

Appendix 4F

Narratives of Potentially Feasible Flood Management Strategies

Appendix 4F. Narratives for Flood Management Strategies

4F-1. Flood Management Strategy ID: 142000001

Name: FEMA Levee Accreditation for All Rio Grande Levees at El Paso.

Description: Coordination needed between the United States International Boundary and Water Commission (USIBWC), the Federal Emergency Management Agency (FEMA), El Paso Water (EPWater), El Paso County, Doña Ana County, and Hudspeth County to certify and accredit all remaining levee segments through El Paso County. Interior drainage studies are needed in Hudspeth and Doña Ana counties.

Affected Jurisdictions: City of El Paso, El Paso County, Hudspeth County, Doña Ana County

Discussion on Flood Risk: Areas adjacent to the Rio Grande River protected by FEMA-accredited levees are not only protected from riverine flooding, but residents will also be eligible for reduced flood insurance premiums.

Flood Management Strategy Scope of Work:

There are multiple unaccredited levee segments along the Rio Grande River through El Paso County that currently provide flood protection to adjacent areas. These levees are designed and operated by the USIBWC. A certified levee indicates that the levee segment is formally recognized by FEMA as providing flood risk reduction for the 1% annual chance (AC) flood on the applicable Flood Insurance Rate Map(s) (FIRMs). To achieve this recognition, the levee systems must meet and continue to meet the minimum design, operation, and maintenance standards per Title 44, Chapter 1, Section 65.10 of the *Code of Federal Regulations* (44 CFR Section 65.10). This regulation specifies select items that need to be submitted and reviewed by FEMA to obtain levee accreditation, including the following:

- Documentation that the levee meets design criteria (freeboard, stability, settlement, etc.);
- Certified as-built levee plans showing tie-ins;
- Officially adopted operation and maintenance (O&M);
- Emergency Preparedness Plan (including documentation of flood warning systems, emergency notification flowchart); and
- Interior drainage evaluation.

This Flood Management Strategy (FMS) will prepare an individual certification package and summary report, including all associated attachments, by levee segment for FEMA submission. The package will include all elements required by 44 CFR Section 65.10 and described in FEMA guidance, *Meeting the Criteria for Accrediting Levee Systems on Flood Insurance Rate Maps* (FEMA Fact Sheet May 2021). The text of the report will reference other studies/data as necessary to show compliance with 44 CFR Section 65.10. Preparation of each package does not include performing the detailed studies required for certification, but rather aggregation,

review, and summary/presentation of the certification material. Sections and/or items to be included in the package and report include the following:

Purpose of Certification package and background;
Certification Statement (to be signed by levee owner/sponsor);
Regulation Compliance;
As-Built Plans and Freeboard Check;
Natural Valley Analysis;
Levee System Check (roadway crossings, structure crossings, upstream and downstream tie-in locations);
Interior Drainage Analysis;
Geotechnical Report of the levee assessing embankment and foundation stability, seepage, and settlement;
Embankment Protection, including vegetation and cover assessment and analysis of shear stress ;
Closure Structure Data;
O&M Plan;
Emergency Preparedness Plan;
Inspection reports, and
Statement of compliance with all local, state, and federal laws.

There are eight USIBWC levee segments along the Rio Grande within the County of El Paso that require certification, three of which extend outside of the County limits, requiring an interior drainage study and/or a hydraulic independence analysis to be performed to certify portions of the levee segments within El Paso County:

Canutillo/Mesilla – East 1 (extends into New Mexico):

- Requires interior drainage study in Doña Ana County and/or hydraulic independence analysis to certify levee segments in El Paso County.

Canutillo/Mesilla – East 2 (includes Canutillo Phase 2 Floodwall and Sunland Park East).

- A construction contract for levee repair of the Sunland Park East levee from the Borderland Road Bridge to the El Paso Electric Rio Grande Power Plant (8.42 miles) was awarded on September 20, 2022 and is expected to be completed by March 2025.

Canutillo/Mesilla – West (extends into New Mexico, includes Nemexas and Sunland Park West):

- Requires interior drainage study in Doña Ana County and/or hydraulic independence analysis to certify levee segments in El Paso County.
- Levee repair construction of the Sunland Park West levee from the Borderland Road Bridge to Country Club Road Bridge reached substantial completion on June 11, 2021.
- A construction contract for levee repair of Sunland Park West levee from Country Club Road Bridge to the Nemexas Siphon (0.59 miles) was awarded on September 20, 2022.

Courchesne – West.

El Paso 1 / Paisano (American Dam to International Dam).

El Paso 2B (South Zaragoza Road to Riverside Weir).

El Paso 3 (Riverside Weir to Wingo Reserve Road/upstream of Shaffer Road, Tornillo, TX, includes Ysleta to Fabens and Fabens).

El Paso 4 (Wingo Reserve Road/upstream of Shaffer Road, Tornillo, TX to extends into Hudspeth County):

- Requires interior drainage study in Doña Ana County and/or hydraulic independence analysis to certify portions of levee segments in El Paso County.

The project is divided into the major tasks below.

Task 1 – Stakeholder Coordination;

Task 2 – Meetings;

Task 3 – Data Collection;

Task 4 – Interior Drainage Studies; and

Task 5 – Levee Certification Package by Segment.

Estimated Cost for FMS:

Labor Cost	
Task 1 – Stakeholder Coordination	\$ 40,000
Task 2– Meetings	\$ 49,200
Task 3 – Data Collection	\$ 40,380
Task 5 – Levee Certification Package Preparation	\$ 350,620
Total Project Labor	\$ 480,200
Travel	\$ 2,091
Total FME cost	\$ 482,000

4F-2. Flood Management Strategy ID: 142000002

Name: Irrigation and Recharge Application of Captured Rainwater Runoff at Alpine.

Description: Construct rainwater basins at three locations around Kokernot Park to drain neighboring streets, impound runoff volume, promote infiltration and aquifer recharge, reduce landscaping water costs, and remediate pollutants.

Affected Jurisdictions: City of Alpine, Brewster County

Discussion on Flood Risk: This strategy was recommended in the Regional Water Plan for Region E (January 2021, FNI and WSP). A description of the flood risk in Alpine from Section E-2 of the Regional Water Plan for Region E (January 2021, FNI and WSP) is provided below for reference:

“In a good year, the City of Alpine receives approximately 17 inches of rain, much of which is lost to runoff. High-intensity thunderstorms contribute to greater runoff into nearby Alpine Creek, causing higher peak flooding. This prevents the creek from functioning properly as evidenced by the scoured, cut and straightened channel that exists today which must be armored with engineered banks. Additionally, runoff transports pollutants into the creek, which eventually flows into the Rio Grande. As with many towns in West Texas, the streets act as a storm water drainage system. These water catchments take that liability and turn it into an asset.”

Flood Management Strategy Scope of Work:

A description of the strategy from Section E-2 of the Regional Water Plan for Region E (January 2021, FNI and WSP) is provided below for reference:

“This strategy proposes constructing rainwater catchment basins at three locations around Kokernot Park, which will drain neighboring streets. Impounding a large volume of water from the roads will allow the captured water time to infiltrate the soil, recharge the underlying aquifer, and remediate pollutants. These basins will also be landscaped with water-efficient plants without tapping into the city’s aquifer water for irrigation. These catchments will also demonstrate how residents can reduce water use and cost by capturing rainwater and landscaping with water-efficient native plants. This project will also help reduce down-stream flooding.”

A figure of the three proposed project locations where runoff will be diverted from roadways toward Kokernot Park is provided below.

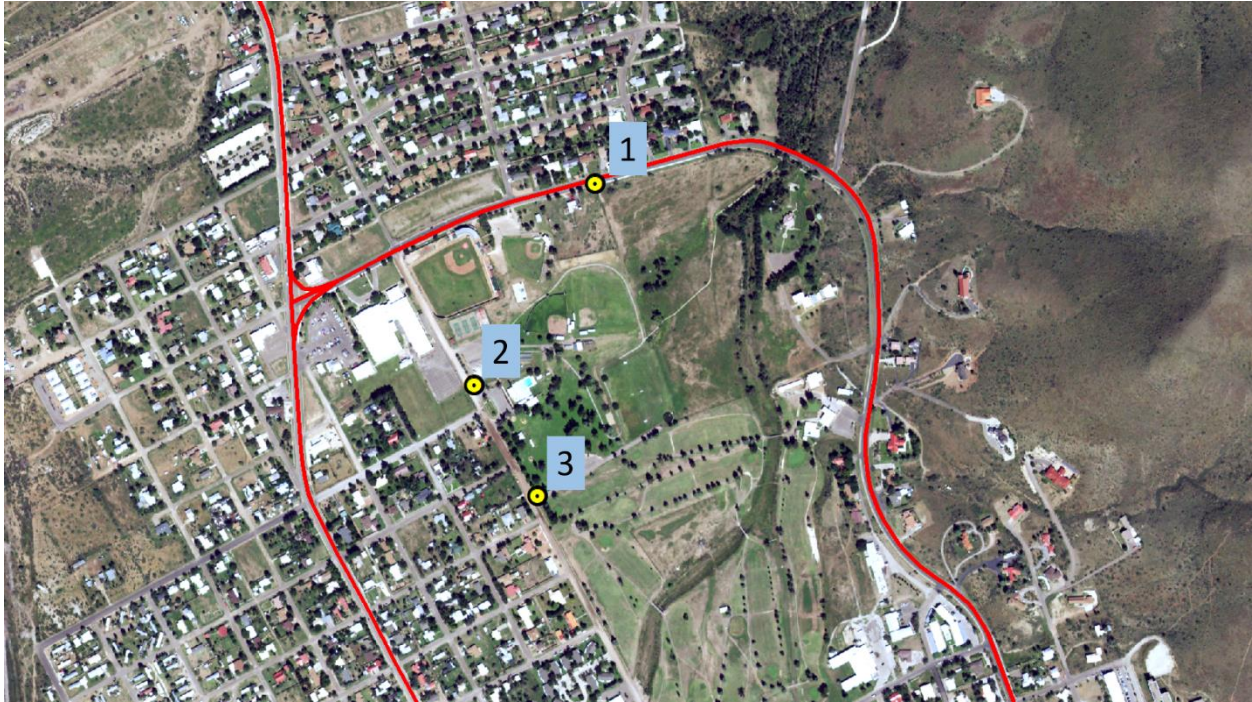


Figure 4D-2. Project locations for diverting runoff to Kokernot Park

Estimated Cost for FMS:

The total estimated Cost for this strategy is \$1,282,000. The strategy cost from the Region E water plan (\$1,296,000) was adjusted from January 2021 dollars to September 2020 dollars (\$1,282,000) using the Construction Cost Index to be consistent with other costs documented in the Regional Flood Plan. A description of the cost associated with this strategy from Section E-2 of the Regional Water Plan for Region E (January 2021, FNI and WSP) is provided below for reference:

“The three catchment basins (approximately 70 acres in combined size) are calculated to capture approximately 70 acre-feet during an average drought (12 inches or 75% of average annual rainfall) year. The project is planned for construction within the 2030 decade and come online prior to 2030. The estimated capital cost to construct the three catchment basins and retention dams is \$1,296,000.”

