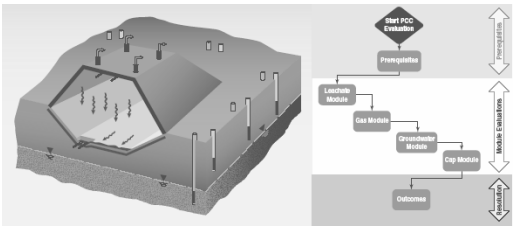
1

Welcome – Thanks for joining us.
ITRC's Internet-based Training Program

Evaluating, Optimizing, or Ending Post-Closure Care at Municipal Solid Waste Landfills



Technical and Regulatory Guidance: Evaluating, Optimizing, or Ending Post-Closure Care at Municipal Solid Waste Landfills Based on Site-Specific Data Evaluations (ALT-4, 2006)

This training is co-sponsored by the EPA Office of Superfund Remediation and Technology Innovation

Since 1988, more than 6,100 municipal solid waste (MSW) landfills have closed (see http://www.epa.gov/epaoswer/non-hw/muncpl/pubs/msw05rpt.pdf). Determining when the regulatory post-closure care (PCC) period can be ended for a permitted solid waste disposal facility is one of the greatest challenges facing the solid waste industry in recent times. Using a performance-based process, conducted on a site-specific basis, to determine if a closed landfill poses a threat to human health and the environment provides information necessary to defensibly conclude that the closed landfill does not pose a threat and allows termination of the regulatory post-closure care period.

This training, based on ITRC's *Technical and Regulatory Guidance: Evaluating, Optimizing, or Ending Post-Closure Care at Municipal Solid Waste Landfills Based on Site-Specific Data Evaluations* (ALT-4, 2006), describes a method to evaluate the performance of post-closure care (PCC) at a landfill and determine when leachate recovery, landfill gas management, ground water monitoring and cap maintenance can be reduced or even ended based on threats (to human health and the environment) posed by the closed landfill. The training and document describe "custodial care" as those requirements the property owner must follow after PCC has ended. They include de minimus site management and care activities including meeting end-use obligations, maintaining institutional control, controlling access, satisfying local ordinances, and fulfilling other applicable regulations and are included as deed restrictions or other enforceable means which follow all land transfers. The training and document focus on PCC of municipal solid waste landfills. However, PCC is relevant to closed sites and facilities managed in accordance with a variety of regulatory programs including RCRA, CERCLA, Solid Waste, Brownfields, Voluntary Cleanup, mined land reclamation, and others. Solid waste professionals and other landfill decision makers (e.g. owners; operators; consultants; Federal, state and local government; and the public) should attend this training.

ITRC (Interstate Technology and Regulatory Council) www.itrcweb.org

Training Co-Sponsored by: US EPA Office of Superfund Remediation and Technology Innovation (www.clu-in.org)

ITRC Training Program: training@itrcweb.org; Phone: 402-201-2419

2

ITRC Disclaimer and Copyright

Although the information in this ITRC training is believed to be reliable and accurate, the training and all material set forth within are provided without warranties of any kind, either express or implied, including but not limited to warranties of the accuracy, currency, or completeness of information contained in the training or the suitability of the information contained in the training for any particular purpose. ITRC recommends consulting applicable standards, laws, regulations, suppliers of materials, and material safety data sheets for information concerning safety and health risks and precautions and compliance with then-applicable laws and regulations. ECOS, ERIS, and ITRC shall not be liable for any direct, indirect, incidental, special, consequential, or punitive damages arising out of the use of any information, apparatus, method, or process discussed in ITRC training, including claims for damages arising out of any conflict between this the training and any laws, regulations, and/or ordinances. ECOS, ERIS, and ITRC do not endorse or recommend the use of, nor do they attempt to determine the merits of, any specific technology or technology provider through ITRC training or publication of guidance documents or any other ITRC document.

Here's the lawyer's fine print. I'll let you read it yourself, but what it says briefly is:

•We try to be as accurate and reliable as possible, but we do not warrantee this material.

•How you use it is your responsibility, not ours.

•We recommend you check with the local and state laws and experts.

•Although we discuss various technologies, processes, and vendor's products, we are not endorsing any of them.

•Finally, if you want to use ITRC information, you should ask our permission.

3

ITRC (www.itrcweb.org) – Shaping the Future of Regulatory Acceptance

- Host organization
- Network
  - State regulators
    - All 50 states and DC
  - Federal partners

DOE DOD EPA

  - ITRC Industry Affiliates Program
  - Academia
  - Community stakeholders
- Wide variety of topics
  - Technologies
  - Approaches
  - Contaminants
  - Sites
- Products
  - Documents
    - Technical and regulatory guidance documents
    - Technology overviews
    - Case studies
  - Training
    - Internet-based
    - Classroom

The Interstate Technology and Regulatory Council (ITRC) is a state-led coalition of regulators, industry experts, citizen stakeholders, academia and federal partners that work to achieve regulatory acceptance of environmental technologies and innovative approaches. ITRC consists of all 50 states (and the District of Columbia) that work to break down barriers and reduce compliance costs, making it easier to use new technologies and helping states maximize resources. ITRC brings together a diverse mix of environmental experts and stakeholders from both the public and private sectors to broaden and deepen technical knowledge and advance the regulatory acceptance of environmental technologies. Together, we're building the environmental community's ability to expedite quality decision making while protecting human health and the environment. With our network of organizations and individuals throughout the environmental community, ITRC is a unique catalyst for dialogue between regulators and the regulated community.

For a state to be a member of ITRC their environmental agency must designate a State Point of Contact. To find out who your State POC is check out the "contacts" section at www.itrcweb.org. Also, click on "membership" to learn how you can become a member of an ITRC Technical Team.

4

ITRC Course Topics Planned for 2009 – More information at www.itrcweb.org

Popular courses from 2008

- Enhanced Attenuation of Chlorinated Organics
- Evaluating, Optimizing, or Ending Post-Closure Care at Landfills
- In Situ Bioremediation of Chlorinated Ethene - DNAPL Source Zones
- Perchlorate Remediation Technologies
- Performance-based Environmental Management
- Protocol for Use of Five Passive Samplers
- Decontamination and Decommissioning of Radiologically-Contaminated Facilities
- Real-Time Measurement of Radionuclides in Soil
- Determination and Application of Risk-Based Values
- Survey of Munitions Response Technologies

New in 2009

- An Improved Understanding of LNAPL Behavior in the Subsurface
- LNAPL: Characterization and Recoverability
- Use of Risk Assessment in Management of Contaminated Sites
- Phytotechnologies
- Quality Consideration for Munitions Response
- More in development…

More details and schedules are available from www.itrcweb.org under “Internet-based Training.”

5

Evaluating, Optimizing, or Ending Post-Closure Care at MSW Landfills

Logistical Reminders

- Phone line audience
  - ✓ Keep phone on mute
  - ✓ *6 to mute, *7 to un-mute to ask question during designated periods
  - ✓ Do NOT put call on hold
- Simulcast audience
  - ✓ Use  at the top of each slide to submit questions
- Course time = 2¼ hours

Presentation Overview

- New elements of performance-based evaluation of post-closure care
- Regulatory flexibility
- Why should we end post-closure care?
- Advantages and issues
- Questions and answers
- Elements of performance-based PCC evaluation
- Modular evaluation process
- Outcome and monitoring the end of PCC
- Links to additional resources
- Your feedback
- Questions and answers

No associated notes.

6

Meet the ITRC Instructors

Charles Johnson
Colorado Department of Public Health and Environment
Denver, CO
303-692-3348
charles.johnson@state.co.us

Mike Houlihan, P.E.
GeoSyntec Consultants
Washington, DC
410-381-4333
mhoulihan@geosyntec.com

Charles Johnson is the Solid Waste Unit Leader at the Colorado Department of Public Health and Environment in Denver, Colorado. Charles has worked with the Hazardous Materials and Waste Management Division since 1991. He issues hazardous waste operating and post-closure permits as well as oversees corrective action site inspections and characterization, remediation, and post-closure care projects. Charles routinely presents at conferences and is an instructor for ITRC's training courses on alternative landfill technologies and ecological reuse. Charles has been active in the ITRC since 2000 serving as Colorado's ITRC Point of Contact, a DNAPLS Surfactant and Cosolvent subteam leader, and team leader for both the ITRC Alternative Landfill Technologies team and the ITRC Ecological Reuse team. Charles earned a bachelor's degree in geology from the University of Texas in Austin in 1980, a master's in geology from Texas A&M in College Station in 1983, and a master's in civil engineering from the University of Colorado in Denver in 2005.

Mike Houlihan is a Principal with GeoSyntec Consultants in Columbia, Maryland. He has over 16 years of experience in the design of municipal and hazardous waste landfills, including design and performance evaluations of closure systems, design and construction of alternative cover systems, contract research related to bioreactors and landfill liner system performance, long-term geotechnical stability of landfills, forensic analyses of liner and cover systems, and monitoring of the performance of liner and cover systems. In the past several years, the focus of his practice has been on the development of designs for alternative covers in both wet and dry climates, as well as the application of bioreactor technology at municipal solid waste landfills. He is currently the project manager for the Environmental Research and Education Foundation (EREF) study "*Evaluation of Post-Closure Care at MSW Landfills*" and is the lead engineer for the design of an evapotranspirative alternative cover at the Welsh Road Landfill Superfund Site in Pennsylvania. In addition, Mike is an active member of the ITRC Alternative Landfill Technologies Team.

7

What You Will Learn…

- A new method for evaluating progress during post-closure care
- Why do we have post-closure care (PCC)?
- What is custodial care?
- Why do we need custodial care?
- What are landfills used for after PCC?
- What are some of the advantages and disadvantages of using this method to evaluate PCC?
- What are the critical components of a closed landfill that define protective performance?

Photos courtesy state of Kansas

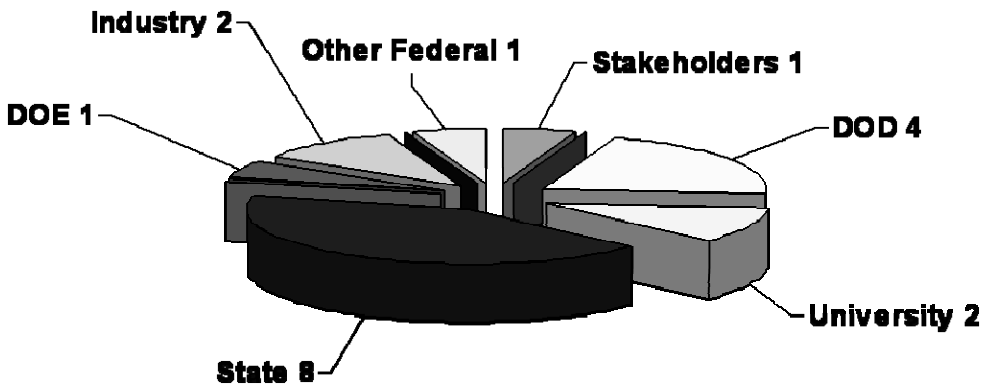
During today's training on the ITRC Tech-Reg guidance document, we'll cover the above major topics.

"Technical and Regulatory Guidance: Evaluating, Optimizing, or Ending Post-Closure Care at Municipal Solid Waste Landfills Based on Site-Specific Data Evaluations" (ALT-4, 2006) is available from www.itrcweb.org under "Guidance Documents" and "Alternative Landfill Technology."

Applicability- Any cell, group of cells or landfill that has closed and has begun PCC.

8

ITRC Alternative Landfill Technologies Team



Hallmark of ITRC teams is the broad representation of a variety of perspectives. The team was comprised of federal regulators, state regulators, industry representative, consultants, academics, citizen stakeholders, DoD, and DOE. We believe this approach yields a guidance that has broader applicability.

