

Texas OneGulf RESTORE Center of Excellence: Hurricane Harvey Decision-Support - Resilient Environments and Communities

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Final Project Report

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Introduction

With winds in excess of 130 mph, Hurricane Harvey made landfall in Rockport and Fulton as a Category 4 storm on August 25, 2017. In the initial impact and torrential rain of the ensuing days, Harvey caused widespread destruction along the Texas coast, resulting in 103 confirmed U.S. deaths and an estimated \$125 billion in damages – the second costliest hurricane ever, following Katrina. It will take us years, if not decades, to recover.

Out of the disaster, however, emerges an opportunity to build back stronger, more resilient communities along the coast – communities that can better withstand the impacts of future events, and that are positioned to make a ‘developmental leap’ by mitigating risk while aligning economic development with recovery efforts. We can especially do so by taking into account the specific characteristics that make Texas counties, cities and towns desirable places to work and

raise our families. For each community, recovery isn't only about housing and critical infrastructure. Though those are key components indeed, we also need to recover and strengthen the social processes that make our communities whole, as well as the natural components that make areas along the Texas coast special places to visit and live.

This project, *Hurricane Harvey Decision-Support -Resilient Environments and Communities*, set out to examine recovery and resilience from this holistic perspective by forming and integrating experts, researchers and stakeholders across disciplinary fields and recovery aspects including ecosystems, urban areas, communities, organizations, society, and policy and law. The initial goal of the project was to provide a framework for recovery that outlines strategic recommendations to improve resilience to future events by identifying gaps across and between recovery aspects, and then providing integrated recommendations to researchers and decision-makers to improve response, recovery, mitigation and data collection in subsequent events. To do so, interdisciplinary researchers would be required to assess social, policy, legal and environmental impacts, linkages across them, and then use an enhanced, holistic understanding of impacts to evaluate the vulnerability and resilience of the Texas coast.

In that sense, the project team had hoped to provide a comprehensive framework to systematically identify key data gaps and outline strategic recommendations in responding to current and future disaster recovery processes. The team had a view to identify linkages and interdependencies across issues and provide high priority recommendations to state and local decision-makers in strengthening Texas' resilience across environmental, public health, socioeconomic, and policy and legal aspects.

This final project report is notably short of that ambitious goal, due to two challenges that emerged when the project was in its initial stages. First, research teams related to collection of environmental, socioeconomic and public health data to evaluate community vulnerability and resilience pre- and post-Harvey were not funded, and thus could not participate in the project. Second, though Texas OneGulf had funds, funding was not authorized for researchers to travel and meet together on a regular basis, which is a necessary function of successful interdisciplinary projects. Thus, rather than a comprehensive view of disaster recovery with a more complete analysis of gaps and prioritized, integrated recommendations on strengthening resilience, project results are instead offered as separate components.

Nevertheless, important research was completed that, though short of comprehensive, do provide insight for Texas decision-makers and stakeholders in the areas of environmental waterbody recovery and remediation, the role of organizations and stakeholders in building resilience, planning policy-resource assessment in hazard mitigation, and in addressing key policy and legal issues that arise during disaster response.

More work remains to advance a comprehensive and shared vision for recovery and resilience in Texas and, guided by locally contextualized data and tools, to create an identity for the state that matches local culture and capabilities, integrates sophisticated infrastructure, and is resilient in the face of change. The following research adds to and provides foundations on which we must continue to build. Together with our elected leaders, experts and citizens, we will continue to identify our greatest strengths and needs as we rebuild Texas. We can emerge as a leader in disaster recovery and resilience – and we can do it Texas style.

Research Findings Summary

Environmental Waterbody Impacts

The goal of the performed study was to compare the established baseline of the diversity and species composition in microbial communities across Galveston and Trinity Bays before August 2017 when Hurricane Harvey hit Texas shores and assess the microbial recovery over the next 2 years. In order to achieve this goal, the collaborative team between UTMB and TAMUG performed regular sample collection and DNA sequencing of bay water samples. The genomic characterization of newly collected samples and comparison against previously collected baseline data represents a viable mechanism of assessment of the remediation efforts to predict long-term environmental changes in the Gulf attributed to climate and Hurricane recovery efficacy. The project team was able to not only generate a novel set of samples that allows studying specific changes in microbial communities at the collection points but also build up and strengthen the analytical power of previously generated data. In addition to the analytical component, during the progress of the project resulted in the development of new high dimensional microbial network interaction technique. Raw sequencing data consisting of a total of 402 samples were uploaded to The National Center for Biotechnology Information Sequencing Read Archive (accession number: PRJNA545502). The methods manuscript is currently in the accepting stages of the BMC Microbiome journal, and the public version is available in the BioRxiv: Golovko G, Khanipov K, Albayrak L, Fofanov Y. Identification of Complex Multidimensional Patterns in Microbial Communities. bioRxiv. 2019 Jan 1:540815. The developed approach will allow establishing a functional relationship between microbes using a pattern detection approach without assuming any model of the organismal dependency. While it has some biological limitations, it will allow the study of the unknown microbial community that has yet to be found and sequenced in the complex environmental samples. This approach will be applied to the data generated through the samples collected within the 4 year period, and results will be reported in the upcoming manuscript.

Role of Coastal Bend Organizational Stakeholders in Resilience & Resilience

An in-depth survey of Texas Coastal Bend Regional Stakeholders was conducted to identify their views on problem sources, risk perceptions, planning goals, policy evaluations, resource allocations, and patterns of interaction across groups related to recent environmental stressors like Harvey. Texas Coastal Bend stakeholder organizations included in this study were selected from local, regional, state and national governmental units, and more locally centered businesses, health providers, advocacy groups, and nonprofit organizations within the counties of Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, Nueces, Refugio, and San Patricio. Of the 2,007 potential participants who received an invitation to the survey, 448 opened the survey link. Participants who did not complete any portion of the survey or click through the

entire study were removed. Participants who did not provide organizational information were also removed, as were participants who did not complete a majority of the survey information. In the end, 217 participants were retained for data analysis. Among other areas, respondents were asked to indicate how much they oppose or support policy actions meant to improve recovery and resiliency to hurricanes and strong storms in the Coastal Bend area. Recommendations for action are for the top three most supported actions, which were safeguarding natural flood protection areas, strengthening infrastructure design standards, and strengthening building design standards. Other supported policy actions clustered around limiting rebuilding and development in flood prone areas. The least supported policy action was charging impact fees for development in flood prone areas. In fact, there was a significant difference in support by race, such that racial minority participants were less likely than white participants to support charging impact fees.

Plan Integration for Resilience Scorecard-Disaster Recovery [Pending Publication]

The Plan Integration for Resilience Scorecard *for Disaster Recovery* tool was effectively applied, to varying ends, in the Texas Coastal Bend Region. In the City of Rockport, working to recover from the impacts of Hurricane Harvey and plan a more resilient future, the tool was used to evaluate the existing network of plans and provide additional technical input to the ongoing comprehensive planning process. Findings revealed instances and locations of potential policy conflict and insufficient attention to flood risk, such as in and near Downtown Rockport, where opportunities exist to improve alignment and reinforce resilience by adjusting or adding policies. Using the PIRS-DR tool to evaluate the network of plans in and around the Port of Corpus Christi was a departure from the typical application of a resilience scorecard in a city. The Port Authority's mission and function is somewhat different than that of a municipality, and its network of plans, like its planning organization, is relatively young—albeit sophisticated, and growing. Yet it was ultimately a productive and useful exercise, particularly while the PCCA augments its planning efforts to meet the challenges of the future. The PIRS-DR evaluation reflected the generally positive state of planning and policy in the study area with respect to mitigating flood-vulnerability; many policies across the existing network of plans work to strengthen resilience. It also revealed instances of policies and locations that may benefit from a closer look – particularly in an era of growing uncertainty regarding flood hazards – which may be useful as the port and city work together to foster greater resilience in the area.

Legal Disaster Response & Resilience Framework

This project initiated a series of interviews with first responders and public stakeholders to further understand and improve disaster response. From this effort common concerns were expressed across the various professional disciplines that gave rise to the content of a framework. Subsequent hazardous material fires and chemical spills in the Texas water channels and coastal

areas, along with the evolving effects of climate change, demonstrate that these natural and man-made disasters have begun to expand the boundaries of disaster law. Texas communities are subject to federal, state and local laws that address emergency and disaster response, and the fact that first responders and emergency managers will be called upon to carry out those laws is undeniable. Their knowledge is essential today. The core legal issues related to the response phase include but are not limited to: Public authorities for emergency response; Modifications of scope of employments; Liability of responders; and Suspension of relevant laws during a state of declared emergency. The purpose of the project's resulting framework is to give answers about the legal considerations emergency responders and managers should face when dealing with natural disasters, and by analogy, to catastrophic situations. The framework also provides high priority recommendations to state and local decision-makers in strengthening Texas' resilience. While the framework has an expansive scope, it focuses on the policy and legal considerations in declared emergencies and the decisions taken in this context. Notably, however, its content only represents a sample of the laws and policies that disaster response can invoke, and aims primarily at state laws and policies, although it also discusses some local provisions in certain examples. It is also important to note that Texas allows the Governor or Mayor to suspend laws during times of disaster response, which would not apply to this framework. Several questions come to mind when identifying the purpose of the framework. These are the questions the framework seeks to answer: is there an international background for disasters law framework? Is there any impact of those recommendations in Texas Law? From the strategic level (the City council), going through the tactical level (Fire Chief departments) and ending up at the task level (First responders), what are the elements to keep in mind when taking a decision where time is of essence? What are the legal issues around those situations? What should lead the decision when there would be a lack of law to be applied? And more. This project offers its conclusions in a format designed to assist Texas agencies and communities in their effort to navigate relevant laws and policies of disaster response. In an effort to make information usable in field operations, sample flowcharts have been provided in the Appendix A. The flowcharts can be reduced to a pocket-size guide for responders, commanders and emergency managers during deployment to remote command posts or operations centers.

APPENDICES: *PROJECT RESEARCH RESULTS*



APPENDIX I: TCEQ Project Report on the Environmental Waterbody Impact on Houston Ship Channel and Galveston-Trinity Bay

Microbial communities (MC) are the foundation of the marine ecosystem and functional components of bioremediation and recovery from natural (hurricanes, floods) and human-associated environmental disruptions. Drastic and unprecedented changes in MC can cause domino effects on overall productivity (fisheries) and the safety of the marine environment (pathogenic outbreaks in recreational areas) with dramatic effects on coastal area's economic and social activities.

Monitoring of microbial compositions for over 2 years (2016-2018) across Galveston Bay, East Bay, and Trinity Bay created the initial foundation of one of the first large-scale studies of such nature that resulted in producing a longitudinal baseline. Developed protocols, databases, as well as analytic pipelines generated during the previous study, were significantly expanded and utilized to monitor continuous trends of pre- and post-hurricane Harvey microbial changes until December 2019.

The key outcome of the performed study is the creation of a bacterial data repository that offers the capability to look through the longitudinal changes in microbial composition over the four years (2016 – 2019) period. The observed reduction of biodiversity concomitant with changes in microbial composition, especially changes in cyanobacteria, suggests a possible shift in the mechanism of oxygen production critical to the overall health status of the marine ecosystem. During the data analysis, a novel approach to study microbial interactions has been developed in an attempt to identify the systematic changes and detect a specific association between bacterial changes and descriptive metadata of the samples. At the moment of the report writing, the publication is in undergoing the review of minor revisions in the BMC Microbiome journal.

Introduction

The resiliency of coastal communities along the U.S. Outer Continental Shelf depends upon successfully planning for and mitigating chronic (such as sea level and global temperature rise, hypoxia) as well as episodic (e.g., human-made disasters and hurricanes) environmental disruptions. In large part, this depends on the availability of reliable information regarding the dynamic and immediate status of the coastal ecosystems. Baseline biological assessment of these ecosystems is necessary for the estimate of the global impact of disturbances for the planning of both short- and long-term recovery.

Microbial composition (microbiome) and its metabolic activity are inherent to every ecosystem. Each member of the microbiome has a specific functional role required for the survival of the entire community, including other organisms from the tree of life coexisting in the same ecosystem. While larger animals can tolerate different toxicological impacts in a more resilient way that might not be evident in short time observations, the extreme changes in the surrounding environment will have a direct effect on the smallest member of the community. For example, a small-scale oil spill might not change the overall fish population, yet it can be easily detected by the appearance of the hydrocarbon-degrading bacteria that not a regular inhabitant of such an ecosystem.

The goal of the performed study was to compare the established baseline of the diversity and species composition in microbial communities across Galveston and Trinity Bays before August 2017 when Hurricane Harvey hit Texas shores and assess the microbial recovery over the next 2 years. In order to achieve this goal, the collaborative team between UTMB and TAMUG performed regular sample collection and DNA sequencing of bay water samples. The genomic characterization of newly collected samples and comparison against previously collected baseline data represents a viable mechanism of assessment of the remediation efforts to predict long-term environmental changes in the Gulf attributed to climate and Hurricane recovery efficacy.

Sample Collection

Sample collection was performed by the Texas A&M Galveston and the University of Texas Medical Branch teams. The sampling effort was focused on four segments of the Galveston Bay: Upper Galveston Bay, Trinity Bay, East Bay, and Lower Galveston Bay (**Table 1**). Reusable 1 L glass bottles (autoclavable, with polypropylene caps) were used for the liquid sample collection. Before each sampling trip, the bottles were cleaned in a Hydrochloric acid wash and sterilized. During the sampling, the bottles were kept on ice and processed at UTMB within 12 hours of collection.

Table 1. Gulf Bay Sample Collection.

Description	TCEQ Segment ID	Number of Samples
Upper Galveston Bay	2421	153
Trinity Bay	2422	179
East Bay	2423	28
Lower Galveston Bay	2439	72

DNA Isolation and Sequencing

Water samples were vacuum filtered using 0.2 μ m Polyethersulfone membrane bottle top filters (Thermo Fisher) to concentrate and capture the microbes in the 1 L of sea water. The filter membrane was then cut out with a sterile scalpel and transferred into a 5ml bead beating tube. The DNeasy PowerWater Kit (Qiagen) was used to isolate the genomic DNA of the precipitate. DNA is then quantified using a Qubit High Sensitivity assay.

High-throughput sequencing of the bacterial 16S ribosomal RNA gene was performed to identify the bacterial composition of the water samples. Sequencing libraries for each sample were generated using universal 16S rRNA V3-V4 region primers (Klindworth et al., 2012) in accordance with Illumina 16S rRNA metagenomic sequencing library protocols. The samples were barcoded for multiplexing using the Nextera XT Index Kit v2. Sequencing was performed on an Illumina MiSeq instrument using a MiSeq Reagent Kit v2 (500-cycles). A total of 16,574,394 reads were generated across 402 sequenced samples. The sequencing reads, and related metadata has been uploaded to the National Center for Biotechnology Information Sequenced Read Archive and assigned with PRJNA545502 accession number for public access.

Bioinformatics and Data Analysis Approaches

Identification of the known bacterial taxa using metabarcoding sequences was done using the CLC Genomics Workbench 20.0.1 Microbial Genomics Module (<http://www.clcbio.com>). Reads containing nucleotides below the quality threshold of 0.05 (using the modified Richard Mott algorithm) and those with two or more unknown nucleotides or sequencing adapters were trimmed out. Reference-based OTU picking was performed using the SILVA v132 databases with a 97% similarity threshold. Sequences present in more than one copy but not clustered to the 97% similarity database were placed into de novo OTUs and aligned against the reference database with an 80% similarity threshold to assign the "closest" taxonomical name where possible. Chimeras were removed from the dataset with the absolute crossover cost of 3 using a k-mer size of 6. Alpha diversity was measured using a number of organisms (OTU level), rarefaction sampling without replacement at 4,000 reads, and with 1,000 replicates at each point. Beta diversity was calculated using the Bray-Curtis diversity measure (OTU level). PERmutational Multivariate ANalysis Of VAriance (PERMANOVA) analysis was used to measure effect size and

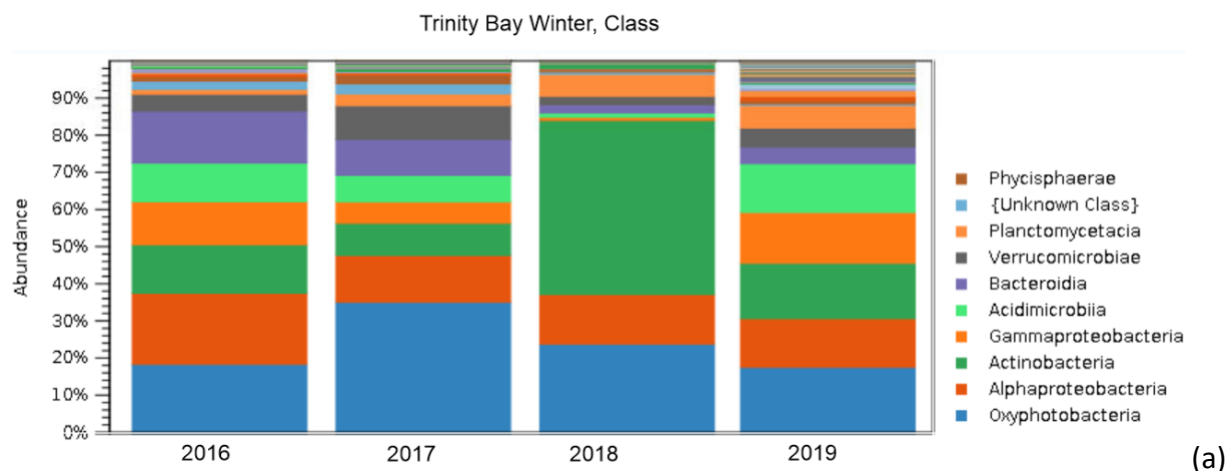
significance on beta diversity for grouping variables. The raw counts of the filtered and cleaned data are available for the public and research community at the GitHub repository: <https://github.com/kkhanipov/MultidimensionalBooleanPatterns>

Results: Changes of Microbial Diversity Before and After Hurricane Harvey

Our previous study based on the samples collected between the years 2016 and 2018 has already shown that the majority of the observed deviation between microbial sample population have seasonal tendencies. Therefore, in order to investigate what was the impact of Hurricane Harvey that happened during the end of August 2017, we structured analysis based on season, as well as separated in 2 distinct regions: Trinity (Figure 1) and Upper Galveston bay (Figure 2). This decision was based on the density of collected samples and the proximity of land run-off locations to the investigated areas.

One of the most fascinating observation is the dramatic growth of *Oxyphotobacteria* are a class of the phylum Cyanobacteria, one of the most important groups of prokaryotes and the only group of Bacteria that can carry out oxygenic photosynthesis. During Summer 2017, the level of this class of bacteria averaged more than 40% of the total population, falling about 5% each consecutive season. It is important to emphasize that samples collected during Summer 2017 do not include samples collected during Harvey, so one can hypothesize that loss of the oxygenic photosynthesis bacteria was the result of the hurricane.

Overall, diversities of the bacterial population for years 2017 and 2018 were severely reduced. However, if we look at the taxonomical diversity at the Class level for both areas of interest throughout the seasons, the bacterial population in 2016 and 2019 is similar. Leading to the overall observation that it takes about one full year for the bacterial composition in the Galveston bay to return to a similar state after a temporary disturbance.



