ARCADIS Design & Consultancy for natural and built assets

Programmatic Approaches to Assessing and Mitigating Risk to Pipelines from Natural Forces

23rd International Petroleum Environmental Conference

New Orleans, Louisiana

November 8-10, 2016

Introduction

Jeff Budzich, PE

Principal Engineer/Program Manager
Syracuse, New York

jeffrey.budzich@arcadis.com
315-671-9510

Arcadis Statistics

- Global design, engineering and management consulting company
- 350 offices in 40 countries
- 28,000 professionals worldwide
- >6,000 professionals in North America

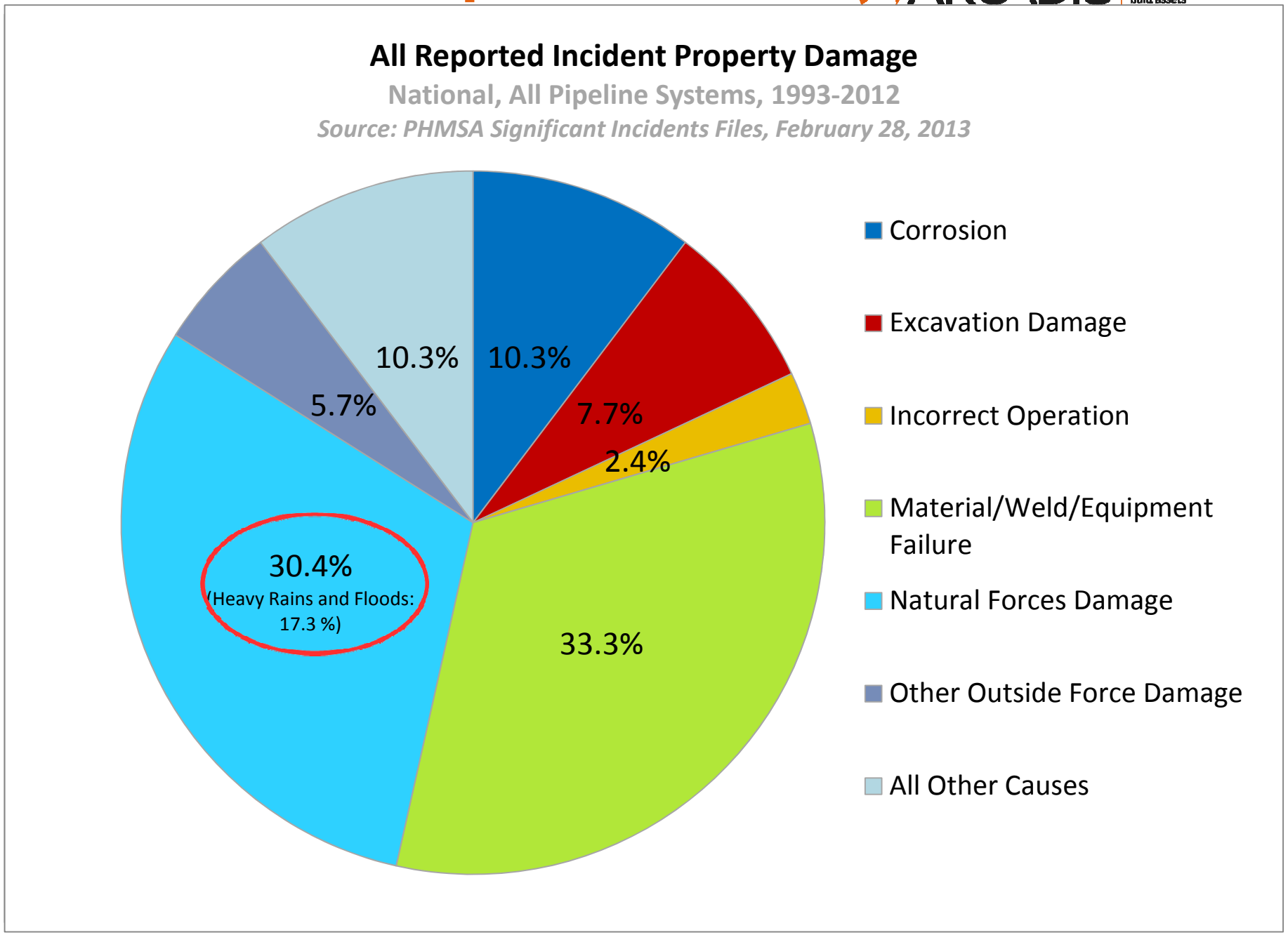
Arcadis has been providing services to the oil & gas industry for more than SIX decades

