CHAPTER 3

S30K Project Objectives, Goals, and Methodology

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CHAPTER 3

S3OK Project Objectives, Goals, and Methodology

Over the past five years, the S3OK project evolved to sharpen its focus while remaining firmly committed to its original goals and relevance. This chapter outlines the project's initial objectives, goals, and methodology. It also embeds an overview of the iterative process throughout and addresses how S3OK researchers leveraged insights from the Extended Peer Science Advisory Network (EPSAN), Opinion Leader Advisory Network (OLAN), and the Meso-scale Integrated Socio-geographic Network (M-SISNet) to strategically refine its efforts over time. This approach enabled S3OK researchers to address a set of three high-impact challenges—areas identified as having strong **Potential for Agreement and Refining Solutions** across sectors and communities in Oklahoma. These areas now anchor the work of S3OK's interdisciplinary teams and serve as the foundation for actionable, science-informed solutions designed to meet Oklahoma's most pressing environmental and infrastructural needs.

Original Objectives

S3OK was launched to tackle **"wicked problems"** at the intersection of **land use, water availability, and infrastructure resilience** in Oklahoma. These problems are marked by complexity, uncertainty, and competing stakeholder interests. The project's central task has been to develop and test science-based solutions that can meet these challenges head-on through an integrated and interdisciplinary approach. Underlying this task is a central, unifying research question: *Can science-based assessment of the intersections of wicked problems, coupled with systematic and iterative engagement with Oklahoma opinion leaders and input/feedback from members of the Oklahoma public, result in the development of socially sustainable solutions*?

We asked:

Can science-based assessment of wicked problems, coupled with input and feedback from Oklahoma opinion leaders and the public, result in the development of socially sustainable solutions?

Spoiler: The answer is yes.

Our working hypothesis was that socially sustainable solutions would be found at the intersections of related but distinct problem areas,

where a broad range of stakeholders could find agreement because the array of issues cut across the usual narratives that frame social conflict.

To realize our mission, S3OK researchers pursued three overarching objectives:

- **Deepen scientific understanding across five integrated focus areas initially identified by S3OK researchers**
  S3OK grounded its work in research across domains where scientific insights and policy relevance intersect and have the potential to positively impact day-to-day decisions for communities and leaders across Oklahoma. These include areas that were the foundation for cross-disciplinary research:
  - Subseasonal to seasonal (S2S) weather, water availability, and stormwater runoff management
  - Economic and environmental applications for produced water reuse
  - Marginal water quality and reuse
  - Shifting subseasonal to seasonal weather patterns and wildfire threat
  - Reliable interdependent infrastructures
- **Improve engagement and collaboration among key stakeholders**
  Socially sustainable solutions require more than good science—they require relationships, feedback, and trust. S3OK researchers developed multiple engagement platforms to ensure that policy, community, and industry voices shaped the work and informed priorities throughout the project lifecycle.
- **Identify socially sustainable solutions to challenging problems within the five integrated focus areas**
  S3OK researchers placed a strong emphasis on identifying strategies that are scientifically sound, publicly supported, and institutionally feasible. By working at the intersection of technical innovation and social engagement, S3OK researchers created a pathway for the development of durable solutions that reflect Oklahoma values and realities.

Objective 1: Deepen Scientific Understanding Across Focus Areas

Recognizing the interconnected and variable nature of the challenges S3OK sought to address, one of the project's primary and original objectives was to deepen scientific understanding across five integrated areas identified prior to the project's inception. These included:

- Subseasonal to seasonal (S2S) weather, water availability, and stormwater runoff management
- Economic and environmental applications for produced water reuse
- Marginal water quality and reuse
- Shifting subseasonal to seasonal weather patterns and wildfire threat
- Reliable interdependent infrastructures

While these five domains were selected as foundational areas based on initial interdisciplinary scoping and research priorities, the emphasis of each evolved over time in response to engagement with the S3OK Opinion Leader Advisory Network (OLAN). The input gathered from OLAN facilitated place-based insight, helping refine questions and adjust emphasis to align with local practitioner needs, knowledge gaps, and feasible applications. Across all five areas, the project remained committed to advancing scientific understanding, while OLAN feedback helped to shape more actionable, regionally grounded applications of that science. This dynamic process ensured that each focus area remained integral to S3OK, even as emphases shifted to better meet the evolving priorities of stakeholders across Oklahoma.

