

# ***Risk in Technically Severe Environments: Contaminant Isolation Facilities***

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***SRA 2004 Annual Meeting  
December 5-8, 2004 — Palm Springs, California***



# ***Environmental degradation has resulted from numerous anthropogenic causes***



- ***Waste management***
  - *Hazardous,*
  - *Radioactive,*
- ***Energy production***
- ***Manufacturing***
- ***Defense related***





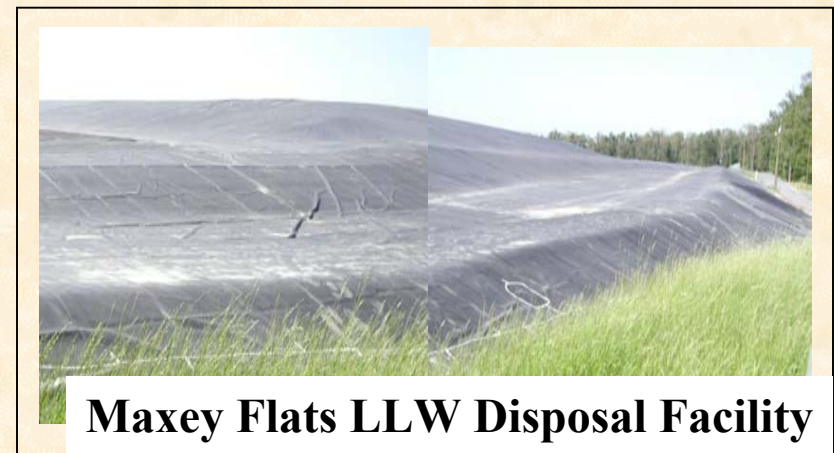
# ***Contaminant Isolation Facilities***

***A set of natural conditions, engineered barriers, and institutional controls that effectively prevent the unwanted release of contaminants.***

## ***Desired Attributes:***

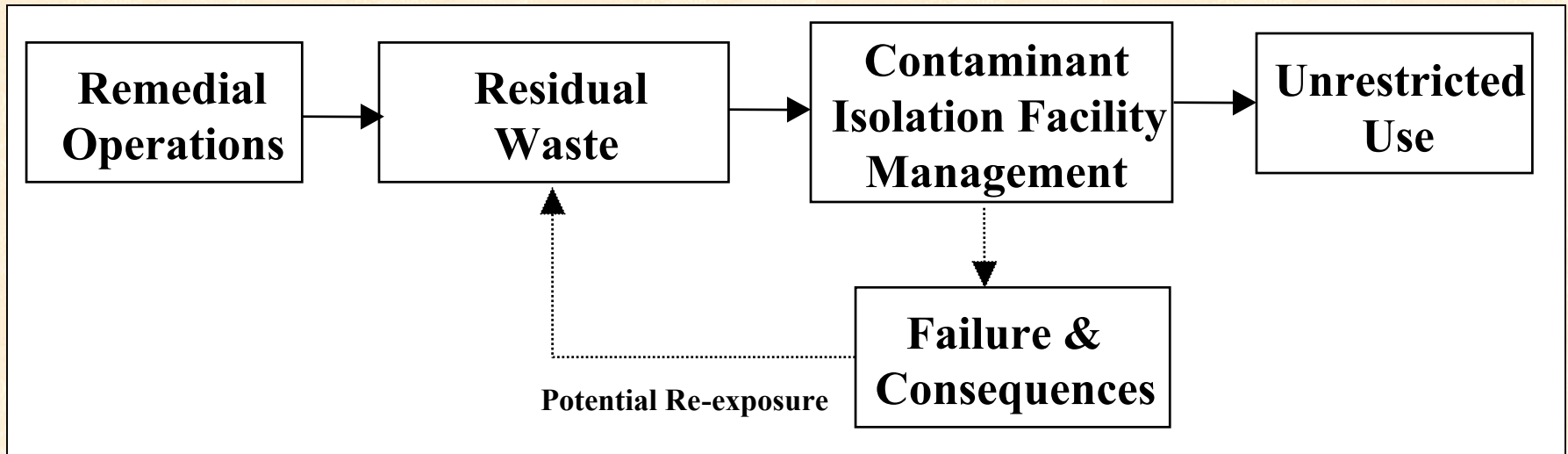
- System performance is verifiable (transparent),***
- System performance is maintainable (repairable), and***
- System performance is sustainable (affordable, doable).***

