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CNRL Horizon Oil Sands Project

Open Pit Mine Depressurization and Re-Injection Program

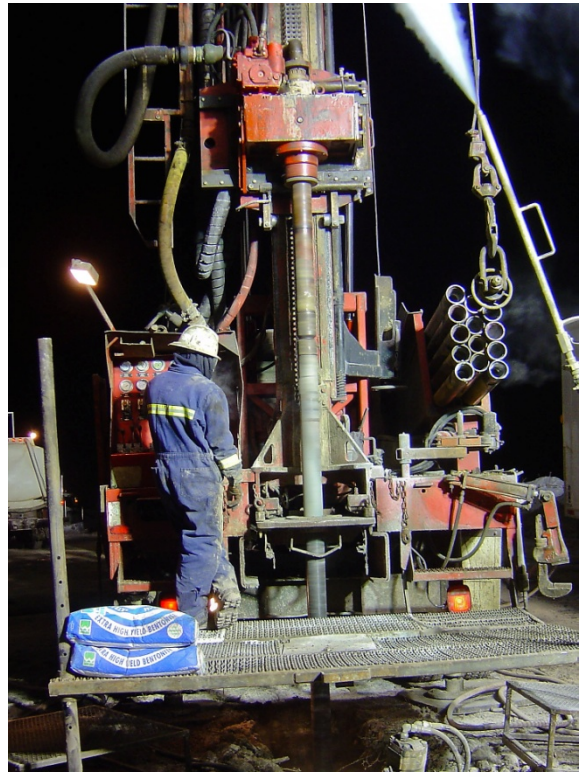
Presented by: Justin Bourne
Burnaby, BC

Canadian Natural

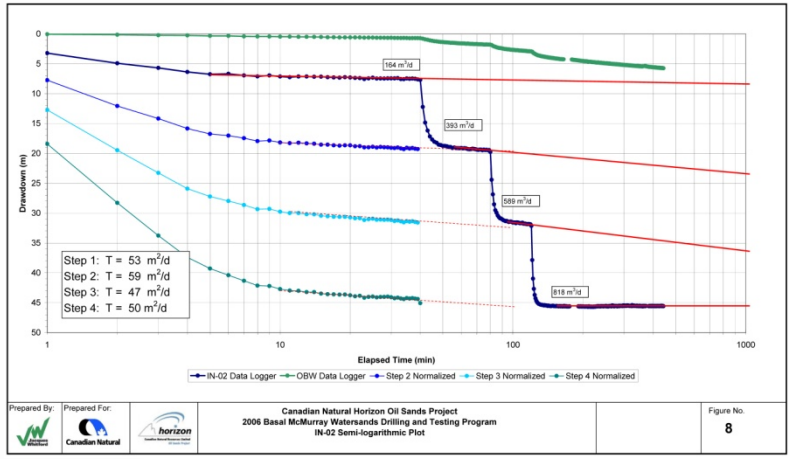
horizon

Jacques Whitford AXYS

Outline



1. Horizon Project Overview
2. PW/OBW Drilling
3. Pump Testing
4. Selected Results
5. Conclusions



Canadian Natural

horizon

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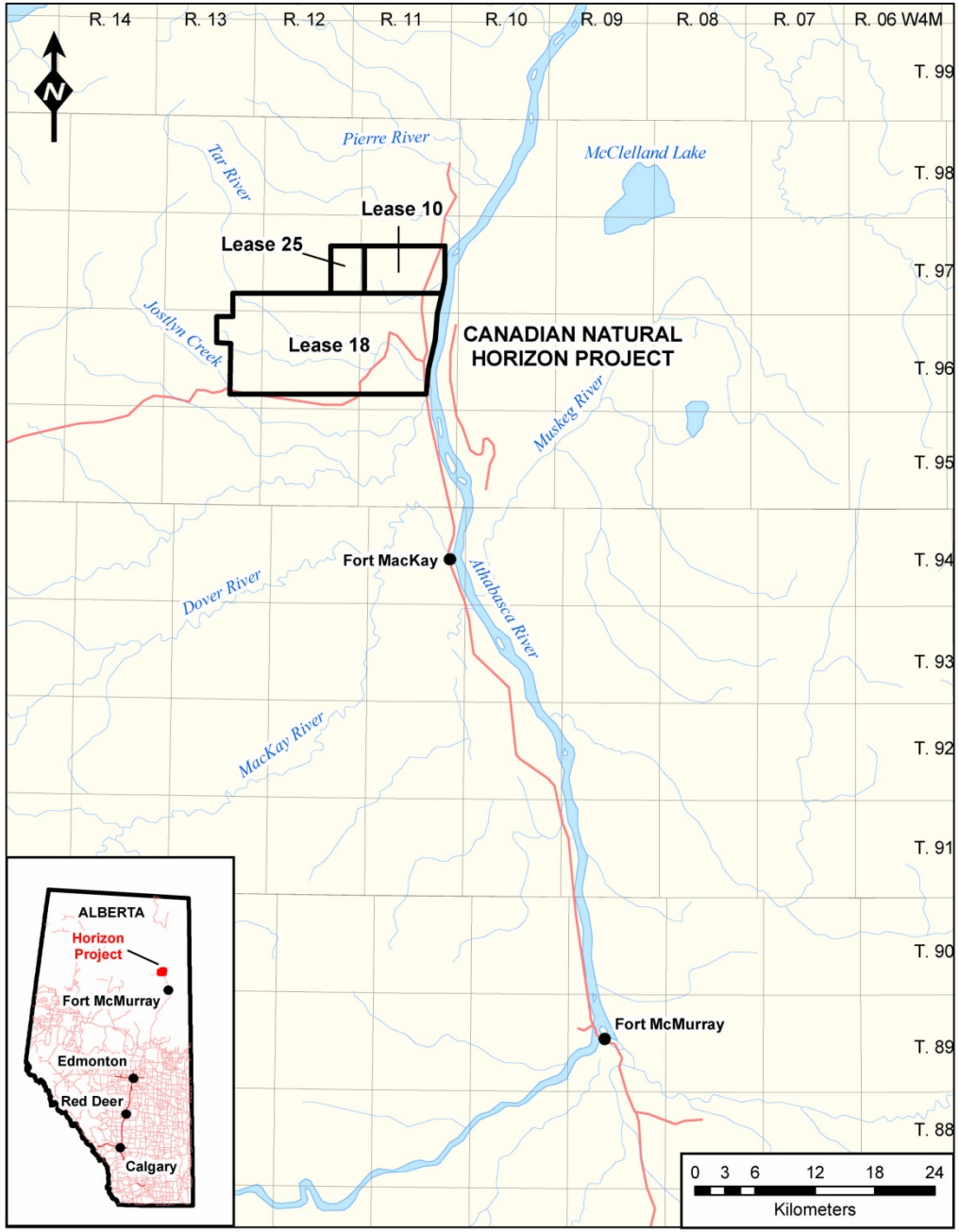

Prepared By:	Prepared For:	Scale: 1: 500,000 Date: 22/03/05 Drawn By: SAR Approved By:	Client: CANADIAN NATURAL HORIZON OILSANDS PROJECT Title: 2006 BASAL McMURRAY WATERSANDS DRILLING AND TESTING PROGRAM **Location Plan**	Reference: Digital Chart of the World 1:1,000,000	Figure No.: **1**

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Canadian Natural

horizon

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Horizon Project Overview

- Open pit oil sands mine
- $11 billion start-up cost
- 16 billion barrels in-place
  - 6 to 8 billion recoverable
- First oil August 2008
- Production 500,000 bbl/d