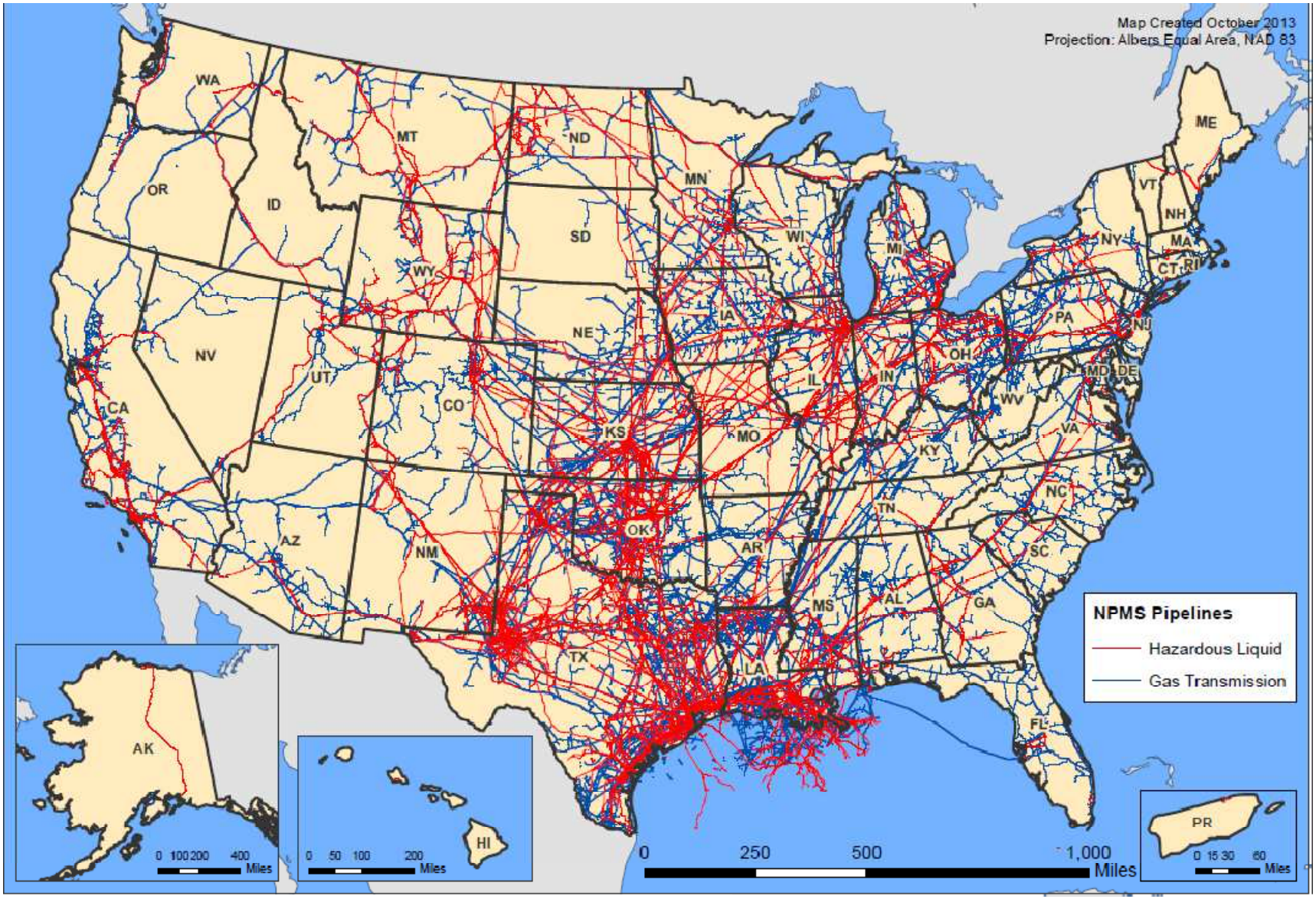
Agenda

- Pipeline Integrity and Natural Forces
- Assessment of Potential Risks
- Management of Risks
- Q&A

Historical Perspective

ARCADIS Design & Consultancy for natural and built assets





PHMSA – 09/29/2013

Pipeline Integrity

Heightened awareness!

