NAVASOTA RIVER
FLOODING PROJECT

SUPPLEMENTARY MATERIALS

STAKEHOLDER PERSPECTIVES

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STAKEHOLDER PERSPECTIVES

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METHODOLOGICAL OVERVIEW

The aim of this component of the study was to assess local knowledge and lived experiences of flooding of the Navasota River. To capture this information, the research team focused on individuals who own or lease land along the Navasota River within the study area. Multiple methods were used to collect information, including an online survey, interviews, and a focus group. Additionally, documents and statements were collected from stakeholder groups representing property owners along the Navasota River and upstream at Lake Limestone. The data collection was limited by the small number of survey respondents (n=22), interviewees (n=5), and focus group participants (n=8), most of whom own property in the southern portion of the study area.

Among the multiple methods used to collect information from stakeholders, all were convenience or opt-in methods. It should be recognized that such voluntary participation introduces bias into the study. Individuals who were most likely to participate are those who are most interested in the issue of flooding, potentially for various reasons including having experienced severe flooding and/or asset losses due to flooding. Alternative data collection methods, however, were not feasible because of the narrowly targeted stakeholder group, limited to property owners or tenants of land along the Navasota River within the small study area. Therefore, this component of the study relied on the following information sources and data collection methods:

> ***Online survey***. An online survey was developed by the research team and launched in February 2022. Approximately 200 property owners in the study area were notified of the survey via a mailed postcard. Additionally, email notifications inviting stakeholders to participate in the survey were circulated among Texas A&M AgriLife Extension and Farm Bureau offices in each county in the study area as well as with local government organizations, including the Brazos Valley Council of Governments.
>
> The survey consisted of multiple sets of closed- and open-ended questions on themes pertinent to the study—property tenure, flood experience, and perceptions of flood management (Appendix A). Twenty-two individuals responded to the online survey, for a response rate of approximately 10%. The majority of participants were male, 55 years or older, and White, non-Hispanic. Participants reported land tenure of two years to 50+ years, with the majority owning or leasing land for the past 20+ years. Locations of the property owned by participants spanned from Lake Limestone to the City of Navasota; however, the majority of participants reported owning land in the southern region of the study area (Appendix B). Land use was evenly split between participants whose land predominately

[1] The author would like to thank Texas A&M University at Galveston doctoral student research assistants, Kelli Goddard-Sobers and Virgie Greb, for their efforts in the data collection for this chapter.

supports cattle and livestock production and those who use their land mostly for recreation and wildlife. Only two participants noted their property is the location of their homestead.

Interviews. In-person and phone interviews were conducted with individuals contacted by or referred to the research team. These interviews were open-ended, allowing for in-depth discussion of topics guided by the participant. In total, five interviews were conducted from February to July 2022. All participants were landowners, owning property along the Navasota River for the past six years to 50+ years. Three of the participants have homes on their property, while one uses their land to support cattle operations, and another uses their property for recreation and wildlife.

Focus group. An in-person focus group was held in July 2022 to solicit feedback on the study. The primary objective of the focus group was to assess how local experiences and knowledge aligned with preliminary study findings. Eight individuals participated in the focus group. All participants were owners of property along the Navasota River with a range of land ownership from 30 years to 100+ years family ownership. All indicated experiencing flooding at some point on their property; most conveyed that this flooding has been moderate to severe. Participants reported using their land for cattle and livestock production, hay and pastureland, and recreation and wildlife.

Written statements. Information was solicited from two landowner groups – Navasota River Flooding and Friends of Lake Limestone. The Navasota River Flooding group includes property owners along the river, downstream of the Lake Limestone dam. They provided a document containing written concerns related to Navasota River flooding from property owners participating in a virtual meeting held by the group on April 22, 2021. The Friends of Lake Limestone group is composed of individuals who own property on Lake Limestone, above the dam. They provided a written statement of concerns related to Navasota River flooding on March 22, 2022.