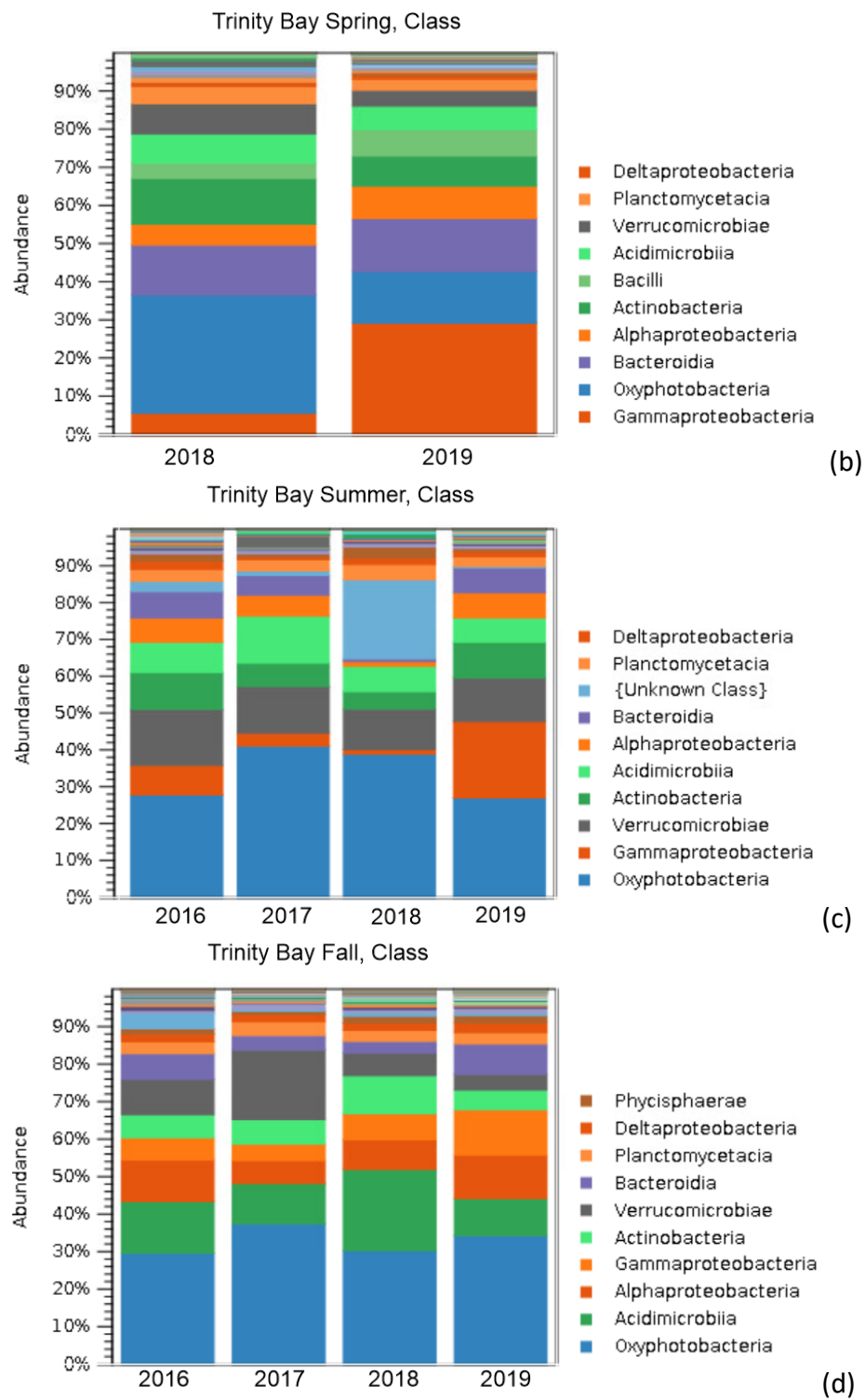
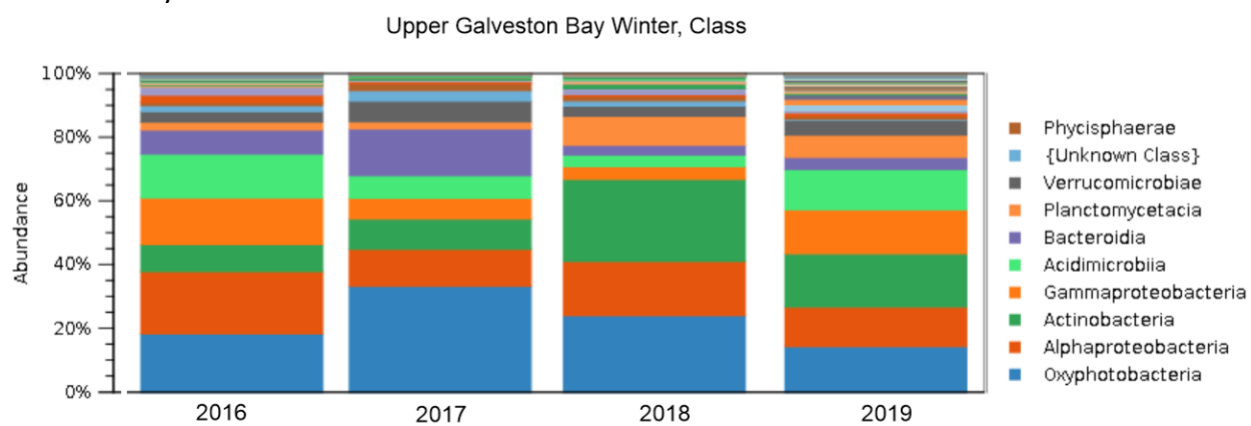
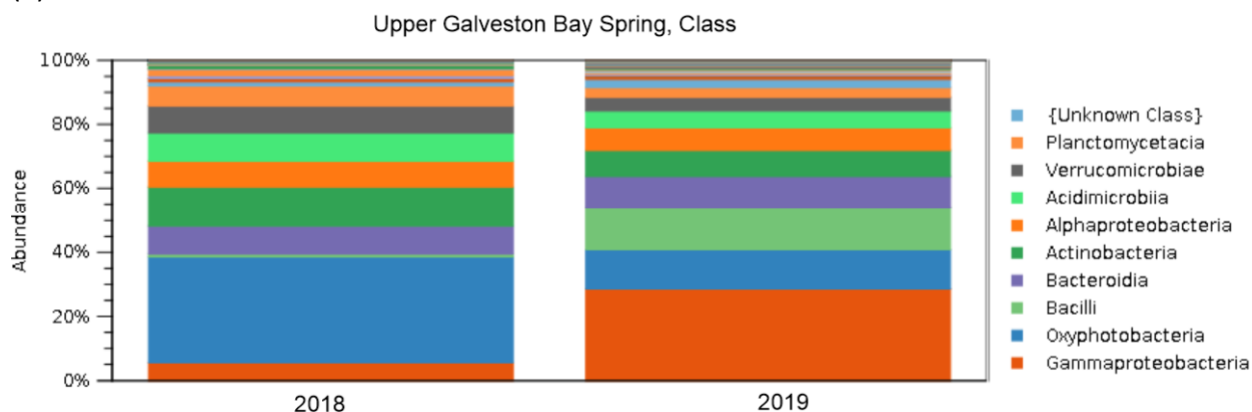


Figure 1. Changes of the bacterial population on the Class level during Winter, Spring, Fall, and Summery seasons for 2016-2019.

Striking deviation from the overall bacterial abundance in Trinity Bay was also observed during the Summer '18. Results of the sequencing identified almost 20% of the unknown class of bacteria, that have not been observed in other seasons. We conclude that this observation cannot be directly associated to the impact of Hurricane Harvey, and impacts from human activities impacted the observation. However, direct analysis of the Coast Guard disasters records were unable to establish a link between this observation and recorded incidents in the area. Interestingly, results of samples collected from the Upper Galveston Bay showed similar trends with one significant distinction. Upper Galveston Bay continued harboring the unknown taxa during the Fall '18, showing recovery only in Winter' 18(Dec)-19. Meanwhile, Trinity Bay recovered by Fall '19.



(a)



(b)



Figure 2. Changes of the bacterial population on the Class level during Winter, Spring, Fall, and Summery seasons for 2016-2019.

Seasonal Comparison of Beta Diversity of Trinity and Upper Galveston Bays

Both geographic locations' microbial communities were compared using beta diversity measures. We utilized known bacterial results from all of the collected samples throughout 4 years to understand how specific taxa has changed and assess the relative distance between observed regions with respect to other collection sites throughout the Galveston Bay. The beta diversity of the samples collected during the Winter season shown in Figure 3, confirms the previous observations reflected in Figure 1. Samples collected during the Winter 2017 that corresponds both to the beginning (Jan) and end (December) of 2017 are relatively close to the samples

collected during 2016 and 2019, while samples collected during 2019 are positioned between other clusters representing both annual diversity shift and rebound process. At the same time, we can see the similarity of some of the samples collected during the 2016- and 2019-years, reflecting the return of the overall diversity to the pre-Harvey state.

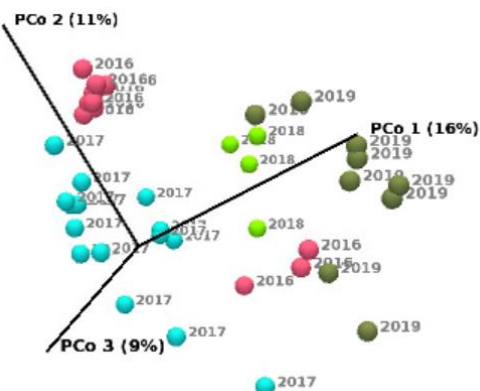


Figure 3. Beta diversity of Trinity Bay region for the samples collected during the Winter season during 2016-2019

Due to the limitation of the samples available for years 2016 and 2017, it is difficult to make any meaningful observation in respect to Trinity Bay samples collected during the Spring season. Yet we can observe a close proximity of some of the samples between 2 collection years (Figure 4).

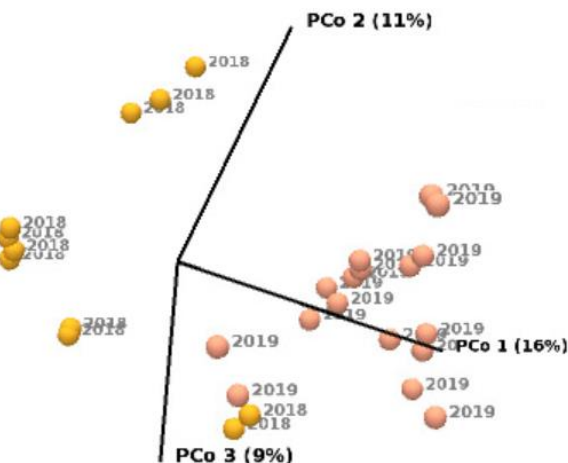


Figure 4. Beta diversity of Trinity Bay region for the samples collected during the Spring season during 2016-2019

Analysis of the samples collected during the Summer season shown in Figure 5 reflects that the overall microbial shift during the Summer is very different in comparison to other seasons. We can see a separate pre-Harvey cluster of samples collected during Summer 2017, a distinct set of samples collected during 2016, and a mix of clusters showing similar bacterial profiles for the years 2016, 2018, and 2019.

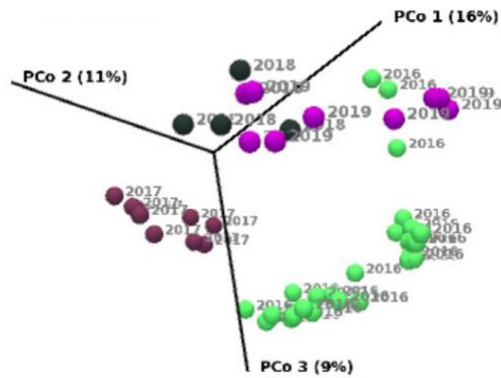


Figure 5. Beta diversity of Trinity Bay region for the samples collected during the Summer season during 2016-2019

Seasonal analysis of Fall samples shown on Figure 6 is illustrative to a generally observed seasonal shift where the proximity of samples is mostly defined by the year of collection.

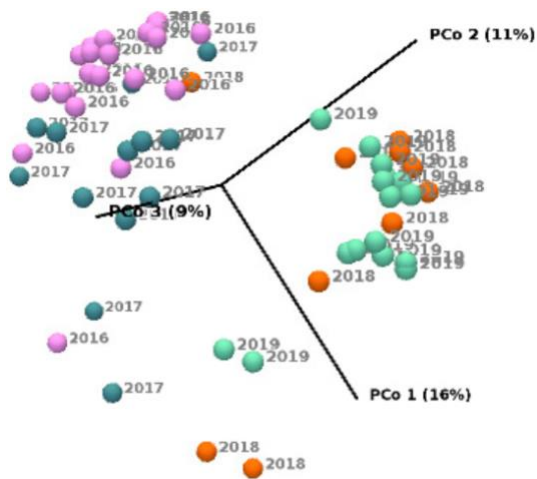


Figure 5. Beta diversity of Trinity Bay region for the samples collected during the Fall season during 2016-2019

The detailed analysis of the Upper Galveston Bay (UGB) samples, shows a slightly different situation observed in comparison to Trinity Bay analysis (Figure 7). Samples collected during 2019 form a distinct cluster, while other years have shown more or less a similar microbial profile

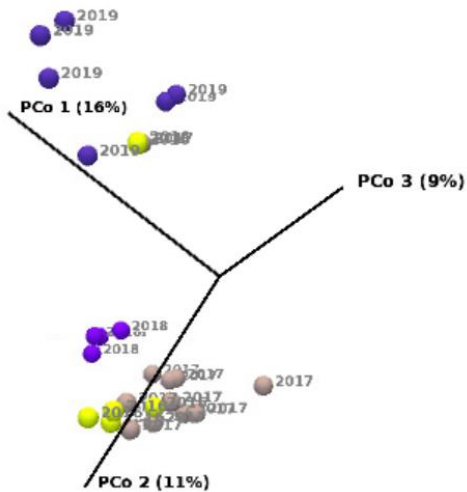


Figure 6. Beta diversity of Upper Galveston region for the samples collected during the Winter season during 2016-2019

Analysis of the UGB Summer samples also shows the overall resilience and the effects of 2017 and 2018 by the closeness of 2016 and 2019 clusters (Figure 8).

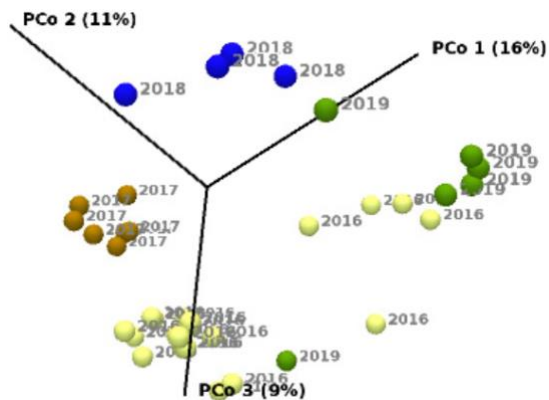


Figure 7. Beta diversity of Upper Galveston region for the samples collected during the Summer season during 2016-2019

Similar to the Fall observations of Trinity Bay samples, UGB samples do not show any drastic changes or mix of samples in the cluster. As we can see in Figure 9, each year represents a distinct cluster of samples forming a specific microbial community with annual tendencies.

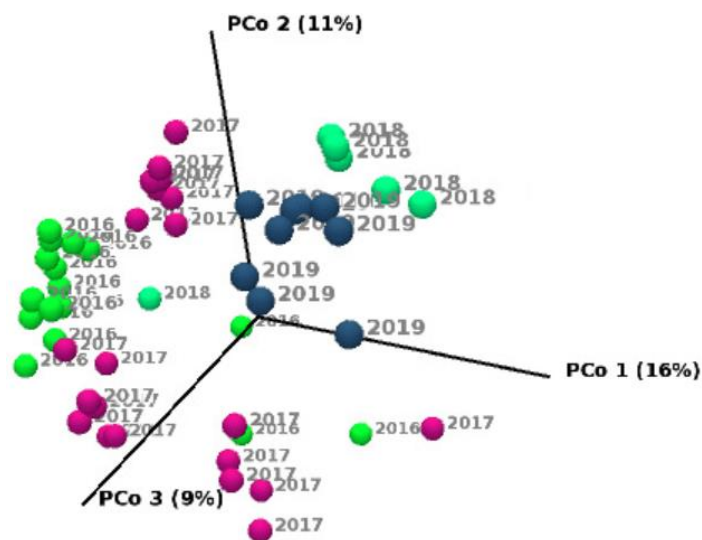


Figure 8. Beta diversity of Upper Galveston region for the samples collected during the Fall season during 2016-2019

Results: Detection of Pathogenic Organisms

As a part of the study, microbes with potential pathogenic activity were identified, and their abundance monitored. The analysis was focused on the abundance of several microbial genera, which are known to include both pathogenic and non-pathogenic microorganisms: *Mycobacterium*, *Flavobacterium*, *Anabaenopsis*, *Coxiellaceae*, *Psychrobacter*, and *Rickettsiales*.

It is noteworthy, however, that some of the detected microorganisms are naturally present in the marine environment. For example, environmental *mycobacteria* (EM) are generally considered non-obligate human pathogens, and their natural reservoirs include aquatic and terrestrial environments. However, immunocompromised people prone to infection (e.g., skin lesions, immune dysfunctions, or chronic disease) are at risk for developing EM diseases. EM has generally shown an ability to form biofilm, amoeba-associated lifestyle, and resist chlorine. The presence of EM in drinking water has previously been associated with nosocomial and pseudo-infections.

Another example includes the genera of *Flavobacteria*, some species of which pose a serious potential threat to wild and propagated fish stocks by causing a variety of infectious conditions including columnaris and bacterial gill diseases. In acute flavobacteriosis, cumulative mortality upwards of 70% can occur among affected fish stocks. Further associated studies, fish surveys, and deep sequencing are required to determine whether pathogenic strains of *Flavobacteria* are affecting the fish stock in the Galveston Bay.

It is important to mention that in order to distinguish between harmless, pathogenic, and non-obligate human/animal pathogens, as well as identify the presence of antibiotic resistance genes, the 16S rRNA sequencing approach used in the presented study needs to be supplemented with deep whole-genome sequencing that should be integrated into future studies. Figures 10-14 demonstrate the appearance of traces of the pathogenic bacteria within studied regions throughout the entire four years of collected samples to demonstrate the relationship between seasons and appearance. It is important to emphasize that *Psychrobacter*, *Micobacteria*, and *Flavobacteria* become more abundant in the years following Hurricane Harvey.

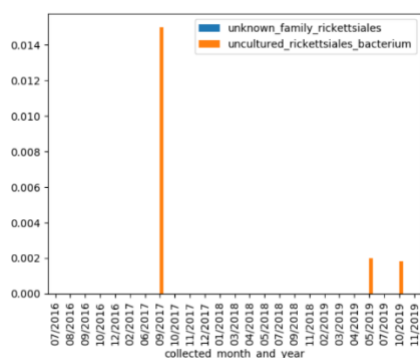


Figure 10. Percent of *Rickettsiales* bacteria in Trinity Bay

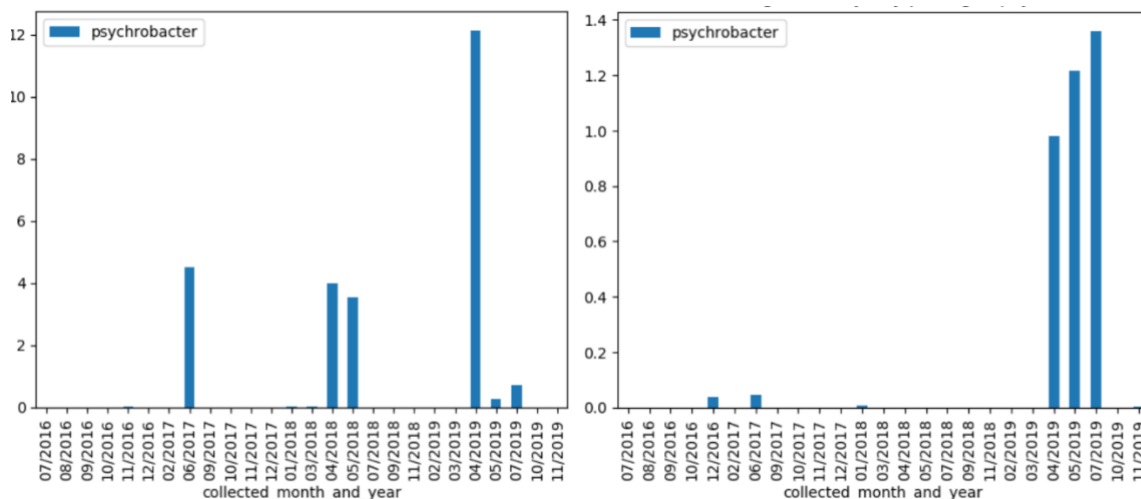


Figure 11. Percent of *Psychrobacter* in Upper Galveston Bay(left) and Trinity Bay(right)

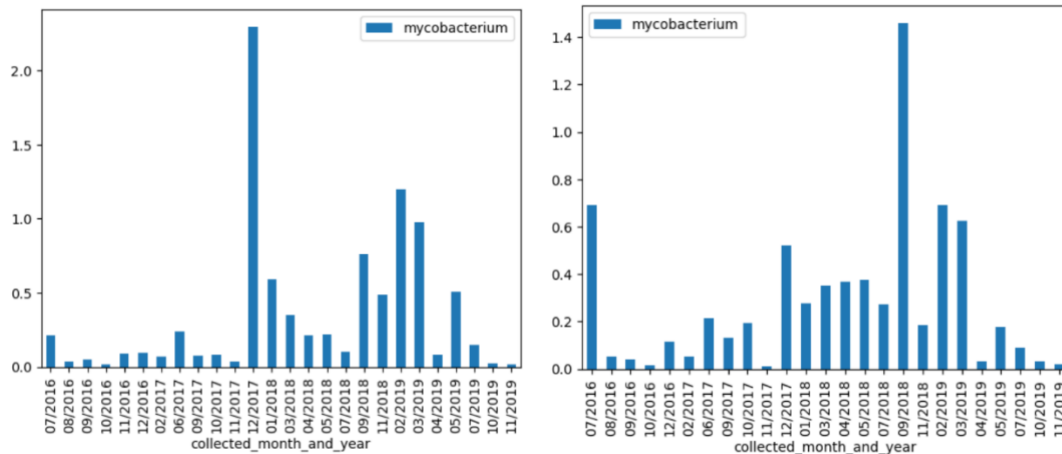


Figure 12. Percent of *Mycobacterium* in Upper Galveston Bay(left) and Trinity Bay(right)

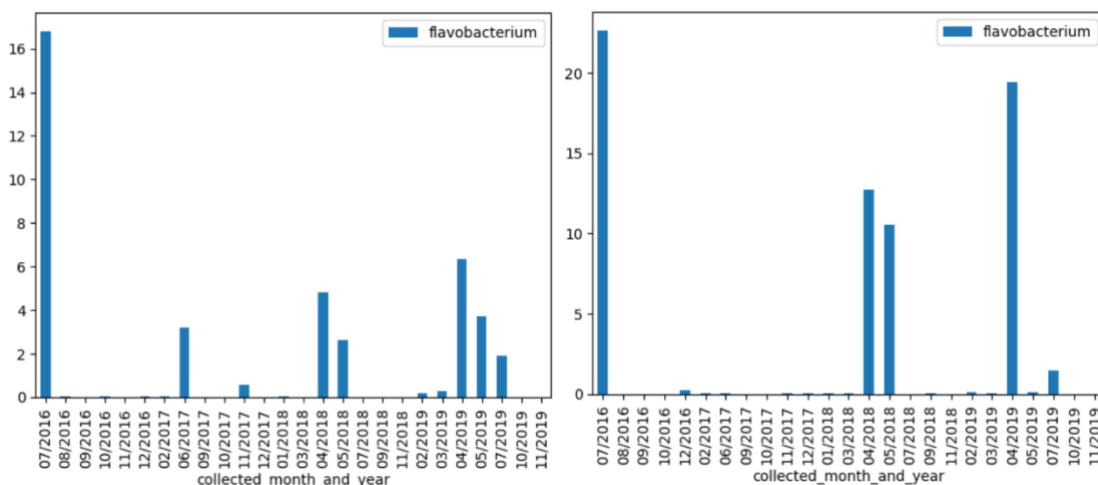


Figure 13. Percent of *Flavobacterium* in Upper Galveston Bay(left) and Trinity Bay(right)

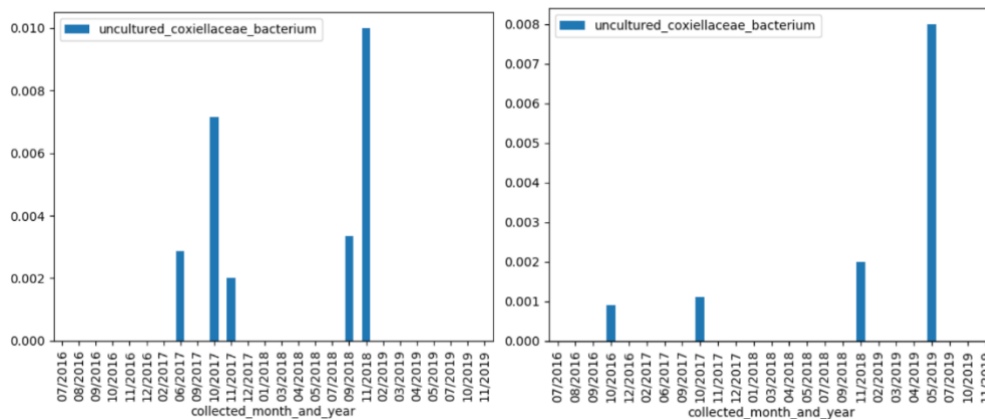


Figure 14. Percent of *Coxiellaceae* bacteria in Upper Galveston Bay(left) and Trinity Bay(right)

Conclusion

This project was unique in its scale and produced large amounts of data on the microbial composition of the Galveston and Trinity Bays. We were able to not only generate a novel set of samples that allows studying specific changes in microbial communities at the collection points but also build up and strengthen the analytical power of previously generated data. Only due to the availability of data between 2016 and 2019, it was possible to establish a hurricane recovery timeline for both Upper Galveston and Trinity Bays. The more detailed analysis of the changes and additional impact factors that might have caused such changes will be reported in the manuscript that is currently under development and will be published. The vast amount of high-quality data just could not be completely analyzed within the year scope of this project. However, the value it provides will establish an analytical model to study ecosystems of such type.