Initial Integrated Focus Area 1: Subseasonal to Seasonal (S2S) Weather, Water Availability, and Stormwater Runoff Management

Oklahoma faced, and continues to face, increasingly extreme shifts in subseasonal to seasonal (S2S) weather patterns—rapid swings between drought and pluvial events—that result in both acute water shortages and damaging surpluses. While federal regulations require

municipalities to implement stormwater utilities to manage runoff, public resistance to the design, funding mechanisms, and long-term value of these programs has often stalled their adoption. This lack of posed a significant challenge the development of essential infrastructure. However, integrating solutions that couple water surges with reuse strategies—such as surface water storage or aquifer recharge—may offer a more compelling path forward. By addressing both shortages and surpluses in tandem, these approaches open the door for broader coalitional support.

This focus area presented an opportunity to deepen scientific understanding across multiple focus areas, including Subseasonal to Seasonal Weather (S2S), Variable and Marginal Quality Water Supplies (V-MQW), and Sustainable Infrastructure (SI). By drawing connections between extreme weather variability, water management technologies, and infrastructure readiness, researchers and decision-makers could develop strategies that reflect both technical feasibility and social acceptability. This approach was essential for identifying science-informed pathways that transcend traditional divides and responding directly to Oklahoma's shifting weather patterns and water realities. **The goal here was to help Oklahoma communities build systems that are ready for Oklahoma's weather extremes and supported by the people they serve.**

Initial Integrated Focus Area 2: Economic and Environmental Applications for Produced Water Reuse

At the onset of the S3OK project, Enhanced oil recovery (EOR) operations were a significant economic consideration for oil-producing states like Oklahoma. While hydrocarbon extraction contributes to greenhouse gas (GHG) emissions, EOR presented a strategic opportunity to address multiple challenges simultaneously. EOR processes can both enhance production and support carbon sequestration by injecting CO_2 into depleted formations—effectively reducing net emissions. Simultaneously, EOR operations could offer a pathway to reuse "produced water," a byproduct of oil and gas activities that has been linked to induced seismicity when reinjected without sufficient safeguards. By developing and deploying innovative methods for carbon storage and produced water reuse through EOR, Oklahoma could lead in creating technologies with dual economic and environmental benefits. These included immediate emission reductions, safer produced water disposal at depths that mitigate seismic risks, and the foundation for future commercial applications in carbon capture and storage.

The convergence of challenges concerning carbon emissions, water reuse, and seismic safety underscores the importance of deepening scientific understanding across focus areas such as Terrestrial Water and Carbon Dynamics (TWCD), Variable and Marginal Quality Water Supplies (V-MQW), and Sustainable Infrastructure (SI). By advancing research that links these domains, Oklahoma could evaluate how previously distinct challenges become interlocking solutions. This integrated understanding supports the development of targeted policies and infrastructure investments that align with state energy goals while addressing long-term sustainability and risk mitigation. **This work connected science with policy, with the goal of helping Oklahoma position itself as a leader in sustainable energy practices that balance growth with environmental responsibility.**

Initial Integrated Focus Area 3: Marginal Water Quality and Reuse

Throughout the S3OK project Oklahoma faced increasing water scarcity and variability in water quality, the pressure to expand water reuse strategies has intensified. These challenges in water quality and quantity persist, as do public narratives that reused water is inherently unsafe for human consumption. This perception limits both policy support and investment in scalable water reuse infrastructure. Reframing the challenge to focus on how Oklahoma will meet its future water needs, particularly as a growing portion of available supplies are of marginal quality, can shift the conversation. Doing so opens the door for investments in fit-for-purpose treatment systems that combine natural/

passive and active/high-pressure technologies, calibrated to specific end-use requirements such as agriculture, industrial use, or non-potable urban applications.