The Texas A&M University Institutional Review Board approved all data collection protocols related to this study (IRB2022-0041M).

KEY FINDINGS

LIVED FLOOD EXPERIENCES

Flood Frequency and Duration

Survey participants reported varied flood experiences (see Table 1). In terms of frequency of flooding, 14% of survey participants (n=3) said their property does not flood or floods less than once per year. These individuals estimated flood depth to be less than 0.5 feet, lasting only a couple of days, and causing no damage to property. Thirty-six percent of survey participants (n=8) reported flooding about once per year. These individuals said that flooding, in their experience, was about 5 feet, lasted about 10 days, and caused what they would call “mild” to “moderate” damages. Another 36% of survey participants (n=8) said their property floods about twice per year. Flooding for these individuals has been deeper—about 8 feet, tends to last about 10 days, and causes “somewhat

severe" to "extremely severe" damages. The final 14% of survey participants (n=3) said their property tends to flood three to five times per year. In their experience, flood depth was about 5 feet, and flooding was reported to last about seven days with "somewhat severe" property damages.

Table 1. Flood Experiences of Survey Participants

FLOODS/YEAR		DEPTH	DURATION	DAMAGES
<1 flood	*Median:*	0 feet	none	none
	Range:	0 to 0.5 feet	0 to 1-2 days	none to mild
1 flood	*Median:*	5 feet	10 days	mild to moderate
	Range:	3 to 8 feet	3-5 days to 2-3 months	mild to extremely severe
2 floods	*Median:*	8 feet	10 days	somewhat to extremely severe
	Range:	5 to 12 feet	3-5 days to 1 month	mild to extremely severe
3 to 5 floods	*Median:*	5 feet	7 days	somewhat severe
	Range:	4 to 8 feet	3-5 days to 1 month	moderate to somewhat severe

Note: Figures reported are aggregated survey responses (n=22).

Many interviewees and focus group participants commented that flooding of the Navasota River has changed in the last few decades. Reflecting on this, a participant in the Navasota River Flooding focus group meeting shared this:

> *The land that we have has been in our family since 1918. Was given to my dad by his dad in 1954. And as a child, I remember very little flooding of the river. We've always had deer hunters on our property, and during deer season, which is part of the wet season of the year, we never had flooding like we have now. Sometimes the hunters couldn't even get to their stands.*

Duration of flooding was identified by multiple stakeholders as a critical change. One interviewee described flooding on their property as lasting three to five months in recent years and being fairly "constant" in terms of land submerged in floodwater or being saturated and muddy. Focus group participants also observed that the extended duration of flooding is the factor most damaging to property.

Flood Losses & Impacts

Survey participants were asked: "Typically, how severe are property damages and economic losses due to flooding on your property?" Twenty-seven percent of survey participants (n=6) said "extremely severe," and another 27% (n=6) rated flood losses as "severe." Nine percent of survey participants (n=2) said the losses they typically incur are "moderate," while another 27% (n=6) estimated their losses have been "mild." Finally, 9% of survey participants (n=2) said they have had "no losses" due to flooding.

A range of losses due to flooding of the Navasota River were reported by survey and focus group participants and interviewees. These losses included damages to infrastructure (private fences, roads, bridges, driveways, walkways); assets (deer feeders and blinds, farm equipment); and structures (flood waters in home/camp house). Stakeholders also noted loss of livestock, fish stock, hardwood trees, crops, and grass as a result of flooding. Focus group participants emphasized that it is not only the impact of floodwater force, but also the extended time of floodwaters on their land,

that damages property and assets. Oversaturated land, in their experience, has led to root ball rot and the loss of numerous trees. Additionally, stakeholders said that the deposit of sediment as a result of flooding blocks natural drainage and kills grass.

The movement of flood waters was also noted by stakeholders to destroy existing channels and create new gullies, some of which cut off access to portions of their property. Multiple interviewees noted erosion of their property and shifting riverbanks, which they attributed to increased volume and flow of the river. Similarly, one focus group participant said they sold part of their land to individuals on the other side of the bank because the river's path had changed so drastically.

