Chapter 4: Identification of Flood Mitigation Needs and Solutions

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4. Flood Mitigation Solutions

4.1 Flood Mitigation Needs Analysis

Based on the flood risk analyses described previously in *Chapter 2 (Flood Risk Analyses)* and the Regional Flood Planning Group (RFPG) goals identified in *Chapter 3 (Floodplain Management Practices and Goals)*, a needs analysis was performed to identify locations within the region which have the greatest flood mitigation and flood risk study needs.

Flood mitigation needs were identified based on a quantitative comparison of the Task 2 exposure results at the county and subcounty level as well as a qualitative consideration of the following factors outlined in the Task 4 Scope of Work (SOW):

a. The areas in the Flood Planning Region (FPR) that the RFPG identified as the most prone to flooding that threaten life and property;

b. The relative locations, extent, and performance of current floodplain management and land use policies and infrastructure located within the FPR, particularly within the locations described in (a);

c. Areas identified by the RFPG as prone to flooding that do not have adequate inundation maps;

d. Areas identified by the RFPG as prone to flooding that do not have hydrologic and hydraulic (H&H) models;

e. Areas with an emergency need;

f. Existing modeling analyses and flood risk mitigation plans within the FPR;

g. Flood mitigation projects already identified and evaluated by other flood mitigation plans and studies;

h. Documentation of historic flooding events;

i. Flood mitigation projects already being implemented; and

j. Other factors that the RFPG deemed relevant, such as flood projects with nature-based solutions and equal representation throughout the region.

The quantitative needs analysis included an evaluation of: (1) the greatest gaps in flood risk information; and (2) the areas with the greatest flood risk, as described in Sections 4.1.1 through 4.1.3. The qualitative needs analysis was conducted over several stakeholder workshop meetings, described as part of the flood solutions identification process overview in Section 4.2. Both quantitative and qualitative needs analyses were utilized to identify Flood Management Evaluations (FMEs), Flood Mitigation Projects (FMPs), and Flood Management Strategies (FMSs) across the region as described later in this chapter in Sections 4.3 through 4.5.

4.1.1 Greatest Gaps in Flood Risk Information by County

Flood risk information gaps are areas that do not have sufficient flood risk data to estimate flood risks or to identify or compare project alternatives to mitigate the associated flood risks. These gaps may include areas that have limited or no Federal Emergency Management Agency (FEMA) regulatory flood mapping data as well as areas that have flood data lacking sufficient quality, such as outdated information or data with inadequate resolution. Summaries of the region's existing conditions and future conditions flood risk data gaps are presented in Chapter 2 Section 2.2.2 and Section 2.3.5, respectively.

To identify the greatest flood risk information gaps, counties were ranked based on the results of the existing conditions 1% annual chance (AC) flood exposure analysis from Chapter 2, accounting for the following flood hazard exposure estimate categories:

- Number of residential and non-residential properties and associated population;
- Number of roadway crossings;
- Length of roadway segments;
- Agricultural area;
- Number of critical facilities; and
- Average Social Vulnerability Index (SVI) of buildings in the floodplain.

The results of this county ranking analysis are presented in **Table 4.1**. Comparing these county ranks with the flood risk information gaps identified in Chapter 2, counties with the greatest flood risk data gaps were identified if they ranked among the top 10 (roughly equivalent to the top 40%) of all counties in the region for any of the flood exposure categories. These greatest flood risk data gaps are presented in **Map Exhibit 14** (Greatest Gaps in Flood Risk Information).

Based on this analysis, the greatest gaps in terms of areas with limited or no FEMA regulatory flood mapping data include the counties of Reeves, Winkler, Pecos, Andrews, Upton, and Crane (in ranked order).

Similarly, the greatest gaps in terms of areas with outdated FEMA regulatory flood mapping data include the counties of Brewster, Ward, Presidio, Crockett, Sutton, Hudspeth, Culberson, Jeff Davis, and Terrell (in ranked order).[1]

[1] Although Midland County was ranked among the top 10 counties for greatest flood risk data gaps based on "Average SVI of Buildings in the Floodplain", it was excluded from the final ranked list since there is only a small portion of the county which overlaps the Upper Rio Grande region.

Table 4.1 Greatest Flood Data Gaps by County (Exposure to 1% AC Flood Risk)

County Rank	County	Number of Structures in Floodplain	County	Residential Structures in Floodplain	County	Population	County	Roadway Stream Crossings (#)	County	Roadway Segments (miles)	County	Agricultural Areas (sq. mi.)	County	Critical Facilities (#)	County	Average SVI of Features in Floodplain or Flood-Prone Areas
1	El Paso	21,377	El Paso	16,860	El Paso	70,260	El Paso	457	El Paso	458	Hudspeth	246	El Paso	37	Culberson	0.935
2	**Reeves**	**3,535**	Brewster	1,615	**Reeves**	**10,707**	**Pecos**	**182**	**Reeves**	**337**	El Paso	61	**Reeves**	**10**	Hudspeth	0.932
3	Brewster	2,640	**Reeves**	**1,580**	Brewster	7,217	Presidio	101	Culberson	317	Jeff Davis	53	**Pecos**	**9**	Presidio	0.916
4	Ward	2,071	**Winkler**	**1,126**	Ward	4,189	Culberson	90	Hudspeth	288	**Pecos**	**47**	Crockett	8	El Paso	0.665
5	**Winkler**	**1,680**	Presidio	696	**Winkler**	**3,675**	Brewster	81	**Pecos**	**284**	Presidio	45	Brewster	7	Midland	0.664
6	Presidio	1,353	Crockett	680	**Pecos**	**3,424**	Crockett	80	Brewster	210	Brewster	43	Sutton	5	Sutton	0.651
7	Crockett	1,292	Sutton	492	Presidio	2,973	**Reeves**	**72**	Ward	196	Culberson	32	Ward	4	**Reeves**	**0.646**
8	**Pecos**	**1,040**	Ward	470	Crockett	2,392	Hudspeth	70	Crockett	187	Val Verde	22	**Winkler**	**4**	Crockett	0.607
9	Sutton	963	**Pecos**	**370**	Hudspeth	1,629	Jeff Davis	53	Val Verde	163	**Andrews**	**18**	**Upton**	**3**	Ector	0.593
10	Hudspeth	823	Ector	234	Sutton	1,562	Terrell	50	**Winkler**	**126**	**Reeves**	**18**	Hudspeth	2	**Crane**	**0.559**
11	Jeff Davis	660	Upton	185	Jeff Davis	1,431	Val Verde	38	Presidio	122	Crockett	7	Terrell	2	Reagan	0.558
12	Val Verde	577	Val Verde	147	Val Verde	1,393	Ward	30	Sutton	96	Loving	4	Crane	1	Winkler	0.555
13	Culberson	567	Terrell	146	Culberson	1,382	Schleicher	29	Jeff Davis	63	Schleicher	4	Jeff Davis	1	Val Verde	0.549
14	Terrell	391	Jeff Davis	135	Terrell	945	Upton	21	Terrell	51	Ward	4	Loving	1	Upton	0.539
15	Ector	340	Culberson	115	Ector	606	Edwards	11	Crane	41	Crane	3	Andrews	0	Schleicher	0.534
16	Upton	331	Hudspeth	44	Upton	599	Crane	7	Upton	28	Terrell	3	Culberson	0	Ward	0.531
17	Crane	277	Edwards	27	Crane	591	Loving	3	Ector	26	Winkler	3	Ector	0	Brewster	0.515
18	Loving	95	Schleicher	5	Loving	291	Reagan	1	Edwards	19	Sutton	2	Edwards	0	Loving	0.502
19	Edwards	58	Loving	2	Edwards	127	Winkler	1	Loving	17	Upton	1	Midland	0	Pecos	0.502
20	Schleicher	33	Midland	2	Schleicher	73	Andrews	0	Andrews	8	Ector	0	Presidio	0	Edwards	0.47
21	Andrews	9	Andrews	0	Andrews	41	Ector	0	Schleicher	5	Edwards	0	Reagan	0	Terrell	0.453
22	Midland	7	Crane	0	Midland	20	Midland	0	Midland	3	Reagan	0	Schleicher	0	Jeff Davis	0.408
23	Reagan	2	Reagan	0	Reagan	3	Sutton	0	Reagan	0	Midland	0	Val Verde	0	Andrews	0.234

Legend:

Greatest Gaps in Flood Risk (limited or no FEMA flood mapping information)

Greatest Gaps in Flood Risk (old FEMA flood mapping information)

4.1.2 Greatest Flood Risk by County and Community

Areas of greatest flood risk were identified at the county level by ranking each county based on the results of the existing conditions 1% AC flood exposure analysis from Chapter 2 and using the same exposure estimate categories as described in Section 4.1.1. In the county analysis, counties with the greatest flood risks were identified if they ranked among the top 6 (roughly equivalent to the top 25%) of all counties in the region for any of the flood exposure categories. The results of this county ranking analysis are presented in **Table 4.2**. Based on this analysis, the greatest flood risks by county include the counties of El Paso, Reeves, Brewster, Ward, Winkler, Presidio, Crockett, Pecos, Culberson, Hudspeth, Jeff Davis, and Sutton (in ranked order).[2]

In addition to ranking flood risk by county, subcounty entities were ranked (including both incorporated and census designated places [CDPs]) according to the estimated number of structures in the floodplain within each community. The results of the community ranking analysis are presented in **Table 4.3**. Based on this analysis, the top 10 subcounty entities by flood risk to structures include the City of El Paso, the City of Socorro, the City of Pecos, the City of Alpine, Fort Bliss CDP, the City of Kermit, Ozona CDP, Southwest Sandhill CDP, the City of Sonora, and Canutillo CDP (in ranked order).

