

Task 6A: Impacts of the Regional Flood Plan

The goal of Task 6A is to summarize the overall impacts of the Regional Flood Plan. This includes potential impacts to areas at risk of flooding, structures and populations in the floodplain, number of low water crossings impacted, impacts to future flood risk, impact to water supply (details provided in Chapter 6B), and overall impact on the environment, agriculture, recreational resources, water quality, erosion, sedimentation, and navigation. This chapter describes the processes undertaken by the RFPG to achieve these tasks and summarizes the outcomes of this effort.

The impacts will generally be determined based on before-and-after (regional flood plan implementation) comparisons of the same types of information provided under the Task 2 Existing Flood Risk and Future Flood Risk Analyses. These two comparisons may, for example, indicate a percent change in flood risk faced by various elements, including critical infrastructure. These two comparisons (one comparison each for a 1% ACE and another for a 0.2% ACE) should illustrate both how much the region's existing flood risk will be reduced through implementation of the plan as well as how much additional, future flood risk (risk that might otherwise arise if no changes were made to floodplain policies etc.) will be avoided through implementation of the regional flood plan, including recommended changes/improvements to the region's floodplain management policies.

This effort included a:

1. region-wide summary of the relative reduction in flood risk that implementation of the Regional Flood Plan would achieve within the region including with regard to life, injuries, and property.
2. statement that the FMPs in the plan, when implemented, will not negatively impact neighboring areas located within or outside of the Flood Planning Region (FPR).
3. general description of the types of potential positive and negative socioeconomic or recreational impacts of the recommended FMSs and FMPs within the FPR.
4. general description of the overall impacts of the recommended FMPs and FMSs in the Regional Flood Plan on the environment, agriculture, recreational resources, water quality, erosion, sedimentation, and navigation.

FMP Impacts

37 FMPs were identified and recommended, as discussed in detail in Chapters 4 and 5. As proposed, the recommended FMPs within this plan, will not negatively impact neighboring areas located within or outside of the FPR. The local sponsor will ultimately be responsible for proving that the final project design and implementation has no negative flood impacts prior to construction.

1 Of these FMPs, a little less than half are conveyance improvement projects that have the potential to
 2 increase flows downstream by expanding channels, culverts, and/or bridges. To ensure that there will be
 3 no negative impacts to neighboring areas, conveyance mitigation measures, such as detention or valley
 4 storage have been included in the projects and will have to be analyzed and designed once the projects
 5 are funded. The remaining FMPs consist of new or improved detention facilities without conveyance
 6 improvements, acquisition or elevation of repetitive loss properties, installation of emergency
 7 generators, or infrastructure hardening. The RFPG reviewed previous assessments of impact to
 8 upstream or downstream areas or neighboring regions, and deferred to the professional engineering
 9 judgement expressed in those assessments to determine whether no negative impact exists. The local
 10 sponsor will be ultimately responsible for proving the final conveyance project design has no negative
 11 flood impact prior to initiating construction. As proposed, the recommended FMPs, when implemented,
 12 will not negatively impact neighboring areas located within or outside of the FPR.

13 As detailed in Table 13 (Appendix X) and summarized in **Table 6A.1** below, the 37 FMPs would reduce
 14 the number of structures in the 1% ACE floodplain by 700, and the number of structures in the 0.2% ACE
 15 floodplain by 469. This would help protect approximately 1,864 people from living within the 1% ACE
 16 floodplain. An estimated 24 road closure occurrences can be avoided within the 1% ACE floodplain.
 17 Some of these projects are expected to benefit agricultural lands. Additional benefits will include
 18 reduction in flooding in park lands, which will benefit recreational users. The streams impacted by the
 19 FMPs are not currently navigable, and this will not change when the projects are implemented.

20 If fully implemented, the RFP will have profound and lasting impacts on flooding in Region 11. It is
 21 important to note that Table 6-1 only demonstrates the flood exposure analysis for the 37
 22 recommended FMPs.

