EERC Legacy Brine Pit Remediation Demonstration Project

Briefing to the Oil & Gas Research Council

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Critical Challenges. **Practical Solutions.**

Bull B-1 Site History

- Three associated Madison wells:
  - Bull B1R (5318) spudded in 1973, P&A in 2004.
  - Bull B1 (2801) spudded in 1961, listed as inactive.
  - Bull B7-23H (15200) spudded in 2001, listed as active.
- Legacy brine evaporation pit from early well activities
  - Evaporation pits were allowed until the late 1970s, when they began to be phased out.
- Brine impacts identified at Bull B1 by NDIC in 2004
- NDIC-approved remediation activities completed in 2007
  - No record of areas that were remediated.
- Ongoing soil sampling in 2008, 2010, and 2014 prior to EERC involvement.

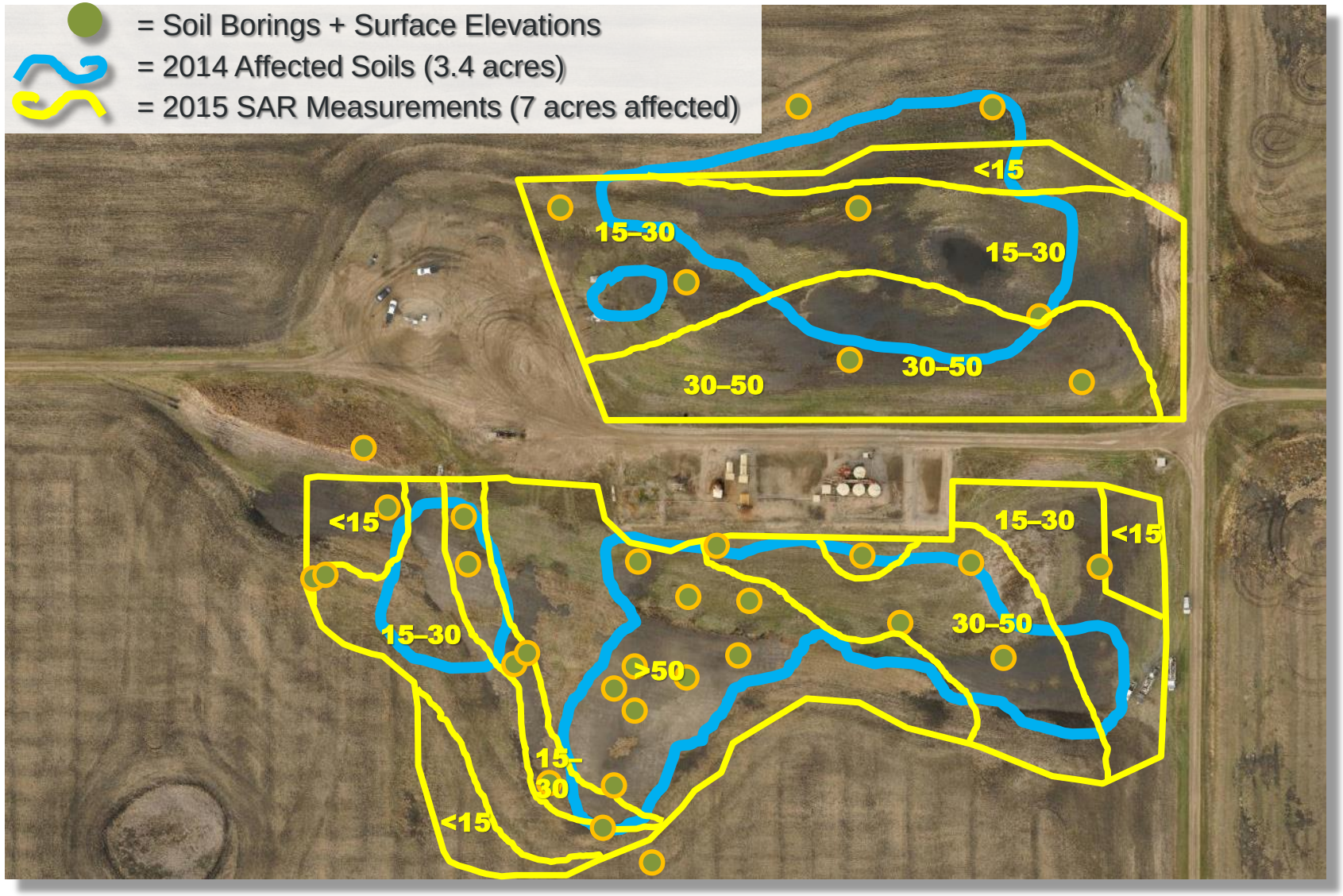
Original Approach

Need for a New Approach

- Site characterization, soil sampling, and dramatic changes within the site operator's organization now indicate that the proposed approach is infeasible.

- COP/TriHydro 2014 report:
  - ≈3.4 acres are impacted by produced brine water, distributed among three distinct areas.
  - Brine pit measured to 24 in.
- EERC fall 2015 field sampling:
  - ≈7 acres impacted.
  - Brine pit down to 15^{+} ft below surface.
  - Brine pit larger and deeper than expected (migration + incomplete previous analysis).

