

Do public comments matter? Exploring narrow openings in closed policy
subsystems: Nuclear waste governance in St. Louis Superfund sites

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Summary

The St. Louis region was home to the earliest large-scale processing of uranium for the U.S. nuclear weapons program and is facing ongoing efforts to clean up the resulting waste under the Superfund contaminated site program. Within a 17 km radius, there are three notable instances major changes in long-term environmental governance efforts: A mound built to hold radioactive waste material for 1,000 years, cleanup of improperly stored and transported wastes that contaminated soil and leached into a neighborhood creek, and an underground landfill fire encroaching on illegally dumped nuclear waste. This thesis is a nested case study of the St. Louis Superfund sites that explores the role public comments play in technocratic decisions surrounding three subcases. It applies qualitative textual analysis and elements of the Advocacy Coalitions Framework to examine a gap in the literature surrounding Environmental Governance, Contaminated Site studies, Nuclear Waste Management, and Participatory Processes. This project explores how legal context likely overshadows differences in time and institutional ownership in affecting the role of public opinion and the openness of technocratic policy subsystems in the administration of long-term environmental governance projects.

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List of Acronyms

ACF – Advocacy Coalition Framework

AEC – Atomic Energy Commission

CFR – Code of Federal Regulations

DOE – Department of Energy

EPA – Environmental Protection Agency

FUSRAP – Formerly Utilized Sites Remediation Action Program

RO – Research Objective

ROD – Record of Decision

RQ – Research Question

SLAPS – St. Louis Airport Sites

SLAPSVP – St. Louis Airport Sites Vicinity Properties

SLDS – St. Louis Downtown Sites

USACE – United States Army Corps of Engineers

UUUE – Unrestricted Use, Unrestricted Exposure

1. Introduction

The St. Louis region in the U.S. state of Missouri is home to multiple long-term contaminated sites resulting from uranium enrichment efforts conducted on the behalf of the United States government between 1942 and 1966. These waste sites contain varying levels, types, and amounts of radiological materials from the storage and transportation of byproduct materials in a time before robust safety, security and environmental management processes.

As the presence, dangers, and effects of this waste – as wells as other contaminated sites across the country – became clearer to the public and governing institutions, formal governance processes were developed to contain, clean up, and generally make these sites safer. The persistent, lasting threats posed by nuclear waste and other contaminants, created the need for long-term, technical-regulatory approaches, most notably the Superfund program.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) commonly known as the Superfund program is governed by U.S. federal regulation, regulated by the Environmental Protection Agency (EPA) but administered by a variety of national and state¹ agencies as well as private property owners. This fragmented, multi-level approach creates governance challenges, particularly when administering the long-term security issues posed by nuclear waste. The legal requirements for public participation and acceptance imbedded in this program further complicates its governance. This legal requirement for public comment is one of the few institutional structures inviting public opinion into an otherwise closed, technocratic decision-making subsystem. Compared to members of the policy subsystems in Superfund decisions, members of the public have

¹ For the purposes of this project, references to “the state” or “state-level” government refers to states within the United States federal system, not conception of a national government or country as a state i.e. a nation state.

access to less information, formal training or professional background on these complex problems. Likewise, their motivations and concerns are likely elevated because of the proximity to the contaminated site compared to technical decision makers.

Research on the implications of this combination of technical and long-term administrative challenges is underrepresented in the environmental governance literature. Specifically, this literature doesn't fully account for tensions resulting from mandated public participation in governance processes where long-term public safety challenges favor more-closed technical decision making. This research project aims at contributing to this gap in the scholarship. It takes the form of a nested, comparative case study of the St. Louis Superfund sites that focuses on the role public comments play in remediation decisions. It analyzes and compares the individual public comments and formal decisions in three sub-cases of Superfund decision making.

This paper seeks to explore the core questions: did public comments, effect the final decisions in these sub-cases? And did the openness to public comments change in different institutions or in different time periods? This addresses a gap in literature by examining a case of environmental governance where mandatory participatory processes run up against decision-making processes designed to prioritize technical criteria. Through this exploration, the project also seeks to understand what role public opinion may play in other technical administrative decisions. This may be primarily applicable to the Superfund program within the United States, but also similar cases outside of the U.S. where technical and political considerations play a role in a policy subsystem. For example, decisions in cases of long-term, large-scale infrastructure projects which require technical expertise but create the potential for significant harm to communities or ecosystem. A more specific example could be examining the public participation processes in fossil fuel pipeline construction and

sighting. More broadly, this study could be applied to explore issues of participation and administration of long-term decisions on climate change.

Using the Advocacy Coalition Framework (ACF) as a theoretical guide, this thesis explores the role public comments play as an opening for public opinion to infiltrate closed, technical-scientific decision-making processes. To do this, the paper examines the context in which these remediation decisions took place, the legal and institutional processes to gather, filter and weigh public comment, as well as the actual public comments submitted in each subcase.

From a theoretical standpoint, this case study also attempts to further explore the role public opinion plays within the structures and dynamics of the ACF. The ACF treats public opinion as a factor that can be both internal and external to policy subsystems (Sabatier & Weible, 2007; Jones & Jenkins-Smith, 2009). The legacy nuclear waste sites in St. Louis offers an opportunity to gain a greater understanding of public comments and public opinion's role within the ACF. It does this by focusing on several elements of the ACF. These include the constitutional structure of the system, the openness of the political system, and the dual role public opinion plays as both an internal and external factor to a policy subsystem. This selective approach helps explore the ACF's conception of public opinion within a closed subsystem.

This study employs a small-N comparison strategy of three subcases based on a qualitative textural content analysis of the three official Records of Decision (ROD) and accompanying public comments in each subcase. All located in the St. Louis region, it focuses on the following three contaminated sites and specific decisions in each subcase to explore a major change in the governance of that site:

1. Weldon Spring Ordinance Works (Weldon Spring), a former uranium enrichment plant and explosives factory, the waste from which has been collected and capped in a long-term storage cell
2. St. Louis North County Sites (North County) a collection of properties where uranium refinemening by-products were improperly stored, transported and allowed to spread into commercial and residential areas, but later remediated
3. Westlake Landfill (Westlake), the site of illegally dumped irradiated soil that is adjacent to an underground landfill fire, which is set to be excavated

The three ROD's and the comments in each subcase serve as the data for analysis.

This strategy and these methods are applied in an effort to answer the research questions.

These research questions are, in turn, an attempt to operationalize the objectizes of this thesis imbedded in the problem statement.

1.1 Problem Statement

Unlike other environmental issues, nuclear contamination management presents significant security, health, and long-term technical challenges requiring policy specialists to make evidence-based decisions. It is important that these deliberations be shielded from undue political influence or short-term changes in public opinion. However, democratic principles, issues of environmental justice, and laws requiring public participation are important to ensure the needs and concerns of residents involved in public processes are met. These conflicting needs are represented in this project's problem statement:

Long-term nuclear site governance and remediation require complex decision spaces where closed, technical-scientific decisions are made to account for public safety, but public participation appears necessary to maintain legitimacy and account for marginalized voices. Within this tension, public comments are one of only a few avenues for public opinion to be internalized into this process and reflects an entry point into this otherwise closed system.

1.2 Thesis Objectives

The primary research objective of this project is to:

- RO1. Better understand the role public opinion plays in mostly-closed, long-term policy subsystems decisions

Two secondary objectives are to:

- RO2. Explore the role public comments play in differing administrative contexts within the Superfund program
- RO3. Explore how public opinion has changed over time as a factor in Superfund program decisions

1.3 Research Questions

To address the research objectives, this paper attempts to answer the following research questions:

- RQ1 Are the concerns of public comments, reflected in the final decisions of Superfund administrators?
- RQ2 Does administrative ownership or fragmentation affect the impact of public comments?
- RQ3 Has the openness to influence of public comments in these subcases changed over time?
- RQ4 Can administrative Superfund site cleanup decisions be classified within the Advocacy Coalition Framework?

Research questions RQ1, RQ2 and RQ3 all flow directly from the objectives RO1, RO2 and RO3. Each research question is an attempt to operationalize the corresponding research objective into an answerable question. Since the research objectives are exploratory, there is no attempt in this paper to make causal claims. Likewise, there is no attempt to prove or disprove a hypothesis or theory. Instead, there is an attempt to uncover new or novel

understanding of this phenomena by connecting observation and interpretation of this case and its three subcases to a broader context (Dey, 2004). RQ4 specifically ties these cases to the theoretical framework of the ACF. Section 5 Research Strategy and Methods delves deeper into how this paper attempts to answer these questions. That sections details how different administrators and time periods are addressed within a similar context in this paper to examine the role of public comments across these decisions.

1.4 Thesis Organization

Following this introduction; Section 2, a brief narrative literature review places this thesis in relation to the work of the broader scientific community and examines the gaps in that literature. Section 3, Case Selection outlines the justifications for the selection of these subcases as well as a description of the historic and institutional context in which these subcases exist. Section 4 describes the ACF and its formulation of public opinion in policy subsystems, which serves as the theoretical underpinning of this study. Section 5 Research Strategy and Methods lays out and justifies the approach to structuring and conduction this study. Section 6 details the data used in this study, its collection, reduction, analysis as well as the results of that analysis. Section 7 is an in-depth discussion of those finding and connects back to the research objectives, questions and theory in the case. Section 8 contains the project's conclusion and is followed by the references in Section 9.

2 Literature review

The St. Louis Superfund sites and the role of public comments lay at the intersection of several areas of study: Environmental Governance, Contaminated Sites, Participatory Processes, and Nuclear Waste Management. Figure 1 is a visualization this case study's connection to the overlapping literature.

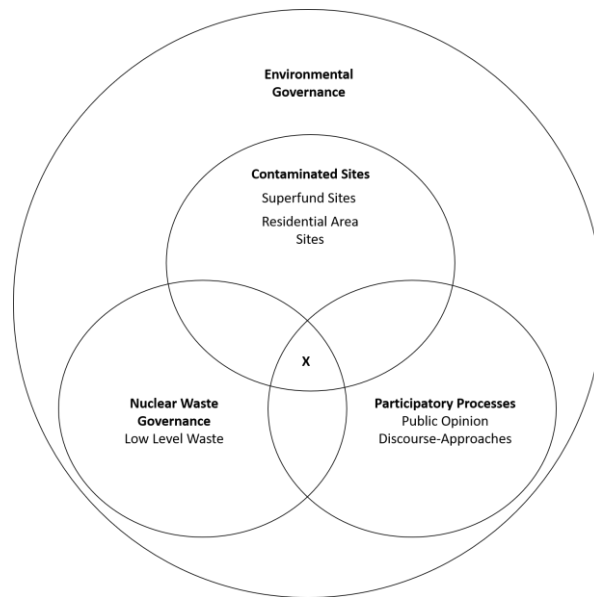


Figure 1 Orientation of this study to existing literature

This section contains a brief narrative review of relevant literature from these fields that pertain to this study, describing gaps in the literature where this study may shed new insight (Sovacool et al., 2018).

2.1 Environmental Governance

The growing field of Environmental Governance focuses on similar dilemmas to the one posed in this research project: How can solutions to environmental problems balance science, social pressure, democratic ideals in complex, multi-level contexts? The field focuses on new approaches to decision making that incorporate greater levels of public participation, ecological thought, collaborative approaches, non-state actors and highlights the importance of legitimacy and perception among the public (Bäckstrand, et. al 2010). However, a gap exists in this literature that fails to address how these new, open approaches to participation and governance can be applied in cases where high degrees of technical knowledge are required to maintain public safety.

The core aspects of environmental governance are present in the St. Louis Superfund sites. Their complex, long-term nature of nuclear waste management connects with Underdal's (2010) categorization of long-term environmental governance challenges. These

governance challenges are rooted in uncertainty around long term policy consequences as well as large complex systems (Underdal, 2010). Both of these challenges of uncertainty around the long-term effects of radiation and the complexity of nuclear remediation efforts in the fragmented interconnected context of the Superfund Program make the St. Louis Sites a case of long-term environmental governance. Likewise, Underdal's focus on mitigation and adaptation connects to different remedial action taken within the St. Louis cases.

In another conception of Environmental Governance, Hegger (2020) connects the field to policy studies and attempts to further classify and define the effects of changes of modes within environmental governance. Hegger reviews different approaches to environmental governance and formulates standard explanatory factors for comparing studies. While this research project does not aim to address causality, Hegger's analysis and inclusion of the ACF offers some support for the use of it in this case. Further support for this study can be found in Hegger's explanatory factors for physical circumstances, infrastructures, institutional settings, discourse, characteristics of agency and shock events (Hegger, 2020, p. 1). These factors offer a helpful aid in the discussion of this study.

An earlier survey of environmental governance studies, Newig & Fritsch's (2009) questions the effectiveness of multi-level and participatory governance. This questioning of effectiveness of these participatory processes exemplifies and highlights the core tension between public involvement and public security contained this projects problem statement. Newig & Fritsch's call for additional empirical study of participatory approaches also illustrates the gap of literature this study attempts to address.

One challenge raised within literature on Environmental Governance, that is not fully addressed is the role that these novel participatory processes may have in long-term management of problems that have highly technical public safety ramifications. The openness vs. closeness of less security-focused governance includes watershed management (Benson

et. al, 2013), forestry management (Emborg, Walker, Daniels, 2012), and broader environmental conflicts (Daniels, Walker, Emborg, 2012) among others. The circumstances of more-security focused challenges faced by nuclear waste management and other contaminated sites create a more-closed system than many environmental concerns. Furthermore, resource management, environmental conservation or other types of pollution mitigation lack the same security concerns and can be seen as fundamentally different from the immediate and long-term threats posed by nuclear waste mitigation. This gap is more concretely detailed in Ruseva et al's (2019) survey of Environmental Governance literature applying process theories, such as the ACF among others. In their analysis, only 8% of environmental governance literature focuses on pollution or environmental justice (Ruseva et al, 2019, p. S70). Of these cited cases, none posed the interrelated long-term challenges of administering contaminated sites and nuclear waste management.

This is a gap in the literature that the St. Louis sites help fill. This study looks at a narrow opening in a closed system, the formal public comment process in the Superfund program, which predates more pluralistic, contemporary environmental governance processes. Likewise, the role that these closed - or semi-closed - systems have in the long-term administration of environmental governance does not yet appear to have been studied.

2.2 Residential Area Contaminated Sites

Contaminated Sites can be defined as areas that have been exposed to long-term damage from radionuclides and hazardous chemicals (Burger, 2019). The proximity of people to contaminated sites creates a level of severity and increased risk of contamination compared to more remote sites (McIntyre et al., 2018; Ramirez-Andreotta et. al, 2014). This closeness to people and key infrastructure also elevates the case beyond mere environmental impact, to incorporate public health, security, political, and social factors. These factors are complicated by the socio-economic background of the proximate communities (McIntyre et

al., 2018). This can also be seen as increasing the amount of attention and pressure on the administrators of the site. That complex interaction of factors is present in the broader phenomena of residential area contaminated sites inside and outside of the U.S. However, that insight is limited by different regulatory schemes in different national contexts. There may be a greater level of comparison to residential contamination sites in more-open, democratic, and developed contexts. Likewise, the proximity to inhabited areas could be one potential factor increasing the likelihood of community-based advocacy.

2.3 Participatory Processes, and Contaminated Sites

Separate from scholarship explicitly focused on Environmental Governance, literature connecting participatory processes to contaminated sites through different approaches help bring additional insight to this project (Cox et. al, 2019). Culley, Hughey (2008) use a conception of power within social settings to examine factors that may limit or manipulate people's participation in hazardous waste site decision making processes.

2.4 Nuclear Waste Management

The long-term governance challenges contained within Nuclear Waste Management are significant and the subject of noteworthy scholarship (Lee, Ojovan, 2013). Storage, transportation (Forrest, 2015), politics and public opinion (Moe, 2010; Grove-White et. al, 2006) contribute to make nuclear waste management a challenging technical decision space that is the focus of public scrutiny and efforts to improve participatory processes (Chilvers & Burgess, 2008).

3. Case Selection

The clustering of Superfund sites within the St. Louis region creates a unique case to explore the gap in Environmental Governance literature detailed above. It also offers the chance to apply the Advocacy Coalition Framework in a targeted way that examines the role of public opinion in policy subsystems that are mostly closed to public influence. This case is

an opportunity to examine how time and institutional ownership have impacted the openness of technocratic subsystems by exploring the role of public comments across the region.