Addressing this challenge requires deepening scientific understanding across the Subseasonal to Seasonal Weather (S2S), Variable and Marginal Quality Water Supplies (V-MQW), and Sustainable Infrastructure (SI) focus areas. Scientific insight into water quality variability and treatment efficacy enables decision-makers to assess and communicate risks more effectively. This interdisciplinary research was critical to developing socially acceptable and technically viable water reuse systems that can adapt to Oklahoma's evolving environmental conditions while addressing long-standing public concerns. **Work in this focus area enabled decision-makers to evaluate options that are safe, cost-effective, and aligned with public values while building support for the infrastructure investments needed to move reuse from theory to practice.**

Initial Integrated Focus Area 4: Shifting Subseasonal to Seasonal Weather Patterns and Wildfire Threat

Throughout the S3OK project, wildfires represented an escalating threat across Oklahoma, driven by the combination of intense rainfall events (pluvials) followed by drought that generates abundant and highly flammable vegetation. Recent fire seasons have placed increasing strain on both agricultural producers and urban communities, disrupting livelihoods, endangering infrastructure, and degrading water quality.

Beyond their immediate impacts, wildfires can significantly alter the state's landscape carbon balances, exacerbate runoff contamination, and weaken infrastructure systems already vulnerable to climate extremes. Recognizing the growing risk offers an opportunity to engage stakeholders around the development of socially sustainable solutions for water and land-use practices, especially when framed as essential to protecting valued ways of life such as rural traditions, land-based economies, and community safety.

Responding effectively to this challenge area requires deepening scientific understanding across S3OK domains including Subseasonal to Seasonal Weather (S2S), Terrestrial Water and Carbon Dynamics (TWCD), Variable and Marginal Quality Water Supplies (V-MQW), and Sustainable Infrastructure (SI). **The goal here was to advance fire resilience strategies that protect community safety, land-based economies, and Oklahoma's environmental assets before disaster strikes.**

Initial Integrated Focus Area 5: Reliable Interdependent Infrastructures

Reliable infrastructure systems are foundational to Oklahoma's economic vitality, public safety, and environmental well-being. They are also essential to national security. These systems—ranging from water and energy to transportation and wastewater—are deeply embedded within social institutions, cultural values, and organizational structures. Today, in Oklahoma, they face mounting stress from multiple, overlapping hazards, including more frequent and severe weather events, wildfires, and seismicity. S3OK's work addresses the resilience of these interdependent infrastructures, including oil and gas, potable and wastewater systems, transportation networks, and the electric power grid. As communities navigate tradeoffs in resilience investments such as where to harden infrastructure or how to prioritize limited resources there is also a need to address the social and political tensions that arise when infrastructure decisions intersect with conflicting public narratives.

This challenge highlights the importance of deepening scientific understanding across Subseasonal to Seasonal Weather (S2S), Variable and Marginal Quality Water Supplies (V-MQW), and Sustainable Infrastructure (SI) focus areas. By integrating physical systems research with insights into public values, institutional behavior, and governance capacity, S3OK supports the development of resilience strategies that are both technically sound and socially feasible. This approach enables Oklahoma decision-makers to identify overlapping risks, assess the consequences of inaction, and design coordinated

solutions that reflect both infrastructure needs and the communities they serve. **This resulted in strategies that reduced risk, stretched limited resources, and reflected the real-world needs of Oklahoma communities.**

Objective 2: Improve Engagement and Collaboration

Engagement and collaboration are necessary precursors to developing sustainable solutions to wicked problems. Throughout the period of performance, S3OK researchers utilized diverse strategies and pathways to foster engagement and collaboration among key stakeholders **(Figure 3.1)**. This included a 5-year process to refine the focus to three final wicked problem area that had strong Potential for Agreement and Refining Solutions. Part of this process of refinement included participation in important milestone gatherings:

- Annual **Research Retreats** brought together interdisciplinary teams to coordinate science, align research efforts, and plan collaborative opportunities.
- Annual **State Conferences** opened space for sharing breakthroughs and connecting research to real-world problems, inviting broad participation from partners across sectors when appropriate.
- Annual **S3OK Academies** served as invitation-only gatherings of key stakeholders—including business leaders, utility operators, municipal officials, tribal representatives, and scientists—to collaborate on the direction of S3OK research and emerging policy needs.
- Focus group style **Deep Dive Discussions** in year three offered a targeted forum for tackling specific issues raised by stakeholders leading to sharper problem definitions and cross-sector learning.
- Three **Working Groups** in years four and five formalized collaboration around three major challenge areas, creating a platform for joint action among scientists, industry, and policy leaders **(Figure 3.2)**.

Objective 3: Identify Socially Sustainable Solutions

Through the engagement and collaboration process outlined above, S3OK honed in on three critical wicked problem challenge areas that emerged as having strong Potential for Agreement and Refining Solutions for implementation across Oklahoma. These areas formed the basis for the Working Groups and were identified at the intersection of five previously established integrated focus areas, reflecting a careful synthesis of insights gained from Deep Dive sessions, direct collaboration with the EPSAN network, input from OLAN, and public opinion data gathered through the M-SISNet. This multifaceted approach ensured that the selected challenges were rooted in interdisciplinary understanding

Figure 3.1. Annual retreats, conferences, academies, and other meetings allowed face-to-face collaboration.

Figure 3.2. Working groups formed to address identified wicked problem areas.

and were informed by diverse stakeholder perspectives.

The process of identifying these challenge areas emphasized the importance of integrating research findings with practical needs and stakeholder priorities through touchpoints embedded in programming at the Academies, Deep Dives, and Working Groups. EPSAN and S3OK researchers provided scientific advances and technical insights shared throughout the annual state conference and research retreat programming. At the same time, OLAN contributed grounded, community-focused perspectives that highlight the unique challenges faced across Oklahoma.

Additionally, public opinion data from the M-SISNet offered a critical and contextualizing lens into the perceptions, needs, and concerns of Oklahoma residents across challenge areas. Researchers leveraged insights from the M-SISNet, alongside feedback from the OLAN, to ensure that the identified challenges and prospective solutions developed resonated with public priorities and needs.

These working groups were designed to foster broad-scale collaboration and coalescence, bringing together researchers, policymakers, and community members to co-develop actionable strategies. The synthesis of inputs from multiple sources not only sharpened the focus on challenges the working groups sought to address, but also provided the foundation for scalable, evidence-based solutions. This collaborative process positions S3OK to address pressing environmental and infrastructural challenges across the state.

Goals

The initial overarching goals of S3OK were to foster innovation, collaboration, and leadership to address Oklahoma's most pressing environmental and infrastructural challenges. By aligning these efforts, S3OK has become a leader in advancing science-informed sustainable solutions while cultivating an innovative, collaborative, and sustainable research ecosystem.

These goals are achieved through:

- Strengthening interdisciplinary collaboration
- Advancing creative, science-informed solutions
- Establishing a test bed for solutions
- Training future leaders
- Creating a network of advocates

Strengthening Interdisciplinary Collaboration

S3OK researchers deepened collaboration across disciplines by facilitating meaningful engagement among researchers, practitioners, and stakeholders. To do so, S3OK researchers integrated public policy learning theories which informed the development of a three-pronged collaborative structure and process carried forth through the project culminating in S3OK's collaborative framework. This collaborative framework integrates diverse perspectives and expertise to address complex challenges.

Advancing Creative, Science-Informed Solutions

By routinely gathering stakeholders at Academy meetings and "Deep Dive" conversations, S3OK researchers listened to their ideas, reflected on them, and adjusted course in real time. This

It was critical to integrate research with the practical needs identified by Oklahomans.

feedback loop fueled science-based, practical fixes to real-world problems and pointed the project toward its next steps.