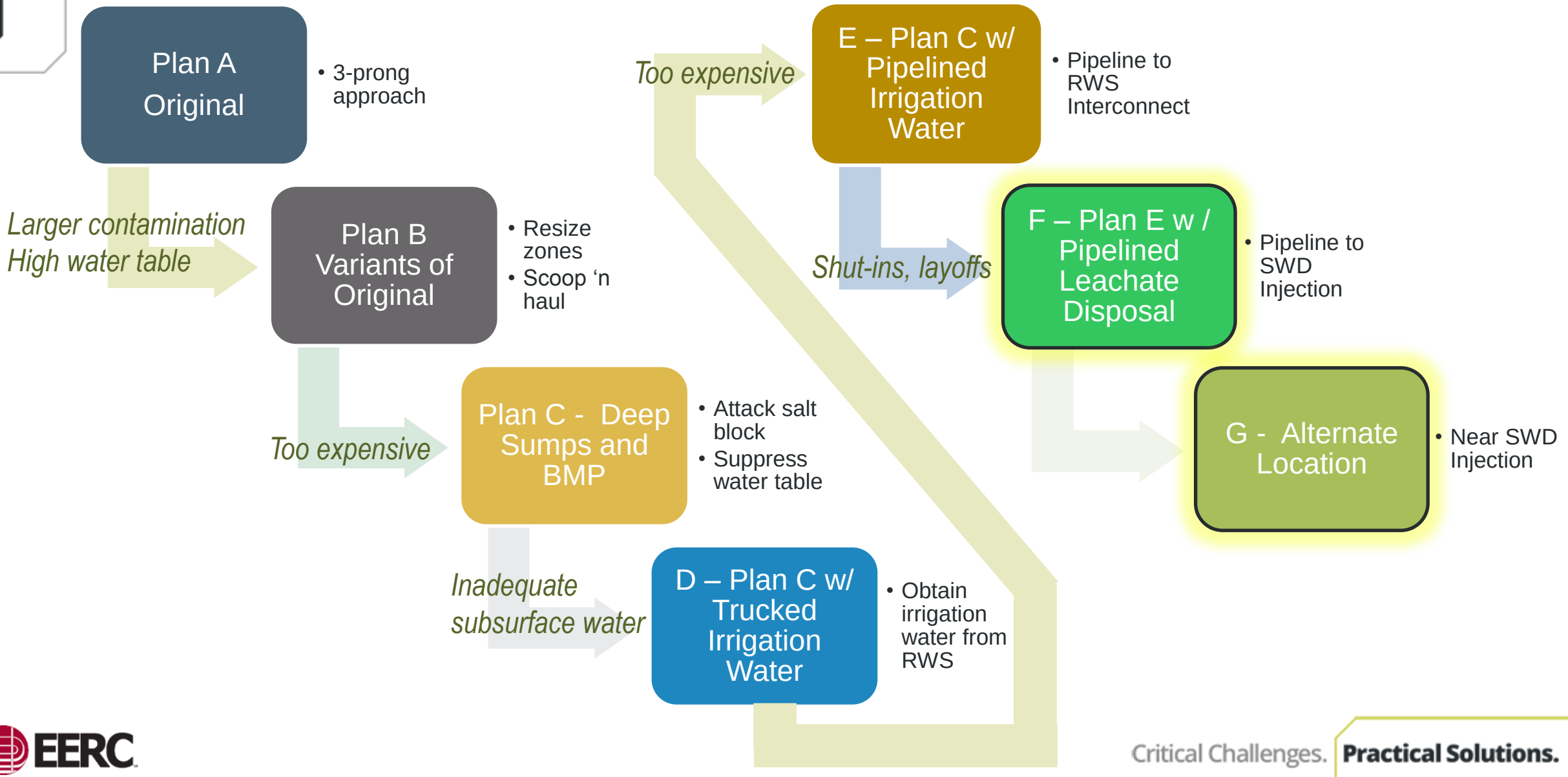
New Understanding of Selected Site



Challenges to Original Plan

- Deeper and wider contamination more than triples the volume of soil needing treatment.
- Test wells to 210’ and 320’ have produced sufficient water quality, but insufficient flow rate for irrigation … water must now be obtained at greatly increased cost (rural water system).
- Extremely shallow current water table sits 2’–3’ below surface, immersing nearly the entire concentrated pit.
- Current site operator has shut in all OG and SWD wells in the area due to oil price environment, and has laid off workers.
- Long-term leachate disposal needs created by scope adjustment create a post-project liability.

