DEMONSTRATING THE EFFECTIVENESS OF NATURAL SOURCE ZONE DEPLETION COMPARED TO HYDRAULIC LNAPL RECOVERY

William Parry – CSX Transportation, Inc
Steven Gaito and Mark Klemmer - Arcadis

October 2015

HOW TOMORROW MOVES

ARCADIS Design & Consultancy for natural and built assets

WHAT IS NATURAL SOURCE ZONE DEPLETION?

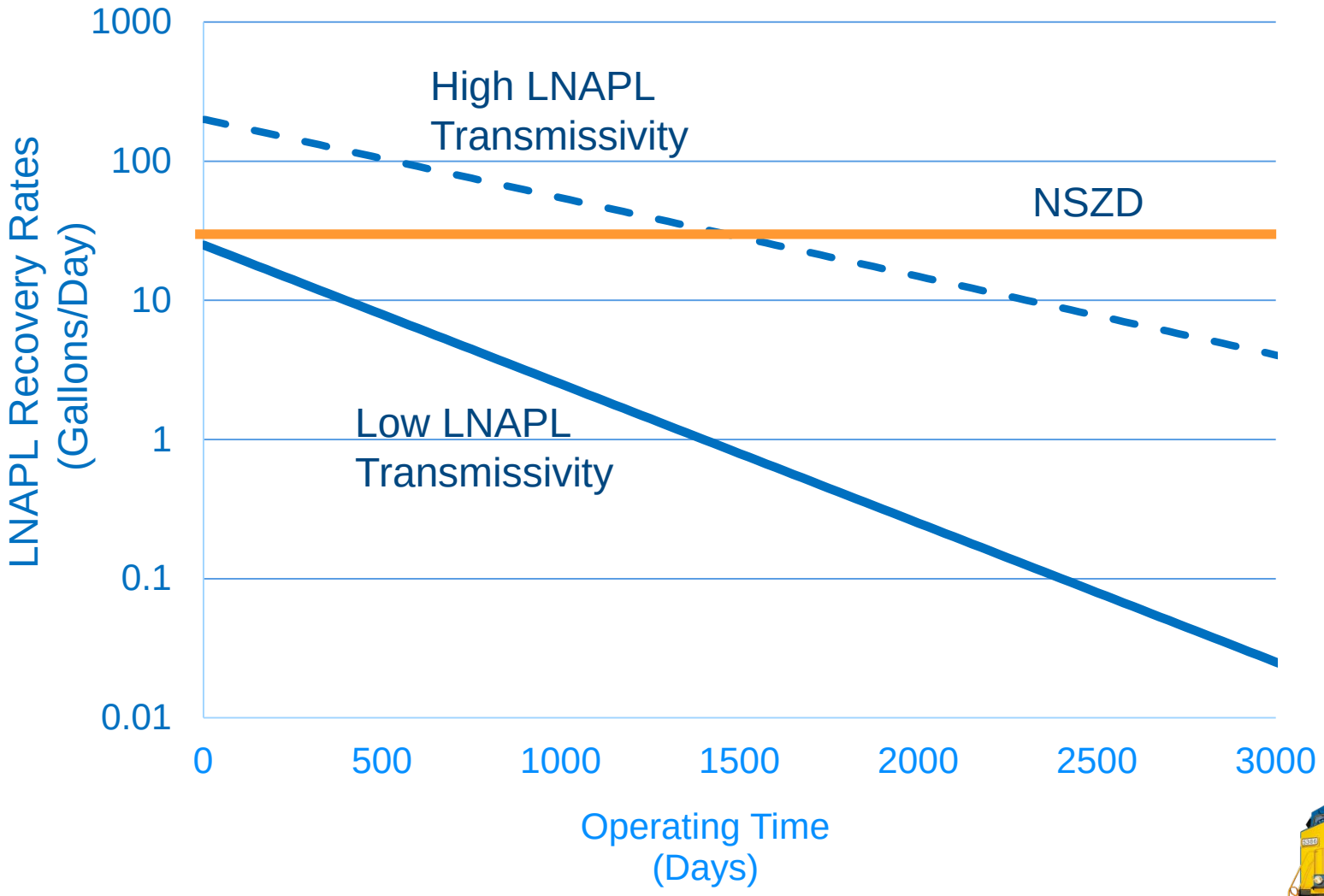
Photo Courtesy of M. Lyverse

WHY EVALUATE NSZD?

