

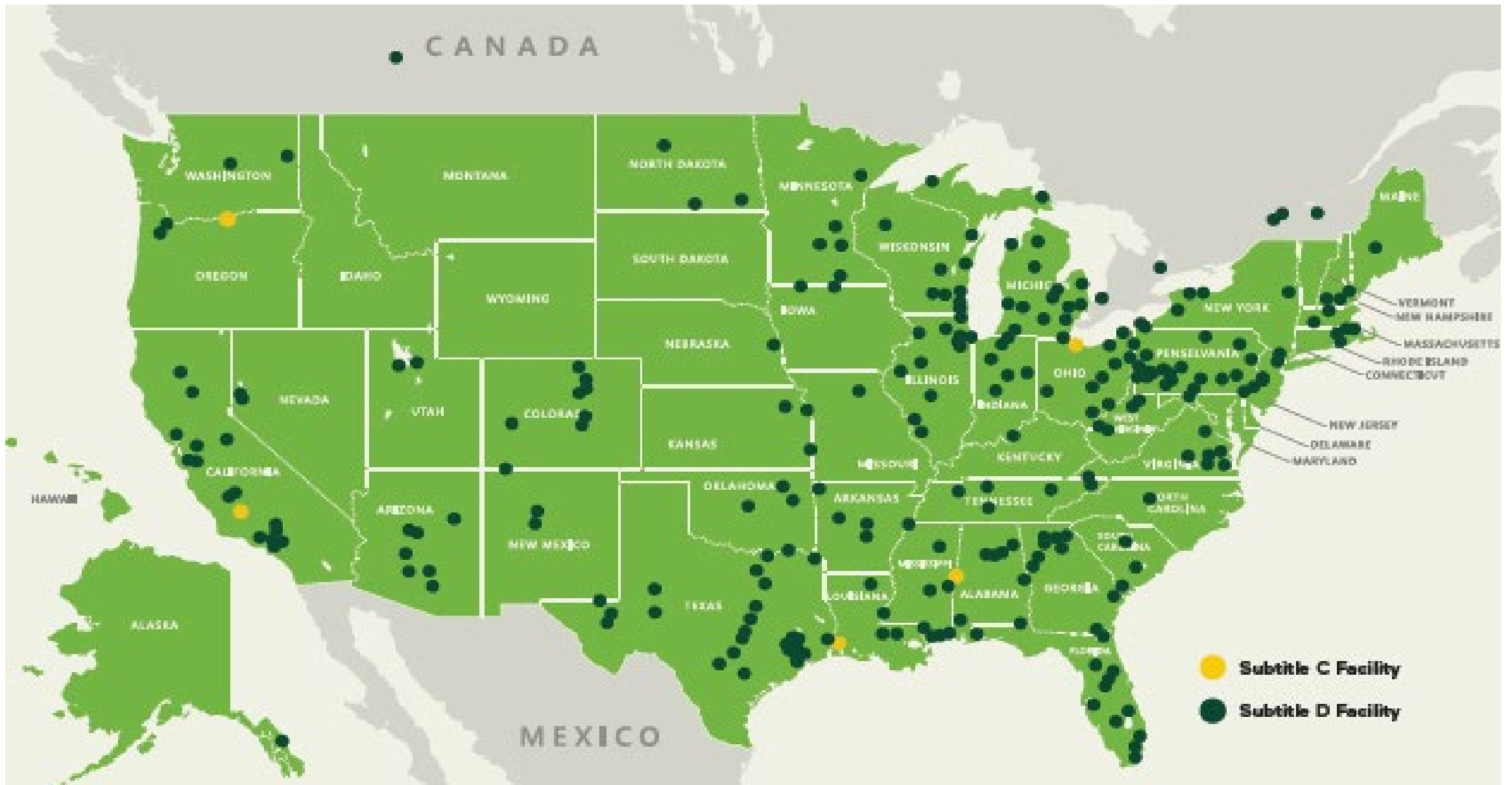
UNCERTAINTY!



January 18, 2022

Midwest A&WMA Meeting
WM Landfills







January 18, 2022

Midwest A&WMA Meeting

Risk Management Principles



Risk Management Principles

Special/WWL Waste Risk = Tonnage X Consequence

Risk Identification

Risk Ranking

Risk Mitigation

Risk Monitoring

Managing Waste - Risk Complexities

Where is there uncertainty or risk?