- Perceived aging infrastructure
- Increased regulatory scrutiny
- Increased pipeline usage
- Management AND operations recognize unknown risk
- Business continuity vital
- Reputational risk unquantifiable

Pipeline Integrity – Natural Forces

Riverine

- Hydrologic and hydraulic phenomenon

Coastal

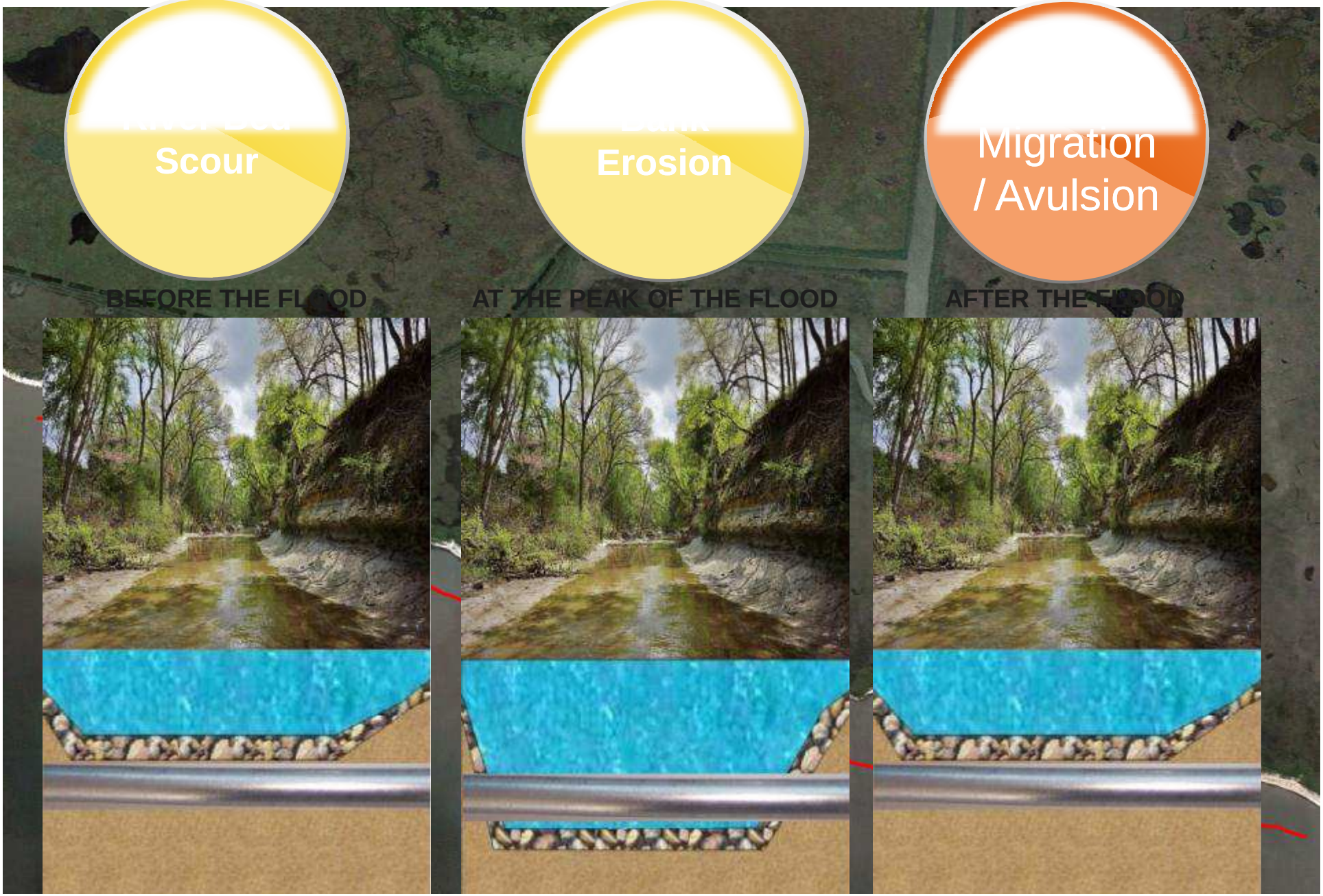
