calving occurs in May – June. Calf survival increases exponentially over the first year, with most calves dying between late May and late June following birth (Stuart-Smith et al. 1997). Clearing activities will be conducted primarily during frozen conditions. During the calving season and summer period, activity will be conducted on cleared areas and will be localized.

StatoilHydro is monitoring the population size, habitat use, and stress (thyroid hormone and cortisol) of caribou, moose and wolves in the region. Wolves are the primary predator of caribou within the ESAR while moose are a major alternate prey species. By monitoring these species, StatoilHydro intends to adaptively manage project activities with respect to caribou. There is no ESAR recovery program at this time, but the monitoring program will allow industry and government to assess the influence of activity and respond appropriately.

112	d) What initiatives is StatoilHydro taking part in to increase caribou numbers?

Response

See AENV SIR Response 112 c.

113	**Volume 4, Section 11.6.2** a) Discuss Kai Kos Dehseh's wildlife compensation strategy and plan. Include: i. compensation strategies, ii. methods and habitat types to be reclaimed on a species specific basis, iii. schedule for implementation, iv. commitment to all compensation measures In this discussion, include potential short, middle, and long-term effects of major developments in the EIA on wildlife. Update the EIA accordingly.

Response

Historically, if required, compensation plans for alteration to fisheries habitat have been provided in EIAs; however, compensation plans for wildlife are not included in the Terms of Reference nor other recent EIAs. Based on the assessed level of potential environmental impacts to wildlife, StatoilHydro does not believe that specific wildlife compensation is required, but rather that the proposed mitigation is adequate. Wildlife mitigation, as described in the original EIA, the Conservation and Reclamation Plan, AENV SIR Responses 112 c, 114 a, 116 b and as outlined in the Caribou Protection plans will be implemented throughout construction and operation and as such there is no specific schedule for implementation. StatoilHydro is committed to developing the Kai Kos Dehseh Project as described in the regulatory application and as such will implement the mitigation measures as described

Primary goals of reclamation are to achieve equivalent land capability to support similar land uses to pre-disturbance conditions. To achieve this, reclamation measures are aimed at achieving soils and landforms/drainage similar to pre-disturbance conditions and compatible with the adjacent undisturbed areas. Reclamation target species for a given site are based on achieving similar (self-sustaining) ecosite phases similar to pre-disturbance/adjacent vegetation. Target planting prescriptions for the target ecosite phases that occur in the Project area are presented in Volume 1, Section 8 (Table 8.6-4). The species listed are the prime species considered for the ecosite phase; however, due to natural variability the target species for the target ecosite phase at a given site may be revised based on additional site-specific information to be collected in Pre-Disturbance Assessments.

<table>
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Volume 4, Section 11.6.3.1, Page 11-82

StatoilHydro states *StatoilHydro will implement the following mitigation measures:*

- *Provide wildlife crossing points through the use of natural terrain features;*
- *Install above-ground pipeline crossing structures for wildlife where natural terrain features are not suitable for below pipe movements; and*
- *Locate wellpads at least 100 m from waterbodies (including creeks) where practicable.*

a) Review and revise all mitigation measures with respect to the following documents:

- *BCC guidelines* (Boreal Caribou Committee Strategic Plan and Industrial Guidelines for Boreal Caribou Ranges in Northern Alberta (September 2001; http://www.deer.rr.ualberta.ca/caribou/StrategicPlanandIndustrialGuidelinesSept2001.pdf),
- *Recommended Land Use Guidelines for Key Ungulate Areas* (http://www.srd.gov.ab.ca/fishwildlife/guidelinesresearch/pdf/landuse/UngulateWinterRange.pdf).

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Response

StatoilHydro will locate well pads the required distance from water bodies (including creeks) where practicable, and outside of key ungulate ranges where possible. StatoilHydro will adhere to access restrictions through key ranges as committed to annually in Caribou Protection Plans approved by ASRD so as to 1) protect the long-term integrity and productivity of key ungulate ranges and 2) avoid direct and indirect disturbance to animals using them.

During the Woodland Caribou protection planning for the 2007/2008 season, ASRD requested that the company commit to the September 20, 2007 DRAFT *Wildlife Guidelines for the Use of Above-ground Pipelines*. StatoilHydro commits to all additional mitigative measures as outlined in the September 20, 2007 DRAFT *Wildlife Guidelines for the Use of Above-ground Pipelines Guidelines*. It should be noted that some of the mitigation measures from the September 20, 2007 DRAFT *Wildlife Guidelines for the Use of Above-ground Pipelines* differ from the mitigation measures listed in the *BCC guidelines* (Boreal Caribou Committee Strategic Plan and Industrial

Guidelines for Boreal Caribou Ranges in Northern Alberta September 2001 and the *Recommended Land Use Guidelines for Key Ungulate Areas*.
For clarity StatoilHydro commits to the key mitigation strategies from the September 20, 2007 DRAFT *Wildlife Guidelines for the Use of Above-ground Pipelines Guidelines* as reproduced below.

Wildlife Crossings:

- Elevated sections of pipe should be used to facilitate wildlife passage underneath the pipeline and are preferred to other crossing types. These crossings should be:
    - Located in areas where there is at least 1.8 m clearance between the ground (in addition to average snowfall depth) and the lowest part of the pipe and associated gas-lines/fiber optic cables, and;
    - Located in suitable areas that encourage wildlife use and movement (e.g., away from areas with standing water or difficult footing), and;
    - Suitably located between consecutive pipe racks (i.e., maximum distance).
- Overpass crossing structures allow wildlife to cross over the pipeline and are typically constructed out of wood, culverts, and/or soil. These crossings should be:
    - Blended into natural surroundings in design and structure, and;
    - Covered with a natural substrate and vegetated to encourage wildlife use and provide protective cover, if possible, and;
    - No steeper than a 3:1 ratio between the approach slopes and level ground, and;
    - A minimum of 2.5 m wide - 3.0 m wide or greater is likely optimal.

- If above-ground pipelines are designed to allow wildlife to step or jump over the pipe, a maximum of two adjacent pipelines with 50 cm spacing is recommended. The spacing will allow larger ungulates (moose) to step between the pipes or smaller ungulates (deer) to jump over both pipes. Pipeline height should be max. 0.5-0.6 m from the ground to the bottom of the pipe(s) to allow wildlife to cross over.

- Wildlife crossing areas or structures should be situated:
    - Along existing game trails, ephemeral draws or creeks, or known wildlife corridors, as dictated by pre- and post-monitoring programs in the area;
    - At least every 250 m in good quality habitat or every 400 m in poor quality habitat;
    - Away from intersections with roads or areas of high human disturbance;
    - In areas where natural vegetative cover is present, and;
    - If caribou are known to occur in the area (transient or local populations), every 200 m along routes used frequently by caribou.

General:

- Pipelines should be buried underground when and where possible, to avoid creating a sensory disturbance and/or physical barrier to wildlife movement.
- Overall width of the pipeline corridor (including adjacent roads) should be 40 m. Where woodland caribou are known to occur, the right-of-way should be a maximum of 25 m wide. This requirement needs to be balanced with the minimization of multiple corridors in the area.
- Companies should consider replacing existing pipes rather than widening the right-of-way for additional lines.
- If above-ground pipelines are situated near roads:
    - Wildlife crossings across pipelines should be marked to dissuade increased pedestrian and vehicular traffic, and prevent wildlife mortality, and;
    - Winter snow drifts should be plowed away from all wildlife crossings.
- A monitoring program is integral to determining optimal placement of wildlife crossing areas and measuring the success of existing structures (i.e., extent of wildlife use of the crossings).

Additional mitigation measures for seismic are also outlined in AENV SIR Response 115 b. Finally, StatoilHydro will use existing access where possible, and will site borrow areas outside of Caribou zone where feasible.

114	b) In addition, ensure proposed mitigation addresses timing, options to minimize permanent plant sites, roads, and infrastructure, camp placement, construction sequencing, and commitment to Low Impact Seismic.

Response

Proposed mitigation outlined in each annual Caribou Protection Plan approved by ASRD for work in key ungulate and caribou protection areas addresses timing and the above listed options.

114	c) Discuss the updated wildlife mitigation in more detail. Include: i. impacts to be mitigated, ii. specific mitigation measures, iii. long-term monitoring strategy, iv. schedule for implementation, v. commitment to all mitigation measures

Response

Specific impacts to caribou requiring mitigation include loss of habitat, barriers to movement, and increased mortality. Mitigation measures that will be employed to reduce impacts are described in Volume 4, Section 11.6.2 (for habitat availability and reduced habitat effectiveness), 11.6.3.1 (for habitat connectivity), and 11.6.4.1 (for mortality), and in response to AENV SIR 114 a. As a short summary, mitigation measures focus on:

- reducing new disturbances during sensitive timing windows, *i.e.*, not conducting new ground disturbances during the caribou calving period and avoidance of bird nests if clearing is required between May 1 and August 15.
- providing safe access throughout the Project area, *i.e.*, spacing of surface pipelines and windrows during construction, wildlife crossing structures and the use of semi-submerged culverts for aquatic wildlife.
- where possible, avoidance of key habitat features, *i.e.*, designing the road network to avoid placements between sandy hibernation sites and aquatics habitats for toads, preferentially placing borrow areas and plant sites outside designated caribou zones and ungulate winter range.

StatoilHydro has already commenced a long term monitoring program for moose, caribou and wolf and has two years of baseline data collected (Volume 4, Section 11.4.1.1). StatoilHydro intends to continue this monitoring in future years. The goal of the monitoring program is to provide actual data on the effects of human activity on the three target species so that mitigation measures can be modified or refined in the future.
StatoilHydro has committed to all mitigation measures described in Volume 4, Section 11.6 and in AENV SIR Response 114 a.

114	d) Provide a discussion of development sequencing and how this can be used to enhance mitigation measures. Update the EIA according to include changes made in the mitigation.

Response

The sequence of development for successive project phases is conceptual and is provided in AENV SIR Response 79 a. The wildlife impact assessment incorporated a worst case approach assuming that all Project phases will be developed at the same time. Since the Project will be phased with some components being reclaimed as others are developed, actual Project impacts will be less than that predicted.

StatoilHydro will be continuing the monitoring program for moose, caribou and wolves so information gathered from monitoring the first phases (Leismer and Corner) can be used to adjust mitigation, as necessary, as the other phases are developed.

115	**Volume 4, Section 11.6.4.1, Page 11-82** StatoilHydro notes that access controls are not proposed to limit direct mortality to wildlife by non-project personnel. a) Describe any access controls that will be applied to the Project. b) Describe activities by StatoilHydro to promote seismic line regeneration and prevent access to the area via seismic lines.

Response

StatoilHydro, like all other operators that construct private roads on Crown land, has limited authority to restrict access to public lands and as such will not be implementing any access control on the private roads.

StatoilHydro will incorporate standard mitigation measures for linear disturbances such as using doglegs to prevent lines of sight and rollbacks to limit access. Meandering hand cut lines also limit lines of sight. Low impact seismic practices leave cut vegetation behind, reducing accessibility and providing adequate seedbank to allow vegetation to regenerate quickly thus further restricting access.

116	**Volume 4, Section 11.6.4.1, Page 11-83** StatoilHydro indicates that clearing will be avoided from May 1 to August 15 to minimize effects on nesting birds, and from January 15 to April 30 in ungulate winter ranges, which encompass the majority of StatoilHydro's leases. a) Confirm that StatoilHydro will be able to complete all necessary clearing in the remaining period from August 16 to January 14.

Response

Ungulate winter ranges encompass a minor portion of StatoilHydro's leases, not as stated in the question, hence the timing to complete all necessary clearing is not as stated in the question. StatoilHydro confirms that the Company will be able to complete all clearing outside of relevant timing restrictions and according to guidelines.

116	b) If clearing or non-clearing activity is to occur during the breeding bird season, describe what buffers or setbacks will be applied to active nests.

Response

If clearing activity is to occur during the breeding bird season and active nests are found, the setback for songbird nests will be 30 m and for raptors will be 100 m (Paul Gregoire, CWS, Pers. Comm., June 2008). There are no restrictions for activity on cleared areas.

117	**Volume 4, Section 11.4 and Section 11A1.2, Page 11A-2** Models in biology are only as good as the data that support them. In this EIA, 15 Habitat Suitability Index (HSI) models have been constructed and only 2 of them have data to test the validity of the model. It is understood that ASRD agreed to not have data collected on certain species. Of the two validated models, lynx and moose, sample size by habitat preference index is not presented and the models are poorly supported by the data. a) It is understood that StatoilHydro has access to additional lynx data. Re-validate the HSI model using combined lynx data, improving the HSI model as necessary.

Response

The first statement above describes the adequacy of the models used in this and all other EIA's in the region. The models were developed and based on extensive literature review for each indicator species and is updated as new information comes available. The studies referred to are published in peer reviewed journals and are results of extensive research. These studies were designed specifically for single species with focused objectives. Studies conducted for EIA's are primarily designed for multi-species presence and distribution.

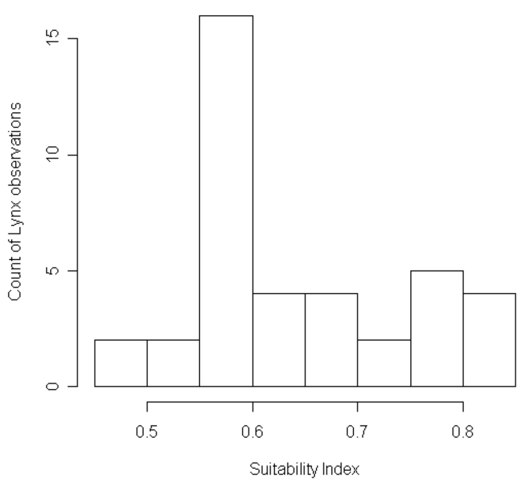
Collecting a representative data set for developing or evaluating wildlife habitat models requires intensive sampling. A retrospective analysis was conducted using 357 km of transects that were not established solely for lynx. These data were taken by combining transects reported in the EIA (157 km) and additional transects located in areas adjacent to the lease within the RSA (200km). Despite the large search area, only 39 lynx tracks were recorded.

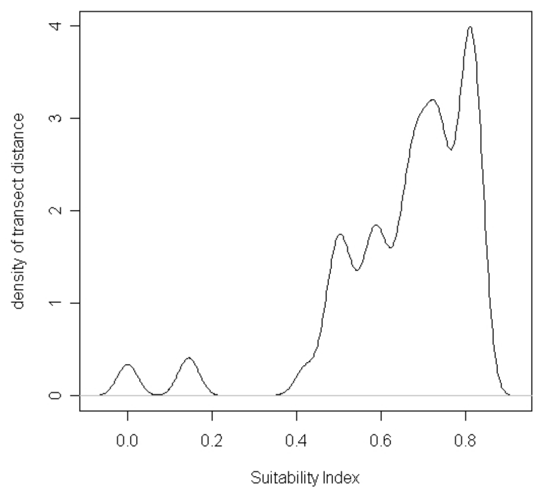
The HSI model was validated by looking at lynx locations and search area by HSI score. Much of the search area was located in high HSI values (Figure 117-1), but because this was a retrospective study, the search areas are not necessarily reflective of the distribution of lynx habitat. None the less, Figure 117-2 shows that lynx were found in areas with an HSI value >0.48, indicating that lynx were found in areas of relatively high habitat suitability and not in areas of relatively low suitability. Short comings of the validation include low sample size (n=39) and the fact that the HSI model predicted predominately moderate and high quality habitat in the LSA, thereby limiting the ability to test the low end of the model (i.e., HSI values <0.48). The validation is therefore inconclusive, despite >60 person-days of sampling along 357 km.

In the absence of conclusive model validation and an adequate sample of lynx observations to create an updated model, we used HSI models that were developed using due diligence by professional biologists. The models used are consistent to what has been used for lynx in this region in the past among numerous other EIAs and from peer reviewed research articles.

Figure 117-1. Frequency histogram giving the number of lynx observations by habitat suitability index value.

Figure 117-2. Density histogram giving the density of transect distance (survey search area) by habitat suitability index value.





117	b) Present updated moose HSI model including model validation, sample size, and evaluation model fit.

Response

The resource selection models (RSF and RSPF models) derived from the scat location data for wintering moose in the study area are presented in Appendix B. Provided in the appendix is: a description of the data and statistical analysis; the final statistical model function selected; covariates, coefficients, and standard errors for each covariate in the final model; and an evaluation of fit for two model forms considered (exponential RSF and logistic RSPF).

117	c) Section 11.4.2.1, Page 11-14, StatoilHydro states *Thus, regardless of the suitability of an area, a species may be unwilling to use the habitat due to factors such as its proximity to human disturbance*. Do the HSI models in this EIA include habitat loss due to proximity of development and human disturbance, including current and future seismic activity? If they do not, add human disturbance as a factor and update the EIA accordingly.

Response

The models incorporate a region of influence for some species as described in Volume 4, Section 11.4.2.3 and in Appendix 11A. The region of influence lowers the habitat quality adjacent to anthropogenic disturbances to varying degrees depending on species and disturbance type.
See AENV SIR Response 101a vi for information regarding future seismic.

Biodiversity

118	**Volume 4, Section 12.6.3.2, Page 12-30 to 12-31; and Table 12.6-1, Page 12-24 and Table 12.6-2, Page 12-25** StatoilHydro concludes that the magnitude of habitat fragmentation effects is predicted to be low, with a low environmental impact. However, Tables 12.6-1 and 12.6-2 show a change in patch size distribution an increase in patch numbers that often exceeds 10% during the construction and operations phases of the Project. Using criteria provided in Volume 2, Section 1, these should be considered a high magnitude effect. a) Explain this apparent discrepancy.

Response

The value of 10% does not appear in the assessment criteria table given in Volume 2, Section 1 and is not used as a criterion in the biodiversity assessment. The overall low environmental impact rating is a quantitative and qualitative assessment at closure based on data indicating that habitats in the LSA are already highly fragmented and largely comprised of fragments <10 ha in area (Table 10.6-1). Table 10.6-1 indicates that the greatest fragmentation will occur in patches >50 ha in area, rather than patches that are already small and therefore host to more vulnerable populations of resident species. Given that such patches represent a small proportion (<2.0% in most cases) of the total number of patches in most of the ecosite phases shown to have >10% increases in patch frequency in Volume 4, Table 10.6-2, some of these increases are a mathematical artifact; almost any increase in patch number in these ecosite phases would appear to be a relatively large change from baseline.

The low environmental impact rating is also based on the assumption that vegetation reclamation objectives will be successful. Under this scenario, it is expected that levels of fragmentation at closure will be similar to those at baseline.

118	b) Discuss how linear disturbances from seismic activity were included in the fragmentation analysis.

Response

The pre-Project anthropogenic disturbances such as existing well pads, roads, and historical seismic lines are included in the baseline and therefore are presented as part of the application case. These activities are captured under the headings of, “Gas production facilities” and “Pipeline/roadway/electric transmission/other linear” in Volume 4, Table 10.5-1.

The inclusion of future oil and gas exploration into the CEA assessment is only possible in qualitative terms as there is no regulatory requirement for operators to predict where these activities may occur and as such footprints for future activities are not available.

Seismic lines existing at baseline were not explicitly identified in the biodiversity assessment. At the RSA level, seismic lines could not be assessed because the GIS data used (AGCC cover classes) were of too low resolution to accurately identify the extent of such disturbances. At the LSA level, such disturbances were not included in the fragmentation analysis because it was considered that their impacts could not be reliably represented with generalized quantitative metrics. When seismic lines bisect contiguous patches of habitat, the physical result, in quantitative terms, is the subdivision of those patches (albeit possible only in the short term). However, the impacts of such fragmentation on most species, and therefore on species diversity, are not well understood. Such fragmentation may represent a decrease in the amount of core habitat in those patches bisected by seismic lines, but the severity of these impacts will vary among species and habitat types. For example, edge effects in thickly forested habitats may be more severe than those in open habitats such as peatlands because the later are more open to start with. Edge effects are likely to vary even among forested sites, however. For instance, edge effects in forests with a high aspen component may persist for a relatively short period of time because aspen tend to regrow relatively rapidly from rhizomes. In terms of species impacts, Machtans (2006) found that songbirds were not dramatically affected by seismic lines, whereas ovenbirds tended to avoid these disturbances. Dyer et al. reported evidence in one study (2001) that seismic lines were avoided by caribou and in another study (2002) that seismic lines were not barriers to caribou movements.

Given the complicating factors described above, it was considered appropriate to address impacts that may be associated with specific species of flora and fauna in the Vegetation and Wildlife components of this assessment. Given that no significant impacts of changes in the density of linear disturbance were reported in those disciplines, it was concluded that there would be no overall impacts on biodiversity. Within the LSA, recent and preliminary results from the scat monitoring program (see AENV SIR Response 109b) indicate that it is the level of human activity (detectable by caribou) on anthropogenic features, rather than the footprint itself, that changes habitat selection by caribou.

REFERENCES

Dyer, S.J., J. O'Neill, S.M. Wasel and S. Boutin. 2001. Avoidance of Industrial Development by Woodland Caribou. The Journal of Wildlife Management. 65: 531-542.

Dyer, S.J., J. O'Neill, S.M. Wasel and S. Boutin. 2002. Qunatifying barrier effects of roads and seismic lines on movements of female woodland caribou in northeastern Alberta. Canadian Journal of Zoology. 80: 839-845.

Machtans, C.S. 2006. Songbird response to seismic lines in the western boreal forest: a manipulative experiment. Canadian Journal of Zoology. 84: 1421-1430.

118	c) Update conclusions of the EIA if required.

Response

Existing seismic lines are part of the baseline scenario and therefore will not affect the impact assessment. Impacts of future seismic activity are expected to vary among species and depend upon the habitats affected. Two of the most common ecosite phases in the LSA, h1 (treed bog) and j1 (treed rich fen), are relatively open habitats and are therefore not expected to be significantly impacted by edge effects resulting from seismic activity. Two other relatively common ecosite phases, c1 and d1, are forested and may experience greater impacts. However, these habitats occupy <10% of the LSA, are already highly fragmented and are considered to have low or very low rare plant potential (Vegetation assessment; Volume 4, Section 10). Moreover, most of the fragments that comprise the area of these habitats in the LSA are <10 ha in area. Overall, therefore, future seismic activity is expected to have low environmental impact in the LSA.

119	**Volume 4, Section 12.4.3.2, Page 12-9** StatoilHydro states that e*dge effects were not considered in this assessment as their severity varies among species and depends on the structure of adjacent patches*. a) Discuss how changes in the density of linear disturbance were considered in the assessment.

Response

Changes in the density of linear disturbances were addressed in the EIA qualitatively but not quantitatively for reasons described in more detail in the response to AENV SIR Response 118. Given the complicating factors described therein, it was considered appropriate to address impacts that may be associated with specific species of flora and fauna in the Vegetation and Wildlife components of this assessment. Given that no high impacts of changes in the density of linear disturbance were reported in those disciplines, it was concluded that there would be no overall impacts on biodiversity.

119	b) Provide an assessment of changes in linear disturbance density in the LSA that included seismic disturbance. c) Compare these densities to published thresholds in the scientific literature for the wildlife species assessed in Section 11.

Response

From StatoilHydro's perspective, the Kai Kos Dehseh footprint includes all major linear disturbances for the projects 30 year life and all anthropogenic disturbances (including existing seismic). These were included in the baseline and application assessments. Future linear disturbance projections, which may result from other resource developers (i.e. local gas producers, pipeline companies), are not available in the public domain. Therefore, changes in the density of linear disturbances as a result of future activities is not possible. Existing and future low impact seismic activities are further discussed in AENV SIR Response 101.

120	**Volume 4, Section 12.6.3.1, Page 12-29** One mitigation measure incorporated into Project design is to use existing disturbances where possible. a) Provide examples of where this has occurred and the types of existing disturbances that were used.

Response

The majority of the linear rights-of-way shown in the Project footprint (Volume 1, Figure 1-2) follow existing disturbances, which is why most of these corridors are not straight lines and at times may not be the most direct routes from one pad to the next. As part of the footprint development and constraint mapping, care was taken not to include existing disturbances that are in potential conflict with other operators (i.e., operating gas wells were avoided). In the future, if other operators facilities become surplus to their operations, StatoilHydro will consider these existing disturbances for inclusion into the Project footprint.

Conservation and Reclamation

121	**Volume 1, Section 2.1, Page 5** It is stated that *StatoilHydro is committed to conducting even more detailed soil surveys (e.g., Survey Intensity Level One) as part of the pre-disturbance assessment (PDA) process*. a) Confirm that these methods are in concordance with the Agriculture Canada (1987) document identified in the TOR, Appendix C&R b).

Response

Soils will be classified according to the *Manual for Describing Soils in the Field* (Agriculture Canada, 1982), the *Soil Survey Handbook* (Agriculture Canada, 1987) and the *Canadian System of Soil Classification* (CSSC) developed by the SCWG (1998).

REFERENCES

Agriculture Canada. 1982. “The CanSIS Manual for Describing Soils in the Field (Revised).” Agriculture Canada, Land Resources Research Institute Report LRRI No. 82-52.

Agriculture Canada, 1987. “Soil Survey Handbook.” Volume 1. G.M. Coen, ed. Expert Committee on Soil Survey, Land Resource Research Centre, Contribution No. 85-30. Tech. Bull 1987-9E. Research Branch, Agriculture Canada, Ottawa, Ontario.

Soil Classification Working Group (SCWG), 1998. “The Canadian System of Soil Classification.” Agriculture and Agri-Food Canada, Publication 1646 (Revised).

122	**Volume 1, Section 8.3.4, Page 153** a) Explain how StatoilHydro has incorporated issues raised by regional groups and integrated land management initiatives into the development of its reclamation plan (TOR 3.6, 2nd b).

Response

StatoilHydro is participating in the Chamber of Resources integrated land management activities along with Al-Pac and other oil and gas operators in the region referred to as the Southern Athabasca Oil Sands Group. One issue that has been incorporated into the reclamation plan is the proposed reclamation of pads on deep organic soils into transitional uplands. The transitional uplands are closely aligned with Al-Pac’s long term desire to harvest forest products. A second issue, that would be coordinated with the County, the Forestry office and other industrial stakeholders, is the reclamation of roads. At the time of project decommissioning, specific roads may be requested by other stakeholders to be left in place and if so, StatoilHydro will adjust the reclamation plan accordingly.

123	**Volume 1, Section 8.3.4, Page 153** a) Explain how the Sustainable Ecosystems Working Group (SEWG) Management Framework will affect the Project for the area within the Regional Municipality of Wood Buffalo.

Response

Several management frameworks have been issued by the SEWG including: the Land Capability Classification, Ozone Management Framework, Landscape Design Checklist, Acid Deposition Management Framework, Ecosystem Management Tools, and the Trace Metals Management Framework. The guidelines and recommendations provided within each of these frameworks were taken into consideration during Project planning and assessment.

The Terrestrial Ecosystem Management Framework was published on June 5, 2008 – after the Kai Kos Dehseh EIA was submitted. The Framework represents CEMA's approach to managing the cumulative effects of development and resource use in the RMWB, and is intended to complement policies and regulations that currently exist. The Framework focuses on regional planning and long-term monitoring and management within the RMWB. StatoilHydro believes that the regional approach taken with the Kai Kos Dehseh EIA and our commitments to long term monitoring complement this framework.

In addition, StatoilHydro would like to point out that while the SEWG framework focuses on the RMWB, the Kai Kos Dehseh Project is in both the RMWB and Lac La Biche County. StatoilHydro believes the regional EIA approach is appropriate for both the RMWB and Lac La Biche County but notes that the SEWG framework may need to be adjusted to reflect local ASRD preferences in the south.

124	**Volume 1, Section 8.5, Page 159** StatoilHydro states that potential impacts to the soils and terrain, if sufficiently severe, could lower the baseline land capability for forest ecosystems of an area. a) How would potential future impacts affect the current baseline land capability?

Response

The statement referred to in the question is just an introductory statement in discussing potential impacts from the Project, to indicate that the land capability of the footprint areas that existed before any project disturbance, could be impacted by the Project. The C&R plan aims to minimize and remedy such impacts.

124	b) Describe the effect on commercial forest potential for the local and regional study areas and impact on the future Annual Allowable Cut.

Response

The goal of the conservation and reclamation measures is to return upland areas (including areas of commercial forest potential) to equivalent land capability for forest ecosystems, and meet the relatively new reclamation criteria for the Green Area (which has additional focus on woody species and tree growth). Land Capability Classes 1 to 3 are capable of supporting commercial/productive forests and are generally found in upland areas. With successful implementation of the conservation and reclamation measures proposed, it is anticipated that these upland areas with pre-disturbance land capability Classes 1 to 3 will be reclaimed to the same Class as pre-disturbance conditions at a given site. StatoilHydro will work with Al-Pac to co-ordinate the Project Development with Al-Pac's logging plans. While these areas will not be available for logging during the operation and reclamation period, over the long term trees will be re-established on these reclaimed sites for logging purposes.

125	**Volume 1, Section 8.6.3.1, Page 164** StatoilHydro states *A Conservation and Reclamation Inspector will be contacted when a land surface disturbance that has not been approved is required.* a) Clarify StatoilHydro's intent to use a qualified soil specialist to oversee all salvage and replacement operations. Confirm the qualifications and duties of this person and what authority they will have.

Response

StatoilHydro confirms that both construction and reclamation operations will be conducted under the guidance of a qualified soil specialist. The soil specialist will have the capability of identifying soil types, will be familiar with proper soil handling techniques and will have authorization to suspend earth moving operations if site conditions may the degradation of topsoil or subsoil or reduce the effectiveness of reclamation activities.

126	**Volume 1, Section 8.6.3.3, Page 165** **Volume 1, Section 8.6.4.3, Page 170** **Volume 1, Section 8.6.5, Page 171** a) Describe the sequencing for salvaged fill use from reclaimed well pads in development of new facilities and well pads within the same project or nearby projects.

Response

New SAGD pads will be constructed to maintain ongoing production levels and as such will be constructed before existing pads are ready to be reclaimed. Initial production estimates and schedules show a temporal overlap of new pad construction and pad reclamation in the later stages of the Project (15-20 years). These overlaps appear to be geographically separate, and as such the EIA has been completed based on the assumption that old fill cannot be reused on new pads. However, StatoilHydro will continue to assess salvage and fill requirements to explore possible reuse options, and will reuse materials where feasible. See AENV SIR Response 79 a for further discussion.

126	b) Elaborate on methods planned to ensure recycled fill is contaminant free.

Response

Soil handling practices are designed to follow the guidelines presented in the *Land Capability Classification for Forest Ecosystems in the Oil Sands Region*, Working Manual (CEMA 2006).

Prior to construction, the disturbed areas will be assessed for contamination through visual inspections. Any noted contamination will be assessed (including laboratory analyses) and remediated as appropriate.

127	**Volume 1, Section 8.6.3.5, Page 169** StatoilHydro states that *topsoil, peat and subsoil salvaged for reclamation will generally be stockpiled on the site of origin where feasible. Stockpiles will be located along the edge of the facility or along the access ROW.* a) Discuss the total volume, individually, of topsoil, subsoil and peat, to be stored and the stockpile design details (e.g., maximum pile heights, slopes and size).

Response

Successful construction of the Leismer Demonstration Project pads, CPF and roads have confirmed that StatoilHydro's design parameters for pads, including the provision for on-site soil storage, are accurate. Precise volumes, storage locations and soil handling will be assessed in the PDAs for each pad and CPF. Subsequently, the overall storage dimensions cannot be defined at this point. Additional details may be found in:

- Volume 1, Appendix A, Table A.5.6.1 provides details on anticipated topsoil, peat and subsoil for the Leismer Commercial Hub.
- Volume 1, Appendix B, Table B.5.6.1 provides details on anticipated topsoil, peat and subsoil for the Leismer Expansion project.
- Volume 1, Appendix C, Table C.5.6.1 provides details on anticipated topsoil, peat and subsoil for the Corner Hub.

In general terms, the stockpiles will be contoured to avoid excessive slopes (nominal slope of 1:1) and will be re-vegetated or otherwise protected. The stockpiles will have a maximum height of 15 m although stockpile sizes will be determined by site conditions (e.g., whether there are topsoil, subsoil and peat stockpiles, or one larger peat stockpile). A separation of two or more metres will be maintained between separately salvaged stockpiles of different materials to ensure no soil mixing occurs.

127	b) Confirm that StatoilHydro's proposed footprint can accommodate these stockpiles as well as support StatoilHydro's proposed operations.

Response

The Leismer Demonstration Project has demonstrated that SAGD well pads will be able to accommodate the stockpiles and operations. Depending on the volume of peat material present at a CPF, there may be a need to enlarge the CPF to allow for storage of peat material. It is anticipated that CPFs with significant peat content may need to be enlarged by approximately 10%.

127	c) Discuss the length of time that topsoil, subsoil and peat will be stored and the associated potential impacts to the soils and seed bank viability as a result of the duration of storage.

Response

The objective of soil salvage and management is to provide valuable topsoil for reclamation purposes by stripping and storing topsoil in a manner that will minimize loss until it is required for future replacement and reclamation. Through proper handling and conservation, the degradation of topsoil by erosion, compaction, rutting, loss of viable plant material, and soil mixing is reduced.