Fixed	Technical	People	Unknown
<ul style="list-style-type: none">• Environment• Waste• Regulations	<ul style="list-style-type: none">• Design• Modeling• Operations	<ul style="list-style-type: none">• Decisions• Regulators• Community	<ul style="list-style-type: none">• Unknowns• e.g. ETLF

WM sees more risk associated with managing certain special wastes and the approval process needs to cover a wider range of uncertainty to be protective of people, the environment and assets



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Special Waste Program



Special Waste Policy and Procedure

SPECIAL WASTE POLICY

Purpose:

To communicate Waste Management's objectives for management of all Special Wastes entrusted to the Company's care including, but not limited to, identifying, documenting and managing Special Waste to ensure regulatory compliance and protection of our employees, our assets, human health, and the environment.

Policy:

This Policy applies to all landfills, collection operations, transfer stations, recycling or treatment facilities, or any other operating or non-operating asset.

Special Waste is defined to be all wastes (hazardous and non-hazardous) that require additional evaluation, handling, documentation, packaging and/or treatment prior to transportation, management and/or disposal to ensure that any risks associated with them are properly mitigated.

This policy also applies to special non-waste materials that require similar scrutiny due to regulatory or permit requirements, receiving facility acceptance criteria, and/or other requirements.

Special Waste Process:

- Waste Management will develop, implement, and maintain a [Special Waste Procedure](#) to mitigate known, potential, or emerging risks presented by Special Wastes and will ensure this information is communicated to all stakeholders.
- The WM Waste Approvals Team is responsible for evaluating all Special Wastes utilizing Generator or Generator's agent-provided information, analytical data and other supporting documentation. Waste Approval Managers are solely authorized to complete waste approval decisions. All waste approval decisions will encompass compliance with regulatory requirements, permit restrictions, health and safety criteria, best operating and management practices and good environmental stewardship.
- WM will ensure that all individuals responsible for implementation and utilization of the Special Waste Policy are trained. This includes, but is not limited to, Technical Service Center Staff, Customer Experience Center Staff, Dispatchers, Drivers, Sales, receiving facility Gatehouse Attendants and Operators, District and Market Area Management, and Waste Approval Managers. Training will be updated routinely.

Policy Audit Process

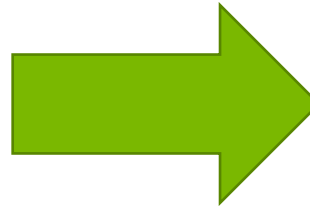
Goals and objectives specific to the Policy are established, reviewed and approved during Management review. Waste Management will regularly monitor Special Waste Policy adherence and make recommendations to the Board of Directors and executive leadership team to ensure continuous improvement.

Approval Requirements:

N/A

Variance Approvals:

Policy variances must be obtained from the Policy Owner. Variances must be requested using the [Variance Approval Form](#).



Waste Approval Procedure 005

SPECIAL WASTE PROCEDURE	
SECTION / TOPIC	REQUIREMENT
1. Background	<p>Waste Management (WM) recognizes that its position as industry leader creates a responsibility for leadership in self-regulation, and this responsibility includes the appropriate management of all materials entrusted to the Company's care.</p> <p>In addition to hazardous waste, certain non-hazardous wastes from residential, commercial and industrial customers as well as certain other non-waste material streams, such as compost wetting agents or 'clean' soil, that may require additional scrutiny and/or special handling are included under this Procedure.</p> <p>WM also recognizes that some Federal, Canadian, State, Provincial and/or Local regulations may need to be supplemented by an internal program which ensures that all material streams receive attention commensurate with the risks associated with managing the material.</p>
2. Procedure Basis	<p>This Procedure addresses Special Waste identification, evaluation, documentation, and management to ensure regulatory compliance, including compliance with the waste screening requirements of the United States Federal Subtitle D regulations (40 CFR Part 258.20(a)(1)-(3)), and protection of our employees, our assets, and human health and the environment. This Procedure supports the Special Waste Policy.</p> <p>The Special Waste Procedure (Procedure) will:</p> <ul style="list-style-type: none"> • Provide the framework for protection from the potential dangers that certain wastes and other materials could pose to our employees, the public, the environment or Waste Management assets, • Serves as a hazardous waste, PCB, and radioactive waste evaluation tool that assures that these materials are properly managed, and • Minimize the customer's and the Company's potential liabilities.