4F-3. Flood Management Strategy ID: 142000003

Name: Implement Colonia-wide Drainage System and Maintenance and Outreach Program for Roadside Swales and Driveway Culverts at Fort Hancock.

Description: Construct drainage improvements as detailed in FME ID: 141000014; maintain existing roadside ditches/swales to ensure positive drainage; and develop an outreach program to encourage residents to maintain and repair driveway culverts.

Affected Jurisdictions: Fort Hancock (CDP), Acala (CDP)

Discussion on Flood Risk: Fort Hancock and Acala are unincorporated areas in Hudspeth County located within the Rio Grande terrace, just downstream from El Paso County. The area has been recently developed without strict drainage controls, and as a result, is subject to frequent shallow flooding which interrupts routine road traffic. The County is responsible for the road maintenance which provides the primary drainage in the area. The County lacks the resources to plan for system improvements and has limited staff and means for system maintenance. The Regional Flood Planning Group (RFPG) has proposed a Flood Management Evaluation (FME ID: 141000014) for Fort Hancock and Acala that will develop and select Flood Mitigation Project (FMP) alternatives (both structural and non-structural) for the mitigation of the identified flood risk. This strategy follows this FME and develops a County program to sustain the FME-recommended improvements.

Flood Management Strategy Scope of Work:

This FMS has the goal of establishing a program for long-term maintenance that includes a plan for future county staff, county equipment, and county infrastructure needed to sustain the flood improvements recommended under FME ID: 14000014. The FMS will include a recommended funding strategy and public education program to develop support for that strategy.

The Scope of Work (SOW) for this FMS includes five tasks.

Task 1. Assessment of existing county drainage maintenance program needs. The existing county program will be reviewed, and interviews/data collected from the County to assess current needs in terms of staffing, equipment, and infrastructure.

Task 2. Assessment of future county drainage maintenance program needs. The study associated with FME 14000014 will be reviewed to estimate County needs (staffing, equipment, and infrastructure and associated annual costs) following planned execution of recommended FMPs.

Task 3. Develop a plan to fund the estimated annual costs. The funding of similar regional county maintenance programs will be reviewed. A plan will be developed to address: 1) existing funding needs and 2) future funding needs.

Task 4. Public Education Program. A public education program will be developed that explains drainage system maintenance needs and solicits public ideas and support for addressing the funding of those needs.

Task 5. Develop report. The report will include documentation of Tasks 1-4.

Task 6. Stakeholder Coordination.

Estimated Cost for FMS:

In addition to the labor costs associated with the tasks noted above, this strategy includes a recurring cost associated with the public education program and a lump sum assumed for construction and implementation of this strategy, including recommendations from FME 14000014. The lump sum construction cost is based upon the cost requested in a 2022 earmark funding request by Hudspeth County and the planning document entitled, “Villa Allegre, Fort Hancock East Unit 1, & Fort Hancock East Unit 2 Colonia Area Study and Plan 2019-2029” (Grantworks, 2019).

Labor Cost	
Task 1 – Assessment of existing county drainage maintenance program needs	\$ 12,820
Task 2– Assessment of future county drainage maintenance program needs	\$ 5,760
Task 3 – Develop plan to fund estimated annual costs	\$ 8,060
Task 4 - Public Education Program	\$ 12,140
Task 5 – Report	\$ 11,860
Task 6 – Stakeholder Coordination	\$ 5,360
Total Project Labor	\$ 56,000
Travel	\$ 1,500
Total Fixed Non-Construction Costs	\$ 57,500
Implementation Estimate	
Subtotal 1 - Recurring Cost Associated with Public Education and Outreach Program	\$ 3,500
Subtotal 2 - Assumed Construction Cost From 2019-2029 Colonia Plan (Dec. 2019)	\$ 251,000
Subtotal 3 – RFP Construction Cost (September 2020, using CCI)	\$ 254,000
Subtotal 4 – RFP Construction Contingency (35%)	\$ 88,900
Total Construction Cost	\$ 342,900
Total Fixed FME cost	\$ 400,000
Total Recurring FME cost	\$ 3,500

4F-4. Flood Management Strategy ID: 142000004

Name: Coordination with Ft. Bliss for FMP Permitting and Maintenance Access.

Description: EPWater designed NE7 on Ft. Bliss near unexploded ordinances (UXOs) and has an easement to maintain Fusselman and Northgate Dams, but can't access them due to UXOs. El Paso County designed MON1 on Ft. Bliss near a training ground and potential UXOs.

Affected Jurisdictions: Fort Bliss (CDP), City of El Paso, El Paso County

Discussion on Flood Risk: The U.S. Army Ft. Bliss has an area of about 1,700 square miles, including a large tract within the Franklin Mountains north, west, and adjacent to the City of El Paso, and a large portion of the northeast portion of El Paso County. Training ranges within Fort Bliss have historically been used for live fire exercises, and in these areas, there is some risk of UXOs being present in surficial soils. The potential presence of UXOs impacts the permitting, construction, and maintenance of needed flood mitigation infrastructure in both the City of El Paso and El Paso County. In the City of El Paso and El Paso County, needed new sediment/debris flow basins identified as part of extensive public stormwater master planning are impeded from construction due to UXO issues. These basins are designated as project NE7 within the City of El Paso Stormwater Master Plan (AECOM 2021) and as project MON1 within the El Paso County Stormwater Master Plan (AECOM, 2021). The easements to maintain existing stormwater detention infrastructure (Fusselman Dam and Northgate Dam) cannot be accessed due to UXO issues.

Flood Management Strategy Scope of Work:

This FMS has the goal of developing a plan for the resolution of UXO-related impediments to implementation and maintenance of stormwater infrastructure within the City of El Paso and El Paso County.

The SOW for this FMS includes the following tasks.

Task 1. Identification and characterization of UXO-related impediments to implementation and maintenance of stormwater infrastructure within the City of El Paso and El Paso County. This task will involve two meetings with the U.S. Army staff at Fort Bliss and review of existing relevant studies. The deliverable from this task will be a memorandum summarizing the issues and providing available details useful in planning solutions.

Task 2. Stakeholder meetings. A series of three meetings will be held with City of El Paso, EPWater, El Paso County, and the U.S. Army to develop short- and long-term plans with solutions that address issues defined in the Task 1 memorandum. This SOW includes:

Meeting 1 will be a workshop including City of El Paso, EPWater, and El Paso County where alternatives are developed for addressing issues defined in the Task 1 memorandum. These suggested alternatives will be summarized in a written communication to the U.S. Army.

Meeting 2 will be a workshop including the City of El Paso, EPWater, El Paso County, and the U.S. Army and will include discussions centered on the suggestions from Meeting 1. Remaining/edited /new alternatives and ideas on how to proceed with implementing those ideas will be summarized in a written communication to the U.S. Army.

Task 3. Plan to address City/County actions. A plan will be developed including concept designs and costs sufficient to define a FME, FMS, or FMP per the RFP, for actions that will have City/County sponsorship.

Task 4. Stakeholder coordination.

Estimated Cost for FMS:

Labor Cost	
Task 1 – ID and Characterization of UXO Issues	\$ 10,210
Task 2– Stakeholder Meetings	\$ 20,500
Task 3 – Plan to address City/ County actions	\$ 14,700
Task 4 – Stakeholder coordination	\$ 3,570
Total Project Labor	\$ 48,980
Travel	\$ -
Public meeting materials cost	\$ -
Total FME cost	\$ 49,000

4F-5. Flood Management Strategy ID: 142000005

Name: Maintenance Program to control Salt Cedar vegetation along Rio Grande upstream of Presidio.

Description: Study to develop alternatives to clear vegetation along the Rio Grande between Candelaria and the City of Presidio to allow for proper drainage for communities located along FM 170. Coordination needed between the Rio Grande Council of Governments (RGCOG), Presidio County, Texas Department of Transportation (TXDOT), U.S. Army Corps of Engineers (USACE), and USIBWC.

Affected Jurisdictions: Presidio County, Candelaria Colonia

Discussion on Flood Risk: In Rio Grande reach between Candelaria and the City of Presidio, the growth of saltcedar between FM 170 and the Rio Grande, and within the flood conveyance area of the river has a number of ancillary negative impacts on flooding and drainage: the cedar growth promotes sedimentation that reduces flow area, the height of the vegetation impinges on flood flows and increases resistance to flow (roughness). This increases riverine flood risk and causes issues for communities adjacent to FM 170 with local runoff draining toward the Rio Grande. The sediment accumulation in the river blocks gravity outfalls of stormwater into the river, increasing interior flooding adjacent to the river. The saltcedar growth has also been studied for other impacts (USACE, *Forgotten Reach of the Rio Grande, Fort Quitman To Presidio, Texas*, Section 729, January 2008). Identified impacts of cedar growth include:

“The consequences of this noxious shrub invasion is increased salinization of soils and water, substantial loss of habitat quality for many faunal species, displacement of native flora, increased surface and groundwater loss due to evapotranspiration losses by saltcedar, and loss of agricultural productivity. Seventeen faunal or fish species are federally or state listed in the study area (Rio Grande reach upstream of Presidio) and the entire reach is declared an impaired stream by TCEQ for total dissolved solids, bacteria, and chloride salts (USACE, 2007).”

This strategy will be focused on providing basic planning information necessary for later definition of projects/strategies that meet the multiple goals associated with saltcedar removal. This strategy will:

- Estimate current flood capacity within the reach;
- Set goals for minimum flood capacity at selected population centers;
- Estimate flood benefits associated achieving those capacities;
- Estimate annual sediment loadings into the reach;
- Develop alternatives for communities along FM 170 which have drainage issues with runoff directed toward the river; and
- Include a qualitative evaluation of alternatives for cedar control in this reach for criteria to be determined by the public sponsors of the FMS.

The 2008 report proposes a number of alternatives for addressing saltcedar growth in the Rio Grande reach upstream of Presidio. These alternatives include:

Vegetation Management: large-scale land treatment;
Saltcedar Controls: biological control using natural predators, active re-vegetation;
Sediment management: in-channel enhancements to increase sediment transport capacity, and arroyo detention structures;
Channel improvement via river training measures;
Wetland construction;
Water Management and Improved Stream Flows; and
Research.