The soil will be preferentially stored at the location of origin until the time of reclamation (10-15 years). Volumes and locations of stored salvaged soil will be recorded for future reference. Unless otherwise authorized in writing by a Conservation and Reclamation Inspector, topsoils and subsoil salvage will be suspended if: (i) wet or frozen conditions will result in degradation of topsoil or subsoil quality; (ii) high wind velocities will result in degradation of topsoil or subsoil quality. Where practicable saturated peat on organic soils will be salvaged under frozen conditions. Industry research is currently underway to determine if frozen organic stockpiles will remain frozen over time and to the ultimate viability of the seed banks.

127	d) Confirm that StatoilHydro will adhere to the most current reclamation guidelines and criteria at the time of reclamation.

Response

StatoilHydro confirms that it will adhere to the reclamation guidelines and criteria in place at the time of reclamation.

128	**Volume 1, Section 8.6.5, Page 171** **Volume 4, Section 10.4.3.4, Page 10-11** **Volume 5, Section 13.7.6, Page 13-22** With the exception of berries, traditional vegetation is not considered in the reclamation and closure plan. This presents a concern as Volume 5, Section 13.7.6, Page 13-22 only considers berry picking, and ultimately only blueberry, wild strawberry and low-bush cranberry species as assessment indicators. Furthermore, it is implied that reclamation of wetland ecosites to a ‘g1’ ecosite type will mitigate the removal of traditional and medicinal plants in wetland ecosites by providing an increase in blueberry habitat. a) Provide rationale for only selecting berries in the consideration of traditional and medicinal plants.

Response

Berries were not selected because they are a traditional or medicinal plant, rather berries were selected because berry picking is a land use activity engaged in by both Aboriginal and Non-Aboriginal individuals. In addition, berries were selected as this was the information available from Volume 4, Section 10 of the EIA. The Traditional Use study may address more broadly traditional and medicinal plants.

128	b) Indicate how StatoilHydro will use Traditional Ecological Knowledge (TEK) and Traditional Use (TU) studies to develop revegetation prescriptions that consider multiple traditional and medicinal plant uses.

Response

The Kai Kos Dehseh Application and EIA states that berry picking is an important activity in the land and resource use LSA and RSA. Berries and other traditional plants, such as mint, are picked by First Nations people and by recreational berry pickers. Blueberries were the most commonly picked berry in the Meadow Creek LSA for nontraditional purposes, followed by cranberries (high and low bush), strawberries and raspberries. Other berries that may be sought in the area are saskatoons, chokecherries and rose hips (Devon, 2003). Blueberry habitat covers approximately 26% of the LSA, with cranberries covering 13% and strawberries covering 1% of the LSA.

The TEK and TU studies were initiated in the summer of 2006 with four Aboriginal groups, specifically: the CPDFN, Chard Métis Local 214, Conklin Métis Local 193 and Fort McMurray No. 468 First Nation. The TEK and TU studies were more formally commenced in 2007 with meetings, area tours and on-going discussions.

As documented in the EIA, the concerns regarding vegetation and reclamation of impacted areas included cumulative effects (Conklin), and cumulative effects of community health (Chard/Janvier). No special interest group specifically identified vegetation and the potential loss of berry or medicinal plant use as a concern. In light of this, the TEK/TU study objectives were to facilitate consultation regarding vegetation and wildlife used for nutritional and medicinal purposes.

The TEK/TU study scope is still being developed through conversations with each First Nations group. Conversations have been held and have resulted in further understanding of issues or concerns. These conversations are enabling StatoilHydro to deal with these issues in a timely manner with the people that raised the concern. StatoilHydro will continue this approach throughout the Project based on the needs of the communities.

129	**Volume 1, Section 8.6.5.2, Page 172** Although the restoration success of peatlands is generally unknown, there are documents that discuss peat compressibility (Price et al. 2005) and restoration (Quinty and Rochefort 2003). a) For peatlands with peat greater than 40cm in depth, discuss the rebound, water infiltration and successful interfacing of compressed peat with salvaged peat.

Response

Price et al (2005: *Advances in Wetland Hydrology* 1999 – 2003) comments on drainage of peatlands for commercial peat harvesting and on the resulting peat subsidence and decrease in hydraulic conductivity as the water table drops. Price et al (2005: Assessment of peat compressibility) assesses the relation of peat compression to peat characteristics such as fibre content, Van Post number, and bulk density. Price concluded in that paper that easily measured soil parameters are not good indicators of soil compressibility.

Peat under pads may remain saturated, but compression of the peat will occur due to the pad loading. There does not appear to be sufficient information to easily predict the actual amount of peat compression, or to predict the amount of rebound (and recovery of associated peat parameters such as bulk density and hydraulic conductivity) upon removal of the loading.

In any case, compression of the peat and a decrease in hydraulic conductivity under the pads are anticipated. Pad removal will likely promote rebounding of the underlying peat and some recovery of hydraulic conductivity. Additional measures to promote recovery of hydraulic conductivity of the peat will be considered at the time of reclamation depending on site specific peat and moisture conditions. These include limited ripping (e.g. freezing of the area & using a single tooth on wide pad equipment in winter) of the compressed peat to relieve compression and facilitate vertical and horizontal water movement before the salvaged peat is replaced on top. The surrounding adjacent undisturbed peatland area will be an important source of water to the replaced peat area (Quinty and Rochefort, 2003), and it is anticipated the water table in the replaced peat area will equilibrate with that of the adjacent peatland.

An important aspect of peatland reclamation is establishment and maintenance of the water table near the surface; thus storing more water and limiting water loss is an important objective of peatland reclamation (Quinty and Rochefort, 2003; Peatland Restoration Guide). In addition to the above measures for the potentially compressed peat, the following measures assessed for the replaced peat layer, depending on site-specific conditions:

- The replaced peat surface will be fairly level (for even water distribution and to prevent runoff) but small, shallow depressions will be left in order to assist in water retention (e.g., retention of snowmelt) on the replaced peat area.

- Woody mulch may be spread on the surface to reduce loss of water by evaporation (other mulch material may be considered, but straw mulch will not be used due to weed concerns). This layer would be kept thin in order not to interfere with vegetation growth.

130	**Volume 1, Section 8.6.5.2, Page 172** A new policy is being considered by Alberta Sustainable Resource Development and Alberta Environment that will require all fill to be removed from peatland developments prior to the issuance of reclamation certificate. a) Explain how pad/road construction techniques and how reclamation will be carried out on these sites if this policy were implemented.

Response

StatoilHydro is committed to meeting the reclamation policy in place at the time that sites are decommissioned. It is StatoilHydro's understanding that recent draft criteria from AENV and ASRD do not require complete pad removal in deep peatlands, but instead focus on removing the pad to, at, or near the water table so that sites are inundated with water in the spring and moist to wet in the fall. Additionally, these draft criteria give provision for reclamation of peatlands to an alternative end-use, provided that an agreement with the landowner has been reached.

During the life of the Project, some fill materials may be able to be reused for future construction. However, in the future StatoilHydro suspects that the environmental impacts of completely removing a road bed or pad will have to be weighed against the environmental impacts of reopening reclaimed borrow areas to replace these materials. In this case, it would likely be more environmentally acceptable to reclaim these road beds and pads in place and focus on developing them into functional and naturalized ecosites.

In the case that StatoilHydro were required to reclaim deep peatland according to this (draft) criteria, and no agreement on alternative end-use was reached or requested, StatoilHydro would then construct pads in a manner consistent with that currently proposed in the EIA. When reclaiming the site, StatoilHydro would propose removing fill to, at, or near the watertable (or to a level to allow revegetation to be consistent with adjacent vegetation), and would transport the fill from the site to either be used in then ongoing site construction, where feasible, or to be used or located in a manner consistent with current ASRD and AENV policy. See AENV SIR Response 93 for further discussion.

130	b) How will this affect borrow requirements?

Response

In the event that the fill material is needed to construct a pad or road in a reasonable distance from the pad being reclaimed, this policy would result in reduced borrow requirements. In the event that the fill material cannot be reused, the policy would result in additional land disturbance. The additional land disturbance would result from the need to reopen borrow areas, that have been reclaimed, so that the recovered fill can be replaced into the borrow area. These "refilled" borrow areas would then have to be reclaimed a second time.

131	**Volume 1, Section 8.6.5.6, Page 174** StatoilHydro discusses removal of gravel and culverts from access roads and decompacting as required. It has been well documented in the research literature that access corridors encourage wolves and bears to travel through the wetland habitats frequented by caribou resulting in greatly increased mortality of the caribou calves. a) How does StatoilHydro propose to stop the use of these man- made "upland" areas by predators and what will the impact be on caribou if StatoilHydro's access reclamation proposal is implemented?

Response

During winter, wolves use snowmobile paths as travel routes (Edmonds and Bloomfield 1984), which can result in increased predation (Bergerud et al. 1984). Although it is known that wolves can move faster on linear features (James 1999) and have higher encounter rates (McKenzie 2006), all things being equal, it is not known that wolves will kill more caribou. This is difficult to ascertain as encounter and kill rates depend on numerous factors not limited to, but including:

- Abundance of predators, prey, alternate prey (Patterson and Messier 2000, McKenzie 2006)
- Distribution of predators and prey across the landscape (McKenzie 2006)
- Uncertain effects of the spatial location and pattern of corridors in relation to prey distribution across the landscape.

StatoilHydro will mitigate the potential effects of winter use of corridors within the LSA by preventing access through the use of rollback. Reducing public use of corridors will remove this resource, mitigating a potential source of mortality.

The reclamation strategy described in the EIA follows recommendations provided by Alberta Environment and this changes as new technologies are developed. Research is ongoing to develop effective lowland reclamation and new strategies will be employed as they are made available. StatoilHydro will monitor the abundance and habitat use/selection of caribou, moose and wolves in the LSA during the project. By monitoring these species, StatoilHydro intends to adaptively manage project activities with respect to caribou.

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132	**Volume 1, Section 8.6.5.10, Page 177** a) Discuss how StatoilHydro will be working with the FMA holder with respect to *Standards for Tree Improvement in Alberta* (ASRD, July, 2005) (seed zone requirements for tree seedlings) and the necessity to replant given the FMA holder's timeline for harvesting adjacent areas where structural stage would be much greater than the replanted areas.

Response

The *Standards for Tree Improvement in Alberta* ASRD, July 2005 are specific for collection of seed or propagules from lands in the green zone that will be grown in greenhouses and used in reclamation planting prescriptions. StatoilHydro does not anticipate undertaking this process but will seek revegetation species from growers/supplies approved by ASRD at the time of reclamation.

133	**Volume 1, Section 8.6.5.9, Page 177** StatoilHydro describes the difficulty in reclaiming access roads and pad sites where geotextile has been used. a) Describe alternative technologies/methods/ideas of construction capable of replacing the geotextiles and the benefits/changes to the final reclamation process?

Response

StatoilHydro is aware of a number of technologies or processes that could be used instead of geotextile. StatoilHydro will evaluate new technologies and should a superior technology or process become available, StatoilHydro will consult with ASRD and AENV and adapt as appropriate. A summary of known technologies or processes, and benefits or changes to the final reclamation process are listed below.

1) Removing all peat until mineral soil is reached, and building the pad or road upon a mineral soil foundation.

Benefits:
   a. No geotextile would be utilized

Changes:
   a. Very large quantities of fill may be required, requiring significantly larger borrow areas, and consequentially greater haulage impacts;
   b. Large stockpiles for peat would be required;
   c. Potential alteration of water flows in local area, negatively impacting upon vegetation
   d. Final reclamation would be similar to that planned if using geotextile.

2) Use of 'corduroy' (conglomeration of locally felled timber, placed on site) to provide a foundation for the pad (clay fill added to make the final pad surface)

Benefits:
   a. Avoids the use of geotextile;
   b. Uses a locally available material;

Changes:
   a. Large volumes of salvageable timber would be required for construction of pads and access roads, and may negatively impact upon the FMA holder;
   b. The corduroy may need to be banded together to avoid movement during construction;
   c. Corduroy can partially degrade within 3 or 4 years, resulting in serious damage to the well pad or road surface above (which will be in service for significantly longer periods of time).
   d. Biodegradation of corduroy is preferable to leaving geotextile (an inert material) in place at time of reclamation.

3) Use of rig mats in place of geotextile

Benefits:
   a. Avoids the use of geotextile;
   b. Uses a biodegradable material;

Changes:
   a. This process may be prohibitively expensive;
   b. Biodegradation of rig mats is preferable to leaving geotextile (an inert material) in place at time of reclamation.
   c. Large volumes of salvageable timber would be required for construction of rig mats.
   d. Biodegradation of rig mats will be slow and will not significantly damage the well pad or road surface.

134	**Volume 1, Section A.5.6.3, Table A.5.6-1, Page A-80** Table A.5.6-1 provides a material balance for approximate soil volumes. a) How will the stockpile volumes be monitored throughout the operational phase of the Project to ensure there are no large volumes of soil loss?

Response

Soil stockpiles will be monitored as part of the Project's environmental management plan. To ensure no large-scale loss of mineral soils, StatoilHydro will ensure that stockpiles are appropriately sited (on higher ground, or on geotextile), and the revegetation of the stockpile occurs as planned. Any wind or rain erosion of the stockpile will be monitored and mitigative measures taken if significant amounts of erosion occur.

135	**Volume 1, Appendices A, B & C** a) Conceptually describe StatoilHydro's timber salvage plan, providing a tracking mechanism to ensure the appropriate utilization of the timber volumes by species year, or periodically as the Project progresses. Include opportunities for timber salvage, revegetation, reforestation and harvest for the reduction of fuel hazards as indicated in TOR, Appendix C&R, h).

Response

The integrated Forest Management Plan between StatoilHydro and Al-Pac has been developed to optimize forest harvesting operations with construction operations. The Plan allows Al-Pac to schedule cut-blocks, where possible, to coincide with pad clearing by StatoilHydro. Where cutblocks are not feasible for initial clearing, timber salvage on the clearing will be arranged with Al-Pac. This coordination will result in no loss of forest resources.

Pad areas that are cleared to a larger extent than needed through the operations phase will be allowed to revegetate, and will be harvested with the surrounding stands in the next harvest rotation. Cleared areas will be revegetated upon Project completion and reclamation.

StatoilHydro's underlying timber salvage plan will be to deck all salvageable timber for Al-Pac, unless Al-Pac has precleared the area for StatoilHydro.

136	**Volume 2, Section 1.5.5, Page 1-17; Volume 4, Section 9.2; Page 9-1; Volume 4, Section 10.3, Page 10-5** StatoilHydro discusses the magnitude of project impacts, which are a key factor in determining residual project impacts or cumulative effects impact. In Volume 4, Section 9.2 there is no discussion of magnitude criteria established for soils and vegetation. a) Outline the magnitude criteria for soils, and provide a scientifically defensible rationale for the categories used. Cite the appropriate references if the criteria are based on published literature. b) Magnitude categories are provided for vegetation in Volume 4, Section 10.3. Provide a scientifically defensible argument as to why these criteria were used. Cite the appropriate references if the criteria are based on published literature.

Response

Magnitude criteria are provided to classify the size and severity of the predicted impacts to vegetation indicators from the Project and are based partly on the range of natural variation present for vegetation communities in the Boreal forest and partly on knowledge of the range of vegetation impact sizes from SAGD projects. It is important to recognize that the overall significance of an impact is based on a number of criteria, one of which is magnitude, and that professional judgment is incorporated into each assessment (Sadler 1996; Lawrence, 2007a).

Natural disturbance regimes in the Boreal forest are primarily due to forest fire activity (Hansson, 1992). A range of values for average annual area burned in the Boreal forest are available for various regions in Canada. The values range from 0.5% to 2% for northern Alberta (Cumming, 1997; Murphy, 1985) to 0.32% for the Boreal mixedwood in Saskatchewan (Kabzems et al., 1976) and 1.68% for northwest Ontario (Boychuk and Perera, 1997). A more recent analysis by Armstrong (1999) for northeastern Alberta determined that the average annual area burned was 0.3% from 1961 to 1995, but would be 0.56% without the current levels of fire suppression. They also determined that the oldest known forest for their study area was 230 years, which corresponds to an average annual area burned of 0.43% (Armstrong, 1999). Al-Pac, the FMA holder in the area of the Project, states that 0.4% of the land in northern Alberta has burned annually since 1961 (Al-Pac, 2004). Given the 50 year lifespan of the Project, including construction and operation, this would result in a range of 15% to 100% of the study area burned naturally over the life of the project. The most recent and regionally applicable results (Armstrong, 1999; Al-Pac, 2004) estimate that between 22% and 28% of the study area will be burned over 50 years. Therefore the impact magnitudes of <1% for negligible, 1-10% for low, 10-20% for moderate and greater than 20% for high fit well within this range, and are actually on the low end of the natural variation known for this region.

Other guidelines state that at least 20-30% of forested or breeding habitat should be maintained to prevent dramatic decreases in species' populations (Fahrig, 1998; Andren, 1994; Environment Canada, 2004), while 50-75% of natural habitat must be protected to represent and maintain all species and ecosystem types (Carlson and Stelfox, 2007). The impact magnitudes used for the Project assessment are much more conservative than these guidelines call for and add conservatism to the impact significance determinations.

The magnitude criteria were also created to appropriately classify the predicted impacts of the Project. Therefore, these categories must take into account the variability of the impacts and be defined in the same way. For example, if most impacts to vegetation from SAGD projects range from 1-5%, then it is not useful for the low category to be defined as less than 5% because all impacts will be rated as low. The magnitude criteria are used in the final decision-making process for determining impact significance, and therefore are most useful and relevant if they represent the actual range of potential impact values predicted for the Project.

The final impact significance rating takes into account impact magnitude, but also a number of other important criteria such as permanence, reversibility, duration and confidence. Most importantly, best professional judgment is also incorporated into each impact significance decision. While this input may not be described explicitly in the text of the application, it is implicitly incorporated into each assessment. For example, an impact with low magnitude to a particularly sensitive indicator might be rated as having high significance, while a low magnitude impact to a less sensitive indicator could be rated a low significance impact. Public opinion can also be incorporated in the same manner, as for an indicator of considerable public interest such as the wetlands versus a less important indicator (Sadler, 1996). In this way, professional judgment integrates all of the impact criteria to provide a relevant impact significance rating and facilitate decision-making (Lawrence, 2007a).

The Supplemental Information Request posed seems to imply that the magnitude ratings are synonymous to ecological thresholds. In other words, to levels at which significant shifts or changes in the indicator in question will occur. The magnitude ratings used in this EIA are not threshold levels. Threshold levels correspond more appropriately to the impact significance ratings. There are a number of reasons why quantitative ecological thresholds are not utilized for this Project. Firstly, there is little evidence that there are universal thresholds for forests; instead local thresholds appear to be ecology and species specific (Dykstra, 2004). Also, the data and knowledge to accurately determine thresholds for the vegetation indicators is not available for the study area and are well beyond the scope of this assessment. The complexity of ecological systems and interactions, including: multi-causal effects, species-specific responses (Bender et al., 1998; Dykstra, 2004; Huggett, 2005), variations in landscape context and disturbance regime

(Schmiegelow and Monkkonen, 2002; CACR, 2007) and even differences between separate studies (Lindenmayer and Luck, 2005) make determining ecological thresholds extremely time- and data-intensive. In many cases, the baseline studies performed for the application are the first data gathering exercises completed for the area. Instead of establishing arbitrary thresholds with a paucity of data, what is more useful is to emphasize monitoring for significant effects during the Project lifetime and quickly incorporate appropriate mitigation to minimize impacts (Dykstra, 2004; Lawrence, 2007b).

136	c) Provide a scientifically defensible argument as to why the same magnitude categories (i.e., no discernible contribution, less than 1% measurable change, 1% or greater but less than 10% measurable change, etc) can be applied universally to the key indicators for vegetation, wetlands and forest resources (i.e., vegetation communities, rare plants, vegetation communities with limited distribution, wetlands, economic forests, old-growth forests, and traditional and medicinal plants). Describe how the magnitude categories for key indicators were determined. Cite the appropriate references if the criteria are based on published literature.

Response

As described above in AENV SIR Response 136a, the magnitude categories do not describe ecological thresholds for the vegetation, wetland, and forest resource indicators, but instead are used as a measure of the magnitude of change. The magnitude categories are based partly on the natural variation regime of the area and are designed to encompass the predicted variation in project impact magnitudes for the Project. A description of how the impact magnitude categories were determined is also provided above.

As disturbance regimes are similar for each vegetation indicator within the study area, the argument can also be made that the impact magnitude criteria should be the same for different key vegetation indicators. For example, rare plants, vegetation communities, etc. will all be adapted or possibly reliant on a similar disturbance regime, based primarily on forest fire activity.

However, the impact magnitude categories do not correspond directly to impact significance. They are used in conjunction with a variety of other impact criteria and best professional judgment to determine the impact significance. A high or moderate magnitude rating for an impact does not translate directly into a medium or low significance impact, the sensitivity of the indicator and other case-specific information will be incorporated into the assessment utilizing best professional judgment.

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Land and Resource Use

137	**Volume 5, Section 13.6.3, Page 13-8** a) Based on the close proximity of the Stoney Mountain Wild Land Park, summarize the discussions with Alberta Tourism, Parks and Recreation describing the potential impacts on the park and a mitigation plan to deal with these impacts.

Response

As described in section 13.8.2.2 of the EIA, Alberta Tourism, Parks and Recreation (ATPR) was contacted in April 2007 to discuss the formal management directive for the Stony Mountain Wildland Park. During this conversation, ATPR disclosed that there was no formal management directive for the Stony Mountain Wildland Park. Section 13.8.2.2 of the EIA also states that StatoilHydro will not locate any facilities or conduct any drilling in the Stony Mountain Wildland Park, therefore no mitigation is necessary as there will be no surface disturbance and no overall impact on the Stony Mountain Wildland Park.

138	**Volume 5, Section 13.8.2.6, Page 13-44** a) Summarize, in a table format, the anticipated pads that will be cleared as part of Al-Pac's harvest plan for the Project Area. Include a time line of harvest/ foot print clearing for each of the hubs planned and the estimated volumes of merchantable timber involved.

Response

See AENV SIR Response 135.

E. HEALTH

139	**Volume 2, Section 2, Page 2-1** StatoilHydro identifies several contaminants that will be emitted by the Project, and suggests that these will be evaluated in the assessment. Typically, an EIA will include compounds deemed a concern by local stakeholders. a) Confirm that compounds identified as a concern by regional stakeholders were evaluated in the assessment.

Response

The Public Consultation section of the EIA (Volume 1, Section 6) was evaluated, and no additional chemicals of potential concern were identified beyond what was identified in the air emissions inventory.

140	**Volume 2, Section 2, Page 2-4** StatoilHydro indicates that impacts of particulate matter were assessed using $PM_{2.5}$. a) Discuss whether it was assumed that all particulate matter (PM) was emitted in the $PM_{2.5}$ fraction, or was a fraction of the total used?

Response

For the purposes of the particulate matter assessment, and as a conservatism, it was assumed that all particulate matter emitted was in the $PM_{2.5}$ fraction.

140	b) Identify if secondary particulates included in the $PM_{2.5}$ fraction? If not, update the Human Health Risk Assessment (HHRA) to include this fraction.

Response

Secondary particulate formation was included in the $PM_{2.5}$ modelling predictions. For details of secondary particulate formation calculation see Volume 2, Appendix 2D, Section 2D3.6.

141	**Volume 2, Section 2, Table 2.5-3, Pages 2-22 & 2-23** StatoilHydro states *In summary, while there is evidence of local source influences in the air LSA, the air quality in air LSA appears to be similar to that of remote areas.* a) Identify if the "air LSA" refers to the "Project Area" and if so, to what extent was the Project Area monitored for the air contaminants? In other words, how many data points are available?

Response

In Table 2.5-3 of Volume 2, Section 2, the Project area does refer to the air LSA. The area of the air LSA has been monitored less than areas located to the north (Fort McMurray region) and to the south (Cold Lake). The only continuous monitoring station that has been operational in the LSA is the EnCana Conklin station.

141	b) No data was collected for total hydrocarbons (THC), $PM_{2.5}$, or ozone in the Project Area. Discuss how it was concluded that the concentrations of these compounds in the LSA would be comparable.

Response

As there were no data collected for THCs, $PM_{2.5}$ or ozone in the LSA, the closest station (Anzac) to the LSA was selected for these compounds. This site is located just outside of the LSA to the north. Relative to the Project, the Anzac station is approximately 50 – 70 km away, and therefore, measurements from this station represent the best available data to make comparisons to the ambient air quality in the LSA. Conclusions made regarding background concentrations for these species in the LSA were based on the Anzac records.

142	**Volume 2, Section 2, Page 2-24** StatoilHydro notes that the predicted maximum sulphur dioxide (SO_2) in the Baseline case is higher than the maximums measured at Mildred Lake and Buffalo Viewpoint. a) Clarify if the maximum predicted value was at the same location, or close to, these monitoring stations.

Response

The maximum predicted Baseline SO_2 concentrations are not predicted at either the Mildred Lake or Buffalo Viewpoint monitoring stations. The maximum predicted concentration is predicted at a distant receptor that is approximately 6 km southeast of the Mildred Lake station and 7.5 km northeast of the Buffalo Viewpoint station.

143	**Volume 2, Section 2, Table 2.6-4, Page 2-44** For the upset scenarios, the predicted maximum SO_2 concentrations range from 0.97 to 33.05 $\mu g/m^3$. a) Verify that these values include the contribution from Baseline sources. If not, provide an updated table that takes into account Baseline sources along with upset emissions.

Response

The predicted concentrations for modelled upset scenarios are representative of only the Project and do not include baseline sources. Modelled predictions for upset scenarios plus baseline sources in the LSA are presented below.

Table 143-1 Modelled Predictions for Upset Scenarios

Case	Averaging Period	Project Upset Scenario ($\mu g/m^3$)	Baseline Plus Upset ($\mu g/m^3$)	AAAQO ($\mu g/m^3$)
Upset Case 1	1-h Maximum	9.46	-	450
	1-h 9^{th} Highest	7.91	284	450
Upset Case 2	1-h Maximum	0.97	-	450
	1-h 9^{th} Highest	0.81	284	450
Upset Case 3	1-h Maximum	33.05	-	450
	1-h 9^{th} Highest	18.86	284	450

Note: '-' represents that values are not presented as per the Alberta Model Guideline the highest eight predictions are disregarded as outliers of extreme meteorological conditions

144	**Volume 2, Section 4.4.3.3, Page 4-12** StatoilHydro states a *separate assessment was completed using a multi-media model for the chemicals of potential concern (COPC) that could enter the food chain via soil, plants and other organisms. To focus the multi-media assessment, environmental fate and persistence screening was conducted. A separate assessment was completed using a multi-media model for the COPCs that could enter the food chain via soil, plants and other organisms. To focus the multi-media assessment, environmental fate and persistence screening was conducted.* Screening for chemicals to include in the multi-media assessment was based on: having a soil half-life greater than or equal to 6 months or 182 days, or an octanol-water partition coefficient (log K_{ow}) greater than or equal to 5. The definitions set out for persistence and bioaccumulation are determined within Canadian Environmental Protection Act (CEPA) to prioritize substances on the domestic substances list (DSL). While this is a useful method to prioritize which compounds need national guidance and regulation it in no way implies that if a substance does not meet these criteria that the chemical should be consider to be safe and/or non-toxic. a) Conduct a toxic potency screening in addition to the environmental fate and persistence screening to ensure that all COPCs are addressed in the HHRA. Discuss the implications to the HHRA.

Response

StatoilHydro maintains that the environmental fate and persistence screening conducted in the original EIA is the most scientifically appropriate approach for identifying substances that may persist or accumulate in the environment. However, as requested, a toxic potency screening has been conducted as part of this Supplemental Information Response.

To identify the toxic potency of the chemicals of potential concern (COPCs), the following steps were taken:

- Determining of emission rates for all potential emissions associated with the Project (e.g., PAHs and VOCs);
- Identifying chronic oral and inhalation Toxicity Reference Values (TRVs) for all chemicals. The TRVs adopted for the current exercise represent the most stringent of those limits published by Health Canada and the United States Environmental Protection Agency;
- Calculating the toxic potency of each chemical using the following equation:

$$\text{Toxic Potency} = \frac{\text{Emission Rate}}{\text{TRV}}$$

- Sorting the emissions profile by relative toxic potency; and
- Identifying those chemicals that make up 99% of the emission profile's cumulative toxic potency.

The chemicals that made up 99% of the toxic potency are shaded in Tables 144-1 and 144-2 below.

Table 144-1 Inhalation Toxic Potency Screening

Inhalation					
Parameter	**Emissions (g/s)**	**TRV**	**Toxic Potency**	**Relative Potency**	**Cumulative**
NOx	187.4389	60	3.123981	33.72%	33.72%
Acrolein	0.042352	0.02	2.117609	22.85%	56.57%
Formaldehyde	1.282439	0.77	1.665505	17.98%	74.55%
PM2.5	14.19026	12	1.182522	12.76%	87.31%
SO2	33.12	30	1.104	11.92%	99.22%
Benzene	0.076315	1.3	0.058704	0.63%	99.86%
Acetaldehyde	0.095391	17.2	0.005546	0.06%	99.92%
Hexane	3.433911	700	0.004906	0.05%	99.97%
Naphthalene	0.004946	3	0.001649	0.02%	99.99%
Xylenes	0.056665	100	0.000567	0.01%	99.99%
Pentane	4.960093	18400	0.00027	0.00%	100.00%
Benzaldehyde	0.05189	360	0.000144	0.00%	100.00%
Dichloro benzene	0.002289	60	3.82E-05	0.00%	100.00%
Toluene	0.143228	5000	2.86E-05	0.00%	100.00%
Dibenz(a,h) anthracene	2.66E-06	0.290909	9.14E-06	0.00%	100.00%
Benzo(a) pyrene	2.66E-06	0.32	8.31E-06	0.00%	100.00%
Fluoranthene	3.45E-05	6.4	5.39E-06	0.00%	100.00%
Ethyl benzene	0.004292	1000	4.29E-06	0.00%	100.00%
Benzo(b) fluoranthene	3.8E-06	3.2	1.19E-06	0.00%	100.00%
Indeno(1,2,3-cd) pyrene	3.8E-06	3.2	1.19E-06	0.00%	100.00%
Benzo(k) fluoranthene	3.8E-06	6.4	5.94E-07	0.00%	100.00%
Chrysene	3.86E-06	10.66667	3.62E-07	0.00%	100.00%
7,12-Dimethylbenz(a) anthracene	3.05E-05	110	2.77E-07	0.00%	100.00%
2-Methylnaphthalene	4.59E-05	200	2.29E-07	0.00%	100.00%
Benzo(g,h,i) perylene	3.08E-06	16	1.92E-07	0.00%	100.00%
Phenanthrene	9.08E-05	640	1.42E-07	0.00%	100.00%
Benzo(a) anthracene	5.81E-06	64	9.07E-08	0.00%	100.00%
Acenaphthylene	6.2E-05	830	7.47E-08	0.00%	100.00%
Pyrene	2.25E-05	320	7.03E-08	0.00%	100.00%
3-Methylchloranthrene	3.43E-06	110	3.12E-08	0.00%	100.00%
Fluorene	1.15E-05	640	1.79E-08	0.00%	100.00%
Anthracene	4.95E-06	640	7.73E-09	0.00%	100.00%
Acenaphthene	3.8E-06	830	4.58E-09	0.00%	100.00%
Perylene	4.94E-10	16	3.09E-11	0.00%	100.00%
Benzo(e) pyrene	4.94E-10	160	3.09E-12	0.00%	100.00%
CO	112.5631	not available	0	0.00%	100.00%
Total Toxic Potency			9.2655		

Table 144-2 Oral Toxic Potency Screening

Oral					
Parameter	**Emissions (g/s)**	**TRV (ug/kg bw-d)**	**Toxic Potency**	**Relative Potency**	**Cumulative Potency**
Benzene	0.076315	0.0322	2.370025	95.90%	95.90%
Acrolein	0.042352	0.5	0.084704	3.43%	99.33%
Formaldehyde	1.282439	200	0.006412	0.26%	99.59%
Dibenz(a,h) anthracene	2.66E-06	0.001273	0.00209	0.08%	99.67%
Benzo(a) pyrene	2.66E-06	0.0014	0.0019	0.08%	99.75%
Toluene	0.143228	80	0.00179	0.07%	99.82%
Fluoranthene	3.45E-05	0.028	0.001233	0.05%	99.87%
Pentane	4.960093	4100	0.00121	0.05%	99.92%
Benzaldehyde	0.05189	100	0.000519	0.02%	99.94%
Xylenes	0.056665	200	0.000283	0.01%	99.95%
Benzo(b) fluoranthene	3.8E-06	0.014	0.000272	0.01%	99.96%
Indeno(1,2,3-cd) pyrene	3.8E-06	0.014	0.000272	0.01%	99.97%
Naphthalene	0.004946	20	0.000247	0.01%	99.98%
Benzo(k) fluoranthene	3.8E-06	0.028	0.000136	0.01%	99.99%
Chrysene	3.86E-06	0.046667	8.27E-05	0.00%	99.99%
Benzo(g,h,i) perylene	3.08E-06	0.07	4.4E-05	0.00%	99.99%
Ethyl benzene	0.004292	100	4.29E-05	0.00%	100.00%
Phenanthrene	9.08E-05	2.8	3.24E-05	0.00%	100.00%
Dichloro benzene	0.002289	90	2.54E-05	0.00%	100.00%
Benzo(a) anthracene	5.81E-06	0.28	2.07E-05	0.00%	100.00%
Pyrene	2.25E-05	1.4	1.61E-05	0.00%	100.00%
Fluorene	1.15E-05	2.8	4.1E-06	0.00%	100.00%
Anthracene	4.95E-06	2.8	1.77E-06	0.00%	100.00%
Acenaphthylene	6.2E-05	60	1.03E-06	0.00%	100.00%
2-Methylnaphthalene	4.59E-05	45	1.02E-06	0.00%	100.00%
7,12-Dimethylbenz(a) anthracene	3.05E-05	30	1.02E-06	0.00%	100.00%
3-Methylchloranthrene	3.43E-06	30	1.14E-07	0.00%	100.00%
Acenaphthene	3.8E-06	60	6.34E-08	0.00%	100.00%
Perylene	4.94E-10	0.07	7.06E-09	0.00%	100.00%
Benzo(e) pyrene	4.94E-10	0.7	7.06E-10	0.00%	100.00%
SO2	33.12	not available	0	0.00%	100.00%
NOx	187.4389	not available	0	0.00%	100.00%
CO	112.5631	not available	0	0.00%	100.00%
PM2.5	14.19026	not available	0	0.00%	100.00%
Acetaldehyde	0.095391	not available	0	0.00%	100.00%
Hexane	3.433911	not available	0	0.00%	100.00%
Total Toxic Potency			2.471366		

According to the toxic potency screen, the following substances make up 99% of the potency of the Project emissions.

