# SUNCOR ENERGY

# FIREBAG PROJECT

**COMMERCIAL IN-SITU OIL SANDS PROJECT (Approval No. 8870)**
**Annual AEUB Review Presentation**

Chris Fordham
Suncor Energy Inc.
Submission to the
Alberta Energy and Utilities Board
May 13, 2005

SUNCOR ENERGY

Firebag Project

# Presentation Overview

- Project Overview
- Performance to Date
- Compliance
- Future Plans

SUNCOR ENERGY

Firebag Project

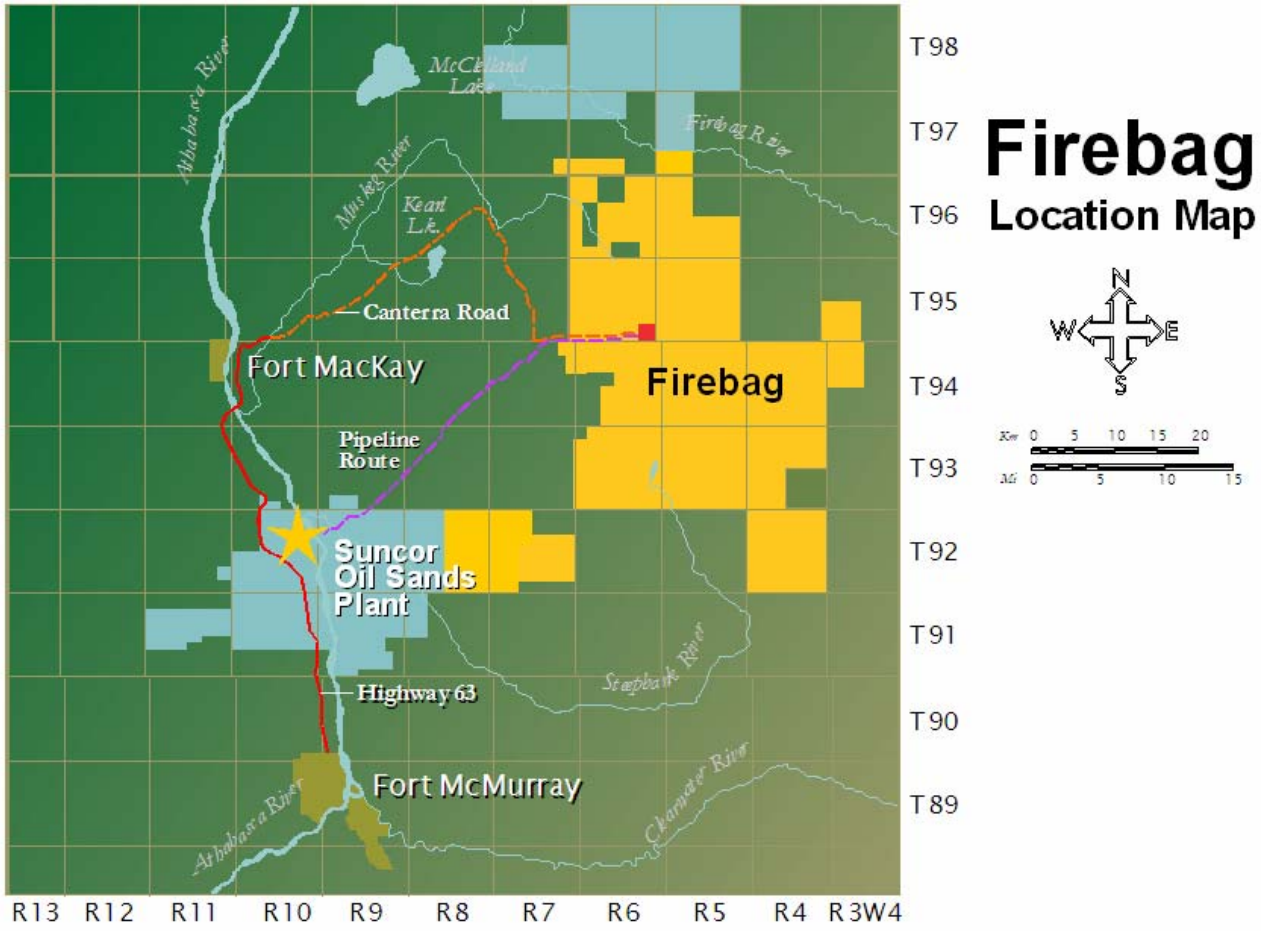
# Firebag Project Overview

- The Firebag Project is Suncor Oil Sands in-situ supply of bitumen for the Upgrader
- The Firebag Project consists of an experimental solvent injection pilot (ETS) and a commercial Steam Assisted Gravity Drainage (SAGD) scheme
- Ultimately, the Firebag Project will supply 350,000+ bbl/day (55,645 $m^3$/day) of bitumen feed