Canadian Natural

horizon

Jacques Whitford

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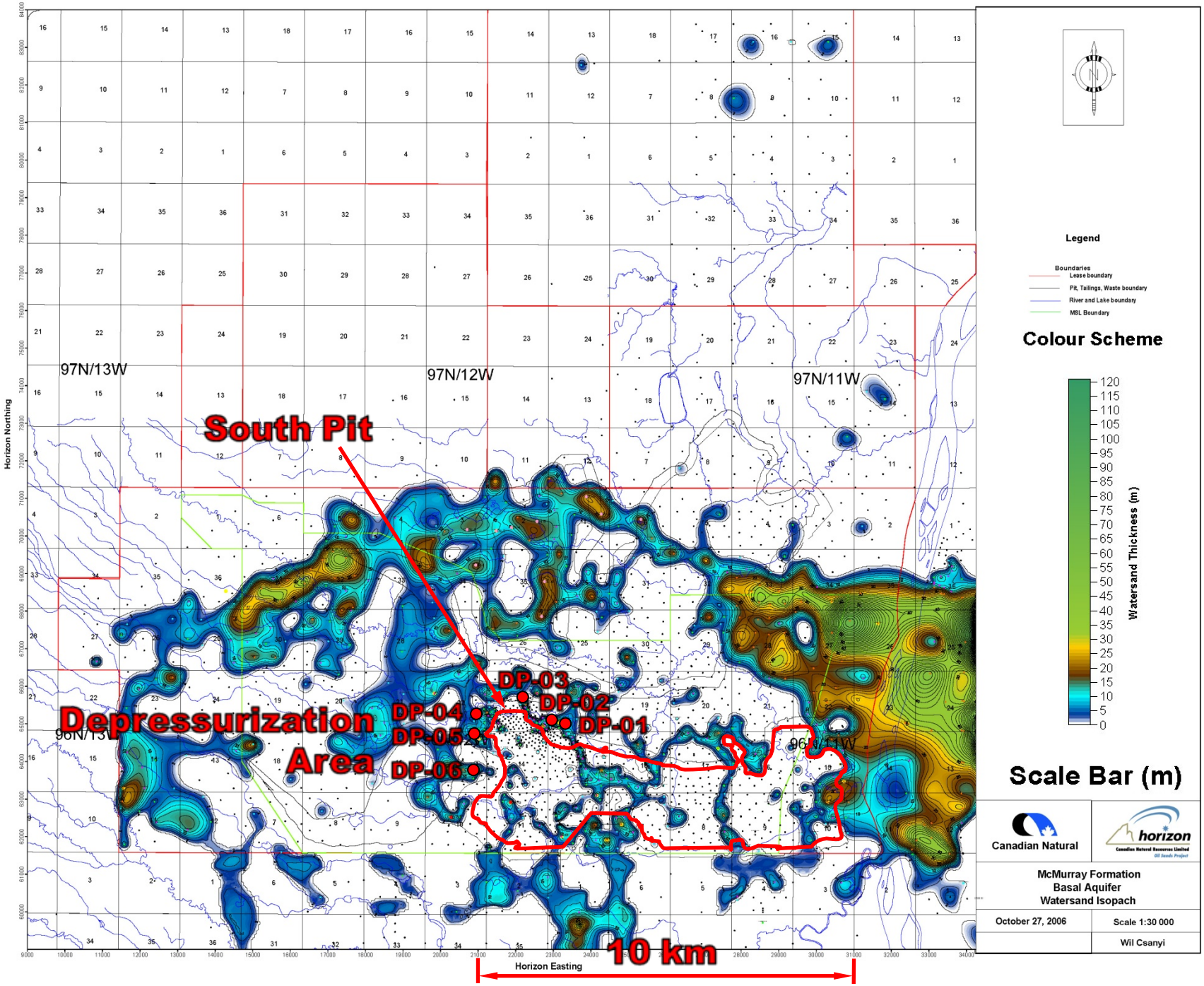
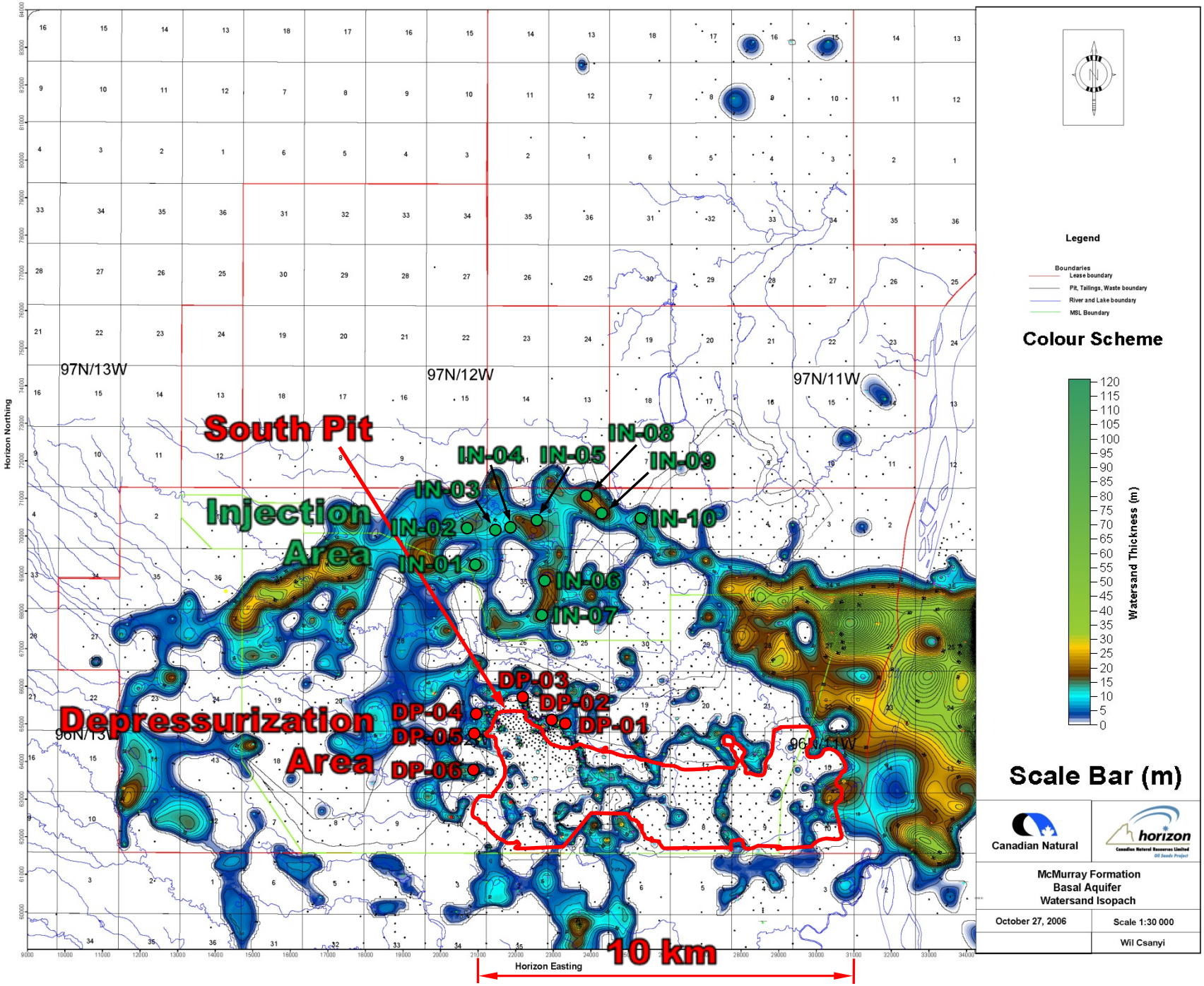
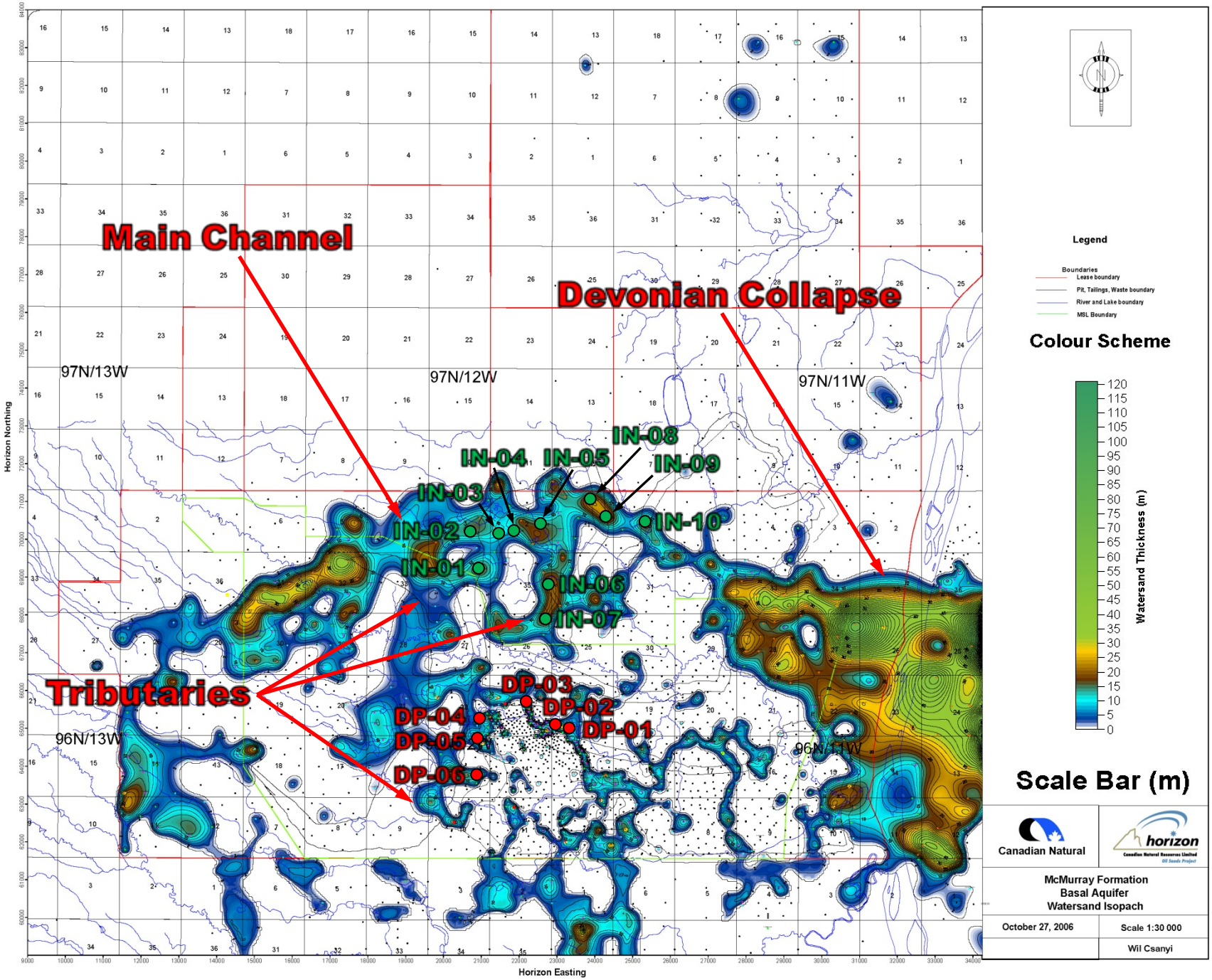

South Pit
Depressurization Area
DP-03
DP-02
DP-01
DP-04
DP-05
DP-06
97N/13W
97N/12W
97N/11W
96N/13W
96N/11W
10 km
Horizon Northing
Horizon Easting
Legend
Boundaries
Lease boundary
Pit, Tailings, Waste boundary
River and Lake boundary
MSL Boundary
Colour Scheme
Watersand Thickness (m)
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Scale Bar (m)
Canadian Natural
horizon
Canadian Natural Resources Limited
Oil Sands Project
McMurray Formation
Basal Aquifer
Watersand Isopach
October 27, 2006
Scale 1:30 000
Wil Csanyi


South Pit
Injection Area
Depressurization Area
IN-01
IN-02
IN-03
IN-04
IN-05
IN-06
IN-07
IN-08
IN-09
IN-10
DP-01
DP-02
DP-03
DP-04
DP-05
DP-06
97N/13W
97N/12W
97N/11W
96N/13W
96N/11W
10 km
Horizon Northing
Horizon Easting
Legend
Boundaries
Lease boundary
Pit, Tailings, Waste boundary
River and Lake boundary
MSL Boundary
Colour Scheme
Watersand Thickness (m)
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Scale Bar (m)
Canadian Natural
horizon
Canadian Natural Resources Limited
Oil Sands Project
McMurray Formation
Basal Aquifer
Watersand Isopach
October 27, 2006
Scale 1:30 000
Wil Csanyi

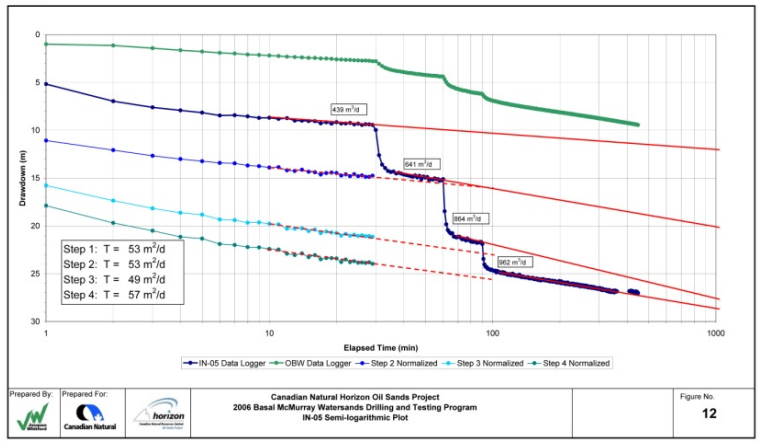
BOILERMAKER
Terroco
Terroco
Terroco
WACKER