- NO_x
- Acrolein
- Formaldehyde
- $PM_{2.5}$
- SO_2
- Benzene

The toxic potency screen identified volatile organic compounds (acrolein, formaldehyde, benzene) and three criteria air contaminants (NO_x, $PM_{2.5}$ and SO_2).
All of these substances were included in both the acute and chronic inhalation assessments.

The potential for a substance to bioaccumulate or persist in the environment must also be considered when determining if multiple routes of exposure (other than air) are 'open' pathways of exposure. The available scientific literature suggests that VOCs and other airborne contaminants are not anticipated to significantly contribute to human exposure *via* consumption of plant-based foods. For example, approximately 99% of human exposure to benzene is through inhalation (ATSDR 2007). Therefore, the HHRA evaluated non-persistent and non-bioaccumulative VOCs through the inhalation pathway only. Evaluating these compounds in the multi-media exposure model would result in similar risk values to those predicted in the inhalation assessment.

In the oral potency screen, benzene and acrolein comprised 99% of the total toxic potency of the Project emissions. Level I fugacity modeling for VOCs such as benzene, toluene, ethylbenzene and xylene indicates that 99% of these compounds will partition to air (Mackay et al. 1992). As such, acrolein, benzene and formaldehyde were only evaluated with respect to inhalation. Persistence or bioaccumulation of these substances in environmental media is unlikely, and direct air inhalation is the pathway associated with the greatest potential for human exposure.

Thus, the results of the oral toxic potency screening do not require modifications to the original HHRA. In contrast, the environmental fate and persistence screening tool used in the HHRA appears to have been more conservative and inclusive as several additional COPCs (such as benzo(a)pyrene and other carcinogenic PAHs) 'screened on' based upon the potential to accumulate in the environment.

REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR).2007. Toxicological Profile for Benzene. US Department of Health and Human Services.

Mackay, D., Shiu, W.Y., and Ma, K.C. 1992. Illustrated Handbook of Physical-chemical Properties and Environmental Fate for Organic Chemicals. Volume I -IV. Lewis Publishers.

U.S. EPA OSW (United States Environmental Protection Office of Solid Waste). 2005. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. Final. United States Environmental Protection Agency Region 6. Multimedia Planning and Permitting Division. Center for Combustion Science and Engineering. Office of Solid Waste.

145	**Vol. 2, Section 4, Page 4-14** StatoilHydro states that *groundwater quality within the oil sands region is generally poor quality and as such is not a primary source of drinking water…Negligible to low impacts to groundwater quality were predicted in association with the Project…For these reasons, groundwater ingestion was considered to be a closed exposure pathway and was not evaluated within the quantitative HHRA.* a) Provide evidence that absolutely no receptors use groundwater as a source of potable water. If receptors are using groundwater, update the HHRA accordingly.

Response

See AENV SIR Responses 56 and 158 for discussion of potential groundwater users in proximity of the Project. Based on StatoilHydro's commitment to monitor groundwater quality, and if required to provide mitigation, there is no need to update the HHRA.

146	**Volume 2, Section 4, Page 4-14** StatoilHydro states that *non-local foods and beverages were not evaluated within the HHRA, due to limited information regarding the intake of these foods within the study area and about the levels of COPCs within such items.* a) Discuss the implications that these assumptions have on the assessment of health impacts for the residential receptor, who were assumed to not eat a large proportion of local foods.

Response

In an attempt to conservatively predict potential health risks associated with food consumption, the study team assumed that 100% of country foods (game tissue, fish, fruits and vegetables) were obtained locally for the Aboriginal receptor, and that a reasonable proportion of different types of foods consumed by the Non-Aboriginal resident were locally sourced. As non-local commercial foods are not obtained from the study area, the concentrations of the COPCs associated with the Project or other projects in the area (e.g. cumulative case) would not change corresponding to any changes in local air quality. The assessment was focused on local foods, as it is these items that may theoretically fluctuate in COPC concentrations over time as a result of airborne deposition from the Project and/or other area sources.

146	b) Health Canada has data available regarding contaminant concentrations in several foods that can be used for the purposes of a HHRA. Discuss why StatoilHydro did not use this data for non-local foods and beverages in the assessment.

Response

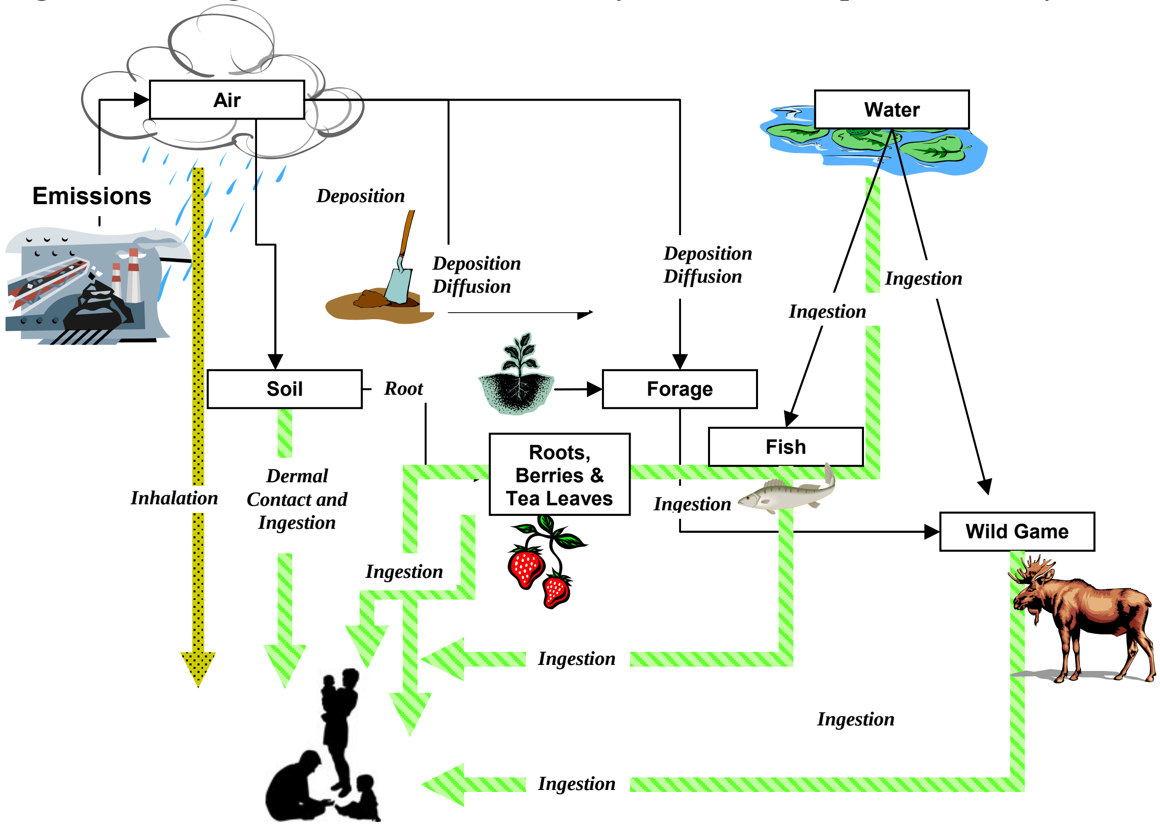
Exposures to commercially purchased foods were not included in the health risk assessment. To date, there is a lack of information regarding the consumption of store-bought foods for the populations in the area, and reliable information regarding the concentrations of various chemicals in store-bought foods. It is not clear what Health Canada sources reference is being made to, and how these are relevant to the study area. In order to provide a meaningful assessment of commercial foods, high quality market basket and other relevant consumption studies would have to be completed. To provide an estimate of commercial food consumption would be potentially inaccurate and provide unrealistically over- or under-conservative estimates of exposure. Thus, an assessment of commercial foods was not added to the HHRA.

147	**Volume 2, Figure 4.4-2, Page 4-34** The conceptual plan does not include the dermal contact pathway. a) Confirm that this pathway was evaluated in the HHRA. If not, update the HHRA accordingly.

Response

The dermal contact pathway was included in the multiple-exposure pathway exposure modelling in the original EIA for the First Nations, Residential and Commercial receptor groups. The conceptual diagram has been updated to reflect this.

Figure 147-1 (Figure 4.4-2 Revised) Summary of Relevant Exposure Pathways



148

Volume 2, Section 4.5.2.2, Pages 4-37 to 4-41

StatoilHydro states *the Alberta Cancer Registry (ACB, 2005) report that describes the most recent data for cancer incidence in Alberta notes that 8 cancer cases due to tumours of the nasal cavity were diagnosed per 100,000 people (male and female) in 2003.*

Based upon the most recently published cancer data from the Alberta Cancer Board (ACB, 2005) for the year 2003, a total of 392 cases attributable to leukemia (men and women combined) out of a total number of cases of all cancers of 12,571 per 100,000 (ACB, 2005).

The Alberta Cancer Registry quantity of 8 cancer cases per 100,000 represents an age-standardized annual statistic; whereas the potential contribution of background acetaldehyde exposures – 1.3 nasal tumours per 100,000 – represents a lifetime statistic assuming equivalent exposure. These statistics (lifetime exposure to an annual value) are not necessarily comparable.

a) Update the discussion where applicable to account for this discrepancy.

Response

The ACR data (reported by the ACB 2005) is used only to *illustrate* the relative prevalence of various tumour types in the population, and is not intended to be a direct comparison. While it is agreed that the ACR values represent statistics, it is reasonable that background exposures to carcinogens (such as acetaldehyde, benzene, formaldehyde) impact observed tumour incidences in the population over time, and that the individuals with new tumours reported in the ACR data were exposed to some level of 'background' over a better part of their lifetime.

In the example of acetaldehyde, the actual tumour prevalence from the ACR data is relatively low, suggesting that the predicted LCR is perhaps an overestimate. This was the type of comparison that was intended.

The paragraphs in the HHRA where this type of discussion was included are revised below to provide clarification.

Acetaldehyde (page 4-38, last paragraph)

The exposure limit for acetaldehyde is based on the incidence of nasal tumours (nasal adenocarcinomas and squamous cell carcinomas) in rats (Government of Canada, 2000), as the database associated with the long term effects of acetaldehyde in humans is limited. The Alberta Cancer Registry (ACB, 2005) data represents the most recent data for cancer incidence in Alberta notes that about 0.06% of the total number of cancers diagnosed in 2003 were of the nasal cavity, suggesting that the prevalence of this tumour type is relatively low in the general population.

The potential contribution of background acetaldehyde exposures, as described in this assessment, theoretically would contribute 1.3 nasal tumours per 100,000 people.

Benzene (page 4-40, second paragraph)

The critical toxicological effect associated with chronic benzene exposure is cancer, particularly leukemia and other tumours of the hematological system (U.S. EPA, 2007). The current assessment suggests that background benzene exposures may contribute to the development of about 2.4 per 100,000 people. Based upon the most recently published cancer data from the Alberta Cancer Board (ACB, 2005) for the year 2003, the number of new cases of leukemia comprised about 3% of all tumours.

Formaldehyde (page 4-40, fifth paragraph)

Nasopharyngeal tumours are the critical chronic toxicological effect for formaldehyde, although reports of other respiratory tumour types have been noted sporadically (Government of Canada, 2001). The estimated LCR of 58 per 100,000 for background formaldehyde suggests that formaldehyde may contribute to the existing incidence of respiratory tumours.

The ACB (2005) data for 2003 indicates that a total of 27 new tumours attributable to cancers per 100,000 (males and females combined) of the nasopharynx and nasal cavity were diagnosed. Out of all cases of cancer in 2003 for Alberta, about 0.2% were of the nasopharynx and nasal cavity. Tumours of the nasopharynx and nasal cavity seem to have a relatively low prevalence in the general population.

149	**Volume 2, Section 4.7.1.3, Page 4-63** a) Discuss how the caribou scat program augments the Wildlife Health Risk Assessment.

Response

No adverse health effects are associated with the Project's emissions. All risk quotient (RQ) and incremental lifetime cancer risk (ILCR) values for the project alone were less than one (Volume 2, Section 4, Page 57). Predicted concentrations of acrolein, $PM_{2.5}$, and the eye irritant mixture are greater than one, but sources other than the project appear to be responsible for the elevated risks (Volume 2, Section 4, Page 75-76).

The caribou scat program augments the health risk assessment by providing metrics of physiological stress. Cortisol, thyroid hormone, and immunoglobulins concentrations change in response to external stressors, nutritional stress, endocrine disruption, and immunosuppression. By monitoring these metrics, StatoilHydro can assess the stress of caribou, moose, and wolves and adapt its management strategy to minimize the source of the stress.

150	**Volume 2, Section 4.8, Page 4-74** StatoilHydro states that *the soil/vegetation sampling program will be conducted prior to Project start-up. A detailed work plan for the program will be developed in consultation with Alberta Health and Wellness (AHW). Various species of vegetation known to be consumed by people will be collected for chemical analysis. The sampling program will be refined upon review of the following: Soils, vegetation and ecosite mapping for the region; Traditional use information based on available reported information and ongoing First Nations consultation; and, Air modelling and any existing terrestrial monitoring program information. This information will be used to finalize the number and location of samples and to develop a sampling and analytical plan based on the best available information*." a) Confirm whether the HHRA will be updated with measured data from the soil/vegetation sampling program.

Response

As discussed in Appendix B of the HHRA, measured soil and vegetation data from the following EIAs were evaluated. For all of the COPCs, the measured concentrations were below analytical detection limits and background soil and plant concentrations were predicted from background air concentrations.

Data is available from three other applications within the area of the StatoilHydro Project. Soil and vegetation data from the sampling programs associated with these three projects were evaluated, and are summarized in Tables 150-1 to 150-5 below. Overall, the COPCs were below analytical detection limits in the soil and vegetation samples. This suggests that baseline exposures via these environmental media is likely negligible.

Table 150-1 Summary of PAHs in Soil from the Projects

	#1 (Sampled Sept. 2007)	#2 (Sampled Aug. 07)	#3 (Sampled Aug. 07)
Units	**mg/kg**	**mg/kg**	**mg/kg**
3-Methylcholanthrene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	n/a
7,12-Dimethylbenz(a)anthracene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	all non-detect (DL <0.1)
Acenaphthene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	all non-detect (DL <0.05)
Acenaphthylene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	all non-detect (DL <0.05)
Anthracene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	all non-detect (DL <0.05)
Benzo(a)anthracene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	all non-detect (DL <0.1)
Benzo(a)pyrene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	all non-detect (DL <0.05)
Benzo(b)fluoranthene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	all non-detect (DL <0.1)
Benzo(c)phenanthrene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	all non-detect (DL <0.1)
Benzo(g,h,i)perylene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	all non-detect (DL <0.1)
Benzo(j)fluoranthene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	all non-detect (DL <0.1)
Benzo(k)fluoranthene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	all non-detect (DL <0.1)
Chrysene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	all non-detect (DL <0.05)
Dibenzo(a,h)anthracene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	all non-detect (DL <0.05)
Dibenzo(a,h/a,i/a,l)pyrene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	all non-detect (DL <0.05)
Equivalent B(a)P Concentration	all non-detect (DL <0.03)	all non-detect (DL <0.03)	n/a
Fluoranthene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	all non-detect (DL <0.05)
Fluorene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	all non-detect (DL <0.05)
Indeno(1,2,3-cd)pyrene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	all non-detect (DL <0.1)
Naphthalene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	all non-detect (DL <0.05)
Phenanthrene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	all non-detect (DL <0.05)
Pyrene	all non-detect (DL <0.01)	all non-detect (DL <0.01)	all non-detect (DL <0.05)

n/a = not assessed

Table 150-2 Summary of PAHs in Alder from the Projects

	#1 (Sampled Sept. 2007)	#2 (Sampled Aug. 07)	#3 (Sampled Aug. 07)
Units	**mg/kg**	**mg/kg**	**mg/kg**
3-Methylcholanthrene	all non-detect (DL <0.01 - <0.4)	all non-detect (DL <0.01 - <0.04)	n/a
7,12-Dimethylbenz(a)anthracene	all non-detect (DL <0.01 - <0.4)	all non-detect (DL <0.01 - <0.04)	all non-detect (DL<1)
Acenaphthene	all non-detect (DL <0.01 - <0.4)	all non-detect (DL <0.01 - <0.04)	all non-detect (DL<0.25)
Acenaphthylene	all non-detect (DL <0.01 - <0.4)	all non-detect (DL <0.01 - <0.04)	all non-detect (DL<0.25)
Anthracene	all non-detect (DL <0.01 - <0.4)	all non-detect (DL <0.01 - <0.04)	all non-detect (DL<0.25)
Benzo(a)anthracene	all non-detect (DL <0.01 - <0.4)	all non-detect (DL <0.01 - <0.04)	all non-detect (DL<0.5)
Benzo(a)pyrene	all non-detect (DL <0.01 - <0.4)	all non-detect (DL <0.01 - <0.04)	all non-detect (DL<0.25)
Benzo(b)fluoranthene	all non-detect (DL <0.01 - <0.4)	all non-detect (DL <0.01 - <0.04)	all non-detect (DL<0.5)
Benzo(c)phenanthrene	all non-detect (DL <0.01 - <0.4)	all non-detect (DL <0.01 - <0.04)	all non-detect (DL<0.5)
Benzo(g,h,i)perylene	all non-detect (DL <0.01 - <0.4)	all non-detect (DL <0.01 - <0.04)	all non-detect (DL<0.5)
Benzo(j)fluoranthene	all non-detect (DL <0.01 - <0.4)	all non-detect (DL <0.01 - <0.04)	all non-detect (DL<0.5)
Benzo(k)fluoranthene	all non-detect (DL <0.01 - <0.4)	all non-detect (DL <0.01 - <0.04)	all non-detect (DL<0.5)
Chrysene	all non-detect (DL <0.01 - <0.4)	all non-detect (DL <0.01 - <0.04)	all non-detect (DL<0.25)
Dibenzo(a,h)anthracene	all non-detect (DL <0.01 - <0.4)	all non-detect (DL <0.01 - <0.04)	all non-detect (DL<0.5)
Dibenzo(a,h/a,i/a,l)pyrene	all non-detect (DL <0.01 - <0.4)	all non-detect (DL <0.01 - <0.04)	all non-detect (DL<1)
Fluoranthene	all non-detect (DL <0.01 - <0.4)	all non-detect (DL <0.01 - <0.04)	all non-detect (DL<0.25)
Fluorene	all non-detect (DL <0.01 - <0.4)	all non-detect (DL <0.01 - <0.04)	all non-detect (DL<0.25)
Indeno(1,2,3-cd)pyrene	all non-detect (DL <0.01 - <0.4)	all non-detect (DL <0.01 - <0.04)	all non-detect (DL<0.5)
Naphthalene	all non-detect (DL <0.01 - <0.4)	all non-detect (DL <0.01 - <0.04)	all non-detect (DL<0.25)
Phenanthrene	all non-detect (DL <0.01 - <0.4)	12/13 non-detect (DL <0.01 - <0.04)	all non-detect (DL<0.25)
Pyrene	all non-detect (DL <0.01 - <0.4)	all non-detect (DL <0.01 - <0.04)	all non-detect (DL<0.25)

n/a = not assessed

Table 150-3 Summary of PAHs in Berries from the Projects

	#1 (Sampled Sept. 2007)	#2 (Sampled Aug. 07)	#3 (Sampled Aug. 07)
Units	**mg/kg**	**mg/kg**	**mg/kg**
3-Methylcholanthrene	n/a	all non-detect (DL <0.01)	n/a
7,12-Dimethylbenz(a)anthracene	n/a	all non-detect (DL <0.01)	all non-detect (DL <1)
Acenaphthene	n/a	all non-detect (DL <0.01)	all non-detect (DL <0.25)
Acenaphthylene	n/a	all non-detect (DL <0.01)	all non-detect (DL <0.25)
Anthracene	n/a	all non-detect (DL <0.01)	all non-detect (DL <0.25)
Benzo(a)anthracene	n/a	all non-detect (DL <0.01)	all non-detect (DL <0.5)
Benzo(a)pyrene	n/a	all non-detect (DL <0.01)	all non-detect (DL <0.25)
Benzo(b)fluoranthene	n/a	all non-detect (DL <0.01)	all non-detect (DL <0.5)
Benzo(c)phenanthrene	n/a	all non-detect (DL <0.01)	all non-detect (DL <0.5)
Benzo(g,h,i)perylene	n/a	all non-detect (DL <0.01)	all non-detect (DL <0.5)
Benzo(j)fluoranthene	n/a	all non-detect (DL <0.01)	all non-detect (DL <0.5)
Benzo(k)fluoranthene	n/a	all non-detect (DL <0.01)	all non-detect (DL <0.5)
Chrysene	n/a	all non-detect (DL <0.01)	all non-detect (DL <0.25)
Dibenzo(a,h)anthracene	n/a	all non-detect (DL <0.01)	all non-detect (DL <0.5)
Dibenzo(a,h/a,i/a,l)pyrene	n/a	all non-detect (DL <0.01)	all non-detect (DL <1)
Fluoranthene	n/a	all non-detect (DL <0.01)	all non-detect (DL <0.25)
Fluorene	n/a	all non-detect (DL <0.01)	all non-detect (DL <0.25)
Indeno(1,2,3-cd)pyrene	n/a	all non-detect (DL <0.01)	all non-detect (DL <0.5)
Naphthalene	n/a	all non-detect (DL <0.01)	all non-detect (DL <0.25)
Phenanthrene	n/a	all non-detect (DL <0.01)	all non-detect (DL <0.25)
Pyrene	n/a	all non-detect (DL <0.01)	all non-detect (DL <0.25)

n/a = not assessed

Table 150-4 Summary of PAHs in Cattail from the Projects

	#1 (Sampled Sept. 2007)	#2 (Sampled Aug. 07)	#3 (Sampled Aug. 07)
Units	**mg/kg**	**mg/kg**	**mg/kg**
3-Methylcholanthrene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a
7,12-Dimethylbenz(a)anthracene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a
Acenaphthene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a
Acenaphthylene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a
Anthracene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a
Benzo(a)anthracene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a
Benzo(a)pyrene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a
Benzo(b)fluoranthene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a
Benzo(c)phenanthrene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a
Benzo(g,h,i)perylene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a
Benzo(j)fluoranthene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a
Benzo(k)fluoranthene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a
Chrysene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a
Dibenzo(a,h)anthracene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a
Dibenzo(a,h/a,i/a,l)pyrene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a
Fluoranthene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a
Fluorene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a
Indeno(1,2,3-cd)pyrene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a
Naphthalene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a
Phenanthrene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a
Pyrene	non-detect (DL <0.01 - <0.04)	all non-detect (DL <0.01)	n/a

n/a = not assessed

Table 150-5 Summary of PAHs in Labrador tea from the Projects

	#1 (Sampled Sept. 2007)	#2 (Sampled Aug. 07)	#3 (Sampled Aug. 07)
Units	**mg/kg**	**mg/kg**	**mg/kg**
3-Methylcholanthrene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	n/a
7,12-Dimethylbenz(a)anthracene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	all non-detect (DL <1)
Acenaphthene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	all non-detect (DL <0.25)
Acenaphthylene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	all non-detect (DL <0.25)
Anthracene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	all non-detect (DL <0.25)
Benzo(a)anthracene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	all non-detect (DL <0.5)
Benzo(a)pyrene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	all non-detect (DL <0.25)
Benzo(b)fluoranthene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	all non-detect (DL <0.5)
Benzo(c)phenanthrene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	all non-detect (DL <0.5)
Benzo(g,h,i)perylene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	all non-detect (DL <0.5)
Benzo(j)fluoranthene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	all non-detect (DL <0.5)
Benzo(k)fluoranthene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	all non-detect (DL <0.5)
Chrysene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	all non-detect (DL <0.25)
Dibenzo(a,h)anthracene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	all non-detect (DL <0.5)
Dibenzo(a,h/a,i/a,l)pyrene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	all non-detect (DL <1)
Fluoranthene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	all non-detect (DL <0.25)
Fluorene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	all non-detect (DL <0.25)
Indeno(1,2,3-cd)pyrene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	all non-detect (DL <0.5)
Naphthalene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	all non-detect (DL <0.25)
Phenanthrene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	all non-detect (DL <0.25)
Pyrene	all non-detect (DL <0.1 - <0.4)	all non-detect (DL <0.01 - 0.2)	all non-detect (DL <0.25)

n/a = not assessed

In general, the PAH concentrations were below analytical detection limits. Given the proximity of the StatoilHydro Project area to these other locations, it is feasible that the background concentrations in soil and vegetation are similar. As such, the approach used in the original HHRA is the most appropriate and it is StatoilHydro's view that an update is not required.

151	**Volume 2, Section 4** The results of the HHRA are presented in this section. a) Explain the potential implications to human health for elevated risk quotients (RQ) for cumulative regional health impacts. Include all exceedanes, not just project-alone impacts. For example, StatoilHydro states *Slightly elevated health risks were predicted for the eye irritants mixture (all receptor groups). These mixture values appear to be driven by background acrolein and formaldehyde concentrations, with some contribution from area sources other than the Project. A slightly elevated nasal irritant risk was predicted for the residential receptor. This mixture seems to be affected by background and area sources of formaldehyde. No adverse health effects were associated with the Project emissions alone.* In some cases, the reported RQs are 70 times higher than their corresponding exposure limits. Discuss the potential human health impacts on a cumulative basis.

Response

Risk estimates for the (CEA) case were provided in Section 4.7 "Cumulative Effects" of the original EIA for all receptors and COPCs (see pages 60 – 74). As noted, in many instances, there was little to negligible change between the background, baseline and CEA cases. Thus, the discussion for the CEA case for many COPCs is identical to the discussion of background in Section 4.5 and the baseline and application cases in Section 4.7. Reference is made to the appropriate sections in the EIA for each COPC with an exceedance in the CEA case in the event that risks were attributable to background or baseline.
This approach was used as it was redundant to re-present the same discussion that was provided for the baseline and application cases.

For convenience, the discussion for the CEA case is re-presented below in consolidated form, and has been directly obtained from Sections 4.5 – 4.7 of the original HHRA. For the complete set of RQ values, please refer all Tables within Section 4.7 of the HHRA.

Acrolein

Acrolein presented an RQ of 3.7 in the baseline, application and CEA cases suggesting that sensitive individuals may be at increased risk of experiencing eye irritation as a result of acute exposure. This RQ (in all development cases) is based upon the maximum predicted acrolein concentration out of all residential areas, and thus is a conservative estimate. Although background concentrations contribute to these RQ values, other area sources included in the baseline air quality predictions appear to be the major contributors to the acrolein concentrations for this receptor in the acute assessment.

Acrolein exceedances were identified in the acute assessment for the residential receptor, and in the chronic assessment for all four receptor groups. Within the acute assessment of the residential receptor, area sources contributed the most risk, while background indoor acrolein concentrations were the determinant of the chronic RQ values. Section 4.7.1.4 provides a discussion on background acrolein.

The maximum predicted acute acrolein concentration (~1 ug/m^3) of all residential receptor locations was used to evaluate the residential (RESI) group within the baseline and application cases. This concentration was predicted at the Fort McMurray receptor location, and resulted in an RQ value of 3.4 (before the addition of background).

This concentration represents a concentration that is not anticipated to occur frequently. In a study of the oil sands region by Golder Associates (2005), acrolein was not detected in ambient air samples taken in the region. This comprehensive ambient air monitoring program for acrolein was implemented at the Suncor Steepbank Mine, Albian Sands Muskeg River Mine, Fort MacKay, Fort McMurray and Suncor Borealis Camp (Golder, 2005). The analytical detection limits for acrolein ranged from 0.05 ug/m^3 to 0.75 ug/m^3. Ambient acrolein concentrations appeared to be below the lowest detection limit of 0.05 ug/m^3, which is below the acute health based guideline of 0.29 ug/m^3.

Table 151-1 summarizes some of the health effects associated with acrolein exposure in the scientific literature.

Table 151-1 Summary of the Potential Health Effects of Acrolein Exposure

Exposure Concentration (ug/m^3)	**Effects**	**References**
70	Odour perception	WHO IPCS, 1991
130	Eye irritation	WHO IPCS, 1991; Darley et al., 1960
340	Nasal irritation	Weber-Tschopp et al., 1977
480	Odour recognition	Sinkuvene, 1970
600-700	Reduced respiratory rate, coughing, nasal irritation, chest pain, difficult breathing	Kirk ,et al., 1991; WHO, IPCS 1991; Weber-Tschopp et al., 1977
>700	Respiratory and eye irritation, degeneration of respiratory epithelium, edema of tracheal and bronchial mucosa	WHO 1991
> 5,000	Intolerable to humans	Einhorn, 1975; Kirk et al., 1991
>20,000	Lethal	Einhorn, 1975; Kirk et al., 1991

The exposure limits used in the acute and chronic effects assessment of acrolein are protective of sensitive individuals, and potentially over-conservative. No information exists in the literature regarding the chronic effects of acrolein on people.

The acute California OEHHA 1-hour limit of 0.29 ug/m^3 used in this assessment was based on eye irritation in healthy human subjects. A LOAEL of 138 ug/m^3 was identified following a 5 minute exposure. Using Haber's Law this LOAEL was extrapolated to a 1-hour LOAEL of 11.5 ug/m^3. An uncertainty factor of 60 was applied to account for intra-species variability (10) and the use of a LOAEL (6). OEHHA (1999) notes that this limit is associated with significant uncertainty due to the lack of an observed study NOAEL, and the short exposure period.

The chronic U.S. EPA reference concentration (RfC) was developed from a LOAEL of 900 ug/m^3, based upon the incidence of nasal lesions in a sub-chronic rat inhalation study. The U.S. EPA adjusted the LOAEL for continuous exposure (6 hours/24 hours x 5 days/7 days). This adjusted LOAEL of 160 ug/m^3 was then used to calculate the human equivalent concentration (HEC) of 20 ug/m^3. An uncertainty factor of 1,000 was applied to the HEC to account for inter-species differences (3), intra-species differences (10), sub-chronic to chronic exposure (10), and for use of a LOAEL instead of a NOAEL (3). In the supporting documentation for the RfC derivation, the U.S. EPA acknowledges that the principal study had several shortcomings, including a limited number of nasal histopathological specimens, small sample size, and a lack of incidence data (U.S. EPA, 2007). Thus, the exposure limit used in the chronic effects assessment is considered highly conservative.

Maximum chronic RQ values for the CEA case ranged from 70 – 73 for acrolein. For all receptors, the RQ value was consistent between the baseline, application and CEA cases. The background RQ value for acrolein in the assessment was 70, indicating that background sources are associated with the most risk.

The chronic exposure limit for acrolein is based upon the incidence of non-cancerous nasal lesions in rats. The notion that background acrolein concentrations may result in sensitive and healthy individuals experiencing nasal irritation under worst-case exposure conditions is examined further below.

No long-term studies of the long-term effects of acrolein are available (U.S. EPA, 2003; WHO, 2002; Government of Canada, 2000; WHO, 1991), thus the true threshold of effects in humans is unknown. As a result, studies have been based upon animal exposures, and the threshold of effect in humans is unknown. Through the application of uncertainty factors in the derivation of the exposure limit, the effect-threshold for nasal lesions in rats has been adjusted such that the estimated human threshold is about 1,000-times lower than in rats. As such, the true risk of experiencing adverse nasal irritation as a result of current background exposures is likely much less than predicted. Appendix 4A provides additional information regarding the chronic acrolein exposure limit.

The background risk for acrolein is primarily due to the use of an indoor air concentration of 1.3 ug/m^3. This value is based on 59 indoor air samples collected from Canadian cities during 2005 (CEI, 2006). The background outdoor air concentration of 0.18 ug/m^3 is based on the mean of samples collected from seven Canadian cities (CEPA, 2000a). The indoor and outdoor background air concentrations were added together to yield a total background air concentration, which was used in the chronic inhalation assessment. This approach is likely over conservative, as it is feasible that individuals would spend part of their day outdoors. Table presents a summary of some acrolein indoor air concentrations from various locations, and associated RQ values assuming the same exposure limit of 0.02 ug/m^3 that was used in the chronic assessment.