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Flood Exposure	Existing Conditions		After FMP Implementation		Exposure Reduction from FMPs	
	1% ACE	0.2% ACE	1% ACE	0.2% ACE*	1% ACE	0.2% ACE*
Exposed Structures	13,438	15,023	12,738	14,554	700	469
Exposed Population	20,723	23,805	18,869	N/A	1,864	N/A
Exposed LWC	266	270	242	N/A	24	N/A

* 0.2% ACE impacts were not provided by FMP sponsor

Table 6A.1: Summary of impacts of FMPs to flooding in Region 11

24

1 FMS Impacts

2 The RFPG identified and reviewed more than 150 individual strategies from stakeholders within the
3 region. Many of the identified strategies were found in existing Hazard Mitigation Action Plans, and it
4 was noted there is a lot of similarity in the strategies. It was therefore determined to group the FMSs
5 into the five strategy types identified in the TWDB Guidance Documents, and to consolidate the
6 individual FMSs into five regional FMSs. The main reasons for this decision were to make each strategy
7 inclusive of all communities within the region that choose to pursue them, and to encourage
8 collaboration between sponsors, particularly neighboring communities.

9 There are 32 individual actions that are bundled into the Regulatory and Guidance regional FMS. Actions
10 listed within this category will improve regulation of development to decrease current and future flood
11 risks. Some sample FMSs are NFIP participation, stormwater management criteria development
12 including higher standards, floodplain management staff acquisition and training, ordinances, land
13 use/zoning, and developing and implementing Green Infrastructure programs. Positive impacts include
14 reducing the number of structures and roadways built in the floodplain, minimizing expansion of future
15 floodplains, protecting riparian areas from development, which protects the environment, water quality,
16 erosion, and sedimentation, and providing more regulatory certainty and consistency across the Region.
17 Potential negative impacts include the increased regulatory and financial burden on citizens and the
18 increase in staff workload for communities.

19 Property Acquisition and Structural Elevation actions involve voluntary buyout programs and/or
20 structural elevation assistance programs. There are 32 individual actions that are bundled into the
21 Property Acquisition and Structural Elevation regional FMS. Although the individual actions focus on
22 open space preservation, the regional FMS includes land acquisition to protect open space, acquiring or
23 buying out flood prone structures, and elevation assistance programs. Anticipated positive impacts
24 include reducing the number of structures in the floodplain and increased protection of citizens,
25 allowing people to remove themselves from the floodplain without losing their investments,
26 restoring/preserving floodplain functionality and conveyance, and ultimately protecting riparian areas
27 from development – which protects natural environments, water quality, erosion, sedimentation.
28 Potential negative impacts include increasing the regulatory and financial burden on citizens, increasing
29 staff workloads for each community, causing “blight” in certain neighborhoods if not handled
30 appropriately, and could be politically objectionable in some circumstances.

31 Some strategies considered Education and Outreach to increase awareness of flooding issues, risks, and
32 regulation to citizens and other stakeholders. There are 62 individual actions that are bundled into the
33 Education and Outreach regional FMS. These include public awareness campaigns; flood safety
34 education for residents, elected officials and real estate agents/developers; and flood insurance
35 campaigns. Anticipated positive impacts include reduced violations of floodplain regulations which can
36 decrease flood risks, increased public awareness of flood hazard areas, increased NFIP participation, and
37 increased awareness of imminent flood events - which can help with early evacuations and mitigation
38 measures to prevent further damages, save lives, and minimize risky behavior during floods which can
39 reduce deaths, especially while driving. One negative impact of this strategy category is that it could

1 increase staff workloads for communities. Establishing these types of programs would also introduce a
2 small financial burden on citizens.

3 There are 46 individual actions that are bundled into the Flood Measurement and Warning regional
4 FMS. This type involves the installation and operation of rainfall and flow measurement devices. These
5 devices may have predictive systems in place to better forecast flooding, barricades, and warnings.
6 Example FMSs include flood gauges, early alert systems, flood warning systems, evacuation/emergency
7 management plans, and flood safety systems at Low Water Crossings. The anticipated benefits of
8 implementing this FMS would be allowing people at risk of flooding to better prepare for flood events,
9 mitigate damages, evaluate their respective area(s), and prevent vehicles from driving on flooded roads.
10 All of these measures can help save lives by allowing local officials and community staff members to
11 take proper precautions such as: closing hazardous roads and evacuating the predicted flooded areas
12 before the actual flood begins. Potential negative impacts include increasing the financial burden on
13 citizens, increasing staff workloads for communities, and the potential for false alarms or failed warnings
14 if the system is not properly maintained and calibrated.