Establishing a Test Bed for Solutions

Key challenge areas identified through collaborative processes served as focal points for implementing and evaluating research-driven strategies, demonstrating their relevance and scalability in addressing critical issues. Through the M-SISNet, S3OK researchers received input from the public for assessing public perception of developed solutions. Using these inputs, by Year 3 in the project, S3OK researchers further established a testbed for solutions that were collaboratively assessed and refined by project stakeholders including EPSAN and OLAN.

Training Future Leaders

S3OK researchers empowered the next generation of scholars by meaningfully involving students in research and engagement activities. Student researchers advanced cutting edge science in collaboration with scholars and practitioners across the S3OK network, led their own professional development programming, and actively engaged in all S3OK initiatives. This provides hands-on experience and fosters leadership in interdisciplinary problem-oriented research and applications.

Creating a Network of Champions

Through engagement with OLAN, students, researchers, and practitioners, S3OK researchers built a robust network of champions for both the process and outcomes of the S3OK project. These champions sustain and expand the impact of its solutions across academic, professional, and community contexts.

Methodology

S3OK drew upon the Advocacy Coalition Framework public policy theory to guide our approach to advancing socially sustainable solutions. These theories emphasize that long-term change happens when evidence and collaboration help coalitions adapt and refine their beliefs and priorities, and find common ground despite continuing areas of disagreement. Our working hypothesis was that socially sustainable solutions for wicked problems are found at the intersections of related but distinct problem areas, where diverse stakeholders can find agreement because the array of issues cut across the usual narratives that frame social conflict.

We developed a new, innovative way to identify socially sustainable solutions to wicked problems by leveraging the Advocacy Coalition Framework

These public policy learning theories included:

1. Jenkins-Smith (1990)[1]: Democratic Politics and Policy Analysis
2. Sabatier and Jenkins-Smith (1993)[2]: Advocacy Coalition Framework (ACF)
3. Shahan, Jones, McBeth, and Radaelli (2018): Narrative Policy Framework (NPF)
4. Jenkins-Smith and Weible (2025)[3]: Revised and expanded Advocacy Coalition Framework (ACF)

Jenkins-Smith (1990): Democratic Politics and Policy Analysis

Public policy learning takes place, and shifts in policy occur, when groups of people with shared beliefs, called advocacy coalitions, push for new policies. These coalitions can include policymakers, researchers, and activists who have worked together over time. They learn from experiences, scientific evidence, and debates to improve their strategies and influence policy decisions. **S3OK deliberately created an advocacy coalition through careful and sustained engagement with OLAN and EPSAN around key topic areas**.

Sabatier and Jenkins-Smith (1993): Advocacy Coalition Framework (ACF)

While deep core beliefs remain stable, and are difficult to change, people's policy preferences can shift when they see compelling evidence or

experience major events. Learning within these coalitions is key to policy evolution. For example, a major disaster or breakthrough in science might cause coalitions to reconsider their policy positions. **Informed by this, we built structured opportunities and embedded strategic touch points—like Academies and Deep Dives—to allow for learning and change to happen.**

Shanahan, Jones, McBeth and Radaelli (2018): The Narrative Policy Framework (NPF)

Narrative strategies are used in an attempt to influence the policy process. The NPF identifies operational measures of policy beliefs through narrative elements such as characters and other symbolic, metaphorical, or contextual means by which collective understandings of the policy are generated. **The NPF informed the S3OK strategy of identifying and characterizing the policy narratives that shape responses to policy options, with an eye toward facilitating technical solutions to wicked problems.**

Jenkins-Smith and Weible (2025): Expanded and Updated ACF

In more complex policy arenas, outside influences like media, legislation, public opinion, and powerful stakeholders can influence what coalitions seek to accomplish. Moreover, trust and relationships among coalition members play a big role in how they learn and adapt. Accounting for this, we embedded input from public opinion via the M-SISNet and kept tabs on evolving state and national policy shifts. **This approach ensured S3OK research remained relevant and responsive to ongoing events,** and allowed us to carefully integrate conversations on key changes in policy and legislation during Academies, Deep Dives, and Working Group meetings when appropriate.

