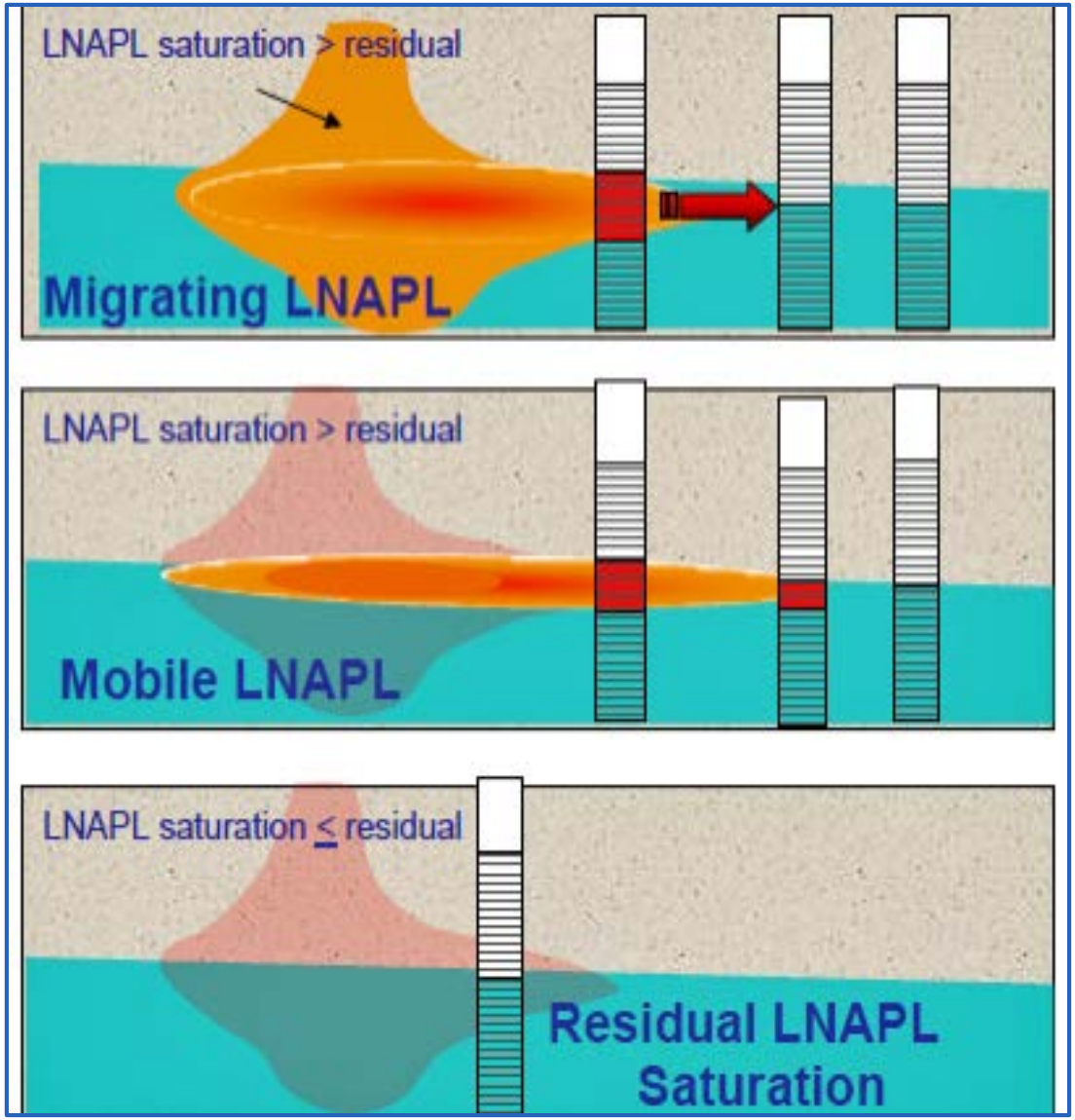


LNAPL Transmissivity

Acceptance and Use by the Regulatory Community

October 2017

LNAPL TRANSMISSIVITY (T_N) ACCEPTANCE AND USE BY THE REGULATORY COMMUNITY

- **Kimball, C.G., Hawthorne, J.M., Menatti, J.A., Rousseau, M.**

- **Historically, apparent NAPL thickness (ANT) gauged in wells has been utilized as the threshold metric for determining when LNAPL recovery was needed and the shutdown metric to signify the end-point to LNAPL recovery.**
- **LNAPL transmissivity (T_n) is an improved metric over ANT to quantify LNAPL recoverability and provides a reliable metric to define when LNAPL has been removed to the "Maximum Extent Practicable" (MEP), and may also be used to determine when hydraulic recovery of LNAPL may be a feasible LNAPL mass reduction technology.**

SURVEY GOALS AND METHOD

- **How is the T_n being used in the regulatory decision process, to determine:**
  - 1.) the feasibility of or regulatory requirement for hydraulic LNAPL removal
  - 2.) the ability to cease hydraulic LNAPL recovery based at least in part on T_n values while LNAPL is still present at a site