15 The Infrastructure Projects category is specific to Region 11 and is comprised of any other type of FMS
16 that does not fall within the five categories outlined above. There are 17 individual actions that are
17 bundled into the Infrastructure Projects regional FMS. While these may lead to future FMEs and FMPs,
18 the specific actions represent the creation of programs. These include nature-based solutions (i.e., green
19 infrastructure), site-specific maintenance programs, and county-wide maintenance programs. Some
20 positive impacts include an established, routine-level maintenance plan/program to clear debris from
21 flood-prone areas such as bridges, box culverts, and drainage systems to prevent overtopping and
22 backup during flood events; developing plans to increase channel and bank stabilization by reducing
23 erosion impacts; preserving system functionality (man-made and natural); avoiding large capital
24 expenses resulting from deferred maintenance; prolonging facilities performing at their desired level of
25 service; and financial transparency to customers about major capital expenses. Potential negative
26 impact include increasing the financial burden on citizens and increasing local staff workloads to
27 maintain these areas routinely and properly.

28 While not readily quantifiable, these strategies and measures will generally protect the health, safety,
29 and well-being of individuals within the region while simultaneously improving the region's economic
30 well-being by reducing the flood frequency and severity, providing advanced warning of flood risks,
31 minimizing the number of drivers on flooded roads, giving community officials the resources they need
32 to prevent construction in flood prone areas, and alleviating known flooding issues. Development,
33 especially in the floodplain, leads to increases in flood flows that can cause downcutting and erosion of
34 streams – both of which ultimately lead to environmental issues. The FMSs in Region 11's RFP will help
35 minimize and prevent future damage, which will help preserve developable land, protect agricultural
36 land, reduce erosion, and prevent downstream sedimentation. Most flood mitigation measures have the
37 potential to negatively impact neighboring areas, especially when conveyance is increased. These
38 impacts will be mitigated during design and construction to ensure that no negative impacts occur.
39 Many of the FMSs will require more active floodplain management by communities in the region which
40 will burden community officials who must enforce regulations and will likely meet some resistance from

1 citizens and developers wishing to engage in floodplain construction. Most of these strategies would add
 2 costs that would be incurred by the citizens of the community. These issues can be overcome and lead
 3 to stronger communities, and this fully funded RFP would aid in providing the tools needed to
 4 accomplish these goals.

5 If all of these FMSs are implemented and enforced, then Region 11 will prevent a significant increase in
 6 flood exposures. Without these FMSs in place, the Region could see the 1% ACE floodplain area increase
 7 by 183 square miles and the 0.2% ACE floodplain increase by 32 square miles. This would expose an
 8 additional 22,667 structures and 92,715 people to the 1% ACE floodplain, and 3,318 structures and
 9 9,569 people to the 0.2% ACE floodplain.

10 FME Impacts

11 A total of 136 FMEs were recommended by the RFPG in three broad categories. These categories,
 12 examples, and their positive and negative impacts are described below.

13 The Preparedness category includes evaluations pertaining to communities being prepared for flood
 14 events. Example FMEs in this category are inundation studies, dam compliance assessments,
 15 hazard/vulnerability assessments, dam integrity studies, evacuation and dam safety plans, road access
 16 studies. These actions can provide a positive impact by having preemptive evaluations and strategies to
 17 better prepare an area or community in the event of flood. There are 6 FMEs in this category.

18 Evaluations marked as Project Planning conduct up to 30% design for specific projects and flood
 19 mitigation measures that were previously identified by sponsors. There are 92 FMEs in Region 11 in this
 20 category. Typical projects include storm drain upgrades, culvert upsizing, and channel modifications.
 21 Expected positive impacts include reducing flooding and exposure to flooding, reducing impact of
 22 flooding on existing facilities, and reducing roadway overtopping. One negative impact is that all
 23 conveyance improvement projects have the potential to increase flooding downstream. Mitigation
 24 measures will need to be considered during the development of these actions.