The Superfund program represents an early attempt for a national government to address contaminated sites and pollution resulting from industrialization, mining, and in the case of St. Louis, the production of nuclear materials. It was an outgrowth of the environmental movements of the late 20th century and is an early example of administering environmental governance (EPA, 2020b). It is comparable to other national attempts to remediate contaminated sites. Literature pertaining directly to the Superfund Program and public involvement include studies of the public's technical capacities (Finney, Polk, 1995), the public's perception of safety following remediation activities (Lioy, Burke, 2010), and potential biases within the Superfund program based on socioeconomic conditions of neighboring communities (Burda, Harding, 2014).

Because the Superfund program is holistic in its approach to contaminated sites, it applies a similar approach to waste from different sources. The St. Louis sites containing radionuclides presents a longer-term governance challenge which is applicable to nuclear waste management in other national contexts, as well as some of the deeper issues in environmental governance (MCE, 2018). The long-term technical challenges weighed against public opinion creates a nuanced core tension that could be loosely generalized to smaller scale public policy decisions as well as larger debates within environmental governance on long-term fragmented approaches to climate change.

The clustering of nuclear waste sites in St. Louis creates a unique pseudo-experimental setting (Yin, 2018) where the role of public opinion - as characterized by the ACF - can be explored across small differences in time, and institutional context. This study takes advantage of the shared St. Louis context by exploring how the formal public comments process may have impacted decisions within this case.

Because this is a nested, exploratory study, the generalizations of this project are limited. However, this exploration of case and theory could have some potential analytic generalization and comparability to environmental governance. This study could also have applicability to help understand differences in long-term administration and technocratic closed systems vs. open participatory processes. Likewise, this multi-dimensional study could generate some helpful insights in how public opinion affects the subfields of contaminated sites, nuclear waste management and participatory processes.

This section details how this study of St. Louis Superfund Sites help fills the gap in Environmental Governance literature. It begins by detailing the legal context that shapes the decision space in each case, explains the overall case boundaries, outlines previous studies of the case, describes the subcase selection criteria.

3.1 Legal Context: Superfund and public participation

In each subcase of the St. Louis Sites – as well as all decisions within the Superfund program and many public decisions made under U.S. Federal regulations – decisions are subject to some element of public input (Regulations, 2020). This public input can take many forms and fall under different regulatory systems. In the Superfund program, the criteria for public input was established by CERCLA, the federal law creating the program and codified in Chapter 40, Section 300 of the Code of Federal Regulation (CFR) (CFR, 2020). These codes form the legal foundation for much of the U.S. federal policy and rulemaking efforts. Understanding the legal context for the decisions in the subcases is important to assess the role of public comments and public opinion as well as the overall criteria shaping the decisions in each case.

These regulations create the process under which a contaminated site is identified, a methodology for ranking and prioritizing cleanup efforts and the investigative, decision making and implementation of remediation (CFR, 2020). If an identified contaminated site

meets the criteria of the Hazard Ranking System and is assigned to the Superfund National Priorities List, a deeper investigation is conducted of the site conditions, contamination, and threats. Based on that evaluation the lead agency and a technical committee collaborate to define and evaluate a range of clean up options. These potential solutions are then weighed against each other based on a series of criteria detailed in the following subsection. Based on that assessment, the lead agency and technical committee develop a proposed plan. This proposed plan is then presented to the state and community for input and acceptance. Based on that public feedback process, a final remedy is selected for implementation. This process is detailed in the Record of Decision as laid out in federal code (CFR, 2020).

Remediation Selection Criteria.

Within the remedial investigation and decision-making process there are nine criteria for assessing the efficacy of a proposed plan for remediation. These nine criteria are detailed in Table 1:

Table 1. Remedial Investigation Criteria from (CFR, 2020)

Criteria Classification	Selection Criteria
Threshold Criteria	(A) Overall protection of human health and the environment
	(B) Compliance with Applicable or Relevant and Appropriate Requirements
Balancing Criteria	(C) Long-term effectiveness and permanence
	(D) Reduction of toxicity, mobility, or volume through treatment
	(E) Short-term effectiveness
	(F) Implementability
	(G) Cost
Modifying Criteria	(H) State acceptance
	(I) Community acceptance

These criteria highlight the complexity of these decisions as well as the technical aspects of this policy subsystem. The criteria span issues of physical sciences, economics, legal compliance, engineering, and they present complex, technical challenges. Based on an assessment of criteria (A) through (G), the lead agency and technical committee select from the range of possible remediation activities: the proposed plan. This proposed plan is then

presented to the state government and community for input and acceptance (CFR, 2020). The process created by these regulations forms the basis for this study's approach to the decision-making process as a technocratic decision space. The legally-mandated structure of this process prioritizes these technical criteria as the basis for selecting a proposed plan before including public opinion formally. Since the proposed remediation plan and the alternative approaches are mostly formed independent of public input, this study classifies the policy subsystem as mostly closed, with public comments being the chief opening for public opinion to affect the decision and process (CFR, 2020; EPA, 2011). A theoretically grounded description of an open policy system is detailed in Subsection 4.2 Applying the ACF.

This study focuses on community acceptance as the criterion contained that allows for public opinion into impact the decision space. The federal code defines community acceptance as: an agency's assessment of what elements of a proposed plan have support from interested individuals in a community (CFR, 2020). It also aims for the lead agency to understand reservations or opposition to a proposed plan. The sections of each subcase ROD that detail community acceptance forms part of the data analyzed in this study.

Modifying Criteria.

Within the federal code governing the remediation process, Community Acceptance and State Acceptance are classified as modifying criteria. This means that the results of the public comment process can only modify the proposed plan, not significantly alter or disqualify the decision (CFR, 2020).

In contrast, criteria (A) and (B) from Table 1, are classified as threshold criteria, meaning that they represent minimum requirements that must be met by the proposed alternatives in order to be eligible. These reflect the importance of human and environmental protection as well as legal compliance with existing law as the two most important factors to be considered in the remediation process (CFR, 2020). Likewise, criteria (C) through (G) are

balancing criteria. Balancing criteria must be weighed and valued against one another during the remedy selection process (CFR, 2020). This can be understood as a way of incorporating the various important tradeoffs in the selection process. For instance, a cheaper, less-comprehensive, short-term, approach could be weighed against a more expensive, robust, permanent remedy and these criteria would be used to balance and create a process of assessing the alternatives. This prioritization of threshold and balancing criteria again highlights the legal-contextual elements of the decision space that can be interpreted as prioritizing technical features over public participation. Community Acceptance's status as a modifying criterion plays a role in the impact that public comments may have in Superfund decisions.

Public Comments Mandate.

The legal context of the Superfund program also frames the process of seeking community acceptance as a means of supporting remedy selection, not in formulating potential remedies. The federal codes operationalize and mandate community participation through a defined process (CFR, 2020). This process includes the lead agency publishing the proposed plan in local media and making it publicly available for review, having a minimum 30-day public comment process where the agency solicits written comments from the public and holding a public meeting to present the proposed plan and seek verbal comments. A response summary to the comments is then prepared and included in the ROD (CFR, 2020).

This process is similar in form to the public comment process in the US and state-level rulemaking and environmental project process outside of the Superfund program (Regulations, 2020). This similarity helps in the potential applicability of this study to other areas of environmental governance in the U.S. context. It differs from more participatory approaches that seek to incorporate community participation in the development of potential solutions (Steelman, 1999). The Superfund sites' legal mandate to include public

participation through a formal public comment is interpreted in this study as a narrow opening in an otherwise closed system.

3.2 Case Boundaries: geographic and shared source of pollution

The clustering of Superfund sites in the St. Louis region creates a unique opportunity to explore public opinion within the legal context of the Superfund program. It typifies the broader tension of balancing public participation against public safety, demonstrates a mostly closed policy subsystem, and provides several subcases that can be compared. The presence of multiple administrative agencies, the long-term, complex nature of the nuclear contamination, these site's proximity to human populations, and the legal requirement to include public opinion make this a case that helps fill the previously established gap in environmental governance literature. This unique clustering makes St. Louis a case that can offer some insight to other disparate policy subsystems at the intersection of public engagement and public safety.

For the purposes of this study, the case of St. Louis Superfund Sites is bounded by geography and political designation as well as source of pollution. These boundaries were chosen in order to focus the study and control for other factors.

The geographic and political boundaries of the case include the Superfund sites within the St. Louis Metropolitan area - within the state of Missouri. This boundary was selected to include the sites within St. Louis County (North County and Westlake Landfill) and St. Charles County (Weldon Spring) as well as the downtown sites in St. Louis City. The inclusion of these cases represents the Superfund sites within close proximity to the same general population, news media market, and under the Missouri Department of Natural Resources (MDNR) as the secondary agency in each superfund decision. Figure 2 details the location of these waste sites relative to one another, the Missouri and Mississippi RIVERS and major roadways.



Figure 2 Location of nuclear waste sites in St. Louis Region (MEC, 2020)

This boundary intentionally excludes a superfund site across the Mississippi River in the city of Madison, Illinois (FUSRAP, 2020). Madison and the other neighboring municipalities in Illinois, known as the Metro East, are part of the St. Louis Metropolitan area. The Madison site was excluded because of the greater level of complexity of studying a site under a different state government. Illinois has its own department of natural resources as well as a separate Illinois Department of Nuclear Safety (FUSRAP, 2020). The presence of these additional layers of institutional differences would add more complexity to an already complex research design. A more exhaustive study could include Madison and explore the institutional differences between the two state administrators.

This case is also bounded by source of pollution. This is done in order to look exclusively at radiological wastes from nuclear weapons manufacturing. This boundary was established to include sites facing similar long-term administrative challenges tied to nuclear waste governance in an attempt to help fill the gap identified in Section 2 Literature Review. This boundary was also chosen to exclude other Superfund sites in St. Louis County. These include Times Beach, Ellisville, and Valley Park. Times Beach is a contaminated site and the

location of a now-abandoned town that was exposed to the chemical dioxin (Walter, 1997). Ellisville is home to a contaminated site where oil was improperly disposed (EPA, 2020a). Valley Park is the location of a former metal works that polluted the groundwater with industrial solvents (EPA, 2020d). While Times Beach, Ellisville, and Valley Park are other Superfund sites in the region, their contamination and remediation efforts differ from the security and long-term risks posed by nuclear waste, and were therefore excluded.

3.3 St. Louis Specific Literature

There has been limited scholarship on the St. Louis sites. The most relevant works are Witt & Morgan's (1993) study of public participation and independent oversight of Westlake Landfill, Carnes et. al's (1998) analysis of public participatory processes across DOE environmental management sites including Weldon Springs, a study of public perceptions on contaminated site cleanup (Feldman et. al 1995), and Diaz-Maurin's (2018) discussion of the knowledge gap on radiation risks within the St. Louis community. General case scholarship includes Alvarez (2013), Horne (2016), and Youmaran (2016). The technical, environmental effects of the Superfund sites have received more focus from the academic community (Kaltofen et. al, 2016; Kaltofen et. al, 2018; Rodriguez et. al, 1991). Outside of peer-reviewed academic works, official government publications (EPA 2019; NRC, 1988; ATSDR, 2015; Charp, 2015; Denton, 1988; Price, Ginsburg, 1996;), and regional journalistic sources (Chin, Toler, 2019, Corrigan, 2015; Corrigan, 2018) are used in this study to establish context and case background.

Specific government publications employed to provide context for this study include community engagement plans around each subcase site (LEI 1987; USACE 2015), publications guiding administrators in the superfund process (EPA, 2011; Regulations 2020), and the Code of Federal Regulation (CFR, 2020). Likewise, Feldman et. al's (1995)

assessment of public perceptions in the case is used to create baseline themes for the textual analysis.

The Record of Decision (ROD), a formal explanation of an administrative decision in each case, as well as the accompanying catalog of public comments serve as the primary sources of data for this project (DOE, 1993a; USACE, 2005; EPA, 2018). These comments and corresponding RODs are analyzed in order to answer the research questions and address this paper's research objectives.

St. Louis's connection to the broader phenomena of contaminated sites can be understood by these sites' proximity to residential areas and the impact that has on seeking public acceptance. Weldon Spring is less than 1 km from a high school and located in a county with 402,000 residents, North County contamination spread to nearby neighborhoods and Westlake is less than 3 km from the closest residential area – a 125 site mobile home park - , a youth sport recreational facility, SSM Health DePaul Hospital, St. Louis Lambert International Airport and the Missouri River (US Census, 2020). Both Westlake and the North County sites are located within St. Louis County with 994,000 people (US Census 2020). This proximity to people's homes, jobs, schools, key infrastructure and the way that proximity impacts public opinion is detailed in case-specific to literature on contaminated sites and public participation.

Contaminated Sites.

One central theme to issues of public participation in technocratic decision spaces is the knowledge gap between members of the public and policy experts. Diaz-Maurin's (2018) focus on the knowledge gap pertaining to long-term risks to low-level radiation is a study of the St. Louis community but also addresses the larger challenge facing participatory processes in closed, technical spaces.

The St. Louis sites have similarities to the global phenomena of residential contaminated sites. The U.S. Superfund Program is one such policy response to legacy pollution and contaminated sites. As of August 2020, there are 1,333 national priority Superfund sites (EPA, 2020c). The regulations around superfund sites include a requirement for public engagement and input. This mandated openness to the technocratic subsystem creates tension between technical expertise and public acceptance which is at the heart of this study.

Public Participation.

Carnes et. al (1998) aggregates and weighs the benefits and costs of public participation within the DOE environmental management program. That process highlights the choices governments face when budgeting for community engagement. This study shows the perceived importance of participatory processes but conditions that importance based on available resources. The fractured institutional nature of the St. Louis Superfund Sites and the complex multi-level relationship between actors within the Superfund system parallels Newig & Fritsch's (2009) criteria for assessing multi-level decisions.

3.4 Subcase selection

The St. Louis Superfund sites allows for a most-similar comparative strategy creating an opportunity to look at multiple subcases with many shared contextual characteristics. The three subcases nested in this case study represent instances of major shifts or developments in the clean-up processes of the specific sites. These major development in the governance of each site were selected as a way to apply the ACF and address RQ4. These subcases' distribution over time and across different administrative agencies to create a unique comparative strategy detailed in Section 5 Research Strategy and Methods. This strategy also applies to RQ2 as well as RQ3 and addresses the long-term and fragmented nature of environmental governance (Underdal, 2010). Within the St. Louis Superfund Sites, the EPA

aggregates them into four larger sites: Weldon Spring, North County, Westlake Landfill, and the St. Louis Downtown Sites (SLDS) which was excluded from this study.

St. Louis Downtown Sites.

SLDS is a collection of sites that were the location of the original uranium processing plants in the region. The pharmaceutical and chemical firm, Mallinckrodt Chemicals operated as a contractor for the U.S. government's efforts to develop nuclear weapons during WWII, the Manhattan Project (Fleishman-Hillard, 1967). Between 1942 and 1957 Mallinckrodt refined more than 50,000 tons of uranium ore, at its chemical works in a largely industrialized area of downtown St. Louis (Westbrook, Bloom, 2010). Beginning in a single laboratory in 1942, uranium processing at Mallinckrodt eventually spanned 60 buildings on the company's property in Downtown St. Louis. These buildings were frequently repurposed from other chemical and pharmaceutical production and often "hastily converted" due to short timeframes, as well as the experimental and confidential nature of the work (Westbrook, Bloom, 2010, p. 15; Fleishman-Hillard, 1967). Figure 3 details the close-packed nature of these plants, their presence in a developed cityscape as well as their proximity to the Mississippi River.