# *A variety of Contaminant Isolation Facilities are being used to isolate residual waste.*





# ***Experience is beginning to show that CIF do not always perform as expected***



***Failure – loss of contaminant isolation either through ingress (intruders) or migration of contaminants from the facility (egress)***

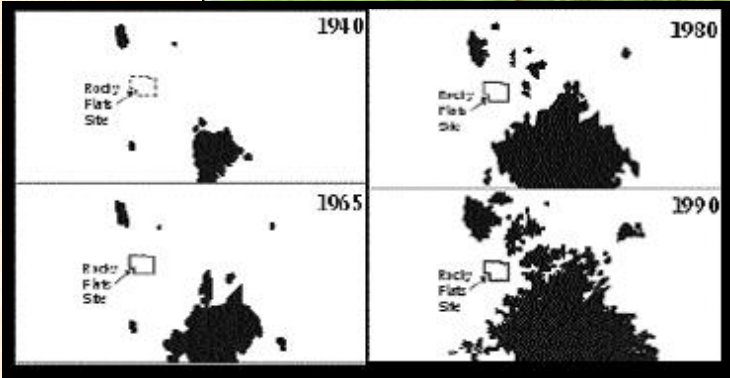
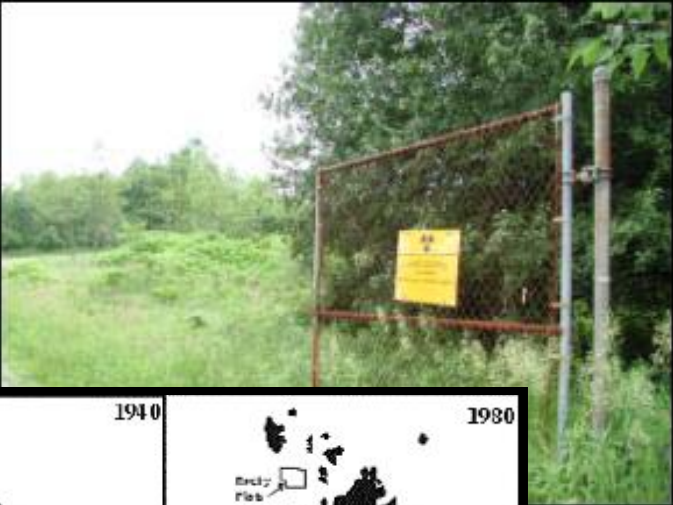
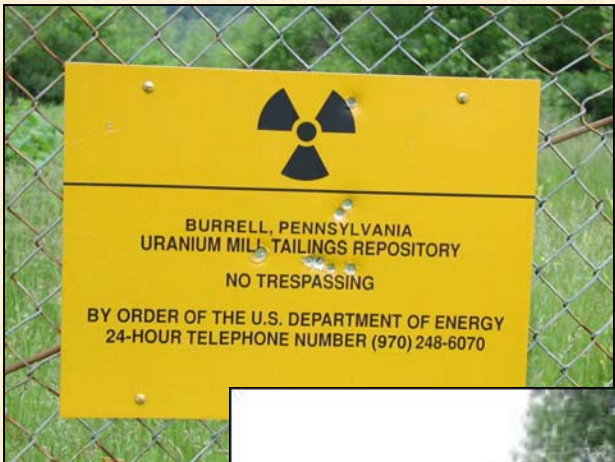
***Consequences – site-specific; depending on contaminants, exposure routes/rates, receptors***

