Beyond Generic Criteria: Using Screening-level Risk Assessment to Support Practical, Defensible Due Diligence Decisions

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Conducting Environmental Due Diligence Investigations

- Generic regulator-published criteria (i.e., Tier 1 guidelines) are often used for environmental due diligence investigations
- Tier 1 Guidelines are conservative
  - Developed using default site-specific conditions
  - Developed considering many exposure scenarios
  - Not all exposure scenarios are applicable to all sites, especially in urban settings
- Use of Tier 1 guidelines is <u>not mandatory</u>
  - Generally results in overestimating the risk to receptors
  - Could result in unnecessary costs for interventions (i.e., remediation)

A Deeper Look Into Tier 1 Guidelines

- Focus investigations on what matters
  - Focus on what is driving the risk on a site
- Site-specific risk assessments (SSRAs) are an option
  - But are in-depth analysis of each exposure pathway and review of all regulatory assumptions for criteria development required?
- Consider use of screening-level risk assessments (SLRAs) in due diligence

What Do I Mean by SLRA?

- SLRA = Screening-level risk assessment
  - A site-specific evaluation that considers the relevant exposure pathways and receptors
  - Examines which exposure pathways and receptors are driving the risk at the site
  - Looks behind the Tier 1 exceedances

What Do I Mean by SLRA?

- Generic regulatory criteria are pathway-specific
  - They break criteria into acceptable values for each exposure pathway
- An SLRA can modify input parameters to regulatory models
  - Update of select site-specific parameters
  - Otherwise, an SLRA uses the same models and assumptions as regulator-published criteria
  - Offers results of site-specific criteria for each exposure pathway
- Consider qualitative assessment
  - i.e., depth of exceedances relative to an exposure point

Additional Uses of SLRAs

- Allows for identification of exposure control measures
  - Hard or fill capping
  - Administrative exposure control measures
    - Health and safety plans
    - Prohibitions (i.e., potable wells)
- Establish site-specific guidelines
- Site-specific criteria are protective of relevant exposure scenarios specific to the site

Flexibility in SLRA Approach

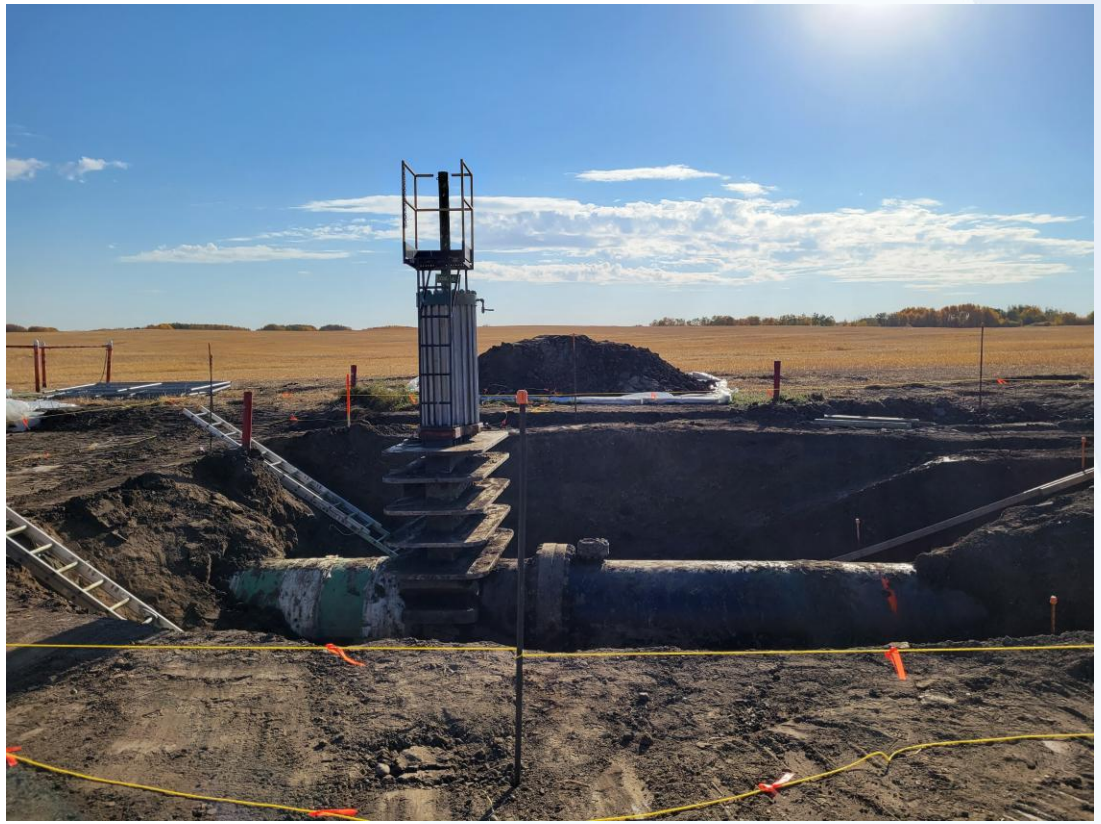
- Standalone SLRA report
- Discussion of site-specific pathways within other reports including:
  - Phase II environmental site assessment
  - Soil and/or groundwater quality investigation
- A conceptual site model (CSM) is required to support the SLRA