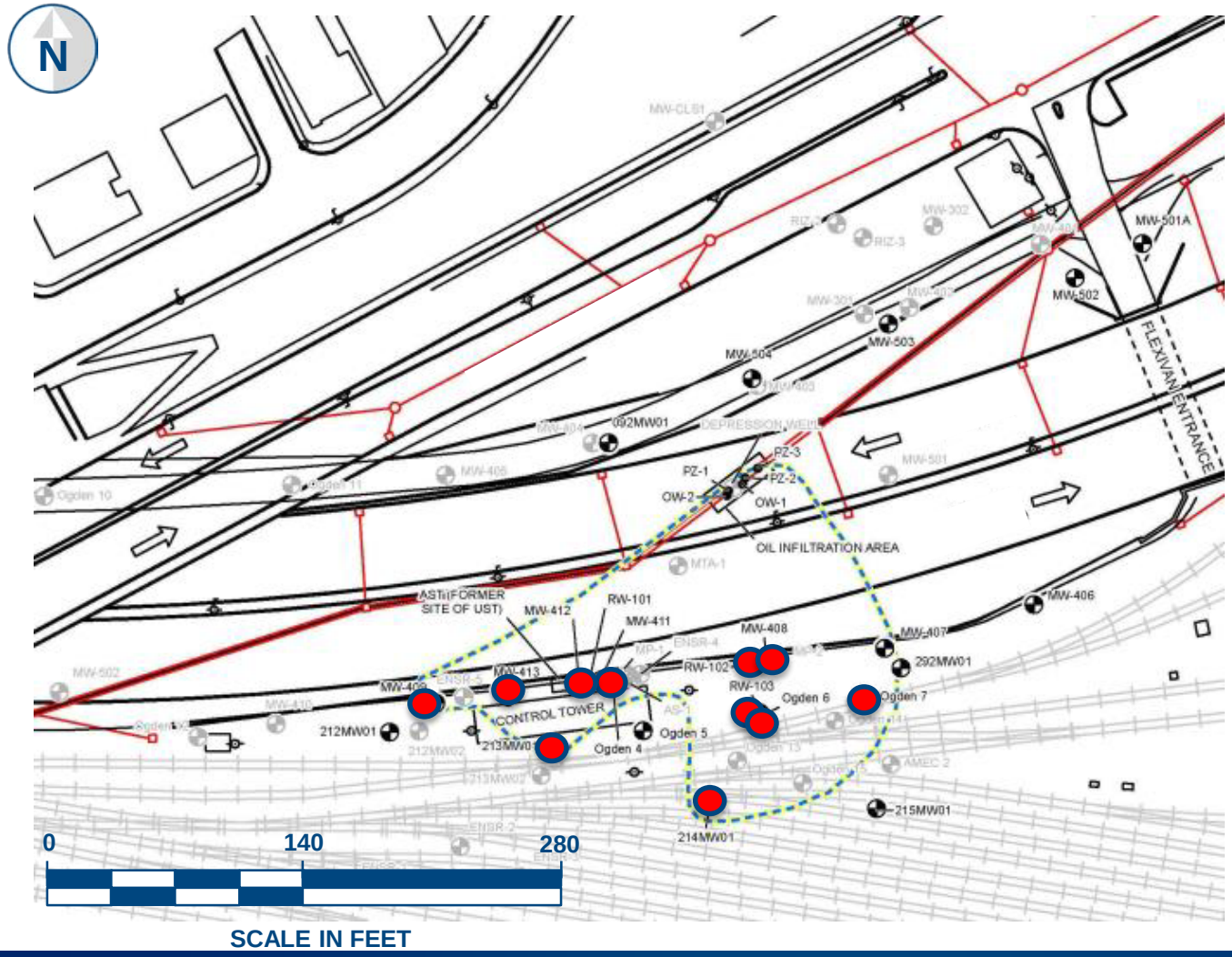
- Supports LNAPL Stability Determination
- Remedy Cost-Benefit
  - Serves as a baseline mass removal rate
  - NSZD is the final remedial step at every LNAPL site
    - Position for transition to NSZD