# *Natural processes can influence system performance*

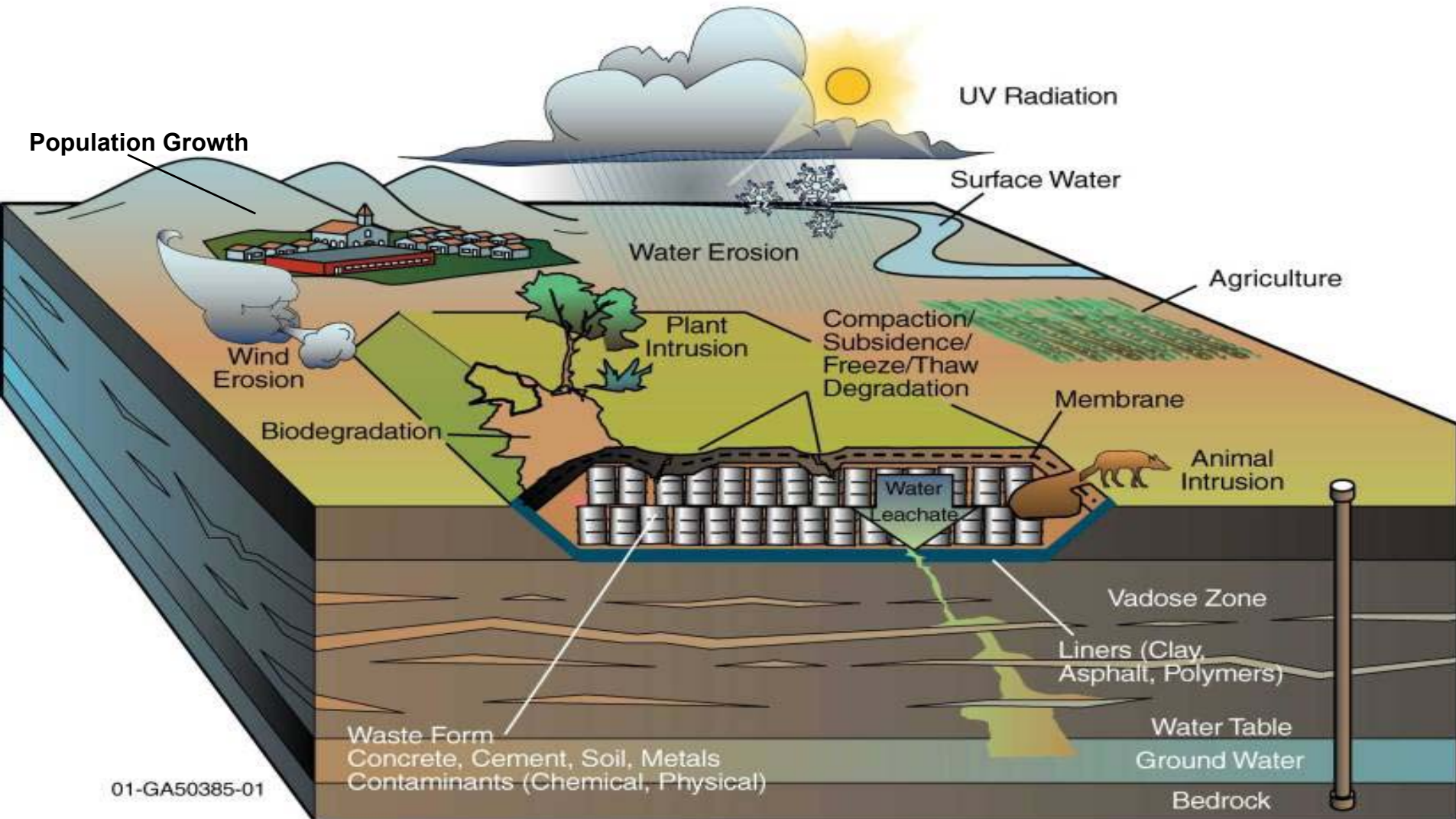




# Social conditions can influence system performance



# Many factors influence contaminant isolation system performance





# ***Various configurations of Engineered Barriers and Institutional Controls are being used for long-term waste isolation***