In addition to the analytical component, during the progress of the project resulted in the development of new high dimensional microbial network interaction technique. The methods manuscript is currently in the accepting stages of the BMC Microbiome journal, and the public version is available in the BioRxiv: Golovko G, Khanipov K, Albayrak L, Fofanov Y. Identification of Complex Multidimensional Patterns in Microbial Communities. bioRxiv. 2019 Jan 1:540815.

The developed approach will allow establishing a functional relationship between microbes using a pattern detection approach without assuming any model of the organismal dependency. While it has some biological limitations, it will allow the study of the unknown microbial community that yet to be found and sequenced in the complex environmental samples. This approach will be applied to the data generated through the samples collected within 4 years period, and results will be reported in the upcoming manuscript.

Raw sequencing data consisting of a total of 402 samples were uploaded to The National Center for Biotechnology Information Sequencing Read Archive (accession number: PRJNA545502).

A dedicated GitHub project containing read counts on all of the taxonomic levels (Phylum, Class, Order, Family, Genus, Species, OTU), as well as figures summarizing the observations for stable (presence threshold in samples: 80%, 90%, 100%) and pathogenic microbes are available at <https://github.com/kkhanipov/GulfOneMicrobiome>

APPENDIX II: Role of Coastal Bend Organizational Stakeholders in Regional Recovery and Resilience Efforts

Bush School Institute for Science, Technology and Public Policy Team
Stephanie Brown, Carol Goldsmith, Ian Seavey, Kimberly Winarksi, and Arnold Vedlitz

Introduction

Severe storms such as Hurricane Harvey that battered the Texas Gulf Coast in August 2017 not only stretch resources related to short-term rescue, safety and health, but also generate extensive discussion and planning to manage long-term recovery as well as to improve the resilience of Texas coastal communities. Any future planning, policies, and resource allocation strategies should reflect key local and state stakeholders' views regarding risk, cost, capacity, and policy options (see, for example, Alexander, 2000; Adger et al. 2005; Comfort, Boin and Demchak, 2010; Portney, 2015; and Wenger, 2017). An in-depth survey of Texas Coastal Bend Regional Stakeholders was conducted to identify their views on problem sources, risk perceptions, planning goals, policy evaluations, resource allocations, and patterns of interaction across groups related to recent environmental stressors like Harvey. The findings from this survey are below.

Participants

Texas Coastal Bend stakeholder organizations included in this study were selected from local, regional, state and national governmental units, and more locally centered businesses, health providers, advocacy groups, and nonprofit organizations within the counties of Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, Nueces, Refugio, and San Patricio. We sought to identify the universe of relevant organizations working on issues of recovery and resilience in this coastal region of Texas. Stakeholder organizations were identified through several approaches. First, the Texas OneGulf project team and personnel from Texas Sea Grant Extension were asked to share contact information for relevant organizations and to distribute a recruitment flyer through their outreach channels. Second, the research team used various online resources to identify relevant organizations and collect contact information for the appropriate individuals. The Stakeholder Survey was conducted by the Public Policy Research Institute at Texas A&M University from January 21 to March 10, 2020.

Participants were sent an initial email customized to their organization type. These initial emails were followed by reminder emails for individuals who had not yet completed the survey. If the surveys were still not completed, the survey lab called participants to confirm their email addresses, encourage their participation, or to request the contact information of the most relevant person in the organization.

Of the 2,007 potential participants who received an invitation to the survey, 448 opened the survey link. Participants who did not complete any portion of the survey or click through the entire study were removed. Participants who did not provide organizational information were also removed, as were participants who did not complete a majority of the survey information. In the end, 217 participants were retained for data analysis.

Participants in this study worked for a variety of organizations (see Appendix B, Figure B-1). The majority of participants worked for nonprofits/non-governmental organizations (32.7 percent) and government organizations (29.5 percent). On average, participants had been with their current organization for 9.8 years ($SD = 8.68$). Respondents also held various, and often multiple, roles within their organization (see Appendix B, Figure B-2). By far the most common role performed was that of executive management. However, many respondents also worked in public engagement, planning, project management, and education.

Summary of Risks to the Coastal Bend

Perceived Unit Competence

Stakeholder respondents were asked to indicate how competent or incompetent they found the various organizational entities that were working to provide help for their communities when faced with natural disasters like Harvey. The full list of responses and the scale used are included in Appendix B, Figure B-3. We summarize here the major stakeholder observations.

Overall, participants indicated that most organizations fell somewhere in the range of *Neutral* to *Competent*. Participants indicated that they found community religious organizations (such as churches, mosques, or synagogues), nonprofits, and the Texas Division of Emergency Management to be the most competent at helping their communities recover from natural disasters, with average ratings falling between *Competent* and *Very Competent*. Other state agencies such as the Governor's Office, the Texas General Land Office and the Texas Legislature also received relatively good ratings. The U.S. Corps of Engineers, FEMA and U.S. EPA also received generally good marks, if slightly lower than state offices. Participants rated insurance companies lowest, but still as at least *Neutral* at helping local communities recover. No group received an overall negative rating.

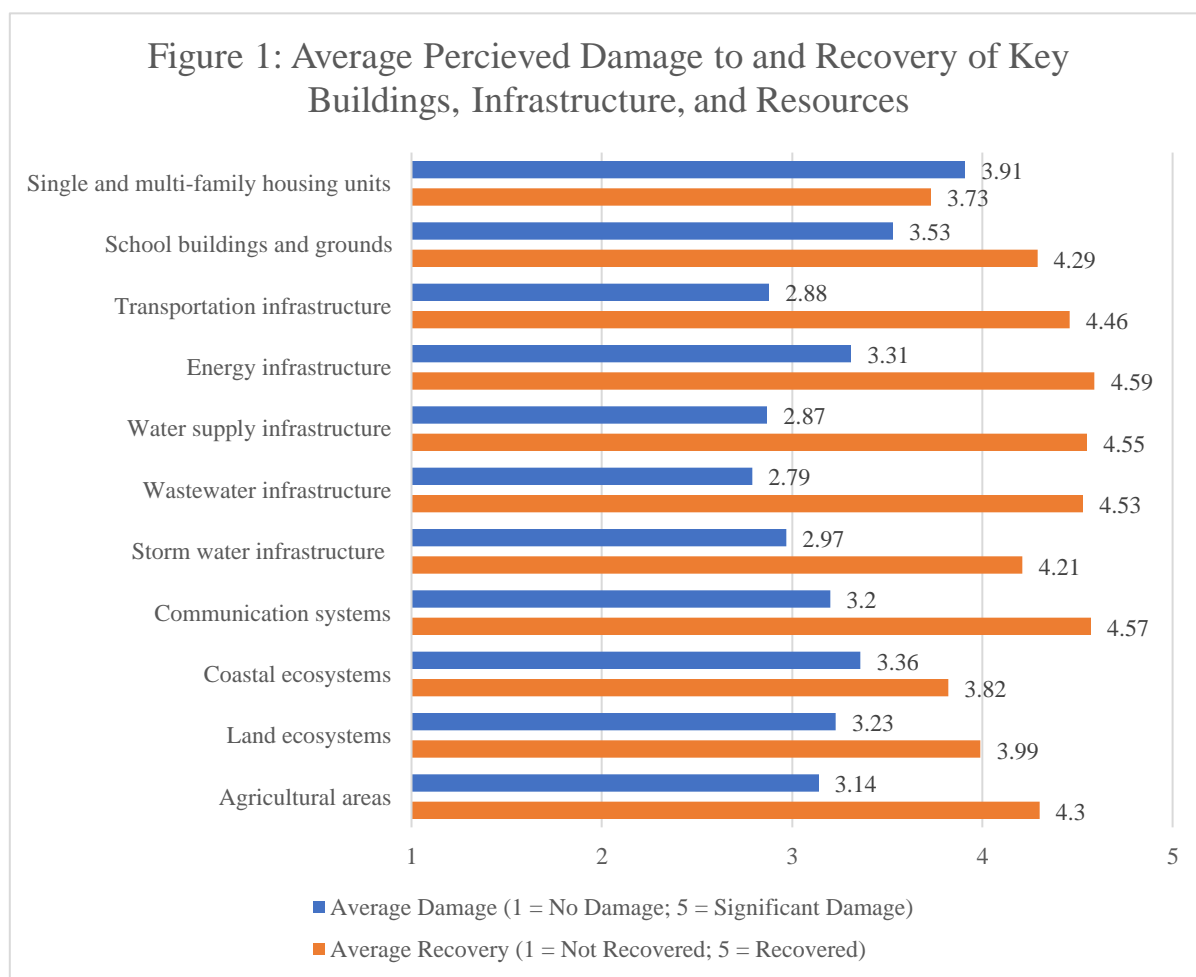
Impact of Hurricane Harvey on Flooding, Damage, and Recovery

Participants were asked to examine a list of potential causes of flooding and to list how much impact they believe each cause had on the amount of flooding that occurred in the Coastal Bend area as a result of Hurricane Harvey. Refer to Appendix A, Table A-1 for the list of potential causes and respondents' ratings of their impacts. Of the potential causes of flooding listed, over 65

percent of participants believed that inadequate drainage of flood prone areas had a *Strong* or *Very Strong* impact, nearly 60 percent believed that building in areas prone to flooding had a *Strong* or *Very Strong* impact, and almost 51 percent believed that degraded natural flood control areas (e.g., wetlands, coastal barrier islands, sand dunes) had a *Strong* or *Very Strong* impact on flooding in the Coastal Bend area. A substantial number of respondents also believed that inadequate flood protection infrastructure had a *Strong* or *Very Strong* impact on flooding.

Impact in the Community Coastal Bend

In order to assess both perceived damage and subsequent recovery, participants were asked two questions: 1) “How much damage did Hurricane Harvey cause to the following buildings, infrastructure, and resources in your community?” and 2) “How much have the following buildings, infrastructure, and resources in your community recovered since Hurricane Harvey?” Participants rated damage on a 1 to 5 scale, ranging from *No Damage* to *Significant Damage*. Likewise, participants rated recovery on a 1 to 5 scale, ranging from *Not Recovered* to *Recovered*. Responses are reported in Figure 1 below.



As shown in Figure 1, participants indicated that single and multi-family housing units sustained the most damage out of all of the listed buildings, infrastructure, and resources, and were considered to be the least recovered. Energy infrastructure, while identified as having incurred between some damage to a lot of damage, was considered to have recovered the most, followed closely by communication systems, water supply infrastructure, and wastewater infrastructure.

Participants were also asked to indicate which, if any, segments of their communities were especially hard hit by Hurricane Harvey. Of the community segments listed in Appendix B, Figure B-4, 158 participants indicated that low income residents in their community were especially hard hit. About the same number of participants indicated renters (136), the elderly (133), and homeowners (131) were especially hard hit. Children were selected by the least number of participants (101).

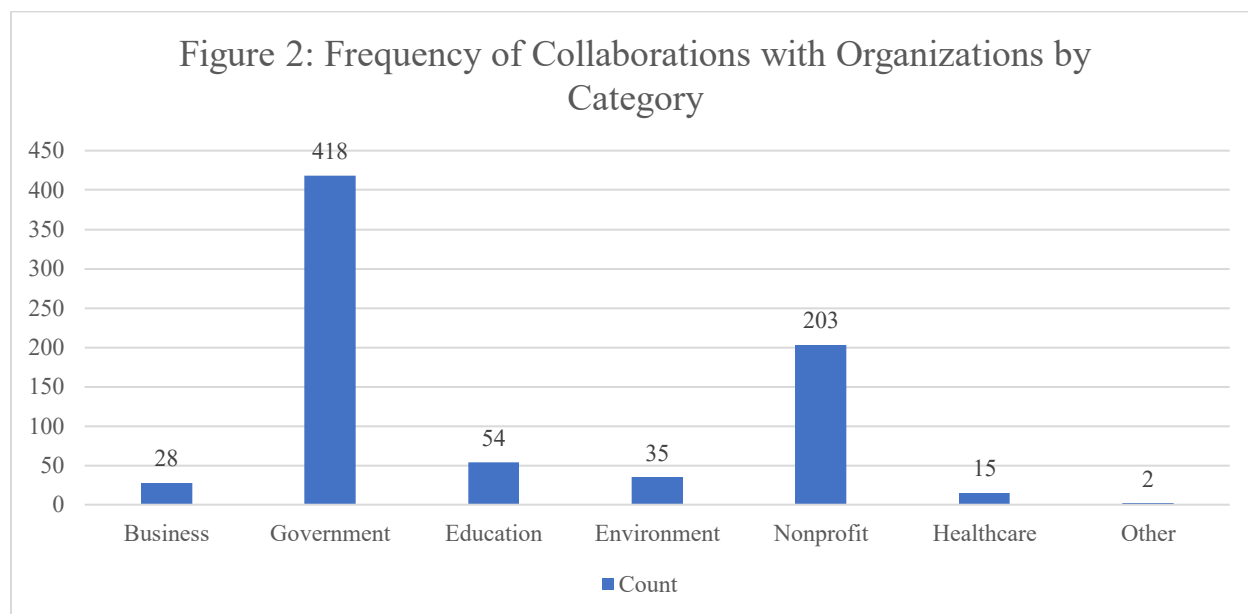
Market Sector Recovery

In addition to other areas of recovery, participants were asked about their perceptions of the recovery of various market sectors in their communities. Overall, participants believed that the large-scale commercial enterprise sector was the most recovered. Almost 69 percent of respondents indicated that they found that sector to be *Mostly Recovered* or *Recovered*. There was less certainty about small businesses and the rental housing market. While 44.1 percent of respondents believed that small businesses were *Mostly Recovered* or *Recovered*, another 27.7 percent indicated that the small business sector was only *Somewhat Recovered*. Similarly, 44 percent believed that the rental housing market *Mostly Recovered* or *Recovered*, while 21.8 percent indicated that it was *Somewhat Recovered*, and 14.6 percent believed it was *Not Recovered* or only *A Little Recovered*. Refer to Appendix A, Table A-2 for the full list of responses and the scale.

Organizational Collaboration and Activities

Next, organizational representatives were asked to list organizations with whom they have collaborated on recovery and resilience issues since Hurricane Harvey. Along with the name of the organizations with whom they have collaborated, participants were asked to identify the frequency of the collaboration (either weekly, monthly or annually) as well as the importance of the collaboration for improving resiliency. Participants identified approximately 362 organizations with whom they have collaborated since Hurricane Harvey. The top five most collaborated with organizations are FEMA (52 collaborations), the Texas General Land Office (39 collaborations), various county governments (17 collaborations), Red Cross (14 collaborations), and the Texas Division of Emergency Management (14 collaborations).

These organizations were coded into seven categories: Business, Government, Education, Environmental, Nonprofit, Healthcare, and Other. The frequency of these collaborations is depicted in Figure 2. By far, organizations collaborate most often with government organizations. These include local, state, and federal government entities. The second most collaborated with groups include nonprofit organizations. These entities include national groups like the American Red Cross as well as several nonprofit organizations local to both Texas and the Coastal Bend.

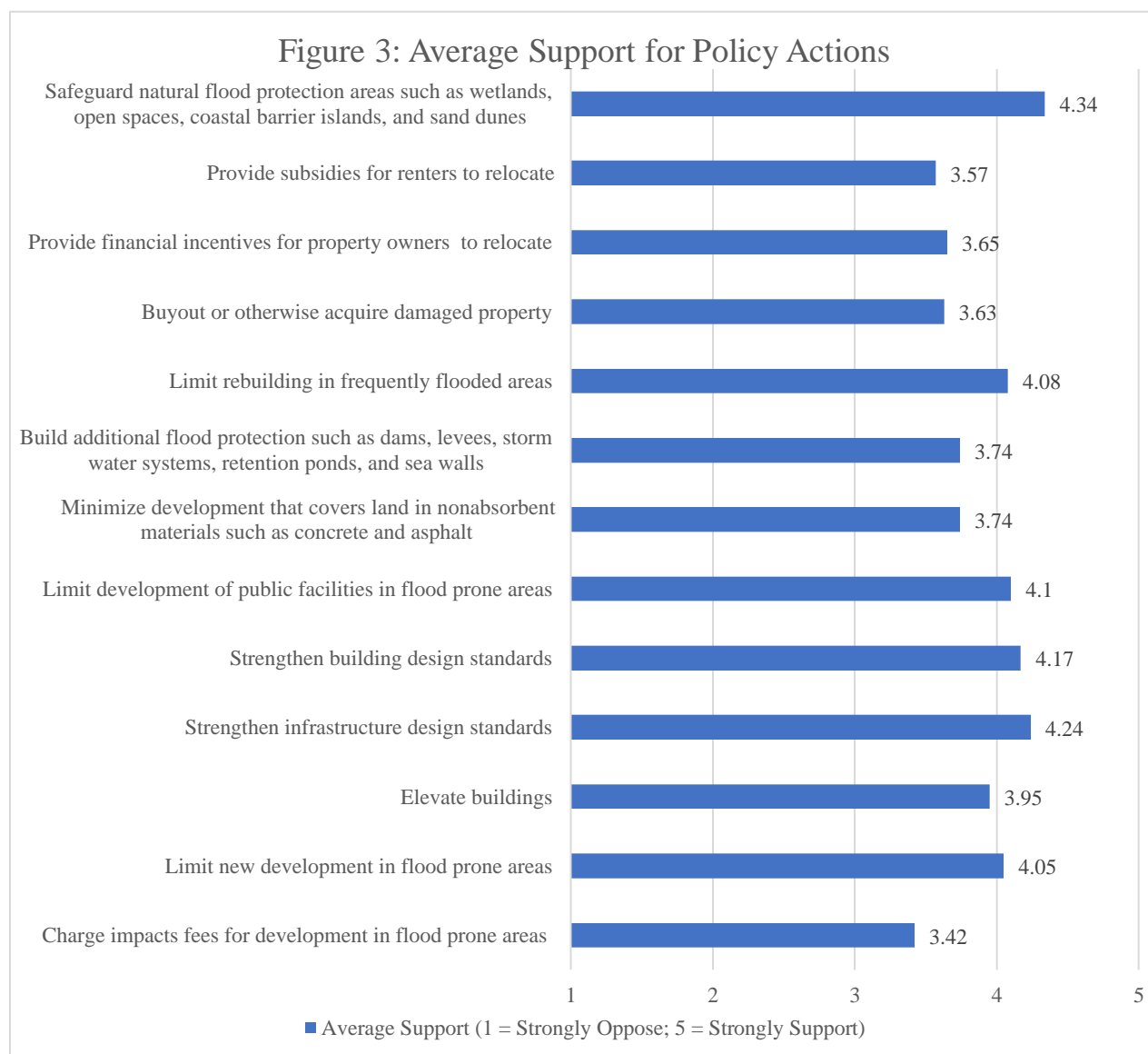


In terms of recovery and resiliency activities, organizational representatives were asked to indicate whether or not they had engaged in specific activities, either individually or with other organizations. The most engaged-in activity was increasing the sharing of information. For this activity, 61 organizations worked to increase information sharing individually, while 103 organizations worked on this task with other organizations. Infrastructure repair and construction-related activities were also popular, and included the funding, planning, and making of infrastructure repairs and construction.

Recommendations: Support for Policy Actions

Respondents were asked to indicate how much they oppose or support the following policy actions meant to improve recovery and resiliency to hurricanes and strong storms in the Coastal Bend area. Support was rated on a 1 to 5 scale, where 1 indicated that the participant *Strongly Opposed* the policy action and 5 indicated that they *Strongly Supported* the action. Recommendations for action are for the top three most supported actions, which were safeguarding natural flood protection areas, strengthening infrastructure design standards, and strengthening building design standards (see Figure 3). Other supported policy actions clustered

around limiting rebuilding and development in flood prone areas. The least supported policy action was charging impact fees for development in flood prone areas. In fact, there was a significant difference in support by race, such that racial minority participants were less likely than white participants to support charging impact fees.



Finally, participants were asked to assess how ineffective or effective they believe certain government actions would be for improving community resilience. As Table 1 indicates, over two-thirds of all participants indicated that all policies listed would be either *Effective* or *Very Effective* government actions. Specifically, over 85 percent of participants indicated a belief that forming partnership agreements for recovery work would be an effective government action, and over 84 percent believed that prioritizing functions most critical to recovery would be an effective government action.

Table 1*Perceived Efficacy of Government Actions on Improving Community Resilience*

Government Actions	Very Ineffective	Ineffective	Neutral	Effective	Very Effective	Not Sure
	<i>(Percentage)</i>					
Establish coordination agreements between municipalities to provide mutual aid	0.49	3.45	9.85	48.28	25.12	12.81
Establish coordination agreements for using municipal and state resources	0.49	1.48	9.85	49.26	29.56	9.36
Prioritize functions most critical to recovery	0.49	0.49	7.39	42.86	41.38	7.39
Form partnership agreements for recovery work such as debris removal and road repairs	0.00	0.99	5.91	45.32	39.90	7.88
Streamline application processes for social services and disaster programs	0.99	1.97	7.39	31.53	48.28	9.85
Create a regional task force to prioritize and oversee the recovery process	0.99	5.42	14.29	33.99	33.99	11.33
Identify regulatory waivers needed during a disaster	0.99	3.96	14.85	29.70	36.63	13.86

Sub-Appendix A: Tables

Table A-1

Impact of Various Causes of Flooding in the Coastal Bend Area due to Hurricane Harvey

Potential Causes of Flooding from Hurricane Harvey	No Impact	Weak Impact	Somewhat Strong Impact	Strong Impact	Very Strong Impact	Not Sure
	(Percentage)					
Building in areas prone to flooding	3.24	11.57	17.13	24.54	35.19	8.33
Degraded natural flood protection areas such as wetlands, open space, coastal barrier islands, and sand dunes	4.61	15.67	15.21	24.42	26.27	13.82
Inadequate drainage of flood prone areas	3.24	7.87	13.89	35.65	30.09	9.26
Development that covers too much land in nonabsorbent materials such as concrete and asphalt	4.17	22.69	12.50	19.44	25.46	15.74
Inadequate flood protection infrastructures such as dams, levees, storm water systems, retention ponds, and sea walls	5.56	24.07	18.52	21.30	18.06	12.50
Ineffective intergovernmental flood planning and cooperation	4.63	22.22	17.59	19.44	19.91	16.20
Funding shortage to build appropriate flood protection infrastructures	3.24	15.74	17.59	20.83	25.46	17.13
Local hazard mitigation plan does not require implementation of the actions	4.65	16.74	19.53	13.02	14.88	31.16

it identifies as ways to
improve flood protections.