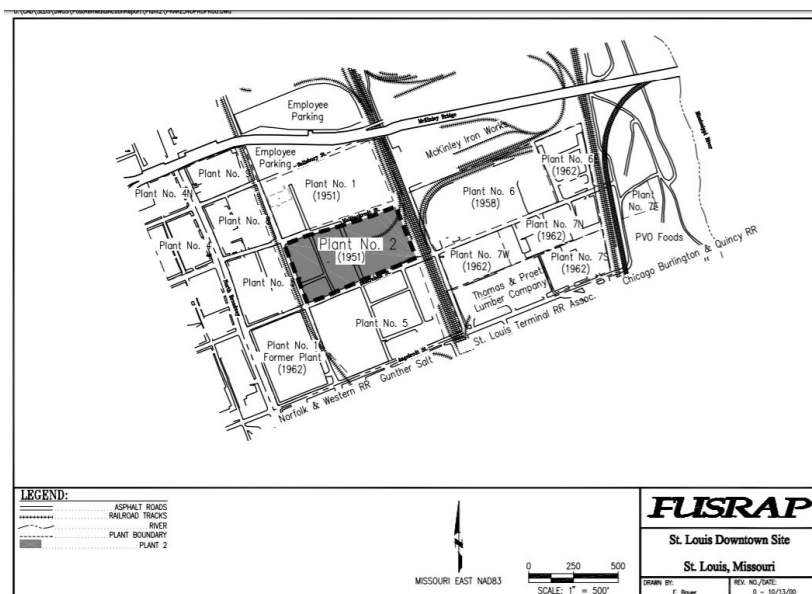


Figure 3. Map of St. Louis Downtown Site (USACE, 1998, p. 4)

Because of the limited experience with radioactive materials and a general ignorance of the dangers of radiation, health and safety procedures at the downtown site were well below modern standards. This lack of protection led to significant radiological exposure of the employees at the site and contamination of the buildings and surrounding land (Westbrook & Bloom, 2010). After operations were shut down at this location, uranium processing shifted to Weldon Spring and contamination cleanup at SLDS was conducted between 1948 and 1951 by the Atomic Energy Commission (AEC), the successor to the Manhattan Project (Fleishman-Hilliard 1967; USACE, 2020). Additional minor cleanup was undertaken in 1998 and 2014 under the Superfund program and Formerly Utilized Sites Remedial Action Program (FUSRAP) (USACE, 2014). Because the majority of the remediation occurred prior to the Superfund program and on account of the limitations of this study, SLDS was not selected as a subcase. A more robust or exhaustive study of the St. Louis Sites could benefit from including SLDS to compare the role of public opinion in pre-superfund remediation processes.

Weldon Spring.

Weldon Spring is the site of a former uranium processing plant, explosives plant, and quarry. It is administered by the DOE office of Legacy Management. In 1957, Mallinckrodt and the AEC moved uranium processing from SLDS to a new purpose-built facility in St. Charles County, across the Missouri River from St. Louis County (Fleishman-Hilliard, 1967). This location had previously housed an explosives manufacturing plant for the US Army during WWII. Despite originally being chosen for its remote location from developed suburbs of the time, the suburban growth of the St. Louis metropolitan reached Weldon Spring. Most notably a public high school built in 1991 is located 750 m from the site (DOE, 1993a).

The Weldon Spring plant produced refined uranium that helped feed nuclear weapons production during the early stages of the Cold War until the plant was decommissioned in 1966. Waste generated during the uranium refinement process was stored in drums as well as open pits in the quarry (DOE, 1993a). In the following years, management of the site changed hands between AEC, the Army, and then finally the Department of Energy the successor of the AEC.

In 1987, Weldon Spring was added to the Superfund National Priorities List (DOE 2020). It is the subject of numerous RODs dealing with different aspects of the contamination. The ROD analyzed in this study is a 1993 decision to excavate the waste, and store onsite in an engineered disposal cell (DOE, 2020).



Figure 4 Aerial photo of Weldon Spring disposal cell (DOE, 2020, p. 2)

Picture in Figure 4, this disposal cell is 21 m tall. It is constructed of clay, soil, sand and stone. It covers 16.5 hectares and was completed in 2001 (DOE, 2020). Designed to account for erosion, earthquakes, and the natural migration of material this cell is supposedly designed to store 1.13 million cubic meters of irradiated material for 1,000 years (DOE, 2020). The site surrounding the cell has been reverted to a conservation area, which serves the practical function of restricting future land use. While the majority of waste was removed

and has reached a relatively safe level, the level is not low enough for unrestricted use or unrestricted exposure (DOE, 1993a; DOE, 2020).

St. Louis North County Sites.

The North County sites includes numerous individual properties in northern St. Louis County impacted by the improper storage and transportation of the uranium processing byproducts from SLDS. This site is administered by FUSRAP and was the subject of a 2005 ROD. The North County Sites are aggregated under several smaller organizational headings: St. Louis Airport Site (SLAPS), the Latty Avenue Sites, and St. Louis Airport Site Vicinity Properties (SLAPSVP). Figure 5 gives an organizational breakdown of how these sites are organized under FUSRAP, while Figure 6 shows geographic location and proximity of the North County Sites.

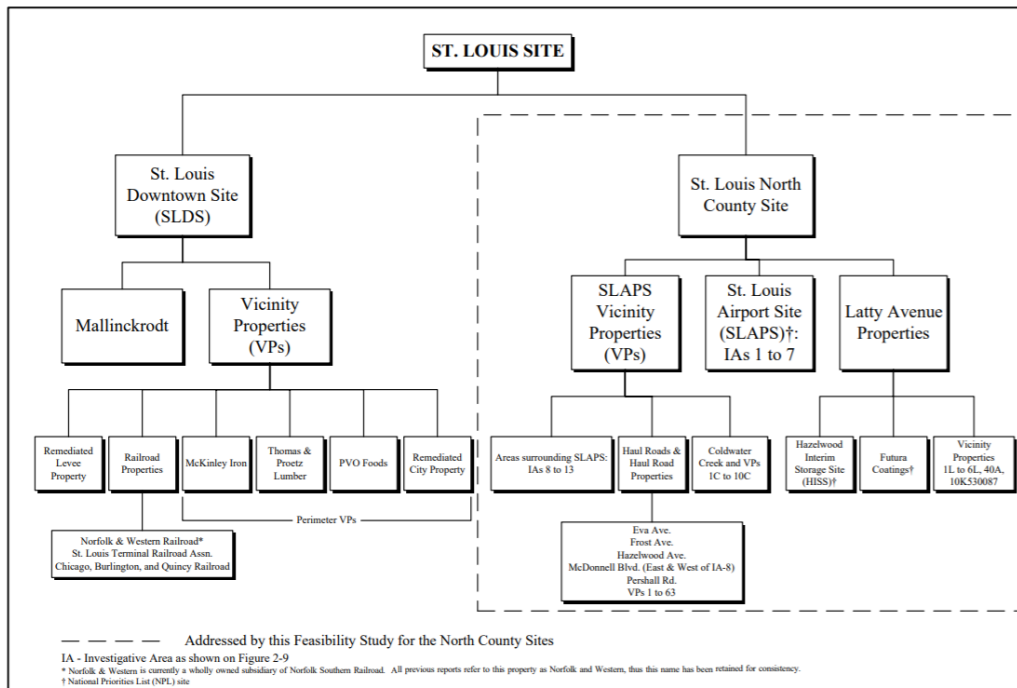


Figure 5 Organizational breakdown of the St. Louis FUSRAP sites (USACE, 1998, p.2)

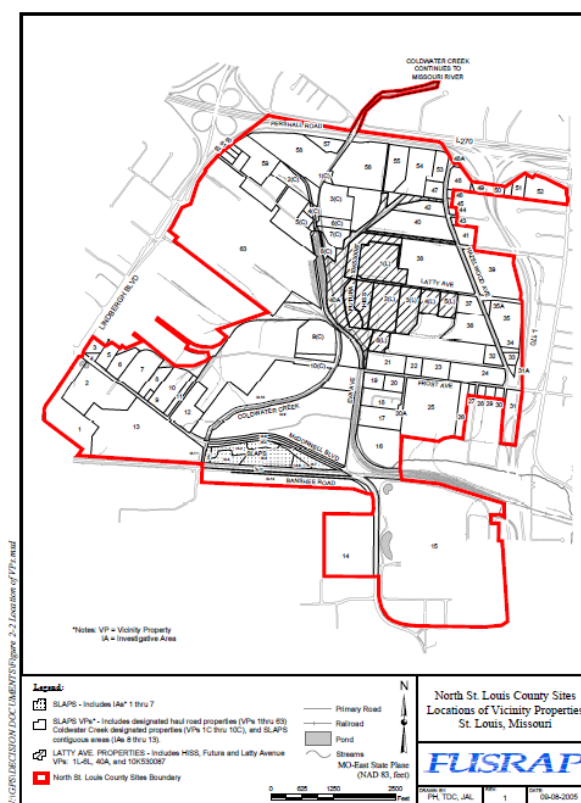


Figure 6. Location and proximity of the North County FUSRAP sites (USACE 2005, p. 2-106) *St. Louis Airport Sites.*

Between 1946 and 1966 the AEC stored 109,000 tons of radiological materials at a military-owned site near Lambert Air Field, now St. Louis Lambert International Airport (USACE, 2020, p. 2). The 8-hectare SLAPS held that waste in sheds, buried under topsoil and in the open air until it was sold to a private company for processing and second-use between 1960 and 1967 (USACE, 2020, 1). Following the removal of waste from the site in 1967 the remaining buildings were demolished and the land was covered with 1 m of clean topsoil. At the time this resulted in safe surface levels of radiation, but deposits of radiological materials remained on the site (USACE, 2020, 1). In 1981 SLAPS was listed for cleanup under FUSRAP and later in 1989 it was listed as a Superfund site along with the other North County Sites. This led to the 2005 Record of Decision with final excavation and removal of irradiated soil occurring between 2009 and 2014 (MDNR, 2020).

Latty Avenue Sites.

The Latty Avenue sites consist of several industrial properties contaminated during the processing, transportation and short-term storage of the SLAPS waste. After the SLAPS waste was sold, the Army and Mallinckrodt moved the radiological material 800 meters to a warehouse on Latty Avenue (USACE 2005). This is known as the Hazelwood Interim Storage Site where the waste was dried and prepared for long-distance transportation out of the state for processing, between 1967 and 1969 (MCE, 2018). The presence of this waste, contaminated the soil and buildings on the site as well as the surrounding properties (MCE, 2018). Once the bulk of the waste was removed, the property was sold. The subsequent owner, following a radiological survey demolished an existing structure, and excavated the remaining irradiated soil to prepare the site for future use. This irradiated soil was stored on site, and was used by FUSRAP throughout remediation efforts (Chin, Toler, 2019).

St. Louis Airport Site Vicinity Properties.

The SLAPSVLP consist of the land and buildings surrounding SLAPS that was contaminated by the initial storage of waste, land along the truck haul routes used to transport the waste from SLAPS to Latty Ave where irradiated soil was allowed to fall from the trucks and Coldwater Creek a small stream that became contaminated from water runoff and erosion at the other North County Sites. Unlike the vicinity properties which are chiefly industrial, Coldwater Creek runs through commercial and residential areas as well as several public parks before flowing into the Missouri River (MDNR 2020). Figure 7 shows Coldwater Creek's course and its proximity to residential areas is visible.

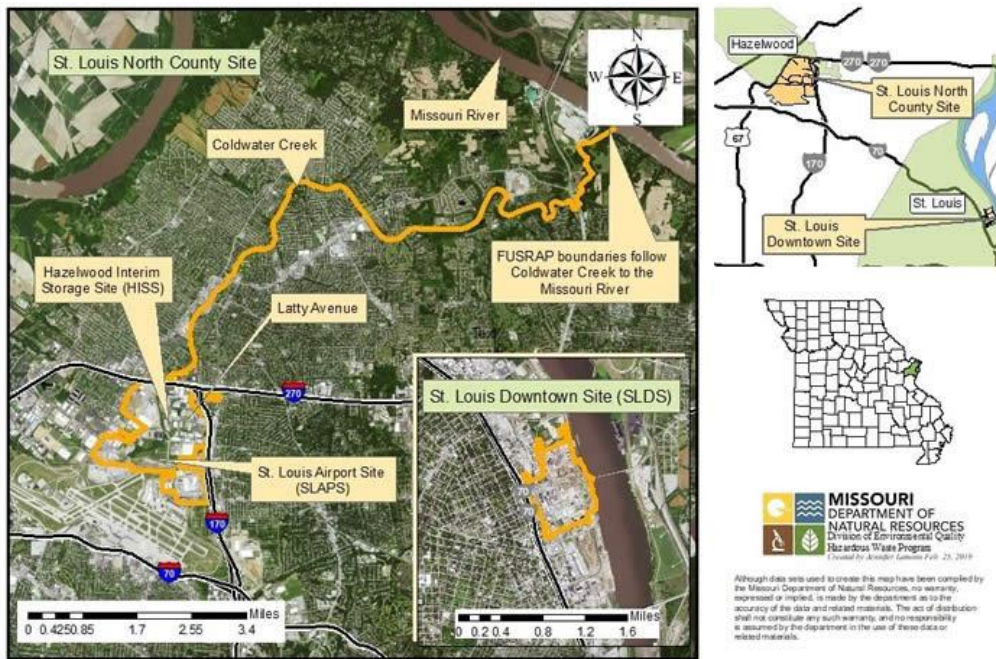


Figure 7 Map of contaminated sites administered by USACE (MDNR 2020)

Coldwater Creek has received significant, attention and concern from the public, including increased requests for testing, remediation, and studies of cancer rates for residents in the adjacent neighborhoods (Kaltofen, 2016). The path of the haul routes, the primary contamination at SLAPS and Latty Ave, as well as the course of Coldwater Creek are visible FUSRAP’s soil sampling in Figure 9.

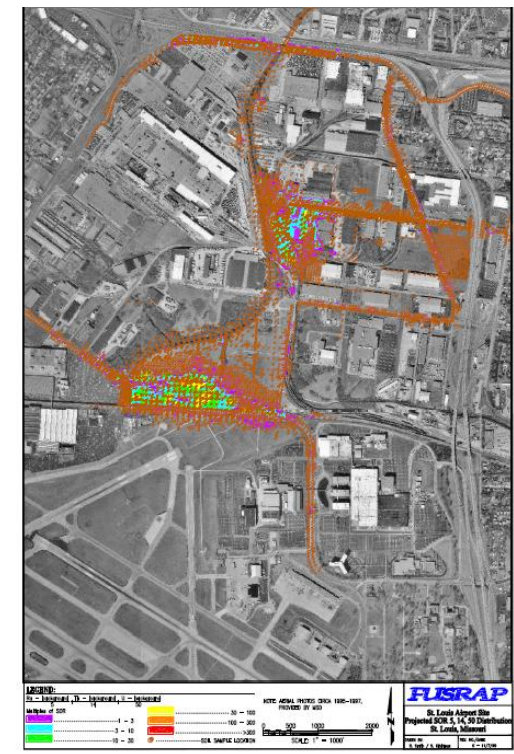


Figure 8 Extent of Radiological Contamination at the North St. Louis County Sites (USACE, 2005 2-113).

The combined North County sites were the subject of a 2005 ROD, where FUSRAP decided to excavate and remove all currently-accessible irradiated soil at the numerous sites and along the course of Coldwater Creek and its flood plain. Inaccessible soil was left in place. This inaccessible material includes soil under buildings, roads, and train track that had been constructed after contamination. This inaccessible soil was left in place but safeguarded with legal intuitional controls to restrict future land use, or trigger remediation activities if those structures are torn down or modified (USACE, 2005).

Westlake Landfill.

Westlake Landfill is a former municipal waste landfill. It is administered by the EPA as the lead agency. B&K Construction a sub-contractor for Cotter Corp. who was hired by the government to transport waste from the North County sites is responsible for the contamination (EPA, 2008). In 1973, B&K Construction illegally mixed 8,700 tons of radiologically material from Latty Avenue with about 39,000 tons of soil and delivered it to

West Lake Landfill. The landfill then unknowingly used this mixture as ground cover in daily operations (EPA, 2016). A year later the landfill was closed due on unrelated regulatory changes, and operations shifted to the neighboring Bridgeton landfill (NRC, 1988). In 1976, the public was first notified of the nuclear waste contamination (Chin, Toler, 2019).

In 1990 Westlake Landfill was added to the Superfund national priorities list. Westlake was the subject of a 2008 Superfund ROD which required the current owner, Republic Waste Management, to cap and monitor the landfill as well as groundwater. The 2008 ROD did not require any excavation the buried waste. In 2010, an underground subsurface heating event - essentially a smoldering underground fire - was discovered at the neighboring Bridgeton Landfill (Chin, Toler, 2019). In context of this fire, and increased public attention, the EPA began a second decision process resulting in a 2018 ROD. The 2018 ROD requires the excavation and removal of the majority of radiological material.

The three contaminated sites, this paper focuses on: Weldon Spring, North County, and Westlake Landfill share a common source of radiological pollution: early U.S. nuclear armament production. They also share legal requirements governing decision making processes through the Superfund program. However, their differing administrative owners and the differences in time between these decisions, help address the research questions by creating a chance to explore how public comments affected decisions. Table 2 provides a basic overview of the three sites, sources of, the administrative owners of the case.