Using the results of the existing conditions 1% AC flood exposure analysis, a spatial density analysis was also performed across the region to identify potential flood risk "hot spots." The results of this density analysis, along with detailed flood hazard and building exposure maps for the top-risk subcounty entities, are presented in **Map Exhibit 15** (Greatest Flood Risk).

[2] Although Midland County was ranked among the top 6 counties for greatest flood risks based on "Average SVI of Buildings in the Floodplain", it was excluded from the final ranked list since there is only a small portion of the county which overlaps the Upper Rio Grande region.

Table 4.2 Greatest Flood Risk by County

County Rank	County	Number of Structures in Floodplain	County	Residential Structures in Floodplain	County	Population	County	Roadway Stream Crossings (#)	County	Roadway Segments (miles)	County	Agricultural Areas (sq. mi.)	County	Critical Facilities (#)	County	Average SVI of Features in Floodplain or Flood-Prone Areas
1	El Paso	21,377	El Paso	16,860	El Paso	70,260	El Paso	457	El Paso	458	Hudspeth	246	El Paso	37	Culberson	0.935
2	Reeves	3,535	Brewster	1,615	Reeves	10,707	Pecos	182	Reeves	337	El Paso	61	Reeves	10	Hudspeth	0.932
3	Brewster	2,640	Reeves	1,580	Brewster	7,217	Presidio	101	Culberson	317	Jeff Davis	53	Pecos	9	Presidio	0.916
4	Ward	2,071	Winkler	1,126	Ward	4,189	Culberson	90	Hudspeth	288	Pecos	47	Crockett	8	El Paso	0.665
5	Winkler	1,680	Presidio	696	Winkler	3,675	Brewster	81	Pecos	284	Presidio	45	Brewster	7	Midland	0.664
6	Presidio	1,353	Crockett	680	Pecos	3,424	Crockett	80	Brewster	210	Brewster	43	Sutton	5	Sutton	0.651
7	Crockett	1,292	Sutton	492	Presidio	2,973	Reeves	72	Ward	196	Culberson	32	Ward	4	Reeves	0.646
8	Pecos	1,040	Ward	470	Crockett	2,392	Hudspeth	70	Crockett	187	Val Verde	22	Winkler	4	Crockett	0.607
9	Sutton	963	Pecos	370	Hudspeth	1,629	Jeff Davis	53	Val Verde	163	Andrews	18	Upton	3	Ector	0.593
10	Hudspeth	823	Ector	234	Sutton	1,562	Terrell	50	Winkler	126	Reeves	18	Hudspeth	2	Crane	0.559
11	Jeff Davis	660	Upton	185	Jeff Davis	1,431	Val Verde	38	Presidio	122	Crockett	7	Terrell	2	Reagan	0.558
12	Val Verde	577	Val Verde	147	Val Verde	1,393	Ward	30	Sutton	96	Loving	4	Crane	1	Winkler	0.555
13	Culberson	567	Terrell	146	Culberson	1,382	Schleicher	29	Jeff Davis	63	Schleicher	4	Jeff Davis	1	Val Verde	0.549
14	Terrell	391	Jeff Davis	135	Terrell	945	Upton	21	Terrell	51	Ward	4	Loving	1	Upton	0.539
15	Ector	340	Culberson	115	Ector	606	Edwards	11	Crane	41	Crane	3	Andrews	0	Schleicher	0.534
16	Upton	331	Hudspeth	44	Upton	599	Crane	7	Upton	28	Terrell	3	Culberson	0	Ward	0.531
17	Crane	277	Edwards	27	Crane	591	Loving	3	Ector	26	Winkler	3	Ector	0	Brewster	0.515
18	Loving	95	Schleicher	5	Loving	291	Reagan	1	Edwards	19	Sutton	2	Edwards	0	Loving	0.502
19	Edwards	58	Loving	2	Edwards	127	Winkler	1	Loving	17	Upton	1	Midland	0	Pecos	0.502
20	Schleicher	33	Midland	2	Schleicher	73	Andrews	0	Andrews	8	Ector	0	Presidio	0	Edwards	0.47
21	Andrews	9	Andrews	0	Andrews	41	Ector	0	Schleicher	5	Edwards	0	Reagan	0	Terrell	0.453
22	Midland	7	Crane	0	Midland	20	Midland	0	Midland	3	Reagan	0	Schleicher	0	Jeff Davis	0.408
23	Reagan	2	Reagan	0	Reagan	3	Sutton	0	Reagan	0	Midland	0	Val Verde	0	Andrews	0.234

Legend:

Greatest Flood Risk

Table 4.3 Estimated Number of Structures in Floodplain by Community

Rank	Community	County	Number of Structures in Floodplain within Community
1	El Paso city	El Paso	12,324
2	Socorro city	El Paso	2,578
3	Pecos city	Reeves	1,944
4	Alpine city	Brewster	1,643
5	Fort Bliss CDP	El Paso	1,145
6	Kermit city	Winkler	1,126
7	Ozona CDP	Crockett	944
8	Southwest Sandhill CDP	Ward	794
9	Sonora city	Sutton	690
10	Canutillo CDP	El Paso	676
11	Presidio city	Presidio	655
12	San Elizario city	El Paso	544
13	Monahans city	Ward	440
14	Balmorhea city	Reeves	361
15	Homestead Meadows North CDP	El Paso	359
16	Dell City city	Hudspeth	293
17	Imperial CDP	Pecos	272
18	Sanderson CDP	Terrell	258
19	Clint town	El Paso	249
20	Marfa city	Presidio	212
21	Fabens CDP	El Paso	200
22	Thorntonville town	Ward	195
23	Lindsay CDP	Reeves	189
24	McCamey city	Upton	172
25	Van Horn town	Culberson	170
26	Fort Stockton city	Pecos	168
27	Barstow city	Ward	149
28	Crane city	Crane	143
29	Fort Davis CDP	Jeff Davis	131
30	Prado Verde CDP	El Paso	112
31	Toyah town	Reeves	101

4.1.3 Summary of Flood Mitigation Needs

Combining the results of the quantitative needs analysis for the greatest flood risk data gaps and greatest flood risks, a summary of flood mitigation needs by county was developed as shown in **Table 4.4**. For reference, this table also includes the corresponding IDs to potential flood solutions for each county, including FMEs, FMPs, and FMSs, that were identified based on both quantitative and qualitative needs analyses. These flood solutions are described later in this Chapter in Sections 4.3 through 4.5 as well as in *Chapter 5 (Evaluation and Recommendation of Flood Solutions)*.

Table 4.4 Summary of Flood Mitigation Needs by County

County	Greatest Flood Risk Data Gap (Limited or No FEMA Flood Mapping Information)	Greatest Flood Risk Data Gap (Old FEMA Flood Mapping Information	Greatest Flood Risk	Top At Risk Communities by Estimated Number of Structures in Floodplain (from Table 4.3)	FMEs	FMPs	FMSs[a]
Andrews	✓	-	-	-	-	-	142000013
Brewster	-	✓	✓	Alpine city	141000023	-	142000002, 142000013, 142000017, 142000022
Crane	✓	-	-	Crane city	-	-	142000007
Crockett	-	✓	✓	Ozona CDP	141000025	-	142000007
Culberson	-	✓	✓	Van Horn town	-	-	-[a]
Ector	-	-	-	-	-	-	-[a]
Edwards	-	-	-	-	-	-	142000013
El Paso	-	-	✓	El Paso city, Socorro city, Fort Bliss CDP, Canutillo CDP, San Elizario city, Homestead Meadows North CDP, Clint town, Fabens CDP, Prado Verde CDP	141000001, 141000003, 141000004, 141000005, 141000006, 141000015, 141000018, 141000019, 141000033, 141000034, 141000035	143000003, 143000005, 143000011, 143000021, 143000024, 143000025, 143000097, 143000100, 143000105, 143000111, 143000113, 143000116	142000001, 142000004, 142000009, 142000010, 142000015, 142000017, 142000019, 142000020
Hudspeth	-	✓	✓	Dell City city	141000014, 141000022	143000009	142000003, 142000013, 142000017
Jeff Davis	-	✓	✓	Fort Davis CDP	-	-	-[a]
Loving	-	-	-	-	-	-	142000007
Midland	-	-	-	-	-	-	-[a]
Pecos	✓	-	✓	Imperial CDP, Fort Stockton city	141000012	-	142000007, 142000013, 142000024