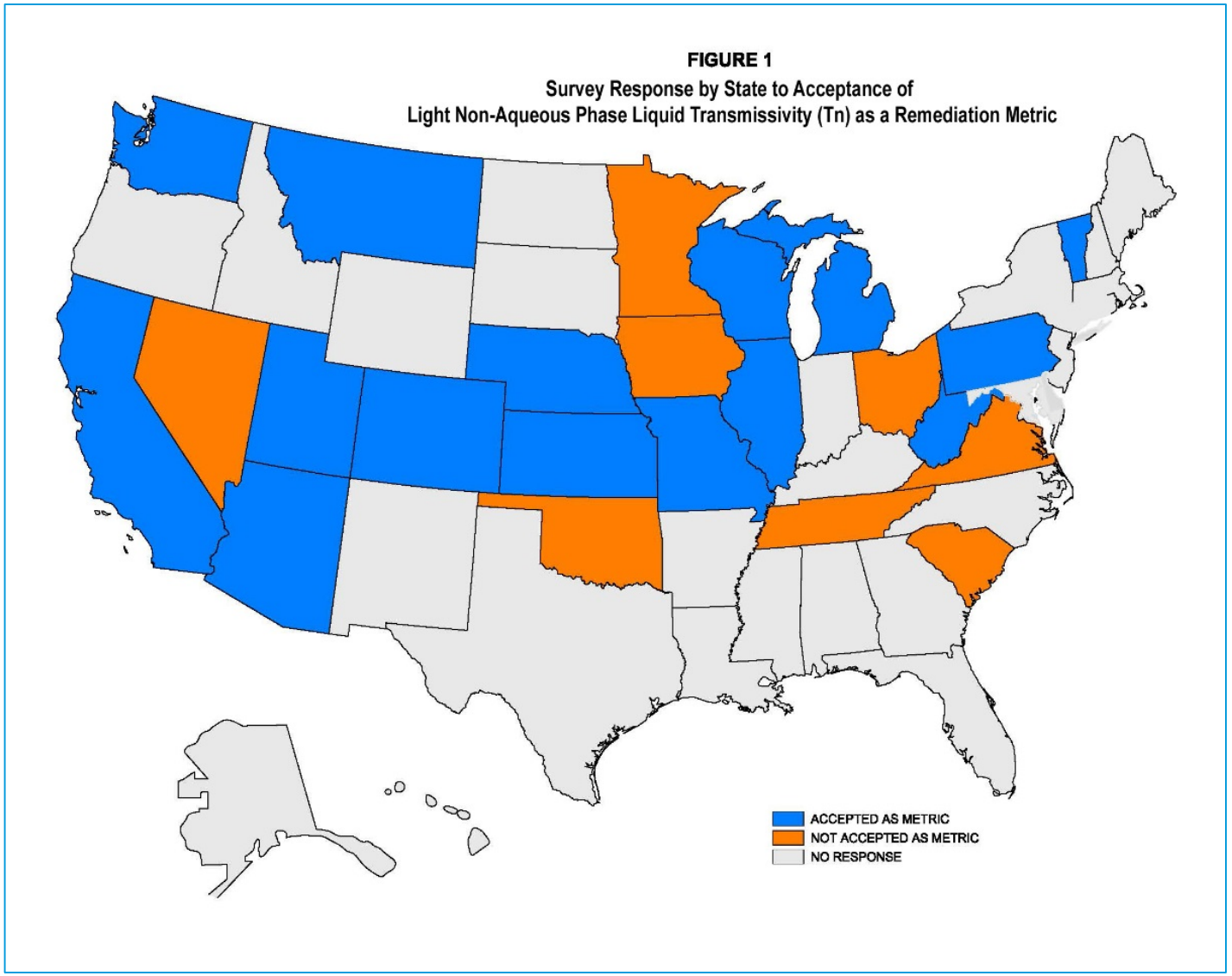
- **10 question internet survey**
  - United States, Canada, Australia and New Zealand