9

Key Discussion Points

- Post-closure care can be shortened or lengthened
- Defining the end-use of a successfully closed landfill site is a important first step in permitting a landfill operation
- Four components evaluate landfill closure performance
  - Leachate
  - Groundwater
  - Landfill gas
  - Cap
- Evaluate performance by assessing threat at the point of exposure
- Ending post-closure care is possible as well as practical
- Custodial care is the minimal amount of care required after ending PCC
- This is a performance-based approach rather than a prescriptive approach to ending PCC

The following issues are highlighted as key items for state's concurrence on the guidance document. We will demonstrate:

That there is a regulatory basis for shortening or lengthening PCC,

That early planning of future land use can help guide the design, operation, closure and PCC of a landfill,

That the regulation call out specific landfill elements that can we can use to helped evaluate the effectiveness of a landfill's PCC and its potential threat to human health and the environment.

That the EPA regulations identify evaluating the threat of a landfill at the point of exposure.

That optimizing and ending PCC is possible given an appropriate administrative mechanism to guide us through custodial care. Custodial care is a term that will be introduced as part of this training, and

That all of this is based in regulation and is protective of human health and the environment and that it is conducted as a performance based approach.

10

Applicability for ITRC Guidance Document

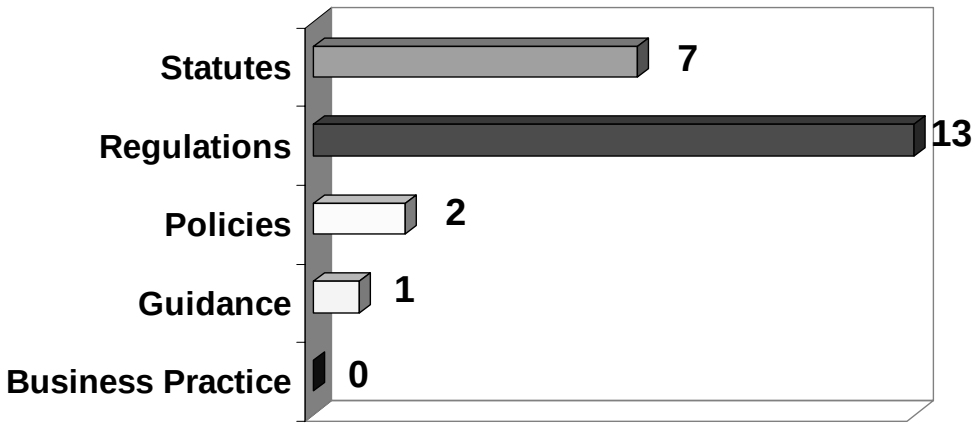
- Solid waste landfills
  - Pre-subtitle D
  - Subtitle D
  - Historical landfills
- State wants
  - End PCC in a safe and defensible manner
  - Avoid an ever increasing workload
    - 188 facilities in Colorado
    - 230 facilities Kansas
    - 6,100 landfills nationally closed since 1988

This training is specific to municipal solid waste (MSW) landfills but can apply to other waste management programs. The substantive information used to support development of this guidance was derived for MSW facilities. The details of the evaluations contained in the EREF guidance (Environmental Research and Education Foundation (EREF) report entitled "Project Summary Report—Performance-Based System for Post-Closure Care at MSW Landfills: A Procedure for Providing Long-Term Stewardship Under RCRA Subtitle D") are supported by MSW experience. In addition, the decision process contained in this ITRC guidance were developed from MSW facilities. However, given that this ITRC guidance document contains an approach and basis for making decisions regarding the evaluation, optimization,and potential ending of PCC, the process and approach, with program specific modification, could be applied to other regulatory programs. These programs could include hazardous waste, Brownfields, Voluntary Cleanup, CERLCA, mining, and others.

Since 1988, more than 6,100 municipal solid waste (MSW) landfills have closed (see http://www.EPA.gov/epaoswer/non-hw/muncpl/pubs/msw05rpt.pdf).

.

11 **Post-Closure Care Questionnaire: Does Your State Have Statutes, Regulations, Policies, Guidance, or Business Practices that Pertain to PCC?**



As part of developing the tech-reg guidance on evaluating, optimizing, and ending PCC ("Technical and Regulatory Guidance: Evaluating, Optimizing, or Ending Post-Closure Care at Municipal Solid Waste Landfills Based on Site-Specific Data Evaluations" (ALT-4, 2006)), the team developed and delivered a questionnaire to the ITRC states and our associated industry partners. These results and findings of some of the key questions are as follows:

Does your state have statutes, regulations, policies, guidance or business practices pertaining to PCC? Since all states in the US have approved solid waste programs, they should have statutes and regulations that at least discuss some aspects of PCC, but not the details, policies, guidance, or a structured process regarding how to or what to evaluate when determining the effectiveness of the PCC program or an appropriate time to end PCC.

12

Landfill Life Cycle

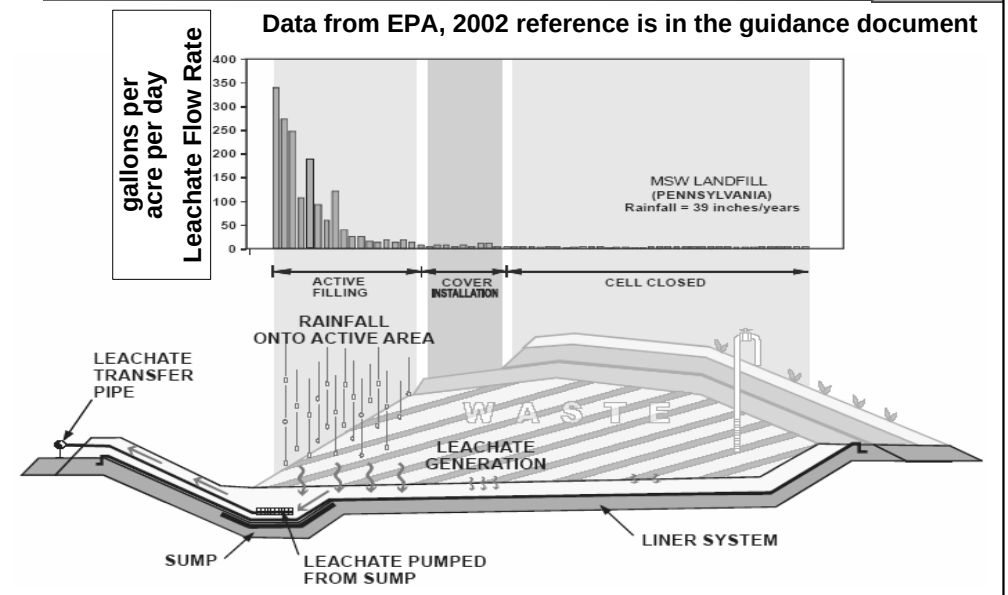


Diagram presents the life-cycle of a landfill.

Early phase during filling the cell is open and subject to precipitation events and increasing overburden which generates leachate.

Following filling and placement of the final cover, precipitation is minimized or prevented from entering the cell and the amount of leachate will decrease with time. In addition, with increasing time, leachate quantity may decrease while leachate quality will improve. Landfill gas production will increase following cover placement and eventually decrease with time. The ultimate reduction in leachate volume, improvement in leachate quality and reduction in landfill gas are trends towards a reduced potential risk associated with the landfill. These dynamics lend themselves to changing and optimizing a PCC program. In addition, the ultimate trend towards reduced risk asks when would it be appropriate to potentially end PCC.

13

Regulatory Flexibility: United States Federal Solid Waste Regulations

40 CFR Section 258.61 Post-Closure Care Requirements

(a) Following closure of each MSWLF unit, the owner or operator must conduct post-closure care. Post-closure care must be conducted for 30 years, except as provided under paragraph (b) of this section,

(b) The length of the post-closure care period may be:

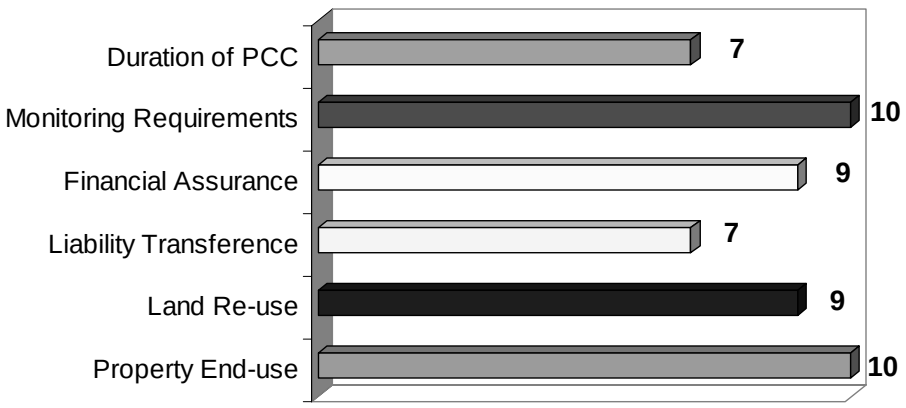
(1) Decreased by the Director of an approved State if the owner or operator demonstrates that the reduced period is sufficient to protect human health and the environment and this demonstration is approved by the Director of an approved State; or

(2) Increased by the Director of an approved State if the Director of an approved State determines that the lengthened period is necessary to protect human health and the environment

As previously stated, this guidance is founded on regulatory authority.

The text on the slide is an excerpt from the federal solid waste rule. Most states adopted regulations that contain the exact same or very similar language. The language includes the provision for lengthening or shortening PCC predicated on a demonstration that either case is protective of human health and the environment. The language indicates that a regulatory agency must make a demonstration that PCC should be lengthened, while the owner/operator needs to make a demonstration that PCC could be shortened. Note that, without either action taking place, PCC ends automatically after 30 years.

14 **Post-Closure Care Questionnaire: Do Your State Regulations Governing Post-Closure Care Contain Flexibility in the Following Categories?**



States also demonstrated through the questionnaire that their regulations governing PCC contain flexibility in the above areas. This result indicates that the states recognize the regulatory flexibility, but may not be sure how to evaluate all of the data to take advantage of the flexibility while ensuring that the decisions are protective of human health and the environment.

15

PCC Regulatory Flexibility

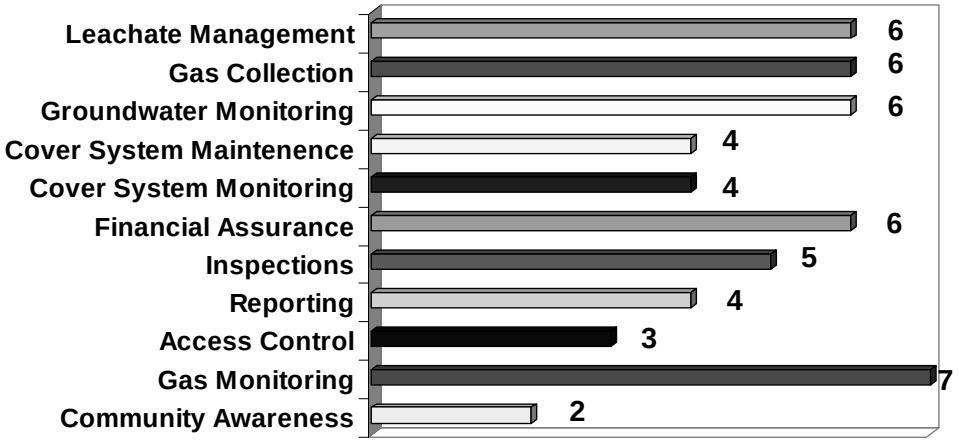
(1) Maintaining the integrity and effectiveness of any final cover,…….;

(2) Maintaining and operating the leachate collection system ……if applicable. The Director of an approved State may allow the owner or operator to stop managing leachate if the owner or operator demonstrates that leachate no longer poses a threat to human health and the environment;

(3) Monitoring the ground water in accordance with the requirements of subpart E of this part,…… if applicable

Again, the text on the slide is from the federal solid waste rule; similar or exactly the same language was adopted by many states. This language points out key elements related to landfill PCC. These elements include the cover, leachate collection and recovery system, and the groundwater monitoring program. The integrity of the final cover must be maintained. This language does not say that the final cover may never be used for dual or multiple purposes. This integrates with the future use of the facility. The final cover and its integrity may be the parking lot or sub foundation of a future development. If there is no leachate, or the leachate contains constituent concentrations less that drinking water standards, then what real threat does it present and how should it be managed? If the leachate contain constituent concentrations are less than drinking water standards, then what does the phrase “if applicable” really mean in terms of groundwater monitoring? All of the data associated with each of these elements should be evaluated and integrated into an optimal PCC strategy.