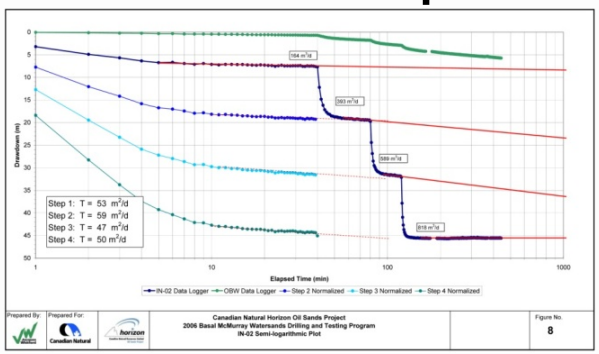
BOILERMAKER

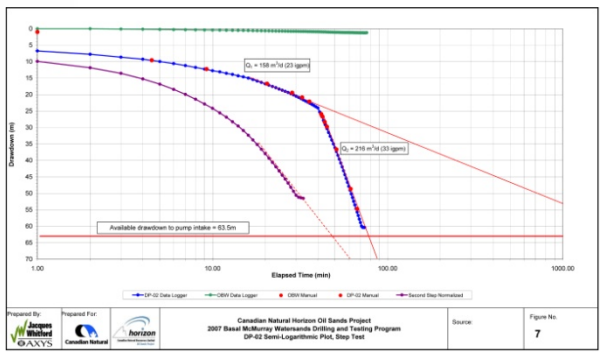

Main Channel
Devonian Collapse
Tributaries
97N/13W
97N/12W
97N/11W
96N/13W
96N/11W
IN-01
IN-02
IN-03
IN-04
IN-05
IN-06
IN-07
IN-08
IN-09
IN-10
DP-01
DP-02
DP-03
DP-04
DP-05
DP-06
Horizon Northing
Horizon Easting
Legend
Boundaries
Lease boundary
Pit, Tailings, Waste boundary
River and Lake boundary
MSL Boundary
Colour Scheme
Watersand Thickness (m)
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Scale Bar (m)
Canadian Natural
horizon
McMurray Formation
Basal Aquifer
Watersand Isopach
October 27, 2006
Scale 1:30 000
Wil Csanyi

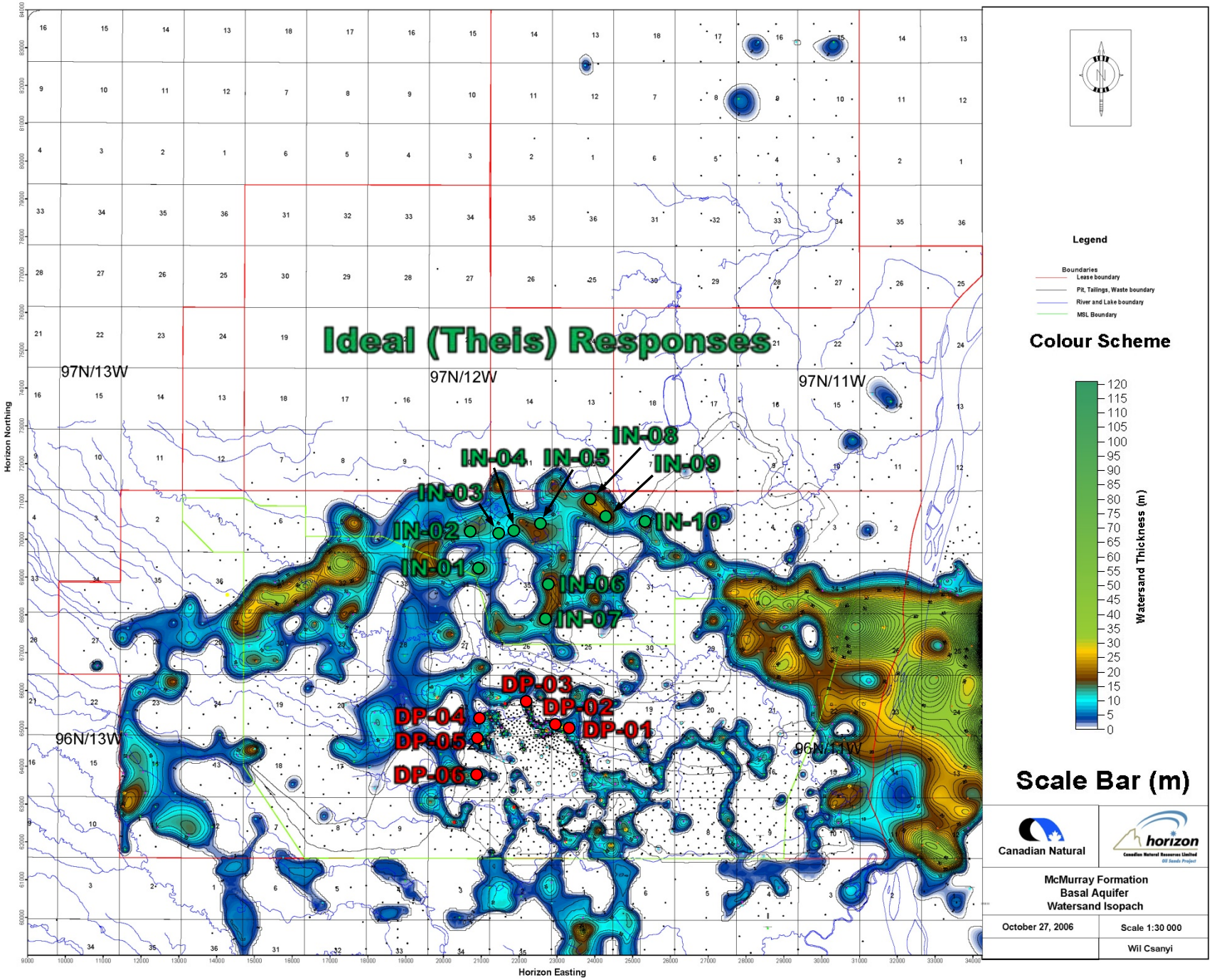
Selected Results

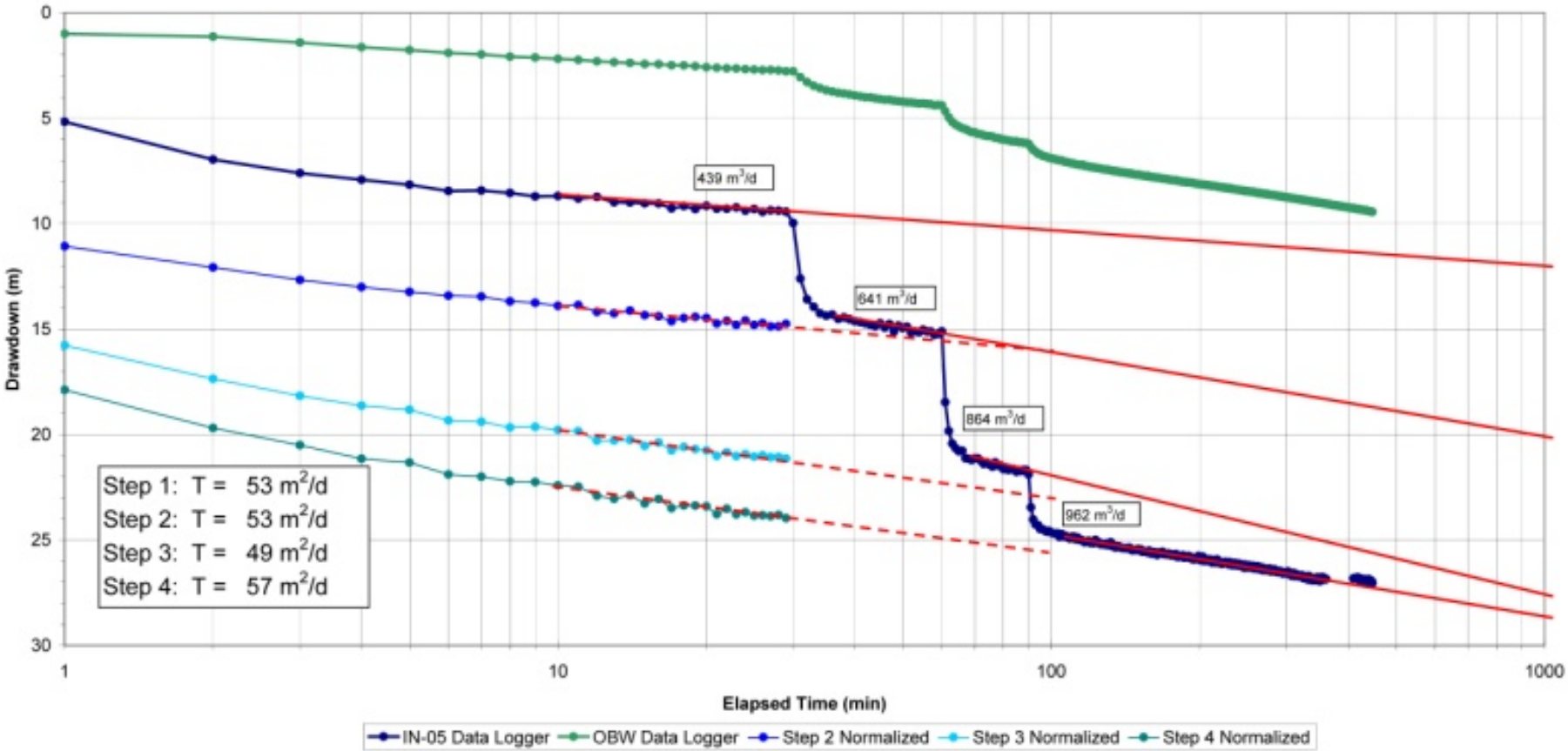
- Observed four types of response:
  - i. Ideal (Theis)
  - ii. Positive
  - iii. Negative
    - a. Physical
    - b. Due to degassing
  - iv. Just plain odd