- **26 of 50 US State Regulators responded**

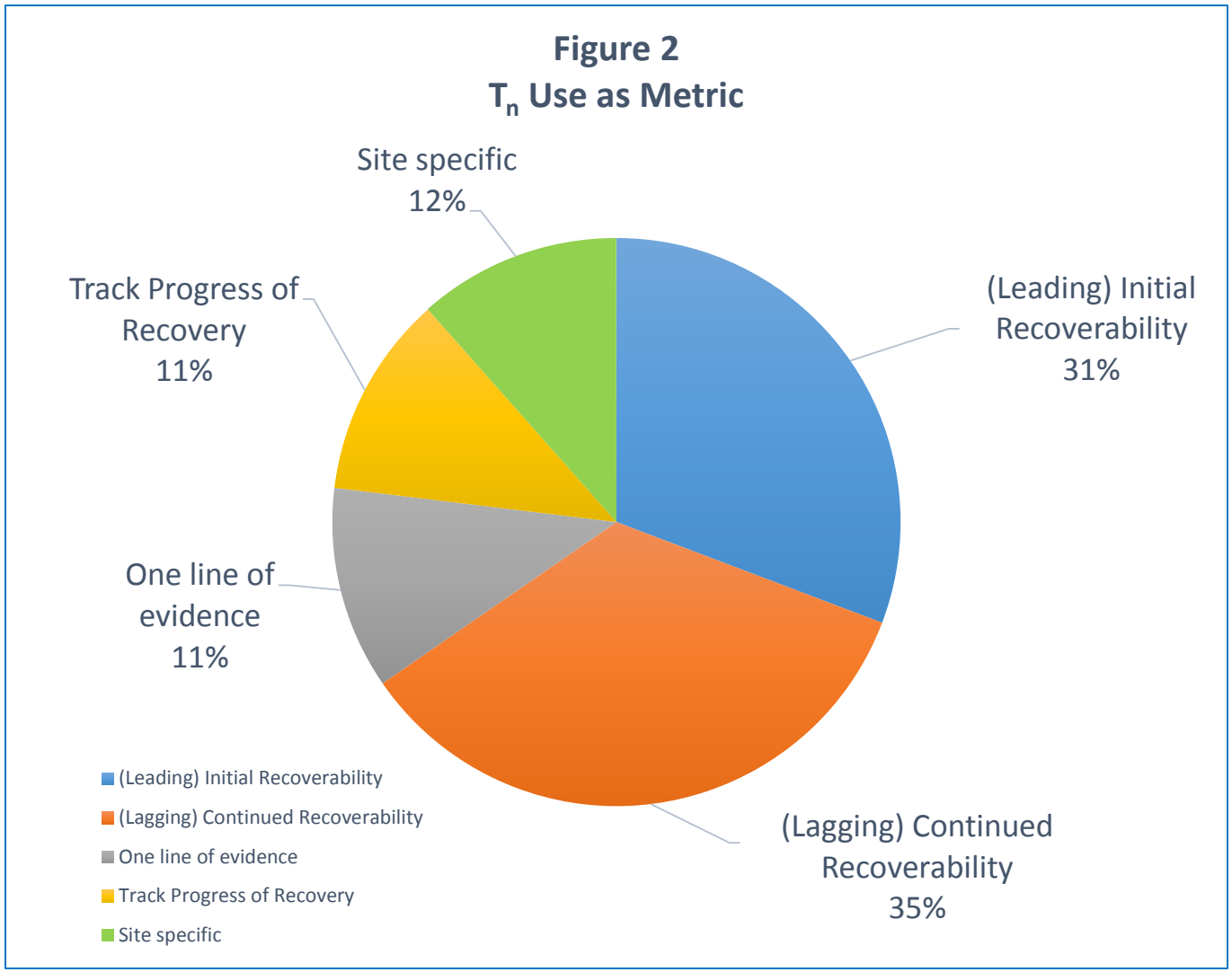
- **US response is the primary focus, international comparison where appropriate**

STATE ACCEPTANCE OF T_N AS A METRIC

- 26 responses
- (blue) 18 (69%) accept Tn as a metric
- (orange) 8 (31%) do not accept Tn as a metric
- International 67% accept T_n: Canada 60%, Australia 100%, New Zealand 0%