Table 2 Overview of subcases and contextual features (DOE, 1993a; USACE, 2005; EPA, 2018)

Feature	Subcase		
	Weldon Spring	North County Sites	Westlake Landfill
Source of Contamination	On-Site uranium processing	Improperly stored uranium processing byproducts from SLDS	Illegally dumped irradiated soil from North County
Parties responsible for contamination	U.S. Atomic Energy Commission	U.S. Army, Mallinckrodt Chemicals	B&K Construction, Cotter Corp.
Dates of Contamination	1956-1966	1946-1967	1973
Party responsible for cleanup	U.S. Department of Energy - Legacy Management	U.S. Army Corps of Engineers - FUSRAP	Republic Waste Management
Lead Agency	U.S. Department of Energy - Legacy Management	U.S. Army Corps of Engineers - FUSRAP	Environmental Protection Agency
Record of Decision Year	1993	2005	2018

4. Theory

This paper applies the Advocacy Coalition Framework (ACF) to ground the case study in relevant theoretical literature. The ACF is a process oriented theoretical approach from the field of policy studies (Ruseva et. al, 2019). It attempts to study how policy changes occur through the interaction and competition of policy coalitions. These coalitions consist of individuals and organizations who coalesce around shared beliefs, and cooperate to advance those beliefs (Sabatier & Weibel 2007; Cairney, 2015; Kern & Rogge, 2018). The ACF rose to prominence within the field of policy studies during the 1990s. (Cairney, 2015). First developed in the 1980s by Paul Sabatier, the theory is intended to study how policy changes result from the interaction of these coalitions working within specialized policy subsystems. The ACF formulates a system where these coalitions with shared beliefs engage with each other in “non-trivial” ways in order to translate those beliefs into policies (Kern & Rogge, 2018).

This study addresses several key aspects of the ACF in the formulation of the research design to look at the openness of a decision space, the basic constitution or rules of a

subsystem, and examines public opinion as both a resource that is utilized by these constellations as well as an external factor. This section describes the fundamental aspects and mechanics of the ACF in order to lay out a basic understanding. It then focuses on those aspects of the framework that are directly applied in this case study, as well as several limitations to the use of the ACF in this project.

4.1 Fundamentals of the ACF

The key components and mechanics of the ACF are visualized in Figure 10. The ACF organizes public policy decision around specialized communities of experts: policy subsystems where policy coalitions compete to influence decisions. The ACF outlines the relationship between relatively stable parameters, external system events, long term coalition opportunity structures, and short-term constraints that affect the subsystem. Figure 10 lays out the major features and mechanics of the ACF.

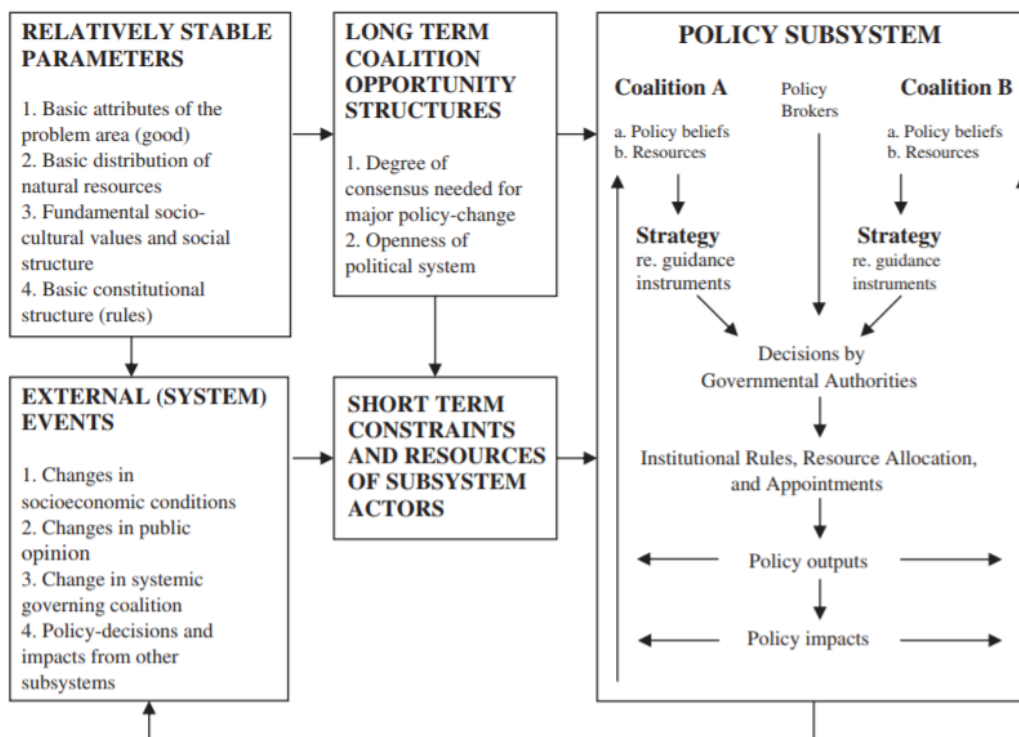


Figure 9 Diagram of the 2005 Advocacy Coalition Framework (Sabatier & Weible, 2007)

Foundation Stones.

The ACF is built on three core “foundation stones” organized along a macro, meso, micro scale (Sabatier & Weibel, 2007, p.191). On the macro level is the assumption that policy making occurs among small specialist groups in a “policy subsystem” and that those specialists are affected by broader system factors including socio-economic and political context (p. 191). The meso-level assumption is the aggregation of actors into policy coalitions. The micro-scale assumption grounds the role of individual actors in social psychology that diverts from a rational choice approach. The ACF promotes a view that individuals’ material interests are less important in decision making than, context- and institutional-dependent beliefs. In this way it diverges it from strict rational-choice approaches (Sabatier & Weible, 2007).

Beliefs.

These beliefs are aligned into a hierarchy of “deep core beliefs”, “policy core beliefs” and “secondary aspects” (Cairney, 2015, p. 486). Deep core beliefs are basic beliefs that “involve very general normative and ontological assumptions about human nature” and need to be shared by coalition members (Sabatier & Weible, 2007, p. 194). Policy core beliefs are the policy stances of a coalition, they entail the shared beliefs of how to answer policy questions—these must also be shared by all individual coalition members, but are less integral than deep core beliefs (Cairney 2015). Secondary aspects represent less-vital beliefs on how or in what way policy beliefs should be implemented, these are more procedural and a shared coalition consensus is less important (Kern & Rogge, 2018).

Paths to Policy Change.

Within the ACF there are two original potential paths to policy and belief change “Policy oriented learning” and “external perturbations and shocks” (Sabatier & Weible, 2007, p.198). Policy-oriented learning is long-term behavioral changes dealing with policy

objectives and is similar to concepts of learning-by-doing dynamics (Bhattacharyya, 2011). External shocks are major system-wide changes that require a policy subsystem to adapt, often redistributing resources, changing public opinion and resulting in influence shifting between coalitions (Sabatier & Weibel, 2007). These original pathways to change have been expanded to include additional considerations as an attempt to make the framework more applicable outside of open, pluralist systems (Cairney, 2015). The alternative paths to major policy change from the 2007 revision of the ACF are: “internal shocks” and “negotiated agreements” (Sabatier & Weibel, 2007 p. 204-5) Internal shocks are major changes within a subsystem which either change the distribution of power and resources, or affect the beliefs of the coalitions. Negotiated agreements is an ACF pathway that incorporates elements of Alternative dispute resolution literature to capture policy changes that result from negotiation or other dispute resolution channels (Sabatier & Weibel, 2007).

Coalition Resources.

One defining features of the ACF is the distribution of resources amongst coalitions within a policy subsystem. These resources take different forms and help determine the success of a coalition in influencing decision makers. While Sewell (2005) lays out a formal typology of coalition resources, public opinion, information, and mobilizable troops (Sabatier & Weible, 2007, p. 201-203). These are referenced in Subsection 6.3 results and figure into Section 7 Discussion.

Mechanics of the ACF.

Along with its formalized view of the policy subsystem and coalition, the ACF is built around the interactions of these coalitions: how the members of a coalition relate to each other internally, coalitions’ interactions with other coalitions and coalitions response to external events. Figure 10 illustrates the dynamics of the ACF between stable parameters, long- and short-term factors, external events as inputs to the policy subsystem; how

conflicting coalitions struggle for policymaker influence within the subsystem; how the resulting policies effect coalitions; and how policy changes have the ability to influence external systems (Sabatier & Weible, 2007, p. 202). This paper applies long-term coalition opportunity structures, specifically the conception of openness of a system in the structure and analysis which is detailed in following subsections.

4.2 Applying the ACF

This study employs specific elements of the ACF for its research strategy, analysis and discussion. Rather than conduct a full-fledged ACF analysis of the case and subcases, this selective approach is used to explore the specific role public comments play in this case decisions. This approach focuses on the basic constitutional structure, openness of political systems, and the dual role public opinion has within the ACF as both an external systems factor and a coalition resource.

Basic Constitutional Structure.

Basic Constitutional Structure is one of the relatively stable parameters set out in the ACF. It contains and establishes the basic rules governing a system and subsystem. Together with basic attributes, cultural norms and distribution of resources, these macro-level rules create a level of stability and context for decisions to occur and shape the policy subsystem (Cairney, 2015). In this project, the federal codes and legal context regulating the role of public comments, community acceptance and the criteria for remediation alternatives serves as the main element of constitutional structure to the policy subsystem. How these rules shape the role of public comments is integral to the discussion in this project.

Openness of Political System.

The way the ACF addresses the openness of political systems has changed over time to address criticism. One recurring source of critique of the ACF is its limited applicability to more-closed political systems (Henry et. al, 2014). The ACF was developed largely from

studies in the North America and Western Europe, but has evolved and been broadened to include coalition opportunity structures beyond those of developed, populist democracies (Sabatier & Weible, 2007). While there have been calls to apply the framework outside of OECD nations, its application in non-western political systems has been limited (Henry et. al, 2014). Clearly this research project falls outside of Henry et. al's call for studies in non-OECD nations, and is clearly inside of the U.S. political system. However, the centralized, highly technical, centralized decision space created by the Superfund program, creates an opportunity to apply the ACF to more-closed system.

The 2007 revision to the ACF (Sabatier & Weible, 2007) outlined two variables to define openness: the number of decision-making venues, and the accessibility of each venue. In the case of the Superfund program, there are very few actual venues of decision making since the primary decisions are held internally within the lead agency. The accessibility of the venue or decision space is a key element of this study. Based on the legal context, this paper assumes a general lack of accessibility to these decision with the public comments process being one of the few openings for public opinion to affect the decisions. The discussion of this paper explores how the openness of superfund process may have changed and if that affected the impact of public comments.

Public Opinion: System Event or Coalition Resource.

Public opinion has evolved to play a unique role in the formulation of the ACF. It is categorized as both a coalition resource and an external systems factor (Jones & Jenkins-Smith, 2009). As a coalition resource, public opinion is something to be wielded by subsystem actors to influence decisions. As an external system factor, public opinion can act as a shock to the policy subsystem, reorient power or otherwise restructure the relationship between coalitions. Both conceptions present public opinion as a force that can affect the

decisions made within the system (Sabatier & Weible, 2007). This dual role within the framework presents some issues outlined by Jones and Jenkins-Smith (2009):

“First, conceptualization and placement of public opinion within the ACF has proven to be a difficult task for ACF scholars. Second, indications of the importance of public opinion to public policy maintenance and change (or lack thereof) in the literature are quite pervasive. Third, the relationship between public opinion and public policy speaks directly to norms of democratic systems.” (Jones & Jenkins-Smith, 2009, p. 38).

These assertions on the role of public opinion in the ACF parallel some of the concepts within environmental governance literature explored in this paper. Specifically, Jones and Jenkins-Smith’s discussion on the growing importance of public opinion in the literature that employs the ACF, as well as the role of public opinion as a norm in democratic systems.

This paper employs the dual view of public opinion in the ACF: as a resource that is tapped or a force that can erupt to change policy decisions. By looking through the narrow window of public comments, the discussion of this paper explores how public opinion might affect the Superfund decisions in these Superfund sites as either a resource or as external shock.

4.3 Limitations of the ACF and application

Core beliefs vs. policy beliefs.

The ACF’s grounding in core beliefs as a driver of coalition creation is hard to assess without directly surveying the members of the coalitions. While methods have developed to examine these beliefs, because this study focuses on the public comments in this case, the deeper fundamental issues of core belief are not addressed. Even specific policy beliefs would be difficult to ascertain from this study’s research strategy and methods because of its focus on public opinion, not the makeup of potential coalitions. By using a more limited application of the ACF and only applying some elements, this study partially ignores some of the key drivers of the framework (Sovacool et. al, 2018).

Decades long approach.

One limitation that shaped this paper's application of the ACF is the framework's focus on long-term policy changes. It would be an imperfect approach to apply the ACF directly to analyze individual decisions in each subcase. The ACF was designed to look at decades-long policy changes. Sotirov (2012) makes a case for its applicability to smaller decision spaces of recurring policy conflicts, which would complement the Superfund decisions. However, the selective approach used in this paper avoids this limitation by applying elements of the ACF as a theoretical grounding to address the research questions. An alternative— and more traditional — application of the ACF could be to look at the coalitions within the St. Louis sites, review their resources, beliefs as well as the broader system factors and analyze the coalition interactions to gain a greater understanding of the case or attempt a causal explanation. This traditional approach was rejected in order to examine public opinion and openness specifically in several decisions, the other factors of coalition mechanics are less relevant to this study.

Another application of the role public opinion plays within the ACF and these cases would be to identify and study certain aspects of public opinion and how they may have changed within the St. Louis Region over the course of these decisions. An analysis of public opinion polling, media coverage, and other relevant proxies for public opinion as both a resource or external factor would be a more traditional approach incorporating elements of the ACF. However, because of the closed nature of the superfund decision subsystem it would be difficult to assess what role any system shocks from public opinion may have played.

5. Research Strategy and Methods

In order to answer this project's research questions, it employs an abductive small-n comparative research strategy and a qualitative content analysis as the primary methodology.

These two approaches were selected to address the explorative nature of the research questions and objectives. This section details the rationale behind the strategy and methods.

5.1 Research Strategy: Small N Comparative Nested Case Study

As discussed in the case selection section of this study, these three subcases exist within a most similar systems conception of a small-n comparative strategy (Halperin & Heath 2017). A small-N strategy was chosen to allow for more in-depth analysis of each subcase than a statistical approach while allowing an element of broader contextualization of similar cases (Halperin & Heath 2017). Likewise, the explorative nature of the research questions calls for a strategy that allows for an approach that is not focused on causality and the challenges that entails. This comparative design is derived from a logical progression of the research questions, the context of the cases and the theoretical framework of the ACF (Yin, 2018). While the design of this study is derived logically, the results are not. In this way, it is an abductive strategy which relates these observed subcases to the existing theoretical framework of the ACF and the existing literature (Dey, 2004). In a similar fashion this abductive approach is evident in the interpretive nature of this exploratory study. The small-N most similar systems comparative strategy and the textural analysis methods are applied to interpret the case data. This process of abductive interpretation forms the basis of this exploratory study (Dey, 2004).

This most-similar systems approach is evident as each of the three subcases are governed by the same regulatory framework of CERCLA and the EPA and MDNR, they occupy a similar proximity to residential areas, they share a similar type of low-level nuclear waste, their geographic proximity means community and political context is largely the same. These are a few of the key similarities in these systems and while not exhaustive, help frame and control for significant factors (Halperin & Heath 2017).

The key differences that are explored in this strategy are the institutional differences and the temporal differences between the subcases. Attempting to address these two variables – fragmented administrative ownership and time - leads to a more-complex, less-definitive research design. Table 3 outlines the multidimensional organization of the specific subcase decisions in this research strategy. The table visualizes the selected approach to individual decisions over time and across administrative ownership. As detailed in Subsection 3.4 Subcase selection, each specific decision reflects the largest remediation effort in each subcase. This selection of major changes also feeds into this multidimensional approach, exploring cases over time and across lead agency.