County	Greatest Flood Risk Data Gap (Limited or No FEMA Flood Mapping Information)	Greatest Flood Risk Data Gap (Old FEMA Flood Mapping Information	Greatest Flood Risk	Top At Risk Communities by Estimated Number of Structures in Floodplain (from Table 4.3)	FMEs	FMPs	FMSs[a]
Presidio	-	✓	✓	Presidio city, Marfa city	141000002, 141000008	143000007	142000005, 142000006, 142000008, 142000013, 142000017, 142000023, 142000025
Reagan	-	-	-	-	-	-	-[a]
Reeves	✓	-	✓	Pecos city, Balmorhea city, Lindsay CDP, Toyah town	141000010		142000007, 142000013, 142000021
Schleicher	-	-	-	-	-	-	-[a]
Sutton	-	✓	✓	Sonora city	141000024	-	142000013
Terrell	-	✓	-	Sanderson CDP	-	-	142000007, 142000017
Upton	✓	-	-	McCamey city	-	-	-[a]
Val Verde	-	-	-	-	-	-	142000007
Ward	-	✓	✓	Southwest Sandhill CDP, Monahans city, Thorntonville town, Barstow city	141000026	-	142000007, 142000013
Winkler	✓	-	✓	Kermit city	141000021	-	142000013

[a]FMS 142000014 and FMS 142000016 are identified for all counties. FMS 142000013 includes the following entities as well as those listed in this table: City of Rankin, Town of Valentine, City of Wickett, and City of Wink.

4.2 Process for Identifying Flood Mitigation Solutions

The primary objective of the Upper Rio Grande Regional Flood Plan (RFP) is to identify specific flood risks within the region and identify, evaluate, and recommend potential solutions to mitigate and manage these risks in alignment with the region's short-term and long-term goals. These solutions may include FMEs, FMSs, and FMPs, as defined below:

- Flood Management Evaluation – a proposed flood study of a specific, flood-prone area that is needed to assess flood risk and/or determine whether there are potentially feasible FMSs or FMPs;
- Flood Mitigation Project – a proposed project, either structural or non-structural, that has non-zero capital costs or other non-recurring costs, and when implemented, will reduce flood risk, mitigating flood hazards to life or property; and
- Flood Management Strategy – a proposed plan to reduce flood risk or mitigate flood hazards to life or property.

FMPs and FMSs that were identified as potentially feasible flood reduction projects with measurable benefits require the use of detailed H&H models to quantify flood risk reductions to structures and populations, including residential properties, agricultural land, and critical facilities. Furthermore, applicable FMSs and FMPs must be evaluated to adhere to General Mapping and Modeling Guidelines (defined in Section 3.5 of the Technical Guidelines) and ensure that no negative impacts are received by neighboring areas.

FMSs and FMPs that were identified to be potentially feasible through the processes described in this section were selected for further evaluation as part of Task 4B to determine whether they have sufficient H&H modeling data to be analyzed for project impacts and benefits. The FMP flow chart from Section 2.4B of the RFP Technical Guidelines (shown in **Figure 4.1**) was implemented as part of this screening process.

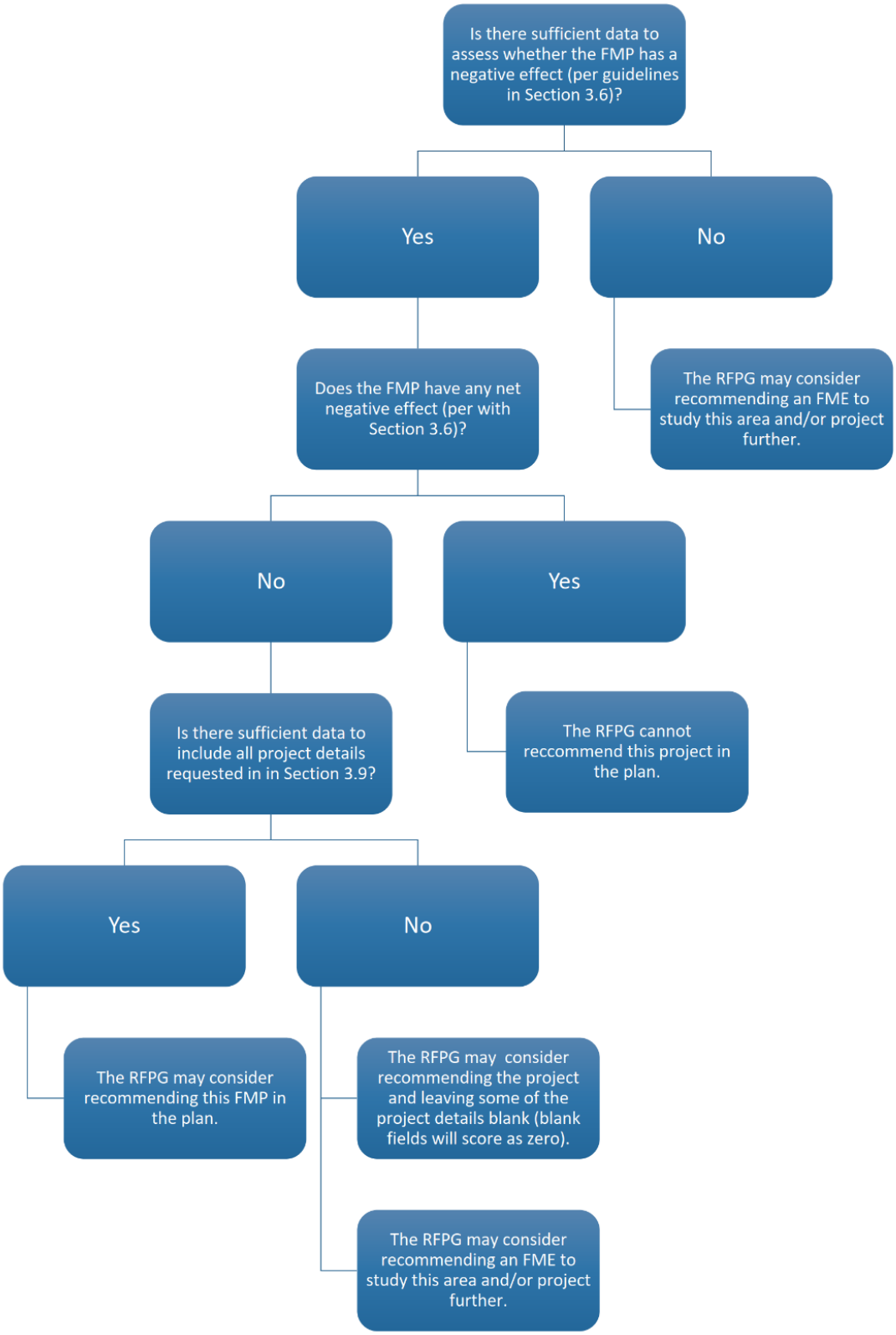

Figure 4.1 FMP Flowchart from Texas Water Development Board (TWDB) Technical Guidelines for Regional Flood Planning

If best available H&H models were deemed insufficient for quantifying project benefits and impacts, or if negative impacts are estimated for neighboring areas, those potentially feasible FMSs and FMPs were categorized instead as potential FMEs. The general scope items associated with those FMEs would include:

- Development of detailed H&H models;
- Evaluating alternatives to define flood mitigation projects resulting in no negative impacts;
- Quantifying project impacts and benefits; and
- Estimating project costs.

The process described in the following section would then be re-applied to the potentially feasible FMSs and FMPs to be considered for recommendation in either the amended RFP for this cycle or for the next RFP cycle.

There are some exceptions where FMSs cannot be modeled, but do not fall into the typical categories of FMPs or FMEs due to their requiring recurring costs or if it is an educational outreach program, for example. Other types of specific FMSs are described in Section 4.5, along with the reasons they were classified as FMSs. In addition, some FMPs or FMSs that were identified in the RFP may be non-structural, such as regulatory requirements for reduction of flood risk or early warning systems. These types of FMPs and FMSs are discussed in Sections 4.4 and 4.5, respectively. The RFPG approved the process for identifying FMEs, FMSs, and FMPs in a technical memorandum to the TWDB, signed January 7, 2022 and in a General RFPG Meeting held December 16, 2021.

4.2.1 Process for Identification of Potential FMEs and Potentially Feasible FMSs

A subcommittee of the RFPG was formed to identify and evaluate potential FMEs and potentially feasible FMSs (Subcommittee 3 for Task 4B, a-b). This subcommittee developed recommendations to define the process used to identify potential FMEs and potentially feasible FMSs, which were then voted on by the subcommittee, presented to the RFPG, and ultimately approved by the RFPG.