Special Waste Program

Goals and Scope

Special Waste Program Goals

- Protect human health, environment, disposal assets
- Assure compliance with regulatory and facility permit requirements
- Reject hazardous wastes from Subtitle D/redirect to Subtitle C sites
- Support integrated efforts of sales, ops, env. protection, legal etc.
- Strive to identify, mitigate risks for Waste Watch wastes (e.g., PFAS-Containing Wastes)
- Establish special waste approval procedure
- Train special waste stakeholders

Special Waste Program Scope

- 24 Waste Approval Managers (WAMS)
- 500,000+ special waste profiles in the system
- 60,000+ special waste requests and amendments per year

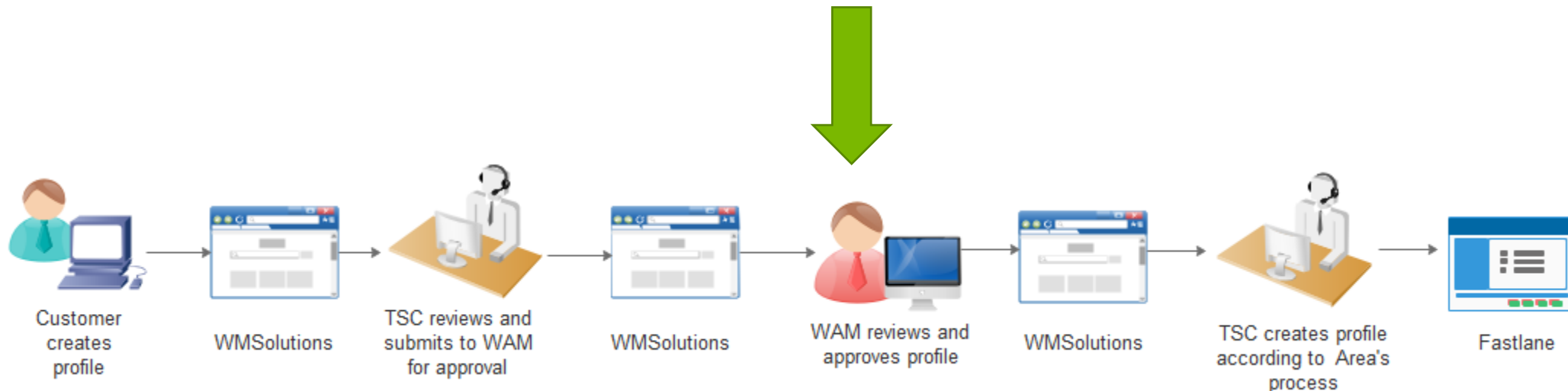
WAMs - Key Resources for Risk Mitigation

How do we stay in compliance?

Waste approval process success depends upon highly experienced team of 24 WAMs with a combined 450+ years of waste industry experience.

Special Waste Approval Process

Special Waste Decisioning



- Is the waste regulated under RCRA, TSCA, CERCLA ...?
- If it is a nonhazardous waste, does it exhibit any occupational risks?
- Does it require manifesting, packaging, labeling, and/or placarding under DOT?
- Does it conform with facility permit requirements?
- Does it exhibit heat, hydrogen sulfide, and/or landfill instability risks?
- Are there any conditions for approval in terms of facility selected, placement, beneficial reuse, etc.



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Waste Watch Program



Waste Watch Risks

Are we assessing risk completely? Does a waste exhibit unique risks?

Landfill
Instability

Hydrogen
Sulfide

Hydration
Heat

Carbonation
Heat

Metal
Corrosion
Heat

Human
Exposure

Emerging
Wastes

Business

Regulatory

Environmental

Elevated
Temperatures

Operational

Waste Watch Policy and Procedures

MANAGING WASTE WATCH LIST SPECIAL WASTES POLICY

Purpose:

The purpose of this policy is to communicate management objectives for disposing of special wastes that exhibit stability, heat generation and/or hydrogen sulfide or associated emission risks when managed at Waste Management (WM) landfills. Special wastes that exhibit these risks are identified on the Waste Watch List (WWL) created by the Waste Approvals Team. The key risk mitigation for managing Waste Watch List wastes is to isolate them from Municipal Solid Waste (MSW).