Table 3 Multidimensional approach to subcase ROD selection

Subcase and Lead Agency		
Weldon Spring, DOE	North County Sites, USACE	Westlake Landfill, EPA
<i>DOE 1990-</i> Transport contaminated bulk waste from Quarry Site to Chemical Plant		
<i>DOE 1993-</i> Removal of waste and construction disposal cell at the Chemical Plant		
<i>DOE 1998-</i> Incineration of contaminated soil and on-site storage of lead contaminants		
<i>DOE 2000-</i> Additional soil removal at Quarry Site		
<i>DOE 2004-</i> Groundwater remediation at Chemical Plant Disposal Cell		
<i>USACE 2005-</i> North County Sites Cleanup		
<i>EPA 2008-</i> Cap and monitor waste		
<i>EPA 2018-</i> Excavation and removal of waste		

Bolded text denotes selected decisions

These two crucial differences, time and lead agency, between the subcases creates the opportunity for more uncertainty and introduces additional factors that will be more difficult to address. For example, drawing from the ACF’s conception of a policy subsystem, the temporal differences introduce changes in external system events, short term constrains and coalition resources, socio-economic conditions, public opinion, governing coalitions, and impacts from other subsystems (Sabatier & Weible, 2007).

One alternative comparative strategy to control for these temporal differences - and the resulting subsystem changes - could examine decisions made closer together in time, a cross sectional approach. Table 4 reflects a cross sectional comparative strategy.

Table 4. Alternative Strategy to subcase ROD selection, Cross-Sectional

Subcase and Lead Agency		
Weldon Spring, DOE	North County Sites, USACE	Westlake Landfill, EPA
<i>DOE 1990- Transport contaminated bulk waste from Quarry Site to Chemical Plant</i>		
<i>DOE 1993- Removal of waste and construction disposal cell at the Chemical Plant</i>		
<i>DOE 1998- Incineration of contaminated soil and on-site storage of lead contaminants</i>		
<i>DOE 2000- Additional soil removal at Quarry Site</i>		
<i>DOE 2004- Groundwater remediation at Chemical Plant Disposal Cell</i>		
	<i>USACE 2005- North County Sites Cleanup</i>	
		<i>EPA 2008- Cap and monitor waste</i>
		<i>EPA 2018- Excavation and removal of waste</i>

Bolded text denotes selected decisions

Likewise, the key difference of administrative ownership introduces additional issues since each subcase is a similar yet inherently different decision space. Each lead agency introduces different actors, different decision makers and therefore more coalitions. Following this thinking, another alternative strategy to account for institutional difference could structure the study around multiple decisions within a single subcase to see how processes were affected by time while controlling for institutional differences, a longitudinal approach. Table 5 visualizes this alternative longitudinal strategy.

Table 5. Alternative Strategy for subcase ROD selection, longitudinal

Subcase and Lead Agency		
Weldon Spring, DOE	North County Sites, USACE	Westlake Landfill, EPA
DOE 1990- Transport contaminated bulk waste from Quarry Site to Chemical Plant		
DOE 1993- Removal of waste and construction disposal cell at the Chemical Plant		
DOE 1998- Incineration of contaminated soil and on-site storage of lead contaminants		
DOE 2000- Additional soil removal at Quarry Site		
DOE 2004- Groundwater remediation at Chemical Plant Disposal Cell		
	USACE 2005- North County Sites Cleanup	
		EPA 2008- Cap and monitor waste
		EPA 2018- Excavation and removal of waste

Bolded text denotes selected decisions

While either alternative strategy could better control variables and may be able to offer stronger causal connections, this is an explorative study that makes no causal claims. Instead, by taking a multi-dimensional approach and exploring the impact of these two variables: institutional fragmentation and differences of time, this chosen strategy connects to the time lags and institutional complexity facing environmental governance (Underdal, 2010). As described in Section 3 Case Selection, the selected ROD in each subcase represents a significant change in the status of the policy subsystem. The freedom offered by this multi-dimensional approach to look at more significant changes in each subcase - as opposed to being self-restrictive to look only at decisions along one dimension – allows this study to explore they systems in which public comments may be most impactful. The underlying assumption being: if a major change is being proposed or decided within a subsystem, then more public opinion and public comment will be generated: In the case of Weldon Spring, the construction of the 1,000 year life-span disposal cell; in the North County Sites, the sole decision to remediate waste; and in Westlake Landfill a decision to excavate and remove previously untouched waste. By looking at these decisions, where significant changes are being made, with potentially elevated public attention and increased public comments, this

may also create more opportunity for narrow openings in the more-closed technocratic policy subsystems.

This multi-dimensional also allows for improved comparability by exploring how small differences from agency to agency may influence the openness of a policy subsystem. Likewise, by building a strategy around both factors it also helps capture an important factor of the Superfund programs, contaminated site management and long-term environmental governance. That factor is the fractured nature of this type of governance work, for which any comparative study will need to account. Looking at these three subcases across time and institution, but an otherwise similar context, is an opportunity to explore participatory processes in this mostly-closed technocratic system.

Compared to Alternative Designs 1 & 2 this study's approach is a compromise, that attempts to understand the openness of these subsystems and the role public comments play within them by examining three snapshots. A more robust study could incorporate both alternatives by conducting an analysis of all the decisions within the three sites.

These institutional differences in the administration of the three cases are: Weldon Spring with DOE, North County with USACE, and Westlake Landfill with Republic Services and EPA. These differences highlight the significant complex and fractured nature of long-term environmental governance. DOE, which manages Weldon Spring evolved from the AEC, which in turn grew out of the Manhattan Project which was responsible for the initial uranium processing in St. Louis. The specific division of the department currently governing Weldon Spring is the Office of Legacy Management. It was formed in 2003 as a hybrid of different organizational entities within DOE to specifically administer contaminated sites left over from nuclear weapons and energy industries as well as respond to the needs of workers exposed to these sites (DOE, 2020^x). However, at the time of the 1993 ROD, Weldon Spring was managed by FUSRAP. This program was established in 1974 initially as part of DOE to

address nuclear waste from early weapons production efforts, but later transferred to USACE in 1997.

USACE oversees SLAPS and is an entity within the Department of Defense and the U.S. Army's chain of command. It is staffed by both soldiers and civilian personnel and domestically serves a security purpose to maintain vital infrastructure (USACE, 2020a). USACE currently administers SLAPS through the FUSRAP program. FUSRAP is a program created under DOE before being moved to USACE, but then replaced partially by the DOE office of legacy management (USACE, 2020a). This changing of hands of FUSRAP between DOE, and USACE connects to the fractious administrative context detailed by Underdal (2010) in environmental governance.

In the Westlake subcase, the EPA serves a dual role. It is both the regulator of the entire Superfund program but also the administrator of the specific site. Since Westlake is owned by the private municipal waste company Republic Services, not a government entity like the other subcases, it lacks the capacity to facilitate a ROD. Republic Services, is the potentially responsible party, meaning they are responsible for funding and carrying out much of the study and remediation efforts in this process. Within the Superfund program, this responsibility then defaults to the EPA. The EPA was founded in 1970 as an independent executive agency, that consolidated environmental governance from other areas of the federal government (EPA, 2020b). As detailed in Section 3 Case Selection, the Superfund program was founded in 1987 to address contaminated sites.

Beyond the institutional changes, the temporal differences come into play as these decisions span 25 years and cannot be ignored. Although this study does not employ explicitly historical analyses – Alternative Strategy 2 - of these subcases, the changes to the Superfund program over time, as well as the potential feedback effects of multiple cases within the same metropolitan area present interesting potential avenues of exploration. In the

25 years between the 1993 Weldon Spring ROD and the 2018 Westlake decision, the role of email and internet as a means of giving public comment, the overall awareness of these sites within the proximate populations, and the government's approach to participatory processes have all changed and could contribute to changes within sub-system openness and the role public opinion may play in each decision.

This research strategy is designed to account for issues of validity and reliability (Yin, 2018). It addresses construct validity by drawing data from multiple sources, a combination of the RODs and public comments in each subcase as well as additional governmental and journalistic sources for contextual evidence. By using the RODs and individual comments to explore policy-subsystem openness, this paper employs converging lines of inquiry evidence (Yin, 2018). In order to address external validity, the strategy uses replication logic by looking at the same type of data and applying the same data in each subcase. Likewise, reliability is achieved by using publicly available data from each subcase's administrative record. This intentional use of data also makes this cases methodology applicable to other Superfund decisions. As an exploratory study, internal validity is not addressed, since it is making no causal claims (Yin, 2018). However, because there is an increased level of subjectivity in the classification and interpretation of public comments, there is an increased opportunity for bias affecting the external validity and reliability. The following subsection, attempts to address this opportunity for bias by describing the methods used to pursue this study's objectives and answer its research questions.

5.2 Methodology: Content analysis

This study applies a qualitative, textual content analysis of the data. A qualitative approach was chosen over a quantitative approach in part to address the research questions. The qualitative approach also focuses on the latent meanings and themes of the comments, which were deemed more relevant to the research questions than the specific words or

phrases used by the commenters. This is because if the themes have infiltrated the decision that is more important than the phrasing or presence of specific text. This decision was also informed in-part by this study's use of the ACF and its focus on coalition beliefs (Sabatier & Weibel, 2007). While this study does not seek to analyze the beliefs or make up of coalitions in these subcases, the use of the ACF's conception of public opinion and the role of openness in a policy subsystem draw a stronger connection to looking at deeper latent meaning. These deeper latent meanings, specifically the themes contained in each public comment and the RODs, can be studied more effectively in a qualitative content analysis than a surface level quantitative approach (Halperin & Heath 2017).

A textural analysis was chosen as the primary methodological approach over alternative options, chiefly interview-based methods to avoid interview biases and issues of access to subjects. Because the three subcases span nearly three decades, accessing the individual decision makers, advocates, and administrators in each case, would have created validity issues. Likewise, this textural approach aids potential repeatability of this study because these official documents are mandated by federal law in each superfund site and each site's administrative record is accessible to the public. This process of analyzing these documents would also aid in expanding the comparison to include other subcases within the Superfund program (Halperin & Heath 2017).

A content analysis was also chosen over a discourse analysis methodology. For the purposes of this study, the content of the texts themselves are more important to addressing the research questions and objectives particularly RQ1 and RO1 and RO2. A content analysis assesses particular meanings of a subject text as opposed to a discourse analysis which focuses on the broader relational power context being formed by a discourse (Halperin & Heath 2017). While understanding the context surrounding these cases is important, it isn't the primary focus of this study.

The relevant texts for analysis are the ROD in each subcase: DOE (1993) for Weldon, USACE (2004) for North County and EPA (2018) for Westlake, as well as the compiled public comments in each sub cases' administrative record. Within each ROD, the sections analyzed were the overview, sections detailing community participation, modifying criteria, the final selected remedy, and significant changes.

6 Data

6.1 Data Collection

The data used for this study are: (a) the public comments submitted in each decision (b) the RODs in each subcase. The public comments and RODs are publicly-available records and part of the official administrative record for each Superfund Site and are required by federal code to be accessible to the public (CFR 2020). This subsection details how each document or set of documents was collected in each subcase.

Public Comments.

The public comments submitted during each Superfund Decision are collected and saved in the administrative record² of each site. Because of differences in time, and technology associated with each site and differences in the lead agencies, the administrative records had to be accessed in different manners.

Weldon Spring: The public comments are contained in a pdf of the Responsiveness summary on an archived website index of the DOE office of Legacy Management Weldon Spring Administrative Record.

North County: The Administrative Record exists as a paper copy in the archives of the central branch of the St. Louis Public Library, as an official document repository. This record

² It should be noted, some of these records do contain the names of the individuals leaving the comments. This reflects personally identifying information under the Norwegian Centre for Research Data guidelines. However, all data used in this report is publicly available, comments were offered as part of an open government process with no expectation of privacy, and no personally identifying information is included in this report.

was accessible through coordination with the History and Languages reference staff.

Individual records had to be identified from an index, assembled for viewing by the library staff, then reviewed and digitized by the author while at the library. Only comments from members of the public were digitized; comments from government or technical personnel were excluded.

Westlake Landfill: Each comment is accessible as an individual pdf on the EPA Superfund online database (EPA, 2020c).

Records of Decision.

Each ROD in this study was accessed via its lead agencies' website, and downloaded as a pdf. The Weldon Spring ROD came from DOE office of Legacy Management Weldon Spring page. The North County ROD was downloaded from USACE FUSRAP- St. Louis's division website. Westlake Landfill's ROD is available on EPA's Superfund profile page for Westlake Landfill.

6.2 Data Reduction and Analysis

Public Comments.

The individual public comments were read and analyzed in order to interpret the latent meanings of the text and to identify themes. In the cases of Weldon Spring and North County, all the available public comments from the administrative record were read. In the Westlake decision the number of individual comments, 4,251 precluded an overall analysis of every comment. Instead a simple random sample was selected.

For the purposes of this study, commenters who appeared to be participating in an official role as an employee for a company, agency, or unit of local government, or as a hired consultant were deemed to be providing technical input and not analyzed. Based on the ACF's conception of public opinion as largely an exogenous to a policy subsystem, if a commenter appeared to be from a "community of experts," they were left out in order to

capture strictly comments from lay-persons. There were several exceptions where an individual listed their profession, which appeared to be technical in nature, but framed their comment as outside of their normal scope of work and therefore deemed to be coming from a place of personal interest. For example, these hybrid comments included a physician writing from the perspective of a concerned citizen, with additional knowledge or a college professor writing outside of their stated field of study. Likewise, there were several individuals who submitted comments claiming membership or leadership in a citizen-organized advocacy organization. They were included as a public comment, when expressing personal views on the process, but not the technical reports of their hired consultants. These steps to exclude technical comments were an attempt to limit comments to those expressing some element of public opinion within the ACF's (Sabatier, Weible, 2007).

Table 6. Type and number of comments analyzed in subcases

	Comment Type	Subcase		
		Weldon Spring	North County	Westlake Landfill
Total Public Comments		25	21	4,251
Comments Analyzed	Letter	8	11	6
	Email	0	3	21
	Handwritten Comment	19	7	1
	Printed Card	0	0	14
	Total Analyzed	25	21	42

A 1% simple random sample was selected for the Westlake Landfill comments. The EPA assigned ID numbers to each public comment. In order to pull a random sample, from this universe a new unique identifier was assigned to every comment ID number, then Microsoft Excel's random number function was used to pull 42 random integers between 1 and 4,251. The corresponding unique identifier was then used to pick the corresponding EPA ID number and download the matching file from the web-based archive. In an explanatory or

quantitative analysis of this case, a larger sample size should be employed to reduce randomization error.

The textural content analysis of the public comments began with loose, case-specific, thematic *a priori* codes as a starting point (Halperin & Heath 2017)). The analysis employed “issues of concern” identified by Feldman et. al (1995, p, 18) in a study of public perception in the St. Louis region. These issues of concern were developed through surveys of the community in relation to the nuclear waste Superfund remediation efforts at Weldon Spring. While this is no guarantee of the potential concerns and themes that exist within the public comments, these issues of concern served as a starting point to categorize the comments and identify themes. Comments were read through and recorded if a concern was present. The codes were recorded along with an author-assigned identification number in a spreadsheet. The *a priori* codes adopted from Feldman et. al (1995) outlined in Table 7.

Table 7. *A priori* codes adopted from Feldman et. al (1995)

Issue of concern From Feldman et. al (1995)	Operational description of theme Developed by Author
Water Contamination	Does the comment mention water, erosion, or migration of material offsite?
Health Risks to Community	Is there an expressed or implied fear of pollution harming people?
Public Involvement	Is there express or implicit distrust of the agencies, or fear of input being ignored, dislike of the process?
Environmental Risks	Do they express risk to plant or animal life, ecosystems or other non-human entities?
Cleanup Costs	Are concerns financial or economic costs present, mentions of taxpayer dollars, etc.?
Impact on Local property Values	Does the commenter express fear of being able to sell their homes or imply a loss of value?
Waste Transport (originally “Soil Transport”)	Do their comments imply fears around waste being shipped through or into the community?
Future Land Use Restrictions	Does the commenter show concern about how these sites will be used in the future?
Community Image	Is the perception of the community, as a nice place to live, or similar issues addressed?

If a comment or its underlying meaning did not fit any of the *a priori* issues of concerns, the new concern was recorded. These new concerns formed a basis for new theme

derived from the text. These derived concerns were then carried over to the other subcase. Only themes that appeared multiple times in these texts within a subcase were carried over. Concerns raised only once or twice, but did not appear to be overly influential to other commenters were not applied to other cases. Because this is a qualitative textual analysis, there were no formal numerical criteria for a new derived theme to be applied to the other subcases. Instead a combination of factors was considered: did the theme appear to be a main focus of the comment, did it appear as a major focus in several comments, was it explicitly mentioned or was it alluded to – together these factors were weighed. The subcases were analyzed in chronological order. After the three subcases' comments were analyzed once and derived themes were added, the comments were reviewed a second time to see if the derived themes were also present in the older texts. This process was chosen in order to capture the presence of these themes over time, and in order to move beyond the themes identified by Feldman et al. (1995). The derived themes are detailed in Table 8.