Current information on these alternatives will be assembled and applied to this reach to perform this FMS qualitative assessment.

Flood Management Strategy Scope of Work:

This FMS includes the development of alternatives to address saltcedar impacts in the Rio Grande, and includes two tasks (literature review, qualitative comparison of salt cedar controls) that will have overlap with FMS ID: 142000007. Costs for FMS ID: 142000007 are reduced assuming FMS ID: 142000005 will be executed prior to it.

The SOW for this FMS includes five tasks:

Task 1. Literature Review. The science that underlies identifying potential solutions to saltcedar growth is rapidly expanding. The USACE 2007 report reviewed for this FMS provides recommendations for important research on the issue that are likely to have been initiated and partially completed prior to issuance of this RFP. This task will include coordination between RGCOG, Presidio County, TXDOT, USACE, USIBWC, and other public stakeholders to identify the most current relevant research. This research will be reviewed and a meeting held with coordination partners to develop: 1) a list of priority data gaps and identify alternatives for cedar control to be evaluated in Task 4, and 2) a list of the evaluation criteria to be quantitatively applied for each method.

Task 2. Data Collection. Data collection will include:

Assembly of the full range of available recent (2000-current) LiDAR for the subject reach.

Assembly of the best available hydraulic and hydrologic models for the reach.

Assembly of historic (2000-current) imagery suitable for estimating vegetation change by species.

Review of existing well locations relative to the Rio Grande floodplain, using Fathom risk boundaries and the TWDB groundwater data viewer. There are expected to be shallow wells in unconfined riparian aquifers, which could be negatively impacted by increased conveyance velocities.

Task 3. Engineering Analyses. This task includes these subtasks:

Risk Analyses for Riverine Floods. Available hydrologic and hydraulic models will be revised as needed to map flood risk for three flood risk levels deemed appropriate by the sponsors of the FMS, for existing conditions:

The goal for riverine flood capacity in terms of statistical flood (e.g., 4% AC) within the limits of the study area will be procured from the USIBWC.

The existing condition hydraulic model will be altered (by removal of vegetation and sediment) such that the goal flood risk criterion is met within the reach within the boundaries of defined populated areas (cities, census designated place, colonia).

Estimation of Sedimentation/Vegetation Removal to Meet Goals. The volume of sediment removal and area of vegetation removal needed to achieve the riverine flood capacity goal will be estimated using the above model results.

Estimation of Historic Annual Changes in Vegetation and Sedimentation. Historic LiDAR and aerial imagery in the reach will be analyzed to quantify changes in channel conveyance volume and areas of major vegetation types within the data record. These changes will be summarized in terms of average and extreme annual changes within the reach within the areas affecting flood stage in the populated areas.

A desktop analysis of Candelaria drainage patterns will be performed with best available topographic data. Coordination will take place with Presidio County and/or local stakeholders to investigate historical drainage issues for the community related to excessive sediment and/or vegetation in outfalls draining to the Rio Grande. Solutions identified for outfalls will be considered for application at other communities along FM 170 with similar drainage issues. Alternatives will be reviewed with coordination partners to discuss maintenance responsibilities.

Task 4. Qualitative Comparison of Salt Cedar Controls. The alternatives for saltcedar control identified in Task 1 will be qualitatively evaluated versus the evaluation criteria set in Task 1. Reasoning underlying selection of qualitative rankings for each criterion will be documented. Data gaps impeding evaluation will be noted, and details provided as to data/research required for evaluation.

Task 5. Report: Future Planning Information. A summary report will be prepared that summarizes Tasks 1-4.

Estimated Cost for FMS:

Labor Cost	
Task 1 – Literature Review	\$ 11,340
Task 2– Data Collection	\$ 23,340
Task 3 – Engineering Analysis	\$ 31,240
Task 4 - Qualitative Comparison of Salt Cedar Controls	\$ 14,100
Task 5 – Report	\$ 9,780
Task 6 – Stakeholder Coordination	\$ 7,600
Total Project Labor	\$ 97,400
Travel	\$ -
Total FME cost	\$ 97,000

4F-6. Flood Management Strategy ID: 142000006

Name: Study Binational Streamflow Recommendations for Big Bend Reach of Rio Grande/Rio Bravo.

Description: Conduct study with recommendations for binationally beneficial stream flows for Big Bend reach of the Rio Grande/Rio Bravo. Study will identify stream flows to support the river's ecological environment in state and federal parks in the U.S. and Mexico.

Affected Jurisdictions: City of Presidio, Presidio County, Brewster County, Big Bend National Park, Rio Grande Wild and Scenic River, Big Bend Ranch State Park, Black Gap Wildlife Management Area, Santa Elena Canyon Wildlife and Plant Protection Area, Maderas del Carmen Wildlife and Plant Protection Area, Ocampo Wildlife and Plant Protection Area, and the Rio Bravo Monument

Discussion on Flood Risk:

The reach of the Rio Grande adjacent to the City of Presidio and including a series of downstream state and federal parks in the U.S. and Mexico (listed under "Affected Jurisdictions" above) is subject to loss of hydraulic capacity due to sediment inflows from the Rio Conchos (upstream of the city), and from Alamito and Ternereros Creeks (downstream of the city). Prior fluvial geomorphic and environmental study of this reach (downstream through Big Bend National Park) includes this report:

"Environmental Flows Recommendations Report, Final Submission to the Environmental Flows Advisory Group, Rio Grande Basin and Bay Area Stakeholders Committee, and Texas Commission on Environmental Quality", Upper Rio Grande Basin and Bay Expert Science Team, July 2012.

This report includes this recommendation for high pulse flows that "mobilize and reorganize coarse gravel and cobble deposits on the [Rio Grande] channel bed, and must be of sufficient duration to export fine sediment that has accumulated within the river channel." Specifically, the report recommends:

"To achieve these geomorphic goals, we recommend that annual channel filling flows of 10,500 ft³/s with a minimum of a 5-day duration be excluded from permit consideration. Ideally, high-flow pulses for channel maintenance purposes would happen during, near the end of, or soon after monsoon season for the purposes of exporting the sediment inputs that occur during the monsoon. Alternatively, if an annual high flow pulse is not available during the monsoon season; geomorphic goals could be met with a high pulse flow during the Spring season and would have the benefit of providing biological cues to species such as the Rio Grande Silvery Minnow. Therefore, The URG BBEST recommends that the first high flow pulse of the above stated magnitude and duration following the monsoon season be excluded from permit consideration."

This recommendation has numerous benefits to the environment (cited in the report), in addition to flood benefits to the City of Presidio and downstream communities adjacent to the Rio Grande. The flood benefits are primarily associated with maintaining Rio Grande flood conveyance capacity.

Flood Management Strategy Scope of Work:

This FMS has the goal of facilitating use of high pulse flows to maintain both flood capacity and riverine environmental function in the reach of the Rio Grande downstream of the Rio Conchos. The releases for these high pulse flows will necessarily originate from reservoir storage in Mexico. FME F141000008 within this plan has the goal of developing sediment controls on Alamito Creek and Terneros Creek, which would have the potential for lessening the high pulse flows needed from the Rio Conchos watershed per the 2012 study cited above. This FMS would follow FME F141000008 and would assemble a portion of the 2012 technical team to assess whether potential sediment control improvements to Alamito Creek and Terneros Creek would affect recommended pulse flows from the 2012 study.

The SOW for this FMS includes five tasks:

Task 1. Given revised sediment inflow estimates to the Rio Grande from Alamito Creek and Terneros Creek (per improvements defined in FME F141000008), confirm or adjust the 2012 recommendations for magnitude and frequency of high pulse flows from the Rio Conchos, and given the specific goal of maintaining Rio Grande channel capacity in the vicinity of the City of Presidio. It is expected that the modeling performed for the 2012 study would serve as a starting point for the revised estimates.

Task 2. Estimate flood benefits to City of Presidio of maintaining Rio Grande capacity via management of high pulse flows. This task will include: estimation of Rio Grande bed and banks configuration in the reach affects flooding in the City of Presidio that: 1) meets the regional goal for riverine flood protection in this area and 2) serves environmental goals in the 2012 study. Hydraulic modeling will be performed to compare flood risk in the City of Presidio with and without high pulse flows. Assumptions for the “without high pulse flows” condition will be developed in consultation with strategy stakeholders.

Task 3. Estimate multiple benefits (to habitat, stream function) associated with the revised recommended high pulse flows for the full reach of the Rio Grande from the junction with the Rio Conchos downstream through Big Bend National Park to Amistad Dam.

Task 4. Develop report. The report will provide recommendations from the RFPG to TWDB detailing benefits to reduction of flood risk associated with providing high pulse flows from the Rio Conchos.

Task 5. Stakeholder coordination.

Estimated Cost for FMS:

Labor Cost	
Task 1 – Revise High Pulse Flow Recommendations for Rio Conchos	\$ 4,660
Task 2 – Estimate Flood Risk Benefits of Task 1 Recommendations	\$ 26,300
Task 3 – Estimate Multiple Benefits of Task 1 Recommendations	\$ 15,740
Task 4 – Define FMPs and FMSs to improve sediment controls on 2 creeks	\$ -
Task 4 – Report	\$ 10,420
Task 5 – Stakeholder Coordination	\$ 5,420
Total Project Labor	\$ 63,000
Travel	\$ -
Total FME cost	\$ 63,000

4F-7. Flood Management Strategy ID: 142000007

Name: Study to plan the management of saltcedar growth and debris in channels in/adjacent to City of Pecos

Description: Study to identify and characterize alternatives to manage vegetation in natural drainages in and adjacent to the City of Pecos to increase conveyance and reduce flooding within the City of Pecos.

Affected Jurisdictions: City of Pecos, Reeves County

Discussion on Flood Risk: The growth of saltcedar within the Pecos River has a number of ancillary negative impacts on floodwater conveyance: the saltcedar growth promotes sedimentation that reduces flow area, and the height of the vegetation impinges on flood flows and increases resistance to flow (roughness). This increases riverine flood risk. The sediment accumulation in the river blocks gravity outfalls of stormwater into the river, increasing interior flooding adjacent to the river. The saltcedar growth has also been studied for other impacts, which have been identified in a study of the Rio Grande (US Army Corp of Engineers [USACE], Forgotten Reach of the Rio Grande, Fort Quitman To Presidio, Texas, Section 729, January 2008). Identified impacts of cedar growth include:

“The consequences of this noxious shrub invasion is increased salinization of soils and water, substantial loss of habitat quality for many faunal species, displacement of native flora, increased surface and groundwater loss due to evapotranspiration losses by saltcedar, and loss of agricultural productivity.”

