



Solving Regulatory Requirements by Integrating GIS and Complex Data Models



Agenda

- Oil Sands Regulatory Requirements
- Data Availability
- Combining Data



Oil Sands Tenure Regulation, 2010

With amendments up to and including Alberta Regulation 89/2013

- 36 pages

Mines and Minerals Act

OIL SANDS TENURE REGULATION, 2010

Table of Contents

- 1 Interpretation
- 2 Designation as producing and non-producing
- 3 Minimum level of evaluation

Part 1 Oil Sands Agreements

- 4 Rights conveyed



Minimum level of evaluation (section 2)

- a) the drilling of at least one evaluation well in each section and parts of sections referred to in the application,
- b) the evaluation wells being located in a pattern that, in the opinion of the Minister, is sufficiently even and uniform, and
- c) obtaining data from the oil sands zone or zones from evaluation wells from at least 25% of the sections or parts of sections on which at least one evaluation well is located by coring through each of the oil sands zones, in their entirety, within the locations of those evaluation wells and submitting that data to the Department.



MLE and Public Data

- Does the regulator agree that MLE has been met?
- Are there leases in my area that may be surrendered because they don't meet MLE?



Confirming MLE





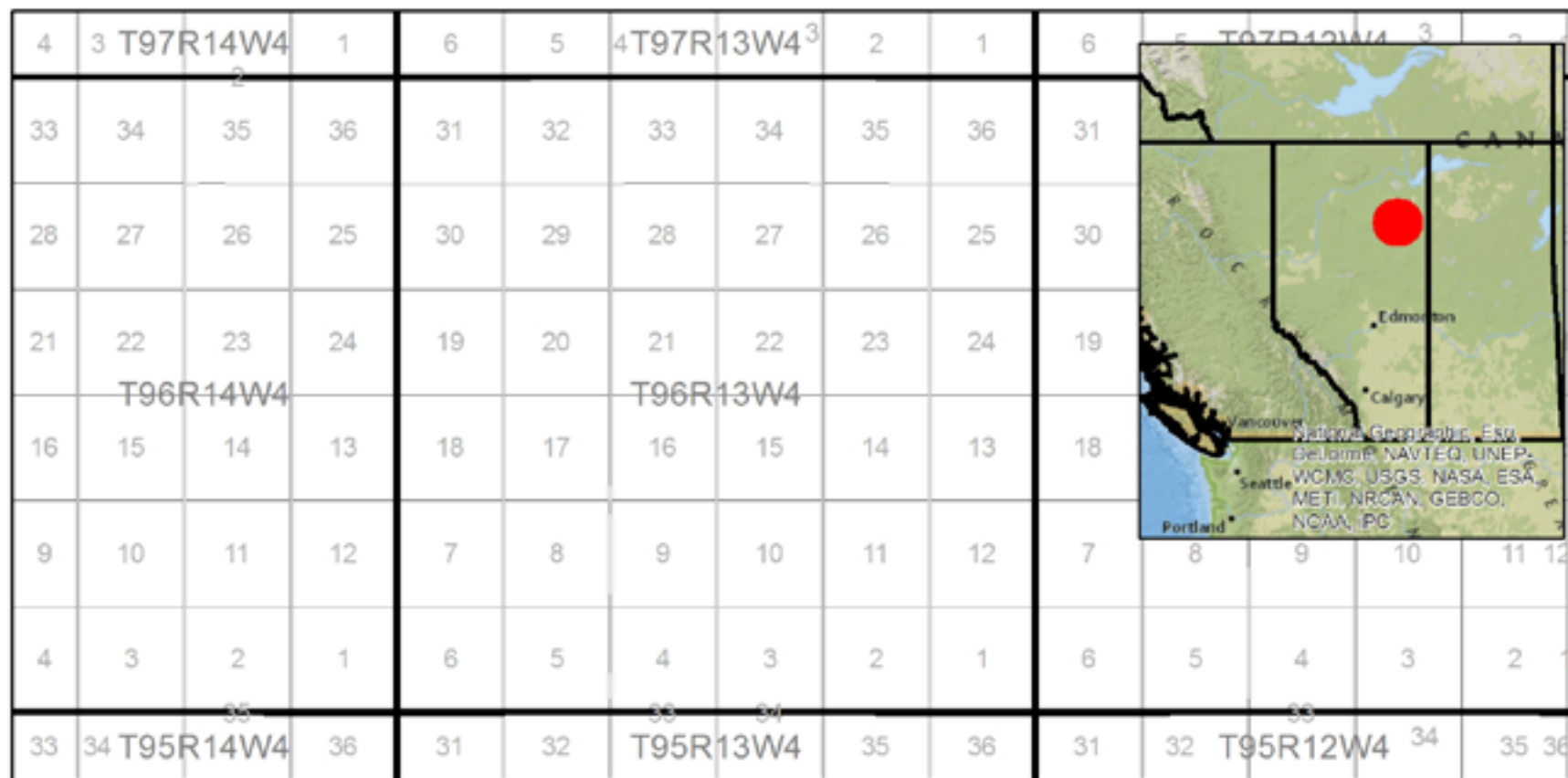
Digital Data Availability

- Identify the data required to confirm MLE
 - Grid data “in each section and parts of sections”
 - Well data “drilling of at least one evaluation well”
 - Cores “well is located by coring”
 - Formations “through each of the oil sands zones”
 - Land leases



Grid Data

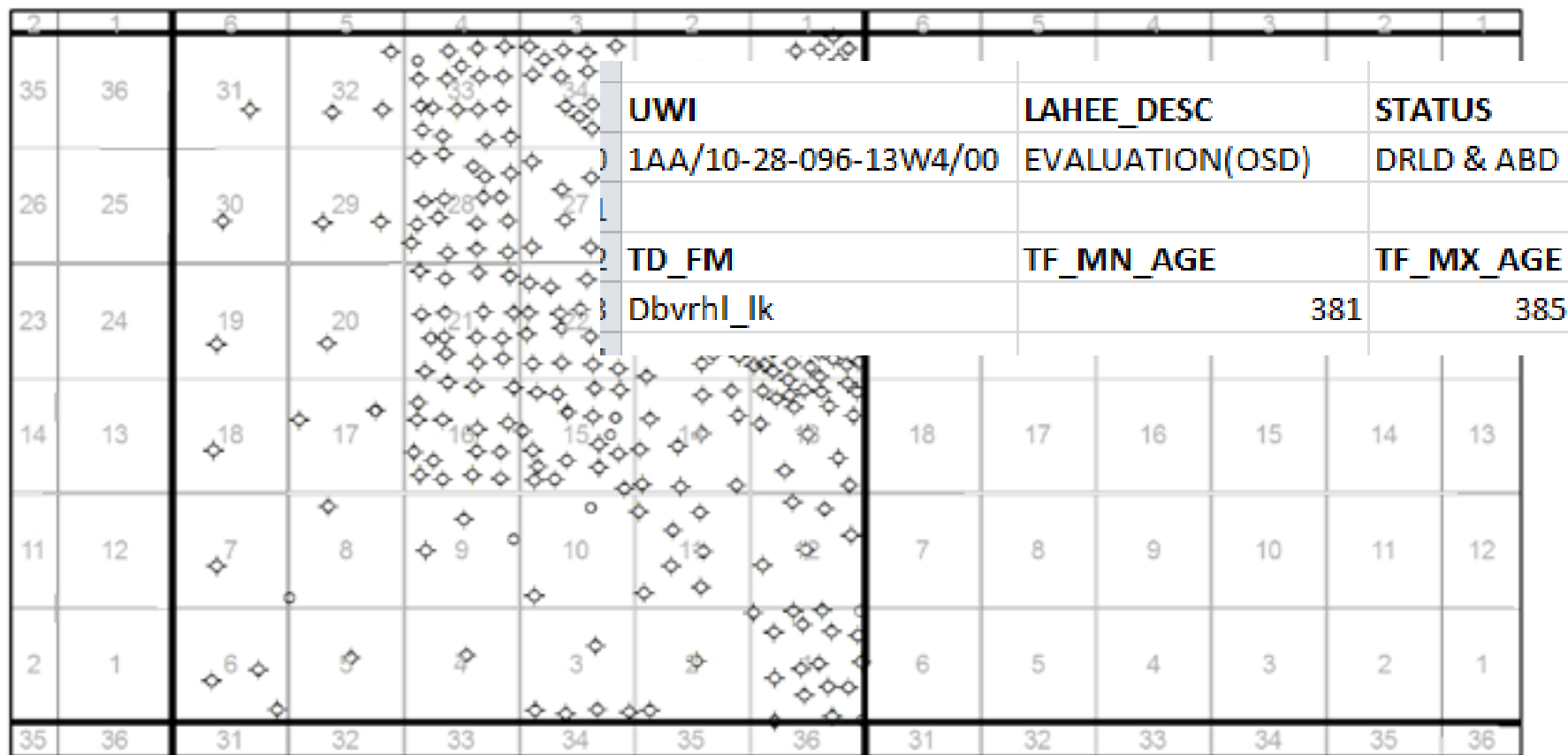
- PPDM
 - Not available
- Spatial Data
 - Full polygons and attributes





