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Water Production, Disposal, and Midstream Synergies in the Duvernay

Mighty Peace Watershed Alliance 2019 AGM

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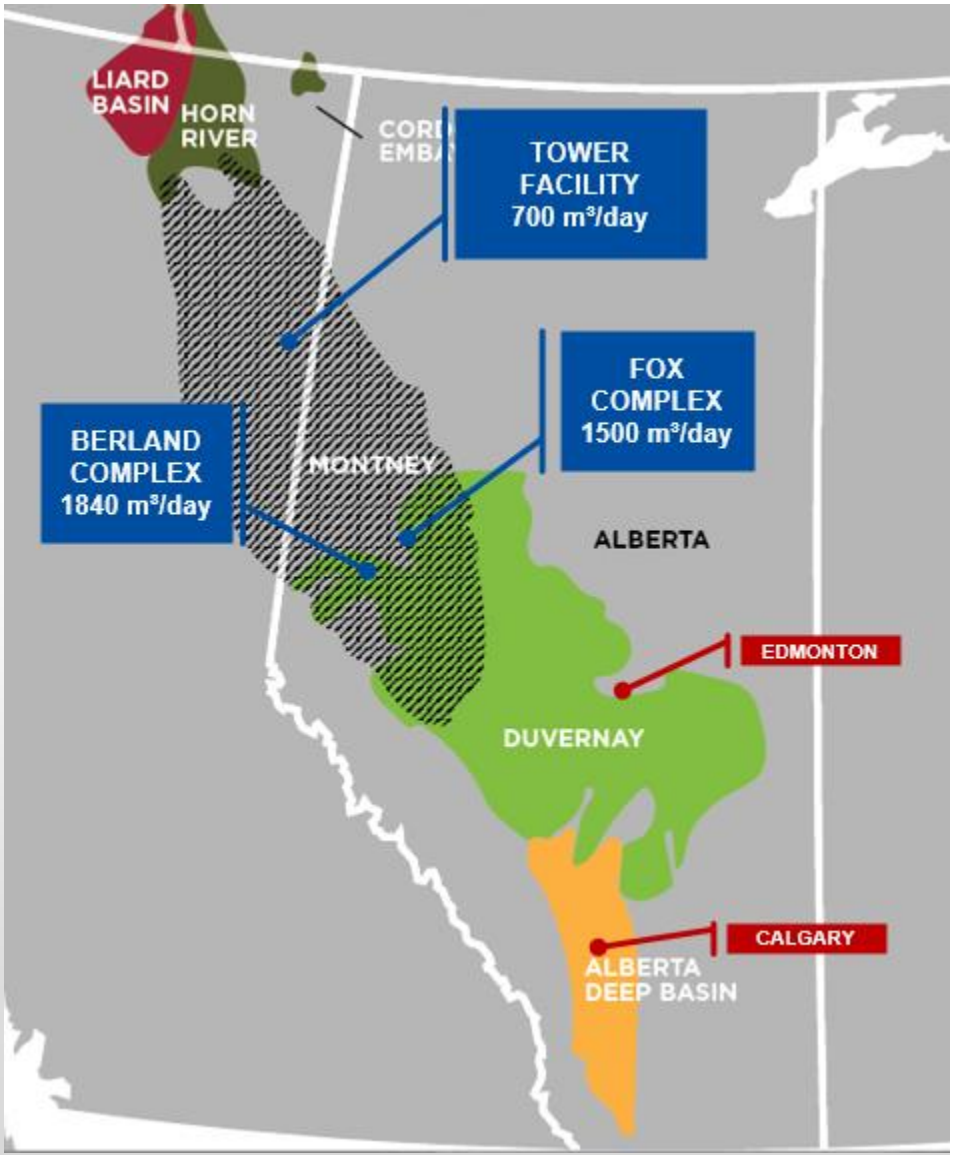
COMMERCIAL SLIDE

PIPELINE CONNECTED LOW COST DISPOSAL

- **Three operating facilities:**
  - Deploy our capital on fit-for-purpose water management facilities
  - Focus on areas with higher water Opex
  - Pipeline connecting is key
- **The Partnership advantage is our differentiator**



QUESTIONS

APPRAISAL TO COMMERCIALITY

- What impact will the commerciality of the Duvernay have on water management?
- How can we ensure water security?
- What can we do to lower the costs of water with economy of scale?

Source: Select Energy Investor Presentation

	Pre-2008 Conventional Vertical	2008-2010 Early Horizontal	Current Leading Edge Horizontal	Still Emerging Multi-Well Superpads
Frac Water Per Well	~2500m3	~12,500m3	~100,000m3	~1,000,000m3/pad
Equivalent Tank Truck Loads	~115	~575	~4600	~46000
Lateral Length (meters)	~500m	~1000m	~4000m	~4000m
Logistical Challenges	Minor →			Complex
E&P Approach	Minimal Attention (low-cost) →			Mission Critical