Table 151-2 Mean Acrolein Concentrations Measured in Indoor Air and Associated Risk Quotients

Location	Air Concentration (ug/m^3)	Number of Residences Evaluated	Associated Risk Quotient
Hamilton, Ontario	1.1	11	55
Windsor, Ontario	3.0	29	150
Los Angeles, California	1.2	134	60
Elizabeth, New Jersey	0.96	139	48
Houston, Texas	3.1	125	155
Japan	8.3	1,417	415

The background air concentration for acrolein appears to be within the range of values estimated for other areas in Canada and the world.

Overall, the risk of adverse health effects in association with acrolein exposure are anticipated to be low due to the following:

- Predicted maximum air concentrations are likely over-estimates, due to conservative assumptions used in the air quality assessment model;
- Measured ambient concentrations of acrolein in the region are lower than the predicted baseline concentrations;
- The exceedances are based on peak acrolein concentrations that are unlikely to occur frequently;
- The acute and chronic acrolein exposure limits incorporate margins of safety, but are both associated with uncertainty; and
- The highest RQ associated with Project emissions for acrolein out of all of the four receptor groups was 0.002.

$PM_{2.5}$

Slight $PM_{2.5}$ exceedances were observed for the RESI receptor group within both the acute (RQ 1.5) and chronic (RQ 1.2) assessments for the baseline, application and CEA cases. The maximum air concentration used in the inhalation assessment of all residential receptors was for the Anzac receptor, which is within the RSA but is outside of the LSA. The RQ for the Project alone (representing the difference between the baseline and application cases) for this receptor was about 0.003, indicating that the Project has a negligible impact on $PM_{2.5}$ concentrations.

With the exception of the Anzac and Fort McMurray locations, the probability of exceeding the CCME (2000) Canada-Wide Standard of 30 ug/m^3 is zero at all locations. At the Anzac and Fort McMurray receptor locations, the probabilities of exceeding this standard are about 9% and 0.3%, respectively. However, to put these values into perspective, consideration must be given to urban and other area sources.

The 24-h (8th highest) baseline $PM_{2.5}$ concentration was 46.3 ug/m^3 at the Anzac location and 20.9 ug/m^3 at the Fort McMurray location. Within the chronic assessment, these locations were associated with $PM_{2.5}$ concentrations of 14 ug/m^3 and 5.9 ug/m^3, respectively. These concentrations may be compared to the values in Table for various locations in Canada.

Table 151-3 Ambient $PM_{2.5}$ Concentrations in the Form of the Canada-Wide Standard (2003-2005)

Location	Range in Ambient Air Concentrations[1] (ug/m^3)	Risk Quotient (RQ)[2]
Yukon and Northwest Territories	17 to 23	0.57 to 0.77
British Columbia	10 to 34	0.33 to 1.1
Alberta	11 to 22	0.37 to 0.73
Saskatchewan and Manitoba	9 to 15	0.30 to 0.50
Ontario	28 to 34	0.93 to 1.1
Quebec	23 to 40	0.77 to 1.3
Atlantic Canada	10 to 16	0.33 to 0.53

Notes:

1 Averaging times not evident from data source.

2 Risk quotients were calculated using the Health Canada CWS of 30 ug/m^3 (CCME, 2000b)

Source: Environment Canada, 2006.

The recent WBEA HEMP (2007) monitoring report for the Wood Buffalo region noted that the 95th percentile of $PM_{2.5}$ concentrations within the Fort McMurray area were 74.8 ug/m^3 (indoor air) and 20.5 ug/m^3 (outdoor air). In Fort Chipewyan, these concentrations were even higher, with the 95th percentile for indoor air being 86.4 ug/m^3, and outdoor air at 46.4 ug/m^3. The chronic Anzac baseline maximums of 46 ug/m^3 (acute) and 14 ug/m^3 (chronic) both appear to be similar or below the measurements reported in WBEA 2007.

Overall, the potential contribution of the Project to health risks associated with short and long-term exposures to $PM_{2.5}$ is minimal. The following factors contributed to this conclusion.

- There is little to no difference in the RQ values predicted for the baseline and application;
- Predicted concentrations are similar to or below measured ambient concentrations; and
- The highest RQ predicted for the Project alone (i.e., application case minus baseline case) is 0.003.

Acetaldehyde

No acute exceedances in the CEA case were observed.

For the chronic assessment, an LCR of 1.3 per 100,000 was determined for acetaldehyde in the CEA Case for all receptors. Background acetaldehyde concentrations were also associated with an LCR of 1.3 per 100,000, as were the baseline and application cases. Thus, background concentrations contribute the most risk to the CEA case.

The chronic exposure limit for acetaldehyde is based on the incidence of nasal tumours (nasal adenocarcinomas and squamous cell carcinomas) in rats (Government of Canada, 2000), as the database associated with the long term effects of acetaldehyde in humans is limited. The Alberta Cancer Registry (ACB, 2005) report that describes the most recent data for cancer incidence in Alberta notes that about 0.06% of the total number of cancers diagnosed in 2003 were of the nasal cavity, suggesting that the prevalence of this tumour type is relatively low in the general population.

The exposure level in this assessment for background acetaldehyde represents the total of background indoor and outdoor exposures, and is dominated by indoor exposure. The background indoor air level of 21.5 ug/m^3 was obtained from Government of Canada (2000), and represents the mean level of indoor acetaldehyde levels in Canadian urban homes (Windsor, Ontario) as local and rural data were not available. As such, this exposure estimate may be overly conservative for rural homes and represents a worst-case scenario.

Benzene

No acute exceedances for benzene were observed in the CEA case.

Chronic lifetime cancer risks for benzene in the CEA case were determined to range from 2.4 to 2.6 per 100,000. For all receptors, the LCR in the CEA case was identical to those predicted for both the baseline and application cases. The LCR for background benzene exposure was determined to be 2.4. Thus, background benzene exposures appear to be “driving” the risk estimates.

The critical toxicological effect associated with chronic benzene exposure is cancer, particularly leukemia and other tumours of the hematological system (U.S. EPA, 2007). The current assessment suggests that background benzene exposures may contribute to the development of about 2.4 per 100,000 people. Based upon the most recently published cancer data from the Alberta Cancer Board (ACB, 2005) for the year 2003, the number of new cases of leukemia diagnoses comprised about 3% of all tumours.

The chronic background indoor and outdoor air concentrations used in this assessment were obtained from the recently released WBEA (2007) monitoring program report. The median was selected to represent the concentration to which a person might reasonably be exposed over a 75 year lifetime. Estimated indoor air exposures were slightly higher than outdoor exposures, but the two median concentrations were fairly similar.

Formaldehyde

Acute formaldehyde exposure in the baseline, application and CEA cases was associated with an RQ value of 1.1 for the residential receptor only. This indicates that sensitive individuals may be at a slightly increased risk of experiencing nasal irritation in association with acute formaldehyde exposures. The background case contributes almost 50% of the risk associated with the RQ of 1.1, while the Project is associated with an RQ is negligible.

The chronic LCR values in the CEA case for formaldehyde for all receptors were the same as in the baseline and application cases (ranging from 58 – 61 per 100,000). The background air concentrations for formaldehyde used in the chronic assessment was associated with an LCR of 58 per 100,000.

Nasopharyngeal tumours are the critical chronic toxicological effect for formaldehyde, although reports of other respiratory tumour types have been noted sporadically (Government of Canada, 2001). The estimated LCR of 58 per 100,000 for background formaldehyde suggests that formaldehyde may contribute to the existing incidence of respiratory tumours.

The ACB (2005) data for 2003 indicates that a total of 27 new tumours attributable to cancers per 100,000 (males and females combined) of the nasopharynx and nasal cavity were diagnosed. Out of all cases of cancer in 2003 for Alberta, about 0.2% were of the nasopharynx and nasal cavity. Tumours of the nasopharynx and nasal cavity seem to have a relatively low prevalence in the general population.

The LCR values are based on assumed background air concentrations. The indoor and outdoor background concentrations used in this assessment consisted of measurements from urban Canadian areas, as no rural or relevant local information was available. Thus, these exposure levels may be overly conservative for rural areas and as such, the LCR is likely an overestimate.

Although formaldehyde is recognized as a human carcinogen (IARC, 2006), the majority of the evidence appears to be from animal studies with exposure levels greater than 7,300 ug/m^3 and from epidemiologic (occupational) case control studies. It is important to recognize that the weight of evidence with respect to the potential for formaldehyde to cause cancer in humans is affected by:

- Differences between rats and humans, such as nasal vs. oronasal breathing patterns, and anatomical differences in relation to dosimetry that may affect the integrity of extrapolating of animal data to humans (Government of Canada, 2001).
- Limited weight of evidence of an association between human cancers and formaldehyde exposure (Hauptmann et al., 2004; Liteplo and Meek, 2003). Health Canada and Environment Canada (Government of Canada, 2001) concluded that although some human case control studies suggest an increased incidence of nasal and nasopharangeal tumours, the findings of these human studies are “less reliable” as a result of limitations in study methodology and design. In contrast to the case studies, larger human cohort studies have not found an association between exposure and nasal cancers (Government of Canada, 2001).

Acute Eye Irritants Mixture

Acute eye irritant mixture RQ values for the CEA case ranged from 1.0 to 4.8. The mixture RQ values for the CEA case were the same as the values predicted for the baseline and application cases. In all cases, background exposures to acrolein and formaldehyde contributed the most risk to the mixture RQs. Please refer to the discussions on these two COPCs for additional information regarding conservatism.

Chronic Nasal Irritants Mixture

The nasal irritant mixture, consisting of acrolein, dichlorobenzene, and naphthalene, presented RQ values ranging from 70 to 73 in the CEA case. The mixture values in the CEA case were identical to those predicted in the baseline and application cases. The background mixture RQ was determined to be 70, indicating that background exposures contribute the most risk to the CEA case. The nasal irritant mixture is dominated by acrolein, given that the RQ of acrolein is 70 and the RQ values for dichlorobenzene and naphthalene are both less than one.

As discussed above in relation to the acrolein results, this prediction is likely overly conservative given that the exposure limit assumes that the effect-threshold in humans is about 1,000-times lower than in rats. There is a potential risk that sensitive individuals may experience nasal irritation in association with the assumed background concentrations of the nasal irritants. However, the predicted risks are likely over stated.

Chronic Carcinogen Mixture

Cancer mixture LCR values range from 60 to 62 in the CEA case. For all receptor groups, the LCR value remained consistent between the baseline, application and CEA cases. Background carcinogens, when added together, resulted in an RQ of 62. The primary contributors to the overall carcinogenic risk are background concentrations formaldehyde, benzene and acetaldehyde. Although the tumour types associated with these three COPCs are different, this RQ value indicates that existing background exposures appear to contribute to an individual's risk of developing cancer within a lifetime.

151	b) Identify the primary sources of the air RQ exceedances (e.g., indoor acrolein sources, outdoor etc.).

Response

The primary sources of the inhalation exceedances are discussed in Table 151-4 below for the non-carcinogens. The primary sources of the inhalation LCR values greater than 1 in 100,000 are presented in Table 151-5.

Table 151-4 Summary of Primary Contributors to Inhalation Exceedances

COPC	Primary Contributor to Exceedance
Acute Inhalation Assessment	
Acrolein	Residential receptor only. Acrolein RQ attributable to existing/approved ambient sources included in baseline, application and CEA cases. Also related to the conservative exposure limit used in the assessment.
$PM_{2.5}$	Residential receptors only. $PM_{2.5}$ RQ values attributable to existing/approved ambient sources included in baseline, application and CEA cases, given the similarity of the RQ values.
Chronic Inhalation Assessment – Non Cancer	
Acrolein	All receptors. The background indoor air concentration assumed in the HHRA contributed the most risk to all assessment cases.

Table 151-5 Summary of Primary Contributors to Lifetime Cancer Risks

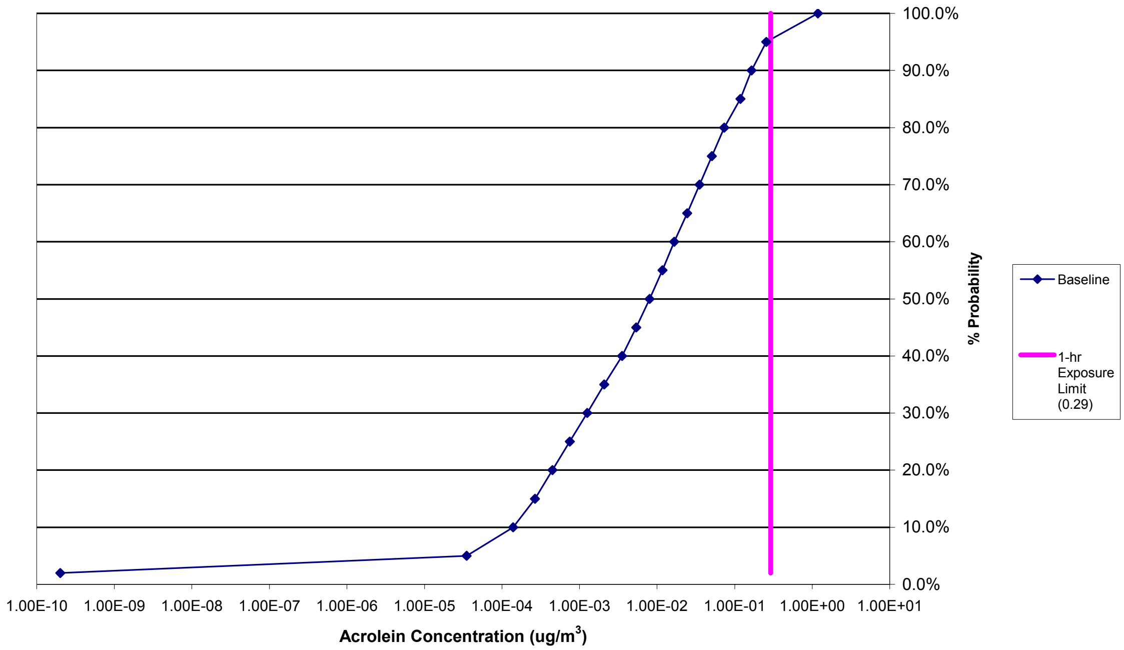
Chronic Inhalation Assessment - Cancer	
Acetaldehyde	All receptors. Chronic LCR values included background indoor and outdoor air. In all instances, the assumed indoor air concentration of acetaldehyde (~21.5 µg/m^3) appeared to contribute the most risk to the background LCR of 1.3, which was included in the baseline, application and CEA cases.
Benzene	All receptors. Chronic LCR values included background indoor and outdoor air. In all instances, both the indoor and outdoor air measurements used as background contributed risk to the background LCRs.
Formaldehyde	All receptors. Chronic LCR values included background indoor and outdoor air concentrations, which contributed to the background LCRs.

151	c) Provide exceedance frequencies for short-term exposures.

Response

Acrolein exceedances were only identified at receptor location 75 (Fort McMurray). Hourly time series data was obtained for the baseline, application and CEA cases for this receptor location to evaluate the potential for 1-h acrolein concentrations to exceed the acute exposure limit of 0.29 µg/m^3 (refer to Appendix A of the HHRA for information about this limit). The probability that acrolein concentrations will exceed the acute exposure limit in the baseline, application and CEA cases is approximately 4%. The other 96% of the time, concentrations will be below this limit. As outlined in the HHRA, the acute acrolein exposure limit is likely overly conservative, thus an exceedance does not necessarily suggest that adverse health impacts may occur. Figure 151-1 below presents a graphical representation of the data distribution relative to the exposure limit.

Figure 151-1 Cumulative Probability vs. Acrolein Concentration, Ft. McMurray Receptor (Residential Group)



151	d) To be consistent with the conservative approach throughout the assessment it would seem prudent to include acrolein in the acute respiratory irritants mixture, especially in light of the fact it is considered to be a respiratory irritant. Even though the exposure limit endpoint for acrolein is based on nasal lesions, acute exposures could result in respiratory effects. i. Justify the lack of inclusion of acrolein in the acute respiratory irritants mixture. ii. Present the acute mixture group with acrolein included. Discuss the results.

Response

As requested, acrolein was also evaluated in the acute mixtures assessment using a respiratory-irritation based 1-h exposure limit.

The ATSDR (2006a) has derived an acute MRL of 0.003 ppm (0.0069 mg/m^3) based on decreased respiratory rate and nose and throat irritation. Forty-six (46) volunteers were exposed to a gradually increasing concentration of acrolein for 40 minutes. Participants subjectively scored irritancy at 5-minute intervals as the concentrations increased from 0 to 0.6 ppm (0 to 1.3 mg/m^3) over a 35-minute period. For the final 5 minutes of exposure, participants were exposed to 0.6 ppm. A LOAEL for nose irritation of 0.26 ppm (0.60 mg/m^3) was identified. The ATSDR applied an uncertainty factor of 100 to the LOAEL to account for the use of a LOAEL (10-fold) and intra-species variability (10-fold). This acute MRL of 6.9 µg/m^3 was used as a 1-h inhalation limit in the assessment of nasal and respiratory tract irritant mixtures. The revised mixture risk estimates are provided in the tables below. No respiratory irritation mixture RQ values greater than one were identified. Thus, there are no changes to the conclusions of the HHRA with respect to this mixture. Tables 151-6 and 151-7 below present the revised mixture risk estimates.

Table 151-6 Summary of Revised Acute Respiratory Irritant Mixture RQ Values (Residential and First Nations Receptor Groups), Including Background

	Residential			First Nations		
	Baseline	Application	CEA	Baseline	Application	CEA
Respiratory Mixture RQ	5.1E-01	5.1E-01	5.8E-01	2.5E-01	2.5E-01	6.3E-01

Table 151-7 Summary of Revised Acute Respiratory Irritant Mixture RQ Values (Commercial and Recreational), Including Background

	Commercial			Recreational		
	Baseline	Application	CEA	Baseline	Application	CEA
Respiratory Mixture RQ	2.0E-01	2.0E-01	3.5E-01	2.8E-01	2.8E-01	4.3E-01

151	e) Identify mitigation measures proposed by StatoilHydro for the elevated concentration presented.

Response

As stated in Section 4.8 of the HHRA, StatoilHydro plans to participate in regional initiatives, including ambient air and water quality monitoring programs. In general, the exceedances observed in the HHRA were a function of background sources with minimal contributions from the Project.

151	f) Clarify whether a human health risk assessment was completed for the construction phase and for upset conditions. If not, discuss the associated potential health impacts. Provide evidence to support the discussion.

Response

The ratio of construction emissions to operations emissions shows that construction emissions are considerably less relative to operations emissions. As such, a detailed HHRA of construction emissions was not required for this assessment.
See AENV SIR Response 17 a for further discussion.

On pages 2D-16 to 2D-17, the Air Quality team has provided estimated SO_2 MPOI concentrations in association with various upset flaring conditions on an hourly basis. The maximum 1-h 9th highest SO_2 concentration of these three upset scenarios was determined to be 18.9 µg/m^3 (low pressure flare). The current 1-h AAQO for SO_2 is 450 µg/m^3. The predicted air concentration is considerably less than the AAQO, suggesting that the potential health effects of acute exposure in association with an upset flaring condition are likely to be negligible.

151	g) Present lifetime cancer risks (LCR) for a typical Canadian receptor.

Response

The residential receptor RQs for the background case may be reasonably assumed to represent a 'typical Canadian receptor' due to the exposure assumptions (i.e. consumption rates) applied, and the use of background air concentrations from the oil sands *and* other areas in Canada.

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152	**Volume 2, Appendix 4A, Section 4A1.1, Page 4A-1** StatoilHydro states *The complete inventory of chemicals that may be emitted from the Project are presented in Table 4A1-1, listed by category. Only airborne releases of COPCs were determined to be relevant to the Project.* a) Discuss whether emissions from construction fleet were included (i.e., metals in exhaust fumes) in the HHRA. If metals were not included in the HHRA, provide a rationale for the exclusion of these chemicals.

Response

Emissions of metals related to the construction fleet were not accounted for in the HHRA as they are produced in very small quantities. As noted in AENV SIR Response 17, the majority of the contaminants of interest discharged from the construction fleet are related to combustion products such as SO_2, NO_x, CO, $PM_{2.5}$ and VOCs. Emissions will be derived from activities related to normal construction equipment including earth moving equipment, excavators, trucks, side booms, graders, cranes, packers and other miscellaneous construction equipment. Trace levels of metals would represent a small fraction of $PM_{2.5}$ and would typically be related to vehicle brake wear and engine wear. The ratio of $PM_{2.5}$ emissions from construction activities relative to operations was 9% (see Table 17-1) which indicates that fleet metal emissions related to construction would be considerably less than operations. This is an overly conservative assumption, since as noted in AENV SIR Response 152 b, no metal emissions are expected from gas combustion used to fuel the SAGD process. As such, a detailed HHRA of construction fleet metal emissions was not required.

152	b) Provide quantitative evidence that metals are not being released from the Project.

Response

The Kai Kos Dehseh Project will use natural gas and small amounts of produced gas to fuel its SAGD process. No on-site upgrading of bitumen is planned. Also, the VRU is expected to capture emissions of fine particulate matter. Chao et al. (1999) conducted measurements designed to detect trace element emissions from natural gas combustion. The study was conducted in response to U.S. EPA AP-42 emission estimates that currently include metals as one of the suite of chemicals emitted during natural gas combustion. The study found all metals to be below detection levels. This finding ruled out both the combustion process itself as a source of metals as well as any corrosion from metal pipes and fittings. The study concluded that the U.S. EPA had incorrectly identified natural gas combustion as a source of metal emissions. The presence of metals in the test data used by the U.S. EPA was attributed by Chao to small amounts of contamination by dust or soot in the sampling equipment from previous sampling of flue gas in boilers fuelled by coal or oil.

For the reasons stated, metals were not included in the air quality and human health risk assessments.

In addition to the Chao et al. citation, the following references also support the assertion that the combustion of natural gas will not emit metals into the environment:

- Bateman (2005) from the Bay Area Air Quality Management District makes the following comments in a memorandum to his engineering staff: “AP-42 emission factors for metal emissions are not used because they are based on a small number of tests and have poor EPA data rating”. The Bay Area Air Quality Management District contends that there is insufficient evidence to support the AP-42 emission factors for metal emissions from natural gas combustion processes.

- The Danish National Environmental Research Institute (NERI) reports that for gas turbines, stationary engines and combustion sources fired with natural gas, the heavy metal emission factors are reported as 0 mg/GJ. (http://www2.dmu.dk/1_Viden/2_miljoe-tilstand/3_luft/4_adaei/tables/emf_stat_combustion_hm_pah_2005.html)
- Under the general terms and conditions of Alberta natural gas transportation tariffs (e.g., Nova Gas Transmission Ltd.), "gas … shall be free … from dust, gums, crude oil, contaminants, impurities or other objectionable substances which will render the gas unmerchantable, cause injury, cause damage to or interfere with the operation of the facilities" (NGTL 2007).
- As well, the ERCB (1982) stated that: "In 1970, the Board's chemical laboratory conducted a study into the mercury content of natural gas, and found that such contamination, while common in other parts of the world, is essentially absent in Alberta natural gas samples".

In light of the weight of evidence provided by these references, it is StatoilHydro's view that metals will not be emitted as a result of the combustion of gas used to fuel its SAGD process.

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153	**Volume 2, Appendix 4A, Section 4A.2.4.7, Page 4A-17** StatoilHydro states *Although supporting documentation is not available, this ambient air quality objective (AAQO) was used in the current short-term assessment of benzene in air, as per discussions with Alberta Health and Wellness. As a result, the study team is unable to comment on the scientific merit of this limit, and it was not used in this assessment.* This sentence is confusing. a) Confirm whether the AAQO for benzene was used in the short-term assessment or not.

Response

The paragraph in Volume 2, Appendix 4A, Section 4A.s.4.7, Page 4A-17 should read:

“As supporting documentation is not available, this ambient air quality objective (AAQO) was not used in the short-term assessment of benzene, as per discussions with Alberta Health and Wellness. The study team is unable to comment on the scientific merit of this limit, and it was not used in this assessment”.

154	**Volume 2, Appendix 4B, Section 4B.4.3.4, Page 4B-34** The equations for the **incidental exposure to soil during winter** (EXP_{WGAO}) and the **incidental exposure to indoor dust during winter** (EXP_{WGAI}) have a **relative bioavailability** factor (RF_{oral}) factor that is shown as 1 in the description of this factor, but is shown as 80% in the example calculation. a) Clarify this apparent discrepancy.

Response

The value of ‘1’ in the description of the factor on this page should be 0.8. The value of 0.8 or 80% was obtained from RAIS 2007 for naphthalene.

154	b) Update the HHRA as necessary.

Response

No update of the HHRA is required – the multiple pathway exposure assessment employed the correct value.

REFERENCE

Risk Assessment Information System (RAIS). 2007. Oak Ridges National Laboratory. http://rais.ornl.gov/cgi-bin/tox/TOX_select?select=chem

155	**Volume 3, Section 5, Pages 5-48 to 5-49** StatoilHydro notes that overburden aquifers have not been explored within the LSA, and the assessment assumes potable water can be sourced from the Empress Terrace or Channel Aquifer. a) What is the confidence that these aquifers can supply the required potable water, in light of the fact that they have not been measured in the LSA?

Response

StatoilHydro's confidence in the Empress Terrace or Channel aquifers delivering the required potable water for the Project is high. As discussed in Volume 3, Section 5.6.2.2, previous testing of these aquifers have suggested that the long term safe yield of single wells completed in these aquifers exceed 500 m^3/d (much higher than the required potable water demand). Also on page 5-48, it is discussed that StatoilHydro already has a license to divert 102 m^3/d from the Empress Terrace Aquifer from a well located at 11-14-78-9 W4M (license No. 00238979). Recently a well was drilled at 2-32-78-9 W4M and initial pump testing results indicate high rates of deliverability.

156	**Volume 3, Section 5, Page 5-64** StatoilHydro states *Wastewater injected into the Basal McMurray Aquifer is predicted not to migrate vertically to the overlying aquifers*. a) Provide evidence to support this conclusion.

Response

Wastewater injected into the Basal McMurray Aquifer is not predicted to migrate vertically to the overlying aquifers because it is overlain by the McMurray Bitumen Aquitard. As well, the closest non-saline aquifer is the Clearwater A Aquifer which is typically separated from the Basal McMurray Aquifer by approximately 100 m of deposits (including the McMurray and Wabiskaw Bitumen aquitards). StatoilHydro has committed to monitoring the wastewater injection wells (Volume 3, Section 5 page 5-69), which includes pressure migration in overlying aquifers.

Other operators in the region have been injecting wastewater in the Basal McMurray Aquifer and monitoring groundwater quality and pressure effects. To date, operators have not identified wastewater migrating vertically to overlying aquifers.

157	**Volume 3, Section 5, Page 5-65** StatoilHydro indicates that there is "decreased" risk of casing failure using a SAGD technique, thus contamination of potable water through casing failures is minimal. a) Provide an estimate of the likelihood of casing failure using similar extraction techniques.

Response

StatoilHydro has become aware of failures in SADG wells within the industry through benchmarking and discussions with adjacent operators. Currently, the number of failures, is scattered and most of the information gathered points to production failures vs. intermediate casing failures. However, StatoilHydro estimates at this time that intermediate casing failures range from 0.5 to 2% of the total well count. StatoilHydro believes that most of these failures can be avoided through improved drilling, completion and production strategies and attention to detail during drilling and production operations. These will include

1. Material selection of the intermediate casing and completion tubulars is significant. Material selection, which primarily has focused on thermal strain, should also focus on corrosion from H_2S and CO_2. StatoilHydro believes its material selection has accounted for both of these effects.

2. Exemplary cementing practices of the intermediate casing which include the utilization of advanced thermal cement blends, improved application and installation of the intermediate cement, and higher quality bond logs which will improve reactions to changing conditions.

3. Better directional drilling practices which reduces the dogleg severity and the strain on the intermediate coupling during thermal cycling.

4. StatoilHydro is currently conducting a study for clarification of the stress versus strain relationship of thermal temperatures on casing and cement as a result of the steaming process. This will determine the ramp up during initial steaming and cool down should either a plant upset occur, or the need to shut in the well for a completion work over. Understanding the correct operating parameters will reduce the thermal strain on both the cement, and the casing and completion tubulars, which is paramount in extending the life of the well through its predicted lifespan.

5. Mitigation strategies of a casing failure, should one occur, would involve monitoring injection steam pressures, pulling completion tubulars, and pressure testing the intermediate casing. Mitigation strategies also include purging the annulus with fuel gas to reduce H_2S and CO_2 contact with the intermediate casing and completion tubulars during the cool down process. This procedure will reduce the sulfide stress cracking which will occur once the well temperature drops below 80-90°C.

With all of these strategies in place, StatoilHydro believes that it can reduce the likelihood of casing failure. Regardless of all mitigation strategies, there will be casing failures. Early detection of these failures is based on a good monitoring program, which will reduce exposure of potable aquifers to steam.

158	**Volume 3, Section 5, Page 5-66** With respect to thermal mobilization of compounds and increase in water temperature, StatoilHydro states *The final impact rating is considered low because there are only three wells (all completed in the Undifferentiated Overburden Aquifer/Aquitard) located near Project well pads.* a) Confirm that these wells will not be used for potable water.

Response

StatoilHydro stated that two of the three wells located within the lease boundary are potentially used for potable water (Volume 3, Table 5.5-7). The details of all three wells are listed below:

1. 14-04-81-09 W4M – owned by “Paramount Res” for domestic purposes
2. 11-31-79-11 W4M – owned by “Logan Res” for domestic purposes
3. 04-20-80-12 W4M – “Atco Drlg Rig 3” for industrial purposes

StatoilHydro believes that the final impact rating is low because these three wells are located much greater than 25 m from proposed Project well pads (Volume 3 page 5-66).

StatoilHydro is committed to monitoring representative Project well pads in order to monitor and understand possible impacts to groundwater quality as a result of thermal plumes. StatoilHydro will work closely with all potable water users in the Project area to ensure the protection of potable aquifers and implement appropriate mitigation measures that may be required

StatoilHydro will field-verify all three of the above wells to confirm their status with regards to condition, use and distance to Project well pads.

158	b) Discuss potential liberation of minerals, such as arsenic, into ground and surface water.

Response

The potential liberation of minerals, such as arsenic, into ground and surface water is discussed in Section 5.6.4 Volume 3 page 5-65.

159	**Volume 3, Section 7, Page 7-70** **Volume 3, Section 8, Page 8-54** **Volume 3, Section 8, Page 8-55** StatoilHydro states (Page 7-70) *Any unanticipated spills or releases have the potential to influence water chemistry. However, in the event of an unanticipated spill, the recommended mitigation which includes following the Project Environmental Management Plan, is intended to prevent or minimize potential effects to surface water quality.* StatoilHydro states (Page 8-54) *Planned mitigation will ensure that construction activities associated with the Project and watercourse crossings will have a negligible effect on suspended sediment concentrations in receiving streams, lakes, ponds and wetlands.* StatoilHydro highlights mitigation measures to prevent/minimize spills at the Project site, as well as hydrocarbon and chemical leaks at pipeline and road crossings (Page 8-55). a) What level of confidence does StatoilHydro have in these conclusions (i.e., that there will be no impacts)?

Response

Personnel are currently being identified for training on spill response procedures, both at site and at river crossings. Equipment needs are being assessed and equipment will be purchased in the near future to complement trained personnel. StatoilHydro is confident that it will be able to respond in a quick and efficient manner to minimize any impacts resulting from an accidental release.

159	b) Provide more detail with respect to the spill management plan (i.e., Environmental Management Plan) that StatoilHydro plans to implement. Specifically, as per the Terms of Reference Section 5.0: l. provide a summary of StatoilHydro's emergency response plan and discuss mitigation plans to ensure workforce and public safety during pre-construction, construction, operation and reclamation of the Project. Include prevention and safety measures for wildfire occurrences, accidental release or spill of chemicals to the environment and failures of structures retaining water or fluid wastes;

Response

StatoilHydro has a corporate Emergency Response Plan which has been filed with the ERCB. This Plan has been successfully tested and is being updated to include learnings from previous exercises. The Plan outlines roles and responsibilities for personnel during a response and assigns worker and public safety actions to specific emergency response team members. In addition, StatoilHydro has held several training sessions both at the field and corporate level, including a recent full-scale deployment exercise.

A site-specific emergency response plan for the project is also being developed.

The corporate Emergency Response Plan is designed to work in every phase of the project and acts as the link between the different phases. Additionally, HSE personnel are actively involved in the transitions between Project phases, to ensure there are no interruptions in safety measures. Spill prevention measures will also be implemented during all Project phases. Ongoing training of personnel in spill response will take place so that there is not an interruption to response capabilities.

StatoilHydro has prepared a Wildfire Control Plan for 2008 summer construction and drilling activities and will prepare a FireSmart plan for its SAGD facilities and campsites.

159	m. describe how local residents will be contacted during an emergency and the type of information that will be communicated to them;

Response

The corporate Emergency Response Plan assigns public safety concerns to a specific responder. Local residents will be contacted in the most appropriate way possible, and may include telephone contact or personal visits. The method of contact will depend on the severity of the situation, the hazard to the public and the urgency of the contact. In all cases, every possible effort will be made to contact residents. Residents will be given brief details of the incident, contact information for a Company representative who will be able to assist them with any needs or concerns, as well as safety messages, incident notification, shelter in place or evacuation

159	n. describe the existing agreements with area municipalities or industry groups such as safety cooperatives, emergency response associations and municipal emergency response agencies.