Well data

- PPDM
 - Licenses
 - Drilled wells
 - Formation @ TD
- Spatial Data
 - Well locations and attributes





Cores

- PPDM
 - Individual cored intervals
 - Many intervals to a single well
- Spatial Data
 - Data available indicator



```
select reported_core_num, top_depth, base_depth, recovered_amount  
from well_core wc, well w  
where w.gsl_uwi = '1AA102809613W400'  
and w.uwi = wc.uwi  
order by reported_core_num;
```

	REPORTED_CORE_NUM	TOP_DEPTH	BASE_DEPTH	RECOVERED_AMOUNT
1	001	164.5	165.6	1.1
2	002	165.6	168.9	2.6
3	003	168.9	171.4	1.0
33	033	247.5	250.5	2.6
34	034	250.5	251.5	1



Formations

- PPDM
 - Picked Tops
 - Many tops to a single well
 - Formation ages (approx. millions of years)
- Spatial Data
 - Some pre-calculated fields based on ages and tops
(ie. TD_FM, TF_MX_AGE)



```
select su.description, sws.pick_depth, sua.min_age, sua.max_age
from strat_well_section sws, strat_unit su, strat_unit_age sua, well w
where w.gsl_uwi = '1AA102809613W400'
and w.uwi = sws.uwi
and sws.source = 'GEOLOGIC'
and sws.strat_unit_id = su.strat_unit_id
and su.strat_unit_id = sua.strat_unit_id
order by pick_depth;
```



	DESCRIPTION	PICK_DEPTH	MIN_AGE	MAX_AGE
1	Clearwater Formation (AB)	93.9	109	112
2	Wabiskaw A Sand (AB)	171.4	112	112.25
3	Wabiskaw Member (AB)	171.4	111	112
4	Wabiskaw A Shale (AB)	173.1	112	112.25
5	Wabiskaw C Sandstone (AB)	178.2	112.5	112.75
6	Wabiskaw D Sandstone (AB)	180.3	112.75	113
7	McMurray Channel (AB)	181.9	122	127
8	Beaverhill Lake Group (AB)	243	381	385



Land Leases

PPDM

- Mineral rights
- Current term
- Legal descriptions

Spatial Data

- Spatial outline of each lease



2	1	6	5	4	3	2	1	6	5	4	3	2	1
35	36	31	32	33	34								
26	25	30	29	28	27								
23	24	19	20	21	22								
14	13	18	17	16	15	14	13	18	17	16	15	14	13
11	12	7	8	9	10	11	12	7	8	9	10	11	12
2	1	6	5	4	3	2	1	6	5	4	3	2	1
35	36	31	32	33	34	35	36	31	32	33	34	35	36

	A	B	C	D	E	F
1	GOVT_ID	TERM_DATE	ORIG_EFFEC	AGR_ST	RES	
2	74740701090	24-Jan-22	24-Jan-07	Primary	Term	
3	MIN_AGE	MAX_AGE				
4	101	381				
5	SUBSTANCE	RIGHTS				
6	OS	BELOW TOP OF VIKING FM TO BASE OF WOODBEND GRP OS				