25 Actions conducting watershed studies to establish accurate floodplain modeling and mapping and
 26 evaluation of potential flood mitigation measures are marked as Watershed Planning. These include
 27 Flood Insurance Studies (FIS), watershed studies, and city-wide and county-wide drainage master plans
 28 (DMPs). Typical positive impacts include:

- 29 • more accurate flood maps, which allow for risk avoidance, better regulations, and better
 30 planning;
- 31 • understanding the needs for flood reduction in a watershed, which allow for better allocation of
 32 resources, providing design details needed for eventually converting an FME into an FMP that
 33 can be funded and implemented; and
- 34 • projects that come from these FMEs can reduce flooding and exposure to flooding.

35 Potential negative impacts are that all conveyance improvement projects have the potential to increase
 36 flooding downstream; therefore, mitigation measures will need to be considered if any such projects are

1 identified during the FME, and more projects are usually identified than there is available funding. There
2 are 38 FMEs in this category.

3 The watershed studies and project specific FMEs will provide the information needed to ensure that
4 cost-effective flood mitigation measures are implemented in the Region that do not negatively impact
5 other areas. These projects will reduce flood risks, saves lives, and protect valuable infrastructure.

6 Detailed modeling and mapping will also help protect recreational resources and agriculture by
7 identifying flood risk to these areas and allowing evaluation of impacts of future development.

8 Until all of these FMEs are completed, their specific benefits cannot be quantified; however, upon initial
9 analysis, it is evident that approximately 18,878 residential structures are currently in the 1% ACE
10 floodplain. These structures house approximately 89,019 people. Tens of thousands more are exposed
11 to risk as they travel across flooded roadways and low water crossings. These FMEs will help reduce the
12 risks to these people and help prevent additional people from becoming exposed to the 1% ACE
13 floodplain due to expansion of the floodplain and uncontrolled development. By providing more
14 accurate information on the flood risks, the communities will be empowered to control development
15 within the floodplain.

16 **Impacts of RFP Implementation**

17 *Avoidance of Negative Impacts*

18 During the evaluation of alternatives for a flood mitigation project, potential negative impacts of
19 alternatives are analyzed and those alternatives are removed from consideration if the negative impacts
20 cannot be reasonably mitigated for. Therefore, for each FMP considered, the preliminary engineering or
21 alternative analysis reports that were obtained for each FMP were reviewed to determine any
22 potentially unmitigated negative impacts. No unmitigated negative impacts were discovered for any of
23 the 37 FMPs. Some FMPs related to installation of stream gauges or emergency generators did not
24 include modeling, but were assumed to inherently have no negative impacts.

25 Potential negative impacts were also considered for the FMEs and FMSs. The planning-level assessment
26 for these actions included a much simpler review of the potential impacts, based on the limited data
27 available to determine potential impacts. The FMEs are set forth to identify if there are any potential
28 negative impacts of the proposed action. There are no negative impacts for completing a study or
29 evaluation to gain a better understanding of the proposed flood mitigation action. Like the FMEs, the
30 FMSs will also identify negative impacts if the proposed action is executed. However, there are no
31 negative impacts to implement new flood management strategies. The sponsors for all actions will need
32 to demonstrate a commitment to no negative impacts before they can receive funding. Ultimately, it will
33 be the responsibility of the local sponsor to demonstrate the final project design has no negative
34 impacts prior to construction.

35 *Potential Future Benefits*

1 Many of the proposed actions included in this plan will reap benefits now and long into the future.
2 Evaluations and strategies are the best candidates for actions that include current benefits, future
3 benefits, and no negative impacts. Examples of these actions include flood warning systems, buyouts,
4 higher design standards, education and outreach programs, and flood preparedness. These types of
5 actions will increase the community's resiliency by providing knowledge in advance of a storm, removing
6 development in the floodplain, and preventing future development in the floodplain. With higher design
7 standards, population growth and economic development would occur in areas outside of the floodplain
8 and further away from the flooding source. Together these actions will remove people and structures
9 from the existing floodplain and reduce the future flood risk.