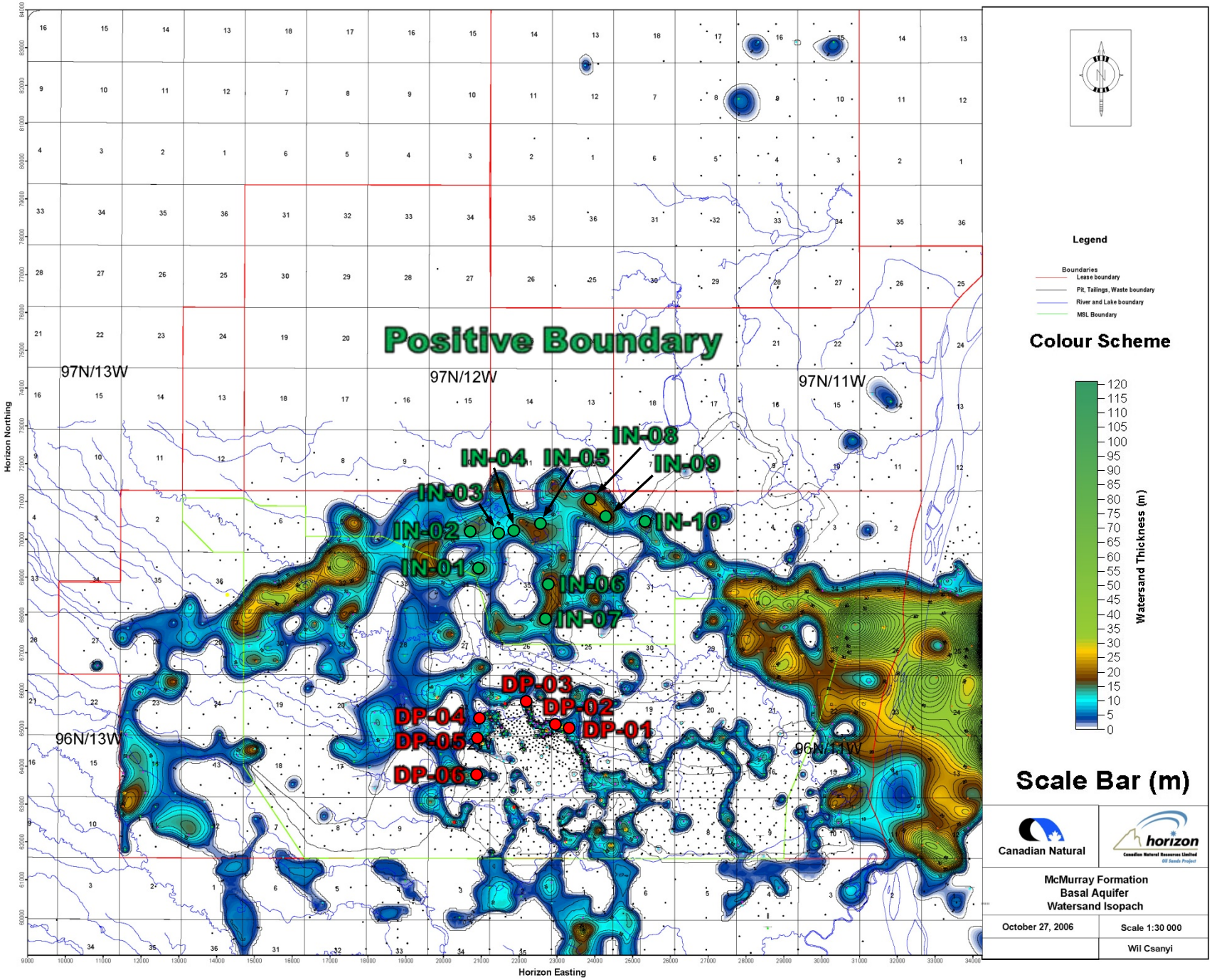


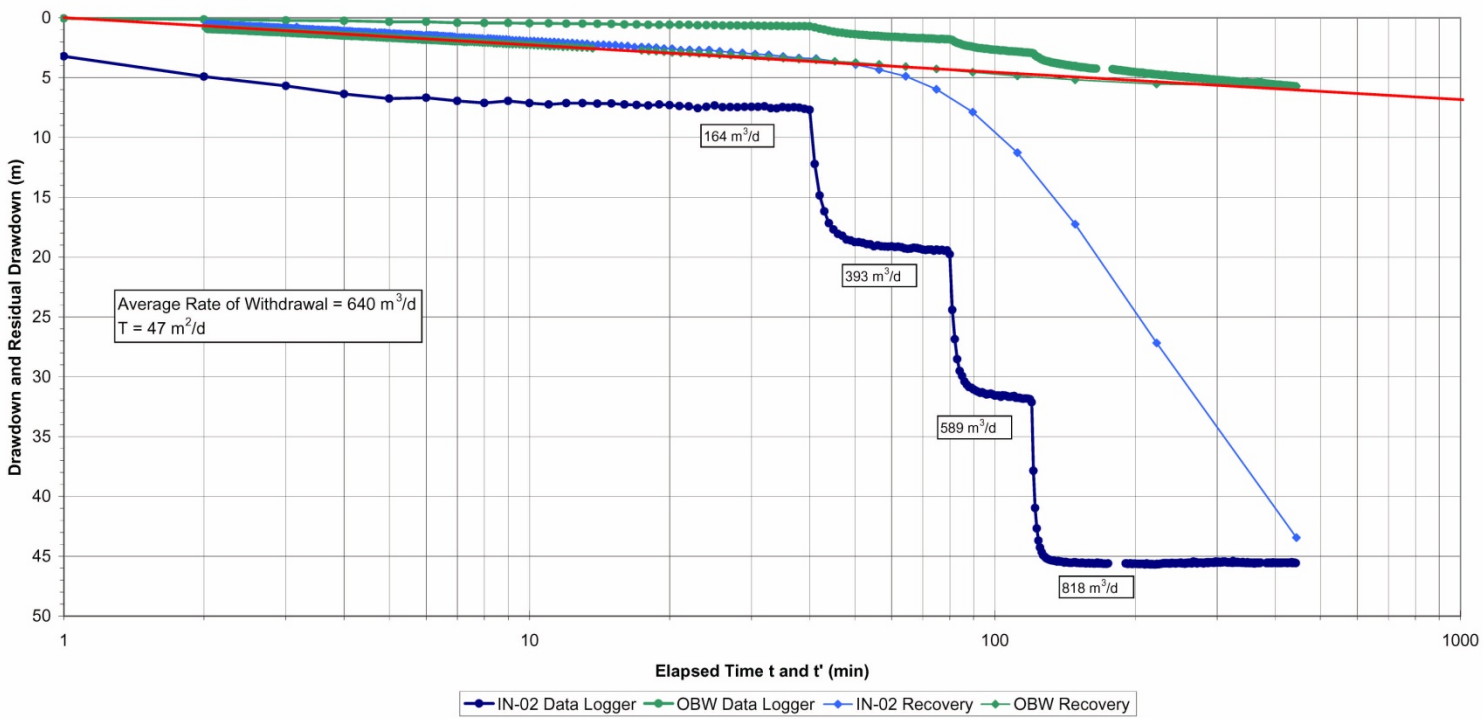

Ideal (Theis) Responses
97N/13W
97N/12W
97N/11W
96N/13W
96N/11W
IN-01
IN-02
IN-03
IN-04
IN-05
IN-06
IN-07
IN-08
IN-09
IN-10
DP-01
DP-02
DP-03
DP-04
DP-05
DP-06
Horizon Northing
Horizon Easting
Legend
Boundaries
Lease boundary
Pit, Tailings, Waste boundary
River and Lake boundary
MSL Boundary
Colour Scheme
Watersand Thickness (m)
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Scale Bar (m)
Canadian Natural
horizon
Canadian Natural Resources Limited
Oil Sands Project
McMurray Formation
Basal Aquifer
Watersand Isopach
October 27, 2006
Scale 1:30 000
Wil Csanyi



Prepared By:	Prepared For:				Figure No.
Jacques Whitford	Canadian Natural	horizon	**Canadian Natural Horizon Oil Sands Project** **2006 Basal McMurray Watersands Drilling and Testing Program** **IN-05 Semi-logarithmic Plot**		**12**

Jacques Whitford AXYS


Positive Boundary
97N/13W
97N/12W
97N/11W
96N/13W
96N/11W
IN-01
IN-02
IN-03
IN-04
IN-05
IN-06
IN-07
IN-08
IN-09
IN-10
DP-01
DP-02
DP-03
DP-04
DP-05
DP-06
Horizon Northing
Horizon Easting
Legend
Boundaries
Lease boundary
Pit, Tailings, Waste boundary
River and Lake boundary
MSL Boundary
Colour Scheme
Watersand Thickness (m)
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Scale Bar (m)
Canadian Natural
horizon
Canadian Natural Resources Limited
Oil Sands Project
McMurray Formation
Basal Aquifer
Watersand Isopach
October 27, 2006
Scale 1:30 000
Wil Csanyi