Policy:

This policy applies to all owned or operated WM landfills accepting WWL special waste. Management requirements for special wastes identified on the WWL are defined by specific procedures created by the Waste Approvals Team and stored on the [Waste Approvals site](#).

WWL Procedures are developed based on subject matter expert input from operations, safety and academia with individual procedures potentially covering more than one WWL type. The WWL is managed and updated by the Director, Waste Approvals.

Waste Watch List Procedures define:

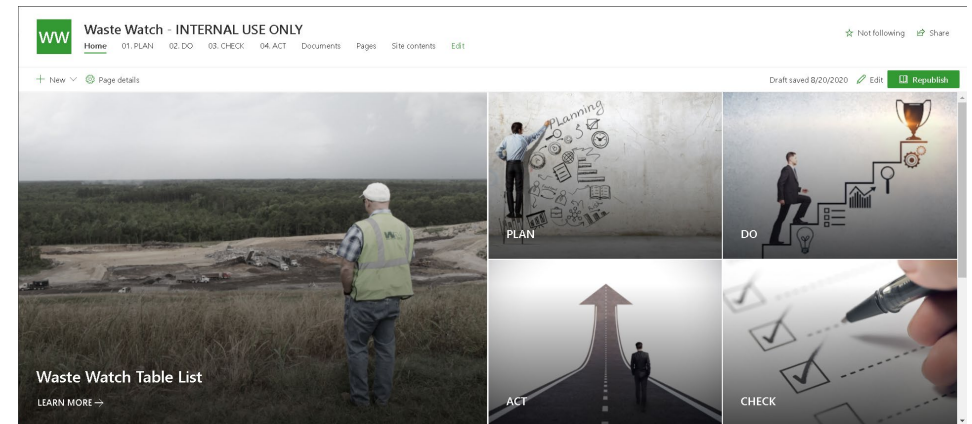
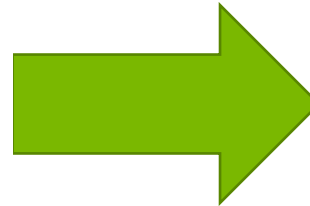
- Facility Applicability
- Risks of managing specific Waste Watch List waste
- Examples of Waste Watch List waste
- Mitigation options for minimizing risks through isolated barriers, isolated barriers with separate leachate collection systems, monofills, block fills, etc.
- Waste Approval requirements including analytical testing and de minimus approval authority of Waste Approval Managers (WAMs) and Directors of Disposal Operations (DDOs)
- Safety considerations for managing specific Waste Watch List waste
- Waste Watch List Procedural variance requirements that are submitted using the [EMG Variance Approval Form](#).

Approval Requirements:

N/A

Variance Approvals:

Policy variances must be obtained from the Policy Owner. Variances must be requested using the [Variance Approval Form](#).



Waste Watch List Table Status - Version 18

Waste Watch List Table Status - Version 18

Waste Code	Waste Name	Waste Type	Waste Class	Waste Status	Waste Description	Waste Quantity	Waste Location	Waste Date
001	Sulfate-Bearing Waste	001						
002	Elemental Sulfur Waste	002						
003	Ash & Ash-Bearing Waste	003						
004	Aluminum Recycling Waste	004						
005	Sludge, Soft & Wet Waste	005						
006	PFAS Containing Waste	006						
007	Auto Shredder Residue	007						
008	Coal Waste	008						
009	NORM/TENORM	009						

WWL Procedure for:	Revision	Date of Issuance
Sulfate-Bearing Waste 001	3	27-Feb-19
Elemental Sulfur Waste 002	1	31-May-18
Ash & Ash-Bearing Waste 003	3	25-Feb-22
Aluminum Recycling Waste 004	1	31-May-18
Sludge, Soft & Wet Waste 005	2	5-Nov-21
PFAS Containing Waste 006	0	31-Oct-19
Auto Shredder Residue 007	0	8-May-20
Coal Waste 008	0	15-Jan-21
NORM/TENORM 009	0	24-Sep-21