- Storm surge erosion and land loss

Land Movement

- Stability, subsidence, seismic

Riverine

ARCADIS Design & Consultancy for natural and built assets



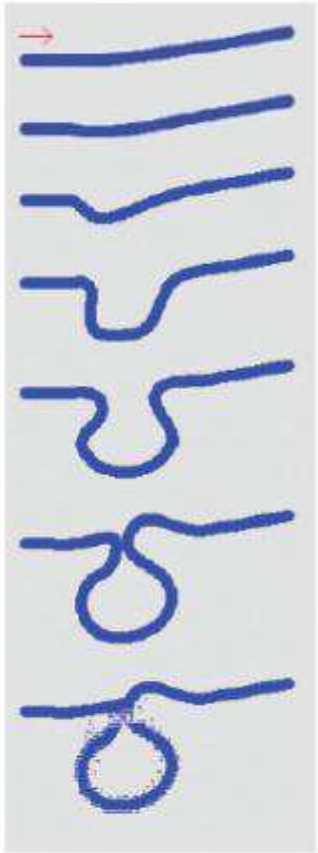
Riverine

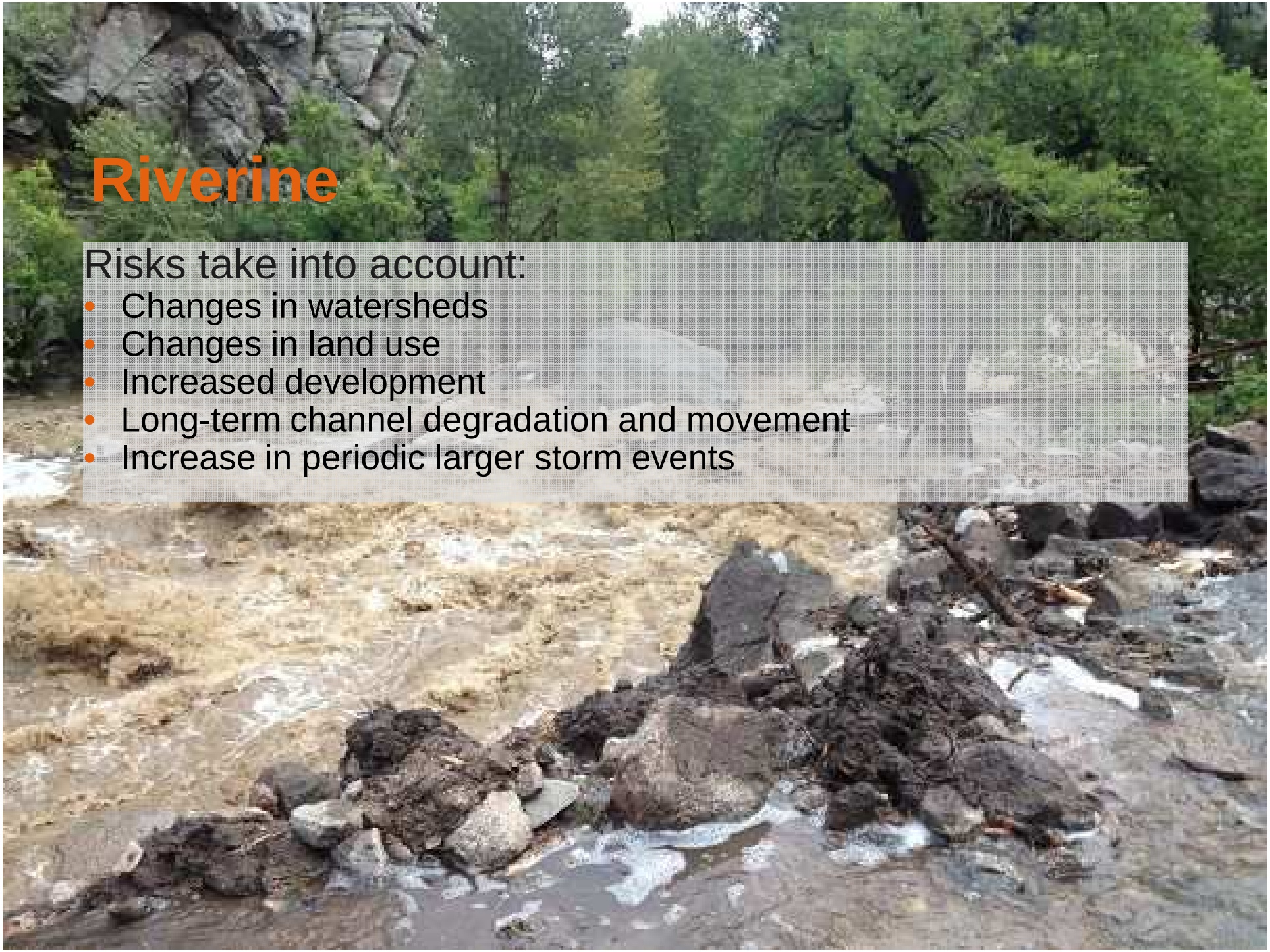
ARCADIS Design & Consultancy for natural and built assets