Progression of Options Investigated



EERC RECOMMENDATION

OPTION A

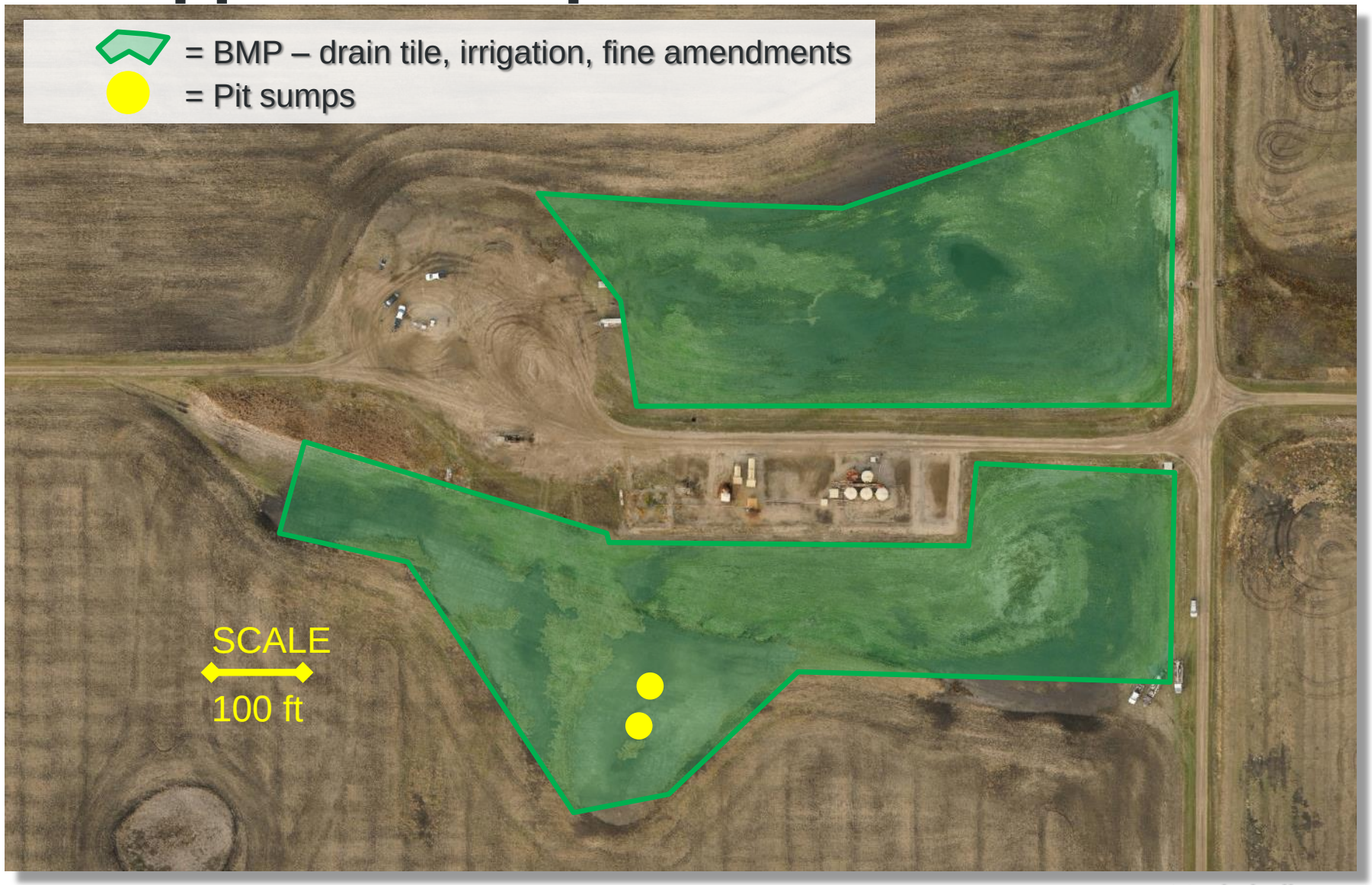
Current Site

Pipelined Irrigation

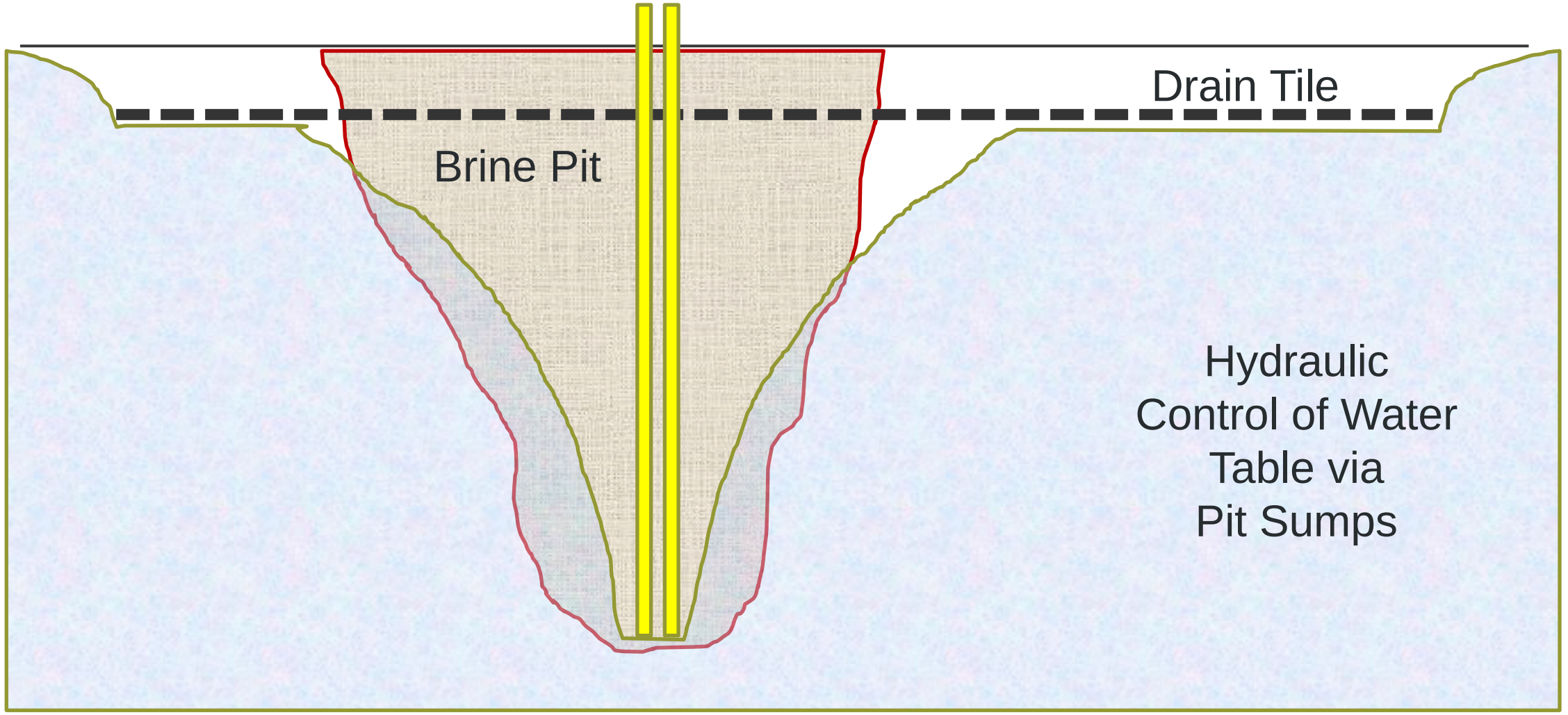
Pipelined SWD

Fewer Unknowns

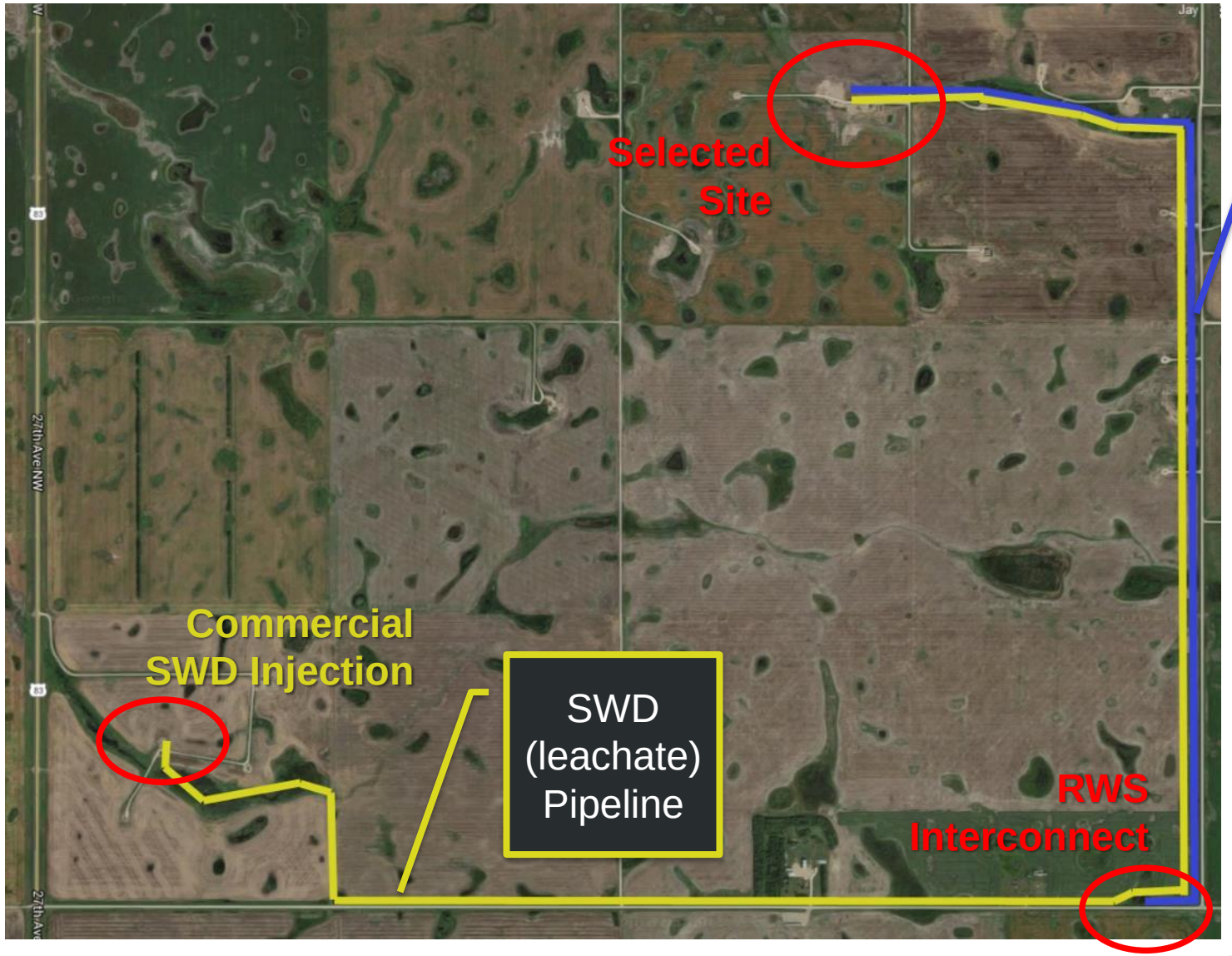
Revised Approach – Option A



Site Cross Section – Option A



Pipeline Routing – Option A



Incremental Costs – Option A

- Additional project costs
  - Significantly more drain tile and sumps (AWPSRF has agreed to assist)
  - Pumping test to determine effective soil permeability
  - Multiple evaporation pit deep sumps
  - Install pipeline to provide irrigation water via county ditches from rural water system interconnect 1 ½ miles south of site
  - Purchase irrigation water from RWS