Increased Acceptance of SLRAs

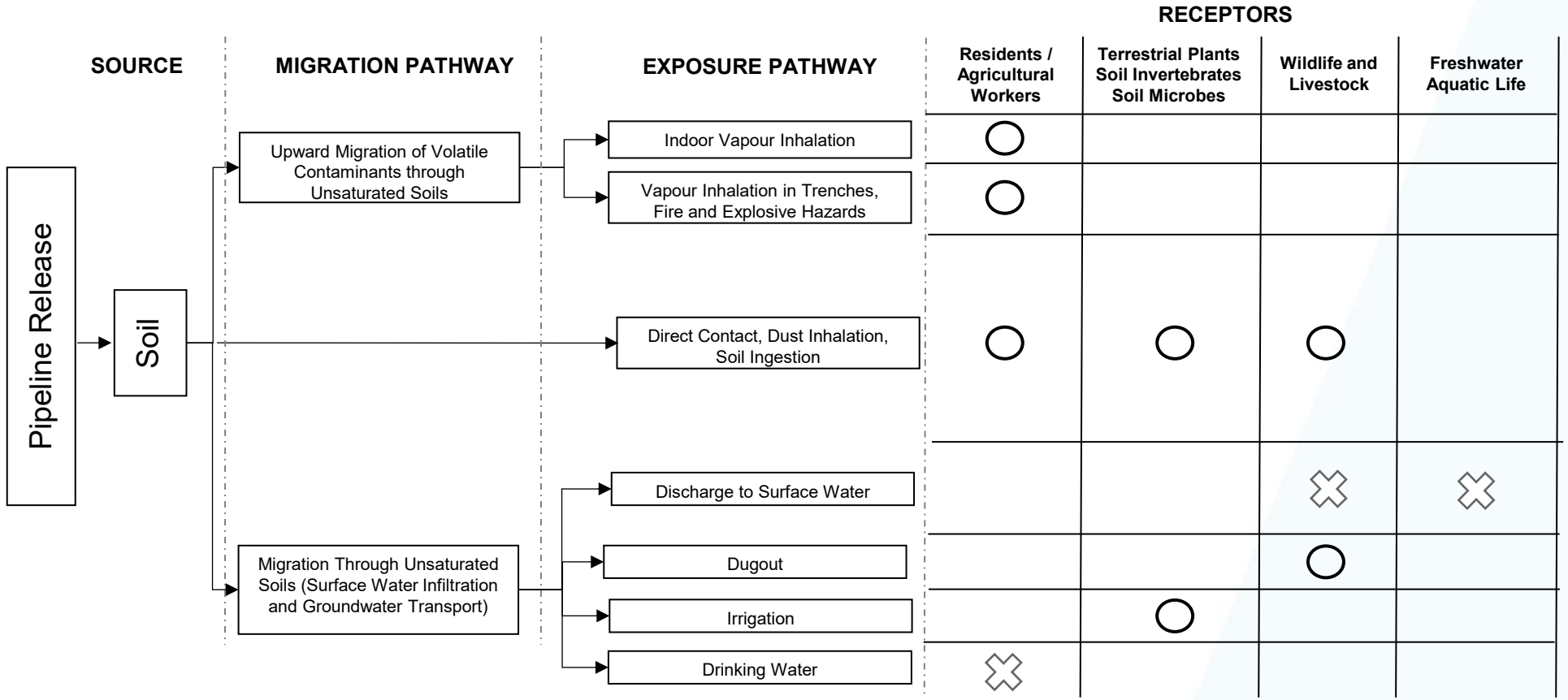
- Trace Associates Inc. has had success implementing SLRA approaches in multiple provinces within the due diligence framework
- SLRAs enable site-specific, defensible, cost-effective decisions
- Increasing acceptance by:
  - Financial lenders
  - Real estate brokers
  - Insurers
  - Corporate risk managers