Response

StatoilHydro is a member of Western Canadian Spill Services (WCSS) Ltd. local oil spill cooperative.

F. NOISE

160	**Volume 1, Section 8.2.1, Page 148** StatoilHydro states that *permanent operations camps will also be constructed*. a) Provide a map depicting the location of all proposed permanent work/operation camps.

Response

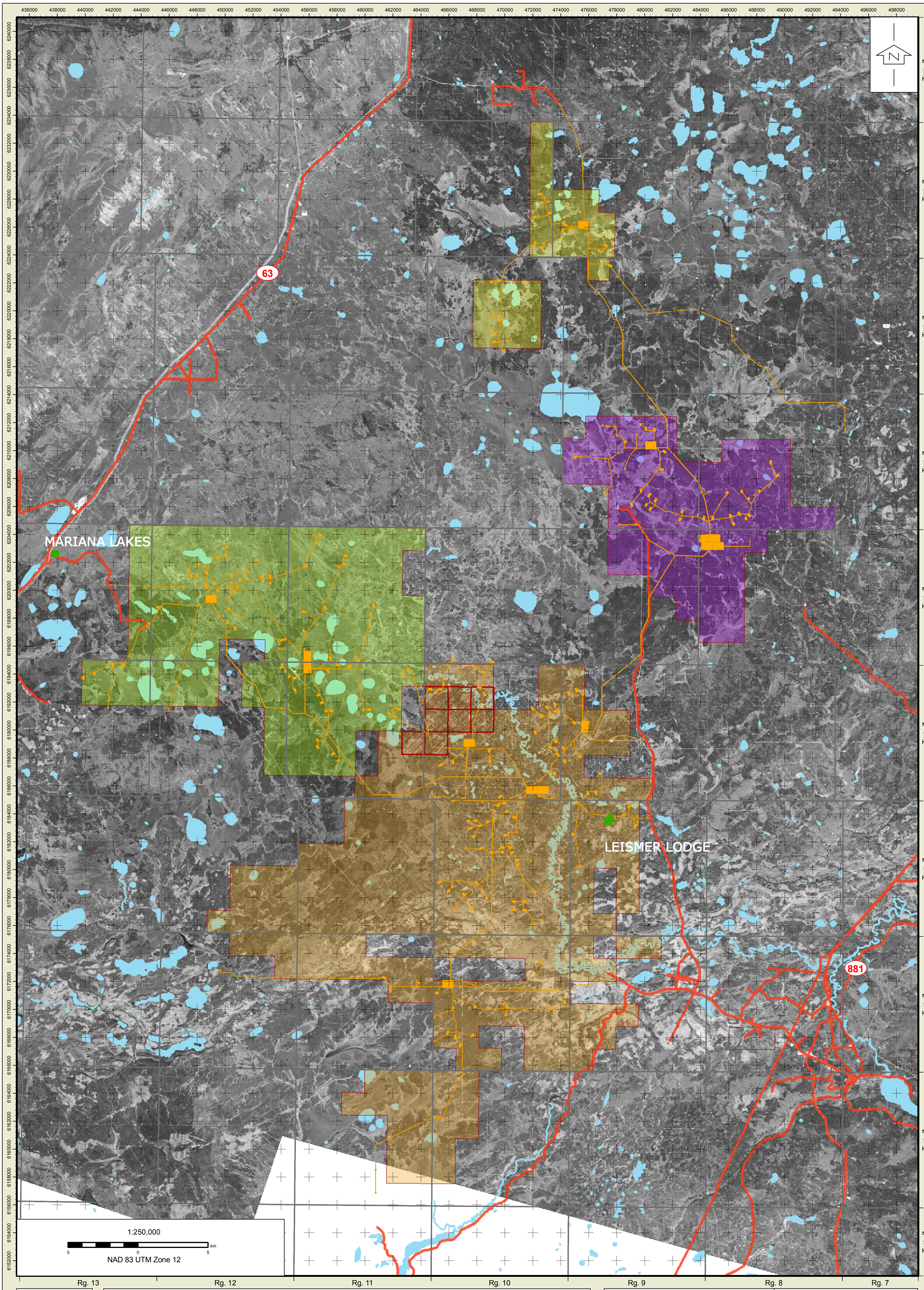
Figure 160-1 shows the location of both operations camps.

160	b) Provide all the noise sources associated with these camps and how they can contribute to the overall sound levels for the Project.

Response

The only noise sources of consequence associated with the camps are temporary power generation, until the camps are connected to the electrical grid. There will be two temporary generators per camp (each one has a sound power level [SWL] of 108 dBA re 10^{-12} Watts) and approximately six hundred (600) A/C Units per camp (each one has a SWL of 70 dBA re 10^{-12} Watts). As such, the total SWL for each camp is 108.4 dBA re 10^{-12} Watts.

The contribution from each work camp is only 25.8 dBA at 1500 m (35.5 dBA when added to ambient of 35 dBA). Each of the two camps is well beyond 1500 m from any of the nearby noise sources (either CPFs or well pads). As such, the noise level from each at 1500 m is well below the PSL of 40 dBA and their contribution to the overall noise climate closer to other noise sources is also well below 40 dBA.



Legend

- NAOSC LEASE
- NAOSC JOINT VENTURE
- FOOTPRINT
- CAMP
- CORNER
- HANGINGSTONE
- LEISMER
- THORNBURY
- WATERBODY
- WATERCOURSE
- ROAD

Title:

PERMANENT WORK/OPERATION CAMPS

StatoilHydro

Approved:	Revision Date: June 13, 2008	
File: F:\4455 NAOSC\GIS and Drafting working folder\Permanent_Work_Operation_Camps.pdf		
Drawn by: DR	Checked:	Fig. No.: 160-1

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161	**Volume 2, Section 3.2, Page 3-1** StatoilHydro states that *the noise associated with the other CNRL and Paramount Trust facilities is not significant enough to affect the noise climate in the area relative to the nearest hub. At the Northeast Leismer and Thornbury locations, the CNRL and Paramount Trust facilities may have an impact. However, noise level data and equipment data for these facilities were not obtained…* a) Due to the fact that the Northeast Leismer facility is located further away from the Thornbury facilities, clarify if StatoilHydro is referring to the northwest Leismer facility, or the northeast Leismer facility in the above quote.

Response

StatoilHydro is referring to the Northeast Leismer facility in the above quote. Neighbouring oil and gas facilities are present near both the Thornbury and Northeast Leismer facilities. The Paramount 12-16-79-9-W4M battery is located approximately 2 km southeast of the proposed Northeast Leismer CPF location, and the CNRL 11-31-079-11 W4M battery is located approximately 1 km west of the proposed Thornbury CPF location

161	b) Provide empirical evidence (modelled or measured) to support StatoilHydro's above statement to not include the CNRL and Paramount facilities. If no direct evidence can be presented then resubmit the model to include this information.

Response

CNRL Facility

The noise producing equipment associated with the CNRL facility at LSD 11-31-79-11-W4M is as follows:

1 x 1200 HP (895 KW) Compressor: 119 dBA SWL - 15 dBA for building with open doors/windows
1 x 735 HP (550 KW) Booster: 106 dBA SWL - 15 dBA for building with open doors/windows
1 x 120 HP (90 KW) Generator: 114 dBA SWL - 15 dBA for building with open doors/windows
TOTAL SWL = 120.4 dBA (with buildings subtract 15 = 105.4 dBA)

The projected noise level from the CNRL Facility alone at 1500 m is 18.2 dBA (35.1 dBA with 35.0 dBA ambient). With CPF and well pads for southeast Thornbury included in the model, the projected noise level at 1500 m from the CNRL facility and southeast Thornbury CPF and well pads is 30.4 dBA (36.3 dBA with 35.0 dBA Ambient). Thus, the impact from Paramount Facility on each of the closest CPFs or well pads is minimal and well under the PSL of 40 dBA.

Paramount Energy 12-16 Facility
The noise producing equipment associated with the Paramount Energy Operating Corp (Trust) facility at LSD 12-16-79-9-W4M is as follows:

2 x 1100 HP (820 KW) Compressor: 118 dBA SWL Each - 15 dBA for building with open doors/windows
1x 2000 HP (1500 KW) Compressor: 121 dBA SWL - 15 dBA for building with open doors/windows
2x 150 HP (110 KW) generators: 114 dBA SWL Each - 15 dBA for building with open doors/windows
TOTAL SWL = 125.0 dBA (with buildings subtract 15 = 110.0 dBA)

The projected noise level from the Paramount facility alone at 1500 m is 22.5 dBA (35.2 dBA with 35.0 dBA ambient). With the CPF and well pads for northeast Leismer included in the model, the projected noise level at 1500 m from both the Paramount facility and the CPF is 29.4 dBA (36.1 dBA with 35.0 dBA Ambient). The Paramount facility is 1500 m away from closest CPF (northeast Leismer). Thus, the impact from Paramount Facility on each of the closest CPFs or well pads is minimal and well under the PSL of 40 dBA.

Paramount Energy 14-4 Facility
The noise producing equipment associated with the Paramount Energy Operating Corp (Trust) facility at LSD 14-4-81-9-W4M is as follows:

1 x 1200 HP (895 KW) Booster: 107 dBA SWL - 15 dBA for building with open doors/windows
1 x 100 HP (75 KW) Generator: 114 dBA SWL Each - 15 dBA for building with open doors/windows
TOTAL SWL = 114.8 dBA (with buildings subtract 15 = 100 dBA)

The projected noise level from the Paramount facility alone at 1500 m is 19.1 dBA (35.1 dBA with 35.0 dBA ambient). With the surrounding well pads for northwest Corner and Southeast Corner facilities included in model, the noise level at 1500 m from both the Paramount facility and the closest well pad is 20.0 dBA (35.1 dBA with 35.0 dBA Ambient). The Paramount facility is 4800 m away from closest CPF (northwest Corner). Thus, the impact from Paramount Facility on each of the closest CPFs or well pads is minimal and well under the PSL of 40 dBA.

161	c) Provide a map depicting the locations of all neighboring oil and gas operations, such as the CNRL and Paramount facilities.

Response

Figure 2.4-1, Volume 2 includes the location of all neighbouring oil and gas operations within StatoilHydro oil sand lease boundaries.

162	**Volume 2, Section 3.5.1, Page 3-6** StatoilHydro states that *the noise levels generated from the well pads is insufficient to affect the noise climate beyond a few hundred meters from each pad. Since the pads are typically several hundred meters from their respective CPF, well pad noise sources were not included in the modelling scenarios*. a) Directive 038 states that a Noise Impact Assessment (NIA) must contain a cumulative noise level of existing and proposed facilities. Therefore, all noise sources (such as wells pads) must be included in the model. StatoilHydro must resubmit the model including the noise contributions from all proposed well pads and possibly from the CNRL and Paramount facilities if no direct evidence supporting SIR Question #97b) can be provided.

Response

The noise sources associated with each well pad are as follows:

Pumps at well pads are down-hole (i.e., no noise)

Pad A Casing Gas Cooler (Warm Up) 16 kW (SWL = 102 dBA – 30 for building = 82 dBA re 10^{-12} Watts)
Pad A Casing Gas Cooler (Production) 16 kW (SWL = 102 dBA – 30 for building = 82 dBA re 10^{-12} Watts)

Pad A Instrument Air After Cooler Fan+Motor 0.746 kW (SWL = 90 dBA re 10^{-12} Watts)
Pad A Instrument Air Compressor (SWL = 102 dBA – 30 for building = 82 dBA re 10^{-12} Watts)
Pad A Heat Medium Circulation Pump (SWL = 90 dBA – 30 for building = 60 dBA re 10^{-12} Watts)
Pad A Casing Gas Multi-Phase Pump (Warm Up) (SWL = 100 dBA – 30 for building = 70 dBA re 10^{-12} Watts)
Pad A Casing Gas Multi-Phase Pump (Production) (SWL = 100 dBA – 30 for building = 70 dBA re 10^{-12} Watts)

TOTAL SWL for each Wellpad = 92 dBA re 10^{-12} Watts

The contribution from each well pad is only 9 dBA at 1500 m (35.0 dBA when added to the ambient of 35 dBA). Therefore, for remote well pads (i.e. further than 1500 m from any other well pad or CPF), the resultant noise levels are well below the PSL of 40 dBA and will be completely inaudible. For well pads which are within the 1500 m radius from a CPF, the modelling results have been re-generated as shown below. There are no noise levels higher than the PSL of 40 dBA.

Table 162-1 Revised Noise Levels

Hangingstone	L_{eq} Day/Night (dBA)
North (1.5km)	36.9
East (1.5km)	35.9
South (1.5km)	35.8
West (1.5km)	36.5
Trapper 2097	35.1
Trapper 2820	35.1
Trapper 69	35.1
Trapper 2277	35.1

Northwest Leismer	L_{eq} Day/Night (dBA)
North (1.5km)	36.1
East (1.5km)	35.7
South (1.5km)	35.8
West (1.5km)	36.1
Trapper 1474	35.0

South Leismer	L_{eq} Day/Night (dBA)
North (1.5km)	36.2
East (1.5km)	38.3
South (1.5km)	36.7
West (1.5km)	36.6
Trapper 1659	35.1
Trapper 1569	35.0

Corner	L_{eq} Day/Night (dBA)
North (1.5km)	37.8
East (1.5km)	36.2
South (1.5km)	37.2
West (1.5km)	37.2
Trapper 2751	35.5

Northeast Leismer	L_{eq} Day/Night (dBA)
North (1.5km)	36.0
East (1.5km)	36.4
South (1.5km)	36.5
West (1.5km)	36.2
Trapper 1474	35.3

Thornbury Expansion	L_{eq} Day/Night (dBA)
North (1.5km)	37.3
East (1.5km)	36.3
South (1.5km)	36.4
West (1.5km)	36.2
Trapper 2318	35.5
Trapper 1303	35.1

Corner Expansion	L_{eq} Day/Night (dBA)
North (1.5km)	37.1
East (1.5km)	35.8
South (1.5km)	36.0
West (1.5km)	37.8
Trapper 2751	35.5

Leismer Demo/Comm/Ex	L_{eq} Day/Night (dBA)
North (1.5km)	36.6
East (1.5km)	35.3
South (1.5km)	36.1
West (1.5km)	37.0
Trapper 1474	35.3
Trapper 1523	35.0

Thornbury	L_{eq} Day/Night (dBA)
North (1.5km)	36.8
East (1.5km)	38.0
South (1.5km)	37.0
West (1.5km)	38.0
Trapper 2318	35.5
Trapper 1303	35.1