FMS ID: 142000005 includes the development of alternatives to address saltcedar impacts in the Rio Grande, and includes two tasks (literature review, qualitative comparison of salt cedar controls) that will have overlap to this strategy. Costs for this strategy are reduced assuming FMS ID: 142000005 will be executed prior to this strategy. In addition, FME ID: 141000010 (which models and maps flood hazards in City of Pecos) will be performed prior to FMS ID: 142000007, as this FMS would potentially benefit from knowing the locations of existing flood hazards relative to locations of saltcedar growth.

This strategy will also include a qualitative evaluation of alternatives for cedar control in the vicinity of the City of Pecos, which is the primary population center potentially affected by riverine flooding in the Pecos River basin. The 2007 report proposes a number of alternatives for addressing salt cedar growth in the Rio Grande reach upstream of Presidio. These alternatives (which might be considered for the City of Pecos area) include:

Vegetation Management: large scale land treatment;
Saltcedar Controls: biological control using natural predators, active re-vegetation;
Sediment management: in-channel enhancements to increase sediment transport capacity, and arroyo detention structures;
Channel improvement via river training measures;
Wetland construction;

Water Management and Improved Stream Flows; and Research.

Current information on these alternatives will be assembled and applied to the relevant waterways for the City of Pecos.

Flood Management Strategy Scope of Work:

Task 1. Literature Review. The science that underlies identifying potential solutions to salt cedar growth is rapidly expanding. The USACE 2007 report reviewed for this FMS provides recommendations for important research on the issue that is likely to have been initiated and partially completed prior to issuance of this RFP. Recent relevant studies on the Pecos River and relevant tributaries from the west (e.g., Cottonwood Creek) will also be reviewed. This task will include coordination between RGCOG, City of Pecos, Reeves County, TXDOT, USACE, and other public stakeholders to identify the most current relevant research. This research will be reviewed and a meeting held with coordination partners to develop 1) a list of priority data gaps to identify alternatives for saltcedar control to be evaluated in Task 4, and 2) a list of the evaluation criteria to be quantitatively applied for each method.

Task 2. Data Collection. Data collection will include:

Assembly of full range of available recent (2000-current) LiDAR for reaches of the Pecos River and tributaries to the Pecos River from the west.

Assembly of best available hydraulic and hydrologic models for relevant reaches (note FME 141000010 will develop updated models for these reaches).

Assembly of historic (2000 – current) imagery suitable for estimating vegetation change by species.

Task 3. Engineering Analyses. This task includes these subtasks:

Risk Analyses for Riverine Floods. The existing condition hydraulic models for the Pecos River and tributaries from the west will be altered (by removal of vegetation and sediment) such that the goal flood risk criterion is met within boundaries of defined populated areas (cities, census designated place, colonia).

Estimation of Sedimentation/ Vegetation Removal to Meet Goals. The volume of sediment removal and area of vegetation removal needed to achieve the riverine flood capacity goal will be estimated using the above model results.

Estimation of Historic Annual Changes in Vegetation and Sedimentation. Historic LiDAR and aerial imagery in the reaches will be analyzed to quantify changes in channel conveyance volume and areas of major vegetation types within the data record. These changes will be summarized in terms of average and extreme annual changes within the reach within the areas affecting flood stage in the populated areas.

Task 4. Qualitative Comparison of Saltcedar Controls. The alternatives for saltcedar and sediment control identified in Task 1 will be qualitatively evaluated, including the consideration of nature-based solutions for upland restoration of tributaries to the west, utilizing structures such as loose rock dams or gabion baskets. Reasoning underlying selection of qualitative rankings for each criterion will be documented. Data gaps impeding evaluation will be noted, and details will be provided as to data/ research required for evaluation.

Task 5. Report: Future Planning Information. A summary report will be prepared that summarizes Tasks 1-4.

Estimated Cost for FMS:

These costs assume that this strategy will be preceded by FMS 14200005 (development of alternatives to address salt cedar impacts in the Rio Grande) and FME 141000010 (storm water planning for City of Pecos). These two studies will perform tasks relevant to this FMS, reducing the costs for Tasks 1 and 3.

Labor Cost	
Task 1 – Literature Review	\$ 11,340
Task 2– Data Collection	\$ 11,520
Task 3 – Engineering Analysis	\$ 23,440
Task 4 - Qualitative Comparison of Salt Cedar Controls	\$ 11,780
Task 5 – Report	\$ 9,780
Task 6 – Project Management	\$ 5,120
Total Project Labor	\$ 72,980
Travel	\$ -
Total FME cost	\$ 73,000

4F-8. Flood Management Strategy ID: 142000008

Name: Develop Certification Package for Cibolo Creek Channel and Levee

Description: Perform planning and design required by FEMA for levee accreditation, then complete certification package for Cibolo Creek levee in vicinity of City of Presidio. Package includes O&M Plan.

Affected Jurisdictions: City of Presidio

Description of Flood Risk:

The City of Presidio is protected by a levee owned by the City. The levee was constructed by the U.S. Army Corps of Engineers to meet federal levee standards, but the levee has not been certified under the federal NFIP. Per recent approximate hydraulic modeling performed as part of Regional Flood Plan risk analysis, over 600 structures in the City would be at risk without the levee. This strategy is to develop a FEMA-compliant levee maintenance program for the city that sustains the infrastructure and allows for levee certification. FME ID: 141000002 will precede this FMS, as the FME includes an interior drainage analysis, which is a requirement for levee certification.

Flood Management Strategy Scope of Work:

The reach of levee along Cibolo Creek adjacent to the City of Presidio is not certified the requirements of the NFIP. A certified levee indicates that the levee segment is formally recognized by FEMA as providing flood risk reduction for the 1% annual chance (AC) flood on the applicable FIRMs. To achieve this recognition, the levee systems must meet and continue to meet the minimum design, operation, and maintenance standards per Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44 CFR Section 65.10). This regulation specifies select items that need to be submitted and reviewed by FEMA to obtain levee accreditation, including the following:

- Documentation that the levee meets design criteria (freeboard, stability, settlement, etc.);
- Certified as-built levee plans showing tie-ins;
- Officially adopted operation and maintenance (O&M);
- Emergency Preparedness Plan (including documentation of flood warning systems, emergency notification flowchart); and
- Interior drainage evaluation.

It is assumed that an Emergency Preparedness Plan is currently available for the levee, and that modeling for an interior drainage evaluation will not be needed.

Task 1. Stakeholder Coordination

It is assumed that coordination web/phone meetings will need to occur with stakeholders and sponsoring entities involved.

Task 2. Data Collection

Collect, review, and organize applicable studies and plans necessary for submittal to FEMA for levee certification.

Task 3. Develop an Operations and Maintenance Plan for the Levee.

An Operations and Maintenance (O&M) Plan for the levee will be developed in accordance with USACE and FEMA requirements. This will include:

- Meeting with City staff to ascertain and document the existing maintenance program, and to document any known city needs identified as part of the current program;
- Assessment of the existing program versus federal requirements;
- Meeting with the City to strategize means to meet federal maintenance requirements, if needed; and
- Writing the O&M Plan.

Task 4. Prepare Levee Certification Package.

This FMS will prepare an individual certification package and summary report, including all associated attachments, for the Cibol Creek levee segment adjacent to the City of Presidio for FEMA submission. The package will include all elements required by 44 CFR Section 65.10 and described in FEMA guidance, *Meeting the Criteria for Accrediting Levee Systems on Flood Insurance Rate Maps* (FEMA Fact Sheet May 2021). The text of the report will reference other studies/data as necessary to show compliance with 44 CFR Section 65.10. Preparation of each package does not include performing the detailed studies required for certification, but rather aggregation, review, and summary/presentation of the certification material. Sections and/or items to be included in the package and report include the following:

- Purpose of Certification package and background;
- Certification Statement (to be signed by levee owner/sponsor);
- Regulation Compliance;
- As-Built Plans and Freeboard Check;
- Natural Valley Analysis;
- Levee System Check (Roadway crossings, structure crossings, upstream and downstream tie-in locations);
- Interior Drainage Analysis (to be performed as part of FME ID: 141000002);
- Geotechnical report of the levee assessing embankment and foundation stability, seepage, and settlement;
- Embankment Protection, including vegetation and cover assessment and analysis of shear stress;

Closure Structure Data;
 O&M Plan;
 Emergency Preparedness Plan;
 Inspection reports; and
 Statement of compliance with all local, state, and federal laws.

The project is divided into the major tasks below.

Task 1 – Stakeholder Coordination;
 Task 2 – Meetings;
 Task 3 – Data Collection; and
 Task 4 – Levee Certification Package. Estimated costs for this task derive from recent experience in El Paso County with development of a certification package for a segment of the Rio Grande levee.

Estimated Cost for FMS:

Labor Cost	
Task 1 – Stakeholder Coordination	\$ 6,700
Task 2 – Data Collection	\$ 10,220
Task 3– Develop O&M Plan	\$ 7,020
Task 4 – Levee Certification Package Preparation	\$ 55,260
Total Project Labor	\$ 79,200
Travel	\$ -
Total FME cost	\$ 79,000

4F-9. Flood Management Strategy ID: 142000009

Name: Regulatory Review of Off-Road Traffic on State Lands.

Description: Coordination should take place between EPCWID No. 1, El Paso County, and State land owners to discuss enforcement of restrictions associated with off-road motor vehicles on undeveloped land.

Affected Jurisdictions: El Paso County

Description of Strategy

State Lands in El Paso County (EPC) have annual damages to their arid watersheds due to trespassing off-road motor vehicles. These all-terrain vehicles (ATVs) cause extensive damage to the fragile surficial ecosystem, notably through destruction of native vegetation and creation of surficial trails with exposed alluvial soils. These destruction compounds during flood events, when gulying leads to large volumes of sediment deposition at roads and drainage structures, exacerbating flood-related infrastructure damages.

Flood Management Strategy Scope of Work:

This FMS has the goal of developing data and alternative courses of action for assessing and reducing illegal ATV-induced damage to State Lands within EPC.

The SOW for this FMS is includes five tasks.

Task 1. Assessment of existing damages. This assessment will include:

Review of relevant records of stewards of State Lands within EPC and statewide.

Interviews with relevant staff within oversight agencies.

Identification via the above of priority areas to address.