A few participants noted that their land is completely unusable because of Navasota River flooding and commented that they have had to cease cattle operations on their property. Still, a few claim no losses and see flooding as beneficial to the land and part of owning property along the river. In line with this, one focus group participant shared:

> *My earliest recollections of being on this river, probably two, three years old. I don't live on it, but I've been on it ever since. It's beautiful. The river bottom is just a very special place. We're so lucky that they didn't build that damn dam on the Navasota River and destroy all this. I appreciate the floods. We need periodic floods, and floods in that river bottom to keep the vegetation and the wildlife happy and lush. And it is lush right now. It is crazy. I don't have the same issues as other people. I don't ranch it. I don't try to make money off of it, so my issues are different than other people. But I really enjoy that bottom.*

Changes Made due to Flooding

The survey asked participants if they have made adjustments to their property or use of their land due to flooding of the Navasota River (see Table 2). The majority of survey participants (67%) reported making some kind of modification to their activities or property. Forty-one percent said they have changed agriculture production tied to their property, such as livestock and pasture management strategies. One critical issue is the loss of nutrient-rich grass in the river bottom due to flooding. While this grass is not typically used for cutting hay, it is ideal for grazing. As one focus group participant commented:

> *I want to dispel the notion that it's [the Navasota River bottom] marginal ranch land. It's not. It's really good ranch land. In fact, it's the best ranch land I have right now for sure because I got green grass today and on the upland pastures it's burned.*

As a result of loss of grass for livestock grazing, stakeholders reported having to move cattle to other locations off their river-adjacent property. As interviewees noted, this results in additional costs and often over-grazing on other properties. One survey participant said they just "can't have cows, can't do additional fence as it would just be ruined" by Navasota River flooding. A focus group participant echoed this, noting they ran cattle on their property in the 1980s but now use their land only for recreation purposes.

In addition to changing agriculture production, about one-third (32%) of survey participants reported making structural changes to their property, such as constructing levees and bridges, elevating

buildings, and rerouting roads. One interviewee described building four bridges on their property from railroad boxcar containers, all of which now require additional maintenance and repair due to repeated and "constant" flooding.

Eighteen percent of survey participants said they have changed their place of residence due to river flooding. One individual noted they "bulldozed a house because flooding ruined it." The most prevalent change reported, however, was to recreation—45% of survey participants said flooding has changed recreational activities for them. One individual responded in the survey that "flooding provides the benefit of more outdoor activities" and made the point that many species of wildlife, such as the alligator gar who use flooded backwaters for spawning, depend on flooding to thrive.

Table 2. Reported Changes to How People are Using Their Land

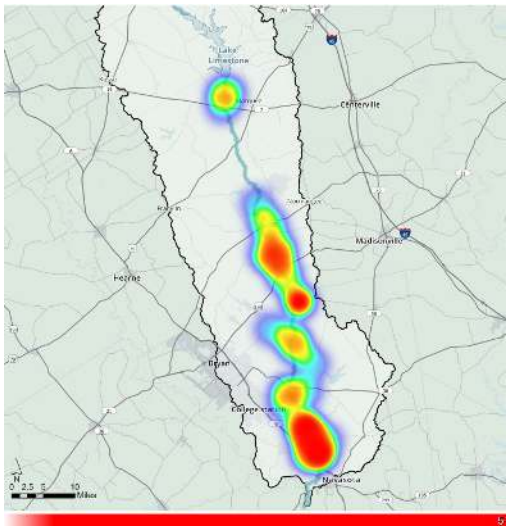
Note: Figures reported do not total 100% because multiple response options were available to survey participants (n=22).