Table A-2
Perceptions of Market Sector Recovery after Hurricane Harvey

Market Sectors	Not Recovered	A Little Recovered	Somewhat Recovered	Mostly Recovered	Recovered	Not Sure
	<i>(Percentage)</i>					
Rental housing market	4.15	10.36	21.76	22.80	21.24	19.69
Real estate market	2.58	3.61	15.98	29.90	27.84	20.10
Recreational fishing	0.54	3.23	10.22	26.88	33.87	25.27
Tourism (other than fishing)	0.53	3.74	20.32	29.41	25.13	20.86
Small businesses	2.05	8.21	27.69	26.67	17.44	17.95
Large-scale commercial enterprises	0.00	1.57	8.38	28.80	39.27	21.99
Healthcare services	7.49	5.88	8.02	14.44	42.25	21.93
Job market	2.08	6.25	17.19	17.19	36.98	20.31

Sub-Appendix B: Figures

Figure B-1: Number of Participants by Organization Type

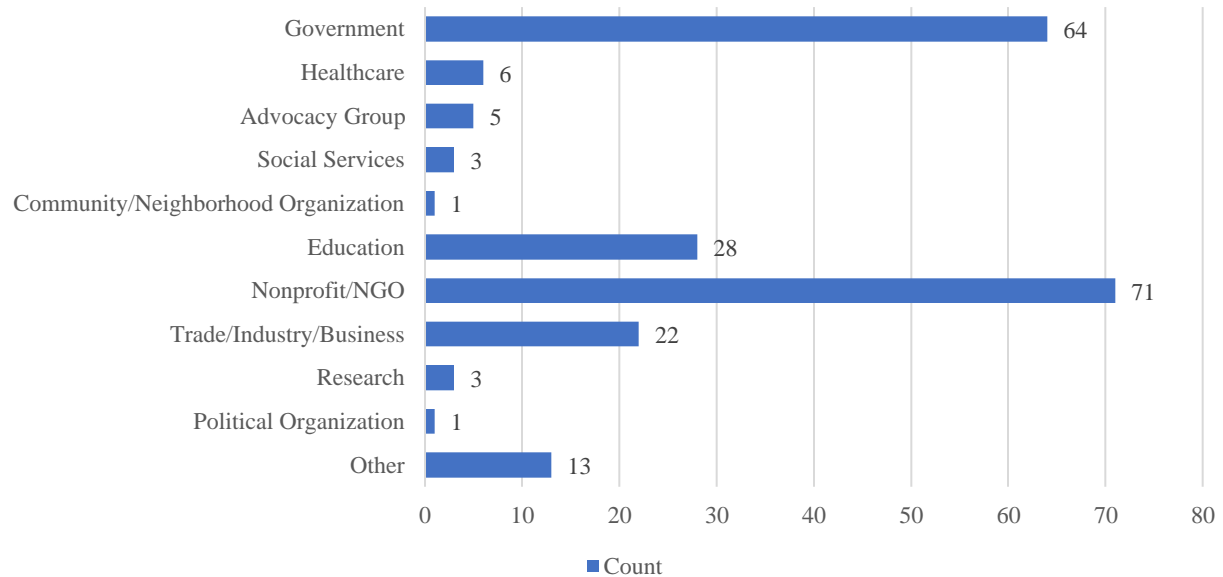


Figure B-2: Roles Performed Within an Organization

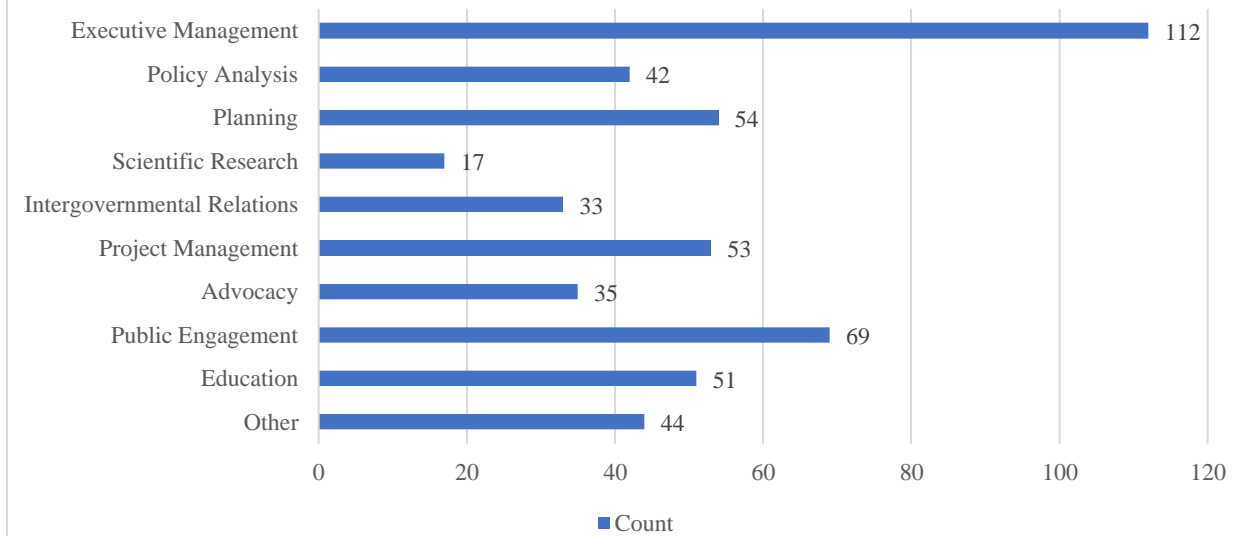


Figure B-3: Perceived Competence of Entities at Helping Local Communities Recover from Natural Disaster

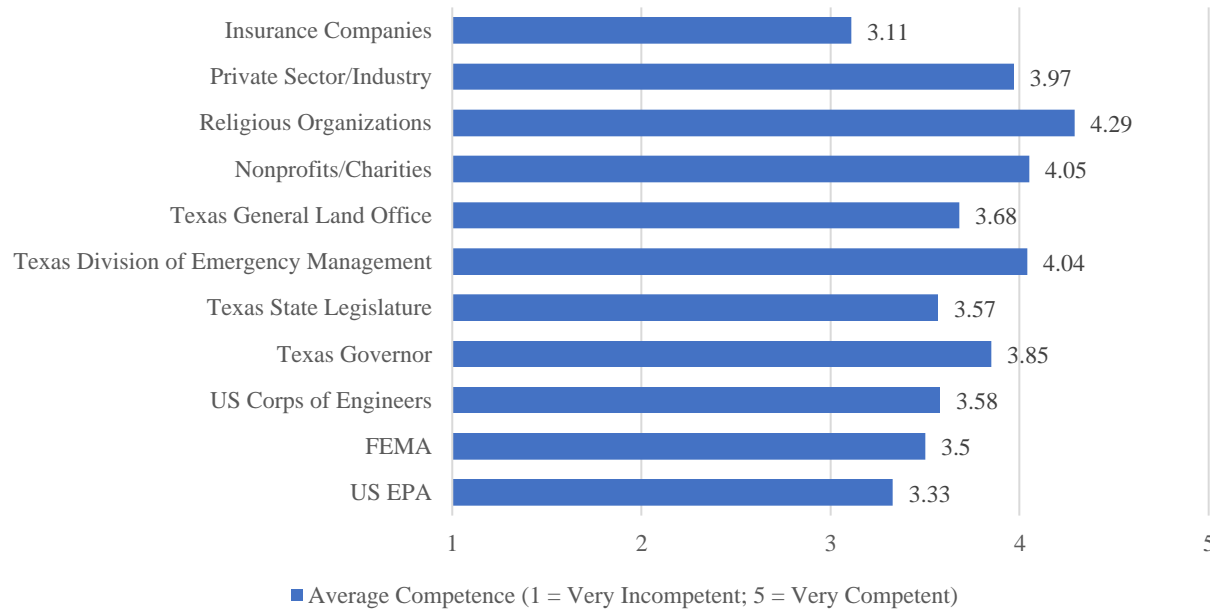


Figure B-4: Perceptions of Which Community Segments were Especially Hard Hit by Hurricane Harvey

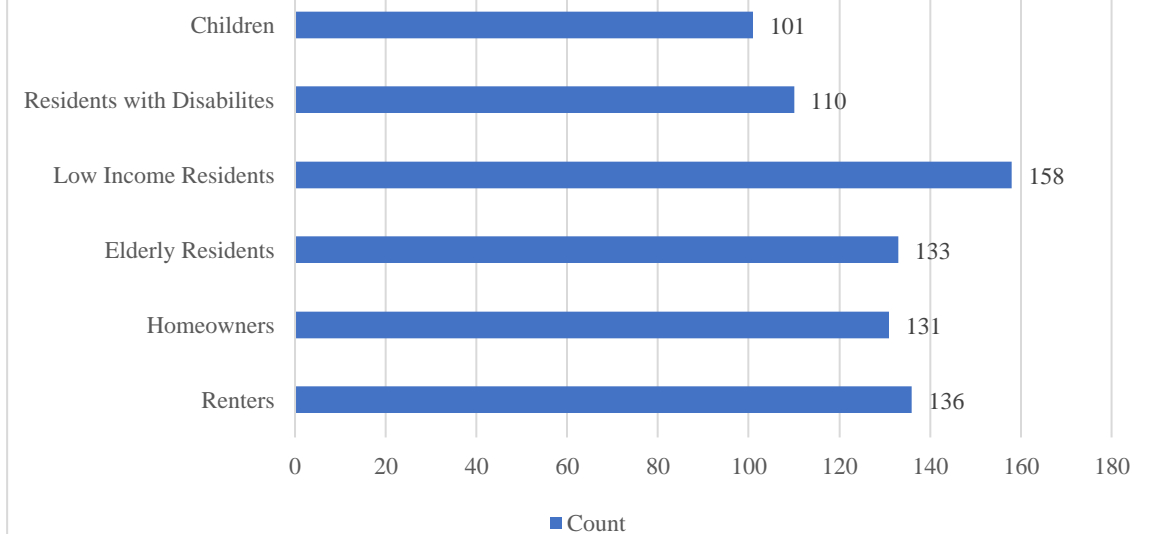
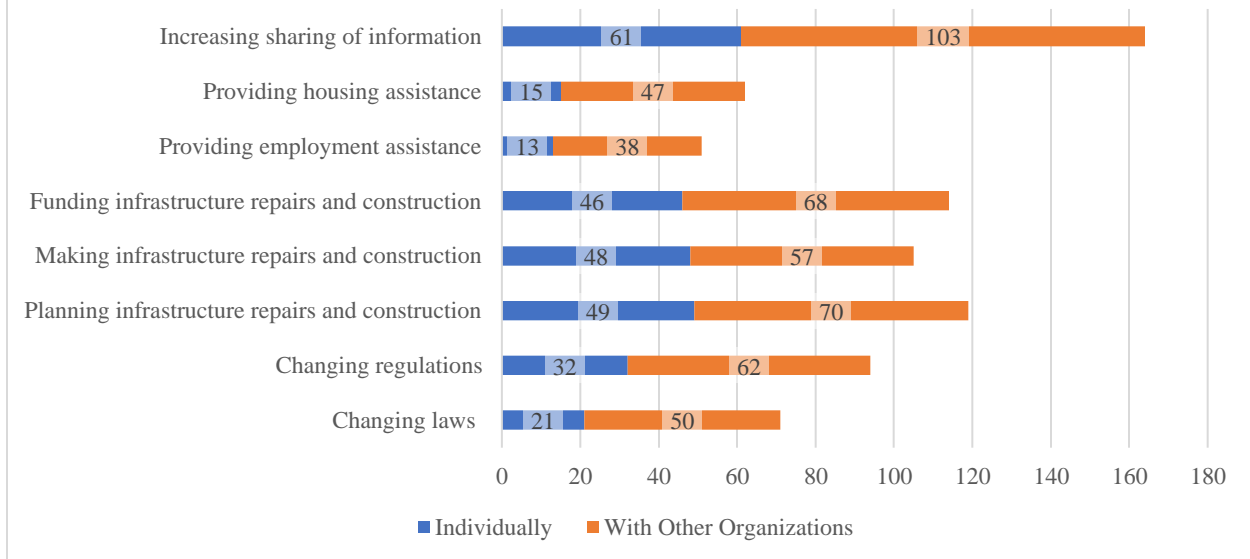


Figure B-5: Number of Groups Performing Specific Hurricane Recovery and Resilience Activities



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APPENDIX III: Plan Integration for Resilience Scorecard for Disaster Recovery (PIRS-DR) - Improving Disaster Recovery through Spatial Plan Evaluation

Application in Flood-Vulnerable Communities in the Texas Coastal Bend

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OneGulf Note: This project report is pending publication and will be released in full once published. Contact Texas OneGulf Director Dr. Katya Wowk for further information: katya.wowk@tamucc.edu

APPENDIX IV: Disaster Resilient Texas Communities - *Natural and Man-Made Disasters* - Legal Disaster Response & Resilience Framework

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Executive Summary

Objectives & Methodology

After Hurricane Harvey decimated the Texas coast in 2017, the Center for U.S. and Mexican Law, at the University of Houston Law Center, as part of the Texas OneGulf Consortium project with the Harte Research Institute and within the research project ‘RESTORE Centers of Excellence: Hurricane Harvey Decision – Support – Resilient Environments and Communities¹’, initiated a series of interviews with first responders and public stakeholders to further understand and improve disaster response. From this effort common concerns were expressed across the various professional disciplines that gave rise to the content of this framework. Subsequent hazardous material fires and chemical spills in the Texas water channels and coastal areas, along with the evolving effects of climate change, demonstrate that these natural and man-made disasters have begun to expand the boundaries of disaster law, justifying a deeper analysis of this new branch of the Law. Disaster Law arises from the lessons learned from past catastrophes, and this law can shape the critical and irreversible decisions made by those in charge of response efforts during the response phase of a disaster. Texas communities are subject to federal, state and local laws that address emergency and disaster response, and the fact that first responders and emergency

¹ This research has been performed by the Center for U.S. and Mexican Law (US-MEX LAW) at the University of Houston Law Center, under the research project “RESTORE, Centers of Excellence: Hurricane Harvey Decision-Support – Resilience Environments and Communities” (1RCEGR480001/TCEQ 582-15-57594/GAD 91613), coordinated by Harte Research Institute for Gulf of Mexico Studies, at Texas A&M University Corpus Christi, and sponsored by the Texas Commission on Environmental Quality (TCEQ).

managers will be called upon to carry out those laws is undeniable. Their knowledge is essential today. The core legal issues related to the response phase include, but are not limited to:

- Public authorities for emergency response
- Modifications of scope of employments
- Liability of responders
- Suspension of relevant laws during a state of declared emergency

The purpose of this framework is to give answers about the legal considerations emergency responders and managers should face when dealing with natural disasters, and by analogy, to catastrophic situations. The framework also provides high priority recommendations to state and local decision-makers in strengthening Texas' resilience.

While this framework has an expansive scope, it focuses on the policy and legal considerations in declared emergencies and the decisions taken in this context. Notably, however, its content only represents a sample of the laws and policies that disaster response can invoke, and aims primarily at state laws and policies, although it also discusses some local provisions in certain examples. It is also important to note that Texas allows the Governor or Mayor to suspend laws during times of disaster response, which would not apply to this framework.² Several questions come to mind when identifying the purpose of the present framework. These are the questions we will seek to answer: is there an international background for disasters law framework? Is there any impact of those recommendations in Texas Law? From the strategic level (the City council), going through the tactical level (Fire Chief departments) and ending up at the task level (First responders), what are the elements to keep in mind when taking a decision where time is of essence? What are the legal issues around those situations? What should lead the decision when there would be a lack of law to be applied? What are the needed ethical aspects of the decision? What is sought to be achieved? Can reasonable or compelling force be used? When? How can risk be minimized? Why is training and education in managing emergency response critical? Why it is so decisive for decision makers to closely understand the situation, being well surrounded by a team? Why are communication techniques are so critical?

This project identifies and analyzes the legal issues that affect first responders, emergency managers and other response providers during the response phase of a disaster. It offers its conclusions in a format designed to assist Texas agencies and communities in their effort to navigate relevant laws and policies of disaster response.

² Tex. Gov't Code § 418.016(a)

First Responder Terminology & Field Guidebook Flowcharts

Merriam-Wester dictionary defines a first responder as “a person (such as a police officer or an Emergency Medical Technician - EMT) who is among those responsible for going immediately to the scene of an accident for emergency to provide assistance.”³ This description seems to reflect the public’s understanding when referring to first responders, but this can also apply to dozens of other professions.⁴ Likewise, multitudes of laws refer to, or scarcely define “first responder,” but their usage lies well beyond the scope of this framework. Recognizing the expanding field, this framework focuses on government responders but may also pertain to private responsible parties and non-governmental or quasi-governmental agencies. In an effort to make information usable in field operations, sample flowcharts have been provided in the Appendix A. The flowcharts can be reduced to a pocketsize guide for responders, commanders and emergency managers during deployment to remote command posts or operations centers.

Introduction

Law & Disaster Response & Resilience Project Background

In March 2015 the United Nations adopted the *Sendai Framework for Disaster Risk Reduction 2015-2030*, after a process of consultation with stakeholder and governments that started in 2012⁵. This instrument is considered the second act of United Nations actions, after the *Hyogo Framework for Action (HFA) 2005-2015: Building Resilience of Nations and Communities to Disasters*. Moving from disaster management, to disaster risk management, the Sendai Framework seeks to define several global targets, preventing new risks, reducing the existing ones, and bringing resilience to a superior level, by understanding disaster risks, vulnerability and hazards, strengthening disaster risk governance, and accountability for disaster risk management⁶.

If progress has been achieved in building resilience and reducing damages, more needs to be done, focusing especially in persons and their health, preventing and reducing hazard exposure

³ <http://www.merriam-webster.com/dictionary/first%20responder>

⁴ http://www.usfra.org/notes/Who_is_a_First_Responder?show=true

⁵ . Sendai Framework for Disaster Risk Reduction 2015-2030, allows to globally agree and understand disaster risk management and mitigation, from an innovative implementation perspective by taking into account holistically the different sectors prevention and preparedness need to be taken into account. Sendai Framework for Disaster Risk Reduction 2015-2030, United Nations (accessed December 15, 2019)

https://www.preventionweb.net/files/43291_sendaiframeworkfordrren.pdf

⁶ . Cfr. Foreword, Margareta Wahlstrom, United Nations Special Representative of the Secretary General for Disaster Risk Reduction, *ibidem*.

and vulnerability to disaster, increasing preparedness to react, to respond and to recover, with the correspondent impact on resilience. For that, a larger involvement of political leadership is required at all levels, internationally, nationally and locally. To achieve this outcome, the Sendai Framework enumerates the multi-factorial dimension of the measures that need to be adopted from an integrated perspective: economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional⁷. The purpose of the present framework and research under the Texas OneGulf Consortium Project is situated in the legal dimension of disaster risk reduction and management and could not be more timely.

1. The Sendai Global targets

The *Sendai Framework for Disaster Risk Reduction* agreed on seven global targets (along with four priority areas⁸), that allow measurement of the achievements of outcomes set in the UN instrument, serving as an inspiration, among others, to the legislative production in the respective country dealing with disasters risk management and response. The seven global targets set by the Sendai Framework are⁹:

- a. To reduce **global disaster mortality** by 2030, lowering the average per 100,000 global mortality rate between 2020 and 2030, compared to period 2005-2015.
- b. To reduce the number of **affected people globally** by 2030, also reducing the global figure per 100,000 between 2020 and 2030, compared to period 2005-2015.
- c. To reduce **disaster economic loss related to GDP** (Global gross domestic product) by 2030.
- d. To reduce **disaster damage to critical infrastructure and disruption of basic services** (i.e. health and educational facilities), making them more resilient by 2030.
- e. To increase the **number of countries that have a national and local disaster risk reduction strategy** by 2020.
- f. To enhance **international cooperation to developing countries** through adequate and sustainable support to complement their national actions by 2030.
- g. To increase access to **multi-hazard early warning systems and disaster risk information and assessments** to people by 2030.

⁷ . *Ibidem*, Paragraph 17.

⁸ . Understanding disaster risk; Strengthening disaster risk governance to manage disaster risk; Investing in disaster risk reduction for resilience; Enhancing disaster preparedness for effective response and to 'Build Back Better in recovery, rehabilitation and reconstruction. Cfr. Sendai Framework for Disaster Risk Reduction 2015-2030, United Nations, IV Priorities for Action, Paragraph 20 (*accessed December 15, 2019*)

⁹ . *Ibidem*, Paragraph 18.

2. Understanding disaster risk

To understand disaster risk is defined by the Sendai framework as the way to understand the vulnerabilities, capacities and exposure of the persons and assets involved, trying to know the hazard characteristics and analyze the situation and evolution of the environment. Knowledge is key to evaluate in advance of risk of a most probable natural disaster, in order to prevent and mitigate it, and to develop and implement preparedness and an effective response to disasters¹⁰. The collection of data and practical information, as well as to dissociate any private protected information before disseminating it, are part of how authorities need to understand risk. The generation of this knowledge is what allows decision-makers to address community needs. This information should be easily available and accessible in real time by everyone.

By understanding risk we consider the periodic assessment of vulnerability, capacity and exposure of communities, including risk maps that need to be known by decision makers and the public, and especially by those communities that are more exposed than others. Information and communication technologies can be a way to measure, collect and analyze data (surveys, disaster risk modeling; assessment; mapping; monitoring; multi-hazard warning systems). Generating awareness and building knowledge at all levels of society is essential. From a multifactorial dimension, to understand disaster risk management goes also through the promotion of a dialogue and cooperation between scientific and technological communities, relevant stakeholders and policymakers to facilitate a scientific interface for effective decision-making on disaster risk management. This cooperation goes also through the combination between different types of knowledge (traditional, indigenous, local, scientific), to develop policies, strategies, plans and programs for specific sectors. One need to consider disaster prevention, mitigation, preparedness, response, recovery and rehabilitation as well, by promoting a culture of disaster resilience.