THE TRANSIT DILEMMA – A HUMAN OPTIMIZATION PROBLEM

CALGARY TRANSIT STATISTICS*

RAYBOB DUVERNAY "TRANSIT STATISTICS"*

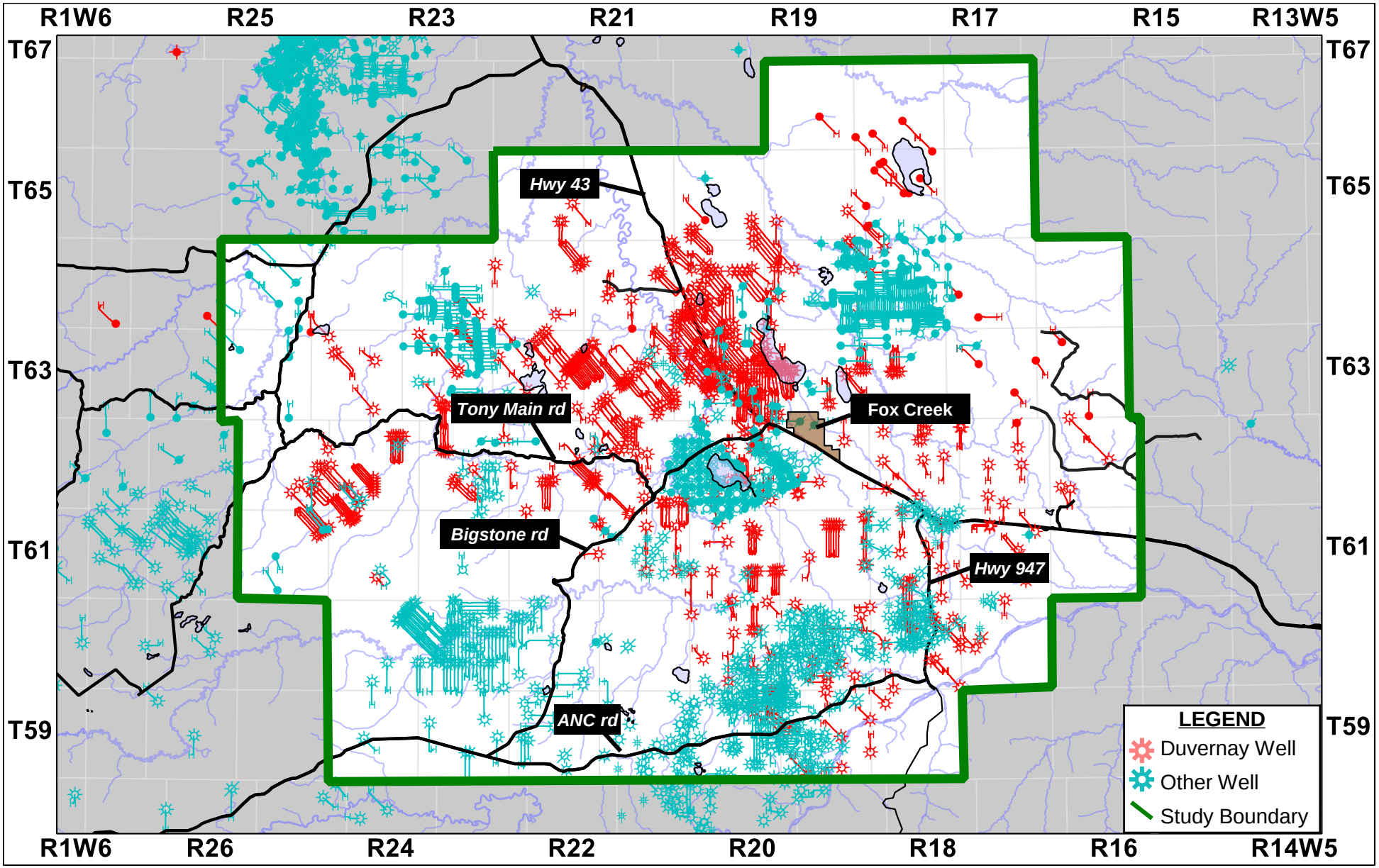
Total Water Frac Water 2018 (m^3)	6.9M
Total Water Disposed 2018 (m^3)	4.3M
Average fare (trucking)	$15/$m^3$
Average fare Disposal	$12.5/$m^3$
Number of Produced Water Pipelines	107
Number of Disposal wells	32
Kms of produced water Pipelines	316 kms
Number of Frac Locations (wells)	164
Number of Notable Fresh Sources	9
Number of Produced water pits	0

THE THING ABOUT OPTIMIZATION

- Less total system cost – reduced "commuting" fees for everyone
- Users of system will pay most for system, but regular users get best value
- Ties to all major infrastructure
- "Uninterrupted Service"
- Still has some inefficiency! (ex. Peak times, not everywhere, costly)