SUNCOR ENERGY

Firebag Project

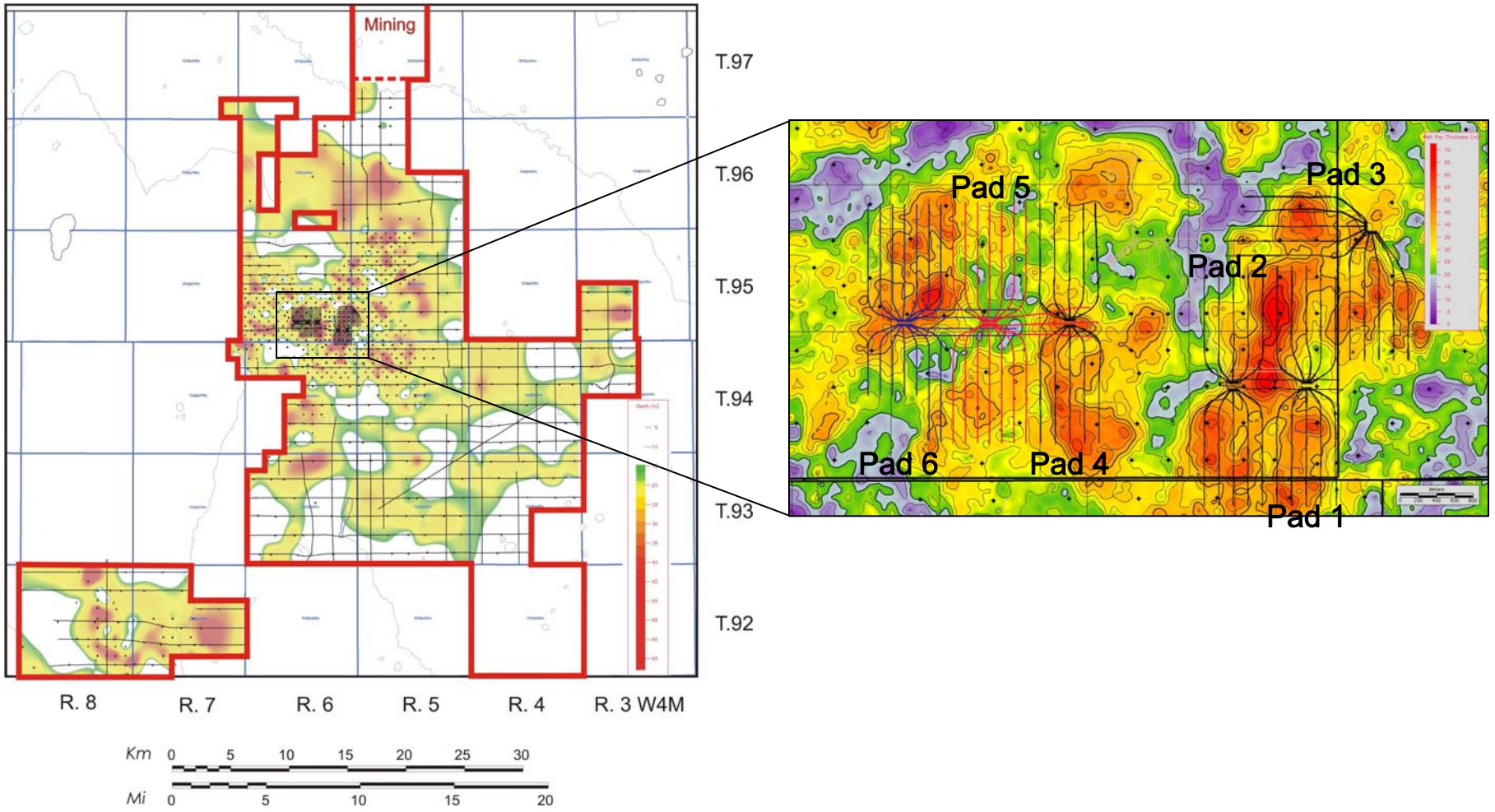
# Firebag Project Location



SUNCOR ENERGY

Firebag Project

# Firebag Net Pay Map



SUNCOR ENERGY

Firebag Project

# Original Project Design

- SAGD project approved to provide up to 140,000 bbl/day (22,258 $m^3$/day) of bitumen to Oil Sands Upgrader
- Project to be constructed in 4 - 35,000 bbl/day (5,565 $m^3$/day) stages
- Design Steam to Oil Ratio 2.0
- Water supply from Oil Sands
- Firebag connected with Oil Sands plant via 4 pipelines (water, gas, diluent, DB) and powerline
- Firebag is a bitumen supply for Oil Sands Upgrader