- ***Remedial Processes***
- ***Physical Site Security***
- ***Surface Covers***
- ***Subsurface Barriers***
- ***Maintenance***
- ***Monitoring***
- ***Information Management***
- ***Stakeholder Awareness***
- ***Government Controls***
  - ***Zoning***
  - ***Ordinances***
  - ***Orders/Decrees***
  - ***Permits***
- ***Property-based Controls***
  - ***“Deed Restrictions”***
    - ***Covenants, Easements, Servitudes***
  - ***Statutory Controls***
  - ***Contracts***

# Case Study Analysis

	Information Management	Stakeholder Awareness	Zoning	Ordinances	Orders & Decrees	Permit System	Deed Restrictions	Contracts	Government Ownership	Physical Site Security	Surface Covers	Subsurface Barriers	Active Processes
Anaconda	★	★	NA	★	★	★	★	★	NA	★	★	★	★
Love Canal	★	★	★	★	★	NA	★	★	★	★	★	★	★
Marey Flats	★	★	★	★	★	NA	★	NA	★	★	★	★	★
Rocky Mt. Arsenal	★	★	NA	★	★	NA	NA	NA	★	★	★	★	★
Spring Valley	★	★	NA	★	NA	NA	NA	NA	NA	★	NA	NA	★
Canonsburg	★	★	NA	★	★	NA	NA	★	★	★	★	★	NA
Burrell	★	★	NA	★	★	NA	NA	★	★	★	★	★	NA

★ = Controls in place; NA = Controls Not Applied at this Site



# Lessons Learned

- **Management Process**
  - Operate in a “Fix-as-Fail” mode
  - A variety of EC and ICs are being used
    - Unintentional vs. Intentional intruder scenarios
- **Information Management**
  - Varies from site to site
  - Varies across regulatory drivers (i.e. CERCLA, UMTRA)
  - Admin Record generally good up to ROD
  - Little/no integration of spatial, temporal, and analytical data
- **Financial Mechanisms**
  - Heavy reliance on annual appropriations
  - Financial sustainability remains a question

# Lessons Learned

- **Multi-organizational Involvement**

- *Legal authority not always clear*
  - *Federal Regulations, State Statutes, Local Zoning*
- *Community involvement varies*
  - *Active participation, neutral/indifferent, opposition*
- *Independent oversight is valuable*

- **Monitoring and Enforcement**

- *Site monitoring generally designed to identify EC failure*
- *Site monitoring often changes post-ROD*
  - *Monitoring is generally reduced rather than increased*
- *Little/no monitoring of ecosystem, land-use, demographic change*
- *Little/no monitoring of ICs (CERCLA 5-year Reviews)*