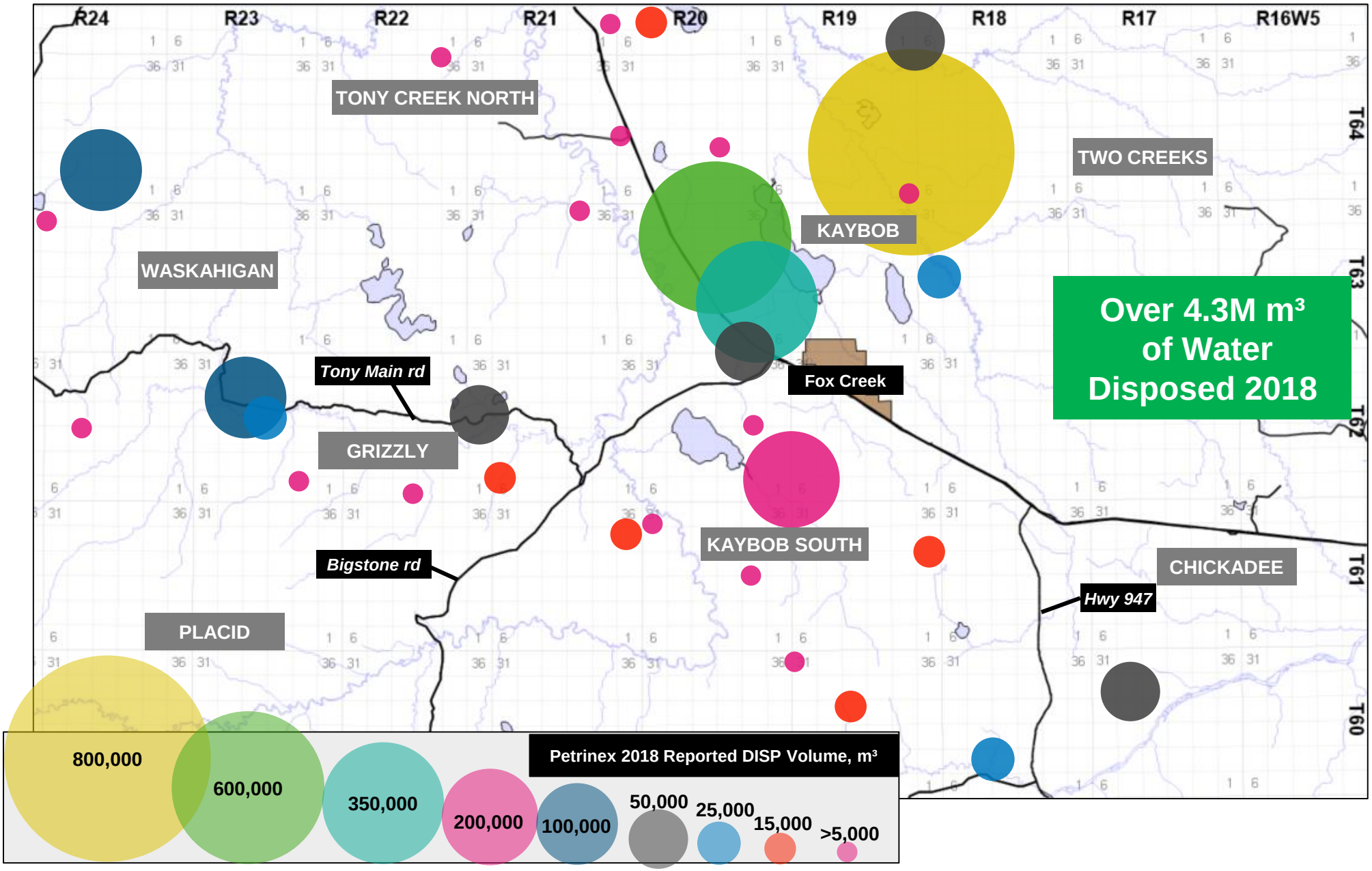
CORE DUVERNAY & OVERLAPPING MONTNEY

STUDY AREA



WATER PRODUCTION IN FOX CREEK AREA

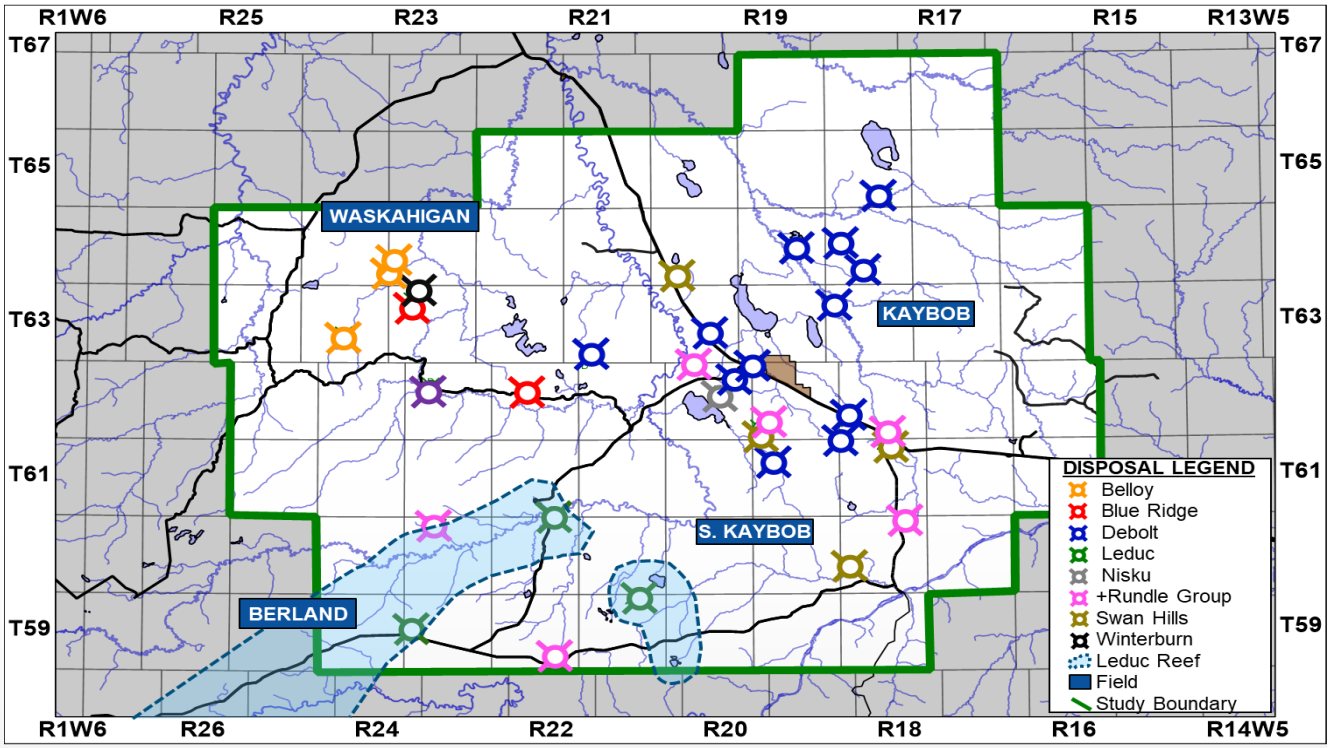
REPORTED WATER SENT TO DISPOSAL

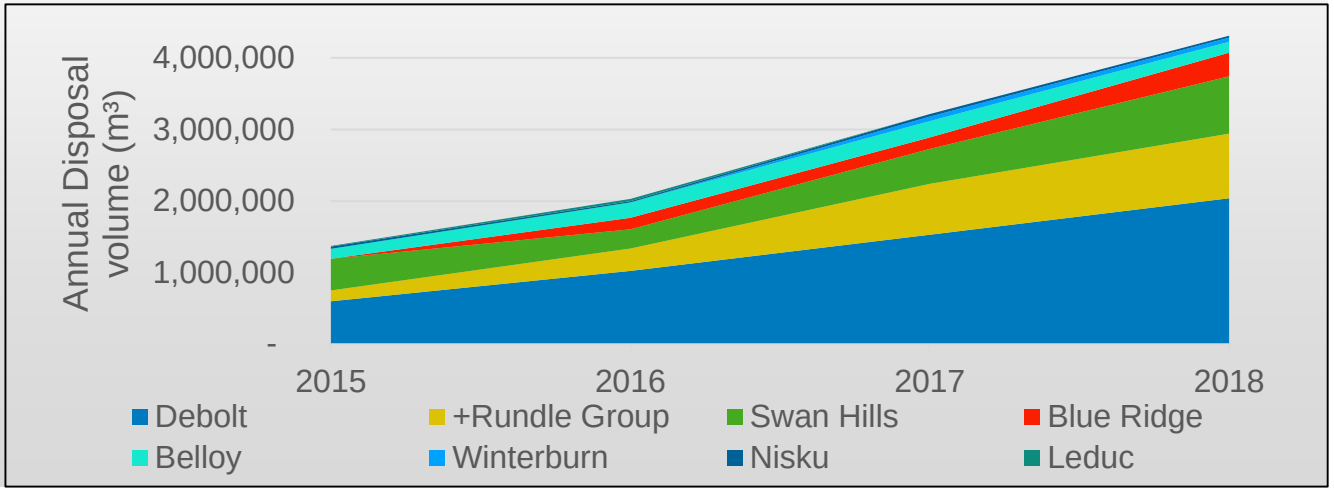


FOX CREEK AREA WATER DISPOSAL OPTIONS

MISSISSIPPIAN & DEVONIAN CARBONATE OPTIONALITY

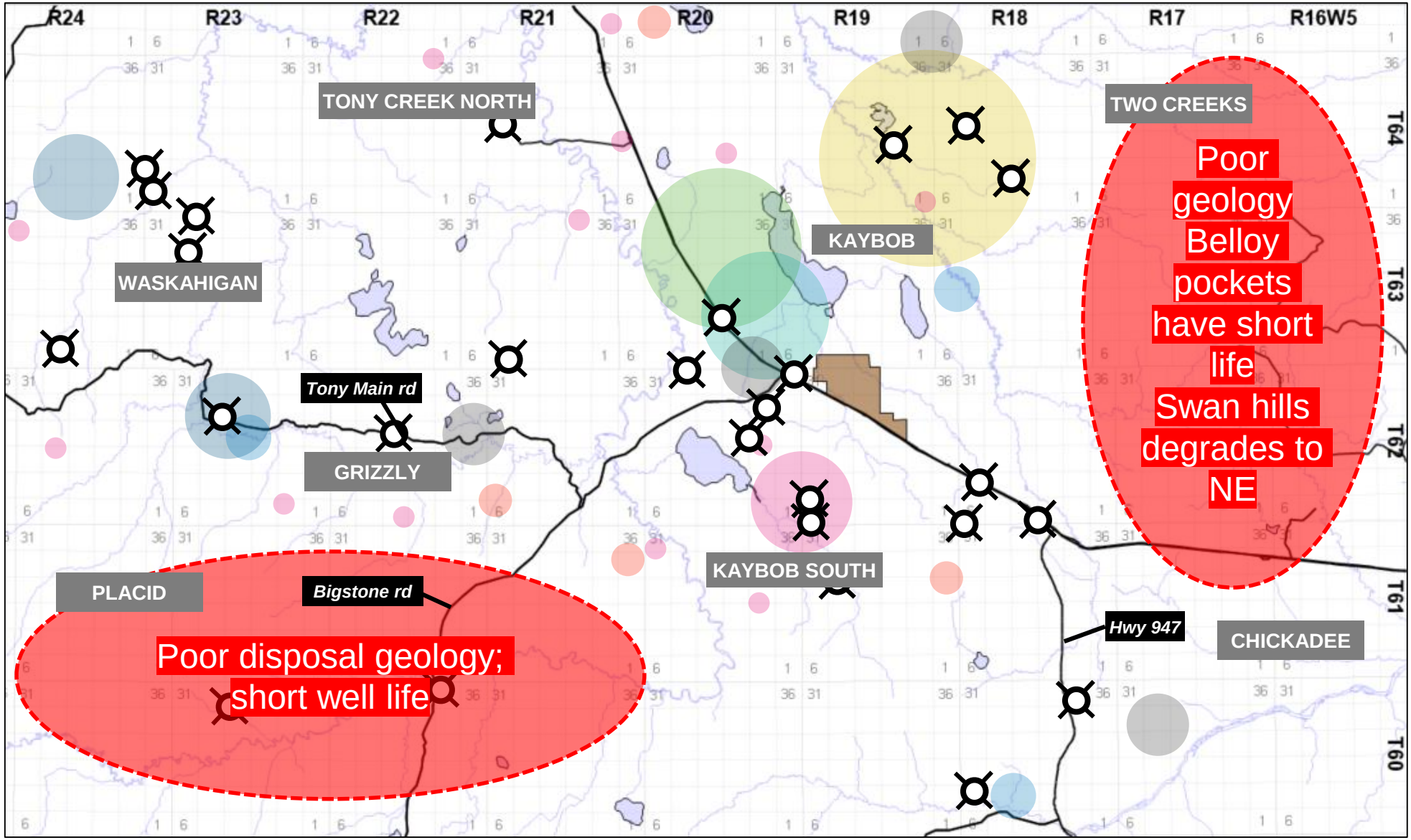
- Carbonate formations are the primary disposal targets in the Fox Creek area
- The Rundle Group (Debolt, Elkton, Shunda, Pekisko) disposal zones are most commonly targeted (15)
  - Debolt is the most prolific disposal zone: 2 MM m^3 of water disposed of in 2018
  - High injection rates (> 1,000 m^3/d) likely due to fracturing
- The Swan Hills formation is a proven, deep and very high volume reef complex
  - Associated hydrocarbon production in areas
- The mixed carbonate-siliciclastic Belloy formation is a disposal target of the Waskahigan field