SUNCOR ENERGY

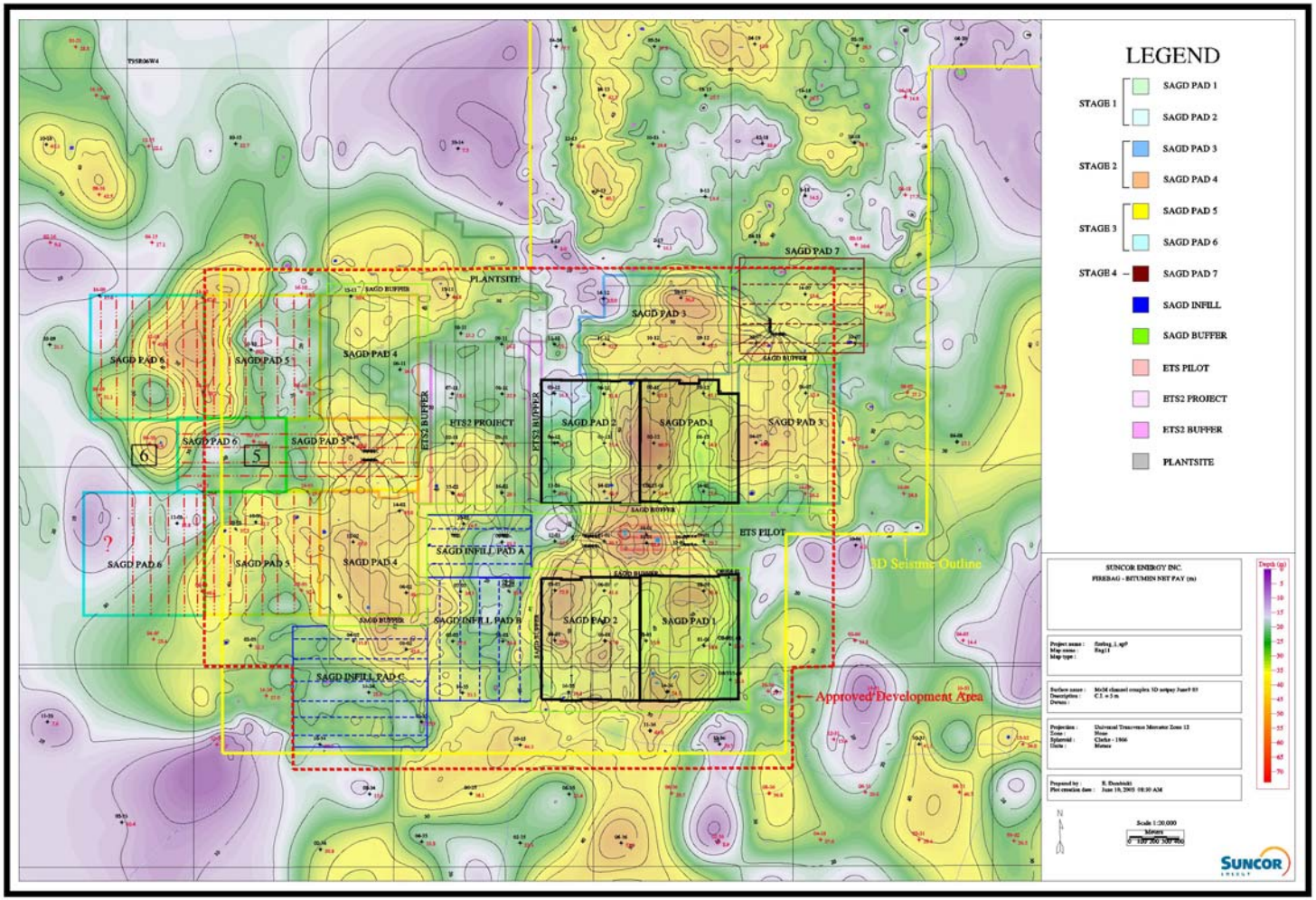
Firebag Project

# Firebag SAGD Project Chronology

- Application and EIA submitted to EUB/AENV on May 10, 2000
- Project received EUB approval 8870 (without public hearing) on October 26, 2001
- Stage 2 approved January, 2003 - under construction
- First steam on September 20, 2003
- First oil to Upgrader on January 12, 2004
- Stage 3 approved in March, 2004
- Pad 6 approved May, 2005