3. Strengthening disaster risk governance and responsibility of states to prevent and reduce disaster risk:

One of the guiding principles set by the Sendai Framework is that each State has the primary responsibility to prevent and reduce disaster risk, including through cooperation. Actually, disaster risk reduction requires that between central government, local government, and relevant national authorities and stakeholders, responsibilities and authorities may be shared overall to protect persons, properties and health. Institutional integrated engagement means to work through partnership, and from an inclusive point of view to avoid discrimination, specifically from those strongly affected by the disaster, and among others, the poor. Also, to manage and

¹⁰ . Cfr. *Ibidem*, Priority 1. Paragraph 23.

reduce disaster risk, a coordination of relevant stakeholders at all levels, and the total engagement of the Nation's institutions is promoted¹¹. From executive and legislative institutions at the national level, to those at local levels. The University or the business sector are also considered as needing to articulate responsibilities through public and private sectors, to obtain the mutual outreach sought. In fact, the United Nations Office for Disaster Risk Reduction (UNDRR) acknowledges the existence of gaps in public and private partnership that exist when addressing disaster risk reduction management, including gaps in urban planning and environmental laws, associated to buildings' safety, land use by constructors, and spatial planning by public authorities. That is why a coherent, inclusive and strong legal framework is a critical tool for good governance in order to reduce the risks that may be caused by natural disasters and in order not to create more risks by human decisions of urban planning.

Society is interlinked and interconnected when addressing disaster risk management. Private sectors must also seek solutions to mitigate risks connected to natural disasters and bring solutions from a shared responsibility perspective. Every action, public or private investment should be risk informed, including in normal market mechanisms. By doing so, societies will reduce risks by creating strategies that foster resilient communities¹².

The Federal governments will exert the role of coordinator at the national level, and at the same time local authorities and communities have to be empowered to reduce disaster risk. This empowerment can be done through providing resources, incentives and identifying decision-making responsibilities. In fact, while disaster risk can be analyzed through a global perspective, reducing it requires understanding of locally specific characteristics. This empowerment can deal with a lack of understanding and communication that exists in these situations. Further, policies, plans, practices or mechanisms can target coherence among the many various factors involved, such as growth and sustainable development, food security, health and safety, climate change, environmental management and disaster risk reduction agendas.

While legislation may be pertinent to and envision precise situations, there is sometimes a gap or distance between the enacted legislation and the specific implementation and enforcement of those norms. The lack of resources at the local level, the weak culture of compliance or the fact that local governments are not prioritizing disaster risk reduction may be among the causes

¹¹ . Cfr. *Ibidem*, Guiding Principles, paragraph (e).

¹² . K.L.H. Samuel, M. Aronsson-Storrier, K. Nakjavani Bookmiller, *The Cambridge Handbook of Disaster Risk Reduction and International Law*, Cambridge University Press, 2019, Foreword by Paola Albritto, p. xvi

of this lack of correlation¹³. Local authorities should be empowered through regulatory and financial means to work and coordinate with society in ways to manage disaster risk at local level.

By strengthening disaster risk governance, the Sendai framework considers the creation of effective and efficient mechanisms of disaster risk management (*clear vision plans, competence, guidance and coordination across sectors, and participation of relevant stakeholders*)¹⁴. To achieve this goal, it is relevant to promote and develop a coherent national and local set of laws, regulation and public policies that define responsibilities and roles, promote incentives for the community, enhance transparency, financial incentives and awareness and create organizational structures. Good governance of also includes promotion of public analysis and encouragement of institutional debates. Legislators should amend relevant legislation and allocate budget. Those mechanisms should ensure compliance with safety provisions considered in laws and regulations (such as mentioned, land use, urban planning, building codes, environmental, health and safety standards). Also, when formulating public policies, aspects such as prevention or relocations of persons and human settlements in disaster zones should be taken into account.

4. Preparedness to build back better

Another interesting priority is to further strengthen disaster preparedness in order to respond to and take actions in an anticipated way, combining both disaster risk reduction (taking steps in advance to avoid the situation if possible) and building the capacities for an effective response at every level of the decision making and action chain. Interestingly, the Sendai Framework highlights that equality is a matter of thought, in the sense that women and persons with disability must be empowered with equitable and universally accessible response, recovery, rehabilitation and reconstruction phase¹⁵. Actually recovery, rehabilitation and reconstruction phases need to be prepared in advance, in the notion that the Sendai Framework calls “Build Back Better”¹⁶.

At national and local level, a number of actions need to be accomplished in order to achieve this priority. This may serve as a recommendation to develop an appropriate set of rules in order to be prepared towards the adversity of climate disasters with equity in mind. By achieve resilience

¹³ . K.L.H. Samuel, M. Aronsson-Storrier, K. Nakjavani Bookmiller, *The Cambridge Handbook of Disaster Risk Reduction and International Law*, Cambridge University Press, 2019, Foreword by Paola Albritto, p. xv

¹⁴ . Cfr. Sendai Framework for Disaster Risk Reduction 2015-2030, United Nations, IV Priorities for Action, Paragraph 26 (*accessed December 15, 2019*)

¹⁵ . To know more about equality and natural disasters, cfr. Kristina Cedervall Lautu, “Human rights and natural disasters”, *Research Handbook on Disasters and International Law*, Edward Elgar Publishing, 2016, p. 91

¹⁶ . Priority 4, Paragraph 32.

and “Build Back Better”, we also understand to review regular plans and programs seeking to consider the different situations that can happen and their impact. Early warnings plans and systems can therefore be developed, encouraging the participation of all actors. Among these actors, infrastructure experts should be involved, as to grant the resilience of buildings, telecommunications and transportation infrastructures, grid¹⁷, and hospitals among others. Other actions that can allow us to achieve resilience is to train first responders, workforce and voluntary forces in coordinated disasters response exercises, including evacuations, relocations, access to safe shelters, to food, etc. Among these trainings, there is also the content of this framework in terms of legal issues for emergency responders and managers on how to deal with disaster response and resilience. Let us turn to this now.

Part 1: Disaster Response Law

Mandatory Evacuations

A mandatory evacuation is when emergency management officials order a compulsory evacuation in a certain area as a protective action to save the lives of the persons in the area: residents, passers-by and first responders. In Texas, a county judge or mayor of a municipality who orders an evacuation may compel persons who remain in the evacuated area to leave, and they can authorize the use of reasonable force to remove such persons.¹⁸ While this legal power places great weight on the exact threshold under which force remains “reasonable,” the statute does not define the terms “reasonable force” and “compel.” As a result, the responsible elected official retains a great degree of discretion to determine the level of appropriate force. First responders should also note that the issuance of such orders can trigger other individual constitutional rights and require the government to provide additional services to carry out a mandatory evacuation (i.e. transportation). With this backdrop, first responders do not have much guidance on determining the correct level of force to execute the evacuation order and may want to contact legal counsel.

¹⁷ . To know more about building resilient grid, see Rosemary Lyster and Robert R.M. Verchick, “Protecting the power grid from climate disasters”, Research Handbook on Climate Disaster Law, Barriers and Opportunities, Edward Elgar Publishing, 2018, p. 275

¹⁸ Tex. Gov. Code Ann. § 418.185

Example of Evacuation Reasonable Force

During Hurricane Harvey, disaster response officials cut electrical power to flooded homes which deterred people from returning to inundated areas. This action avoided emergency responders being dispatched to dangerous flooded locations which posed threats of electrocution and structure fires.

“Mandatory evacuation issued for flooded homes near Addicks and Barker reservoirs.” ABC13.com. Retrieved from <https://abc13.com/power-cut-to-flooded-homes-in-west-houston-evacuation-zone/2370185/>

In terms of security, for groups of people that may want to reenter an evacuated area, first responders may need to implement a phased-reentry program, including requisite credentials, to govern the process.¹⁹ For those first responders arriving at an evacuated area with a restricted access, they must initially check-in at a designated Incident Command Post or staging area instead of directly responding to the stricken area.

Preserving Evidence

In case of man-made disasters, public agents have the duty to preserve evidence. Indeed, in addition to controlling access to a disaster area, emergency responders clearly also have the legal authority to enter private property to resolve an emergency, including investigating the cause of the emergency. To remain on the property for investigation, “officials need no warrant to remain for a reasonable time to investigate the cause of a blaze after it has been extinguished.”²⁰ The notion to determine a reasonable time, one court has stated that the “[a]ppropriate recognition must be given to the exigencies that confront officials serving under these conditions, as well as to individuals' reasonable expectations of privacy.” The court added that, for the emergency responder, the appropriate expectation of privacy can “vary with the type of property, the amount of damage, prior and continued use of the premises, and, in some cases, the owner's efforts to secure it against intruders.”²¹ Therefore, we see that discernment and common sense is asked to emergency responders when giving content to the mentioned notions.

As first responders also now receive tactical ballistic personal protective equipment (i.e. bullet-proof vest, helmets, trauma kits, etc.) at times, the roles of police, firefighters, and emergency medical technicians may overlap during a disaster response. This can be situated, for instance, if

¹⁹ Tex. Gov't Code Ann. § 418.050

²⁰ *Michigan v. Clifford*, 464 U.S. 287; 104 S.Ct. 641 (1984)

²¹ *Id.*

first responders encounter illegal drug substances, paraphernalia or weapons while responding to a disaster, they do not have to confiscate the material themselves and act as police officers, they can call for the police to enter the property and take possession of the items.²² As the Texas appellate court succinctly held in 2019, as a matter of first impression, that a police officer's entry into a defendant's apartment, after a firefighter who responds to a fire at the apartment observed contraband in plain view, and asked the officer to secure the apartment, was lawful.²³

First responders may also need to protect evidence during a hazardous materials response caused by a man-made or natural calamity. Here, the first responders, with or without hazardous materials team, may enter the property to determine the risk to the public and to take samples to confirm the dangers associated with exposures to the chemical or toxic substance. The same principles mentioned above also apply during hazardous material responses. Without the right to enter private property and, if necessary, collect samples that also effectively preserve evidence, first responders may themselves fall victim to toxic or chemical exposures.

A Court's Statement on Overlapping Roles

Police officers often fill many roles, including paramedic, social worker, and fire investigator ... When those roles overlap the role of criminal investigator, it is not unreasonable to allow officers "to step into the shoes of" the firefighter to observe and to seize the contraband without first obtaining a warrant ... Allowing this limited entry by an officer constitutes no greater intrusion upon the defendant's privacy interest than does a firefighter's entry ... Under such circumstances, it would impose needless inconvenience and danger—to the firefighter, the officer, and the evidence—to require suspension of activity while a warrant is obtained ... Firefighters' efforts are best devoted to fighting fire and sorting the aftermath, which are within their mission and core expertise. When, as here, the presence of firearms and contraband distracts from that mission, firefighters should be permitted to call upon police, whose expertise includes handling firearms and securing contraband.

Michigan v. Clifford, 464 U.S. 287; 104 S.Ct. 641 (1984)

²² *Martin v. State of Texas*, 576 S.W.3d 818 (Tex. App. [Fort Worth] 2019)

²³ *Id.*

Oil/Chemical Incidents and Information Sharing

In procedural terms, oil spills in Texas require the responsible party to immediately notify the Commissioner of the General Land Office (GLO) and undertake all reasonable actions to mitigate the pollution.²⁴ Local first responders and emergency managers responding to the oil spill will work under the GLO Commissioner, a state-designated on-scene coordinator and/or a federal on-scene coordinator.²⁵ Responders who voluntarily assist with the clean-up process pursuant to the responsible person or the state or federal on-scene coordinators may enjoy qualified immunity for their response efforts.²⁶ The responsible party may refuse to comply with the GLO Commissioner's directions when they believe the GLO Commissioner's directions will unreasonably endanger public safety or natural resources or conflict with directions or orders of the federal on-scene coordinator.²⁷ For oil spills of 240 barrels or less, the Railroad Commission of Texas (RCT) is the on-scene coordinator.²⁸ For other types of petroleum spills or releases of hazardous waste and/or substances, the Texas Commission on Environment Quality (TCEQ) regulates the relationships between the state, the responsible party and the responders.²⁹ Based on the variety of designated on-scene coordinators as assigned by the proper state agency, information sharing between the emergency responders and responsible party can be difficult, and adding to this complexity the responsible party usually has more expertise and equipment to resolve an emergency incident. While responding to a chemical incident with little or no information about the on-scene chemicals is not uncommon, emergency responders do have some options to assist them with any lack of information sharing that may pose a risk to the responders and community in general.

Engage in Planning and Practicing Spill Response

During the 2010 BP Oil Spill, first responders lacked the specialized equipment and requisite expertise to intervene and take control of the cleanup operations. As a result, the national contingency plan was basically "nullified," the public lost confidence in the Federal/BP response, and the relationship with local/state officials deteriorated.³⁰ To address this issue, it was recommended that state and local leaders engage in the planning and practicing of spill response plans to better

²⁴ Tex. Natural Resources Code Ann., § 40.101

²⁵ Tex. Natural Resources Code Ann. § 40.102

²⁶ Tex. Natural Resources Code Ann. § 40.104

²⁷ Tex. Natural Resources Code Ann. § 40.107

²⁸ Tex. Admin. Code Ann. Title 30m Part 1, § 327.1

²⁹ Tex. Admin. Code Ann. Title 30, Part 1, § 327.2

³⁰ Randle, Russell. "Spills of National Significance and State Nullification." *Ocean and Coastal Law Journal*, Volume 16, Number 2, Article 6. 2010

prepare to implement local emergency powers to aid in the response. This plan connects all three parties (responsible party, local leaders, and first responders) and improve the partnerships for more effective responses.

Evacuation Area Protection

Climate change and intense storms that deliver catastrophic flooding pose new risks to first responders when they manage evacuations zones. The 2017 investigation of the Arkema chemical incident during Hurricane Harvey revealed that multiple police officers and first responders were exposed to toxic chemicals while protecting the evacuation area 1.5 miles away.³¹ The Chemical Safety Board (CSB) recommended the facility update their training procedures to assist with protecting first responders enforcing the evacuation perimeter, as well as, expanding protocols to include air monitoring equipment to provide protection when personnel are moved through an evacuation zone during a hazardous material release. When there is a chemical release due to natural disasters, joint efforts to identify appropriate road closures, evacuations routes, communication channels and personal protective equipment improve the shared knowledge of the chemicals on-hand and subsequent response activities. These recommendations are consistent with the BP Spill's recommendation in that both findings encourage more engagement in training and exercises between responders and facility operators.

Local Emergency Planning Committee (LEPC)

Information on chemical sites can also be shared through active participation in the community's LEPCs. A recent Texas guidebook for LEPCs showed an interesting paradox: the most successful LEPCs cited local government support as the greatest contributing factor, but it also stated that low participation (including local governments) was the greatest obstacle to success.³² Local responders and emergency managers are a vital component to getting members chemical information and establishing relationships with the chemical sector. To help this dilemma, emergency agencies could mandate participation in LEPC exercises through local ordinances or expanding departmental policies. For a thorough

³¹ U.S. Chemical Safety and Hazard Investigation Board. *Investigation Report: Organic Peroxide Decomposition, Release, and Fire at Arkema Crosby Following Hurricane Harvey Flooding*. May 2018. Report Number: 2017-08

³² Trefz, B.A., and Bierling, D.H. *Local Emergency Planning Committee Executive Primer*. Produced by Texas A&M Transportation Institute for Texas Department of Public Safety, Division of Emergency Management. 2018

reference on this subject, the LEPC Executive Primer created by the Texas Division of Emergency Management (TDEM) is an excellent source.

Chemical Facility Anti-Terrorism Standards (CFATS)

1. Infrastructure Protection (IP) Gateway

In 2018 the U.S. Government Accountability Office (GAO) identified the lack of information sharing for high-risk chemical facilities and other emergency personnel.³³ The Department of Homeland Security's (DHS) Chemical Facility Anti-Terrorism Standards (CFATS) program shares protected on-site chemicals through the IP Gateway, which may not be reported to either LEPCs or emergency responders. However, the GAO revealed that the IP Gateway was not widely used at the local level because local agencies did not know about the program and/or DHS did not sufficiently promote access to the IP Gateway. To improve chemical information for the emergency responders, DHS has improved their website to better engage the IP Gateway program and provides other important actions being taken to share information.³⁴

2. Personnel Surety Program (PSP)

Private-sector emergency responders or public support agencies (i.e. power and communications) can obtain protected chemical information by requesting access to Chemical-terrorism Vulnerability Information (CVI).” Because this information is highly protected, CVI may only be disclosed on a need-to-know basis except in exigent or emergency circumstances. But in July 2019 DHS implemented the CFATS Personnel Surety Program (PSP) that can affect emergency responders who are not state and local officials but may need to gain unescorted access to restricted areas or critical assets during emergency situations. This program can enhance the responder/responsible party relationship by developing pathways to work and train together while protecting chemical information.³⁵

Emergency Curfews

Federal and state laws delegate to local jurisdictions that authority to issue emergency curfews, and those jurisdictions usually issue curfews through an executive order that details the reasons

³³ United States Government Accountability Office. *Critical Infrastructure Protection, DHS Should Take Actions to Measure Reduction in Chemical Facility Vulnerability and Share Information with First Responders*. August 2018.

³⁴ dhs.gov/publication/cfats-ipgateway

³⁵ <https://www.dhs.gov/cisa/cfats-personnel-surety-program>

for the curfew (i.e. clearing debris, preventing looting or repairing power outages.) Accordingly, the terms of the curfew order will list the scope, duration, area and penalties that police forces can enforce while still providing exceptions for first responders as needed.

Commandeering Private Property

State law allows first responders to commandeer private property as required to use in coping with the disaster. Once the state exceeds its obligations and it needs the property/services for the disaster response, the governor can authorize the use or destruction of private property or services if the state provides compensation to the affected party. The compensation of compelled personal services, however, must have statutory authorization.³⁶

Handguns

In September 2019, the Texas Legislature expanded state handgun laws to declared disaster areas. A person is authorized to carry a handgun while evacuating from an area following a declaration of state disaster or a local state of disaster with respect to that area, when: 1) reentering the area following the person's evacuation; 2) not more than 168 hours have elapsed since the governor declares a state of disaster or extends time of the declaration; and 3) federal or state law does not otherwise prohibit the person from possessing a firearm.³⁷ Regarding shelters, Texas law authorizes possession of handguns at emergency shelter locations during state or local declared disasters when: 1) the owner, controller, or operator of the premises, or a person acting with the apparent authority of the same, authorizes the handgun carry; 2) the person carrying the handgun complies with any rules and regulations of the owner, controller, or operator of the premises that govern the carrying of a handgun on the premises; and 3) the person is not prohibited by state or federal law from possessing a firearm.³⁸ With respect to first responders, Texas law allows volunteer emergency services personnel to carry a handgun if they are engaged in providing emergency services and comply with the requirements for the state's concealed carry license laws.³⁹

Violence Against Emergency Medical Services (EMS) Responders

As a result of the rapid rise in violence and assaults against EMS responders, like Emergency Medical Technicians (EMT) and Paramedics, the Center for Disease Control and Prevention (CDC) and the National Institute for Occupational Safety and Health (NIOSH) have determined the issue

³⁶ Tex. Gov't Code Ann. § 418.152

³⁷ Tex. Penal Code § 46.15(k)(1)

³⁸ Tex. Penal Code § 46.15(l)

³⁹ Tex. Penal Code § 46.15(a)(10)

to be a workplace hazard.⁴⁰ Disaster stricken areas present high-risk and unstable working environments that expose EMS responders to further risk of violence.⁴¹ And considering the limited police available during disaster response, EMS workers are advise to not rely on police to ensure their safety.⁴² With growing violence directed at EMS and limited police forces, it has become frequently accepted for EMS responders to be trained in self-defense, like martial arts, to restrain the aggressors when necessary.⁴³ However, also much like police officers EMS departments have also used body armor and issuing weapons like guns, Tasers, mace and pepper spray.⁴⁴ In addition to these efforts, other possible violence mitigation techniques include training in:

- Scene size-up;
- Weapons awareness;
- Weapons management;
- Approaching the scene;
- Approaching the vehicle;
- Entering a structure;
- Conflict management;
- Self-defense techniques;
- The legal issues surrounding self-defense;
- The use of force and cover and concealment techniques.

While the above list is not exhaustive, it is offered because the research on this topic shows many of the existing violence reduction methods do not work well in the EMS industry.⁴⁵ Considering also that violence against EMS responders is a fairly new risk recently documented, offering violence mitigation techniques are consistent with the well-established general duty clause of the Texas Labor Code, Title 5. Workers' Compensation Act, Chapter 411.103, "Duty of Employer to Provide Safe Workplace," which states:

- 1) Provide and maintain employment and a place of employment that is reasonably safe and healthful for employees;

⁴⁰ Emergency Medical Services Workers: How Employees Can Prevent Injuries and Exposures. *Center for Disease Control and Prevention*. 2017. Available at <https://www.cdc.gov/niosh/docs/2017-194/pdfs/2017-194.pdf>

⁴¹ Murry, R.M., et al., *A Systemic Review of Workplace Violence Against Emergency Medical Services Responders*. *A Journal of Environmental and Occupational Heal Policy* 0(0) 1-17. 2019.

⁴² Mitigation of Occupational Violence to Firefighters and EMS Responders. *U.S. Fire Administration, FEMA*. June 2017.

⁴³ *Id* at p. 29

⁴⁴ *Id* at p. 30

⁴⁵ *Id*.

- 2) Install, maintain, and use methods, processes, devices and safeguards, including methods of sanitation and hygiene, that are reasonably necessary to protect the life, health, and safety of the employer's employees; and
- 3) Take all other actions reasonably necessary to make the employment and place of employment safe.

Texas Law on Self-Defense
Texas Penal Code § 9.31

It is beyond the scope of this framework to discuss the interesting details of self-defense rights, but Texas has a robust law on self-defense worth mentioning and covers topics like:

- Whether the person reasonably believes that conduct was immediate necessary to protect one's self from another's use, or attempted use of unlawful force;
- When is self-defense presumed to be "reasonable;" (i.e. during a sexual assault);
- When is self-defense not justified (i.e. just venting);
- When is self-defense forfeited (i.e. provoking as a pretext);
- What degree of force is allowed (i.e. when the victim becomes the aggressor);
- Whether there is there a duty to retreat; and
- Can the victim pursue the attacker if they believe danger still exists?