Scour

Erosion

Migration / Avulsion





Riverine

Risks take into account:

- Changes in watersheds
- Changes in land use
- Increased development
- Long-term channel degradation and movement
- Increase in periodic larger storm events

Coastal

Drivers:

- Water flow direction not constrained by channel slope
- Not confined to localized channel crossing
- Flow is driven by tides, winds, waves
- Storm surge, currents, and waves can induce episodic erosion
- Riverine empirical relationships not applicable
- Probability cannot be derived from real data (hurricanes sparse in space and time) – need for computer simulations

Coastal

Combined effects of:

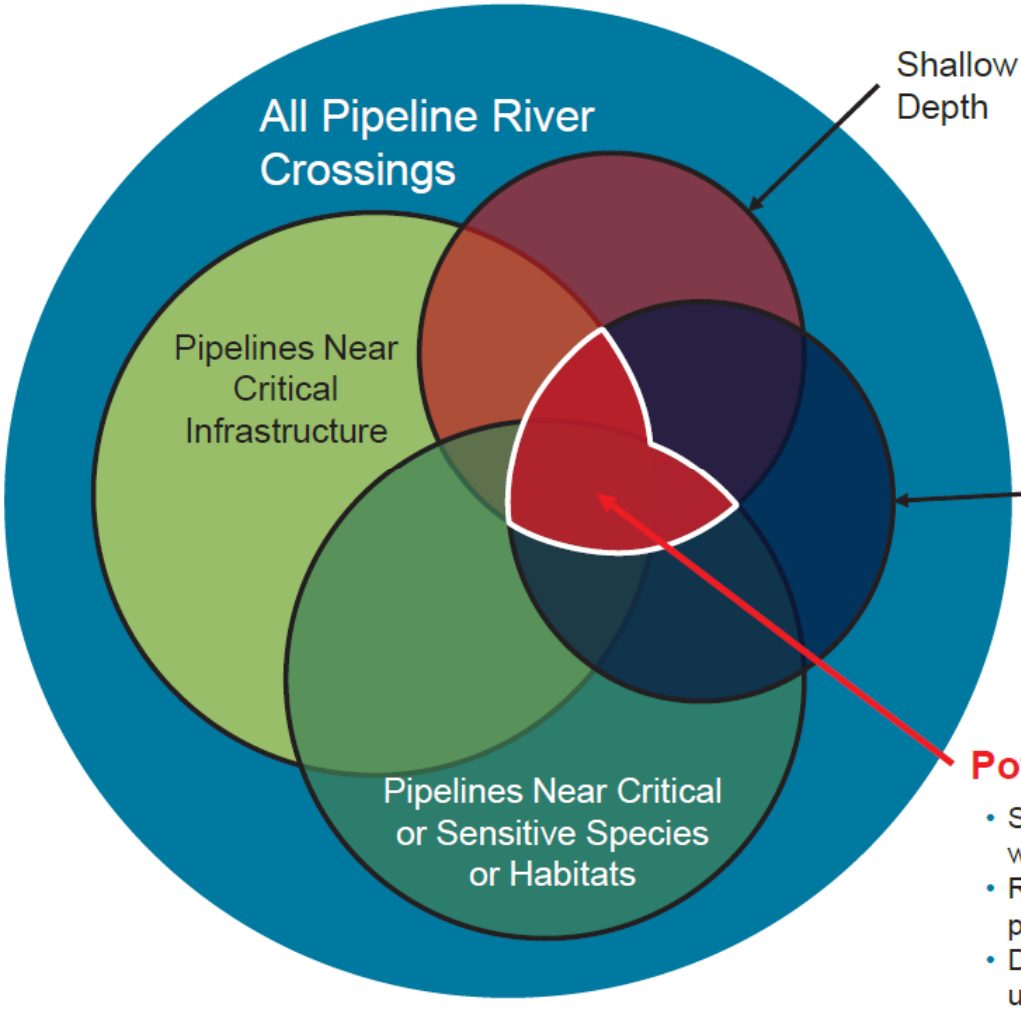
- Urbanization
- Industrial canals and river channelization
- Widening and dredging projects
- Subsidence
- Sea level rise
- Ship wake

Land Movement

The pipeline risk factors associated with potential geotechnical impacts include:

- Ground shaking in seismically active regions
- Damage due to blasting operations at mines and quarries
- Ground subsidence and settlement
- Landsliding and deep seated slope failures
- Displacements across geologically active faults
- Freeze-thaw displacements
- Erosion and upheaval displacement
- Geochemical – including karst, acid rock drainage, and corrosive soils