Firebag Project

# Firebag SAGD Facilities and Layout



SUNCOR ENERGY

Firebag Project

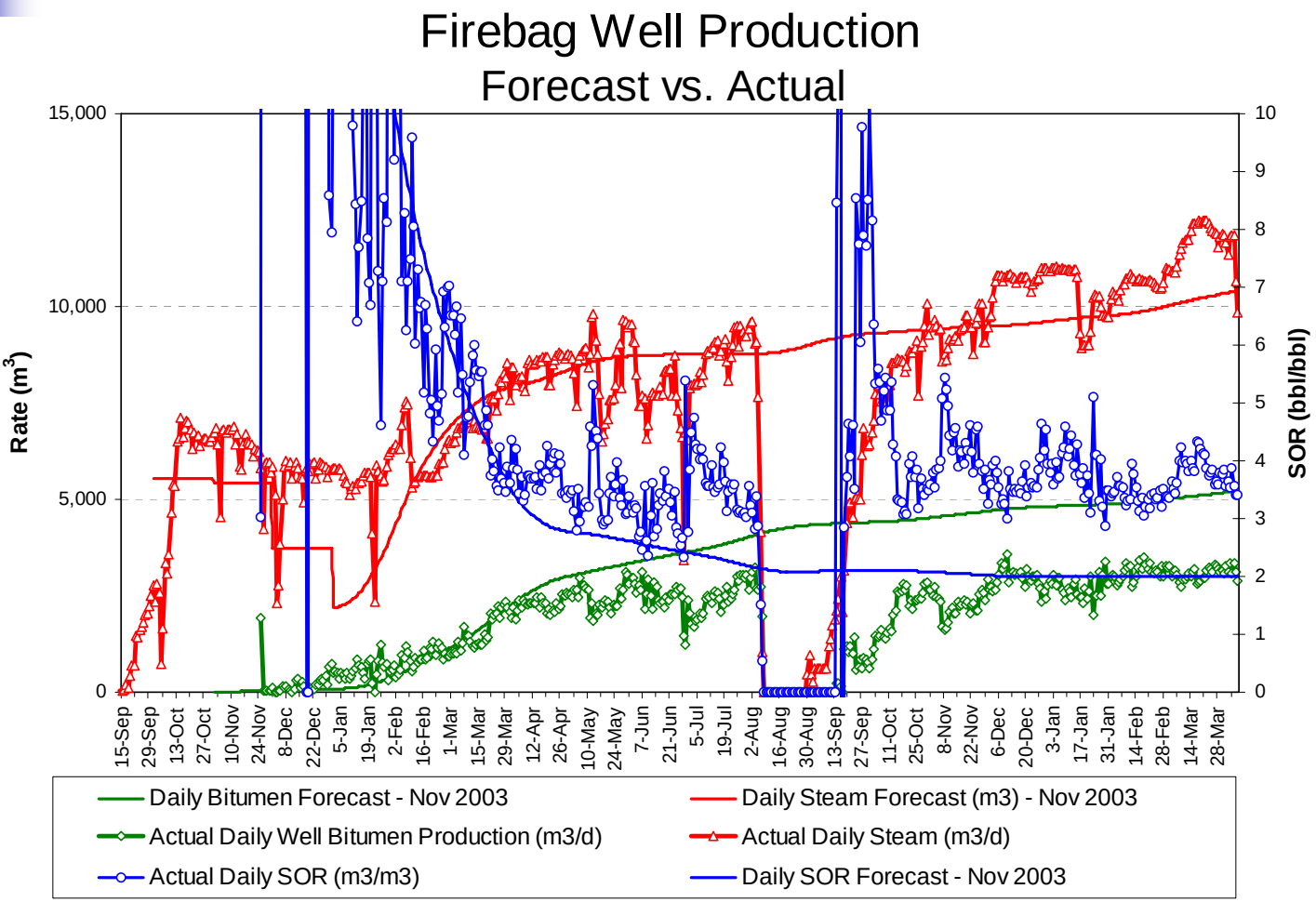
# Firebag Stage 1 Reservoir Properties

| | |
|---|---|
| Depth | 320 m |
| Pressure | 800 kPa |
| Temperature | 8 C |
| Average net pay | 35 - 40 m |
| Permeability | 6 - 10 darcy |
| Porosity | 32 % |
| Bitumen saturation | 85 % |
| Bitumen viscosity | 10 million cp |

SUNCOR ENERGY

Firebag Project

# Firebag Production



SUNCOR ENERGY

Firebag Project

# Firebag Stage 1 Performance

- 12 out of total 20 well pairs converted to SAGD production mode
  - Pad 1
    - 7 well pairs in SAGD
    - 3 temporarily shut in due to steam availability
  - Pad 2
    - 5 well pairs in SAGD
    - 5 temporarily shut in due to steam availability
- 6,000,000$^{th}$ barrel of oil produced in May 2005
- 2.6% OBIP recovered to date from Stage 1
- Facility and reservoir issues delaying ramp-up to full production