Hydraulic Recovery + Soil Vapor Extraction ⇨ NSZD

NSZD VS. ACTIVE RECOVERY



SITE BACKGROUND



- Historical detections of measurable LNAPL in Monitoring Wells

REGULATORY CHANGES

“Source” eliminated or controlled

- Where “source” is the point of discharge and NAPL is considered a “source” to other media via dissolution or volatilization

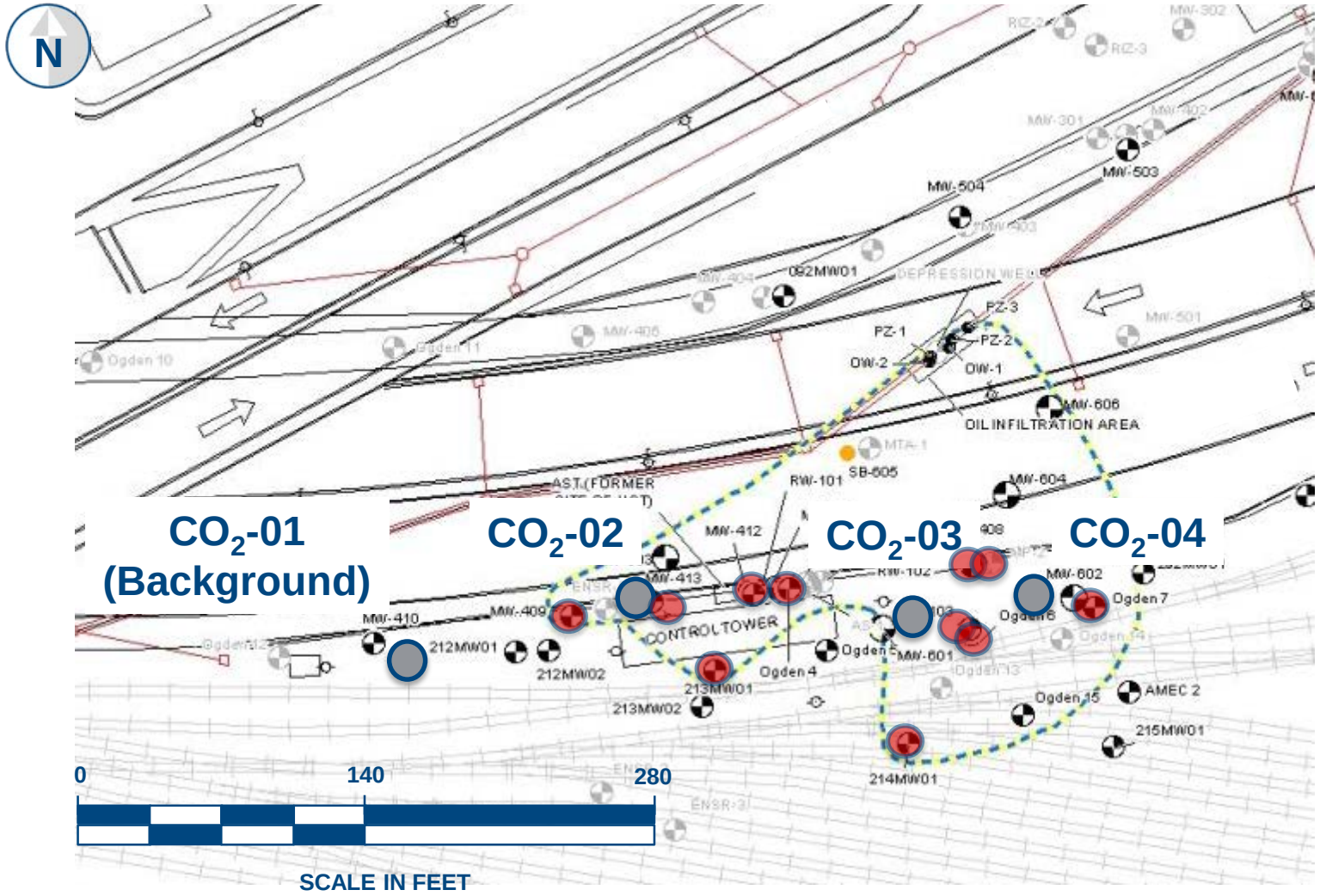
Migration control

- Any plume of dissolved or vapor phase contaminants emanating from NAPL is stable or contracting

NAPL meets following conditions:

- LNAPL footprint is stable (macro-scale)
- LNAPL with micro-scale mobility has been recovered, if feasible
  - LNAPL transmissivity defines feasible

NSZD EVALUATION
LOCATIONS



Location of Carbon Dioxide Trap

ARCADIS Design & Consultancy for natural and built assets

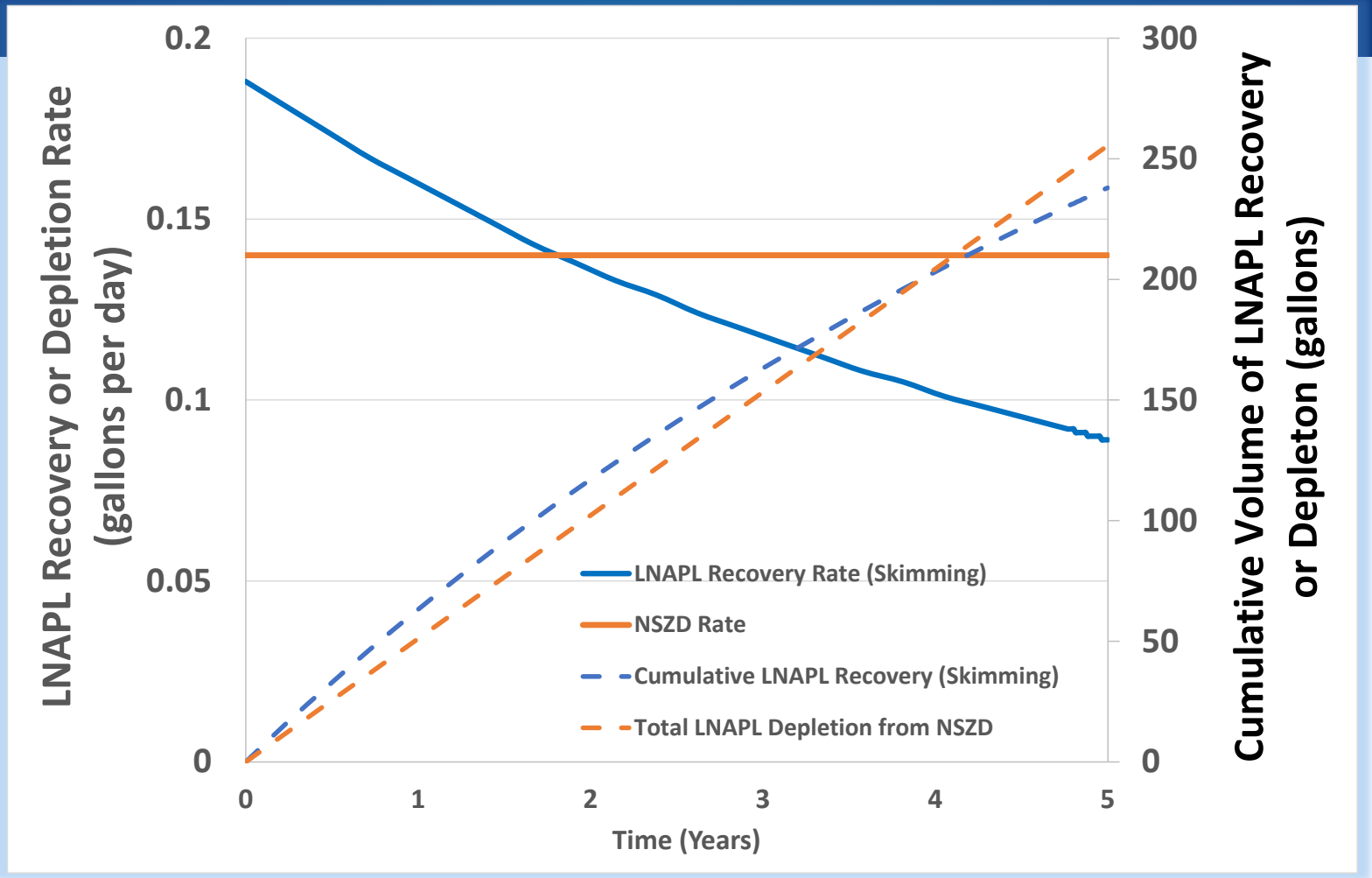
NSZD EVALUATION
RESULTS

Sample ID	Location	Background and ^{14}C Corrected NSZD Rates	
		Fossil Fuel CO_2 Flux	Corrected NSZD Rate
		µmol/m²/sec	gallons/acre/yr
CO_2-01	Background	0.52	0
CO_2-02	LNAPL Footprint	1.76	779
CO_2-03	LNAPL Footprint	3.45	1,832
CO_2-04	LNAPL Footprint	5.17	2,911
AVERAGE NSZD Rate in LNAPL Footprint		**3.46**	**1,800**