GIS analysis following data collection and interviews to quantify rate of watershed damages within the priority areas. Historic high resolution images will be compared using images spanning over a decade to estimate rate of area disturbance. High density historic LIDAR data will be analyzed to estimate gully expansion within portions of priority areas, where data availability permits.

Task 2. Stakeholder meetings. Two meetings will be held with EPC public stakeholders impacted by increased sediment loads from Task 1 priority watersheds.

Meeting 1: Presentation of Task 1 results, definition of issue and workshop to develop potential alternatives and evaluation factors for alternative selection.

Meeting 2: Discussion of results of alternatives analyses and alternative(s) selection.

Task 3. Alternatives analyses. Qualitative estimates of alternative impacts on illegal ATV use per evaluation factors developed in Meeting 1.

Task 4. Public Education Program. A public education program will be developed that presents information developed in Tasks 1-3. Two public meetings will be held.

Task 5. Develop report. The report will include documentation of Tasks 1-4. Alternatives will be presented with actions defined per TWDB guidance as FMEs, FMSs, or as legislative/administrative changes per Task 8 of the RFP.

Task 6. Stakeholder Coordination.

Estimated Cost for FMS:

Labor Cost	
Task 1 – Assessment of existing damages	\$ 25,980
Task 2– Stakeholder Meetings	\$ 18,340
Task 3 – Alternatives Analyses	\$ 15,800
Task 4 - Public Education Program	\$ 12,500
Task 5 – Report	\$ 12,540
Task 6 – Stakeholder Coordination	\$ 8,400
Total Project Labor	\$ 93,560
Travel	\$ 500
Public meeting materials cost	\$ 5,000
Total FME cost	\$ 99,000

4F-10. Flood Management Strategy ID: 142000010

Name: Regulatory Review of Impervious Cover on New Development in El Paso County.

Description: Coordination should take place between EPCWID No. 1, El Paso County, and Texas GLO land owners to discuss revisions to development regulations associated with detention and impervious cover.

Affected Jurisdictions: El Paso County

Discussion on Flood Risk: There has been significant population, public infrastructure, and private infrastructure growth in El Paso County over the past two decades. There have been two historically extreme major floods (August 2006 and August 2021) during that period, each with extensive transportation disruptions and property damage. This experience demonstrates a need for review of existing local (city, county, water district) regulatory restrictions and design guidance associated with addition of impervious cover and associated design of detention/retention basins.

Flood Management Strategy Scope of Work:

This FMS has the goal of facilitating the developing of revisions to existing regulatory restrictions and design guidance associated with addition of impervious cover and associated design of detention/retention basins.

The SOW for this FMS is includes five tasks.

Task 1. Data collection. Recent construction costs will be reviewed and tabulated to provide a current basis for FMS alternatives cost estimates.

Task 2. Workshop to review existing regulatory restrictions and design guidance. The workshop will review and discuss current restrictions and guidance cited by City of El Paso (COEP), El Paso County (EPC), and El Paso County WID1 (EPCWID1). Attendees will include both public agencies (COEP, EPC, and EPCWID1) and representatives of the development community. Alternatives for the current restrictions and guidance will be discussed and selected for further evaluation. Costs per Task 1 will be reviewed. Potential impacts of each alternative to land development feasibility, developer infrastructure costs, and city/county maintenance costs will be tabulated. Impacts that can be quantified in terms of maintenance cost reduction, flood damage reduction, critical route access, and associated developer cost will be identified for study in Task 2.

Task 3. Alternatives analyses. Study on alternatives impacts will be performed per workshop consensus.

Task 4. Public Meeting. A public meeting will be held, using info derived from Tasks 1-2

Task 5. Develop report. The report will include documentation of Tasks 1-4. Alternatives will be presented with actions defined per TWDB guidance as FMEs, FMSs, or as legislative/administrative changes per Task 8 of the RFP. Impacts per Task 3 for each alternative will be presented. No selection of alternatives will be performed within the report.

Task 6. Stakeholder Coordination.

Estimated Cost for FMS:

Labor Cost	
Task 1 – Data collection	\$ 9,820
Task 2– Workshop to review existing regulatory restrictions and design guidance	\$ 18,340
Task 3 – Alternatives Analyses	\$ 11,660
Task 4 - Public Meeting	\$ 8,260
Task 5 – Report	\$ 8,740
Task 6 – Stakeholder Coordination	\$ 5,420
Total Project Labor	\$ 62,240
Travel	\$ 500
Public meeting materials cost	\$ 1,500
Total FME cost	\$ 64,000

4F-11. Flood Management Strategy ID: 142000013

Name: Staff augmentation support or funding for at risk communities to join and/or enforce the NFIP

Description: Prioritize and provide staff augmentation support or funding for at risk communities not currently participating in the NFIP or communities with limited resources to enforce the NFIP. Aid communities in implementing recommended minimum standards.

Affected Jurisdictions: Presidio County, Hudspeth County, Reeves County, Andrews County, Edwards County, Pecos County, Winkler County, City of Alpine, City of Sonora, City of Barstow, City of Kermit, City of Rankin, City of Thorntonville, Town of Valentine, City of Wickett, City of Wink

Discussion on Flood Risk: During several meetings of the RFPG, and during the June 16, 2022 RFPG Subcommittee 4 meeting (with Presidio County, Hudspeth County, Reeves County, City of Alpine and City of Sonora in attendance), jurisdictions within the large sparsely populated Flood Planning Area outside of El Paso County expressed a common major issue: lack of resources. This lack of ability to hire and fund qualified staff is a primary reason for the lack of focus on local floodplain management, flood mitigation planning, and implementation of flood mitigation measures. Specific shortfalls in these areas include:

For floodplain management: lack of qualified staff/ training for administration of the National Flood Insurance Program (NFIP), lack of funding for badly needed new floodplain maps, lack of training of staff in development and technical oversight of local drainage design criteria for new development, lack of resource for education of local populace in importance of floodplain management.

For flood mitigation planning: lack of funding for strategic growth plan essential for planning future drainage infrastructure, lack of training of staff in FEMA disaster programs (e.g., post-disaster Public Assistance), lack of funding for storm water master planning, lack of resources for education of local populace in importance of storm water master planning.

For flood mitigation implementation: lack of training in USACE Section 404 permitting of channel maintenance, lack of training in selection of grant opportunities across the full spectrum of available grants, lack of technical support for the associated grant application data requirements and processes, lack of resources for education of local populace in importance of implementation of priority flood mitigation actions.

One consensus partial solution to the above issues is to establish a Flood Planning Region-wide staff resource that the small population jurisdictions can access as needed. This strategy develops such a solution.

Flood Management Strategy Scope of Work:

This FMS has the goal of establishing a Flood Planning Region-wide staff resource that the small population jurisdictions can access as needed to address wide-ranging needs associated with

flood mitigation. The RFPG will request that this part time position be funded out of the TWDB regional allocation for state-sponsored flood mitigation planning.

The SOW for this FMS includes two tasks.

Task 1. Definition of a part-time position at the Rio Grande Council of Governments to support small population jurisdictions as needed to improve floodplain management, flood mitigation planning, and flood mitigation implementation within the full Upper Rio Grande Flood Planning Region. This position definition will include:

Requirements for education and experience. This position is not expected to have an engineering education, but will be expected to have GIS skills.

Required training to be undertaken once hired, to include training costs (estimated for this FMS as \$30,000)

A list of support activities (derived from the strategy definition above) to be provided

An estimate of hours per year and cost per year required for providing support.

Task 2. Preparation of Regional Interactive GIS Maps. This task will include loading selected GIS layers from the Regional Flood Plan into ArcGIS Online to be available for use as needed by regional jurisdictions. The part time staff that is the focus of Task 1 will be available to aid local jurisdictions with use of these GIS layers.

- Existing Flood Hazard
- Existing Flood Hazard Gaps
- Existing Flood Exposure/Vulnerability
- Future Flood Hazard
- Future Flood Hazard Gaps
- Future Flood Exposure/Vulnerability
- Availability of H&H Models

Task 3. Stakeholder Coordination

Estimated Cost for FMS:

Labor Cost	
Task 1 – Definition of new partial position at RGCOG	\$ 32,000
Task 2– Uploading of Regional GIS Maps to Online Service	\$ 8,000
Task 3– Stakeholder Coordination	\$ 2,000
Total Project	\$ 42,000
Fees to upload data (one time cost)	\$ 2,000
Total FMS cost	\$ 44,000
Recurring Costs (per year)	
Cost of partial staff position at COG	TBD
Fees to ArcGIS Online (Subscription plus hosting)	\$ 700

4F-12. Flood Management Strategy ID: 142000014

Name: Develop new flood gages throughout the region.

Description: Prioritize, fund, and develop new flood gages (rainfall and/or stream gages) throughout the region to support flood warning system improvements and improve ability to validate or calibrate existing and new flood models

Affected Jurisdictions: All of Region 14

Discussion on Flood Risk: Across Flood Planning Region 14 there is a growing need for flood gages that can improve real-time flood alert systems or enhance existing or future flood forecast models. This strategy proposes installing 12 flood gages by using a prioritization process for identifying optimal gage locations, and the development of a simple flood alert system for notifying key emergency personnel. This SOW provides a tailored approach for the Upper Rio Grande Basin, with key aspects that have been used previously for enhancing flood forecast capabilities by the Texas Water Development Board (TWDB) and TxDOT.

Flood Management Strategy Scope of Work:

The preliminary SOW for this project is summarized in five general tasks described below.

Task 1 – Stakeholder Engagement. One in person and up to three virtual meetings with key project stakeholders, such as the flood planning group, will be held throughout the project process to describe the proposed site location prioritization process, solicit feedback on preliminary gage locations, and flood alert or forecasting needs. Stakeholder understanding and contribution will ensure the project's goals are being fully represented and achieved.

Meetings will also be used to better understand long-term objectives for these gage data, such as integrated real-time flood forecasting capabilities or more simplified and easier to maintain flood alert systems. Stakeholder meetings will present opportunities to review and refine the preliminary scope, which will allow the project team to integrate stakeholder knowledge and input across the entire life of the project.

Task 2 – Data Collection and Prioritization. With 10-12 new streamgages being proposed for installation, a framework is necessary to identify and prioritize locations across the flood planning region that will best enhance existing flood warning systems or at locations that have the greatest overall need for flood alerts or forecasting. A site selection process such as the analytic hierarchy process (AHP) is proposed herein, and will provide an objective and defensible process for ranking and recommending streamgage locations. Since its introduction in the 1980s by Saaty, AHP has been applied in a wide variety of settings to model complex decisions and excels at quantitatively ranking decision alternatives, including geospatially.