16 **Post-Closure Care Questionnaire: Which of the Following Elements of Post-Closure Care Can Be Reduced Before the End of the PCC Period?**



Again, back to the questionnaire. Although states may not have guidance or policies related to optimizing and/or ending PCC, they certainly recognize --- as demonstrated on the last questionnaire slide --- the flexibility in the regulations, and based, on the above information, they are taking advantage of and implementing PCC strategies that include flexibility. Note the areas of flexibility above.

17

Why Optimize or End Post-Closure Care? Regulator Perspective

Ability to keep up with the ever increasing growth in the solid waste industry. Don't regulate a stable landfill (e.g. resource utilization)

- Resource optimization
  - 188 active facilities in Colorado
  - 230 active facilities in Kansas
- Land reuse
  - Recreational
  - Commercial
  - Agricultural
- Keeping up with historical landfills

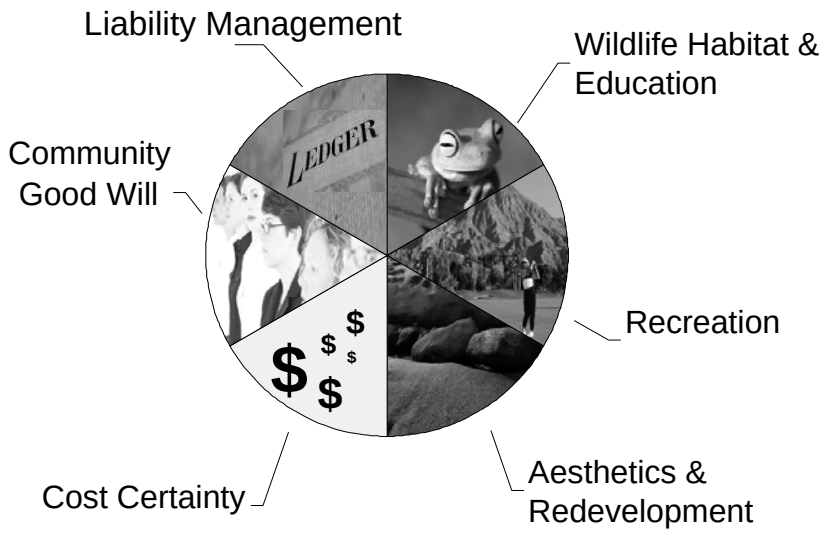
Optimizing or, as appropriate, ending PCC, allows a regulatory agency to leverage its limited staff-time by focusing the majority of their time upon sites that pose a serious threat.

Unless the agency has in place a means for decreasing the degree of focus (time commitment) spent upon landfills that are, or are becoming, of little-or-no threat, the workload will minimize the time available for addressing critical sites.

Typically, at closed landfills, over time, there is an increasing pressure to allow the site to be put back under productive use of some type --- it becomes a political issue. This guidance helps one to PLAN for this, thereby assuring, that the eventual end-use does not cause the site to, once again, become a threat to human health and the environment.

18

Why Optimize or End Post-Closure Care? Stakeholders and Industry



Stakeholders

Land reuse, recreational, commercial, agricultural

- Increased tax revenue during reuse
- Improved property development opportunities
- Improved aesthetic values
- Restores site to a productive use

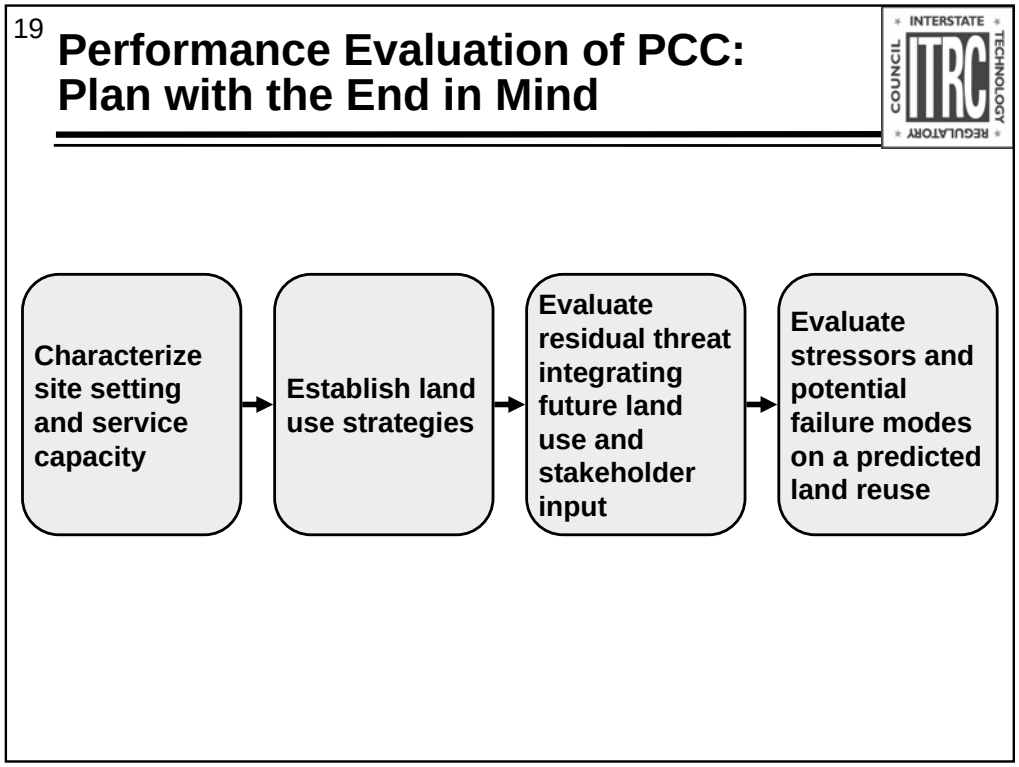
Land re-utilization

Liability management

Resource utilization

Cost certainty

Community goodwill



The previous slides illustrate that regulations allow PCC to be reduced or ended, and that there are positive reasons to reduce or end PCC. It follows that we need a methodology to evaluate reducing or ending PCC. It would be beneficial if a standard, structured approach were used for the evaluation, so that regulated entities could expect uniform/similar requirements in different states. Also, consultants and regulators would not have to reinvent the wheel each time they perform the evaluation, or rely on nebulous professional judgment alone.

Like many regulators and other solid waste professionals, for years I have been hearing that a standard approach for evaluating when to end PCC would be developed on a national level (by EPA or others). In Kansas, they have deferred developing detailed regulations or policy on ending PCC in favor of (most likely) adopting a national approach when it is promulgated. With Environmental Research and Education Foundation (EREF) and ITRC leading the way at this time, it appears that someday is now – a standard approach for reducing or ending PCC has been developed. Through this Internet training and the accompanying guidance document, ITRC is outlining a standard, structured approach to evaluating, reducing, or ending PCC. It is up to states and others to decide if this approach suits their needs.

The approach can be summarized conceptually by the four steps shown above, and described more fully as follows:

1. The level of PCC needed at any site is predicated to some extent upon the site characteristics, type and volume of waste, and future land uses both onsite and in the vicinity. Ideally, these parameters would be evaluated up front, when a waste disposal site is designed and permitted. In reality, many landfills were established (seemingly) without forethought to end conditions.

2. It may be intuitive, but end use plays a significant role in determining what landfill operation, closure, and PCC will look like. For example, if the intended end use is a “closed landfill,” then perhaps a pyramidal mound covered with a Subtitle D cover and an infinitely long PCC period may be appropriate. However, if the intended end use is a park, then perhaps a bioreactor landfill with an undulating, alternative final cover and reduced PCC period may be desirable.

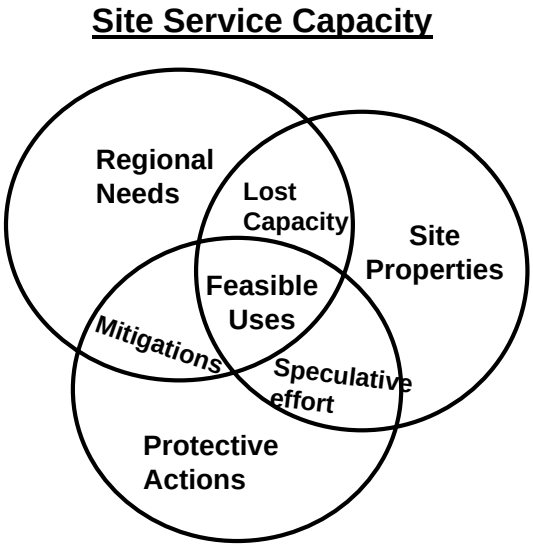
3. In order to justify reducing or ending PCC, we must consider whether the landfill in its current condition poses significant threats to human health or the environment. For example, is the landfill emitting methane at levels that could trigger an explosion? Is leachate being released at levels that could contaminate surface water or groundwater?

4. Finally, if we are considering reducing or ending PCC, we should evaluate whether the landfill would present a threat to human health and the environment into the future. This analysis would have to be performed for each potential end use. For example, a closed landfill used for agriculture may be subject to different stressors and may present different human health and the environment threat levels than a closed landfill used as a parking lot.

20

Long-term Land Use Projections

- Define the long-term use at or near the site
- Site service capacity – see ITRC Technical and Regulatory Guidance: Planning and Promoting Ecological Land Reuse of Remediated Sites (ECO-2, 2006)
- Exposure to potential receptors



In the previous slide, we noted that end use is an important point to consider when designing/permitting a landfill, and is a critical factor to consider when evaluating whether it is appropriate to either optimize or end PCC. However, end use is not always simple to pin down. Site owners may want to keep their options open or may change their minds; surrounding land use and land valuation may change over time and may influence end use of the site; community needs may change. Nevertheless, to the degree possible, end use should be factored into the design/permit process and the optimize/end PCC evaluation.

This graphic illustrates conceptually how site conditions, environmental controls, and regional factors influence and limit feasible end uses. For example, using a closed landfill as a soccer field would only be feasible if the site is dimensionally and topographically appropriate for that use, if the landfill cap and environmental controls (e.g., landfill gas collection system) could support and not interfere with that use, and if the demand for a soccer field is present/emerging within the community.

The related concept of site service capacity is presented in more detail in ITRC's *Planning and Promoting Ecological Land Reuse of Remediated Sites* (ECO-2, 2006) (available from www.itrcweb.org under "Guidance Documents" and "Ecological Enhancements").

Again, the acceptability of a particular end use is predicated upon not exceeding regulatory thresholds for threats to human health and the environment at points of exposure. For example, the evaluation to reduce/end PCC would not seek to determine whether landfill leachate can be directly ingested, but rather, whether it would present a threat to surface water or groundwater quality at the property line, closest offsite well, or other potential point of exposure.

Definition of "End-Use Setting": The characteristics of the landfill and the surrounding area that determine potential of a threat.

Considerations: "**Characteristics**" include the proximity of receptors, the pathways of exposure, and state and local regulations. The characteristics assumed for the module evaluations must always be met after the change is made. If the characteristics change, then the outcomes of the module evaluations need to be reconsidered

End-use setting involves defining: post-closure use of the property; long-term use of properties that could be exposed to a future release; local regulations and obligations; institutional control mechanisms (current or recommended); engineering controls

21

Issues Related to this Approach: Land Reuse

- Establishing the proposed future land use after completion of PCC
- Maintaining the land use after PCC
- Adjusting PCC performance requirements as land use changes

After identifying how a landfill would be used following completion of PCC, the reduce/end PCC evaluation is contingent upon continuation of the selected land use. At such time as a change in post-closure land use is proposed, the PCC evaluation would have to be performed again, using new parameters and parameter values specific to the proposed use. This re-evaluation could alter the outcomes, perhaps requiring a return to PCC, or increased/decreased PCC duration, as necessary to protect human health and the environment from potential threats at points of exposure.