WWL Risk Mitigations

Isolating from MSW is primary

- Quenching ash waste streams (hydration energy mitigation)
- Aging ash waste streams (carbonation heat mitigation - additional discovery)
- Enhanced metal extraction (corrosion heat mitigation)
- Stabilizing wet/liquid wastes with ash or other pozzolanic materials
- Reducing volume of water by centrifuging, dewatering and/or thermal dryers
- LF gas stream H₂S removal (e.g., Cameron SulfaTreat, Carbon media, etc.)
- Containment in macrovaults, roll-off bags, zippered bags, etc.
- Dust control with wetting agents
- Hybrid solidification with combinations of pozzolanic and bulking agents
- Liquid Release Testing @50 and 100 psi for hybrid solidification
- Raw coal dilution with soil and operational mixing practices
- PFAS containment or stabilization agents for contaminated soils, sludges and dredge wastes

Risk mitigation strategies are being tested in both laboratory and field scale and then documented on the WWL Communications Page

WWL Risk Mitigations

Heat Wastes

- Isolation from MSW is primary (block fill, monofill, macro boxes, zipper bags etc.)
- Quenching, aging in atmosphere, metal removal

Sulfur/Sulfate Wastes

- Isolation from MSW is primary (block fill, monofill, macro boxes, zipper bags etc.)
- Pre-treatment with lime or limestone
- LFG pre-treatment
- Mix with high pH waste stream

Wet and Sludge Wastes

- 10% rule, modeling and stability studies
- Solidifying with pozzolanic agents (LKD, CKD, Ashes, Portland Cement, Trona)
- Centrifuge, dry, filter press, belt press

Total Metals/Oxides

- Isolation, solidification/stabilization, restricted use (e.g., no ADC), Landfill Alert (Pb)

PFAS Containing Wastes

- Macro boxes, PacTec Bags, monofills, solidification, dry landfills, engineered containment (monofill)

WWL Risk Mitigations

Other mitigation approaches include:

- Facility and/or environmental characteristics (e.g., CSI and McKittrick)
- Generic waste approvals (e.g., BG1)
- Applied technology (e.g., Dolphin and Ezra Terra)
- Innovative use of existing waste streams (e.g., Trona and E&P)
- Diversion (e.g., WWL/Emerging Wastes such as PFAS to Sub C sites)
- Applied knowledge from research (e.g., pond ash, quenching, ash aging)

Waste Approval Process Resources

Key Resources for WAMs

- WM Policy and Procedure Page
- Waste Approvals SharePoint Site
- Waste Approval Manager Contact and Coverage Information
- Waste Approval Guide
- Waste Analytical Guide
- Waste Watch Communications Page



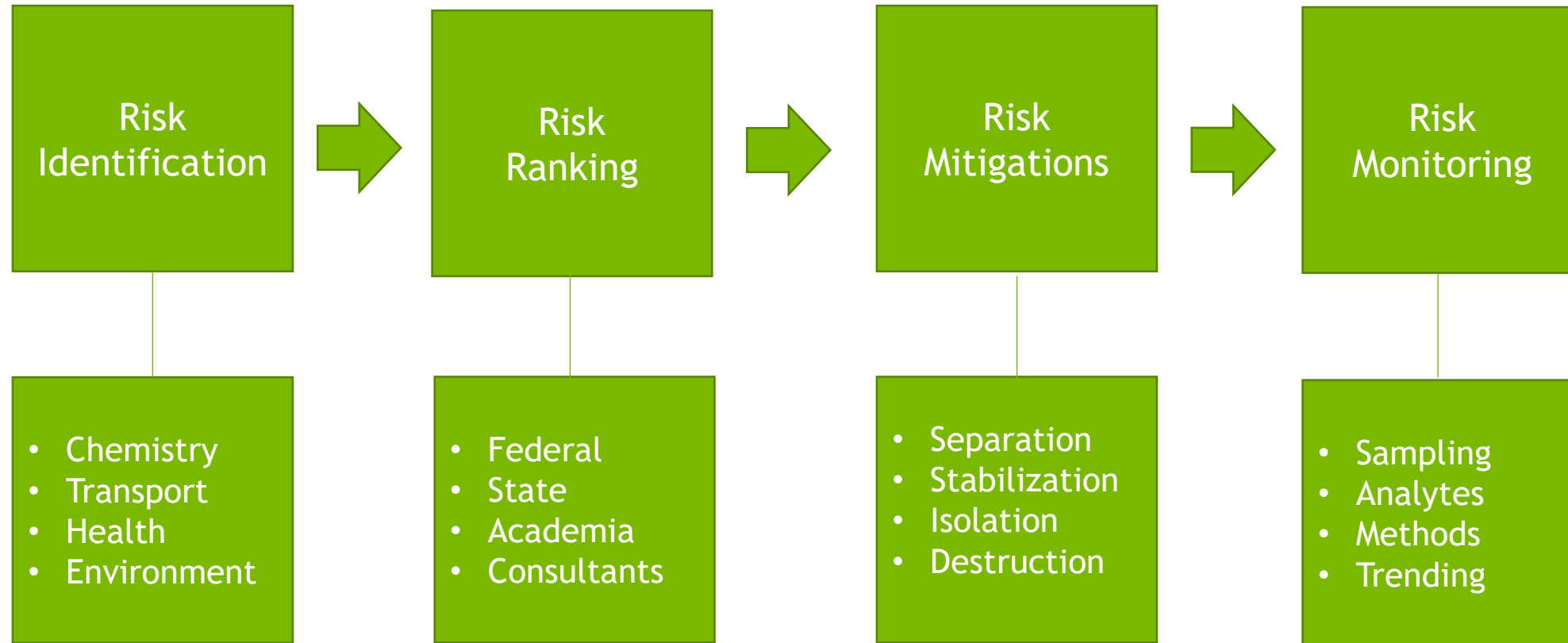
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PFAS-Containing Wastes A WM Waste Watch Waste