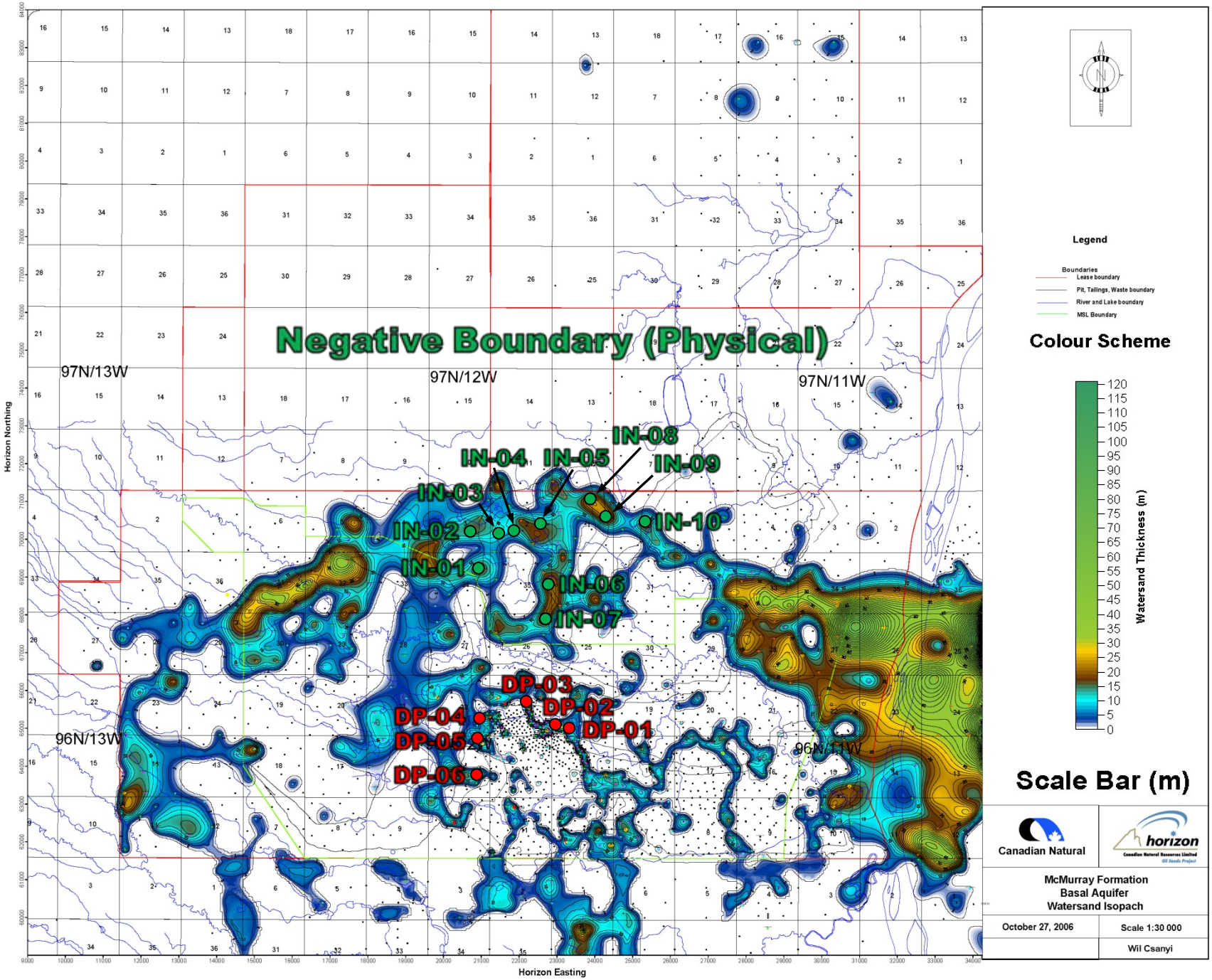


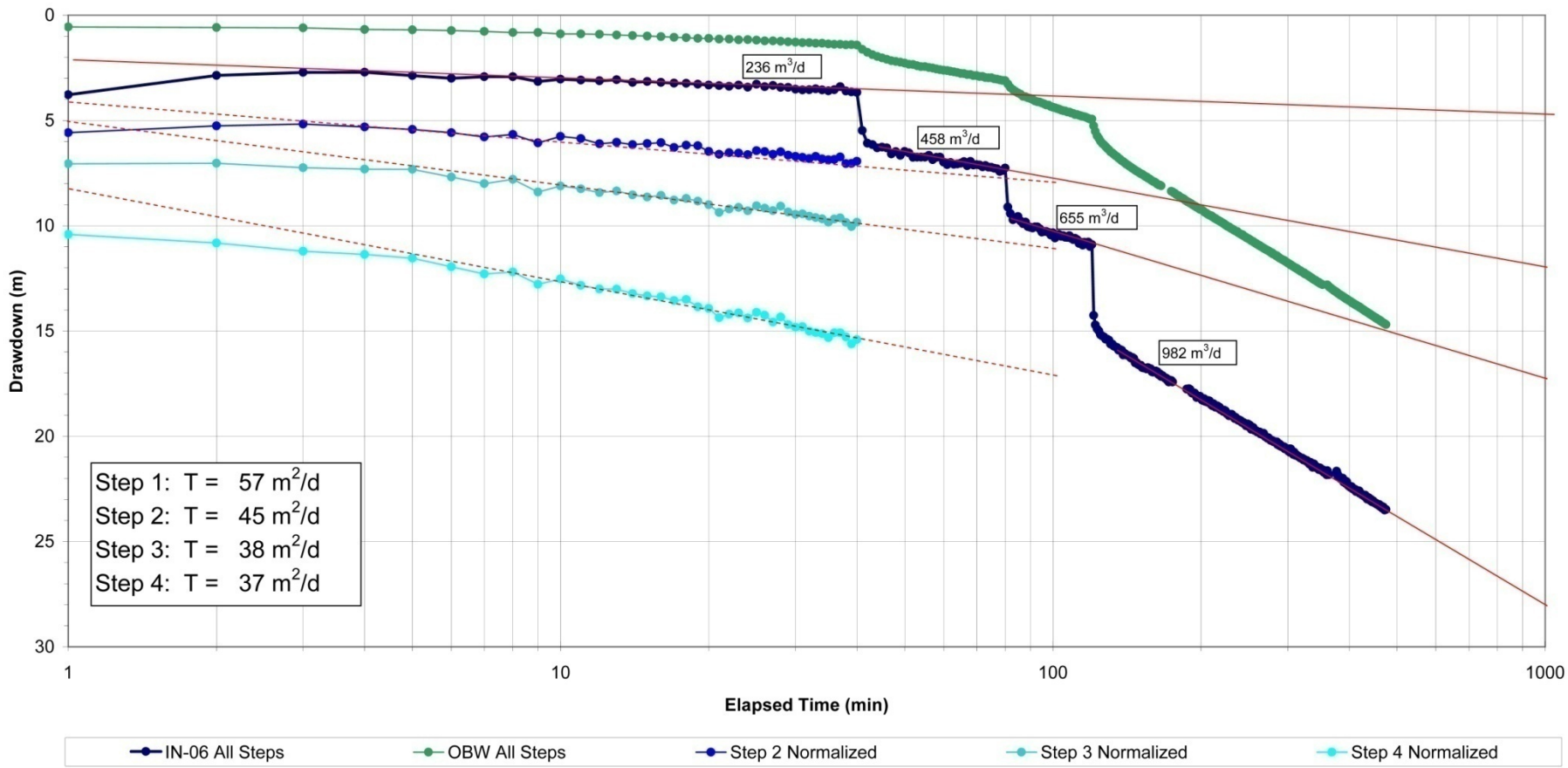
Prepared By:	Prepared For:				Figure No.
Jacques Whitford	Canadian Natural	horizon	**Canadian Natural Horizon Oil Sands Project** **2006 Basal McMurray Watersands Drilling and Testing Program** **IN-02 Recovery Plot**		**9**

IN-02_Normalized.xls

8/25/2006

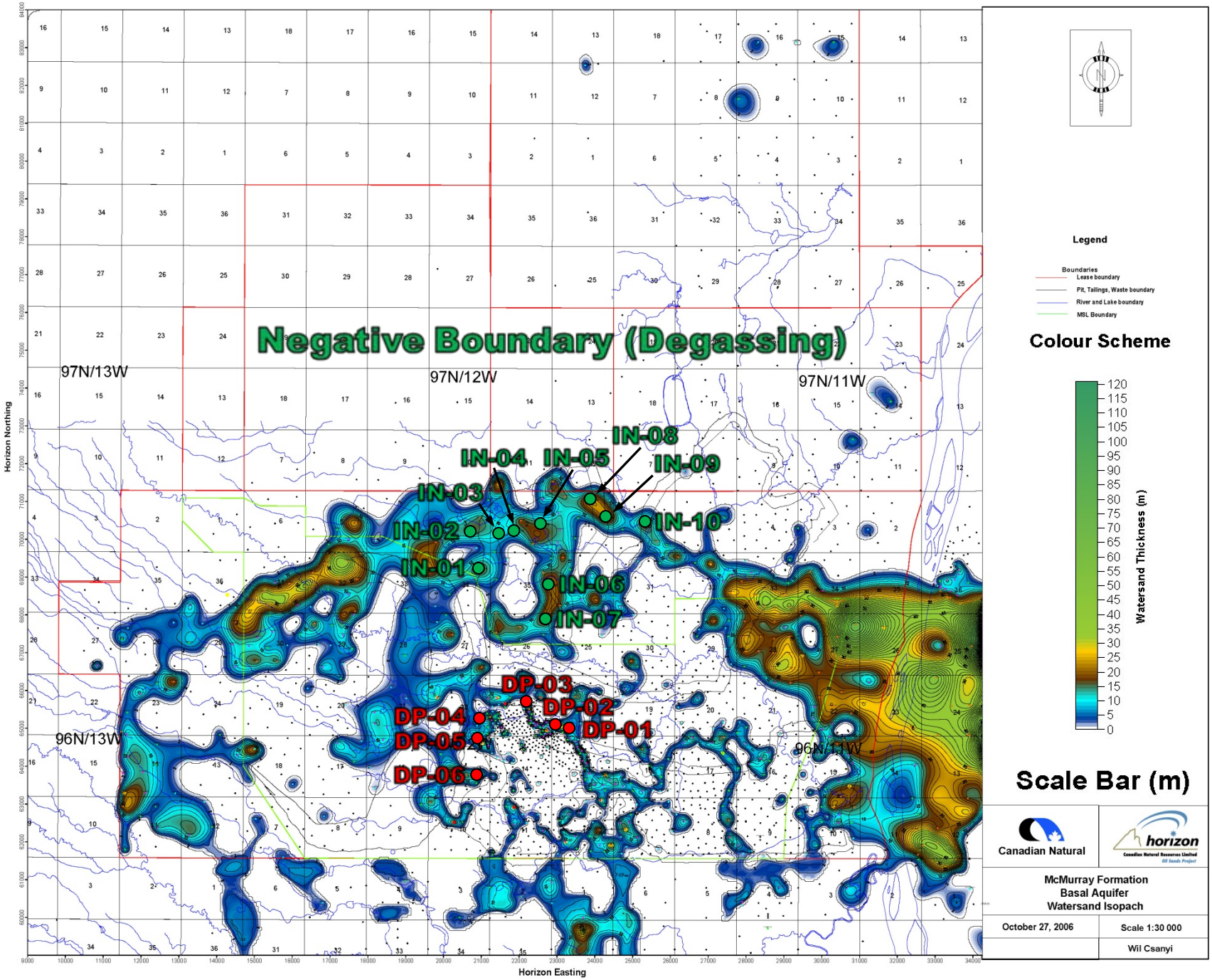
Jacques Whitford AXYS

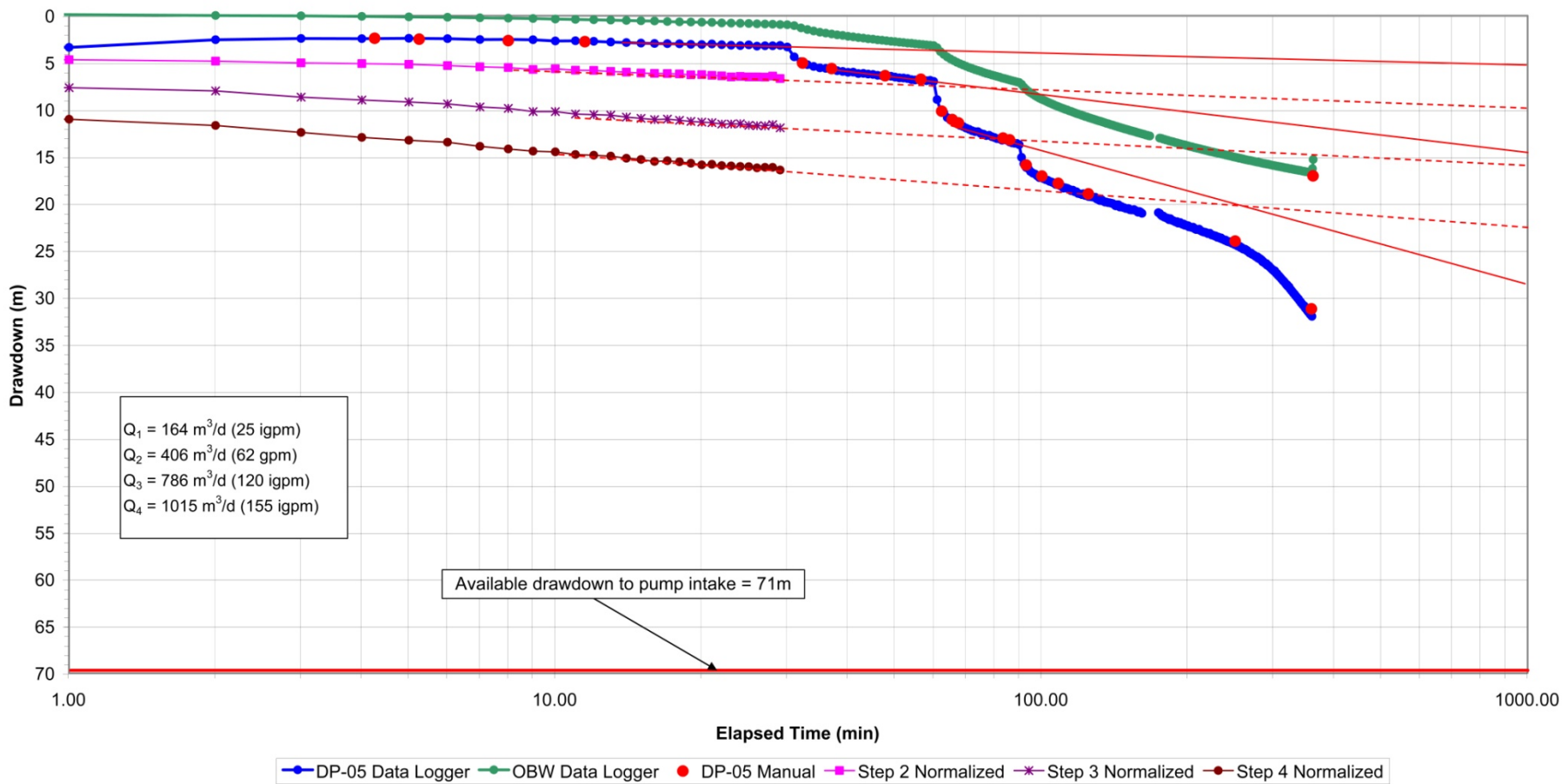

Negative Boundary (Physical)
97N/13W
97N/12W
97N/11W
96N/13W
96N/11W
IN-01
IN-02
IN-03
IN-04
IN-05
IN-06
IN-07
IN-08
IN-09
IN-10
DP-01
DP-02
DP-03
DP-04
DP-05
DP-06
Horizon Northing
Horizon Easting
Legend
Boundaries
Lease boundary
Pit, Tailings, Waste boundary
River and Lake boundary
MSL Boundary
Colour Scheme
Watersand Thickness (m)
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Scale Bar (m)
Canadian Natural
horizon
Canadian Natural Resources Limited
Oil Sands Project
McMurray Formation
Basal Aquifer
Watersand Isopach
October 27, 2006
Scale 1:30 000
Wil Csanyi