The RFPG-approved process for identification of potential FMEs and potentially feasible FMSs included these steps:

- Selection of recent historic storms, either by stakeholders or the public during the General RFPG Meetings, Subcommittee Meetings, or via the public survey process. The selected historic storms would then serve as the basis for identification of needs.
  - Selection of historic storms included the August 2006 storm affecting west and northwest El Paso County, the August 2021 storm affecting east central El Paso, and the September-October 2008 storm affecting the Rio Grande near Presidio.
  - Descriptions of these storms are provided in *Section 1.2 (Historical Flooding)* of *Chapter 1.*

- Within a series of subcommittee meetings:
  - Presentation by RFPG members, stakeholders, and public of experience during the selected events that describes flood-related problems.
  - In public discussion, development of a short description of each problem that defines a need.
  - In public discussion, proposal of FMEs and FMSs to address the need.
  - The subcommittee votes on how to proceed with each FMS and FME identified and makes a recommendation to the RFPG for approval.
  - The RFPG votes on whether to approve the subcommittee's recommendation.

Presentation by RFPG Members, Stakeholders, and Public of Flood Experience

Presenters were briefed at the beginning of Subcommittee 3 meetings to structure their experience of historic flooding as follows: (1) for each storm event discussed, give a tour of the general or specific locations of the experienced damages/ issues; and (2) present a map during the presentation showing locations as discussed. Notes were taken by RFPG consultant staff describing in brief terms the flood-related problem(s) experienced for each storm and location. Following the presentation, RFPG consultant staff queried the presenter to discuss and note each of the following broader issues:

- Primary public concerns;
- Adequacy of early warning;
- Issues with emergency route/ critical facility access;
- Post-flood cleanup issues; and
- Issues with agency coordination.

Background information on historic floods was presented to the subcommittee by:

- Active stormwater professionals at El Paso Water;
- Retired staff from City of El Paso (COEP) and El Paso Water;
- El Paso County Engineer;
- Staff at El Paso County Water Improvement District No. 1 (EPCWID1);
- Current and former staff from the U.S. International Boundary and Water Commission (USIBWC);
- Hudspeth County Emergency Management Coordinator/County Administrator; and
- In the event that a flood experience or potential need was identified by the general public or a stakeholder within the region who could not present their experiences or describe their flood-related issue in a subcommittee meeting, AECOM or a subcommittee member presented to the subcommittee on behalf of that person. In

addition, any flood damage centers that were identified by AECOM through a desktop analysis, but which have not been identified by the public or by stakeholders, were presented to the subcommittee or directly to the RFPG by AECOM. Following the presentation to Subcommittee 3, the subcommittee and/or RFPG decided whether to recommend the FME or FMS for approval by the RFPG.

Develop a Short Description of Each Problem that Defines a Need

In public discussion, the notes from each presentation were reviewed by the subcommittee and public attending the subcommittee meeting. The noted problems were reformulated as needs relevant to the region.

Propose FMEs and FMSs to Address the Need

During the public meetings, drainage issues and challenges were discussed along with identifying potential FMEs and FMSs. Identified FMEs and FMSs were presented, discussed, and refined at subsequent Subcommittee 3 meetings and/or General RFPG meetings as needed.

4.2.2 Process for Identification of Potentially Feasible FMPs

A subcommittee was formed to identify and evaluate potentially feasible FMPs (Subcommittee 2 for Task 4B, c). "Potentially feasible FMPs" comprise a subset of the full list of regional FMPs that are to be carried forward for technical evaluation and considered for recommendation in the RFP. This subcommittee proposed a process for identifying and selecting potentially feasible FMPs, which was then voted on by the subcommittee, presented to the RFPG, and approved by the RFPG. A recommended process was developed for each of two scenarios:

1. FMPs that are currently listed in an active Stormwater Master Plan (SWMP). An active SWMP is defined as current planning for future funding of selected stormwater infrastructure projects, where the projects have been identified, planned (i.e., undergone concept design and cost estimation) and prioritized via a public process; and
2. Other potential FMPs identified by the RFPG process and the public.

Identification of Potentially Feasible FMPs via an Active SWMP

The RFPG identified two recently updated SWMPs that reflect current needs and projects which are still under consideration by city and county officials: a list of 96 stormwater mitigation projects developed by El Paso Water for the City of El Paso (Study ID 13 in *Chapter 1 Appendix Table 1D - Relevant Existing Planning Documents Summary*), and a list of 69 stormwater mitigation projects developed by El Paso County (Study ID 26 in *Appendix Table 1D*). The recommended process for identifying potential FMPs from these two SWMPs is:

- Address all projects within each SWMP as a separate group;
- The subcommittee and public reviews and modifies the existing SWMP project ranking system (if they are ranked) per public discussion within a subcommittee meeting; and

- The subcommittee reviews the list of projects following re-ranking per the revised ranking system and chooses an option for selecting which projects ("Potentially Feasible FMPs") will undergo further evaluation. The project scores used in ranking will limit the number of projects carried forward into the evaluation phase.

Subcommittee 2 has reviewed and approved, with minor alterations, the ranking systems used in the City of El Paso and El Paso County SWMPs.

Identification of Potentially Feasible FMPs not Included in an Active SWMP

The recommended process for identifying "potentially feasible FMPs" from the identified full list of projects not included in an active SWMP is:

- Create a list of regional projects not included in an active SWMP;
- Develop an FMP scoring method in a subcommittee meeting;
- Apply the FMP scoring method to score each project in the regional list; and
- Via subcommittee consensus, select "Potentially Feasible FMPs" from the list using the developed project scores.

Create a List of Regional Projects not Included in an Active SWMP

The RFPG has identified potential FMPs developed outside of a SWMP process by these entities:

- USIBWC;
- EPCWID1;
- U.S. Army Corps of Engineers (USACE);
- Texas Department of Transportation (TXDOT); and
- Others (three counties and a water supply project by El Paso Water).

Develop the FMP Scoring Method in a Subcommittee Meeting

The following two lists of project scoring categories have been recommended to the RFPG by Subcommittee 2 and were voted upon and approved by the RFPG on December 16, 2021. These lists were recommended by Subcommittee 2 based on a comparison of these lists to the finalized Flood Mitigation and Floodplain Management Goals, documented in *Section 3.2 (Flood Mitigation and Floodplain Management Goals)*. These lists derive from similar lists of categories used in the City of El Paso SWMP, with added categories available through information developed as part of the exposure analysis documented in *Chapter 2*.

The first list, shown in **Table 4.5**, is a list of project benefits to be qualitatively compared between projects. These categories were assigned a range of potential scoring points per subcommittee judgement of the relative importance of each category.

Table 4.5 Proposed Benefit Categories and Data Sources

Source	Benefit Category	Current Data Source	Range of Potential RFPG Scoring Points	
			No Benefit	Provides Benefit
City of El Paso SWMP	Increase Dam Safety	National Inventory of Dams, Chapter 299 TWC	0	4
	Reduce Flooding of Property	Best available risk maps, TWDB structure inventory	0	3-4
	Remove 100+ Properties from the Flood Zone	Best available risk maps, TWDB structure inventory	0	4
	Reduce Flooding of IH-10	FMP location versus IH-10	0	1-3
	Reduce Flooding of Major Arterial Roadways	Road classification database	0	3
	Reduce the Risk Associated with Debris Flow	Review of aerial photography to ID mobile bed arroyo	0	3-4
	Reduce Maintenance	Review of aerial photography to ID mobile bed arroyo	0	1-4
	Reduce Nuisance Flooding	Review of likely flat terrain-related routine flooding	0	2
TWDB	Reduce # of low water crossings in floodplain	RFP Task 2 exposure dataset	0	1-3
	Reduce # of vulnerable buildings in floodplain	RFP Task 2 exposure dataset	0	1-3
	Reduce # of critical buildings in floodplain	RFP Task 2 exposure dataset	0	1-4

The second list, shown in Table 4.6, is of federal, state, and local agencies with potential permit authority. The difficulty of obtaining an agency permit for each project was qualitatively judged, adding a positive or negative score adjustment to each project.

Table 4.6 Scoring Adjustments Agencies with Permit Authority

Permit Agency	
• Railroad Permit	• Texas Parks and Wildlife
• USIBWC	• Historic District / Archaeologic
• Texas Commission on Environmental Quality (TCEQ)	• Land Acquisition
• USACE	• Street, Utility, and Amenities Reconstruction
• EPCWID1 / Elephant Butte Irrigation District (EBID) Permit	• Environmental Impacts
• TxDOT Permit	• Other Ordinances (Parks, Unexploded Ordnances, Open Space)
• Fort Bliss Permit	
Scoring Adjustments for Permit Required: Yes (-1), No (0) **Scoring Adjustments for Permit Complexity:** Easy (+1), Normal (0), Difficult (-1), Unknown (-2)	

Apply the FMP Scoring Method to Score Each Project in the Regional List

For each project, the scoring method considers:

- Total scored benefits from **Table 4.5**.
- Total score adjustments from **Table 4.6**.
- The total score when adding the scored benefits from Table 4.5 to the score adjustments from **Table 4.6**.
- After scoring of each project, the list of projects is sorted in order of descending score value.

Select Potentially Feasible FMPs based on Project Scores

The last step in the process for selecting potentially feasible FMPs that are not included in SWMPs is via Subcommittee 2 consensus, selecting "Potentially Feasible FMPs" from the sorted list using the developed project scores.