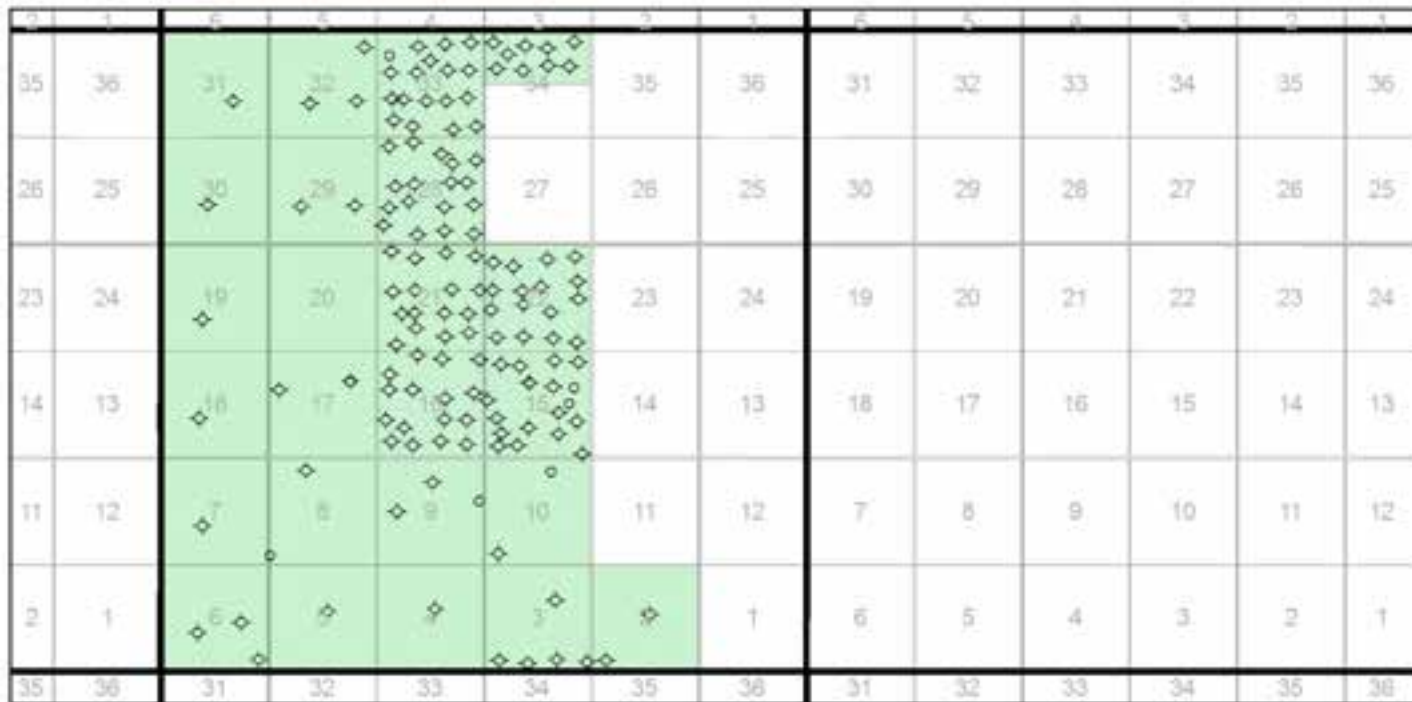


Combining Datasets

- Land Leases to Wells to Grid can be intersected
- Cores need to be grouped
- Cores need formations
- Data is updated daily