Table 8. Derived themes from analyzed comments

Derived issue of concern	Operational Description of theme: Developed by author
Air Contamination	Does the comment concern radiation migrate via the air or wind?
Labor	Does the commenter address the qualifications, residence of the workers at the site or if they are unionized or not?
Relocation of populace	Does the comment include a focus on temporary or permanent relocation of residents in the vicinity of a site
Lead Agency Change	Does the comment address a desired change of the organization administering the process
Preferred solution	Is there a stated remediation option preferred by the commenter?
Risk from fire	Does the comment express concern over the subsurface heating event in Westlake Landfill?

Records of Decision.

As detailed in Subsection 3.1 Legal Context of this study, the lead agency in every Superfund decision is required to follow a detailed legal process established in CERCLA. Once a site is added to the National Priorities list, a remedial investigation process begins by

studying the contaminated site, assessing risks and determining a series of approaches within a community of experts (CFR, 2020). These solutions are then narrowed down to one single proposed plan. That proposed plan is then presented to the public, and other agencies for input. It is at this stage that members of the public are able to provide input by submitting written comments or attending a public meeting to give verbal comments. Following the public comment process, potential modifications to the plan and other requisite approvals from the lead agency, EPA, and state officials, the ROD is published. In each subcase, the ROD serves as a detailed description of the final remedy, but also as a rationale for that action.

Much of each ROD is dedicated to describing the subcase, outlining the threats, discussing decision criteria, laying out potential remedies and justifying the proposed plan. While these documents are several hundred pages long and are primarily technical government documents, there are several sections of each ROD that provide an insight to the role of public comments and serve as the data source for this paper's textual analysis. These sections are the:

- *Overview*, in order to have a broad understanding of the subcase, its context and the organization of the document are necessary to examine.
- *Community Participation*, the sections of the ROD describing how the public was engaged
- *Modifying Criteria*, as detailed in Section 3.1 Legal Context, the role of public comments and public opinion is limited to being only a modifying criterion
- *Final Selected Remedy* and *Significant Changes* were assessed together to see if public comments were explicitly listed as having influenced the decision.

These sections were chosen for analysis after an initial review of the contents of the RODs, to exclude potentially irrelevant materials. An alternative approach to data selection could review the entire document for signs of public comments theme’s however the limitations of this thesis prevented a top-to-bottom analysis of each ROD. Table 9 lists the sections of each ROD included in the analysis.

Table 9. Overview of sections analyzed in each ROD

Section	Record of Decision		
	Weldon Spring (DOE, 1993a)	North County (USACE, 2005)	Westlake Landfill (EPA,2018)
Overview	1. Site Name, Location, and Description (p. 1-7)	2.1 Site Name, Location and Brief Description (§2 p. 1-6)	§2 1.0 Introduction to the Site and Statement of Purpose (§2 p. 5-10)
	2. Site History (p.10)		§2 2.0 Site History and Enforcement Activities (§2 p. 10-11)
Community Participation	3. Highlights of Community Participation (p. 10-11)	2.3 Community Participation (§2 p. 7)	§2 3.0 Community Participation (§2 p. 12-13)
			§3 1.1 Community Involvement (§3 p. 1-2)
Modifying Criteria	8.3 Modifying Criteria (p. 71-73)	2.10.2.8 State and Community Acceptance (§2 p. 75-76)	§2 10.9 Community Acceptance (§2 p. 60)
Final Selected Remedy	9.1 Key Components (p. 73-77)	2.12 Selected Remedy (§2 p. 77-92)	§2 12.0 Selected Amended Remedy (§2 p. 61-63)
Significant Changes	10.7 Significant Changes (p. 113)	2.14 Documentation of Significant and other changes (§2 p.101-103)	§2 14.0 Documentation of Significant Changes from the Proposed Plan (§2 p. 82-84)
Responsiveness Summary	(DOE, 1993b)	3.0 Responsiveness Summary (§3 p. 1-133)	§3 Responsiveness Summary (§3 p. 1-94)

Each selection was first read through for explicit instances or mentions of the public comments and how those comments or that public engagement process was handled by the lead agency. This was done in order to get a prima facia understanding of how the decision makers explicitly describe the role of these comments. This surface-level understanding is important to examine the potential openness of the policy subsystem, from the perspective of the lead agency authoring the RODs. This is an attempt to address part of RQ1 and RQ2 to see how the decision makers in the subsystem present the role of comments in an official manner.

The sections detailed in Table 9 were then read and analyzed using the *a priori* codes from Feldman et al. (1993) as well as the developed codes from the public comments in each subcase. The presence of these areas of concern were noted and in illustrative instances, the relevant passages were recorded for the discussion. This was done in order to see if the concerns of the commenters may have been incorporated into the decision in an implicit way. The presence of these shared themes may reflect the infiltration of public comments and public opinion into the technical decision space. This builds off of the ACF's conception of coalitions working to install their policy beliefs into policy decisions (Sabatier & Weibel, 2007). However, the presence of public comment themes in the RODs may also demonstrate a second alternative relationship, that the commenters focused on specific areas of concern raised by the lead agency in the proposed plan. A third option is that these themes are prioritized by the lead agency and the individual members of the public in each subcase independently. While all three options, or a combination thereof, could come into play in these subcases, it is nonetheless important to explore in order to address RQ1. This exploration can help expand the understanding between public opinion, and these decisions particularly if the lead agency in each case may have internalized the beliefs of actors within an advocacy coalition.

An additional section of each ROD, the responsiveness summaries were not analyzed in their entirety, instead it was used selectively to address or explain the presence of some of the comments or provide insight into how specific themes were handled by the lead agency. The responsiveness summary is an appendix to the three ROD's the responsiveness summary contains the responsible agencies' classification of comments and aggregates shared area of concern into a listing of issues. The agencies then respond point-by-point to each identified issue in the comments. This represents the agencies' formal legal requirement to acknowledge and respond to public comments. It also acts as the agencies' filter of the

comments from the public. This section was not analyzed in the same manner as the other ROD sections, instead it was used selectively to address or explain the presence of some of the comments or provide insight into how specific themes were handled by the lead agency.

Together, an analysis of the themes contained in the public comments, their potential presence in the RODs as well as the explicit mentioning of roles with helps explore the level of openness within the policy subsystem and the role these comments may have played over time and in the differing administrative settings.

6.3 Results

This subsection presents the results of the reduction and analysis. It begins with an overview of the themes from the public comments in the three subcases. It then addresses each subcase individually. It lays out the surface level reading of the ROD's discussion of public involvement, followed by the results of the public comment content analysis and concludes with the thematic comparison between the public comments and the ROD sections.

When presenting the data from public comments in this subsection, a basic distribution of how the themes appeared in the comments of each subcase is used. This is done simply to help visualize the presence of the themes in the comments, which will then be discussed. Figure 11 presents the distribution of these themes, over all three subcases.

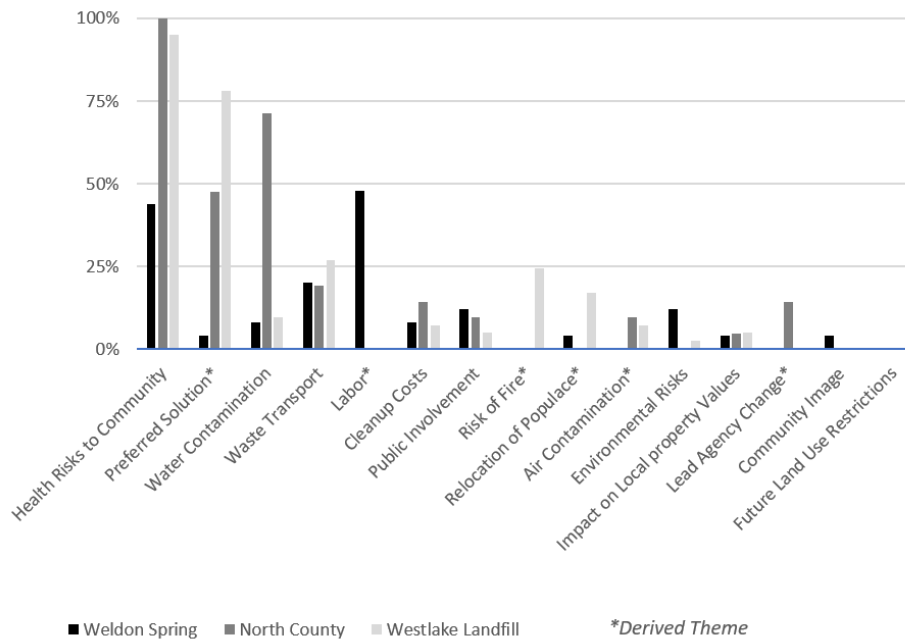


Figure 10. Prevalence of themes in analyzed comments of three subcases

From a brief review of this visualization, it is easily discerned that some themes are more prevalent than others across the three subcases. For instance, “Health Risks to the Community,” “Waste Transport,” among others are present across the three cases, albeit to different extents. On the other hand, there are some themes that are localized to individual subcases. For example, “Labor” is only apparent in Weldon Spring and “Risk of Fire” is only present in Westlake Landfill. This localization is reflective of how the derived themes were developed from the individual subcases and reflect some of the unique elements of each contaminated site.

Weldon Spring.

Surface Level ROD: Weldon Spring.

The results of the explicit review of the ROD for evidence that public opinion influenced the decision-making process yields a fairly clear result. The ROD states in the section on community acceptance:

“Upon review of these comments, it was determined that no significant changes to the remedy, as it was originally identified in the Proposed Plan, were necessary.” (DOE, 1993a, p. 113)

The process to seek public comment was limited to posting a notice in the local and regional newspapers, and making the proposed plan and accompanying documents available at the site itself, the local high school and three public libraries in the region. Public comments were accepted in the forms of letters or comments during a single public hearing. (DOE, 1993a). Compared to North County and Westlake, this was the most limited process of seeking input. It relied on community members to see an advertisement published in the newspaper, and then go in-person to read a copy of the proposed plan.

Themes in Public Comments: Weldon Spring.

In the 1993 Weldon Spring decision, two dominant themes are present in the comments. These themes are the *a priori* theme: “Health Risks to the community” and the derived theme: “Labor.” The other recorded themes appeared fairly scattered through the other comments, mostly serving as secondary themes. The distribution of all the recorded themes are present in Figure 12.

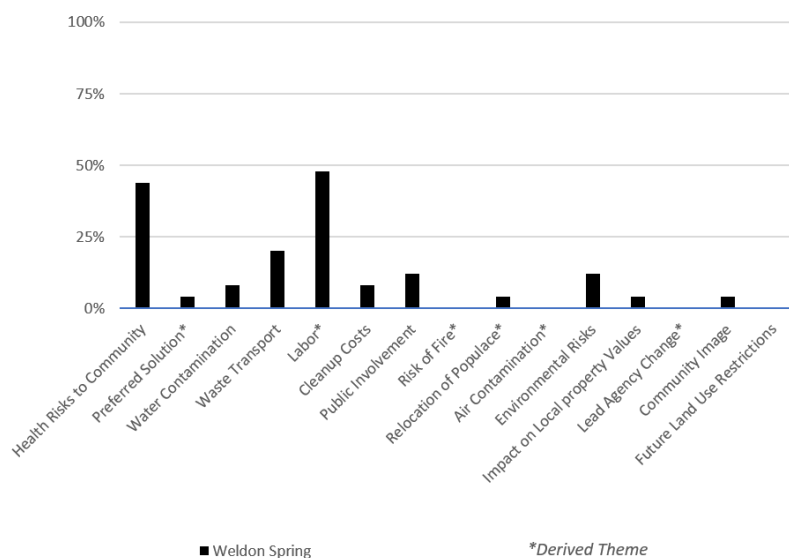


Figure 11. Prevalence of themes in analyzed Weldon Spring comments

The labor-focused comments were exclusively delivered as handwritten comment cards during the public meeting where written comments were collected. These labor-oriented comments are almost exclusively focused on the people allowed to or prevented from working at the site, and few presented any other concerns. The authors of these comments listed themselves as members of Laborer's Local 660 one of the local labor unions. These comments differed in form and content from the others which were primarily longer letters which presented several themes or explicit areas of concern. A preponderance of these letters contained explicit or implicit concerns about health risks to the community. All but one of the long-form, non-labor letters were written by people who did not claim any specific previous training or expertise on waste. One single letter was written by a person who stated they were a medical doctor and presented a mixture of personal concerns while also presenting medical information.

After health risks and labor issues, the theme focused on the Transportation of Waste was the most present of the secondary themes. These concerns were mostly focused around a fear that the disposal cell to be constructed at the former chemical plant site was going to become a destination for waste from other contaminated sites across the country. While this theme appeared in less than a quarter of the submitted, it is a recurring theme that takes a greater share in the other subcases. For that reason, its origins here are noteworthy.

Several of the longer-form letters were written by people listing themselves as member of a locally organized group, St. Charles Countians Against Hazardous Waste. The presence of this group, as well as what appears to be an organized effort by the Laborers present some evidence of policy subsystem actors attempting to use public opinion and mobilization of as a coalition resource.

Themes in ROD Weldon Spring.

The more prevalent themes in the analyzed sections of the ROD included were Health Risks, Public Involvement, Water Contamination, and Waste Transportation all of which align with present themes in the public comments, albeit not entirely to the same extent as in the public comments. For instance, sections of the ROD place a greater emphasis on water contamination, waste transport. The theme of community health risks, as well as specific attention to the proximity of Francis Howell High School to the disposal cell demonstrated some alignment between the ROD and the Comment themes. Likewise, the issue of waste transportation plays centrally in the ROD, with guarantees that only waste from the Weldon Spring site will be housed in the disposal cell, and no off-site wastes will be transported into or through the community.

There is a similar level of alignment between some of the secondary comment themes. For instance, there is attention paid to Cleanup Cost and Environmental impact in the ROD. Both of these themes received minor attention in the public comments. Nonetheless this also presents additional thematic alignment between the comments and the content of the decision.

However, the theme of labor, which was prevalent during the public meeting appears to be completely ignored in the body of the ROD, with only references to the comments and a required response in the responsiveness summary. One potentially illustrative point is that if this analysis were to apply a similar approach to the DOE and disregard the comments focused solely on labor, the prevalence of themes in the comments and ROD would more closely align. The essential rejection of more than half of public comments as irrelevant to the issue itself may present resistance from the lead agency to a specific advocacy coalition and highlight a potential lack of openness or accessibility.

North County.***Surface level ROD: North County.***

The plain-text reading of the 2005 North County ROD presents a result similar to Weldon Spring. The ROD states that after all public comments were reviewed, “no significant changes to the remedy, as originally identified in the Proposed Plan, were necessary or appropriate” (USACE, 2005, p. §2-101).

The existence of stated preferred solutions within the public comments in this subcase is also addressed. The ROD also describes the comments as they relate to the proposed plan and alternative approaches: “The public expressed their dislike of Alternatives 1 through 4” and generally expressed a preference for Alternative 6 (Excavation at All Properties)” (USACE, 2005, p. §2-75). The ROD also states the lead agency’s assessment of the motivations behind that preference, “USACE believes this preference was due to the public’s concern over how inaccessible soil would be managed after completion of active remediation” (USACE, 2005, p. §2-75).

The USACE process of seeking public input and acceptance in the ROD is also detailed in the ROD. These efforts include: the formation and monthly briefings to an oversight committee, public training sessions to educate community members, and a regularly published newsletter. These additional efforts were on top of the legally mandated publishing of a notice for the process, making the proposed plan available to the public, posting an extended public comment period May through July 2003 and holding a public hearing where comments were accepted (USACE, 2005). In addition to written comments and letters, emails and faxes were also accepted in the administrative record. These additional efforts – and use of new technology – differ from Weldon Spring and are closer to the process developed for the Westlake decision.

Themes in public Comments: North County.

The most present themes in the North County public comments are the health risks to the community, water contamination, and preferred solution. Waste transport appears to be the most prevalent of the secondary themes. Figure 13 presents a visualization of the prevalence and distribution of the recorded themes throughout the comments.