Combining and Prioritizing All Groups of Feasible FMPs

After the process described above is implemented to rank FMPs within groups of separate SWMPs and projects not selected from SWMPs, projects in each group were separated into tiers with no more than five projects in each tier (Tier 1 being the highest priority in each group). Then, an additional round of prioritization and ranking was needed to combine all the projects into a single list of FMPs for evaluation. The agreed upon process for further prioritization of projects identified by the RFPG included selecting an equal number of projects (the top tier) from each group identified (five from the El Paso County SWMP, five from the City of El Paso SWMP, and five projects that were not selected from SWMPs). This combined list of FMPs for Region 14 was sorted within a Subcommittee 2 meeting based upon the following factors (in order of sorting priority):

- The ranking/tier of each project within their respective groups;
- Complexity of the required H&H modeling analyses;
- Remaining time and budget to complete the RFP;
- Desire to have an equal number of projects from each group (each separate SWMP and the group of non-SWMPs); and
- One additional project was added to the top 15 for evaluation due to the desire of the RFPG to select projects throughout different areas of the region as opposed to focusing all of them in the most populated county, i.e., El Paso County.

Despite the efforts of the RFPG to identify and select FMPs for evaluation throughout all areas of the region, due to the lack of recent/available H&H models and planning documents in regions outside of El Paso County, the majority of the selected FMPs (12 of the initial 16 projects) were located in El Paso County. This initial set of prioritized projects selected for evaluation as potentially feasible FMPs in the RFP is provided in **Table 4.7**, along with the associated sorting criteria.

Table 4.7 Initial Prioritized List of FMPs for Evaluation

Overall Evaluation Order	FMP Name	Description	Evaluation Complexity/ Level of Effort	Category Name	Category (3rd Sort Priority)	Tier (1st Priority Sort)	Category LOE Rank (2nd Sort Priority)
1	Develop and Implement Floodplain Ordinance to Regulate Development at Hudspeth County	Coordinate with Hudspeth County Commissioners, Road & Bridge Departments, Safety & Inspection Departments, & County Attorney to draft a floodplain ordinance (or modify existing subdivision ordinance) to regulate development standards in Hudspeth County.	Less Complex	Not in SWMP	1	1	1
2	HAC3	Sediment/Retention Basin	Less Complex	El Paso County SWMP	2	1	1
3	EA10A	Build sediment/detention basin upstream of Paseo del Este Drive	Less Complex	COEP/El Paso Water SWMP	3	1	1
4	SOC4	Sediment/Detention Basin at “Mankato Arroyo”	Less Complex	Not in SWMP	1	1	2
5	FAB1	Sediment/Retention Basin	Less Complex	El Paso County SWMP	2	1	2
6	NW16	Expand channel from Village Ct to Doniphan Dr	Average	COEP/El Paso Water SWMP	3	1	2
7	Regional Pond and Storm Drain System at San Elizario	Construct an 11.5 ac-ft regional Pond and storm drain system with drainage inlets and approximately 740-ft of 30" RCP. Described as Alternative 1 from 12/5/2018 City of San Elizario “Drainage Feasibility Study”. (During the evaluation process, Alternative 3 was selected instead of Alternative 1).	Average	Not in SWMP	1	1	3
8	CAN1	Reconstruction of the channel with concrete lining	Less Complex	El Paso County SWMP	2	1	3
9	NW3	Construction of New larger capacity Doniphan Pump Station to replace PS1, with new force main directly to the Rio Grande. Install new catch basin with mechanical bar screen upstream of PS2.	Average	COEP/El Paso Water SWMP	3	1	3
10	SH20 Drainage Improvements from Doniphan Drive to Texas Avenue	Improvements to inlet and culvert capacities at 14 crossings, with cost estimates and prioritizations available.	Average	Not in SWMP	1	1	4
11	MON3	Sediment/Retention Basin	More Complex	El Paso County SWMP	2	1	4

Overall Evaluation Order	FMP Name	Description	Evaluation Complexity/ Level of Effort	Category Name	Category (3rd Sort Priority)	Tier (1st Priority Sort)	Category LOE Rank (2nd Sort Priority)
12	NW26	Acquire land, construct a permanent wetland, install a storm drain system to Doniphan Drive, construct pipeline to Doniphan Pump Station and build new pump station to control flood levels.	Average	COEP/El Paso Water SWMP	3	1	4
13	Excavate Fort Bliss Sump	Excavate Ft. Bliss Sump for additional storage capacity (not in SWMP)	Average	Not in SWMP	1	1	5
14	SSA4	Detention Basin SSA4	More Complex	El Paso County SWMP	2	1	5
15	NE3B	Alcan Pond: new catch basin to capture FP15 upstream	Average	COEP/El Paso Water SWMP	3	1	5
16	Install Flood Gates in Marfa and Monitoring Gage on North Alamito Creek and Highway 17	Add flood gates to Alamito Creek low water crossings in Marfa, and a monitoring gage/early detection on North Alamito Creek under Hwy 17 Bridge (between Marfa and the airport). This would provide 5-10 minutes early warning to allow Presidio County Office of Emergency Management to deploy before imminent road flooding.	Less Complex	Not in SWMP	1	2	6

Secondary Process for Identification and Selection of Potential FMEs, FMSs, and FMPs

The estimation of region-wide 1% AC flood risk has identified a number of regional locations outside of El Paso County with high numbers of estimated structures-at-risk, as discussed in Section 4.1. In general, the data collection process for the RFP has identified few incorporated and unincorporated areas outside of El Paso County with stakeholders who have presented awareness of or current plans for addressing this risk. Through public outreach efforts, including three public "road show" meetings in the cities of El Paso, Pecos, and Presidio, discussed in *Chapter 10 (Public Participation and Plan Adoption)*, additional areas of significant flood risk were identified and discussed with each appropriate local stakeholder, expanding the list of potential regional FMPs.

If no FMP or FMS is previously identified by Subcommittees 2 and 3 for areas at risk of 1% AC flooding, or if the best available H&H models lack sufficient detail to allow for evaluations of FMPs or FMSs, then FMEs to develop detailed H&H models and evaluate flood mitigation alternatives are selected for the at-risk areas. Subcommittee 3 reviewed the higher risk areas identified in Section 4.1 and assigned FMEs for these areas, so that these FMEs can be performed at a later date to identify potential FMSs and FMPs in the amended RFP or in future RFP cycles. Based upon recommendations from Subcommittee 3, the RFPG voted for approval of the potential FMEs.

Refinements to the List of Evaluated FMPs

Throughout the evaluation phase of the first cycle of the RFP, the status of two of the projects from the El Paso County SWMP that were selected for evaluation changed, as alternative sources of funding were identified. Therefore, the RFPG agreed those projects no longer needed to be evaluated (CAN1 and FAB1) for the RFP. In addition, other high priority FMPs and FMSs continued to be investigated as they were brought to the attention of the RFPG by different stakeholders throughout the planning cycle; however, none of these additional projects were determined to have sufficient modeling and documentation to be considered as potentially feasible FMPs or FMSs in the RFP, and they were instead considered as potential FMEs, per the secondary process discussed in the previous section.

4.3 Identification of FMEs

Based on analyses and decisions described in Sections 4.1 and 4.2, the RFPG identified and evaluated 22 potential FMEs throughout Region 14. The extent of these identified FME study areas is shown in **Map Exhibit 16**, along with counties which have existing mapping needs. The FMEs are also listed in an evaluation table with supporting data in **Table 4A** of **Appendix 4A**. A narrative of each FME identified is provided in **Appendix 4B**, including the following:

- Discussion on flood risk;
- SOW assumed for each FME; and
- Cost breakdown of labor fee by task.

Table 4A documents the desktop analysis results of each FME and lists RFP data fields for classifications of FMEs, which require the RFPG to choose from a list of acceptable inputs for attributes such as "Flood Risk Type" and "Study Type." **Table 4.7** includes more region-specific descriptions of FMEs combined with TWDB-allowable categories to provide a more complete representation of the evaluated FMEs for Region 14. Due to the lack of reliable floodplains, modeling, or flood planning documents available outside of El Paso County, the identification of FMEs and FMSs for evaluation required extensive coordination with local stakeholders to understand unique flood issues associated with each part of the region. The types of FMEs identified to address specific flood risks are based upon RFPG and stakeholder goals, which are documented in *Chapter 3 (Floodplain Management Practices and Goals)*.