22

Issues Related to this Approach: Custodial Care

- Custodial care of landfill property after completion of post-closure care
  - Financial assurance is terminated
  - e.g. Land management

Photos courtesy state of Kansas

Which brings us to a key concept – after PCC is completed, an owner cannot simply walk away from a closed landfill. Even after being released from regulatory PCC, a site owner would have the normal responsibilities that any property owner would have – they have to comply with applicable laws and perform a de minimus level of maintenance termed "custodial care." This may include managing the land to prevent noxious weeds and other nuisances. Owners may find it to be in their best interest to control access to the site to limit liability and illegal activities. They may opt to exceed minimum care of the property if, for example, they are seeking to redevelop it for another use. Custodial care might be formalized in a deed covenant or other legal instrument. Such instrument could also be used to trigger re-evaluation and possible return to PCC if land use at the site changes in the future.

Release from regulatory PCC is expected to include release from PCC financial assurance. While regulators might cringe just thinking about this step, it is important to stress that release from PCC financial assurance would only occur after a rigorous evaluation has shown that the landfill no longer presents a significant threat to human health and the environment.

Land management tools as an example.

23

Issues Related to this Approach (continued)

- Lack of familiarity (institutional change)
- How to use the regulatory flexibility
  - Creativity – all parties, not just regulators

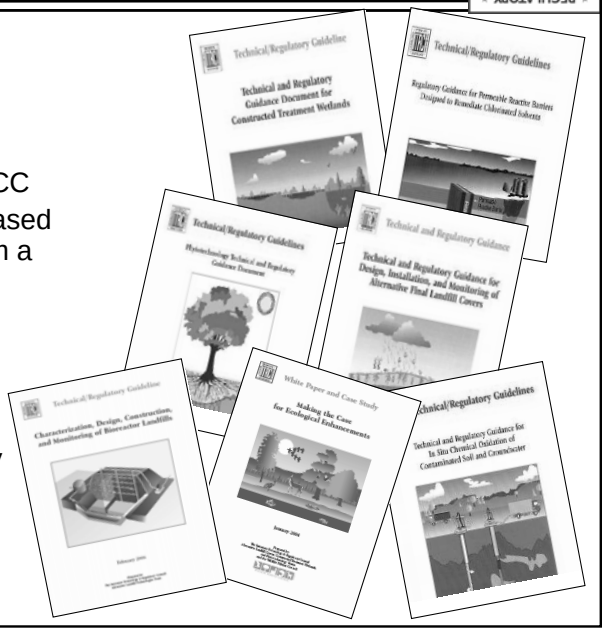
Photos courtesy state of Kansas

One of the goals of this Internet training, and the accompanying guidance document, is to help bring about a change in mindset. For good reasons, landfills are subject to PCC – but for good reasons PCC can and should end when it is no longer necessary (which may include a period of incrementally decreased PCC intensity). This goal can be accomplished using sound scientific principles in applying the flexibility that already exists in landfill regulations. In order to best utilize limited resources and protect human health and the environment, it will be necessary for all parties involved (regulators, owners/operators, consultants, community stakeholders, etc.) to recognize and exercise this flexibility in appropriate ways.

24

Performance Evaluation of PCC

- Progressive evaluation provides a basis for enhancing, extending, shortening or ending PCC
- Decision-making tool based on potential threats from a landfill
- Threat is based on evaluation of
  - Leachate
  - Landfill gas
  - Groundwater quality
  - Final cap



The next part of this training focuses on the PCC evaluation process in more detail. The evaluation involves a series of steps intended to generate an objective conclusion as to whether PCC should be increased or continued at the current level, or whether it could be decreased or ended. The evaluation is not intended to predict how long PCC will last, but rather, whether landfill conditions at a point in time would justify a change in PCC. The evaluation centers on potential threats to human health and the environment at realistic points of exposure, in keeping with regulatory requirements and because potential threats can be readily assessed. **The evaluation consists of four main "modules"** used to assess threats associated with leachate, landfill gas, groundwater quality, and the landfill cap.

ITRC has developed other guidance documents and Internet training courses that may be relevant to the PCC evaluation. For example, guidance on groundwater remediation, treatment wetlands, alternative final covers, bioreactor landfills, and other topics may provide useful information for bringing landfills to an environmentally stable condition from which ending PCC may be possible.

ITRC guidance documents are available at www.itrcweb.org under "**Guidance Documents**." Information about associated Internet-based training courses is available at www.itrcweb.org under "**Internet-based Training**."

25

Advantages of Performance Evaluation of PCC

- Structured approach (uniform process) to objectively evaluate the progress of PCC
  - Defining expectations through uniform process
  - Expectations and monitoring provide uniform benchmarks for both entering and exiting from PCC phase
  - Elements of performance demonstrations could provide the basis for a landfill PCC permit process
- Identify and demonstrate how a site has reduced or eliminated potential threats to human health and the environment
- Tied to specific future use
- Consistent with federal regulations
- Focuses on four PCC components identified by EPA
- Helps build consistency among regulators
- Provides a forum for community input regarding long-term care
- Provides an opportunity to reach concurrence between the regulator and owner/operator

This slide summarizes many of the points made thus far in the presentation. It is important to note that the evaluation process is designed to be consistent with regulations and to rely on widely accepted principles. It is in everyone's best interest to have a process that is rigorous, defensible, and easy to comprehend so that each PCC evaluation, while unique, can utilize a common methodology.

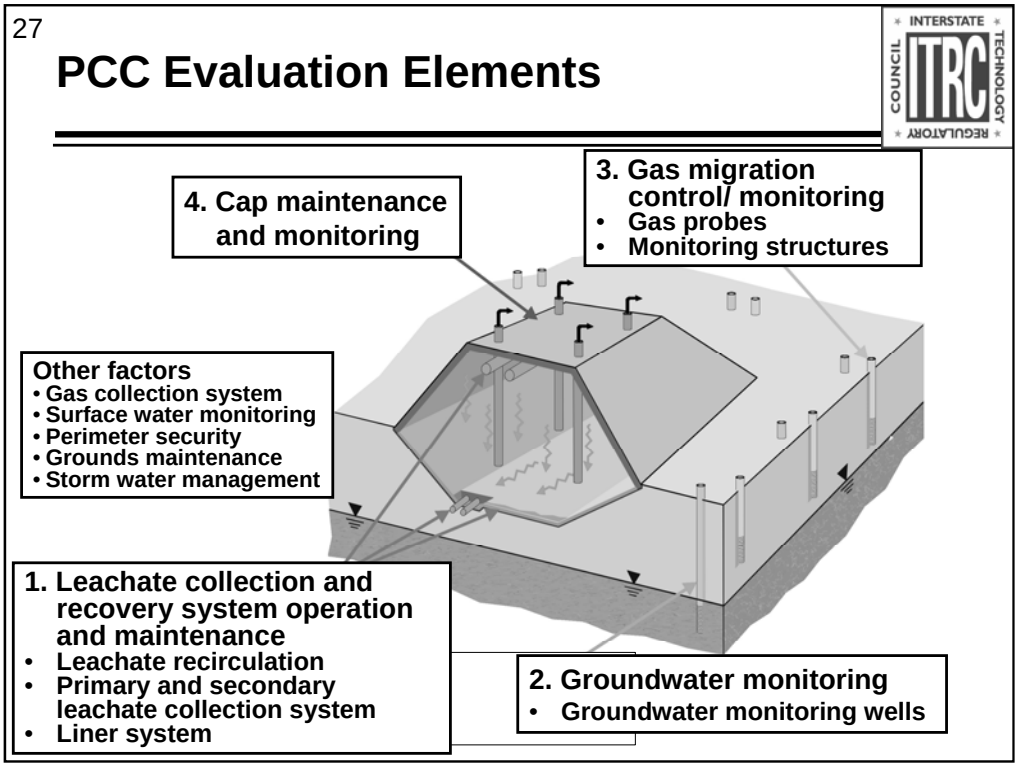
We will discuss the PCC evaluation methodology in more detail following a break for questions and answers.

Examples of covenants and land use restrictions are available in the document from Colorado, Texas, and Kansas. See section 4.8.2 of the document. ITRC's "Technical and Regulatory Guidance: Evaluating, Optimizing, or Ending Post-Closure Care at Municipal Solid Waste Landfills Based on Site-Specific Data Evaluations" (ALT-4, 2006) is available from www.itrcweb.org under "Guidance Documents" and "Alternative Landfill Technologies."

26

Questions and Answers

No associated notes.



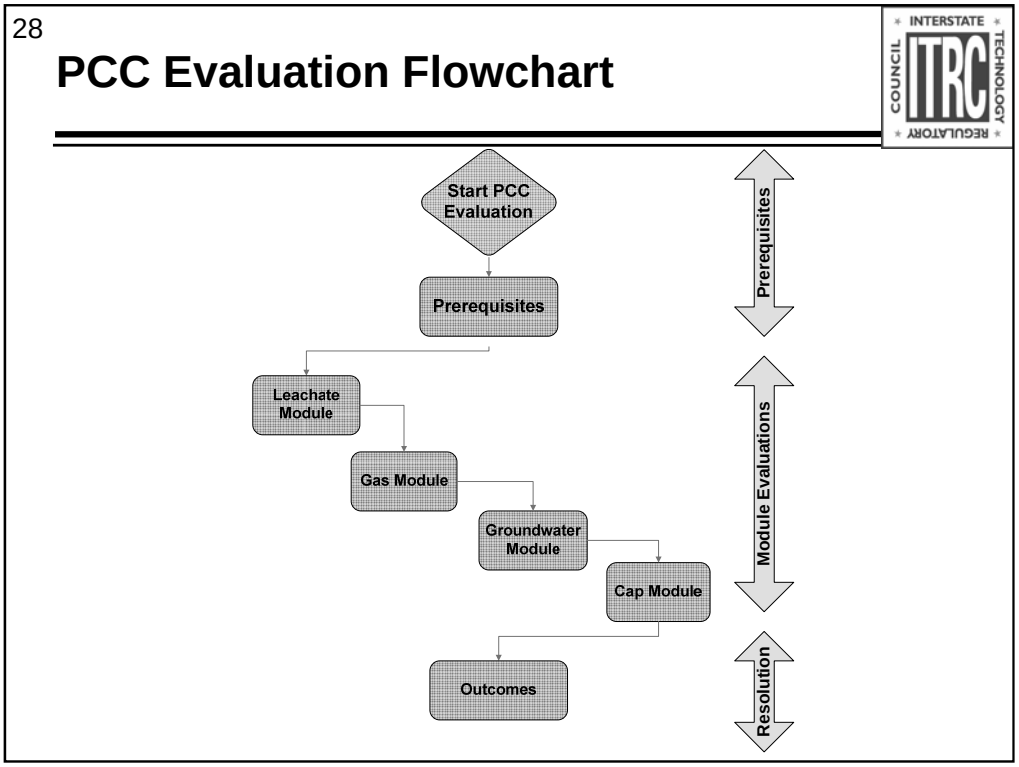
Charles (or Ed, Alternate) talked about the background and the motivation for developing a structured approach to evaluating the need for PCC. In the next 20 slides, we'll talk about a detailed approach for evaluating the need for PCC. But first, on this slide, I want to provide a framework for discussing post-closure care of landfills. This slide shows a typical closed landfill and the environmental protection and monitoring systems that could be in place at the end of post-closure care. The elements are taken from the four elements of PCC under Subtitle D of RCRA for MSW landfills, but these components likely apply to any waste containment unit that is being considered for ending PCC. The elements include:

1. Leachate collection and recovery system (LCRS) operation and maintenance
2. Groundwater monitoring
3. Gas migration control / monitoring
4. Cap maintenance and monitoring

(describe them in numerical order).

In addition to the 4 elements of PCC under Subtitle D, there are other elements of closed landfills that might need to be considered, including (see "Other factors" box).

These five different groups of elements can form the basis for defining the systems that need to be evaluated to determine if PCC is still needed or if PCC can be optimized.