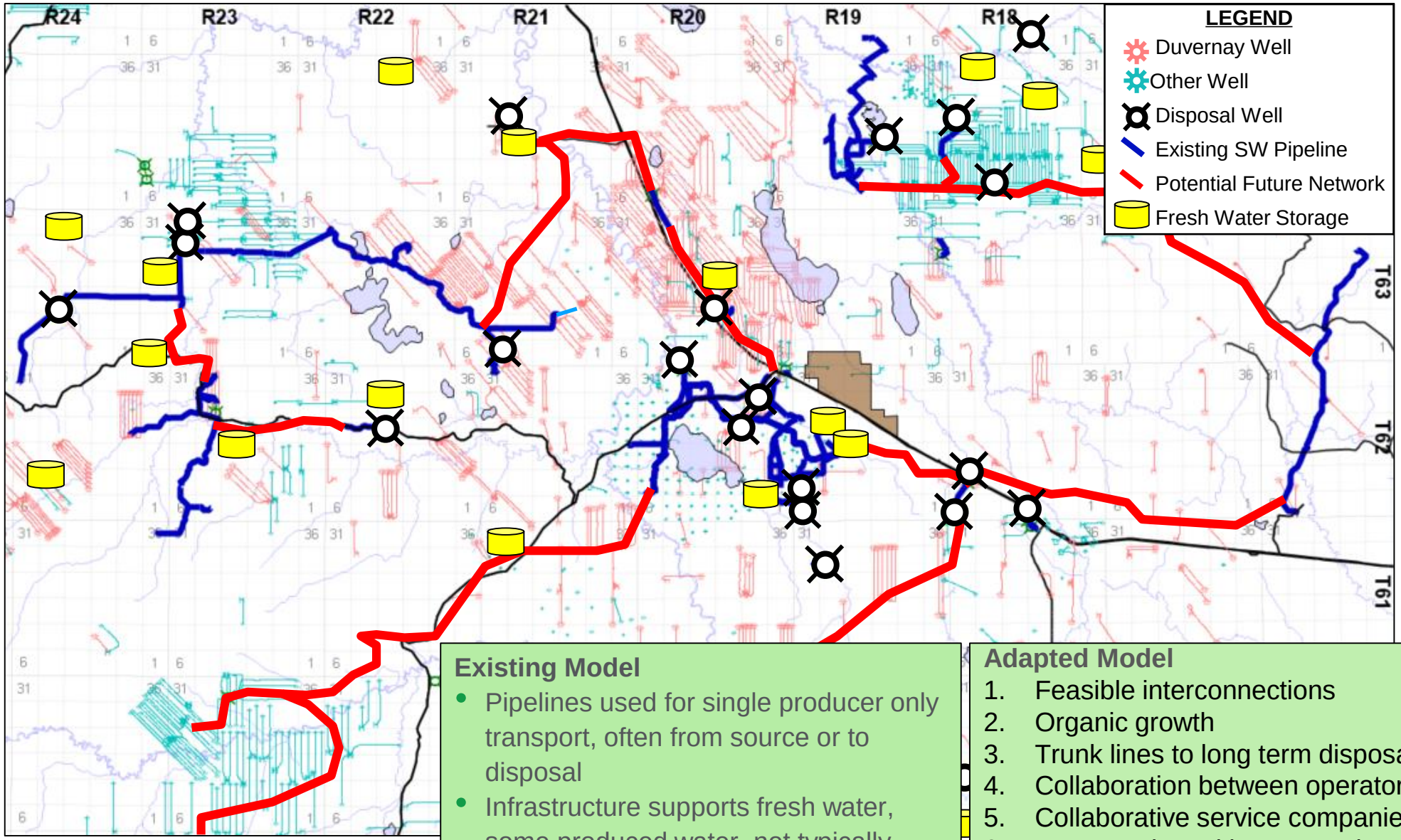
DISPOSAL CONSTRAINTS

CHOICES AND NO CHOICES



MIDSTREAM INFRASTRUCTURE OPPORTUNITIES

SUSTAINABLE FULL SCALE DEVELOPMENT



Existing Model

- Pipelines used for single producer only transport, often from source or to disposal
- Infrastructure supports fresh water, some produced water, not typically used for Flowback

Adapted Model

1. Feasible interconnections
2. Organic growth
3. Trunk lines to long term disposal
4. Collaboration between operators
5. Collaborative service companies
6. Large scale multi-user ponds
7. Water Reuse potential