10 Regional Detention, when sized for future development conditions, is an example of an FMP with
11 current benefits, future benefits, and no negative impacts. This allows for future development to occur
12 upstream while the increased flows have already been mitigated with a detention pond that has been
13 sized to accommodate the increased flows and increased volume of runoff. There are not any
14 anticipated negative impacts for this type of project, as the downstream discharge and volume can be
15 controlled by the outlet structure on the pond.

16 The policies developed in Chapter 3 are another example of how this plan can provide long lasting
17 benefits. The Regional Flood Planning Group (RFPG) approved the following recommended region-wide
18 floodplain management standards for this plan:

- 19 1. Produce and provide updated floodplain maps to the community to minimize the potential of
20 new development within the floodplain. In absence of detailed adopt base level engineering
21 as best available information and use to regulate development;
- 22 2. When developing detailed floodplain models and maps - Use future land use conditions when
23 conducting hydrologic and hydraulic analyses to establish floodplain limits to provide a factor
24 of safety above floodplain maps based on existing conditions;
- 25 3. Adopt higher standards (above NFIP Minimum) - Increase freeboard requirements for new
26 structures so if the BFE were to increase in the future the structure will remain above the
27 anticipated future water surface elevation;
- 28 4. Require detention basins (ponds) – Adopt regulations for new development so that the post
29 development peak flow rate is less than or equal to the existing peak flow rate (undeveloped
30 condition) to protect downstream landowners. This includes managing a full range of storm
31 events from the 2-year to 100-year storm event. To protect natural habitat and minimize
32 creek erosion impacts to existing and future infrastructure within the riparian area, it is
33 advisable to include stream protection volume within the detention basin to manage
34 frequent rainfall events.
- 35 5. Require that new roadway crossings are elevated above the 100-year flood level to minimize
36 the potential loss of life that can result in low water crossings. Where this standard is not
37 practical due to physical or fiscal constraints include enhanced safety features such as
38 barricades, flashers, or other flood warning systems based on risk.

39 The implementation of these standards will reduce the future flood risk throughout the region.
40 Collectively, the standards listed above will protect the riparian areas of the floodplain from encroaching
41 development, providing a buffer between development and the flooding source now and in the future.

1 Socioeconomic & Recreational Impacts of the RFP

2 Flooding can result in significant damage to the economy, environment, infrastructure, property, and
 3 people. Various types of flooding can be caused by flash flooding, coastal flooding, urban flooding,
 4 riverine flooding, and pluvial flooding. Several types of flood strategies and projects have been
 5 developed to protect against flooding. However, the managing of flood risk and the development and
 6 implementation of flood defenses has both advantages and disadvantages in recreation and
 7 socioeconomically.

8 Ultimately, flood evaluations and projects protect homes and people, and decrease the rate of erosion,
 9 preventing foundation and structural damage in the long run. They also save money in terms of roadway
 10 infrastructure repairs due to the impacts of flooding.

11 *Socioeconomic Impacts*

12 According to the American Psychological Association, “socioeconomic advantage and disadvantage can
 13 be defined as people’s access to material and social resources, and their ability to participate in society”.
 14 Studies of socioeconomic status can reveal inequities in access to resources which could prevent
 15 accessing the services to plan, respond and recover from flood events.

16 Flooding does not only result in destroyed infrastructure and damaged property, but also has a negative
 17 social impact on citizens impacted. The impacts both short-term and long-term on physical and mental
 18 health result in changes to the livelihoods of impacted citizens creating greater socioeconomic disparity.

19 The FMSs and FMPs listed are intended to provide watershed wide benefits to the disproportionately
 20 disadvantaged or socially vulnerable population by reducing risk and promoting recovery. Watershed
 21 planning can contribute to the region’s ability to prepare for, respond to, and recover from flood events.
 22 Reducing socioeconomic disparities through the implementation of measures to create equity can be
 23 initiated through planning. This is done by ensuring that vulnerable populations have the same access
 24 to resources and social infrastructure as those unimpacted by flood.