In the next 3 slides, I would like to talk about the process of evaluating the need for PCC in an increasing level of detail. Then, I'll talk about some of the evaluations that are embedded in the process in a greater level of detail.

The purpose of this slide is to show how the components in the previous slide are addressed in the evaluation process. On the right side of this slide, you see three arrows: the first identifies the portion of the process that is focused on evaluating prerequisites, the second arrow identifies the portion of the process that is focused on the evaluations of the different components of PCC, and the bottom arrow shows the part of the process that's focused on resolution. Before moving on, I'd like to go into more detail on the four module evaluations that are in the middle of the slide. They are:

First, the leachate module: related to evaluation of leachate management system components (leachate collection transmission, storage, and treatment/discharge components);

Second, the gas module: related to the active gas management system or a passive wells or a system of passive gas flow through the cap;

Third, the groundwater module: related to groundwater monitoring in wells, monitoring of the vadose zone, or discharges of groundwater to surface-water resources; and

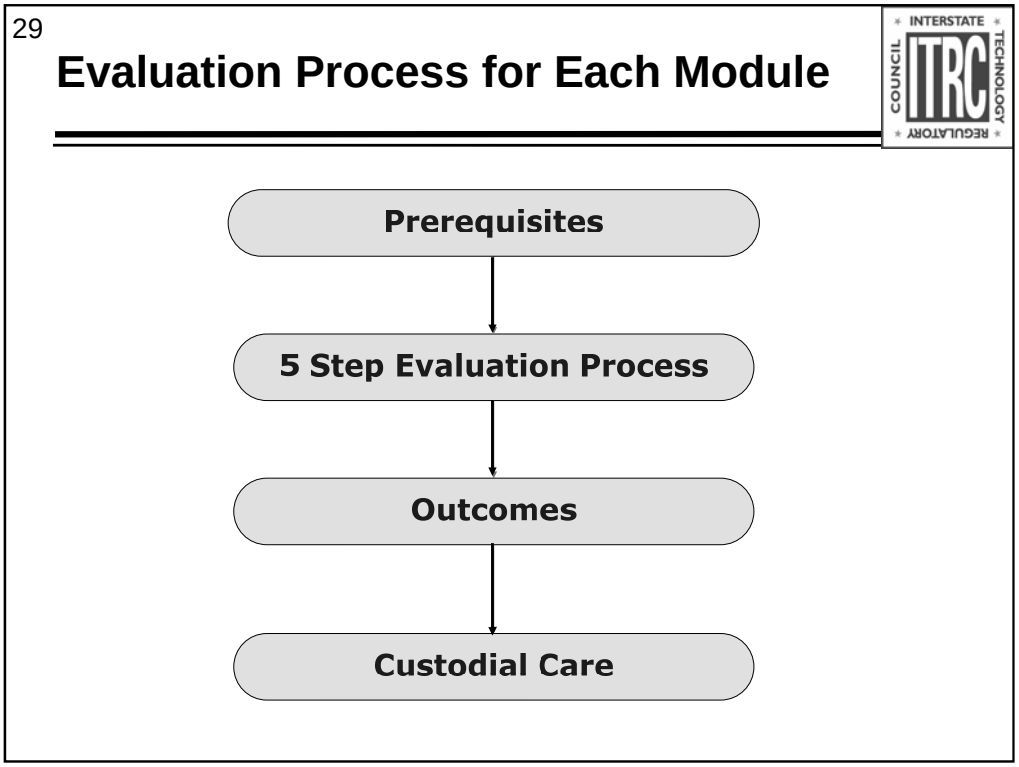
And fourth, the cap module: relates to the above-ground waste containment system.

If there's no leachate management system, or no groundwater monitoring system, you would still perform the evaluation in this order, leaving out the modules that aren't needed.

Also, it's important to note that the order of these modules is important: the leachate and gas modules represent evaluations of the key sources of contamination from landfills and therefore need to be completed before the modules that represent monitoring or containment of the sources. Therefore, the groundwater and cap modules need to be performed after these two other modules, especially because the need for the cap is a function of the outcome of the leachate and gas modules.

Also, note that it's possible to complete one module and start the next BEFORE ending PCC of that module; for example, an evaluation of the need for the gas management system in the gas module can be completed before ending leachate management in the leachate module.

In the next slide, the process for evaluating these modules is presented in some more detail.



This slide shows the evaluation process for each module – that is, each of the four modules shown in the middle of slide 31 – from beginning to end. Note that it's **not** the flowchart for an overall PCC evaluation of a site.

First, there are a set of general prerequisites that must be evaluated, and that is represented in the top box labeled "Prerequisites". In this step, the evaluator would see if certain prerequisites applicable to all modules are fulfilled, like "are all the data needed to perform the evaluation available".

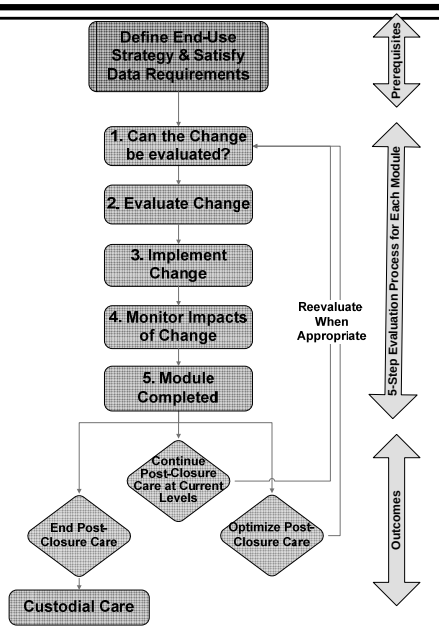
Then, we move to the 5-step evaluation process, in which an evaluation is made to determine if it's appropriate to end or optimize PCC for a site. This process is one of the main contributions of the ITRC Tech/Reg document on this subject (Technical and Regulatory Guidance: Evaluating, Optimizing, or Ending Post-Closure Care at Municipal Solid Waste Landfills Based on Site-Specific Data Evaluations (ALT-4, 2006)) – although the idea of ending PCC has been discussed for many years in many states, this 5-step process provides some structure and definition to the evaluation that hasn't generally been available before.

After the 5-step evaluation is performed, we have an outcome – the potential outcomes are discussed on the next slide. As Charles (or Ed) discussed earlier, one of the possible outcomes is "End PCC," and after all four modules have achieved an outcome of "End PCC," the site would move to custodial care, which is the outcome option that is shown on this slide.

Now, let's drill down another level and discuss these middle two boxes on this slide. Note that this slide begins with "Prerequisites" and ends with "Custodial Care", just like the next slide.

30

PCC Module Evaluation Process



This slide provides more detail in the “5-step evaluation” and the “outcomes” sections than the previous slide did. Hopefully you can see that this diagram illustrates the same process as the previous slide, just in more detail.

What I want to focus on in this slide is the 5-step process and the outcomes sections of the process. First, let’s talk about the 5 steps in the “5-step” process for a moment. You’ll see these 5 steps many times in the next several slides and I won’t read them every time but I will here. The five steps are:

(identify they by reading them off of the slide – no additional detail at this point)

After the evaluation is completed at step 5, we reach an outcome to the evaluations. The three possible outcomes are, from left to right:

First, if the evaluation shows that no more PCC is needed, then PCC would end and we would proceed to custodial care.

Second, if the evaluation shows that PCC is still needed at the levels required in the PCC plan, then PCC would continue as it is currently being provided.

Third, if it isn’t yet time to end PCC but PCC isn’t really needed at the level required in the PCC plan, then it may be appropriate to optimize PCC by reducing to only that care that’s really needed.

Note that only if PCC ends (i.e., the first “outcome” box to the left) can we enter custodial care – under the other outcomes, we are still in regulatory PCC. Also, note that for the “Continue PCC at Current Levels” and “Optimize PCC” outcomes, we need to eventually reevaluate the module at some time in the future before we can achieve a “End PCC” outcome. That reevaluation would occur in the future when the possibility for a different outcome is evident (either because the trends in environmental quality have improved or the need for PCC has reduced).

On the next 15 slides or so, we will go into these steps in more detail.

First, we’ll talk about prerequisites;

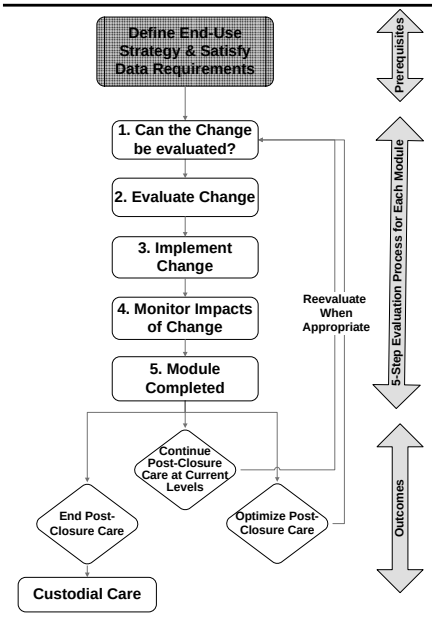
Then, we’ll talk about the 5 steps and how to implement them;

Then, we’ll talk about the possible outcomes of the evaluation; and

Finally, we’ll discuss the concept of “Custodial Care” in more detail.

31

Prerequisites Before Evaluating Any Module



- Define the ***End-Use Setting*** - the characteristics of the landfill and the surrounding area determine potential of a threat
- Satisfy ***Data Requirements*** for all modules
  - PCC site plan
  - Site configuration
  - Site operation and history
  - Leachate, gas, groundwater, and climatic data
  - State regulatory framework
  - End-use plans

On the left side of this slide you see the module-specific process flowchart from the previous slide. We will use this on the next several slides so you can see where we are in the process. On this slide, we are going to talk about the prerequisites that must be fulfilled before performing any evaluation of any module.

There are only 2 key prerequisites that must be filled before starting any of the module evaluations, and they involve (i) defining the End-Use Setting and (ii) making sure that all the data are needed to perform the module evaluations. The end-use setting can be thought of as the _____ (read from slide). The end-use setting could involve passive use, recreation, or active use like redevelopment to a shopping center. Each of these end uses has a different implication for the evaluation of whether PCC is needed or not, and if the end use changes after the PCC evaluation is completed then the need for PCC must be reevaluated to make sure that the outcome fits the new end use.

The second prerequisite relates to data requirements. Data requirements are module specific but, in general, include: (read from slide). This is a lot of data and some forward-thinking may be needed by site operators and owners to collect all of this data if it isn't already required under regulations or site-specific permit conditions.

On the next slide, some more considerations related to data needs are provided:

32

Potential Data Needs for PCC Evaluation

- Landfill design and construction details
- Site development history
- Hydrogeology and meteorology
- Characteristics of receiving water bodies
- Surrounding area details (receptor information)
- Leachate
  - Quality
  - Flow rates
- Landfill gas
  - Quantity
  - Quality
- Groundwater quality (water quality indicators, VOC, metals, etc.)
- Surface water quality

- Many sites already have a lot of data
- Many sites might not have all the data
- Having adequate data to do the evaluation requires proper planning and forward thinking
- Prerequisites for PCC data acquisition are established at point of closure approval

For example, data that is needed includes:

(go through the list, give examples and link the data needs to specific modules – like the leachate data to the leachate module trend evaluation, etc.).