LOCAL KNOWLEDGE OF FLOODING

Flood Hot Spots

The locations of most frequent and severe flooding were identified by survey participants. The survey asked participants to mark up to five locations where they know flooding is the worst along the Navasota River. As shown in Figure 1, the biggest "hot spots" of flooding were reported in the southern region of the study area, south of Highway OSR and Bryan-College Station.

Figure 1. Flood Hot Spots, Reported by Survey Participants



Note: Map depicts up to 5 "hot spots" identified by each survey participant (n=22).

Flood Source & Causes

Stakeholders acknowledged that their land is at risk for flooding from the Navasota River and, as a focus group participant put it, have "lived with this for generations." All survey participants identified the Navasota River (not the Brazos River or tributaries) as the primary source of flooding on their property. Local rainfall, however, was not reported by stakeholders as the cause of flooding; rather, "it's what is dumped in the river upstream that floods us," said an interviewee. Many interviewees and focus group participants noted "blue sky" flooding and pointed to Lake Limestone as the cause. One survey participant reflected, "The river has always flooded, usually in late winter or early spring. Since Lake Limestone was built, it's much worse and somewhat unpredictable."

While the majority of stakeholders pointed to Lake Limestone as the cause of river flooding, other contributing factors were also acknowledged, including increased development. "Because there's so much building, there's so much concrete being poured," one interviewee observed, "there's more water in the river than there used to be." One focus group participant noted experiencing more "localized" flooding on their property in the past 50 years related to stormwater runoff from a tributary of the Navasota River, Wickson Creek, in the Bryan-College Station area.

Debris in the river was also identified as a source of flooding as downed trees, other natural debris, and trash block flows. This is particularly problematic around built infrastructure. One interviewee

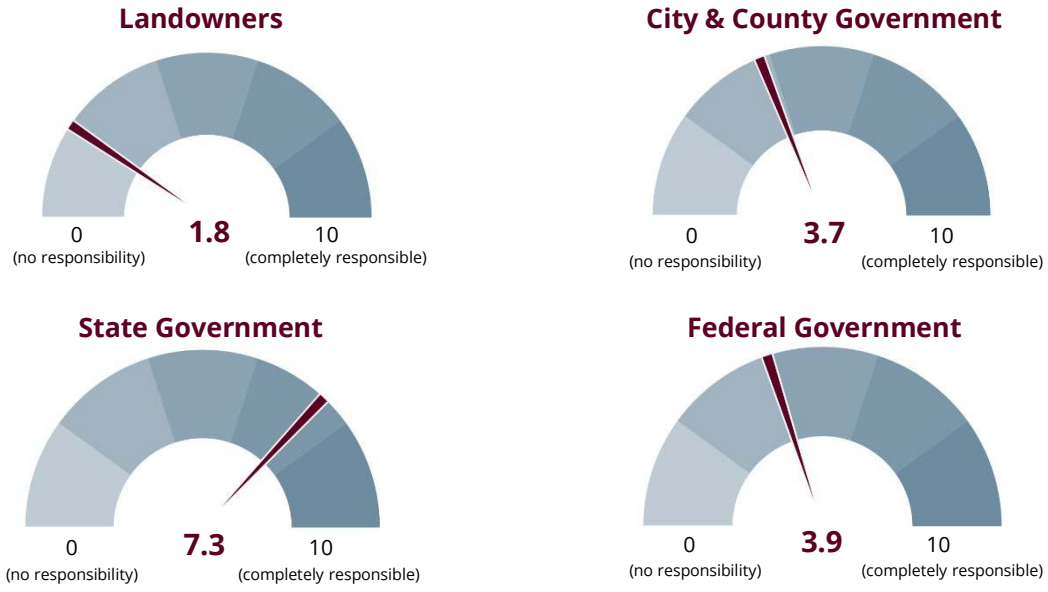
expressed concern about highway bridges, noting that “water stacks up 4 to 5 feet, sometimes even 6 feet higher on the north side of Highway 30 as it does just the other downstream side of the bridge” because “there's no channel under the bridges.” These specific bridges are not the only concern; rather, stakeholders have observed problems all along the river. As an interviewee put it, “The Navasota is a nasty river.” Its excess debris creates the situation, in the words of a focus group participant, that “everywhere we have a bridge crossing, we have another dam.”