Case Study No. 1 – Federal Pipeline

- Petroleum hydrocarbon (PHC) impacts identified in soil during pipeline construction
- Concentrations post-remediation above guidelines in soil (PHCs and polycyclic aromatic hydrocarbons) and groundwater (benzene and PHC fraction [F]2)
- Lateral and vertical delineation achieved in soil and groundwater
- Stable or decreasing trends in groundwater



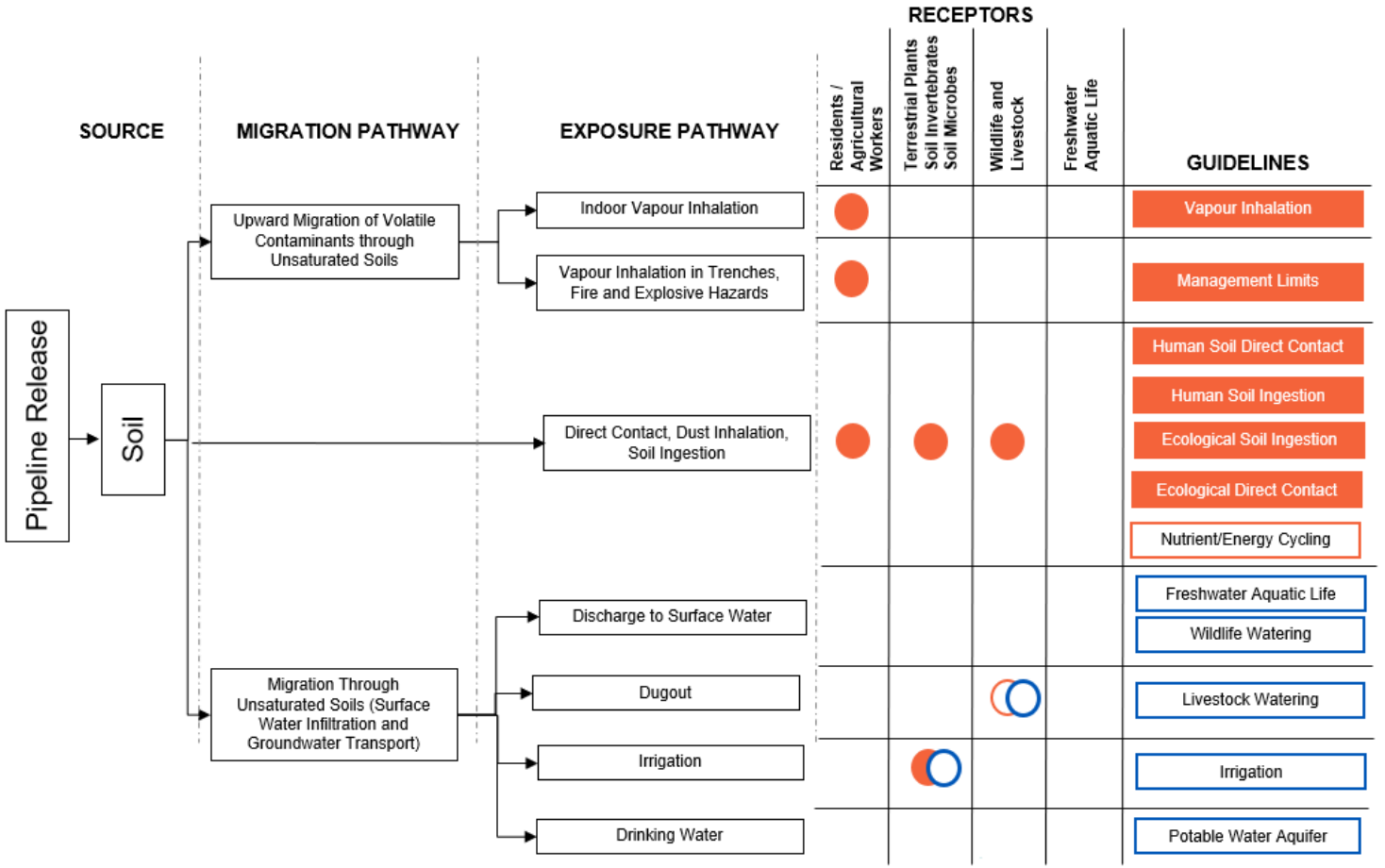
Case Study No. 1 – Conceptual Site Model