Prepared By:	Prepared For:			
Jacques Whitford	Canadian Natural	horizon	**Canadian Natural Horizon Oil Sands Project** **2006 Basal McMurray Watersands Drilling and Testing Program** **IN-06 Semi-logarithmic Plot**	Figure No. **16**

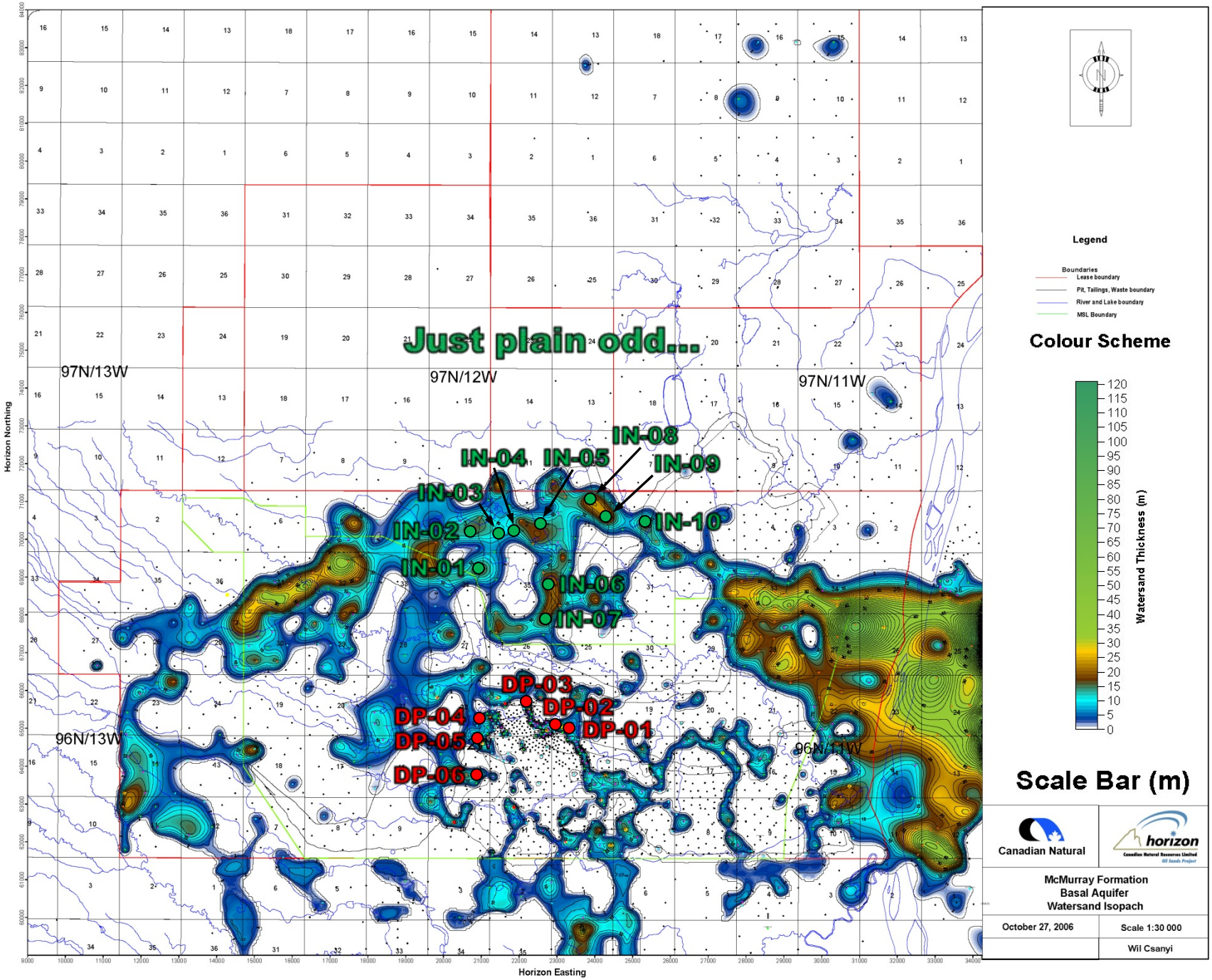
Jacques Whitford AXYS

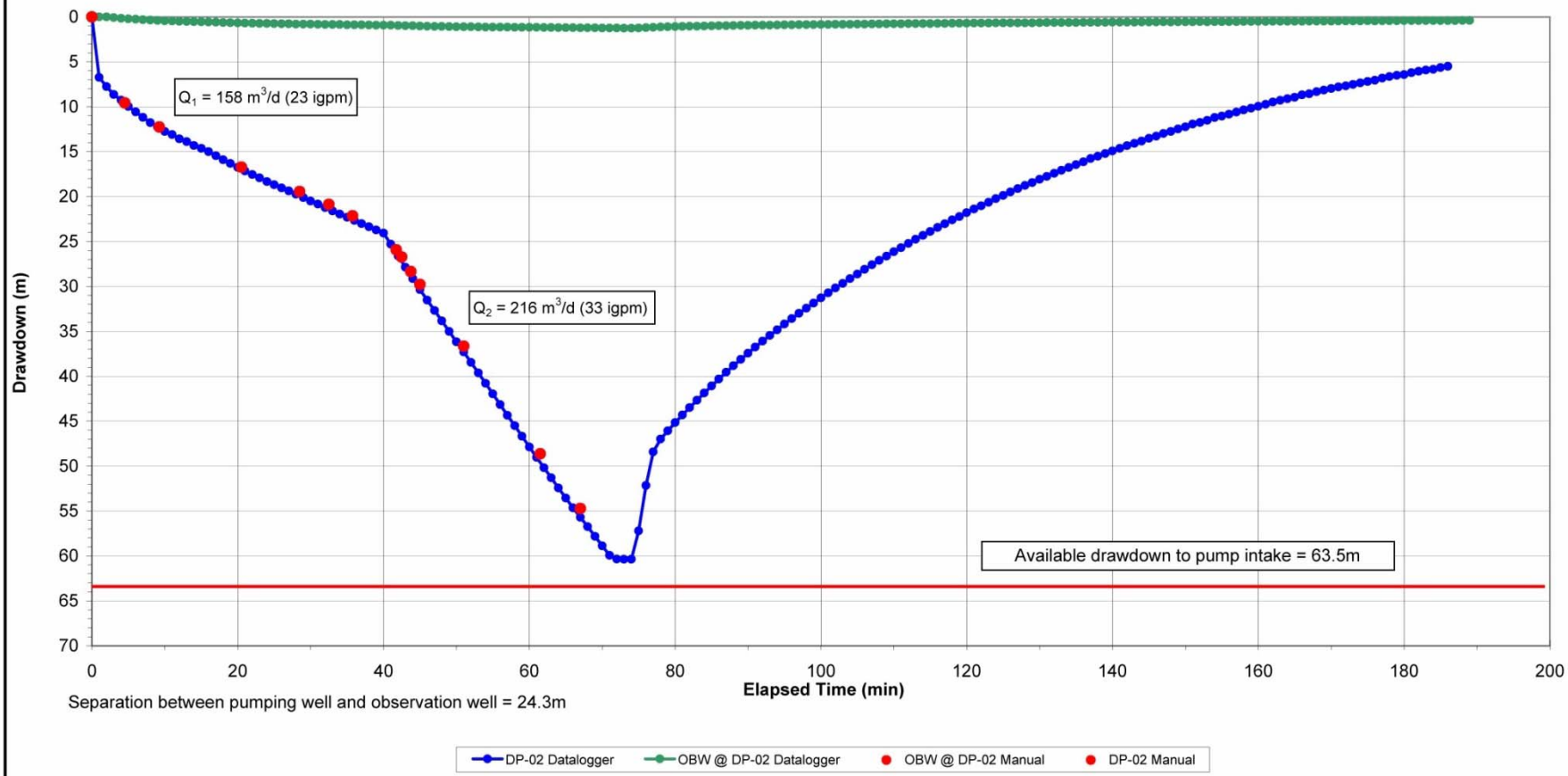

Negative Boundary (Degassing)
97N/13W
97N/12W
97N/11W
96N/13W
96N/11W
IN-01
IN-02
IN-03
IN-04
IN-05
IN-06
IN-07
IN-08
IN-09
IN-10
DP-01
DP-02
DP-03
DP-04
DP-05
DP-06
Horizon Northing
Horizon Easting
Legend
Boundaries
Lease boundary
Pit, Tailings, Waste boundary
River and Lake boundary
MSL Boundary
Colour Scheme
Watersand Thickness (m)
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Scale Bar (m)
Canadian Natural
horizon
Canadian Natural Resources Limited
Oil Sands Project
McMurray Formation
Basal Aquifer
Watersand Isopach
October 27, 2006
Scale 1:30 000
Wil Csanyi



Prepared By:	Prepared For:			Source:	Figure No.
Jacques Whitford AXYS	Canadian Natural	horizon	**Canadian Natural Horizon Oil Sands Project** **2007 Basal McMurray Watersands Drilling and Testing Program** **DP-05 Semi-Logarithmic Plot**		**24**