FLOOD MANAGEMENT PERCEPTIONS

Responsibility for Flooding

Survey participants were asked how responsible they believe landowners, city and county government, state government, and federal government are for reducing the impact of flooding along the Navasota River. Participants expressed their beliefs of responsibility for each group by sliding a bar from 0 (not responsible at all) to 10 (completely responsible). As shown in Figure 2, responses indicated that participants hold state government as most responsible for flooding (average 7.3). Federal (average 3.9) and city and county government (average 3.7) scored much lower on the scale of responsibility, and landowners were assigned the least amount of responsibility (average 1.8). This underscores a prevailing perception, among the small sample of landowners surveyed, that flooding of the Navasota River is state government (and its agencies’) responsibility.

Figure 2. Responsibility Attribution for Flood Management



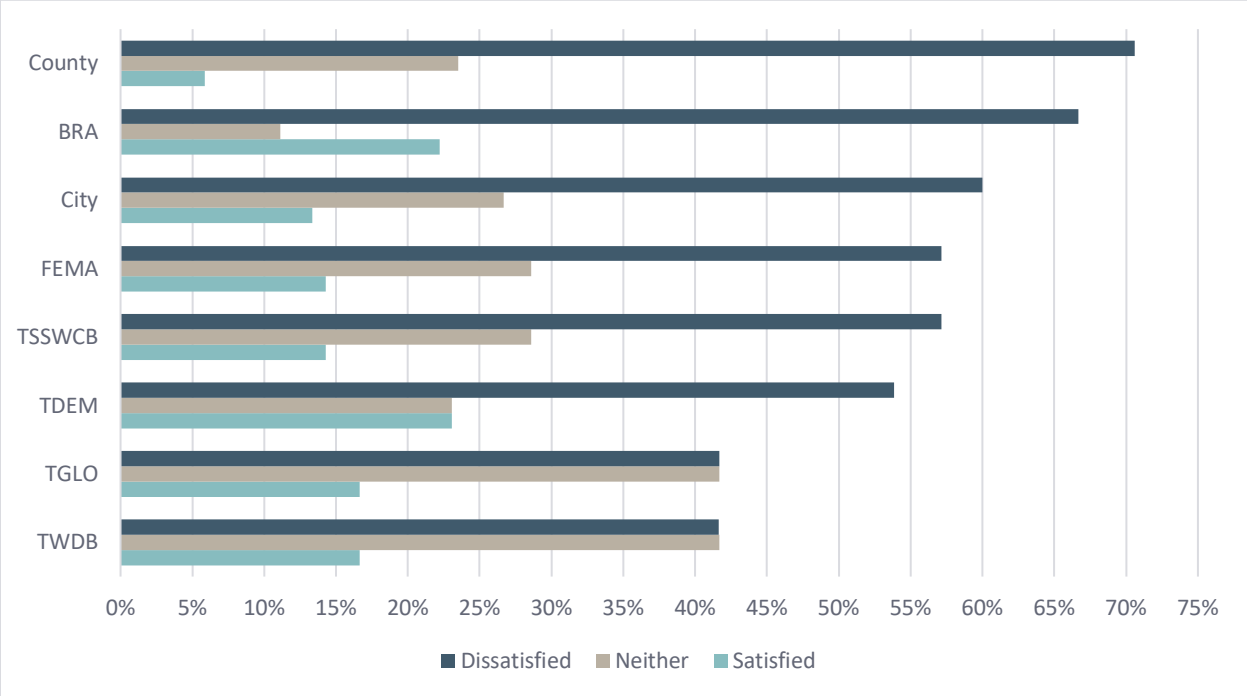
Note: Figures reported represent aggregated survey responses (n=22).