SUNCOR ENERGY

Firebag Project

# Firebag Predicted Recovery

| | Area (m2) | Gross Thickness (m) | Gross Rock Volume (Vr) (e6 m3) | Net-to-Gross Ratio* | Net Pay Thickness (m) | Porosity | So | 1/Bo | OBIP (e6 m3) | OBIP (e6 bbl) |
|---|---|---|---|---|---|---|---|---|---|---|
| SAGD Pad 1 | 1,582,640 | 53.2 | 84.2 | 0.84 | 44.5 | 0.35 | 0.79 | 1 | 19.6 | 123.30 |
| SAGD Pad 2 | 1,592,960 | 52.7 | 83.9 | 0.75 | 39.5 | 0.35 | 0.78 | 1 | 17.2 | 108.36 |
| SAGD Pad 3 | 1,654,720 | 48.0 | 79.5 | 0.81 | 39.1 | 0.35 | 0.80 | 1 | 17.9 | 112.74 |
| SAGD Pad 4 | 1,548,000 | 42.4 | 65.6 | 0.82 | 34.8 | 0.35 | 0.77 | 1 | 14.4 | 90.31 |
| SAGD Pad 5 | 2,481,276 | 40.1 | 99.4 | 0.82 | 32.8 | 0.35 | 0.78 | 1 | 22.1 | 138.72 |
| SAGD Pad 6 | 2,156,963 | 41.2 | 88.9 | 0.77 | 31.9 | 0.35 | 0.78 | 1 | 18.8 | 117.97 |
| **SAGD TOTAL** | 11,016,559 | 45.5 | 501.5 | 0.80 | 36.5 | 0.35 | 0.79 | 1 | 109.9 | 691.39 |
| **Firebag Approved Project Area** | 194,354,522 | 37.9 | 7,364.3 | 0.66 | 25.0 | 0.34 | 0.78 | 1 | 1,269.0 | 7,981.96 |

*Net-to-Gross Ratio = Net pay cutoffs applied are GR>60 API, Porosity < 0.22, and Sw > 0.50.

| | % of Development Area Total Original BIP | Bitumen Below Producer (% of BIP) | Bitumen on & above Producer (% of BIP) | Recovery (% of Total BIP on & above Producer) | Recovery (% of Total BIP in area) | Development Plan |
|---|---|---|---|---|---|---|
| SAGD Pad 1 | 10.8% | 12.0% | 88.0% | 91.5% | 80.5% | On Production |
| SAGD Pad 2 | 9.5% | 15.5% | 84.5% | 90.2% | 76.2% | On Production |
| SAGD Pad 3 | 9.9% | 11.4% | 88.6% | 90.7% | 80.4% | Drilled |
| SAGD Pad 4 | 7.9% | 14.7% | 85.3% | 88.6% | 75.6% | Drilled |
| SAGD Pad 5 | 12.2% | 11.8% | 88.2% | 83.1% | 73.3% | Being developed |
| SAGD Pad 6* | - | 19.8% | 80.2% | 85.7 | 64.3 | Pad location identified |
| **SAGD TOTAL** | **50.4%** | | | | | |

SUNCOR ENERGY

Firebag Project

# Facility Issues

- Warm Lime Softener (WLS) performance affected water quality
- Poor water quality resulted in:
  - Failure of boilers
  - Scaling in afterfilters
  - Plugging in the water coolers
- Outage occurred in August 2004
- Reduced availability of high quality steam impacted reservoir and well performance