PFAS Risk Management Process



PFAS - Containing Waste

Background

- Unique physical and chemical properties impart oil and water repellency, temperature resistance, and friction reduction to a wide range of products used by consumers and industry
- PFAS have a range of applications in the aerospace, photographic imaging, semiconductor, automotive, construction, electronics, and aviation industries
- Certain PFAS are mobile, persistent, and bio accumulative, and are not known to degrade in the environment

PFAS - Containing Waste

Federal Level

- The House, where Democrats will remain in control with a reduced majority, is expected to pursue comprehensive legislation that would regulate PFAS on multiple fronts
- The Senate, will likely be a moderating influence on any PFAS legislation
- The 2020 National Defense Authorization Act included provisions on PFAS reporting, phasing out AFFF, and incineration
- Congress likely will continue to find bipartisan agreement on providing funding for PFAS research efforts, supporting the acceleration of remediation and response activities at military bases, and deferring to traditional federal regulatory, scientific review, and public involvement procedures

PFAS - Containing Waste

State Level

- Various states have stepped out ahead of USEPA in regulating PFAS compounds in response to public pressure
- Waste acceptance decisions will need to factor state regulations as the potential for public opposition which could impact planned landfill expansions
- Since the federal and state activity is so variable, and in a state of flux, there will be multiple State sources that can provide more up to date information on regulatory activity