Need for Assessment Prioritization

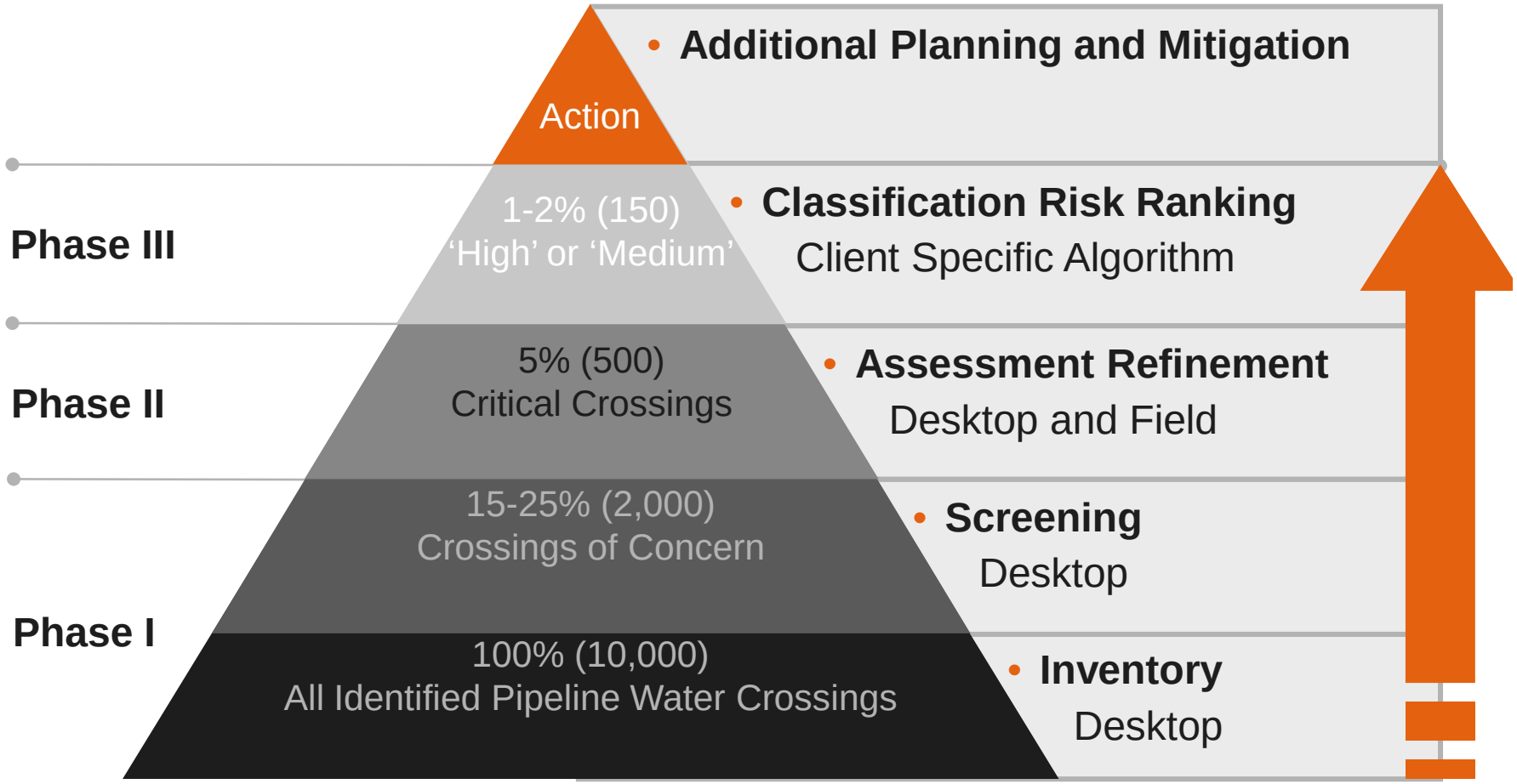


Potential High Risk

- Site inspection and/or modeling where needed at each crossing
- Response planning to minimize potential damage and costs
- Design and permitting support of upgrades at river crossings to further reduce risk of failure

Segments NEVER removed – just prioritized

Phased Assessment Approach



Management – Planning

Options:

- Operational controls – visual inspection, pressure reduction, shutdown, HWAP, etc.
- Engineering controls – armoring beds and banks, pipe sleeves, HDD, etc.