Table 4.8 Classification of Evaluated FMEs

FME ID	Project Planning	SWMPs	Dam Safety/ Emergency Need	Riverine Risk Related to Sediment or Levees	Irrigation and Stormwater Interaction	Preparedness
141000001	-	-	-	✓	✓	✓
141000002	✓	✓	-	✓	-	-
141000003	✓	-	-	-	✓	-
141000004	✓	-	-	-	✓	-
141000005	✓	✓	-	-	✓	-
141000006	✓	-	-	-	-	-
141000008	✓	-	-	✓	-	-
141000010	✓	✓	-	-	-	-
141000012	✓	-	✓	-	-	-
141000014	✓	✓	✓	-	-	-
141000015	-	-	-	✓	✓	✓
141000018	-	-	-	-	✓	✓
141000019	✓	-	-	-	✓	-

FME ID	Project Planning	SWMPs	Dam Safety/ Emergency Need	Riverine Risk Related to Sediment or Levees	Irrigation and Stormwater Interaction	Preparedness
141000021	✓	✓	-	-	-	-
141000022	✓	✓	-	-	-	-
141000023	✓	✓	-	-	-	-
141000024	✓	✓	✓	-	-	-
141000025	✓	✓	✓	-	-	-
141000026	✓	✓	-	-	-	-
141000033	✓	✓	-	-	-	-
141000034	✓	-	✓	-	-	-
141000035	✓	-	✓	-	-	-

4.3.1 Project Planning and SWMPs

The primary study type of the FMEs identified is "Project Planning," with 19 of the 22 FMEs falling into this category. The remaining three FMEs were categorized with the Study Type "Preparedness" in **Table 4A**. Project planning FMEs were primarily selected by the RFPG for evaluation because it was noted during the identification process that very few entities had SWMPs outside of El Paso County, despite there being significant numbers of structures at risk in multiple cities throughout the region (see **Table 4.3**). Eleven of the 19 Project Planning FMEs propose to develop SWMPs; however, some of these FMEs include other more specific tasks as well. The lack of SWMPs in the region is likely related to the lack of updated flood risk maps and H&H models. However, developing these planning documents is essential to reducing flood risk in populated areas, and the public availability of LiDAR terrain throughout the region allows for detailed flood risk models to be developed and used to plan proposed flood improvements. Hazard Mitigation Plans were reviewed for proposed flood-related projects/studies/needs; however, most of these plans in the region were outdated at the time of the selection of FMEs, FMSs, and FMPs for the RFP.

City of Presidio Flood Planning Documents

The only other flood infrastructure planning documents outside of El Paso County that were identified for consideration in the RFP were for the City of Presidio, and both were based upon the same modeling analysis from 2008. The original planning document, entitled, "Final Hydraulic Report/Drainage Study for the City of Presidio, Texas" (S&B Infrastructure, 2008) was developed prior to a TXDOT roadway project, which has since paved several of the roadways throughout the city. These roadways were incorporated into the designs of the proposed improvements by proposing inverse crowns to redirect flows. This planning document was also referenced in the "City of Presidio Comprehensive Plan (2020-2030)", but the existing hydrologic and culvert hydraulic models available from the 2008 study were not updated. Also, the proposed improvements were altered in the Comprehensive Plan relative to the original

planning document. Proposed ponds/sediment basins were relocated upstream of the city rather than downstream, as they were located in the original document. Proposed condition models were not developed for either of the City of Presidio planning documents. FME ID 141000002 proposes to update the H&H models for watersheds draining to the City of Presidio from natural arroyos to the north, as well as developing H&H models for Cibolo Creek, which has an unaccredited levee protecting the City of Presidio from riverine flooding.

FMEs to Develop FMPs from El Paso SWMP Projects

Due to the fast-paced schedule and limited budget associated with this first cycle of Regional Flood Planning, only a limited number of FMPs could be evaluated from the robust list of projects in the recently updated El Paso City and County SWMPs (96 projects in the City plan and 69 in the County plan). Following the FMP prioritization and selection process described in Section 4.2.2, continued coordination took place with El Paso Water and El Paso County stormwater officials to review the details and status of each project from the SWMPs that was not selected for evaluation as an FMP through the approved Subcommittee 2 scoring and ranking process. This coordination led to the selection of 52 El Paso Water projects and 21 El Paso County projects from their respective SWMPs.

4.3.2 Dam Safety and Emergency Needs

A Hudspeth County stakeholder alerted the RFPG to flood risk associated with two dams identified by TCEQ as "hydraulically inadequate" that are located upstream of rapidly developing Fort Hancock and Acala CDPs. As noted in *Chapter 1, Introduction and Description of the Upper Rio Grande Flood Planning Region,* there are 27 dams (approximately 25% of the dams in the region) that are identified by TCEQ as hydraulically inadequate in Region 14. As is the case with many dams throughout Texas, significant development has occurred downstream of Camp Rice Arroyo Dam 1 and Alamo Arroyo Dam 3, located in Hudspeth County.

A colonia-wide SWMP is proposed as FME ID: 141000014, which includes the development of dam rehabilitation alternatives in a Supplemental Watershed Plan for both dams, as defined by the Natural Resources Conservation Service (NRCS). This FME includes a SWMP for Fort Hancock CDP, which is required before an implementation strategy (identified in FMS ID: 142000008) for constructing the stormwater improvements can be performed.

Additional hydraulically inadequate dams identified upstream of populated areas in the region include the following:

- FME ID 141000012 - Comanche Creek Dam upstream of Fort Stockton in Pecos County;
- FME ID 141000024 - Dry Devils and Lowry Dams 3, 4, 5, 7, 8, 10, & 12 upstream of Sonora in Sutton County; and
- FME ID 141000025 - Johnsons Draw SCS Site 7 Dam upstream of Ozona in Crockett County.

The FMEs for Sonora and Ozona also include Supplemental Watershed Plans; however, Comanche Creek Dam does not include one, since it is not an NRCS dam.

All four of these dam-related FMEs include the development of SWMPs for the downstream cities at risk and are identified as having an "Emergency Need" in **Table 4A**. In this RFP, the classification of a proposed action as an "Emergency Need" is reserved for actions related to Emergency Response (such as early warning systems) or significant flood protection infrastructure that has been identified as inadequate by authorities responsible for inspecting and regulating stormwater infrastructure, such as TCEQ Dam Safety.

4.3.3 Riverine Flood Risk Related to Sediment or Levees

Eight of the FMEs identified by the RFPG are categorized as having a "Riverine" flood risk type. Riverine flooding typically occurs along rivers or streams when the runoff exceeds the capacity of the channel. For significant creeks or rivers adjacent to populated areas, levees are sometimes constructed to protect the populated areas from out-of-bank flooding. This is the case for segments of the Rio Grande, including those running through El Paso County and the City of Presidio. This is also the case for Cibolo Creek which flows into the Rio Grande on the western border of the City of Presidio. In arid landscapes such as Region 14, the accumulation of sediment in arroyos and rivers such as these can have a significant effect on flood risk if natural flood patterns or regular maintenance are not achieved. FMEs 141000001 and 141000002 both address flood risk related to these significant sources of flooding in El Paso and Presidio, respectively. In Presidio, the FME includes a coincident peak analysis to assess the probability of peak flows from Cibolo Creek aligning with peak flows in the Rio Grande, creating an even more disastrous flood event. In addition, coincident peaks in the Rio Conchos at the confluence with the Rio Grande will be studied in the FME.

While FME 141000001 is categorized as a "Preparedness" Study type and is primarily related to maintenance of sediment and vegetation in the Rio Grande floodway to prevent overtopping of levees, the Cibolo Creek FME 141000002 is part of a larger strategy (FMS ID: 142000008) to develop a levee certification package for the FEMA accreditation of the "Cibolo Creek Left Levee" (per the National Levee Database) located along the City of Presidio side of the creek. As part of the levee accreditation requirements, an interior drainage study must be performed for the levee adjacent to the city. Since flow in the city limits is primarily draining from north to south, along the outer edge of the levee and is not ponding against the levee, the cost estimate for this FME did not assume a significant effort for the required interior drainage analysis, as it would likely be developed as part of the SWMP analysis.

FMEs 141000008 and 141000015 are both also related to sediment causing flood risk and maintenance issues for entities such as USIBWC, El Paso Water, and EPCWID1. USIBWC is responsible for clearing sediment in problem areas of the Rio Grande, and El Paso Water has urban/local runoff issues with sediment clogging their storm drains and culverts. High intensity storms on the Franklin mountains can wash sediment and large masses of debris into the streets, as it did in the recent August 2021 storm.

4.3.4 FMEs Related to Irrigation Systems in El Paso

EPCWID1 manages the vast and complex system of irrigation canals and drains in El Paso County and coordinates closely with both City and County stormwater officials, as well as with

neighboring irrigation districts (EBID and Hudspeth County Conservation and Reclamation District 1) to aid in managing stormwater during emergency flood events. In the Subcommittee 3 stakeholder workshop, discussed as part of the FME/FMS identification process in Section 4.2.1, RFPG members shared the history of emergency response efforts and coordination that took place between EPWater and EPCWID1 to utilize drains designed to discharge to the Rio Grande as flood relief strategies for the river, which was close to overtopping at some locations. EPCWID1 was able to open irrigation gates at the river to allow flow from the Rio Grande into the irrigations system and helped prevent segments of Rio Grande levees from potentially overtopping or breaching during the 2006 flood. It was reported in the workshop that the high flood levels in the Rio Grande were also related to significant sediment build-up, which is the reason FME 141000001 was established and approved by the RFPG.