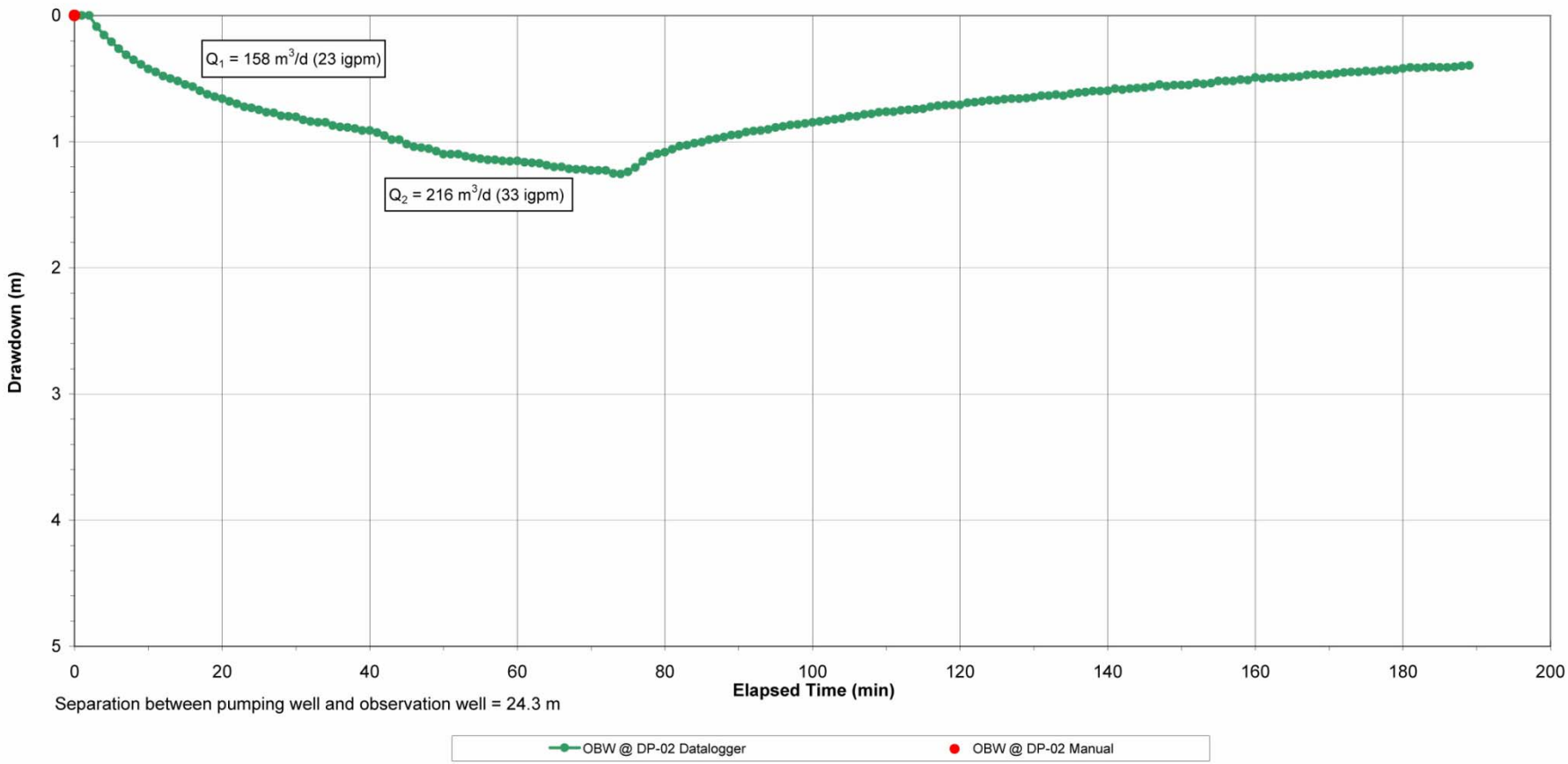
Jacques Whitford AXYS


Just plain odd...
97N/13W
97N/12W
97N/11W
96N/13W
96N/11W
IN-01
IN-02
IN-03
IN-04
IN-05
IN-06
IN-07
IN-08
IN-09
IN-10
DP-01
DP-02
DP-03
DP-04
DP-05
DP-06
Horizon Northing
Horizon Easting
Legend
Boundaries
Lease boundary
Pit, Tailings, Waste boundary
River and Lake boundary
MSL Boundary
Colour Scheme
Watersand Thickness (m)
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Scale Bar (m)
Canadian Natural
horizon
McMurray Formation
Basal Aquifer
Watersand Isopach
October 27, 2006
Scale 1:30 000
Wil Csanyi



Prepared By:	Prepared For:				Figure No.
Jacques Whitford AXYS	Canadian Natural	horizon	**Canadian Natural Horizon Oil Sands Project** **2007 Basal McMurray Watersands Drilling and Testing Program** **DP-02 Arithmetic Plot**		**6**

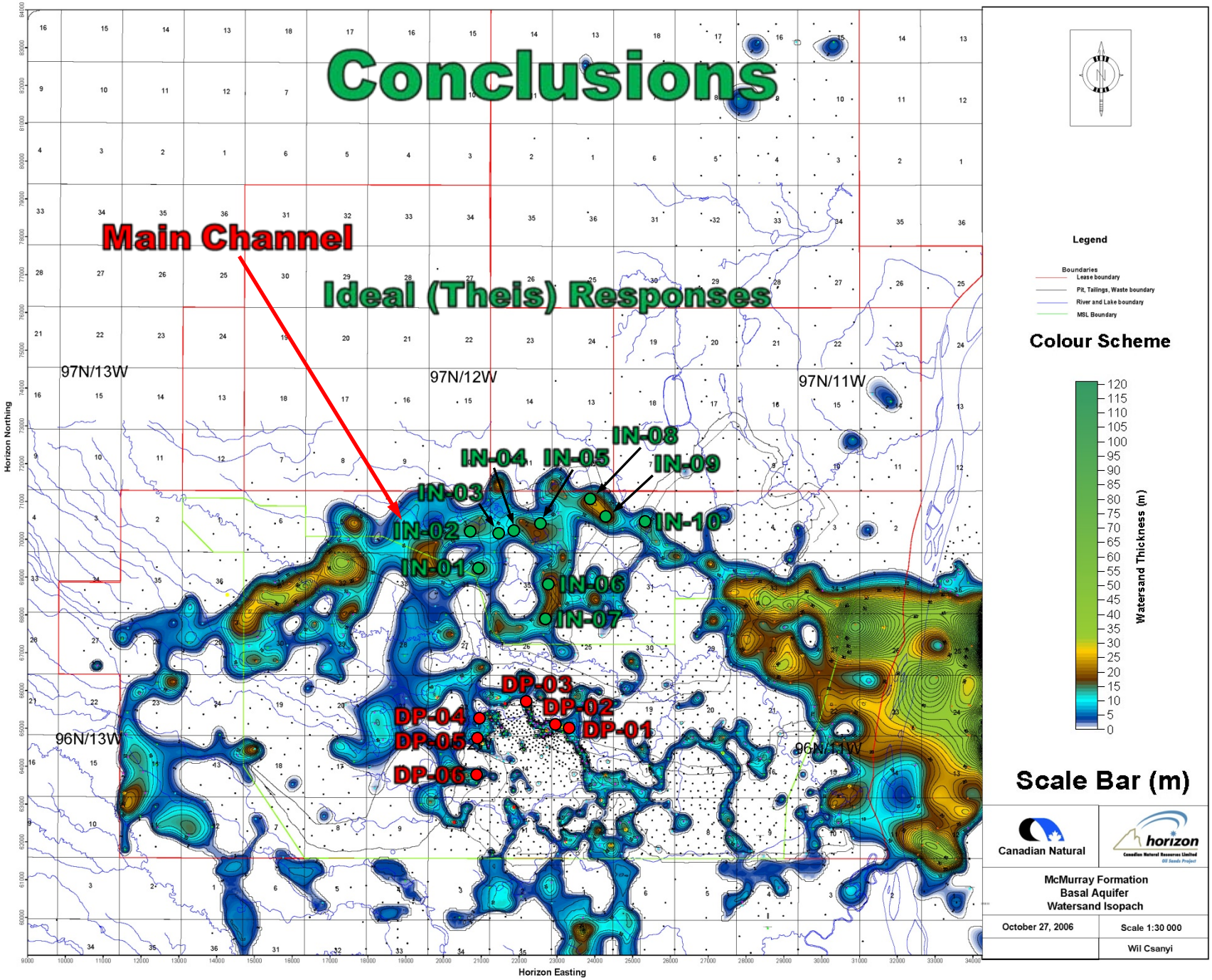
Jacques Whitford AXYS



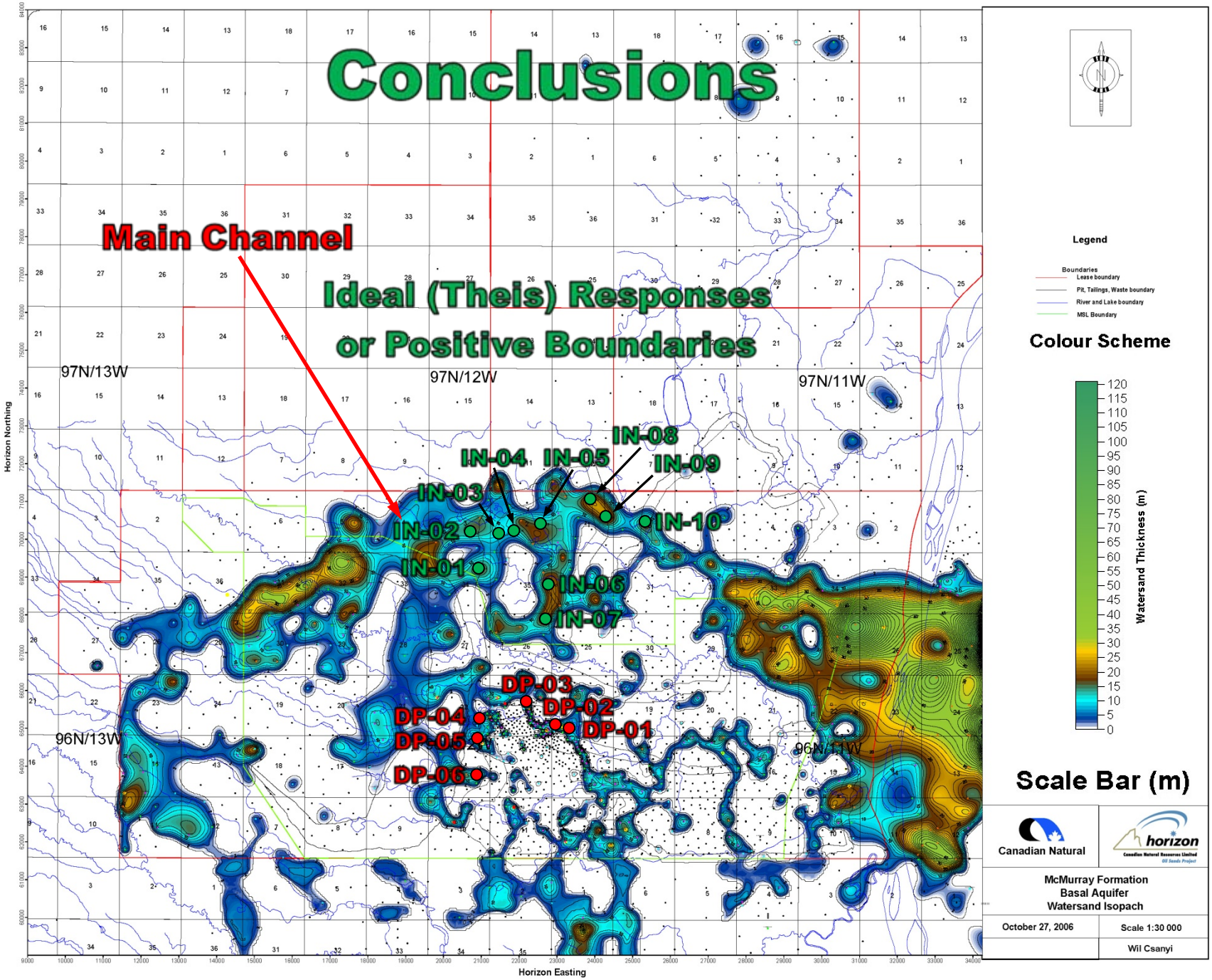
Prepared By:	Prepared For:				Figure No.
Jacques Whitford AXYS	Canadian Natural	horizon	**Canadian Natural Horizon Oil Sands Project** **2007 Basal McMurray Watersands Drilling and Testing Program** **OBW 4-24 Arithmetic Plot**		**8**