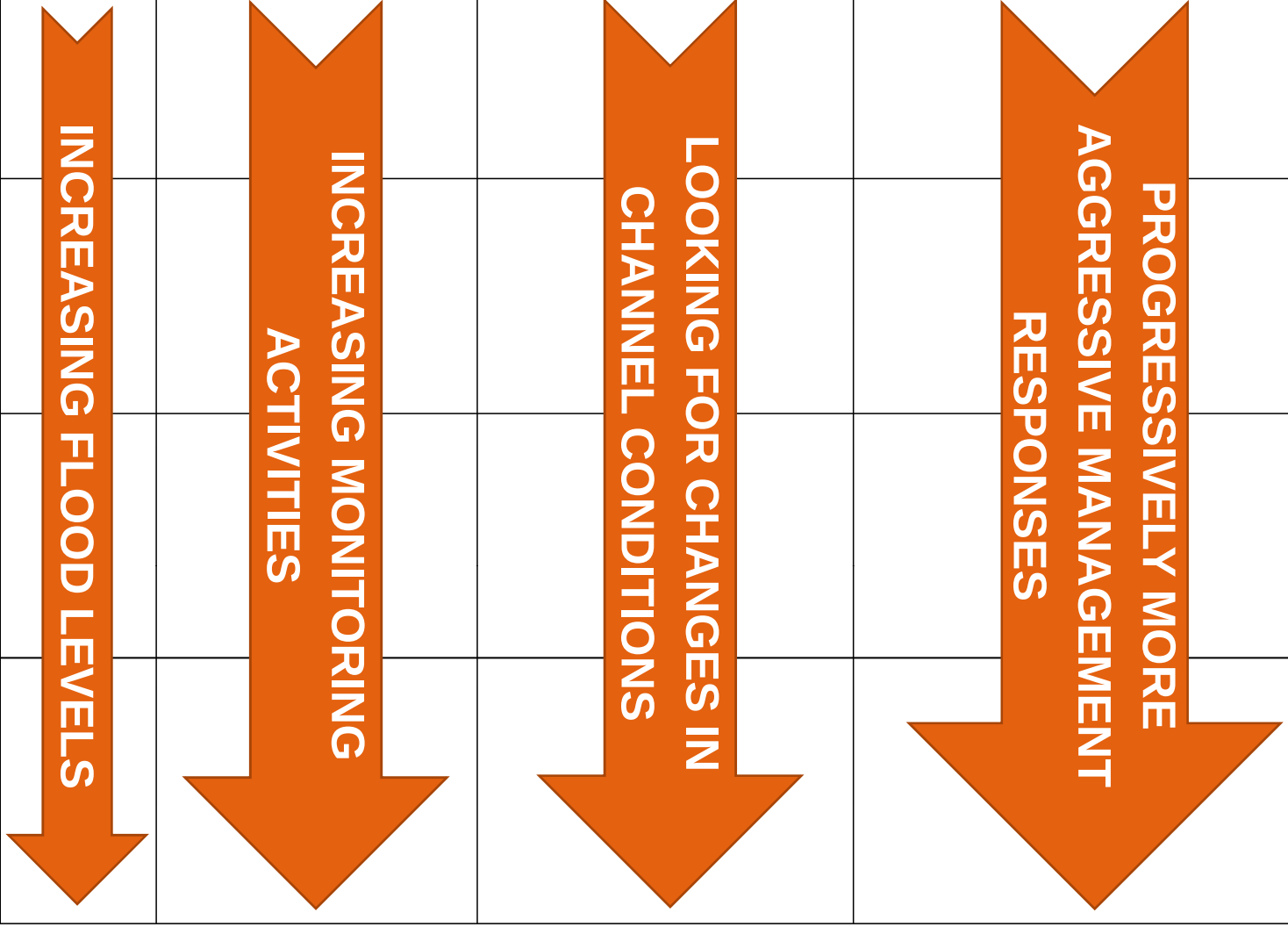
Process:

- Stakeholder involvement
- Data gap assessment
- Feasibility
- Decision implementation

ARCADIS Design & Consultancy for natural and built assets

Operational Controls Example

Scenario	River Condition	Monitoring Activities	Criteria/Considerations	Communications and Action Plan
1				
2				
3				
4				



Engineering Controls Example

Alternatives

- River training structures
- Channel armoring
- Line lowering
- Supports (inc. horizontal)
- Casing
- VIV Mitigation / Reduction
- Interim measures
- Bank stabilization
- Drilling