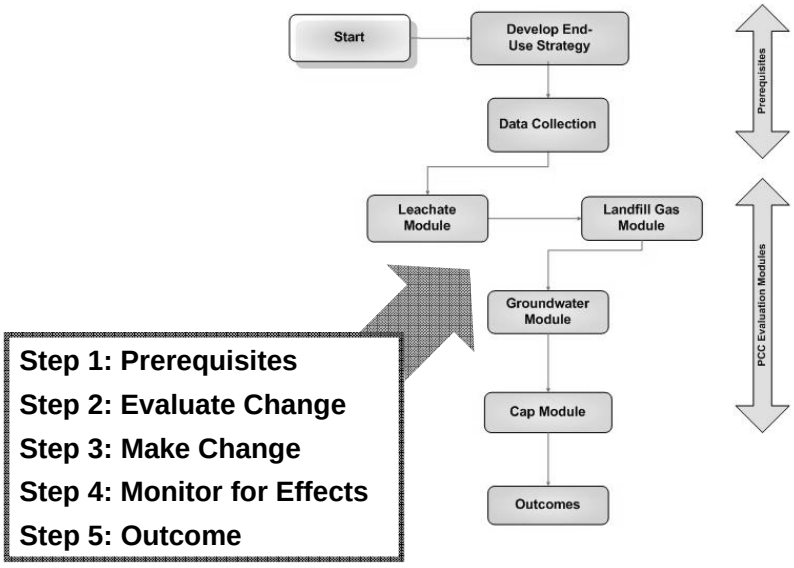
Now, at the bottom of the slide are some points for you to think about. First,

(read the three points).

This last point is particularly important – the PCC evaluation will require a lot of accurate and complete data. Obtaining all of this data may require some forward-thinking by site operators and owners if this data if it isn't already required under regulations or site-specific permit conditions.

33

Master Diagram for Ending PCC Model



Now that we're done with the general prerequisites, we can move into the module-specific evaluations. This slide takes a slight step back up in the organization to make a couple of important points. You can see the two "prerequisite" steps that we just talked about on top in blue, and the 4 module evaluations in brown in the middle. Off to the left you can also see the 5 steps of the evaluation process that we talked about earlier. The points I want to reiterate here are:

1.The 5 steps apply to each of the 4 modules

2.The modules need to be performed in sequence

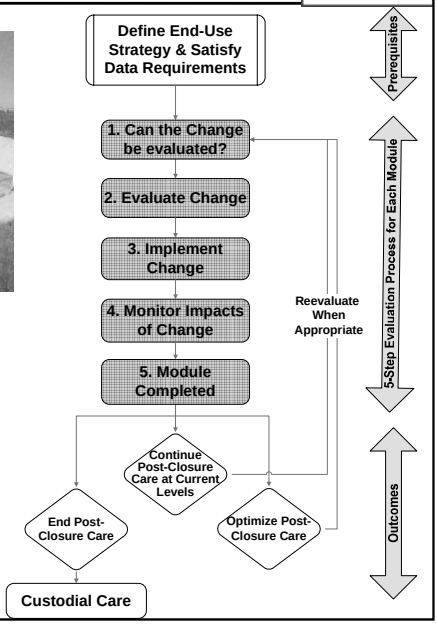
3.The process allows you to start evaluation of subsequent modules before you achieve an outcome of "End PCC".

The outcomes, which lead eventually to custodial care, are as we discussed before too.

Now, let's move to the details of the 5 steps for each module.

34

Five-Step Evaluation Process



So what kind of changes are we evaluating in this process? The first step of the 5-step process says “can the change be evaluated?”, so what kind of changes could we be considering?

The first and most obvious change is ending PCC altogether.

But there are many other changes that might be more common and can also be evaluated through this process to see if they would be expected to be protective of human health and the environment. They might include:

1.Changing the leachate management approach from “pump and haul to publicly owned treatment works (POTW)” to “onsite passive treatment and discharge” or, if the leachate is really clean, direct discharge to a surface-water body

2.Eliminating an active or a passive gas management system

3.Changing the PCC use of the site from restricted, passive use to semi-restricted, active use or even redevelopment.

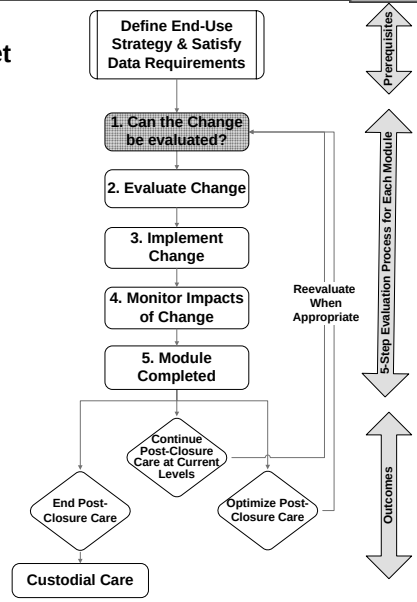
Each of these changes requires some kind of evaluation to make sure that the change can be implemented in a way that is protective of human health and the environment in the **End-Use Setting** that is planned for the site. So let’s talk about how these changes might be evaluated using the 5-step process.

35

1. Module-specific Requirements

Purpose: Evaluate whether module-specific requirements are met

- **Leachate**
  - **Steady improvement in leachate quality and quantity**
- **Landfill gas (LFG)**
  - **No impacts**
- **Groundwater**
  - **Detection monitoring**
- **Cap**
  - **All other modules are completed**
  - **Dependence of other outcomes on the cap are defined**



The first step involves the module-specific prerequisites – “can the change be evaluated?”.

The purpose of this step is listed on the slide.

The TechReg document identifies separate requirements for each module, and some of the key ones are identified on this slide. We already talked about the general prerequisites, which is the top box on this flowchart to the right of the slide – but on this slide we’re only talking about the prerequisites for performing a specific module evaluation.

I’d like to go through the prerequisites listed on the left side of this slide so you can get a feel for what might be required before an evaluation can be performed of ending or significantly changing PCC.

Leachate ____

Landfill gas ____ (at the property boundary or in buildings)

Groundwater ____ (not assessment or Corrective Action monitoring, only detection)

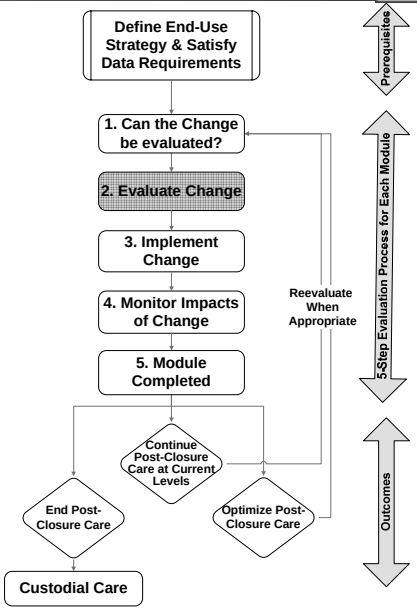
Gas ____

36

2. Evaluate Change of PCC

Goals are to evaluate

- Is change appropriate?
- Will change result in unacceptable threat?



After the prerequisites are fulfilled for a specific module, the change that is planned needs to be evaluated. The goals of the evaluation are to see if:

1. The change is appropriate, and
2. Whether it will result in an unacceptable threat to human health and the environment.

This step represents most of the analytical work of completing the module and, therefore, I'll go into detail on this step – one slide for each module.

37

2. Evaluate Change

Leachate Management

- Define change
- Step-up evaluation of change
  - Step 1: Compare leachate concentrations to standards
  - Step 2: Evaluate diluted leachate concentrations at the point of compliance
  - Step 3: Assess threat at point of exposure
- Optimize leachate collection and removal system operation
- Modify PCC plan

For the leachate module, step 2 involves first defining the change that is proposed. The change might involve, for example, eliminating all management of leachate (i.e., ending PCC of the leachate management system), or changing from leachate removal and treatment to passive leachate flow to a direct discharge point.

After the change is identified, an evaluation is performed of that change to see of it would result in a threat to human health and the environment. We do this evaluation using what we refer to as a "step-up" approach, implying an increasing level of detail in the evaluation to see if the change would cause an impact.

The first "step" involves a direct comparison of leachate concentrations to direct discharge or other water quality standards; this "easiest" step is based on the premise that if leachate is clean enough to put into a creek – and that is the case for many sites – then it shouldn't take very detailed demonstration to show it.

The second "step" involves an evaluation of diluted concentrations of leachate at a point of compliance. This requires a somewhat "harder" evaluation than the first step and involves a "dilution-attenuation" evaluation of what concentrations of groundwater would be at the point of compliance location.

The third "step" involves an assessment of the threat at a point of exposure location. The point of exposure is defined as the closest location at the surface at which a receptor could be exposed to the source and receive a dose in a credible pathway from the waste management unit. Each state should apply this definition according to state statute and regulation. The team does not support defining a credible point of exposure as the leachate collection system or leak detection system that is part of the unit.

If the evaluation passes any of these three steps, then it would be concluded that the proposed change would not be a threat to human health and the environment. If the evaluation fails or if the owner/operator chooses not to attempt a "higher" step, then the change should not be made.

After the "step up" evaluation is completed, the evaluator could make an assessment of whether the leachate collection system could be optimized or not. This is shown on the last two bullets on this slide. Optimizing the system might involve, for example:

1. Reducing the testing frequency or requirements for testing
2. Reducing the inspection frequency
3. Automating operation or monitoring activities

And, of course, any change to the PCC activities requires that the PCC Plan be modified, and that should be considered at this stage of the evaluation.

38

2. Evaluate Change

Gas Management

- Define change
- Step-up evaluation of change
  - Step 1: Preliminary screening evaluation
  - Step 2: Engineering evaluation approach
  - Step 3: Assess threat at point of exposure
  - If changes to PCC monitoring or maintenance are needed to evaluate impact
- Optimize landfill gas system operation
- Modify PCC plan

The second module is the gas module. For this module, step 2 first involves defining the change. Note that, for the landfill gas system, "End PCC" means "no more landfill gas management system", not even a passive management system. For the gas system, the change might involve

1. changing from an active to a passive system,
2. changing from a passive management system to no management system at all, or
3. changing from a passive system with vents to a passive system with attenuation but no vents.

After the change is identified, an evaluation is performed of that change to see of it would result in a threat to human health and the environment. We do this evaluation again using a "step-up" approach, implying an increasing level of detail in the evaluation to see if the change would cause an impact.

The first "step" involves performing a ***qualitative*** preliminary screening evaluation based on the type of change and the amount of landfill gas generation potential that the landfill still has. The evaluation uses conservative criteria for a passing outcome and is relatively simple.

The second "step" involves performing a ***quantitative*** screening evaluation based on the effectiveness of the cover system and the proximity of the landfill to potential receptors. This demonstration requires a greater level of effort and perhaps some more data than the previous step, but is intended to provide an equally accurate and valid result.

The third "step" involves performing an assessment of threat at a point of exposure and is an analytical evaluation of the impacts of gas constituents on receptors if the gas were to reach those receptors. This demonstration requires the greatest level of effort of the three "steps".

It's important to note that the "easier" steps are intended to produce an outcome that is ***just as protective*** as the "harder" steps – it's just that the easier steps require comparison to a more rigorous standard to achieve that level of protectiveness.

If the evaluation passes any of these three steps, then it would be concluded that the proposed change would not be a threat to human health and the environment. If the evaluation fails or if the owner/operator chooses not to attempt a "higher" step, then the change should not be made.

After the "step up" evaluation is completed, the evaluator could make an assessment of whether the leachate collection system could be optimized or not. This is shown on the last two bullets on this slide. For the landfill gas system, optimizing the system might involve, for example:

1. Reducing the number of gas collection wells or vents
2. Reducing the inspection frequency or types of inspections
3. Changing the type of monitoring to automate it

And, of course, any change to the PCC activities requires that the PCC Plan be modified, and that should be considered at this stage of the evaluation

39

2. Evaluate Change

Groundwater Monitoring

- Evaluate potential for future groundwater impacts
  - Confirm that time to impact has passed
  - Consider leachate and landfill gas impacts
  - Different approach required on systems with no leachate collection and recovery system
- Identify opportunities to optimize groundwater monitoring program
- Modify PCC plan as appropriate

After the gas module is the groundwater module. The purpose of the groundwater module is simply to evaluate the potential for future groundwater impacts. The three key concepts involved with the groundwater module are:

1. It must be confirmed that monitoring has occurred for as long as needed to detect an impact if it were to have occurred
2. Impacts from both leachate and from landfill gas should be considered
3. If there is no Leachate Management system, a different approach is needed because we can't get leachate quality data…

Now is the time to optimize if that is a goal of the evaluation, and any change or optimization likely requires a change to the PCC Plan.