SUNCOR ENERGY

Firebag Project

# Reservoir Issues

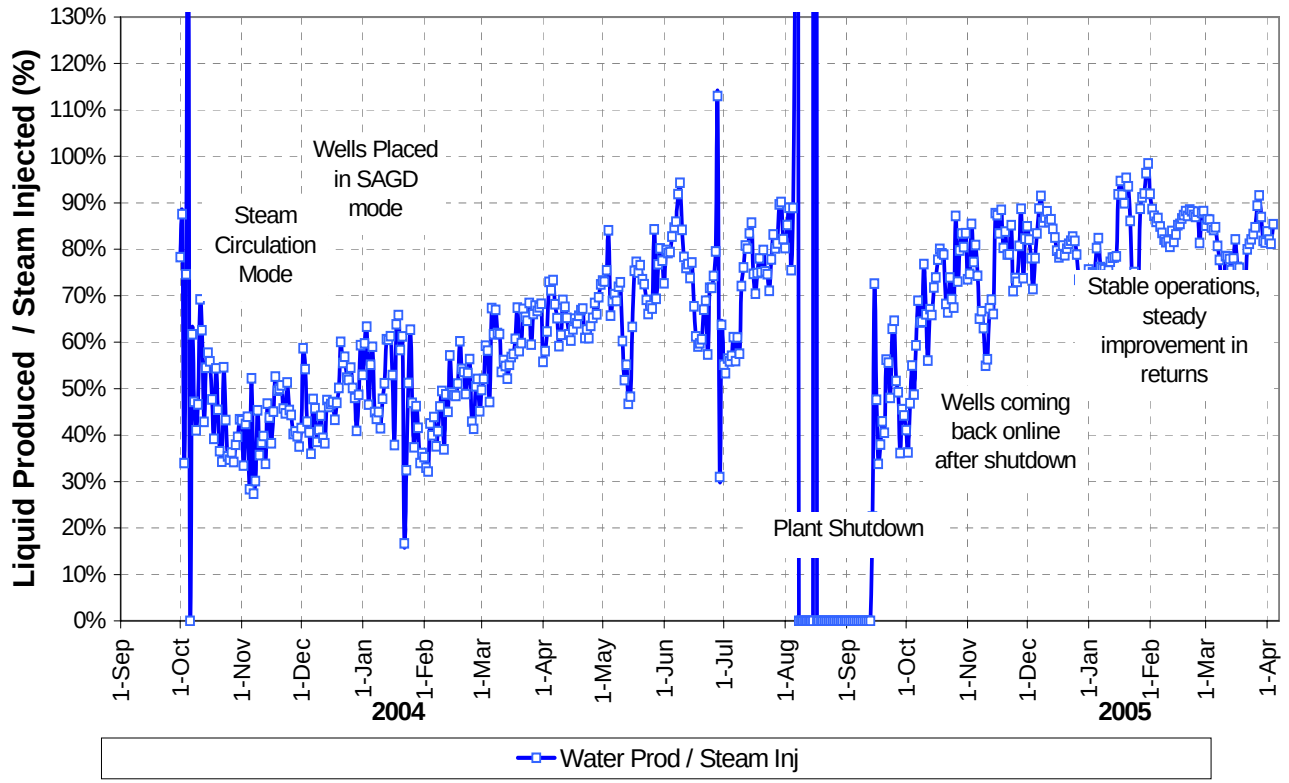
- Originally planned for initial reservoir operating pressures of ~ 4500 kPa
- Initial operation revealed inability to achieve high pressure
- Lowered target operating pressures but observed significant water retention in reservoir
- Lowered target operating pressures below ~3000 kPa to improve water returns but will require artificial lift

Firebag Project

# Firebag Steam/Water Balance

Water Balance

Ratio of Produced Fluids to Steam Injected



SUNCOR ENERGY

Firebag Project

# Firebag Stage 1 Lessons Learned

- Individual wells producing oil at higher than expected rates when steam is available
- High operating pressure decreases water returns - at current operating pressures water return has improved to over 85%
- $H_2S$ production is considerably higher than expected – currently under investigation
- No sand production observed
- LP-SAGD is effective at stabilizing well operation and improving water returns

SUNCOR ENERGY

Firebag Project

# Firebag Produced Gas

- Sulphur content of produced gas has ranged from 0-1.96 t/day
- Exceeded 1 te/day inlet sulphur for Q1 2005
- Produced gas has not been tied into fuel gas system due to low surface operating pressures - compression is being installed

SUNCOR ENERGY

Firebag Project

# Inlet Sulphur Follow-up

- Suncor has committed to review:
  - The accuracy of monitoring equipment used in the sulphur monitoring program
    - Reviewing installation of on-line $H_2S$ analyzer
  - The adequacy of the overall monitoring approach
    - Full time monitoring data
  - A review of the reservoir processes that lead to sulphur release from the bitumen
    - Reviewing other operator data/discussions with other operators
  - Future requirements for sulphur recovery
    - Offset application submitted May 6, 2005
    - Sulphur recovery likely required at Stage 3

SUNCOR ENERGY

Firebag Project

# Firebag Compliance Issues

- Inlet sulphur exceeded 1 te/day in Q1 2005 – EUB notification April 6, 2005
- Facility operations are in accordance with commitments made within the original facility application (exception, produced gas tie-in)

SUNCOR ENERGY

Firebag Project

# ES-SAGD

- Suncor has installed the facilities required to inject solvent (up to 15% of steam volume)
- Solvent injection occurred for a total of 6 weeks in 2004
- Solvent injection has been limited due to diluent availability
- No conclusions drawn due to the limited injection period and data

SUNCOR ENERGY

Firebag Project

# Heave Monitoring

- Monitoring surveys conducted in March 2003, February 2004 and February 2005
- Surveys done using GPS real-time technology and object monuments
- 42 object monuments installed
- Majority of monuments above Pad 1 and 2 well pairs
- 4 object monuments showed some movement within the accuracy of the measurement technique
- No conclusions can be drawn at this time