In 2016 AHP was used in a Texas Water Development Board (TWDB) study, which identified communities with the most pressing need for streamgages for improved flood forecasting services. The TWDB study worked closely with the NWS and USGS in identifying new

streamgage locations and increasing the forecasting accuracy of the NWS Advanced Hydrologic Prediction Service (AHPS). As part of an ongoing TxDOT Project, AHP was utilized to rank 60 new streamgage locations based on vulnerable bridges susceptible to overtopping and sustaining flood and economic damages.

Applicable datasets will be identified and integrated in the AHP for ranking streamgage locations. Each dataset would have a weight, or ranking, compared to other utilized datasets, allowing the project team to decide which data are the most important factors. While dataset are anticipated to be reviewed and selected during the project and through careful consultation with stakeholders, some example datasets that could be utilized are as follows:

Flood fatalities: regions with increased fatalities due to flooding, such as vehicle related

Bridge/Roadway flooding: bridges that have been closed due to flooding or flood damage.

National Flood Insurance Program claim payment data: regions with high levels of flood claim payments, such as high repetitive losses or frequency of flooding.

Recent Fathom Floodplain mapping data: these recently completed data products provide a detailed floodplain map and water level depths in areas previously unrepresented in traditional FEMA maps.

Terrain Slope: regions with higher slope have the potential for increased flash flood risk.

EPA's Environmental Justice Map Data: identify regions with populations more vulnerable to flooding risks and flood impacts.

Task 3 – Site Investigation and Gage Equipment Review. Once a final ranking of gage locations are provided, a further site review to assess the feasibility of a streamgage installation and operation will be conducted. Virtual visits using aerial photography, or even street view photos, will be used to conduct a preliminary site review and reduce the need for physical visits. Many streamgage locations initially ranked through the prioritization process may not be practically feasible due to a number of reasons, including inaccessible location, or other installation or operation and maintenance limitations.

With a large number of gage locations anticipated to be identified at low water crossings or even culverts, a variety of water level monitoring technology will need to be considered. Beyond the traditional streamgage, which uses a pressure transducer to measure water levels, other approaches that will be considered include radar or doppler technology.

Another important component of a gage is its ability to transmit collected data for integration into a flood alert system or forecast model. Data transmission should occur in real-time and can utilize cell, VHF radio, or satellite technology. A variety of options and considerations, such as ongoing operational and maintenance needs, can be discussed during the stakeholder engagement process of this project.

Task 4 – Streamgage Equipment and Installation. Once feasible gage sites and a streamgage type have been identified, gage installation can occur. In addition to necessary equipment, installation will require permitting and approval from the appropriate governing authorities.

Task 5 – Flood Alert System. Flood gages transmitting data will require data storage and management, and to use these data to implement an alert system to notify key emergency personnel when flooding is occurring or water levels have reached a critical level. These systems can range from relatively simple emails, website notifications and visual interfaces, to more complicated system-wide forecasting approaches. Some equipment suppliers offer integrated alert systems and software with associated annual usage fees. For this proposal a simple flood alert system is budgeted, which aims to reduce annual software fees.

Task 6 – Stakeholder Coordination and Reporting. A project manager will oversee the project. A report will also be written, summarizing the project’s methodology, site prioritization process, installed and implemented streamgages, the data management system, and any implemented alert system. A staff training on system operations and maintenance, along with an operations manual, will ensure project continuity and long-term success.

Estimated Cost for FMS:

The total estimated fixed project cost for this FMS is \$240,000, with a task and equipment cost breakdown provided below. Annual operation and maintenance costs are estimated at \$7,000. Alternative flood alert system proprietary software costs can also be explored but will likely cost more than estimated in the second cost stable shown below.

Estimate of Fixed Strategy Costs					
Task	Labor Cost	Travel Costs	Equipment Cost	Estimate of Total Cost	Notes
Task 1 - Stakeholder Engagement	\$ 5,165	\$ 690		\$ 5,855	Three stakeholder meetings, 1 in-person in El Paso, 2 virtual
Task 2 - Data Collection and Prioritization	\$ 8,100			\$ 8,100	
Task 3 - Site Investigation and Gage Equipment Review	\$ 11,200	\$1,997		\$ 13,197	
Task 4 - Streamgage Equipment and Installation	\$ 24,640	\$5,434	\$ 168,000	\$ 198,074	Equipment estimated at \$14,000 per gage site
Task 5 - Real-time Monitoring and Alert System	\$ 10,125			\$ 10,125	Simple flood alert notification system developed by Aqua Strategies
Task 6 - Stakeholder Coordination and Reporting	\$ 4,600			\$ 4,600	
Total	\$ 63,830	\$8,121	\$ 168,000	\$ 240,000	

Estimate of Recurring Annual Strategy Costs			
Annual O&M Costs	Labor Cost	Travel Costs	Annual O&M Total Cost Estimate
Annual site/maintenance visit for 1 staff	\$ 3,240	\$ 2,477	\$ 5,717
Simple Flood Alert Notification/System Maintenance	\$ 980		\$ 980
Total Recurring Costs (Annually)	\$ 4,220	\$ 2,477	\$ 7,000

4F-13. Flood Management Strategy ID: 142000015

Name: Develop and design standard options for addressing identified development-related flooding in El Paso.

Description: Evaluate COEP and EPC drainage design standards for inlets, curb cuts, requirements for on-site storage in new developments, addressing as-built elevations, protecting remaining on-site storage and recovering original storage for existing developments.

Affected Jurisdictions: El Paso County

Discussion on Flood Risk: There has been significant population, public infrastructure, and private infrastructure growth in El Paso County over the past two decades. There have been two historically extreme major floods (August 2006 and August 2021) during that period, each with extensive transportation disruptions and property damage. Local agency experience in two events were discussed in an URGFPG meeting in November, 2021. This expressed experience identified a need for review of existing local (city, county, water district) design requirements for specific types of drainage structures. These structures include 1) storm drain system inlets across the El Paso County environment. Issues include a) inlet capacity on steep slopes, b) addressing risk of sediment blockage, and c) addressing discharge into irrigation drains. Other structures for technical design requirement review include 2) curb cuts into off-channel detention and 3) on-site detention for individual residential structures.

Flood Management Strategy Scope of Work:

This FMS involves coordination between El Paso Water, El Paso County, and EPCWID1 with the goal of facilitating the developing of revisions to existing design guidance for storm drain inlets, curb cuts, and on-site detention.

The SOW for this FMS is includes five tasks.

Task 1. Reference review. Current design guidance will be reviewed versus current technical studies associated with inlets on steep slopes, protection of inlets from sediment blockage, discharge from developments into existing flood channels, rating curves (flow versus depth) of curb cuts, and effectiveness of on-site detention. Interviews will also be held with City of El Paso, El Paso County, and El Paso County Water Improvement District No 1 to document agency history with current design standards addressing these issues.

Task 2. Workshop to review existing design guidance. The workshop will review and discuss current design guidance issued by City of El Paso (COEP), El Paso County (EPC), and El Paso County WID1 (EPCWID1) for the above issues. Attendees will include both public agencies (COEP, EPC, and EPCWID1) and representatives of the development community. Technical recommendations will be presented for improvement of the existing design guidance, with associated technical justification. Issues to address via further technical study will be identified.

Task 3: Issues analyses. Study of outstanding issues will be performed per workshop consensus.

Task 4. Develop report. The report will include documentation of Tasks 1-3. Technical recommendations for revised design standards will be provided for each of the issues associated with this FMS.

Task 5. Stakeholder Coordination.

Estimated Cost for FMS:

Labor Cost	
Task 1 – Reference Review	\$ 14,060
Task 2– Workshop to review existing design guidance	\$ 6,900
Task 3 – Issues Analyses	\$ 5,300
Task 4 – Report	\$ 5,380
Task 5 – Stakeholder Coordination	\$ 3,040
Total Project Labor	\$ 34,680
Travel	\$ -
Total FME cost	\$ 35,000

4F-14. Flood Management Strategy ID: 142000016

Name: Develop regional solutions to address erosion issues in natural channels affecting stormwater conveyance.

Description: Develop consensus region-specific erosion-resistant designs to prevent removal of material from drainage conveyances, with functional comparisons to aid selection of best practices.

Affected Jurisdictions: All of Region 14

Discussion on Flood Risk: In the arid URGFPR, unlined, broad natural channels (e.g., arroyos) convey a significant portion of the flood waters that impact structures (buildings, roads) in the region. Arroyos potentially also convey a high volume of sediment/ debris during floods which can greatly add to the damage of these structures. The sediment deposition leads to high post-flood maintenance/ clean-up costs that can be a significant financial burden on regional cities and counties. This Regional Flood Plan has a Flood Management Evaluation (FME ID: 141000015) that estimates sediment loadings from floods in selected arroyos in El Paso County, and presents a refined method to estimate relative production of sediment in arroyos throughout the region. This FMS follows that FME and is focused on 1) developing structural and non-structural solutions to reduce sediment loadings from arroyos (using an arroyo identified in FME 141000015 as an example), and 2) generalizing the strategies and technical methods suggested for this arroyo for application throughout the region. This strategy is focused on arroyos in general within the region. FME 141000015 is focused more specifically on arroyo-related issues in the El Paso area.

The solutions to be developed as part of this FMS are expected to incorporate the recent experience of the Rio Grande Joint Venture (RGJV). At Alamito Creek Preserve, Rio Grande Joint Venture has installed a dozen loose rock structures and road aprons along with high density large woody debris structures. In Cienega Creek, brush-weir structures at Las Cienegas were installed. The RGJV plans to install Beaver Dam Analogs adjacent to the other structures and scale up these types of streamflow harvesting and groundwater recharge techniques.

Flood Management Strategy Scope of Work:

This FMS has the goal of developing regional solutions to address erosion issues in natural channels affecting stormwater conveyance. These solutions will be designed to meet state-wide and RFPG stated goals to serve multiple purposes: reduce erosion, preserve/ enhance the natural environment, promote water conservation, etc.

The SOW for this FMS includes five tasks.

Task 1. Reference review. Current publicly available design guidance issued/ in use by regional (Texas and New Mexico) natural resource management agencies for erosion mitigation will be collected and reviewed. Each potential erosion mitigation action (and its associated design) will be classified as to relevance for application to the conditions present in the URGRFPA.

Where feasible, watersheds where relevant practices have been employed will be investigated to ascertain relative success in serving the defined RFGP multiple goals.

Task 2. Workshop to review relevant potential erosion mitigation actions. The workshop will review and discuss potential erosion mitigation actions deemed relevant for consideration in the URGRFPA. Invitees to the workshop will be determined by the RFGP. Alternative actions presented will include qualitative technical evaluations as to 1) limitation on applicability within the region, 2) relative benefits in meeting each of the multiple goals, 3) costs of implementation, and 4) costs of maintaining benefits. Issues to address via further technical study for each potential action will be identified. A regional arroyo will be chosen for development of example designs.