.

40

2. Evaluate Change

Landfill Cap Management

- Define post-closure care requirements
  - Regulatory requirements
  - Requirements established by outcomes of other modules
  - Performance requirements
- Evaluate compliance with post-closure care requirements
- Identify opportunities to optimize cap maintenance and monitoring
- Modify PCC Plan as appropriate

The evaluation of the change for the cap is more dependent on the other modules but begins with the same first step: defining the change. For the cap, the change might involve (i) regrading to accommodate a particular post-closure end use, perhaps even involving construction of a reinforced earth wall adjacent to the landfill to make the site more suitable for it's intended future use; (ii) installing an alternative cover system to reduce the amount of maintenance required in the long term; or (iii) ending PCC entirely.

Once the change is defined, the first step in evaluating the change is to identify the post-closure care requirements for the cap system. For the purposes of this program we have classified those requirements in three groups:

1. Regulatory requirements, which include prescriptive requirements that have little or no flexibility (e.g., specified cap components, inflexible reporting or monitoring frequencies, etc.).

2. Requirements established by the outcomes of other modules (for example, if the we ended leachate module because there is very little leachate and that depends on a tight cap, then the permeability of the cap is needed to maintain the outcome of the leachate module)

3. Performance requirements, such as stability, continuity over all waste placement areas, resistance to erosion and wind damage, etc.

After these requirements have been defined, an evaluation is made of whether the cap meets those requirements and would be expected to continue to meet the requirements under the level of care provided in the future (i.e., PCC or custodial care).

As with the other modules, step 2 is where we consider whether or not it is appropriate to optimize PCC if we aren't ending PCC. Optimization of the cap might include:

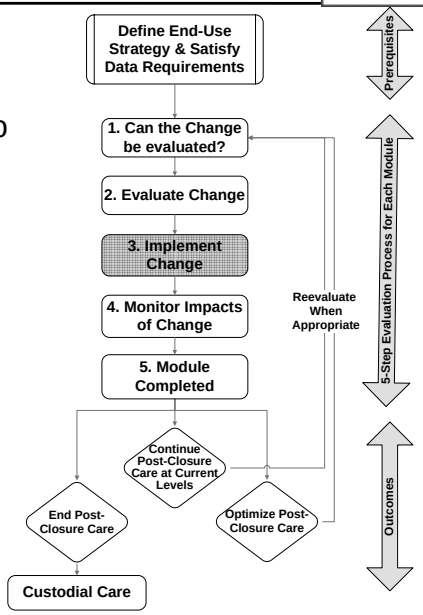
1. Reducing frequency of monitoring
2. Reducing type of monitoring (i.e., aerial instead of walking)
3. Enhancing vegetation or Solid Waste Management features so less maintenance is required

Also, any change or optimization likely requires a change to the PCC Plan.

41

3. Implement Change

- Implements the changes evaluated in step 2 based on "no adverse impacts are expected" result of step 2 evaluations



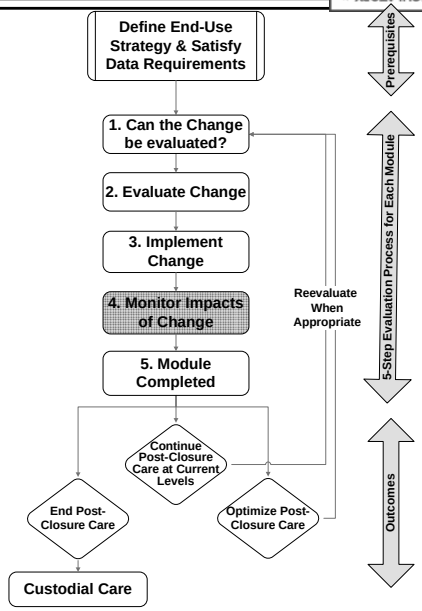
After all of the "step 2" evaluations are completed, changes that were found not to have an adverse impact on human health and the environment can be made.

At this point we transition immediately into step 4, monitoring.

42

4. Monitor Impacts

- Monitor the change made during step 3 and confirm that it works as predicted
- Confirmation monitoring
  - Monitoring **during** PCC to confirm that a change resulted in the predicted outcome
- Surveillance monitoring
  - Monitoring **after** PCC for an extended period to further validate the decision to end PCC for a module



On this slide we begin the discussion of the monitoring that occurs after a change in PCC is made. The purpose of monitoring is:

(read first bullet)

There are 2 types of monitoring: The first is confirmation monitoring, which is…(read)

The second is Surveillance Monitoring, which is….(read)

Let's go into some more detail about confirmation monitoring, please turn to the next slide.

43

Evaluating Performance of Change: Confirmation Monitoring

- "Demonstrating that data on which the evaluation was performed is complete and documents the existence of the trends that the evaluation was based on"
  - Performed for duration and at frequencies established during "Step 2 – Evaluation"
  - Monitoring data comply with performance criteria established during "Step 2 – Evaluation"
- If the change "performs as planned" proceed to surveillance monitoring

The definition of confirmation monitoring, from the Tech/Reg document ("Technical and Regulatory Guidance: Evaluating, Optimizing, or Ending Post-Closure Care at Municipal Solid Waste Landfills Based on Site-Specific Data Evaluations" (ALT-4, 2006)), is listed on the slide.

Confirmation monitoring is performed based on the Confirmation Monitoring Plan, which is developed during step 2. The plan identifies the frequencies (1st bullet) and the data requirements (2nd bullet) for confirmation monitoring.

Now if the goal of confirmation monitoring is to end PCC, then if the results of confirmation monitoring show that the change "performs as planned" we would proceed to surveillance monitoring. We'll talk about that in a couple of slides. But what if the monitoring results aren't as we had hoped?

44

Confirmation Monitoring – Outcome Not As Planned

Two possible outcomes:

1. Out of compliance
   - Evaluate cause, or
   - Return to PCC at original levels
2. In compliance, but behavior is not wholly as predicted
   - Evaluate need for responsive action
   - Responsive action could include
     - Evaluate result, further monitor trends, if appropriate; or
     - Return to previous, more stringent levels of PCC
   - Example
     - Turning off a gas collection system
     - Landfill gas is detected above predictions but below regulatory thresholds
     - Increase frequency or duration of confirmation monitoring, turn gas management system back on
   - After evaluations, confirmation monitoring must continue

There are two possibilities in this case –

First, the results are out of compliance with applicable regulations. In this case, the cause of the result should be evaluated and, if it is accurate, then PCC should be returned to original levels that were in place before confirmation monitoring began.

Second, if the results are in compliance but not quite what we had predicted or anticipated, then evaluate the validity of the monitoring result and the need for a response action. A response action could include….(provided on slide)

As an example of this “low level trigger” in confirmation monitoring, ….(provided on slide)

45

Confirmation Monitoring – Outcome As Planned

Two possible outcomes:

1. If NOT ending PCC, then continue PCC as modified during step 3
2. If ending PCC, then proceed to Surveillance Monitoring

   Provides longer-term monitoring at a reduced level to document that the decision to end PCC was appropriate

   - No operation or maintenance
   - No controls exist other than those that will continue to be in place throughout custodial care
   - It has been demonstrated that the waste management unit is 'self-sustaining'

If confirmation monitoring results are as we expected then, again, we have two possible courses.

1. If our goal was not to end PCC but to optimize or to simply change the design of a PCC system, then continue PCC as modified in step 3.
2. If our goal WAS to end PCC, then proceed to surveillance monitoring.

There are two possible outcomes of surveillance monitoring, as discussed on the next slide.

46

Outcomes of Surveillance Monitoring

Two possible outcomes:

1. Monitoring results as expected: develop custodial care program and proceed to custodial care
2. Monitoring not as expected: re-evaluate the decision to terminate or change PCC

Note that:

- Completion represents the end of post-closure care
- At end of surveillance monitoring, establish custodial care program

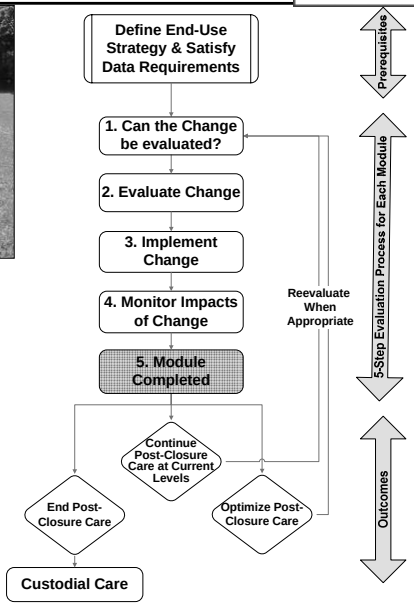
The two outcomes are:

1. Monitoring results are as expected: in this case, develop a custodial care program and proceed to custodial care…
2. If monitoring results are not as expected, then reevaluate the decision to terminate or change PCC.

See notes listed on slide.

47

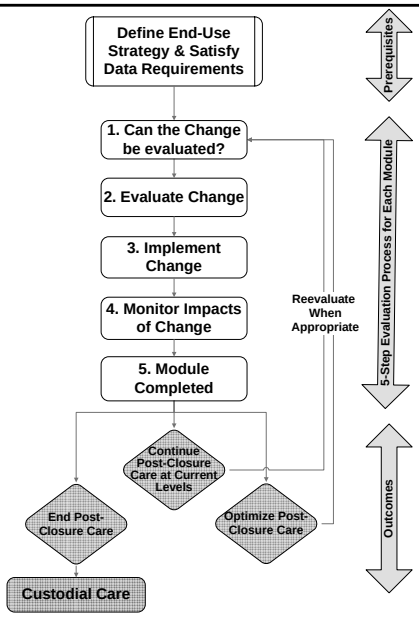
5. Module Completion



Now, we're finished with the discussion of the module evaluations and are ready to begin the more detailed discussion of the evaluation outcomes. Kalpesh Patel, with the Department of Defense at Lackland AFB in Texas, will lead that discussion.

48

Outcomes of Module Evaluations



No associated notes.

49

Outcome: Continue Post-Closure Care at Current Levels

- One or more modules still require PCC
- Evaluations should be performed again in future

One or more modules still require PCC as described in PCC Plan to protect human health and the environment, or inadequate data available to perform evaluations

Evaluations should be performed again in future when conditions change or adequate data is available

50

Outcome: Optimize Post-Closure Care

- Intensity or scope can be reduced
- Justification depends on human health and the environment considerations
- Requires changes to PCC operation and/or maintenance plans

Out come: Optimize Post-Closure Care.

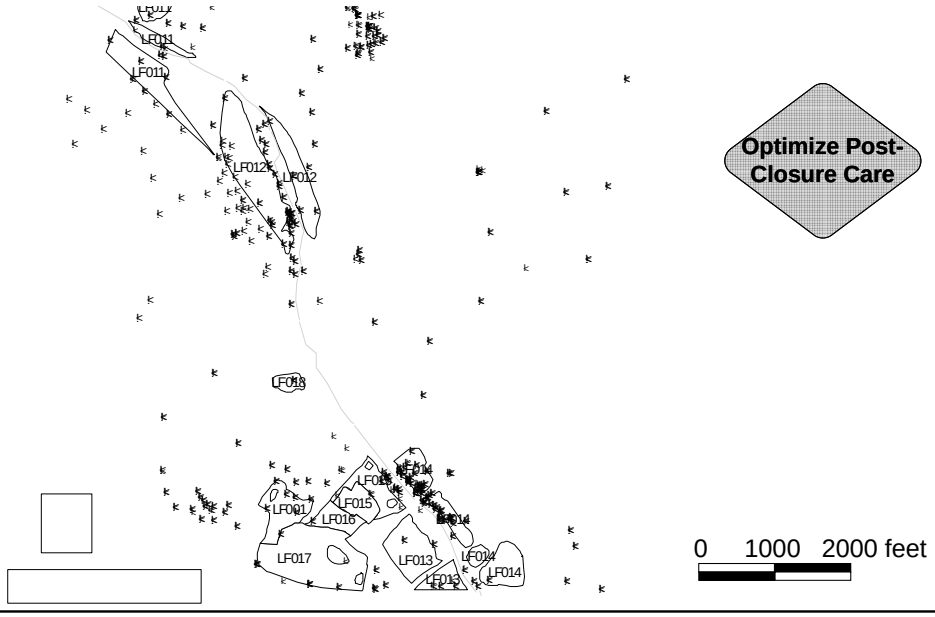
In this outcome, continue post-closure care, however, optimization is needed in post-closure care.