Satisfaction with Flood Protection

Survey participants were asked to evaluate a number of public sector groups directly or indirectly involved in flood management. Specifically, they were asked how satisfied they are with the following groups for protection of their property from flooding: city government, county government, the Brazos River Authority (BRA), the Texas State Soil and Water Conservation Board (TSSWCB), the Texas Division of Emergency Management (TDEM), the Texas Water Development Board (TWDB), the Texas General Land Office (TGLO), and the Federal Emergency Management Agency (FEMA). Response options included "extremely dissatisfied," "dissatisfied," "neither satisfied nor dissatisfied," "satisfied," and "extremely satisfied." These categories were collapsed for reporting purposes.

As shown in Figure 3, more survey participants were dissatisfied than satisfied. A range of 42% to 71% of survey participants said they were dissatisfied with the groups evaluated in terms of flood protection, compared to 6% to 23% who said they were satisfied. County government was the most poorly rated with 71% of participants saying they were dissatisfied with this group. The BRA followed closely behind with 67% of participants reporting dissatisfaction with the group. Looking at satisfaction, the highest percentage of survey participants expressing satisfaction did so for TDEM (23%). Another 22% said they were satisfied with the BRA, highlighting relations with this group are polarized among stakeholders. Regarding the TWDB and TGLO, 42% of participants said they are "neither satisfied nor dissatisfied" with these groups. This neutrality may be due to lack of direct interaction between stakeholders and these state-level groups.

Figure 3. Satisfaction with Public Sector Groups for Protection of Property from Flooding



Note: Figures reported represent aggregated survey responses (n=22).

Regarding the BRA's performance on flood management, focus group participants noted satisfaction, in particular, with the agency's dam release notifications. They reported using these to prepare for flooding by moving tractors, equipment, and livestock out of the river bottom. Most focus group participants said they are able to judge, through experience, the approximate time to expect flooding on their property (given the timing of release from Lake Limestone) and the depth of flooding to expect (given the volume of the release). As one participant explained: "They tell you how many cubic feet per second, how many gates, and how many cubic feet they've opened and they're letting out. So just based on history, I know what that's going to do to my property." Overall, these notifications were perceived as flood warnings with sufficient information to prepare accordingly.

Flood Management Concerns

The stakeholder group participating in the study expressed a need to change current management practices to reduce flooding of the Navasota River. An interviewee said:

> *When you're on the river bottom, you do expect the river to get out and you do expect it to flood on natural events…but this [the constant flooding] is not the way it's been. That's not the way it needs to be. And it can be changed.*

One area of concern related to flood management was cleaning debris from the river. "No one claims responsibility for coming in, cleaning out the river," a focus group participant observed. There was a consensus among stakeholders that cleaning debris from the river and dredging it would smooth flows and potentially reduce the incidence and severity of floods.

A chief concern of stakeholders was the duration of flooding. Multiple focus group participants observed increases in flood duration over the past decades, since the construction of the Lake Limestone dam in 1978. They believe that releases from the dam should be adjusted to move water more quickly down the river. Extended time of flooding creates multiple problems for landowners, ranging from limited access to property to loss of trees and grazing grass due to oversaturation.

Many stakeholders also expressed concern about the timing and volume of Lake Limestone dam releases. Interviewees and focus group participants observed that flooding occurs on their property three to five days after a major precipitation event in the upstream region, north of them. Some focus group participants asserted that flooding could be reduced by adjusting the timing of dam releases, specifically allowing pre-releases of water from the dam ahead of heavy precipitation events. Focus group participants, in addition to multiple interviewees, also questioned if more flexibility in Lake Limestone levels could be exercised to prevent dam releases that cause downstream flooding. Related to this, several individuals commented that the storage capacity of Lake Limestone should be examined, and the lake dredged, if more capacity is needed. With the lake's storage capacity increased, dam releases – and associated flooding – could be reduced.