Case Study No. 1 – Evaluation Process

Pathway	Benz(a)anthracene	Benzo(b+j)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Chrysene	Dibenz(a,h)anthracene	Indeno(1,2,3-c,d)pyrene	B(a)P TPE[a]	Index of Additive Cancer Risk (CCME)	Anthracene	Fluoranthene	Fluorene	Naphthalene	Phenanthrene	Pyrene
Maximum Concentrations (mg/kg)	**10.7**	**12**	**4.07**	**9.14**	**9.2**	**0.84**	**3.31**	**13.1**	**167**	**8.43**	**29.5**	**7.31**	**19.8**	**38**	**24.7**
Human Direct Contact	-	-	-	-	-	-	-	**5.3**	-	-	-	-	-	-	-
~~Protection of Domestic Use Aquifer~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~1~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~
Ecological Soil Contact	-	-	-	20	-	-	-	-	-	**2.5**	50	-	-	-	-
Soil and Food Ingestion	**6.2**	**6.2**	6.2	**0.6**	**6.2**	-	-	-	-	61.5	**15.4**	15.4	**8.8**	43	**7.7**
~~Protection of Freshwater Life~~	~~-~~	~~-~~	~~-~~	~~8,800~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~0.25~~	~~0.013~~	~~0.046~~	~~-~~
Interim/Provisional	**0.1**	**0.1**	**0.1**	**0.7**	-	**0.1**	**0.1**	-	-	-	-	-	**0.6**	**0.1**	**0.1**

Case Study No. 1 – Conceptual Exposure Model



- Based on soil data
- Based on groundwater data
- Exposure Scenario of potential concern (max > guideline)
- Exposure Scenario of potential concern (max < guideline)

Case Study No. 2 – Calgary Commercial / Light Industrial Site

- Large commercial / light industrial site within Calgary city limits
- Following subsurface investigations, concentrations of select parameters were identified above generic criteria
  - In soil and groundwater
  - Lateral and vertical delineation achieved
- Purchaser wanted to understand the liability and quantify the risk during negotiations



Case Study No. 2 – Existing Administrative Controls

- The City of Calgary *Water Utility Bylaw 40M2006*
  - Potable groundwater wells are prohibited for domestic use within the City of Calgary
- Use of groundwater as potable water not an exposure pathway at the site
- Check bylaws within the municipality for existing administrative exposure controls
  - Process implemented by Alberta Environment and Protected Areas



https://www.calgary.ca/environment/resources/guide-to-excluding-domestic-use-aquifer.html

Case Study No. 2 – Classification of Pathways by Area

	Soil	
Pathway	**Xylenes**	**Naphthalene**
Maximum Concentrations (mg/kg)	**3.94**	**0.364**
Human Direct Contact	780	3,000
~~Protection of Domestic Use Aquifer~~	~~0.99~~	~~28~~
Vapour Inhalation	790	**1,600**
Off-Site Migration	7,300	29,000
Ecological Direct Soil Contact	**230**	-
~~Protection of Freshwater Life~~	-	~~0.014~~
SSGLs for Purpose of SLRA	**230**	**1,600**

	Groundwater			
Pathway	**Benzene**	**Ethylbenzene**	**Xylenes**	**Naphthalene**
Maximum Concentrations (mg/L)	**0.115**	**0.02**	**0.07**	**0.002**
~~Potable Groundwater~~	~~0.005~~	~~0.0016~~	~~0.02~~	~~0.47~~
Ecological Direct Soil Contact	**100**	**42**	**21**	-
~~Aquatic Life~~	~~3.6~~	-	-	~~0.001~~
Wildlife Watering	6.8	-	-	-
SSGLs for Purpose of SLRA	**100**	**42**	**21**	**-**

Case Study No. 3 – Ontario Commercial Plaza

- Large commercial plaza
- Historical dry cleaning in one unit
  - Volatile organic compounds in groundwater
- Preparation for potential remediation activities
- Main differences from generic:
  - Shallow groundwater conditions
  - Distance to downgradient waterbody compared to generic

Table B: Modified Generic Risk Assessment Model Input Parameters

Site Descriptor Inputs	Generic Value	Site-specific Settings
Proposed land use	-	Industrial/commercial/community
Site soil texture	-	Coarse
Potable or non-potable groundwater condition	-	Non-potable
Stratified or full-depth cleanup	-	Full depth
Within 30 m of surface water?	-	More than 30 m to surface water
Is the soil less than 2 m deep?	-	Less than 2 m*
Distance from source centre to downgradient waterbody	36.5 m	780 m
Fraction of organic carbon (FOC) - water table to soil surface	0.005 g/g	No change from default
FOC - in upper 0.5 m	0.01 g/g	No change from default
Minimum depth below soil surface to highest annual water table	300 cm	78 cm
Soil type - vadose zone	Generic coarse	No change from default
Soil type - capillary fringe	Sand	No change from default
Number of frozen ground days per year	100 days	90 days
Aquifer horizontal hydraulic conductivity	0.00003 m/s	No change from default
Aquifer hydraulic gradient	0.003 m/m	No change from default
Aquifer dry bulk density	1.81 g/cm^3	No change from default
Aquifer FOC	0.0003 g/g	No change from default