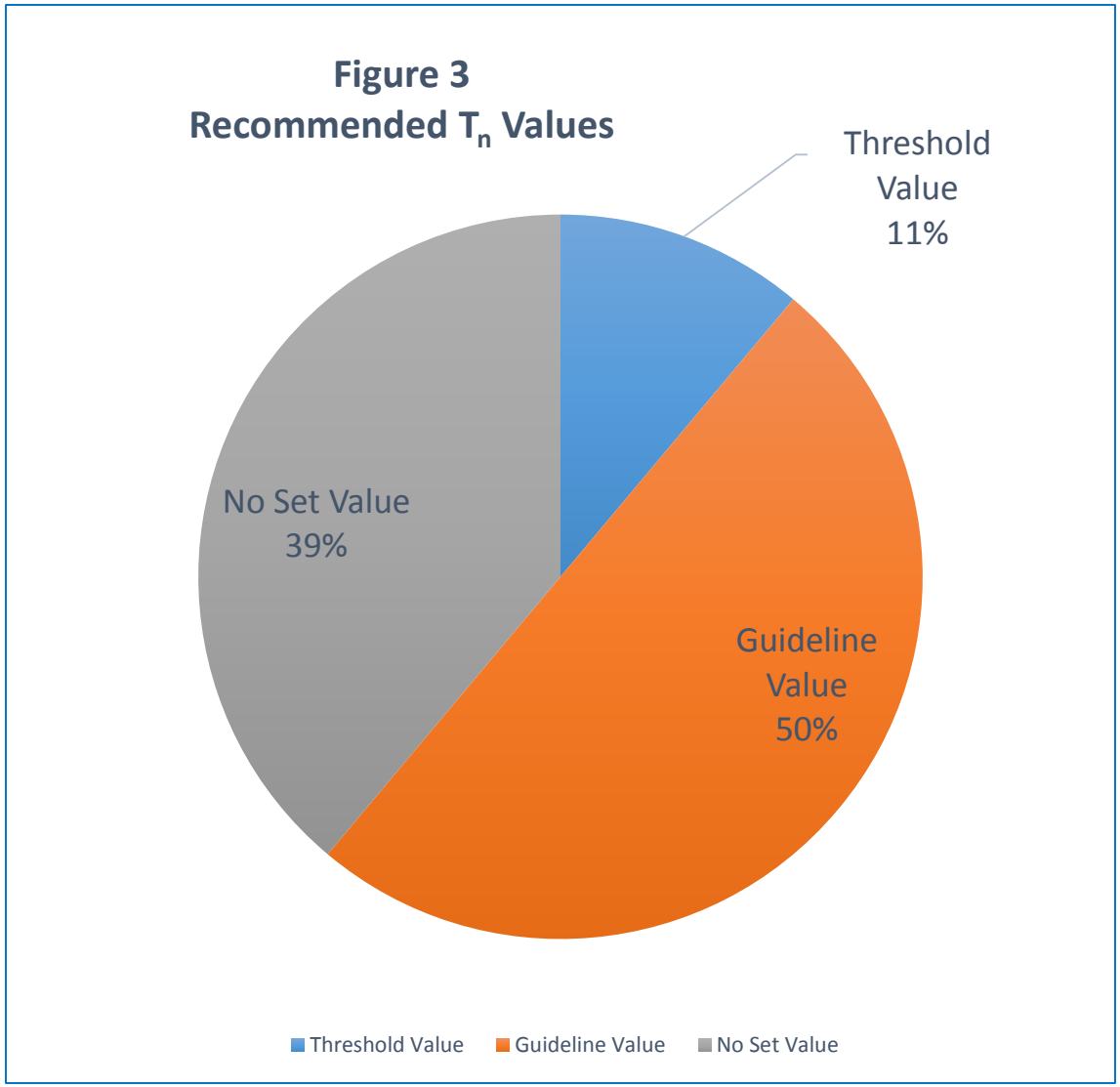
WHEN DOES YOUR REGULATORY AGENCY ACCEPT LNAPL TRANSMISSIVITY AS A METRIC TO DETERMINE IF LNAPL HYDRAULIC RECOVERY IS FEASIBLE OR REQUIRED?



- leading metric 31%
- lagging metric 35%
- additional line of evidence 11%
- track the ongoing progress of recovery 11%
- contingent on site specifics12%

- When asked specifically about using T_n to support that LNAPL has been removed to the "*Maximum Extent Practicable*", 50% indicated that it is accepted as a line of evidence.

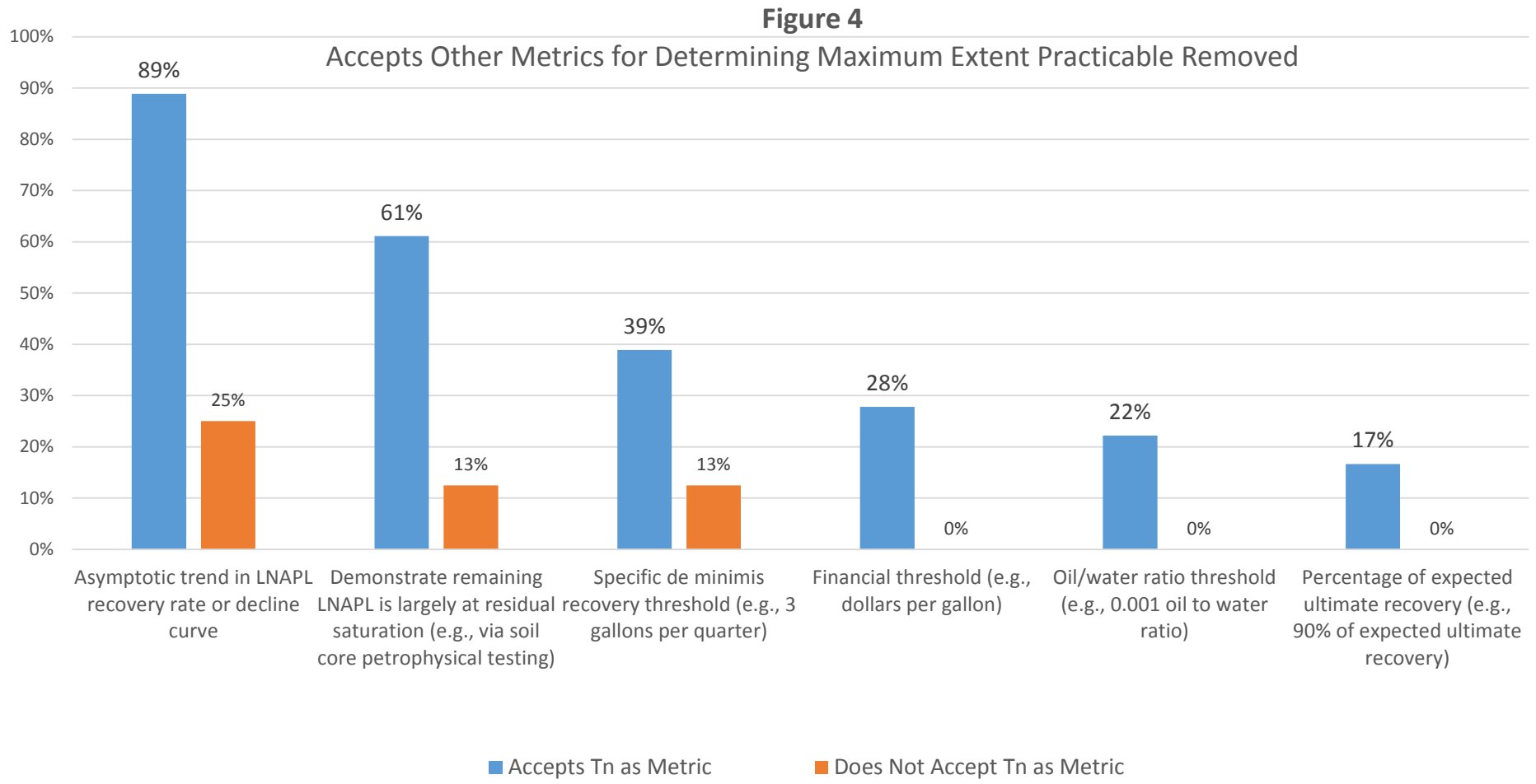
WHAT T_N VALUE DOES YOUR REGULATORY AGENCY ACCEPT AS A THRESHOLD FOR MAKING DECISIONS?