SUNCOR ENERGY

Firebag Project

# Blanket Gas and Monitoring System

- Blanket gas to injection wells has been shut off
- Steam injection pressure on injection wells used to monitor casing integrity - steam injection rate increases if failure – none to date
- Blanket gas still in use on operating producing wells except mechanical lift test - electronic pressure detection used for bottom hole monitoring in ML test

SUNCOR ENERGY

Firebag Project

# Co-gen and Expansion Project (C&E)

- Stage 1/2 water and oil treating facilities will be expanded for production of 25,000 bbl/day (3,975 $m^3$/day) bitumen
- Facilities expansion construction began Q1 2005
- EUB Utilities Application for 85 MW co-generation plant, substation modifications and interconnection submitted in Dec. 2004
- Electricity to be used at Firebag and Oil Sands, steam to be used at Firebag for SAGD
- Utilities Approval expected in May 2005
- Co-gen construction scheduled to commence in July 2005

SUNCOR ENERGY

Firebag Project

# Firebag Landfill

- Class II EUB Landfill to dispose of domestic/construction waste and process wastes from water treatment plants
- Received approval in February 2005 (WM 095)
- Construction currently underway with operation scheduled for July 2005

SUNCOR ENERGY

Firebag Project

# Low Pressure SAGD Pilot Project

- Suncor is currently testing the use of low pressure steam injection and artificial lift systems in the SAGD wells
- Primary LP-SAGD Pilot Objectives:
  - Quantify the SOR reduction potential of LP-SAGD; and,
  - Evaluate artificial lift techniques including a multi-phase pump and gas lift.
- 2 wells on mechanical lift (i.e. pumps)
- 2 wells using gas lift

SUNCOR ENERGY

Firebag Project

# LP-SAGD Pilot Project Results

- Gas Lift:
  - stabilizes well production
  - allows operation at reduced reservoir operating pressures
  - lower operating pressures improve water returns
  - does not provide lift at very low operating pressures
- Mechanical Lift:
  - stabilizes well production
  - allows operation at reservoir operating pressures below those possible with gas lift
  - higher water returns
- Not enough data to evaluate SOR improvements

# Future Plans

SUNCOR ENERGY

Firebag Project

# Artificial Lift Installation

- Based on results of pilot, 10 additional pumps on Pads 1/2 wells in late 2005
- Additional gas lift retrofits planned
- Current well design makes mechanical lift best option for Pad 1-4 wells
- Pad 3 & 4 wells will start on natural lift, convert to artificial lift later
- Still evaluating lift options for Pad 5+
- Re-design of wells for new pads may allow for use of other lift options