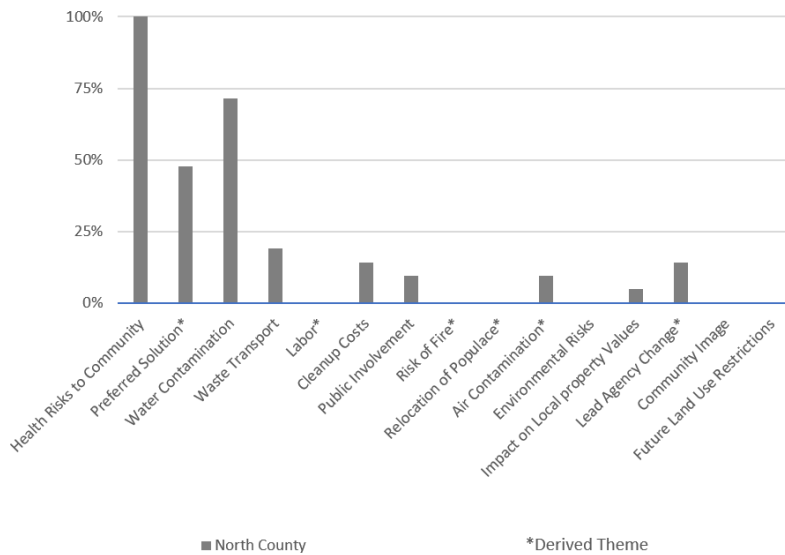


Figure 12. Prevalence of themes in analyzed North County comments

Unlike Weldon Spring, an implicit or explicit focus on health risks to the community was present in all of the North County comments. Concerns over water contamination, specifically the effects of radioactivity in Coldwater Creek, permeated the comments in the North County sites. These concerns came hand in hand with the theme of health risks. Also different from Weldon Spring, more comments included preferences for one of the proposed alternative remediation strategies. The comments with a preference for solutions predominantly focused on either the complete removal of radiological material or the removal of material to the highest amount technologically feasible. In several instances, commenters mentioned specific sites, structures, and technical processes that they recommended or made a clear preference for. This presence of preferred solutions within the comments may

represent the public's greater access to information in the case, the improved education and outreach efforts from USACE, or additional organized comments.

The theme Waste Transport leads the secondary themes which focused on concerns of spread of radioactive material during the remediation process, similar to the spread of waste to the SLAPSVPs and haul roads during the SLAPS cleanup. Similar to Water Contamination, comments addressing waste transportation accompanied concerns of overall risk to the community. This similar to the transportation-related concerns in Weldon Spring, but diverge from the form this theme takes in comments on Westlake. Concerns over Lead Agency Change was an isolated derived theme in this subcase. Several commenters requested that Westlake Landfill be included in this ROD and authority be taken away from EPA. While this theme was present in several comments, and may demonstrate a focus on the fractured nature of these decision spaces, it does not spread beyond this subcase.

Two comments, while not appearing notable enough to warrant addition to the derived themes provided an interesting perspective, they cited issues of morality and integrity. These comments implored the decision makers to make the decisions from a moral perspective and that to do otherwise would potentially imply a level of amorality, or a dereliction of ethical duty. While this theme was only present in two of the 21 comments, it also previews some of the changes to comments which occur in the Westlake subcase.

Themes in ROD: North County

Similar to Weldon Spring, the dominant themes in the analyzed section of the ROD are health risks to the community, water contamination and public involvement in addition to the theme of preferred solution.

The focus water contamination and health risks go hand in hand, much as they do for the public comments in this subcase. Both themes intersect on the topic of Coldwater Creek which was a focal point for the comments, but also presents the greatest potential threat to the

community. More so than irradiated soil along a highway or in an industrial park, water carrying contamination downstream through residential areas, past neighborhood parks, and into sources the source of drinking water for the region, posed a significant threat. This stark focus could be a result of public opinion infiltrating the subsystem, of the public latching onto a point elevated by the lead agency in the proposed plan, or as a joint focus on this as an independent major area of concern.

Similar to Weldon Spring, Waste Transport also plays a role as a secondary theme and point of alignment between the comments and the ROD. Similar to the comments the ROD contains this theme and a focus of the explicit discussion of waste transport is focused on preventing the kind of mishandling of waste that led to the contamination of these sites in the first place. Unlike Weldon Spring, this focus does not include waste coming into the community.

One mismatched theme is a focus on Future Land use restrictions, specifically on the notion that the land will be returned to a state of unrestricted use, unrestricted exposure (UUUE), meaning that the aim of the remediation efforts is to return the land to a level of radiation that is acceptable for any future use. This highlights a difference between the subcases, since the Weldon Spring disposal cell is intended to hold waste indefinitely and Westlake is on a landfill site with restricted land use. This theme of future land use was entirely absent from the North County comments.

Westlake Landfill.

Surface Level ROD: Westlake Landfill.

The 2018 Westlake ROD details a more-extensive public engagement strategy than the other two subcases. In addition to the legally mandated public comment period, the EPA took additional steps to seek public between the 2008 ROD and the 2018 ROD. These steps and the review began “as a result of stakeholder and community concerns following the 2008

ROD” as well as the presence of the subsurface heating event in the neighboring Bridgeton landfill (EPA, 2018, p.1). The steps included two years of stakeholder interviews, a series of meetings within a “community dialogue framework” (EPA, 2018, p. 13), the creation of a community advisory group that gave input on the project as well as holding public listening sessions with local organizations for administrators to hear input from members of the public. These efforts ran concurrent with normal ROD process, which appears to have progressed normally. One key difference is that the EPA released a draft of the proposed plan before the formal public comments process to increase transparency. The head of the EPA’s regional division also met with the more active community organizations “to explain the steps and schedule for EPA’s final decision,” (EPA, 2018, p. 2).

Westlake is the only of the three cases to have significant changes to the recommended action after circulating the proposed plan. However, the changes to the proposed clean up plan appear to be mostly technical alterations that are based on engineering input, not public input. The proposed remedy was changed to more closely target the areas of buried contamination.

The 2018 ROD is more detailed in describing the concerns and preferences contained in the public comments. As opposed to simply stating that comments were received but did not warrant a change to the proposed plan, as was the case in the Weldon Spring ROD; the Westlake ROD acceptance in this process is more focused on describing the comments. The 2018 ROD also presents a more nuanced explanation of competing preferences in the comments than the North County ROD.

Themes in public comments: Westlake Landfill.

The clearest and most notable difference between Westlake’s comments and the other subcases is the abundance of comments. There were more than 4,000 comments in this subcase as opposed to 25 in Weldon Spring and 21 in North County. The theme present in the

sample of Westlake Landfill comments follows a similar distribution as the overall comments in the other subcases. The most prevalent comments within the sample are Health risks to the community, preferred solution, with Waste Transport as a secondary theme. Risk of Fire and Relocation of Populace are unique derived theme for this subcase and is another wide spread secondary theme. The prevalence of these across the sample are visualized in Figure 14.

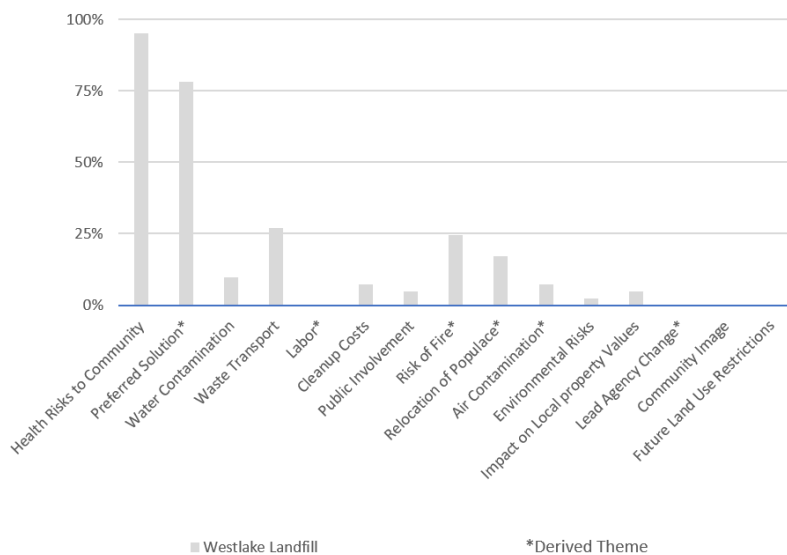


Figure 13. Prevalence of themes in analyzed Westlake Landfill comments

The prevalence of health risks to the community in this sample parallels the role of this themes in Weldon Spring and North County. One of the key differences in how this theme presents itself is in relation to which community’s health is at risk. Of the analyzed comments, there was an apparent division between comments focused on the health of the communities that surround the landfill versus the health of communities outside of the St. Louis metro area. This division is also observable in the themes of preferred solution and waste transport. One observable shared belief in the comments was a preference for removal of the radiological waste, and another focused on capping the waste on site. The comments supporting the removal of waste, highlighted the risks to the local population if the waste remained. The comments supporting capping the waste in place, focused on the health risks

to the rural communities these wastes may be transported through. However, these areas of concern were not mutually exclusive. Some comments supported capping and on-site storage out of a concern for the surrounding community's health because of fears of the excavation spreading more contamination. However, there appeared to be a connection between the concern for rural communities and capping the waste on site. These rural-focused, pro-capping comments largely took the same form. They were predominantly short typed messages that were printed and mailed into the EPA administrators. This shared theme, and similar submission form appears to be a result of some type of concerted effort either to mobilize public opinion or a shared response to the coverage of the case in media across the state. Many comments also demonstrated a potentially greater level of knowledge of the subcase within the theme of preferred solution. In multiple insistence within the sample, commenters discussed or stated a preference on specific elements of the proposed plan. Specifically, individual comments differentiated between the alternative remediation plans presented by EPA. This could be the result of greater access to information because of the prevalence of the internet, as well as an outcome from greater efforts from the EPA to stimulate public comment through education and outreach.

Relocation of populace and risk of fire are two derived themes that were more present in this subcase than the others. These comments could be the result of the basic attributes of the subcase. The subsurface heating event at the Bridgeton landfill, and the potential risks that would pose to the neighboring homes was present in many of the comments. There also appeared to be a shared belief in the comments focused on the underground fire reaching the nuclear waste and releasing radiation into the community.

One less-prevalent but still noteworthy occurrences within the sample was the intertwining of morality into several comments, similar to North County. Another is a more generally more harsh tone in some of the comments with several instances of comments

claiming that the proposed plan to excavate the landfill was the result of radical environmentalist. This notion was present in only a few of the rural-focused, pro-capping comments, but could reflect some of the broader polarization within the American political system.

Themes in ROD: Westlake Landfill.

Similar to the dominant themes in the other subcases, the analyzed section of the 2018 ROD focuses on community health risks and water contamination as the most prevalent themes. Within those themes, there is a notable alignment on some of the secondary themes as well. The Westlake ROD also presents a passing focus on the themes of air contamination, risk of fire and relocation of populace. This passing focus could be the result of public opinion infiltration, a mutual focus on the basic attributes of the situation, or the public attention being shaped by the lead agency's focus.

One notable area of thematic mismatch is the role of waste transportation in the ROD. Waste transportation, which plays a larger role in the sample of comments, does not receive comparable attention within the analyzed sections of the ROD.

Similarly, The ROD does not align with the comment themes in the areas of cleanup costs, future land use, and the role of public input. As with the other RODs the EPA focused more attention on cleanup costs than what is contained in the public comments. This is likely a result of the legal and practical requirements of administrating a site, cost being a balancing criterion within the Superfund regulations. Another possible explanation is that the public deprioritizes the cost of cleanup, when the potential health risks. Simply put: people facing risks of radiation exposure likely don't care about the costs to clean it up. Similarly, the ROD's focus on future land use, parallels the focus on UUUE in the North County subcase. This theme, again, is not a major concern of the analyzed public comments. Likewise, the

ROD's focus on public involvement outweighs the prevalence of that theme within the Westlake comments sample.

7. Discussion

7.1 Do public comments matter?

The core tension this thesis examines is the relationship between the need for specialized technocratic decision-making and the competing desire for public participation in major decision that could have long-term environmental and community health impacts. This core tension exists throughout literature on environmental governance supporting new participatory policy approaches as well as literature on contaminated sites and nuclear waste management. The clustering of Superfund sites in St. Louis offers an opportunity to explore how the administration of long-term, mostly closed technocratic systems is impacted by public opinion. The legal context shaping that decision-making process requires the lead agency in each decision to seek public input through a public comment process.

That public comment process is formulated, in this study, as a proxy for public opinion and one of the few avenues through which that opinion may impact these highly technical decision-making processes.

The first research question in this study is: *Are the concerns of public comments, reflected in the final decisions of Superfund administrators?*

Based on a textual comparative analysis of the three subcase ROD and their accompanying public comments, the likely answer to that question is, yes. This analysis found an observable correlation between the themes present in public comments and themes present in sections of the ROD's. In each subcase, the most prevalent themes of the public comments were reflected in the relevant sections of the corresponding ROD. However, because of the explorative nature of this study, that thematic alignment does not explain how or why that alignment exists. As detailed previously, the presence of that alignment could be

explained several ways: (a) as the lead agency internalizing the themes of the public comments, (b) the lead agency and the public focusing on the same important factors independent of each other, (c) the public's focus being shaped by the priorities of the lead agency. In reality, a combination of these factors, or other outside factors could all intertwine to create that alignment.

While this is an answer to the first research question, additional evidence examined during this analysis challenges that finding, as not fully addressing RQ1's corresponding research objective. The primary research objective of this project was to: *Better understand the role public opinion plays in mostly-closed, long-term policy subsystems decisions.*

The thematic alignment identified in the analysis appears to show a connection between public comments and the content of the RODs. However, that evidence appears secondary to the existing legal context of the Superfund program. The federal codes creating the Superfund program outline both a legal requirement to seek public input and a legal restriction on the role that input can play.

The potentially important role of public acceptance as a modifying criterion surfaced during the analysis. In each subcase, the proposed plan offered by the lead agency was either not significantly changes as a result of the public comments process or was modified but not as a result of public comments. In the ROD's for Weldon Spring and North County the proposed plan was not changed. In the Westlake decision, the proposed plan was modified, but in purely technical ways. While each ROD recorded and addressed the themes and concerns contained in the public comments, it could be interpreted that these comments had no actual impact on the final decision in any of these cases.

Public acceptance's role as a modifying criterion means that the results of the public comment process can only modify the proposed plan, not significantly alter or disqualify the decision (CFR, 2020). This is in contrast to the threshold and balancing criteria detailed in

Table 1. It also could be seen as prioritizing these technical aspects above the input of the communities affected by the change.

Table 10. Remedial Investigation Criteria from (CFR, 2020)

Criteria Classification	Selection Criteria
Threshold Criteria	(A) Overall protection of human health and the environment
	(B) Compliance with Applicable or Relevant and Appropriate Requirements
Balancing Criteria	(C) Long-term effectiveness and permanence
	(D) Reduction of toxicity, mobility, or volume through treatment
	(E) Short-term effectiveness
	(F) Implementability
	(G) Cost
Modifying Criteria	(H) State acceptance
	(I) Community acceptance

This interpretation is further evidenced in the responsiveness summary of in the 2018 Westlake ROD. The responsiveness summary is the lead agencies mandated effort to catalog and respond to the concerns raised in the public comments. In one exchange a commenter stated that because community acceptance is a modifying criterion, it has limited impact.

“The EPA agrees with the commenter that community acceptance is properly treated as a modifying criterion, and that this criterion should not “override” other remedy selection criteria, such as long- and short-term effectiveness, implement ability, and cost.” (EPA, 2018, p. 89-90)

This highlights the potentiality that the legal context – generally – and the role of public opinion being slated as a modifying criterion – in specific – may serve as a greater determinant on the role of public opinion in Superfund decisions.