Mutual Aid Agreements

The increasing number of extreme weather events, hurricanes, and chemical spill emergencies impose a lock step rise in demand on emergency services. Local emergency responders typically meet these demands through using Mutual Aid Agreements and/or Memorandums of Understandings (MOU) to acquire additional personnel and equipment on an as-needed basis. From a legal perspective during disasters, however, these instruments share a common flaw: generally, when severe weather or large disasters (such as Hurricane Harvey) occur, the widespread spike in demand will typically swamp local mutual aid response support resources and hobble their ability to fulfill their MOU commitments. In such situations, fire and police will have to draw upon regional and state plans to meet the demand through the Emergency Management Assistance Compact (EMAC). The Texas EMAC is managed by TDEM and offers a

comprehensive guideline on how to reimburse individuals and jurisdictions for an EMAC deployment.⁴⁶

Examples of the U.S. Fire Administration’s Mutual Aid Agreement Components for Legal Consideration

- A legal basis or authority for establishing the agreement.
- Definitions of terms (first responder credentials; regional boundaries)
- Policies and Procedures (liability; worker’s compensation coverage; reimbursement; documentation requirements)

Source: Operational Lessons Learned in Disaster Response. U.S. Fire Administration. FEMA June 2015.
https://www.usfa.fema.gov/downloads/pdf/publications/operational_lessons_learned_in_disaster_response.pdf

Part 2: Identifying Authority

Unified Command

Texas’ expansive definition of “disasters” includes both natural or man-made events, as well as oil spills, water or air contamination, energy emergencies and many others that stretch across the first responder spectrum.⁴⁷ Declaring a disaster activates the “state emergency management plan.”⁴⁸ The state’s emergency management plan follows the National Incident Management System (NIMS) in responding to disasters.⁴⁹ Under the NIMS approach, incidents that involve multiple agencies and/or jurisdictions with different legal, geographical and functional authorities mandates that they work together without affecting any one agency’s authority or responsibility.⁵⁰ Once engaged, the members of various state and local agencies will assemble according to NIMS and establish a Unified Command (UC) to coordinate the response activities. Members of the UC should have decision-making authority to respond and commit their respective resources to the joint enterprise.⁵¹

⁴⁶ Texas EMAC, <https://tdem.texas.gov/emac>

⁴⁷ Tex. Gov. Code § 418.004(1)

⁴⁸ Tex. Gov. Code § 418.015(1)

⁴⁹ State of Texas Emergency Management Plan. Basic Plan February 2019.

⁵⁰ National Incident Command System. U.S. Department of Homeland Security, December 2008, https://www.fema.gov/pdf/emergency/nims/NIMS_core.pdf

⁵¹ Unified Command: Technical Assistance Document. The National Response Team.

Legal Authority Landscape

Determining the lead agency in a UC structure can be difficult because every agency retains its own legal authority with its own decision-making discretion. For example, a spill of hazardous materials will initially prompt a local response from a local hazardous materials response team with the accompanying municipal environmental enforcement agencies.⁵² The local agency may request assistance from the state for additional resources and agency coordination.⁵³ From here, TDEM may contact the state's lead agency on hazardous materials spills and air contamination, which is TCEQ.⁵⁴ If the substance involves oil that enters or threatens water ways, the lead agency changes to the General Land Office.⁵⁵ If the spill involves the exploration, development, production, including storage and pipeline transportation of oil, gas or geothermal resources then the lead agency turns to the Railroad Commission of Texas.⁵⁶ Further, if the spill affects the health of humans, including radiation, this event points to the Texas Department of State Health Services.⁵⁷ And securing the site of where the spill occurred may require the Texas Department of Public Safety.⁵⁸ Still further, depending on the quantity and type of substance, as well as location, the hazard can prompt a federal response under separate national laws and other authorities.⁵⁹

The shifting ability of disasters to require differing agencies and expertise challenges the responder's ability to identify of who exactly is in charge of the event. The declaration of disaster can invoke the Incident Command System (ICS) as required by the NIMS directives, and those commanders and agencies may further expand the structure of authority and increase the legal landscape determinations. Likewise, private organizations, such as nursing homes and hospitals with high-life expectancy, have their own hierarchy of command detailed in their emergency plans that should be designed to work with first responders. More will be discussed on this below.

⁵² City of Houston Ordinances, Section 34-61, Hazardous materials response team service

⁵³ Texas Government Code § 418.042(a)(11)

⁵⁴ Texas Water Code § 26.261; Texas Health & Safety Code § 382.001

⁵⁵ Texas Natural Resources Code § 40.001

⁵⁶ Texas Natural Resources Code § 85.042, 91.101 and 91.601

⁵⁷ Texas Health & Safety Code § 401.0005

⁵⁸ Texas Government Code § 418.041

⁵⁹ Civins, Jeff, and Scanlon, Michael. *Environmental Issues Associated with Disaster Planning and Response. Key Environmental Issues in Region*. June 11, 2019, Atlanta, Georgia. American Bar Association, Section on Environmental, Energy, and Resources.

Recommended Training for First Responders

To get firm footing on identifying who is in charge, first responders should be trained in the Incident Command System classes ICS-300 and ICS-400 and can be accessed through the Preparing Texas website. This training serves as the foundation to understanding the authority assignments made by the incident command system.

Table 1 below is an example of the primary responding agencies based on jurisdiction and reflects how the legal landscape changes during a disaster response as the support functions required also change.⁶⁰

Table 1 – Coordinating Agencies

Emergency Support Function (ESF)	Jurisdictional Coordinators		
	Federal Support Operations	State Support Operations	City (Houston) Support Operations
Transportation	Department of Transportation	Texas Department of Public Safety	Annex S
Communications	DHS – National Communications System	Texas Department of Public Safety	Houston Emergency Center Annex B
Public Works and Engineering	Department of Defense US Army of Corps Engineers	Texas Department of Transportation	Public Works and Engineering Annex L
Firefighting	US Forest Service	Texas A&M University Forest Service	Houston Fire Department Annex F
Emergency Management	DHS/FEMA	TDEM	Office of Emergency Management (OEM)
Mass Care, Human Services	DHS/FEMA	TDEM	Annex C

⁶⁰ Disaster Operations Legal Reference, ver. 2.0, FEMA, June 1, 2013; State of Texas Emergency Management Plan. February 2019. TDEM; City of Houston Emergency Management Plan, COHOEM, 2016.

Logistics mgt, Resource Support	DHS/FEMA	TDEM	General Services Department Annex M
Public Health, Medical Services	Department of Health and Human Services	Texas Department of State Health Services	Houston Health Department Annex H
Search and Rescue	DHS/FEMA	Texas A&M University Texas Engineering Extension Service (TEEX)	Houston Fire Department Annex R
Oil and HAZMAT Response	EPA/USCG	Texas Commission on Environmental Quality (TCEQ)	Houston Fire & Police Departments Annex Q
Agriculture and Natural Resources	Department of Agriculture	Texas Animal Commission Texas Dept. of Agriculture; Texas Dept. of State Health Services	None
Energy	Department of Energy	Public Utility Commission of Texas	None
Public Safety and Security	Department of Justice	TDEM	Houston Police Department Annex G
Long-Term Recovery	Replaced by the National Disaster Recovery Framework (NDRF)	TDEM	Annex J
External Affairs	DHS/FEMA	Texas Department of Public Safety	Annex I

After identifying the type of incident and determining the correct responding agency, the agencies that comprise the UC will have the responsibility to keep everyone informed of who is in charge, and functions needed in the disaster response. With the assistance of the other ICS members (i.e. IC, Liaison, Planning Section Chief) the UC should establish procedures to document command decisions, command staff positions, and ensure updates from different response organizations into the ICS/UC enterprise.⁶¹ These actions should keep everyone informed of who is in charge and the details regarding that position.

⁶¹ Unified Command Technical Assistance Document. U.S. National Response Team, § 1.1.3

Legal Considerations for Commanders

Tracking and updating personnel changes to the legal landscape of authorities is one of the top problems identified by members that have participated in a UC event. For emergency managers and first responders who are assigned to work in an Emergency Operations Center, the ambiguous and overlapping legal rules in determining “who is in charge” may inflame the types of disputes that inevitably arise in stressful events. To help with this problem, first responders operating in a UC enterprise may consider a few options to determine responsibility and accountability. Let us see them:

Legal Specialist. We know that the ICS allows for a legal specialist position in its planning section.⁶² Likewise, an emergency plan’s crosswalk will assign a legal office (i.e. Attorney’s General office) as the primary or supporting agency to respond to certain emergency functions.⁶³ However this document suggest that the members of the UC themselves select an attorney trained in emergency management operations and alternative dispute resolution. Moreover, dedicating a seat at the Emergency Operations Center (EOC) for a trained and qualified attorney would specifically assist emergency managers and first responders in the field with real-time information funneled to the EOC through radio communications.

Example of an EOC Legal Counseling Position Task Book

Having fast, reliable and competent legal counseling was listed a top priority by responders and managers that are assigned to an EOC, and in 2018 FEMA released its National Qualifications EOC Skillset Templates to help address this important need. The qualification skillset lists at least eight legal services an attorney is expected to be knowledgeable of and to advise EOC leadership and staff, like the UC enterprise, on relevant legal matters. Compiling data from the TDEM, FEMA and the City of Houston, a sample EOC Legal Counseling Position Taskbook was created to illustrate how local jurisdiction can use the information to train local attorneys who respond and operate in an emergency operations center. See Appendix B for the sample task book.

<https://www.fema.gov/media-library/assets/documents/170606>

⁶² Supra, note 4

⁶³ Supra, note 3

Operations Lawyer. Similar to legal experts that deploy with FEMA and military personnel, Operations Lawyers perform much like a Texas All-Hazards Incident Management Teams (AHIMT) because they are NIMS/ICS compliant personnel trained in the roles of Operations “so that the Texas Department of Emergency Management (TDEM) can have the same counterparts as local and federal partners.”⁶⁴ To qualify for membership on an AHIMT the individual must have completed a task book detailing the training and experience received.⁶⁵

Research shows that through training with first responders in table-top exercises, participating in disaster exercises, and attending emergency services continuing education courses greatly increases the effectiveness of the joint-professional (attorney-first responder) relationship. By way of example, FEMA recognizes this effective relationship and agrees that having lawyers trained in EOC operations and possessing the intellectual readiness needed in the response phase of a disaster played a key role for enabling the successful delivery of legal advice.⁶⁶

Part 3: Responsibility, Accountability & Liability

Determining personal liability requires a complex analysis that weaves through different levels of both federal, state and local laws. Limiting our analysis to Texas’ laws, we know generally lawsuits brought against a government employee generally are immediately dismissed.⁶⁷ However, if the lawsuit alleges the employee’s misconduct fell within their scope of employment, the court will deem the suit as against the employee’s official capacity and will dismiss the claim against the employee and, possibly, amend the suit to include the correct government body.⁶⁸ While this protection sets a high bar, it may be helpful nonetheless to review where Texas has waived immunity to get a deeper understanding of the potential liability that might arise from the employee’s official capacity. The liability issue most relevant to disaster response include issues of statutory liability, gross negligence, intentional conduct and state-created dangers. These causes of action must always interact with the first responder’s right to official immunity, which in turn rests on the responder’s “scope of employment” and discretionary duties.

⁶⁴ Texas Emergency Management Online. 2012 Volume 59, Number 6. <http://dps.texas.gov/dem/temoArchives/2012/Vol59No06/index.html>

⁶⁵ <http://ticc.tamu.edu/response/ahimt.htm>

⁶⁶ Advice in Crisis: Towards Best Practices for Providing Legal Advice under Disaster Conditions. Appendix A, *Disaster Operations Legal Reference*. FEMA. Version 2.0 June 1, 2013.

⁶⁷ Tex. Civ. Prac. & Rem. Code Ann. § 101.106(e)

⁶⁸ Tex. Civ. Prac. & Rem. Code Ann. § 101.106(f)

When A Government Agency is Not Liable

The government is not liable for performing acts that are: 1) not required by law; or 2) on failure to make a decision on the performance or nonperformance of an act, if the law leaves the performance of the act to the discretion of the government agency.

Tex. Civ. Prac. & Rem. Code Ann. § 101.056

State Emergency Management Laws

The state emergency management laws limit liability depending on the function performed. Statutory immunity exists when a state employee performs an activity related to sheltering or housing, in connection with an evacuation of an area stricken or threatened by a disaster.⁶⁹ In addition, a public servant carrying out a mandatory evacuation order gains immunity for any act or omission within the course and scope of the person's authority under the evacuation order.⁷⁰ Regarding state, local or interjurisdictional emergency management plans, Texas allows local jurisdictions to implement fines or jail confinement in their own emergency response plans if a person fails to comply with a rule, order, or ordinance adopted under the plan.⁷¹ One must review the respective plans to determine if this clause was included as a basis of personal liability.

State Homeland Security Laws

Texas homeland security laws limit civil liability if a person performs a defined homeland security activity, under certain procedures or circumstances, and acts within the person's authority.⁷² However, those laws deny immunity from civil liability if the person acts willfully or wantonly negligent, or acts with conscious indifference, or reckless disregard for the safety of others the homeland security laws intends to protect.⁷³ As recently as 2019, the Texas legislature updated the state's homeland security law to classify 9-1-1 operators as first responders and affecting immunity protections for persons, among other things, giving emergency care.⁷⁴

⁶⁹ Tex. Gov't Code § 418.006

⁷⁰ Tex. Gov't Code § 418.185

⁷¹ Tex. Gov't Code § 418.173

⁷² Tex. Gov't Code § 421.061(a)

⁷³ Tex. Gov't Code § 421.061(b)

⁷⁴ HB1090, 86th Legislative Session

Municipal Ordinances

For municipalities, emergency response liability insulates them from damages that arise from their government functions, such as police and fire protection, health services, and emergency ambulance operations, if they exercise them in the interest of the general public.⁷⁵ In addition to traditional fire and police protection, agency liability also includes emergency management and homeland security organizations which relate to the governor’s statewide homeland security strategy and responds to TDEM.⁷⁶

The statute specifically preserves municipal immunity for other related duties such as responding or reacting to an emergency event (or failing to provide such services); or in selecting the method used to provide police or fire protection.⁷⁷ However, municipal ordinances can carve out waivers of immunity for employees in specific events such as operating motor vehicles or motorized equipment (i.e. drones), or employees who, while acting within the scope of employment, commit wrongful acts and omissions, or negligently fail to meet other liability standards.⁷⁸ Likewise, municipal liability may attach when a three-part test is satisfied:

- 1) a policymaker is involved;
- 2) an existing official policy is in place; and
- 3) a violation of constitutional rights whose “moving force” is the policy or custom.⁷⁹

Table 2 provides a side-by-side comparison of these three types of laws.

Table 2 - Disaster Response Laws Comparison

Emergency Management TGC 418.006	Homeland Security TGC 421.061	Government Immunity TCRP 101
Officer or employee of a state or local agency	Officer or employee of a state or local agency or volunteer (421.001(1) “agency” means any government entity)	A government unit is liable for 101.001(3) A government unit is: A. State agencies, departments, bureaus, etc; B. Cities, counties, districts, etc; C. Emergency management organization (formed and operated under 421.002

⁷⁵ TEX. CIV. PRAC. & REM. CODE ANN. § 101.0215

⁷⁶ Tex. Civ. Prac. & Rem. Code Ann. § 101.001

⁷⁷ Tex. Civ. Prac. & Rem. Code Ann. § 101.055

⁷⁸ Tex. Civ. Prac. & Rem. Code Ann. § 101.021

⁷⁹ *Piotrowski v. City of Houston*, 237 F.3d 567 (5th Cir., 2001)

		and responsive to TDEM under 418.112
Performing an activity related to sheltering or housing activity related to sheltering or housing	<p>Performing a “homeland security activity”</p> <p>(421.001(3) “Homeland security activity” means any activity related to the prevention or discovery of, response to, or recovery from:</p> <ol style="list-style-type: none"> 1. A terrorist attack; 2. A natural or man-made disaster; 3. A hostile military or paramilitary action; 4. An extraordinary law enforcement emergency; <p>Or a fire or medical emergency that requires resources beyond the capabilities of a local jurisdiction</p>	<p>(1)</p> <ul style="list-style-type: none"> • Property damage, personal injury and death; • Proximately caused by wrongful act, omission, or negligence of an employee; • Acting within the scope of employment, if <ol style="list-style-type: none"> a. Operating or using a vehicle or motor-driven equipment; and b. The employee would be personally liable according to Texas law. <p>(OR)</p>
<p>Does the disaster include the occurrence or imminent threat of:</p> <ol style="list-style-type: none"> 1. Widespread or severe damage; 2. Injury or loss of life or property resulting from any natural or manmade cause; 3. Fire; 4. Flood; 5. Earthquake; 6. Wind; 7. Storm; 8. Wave action; 9. Oil spill or other water contamination; 10. Volcanic activity; 11. Epidemic; 12. Air contamination; 13. Blight; 14. Drought; 15. Infestation; 16. Explosion; 17. Riot; 18. Hostile military or paramilitary action; 19. Extreme heat; 20. Other public calamity requiring emergency action or energy emergency. 	Performing at the request or under the direction of an officer or employee of a state or local agency	<p>(2)</p> <ul style="list-style-type: none"> • Personal injury and death; • Caused by a condition or use of tangible personal or real property; • If the government unit would, were it a private person; • Be liable according to Texas law. <p>Exceptions & Exclusions § 101.055 This chapter does not apply to a claim arising from:</p>

Officer or employee of a state or political subdivision (418.004(6) “political subdivision” means a county or incorporated city)	Performing the homeland security activity under procedures prescribed or circumstances described in the governor’s homeland security strategy	<p>(1)</p> <ul style="list-style-type: none"> • From an action of an employee responding to an emergency call; or • Reacting to an emergency situations; • In compliance with laws applicable to emergency action; or; • If no law exist, then action not taken with: <ul style="list-style-type: none"> a. Conscious indifference; or b. Reckless disregard for the safety of others <p>(OR)</p>
Issued or is working to carry out a mandatory evacuation	Acting within the course and scope of the person’s authority (if a volunteer, then within the course and scope of the request or direction of the officer or employee of the state or local agency)	<p>(2)</p> <ul style="list-style-type: none"> • From the failure to provide; or • The method of providing; Police and fire protection
Acting within the course and scope of the person’s authority under the order	<p>Exception: potential liability for damages resulting from performing a homeland security activity, if under the circumstances, was:</p> <ol style="list-style-type: none"> 1. Willfully or wanton negligence; or 2. With conscious indifference; or <p>Reckless disregard for the safety or persons</p>	<p>Liability of Municipality § 101.0215</p> <p>For damages arising from its government function (non-exhaustive list including police and fire protection, health and emergency ambulance services)</p>

Intentional Conduct

As discussed above, Texas law imposes liability for a person’s conduct depending, in part, on the intention underlying the act itself. As a result, it is critical to understand how Texas law defines the different standards of conduct.

Intentional Acts. The Texas penal code defines this element as when a person “acts intentionally, or with intent, with respect to the nature of his conduct or to

a result of his conduct when it is his conscious objective or desire to engage in the conduct of cause the result.⁸⁰

Knowingly Acts. In close relation, intentional can be synonymous with knowledge and the penal code guides this definition as when a person acts “knowingly,” or with knowledge, with respect to a result of his conduct when he is aware that his conduct is reasonably certain to cause the result.⁸¹

Reckless Acts. A person acts “recklessly,” or is reckless, with respect to circumstances surrounding his conduct or the result of his conduct when he is aware of but consciously disregards a substantial and unjustifiable risk that the circumstances exist or the result will occur. The risk must be of such a nature and degree that its disregard constitutes a gross deviation from the standard of care that an ordinary person would exercise under all the circumstances as viewed from the actor’s standpoint.⁸²

Distinguishing Gross Negligence for Government Liability

When the responder’s conduct is not intentional or reckless it still can be negligent if a person failed to take proper care in performing some action. Public responders typically face liability only if they act with gross negligence, and any action that fails a gross negligent standard will, by definition, also constitute standard negligence.

Standard Negligence. This cause of action must satisfy three elements: 1) the existence of a legal duty; 2) a breach of that duty; and 3) damages that were caused by the breach of duty.⁸³ These three elements cannot be satisfied by mere conjecture, guess, or speculation. In particular the damages element that includes the proximate cause consist of two additional factors: 1) cause-in-fact and 2) foreseeability.⁸⁴

Cause-in-fact is established when the act or omission was a substantial factor in bringing about the injuries, and without it, the harm would not have occurred.⁸⁵

⁸⁰ Tex. Penal Code § 6.03(a)

⁸¹ Tex. Penal Code § 6.03(b)

⁸² Tex. Penal Code § 6.03(c)

⁸³ *IHS Cedars Treatment Center of DeSoto, Texas, Inc., v. Mason*, 47 Tex. Sup. Ct. J. 666, 143 S.W.3d 764, (Tex., 2004).

⁸⁴ *D. Houston v. Love*, 45 Tex. Sup. Ct. J. 943; 92 S.W.3d 450 (2002)

⁸⁵ *Bustamante* at note 22.

Foreseeability exist when the actor as a person or ordinary intelligence should have anticipated the dangers his negligence act creates for others.⁸⁶

Gross Negligence. For government actors such as public first responders, liability requires a higher standard of gross negligence. This standard requires two further elements in addition to standard negligence, which are:

- 1) an act or omission, which when viewed objectively from the standpoint of the actor at the time of its occurrence involves an extreme degree of risk, considering the probability and magnitude of the potential harm to others; and
- 2) of which the actor has actual, subjective awareness of the risk involved, but nevertheless proceeds with conscious indifference to the rights, safety, or welfare of the others.⁸⁷

A review of relevant liability laws will use a variety of similar terms convey the action of “gross negligence” and the courts have equated “gross negligence” with willful negligence, conscious indifference to the welfare of others, and reckless disregard for the rights of others;⁸⁸ including willful negligence, or done with conscious indifference or reckless disregard for the safety of others.⁸⁹ For example, under the Texas homeland security law immunity is waived for activities done with “willful for wanton negligence or with conscious indifference.” Likewise, under the governmental immunity law, liability may attach for acts done with a reckless disregard for the safety of others. See Table 2 for the full text of these two statutes⁹⁰.

Further defining terms of liability, one court held that to establish “deliberate indifference” the environment created by the state actors must be dangerous; they must know it is dangerous; and they must have used their authority to create an opportunity that would not otherwise have existed for the third party’s crime to occur.⁹¹ More on this subject follows below.

⁸⁶ *D. Houston* supra at note 24.

⁸⁷ Tex. Civ. Prac. & Rem. Code Ann. § 41.001(11)

⁸⁸ *Burk Royalty Co. v. Walls*, 616 S.W.2d 911, (Tex. 1981)

⁸⁹ *Chrisman v. Brown*, 246 S.W.3d 102 (Tex.App.-Houston [14th Dist.] 2007, no pet.)

⁹⁰ . See page 44.

⁹¹ *Piotrowski* supra at note 57.

Recklessness Standard for Emergency Vehicle Response

In an incident involving a fire truck that was responding on an emergency call with lights and sirens, where the driver approached an intersection with reduced speed, but ultimately drove through the intersection against the red light, resulted in a collision with a private vehicle and the city was sued for negligent operation of an emergency vehicle. The Texas Supreme Court held that the standard of recklessness, meaning that the fire apparatus driver committed an act that the driver knew or should have known posed a high degree of risk of serious injury, was the correct standard to impose liability which exceeded the standard of mere negligence. The higher standard is based in part on the Texas Transportation Code's statute for emergency vehicle which is included below:

§ 546.001. Permissible Conduct

In operating an authorized emergency vehicle, the operator may:

- (1) park or stand, irrespective of another provision of this subtitle;
- (2) proceed past a red or stop signal or stop sign, after slowing as necessary for safe operation;
- (3) exceed a maximum speed limit, except as provided by an ordinance adopted under Section 545.365, as long as the operator does not endanger life or property; and
- (4) disregard a regulation governing the direction of movement or turning in specified directions.