Figure 162-1 Hangingstone Noise Levels

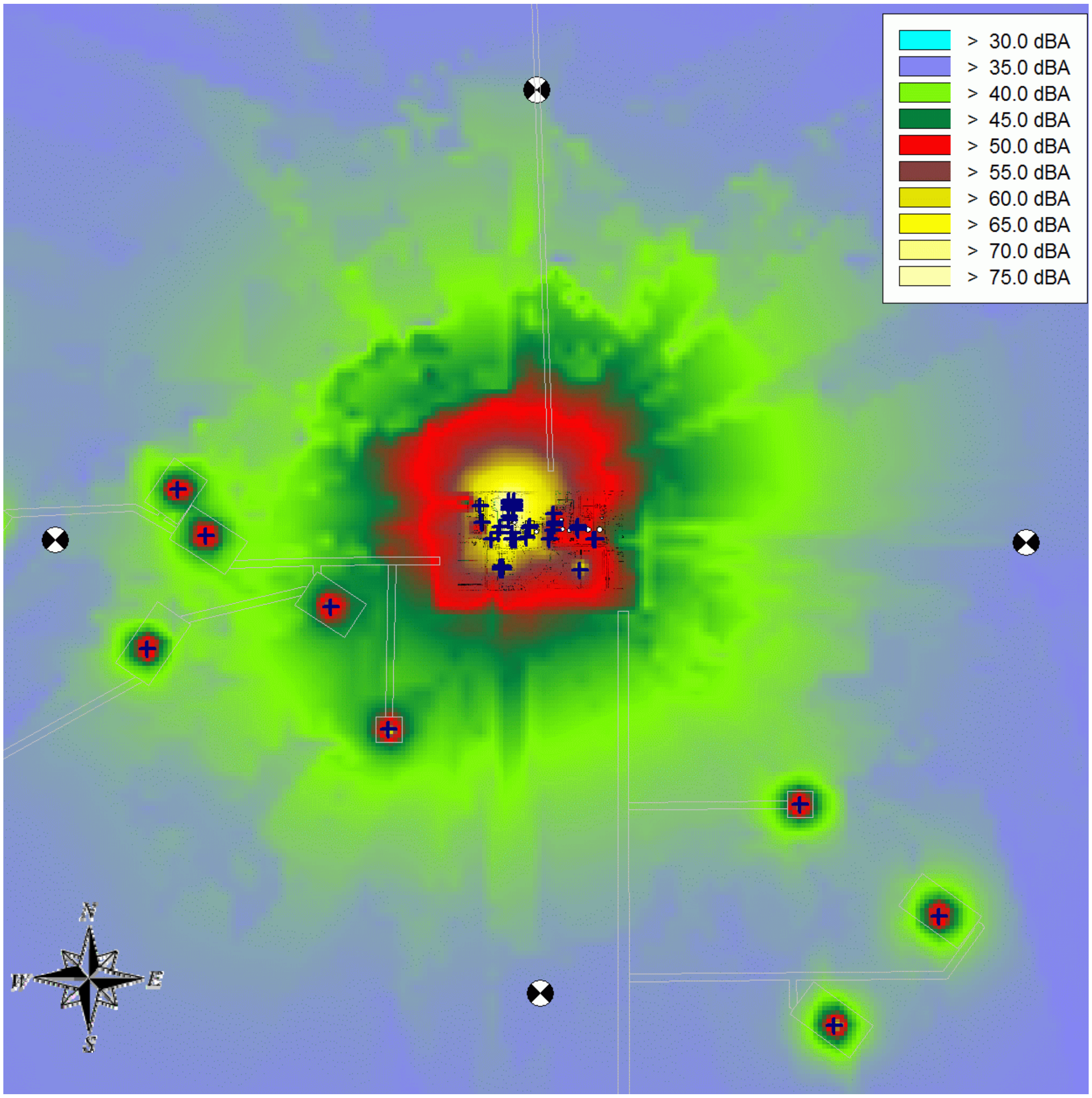


Figure 162-2 Corner Noise Levels

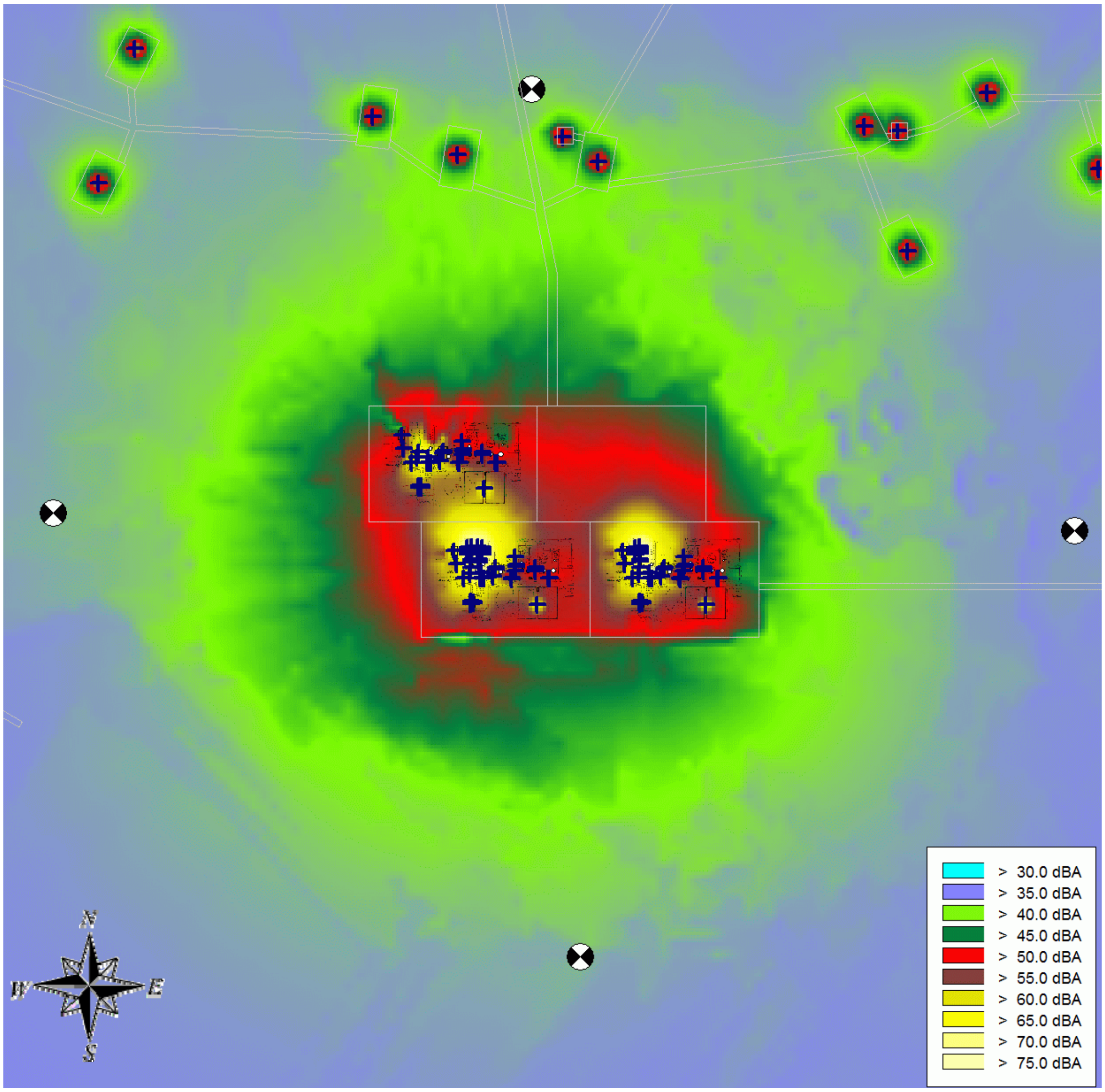


Figure 162-3 Corner Expansion Noise Levels

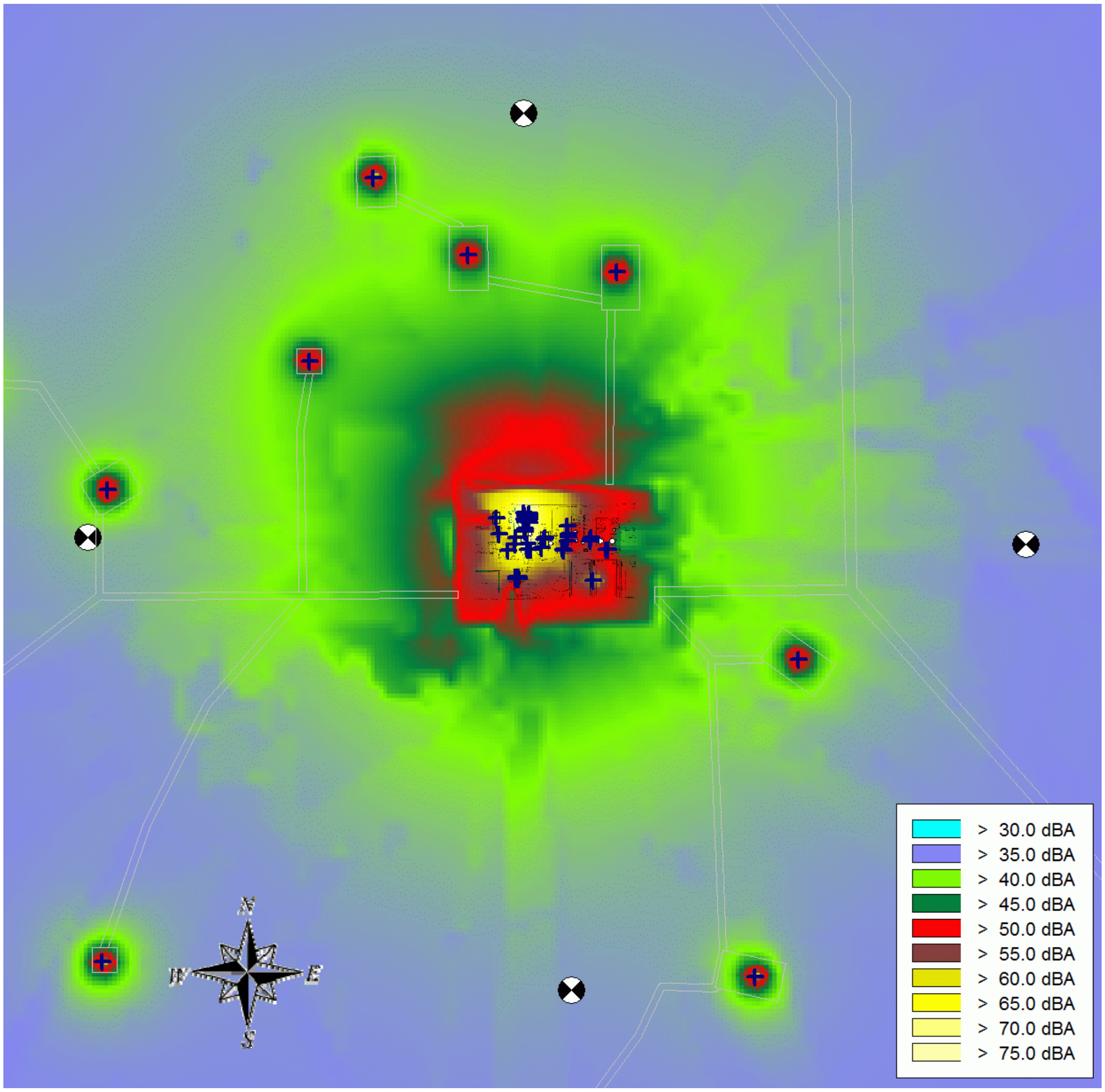


Figure 162-4 Northwest Leismer Noise Levels

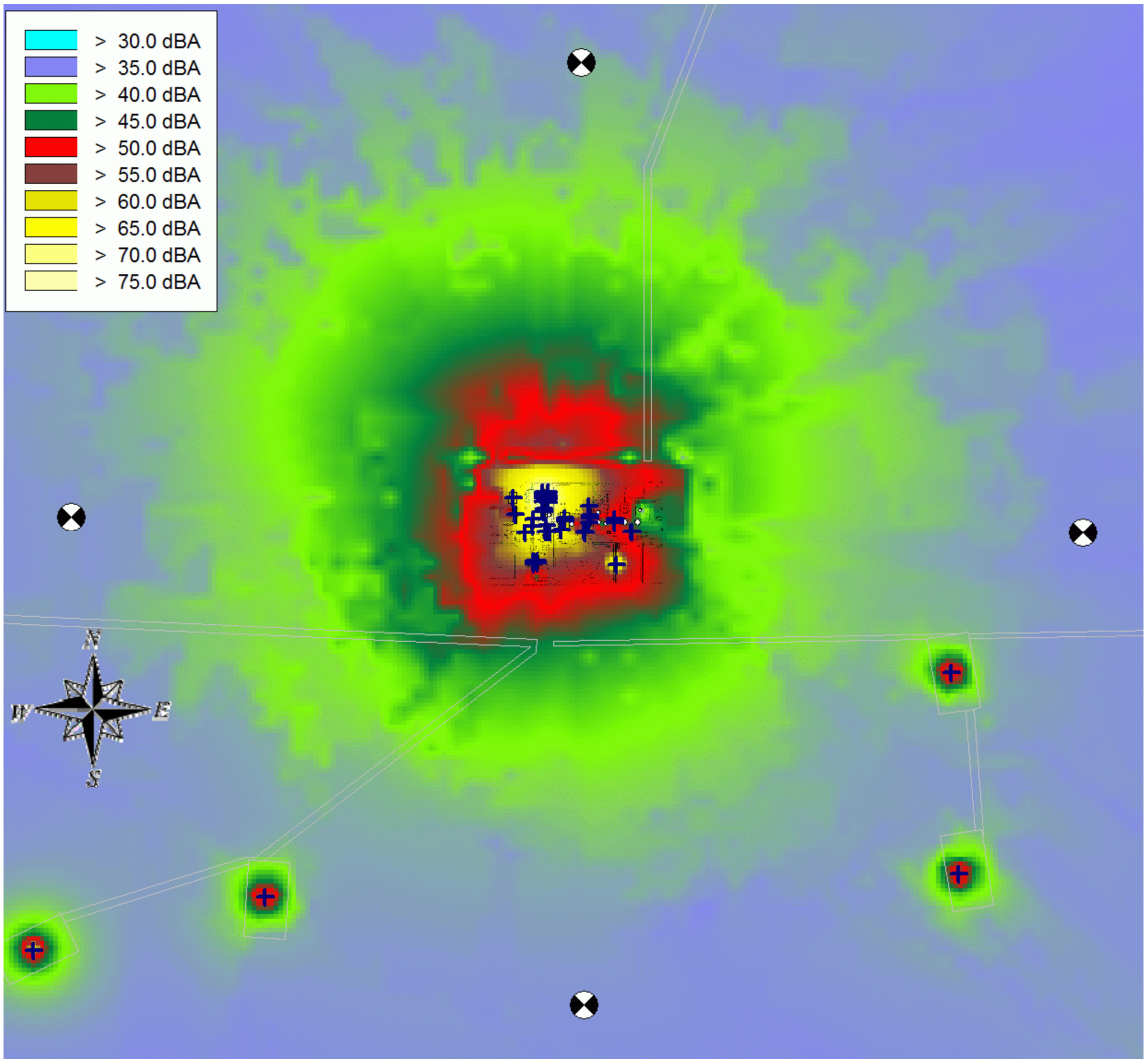


Figure 162-5 Northeast Leismer Noise Levels

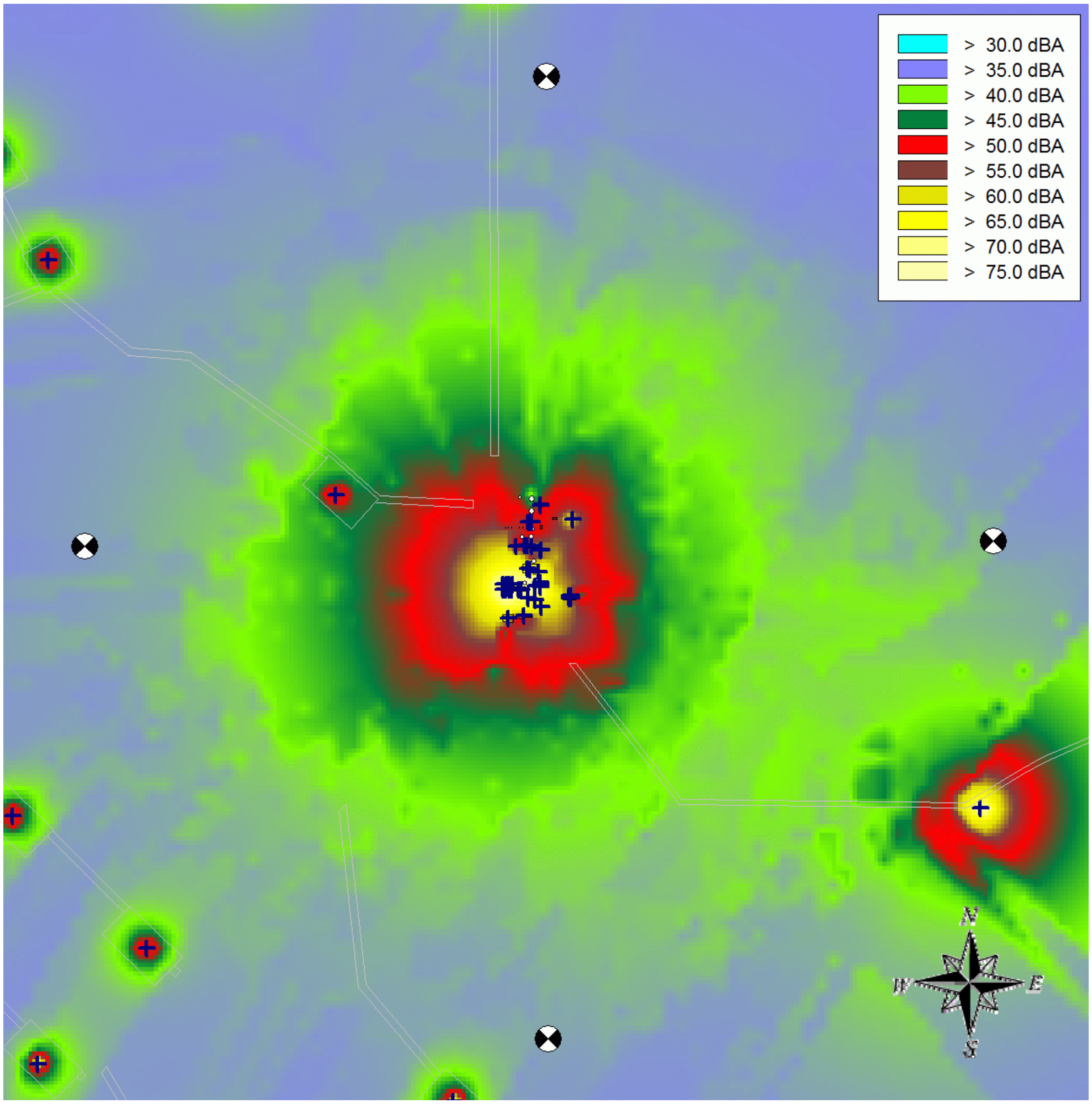


Figure 162-6 Leismer Demonstration/Commercial/Expansion Noise Levels

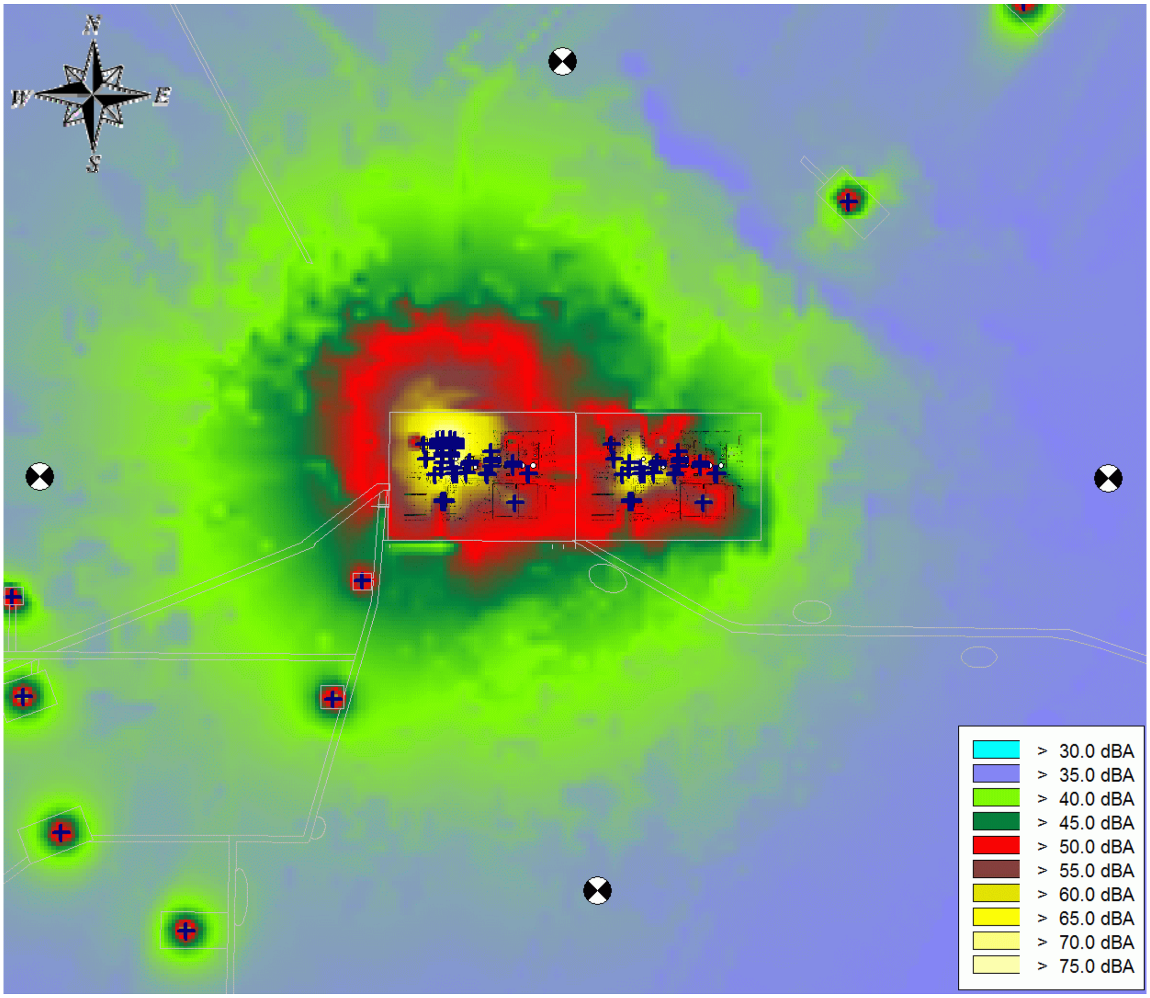


Figure 162-7 South Leismer Noise Levels

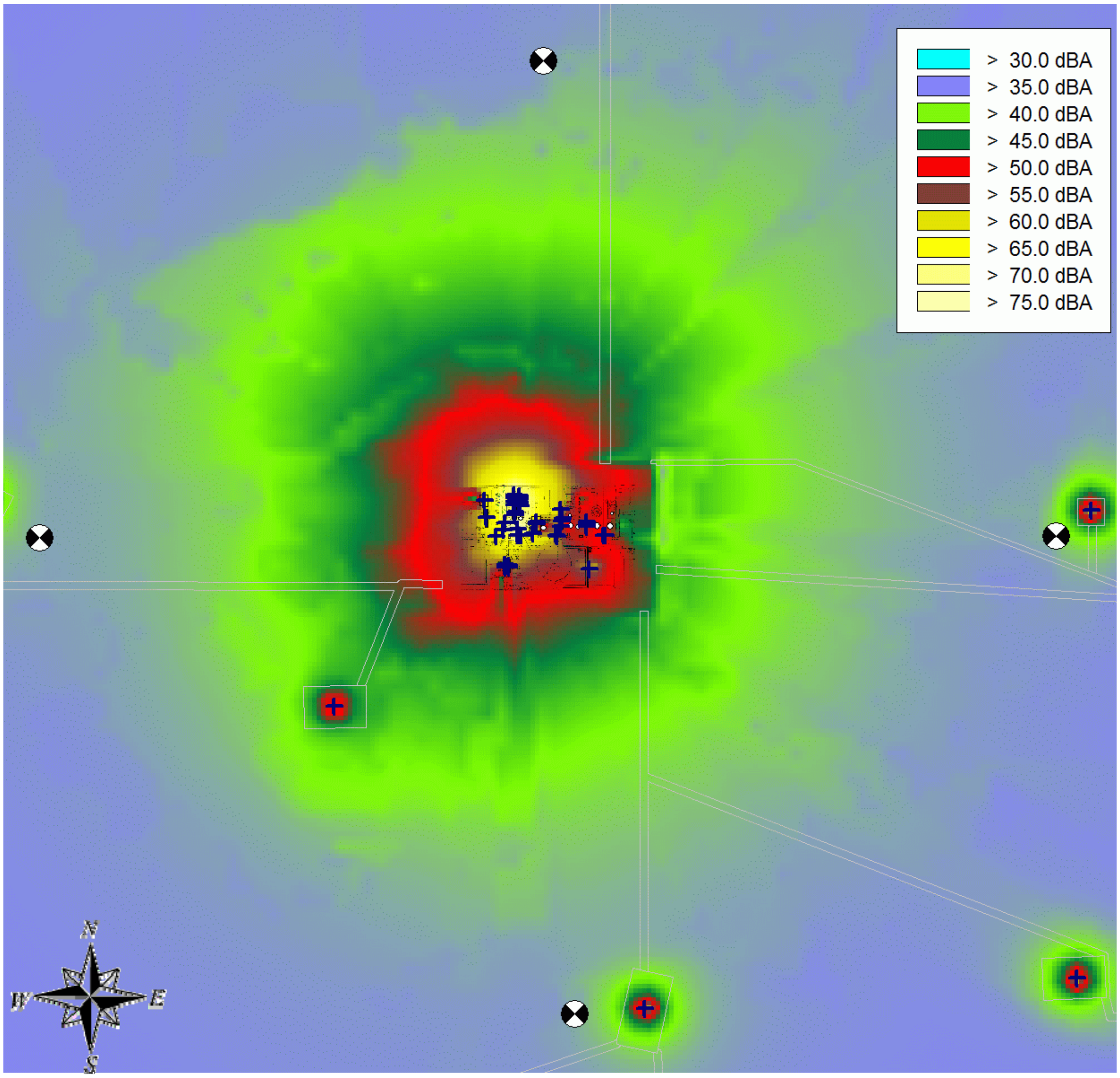


Figure 162-8 Thornbury Expansion Noise Levels

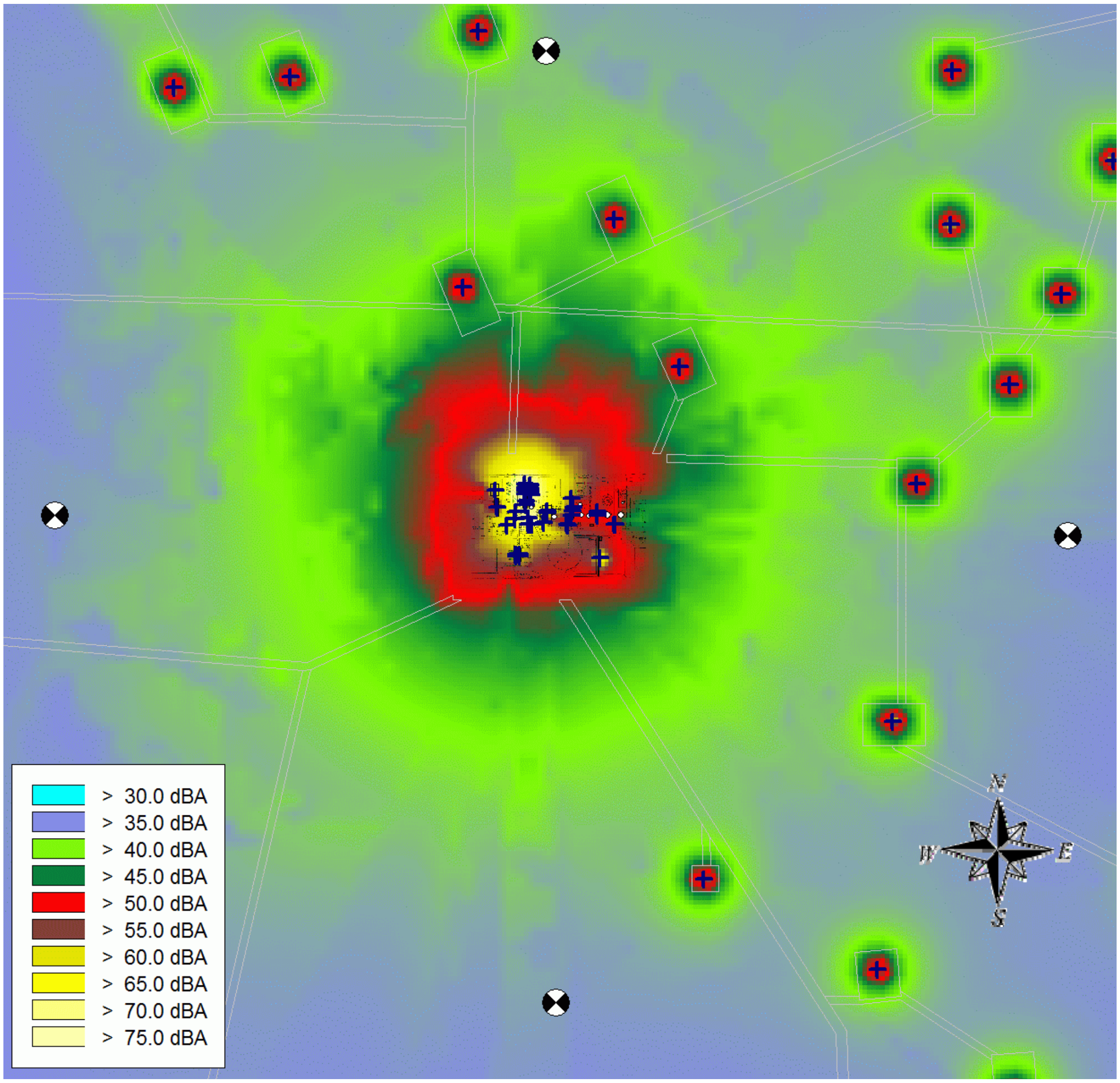
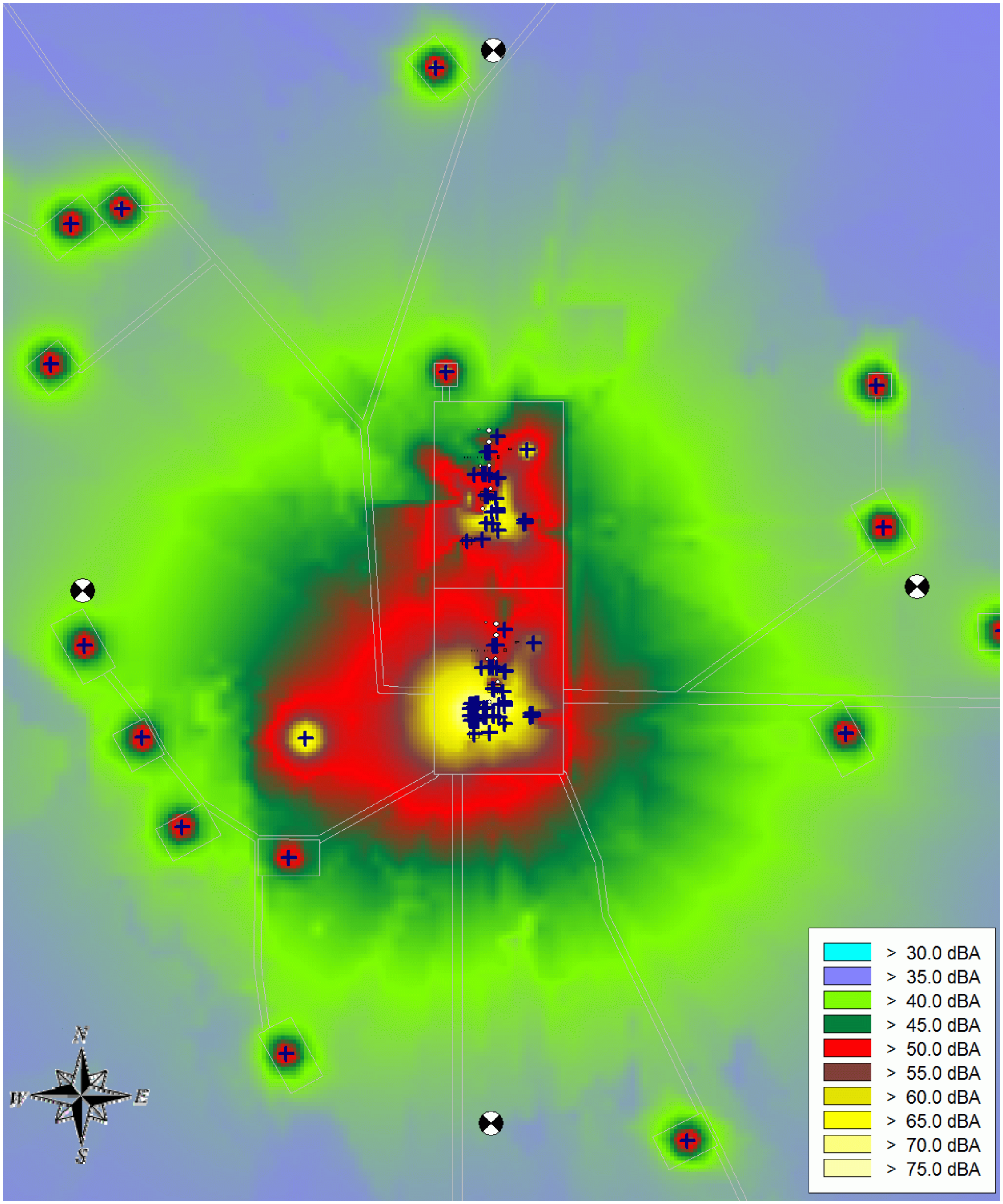


Figure 162-9 Thornbury Noise Levels



163	**Volume 2, Section 3.5.2, Page 3-7** StatoilHydro states that *there is also a limited industrial presence. As such, the ambient noise levels were assumed to be 20 dBA during nighttime, based on historical noise measurement data from studies conducted in similar areas*. However, Section 2.1.2.2, part 6 in Directive 038 states that *the licensee must obtain prior approval from the ERCB's CEO Branch to determine if an ambient sound adjustment is applicable.* No ambient adjustment submission was given to the ERCB for this Project. a) If StatoilHydro wants to continue using a nighttime ambient noise level of 20 dBA, an ambient adjustment proposal must be submitted to the ERCB following Section 2.1.2.2 in Directive 038.

Response

StatoilHydro does not intend to file an ambient sound adjustment with the ERCB. As such, the results were re-calculated with the ambient sound level of 35.0 dBA. Refer to AENV SIR Response 163 b.

163	b) If StatoilHydro does not intend to file an ambient sound adjustment with the ERCB, re-submit all results using an ambient level of 35 dBA.

Response

The results of the re-modelling with the ambient level of 35 dBA included in the calculations are provided in AENV SIR Response 162 a.

164	**Volume 2, Section 3.6.2.1, Page 3-9** StatoilHydro states that doors and windows would remain closed at most times. a) Clarify if the model was run simulating open or closed doors/windows.

Response

The model was run simulating closed doors/windows for all StatoilHydro CPFs and well pad equipment located outside. For the CNRL and Paramount facilities, the equipment was assumed in buildings but with doors/windows open.

165	**Volume 2, Section 3, Page 3-10** StatoilHydro states *while the movement of heavy loads during nighttime will increase the nighttime sound levels, the duration will be short and frequency relatively low.* a) Provide a quantitative indication of what is meant by "short" duration and "relatively low" frequency.

Response

There is no quantitative estimate of the duration and frequency for the movement of oversize and overweight loads during the nighttime. The movement of oversize and overweight loads must be conducted at night on a predetermined route due to safety requirements from Alberta Transportation. The transportation of these loads will adhere to the permitting, safety and routing requirements outlined by Alberta Transportation.

165	b) Clarify if there a quantifiable estimate at which sound levels will be affected by moving heavy loads.

Response

There is no specific quantifiable estimate on the increased noise level since this will vary significantly with the nature of the transportation equipment. Transportation noise is not covered by ERCB Directive 038 *Noise Control* and the movement of heavy loads must be conducted at night due to safety requirements from Alberta Transportation. There is no effective means of noise mitigation for such activities (other than engine and exhaust mitigation which is likely already in place), therefore no additional recommendations are provided.

166	**Volume 2, Section 3, Page 3-20** StatoilHydro states *noise monitoring is only required in Response to a noise complaint. Given that there are no permanent residents in the area, a complaint is unlikely*. a) Discuss the protocol if a hunter/trapper makes a noise complaint.

Response

If a hunter/trapper complaint is deemed to be valid by the local ERCB field office, StatoilHydro will follow the noise complaint protocol outlined in Section 4.0 of ERCB Directive 038: *Noise Control*.

G. SOCIO-ECONOMIC/TRANSPORTATION

167	**Volume 5, Section 14, Page 14-2** StatoilHydro states that *construction is estimated to commence 2008 and be ongoing through 2018 when Thornbury Expansion and Northwest Leismer are constructed. A further construction Project is anticipated at South Leismer in 2032.* a) Comment on the assumption that workers will stay in work camps for 10 years of continuous construction activity.

Response

As stated in Volume 5, Page 14-41, all workers will be accommodated in construction camps on or close to the sites. It also anticipated that there will also be local hires at a rate of 5% from the existing nearby communities.

The Mobile Workers Survey conducted by Nichols Applied Management for the Regional Issues Working Group (Nichols 2007) indicated that 67% of construction workers worked nine months or less in the region in 2006. Only approximately one third of the workers surveyed indicated they anticipate working full time in the region in any given year.

The construction activities vary by trade throughout each sub-project life. It is expected that the number and skill-set of workers will vary through the construction period. Nonetheless, there will be opportunities for some workers to have continuous work of up 10 years or greater subject to scheduling of the sub-projects.

Construction workers are mobile by the nature of their work, and tend to travel to the work site on shift work leaving their families in home bases. It is common for construction workers to work on rotating shifts for extended periods. StatoilHydro trusts that the Leismer Lodge will be more than sufficient quality of accommodation to meet the needs of these workers for both worker attraction and retention purposes.

As indicated in Volume 5, page 14-42, StatoilHydro does acknowledge a growing trend for some construction workers to migrate closer to the construction sites make allowance 10% to 20% to relocate to the RSA with housing market forces responding to this demand .

REFERENCE

Nichols Applied Management, and Economic Consultants, November 2007. Report on Mobile Workers in the Wood Buffalo Region of Alberta.

168	**Volume 5, Section 14, Page 14-2** StatoilHydro indicates that the *RSA does not include the City of Fort McMurray as the Project will be serviced out of Lac La Biche. Although not explicitly included in the RSA, the SEIA considers impact on the Regional Municipality of Wood Buffalo (RMWB) in its role as the provider of infrastructure and municipal services to the communities*. Volume 5, Section 14 Page 14-5, indicates that *the RMWB's issues are centered on Fort McMurray rather than the rural communities. However, the implication for smaller communities is that municipal services may be constrained by the demands of conditions existing in Fort McMurray and by financial, physical and personnel constraints developing infrastructure in the smaller communities.* a) Elaborate on StatoilHydro's discussions to provide the RMWB and the various municipalities with the ongoing information they will need to appropriately plan for an increase in demand on their services.

Response

StatoilHydro is a member of the Lac La Biche Region Industry Consultation Committee (LLBRICC), an ad hoc committee formed and chaired by Community Futures Lac La Biche to facilitate communication between industry and Lac La Biche County. Members include in-situ oil sands companies and Lac La Biche County, and several community organizations such as the Chamber of Commerce and the RCMP also attend meetings.

StatoilHydro management has met with the mayors and other senior community and administration leaders from the area (RMWB and Lac La Biche County) surrounding the Project.

StatoilHydro has participated in a workforce survey conducted by Alberta Energy, which was to be shared with the municipalities.

StatoilHydro has provided RMWB and Lac La Biche County with information packages outlining plans of the Project.

Open Houses have been held in the nearby communities and discussions held directly with Laurene Viarobo, Superintendent, Strategic Planning and Policy Division, Planning and Development Department.

Jeff Penny, Manager, Economic Development Strategic Initiatives, has also been made aware of the Project along with the Regional Airport Authority.

169	**Volume 5, Section 14, Page 14-5** StatoilHydro indicates that *the town of Lac La Biche and Lakeland County have jointly undertaken infrastructure and planning initiatives that position the town to accommodate population increase and resulting economic benefit.* a) What are the planning initiatives that the town and the county are undertaking to accommodate growth?

Response

In 2007, the Town of Lac La Biche and Lakeland County amalgamated. Prior to amalgamation, they often acted jointly on many initiatives that include:

- Water and wastewater treatment facilities;
- Planning for a multiplex with multiple users;
- Planning for a new regional landfill and closure of several smaller sites; and
- Delivery of emergency services, and cost sharing.

Amalgamation has removed some physical barriers to expansion of residential development in the hamlet of Lac La Biche. Approximately 800 housing lots for development are currently available throughout the County, located primarily in the south of the County along the shores of Lac La Biche and in the hamlets. The County has received almost 3,000 applications for lot development.

Lac La Biche County is forward-looking with respect to residential development along the southern edges of Lac La Biche, having expanded water pipeline delivery systems to the west and east of the Hamlet of Lac La Biche. The water treatment facility is built on a modular plan and can be upgraded with further modules, but is currently at approximately 40% capacity. The wastewater treatment facility will require upgrades in the near future and the County is completing feasibility studies. Wastewater collection was recently extended east to residential communities along the southern edge of Lac La Biche. The County has completed an award winning water quality study of Lac La Biche, which has been used to formulate water and wastewater treatment objectives and infrastructure needs.

The County completed a truck route around the southern edge of Lac La Biche in 2006. This alleviates the volume of trucking related traffic in the hamlet of Lac La Biche as the truck route connects highway 55 and highway 881 while bypassing the main street of the Hamlet.

StatoilHydro a member of the Lac La Biche Community Futures Group, and funded a social assessment, which was managed by the (then) County of Lac La Biche.

170	**Volume 5, Section 14.9.2, Page 14-56** StatoilHydro notes that the first camp located just off Waddell road will house 450 and it will be expanded to 600 person capacity in 2010. *The expanded camp will not accommodate the peak construction, drilling and operations workforce anticipated for eastern facilities, estimated to occur in 2012 and 2014. The estimated workforce requiring open camp or temporary construction camp accommodation would be 260 persons.* a) What constitutes a temporary construction camp?

Response

A temporary construction camp is for a particular construction project, which is removed after the completion of the project. Once the camp is removed, the land is reclaimed

170	b) How many open camps are in the area?

Response

At the time of submission, as outlined in Volume 5, page 14-17, there were three open camps located at the Conklin access junction that were considered.

170	c) How many people are expected to be housed at peak in these temporary camps?

Response

At this time, StatoilHydro is not certain how many of the 260 additional peak-period people will be in temporary camp accommodation or open camps. Third-party open camp operators have expressed an interest in providing services to meet StatoilHydro's needs.

170	d) What is the occupancy rate?

Response

Occupancy rates for open camps is competitive information and not readily available. It is dependent on the season and industry activity in the area.

170	e) What percentage of this available temporary accommodation is StatoilHydro anticipated to use during 2012-2014?

Response

Occupancy rates for open camps is competitive information and not readily available. It is dependent on the season and industry activity in the area. It is then not possible to determine what percentage of temporary accommodation StatoilHydro anticipates using during 2012-2014.

170	f) Other major oil sands projects in the area will be using temporary construction accommodation within the region during 2012-2014. Provide further information on how StatoilHydro will help to mitigate this temporary accommodation constraint.

Response

StatoilHydro anticipates that third-party open camp services providers will respond to market demands accordingly, which will be subject to commercial arrangements with industry. A back-up plan would be to supplement the dedicated camps with extra temporary rooms.

171	**Volume 5, Section 14.9.2, Page 14-56 & 14-57** StatoilHydro indicates that *a second camp west camp will be constructed during construction, drilling and operation of the western properties starting with the Thornbury Hub in 2013 and continuing to the end of 2016. It will house 350 persons. The estimated peak workforce requiring accommodation would be 735 people in 2016. Therefore, approximately 400 persons would require temporary accommodation, likely a temporary construction camp during this period. StatoilHydro may consider home ownership incentives for workers wanting to live in Conklin or Janvier*. a) What is StatoilHydro's forecast supply of temporary accommodations in 2016

Response

Currently there are approximately 25,000 possible temporary accommodations, some available to specific companies only, some in camps. With projected cumulative development, in 2016 StatoilHydro is projecting an overall shortage of temporary accommodations, within a reasonable distance, and as such is planning on utilizing local camps.

171	b) Under what circumstances will StatoilHydro not consider providing home ownership incentives for workers?

Response

When the economics or social benefits and impacts do not warrant it.

171	c) Identify the impacts of the increase in traffic due to the two proposed permanent camps. Provide details of any infrastructure upgrades that may be required to mitigate these impacts.

Response

Traffic impacts of the two camps are expected to be minimal.

Transportation of workers to the first camp and associated open or temporary camps will be primarily by fly-in with multi passenger vehicles for ground transportation to the project sites. Existing resource roads will be upgraded and new access roads developed. StatoilHydro is participating in the upgrade of the Leismer Aerodrome and is working with Al-Pac and industry companies on road infrastructure. Preliminary discussions have been initiated on paving the municipal road from Conklin to the Leimer Aerodrome.

As discussed in Volume 5, on page 14-57, for the second camp StatoilHydro anticipates to transport workers by bus. At this time there is no road infrastructure to the Leismer Aerodrome from Mariana Lakes. In the event that a road is built connecting Highway 881 and Highway 63 near the Leismer Aerodrome, a fly-in and bus operations will be considered

StatoilHydro is in the process of commissioning a Traffic Impact Assessment (TIA) for the Project, and this question has been included in the scope of work for the Assessment. The TIA is expected to be submitted to Alberta Infrastructure & Transportation at the end of August, 2008.

Servicing the camps will result in traffic on the roads during daylight hours.

172	**Volume 5, Section 14.9.13, Page 14-57** StatoilHydro notes that *workforce transportation to the second camp near Mariana Lake will be accomplished by bus or individual worker transportation rather than fly-in*. a) Discuss how many StatoilHydro workers (from the 350 workers that are mentioned in the application Volume 5, Section 14.9.2, Page 14-56) will use individual transportation to the site.

Response

StatoilHydro expects that approximately 20% of workers will live locally (as discussed in Volume 5 on page 14-42), and these people will use individual transportation to the site. StatoilHydro will compel all other workers to use buses to access the site, unless there is a work related need for individual transportation.

173	**Volume 5, Section 14.7.5.8, Page 14-33, Section 14.9.4, Page 14-57** *Additionally, 70 oversize loads will be brought to the site in a period between August and December 2008, which is approximately an average of 1 every two days.* a) Provide information on the number of oversized loads for this Project.

Response

StatoilHydro expects that approximately 420 oversize loads will be brought to the Project over the duration of the Project.

173	b) Identify the impact of these oversized loads along Highway 881, especially the impacts on the existing overhead lines along the corridor.

Response

StatoilHydro anticipates that oversized loads will be brought south on Highway 881 from the highway 63 intersection, with no impact on existing overhead powerlines. As discussed in Volume 5 on page 14-64, StatoilHydro intends to coordinate these trips with Willow Lake traffic advisory groups to minimize impacts in the area - for example, loads will travel down highway 881 at night, to mitigate impacts on the local area.

174	**Volume 5, Section 14.9.4, Page 14-57** Diluent will be trucked in until a pipeline is constructed in approximately 2012. It is estimated that there will be 60 B-train trucks daily. a) Identify impacts of this truck traffic and determine if infrastructure upgrading is needed

Response

StatoilHydro is in the process of commissioning a Traffic Impact Assessment (TIA) for the project, and this question will be addressed once the TIA is complete.

175	**Volume 5, Section 14.9.4, Page 14-57** StatoilHydro notes that *in total, daily traffic on local roads is estimated to include approximately 110 different vehicles. Of these approximately 20 vehicles are anticipated to be operating only in the local area, and the remaining 90 will use Highway 881 as well as the local Project-related roads.* a) Clarify if these 110 daily different vehicles include workers using bus transportation.

Response

The 110 vehicle figure includes those workers using bus transportation.

175	b) Clarify if the buses from the camp will need to cross Highway 881. If so, provide a plan to show that the intersection geometry will be adequate.

Response

Buses from the camp (when carrying workers) will not need to cross Highway 881.

175	c) Provide information on any discussions with Alberta Transportation (AT) regarding the increase in total daily construction traffic that StatoilHydro will create on local roads. d) Provide annual average daily traffic (AADT) existing truck volumes for the AM and PM peak hours on Highway 881. e) Provide a summary table by development area and hub including AADT volumes and a timeline for construction and operations with the following information: i. Average on-site personnel ii. Number of bus round trip to the hub iii. Size of vehicle and number of movements. f) Identify the impact of the increased traffic volumes. Provide details of infrastructure upgrades that may be needed on Highways 63 and 881 to mitigate these impacts. g) Provide a map showing the access routes to any Project areas and the proposed locations of any intersection upgrades.

Response

StatoilHydro is in the process of commissioning a Traffic Impact Assessment (TIA) for the Project, and these questions will be addressed once the TIA is complete.

176	**Volume 5, Section 14.9.6, Page 14-61** StatoilHydro notes that *the siting of the future west side camp may affect Mariana Lake although it is unlikely the camp will be on the highway*. a) Provide further discussion regarding how the west side camp may affect Mariana Lake.

Response

The west camp location has not yet been finalized, however, the community of Mariana Lake would be the closest location to the anticipated west camp. StatoilHydro does not anticipate the camp to impact Mariana Lake, other than bus traffic to the camp utilizing the planned overpass on Highway 63. The community of Mariana lake has a service station and café, which would likely see more business from camp residents

177	**Volume 5 Section 14.9.4 Page 14-61** StatoilHydro indicates that *roads within the StatoilHydro Project are technically within Lakeland County, most will be private roads maintained by StatoilHydro or other industrial corporations, including Al-Pac. The road between Conklin and the Waddell turn-off is a provincial road.* a) Provide additional details about access to the plant site during construction and operation. In particular, comment on the extent of traffic congestion occurring at the turn-off to the site and how this may impact traffic flow and traffic safety.

Response

Refer to page 14-64 for further details about traffic movement within the RSA. StatoilHydro is currently commissioning a Traffic Impact Assessment that will address traffic issues at the turn-off to the site.

178	**Volume 5, Section 14.9.9, page 14-62** StatoilHydro notes that *the Aspen Health Region anticipates requiring changes in staffing, structure and funding of the Lac La Biche Healthcare Centre to be able to continue to current and future demand.* a) What is the expected timing of this change being made by Aspen Health Region and will the changes be in place to accommodate the Project?

Response

The business plan for the Lac La Biche Health Facility was completed by Aspen Health Region in October 2006 and submitted to the government for consideration. When considered against other demands on the provincial basis, the proposed changed to the Lac La Biche facility were not ranked very high. The Aspen Health Region anticipates that the proposed facility changes would not occur within 5 to 10 years. The Aspen Health Region anticipates making small renovations to help in facility functionality (Shelly Push, Vice President Corporate Services, Aspen Health Region, Personal Communication, June 2008).

179	**Volume 5, Section 14.9.10, Page 14-63** StatoilHydro indicates that *recent statistics indicate increasing calls from the rural community for the fire and EMS services Fort McMurray. With increasing local permanent population, this is anticipated to continue. Fort McMurray recently advertised for full time fire department personnel. Conklin recently received a new pumper truck.* Volume 5, Section 14.9.15, Page 14-70, StatoilHydro indicates that *increased camp or shadow population placing additional demands on the medical and possibly the emergency services. These are not included in the funding formulae for these services.* a) What is the anticipated impact of the Project in the number of visits to the Emergency Room?