The legal codes shaping the role of public comments can also be interpreted as embodying the core tension of this paper’s problem statement. The CFR lays out a requirement for public input while at the same time likely relegating it to a less impactful modifying criteria. This essentially creates an opening in an otherwise closed system, but an opening that is incredibly narrow. This restriction also could be seen as frustrating efforts

from lead agencies to seek additional public comment. Throughout the three cases, there were increased efforts to seek additional public engagement. One notable example is in the Westlake subcase. In describing the additional efforts on top of the legally mandated public comments process, the EPA conducted multiple hearings, meetings and listening session, but in the end the final step was to explain and teach stakeholders about the decision (EPA, 2018). However, these efforts could reflect a potential alternative avenue for public opinion to infiltrate the policy subsystem. While the outcomes of those efforts are not recorded in the ROD, one potentially significant element is described. The 2018 Westlake ROD describes the rationale for reopening the Westlake decision making process following the 2008 ROD, which should have been much longer-term solution. In that section the EPA states:

“As a result of stakeholder and community concern following the 2008 ROD, the EPA determined that further evaluation of remedial alternatives was warranted, and so required the PRPs to conduct additional investigations and feasibility studies” (EPA, 2018, p. 1)

This is potentially significant because while the ROD process may be fairly closed and insulated from public opinion, it shows the potential for decision makers to be influenced outside of that specific formal decision space. This could also show that while the Superfund process may be highly technical, the decisions to initiate the process may be more susceptible to public pressure.

It is possible to consider how changing community acceptance to a balancing criterion could drastically change the process of developing a proposed plan. If public opinion were a factor to be balanced against cost, long-term effectiveness or the other technical factors, it would likely create a much more complicated, but likely more democratic process. This integration of public engagement earlier in the process is reflecting of the participatory efforts at the core of environmental governance literature.

Knowing the potential limitation on public comments to only modify a decision, several avenues for additional study could be to examine these efforts as either (a) a genuine effort to seek public opinion, (b) attempts to educate the public, (c) approaches to gain acceptance of the plan, (d) efforts to manage public concerns by allowing a venue to vent those frustrations, or a combination thereof. An alternative approach to compare Superfund decisions against other technocratic, federally regulated decisions processes and see if the legal context plays a similar role.

7.2 Administrative Owner and Time

RQ2 and RQ 3 ask questions with a similar purpose: how did the factor of time and lead agency impact the role of public comments? These questions are imbedded in the multi-dimensional research strategy that explored the role of comments over time and across administrative owner. Based on that approach and the analyzed data, the impact of administrative owner and time both appear to be marginal factors with limited impact on the actual effect of public comments when compared to the impact of the legal context. While this studies multi-dimensional approach reduces the certainty of any finding, this exploration still offers potentially meaningful insights into public engagement and the potential for openness in the Superfund program. This subsection first addresses the elements that changes in time had to the public comments process, then looks at the role of administrative owner.

Time.

One likely key change over time has been the role of the internet across these subcases. In the 1993 Weldon Spring decision, email comments played no role and the process of distributing the proposed plan and announcing the public comment period were limited to newspaper ads and required individuals to view the proposed plan in person. The 2005 North County public comments and ROD showed an increase in emailed comments, which could reflect a lower bar to comment. However, access to information was potentially

limited, since the proposed plan was still only available for review in person. By 2018 and the Westlake ROD, email accounted for the majority of the sampled comments, and more resources related to the subcase were available online. This potentially created a context with increased access to information, decreased barriers to commenting and likely contributed to the more-than 4,000 comments submitted to the process. The rise of social media and the ability to more easily share information between peers could have also contributed in a shift to a higher share of short, single concern comments, as opposed to the longer multi-faceted letters in earlier cases. This interconnection between changes in time and changes in technology affecting access to public comments could be seen together as a temporal-technological context.

Another element that time appears to have played in the St. Louis sites is in the cyclical nature of subsystems and system impacts. The cumulative exposure to news coverage (Chin & Toler, 2019) could increase stakeholder understanding and potentially the propensity for individuals to comment (Finney & Polk, 1995). This increased understanding over time could explain the increase of preferences for solutions within the public comment themes over the course of time in the three subcases. Similarly, these cumulative decisions could further shape or calcify beliefs within the community, and policy subsystem. While this research strategy conceives of each subcase as distinct subsystems, since the decision makers and actors within each case and lead agency are inherently different. One view of the cumulative effect of these decisions is an overall maturation of the policy subsystem (Sabatier & Weible, 2007)

Lead Agency.

As detailed above, the legal-regulatory context appeared to play a greater role in shaping the impact of public comments than the lead agency administering the process. The status of public acceptance as a modifying criterion and the likely evidence that none of the

public comments affected the formal decision space, reinforces the assessment that this is designed to be a closed, highly-technical decision space.

While there were differences in the public engagement processes of each lead agency, with differing levels of engagement from subcase to subcase, this study is unable to definitely state if that it is the result of lead agency change, changes in time, changes in other factors, or a combination thereof. There were not clear indicators or evidence that the differences in agency shaped the role of public comments. Despite limited calls within the public comments to move the Westlake Landfill from EPA control under USACE, the analysis of the ROD's did not signal major differences in the decision-making approach.

The difficulty assessing the potential role administrative owner played in the openness of a decision space or role of public comments comes from the design of this study. The multi-dimensional strategy employed in this case did not control for enough variables to make any causal claims or speak to the significance of these differences. As described in Subsection 5.1, a longitudinal or cross-sectional approach, or a survey of all the decisions within these subcases could better define or explain these shifts. However, as an exploratory study it is able to point out some potential explanations. One potential explanation is that the changes in participatory processes are an extension of the backgrounds and core work of each lead agency. Of the three lead agencies in the case two are grounded in military and security needs: The DOE, which oversaw Weldon Spring, evolved from the AEC which in turn grew out of the Manhattan Project (DOE, 2020; Fleishman-Hilliard, 1967). The USACE is under the department of the Army and serves a key security role (USACE, 2020a). The EPA on the other hand grew out of the environmental movement (EPA, 2020b). It could be argued and supported with additional research that DOE and USACE are more focused on the security aspects of the waste, while EPA might have a closer attentiveness to public participation,

which could explain the increase engagement efforts from subcase to subcase. This notion could be developed into a potential hypothesis for future study.

A competing alternative is that this increase in public engagement efforts is part of a broader push for more-participatory governance approaches (Cox et. al, 2019; Culley & Hughey, 2008; Hegger, 2020). This could explain the increase in engagement efforts over the 25-year span of these subcases.

Either approach could better define or explain the perceived shift to more inclusive efforts of encouraging comment.

7.3 ACF

This paper employs elements of the ACF to frame this study. The ACF is applied in both shaping this paper focus on public opinion as both an internal and external event. The framework's conception of coalitions and beliefs helped shape the qualitative textual analysis and comparative strategy employed in this study. The ACF's revisions to include openness also form a key factor of this research project.

RQ4 asks: Can administrative Superfund site cleanup decisions be classified within the Advocacy Coalition Framework? Many elements of this paper suggest that: Yes, it can. Despite not fully applying the ACF to this study, it appears that the ACF's conception of public policy processes can be applied to Superfund decisions, with a key focus on the following factors: legal context, the role of public opinion, and the openness of a decision space.

Legal Context and Constitutional Structure.

As described above, the legal context laid out in CERCLA and codified in the CFR mandates public comments and also potentially relegates them as a modifying criterion serves as the constitutional structure of this policy subsystem. Within the ACF and the evidence of this case study these basic rules form a the relatively stable parameters, which would take a

change of federal law to alter. For instance, an effort to alter public acceptance's role as a modifying criterion to a balancing criterion would need to pass through the US constitutional requirements to become a federal act. This would further feed into the ACF's conception of external system event. These system event would reconfigure the subsystem, and potentially increase the role of public opinion as a coalition resource.

The role of the CFR to shape the subsystem appears to a a successful application of ACF theory to this case.

Conception of Public Opinion.

The dual role Public Opinion plays within the ACF is potentially reinforced by the results of this study's content analysis. There are potential examples of public opinion serving as a coalition resource that is internal to the ACF are from Weldon Spring and Westlake. In both subcases it appears public opinion was mobilized by coalition actors within the pro-union statements in Weldon Spring and the rural-focused, pro-capping comments in Westlake. Each example presented evidence that these comments were part of organized efforts to influence a decision. On the other hand, the less organized comments and themes from the other cases could backup the notion that these comments are part of a broader organic element of public opinion. In this manner this case study could further reinforce calls to better define public opinion within the ACF. Likewise, the comments from individuals that appear motivated by the subsurface heating event in the Westlake subcase could add additional evidence that public opinion is a system event external to the policy subsystem. This case study employed the dual approach to public opinion but future studies could potentially benefit from a refined conception of public opinion within the ACF.

Factors affecting openness.

Within discussions of ACF and its 2007 revisions, openness serves as a coalition opportunity structure and potential pathway to policy change. As discussed in subsection 4.2

Applying the ACF, the conception of openness is based on the number of decision spaces and the accessibility of those decision spaces (Sabatier & Weible, 2007). This study relies on and potentially reinforces that concept of accessibility and could add potential features to its definition.

In the St. Louis Superfund Sites accessibility appears to be dependent on constitutional structures, context and also administrators. As discussed in previous subsections, the legal context appears to be the chief factor controlling the openness of the Superfund process. However, the temporal-technical context of the internet and the actions of the lead agencies to pursue more inclusive efforts also appears to play a role increasing accessibility, albeit marginal. This marginality is a potential effect of the restrictive legal context of the Superfund process but would likely be minimized in less security-focused contexts. For instance, the temporal-technical context, and affirmative action of the decision maker in a case could potentially help define the accessibility of a decision space and likely the openness of a subsystem. While additional scholarship would be necessary to amend or challenge the ACF's conception of openness, this case suggests a potential refinement to the definition of accessibility.

7.4 Applicability and Repeatability

This exploration is most directly applicable to the other nuclear waste Superfund decisions within the St. Louis region. This discussion, while not fully context dependent, could most easily apply to the other ROD's in each subcase that were not analyzed in this study. Because of the shared locality, state-level administration and overall context, the ideas of openness, time and administrative owner could most readily be applied to an analysis of those other RODs. Beyond that an application to the SLDS decisions and remediation processes would also be a fairly seamless application.

Moving outside of the St. Louis context, the findings and strategy of this study could next be applicable to other low-level nuclear waste sites within the Superfund program, followed closely by cases of any type of pollution within the Superfund program. Because any Superfund site is governed by the same ROD process and legal requirements for public comment and community acceptance, this line of inquiry could be applied to or be improved by studies of the other 1,333 sites on the Superfund National Priorities List. Likewise, since many formal decision-making processes in the US – both at a federal, state and local level – rely on a similar legal mandate to include public comments; there may be space to apply the lessons of legal context and openness to non-superfund decisions.

Beyond the US context, there could be some limited applicability to cases of contaminated site or nuclear waste governance where the tension for security and openness intersect. This would likely fit best in more-democratic systems with developed environmental bureaucracies and regulations. Finally, the loosest and broadest applicability could be a minor improvement to the field of environmental governance and the administration of long-term governance decision spaces where security and public participation intersect.

Clearly, any applicability of this case study is restricted by the limitation and assumptions made throughout the course of this research project.

7.5 Limitations and Assumptions

Limitations.

The greatest limitation in this study is an intentional choice to develop it as an exploratory study and not attempt a higher degree of explanatory or causal relationship building. This choice had knock-on effects that shaped the overall structure of the study, as well as, a targeted application of the ACF, and specific choices of data selection as well as data collection. A more rigorous study could have been developed to attempt to form and

support specific hypothesis, however the overall value of a looser exploratory study was determined to be better suited to the present gap in literature as well as the case itself.

Two additional limitations go hand in hand: selection and researcher bias. The selection bias comes in the form of case selection. The author of this study is a past and current resident of St. Louis City and County, and the presence of this waste is one of the largest environmental governance issues in the region. Likewise, because the content analysis methodology in this case relies on the judgment and interpretation of the researcher, the possibility of significant researcher bias exists. This was mitigated by combining the plan-text reading with the deeper thematic analysis. It could be further mitigated through repetition with different researchers.

Another limitation comes from missing data. There are not consistent records of the verbal public comments left during the official public hearings in each subcase decision. The responsiveness summary of several of the RODs stated that a transcript of the hearings was created but these transcripts were unable to be located in the reviews of the administrative record. This paper's focus on the written comments forms a bias towards more dispassionate, orderly comments written in advance and submitted as opposed to what may be more impassioned extemporaneous comments. This bias may have skewed the results of the public analysis. It could also explain the tendency of the Westlake comments to be terser, the ability to quickly email or leave a comment in 2018 online, may have served a similar role to the public hearings of 1993 and 2005. The decreased barrier to leaving a comment could be due to more wide spread access to information and an easier submission process. This could also reflect broader system changes including polarization within American politics.

Another limitation is the lack of interviews in this research project. This paper's reliance on documents and government records, albeit with comments authored by private individuals, presents some issues of validity. This paper's strategy focusing on the content of

these comments and decisions, was designed to meet the realities of the case and create a structure to explore the relationships between subcases. It could have been bolstered by an additional mode of inquiry particularly. Ultimately it was determined that those potential benefits don't outweigh the potential detriments detailed in subsection 5.2: validity issues from the three-decade time span between subcases, issues of accessing decision makers and repeatability issues by not having comparable sources for each case.

Another real limitation of this case study was the time and resources available for this study. A longer, more robust and funded study could include a review of all the ROD's in each subcase as well as extend the process to look at the pre-CERCLA remediation work. Applying this study's methodology to include the SLDS decisions and look at the smaller decisions in the three subcases could offer additional insights and avoid some of the compromises made in this study to prioritize the multi-dimensional approach detailed in subsection 5.1. This decision, while made in the spirit of this explorative study, was in essence a compromise between a longitudinal and cross-sectional approach.

These time and resource limitations also limited of the scale of this study. With more time and resources, this project could shift from a small-N approach to an intermediate-N approach. Instead of studying three subcases within the St. Louis Sites, it could examine the St. Louis Sites as well as other Superfund sites. This intermediate N approach could either explore other nuclear waste sites in different regions or look at non-nuclear superfund sites in St. Louis. Either approach could create opportunities to explore the role of public opinion in Superfund programs across different contexts or different levels of security and openness.

Potential alternative approaches to examine public opinion in the decision-making processes of these subcases could be to address politics or political pressure on these subcases. Pressure from elected politicians could be seen as a potential manifestation of public opinion attempting to intervene in the closed subsystem of the Superfund program.

Another approach following the same logic could look at the role of the media in these cases as potential manifestation of public opinion. Beyond public opinion, alternative approaches could be structured within the ACF, by looking at changes in governing coalitions, socioeconomic changes or the impact from other subsystems.

Assumptions.

This project assumes a basic level of trust that the government follow its own rules: collecting and recording public comments. Likewise, this study assumes that these decision-making processes are free from undue external or illegal influence. Throughout this study there was no discernable evidence of any graft or corruption. However, the presence of that type of influence could significantly diminish the role public acceptance or other key criteria might play.

This paper is also based on an assumption that these public comments are to some extent a reflection of people's actual opinion and therefore part of public opinion. This assumption is essentially that people are not intentionally deceptive in these comments. While this type of deception could be a possibility, the effect would be limited, since – it is also assumed that – the lead agency administrators are taking these comments as honest accounts of people's thoughts and opinions on the case.

Together these limitations and assumptions highlight future areas of study within environmental governance in general, the Superfund program and the St. Louis site in particular just as much as they may reflect deficiencies in this study. This study is the product of these choices, compromises, in an attempt to address the questions at the heart of this study and add a level of meaningful understanding to this case.

8. Conclusion

This study explored the relationship between public comments and corresponding records of decision in three Superfund nuclear remediation projects in the St. Louis region. It examined a core tension between public participation and security needs in these subcases of long-term environmental governance. This exploration identifies the legal context of a decision to be a potential key factor to determine the effect of public opinion. The basic constitutional rules of the Superfund program designate public acceptance of a proposed cleanup plan as a modifying criterion and thereby insulating the closed technocratic system from public opinion. This legal limitation is despite a competing legal mandate to require public input and efforts from site administrators to seek additional public participation.

Based on this analysis, a decision's lead agency and the temporal context likely only play a marginal role determining the impact of public comments.

This exploration also supports the use of the Advocacy Coalition Framework in studying Superfund decisions and offered several alternative applications of the framework.

Do public comments matter? If they're allowed to.

The story of the St. Louis nuclear waste parallels the development of the US nuclear institutions, highlights issues of bureaucratic overlap and development of environmental controls. It also parallels many of the broader aspects of the broader aspects of environmental governance and pollution remediation. This waste is the product of a relatively short window of industrial activity, yet a legacy of negative effects dwarfs that short-lived activity. Likewise, the efforts to undo that negative legacy, will likely take concerted, long-term, and inclusive efforts. In a small way this echoes the issues of contained in environmental governance approaches to address climate change.

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