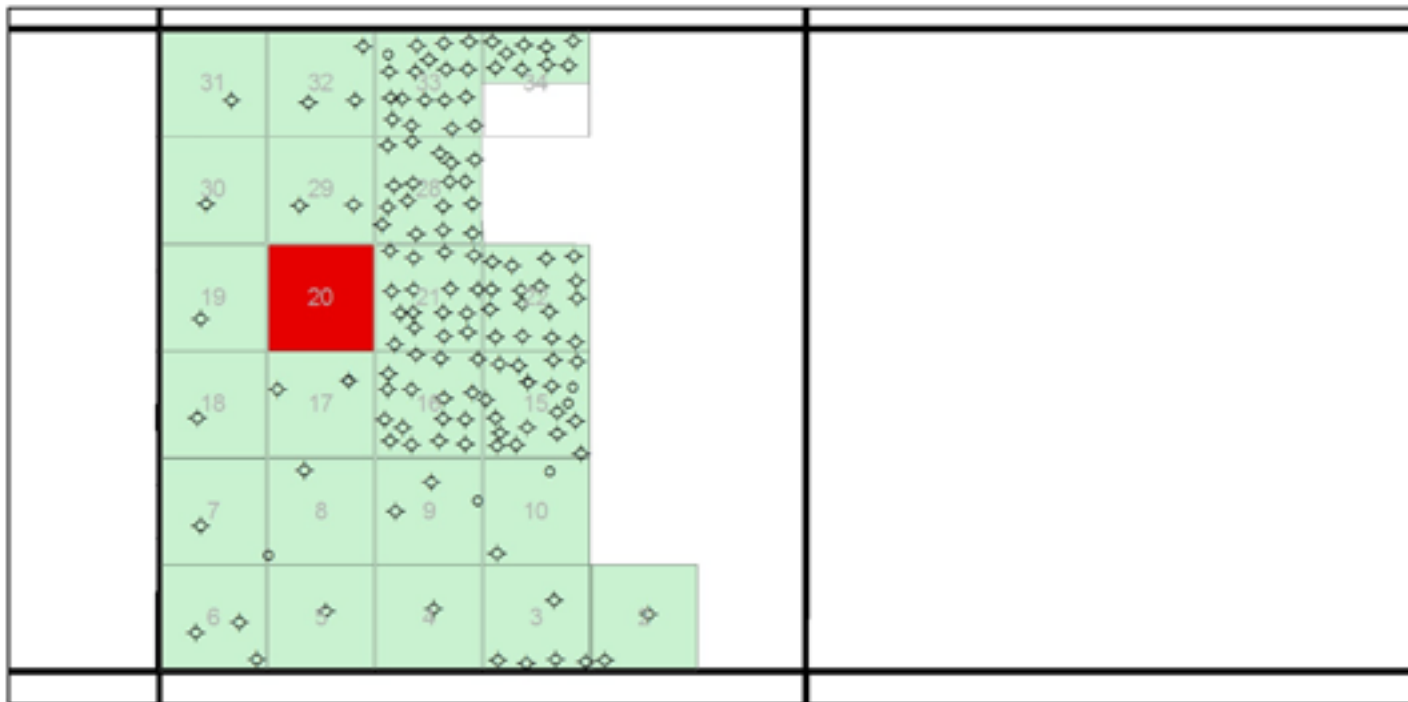


Intersecting Land/Wells





Intersecting Land/Wells/Grid





Intersecting Cores

- Using top depth in PPDM create a contiguous cored interval by depth

REPORTED_CORE_NUM	TOP_DEPTH	BASE_DEPTH	RECOVERED_AMOUNT
1 001	164.5	165.6	1.1
2 002	165.6	168.9	2.6
33 033	247.5	250.5	2.6
34 034	250.5	251.5	1

SQL STATEMENT: SELECT TOP 1000 * FROM PPDM.CORES ORDER BY TOP_DEPTH

REPORTED_CORE_NUM	TOP_DEPTH	BASE_DEPTH	RECOVERED_AMOUNT
1 (null)	164.5	251.5	81.8



Joining Cores/Top Picks/Formation Ages

- With a single depth interval we can add the minimum and maximum of the top picks to the contiguous interval

```
select reported_core_num, top_depth, base_depth, recovered_amount, tsua.min_age, bsua.max_age
from well_core wc, well w,
    strat_unit tsu, strat_unit_age tsua,
    strat_unit bsu, strat_unit_age bsua
where w.gsl_uwi = '1AA102809613W400'
and w.uwi = wc.uwi
and tsu.strat_unit_id = getstratbywellddepth(wc.uwi, wc.top_depth)
and tsu.strat_unit_id = tsua.strat_unit_id
and bsu.strat_unit_id = getstratbywellddepth(wc.uwi, wc.base_depth)
and bsu.strat_unit_id = bsua.strat_unit_id
order by reported_core_num;
```