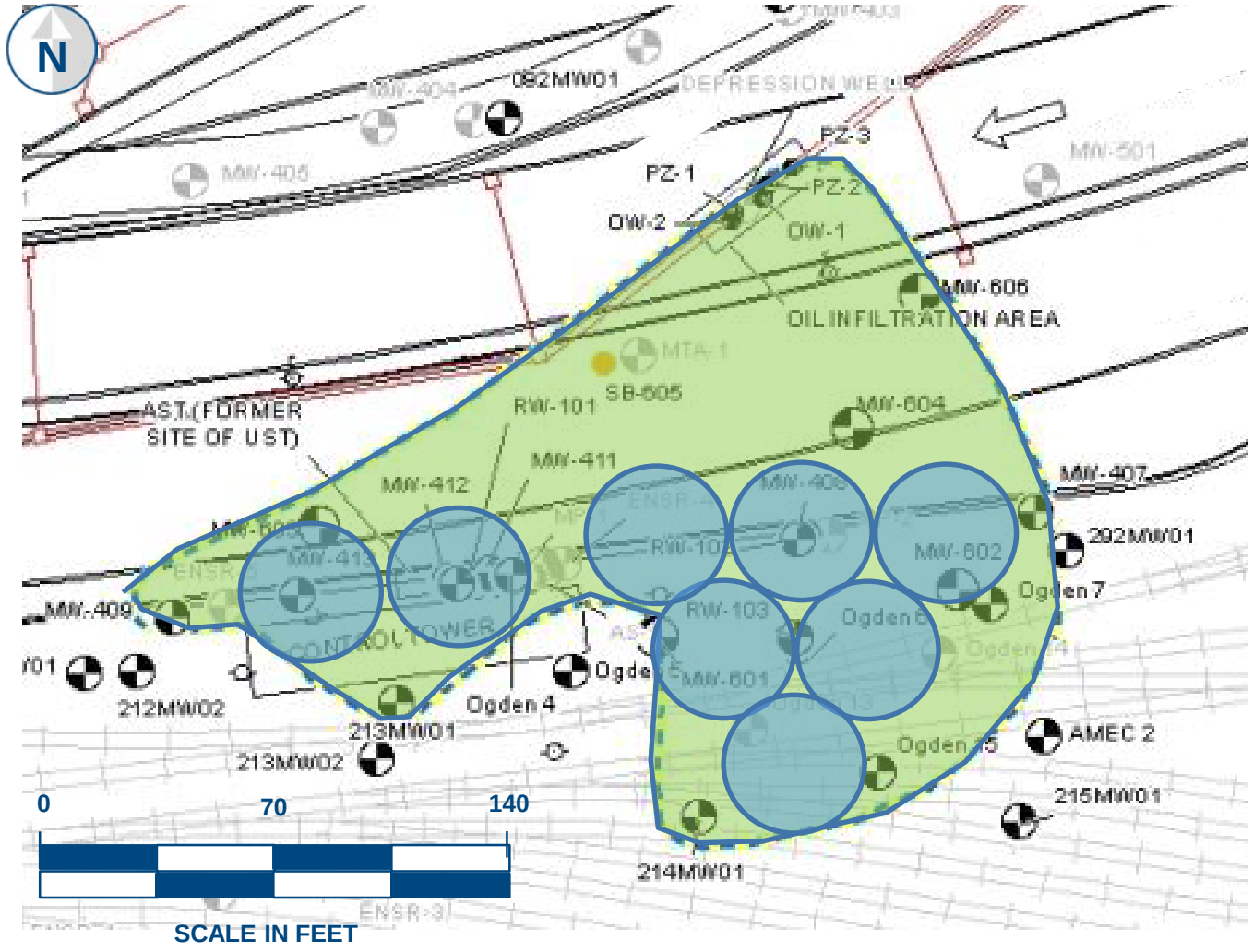
LNAPL TRANSMISSIVITY EVALUATION

Well ID	Date	Initial LNAPL Thickness	LNAPL thickness after ~24 Hours	LNAPL Transmissivity
		ft	ft	ft^2/day
RW-101	9/27/2012	0.16	0.06	**NA**
	9/5/2014	0.01	---	**---**
RW-102	9/27/2012	0.58	0.46	**0.6**
	9/19/2014	0.91	0.78	**0.6**
RW-103	9/27/2012	0.02	---	**---**
	9/19/2014	0.44	0.06	**<0.08**