City of Amarillo v. Martin, 41 Tex. Sup. Ct. J. 870 (1998); 971 S.W.2d 426

Special Relationship I – Failure to Act

Texas law does not impose any general duty for first responders to protect citizens from the invasion of private actors. However, government liability may attach in two distinct occasions when assistance is called for: 1) when there is a “special relationship” between the public responder and the person requesting assistance, and 2) when the state exposes a person to a danger of its own making (i.e. state-created danger).⁹² To date, a “special relationship” only exists if the person is involuntary confined against their will through affirmative exercise of police power.⁹³ Without this type of special relationship the state has no duty to protect, nor liability from, failing to protect persons at the hands of private actors.⁹⁴ Consistent with the absence of a duty to protect the general public at large from other private actors, when conditions become too dangerous for first responders, restricting or denying emergency service operations for a limited time is acceptable to protect the first responders. The length of the acceptable time to

⁹² *DeShaney v. Winnebago County*, 109 S.Ct. 998 (1989); 489 U.S. 189; 103 L.Ed.2d 249

⁹³ *Walton v. Alexander*, 44 F.3d 1297 (5th Cir. 1995)

⁹⁴ *Id.*

halt response will depend on departmental directions and policies, e.g., sustained winds of 39 mph generally are acceptable thresholds for the “no-go” determination for first responders.⁹⁵

Special Relationship II - State Created Danger

The federal courts have not adopted the “state-created danger” theory of liability,⁹⁶ but Texas state courts have recognized this argument. Liability under this doctrine “lies in the state actor’s culpable knowledge and conduct in affirmatively placing an individual in a position of danger, effectively stripping a person of her ability to defend herself, or cutting off potential sources of private aid.”⁹⁷ The two basic requirements of a state-created danger theory are: 1) a plaintiff must show that the state actors increased the danger to the plaintiff; and 2) that the state actors acted with deliberate indifference.⁹⁸ For the element of deliberate indifference, the act must involve a dangerous environment created by the state actors; they must know it is dangerous; and they must have used their authority to create an opportunity that would not otherwise have existed for the third party’s crime to occur.⁹⁹

In a related situation, government agencies may face liability if they fail to train their first responders to recognize when a victim in their custody requires medical aid.¹⁰⁰ For instance, police officers who use lethal force but fails to provide medical aid, or alternatively fails to call for medical assistance, can create both a special relationship and requisite knowledge for medical aid sufficient to impose potential liability.

⁹⁵ Special Report: Fire Department Preparedness for Extreme Weather Emergencies and Natural Disasters. U.S. Fire Administration/Technical Report Series. USFA-TR-162/April 2008. Retrieved from https://www.usfa.fema.gov/downloads/pdf/publications/tr_162.pdf

⁹⁶ *Randolph v. Cervantes*, 130 F.3d 737 (5th Cir. 1997)

⁹⁷ *Johnson v. Dallas Indep. Sch. Dist.* 38 F.3d 198 (5th Cir. 1994)

⁹⁸ *Piotrowski*, *supra* at note 57.

⁹⁹ *Id.*

¹⁰⁰ *City of Canton, Ohio v. Harris*, 489 U.S. 378 (1989)

No State-Created Danger If Provide Alternative Rescue Efforts

Where county sheriffs prevented rescue efforts attempted by volunteer firefighters, which could have limited the victim's injuries related to the spilled chlorine gas from a train derailment, but did manage a delayed rescue by career firefighters, the court stated that there was no state-created danger because: 1) they did not create the immediate danger of the leaking gas, including the fact that the delayed rescue did not show the sheriffs increased a person's vulnerability by interference with protective services which otherwise would be available; and 2) the sheriffs did not fail to take action to alleviate the danger, rather they substituted the rescue efforts with career firefighters instead of volunteer firefighters.

Hale v. Bexar County, Tex., 342 Fed. Appx. 921 (2009)

Police and Firefighter Employment Discipline - Texas Civil Service Protection, Chapter 143

If a police officer or firefighter operates in a jurisdiction that has adopted relevant provisions of the Texas Civil Service statute, a police officer or firefighter may face disciplinary action, including indefinite suspension, for behaviors that display an incompetence, neglect of duty, and "shirking duty or cowardice at fires"¹⁰¹

New Texas First Responders: 911 Dispatchers

In 2019 various statutes changed the definition of "first responders" to include 911 dispatchers. The changes will not only affect statutes like the health and safety code, labor code, and immunity protection laws, but also will give dispatchers recognition with fire, police and emergency medical services.

State Official Immunity

The Texas Supreme Court recognizes official immunity as an affirmative defense for law enforcement, and emergency response personnel, and entitled to official immunity from suits arising from the performance of their: 1) discretionary duties; done in 2) good faith; as long as they are 3) acting within the scope of their authority.¹⁰²

¹⁰¹ Tex. Loc. Gov't Code Ann., § 143.051

¹⁰² *Ballantyne v. Champion Builders, Inc.*, 47 Tex. Sup. Ct. J. 852 (2004); 144 S.W.3d 417

Discretionary duties in this context refers to any action taken that involves personal deliberation, decision, and judgment.¹⁰³ In contrast, **ministerial acts** leave nothing to the exercise of discretion or judgment, and if a public official must obey an order with no choice in complying, then the act is ministerial.¹⁰⁴

Example of Discretionary Duty – Emergency Call Operator

Although the emergency operator’s job appeared to be ministerial and only transcribe information from callers, considering the urgency involved in emergency situations, the emergency operator had to use discretion when interpreting and then classifying and transcribing 911 calls, and was therefore granted immunity from liability for misclassifying the call response level.

Beltran v. City of El Paso, 367 F.3d 299 (5th Cir. 2004)

Example of Not Acting in Good Faith - Not Wearing Corrected Lenses

A firefighter driving a fire truck, who failed to operate the apparatus with his corrected lenses, was found to have acted recklessly and not acting in good faith, and therefore, was not entitled to official immunity or limitation of liability.

Green v. Alford, 274 S.W.3d 5 (Tex. App.- Houston [14th Dist.] 2008)

Because some of these laws require that actions fall within the “scope of employment” or “scope of authority” before they can qualify for immunity, it is helpful to have a definition of those concepts and how Texas laws apply them when considering government immunity.

Scope of Employment means the “performance for a government unit of the duties of an employee’s office or employment and includes being in or about the performance of a task lawfully assigned to an employee by competent authority.”¹⁰⁵

¹⁰³ *Wyse v. Department of Public Safety*, 733 S.W.2d 224 (Tex. App.-Waco, 1986)

¹⁰⁴ *Ballantyne*, supra note 81.

¹⁰⁵ Tex. Civ. Prac. & Rem. Code Ann. § 101.005(5)

Other statutes may use the term “**Scope of Authority.**” At least one Texas court has equated the two terms and confirmed that the focus is not on the employee’s authority to commit an act, rather whether the employee discharged duties normally assigned to them.¹⁰⁶

Example of “Outside” the Scope of Employment

In general, when conduct has nothing to do with an employee’s duties, it can be alleged that the acts are outside the scope of employment or authority. For example, when an on-duty police officer kisses a fellow officer without consent; or when a judge’s secretary causes a fatal car accident while driving her personal car to a doctor’s appointment, are examples of actions not related to the employee’s normal job duties.

Kelemen v. Elliot, 260 S.W.3d 518 (Tex. App. – Houston [1st Dist.] 2008) and
Terrell ex re. Estate of Terrell v. Sisk, 111 S.W.3d 274 (Tex. App. – Texarkana, 2003)

Ultra Vires

Government immunity does not protect every act by a government employee that requires some exercise of judgment. That public official still may act without legal authority, and thus be “ultra vires,” if the official exceeds the bounds of her granted authority or if her acts conflict with the law itself.¹⁰⁷ An *ultra vires* claim based on actions taken “without legal authority” has two fundamental components: (1) authority giving the official some (but not absolute) discretion to act; and (2) engaging in conduct outside of that authority.¹⁰⁸

“Sovereign immunity” bars suits complaining of an exercise of *absolute* discretion but it allows actions contending that an officer’s exercise of judgment, or *limited* discretion, unrelated to (or in conflict with) the limits set out by the underlying law that authorizes the official to act.”¹⁰⁹ A government official acts “*beyond his granted discretion*” if he “exercises judgment or limited discretion ‘without reference to or in conflict with the constraints of the law authorizing the official to act,’ because ‘a public officer has no discretion or authority to misinterpret the law.”¹¹⁰

¹⁰⁶ *Wilkerson v. University of North Texas By and Through Board of Regents*, 878 F.3d 147 (5th Cir. 2017)

¹⁰⁷ *Houston Belt & Terminal Railway Co., v. City of Houston*, 59 Tex. Sup. Ct. J. 512 (2016); 487 S.W.3d 154

¹⁰⁸ *Id.* at 158.

¹⁰⁹ *Id.* at 163.

¹¹⁰ *Chambers–Liberty Counties Navigation Dist.*, 2019 WL 2063575

To fall within this *ultra vires* exception, a suit must not complain of a government officer's exercise of discretion. It instead must allege, and ultimately prove, that the officer acted without legal authority or failed to perform a purely ministerial act.¹¹¹ “Ministerial acts,” on the other hand, are those “where the law prescribes and defines the duties to be performed with such precision and certainty as to leave nothing to the exercise of discretion or judgment.”¹¹² However, it is not an *ultra vires* act for government officials to make an erroneous decision while staying within their authority.¹¹³

Federally Protected Rights

Under federal law, a government entity can incur liability only if its official policy or custom deprives a person of a federally protected right.¹¹⁴ Moreover, a successful claimant must show that the governmental entity, through its deliberate conduct, was the moving force causing the injury. The claimant must establish a direct causal link between the entity’s action and the deprivation of the federally protected right.¹¹⁵

Federal Qualified Immunity

Government officials who perform discretionary functions enjoy qualified federal immunity from liability for civil damages if their conduct does not violate clearly established statutory or constitutional rights, that a reasonable person would have known.¹¹⁶ A right is “clearly established” when it is apparent to the public official that his or her actions are unlawful in light of pre-existing law, and not merely improper or questionable.¹¹⁷ A “reasonable person” in this sense is based on whether other public officers (first responders) could agree if the challenged conduct is legal or not.¹¹⁸

¹¹¹ *City of El Paso v. Heinrich*, 52 Tex. Sup. Ct. J. 689 (2009); 284 S.W.3d 366

¹¹² *Sw. Bell Tel., L.P. v. Emmett*, 58 Tex. Sup. Ct. J. 567 (2015); 459 S.W.3d 578

¹¹³ *Hall v. McRaven*, Tex. Sup. Ct. J. 315 (2017); 508 S.W.3d 232

¹¹⁴ *Graham v. Dallas Area Rapid Transport*, 288 F.Supp.3d 711 (N.D. Tex. Div. – Dallas 2017)

¹¹⁵ *Bryan County v. Brown*, 520 U.S. 404, 117 S.Ct. 1382 (1997); 137 L.Ed.2d 626

¹¹⁶ *Mullenix v. Luna*, 136 S.Ct. 305 (2015); 193 L.Ed.2d 255; 84 USLW 3254; citing *Pearson v. Callahan*, 555 U.S. 223, 129 S.Ct. 808 (2009)

¹¹⁷ *Graham*, supra at note 94.

¹¹⁸ *Id.*

Example of Equal Protection Violation

While there is no special relationship formed during common responses to emergencies, the equal protection clause may impose one in certain situations. For instance, once emergency responders “make an effort to communicate with and extract information from a person, the public entity has a duty, under the American with Disabilities Act, to ensure that a disabled person is ‘afforded ... an equal opportunity to benefit from the services provided by the [city] to those who do not suffer from a hearing-impairment.

Salinas v. City of New Braunfels, 557 F.Supp.2d 777 (W.D. Tex. Div – San Antonio 2008);
36 NDLR P 191

Conclusions & Observations

Natural disasters are increasing. Texas is well situated to lead disaster resilience due to the high frequency of events that recurrently impact the Lone Star state. The approach from decision makers, first responders and the community, has moved from real time reactions to try to cope with the situation in the best way possible, towards prevention and preparedness, improving actions to face disasters, and conceiving different possible scenarios and solutions in advance.

In the legal realm, different terms are being used to denominate a new field that deals with disasters response and prevention: *Disasters Law*, *Disasters Recovery Law*, *Disasters Risk Reduction*, *Disasters and Resilience Law*, *Natural Disasters Management and Resilience Law*, among others. All seek to witness the relevance of the law in dealing with understanding how to respond to and mitigate what traditionally have been called *Acts of God*, where communities were driven back to a stoic *fatum* resignation. Thus, we increasingly associate disasters to irresponsible human actions not taking proper care of the environment, in what makes us combine natural disasters and human-made disasters and treat them as a whole. The need to structure into a legal framework the capacity communities have to respond to natural or human made disasters is critical today. Society is regulated by the Law. The law structures and responds to society’s needs and fulfills existing gaps. We need to build capacity to cope with disasters and be well prepared. We need to be resilient.

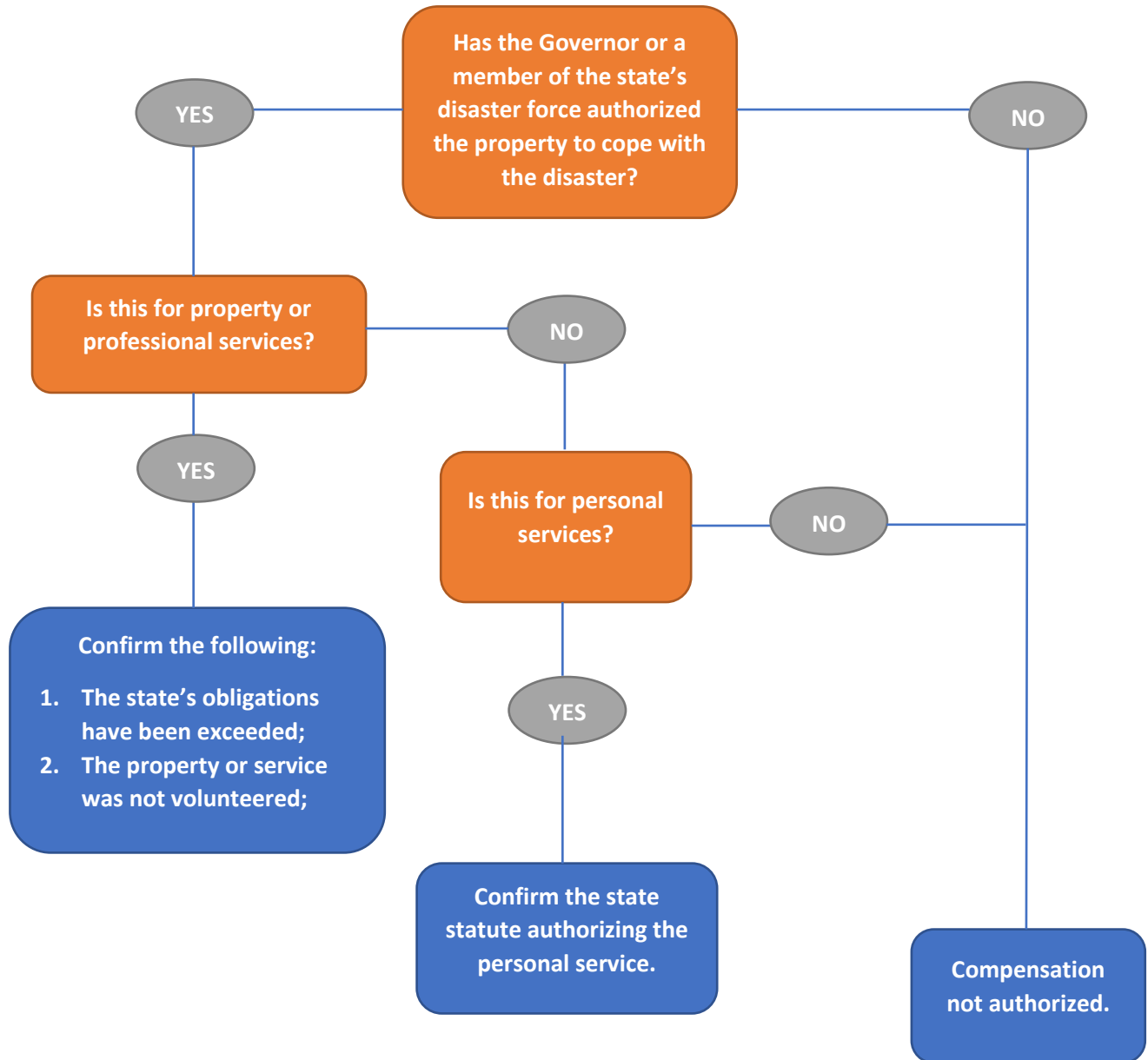
By resilience we understand the human capacity to assume with flexibility extreme situations, and to overcome them. From an even more human psychological dimension, we may add too, resilience to a traumatic situation is fostered through strength. Resilience implies to rethink situations, to imagine new solutions, to be prepared to new similar scenarios. Due to the intensity of climate disasters, we unfortunately know in advance those situations will happen again. Resilient communities are ready to overcome adversity, and disasters make them grow stronger and reach their maximum resilient potential. The situation or natural catastrophe is never chosen, but our own self-determination to overcome it, is key. The impact caused by a natural disaster, such as Hurricane Harvey in Texas, is traumatic from a humane perspective. That said, a resilient community empathetically and positively looks ahead, while minimizing, in real time, human suffering and costs. Beneath Disasters Risk or Natural Disasters and Response Law lies the humanistic dimension of the Law, its inherent principle of protecting human lives and our community. Without this dimension, the law becomes null.

When setting a common legal framework for Disaster Risk Management, it is necessary to identify common rules, and see how the existing mechanisms can be improved where deficiencies exist. Without any doubt, the law has become a tool for disaster mitigation, moreover when we need to manage society, and the materialization and manifestation of natural disaster risks are becoming a more a recurrent matter.

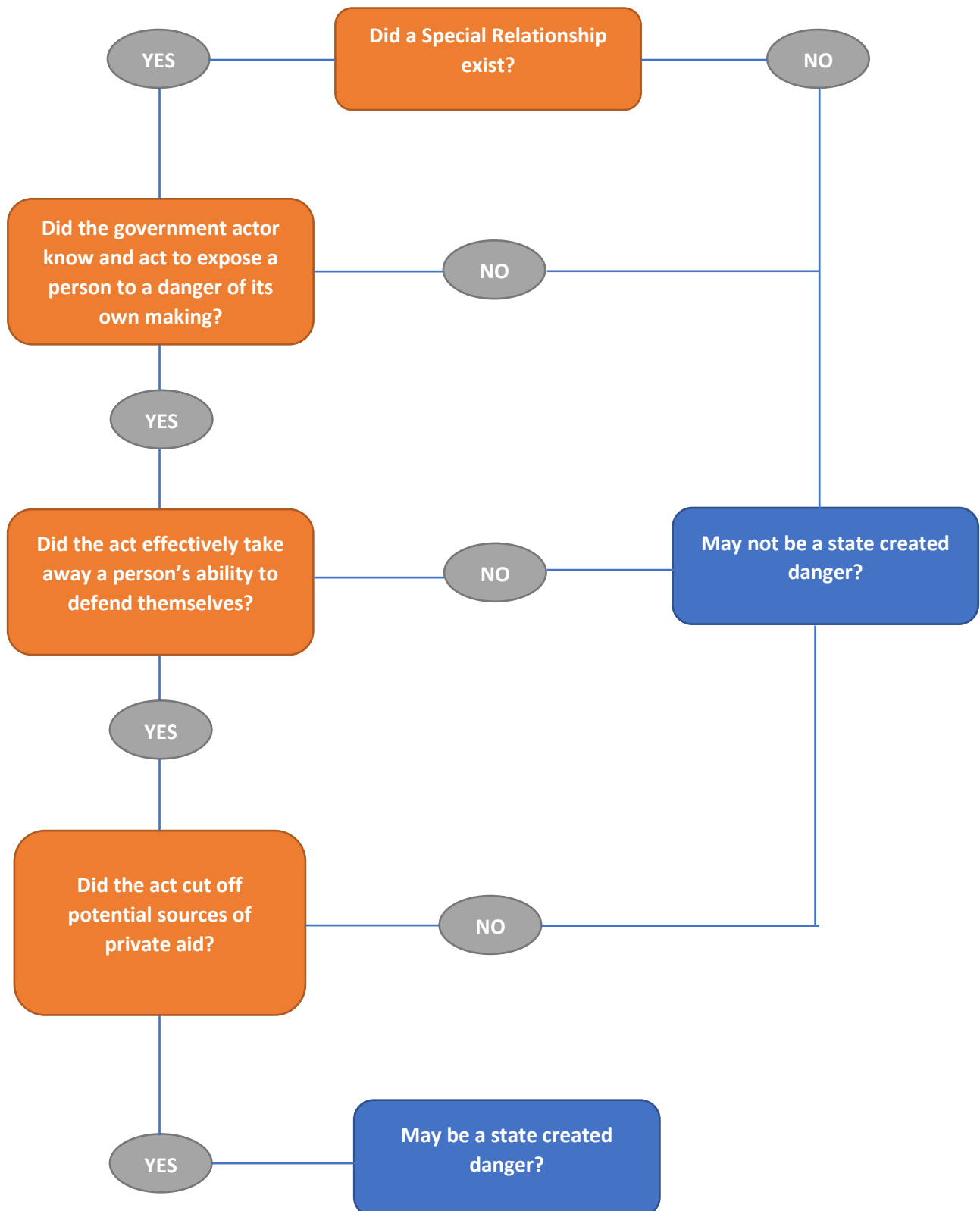
We hope this framework brings answers to many core legal questions, bringing our bit from the Center for U.S. and Mexican Law, at the University of Houston Law Center, and the Texas OneGulf Consortium, to give light to many of the legal circumstances that may turn up when seeking solutions and taking decisions in disaster response and resilience.