25 Ensuring equity in the development and implementation of strategies and projects reduces any
 26 perceived disadvantages. Any disadvantages would occur if the socioeconomically disadvantaged
 27 population was not served directly or indirectly by the FMSs or FMPs.

28 *Recreational Impacts*

29 Using natural or man-made water bodies for recreation is highly valued in the region and throughout
 30 Texas. Many waterfront parks are spaces are designed to be flooded with minimal damage during storm
 31 or flood events. Additionally, urban river restorations focus on restoring aquatic and riparian habitats,
 32 increasing flood protection, and enhancing recreational potential. Wetlands also play an important role
 33 in water resources as these areas store and filter water pollutants. In agricultural areas, when
 34 floodplains are not full of water, they can grow grass and be used as grazing areas. These floodplains
 35 and wetlands can support tourism, recreation, and freshwater fisheries.

36 While flood defense or protection projects do protect homes, infrastructure, and people, they also
 37 provide protection to natural habitats. Many shorelines are conservation areas, and flood defenses help

1 preserve these areas. Maintaining floodplains in their natural states can create positive impacts through
 2 potential recreational, environmental, and biological benefits. Several types of flood projects, mainly
 3 those that are classified as natural systems, promote biodiversity. Wetlands that function as flood plains
 4 support a wide range of bird species while ponds support newts, leeches, and wading birds. Riparian
 5 systems can sustain several types of animal life.

6 There are potential disadvantages to using the floodplain and waterfront parks for recreation. Were
 7 damages to occur to recreational waterbodies, they can become dangerous to use. While flood
 8 strategies and projects can be effective at protecting people, property, and resources, the initial and
 9 ongoing costs of installation and maintenance can be prohibitive. These costs can be prohibitive and can
 10 overwhelm communities struggling to find funding for long-term flooding solutions.

11 Summary of the Impacts of the RFP

12 If fully implemented, the RFP will have profound and lasting impacts on flood risk reduction in Region
 13 11. As a result of the 37 FMPs, the number of structures in the 1% ACE floodplain would be reduced by
 14 700, and the number of structures in the 0.2% ACE floodplain would be reduced by 469. This would help
 15 protect approximately 1,864 people from living within the 1% ACE floodplain. An estimated 24 road
 16 closure occurrences can be avoided within the 1% ACE floodplain. These numbers can be expanded as
 17 FMPs are developed from FMEs in the future. In addition to these tangible reductions in flood risks, the
 18 FMSs and associated FMEs could significantly reduce the expansion of flood risks in the future by
 19 providing communities with the data and resources needed to control floodplain development and
 20 prevent the expansion of the floodplain. This can result in preventing an additional 22,669 structures
 21 being constructed in the 1% ACE (3,318 in the 0.2% ACE), which will help protect 92,715 people from the
 22 1% ACE (9,569 from the 0.2% ACE).

23 While not readily quantifiable, these measures will protect the health and safety of the region, as well as
 24 its economic wellbeing. This is done by reducing the flooding frequency and severity, providing
 25 advanced warning of flood risks, reducing driving on flooded roads, and giving community officials the
 26 tools they need to prevent construction in flood prone areas and alleviating known flooding issues.

27 Development in general, and especially in the floodplain, leads to increases in flood flows that can cause
 28 downcutting and erosion of streams that can lead to environmental issues and sedimentation
 29 downstream.

30 Most flood mitigation measures have the potential to negatively impact neighboring areas, especially
 31 when conveyance is increased. These impacts will be mitigated during design and construction to ensure
 32 that no negative impacts occur. Many of the FMSs will require more active floodplain management by
 33 communities in the Region. This will burden community officials who must enforce regulations and will
 34 meet some resistance from citizens wishing to engage in risky floodplain construction. These issues can
 35 be overcome and lead to stronger communities and this RFP, fully funded and implemented, would
 36 provide the tools needed to make this happen.

37 None of the FMSs, FMEs, or FMPs specifically address water supply issues and are not expected to have
 38 an impact on the water supply, as discussed in the following section.