SUNCOR ENERGY

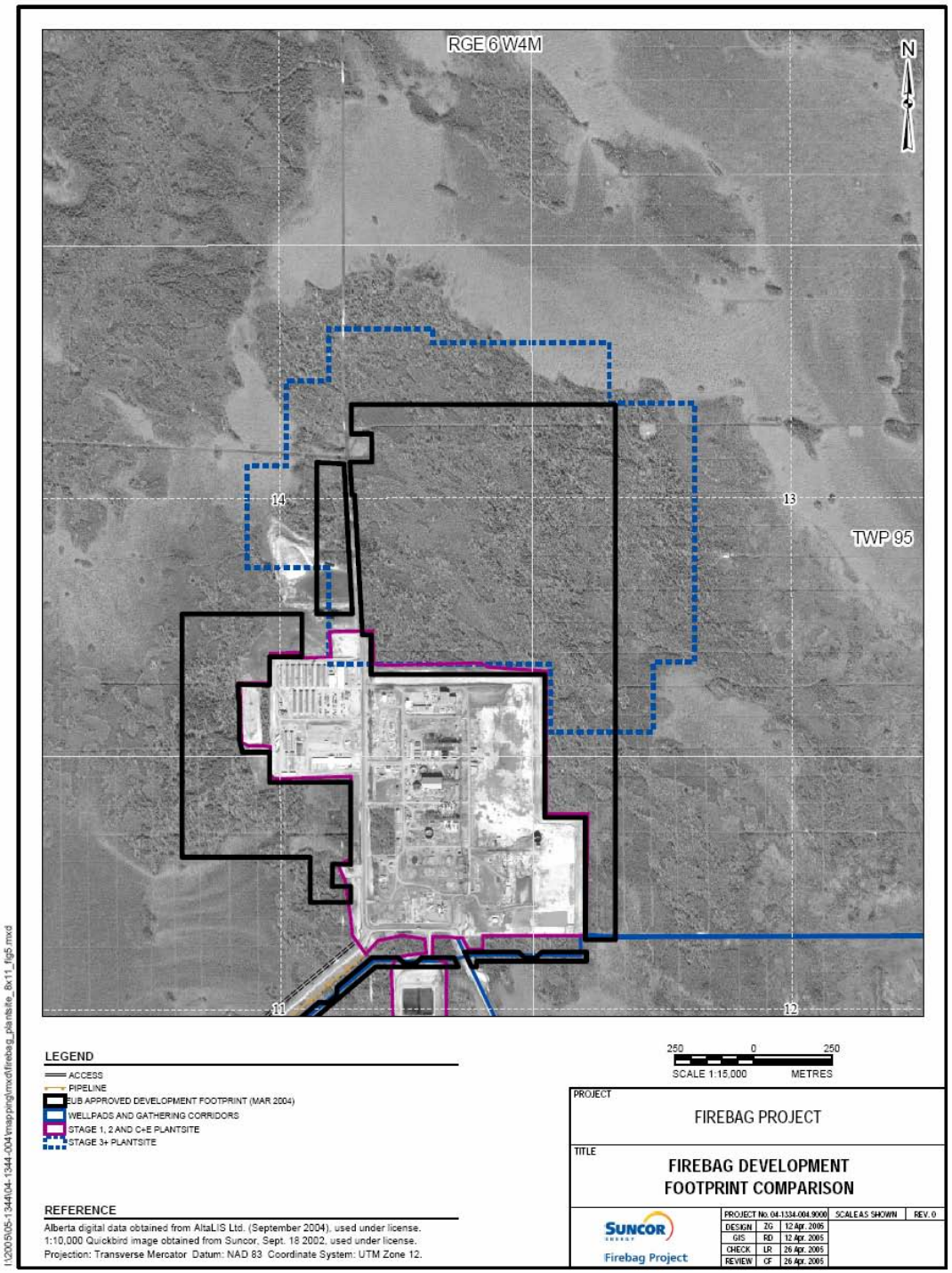
Firebag Project

# Revised Stage 3

- Suncor has elected to increase Stage 3 production to 62,500 BPCD (9930 $m^3$/day) (previously 52,500 BPCD – 8350 $m^3$/day)
- New Stage 3 project will include majority of plantsite and equipment from previous Stage 3 Update Application plus additional footprint area, equipment, production and emissions
- Stage 3 will also include a pre-investment in infrastructure for Stages 4-6

SUNCOR ENERGY

Firebag Project



SUNCOR ENERGY

Firebag Project

# Revised Stage 3 Application

- Application to EUB and AENV will include the following amendment requests:
  - Increase in total production from 140,000 BPCD to 157,500 BPD;
  - Increase in project plantsite footprint and the EUB “Surface Facilities” Area;
  - Addition of two co-generation plants, diluent stripping unit, and sulphur recovery unit; and,
  - Increase in emission limits due to increase in production, added equipment and operational data from Stage 1
- EUB Utilities Application for co-gen plants, substation and transmission lines to be submitted in Q2 2005

SUNCOR ENERGY

Firebag Project

# Pipelines

- Suncor plans to install up to 4 new pipelines in the utility corridor between OS and FB:
  - Make-up water
  - Hot Bitumen
  - Rich Fuel Gas (RFG)
  - Natural Gas
- Transmission line to follow pipelines

SUNCOR ENERGY

Firebag Project

# Stages 4-6

- Firebag will be a key bitumen supply for Suncor's Voyageur project
- Stage 4-6 planning for Firebag is currently underway
- Suncor expects to submit an application for Stages 4+ in early 2006
- Nature of application not yet determined
- Ultimately, Firebag will produce 350,000+ bbl/day (55,645 $m^3$/day) of bitumen for the Oil Sands Upgrader

SUNCOR ENERGY

Firebag Project

# Firebag Regulatory Schedule

| | 2005 | | | | 2006 | | | | 2007 | | | | 2008 | | | | 2009 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| LP-SAGD Pilot | | | | | | | | | | | | | | | | | | | | |
| Cogeneration | | | | | | | | | | | | | | | | | | | | |
| Stage 2 Expansion | | | | | | | | | | | | | | | | | | | | |
| Landfill | | | | | | | | | | | | | | | | | | | | |
| Stage 3 | | | | | | | | | | | | | | | | | | | | |
| Pads 1-4 Mechanical Lift Install | | | | | | | | | | | | | | | | | | | | |
| Pipelines | | | | | | | | | | | | | | | | | | | | |
| Stage 4-6 | | | | | | | | | | | | | | | | | | | | |

Regulatory Process

Construction

Operation