Adding Core Ages to Wells Feature Class

- There is now a single 1-1 relationship between cored ages and a well

	REPORTED_CORE_NUM	TOP_DEPTH	BASE_DEPTH	RECOVERED_AMOUNT	MIN_AGE	MAX_AGE
1 (null)		164.5	251.5	81.8	109	385

	TF_MN_AGE	TF_MX_AGE	PTF_MX_AGE	PTF_MN_AGE	PRD_FM	PRD_MN_AGE	PRD_MX_AGE	COR_TOP_A	COR_BOT_A	Shape *
A0	381	385	127	111.8	<Null>	<Null>	<Null>	109	385	Point ZM
A0	122	127	127	111.8	<Null>	<Null>	<Null>	109	127	Point ZM
A0	381	385	127	111.8	<Null>	<Null>	<Null>	109	385	Point ZM

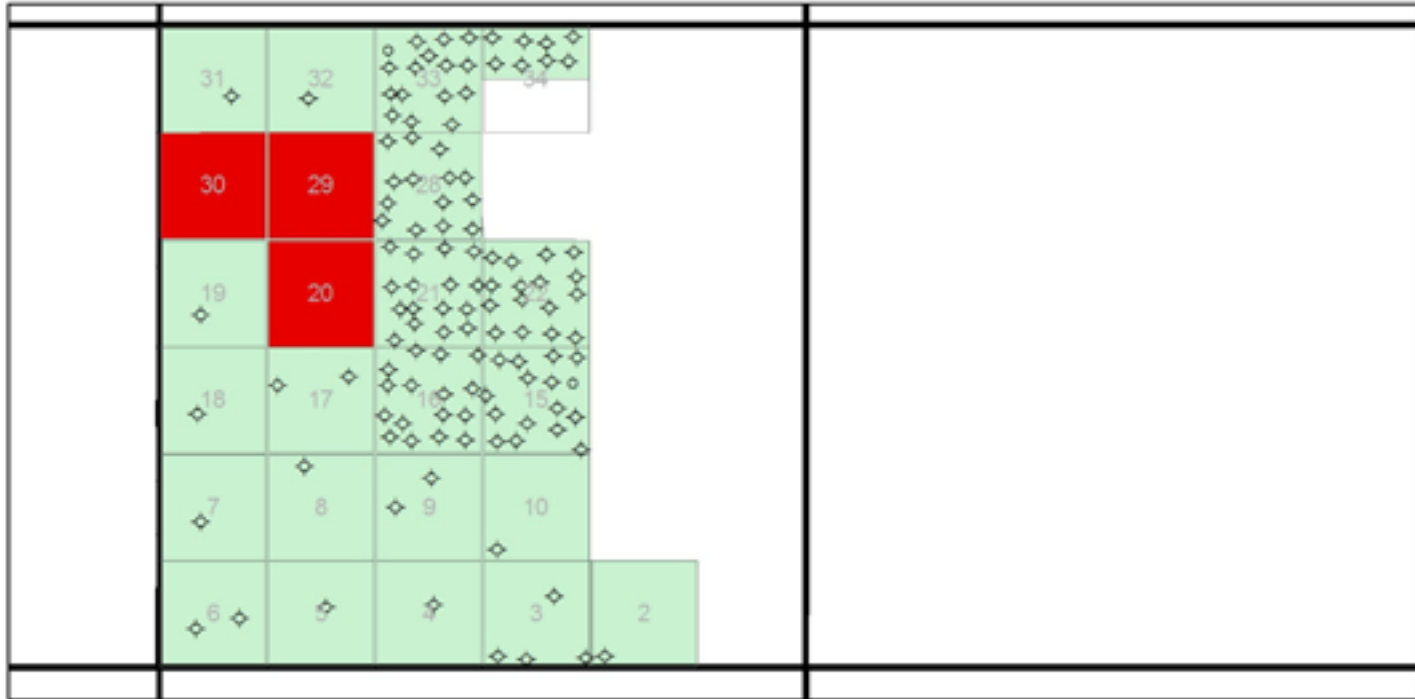


Solving MLE

- Sections with no wells have been identified
- Identify sections where the wells' core ages do not match the land lease ages



Solving MLE





Summary

- Oil Sands Regulatory Requirements
- Data Availability
- Combining Data



Thank you!