In addition to relieving Rio Grande flooding, when necessary, EPCWID1 also has relieved urban/local flood infrastructure from exceeding capacities during interior flood events by allowing El Paso Water to utilize EPCWID1's Mesa Drain for flood control purposes. However, since this drain was not designed for this purpose, it needs to be studied, including the development of a 1D hydraulic HEC-RAS model to evaluate several Mesa Drain crossings, which are identified in the El Paso County SWMP as being undersized. This was the driver for creating FME 141000004, which has been included in grant requests by EPCWID1, who worked closely with the RFPG to review and update best available cost estimates and SOWs needed to document the FME.

FME 141000003 was reported by EPCWID1 as a significant need due to a new arroyo which has formed and causes overtopping of State Highway (SH) 20 in southeast El Paso County. The significant amount of uncontrolled flow over SH20 causes a flood safety hazard to the public. The newly formed arroyo is also a flood risk to agricultural areas (pecan orchards) on the other side of SH20 and transports a significant amount of sediment into EPCWID1's irrigation drain, which runs adjacent to SH20. This study will involve coordination with TXDOT to establish a flood mitigation alternative, likely involving a sediment basin and a siphon to allow the significant flood source to cross under both the roadway and the adjacent drain.

4.4 Identification of FMPs

Based on analyses and decisions described in Sections 4.1 and 4.2, the RFPG identified and evaluated 14 potentially feasible FMPs, which are listed with supporting data in **Table 4C** of **Appendix 4C**. The extent of these identified FMP study areas is shown in **Exhibit Map 17**, along with contributing watersheds. In addition, **Appendix 4D** includes a narrative of each FMP identified, including the following information extracted from associated SWMPs or other feasibility studies:

- Flood risk discussions;
- Project descriptions;
- Breakdown of cost estimates, which include land values, where applicable, as well as final design and construction contingencies. All costs are adjusted to September 2020

dollars (a requirement for the RFP), using the Construction Cost Index (CCI) and the Consumer Price Index (CPI), where appropriate; and

- Figures showing project components and locations.

The 14 potentially feasible FMPs which were evaluated for the RFP have been labeled with the following Project Types:

- One FMP is a non-structural project (FMP ID: 143000009), categorized as "Other" in **Table 4B**;
- Two FMPs are related to storm drains (FMP IDs: 143000005 and 143000111);
- One FMP is for preparedness (FMP ID: 143000007);
- One FMP is a channel improvement (FMP ID: 143000097); and
- The remaining nine FMPs are detention ponds.

These Projects align with the listed RFPG and stakeholder goals shown in **Table 4B**, as documented in *Chapter 3 (Floodplain Management Practices and Goals)*.

4.4.1 Sources of Potentially Feasible FMPs

A variety of structural and non-structural FMPs were selected by the RFPG to address flood risks related to major access routes, residential and commercial structures, agricultural property and infrastructure, and regulation of development. The sources of each FMP and the types of flood issues addressed are discussed in this section.

Non-Structural FMPs and Emergency Needs

Two non-structural FMPs were identified by the RFPG for evaluation. FMP ID: 143000009 is associated with Hudspeth County developing and implementing a floodplain ordinance to regulate development, and FMP ID: 143000007 includes installing a flood gage upstream of Marfa and adding flood gates to roadways at four low water crossings (LWCs).

The Hudspeth County regulatory need was communicated to the RFPG at a Subcommittee 3 workshop by the County Emergency Management Coordinator/Administrator. The issue is related to rapid development, outdated and insufficient floodplain mapping, and limited availability to process and monitor the amount of development that is occurring. The need for this FMP was also documented in the "Colonia Area Study and Plan 2019-2029" (Grantworks, 2019) and in a Fiscal Year 2023 earmark for federal funding, submitted to the Congressman of the 23rd District of Texas in April 2022 (the funding request was initially accepted, but later deemed ineligible).

The LWCs and flood gage project in Marfa (FMP ID: 143000007) was brought to the RFPG's attention through coordination with Presidio County Emergency Management, who informed the RFPG that a flood-related death occurred on June 27-28, 2021 at one of the LWCs considered in the FMP. The location where a driver was swept away in his vehicle is the LWC of Alamito Creek near the intersection of Neville Street and Dallas Street. The other three

proposed locations for automatic road closure gates are also for Alamito Creek LWCs near the intersections of Waco Street and Dean Street, Dallas Street and Spring Street, and Lincoln Street and A Street. This recent flood casualty at the FMP site is the reason that the FMP is documented as having an emergency need and an estimated reduction in fatalities in **Table 4B**. No other FMPs were identified as an emergency need by the RFPG.

The City of Marfa had recently procured a bid for the four LWCs and the flood gage from High Sierra Electronics. This bid is included in **Appendix 4G** for reference and includes an option to wave annual maintenance fees for a one-time training, which City of Marfa confirmed is their preference. Therefore, it was assumed this FMP would be a fixed cost, with no recurring costs.

A related strategy that was identified (FMS ID: 142000025) includes a separate bid for an additional early warning system in Marfa, which does include recurring monthly costs. The RFPG coordinated with High Sierra Electronics, who assisted in preparing the additional bid for FMS ID: 142000025 (also included in **Appendix 4G**), and ensured there is not an overlap in equipment or services proposed in the two bids provided.

FMPs Affecting Mobility and Localized Flooding

Three of the FMPs identified for evaluation are related to mobility and localized flooding, with two of the projects affecting the same roadway, Doniphan Drive. FMP IDs: 143000111 and 143000113 are relatively close in proximity to each other and mitigate flooding on Doniphan Drive by capturing runoff to the roadway on either side of a known localized ponding area between Sunland Park Drive and Racetrack Drive. Doniphan Drive is a major access route and has a roadway classification of "Principal Arterial." Both of the FMPs relieve flooding from a segment of Doniphan Drive identified in the "Incident Management Plan Standard Operating Guidelines" (TXDOT, 2011) as a detour route for Tier 3 traffic incidents occurring on IH-10 between Sunland Park Drive and Paisano Drive.

The known local ponding area on Doniphan Drive is adjacent to a multi-box culvert with sluice gates, draining to the Rio Grande. This ponding area has caused repeated nuisance flooding in El Paso for several years, including during the recent storm event on June 28, 2021, when the world-famous Rosa's Cantina was inundated for long durations with both flood water and sediment/debris. The owner, who reportedly could not initially open the door due to the amount of mud and water in the building, eventually found eight inches of water in the building and stated for news reporters, "After 13 years, this is probably our fifth time flooding but this is definitely one of the worst," Telles said *(Source: https://kfoxtv.com/ news/local/severe-flooding-in-west-el-paso-caused-extensive-damage-to-properties)*.

El Paso Water funded a feasibility study for FMP ID: 143000111 entitled, "Doniphan Storm Water Pump Stations PS1 and PS2 System Evaluation and Potential Improvements" (Study ID 90 from *Chapter 1*), which evaluated alternatives and recommend immediate, short-term, and long-term improvements. One of the mid- to long-term improvements (labeled Project G in the feasibility study and "NW3" in the City of El Paso SMWP) is associated with this FMP and involves constructing a storm drain system to intercept flooding on the southern extension of Racetrack Drive. The intercepted flow would be coming from the northeast side of Loop 375,

and it would be conveyed to a new 110-cfs pump station (with 1% AC capacity) to be constructed next to the existing "Pump Station 1," discharging directly into the Rio Grande.

El Paso Water also funded a separate feasibility study for FMP ID: 143000113 entitled, "Montoya Drain H&H Analysis" (Study ID 38 from *Chapter 1*), which evaluated flooding of Doniphan Drive from a different location (from the northwest, along Doniphan). This project is identified in the City of El Paso SWMP as "NW26." The Project will intercept runoff coming from the northwest along Doniphan Drive and Doniphan Ditch with a storm drain system and/or trench drain and convey flow to the southwest, along the northern extension of Racetrack Drive. The diverted runoff would need to cross Montoya Drain (with either a siphon or pipe bridge) and discharge into a proposed pond on undeveloped property, located adjacent to a Rio Grande levee in Sunland Park, New Mexico.

This general project area surrounding the Doniphan pump station and Montoya Drain wetland FMPs is known to have a high water table, which also causes issues for EPCWID1 draining Montoya Drain into the Rio Grande (FME ID: 141000019 increases the capacity of the Montoya Drain for stormwater conveyance in this area). Therefore, the proposed pond, which will also serve as a constructed wetland habitat, is proposed to include a series of groundwater dewatering wells with submersible pumps to lower the groundwater table when the pond storage volume is needed for the 1% AC event. In addition, the project could benefit the irrigation districts (EPCWID1 and EBID) needing to discharge flow in Montoya Drain to the Rio Grande when groundwater is high. This project provides a nature-based solution with stormwater benefits to a critical roadway, and it reduces flooding in the nearby known ponding area where residential and commercial structures are at risk.