For those accepting T_n:

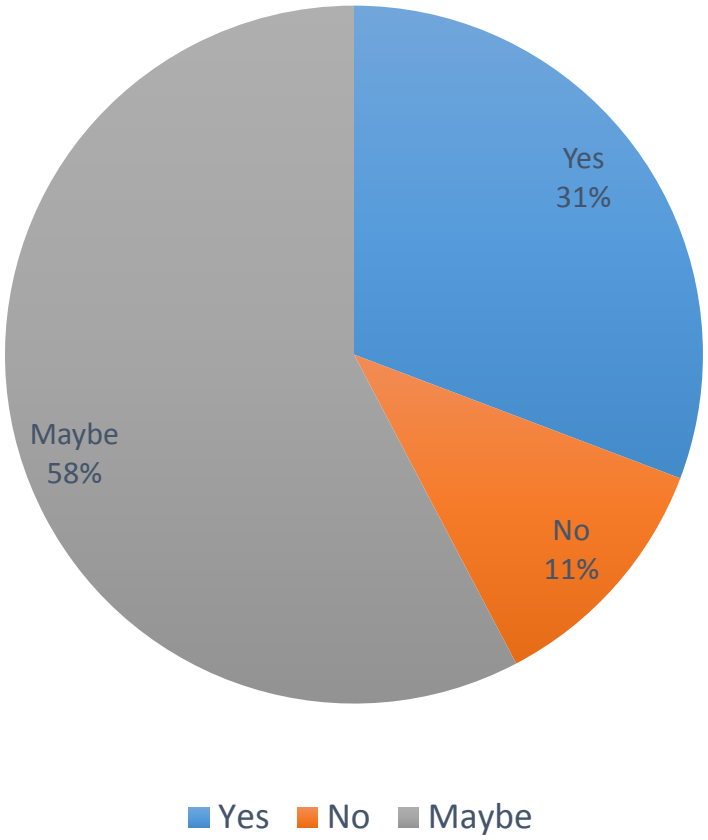
- 11% (two states) have set a numeric threshold value below which hydraulic recovery is not effective or efficient (0.5 ft^2/d and 0.8 ft^2/d).
- 50% have numeric guidelines of 0.1 to 0.8 ft^2/d (ITRC 2009 guidelines)
- 39% have not offered numeric guidelines but consider it to be negotiable dependent upon site conditions

WHAT OTHER METRICS DOES YOUR AGENCY ACCEPT TO DETERMINE WHEN LNAPL HAS BEEN REMOVED TO THE "MAXIMUM EXTENT PRACTICABLE"?