Methods for Collecting Data

The S3OK project implemented a comprehensive methodology to ensure the development of socially sustainable solutions. Data collection was key to this approach, combining surveys, focus group style deep dive discussions, engagement, and feedback loops to define and evaluate solutions aligned with stakeholder values and priorities. This methodology ensured that the proposed solutions were not only technically feasible but also socially sustainable and widely supported.

To ensure broad based representation across the project's science focus areas, researchers designed and utilized a recruitment matrix for the OLAN. OLAN members were recruited across sectors and according to their expertise as it aligned with the primary research domains of the project. The team identified six sectors of interest for recruitment: public/elected official, public appointee, public-civil service, nonprofit, private industry/business, and other/miscellaneous. Crosswalked in the matrix with these 6 identified sectors were 4 domains of expertise: water, land management and agriculture, infrastructure, and a generalist category. Overall, this matrix ensured that the OLAN was comprised of members representing as many sectors and expertise categories as possible. Of note, there were instances where an individual had expertise across more than one category, thus totals in the matrix exceed the number of OLAN members. At full recruitment, representative statistics for OLAN members appear in **Table 3.1**.

These data collection points also allowed us to develop a robust understanding of diverse stakeholder conceptualization of problem areas and to track how beliefs, preferences, and problem definitions evolved over time. Combined, results from this data provided insights into shifting societal priorities and challenges that were used as inputs in the advancement of policy-informed scientific solutions to S3OK challenges.

Three primary data collection methods were used:

- Public opinion panel survey data (M-SISNet)
- Focus group-style Deep Dive discussions
- Engagement between the OLAN and EPSAN

Surveys and focus group style deep dive discussions provided stakeholder input. S3OK researchers relied on public opinion data from The Oklahoma Meso-Scale Integrated Socio-Geographic Network (M-SISNet) panel survey to

Table 3.1 OLAN Area of Expertise and Sector

Area of Expertise	Sector Represented					
	Public Elected Official	Public Appointee	Public Civil Service	Nonprofit	Private Business or Industry	Other
Water	1	0	16	4	8	4
Land Management/ Agriculture	0	2	5	2	3	4
Infrastructure	1	0	7	3	8	4
Generalist	2	1	4	3	4	2

gather insights on perceptions of key problem areas, feasibility of solutions, and willingness to support proposed solutions. The M-SISNet is a panel survey of about 1,500 households across Oklahoma that began in 2014. Participants were initially recruited through a random sample of residential addresses across the state. In 2021, with the launch of the S3OK project, a targeted group of new participants was added to help maintain the sample's demographic and geographic representativeness. During the S3OK project, panelists were contacted twice a year to complete in-depth surveys that captured their perceptions, experiences, and opinions related to the complex challenges addressed by the project teams.

We collected data through opinion surveys, focus group style discussions, and input from Oklahoma's leaders and households.

Through surveys of the public and focus group-style deep dive discussions with OLAN and EPSAN, we assessed key dimensions of solution development and refinement. These methods accounted for the diverse value orientations of Oklahoma stakeholders and ensured the proposed solutions would reflect a range of interests, be broadly acceptable, and reflect current cutting-edge advances in the science. Each year's insights shaped the direction of the next year's research and engagement efforts.

For example:

- The bi-annual M-SISNet public opinion survey provided a pulse on changing social beliefs and preferences, which informed the design of focus group discussions.
- Year three focus group style deep dive discussions revealed nuanced problem definitions and solution opportunities that guided policy discussions.
- OLAN-EPSAN interactions fostered new collaborations and connections among elite stakeholders and scientists, equipping decision-makers with up-to-date scientific advances directly relevant to their fields.

This process not only deepened the understanding of complex sustainability challenges but also allowed elite stakeholder groups in Oklahoma to move forward in their

respective fields with critical insights. These insights often spurred new interdisciplinary collaborations and generated actionable pathways for integrating cutting-edge scientific developments into real-world applications. The results of these actionable pathways are most evident in the potential for agreement and refining solutions, described in brief in the next section and in detail in subsequent chapters.