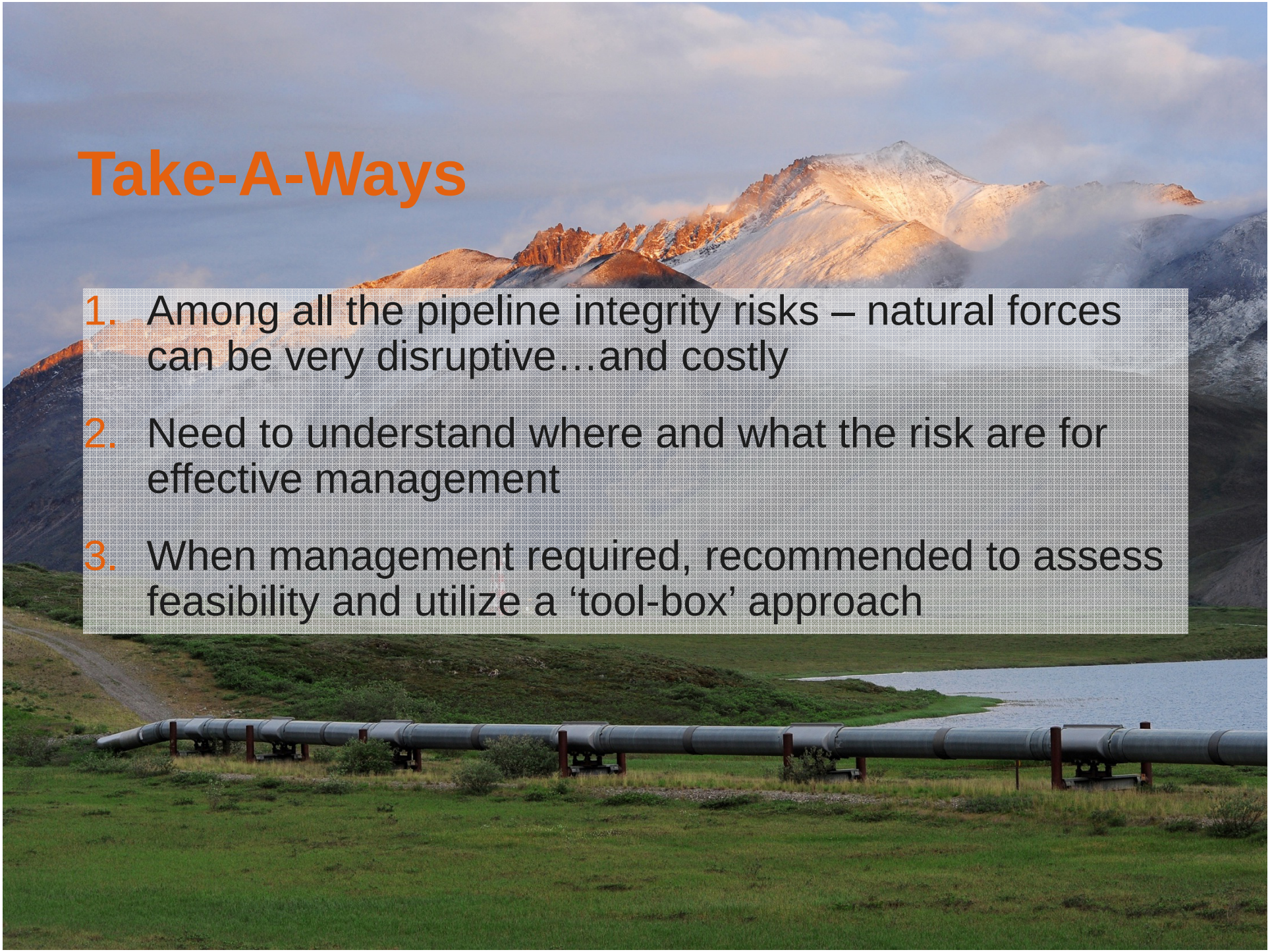
Engineering Controls – Considerations

Permitting:

- Assessments and Requirements
  - Ecological
  - Cultural
  - Species-related

Design:

- Perform feasibility reviews
- Consider existing, as-constructed, and post-scour conditions
- Work hand in hand with permitting team
- Build in site access, staging and work areas
- Perform a constructability review
- Decide on procurement and management processes



Take-A-Ways

1. Among all the pipeline integrity risks – natural forces can be very disruptive…and costly
2. Need to understand where and what the risk are for effective management
3. When management required, recommended to assess feasibility and utilize a ‘tool-box’ approach