Stakeholder concerns related to Lake Limestone levels and dam releases have created conflict with upstream Lake Limestone property owners. In a statement issued to the research team by the group Friends of Lake Limestone, landowners upstream want the lake and dam operations to continue to be managed as they have. They stated:

The Friends of Lake Limestone are concerned that the private property rights of landowners on Lake Limestone will be disregarded in an attempt to further mitigate flooding downstream. Lowering the water level in Lake Limestone to further mitigate downstream flooding might benefit downstream property owners, but only at the expense of public water supplies needed for droughts and the rights of Lake Limestone property owners.

Lake Limestone as a water supply reservoir was discussed in the focus group, and participants generally acknowledged and accepted this purpose. However, the consensus among stakeholders participating in the focus group and interviews was that the dam could be managed in a way that continues that purpose while doing less harm to downstream property owners and residents. Adjusting lake levels and dam releases was seen as a way to, as one focus group participant put it, “be a good neighbor.”

Appendix A. Survey Questionnaire

1) How many years have you owned property along the Navasota River?
2) In the time that you have owned your property, about how many times has it flooded?
3) When your property floods, typically how deep (in feet) is the floodwater at its deepest?
4) When it floods, typically how long does water submerge your property? [Less than a day, 1-2 days, 3-5 days, 1 week, 2-3 weeks, 1 month, 2-3 months, More than 3 months]
5) Typically, how severe are property damages and economic losses due to flooding on your property? [Extremely severe, Somewhat severe, Moderate, Mild, None, Prefer not to say]
6) Please give an example of the type of losses you have incurred because of flooding on your property.

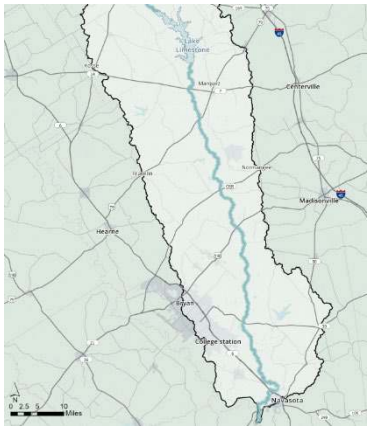
For the next set of questions, please think about the worst flood that has occurred on your property…

7) In about what year did this flood occur?
8) About how deep (in feet) was the floodwater at its deepest?
9) How severe were property damages and economic losses due to this flood? [Extremely severe, Somewhat severe, Moderate, Mild, None, Prefer not to say]
10) If you would like, please give more details on the losses you incurred because of this flood.

Next, we would like to ask you more about the extent of flooding.

11) What would you say is the source of flooding on your property? *Please mark all that apply.* [Navasota River, Brazos River, Ponds and/or streams, Ponding in fields, Other (please write in), Not sure]
12) Have you changed any of the following due to flooding of the Navasota River? *Please mark all that apply.* [Place of residence (meaning where your home is located, Structural changes on your property (such as levees, bridges, elevated buildings, rerouted roads), Recreational activities (such as kayaking, fishing), Agriculture production (such as livestock and pasture management strategies), Economic activities (meaning buying and selling of goods and services), Other (please write in), None]

13) Looking at the map below, please mark where you know flooding along the Navasota River is the worst. *Note that the map outlines the Navasota River from Lake Limestone in the north to its intersection with the Brazos River in the south.*



Now, we would like to ask your opinion about management of flooding.

14) What do you think are the most important things to address with the management of flooding of the Navasota River?