PFAS Waste Mitigation Technologies

PFAS Contaminated Soil

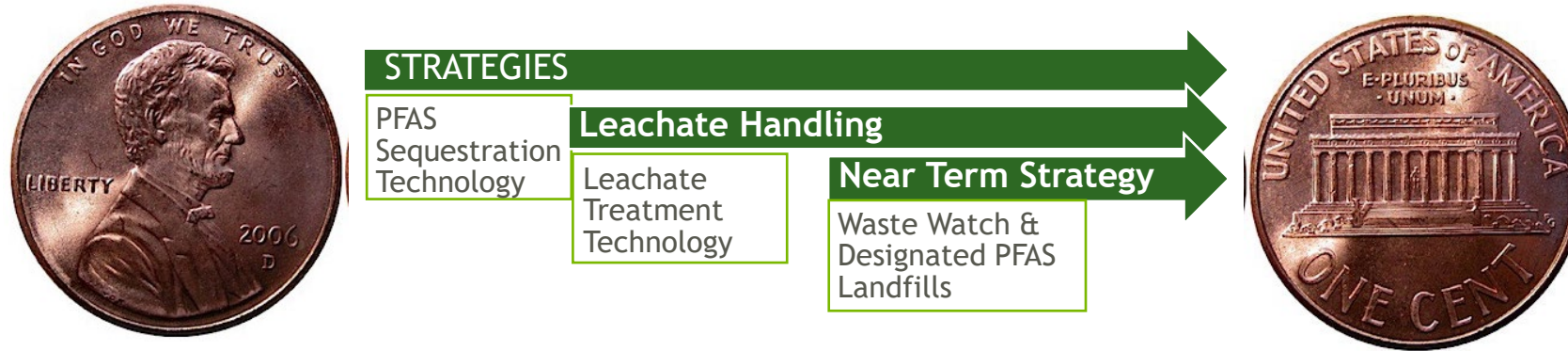
Risk Mitigation Approaches	Key Technologies	Residual Management
Isolation	<ul style="list-style-type: none">Excavation of soil with or without treatment	<ul style="list-style-type: none">Direct landfill (Sub C/D)
Stabilization	<ul style="list-style-type: none">Using Portland Cement, Fly Ash, CKD or LKD as stabilizerCommercial agents	<ul style="list-style-type: none">Treatment In situDirect landfill (Sub C/D)
Destruction	<ul style="list-style-type: none">Incineration (> 1,100 F)	<ul style="list-style-type: none">Direct landfill (Sub C/D)
Separation	<ul style="list-style-type: none">Soil WashingThermal Absorption Separator	<ul style="list-style-type: none">Reduced volume for treatmentLow level thermalIncinerationDirect landfill of residuals

PFAS - Containing Waste

Some Potential Risks for Landfill Operators

- Recognizing and responding to community concerns that could affect landfill expansion projects due to regional and/or localized opposition to managing PFAS waste at WM facilities
- Managing leachate by discharge to POTWs may be restricted if PFAS concentrations exceed established pre-treatment requirements
- Installing leachate treatment systems to eliminate or reduce PFAS concentrations may be required for landfills accepting PFAS impacted waste streams (CAPEX and OPEX impacts)
- Emitting PFAS from flares, leachate evaporators and/or energy projects and contaminating soil and groundwater

PFAS - WM Perspective



Risk Management

- Long-term fate of PFAS in landfills
- Accepting PFAS waste increases concentrations
- Waste Acceptance guidelines are lacking
- Regulatory uncertainty
- Hazardous substance listing planned under CERCLA
- Leachate Treatment - costly and uncertain

Opportunities

- Cusp of large remedial efforts (DOD, Etc.)
- Long-term Generator Liability
- Economics favor Landfills
- Capacity and scalability favors Landfills

WWL PFAS Procedure



Waste Watch List Procedure 006

Waste Watch List Category	PFAS Containing Wastes
Applicability	This Procedure applies to all Waste Management (WM) Subtitle C and D facilities
Background (ITRC)	<p>The unique physical and chemical properties of per- and polyfluoroalkyl substances (PFAS) impart oil and water repellency, temperature resistance, and friction reduction to a wide range of products used by consumers and industry.</p> <p>PFAS have been used in coatings for textiles, paper products, and cookware and to formulate some firefighting foams, and have a range of applications in the aerospace, photographic imaging, semiconductor, automotive, construction, electronics, and aviation industries.</p> <p>The scientific community is rapidly recognizing and evolving its understanding of the environmental and health impacts associated with the release of PFAS. Certain PFAS, most notably some of the perfluoroalkyl acids (PFAAs), such as perfluorooctanoate (PFOA) and perfluorooctane sulfonate (PFOS), are mobile, persistent, and bioaccumulative, and are not known to degrade in the environment.</p> <p>Although peer-reviewed research on the health effects from exposure to PFOA/PFOS-impacted waste is limited and inconclusive, both regulatory and public interest surrounding cleanup and disposal of PFOA/PFOS-impacted soils, and products containing these compounds, has increased significantly in the past few years. As a result, consideration of accepting PFAS-impacted waste must include examination and management of public perception of the site and/or the material to be accepted.</p> <p>For a more comprehensive and more up-to-date understanding of PFAS compounds follow the links provided to the Interstate Technology and Regulatory Council (ITRC) Fact Sheets in the Reference Section of this document (all content above ITRC, 2019).</p>
Federal and State Regulatory Activity	<p>USEPA established a four-step action plan for PFAS which includes, but is not limited to, the following:</p> <ul style="list-style-type: none"> EPA will initiate steps to evaluate the need for a maximum contaminant level (MCL) for PFOA/PFOS in drinking water. EPA is beginning the necessary steps to propose designating PFOA and PFOS as "hazardous substances" through one of the available statutory mechanisms, including potentially Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 102. EPA is currently developing groundwater cleanup recommendations for PFOA/PFOS contaminated sites. EPA is acting in close collaboration with federal and state partners to develop toxicity values for PFAS, including GenX compounds, and perfluorobutanesulfonic acid (PFBS). <p>Further action is also expected with respect to air emission requirements for PFOA/PFOS compounds. This could impact flaring, leachate evaporation and landfill energy projects.</p> <p>Various states have stepped out ahead of USEPA in regulating PFAS compounds in response to public pressure. Waste acceptance decisions will need to factor state regulations and regulatory trajectory as well as the potential for public opposition which could impact planned landfill expansions.</p> <p>Since the federal and state activity is so variable, and in a state of flux, the following link will provide more up to date information on regulatory activity which will be supplemented by the regulatory trends identified by the Waste Management Emerging Waste team.</p> <p>Regulatory Trends</p>