Jacques Whitford AXYS

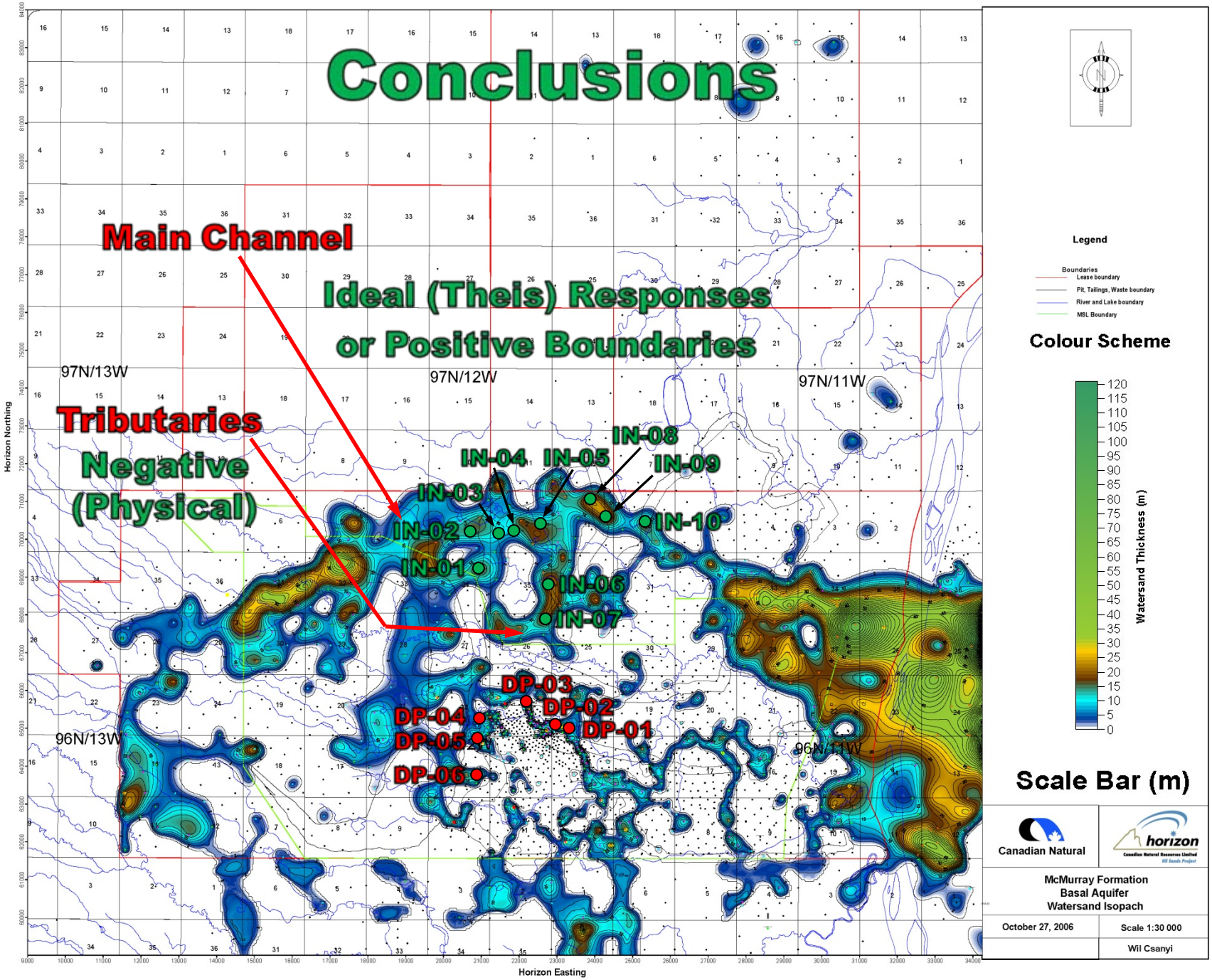
Conclusions



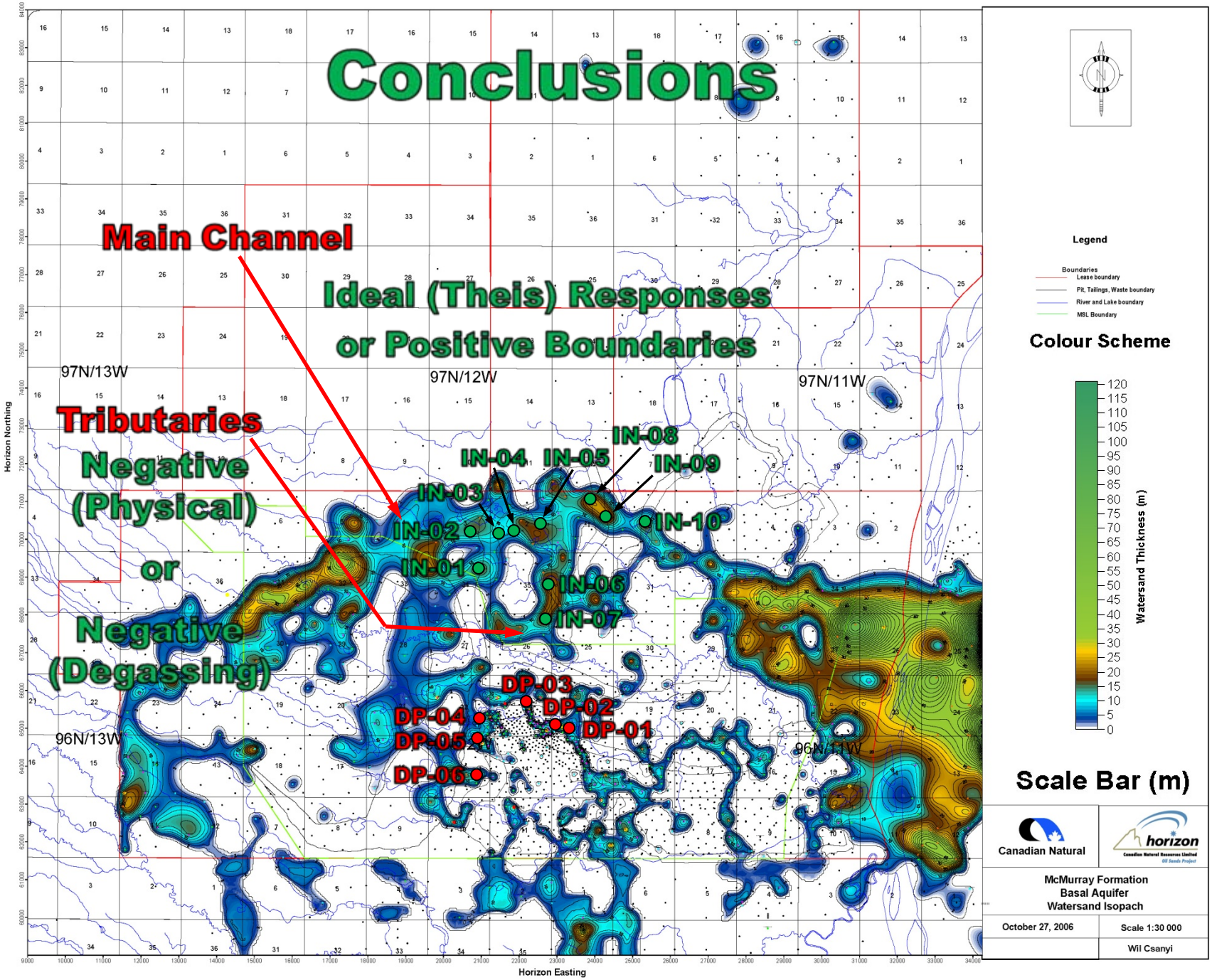
Conclusions



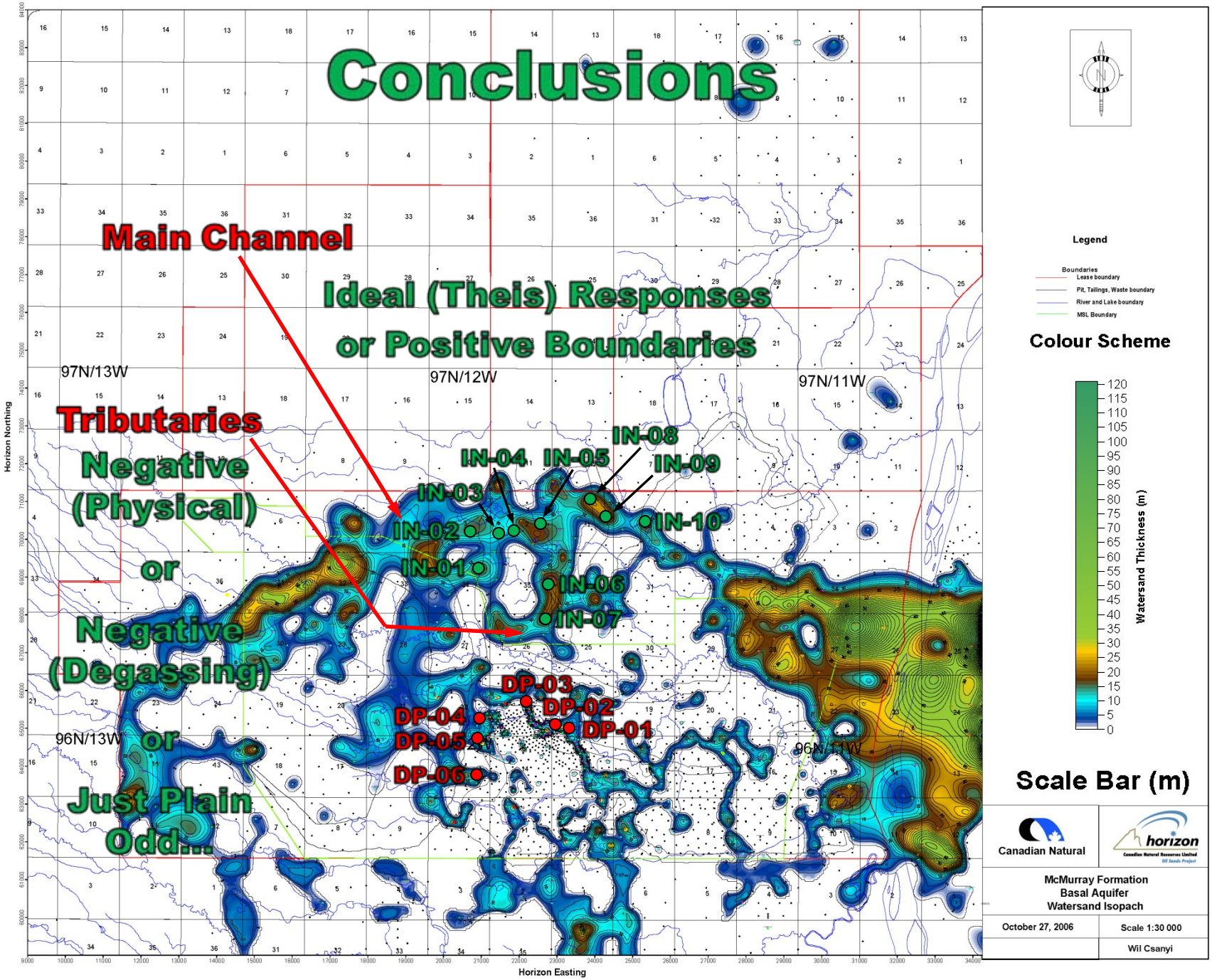
Conclusions



Conclusions



Conclusions



Questions?