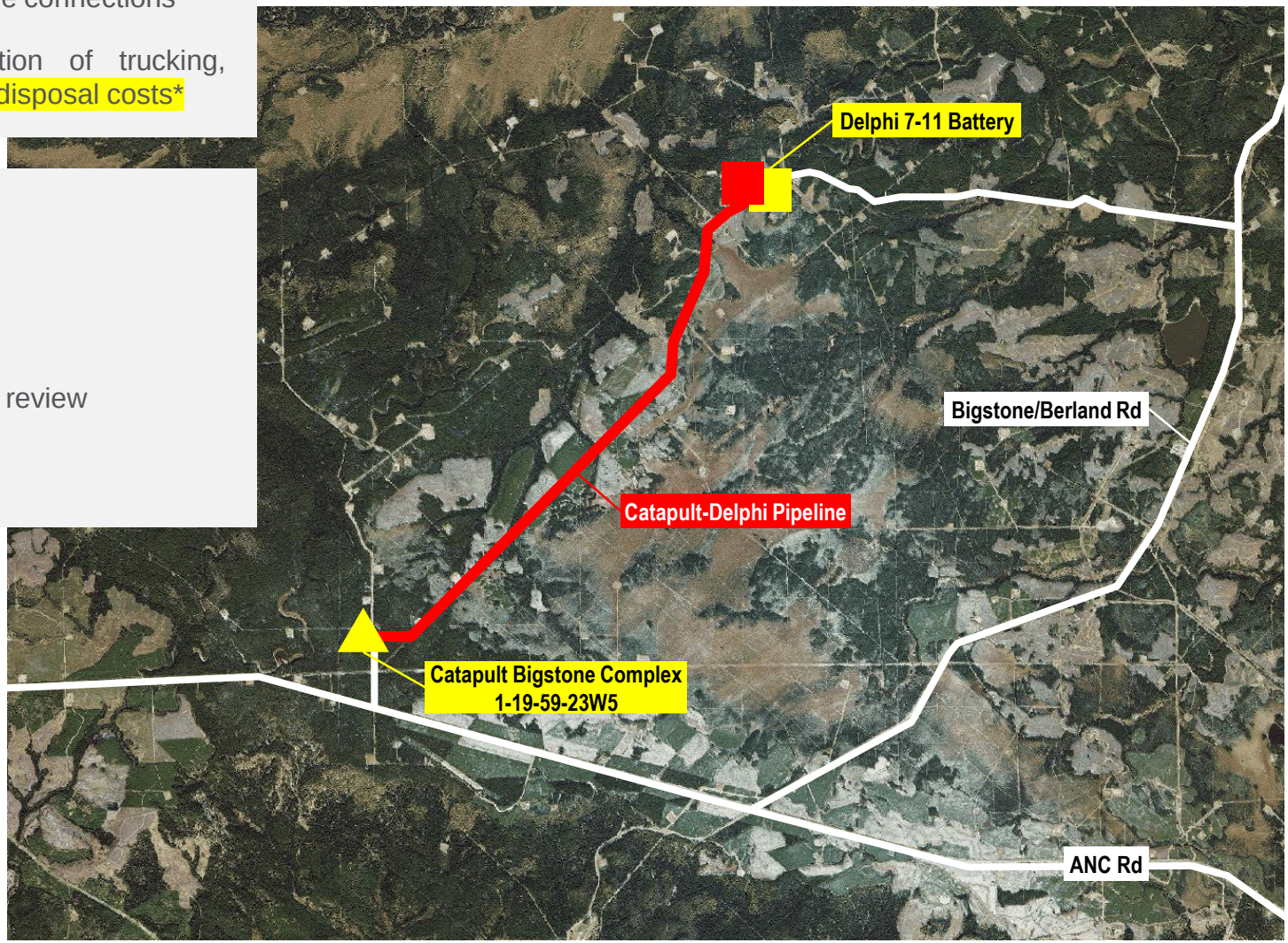
BERLAND CASE STUDY – PIPELINE SOLUTION

INFIELD PIPELINE CONNECTION

- 11 km low pressure pipeline connecting Delphi's battery to Catapult's facility
- Designed future additional pipeline connections
- Economics based on elimination of trucking, estimated over 50% reduction in disposal costs*

LEDUC DISPOSAL WELL

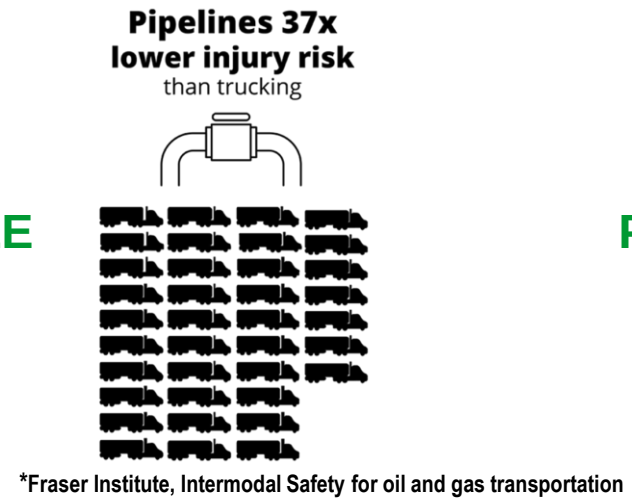
- >3500m vertical new drill
  - first in the reef for the area
- De-risked through seismic & core review
- Disposal capacity >1000m³/day



*Delphi Energy Corp July 18th, 2018 Operation Update, Press Release

PIPELINE SOLUTION – TRIPLE BOTTOM LINE

PEOPLE



*Fraser Institute, Intermodal Safety for oil and gas transportation

PLANET

Berland Facility - Sustainability

- Annual reduction in truck trips:

  >16,000

- Annual CO_2 reduction:

  >1200 tonnes

PROFIT

- 500,000 m³ of water disposed of by Truck
- Average one way distance of 65 km
  - 1 hour load/unload time: ~ 4 hours
  - $5/m³/hour
    - 30m³ x $5/m³/hr x 4 hr = $600/load
    - 16,000 loads x $600/load =