For an example, upon completion of each modules and during the evaluation process, we may find that we still need to collect additional data. However, we do not need to monitor for all parameters and optimization can be performed while continue with PCC. Optimization may involved altering monitoring parameters in light of our ultimate goal of protecting human health and environment.

The important point here is that optimization may requires altering monitoring parameters and also the post-closure care operation and maintenance plans.

51

Landfills and Existing Monitoring Wells

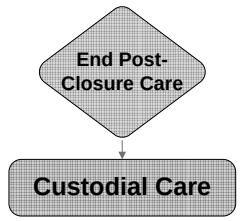


No associated notes.

52

Outcome: End Post-Closure Care

- All confirmation monitoring and surveillance monitoring and maintenance are concluded
- Regulatorily required post-closure care is completed
- Establish de minimus levels of care required for custodial care (e.g. administrative property restriction)



Outcome: End of Post-Closure Care

Under this out come, monitoring and evaluation of all four modules are completed and we meet all regulatory requirements along with our ultimate goal of protection of human health and environment. Consequently, site owner is now released from regulatory post-closure care and have the responsibilities of de minimus levels of care in form of custodial care which was described earlier by Charles.

53

Requirements for *Ending* PCC

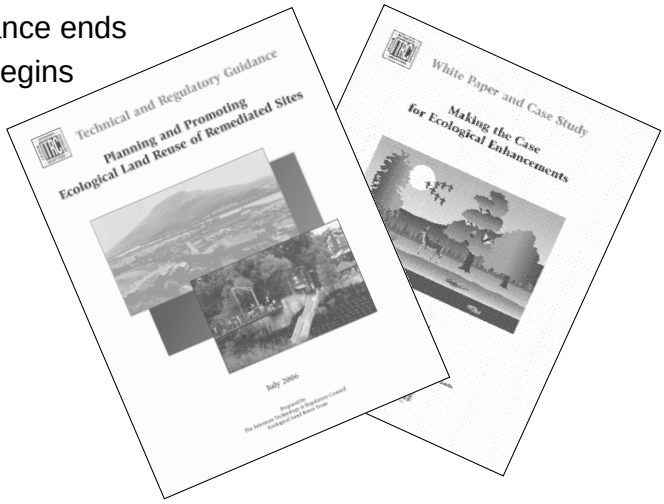
- Leachate management system
  - Concentrations do not pose a threat
  - Build-up of leachate head addressed (e.g., bathtub effects)
- Landfill gas system
  - Gas migration in the future does not represent a threat
- Groundwater monitoring
  - Currently in detection monitoring
  - Monitoring has been performed long enough to have detected a release
- Final cover
  - Cap predicated on other modules' requirements
  - Containment of waste addressed
  - Only provide de minimus care needed to maintain cap and the outcomes of other modules

No associated notes.

54

What Happens after Surveillance Monitoring?

- Regulatory PCC ends
- Financial assurance ends
- Custodial care begins



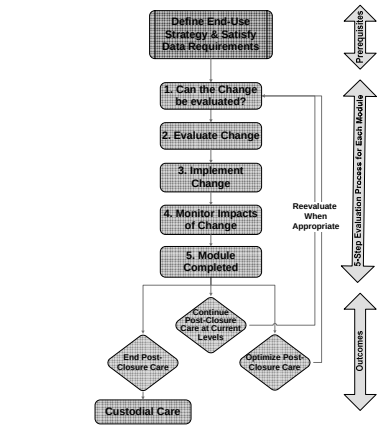
As Charles point out earlier, planning with a particular end use in mind delineates the expected performance of the landfill during PCC and defines the basis for evaluating and unacceptable threat.

ITRC has also published a document titled *Making the Case for Ecological Enhancements* (ECO-1, 2004) and the associated guidance document *Planning and Promoting Ecological Land Reuse at Remediated Sites* (ECO-2, 2006) which describe efficiencies in the design and planning process created by predicting a property use after project completion. Both documents are available at www.itrcweb.org under “Guidance Documents” then “Ecological Enhancements.”

55

Custodial Care

- Continuing obligations to care for the closed landfill
- Ensure that it does not pose a threat to human health and the environment
- Outside of the direct jurisdiction of solid waste regulatory authority
- Institutional controls or covenants to ensure the protective conditions
  - Deed restriction
  - Covenants
  - Alternate land use control mechanisms



Custodial Care

Continuing obligations to care for the closed landfill and ensure that it does not pose a threat to human health and the environment following formal regulatory post-closure care requirements. Custodial care is considered outside of the direct jurisdiction of solid waste regulatory authority. Institutional controls or covenants can accommodate or will include and ensure the protective conditions required in custodial care. Examples include

Deed restriction

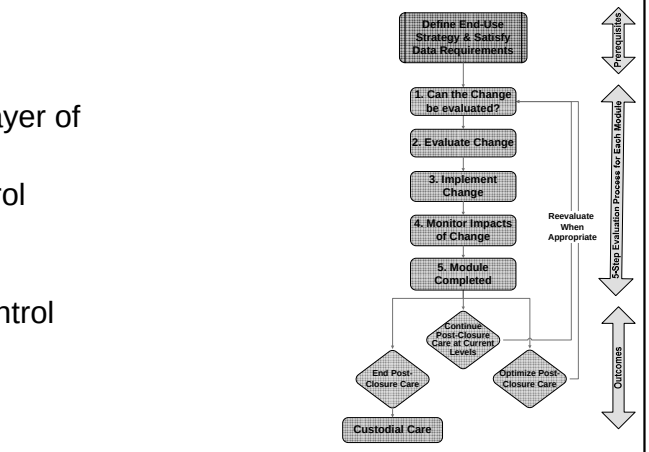
Covenants

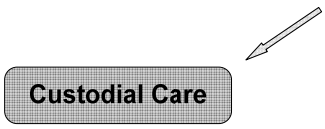
Alternate land use control mechanisms

56

Custodial Care (continued)

- History of good performance
- Maintain the top layer of the cap
- Maintain site control features
  - Fences
  - Stormwater control
  - Erosion
  - Mowing
  - Vegetative maintenance
- In summary





No associated notes.

57

Financial Assurance Mechanisms

Team recommends:

- Funding should be re-evaluated
  - Using outcomes of this four-module evaluation
  - 10 years (minimum) prior to projected end of PCC
- Ensure amount is adequate
  - Reasonably anticipated PCC period based on performance evaluation of the landfill

The team recommends that financial assurance funding should be re-evaluated using, in part, the outcome(s) of this four-module evaluation. This evaluation should occur, at a minimum, 10 years prior to any projected end of PCC. The intent of this evaluation is to ensure that the amount of Financial Assurance is adequate to cover any reasonably anticipated PCC period based on the performance evaluation of the landfill.

Mechanisms available today continue to serve its purpose - to ensure sufficient funds are available for post-closure care if owner/operator is unable to perform.

Financial Assurance ends only when the obligation has been performed by the owner/operator.

Instruments are generally continuous or irrevocable and cannot be terminated until released by the Agency or replaced with another mechanism.

58

In Summary

- Post-closure care can be shorten or lengthened
- Defining the end-use of PCC for a successfully closed landfill site is an important first step in permitting a landfill operation
- Four components of PCC for landfills
  - Leachate
  - Groundwater
  - Gas
  - Cap
- The end of PCC occurs when a landfill no longer threatens human health and the environment base on a performance evaluation of the four components of PCC
- Ending post-closure care is possible as well as practical
- Custodial care
  - After PCC ends custodial care occurs that involves de minimus amounts of care

No associated notes.

59

Other Organizations and Information Sources

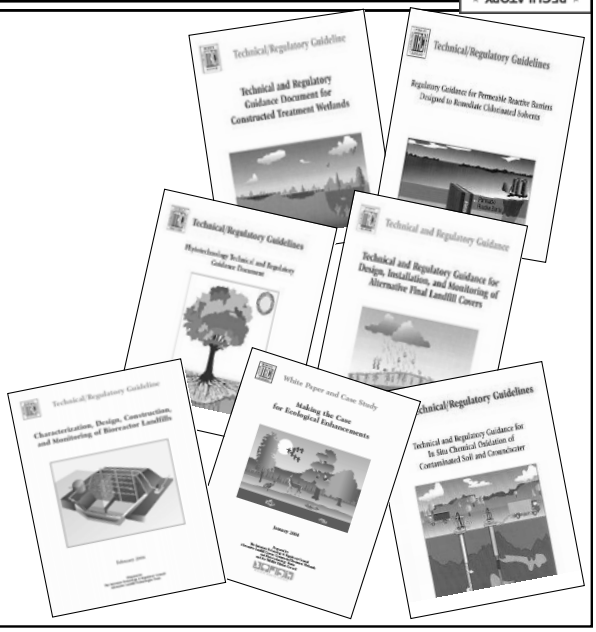
- Environmental Research and Education Foundation
  - www.erefdn.org
- Solid Waste Association of North America
  - www.swana.org
- National Solid Waste Management Association
  - www.nswma.org
- National Solid Waste Management Authority
- EPA Municipal Solid Waste Management
  - www.epa.gov/msw/

No associated notes.

60

Related and Follow-up Guidance

- Available now
  - ITRC Guidance Documents
  - Internet-based training classes
- Future
  - Expert system model for evaluating post-closure care
  - Classroom training course

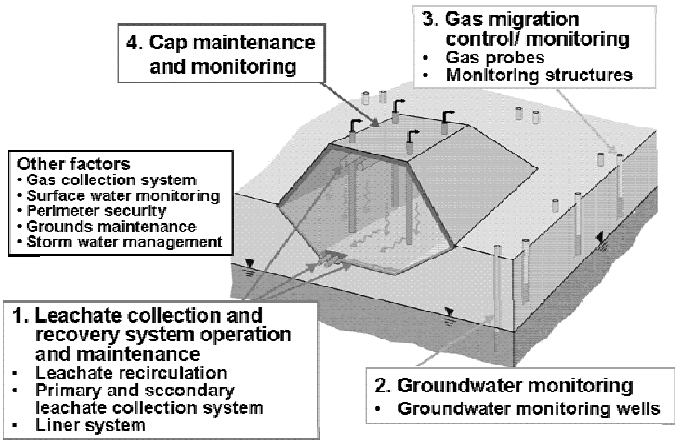


ITRC guidance documents are available at www.itrcweb.org under “Guidance Documents.” Information about associated Internet-based training courses is available at www.itrcweb.org under “Internet-based Training.”

61

Thank You for Participating

- **Links to additional resources**
  - **http://cluin.org/conf/itrc/pcc/resource.cfm**
- **2nd question and answer session**



Links to additional resources:
http://cluin.org/conf/itrc/pcc/resource.cfm

Your feedback is important – please fill out the form at:
http://cluin.org/conf/itrc/pcc/

The benefits that ITRC offers to state regulators and technology developers, vendors, and consultants include:

✓Helping regulators build their knowledge base and raise their confidence about new environmental technologies

✓Helping regulators save time and money when evaluating environmental technologies

✓Guiding technology developers in the collection of performance data to satisfy the requirements of multiple states

✓Helping technology vendors avoid the time and expense of conducting duplicative and costly demonstrations

✓Providing a reliable network among members of the environmental community to focus on innovative environmental technologies

How you can get involved with ITRC:

✓Join an ITRC Team – with just 10% of your time you can have a positive impact on the regulatory process and acceptance of innovative technologies and approaches

✓Sponsor ITRC's technical team and other activities

✓Be an official state member by appointing a POC (State Point of Contact) to the State Engagement Team

✓Use ITRC products and attend training courses

✓Submit proposals for new technical teams and projects