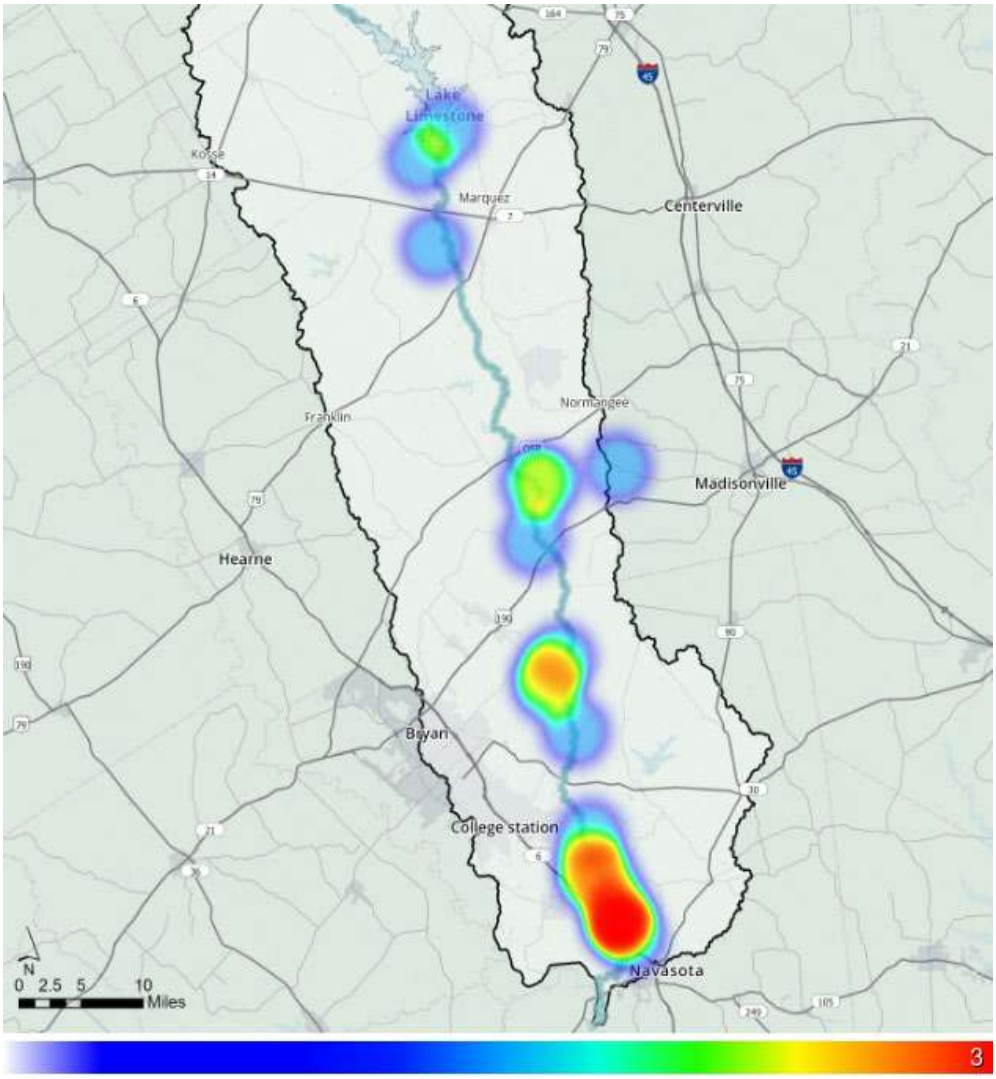
15) Have you ever contacted a government agency about flooding concerns on your property? [Yes (please write in which agency/agencies), No]

16) How satisfied are you with the following groups to protect your property from flooding? *City government, County government, Brazos River Authority, Texas State Soil and Water Conservation Board, Texas Division of Emergency Management, Texas Water Development Board, Texas General Land Office, Federal Emergency Management Agency* [Extremely satisfied, Satisfied, Neither satisfied nor dissatisfied, Dissatisfied, Extremely dissatisfied, I don't know enough to say]

17) How responsible do you think the following groups are for reducing the impact of flooding along the Navasota River? *Landowners, City and county governments, State government, Federal government* [Select from 0 (not responsible at all) to 10 (completely responsible).]

18) Is there anything else you would like us to know about flooding of the Navasota River?

Appendix B. Location of Survey Participants



Note: Locations are based on survey participant self-placement on the map.