NSZD VS. ACTIVE RECOVERY



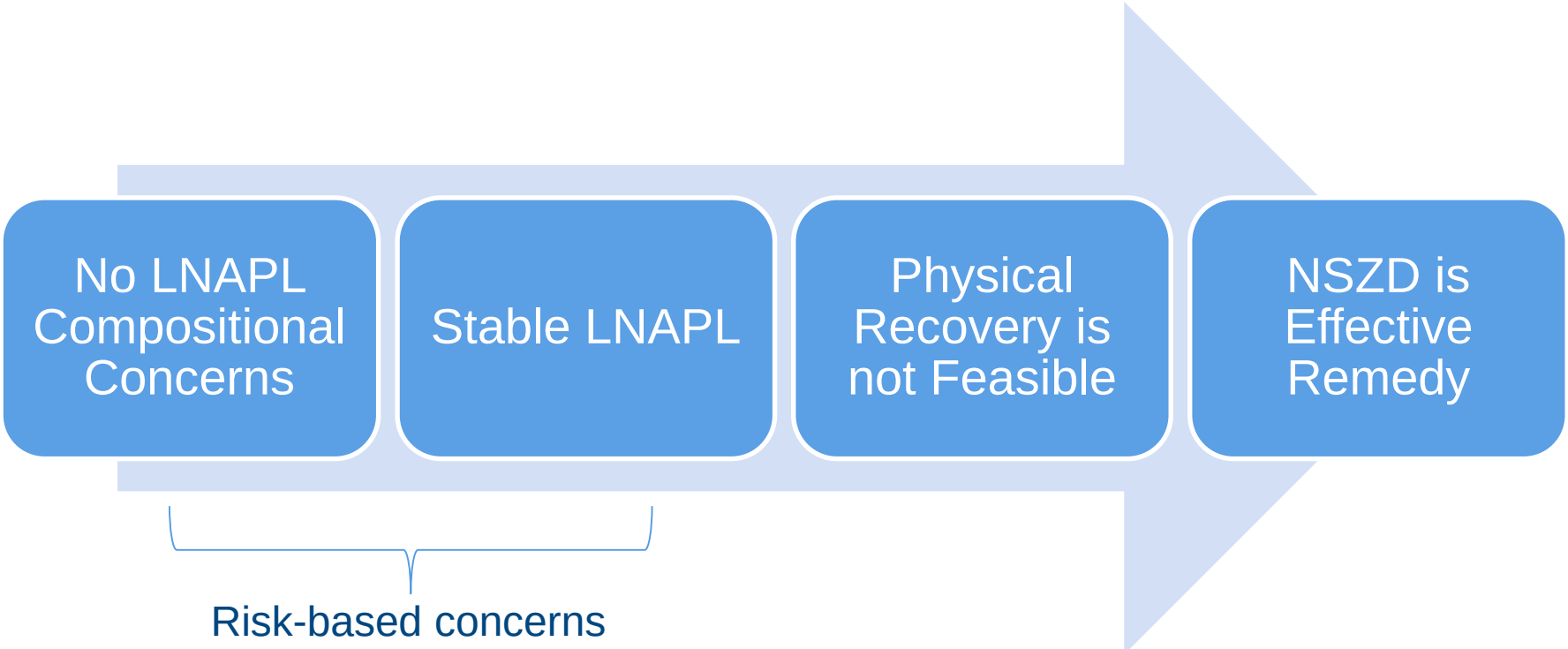
NSZD VS. ACTIVE RECOVERY



Theoretical ROI for LNAPL skimming well

Area outside LNAPL recovery influence

NSZD EVALUATION CONCLUSIONS



Sustainable, Effective, Long-Term Remedy

HOW TOMORROW MOVES

ARCADIS