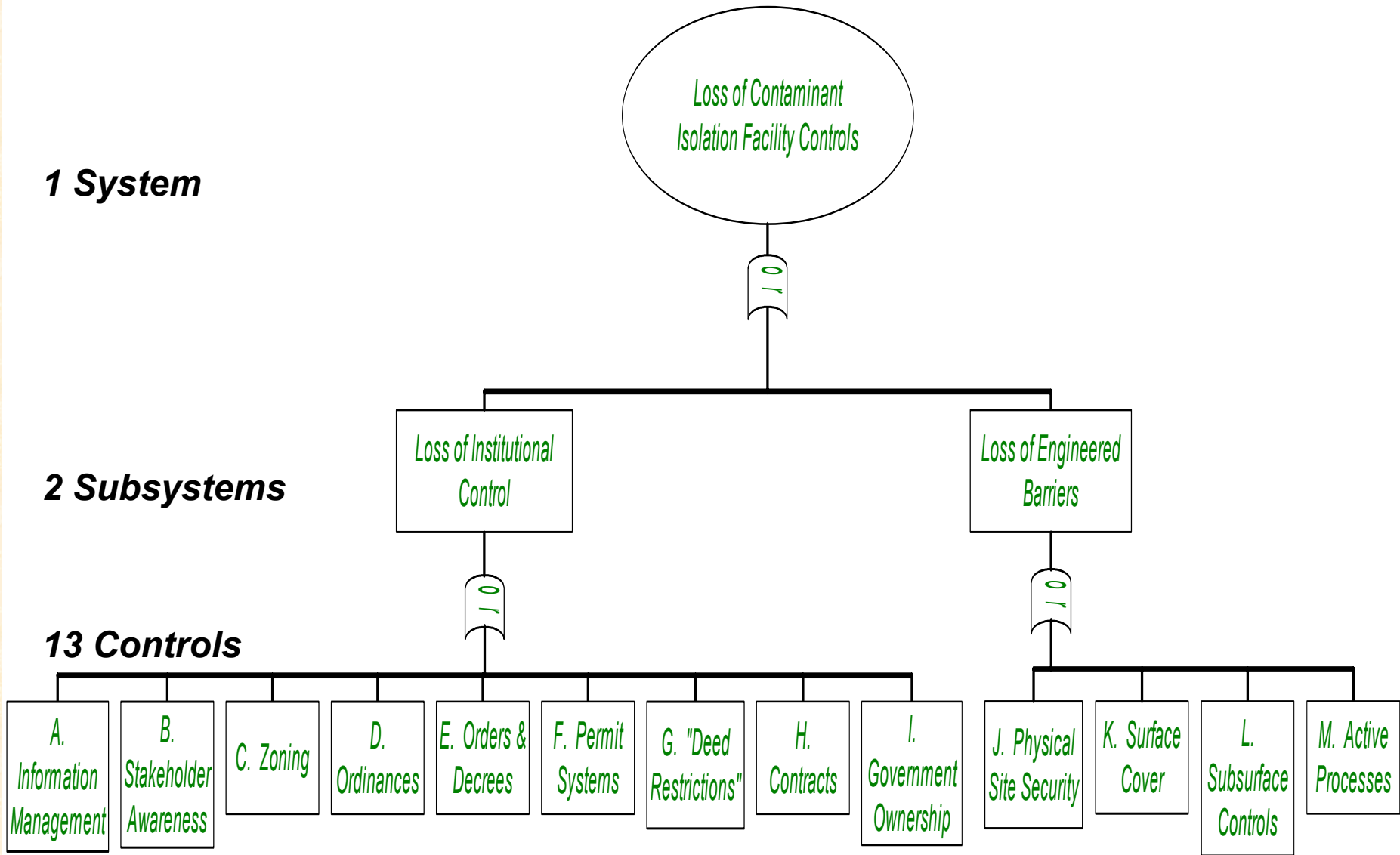
# ***Failure Analysis***

- an analytical technique that describes the collection of events that must occur to explain a described state of a system, i.e. CIF Failure***
- a logical taxonomy for organizing and analyzing the components of a CIF, i.e. Institutional Controls and Engineered Barriers***
- a useful method for identifying how mitigation and monitoring can reduce the risk of failure***

