



Designing for Long-Term Conditions

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What Is the “Long Term”?

(a few answers & perspectives)

Long Term?

- Widely used term, e.g. “long-term stability, long-term monitoring”
 - Not necessarily tied to a specific time frame, e.g. 10 years, 30 years, etc.
 - “Long term” only has meaning at a site specific level, i.e. it is a time period that is decided upon/ negotiated through a combination of regulatory, financial and design considerations
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Long Term?

- Relevance

- Project concepts and design
 - Operating procedures
 - Changing operations to save \$
 - Closure
 - Physical monitoring
 - Financial surety
 - Post-closure
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Differing Social Perspectives

- Geologist can tell the story of the landscape from 100,000 years ago
 - Archeologists have good data on societies and events from 10,000 years ago
 - Egypt has structures that has stood for up to 5,000 years
 - Europe sees and understands at least 2,000 years of site performance
 - In the Midwest are the remains of cities nearly 1,000 years old, and people still live nearby
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Basis for Developing a Site-Specific Design Value for Long Term

- Intellectual considerations – generally we can predict how a site will perform over 2,000 and more years
 - Societal considerations – the people and their institutions may change, but folk are very likely to be around for the next 10,000 years
 - Regulatory considerations – the law is not an excuse for professional inattention to the long-term
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Intellectual Considerations

- Geologic history – understand and accept that processes and forces have taken place for a very long time to shape the earth – hundreds of thousands to millions of years
 - Cultural history – understand and accept the information about various civilizations and their accomplishments – hundreds to thousands of years
 - Recent history of institutions – different forms of government (monarchies, democracies) financial and other institutions - tens to hundreds of years (maybe up to over 1,000 years)
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The Parties and Roles

(who is who in “long-term” site
closure)

The Law Maker

- Establish implementable statutes that society and business can adopt and implement
 - Sets down a number that reflects society's consensus
 - Maybe tied to specific political realities of the time
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The Regulator

- Protect the public and their interests through regulations based on statutes
 - Develop and implement requirements based on national or regional level risks, e.g. seismic risks
 - Regulatory considerations for the long term must rely on a mix of site specific factors, risk assessment and risk management (qualitative or quantitative)
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The Consultant

- Define design criteria based on the law by using engineering principles, experience, body of practice, etc.
 - Compile design to closure criteria
 - To the extent cost-effectively possible, incorporate design details to extend functional performance life of a project
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The Academic

- Explore new technological approaches
 - Explore technical solutions to cost-effective long-term closure
 - Investigate ways to apply Sustainable Development concepts for future land use options
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The Owner

- Desires:
 - Close the site as fast as possible
 - Get a “walk-away” solution
 - Pass long-term custodial care to society or another beneficial user
 - Remove liability from the balance sheet
 - Must:
 - Comply with the law
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Designing for the Long-Term

(what to consider when starting, operating or ending a project that may have “long-term”, i.e. perpetual impacts)

New Projects

- Integrate long-term closure considerations into project evaluation
 - Consider life-cycle costs
 - Don't undertake a project you cannot afford to clean-close for the long-term
 - Design for post-closure
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Project In-Progress

- Develop a strategy for long-term closure
 - Adjust operations to facilitate long-term closure
 - Never too late to start!
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Site Closure

- Balance
 - checkbook vs desire for “walk-away” closure
 - capital expenditure vs. maintenance costs
 - societal “demand” vs. corporate reality
 - Prove at reasonable cost
 - Longest performance life feasible
 - Maximum environmental protection
 - Regulatory compliance
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At all stages of the project

- Stability
 - Replicate local stable geomorphology
 - Erosion
 - Divert watershed
 - Provide erosion protection
 - Contaminant Migration
 - Surface and subsurface control of migration
 - Long-term vegetation
 - Provide soil cover to support climax vegetation
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Technical Possibilities (not necessarily economic!)

- Don't undertake the project
 - Relocate wastes to another, "better" site
 - Place selected waste under water in a pit
 - Treat the wastes to remove specific minerals, e.g. pyrite from tailings
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Preferred Long-Term Uses (the Brownfield approach!)

- Develop site for alternative long-term use
 - Industrial site
 - Recreational (off-road vehicles)
 - Nature preserve
 - Farmland (pigs & fish)
 - Wind energy
 - Reuse the “waste” (mine the landfill).
 - Fill the pit (lined landfill)
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Long Term Costs are Irrelevant!

■ Net Present Value

- after 20 to 30 years long term costs do not change the decision
- Insurance policies are mostly short term, can be extended through innovative thinking

■ Financial institutions & longevity

- Cannot be relied on

Society will ultimately bear the cost (it had better reap the benefits!)

Ideally!

- Integrate:
 - Site specific materials, forces, purpose, etc.
 - Societal values
 - Environmental protection
 - Economics – capital cost vs. maintenance
 - Regulatory requirements
 - Develop a site-specific design that will not break the bank but will protect society and the environment
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Unpopular “Realities”

- There are sites where clean-up & “walk-away” closure is not possible
 - Some sites will always be a “sacrifice” zone
 - The cost of “walk-away” closure may exceed the resources of the responsible company or government
 - Society may choose to bear the cost of “walk-away” closure
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Approach to Select Long- Term

(it is not one number selected
by an engineer!)

Components

- Industry specific
- Waste type specific
- Climate specific
- Specific to site physical conditions
- Societal and regulatory aspects?

Important to have many communities of interest involved in selecting the site-specific value

Some Long-Term Closure Projects

- Radio-active waste:
 - Uranium Mill Tailings Remedial Action Project – 1,000 years to the extent reasonable achievable, and at any rate for 200 years
 - Low-Level Radioactive Waste Isolation – 10,000 years
 - Landfills:
 - Ongoing waste breakdown, methane production, re-mining - 500 year cycle?
 - Mines:
 - Grazing, landfills, recreation – perpetuity?
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Long-Term “Reality”

- Closed sites will be around for the foreseeable future
 - Some form of “custodial” care and maintenance will be required as long as society is stable and concerned
 - Natural processes will inevitably operate on the closed sites
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Long-term **thinking** is the key!

Project is the bridge to a
sustainable future for a site