Task 3: Issues analyses and sample designs. Study of outstanding issues will be performed per workshop consensus. Develop example designs for a selected regional arroyo.

Task 4. Develop report. The report will include documentation of Tasks 1-3. Technical recommendations for design standards will be provided for each of the potential mitigation actions identified with this FMS. Individual action design guidance will generally consist of 1) appropriate site conditions for action application, 2) a reference to existing design guidance (available for download from a public source), 3) a list of the issues identified in Task 2 and their resolution via Task 3, and 4) a qualitative relative cost.

Task 5. Stakeholder Coordination.

Estimated Cost for FMS:

Labor Cost	
Task 1 – Reference Review	\$ 14,060
Task 2– Workshop to review relevant potential erosion mitigation actions	\$ 8,740
Task 3 – Issues Analyses and Sample Designs	\$ 21,400
Task 4 – Report	\$ 7,540
Task 5 – Stakeholder Coordination	\$ 5,120
Total Project Labor	\$ 56,860
Travel	\$ -
Total FME cost	\$ 57,000

4F-15. Flood Management Strategy ID: 142000017

Name: Develop solutions to address city/county stormwater conveyance into the Rio Grande (El Paso County).

Description: Refine agency action coordination in conveyance of interior flooding to the Rio Grande. Develop FMP designs and costs for improvements of conveyance from river terrace storm water infrastructure, considering high ground water.

Affected Jurisdictions: City of El Paso, El Paso County

Discussion on Flood Risk: The City and County of El Paso have 79 outfalls of storm water into the Rio Grande, identified and tabulated in the Interior Drainage Study performed as part of the Rio Grande levee certification process. Ten of these outfalls are associated with pump stations, the remainder drain via gravity into the river. Because of the extreme flat slopes of the river terrace adjacent to the river, when these outfalls fail to properly function (due to blockage or partial blockage by river sedimentation) there can be extensive localized flooding occurring until the flows can be conveyed into the river (by opening the planned outlet, or conveyance to the next outlet). A study recommended by the RFPG, FME ID: 14000018 identifies site for new outfalls and prioritizes existing outfalls for consideration for improvement. This FMS provides concept level designs and costs to install new outfall(s) and improve the existing priority outfalls. In addition, non-structural measures (e.g., improved interagency coordination, early warning planning) will be developed to improve stormwater conveyance into the Rio Grande as part of this FMS.

Flood Management Strategy Scope of Work:

This FMS has the goal of developing structural and non-structural solutions for improvement of conveyance of stormwater into the Rio Grande in El Paso County. This FMS is necessarily preceded by an evaluation of the existing system per the SOW presented in FME 14000018.

The SOW for this FMS includes five tasks.

Task 1. Alternatives Development. For each priority outfall (assumed 5), an alternative will be developed to prevent localized flood damage due to the 1% AC flood, for each of these scenarios

Rio Grande at normal operational stage;

Rio Grande at intermediate flood stage (to be determined by the RFPG); and

Rio Grande at 2% AC flood sage (or alternate level to be determined by the RFPG).

Solutions may include conduit upsizing, addition of a new pump/ expanded pump capacity, addition of detention. Rough order of magnitude coasts will be developed for each outfall and scenario.

Non-structural solutions to be developed will include potential actions to improve system operation/ interagency coordination; and actions to improve early warning, if needed.

Task 2. Workshop to review initial alternatives. The workshop will review and discuss the conceptual designs developed as part of Task 1. The goals of the workshop will be to:

For each outfall addressed:

- Select a scenario to use as a design criteria
- Identify potential improvements for the design for the selected scenario
- Identify issues to address in conversion to a FMP

Review scopes of work (SOWs) for non-structural improvements and:

- Edit per workshop consensus

Task 3: Define a FMP and FMS to improve outfall performance. The concept designs selected for each priority outfall will be refined and aggregated as two FMPs (one for the aggregate City outfalls, one for the aggregate county outfalls). FMPs will conform to TWDB guidance. The SOWs for non-structural solutions will be combined into a single FMS. Agencies expected to be involved in the proposed development of interagency flood and emergency planning concerning Rio Grande discharges will review this FMS. A meeting will be held to achieve consensus on the SOW among planning participants.

Task 4. Develop report. The report will include documentation of Tasks 1-3.

Task 5. Stakeholder Coordination.

Estimated Cost for FMS:

Labor Cost	
Task 1 – Alternatives Development	\$ 30,300
Task 2– Workshop to review initial alternatives	\$ 11,140
Task 3 – Define a FMP and FMS to improve outfall performance	\$ 38,000
Task 4 – Report	\$ 10,580
Task 5 – Stakeholder Coordination	\$ 9,040
Total Project Labor	\$ 99,060
Travel	\$ -
Total FME cost	\$ 99,000

4F-16. Flood Management Strategy ID: 142000019

Name: Initiate program to develop integrated solutions to improve irrigation system/
stormwater conveyance system interaction in El Paso area.

Description: Initiate program to develop integrated solutions to improve irrigation system/
stormwater conveyance system interaction in El Paso area.

Affected Jurisdictions: El Paso County

Discussion on Flood Risk: Historically, river water has been conveyed from the Rio Grande (via diversion at American Dam) via canals into the riverine terrace adjacent to the Rio Grande. These canals are necessarily at an elevation above the agricultural fields. Farmers divert water via gravity flow from the canals into their fields. The flow from the fields is collected in drains (e.g., Mesa Drain), conveyed to wasteways where the water is eventually discharged back into the Rio Grande. These linear structures (canals, drains, wasteways) are operated and maintained by EPCWID1. The Playa Drain, maintained by COEP is an exception. These structures necessarily interact with stormwater and divert and concentrate stormwater into the same wasteways. The historic agricultural operations have been progressively replaced within El Paso County by urban area, and in some areas of the city and county the agricultural drain system is the primary conveyor of urban stormwater. The purpose of this strategy is to enhance the existing active cooperation between EPCWID1, El Paso Water, and El Paso County by developing a storm water-focused report for the canal/ drain/ wasteway system developed jointly by the three entities (and other Regional Flood Plan-defined stakeholders). The report will provide recommendations addressing identified needs for multi-agency administrative and regulatory action for improved storm water conveyance. Identifications of FMPs for system improvements are addressed by FME 141000004 (Mesa Drain improvements) and FME 141000019 (Montoya Drain Improvements) and are not addressed by this FMS.

Flood Management Strategy Scope of Work:

This FMS will identify relevant issues involving administrative (e.g., development permitting) and regulatory actions associated with stormwater conveyance into the Rio Grande via the drains and wasteways operated and maintained by EPCWID1 and COEP. Recommendations will be developed to address those issues.

The SOW for this FMS is includes five tasks.

Task 1. Data Collection. A map will be developed using existing models and agency datasets displaying: 1) city and county jurisdictional boundaries, 2) system elements: canals, drains, wasteways, 3) watershed areas tributary to historic agricultural drains, 4) locations of permitted storm water connections into drains, 5) system gates/ controls, and 6) crossings/ siphons under canals. This map will be prepared in such a way that stakeholders can annotate the map with issues as appropriate. The map will be provided to the sponsors prior to the kickoff meeting.

Task 2. Project scoping and Kickoff Meeting. The sponsors (EPCWID1, EPW, and EPC) will invite other stakeholders representing multipurpose issues (environment, water supply) as appropriate. This kickoff meeting will be a workshop where issues associated with the use of the irrigation system for stormwater conveyance are identified and physically located (if appropriate) on the map developed in Task 1. The deliverable from the meeting will be a list of action items for meeting participants (sponsors, stakeholders, technical consultants). These action items are to be addressed prior to Task 4.

Task 3: Issues analyses. Action items to be performed by the project technical consultant will be performed.

Task 4. Workshop to Define/Address Future Action. A second workshop will be held where sponsors, stakeholders and the technical consultant present their resolution of the action items raised in Task 2. Issues associated with action items will be defined as resolved or deferred for future action. The final deliverable for the FMS will be a summary of the issues, action items, and resolution from this workshop.

Task 5. Stakeholder Coordination.

Estimated Cost for FMS:

Labor Cost	
Task 1 – Data Collection	\$ 4,860
Task 2– Kickoff meeting	\$ 2,850
Task 3 – Issues Analyses	\$ 6,460
Task 4 –Workshop to Address Future Action	\$ 4,530
Task 5 – Stakeholder Coordination	\$ 1,890
Total Project Labor	\$ 20,590
Travel	\$ -
Total FME cost	\$ 21,000

4F-17. Flood Management Strategy IDs: 142000020

Name: Develop and Improve Early Warning System (EWS) for El Paso City/ County interior drainage

Description: Conduct study to evaluate and proposed improvements to Early Warning Systems (EWSs) for interior drainage in El Paso City and El Paso County. Includes assessment of existing flood EWS.

Affected Jurisdictions: City of El Paso, El Paso County

Discussion on Flood Risk: While the City of El Paso has an existing flood warning system in place for both the Rio Grande and interior flooding, there are varying warning times that can be provided from meteorologists associated with providing those warnings. This strategy aims to improve the existing Early Warning System in the City of El Paso County and El Paso County.

Flood Management Strategy Scope of Work:

A proposal prepared by aem and Vieux & Associates (July 2022) for the purposes of the Regional Flood Plan is attached, which describes the SOW and costs associated with this strategy.

Estimated Cost for FMS:

The attached bid estimate prepared by aem and Vieux & Associates (July 2022) includes two options (specified as Level 1 and Level 2 in the proposal) with varying fixed and recurring costs. The equipment/construction costs were adjusted from July 2022 dollars to September 2020 dollars using the Construction Cost Index, while the non-construction costs associated with services, installation, and training were converted to September 2020 dollars using the Consumer Price Index. The fixed and recurring costs for each option are provided in the following two cost tables.