Appendix A: Field Guidebook Flowcharts

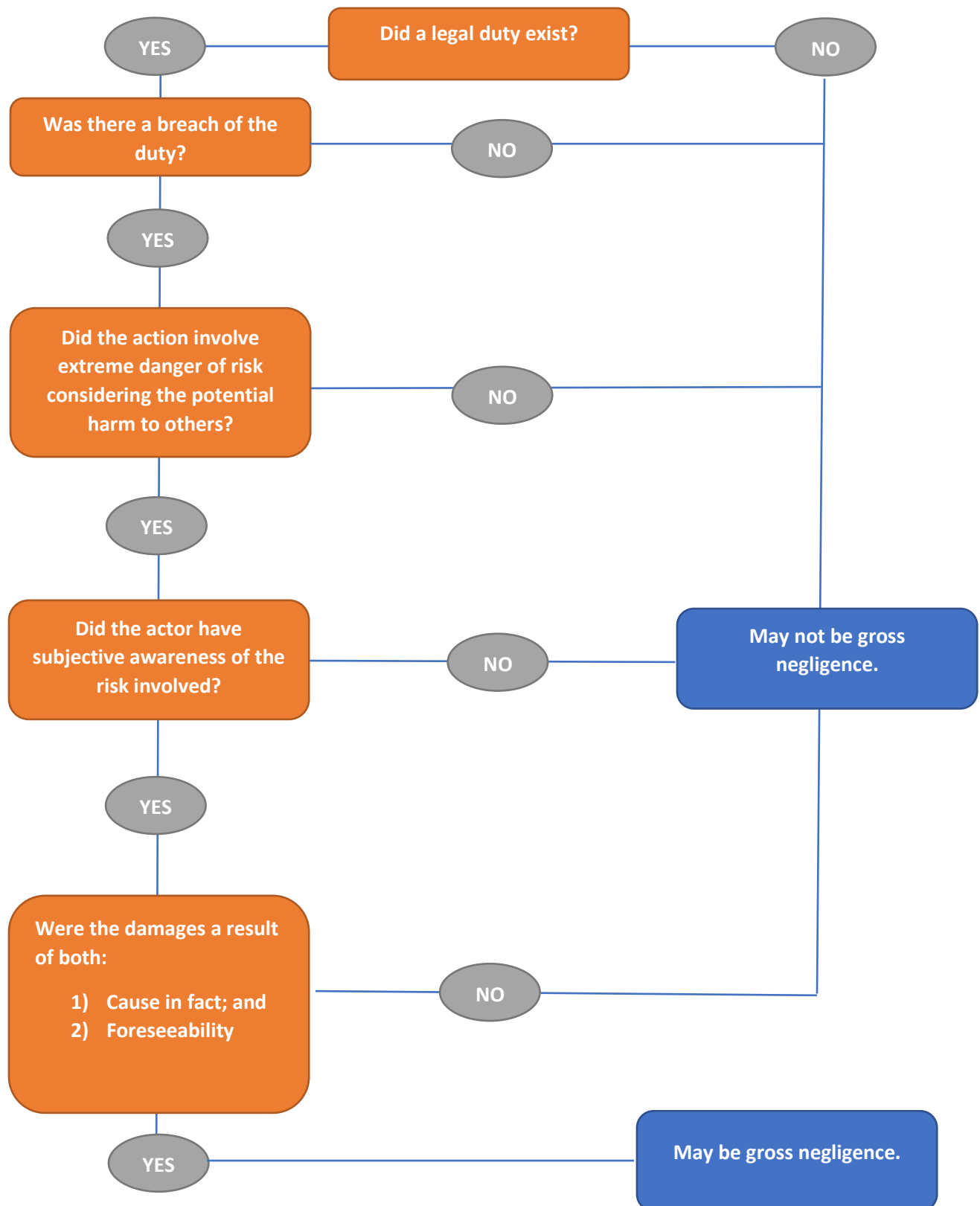
Compensation for Commandeering Property and Services



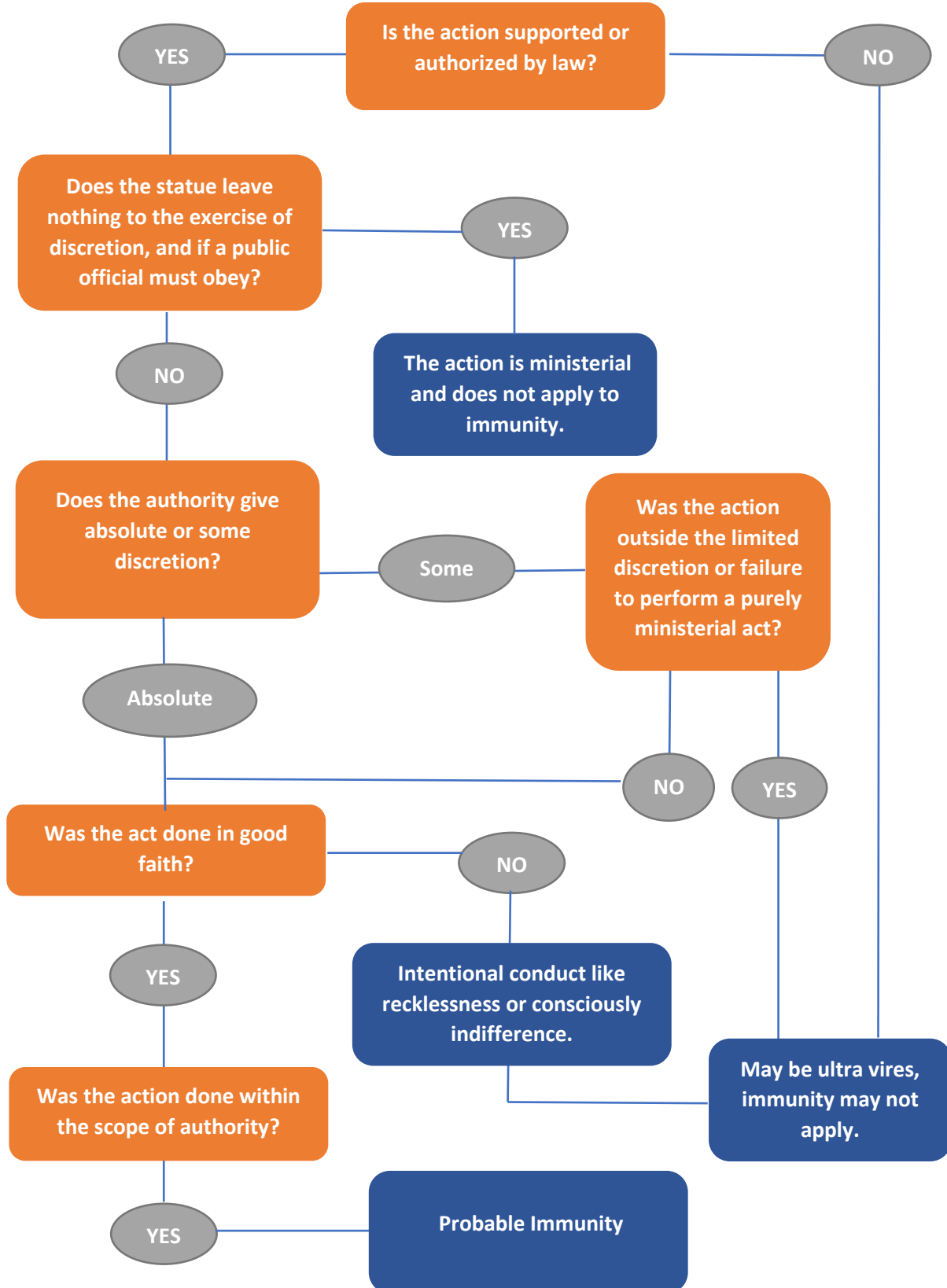
State Created Danger



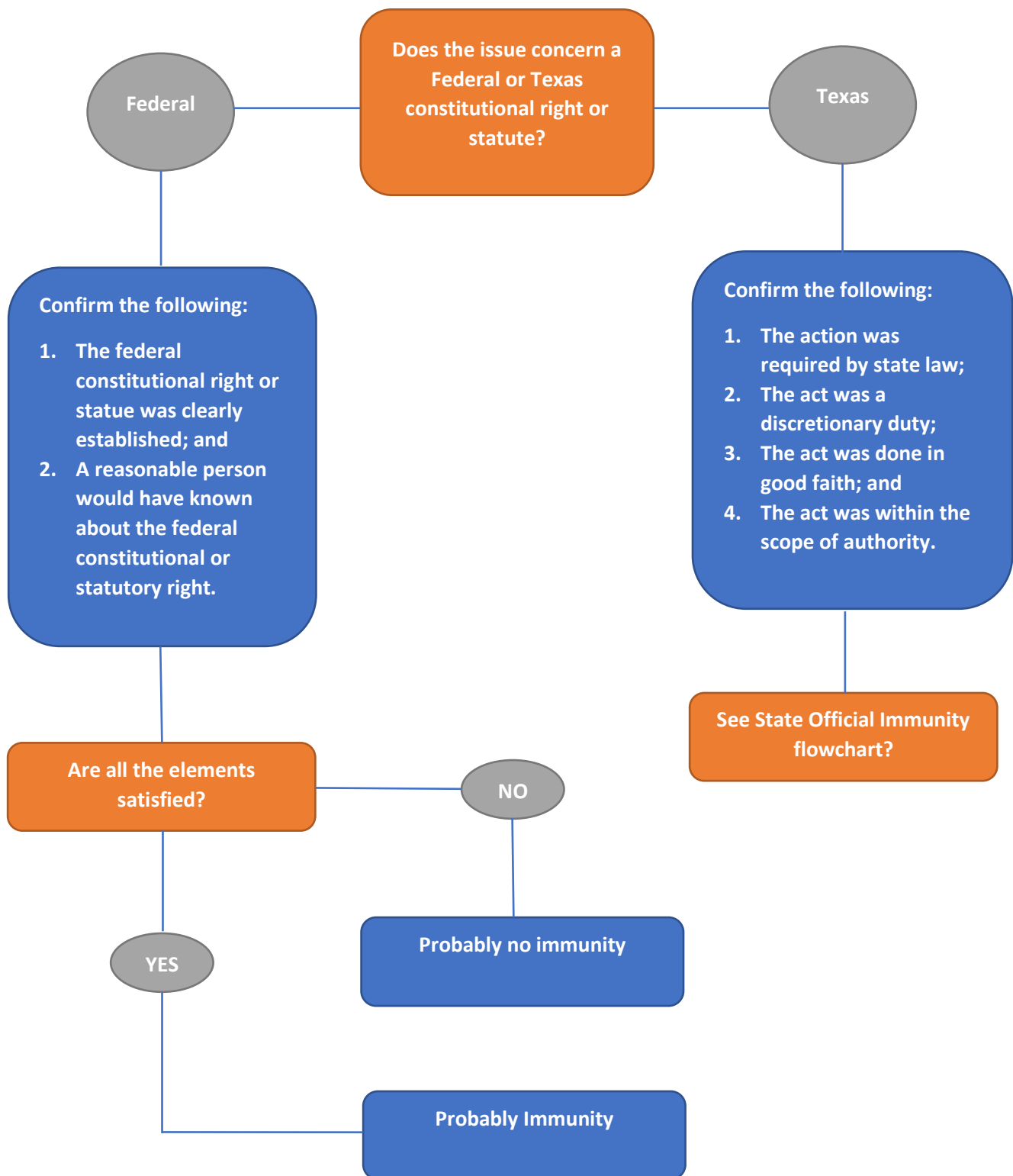
Gross Negligence



State Official Immunity



Governmental Immunity



Sub-Appendix B: Sample EOC Skillset: Legal Counseling

Tasks	Code	Evaluation Record #	Evaluator Initials and Date
<p>1. At the local, state, trial, territorial and federal levels, demonstrate knowledge of:</p> <p>LOCAL</p> <ul style="list-style-type: none"> • City of Houston, City Charter, as amended • City of Houston, Code of Ordinances, • City of Houston, Code of Ordinances, Chapter 13, Emergency Management • City of Houston, Code of Ordinances, Chapter 2, Article II, Division 1 Generally, Section 2-28 • City of Houston, Mayor Executive Order 1-25, Exerciser of Mayor's Emergency Authority during a Local State of Disaster • City of Houston, Mayor Executive Order 1-49, Adopting the National Incident Management System • City of Houston, Administrative Policy 4.2, Internal Disaster Preparation & Recovery <p>STATE</p> <ul style="list-style-type: none"> • Constitution of the State of Texas • Texas Education Code, Chapter 88, §§ 88.112 – 88.116 South Central Interstate Forest Fire Protection Compact • Texas Government Code: <ul style="list-style-type: none"> ○ Chapter 411 Texas Department of Public Safety ○ Chapter 418 Emergency Management ○ Chapter 421 Homeland Security ○ Chapter 433 State of Emergency ○ Chapter 791 Interlocal Cooperative Contracts ○ Texas Health and Safety Code, Title 9, Subtitle B, Chapter 778 Emergency Management Assistance Compact • Texas Local Government Code <ul style="list-style-type: none"> ○ Title 6, Chapter 616 Emergency Interim Public Office Succession Act ○ Title 12, Chapter 391 Regional Planning Commissions • Texas Administrative Code, Title 37, Part 1, Chapter 7, Division of Emergency Management • Texas Governor Executive Orders 	E, F, I, J		

<ul style="list-style-type: none"> ○ GA 05 - Relating to Emergency Management of Natural and Human-Caused Events, Emergencies, and Disasters (2018) ○ RP 1 – Relating to Emergency Management (2001) ○ PR 8 – Relating to the Governor’s Task Force on Homeland Security (2001) ○ RP 16 – Relating to the Creation of the Statewide Texas Amber Alert Network (2002) ○ RP 40 – Relating to the Designation of the National Incident Management System as the Incident Management System for the State of Texas (2005) ○ RP 48 – Relating to the Expedition Restoration of Electrical Services in Areas Damaged by Hurricane Rita (2005) ○ RP 59 – Relating to the Renewal of Disaster Recovery Issues due to the Effects of Hurricanes Katrina and Rita (2005) ○ RP 68 – Relating to the Creation of Blue Alert Program (2008) ○ RP 69 – Relating to the Creation of the Governor’s Commission for Disaster Recovery and Renewal (2008) ○ Texas Homeland Security Strategic Plan 2015-2020 ○ State of Texas Emergency Management Plan 2019 			
<p>FEDERAL</p> <ul style="list-style-type: none"> • Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288m as amended • 42 U.S. Code § 5170 (2013, January 29) Procedure for Declaration • Post-Katrina Emergency Management Reform Act (PKEMRA), 2006 • National Response Framework (NRF), January 2008 • Housing and Economic Recovery Act of 2008 • FEMA REP Manual / NUREG 0654, April 2012 • The National Security Strategy, May 2010 • Emergency Management and Assistance, Code of Federal Regulations (CFR) 44 • Price-Anderson Amendments Act of 1988, Public Law 100-408, as amended • Emergency Management Assistance Compact, Public Law 104-321 			

<ul style="list-style-type: none"> • National Incident Management Systems (NIMS), December 2008 • Homeland Security Presidential Directives: <ul style="list-style-type: none"> ○ HSPD 3: Homeland Security Advisory System, March 2002 ○ HSPD 5: Management of Domestic Incidents. February 2003 ○ HSPD 7: Critical Infrastructure Identification, Prioritization, and Protection, December 2003 ○ HSPD 8: National Preparedness, March 2011 • Americans with Disabilities Act (ADA) of 1990 • ADA Guide for Local Governments, U.S. Department of Justice, July 2005 • Sandy Recovery Improvement Act (SIRA) of 2013 • Disaster Relief Appropriations Act of 2013 • Executive Order 13347, Federal Register, Individual with Disabilities in Emergency Preparedness • Guidance on Planning for Integration of Functional Needs Support Services (FNSS) in General Population Shelters, November 2010 • Developing and Maintaining Emergency Operations Plans: Comprehensive Preparedness Guide (CPG) 101: Version 2.0 November 2010 			
<p>2. At the local, state, tribal, territorial and federal levels, demonstrate knowledge of procurement laws and procedures.</p> <ul style="list-style-type: none"> • Texas Local Government Code, Chapter 252 Purchasing & Contacting Authority of Municipalities • Texas Government Code, Chapter 2254 Professional & Consulting Services • Texas Local Government Code, Chapter 271 Purchasing & Contacting Authority of Municipalities, Counties & Other Certain Local Governments • City of Houston, Code of Ordinances, Chapter 15, Article III Contracts, Procurement • City of Houston, Mayor's Executive Order 1-14, Procurement and Payment Policies • City of Houston, Mayor's Executive Order 1-52, Procurement Governance Board • City of Houston, Administrative Policy 5-7, Procurement Standards • City of Houston, Administrative Policy 5-8, Informal Procurement 	E, F, I, J		

<ul style="list-style-type: none"> • City of Houston, Administrative Policy, 5-11, Exceptions to Competitive Procurements • FEMA Public Assistance Program and Policy Guide. FP 104-009-2 / April 2018 			
<p>3. Demonstrate knowledge of:</p> <p>a. Mutual Aid Agreements (MAA) City of Houston, Basic Emergency Plan, Chapter 10, Section 10.2.2, Tab 4 - List of Agreements and Contracts</p> <p>b. Memorandum of Understanding (MOU) MOU – A document that describes very broad concepts of mutual understanding, goals and plans shared by the parties.</p> <p>c. Memorandum of Agreement (MOA) MOA – A document describing in detail the specific responsibilities of, and actions to be taken by, each of the parties so that their mutual goals may be accomplished. A MOA may also indicate the goals of the parties, to help explain their actions and responsibilities.</p>	E, F, I, J		
<p>4. Brief or inform EOC personnel about legal advice available to guide EOC activities.</p> <p>Performance Criteria for legal advice (SALT) produced by legal officer.</p> <ul style="list-style-type: none"> • Solution Oriented – Focus on legally viable solutions and outcomes, and create solutions to legal problems; help to resolve conflicts and eliminate barriers consistent with agency mission. • Articulate – state legal positions and explanations in an organized, well-reasoned and persuasive manner; limit use of “legalese” • Legally Sufficient – develop facts before applying the law to arrive at legal conclusions or options; cite authorities as required; upholds professional responsibilities to the client and legal community. • Timely – deliver advice and counsel on demand; anticipate issues and obstacles to mission completion; be proactive to prevent problems; meet timelines to support critical agency operations. <p>Producing Substantive Advice in Crisis (SOAP)</p>	E, F, I, J		

<ul style="list-style-type: none"> • Sense-making <ul style="list-style-type: none"> ○ Identify which values (and for whom) are at stake for the situation; ○ What are the key uncertainties in the situation; ○ What is the time frame for developing and delivering advice; • Options <ul style="list-style-type: none"> ○ What authority allows a certain action; ○ What are we prohibited from doing; ○ What are the legal risks associated with the action; (ethical, political, etc) ○ Is there a better way to achieve the goals; • Assessment <ul style="list-style-type: none"> ○ Authorization - Does the option appear to be authorized by statute or authority; ○ Prohibition – Is there a specific legal or policy-based prohibition, and where does it come from; ○ Risk – what are the legal risk associated with the options; ○ Judgment – apply both practical and ethical judgment to the issue in question; is this for the greater good of this situation; • Provision of Advice <ul style="list-style-type: none"> ○ Adapting and packing advice in ways that are appropriate to the situation and the context in which the advice is being delivered. ○ Situational awareness – is the work under crisis-like conditions; time frames involved; pressure on the teams and leaders; ○ Organizational context – what is the nature of the organization (headquarters, regional office, JFO, ICP) and the culture; ○ Venue and form – what is the most appropriate way to convey the advice to a leader or other client (one-on-one meeting, at senior staff meeting, all-hands meeting, local officials meetings) ○ Risk picture – Whether to package the advice in terms of alternative levels of risk associated with an option (or) a go/no-go course of action; if risk level too high, does the leader want their lawyers to be prepared to express their objections; 			
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<ul style="list-style-type: none"> ○ Leader/collaborator personalities – cultivate the ability to adapt to the personalities and leadership styles of their clients; <p>Mission Preparation and Readiness (PREP) for deployment:</p> <ul style="list-style-type: none"> • Personal Commitment and Contact <ul style="list-style-type: none"> ○ Prepare for availability and extended absence; ○ Establish pre-departure communications with relevant agencies and partners; ○ Meet and greet the appropriate with the city attorney (or legal representative), command staff, and other appropriate team members; ○ Have a clear understanding of the ethical duties and the limits of personal knowledge of the law and professional development before providing legal advice in a crisis situation. • Reconnaissance (Mission) <ul style="list-style-type: none"> ○ Inform yourself on the situation, context, and role the attorney will be assuming; review declaration, IMAT reports, source intelligence, hazard types, and historical/geographical/cultural or jurisdictional context. • Emergency/Disaster Legal References <ul style="list-style-type: none"> ○ Compile and research general and specialized legal resources (authorities, regulations, policies, guidelines, procedures) • Packing List for Field Deployments <ul style="list-style-type: none"> ○ Travel or absence preparations; field kits; personal items. 			
<p>5. Provide or arrange for legal advice relating to EOC activities.</p> <p>Contact List (Liaison Officer) of subject matter attorneys (Environmental, Health, Criminal)</p>	E, F, I, J		
<p>6. Provide guidance to senior leadership, Policy Group, and EOC personnel on potential legal risk and liabilities:</p> <p>a. Establish working relationship, including with external partners and subject matter experts.</p>	E, F, I, J		

<p>b. Anticipate potential legal problems and facilitate their resolution.</p> <ul style="list-style-type: none"> • Agency Liability – Official capacity • Personal Liability – Ultra Vires - section of Disaster Handbook (waivers of immunity, scope of authority, gross negligence) 			
<p>7. Coordinate with local, state, tribal, territorial and federal emergency management attorneys.</p>	E, F, I, J		
<p>8. In coordination with EOC leadership and local, state, tribal, territorial and federal officials, draft the following:</p> <p>a. Proclamations</p> <ul style="list-style-type: none"> • City of Houston, Basic Emergency Plan, Annex U Legal, Section 15 Exhibits <ul style="list-style-type: none"> ○ Proclamation Declaring a Local State of Disaster <p>b. Declarations</p> <ul style="list-style-type: none"> • City of Houston, Basic Emergency Plan, Annex U Legal, Section 15 Exhibits <ul style="list-style-type: none"> ○ Request for a State of Emergency after disaster occurs ○ Request for a State of Emergency when disaster is imminent • Texas Emergency Management Executive Guide: <ul style="list-style-type: none"> ○ Sample Disaster Declaration ○ Sample Request Emergency Declaration to the Governor <p>c. Emergency ordinances</p> <ul style="list-style-type: none"> • City of Houston, Basic Emergency Plan, Annex U Legal, Section 15 Exhibits <ul style="list-style-type: none"> ○ City Ordinance Extending a Local State of Disaster ○ City Ordinance Terminating a Local State of Disaster <p>d. Other legal documents</p> <ul style="list-style-type: none"> • City of Houston, Basic Emergency Plan, Annex U Legal, Section 15 Exhibits <ul style="list-style-type: none"> ○ Executive Order ○ Executive Order Terminating a Local State of Disaster 	E, F, I, J		