>$9.6M Trucking

HURDLES TO FULL SCALE WATER

REGULATORY

- Classification of waters
- Pilot project requirement for PW storage
- Point of use requirements for licensing water (watersheds, E&P use)
- Layflat limitations

LEGAL-COMMERCIAL

- Liability/Custody transference mechanism
- Lack of clear commercial model
- Capital constraints in market
- Water seen as a competitive advantage

OPERATIONAL

- Complexity increases
- Managing the longs/shorts on water
- Fluid compatibility
- Scheduling of on-demand requirements
- Design/sizing

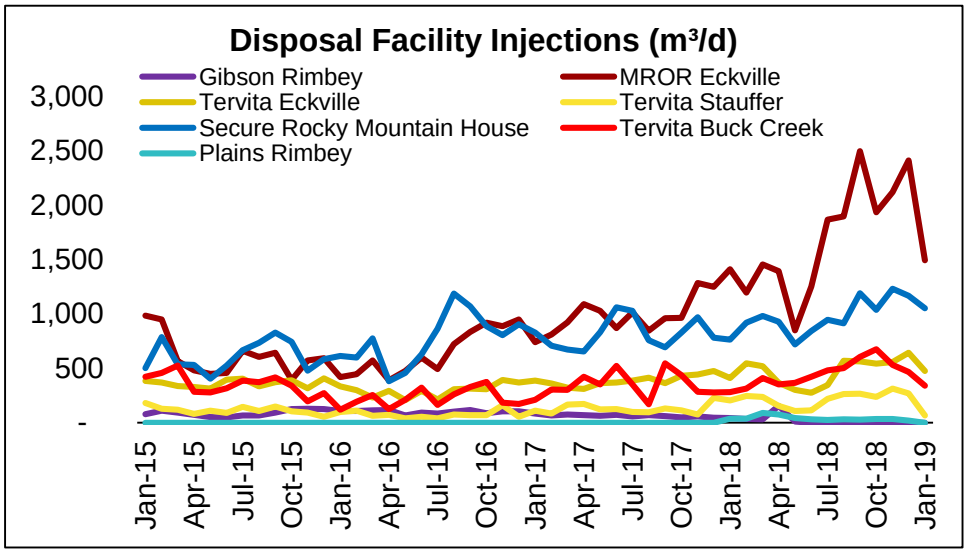
DUVERNAY - EAST SHALE BASIN

SOME KEY CHALLENGES

1. Public perception on water usage (water share with agriculture)
2. Short for completions water
3. Three separate watersheds
4. Not a lot of proximate disposal

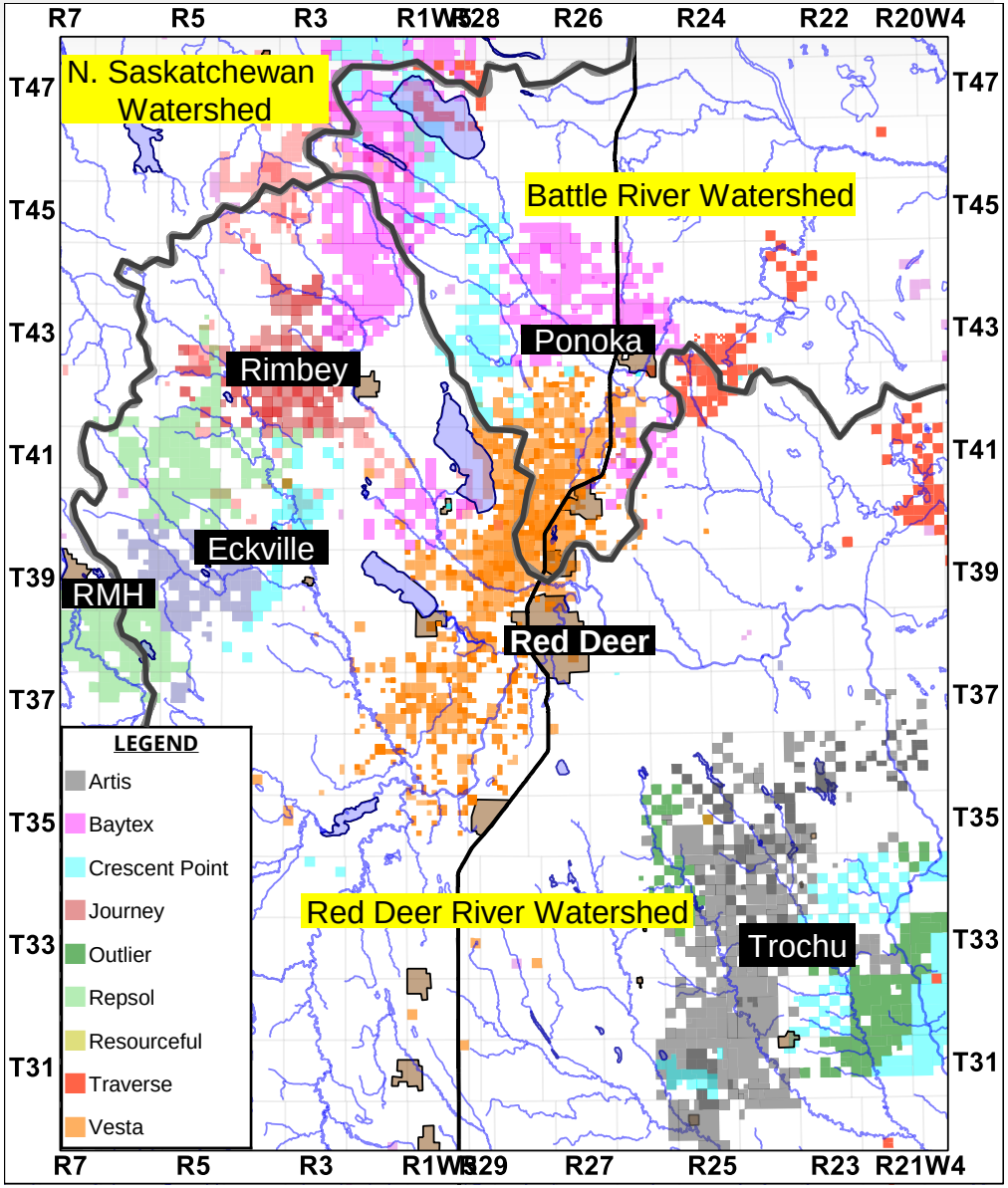
WILLESDEN GREEN

- Area is currently not water short near RMH
- Highest disposal in the area near Eckville & RMH