Potential for Agreement and Refining Solutions

As the project matured, insights gathered through extensive engagement and interdisciplinary collaboration helped shape a clearer set of core focus areas. In the process of advancing S3OK goals and objectives, and heavily informed by discussions at the Year three Academy, we identified three areas of agreement through a series of collaborative sessions involving both OLAN and EPSAN stakeholders. These areas of agreement culminated in the formation of three topically oriented working groups, composed of a cross-section of OLAN, EPSAN, and S3OK researchers covering:

1. Produced water reuse potential for oilfield and agricultural applications
2. Novel hybrid treatment and reuse options for stormwater and municipal wastewater
3. Natural hazards and utility resilience

Produced Water Reuse Potential for Oilfield and Agricultural Applications

This working group was designed to facilitate and enhance collaborations between researchers working to develop novel techniques to clean and pre-treat produced water for possible reuse, and stakeholders seeking solutions to challenges regarding water availability and water management, including logistical and financial challenges surrounding water access and/or disposal **(Figure 3.3)**. This group's collectively defined goal was to make demonstrable progress towards the implementation of a small-scale pilot treatment opportunity for produced water reuse and lay the groundwork for a five-year time horizon implementation guide that underscores future regulatory considerations.

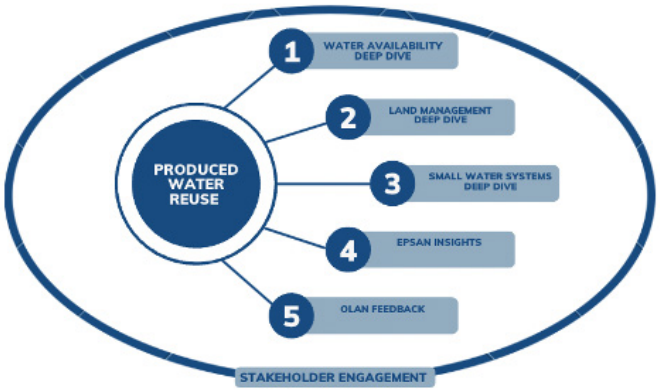

Figure 3.3. The Produced Water Group researches novel techniques to clean and pre-treat produced water for possible reuse.

Novel Hybrid Treatment and Reuse Options for Stormwater and Municipal Wastewater

This working group was designed to facilitate and enhance collaborations between researchers working to develop natural, active, and hybrid water treatment options and practitioners and stakeholders seeking solutions to challenges regarding water supply and management in the face of variable discharge quality and quantity **(Figure 3.4)**.

Figure 3.4. The Novel Hybrid Treatment and Reuse Options for Stormwater and Municipal Wastewater Group develops natural, active, and hybrid water treatment options.

Natural Hazards and Utility Resilience

This working group is designed to facilitate and enhance collaborations between stakeholders tasked with maintaining and augmenting the physical resiliency of the electrical grid and researchers developing novel datasets and predictive techniques that can help stakeholders mitigate against new and increasing threats to resilience from changing extreme weather/climate conditions **(Figure 3.5)**.

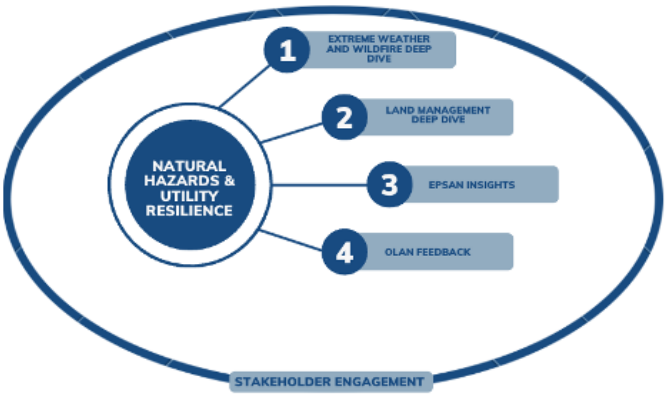

Figure 3.5. The Natural Hazards and Utility Resilience Group focused on the physical resiliency of the electrical grid.

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