A roadway drainage improvement (FMP ID: 143000005) affecting mobility on SH20, also known as Mesa Street, was identified from the TXDOT feasibility study entitled "Drainage Study for SH20, from Doniphan Drive to Texas Avenue" (AECOM, 2019). SH20 is a major access route and has a roadway classification of "Principal Arterial". Conceptual designs for the eight prioritized and recommended improvements from the SH20 Study (all of which are part of the FMP) will improve the capacity of drainage crossings on a critical route from conveying less than the 20% annual chance event to a 10% annual chance level of service. All of the projects are on a segment of SH20 identified in the "Incident Management Plan Standard Operating Guidelines" (TXDOT, 2011) as a detour route for Tier 3 traffic incidents occurring on IH-10 between Executive Center Boulevard and Schuster Avenue.

Channel Expansion FMP

One FMP identified for evaluation in the RFP by El Paso Water (FMP ID: 143000097) involves the expansion of the upper segment of the White Spur Drain in Northwest El Paso (labeled "NW16" in the City of El Paso SWMP). This concrete channel, located in a commercially developed area of northwest EL Paso, conveys stormwater runoff from along SH20 (Mesa Street) and from local drainage systems in the surrounding shopping developments. The downstream portion of the channel, on the other side of Doniphan Drive, is significantly wider than the upper section. Commercial buildings adjacent to the narrower upper section are at risk due to the insufficient capacity of the channel. The channel widening project would not only help contain the 100-

year flows within the channel, but it would lower the tailwater on storm drains discharging to the channel from surrounding roadways and commercial developments.

Sediment and Flood Storage FMPs

The remaining nine FMPs are flood and sediment storage basins or ponds, which are identified in the El Paso County and City of El Paso SWMPs. These projects typically involve detaining and/or retaining runoff upstream of developed areas and/or agricultural areas and critical routes that are known to have flooding issues. They were identified in their respective SWMPs, and by the RFPG because they are considered a high priority for El Paso Water and El Paso County. While each of the flood sources and related flooding issues is unique to the project area, all of the storage solutions were designed to have capacity for at least the 1% AC event.

One of these storage basins (FMP ID: 143000021, labeled "SOC4" in the El Paso County SWMP) was identified by EPCWID1 after a flood event on July 22, 2017 caused damages to commercial development detention ponds, which failed, releasing additional flow into the newly-formed arroyo. This flood source causes erosion, sediment, and flooding issues for downstream rural residences as well as agricultural land and infrastructure, including the Mesa Spur Drain.

Another storage project (FMP ID: 143000100, labeled as NE3B in the City of El Paso SWMP) is a proposed pond in a highly developed area of northeast El Paso. The FMP concept was initially developed in a feasibility study entitled, "Northeast Sump Improvements – Hydrologic and Hydraulic Analysis" (MCi, 2017), where it was modeled in conjunction with the Will Ruth Pond, a proposed project being funded by the Flood Infrastructure Fund. While the FMP does not contribute to any additional flood benefits downstream of Will Ruth Pond, it does intercept runoff and relieve flooding upstream of Will Ruth Pond.

4.5 Identification of FMSs

Based on analyses and decisions described in Sections 4.1 and 4.2, the RFPG identified and evaluated 22 potentially feasible FMSs, which are listed with supporting data in **Table 4E** of **Appendix 4E**. The extent of these identified FMS study areas is shown in **Exhibit Map 18**, along with HUC-12 watersheds. A narrative of each FMS identified is provided in **Appendix 4F**, including the following:

- Discussion on flood risk;
- SOW assumed for each FMS; and
- Cost breakdown of labor fees, construction costs, and/or recurring costs.

These strategies align with the listed RFPG and stakeholder goals shown in **Table 4E**, as documented in *Chapter 3 (Floodplain Management Practices and Goals)*. Almost all of the strategies are associated with Urban/Local and/or Riverine Flood Risk, and strategy types vary between the following:

- Six FMSs are for regulatory and guidance purposes;
- Three FMSs include infrastructure projects;

- Six FMSs are for flood measurement and warning; and
- Two FMSs include education and outreach.

In general, FMSs do not typically fit into the FME or FMP categories for a variety of reasons. Below are a list of criteria that led to the decision to list a flood reduction action as an FMS rather than an FME or FMP:

- Studies, projects, and/or program development involving complex coordination between multiple entities (local, state, federal, or international);
- Associated with other FMEs, FMSs, or FMPs requiring a specified sequence of actions as part of a larger plan;
- Involve multiple projects with varying statuses of design/construction; and
- Include recurring costs.

This section describes the general types of potentially feasible FMSs identified for Region 14, with discussion of specific strategies to explain the importance of varying components affecting each overall flood reduction plan.

4.5.1 FMSs Requiring Complex Coordination

Region 14 has several unique flood-related issues involving multiple entities and stakeholders, sometimes requiring inter-state or international agreements. These types of objectives may require multiple studies or coordination between different entities who may not typically partner on projects. If an initial study is required to quantify flood benefits, but it also requires identifying all necessary stakeholders as well as identifying complex political obstacles and documented agreements, as in the Binational Streamflow Recommendations for Big Bend Reach of Rio Grande/Rio Bravo (FMS ID: 142000006), that flood reduction solution was classified as an FMS rather than an FME. In this example, water rights agreements between the U.S. and Mexico would need to be explored before the opportunity to accomplish the broader goal of releasing environmental flows from the Luis León Dam in Mexico could be deemed as feasible.

Similarly, the type of multi-step process needed to accredit all of the Rio Grande levees in El Paso (FMS ID: 142000001) will require coordination between USIBWC, FEMA, and local stakeholders sponsoring the interior drainage studies (City of El Paso, El Paso County, Doña Ana County, and Hudspeth County) to package and deliver all of the requirements for levee certification. As part of the RFP process, multiple coordination meetings have been conducted between the USIBWC and local stakeholders, as well as between those stakeholders and FEMA. However, each levee segment remaining to be certified in El Paso County has a unique status and set of issues keeping it from being certified. The first step in planning a solution to accomplish the RFPG short-term goal (Goal ID: 14004001) of certifying all levees in El Paso County is to identify the outstanding issues associated with each segment and prioritize which segments should be accredited first, considering population at risk and several other factors.

Due to the high level of complexity and coordination involved in this plan, this solution was categorized as an FMS rather than an FMP or an FME.

Another example of a strategy with complex coordination necessary is FMS ID: 142000004, which involves facilitating discussions between El Paso Water, El Paso County, and the U.S. Army to address the subject of unexploded ordnances (UXOs) on Fort Bliss property, where both the City and the County have planned flood control projects in their respective SWMPs.

4.5.2 FMSs Requiring Associated FMEs, FMSs, or FMPs

If a study or project was identified that requires an initial FME, FMS, or FMP to take place before it can occur, it was also categorized as an FMS. Associated FMEs, FMSs, and FMPs are listed in **Table 4E** for seven of the identified FMSs. For example, FMS ID: 142000003 includes a portion of funding for construction of drainage swales along roadways, documented in the "Colonia Area Study and Plan 2019-2029" (Grantworks, 2019), but first requires FME ID: 141000014 to be performed, which includes developing a SWMP. This strategy also includes a recurring cost associated with an educational outreach program, also documented in the "Colonia Area Study and Plan 2019-2029" (Grantworks, 2019).

4.5.3 Multi-Project FMSs with Varying Statuses of Design or Construction

Similarly, if specific phases or portions of an overall plan have already been designed or constructed, it was classified as an FMS. An example is FMS ID: 142000002, which is a strategy recommended for the City of Alpine in the current Region E Water Plan. This nature-based solution involves three related projects centered around Kokernot Park to accomplish a shared goal of reducing stormwater in roadways while promoting green infrastructure and harvesting rainwater. In this strategy, one of the projects has been constructed, with reconstruction of some portions of that project still pending. Another site location is planned for construction by the City Streets Department in Fall of 2022, and the third phase is not expected to be constructed by TXDOT until 2024. The City confirmed they are still seeking grants, and no funding is currently available. All previous planning time and plants/trees installed to date have been donated.

4.5.4 FMSs Including Recurring Costs

Bids are provided for early warning systems for the City and County of El Paso, as well as for the cities of Pecos (FMS ID: 142000021), Alpine (FMS ID: 142000022), Presidio (FMS ID: Presidio), Fort Stockton (FMS ID: Fort Stockton), and Marfa (FMS ID: 142000025). The general scope and equipment proposed in each system was prepared for each entity as part of the RFP based upon availability of nearby rain/flow gages, radar availability, and the needs and general budget available for such a system by each entity. All of these systems include recurring costs, which are specified in the cost summary tables in **Appendix 4H**. In addition, a bid document is available for each FMS in **Appendix 4G**.

Other FMSs with recurring costs are FMS ID: 142000003 (Fort Hancock Colonia-wide public outreach strategy discussed above), FMS ID: 142000013 (support for at-risk communities to join and/or enforce the National Flood Insurance Program), and FMS ID: 142000014 (developing

new flood gages throughout the region). More information on these FMSs, as well as all other potentially feasible FMSs shown in **Table 4E** can be found in the narratives provided in **Appendix 4F.**