Response

It is not possible to provide a specific number of Emergency Room visits relating to the project. However, The Mobile Worker Survey (Nichols Applied Management, 2007) indicates that visits to the emergency room by out-of-region patients accounted for 32% of all visits to the emergency room in Fort McMurray in 2006/2007. By extrapolation, this will be the likely ratio of visits to the W.J. Cadzow Lac La Biche Healthcare Centre emergency room by out-of-region workers in the coming years. However, Kai Kos Dehseh will be only one of several in-situ operations that may contribute to the use of the emergency room.

The Mobile Worker Survey (Nichols 2007) also indicates that the range of hospital services sought by workers was overwhelmingly in the emergency room (82%). Reasons for visits were largely temporary ailments (59%) and work related injury (30%), chronic ailments (6%) and routine check-ups (5%). StatoilHydro can have the most direct effect on visits to the emergency through prevention of work related injury. There are a variety of initiatives and mitigation measures onsite used to reduce injuries, provide information and share experiences. A health and safety orientation is the first step for every person that comes on site. Secondly, there are daily safety meetings with all contractors on site. The purpose of these morning safety meetings is to review the daily activities, capture worker concerns (e.g. weather, traffic volume etc), review relevant incidents to prevent reoccurrence, as well as to inform workers of any new Corporate (or Project) HSE requirements. Hazard IDs/Worker observations are collected and analyzed at site, and corrective actions are initiated immediately. Documentation is collected weekly during tailgate meetings, Hazard ID reports, Site Safety Inspections, and Equipment Maintenance conducted. The findings are documents and shared with workers on site. Corporately, both Safe Behaviour Training and Driver Training Programs are being developed.

179	b) Other oil sands projects have also provided on-site medical services, according the health and safety standards, yet camp workers have in the past placed increased demands on the health services (especially the emergency room) in Fort McMurray and other Health Regional centers. Provide additional clarification on how the on-site medical centre for the Kai Kos Dehseh Project will meet the needs of camp workers that would otherwise use the ER facilities in Lac La Biche and other health region centers in RSA.

Response

As indicated in AENV SIR Response 179 a, StatoilHydro will emphasize safe work habits as a primary mitigation strategy to reduce work-related injury. On-site medical services will include industrial level paramedics able to provide enhanced first aid level of care particularly with respect to industrial workplace situations. However, for diagnosis and prescription of all injury and disease, patients need to seek qualified medical aid, most likely through health clinics or the emergency room of the nearest health centre. This would be the case in any community in Canada.

179	c) Provide any details of consultation that StatoilHydro has had with Aspen Regional Health Authority about Kai Kos Dehseh Project and the expected construction workforce peak. Provide any additional detail about what the Aspen Regional Health Authority has indicated was its ability to respond to the expected increased demands on health services.

Response

StatoilHydro is a member of the Lac La Biche Regional Industry Consultation Committee (LLBRICC), an *ad hoc* group formed to share information related to proposed and existing projects in the oil sands area north of Lac La Biche. StatoilHydro has made Project information available to the community both in direct communications and open houses, and through venues such as the LLBIRCC. StatoilHydro will suggest that Aspen Health Region be invited to attend future meetings of the LLBRICC group.

When contacted the Aspen Health Region indicated that they have been able to manage the current increases in demand in the Lac La Biche health unit through existing resources. Their assessment indicates that Lac La Biche has a strong physician clinic and is not at the highest need for physician recruitment within their region. The permanent population increase measured by the region as of March 2007 was 1.5% per year, as measured by permanent resident health insurance registration. The Aspen Health Region has initiated a primary health care model in other health centres within it's jurisdiction, to alleviate non-emergency visits to emergency wards. In this primary care model they work with physician clinics to provide more access for non-emergency visits. If the need is identified in Lac La Biche, they will work with local physicians toward a solution.

179	d) Clarify whether Medivac capability will be maintained on-site.

Response

Emergency medical ground transportation will be maintained on site, suitable to transport a passenger to meet an ambulance or air medical evacuation.

180	**Volume 5, Section 14.9.13, Page 14-64** StatoilHydro notes that *the product trucks will be most noticeable around Conklin and Janvier as they will haul to the Cheecham Terminal and Fort McMurray*. a) Indicate what percentage of the product trucks will go to Cheecham Terminal and to Fort McMurray Terminal.

Response

The destination of product trucks will be determined by commercial agreements which will be made at a later date. Consequentially, StatoilHydro cannot indicate the percentage of product trucks that will be going to Cheecham and/or Fort McMurray terminals.

180	b) What is the projected traffic flow (number of vehicles and trucks) through Anzac from the Kai Kos Dehseh Project?

Response

Page 14-64 indicates that Annual Average Daily Traffic counts past Anzac will increase by less than 1%. StatoilHydro is in the process of commissioning a Traffic Impact Assessment (TIA) for the Project, and this question has been included in the scope of work for the Assessment. The TIA is expected to be submitted to Alberta Infrastructure & Transportation at the end of August, 2008.

181	**Volume 5, Section 14.9.15, Page 14-66** StatoilHydro indicated that it will *collaborate with other companies in the area to develop the Leismer airstrip to capacity for larger planes, to enable fly in-fly out transportation of workers and thereby reduce the traffic on the roads.* a) Provide more information on the proposed expansion of Leismer airstrip including who is included in the partnership and what is the stage of planning.

Response

A corporation (Leismer Aerodrome Ltd.) has been set up to hold interests related to this airstrip venture. StatoilHydro is the majority shareholder in this Corporation. Leismer Aerodrome Ltd. has held joint industry meetings with all operators in the area to encourage participation in this venture, and offered commercial terms for participation. Other potential partners have expressed interest in participating in the enterprise.

The Leismer airstrip will be upgraded in stages. The first major upgrade will include navigation and electrical equipment, lighting, parking and paving of the airstrip to 30 m wide and 1,600 m long. Final engineering is complete and Leismer Aerodrome Ltd. is preparing to go out to tender for a planned construction period between July and September, 2008.

Future expansions have been incorporated in the planning process, and the extent of implementation will be driven by local demand for transportation services.

181	b) Confirm whether or not the proposed expansion will be in place before the Kai Kos Dehseh Project starts construction.

Response

The upgrade of the Leismer Aerodrome should be completed prior to the main activity commencing on the Kai Kos Dehseh Project.

181	c) What funding commitments must be made by other parties for this expansion to take place? If these commitments are not forthcoming, will StatoilHydro proceed on its own or can other airstrips be utilized to accommodate StatoilHydro's fly-in/fly-out operations? Indicate which ones.

Response

Funding commitments are expected to be forthcoming from other companies for participation in this venture. Should the commercial relationships with other potential investors not be finalized, Leismer Aerodrome Ltd. will proceed regardless, as no other strips in the area are practical.

181	d) What discussions have taken place with municipal representatives and the Fort McMurray Regional Airport Commission about the proposed airstrip expansion? What concerns have been expressed about the airstrip?

Response

StatoilHydro has joined the Fort McMurray Aerodrome Association, presented the Project to the Association and has received endorsement from the Association and the McMurray Regional Airport Commission.

Concerns about noise in the community of Conklin were expressed; a base ground survey is to be completed along with the approach and takeoff flight plans being developed to avoid the Hamlet of Conklin. The only other concern expressed was potential loss of Aboriginal traditional land use in the area. A site visit was conducted with the specific individual concerned.

182	**Volume 5, Section 14.9.15, Page 14-75** StatoilHydro indicates that *Fort McMurray First Nation, Anzac, and Gregoire Estates will continue to feel an increase in traffic from all the disclosed projects unless the power lines on the south end of Highway 881 are buried, and oversized loads can travel into the region on the south end of Highway 881. Additionally, a project to connect Highway 63 and Highway 881 south of Anzac, known as the Stoney Mountain bypass, would alleviate all of the truck traffic through the communities along the north end of Highway 881. Until bypass is built (no date for a feasibility study has yet been given), all projects will contribute to this increase in traffic. Large oversize loads will likely continue to be staged between midnight and 5 am, reducing conflicts in traffic on the road. Additionally, a connecting road between Highway 881 and Highway 63, located approximately west from Conklin, has been discussed. Again, this is not in the feasibility phase of planning. This road would serve the interest of many companies, including Al-Pac.* a) Provide information on any discussions that StatoilHydro has had with the RMWB and AT regarding mitigation measures to reduce the traffic impacts noted above.

Response

Discussions have been held with Laurene Viarobo, Superintendent, Strategic Planning and Policy Division, Planning and Development Department, Jeff Penny, Manager Economic Development Strategic Initiatives, the Regional Airport Authority and also Shah Syed with Infrastructure and Planning Alberta government.

182	b) Given that the road would serve the interest of many companies, what steps have the companies taken to put the by-pass roads in place?

Response

Infrastructure meetings have been held with all the industry players in the area. The connecting Highway has been discussed at these meetings with Al-Pac in attendance. Local private companies have been engaged and the various routing options are being analyzed. Meetings are being planned to co-ordinate a joint effort for future development of a Highway 63 and Highway 881 link.

StatoilHydro is in the process of commissioning a Traffic Impact Assessment (TIA) for the Project, and further analysis on this issue may be available once the TIA is complete.

182	c) Provide discussions with Provincial Government regarding the connecting road between Highway 881 and Highway 63. How would this road be classified? What is the timeline for construction?

Response

Discussions have taken place with Shah Sayed of Infrastructure and Planning informing him of StatoilHydro's activity in the area and questions were answered relating to the East/West road and the intersection of Highway 881. Discussions with have also been had with Steve Otto with the Alberta government regarding interchanges being planned for Highway 63.

182	d) Given the importance of Highway 63 as the primary access for communities and industry to the north of the site, has StatoilHydro assessed the risk of a disruption of traffic along Highway 63 in certain emergency situations?

Response

StatoilHydro does not anticipate any emergency scenarios that would impact traffic on Highway 63. A temporary increase in vehicle traffic may occur in the event that emergency vehicles need access to the site.

183	**Volume 5, Section 14.9.15, Page 14-75** StatoilHydro indicates that the *volume of traffic anticipated for Conklin will be higher in the cumulative case, as many of the announced projects are east of Conklin. Currently, there is a bypass road which alleviates some of the traffic through the community. StatoilHydro does not contribute a large change to the Conklin traffic, except through permanent employees traveling to work and truck traffic passing Conklin turnoff during construction.* a) Provide additional information on how many StatoilHydro employees will travel to work. b) Identify the impact of these traffic volumes and provide details of the infrastructure upgrades that may be required to mitigate these impacts.

Response

StatoilHydro is in the process of commissioning a Traffic Impact Assessment (TIA) for the Project, and more information on this issue may be available once the TIA is complete.

Historical Resources

184	**Volume 1, Section 7.15, Page 146** **Volume 5, Section 15.10, Page 15-32** StatoilHydro states that *the studies conducted provided baseline data relative to historical resources to support the EIA application. The historical resources studies conducted consisted of a site file search and literature review, development of a model of archaeological potential for use in project planning and management, and field evaluation of the model in pay zones and additional moderate to high potential areas. Ground truthing resulted in some modification of the model.* In Volume 5, Section 15.10, Page 15-32, StatoilHydro states that *StatoilHydro has committed to conducting an HRIA of the finalized footprints for the initial Leismer and Corner developments in the summer of 2008, prior to construction.* a) When does StatoilHydro plan to submit the report(s) discussing the results of the Historic Resources Impact Assessment(s)? Note that Historic Resources Management Branch of Alberta Culture and Community Spirit requires at least three weeks to review the report prior to anticipated EIA completeness.

Response

StatoilHydro is planning to conduct an HRIA for the Leismer and Corner Hubs in August 2008 and will submit the reports to Historic Resources Management Branch of Alberta Culture and Community Spirit in September 2008.

H. EPEA/WA APPROVALS

185	**Volume 1, Section 8.6.5.7, Page 175, Table 8.6-4, Also applies to 8.6.5.10, Page 179** a) Update Table 8.6-4 to show the planting densities for each of the species being proposed.

Response

In general the planting density of species will be determined on a site by site basis in order to meet the reclamation and revegetation objectives stated in the C&R plan (Volume 1, Section 8.3). In order to meet these general objectives, planting density at a given site will depend on several factors including:

- General Parameters
  - Meeting the reclamation criteria and regulatory policies of the day.
  - Consultation with stakeholders (e.g., ASRD and Al-Pac).
  - Attaining a maintenance free, self-sustaining ecosystem that can support a similar range of land uses to pre-disturbance conditions.
- Site-Specific Parameters
  - Planting to achieve ecosite phase and species distribution similar to, and compatible with, pre-disturbance/control (adjacent) vegetation conditions.
  - Re-vegetation monitoring will assess species growth on the reclaimed site relative to the adjacent or target vegetation, and ameliorative measures (e.g., additional planting/seeding) taken as required.

The above site-specific criteria necessitates that the re-vegetation plans will be revised to be specific for each development site at the time of reclamation. As mentioned in the Report, the planting prescription species may be adjusted on a site-specific basis (Volume 1, Section 8.6.5.7). The Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region (Oil Sands Vegetation Reclamation Committee, 1998) provides general densities for tree species of 1800 to 220 stems/ha and for shrub species 500 to 700 stems/ha. These guidelines will be used in determining the species density along with the planting prescriptions in the C&R in conjunction with the above bulleted points on a site-specific basis. Vegetation information collected in the future Pre-Development Assessments to be done for the facility sites will be necessary to determine site-specific planting densities.

REFERENCE

Oilsands Vegetation Reclamation Committee. (1998). Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region. Alberta Environmental Protection, Land Reclamation, Edmonton. 212 pp.

186	**Volume 1, Section 8.6.5.14, Page 180** a) Further describe the components and anticipated frequency of environmental monitoring reporting.

Response

StatoilHydro anticipates receiving similar approval terms and conditions as compared to those recently received by other in-situ operators. As such, StatoilHydro will be providing AENV proposals for soils, wildlife, vegetation, wetland and groundwater monitoring programs. The content of these programs will be negotiated with AENV and if possible may incorporate other operator's regional initiatives and data collection. Reporting will likely follow the standard annual reporting frequency.

187	**Volume 3, Section 5.9, Page 5-70** StatoilHydro states that *the magnitude of the change in aquifer productivity is high within the Lower Grand Rapids and Clearwater A aquifers…. Within areas of LSA it is predicted that competition for groundwater with future users of the Lower Grand Rapids and Clearwater A aquifer is possible….* a) Provide more detail on the monitoring of non-saline (Clearwater A and Lower Grand Rapids Aquifer), as well as the overburden aquifers.

Response

Groundwater monitoring for the Project is discussed in Volume 3 Section 5.8 pages 5-67 to 5-70. With respect to sourcing non-saline groundwater from the Lower Grand Rapids and Clearwater A aquifers, StatoilHydro will monitor these aquifers as outlined in the *Water Conservation and Allocation Guideline for Oilfield Injection* (2006) and the *Groundwater Evaluation Guidelines* (2003). StatoilHydro will conduct pump testing appropriate to the anticipated pumping rate, install observation wells, collect groundwater samples, field-verify adjacent water wells, conduct a technical evaluation of saline sources, conduct an economic evaluation of saline sources, perform a cumulative effects assessment and evaluate environmental impacts.

188	**Volume 3, Section 6.12.2, Page 6-67** StatoilHydro's implementation of a surface water monitoring program and remedial maintenance where and when required is discussed. a) Confirm that StatoilHydro will commit to a surface water monitoring program.

Response

StatoilHydro will undertake a surface water monitoring program.

188	b) Clarify who will be doing the monitoring and the reporting process used to ensure results are reviewed and necessary action taken.

Response

Water monitoring will be undertaken by an independent contractor, with a summary of results to be submitted annually to AENV. StatoilHydro anticipates that the water monitoring program will be a condition of approval for the Project, and StatoilHydro anticipates that commitments to action that may be required will be part of it's approval.

189	**Volume 3, Section 7.8, Page 7-76** **Volume 3, Section 8.6.4.2, Page 8-55 & 8-56** StatoilHydro indicates that they will develop, if necessary, a lake monitoring program to determine the potential effects of increased acidic deposition on lakes within the RSA. However, not all waterbodies that may be sensitive to changes in pH as a result of the Project have been surveyed. a) Due to the fact that StatoilHydro's conclusions in Section 7.6.5.3 show that PAI is exceeding critical load limits at 12 lakes in the RSA under baseline conditions, clarify if StatoilHydro will commit to undertaking the lake monitoring program. b) If monitoring shows detrimental impacts (decline in pH), what are the set points for determining impact and what mitigative measures will be implemented to recover these systems?

Response

Mitigative measures for acid deposition are outlined in the "Application of Critical, Target, and Monitoring Loads for the Evaluation and Management of Acid Deposition" and "Recommendations for the Acid Deposition Management Framework for the Oil Sands Region of North-Eastern Alberta." The application of the Acid Deposition Management Framework is primarily intended for the management of acidifying emissions and acid deposition on a larger scale than an individual project and is not intended for regulatory purposes on a local level. Predictions of acid deposition greater than management benchmarks (i.e., critical loads) at the local scale are meant to prompt an assessment of local issues regarding acid deposition. The Management Framework does not place the responsibility of developing a strategy to mitigate potential effects of acid deposition on one project. Rather it stipulates all stakeholders in the area participate in a regional plan. That being said, StatoilHydro will develop monitoring program according to AENV approval conditions for the Kai Kos Dehseh Project.

REFERENCES

Cumulative Environmental Management Association, 2004. "Recommendations for the Acid Deposition Management Framework for the Oil Sands Region of North-Eastern Alberta."

Alberta Environment and Clean Air Strategic Alliance, 1999. "Application of Critical, Target, and Monitoring Loads for the Evaluation and Management of Acid Deposition"

190	**Volume 4, Section 10.6.11, Page 10-86** StatoilHydro states that *a weed management plan will be forthcoming for the Project.* a) Provide an update on the status of the weed management plan. b) Formulate a detailed plan of action to eliminate the spread of non-native and invasive plant species during construction and operation. Include the details within the required Pre Disturbance Assessment documentation prior to the start of construction. c) Provide a summary of the findings and how they relate to the Project.

Response

The weed management plan has not been finalized. A combination of mechanical methods (e.g., picking and mowing), and if necessary, approved chemical (e.g., herbicides), will be used to control weeds in appropriate locations. Application of weed control methods will be completed by a certified herbicide applicator. Ongoing monitoring will be undertaken during the growing season.

Weed management will begin when site preparation is initiated and will continue throughout Project operations until reclamation certification has been obtained. The weed management plan will establish measures to control weeds of concern to the province, including invasive species. StatoilHydro confirms, as requested in the question, that area specific weed management plans will be included in the PDA documentation.

The weed management plan will include:

- ensuring that equipment arrives on site clean and free of dirt and vegetative material;
- prohibiting harvested weeds from being deposited where they might grow and spread; and
- controlling weed infestation using approved methods.

Methods of weed control will be revised, as required. Weed control activities will depend on the location, surrounding environment, proximity to aquatic resources, species and quantity, and may include spot spraying, mowing and hand weeding. Long-term control will be accomplished by using the product and method best suited for the type of soils and weeds on the site.

I. ERRATA

191	**Volume 1, Section 1, Figure 1-1 and Figure 1-2, Pages 2 & 3** Figure 1-1 shows three small StatoilHydro leases: o T77, R8W4; o T77, R7W4; o T78, R6W4. a) These leases are not shown in Figure 1-2 which defines the Project Area. Confirm that these three small leases are not part of the Kai Kos Dehseh Project and the Environmental Impact Assessment (EIA).

Response

The three oil sands leases referenced in the question are the property of StatoilHydro, but are not part of the Kai Kos Dehseh Project or the Environmental Impact Assessment.

192	**Volume 1, Section 8.6.3.1, Page 164** The merchantable diameter is 15cm at stump height, not breast height as indicated. a) How does this correction affect the merchantable timber calculations? Recalculate and submit all tables where the wrong diameter was used.

Response

Text was a misprint and should read merchantable diameter is 15 cm at stump height. Merchantable timber was calculated by area (ha) for each ecosite phase not volume so with revision to the text the calculations will not change.

193	**Volume 2, Appendix 2B, Section 2B3.6, Figure 2B3-1, Page 2B-16** a) Provide a companion figure for the background Potential Acidifying Impact (PAI) deposition contours based upon the Alberta Environment (AENV) RELAD model showing the RELAD grid cells and the RELAD predicted values for each grid cell.

Response

Figure 193-1 is a companion figure for Figure 2B3-1 of Volume 2, Appendix 2B, Section 2B3.6 illustrating background PAI based on the AENV RELAD model showing PAI based on 1 degree by 1 degree grid cells.

194	**Volume 2, Appendix 4A, Table 4A2-31, Page 4A-39** There appears to be a typographical error in this table. The exposure limit from Ontario Ministry of the Environment (OMOE) for pentane is reported as 25001, however the description below states that this exposure limit is 2,500. Also, there is a footnote for this exposure limit that is labeled as 1. a) Provide clarification.

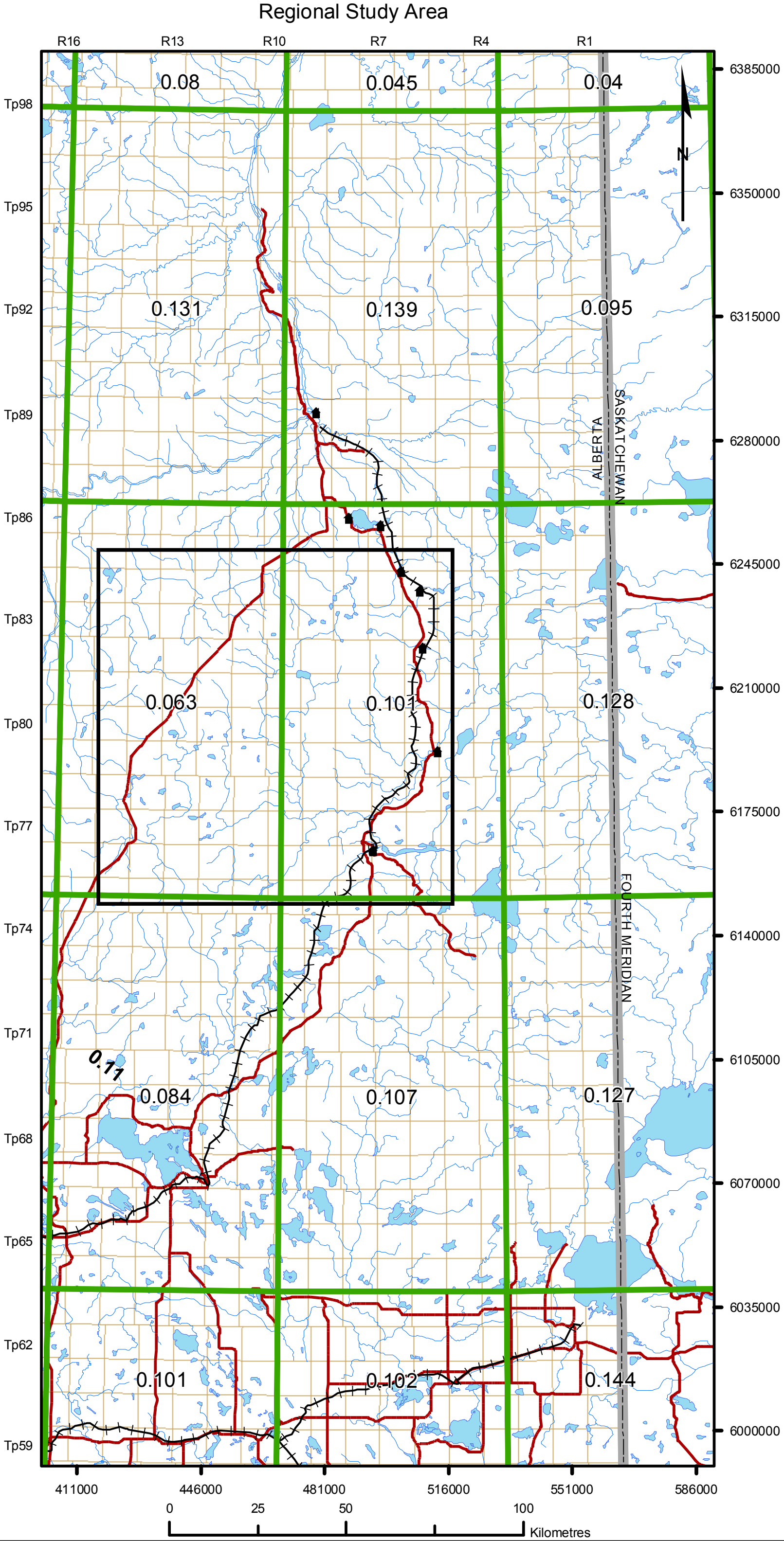
Response

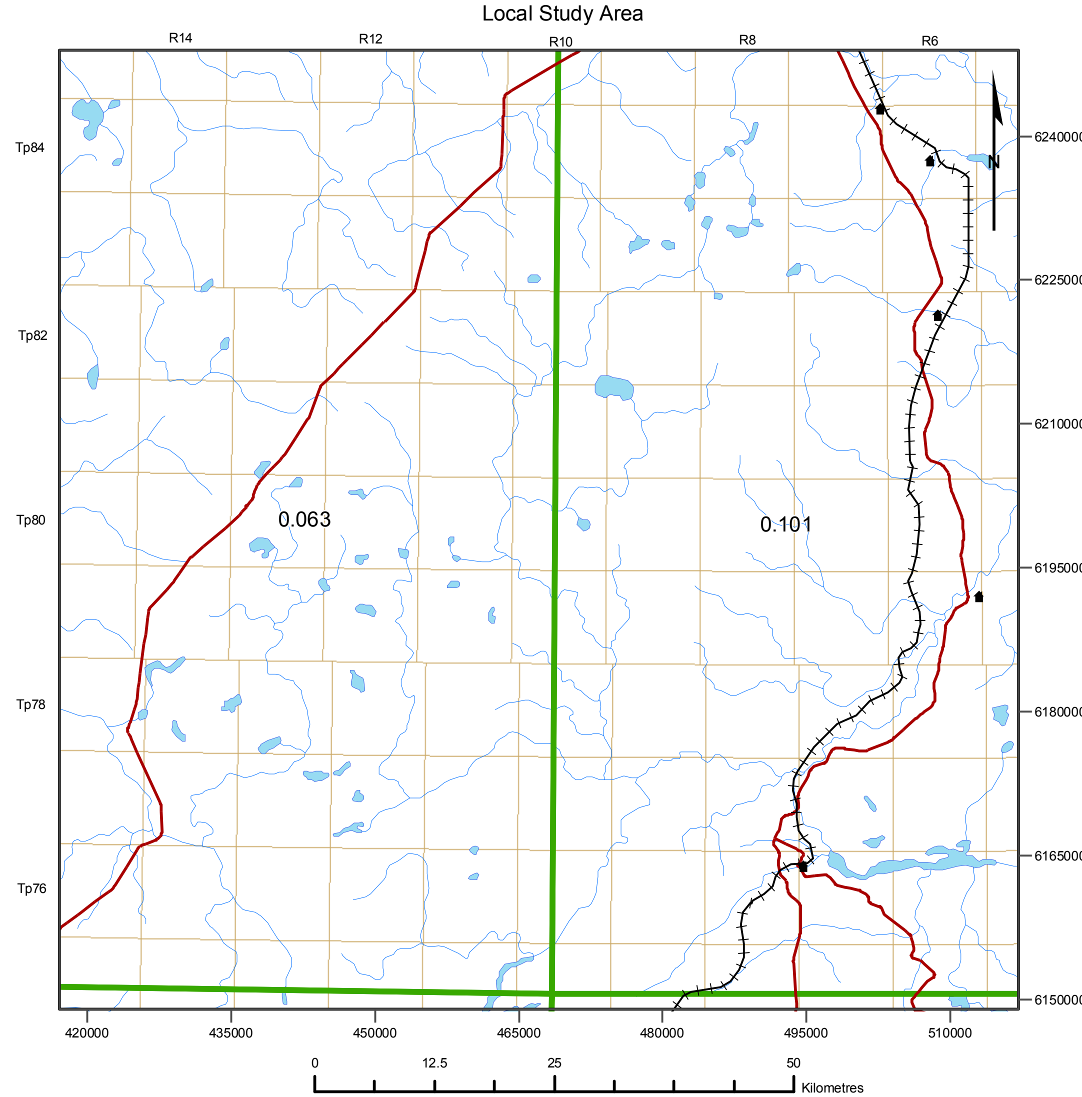
The '1' should be a footnote, and the exposure limit is 2,500. Thus, the value in the table should read '2,500[1]'.

195	**Volume 2, Appendix 4B, Section 4B5.2, Page 4B-38** There is an apparent typographical error on this page. The second equation, dermal risk estimate shows a **relative absorption factor** (RAF) of 0.13/0.8 = 0.1625 or 16.255%. a) Clarify this apparent discrepancy.

Response

The last digit of 16.255% may be dropped, resulting in value of 16.25%. This value is consistent between the description and the equation.

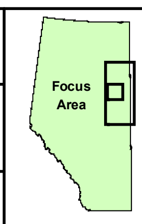




Legend

- PAI Deposition Grid
- Community
- Railroad
- Road
- Lake
- River

PROJECT	StatoilHydro			
TITLE	The Alberta Environment Background PAI Deposition Grid Based on the RELAD Model			
DRAWN	NS	05/2008	Figure 193-1	
CHECKED	SER	05/2008		
REVIEWED	DSC	05/2008		
PROJECT	W06-1126B			



UTM Zone 12 NAD83

196	**Volume 3, Section 7.5.1, Page 7-26** StatoilHydro states that high nutrient concentrations are common to the boreal area. a) Provide references to support this statement.

Response

Many lakes and streams in the Boreal forest are connected with fens and minetrophic peatlands. Unlike poor fens and bogs dominated by sphagnum sp, fens in the Project area have pH levels generally higher than 5.5, high alkalinities and are species rich dominated by Brown Moss. Mineralization of allochthonous organic material in rich fens leads to higher nutrient levels in surface water as observed in historic data presented in Appendix 7B.

REFERENCES

Turetsky, M.R., and S. Ripley, 2005. "Decomposition in Extreme-Rich Fens of Boreal Alberta, Canada. Soil Science Society of America Journal. Vol 69:1856-1860

Whitehouse, H.E., and S.E. Bayley, 2005. "Vegetation patterns and biodiversity of peat land plant communities surrounding mid-boreal wetland ponds in Alberta. Canada" Canadian Journal of Botany. Vol 83: 621-637.

D.H.Vitt, 2000. " Peatlands:ecosystems dominated b bryophites." In Bryophyte Biology, A.J.Shaw and B.Goffinet (eds), pp. 312-343. Cambridge University Press.

197	**Volume 3, Section 8.2, Figure 8.2-2, Page 8-4 & 8-5** In Figure 8.2-2, there is a dashed yellow line called the Regional Study Area. a) Confirm what this line means and if necessary, update table with this clarification.

Response

The dashed yellow line presented in Figure 8.2-2 represents the three distinct study areas located within the projects Local Study Area. Descriptions of these study areas are presented in Volume 3, Section 8.2.1

198	**Volume 3, Section 8.4, Page 8-7 and throughout Section 8** Reference is made to AENV database (Alberta Environment Fisheries Management Information System (FMIS)). This database is managed by Alberta Sustainable Resource Development (SRD). a) Confirm that the information was obtained in consultation with Alberta SRD, not AENV.

Response

The information was obtained through consultation with Alberta Sustainable Resource Development.

198	b) As this is a living database, the date of any information queries needs to be specified. Update Table 8.4-1 to show the date the search was done on.

Response

The Fisheries Management Information System Database was accessed on November 16, 2006 as part of the historical resources information search conducted for this Project. The contact person with Alberta Sustainable Resource Development was Larry Rhude.

199	**Volume 3, Section 8.4, Figure 8.2-2,Table 8.4-1, Pages 8-5 & 8-8** There is a discrepancy between the site locations shown in Figure 8.2-2 and Table 8.4-1. Sites shown on the map are not at the same locations as sites listed in the table. For example, site WCL1 is said to be at ATS 7of 36-82-10-W4 in the table, but the figure shows it to be near 36-78-10-W4. a) Confirm that the locations on the Figure 8.2-2 match the information provided in Table 8.4-1. Update the figure and table as necessary.

Response

A check of Figure 8.2-2 and Table 8.4-1 indicated that the location of WCL1 was incorrect in the Table. The correct location of WCL1 is at 36-78-10 W4. All other corresponding points on Figure 8.2-2 correspond with coordinates in Table 8.4-1.

200	**Volume 3, Section 8.4.3.3, Figure 8.2-2,Table 8.4-2, Pages 8-5, 8-11 & 8-14** Table 8.4-2 indicates that 7 sites on the Christina River mainstream were sampled (WCL1,4,7,9,10,11,15) whereas on Figure 8.2-2 it appears that WCL15 is on a tributary although the base data from AENV indicates the other branch is actually the Christina River. The text at the top of page 8-14 states that only 4 sites on the Christina River were sampled. a) Confirm the locations of the sampling sites and update the figure and table as necessary.