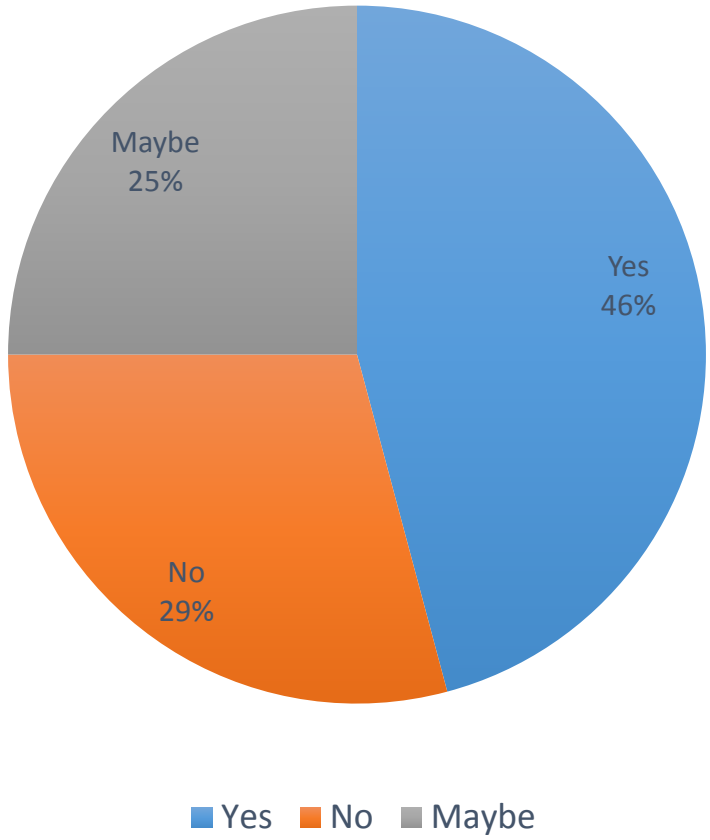
WOULD YOU CLOSE A SITE WITH LNAPL? WOULD IT REQUIRE INSTITUTIONAL CONTROLS?

Figure 5
Would you Close a Site with Mobile, Not Migrating LNAPL



89% consider it a possibility

Figure 6
Would you Require Institutional Controls to Close a Site with LNAPL



71% want Institutional Controls

DOES THE AGENCY REQUIRE T_N TESTING PER ASTM?
DOES THE AGENCY ACCEPT THE API WORKSHEET?