Waste Watch List Procedure for PFAS Waste – Revision 0
Date: October 31, 2019

PFAS Procedural Challenges:

- No waste acceptance requirements
- Uncertain & changing regulatory status
- PFAS compounds are ubiquitous
- Toxicology Uncertainties
- Unknown mobility and stability of PFAS compounds
- No standardized stabilizing agents
- Community opposition & concern
- Asset protection - expansions
- Leachate treatment capacity (POTWs)
- Soils, sludges, products and MSW sources
- Analytical testing and analytes vary



Waste Profiling and Analytical Testing

Decisioning Documentation

- WAMs will review special waste profiles with the aim to identify PFAS contamination based on the generator provided process, waste description and characteristics as well as any analytical data provided by ASTM Method 537M, SDSs etc.
- There are no consistent state or federal waste acceptance criteria for PFAS products and/or contaminated soils, sludges or other sources, so WAMS will be reviewing total concentrations of PFOA and PFOS when provided until, other regulatory requirements are established
- WAMs will not require PFAS analytical testing for special wastes unless the waste comes from a known PFAS contaminated source

PFAS Waste Acceptance

Future

- WM is managing PFAS risks with WWL Procedure for PFAS Containing Wastes
- There are no state or federal waste acceptance requirements to date
- There is a wide variation from state-to-state on what methods/analytes could be included in future waste acceptance decisioning
- Numerous efforts underway looking at additional stabilization agents
- More needs to be known on the fate of PFAS compounds in the landfill mass (i.e., mobility)
- Development of “Easy” waste characterization testing
- RCRA versus CERCLA and when?

What Is WM Doing Going Forward?

Special Waste and Waste Watch Programs implemented waste acceptance procedures/best practices

- ✓ Awareness and Technical training for Operations, Sales, EP, EMG and Legal teams
- ✓ Customer PFAS Technical Bulletin
- ✓ Federal and state regulatory tracking and advocacy leadership initiatives lead by Governmental Affairs and Subject Matter Experts
- ✓ Conducting PFAS basic research related to testing new stabilization and treatment methods
- ✓ Continued effective construction and operation of landfill liners and leachate collection systems to promote protection of groundwater.
- ✓ Review and business collaboration around new PFAS stabilization and treatment methods.
- ✓ Pilot test of in situ thermal PFAS removal system at Lake Charles

PFAS Waste Landfill Mitigations

Sub C and D Landfill Disposal

Approach

- Dry tomb isolation
- Leachate level
- Stabilized waste
- WWTP

Benefits

- 260+ Sub D landfills
- 4 Sub C landfills & 1 deep dell
- Engineered containment
- Gas & liquids management
- Operational experience
- Indemnification



Wrapping Up

- There remains considerable regulatory uncertainty around management of PFAS-containing wastes
- Landfill operators will apply risk principles for management of PFAS-contaminated wastes
- In the short-term landfill operator waste acceptance programs will manage risks related to PFAS-containing wastes
- There are several effective technologies that are being applied to PFAS-containing wastes which will generate residuals they will need to be isolated in engineered landfills or destroyed by thermal treatment
- Both Sub D and Sub C facilities will likely play a role in management of PFAS-containing wastes

Questions, Comments, Open Discussion