Response

A review of Figure 8.4-2 and Table 8.4-1 indicated that a total of eight sites on the Christina River were sampled (WCH3,6,WCL1,4,7,9,10,11). Sampling location WCL15 is located on a tributary to the Christina River. The text at the top of page 8-14 should state that 6 sites were sampled on the Christina River in the Leismer study area rather than 4.

201	**Volume 4, Section 9.5.5, Page 9-26** *Baseline land capability classes were developed for each soil series as described in Section 9.4.5.1*. This section does not exist. Provide the correct reference.

Response

The correct reference is Section 9.4.6.

202	**Volume 4, Appendix 9B** Norwest Lab report included at the beginning of this appendix lists the project name as Nexen Long Lake EIA, not the Kai Kos Dehseh EIA. a) Confirm that the appropriate data set was used in this EIA.

Response

The Norwest Lab report was erroneously included and no data was used in the Environmental Impact Assessment

203	**Volume 5, Section 14.7.5.7, Page 14-21** Note: Lakeland County and the town of Lac La Biche have amalgamated under the new name of Lac La Biche County.

Response

Yes, StatoilHydro acknowledges this.

Appendix A - Summary of Project Impacts on Wildlife Indicators as a Result of the Revised LSA, Revised RSA and Revised Cumulative Effects Assessment

Revised Table 11.6-1 Summary of Project Impacts on Canadian Toad Habitat Availability in the LSA

	Project Specific Impacts	
	Baseline	**Application**
Habitat availability for Canadian toad in the LSA (HU)	37,858.6	36,837.7
Change in habitat availability due to the Project relative to baseline		-1,020.9 (-2.7%)
Change to high quality habitat availability due to the Project relative to baseline		-521.0 (-2.6%)
Environmental impact attributable to the Project		Moderate

Revised Table 11.6-2: Summary of Project Impacts on Northern Goshawk Habitat Availability in the LSA

	Project Specific Impacts	
	Baseline	**Application**
Habitat availability for northern goshawk in the LSA (HU)	10,067.7	9,449.6
Change in habitat availability due to the Project relative to baseline		-618.2 (-6.1%)
Change to high quality habitat availability due to the Project relative to baseline		-246.1 (-9.8%)
Environmental impact attributable to the Project		Moderate

Revised Table 11.6-3 Summary of Project Impacts on Great Gray Owl Habitat Availability in the LSA

	Project Specific Impacts	
	Baseline	**Application**
Habitat availability for great gray owl in the LSA (HU)	62,348.1	58,266.9
Change in habitat availability due to the Project relative to baseline		-4,081.2 (-6.5%)
Change to high quality habitat availability due to the Project relative to baseline		-2,438.4 (-10.6%)
Environmental impact attributable to the Project		Moderate

Revised Table 11.6-4 Summary of Project Impacts on Barred Owl Habitat Availability in the LSA

	Project Specific Impacts	
	Baseline	Application
Habitat availability for barred owl in the LSA (HU)	1,984.7	1,947.4
Change in habitat availability due to the Project relative to baseline		-37.3 (-1.9%)
Change to high quality habitat availability due to the Project relative to baseline		-5.1 (-6.1%)
Environmental impact attributable to the Project		Moderate

Revised Table 11.6-5 Summary of Project Impacts on Boreal Owl Habitat Availability in the LSA

	Project Specific Impacts	
	Baseline	Application
Habitat availability for boreal owl in the LSA (HU)	1,049.2	1,033.9
Change in habitat availability due to the Project relative to baseline		-15.3 (-1.5%)
Change to high quality habitat availability due to the Project relative to baseline		-7.5 (-0.9%)
Environmental impact attributable to the Project		Low

Revised Table 11.6-6 Summary of Project Impacts on Mixedwood Forest Bird Community Habitat Availability in the LSA

	Project Specific Impacts	
	Baseline	Application
Habitat availability for mixedwood forest birds in the LSA (HU)	7,114.4	6,904.5
Change in habitat availability due to the Project relative to baseline		-210.0 (-3.0%)
Change to high quality habitat availability due to the Project relative to baseline		-210.0 (-3.0%)
Environmental impact attributable to the Project		Low

Revised Table 11.6-7 Summary of Project Impacts on Old Growth Forest Bird Community Habitat Availability in the LSA

	Project Specific Impacts	
	Baseline	Application
Habitat availability for mixedwood forest birds in the LSA (HU)	7,046.1	6,906.6
Change in habitat availability due to the Project relative to baseline		-139.5 (-2.0%)
Change to high quality habitat availability due to the Project relative to baseline		-139.5 (-2.0%)
Environmental impact attributable to the Project		Low

Revised Table 11.6-8 Summary of Project Impacts on Beaver Habitat Availability in the LSA

	Project Specific Impacts	
	Baseline	**Application**
Habitat availability for beaver in the LSA (HU)	6,714.0	6,690.9
Change in habitat availability due to the Project relative to baseline		-23.2 (-0.3%)
Change to high quality habitat availability due to the Project relative to baseline		-3.6 (-0.1%)
Environmental impact attributable to the Project		Low

Revised Table 11.6-9 Summary of Project Impacts on Muskrat Habitat Availability in the LSA

	Project Specific Impacts	
	Baseline	**Application**
Habitat availability for muskrat in the LSA (HU)	2,166.2	2,157.4
Change in habitat availability due to the Project relative to baseline		-8.7 (-0.4%)
Change to high quality habitat availability due to the Project relative to baseline		-8.7 (-0.4%)
Environmental impact attributable to the Project		Low

Revised Table 11.6-10 Summary of Project Impacts on Fisher Habitat Availability in the LSA

	Project Specific Impacts	
	Baseline	**Application**
Habitat availability for fisher in the LSA (HU)	70,287.8	68,595.3
Change in habitat availability due to the Project relative to baseline		-1,692.5 (-2.4%)
Change to high quality habitat availability due to the Project relative to baseline		-699.6 (-2.6%)
Environmental impact attributable to the Project		Low

Revised Table 11.6-11 Summary of Project Impacts on Lynx Habitat Availability in the LSA

	Project Specific Impacts	
	Baseline	**Application**
Habitat availability for lynx in the LSA (HU)	79,077.7	76,540.9
Change in habitat availability due to the Project relative to baseline		-2,536.8 (-3.2%)
Change to high quality habitat availability due to the Project relative to baseline		-2,885.8 (-5.4%)
Environmental impact attributable to the Project		Moderate

Revised Table 11.6-12 Summary of Project Impacts on Black Bear Habitat Availability in the LSA

	Project Specific Impacts	
	Baseline	**Application**
Habitat availability for black bear in the LSA (HU)	47,838.5	44,436.5
Change in habitat availability due to the Project relative to baseline		-3,402.0 (-7.1%)
Change to high quality habitat availability due to the Project relative to baseline		-918.0 (-12.8%)
Environmental impact attributable to the Project		Moderate

Revised Table 11.6-14 Summary of Project Impacts on Moose Habitat Availability in the LSA

	Project Specific Impacts	
	Baseline	**Application**
Habitat availability for moose in the LSA (HU)	45,333.2	42,525.1
Change in habitat availability due to the Project relative to baseline		-2,808.2 (-6.2%)
Change to high quality habitat availability due to the Project relative to baseline		-1,464.5 (-6.5%)
Environmental impact attributable to the Project		Moderate

Revised Table 11.6-15 Summary of Project and Cumulative Impacts on Moose Habitat Availability in the RSA

	Project Specific Impacts		
	Baseline	**Project Case**	**Cumulative Case**
Habitat availability for moose in the RSA (HU)	768,460.6	765,572.9	760,353.2
High quality habitat availability in the RSA (HU)	44,154.2	44,050.7	43,878.1
Change in habitat availability relative to baseline		-2,887.7 (-0.4%)	-8,107.4 -1.0%
Change to high quality habitat availability relative to baseline		-103.5 (-0.2%)	-276.1 -0.6%
Environmental impact		Negligible	Negligible

Revised Table 11.6-16 Summary of Project Impacts on Woodland Caribou Habitat Availability in the LSA

	Project Specific Impacts	
	Baseline	**Application**
Habitat availability for caribou in the LSA (HU)	62,374.4	58,876.9
Change in habitat availability due to the Project relative to baseline		-3,497.5 (-5.6%)
Change to high quality habitat availability due to the Project relative to baseline		5,001.0 (-13.3%)
Environmental impact attributable to the Project		Moderate

Revised Table 11.6-17 Summary of Project and Cumulative Impacts on Woodland Caribou Habitat Availability in the RSA

	Project Specific Impacts		
	Baseline	**Project Case**	**Cumulative Case**
Habitat availability for caribou in the RSA (HU)	810,971.5	792,108.6	784,298.9
High Quality Habitat availability in the RSA (HU)	339,777.7	312,460.6	306,434.5
Change in habitat availability due to the Project relative to baseline		-18,862.9 (-2.3%)	-26,672.6 -3.3%
Change to high quality habitat availability due to the Project relative to baseline		-27,317.0 (-8.0%)	-33,343.1 -9.8%
Environmental impact attributable to the Project		Moderate	Moderate

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Table 11.9-1 Final Impact Rating Summary for Project Effects

Indicator	Direction of Impact	Extent of Impact	Magnitude of Impact	Duration of Impact	Frequency of Occurrence of Impact	Permanence of Impact	Level of Confidence	Environmental Impact at Application	Environmental Impact at Closure
Habitat Availability & Reduced Habitat Effectiveness									
Canadian Toad	Negative	Sub-regional	Moderate	Long-term	Continuous	Reversible	Moderate	Moderate	Negligible
Northern Goshawk	Negative	Sub-regional	Moderate	Long-term	Continuous	Reversible	Moderate	Moderate	Low
Great Gray Owl	Negative	Sub-regional	Low	Long-term	Continuous	Reversible	Moderate	Moderate	Negligible
Barred Owl	Negative	Sub-regional	Low	Long-term	Continuous	Reversible	Moderate	Moderate	Low
Boreal Owl	Negative	Sub-regional	Low	Long-term	Continuous	Reversible	Moderate	Low	Low
Mixedwood Forest Bird Community	Negative	Sub-regional	Low	Long-term	Continuous	Reversible	Moderate	Low	Negligible
Old growth Forest Bird Community	Negative	Sub-regional	Low	Long-term	Continuous	Reversible	Moderate	Low	Low
Beaver	Negative	Sub-regional	Low	Long-term	Continuous	Reversible	Moderate	Low	Negligible
Muskrat	Negative	Sub-regional	Low	Long-term	Continuous	Reversible	Moderate	Low	Low
Fisher	Negative	Sub-regional	Low	Long-term	Continuous	Reversible	Moderate	Low	Negligible
Lynx	Negative	Sub-regional	Moderate	Long-term	Continuous	Reversible	Moderate	Moderate	Negligible
Black Bear	Negative	Sub-regional	Moderate	Long-term	Continuous	Reversible	Moderate	Moderate	Negligible
Black Bear Regional Assessment	Negative	Regional	Low	Long-term	Continuous	Reversible	Moderate	Low	Negligible
Moose	Negative	Sub-regional	Moderate	Long-term	Continuous	Reversible	Moderate	Moderate	Negligible
Moose Regional Assessment	Negative	Regional	Negligible	Long-term	Continuous	Reversible	Low	Negligible	Not assessed
Moose CEA	Negative	Regional	Negligible	Long-term	Continuous	Reversible	Low	Negligible	Not assessed
Woodland Caribou	Negative	Sub-regional	Moderate	Long-term	Continuous	Reversible	Moderate	Moderate	Negligible
Woodland Caribou Regional Assessment	Negative	Regional	Moderate	Long-term	Continuous	Reversible	Low	Moderate	Not assessed
Woodland Caribou CEA	Negative	Regional	Moderate	Long-term	Continuous	Reversible	Low	Moderate	Not assessed

Appendix B - Updated Resource Selection Model Analysis

Presented in this model selection analysis are recently developed statistical approaches for evaluating resource selection by animals (RSPF; Lele and Keim, 2006) and conventional techniques (RSF; Manly et al., 2002) for assessing resource selection by animals. Models were fit by researchers who are recognized in peer reviewed publications (including authors cited above) for their applications in resource selection modelling for animals.

WINTERING WOODLAND CARIBOU AND MOOSE RESOURCE SELECTION ANALYSIS

A use / available study design (Manly et al., 2002; Keating and Cherry, 2004; Lele and Keim, 2006) was employed in the analysis of data and in the development of statistical models. In this analysis used sites are defined by the caribou and moose pellet locations (1,188 caribou and 796 moose pellet group locations). Available sites are 6,909 locations that were randomly selected from within the dog-team search area. The search area was delineated to include all locations within a 50 m distance of the transect lines walked by the dog handler, as defined by a global positioning system (GPS) track log collected by each dog handler. A 50 m distance was selected because, although dogs could scent and detect scat from distances beyond 50 m (wind dependent), a 50 m distance was judged as a typical and thus representative search distance from the dog handlers. By considering available sites within the search area, rather than the sample grids for example, we were able to adjust for potential surveyor bias during random transect walks. Hence available sites represent what kinds of habitats might be potentially available to caribou, moose, and wolves within the search area surveyed by the dog-teams. Statistical analysis was conducted in the statistical software program R Statistical Computing Version 2.6.2©. In the following sections the statistical models used, the final model selected, and an evaluation of the final models fit within the study area is presented.

STATISTICAL MODELS

Two statistical models, both applicable to the use / available study design (Manly et al., 2002; Keating and Cherry, 2004; Lele and Keim, 2006), were employed in analysis of the data. The first model, the exponential form of the RSF, is the most common modelling approach for estimating the relative probability of resource selection by animals (Johnson et al., 2004; 2005; 2006). The second, the Logistic RSPF, was recently identified as an alternative approach for estimating the probability of resource selection by animals and has previously been used to estimate caribou site selection (Keim and Lele, 2007, in preparation).

The Logistic RSPF model takes the form:

$$\pi(\underline{x};\beta) = \frac{\exp(\underline{x}\beta)}{1+\exp(\underline{x}\beta)}$$

The exponential RSF model takes the form:

$$\pi(\underline{x};\beta) = \exp(\underline{\chi}\beta)$$

The parameter estimates (β) and the standard errors for the final caribou and moose models are provided in Table 1. All covariates are significantly different from zero.

For moose, a local and a regional (study area) resource selection model was estimated since different data for deriving vegetation covariates was available in each area. The regional model was fit by considering vegetation covariates (open pine stands, wetlands) derived from satellite imagery whereas the local models were fit by considering vegetation covariates (density of conifer trees) derived from the more accurate Alberta Vegetation Inventory data.

TABLE 1 Estimated coefficients (β) and standard errors (SE) for the model covariates used in each of the Exponential RSF and the Logistic RSPF.

Caribou Model Covariates*	Logistic RSPF		Exponential RSF	
	B	SE	B	SE
Intercept	-1.96	0.02	-	-
Terrain Complexity	-0.99	0.02	-0.54	0.005
Distance to features having detectable use by humans	0.015	0.00001	0.006	0.000001
Wetlands	1.68	0.04	0.91	0.004
Linear Features having negligible or low detectable human use	1.15	0.12	0.36	0.01

*Forestry harvest areas are nullified in the caribou models.

Local (LSA) Moose Model Covariates	Logistic RSPF		Exponential RSF	
	B	SE	B	SE
Intercept	0.69	0.18	-	-
Density of Conifer Trees	-3.31	0.19	-1.82	0.02
Areas within 100 m of streams and lakes	0.94	0.07	0.32	0.006
Linear Features having negligible or low detectable human use	-1.52	0.12	-0.75	0.03
Areas within 75 m of anthropogenic features having detectable use by humans	-1.97	0.20	-1.20	0.09

Regional (RSA) Moose Model Covariates	Logistic RSPF*		Exponential RSF	
	B	SE	B	SE
Areas within 100 m of streams and lakes	0.78	0.11	0.56	0.01
Linear Features having negligible or low detectable human use	-0.42	0.05	-0.33	0.03
Areas within 75 m of anthropogenic features having detectable use by humans	-1.22	0.18	-1.03	0.09
Areas of open pine (from satellite imagery)	1.00	0.20	0.72	0.01
Wetlands areas with shrub or black spruce dominant cover (from satellite imagery)	0.56	0.04	0.43	0.01

*Only categorical covariates were considered in the RSA moose model, hence the intercept was not estimable and only a relative RSPF can be calculated.

In Table 2, the Bayesian information criterion (BIC) value (Burnham and Anderson, 2002) for the fitted exponential RSF and the fitted Logistic RSPF models are provided.

TABLE 2. Log-likelihood values for best fit multiple covariate models. A model with a smaller log-likelihood value is considered to provide a better fit.

Model	Log-likelihood value
Caribou Exponential RSF:	-339.44
Caribou Logistic RSPF:	-358.45
LSA Moose Exponential RSF:	-247.20
LSA Moose Logistic RSPF:	-259.78
RSA Moose Exponential RSF:	-86.42
RSA Moose Logistic RSPF:	-86.97

The Logistic RSPF model provides a better descriptor of the data for both caribou and moose, under assumptions of the BIC. The Logistic RSPF model for moose derived from LSA data provides a better fit than the regional model, under assumptions of the BIC.

Based on the final models, wintering caribou select sites:

1. Having lower variation in elevation (meters above sea level) measured within a 140 m radius;
2. That are more distant from high-use anthropogenic disturbances (permanent roads, winter roads, active well sites and facilities);
3. That are not areas that have been cleared of vegetation (forestry cut blocks);
4. That are within wetland complexes; and / or
5. Sites that occur on linear features with little or no detectable human use.

Based on the final models, wintering moose select sites:

1. Having lower densities of pine, spruce and fir trees;
2. That are located within 100 m of streams and lakes;
3. That are located greater than 75 m from high-use anthropogenic disturbances (permanent roads, winter roads, active well sites and facilities); and / or
4. Those sites not located on linear features having little or no detectable human use.

MODEL EVALUATION

A measure of the residual sum of squares (RSS; Lele and Keim, 2007, in preparation.) was used to determine the fit of the final models within the scat search area at baseline condition. In this approach, the final models were applied in a GIS to the extent of the scat search area.

To calculate the RSS the final model needed to be categorized into a grouping of ordinal bins (groupings or classes of selection probability) where the highest ranked bins contained the most preferred sites and vice-versa. The model was converted into an index in a GIS by dividing each pixel value by the maximum model value attained within the study area. This conversion allowed the model to be scaled between 0 and 1.0, where a value of 1.0 represents the most preferred sites. The caribou and LSA moose models were classified into 15 equally distributed bins and the moose RSA model was classified into 6 equally distributed bins, wherein each bin contained multiple (>10) used and available locations. For each bin the area (number of pixels) and the number of scat locations predicted by the model in the study area was calculated. Using these data the proportion of scat locations and the predicted-value (expected) proportion of scat locations was calculated for each bin using the following calculations.

[1] Used Proportion = # of scat locations / ∑ scat locations in all bins

[2] Predicted-value = the bin mid-point value * (Area / ∑ Area in all bins)

To derive the predicted value, the mid-point value of the model interval at each bin was used as per Johnson et al. (2005), and Boyce and McDonald (1999). The RSS was calculated using the Log transformation of the predicted-value and the used proportion using the following function.

$$J = \sum_{i=1}^{K} \{(y_i - x_i) - (\bar{y} - \bar{x})\}^2$$

Where; K is the total number of bins, y_i is the logarithmic transformation of the proportion of predicted use, x_i is the logarithmic transformation of the proportion of observed use.

If a model has a good fit, one would expect:

1. A RSS value approximate to zero; and
2. A linear relationship between the used proportion and the predicted value on the Log scale, to have a slope of 1.0 (with an intercept defined by the relationship).

<u>Caribou Model Evaluation</u>

The RSS for the final Logistic RSPF model is 0.05. The RSS for the final Exponential RSPF model is 2.10. A plot of the residuals is provided in Figure 1.

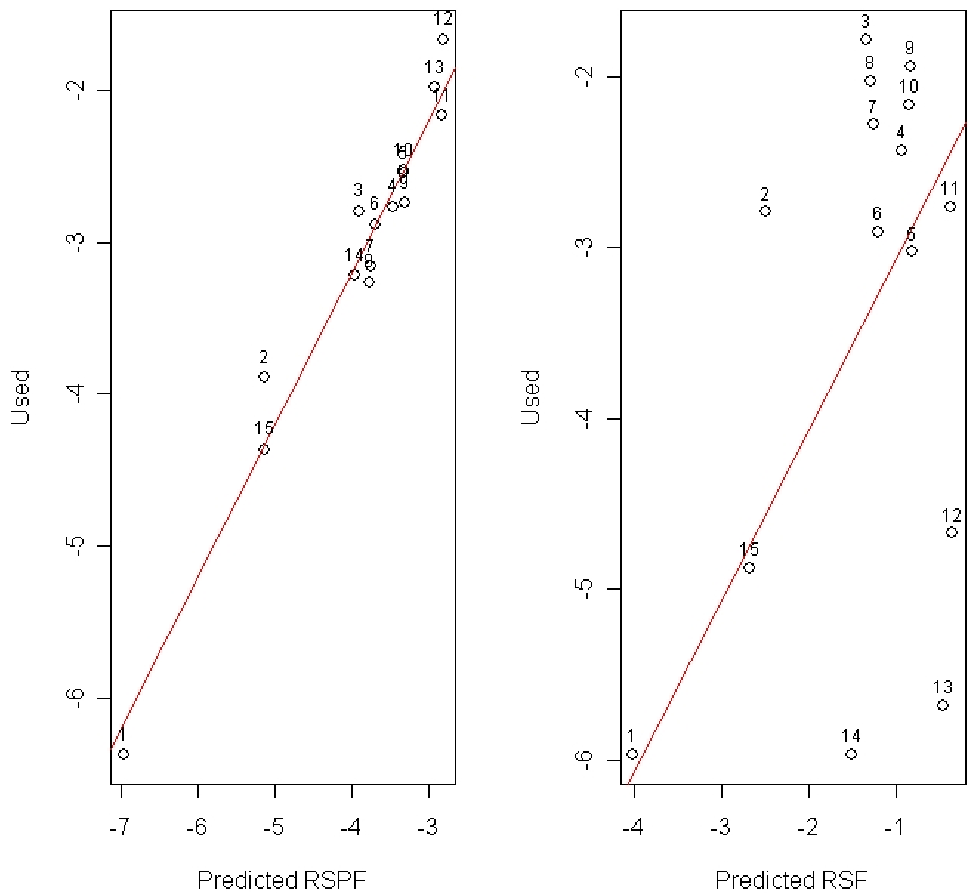

Figure 1: Plots of model fit for both the Logistic RSPF model and the exponential RSF model on the Log scale. A red line indicates the expected model fit (for caribou). The bin number is denoted above each point, where a larger bin number represents a grouping of more preferred sites.

The smaller RSS value for the Logistic RSPF model (0.05), as compared to the exponential RSF model (2.10), indicates that a better fit with the scat caribou locations is attained by the Logistic RSPF model. Furthermore, the RSS value is relatively close to zero indicating a fairly strong model fit.

The effect of the residuals is displayed as the vertical distance between each point (bin) and the expected fit (red line) in the plots (Figure 1). The residuals of the Logistic RSPF model better resemble a linear relationship with a slope of 1.0 along the expected fit line. This indicates that the RSPF model provides a stronger fit with the scat data. Notably, in the exponential RSF model, the bin residuals indicate that use is less than expected among sites that are predicted as better quality habitats (bins 11 to 14). This indicates that the exponential model does not predict higher quality habitats strongly, as compared against scat locations. Alternatively the greatest short-coming of the Logistic RSPF model is that more observations than expected were observed in bin (habitat class) 2; however, the residual distance is relatively small as indicated in the RSS value (0.05 for the sum of all 15 bins).

In our analysis multiple covariates were considered in synchrony (for fit with the data) including consideration of multiple functions for each covariate (linear, exponential, and quadratic) and multiple model forms of the resource selection function (exponential and logistic models). The estimated Logistic RSPF model resulted in the best model fit from the data and provides a strong fit to the scat location data collected for caribou.

LSA Moose Model Evaluation

The RSS for the final Logistic RSPF model is 0.70. The RSS for the final Exponential RSPF model is 1.70. A plot of the residuals is provided in Figure 2.

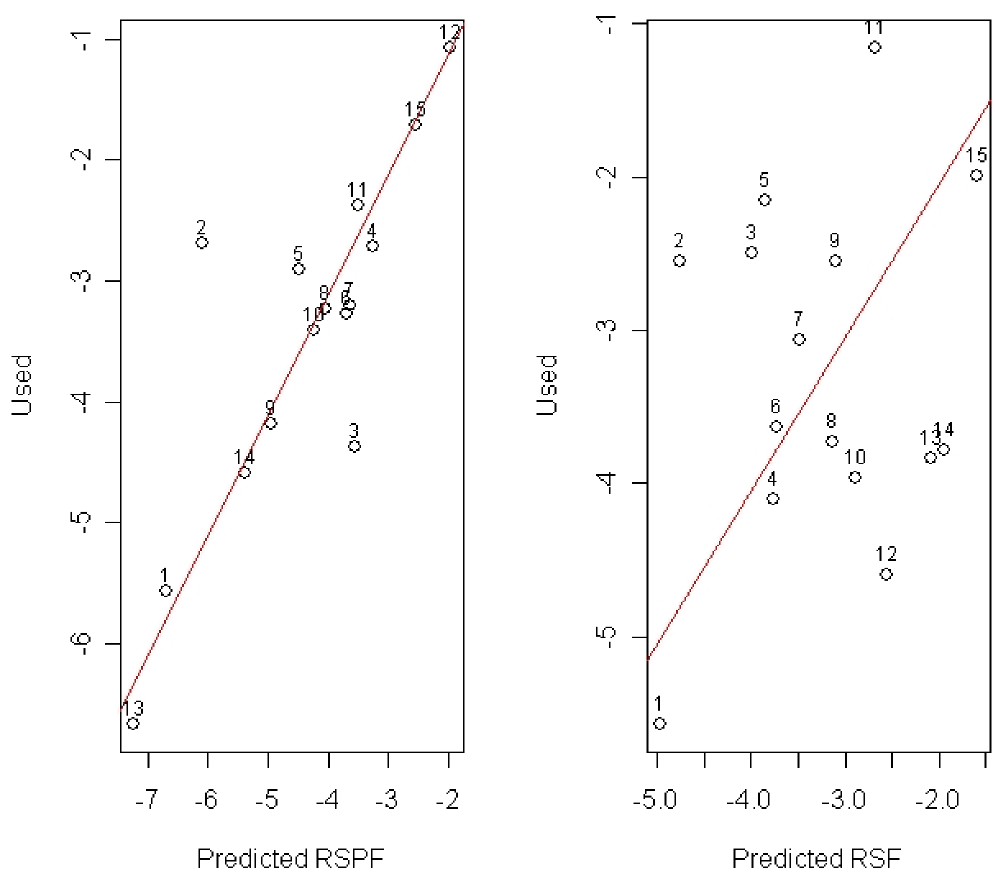

Figure 2: Plots of model fit for both the Logistic RSPF model and the exponential RSF model on the Log scale (for LSA moose). A red line indicates the expected model fit. The bin number is denoted above each point, where a larger bin number represents a grouping of more preferred sites.

The smaller RSS value for the Logistic RSPF model (0.70), as compared to the exponential RSF model (1.70), indicates that a better fit with the moose scat locations is attained by the Logistic RSPF model. Furthermore, the Logistic RSPF model for caribou (0.05) is a better fit than the Logistic RSPF moose model (0.7), with both Logistic RSPF models providing a reasonable fit with the data.

The effect of the residuals is displayed as the vertical distance between each point (bin) and the expected fit (red line) in the plots (Figure 2). The residuals of the Logistic RSPF model better resemble a linear relationship with a slope of 1.0 along the expected fit line. This indicates that the RSPF model provides a stronger fit with the scat data. Notably, in the exponential RSF model, the bin residuals indicate that use is less than expected among sites that are predicted as better quality habitats (bins 10, and 12 to 14) and that use is greater than expected among sites that are predicted as lower quality habitats (bins 2, 3, 5, 7 and 9). This indicates that the exponential model is predicting habitats opposite to what one would expect as compared against scat locations with reference to habitat quality. As indicated in from the plot of the residuals for the Logistic RSPF model, the residuals are emphasized among 2 bins (bin 2 and 3) with the remainder of the bins occurring relatively close to the expected value. More observations than expected were observed in bin 2 and vice-versa in bin 3. Since bins 2 and 3 equate to lower quality habitats the greater than expected number of observation detected in bin 2 is of foremost concern. Since a less than expected number of locations were observed in bin 3 (as contrary to bin 2), the residuals in these two bins would be reduced by grouping bins 2 and 3 together.

In this analysis multiple covariates were considered in synchrony (for fit with the data) including consideration of multiple functions for each covariate (linear, exponential, and quadratic) and multiple model forms of the resource selection function (exponential and logistic models). The estimated Logistic RSPF model resulted in the best model fit from the data and provides a reasonable fit to the scat location data collected for moose.

<u>RSA Moose Model Evaluation</u>

The RSS for the final Logistic RSPF model is 1.05. The RSS for the final Exponential RSPF model is 3.61. A plot of the residuals is provided in Figure 3.

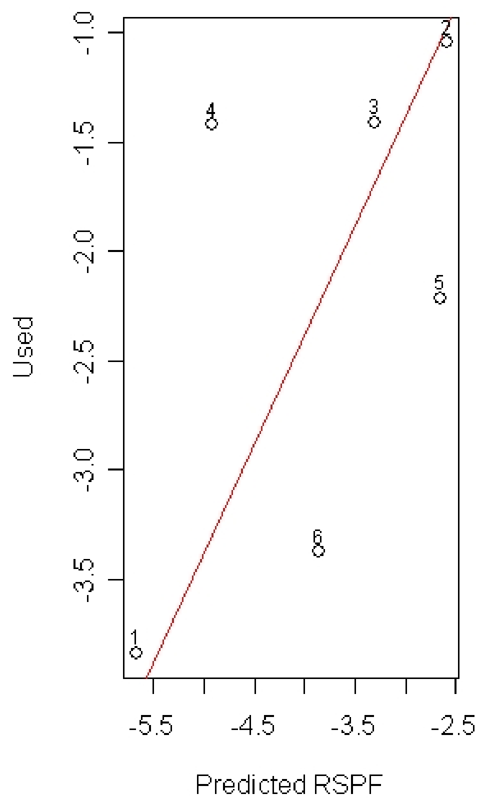

Figure 3: Plots of model fit for both the Logistic RSPF model and the exponential RSF model on the Log scale (for RSA moose). A red line indicates the expected model fit. The bin number is denoted above each point, where a larger bin number represents a grouping of more preferred sites.

The smaller RSS value for the Logistic RSPF model (1.05), as compared to the exponential RSF model (3.61), indicates that a better fit with the moose scat locations is attained by the Logistic RSPF model. The Logistic RSPF model for moose provides a substantially stronger fit when LSA data is used based on the assumptions of BIC (-86.97 with RSA data / -259 with LSA data) and the RSS value (1.05 with RSA data / 0.70 with LSA data).

The effect of the residuals is displayed as the vertical distance between each point (bin) and the expected fit (red line) in the plots (Figure 3). Neither model provides a strong linear relationship with a slope of 1.0 along the expected fit line. Furthermore, only 6 points are available to display in the residual plot and to calculate the RSS value. The result is a lower level of confidence in the fit, since the linear relationship has greater dependence among each point. For example, by removing bins (displayed as points in the plot) 1 or 2 in the Logistic RPSF plot the relationship would less resemble a linear relationship with a slope of 1.0. In the plot of the residuals for the Logistic RSPF model, the residuals are emphasized among bins 4, 5 and 6 with the remainder of the bins occurring relatively close to the expected value. More observations than expected were observed in bin 4 and less observations than expected were observed in bins 5 and 6 (the predicted highest quality habitats). Extreme caution should be considered when interpreting and using the regional moose model since a relatively (as compared to the local model) low level of confidence is provided by the model fit.

LIMITATIONS

Resource selection by both moose and caribou (especially caribou) is dependent upon covariates for anthropogenic disturbances on the landscape. Of particular importance to these covariates is an ability to distinguish how much human activity occurs on such (anthropogenic) features. The rate and abundance of human activity and development in the area make this task difficult, especially during winter months. Preliminary findings from the initial two years of data collection, indicate that it is not the linear feature itself that influences site selection by caribou (and moose to a lesser degree), but rather the intensity of human use on these features and across the landscape (likely resulting from sensory (noise, scent, vision) disturbances at or near anthropogenic features). Extrapolation of the models is dependent on an ability to identify anthropogenic features that are and are not associated with human activities (detectable by caribou and moose).

Future monitoring will hopefully better identify the effects of anthropogenic activities on caribou across the landscape in time. The preliminary results indicate that it is important to assess the level of human activity that is associated with anthropogenic features when considering the impacts of such features (especially human access corridors) on caribou and moose habitat. This is especially relevant in environmental impacts assessments, cumulative effects assessments, and for impact mitigations on woodland caribou in this area.

Also important, is the accuracy of the data used to derive covariates for these models. The moose model resulted in a relatively weak fit with the scat data when lower accuracy vegetation covariates were considered. This is apparent by the better fit of the local moose model than the regional moose model (more accurate vegetation covariates were considered in the local moose model). Caution is highly recommended when evaluating and considering the regional moose model given the lower level of confidence attained in the evaluation of model fit. As feasible the local moose model should be used.

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