Figure 7
Require ASTM Guidance for T_n Testing

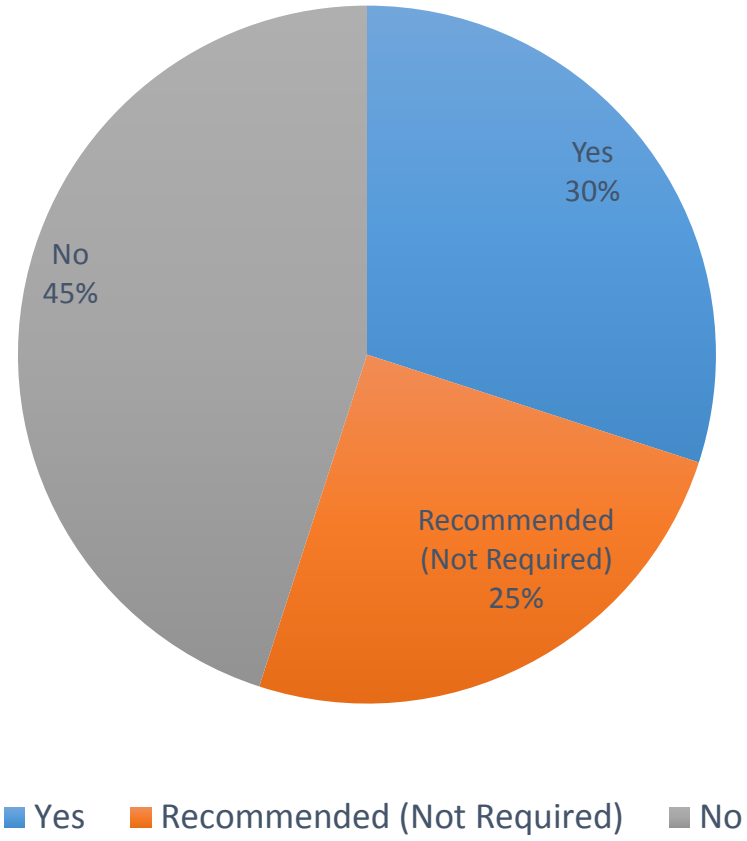
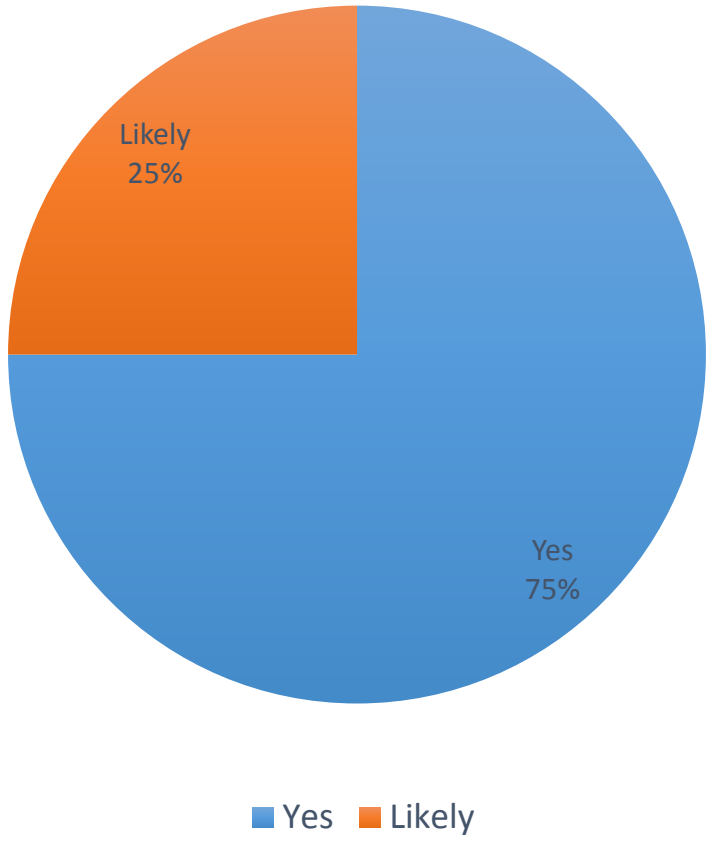
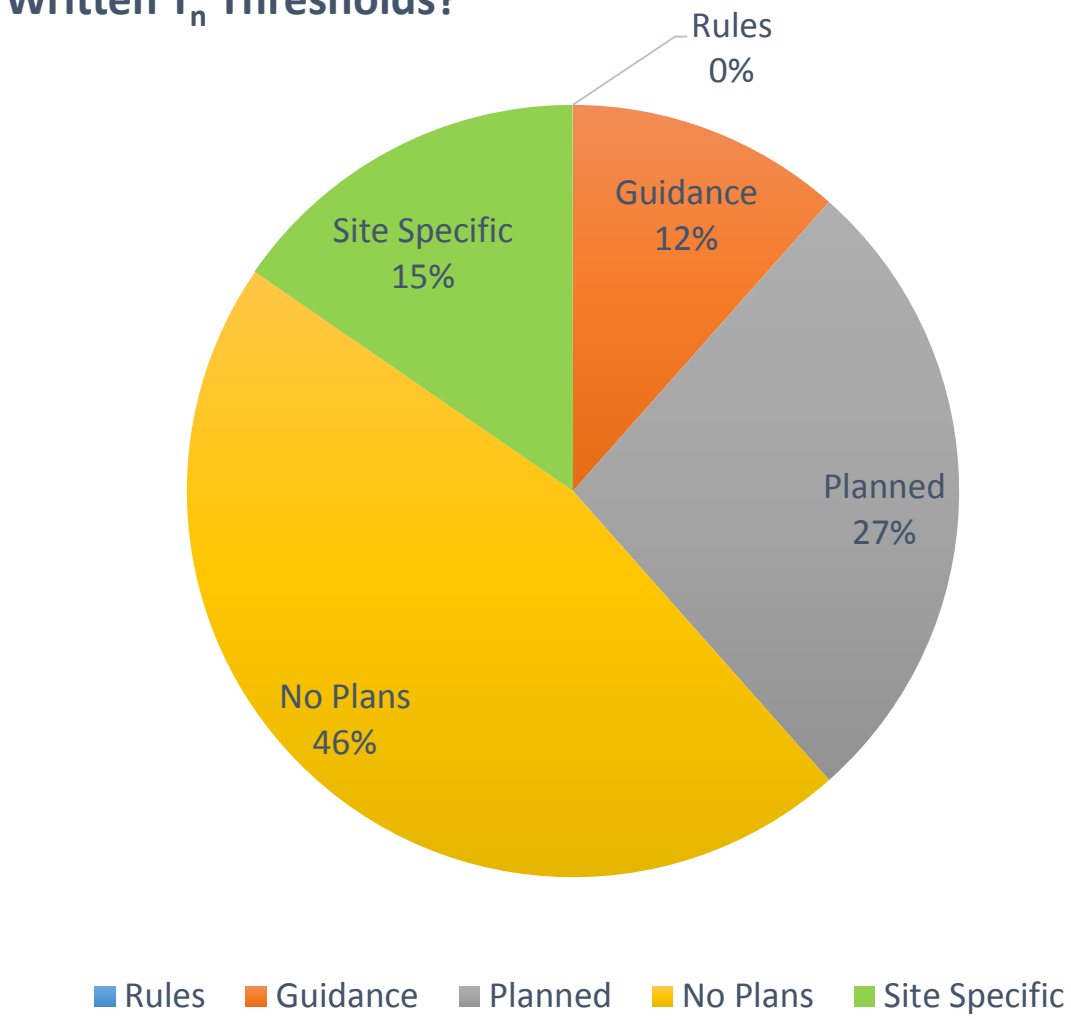


Figure 8
Accept API Worksheet to Calculate T_n



HAS YOUR REGULATORY AGENCY WRITTEN LNAPL TRANSMISSIVITY THRESHOLDS INTO RULES OR GUIDANCE DOCUMENTS?