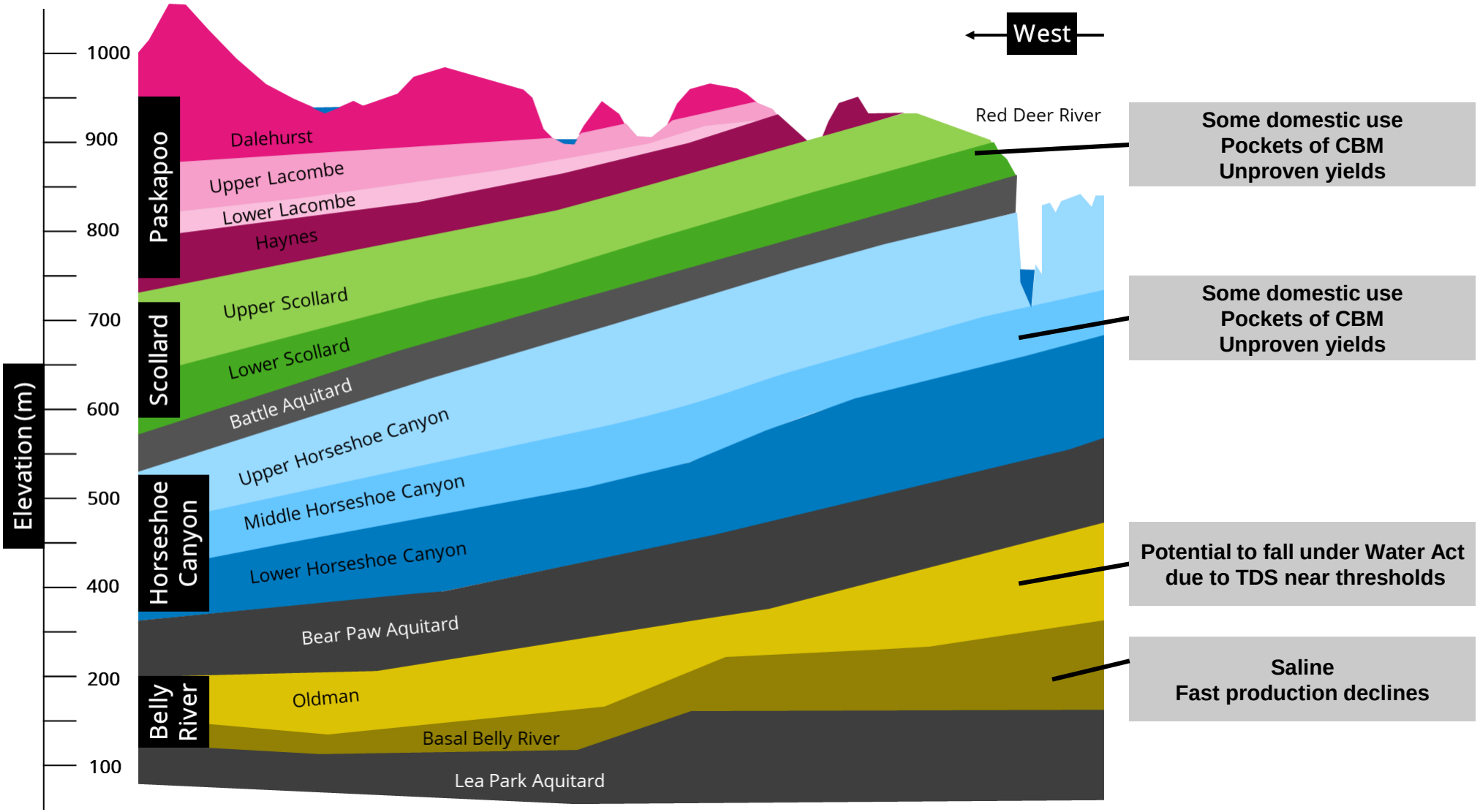
JOFFRE / TROCHU

- Area short on water
- Disposal in the area is challenging, ~ 400-700 m³/day trucked on average 50 km



EAST SHALE BASIN – GUESS WE NEED SOME GROUNDWATER?

CONSIDERATIONS IN GROUNDWATER SOURCING IN THE EAST SHALE BASIN



QUESTIONS

- What impact will the commerciality of the Duvernay have on water management?
  - ~ 3x increase in disposal water, ~3x increase in source water required
  - With status quo: whole bunch of trucks on the road and layflat in the ditch – scrutiny from public, not going away
  - Pressurization of the Debolt/Rundle group?
- How can we ensure water security?
  - Collaborative approach between producers & service companies
  - Develop an effective reuse strategy, leverage the overlapping Montney/Duvernay field
  - Proactive engagement with the regulator & public – execute great pilots
- What can we do to lower the costs of water with economy of scale?
  - Reduce or eliminate trucking through permanent transport infrastructure, ie ponds & pipelines
  - Long term planning for sourcing, incorporating reuse as needed - where it is cost-effective
  - Be more capital efficient, commercial innovation, increase utilization of assets as a whole

FOLLOW UP QUESTIONS

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