# 1 System

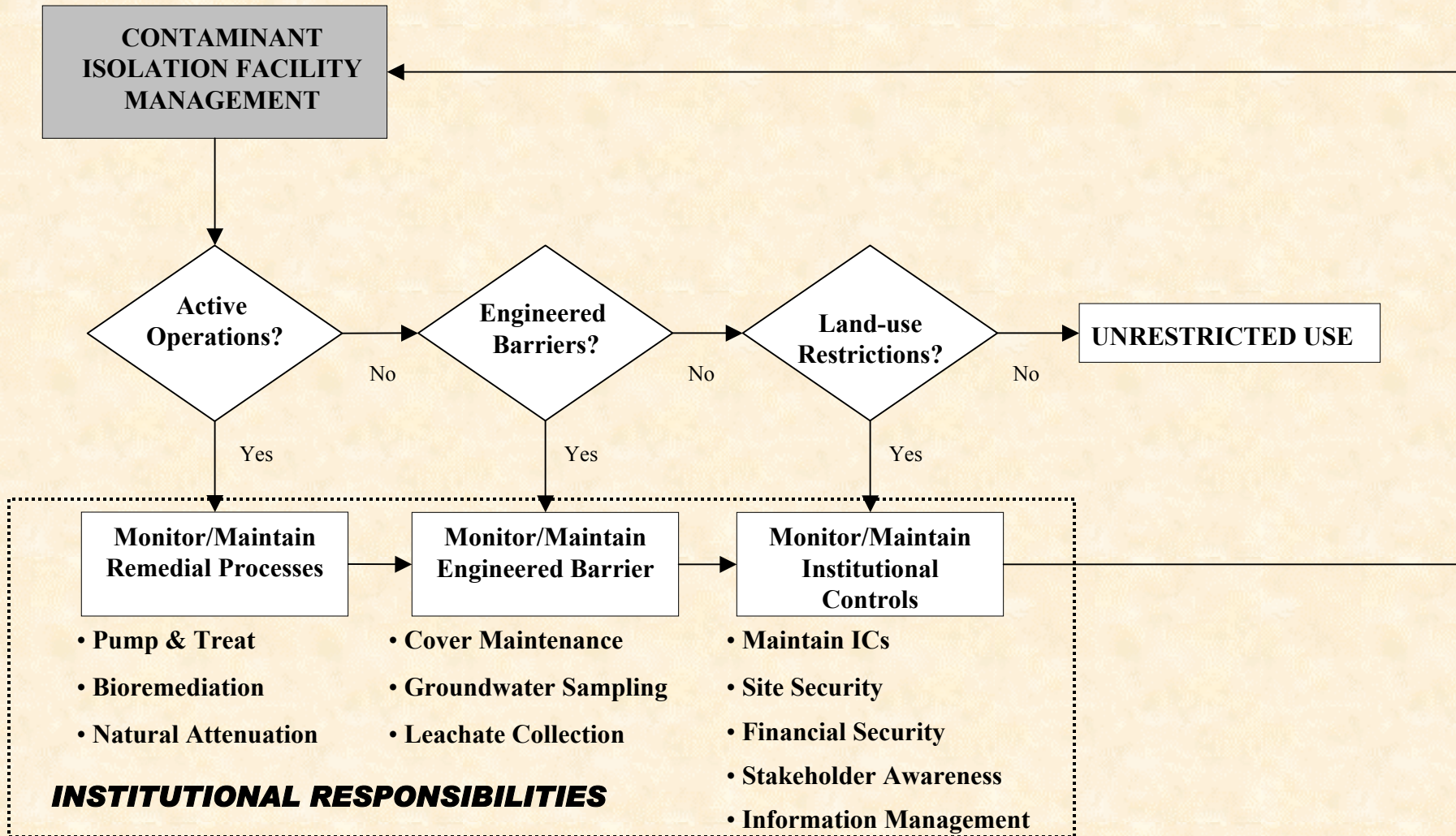
## 2 Subsystems

### 13 Controls





# Contaminant Isolation Facility Management Process



# Summary

## Performance

- *Without intervention (i.e. maintenance) CIFs will ultimately fail*
- *Loss of institutional controls and loss of engineered barriers are precursors to system failure*
- *Current performance does not imply future performance*

## Maintenance

- *Timely maintenance is key to the prevention of system failure*

## Monitoring

- *Monitoring should be focused on precursors to failure and provide timely information that permits corrective action before system failure occurs*



***“Monitoring for Maintenance”***  
**VS.**  
***“Monitoring for Failure”***