Modification of Input Parameters to Regulatory Model

TIER 2 INPUT PARAMETERS	Tier 2 Adjustable Values		
Distance from source centre to downgradient surface water body	36.5		m
SUBSURFACE PROPERTIES			
	Coarse Soil Setting	Medium/Fine Soil Setting	
Fraction of organic carbon (FOC) – water table to soil surface	0.005	0.005	g/g
Fraction of organic carbon (FOC) – in upper 0.5 m	0.01	0.035	g/g
Minimum depth below soil surface to the highest annual water table	300		cm
Soil Type – vadose zone	Generic Coarse	Generic Medium&Fine	NOTE : Soil Type should normally be consistent with Site Soil Texture
Soil Type – capillary fringe	Sand	Loam	
Number of frozen ground days per year	100		days
Aquifer horizontal hydraulic conductivity	3.0E-05		m/sec
Aquifer hydraulic gradient	0.003		m/m
Aquifer dry bulk density	1.81		g/cm^3
Aquifer fraction organic carbon	0.0003		g/g
Depth below soil surface to soil vapour measurement	258		cm

https://files.ontario.ca/moecc-41-figure-4.1.jpg

- Site-specific geophysical parameters
  - Distance to downgradient waterbody
  - Minimum depth of groundwater
  - Soil type
  - Horizontal hydraulic conductivity
  - Horizontal hydraulic gradient
  - Fraction organic

Assumptions for Each Pathway

Appendix 3 Chart to identify which Tier 2 input parameters affect which pathways (subsurface transport components)

Pathway\ Tier2 Input Parameters	S-IA*	S-Odour	S-GW1	S-GW3	S-OA	GW1	GW2	GW2-Odour	GW3	Free Phase Threshold
Distance to surface water	NA	NA	NA	✓	NA	NA	NA	NA	✓	NA
Soil FOC – water table to soil surface	✓	NA	✓	✓	✓	NA	NA	NA	NA	✓
Soil FOC – upper 0.5m	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA
Depth to water table	NA	NA	NA	NA	NA	NA	✓	✓	NA	NA
Property Soil Type – vadose zone	✓	✓	✓	✓	✓	NA	✓	✓	NA	✓
Property Soil Type – capillary fringe	NA	NA	NA	NA	NA	NA	✓	✓	NA	NA
# Frozen Days	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA
Aquifer horizontal hydraulic conductivity	NA	NA	NA	✓	NA	NA	NA	NA	✓	NA
Aquifer horizontal hydraulic gradient	NA	NA	NA	✓	NA	NA	NA	NA	✓	NA
Aquifer dry bulk density	NA	NA	NA	✓	NA	NA	NA	NA	✓	NA
Aquifer FOC	NA	NA	NA	✓	NA	NA	NA	NA	✓	NA

* Best method to do Tier 2 on S-IA pathway is using soil vapour screening methods as described in the body of this document or by selection RMMs that mitigate the vapour intrusion pathway.

NA = not applicable for pathway; ✓ = applicable for pathway

https://files.ontario.ca/mgra_user_guide_tier_2_final_aoda.pdf

- Understand the regulatory guidance's generic assumptions
  - *Rationale for the Development of Soil and Ground Water Standards for Use at Contaminated Sites in Ontario*
- Understand how each input parameter affects each pathway
  - *MGRA User Guide*

Case Study No. 3 – Property-specific Standards

Table C: Property-specific Standards	
Parameter	PSS (Developed From MGRA Model)
PSS for Soil (µg/g)	
1,1-DCE	0.064
Cis-DCE	55
Trans-DCE	1.3
PCE	4.5
TCE	0.0051
VC	0.032
PSS for Groundwater (µg/L)	
Benzene	2.8
Chloroform	180
1,1-DCE	1.2
Cis-DCE	1.2
Trans-DCE	1.2
PCE	1.2
TCE	0.86
VC	0.12

SLRAs in Due Diligence

- SLRAs are a useful tool that can be implemented at any point following the establishment of a robust CSM
- SLRAs enable site-specific, defensible, cost-effective decisions
- Tailor approach depending on complexity
- Increasing acceptance by various stakeholders



QUESTIONS?

We're Here to Help.

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