  - Install pipeline to dispose of leachate (SWD) via county ditches to SWD well 1 ¼ miles southwest of site
  - Dispose of leachate at commercial SWD well
- Unknowns
  - Disposal volume (pumping test will tell)
  - Cost of disposal
  - Cost of SWD pipeline installation
  - ROW issues not fully understood

Incremental Cost Component	Quote?	Cost
Remediation work (incl. Irrgtn.sys)		$260,000
Pit pumping test		$25,000
Drain tile	✓	$155,000
Drain tile sumps	✓	$25,000
Deep sumps in pit	✓	$20,000
Irrigation pipeline	✓	$60,000
Irrigation water supply	✓	$70,000
SWD pipeline		$40,000
SWD injection		$160,000
Electrical power		$30,000
Subtotal		**$845,000**
AWPSRF Assistance		- $200,000
Net Incremental Cost		**$645,000**

End Game – Option A

- We wish to continue this project through the 2017 growing season.
  - Seed fall 2016 or spring 2017
  - Understand trends of salt migration from brine pit over 2 yr.
  - Brine leach will continue from drain tile beyond project end.
  - Progress will stop and possibly reverse when we stop pumping drain tile system.
- BIG QUESTION: *How much pit remediation will be accomplished in the 2-year project span?*
  - Planned effort will indicate whether return to productive soil is as simple as running drain tile pump (virtual barrier) for more years.

ALTERNATIVE
(NOT OUR RECOMMENDATION)

OPTION B
Alternate Legacy Site
Pipelined Irrigation
Onsite SWD
More Unknowns

Drastically Changed Approach – Option B

+ Alternate site is close to commercial SWD → avoid costs and liability of SWD pipeline
+ Cost of irrigation pipeline installation decreased slightly

− New site characterization costs similar to those incurred at originally-selected site
− Unknowns related to lack of knowledge on new site
  - Extent of contamination?
  - Water table?
  - Can BMP approach be implemented here?
  - Pit conducive to deep sump approach?
  - Operator cooperation equal to original site?

Alternate Legacy Site – Adams SWD 1

End Game – Option B

- Larger unknowns based upon lack of site characterization
- Affected land may be less than Site A, but unknown
- May be able to accomplish the same goals as at Site A, but unknown
- Additional site characterization likely to extend project even further

CONTACT INFORMATION

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