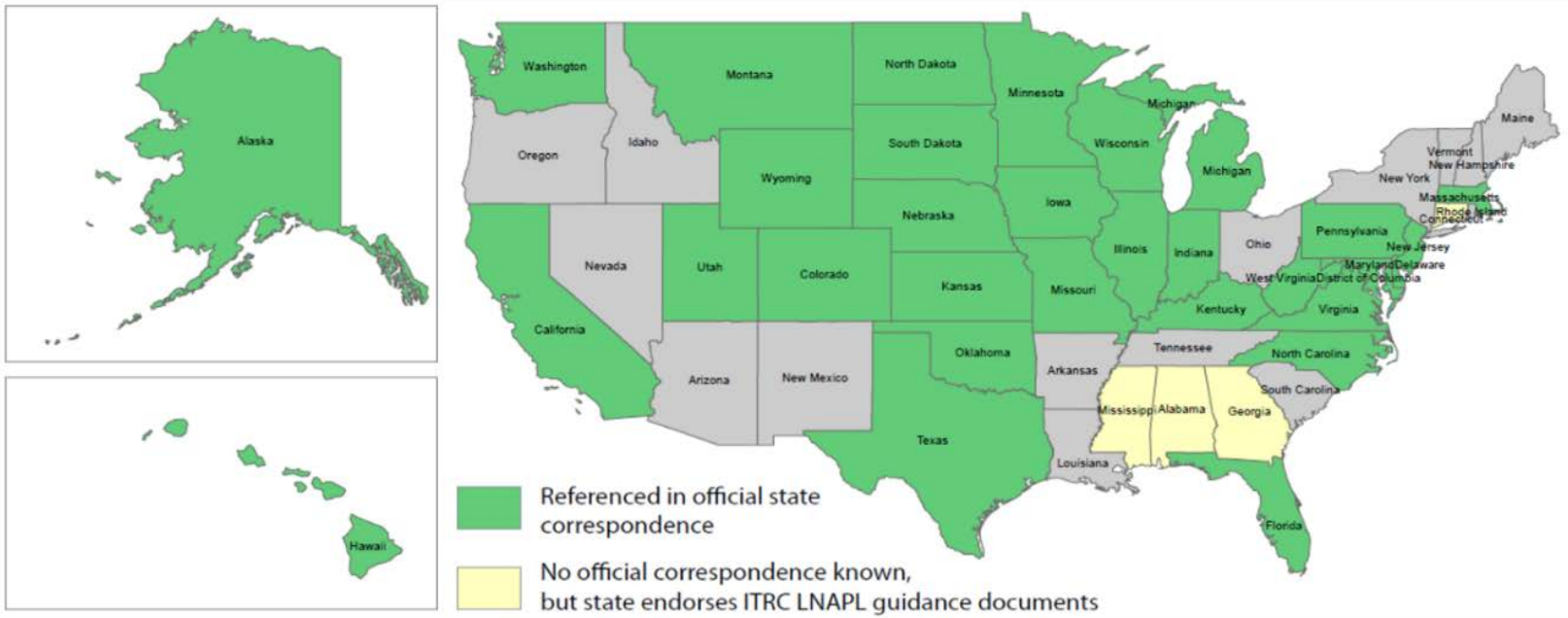
Figure 9
Written T_n Thresholds?



- 12% (two states), have written guidance that includes T_n thresholds
- 15% indicated that there could be written thresholds on a site specific basis: some had procedures but no thresholds, others would consider a lagging threshold depending on the site conditions
- 27% of the responding states are planning to propose written T_n thresholds as rules or guidance
- 46% do not have plans to incorporate T_n thresholds into rules or guidance documents

INFORMAL SURVEY

Figure 10 **A regulatory framework exists. T_n has been accepted in most states in official state correspondence as a remedy start-up metric, progress metric, remedy shutdown metric, and/or to represent MEP.**



Several states have also included LNAPL transmissivity metrics in regulations and/or official guidance documents.

Modified after Hawthorne et al (2016)

State	T_n Threshold	Metric Use
Massachusetts	0.8 ft^2/day	MEP
Kansas	0.8 ft^2/day	MEP
Michigan	0.5 ft^2/day	MEP
Colorado	Site-Specific	MEP
Virginia	Site-Specific	MEP
Iowa	N/A	Site Characterization

COMPARED TO 2009

- **The ITRC 2009 guidance document (*Evaluating LNAPL Remedial Technologies for Achieving Project Goals, Technical/Regulatory Guidance)* included the results of a survey of all 50 states**
  - 38 states responded

- **Using LNAPL thickness as a basis to determine if remediation is required dropped from 18% in 2009, to approximately 3% in 2016**

- **Considering the conditions needed to terminate active remediation systems: In 2009 40% responded that all measurable LNAPL must be remediated, in 2016 approximately 8% of respondents indicated that LNAPL thickness is a primary factor for ending remediation**

CONCLUSIONS

The determining factor for the feasibility of LNAPL hydraulic recovery continues to move away from using measurable thickness in a monitoring well (ANT) as the primary factor. Remediation efforts and site closure are considering site specific geologic conditions, receptor health risks and a growing acceptance of T_n as a way to quantify the recoverability of LNAPL. For most, T_n is primarily a line of evidence, but some regulatory agencies are beginning to establish thresholds for when hydraulic LNAPL recovery could be initiated or may be terminated.