Total FMS Cost - Level 1 Option	
Subtotal 1.1 – Vieux/aem Construction/Equipment Cost (July. 2022)	\$ 17,389
Subtotal 1.2 – RFP Construction/Equipment Cost (September 2020, using CCI)	\$ 15,000
RFP Total Construction/Equipment Cost (Sept. 2020)	\$ 15,000
Subtotal 1.3 – Vieux/aem Services/Installation Cost (July 2022)	\$ 107,420
Subtotal 1.4 - RFP Services/Installation Cost (September 2020, using CPI)	\$ 94,906
RFP Total Non-Construction Cost (September 2020, using CPI)	\$ 95,000
Total Fixed FMS Cost	\$ 110,000
Total Recurring FMS Cost (Annually)	\$ 30,000

Total FMS Cost - Level 2 Option	
Subtotal 2.1 – View/aem Construction/Equipment Cost (July. 2022)	\$ 5,000
Subtotal 2.2 – RFP Construction/Equipment Cost (September 2020, using CCI)	\$ 4,000
RFP Total Construction/Equipment Cost (Sept. 2020)	\$ 4,000
Subtotal 2.3 – View/aem Services/Installation Cost (July 2022)	\$ -
Subtotal 2.4 - RFP Services/Installation Cost (September 2020, using CPI)	\$ -
RFP Total Non-Construction Cost (September 2020, using CPI)	\$ -
Total Fixed FMS Cost	\$ 4,000
Total Recurring FMS Cost (Annually)	\$ 108,000

4F-18. Flood Management Strategy IDs: 142000021

Name: Develop and Improve Early Warning System for City of Pecos

Description: Conduct study to evaluate and propose improvements to Early Warning Systems (EWSs) for City of Pecos and adjacent Lindsay Census Designated Place (CDP). Includes assessment of existing flood EWS.

Affected Jurisdictions: City of Pecos, Lindsay CDP, Reeves County

Discussion on Flood Risk: The City of Pecos incorporated area is located adjacent and to the north of Lindsay CDP, in Reeves County. For the 1% AC flood, per mapping performed for the Regional Flood Plan, the floodplain potentially causes damage to over 1,900 structures and restricts travel. Extent of 1% AC flood risk is depicted in Map 15, Map 3 of 31. This strategy aims to develop an Early Warning System for the City of Pecos and improve Reeves County Emergency Management warning times for road closures and evacuations.

Flood Management Strategy Scope of Work:

A proposal prepared by aem and Vieux & Associates (July 2022) for the purposes of the Regional Flood Plan is attached, which describes the SOW and costs associated with this strategy.

Estimated Cost for FMS:

The attached bid estimate prepared by aem and Vieux & Associates (July 2022) includes both fixed and recurring costs. The equipment/construction costs were adjusted from July 2022 dollars to September 2020 dollars using the Construction Cost Index, while the non-construction costs associated with services and installation were converted to September 2020 dollars using the Consumer Price Index. The fixed and recurring costs for each option are provided in the following cost table.

Total FMS Cost	
Subtotal 1.1 – Vieux/aem Construction/Equipment Cost (July. 2022)	\$ 1,060
Subtotal 1.2 – RFP Construction/Equipment Cost (September 2020, using CCI)	\$ 926
RFP Total Construction/Equipment Cost (Sept. 2020)	\$ 1,000
Subtotal 1.3 – Vieux/aem Services/Installation Cost (July 2022)	\$ 41,580
Subtotal 1.4 - RFP Services/Installation Cost (September 2020, using CPI)	\$ 36,736
RFP Total Non-Construction Cost (September 2020, using CPI)	\$ 37,000
Total Fixed FMS Cost	\$ 38,000
Total Recurring FMS Cost (Annually)	\$ 12,000

4F-19. Flood Management Strategy IDs: 142000022

Name: Develop and Improve Early Warning System for City of Alpine

Description: Conduct study to evaluate and propose improvements to Early Warning Systems (EWSs) for City of Alpine. Includes assessment of existing flood EWS.

Affected Jurisdictions: City of Alpine, Brewster County

Discussion on Flood Risk: The City of Alpine is an incorporated area in Brewster County. Three named creeks traverse the City of Alpine: Paisano Creek and Alpine Creek (combined watershed of 56.2 sq mi) and Moss Creek (watershed of 29.5 sq mi). Per modeling performed as part of Task 2 of the Regional Flood Plan, over 1,600 structures within the city are estimated to be potentially impacted during the 1% Annual Chance (100-year) flood. Map 15, Map 4 of 31 depicts this risk. This strategy aims to develop an Early Warning System for the City of Alpine and improve Brewster County Emergency Management warning times for road closures and evacuations.

Flood Management Strategy Scope of Work:

A proposal prepared by aem and Vieux & Associates (July 2022) for the purposes of the Regional Flood Plan is attached, which describes the SOW and costs associated with this strategy.

Estimated Cost for FMS:

The attached bid estimate prepared by aem and Vieux & Associates (July 2022) includes both fixed and recurring costs. The equipment/construction costs were adjusted from July 2022 dollars to September 2020 dollars using the Construction Cost Index, while the non-construction costs associated with services and installation were converted to September 2020 dollars using the Consumer Price Index. The fixed and recurring costs for each option are provided in the following cost table.

Total FMS Cost	
Subtotal 1.1 – Vieux/aem Construction/Equipment Cost (July, 2022)	\$ 1,060
Subtotal 1.2 – RFP Construction/Equipment Cost (September 2020, using CCI)	\$ 926
RFP Total Construction/Equipment Cost (Sept. 2020)	\$ 1,000
Subtotal 1.3 – Vieux/aem Services/Installation Cost (July 2022)	\$ 41,580
Subtotal 1.4 - RFP Services/Installation Cost (September 2020, using CPI)	\$ 36,736
RFP Total Non-Construction Cost (September 2020, using CPI)	\$ 37,000
Total Fixed FMS Cost	\$ 38,000
Total Recurring FMS Cost (Annually)	\$ 12,000

4F-20. Flood Management Strategy IDs: 142000023

Name: Develop and Improve Early Warning System for City of Presidio, Presidio County

Description: Identify and design access routes and bridges/culverts to provide emergency access during extreme flood events in the City of Presidio.

Affected Jurisdictions: City of Presidio, Presidio County

Discussion on Flood Risk: The City of Presidio is an incorporated area in Presidio County, and is subject to flooding from the confluences of several large creeks with the Rio Grande (Cibolo Creek, Alamito Creek, Terneros Creek), as well as potential flooding from the Rio Conchos confluence with the Rio Grande. Approximate modeling performed as a task for the Regional Flood Plan identified over 650 structures at risk in the 1% AC flood within City of Presidio, assuming the Cibolo Creek and Rio Grande levees (which are not accredited by FEMA) are absent. Extent of 1% AC flood risk is depicted in Map 15, Map 1 of 31.

Presidio does not have a meteorologist dedicated to early flood warnings for the county, and they share information with Jeff Davis (upstream watershed) based off National Weather Service flood warnings. Per Presidio County Emergency Management, the County can check online gage monitors and notify the public through a reverse 911 system. The County also coordinates with the USIBWC on flood warning related to the Rio Grande. This strategy aims to develop an Early Warning System for the City of Presidio and improve Presidio County Emergency Management warning times for road closures and evacuations.

Flood Management Strategy Scope of Work:

A proposal prepared by aem and Vieux & Associates (July 2022) for the purposes of the Regional Flood Plan is attached, which describes the SOW and costs associated with this strategy.

Estimated Cost for FMS:

The attached bid estimate prepared by aem and Vieux & Associates (July 2022) includes both fixed and recurring costs. The equipment/construction costs were adjusted from July 2022 dollars to September 2020 dollars using the Construction Cost Index, while the non-construction costs associated with services and installation were converted to September 2020 dollars using the Consumer Price Index. The fixed and recurring costs for each option are provided in the following cost table.

Total FMS Cost	
Subtotal 1.1 – View/aem Construction/Equipment Cost (July. 2022)	\$ 1,060
Subtotal 1.2 – RFP Construction/Equipment Cost (September 2020, using CCI)	\$ 926
RFP Total Construction/Equipment Cost (Sept. 2020)	\$ 1,000
Subtotal 1.3 – View/aem Services/Installation Cost (July 2022)	\$ 41,580
Subtotal 1.4 - RFP Services/Installation Cost (September 2020, using CPI)	\$ 36,736
RFP Total Non-Construction Cost (September 2020, using CPI)	\$ 37,000
Total Fixed FMS Cost	\$ 38,000
Total Recurring FMS Cost (Annually)	\$ 12,000

4F-21. Flood Management Strategy IDs: 142000024

Name: Develop and Improve Early Warning System for City of Fort Stockton

Description: Conduct study to evaluate and propose improvements to Early Warning Systems (EWSs) for City of Fort Stockton. Includes assessment of existing flood EWS.

Affected Jurisdictions: City of Fort Stockton, Pecos County

Discussion on Flood Risk: The City of Fort Stockton is an incorporated area in Pecos County. Best available floodplain mapping in the area identified over 160 structures at risk in the 1% AC flood within Fort Stockton. Extent of 1% AC flood risk is depicted in Map 15, Map 26 of 31. In addition, Comanche Creek Dam has been identified by the Texas Commission on Environmental Quality (TCEQ) as being in poor condition and hydraulically inadequate. This strategy aims to develop an Early Warning System for the City of Fort Stockton and improve Pecos County Emergency Management warning times for road closures and evacuations.

Flood Management Strategy Scope of Work:

A proposal prepared by aem and Vieux & Associates (July 2022) for the purposes of the Regional Flood Plan is attached, which describes the SOW and costs associated with this strategy.

Estimated Cost for FMS:

The attached bid estimate prepared by aem and Vieux & Associates (July 2022) includes both fixed and recurring costs. The equipment/construction costs were adjusted from July 2022 dollars to September 2020 dollars using the Construction Cost Index, while the non-construction costs associated with services and installation were converted to September 2020 dollars using the Consumer Price Index. The fixed and recurring costs for each option are provided in the following cost table.

Total FMS Cost	
Subtotal 1.1 – Vieux/aem Construction/Equipment Cost (July. 2022)	\$ 1,060
Subtotal 1.2 – RFP Construction/Equipment Cost (September 2020, using CCI)	\$ 926
RFP Total Construction/Equipment Cost (Sept. 2020)	\$ 1,000
Subtotal 1.3 – Vieux/aem Services/Installation Cost (July 2022)	\$ 41,580
Subtotal 1.4 - RFP Services/Installation Cost (September 2020, using CPI)	\$ 36,736
RFP Total Non-Construction Cost (September 2020, using CPI)	\$ 37,000
Total Fixed FMS Cost	\$ 38,000
Total Recurring FMS Cost (Annually)	\$ 12,000

4F-22. Flood Management Strategy IDs: 142000025

Name: Develop and Improve Early Warning System for City of Marfa, Presidio County.

Description: Identify and design access routes and bridges/culverts to provide emergency access during extreme flood events in Marfa. Southeast Marfa and dirt portion of FM 2810 were identified as problem areas by Presidio County Office of Emergency Management.

Affected Jurisdictions: City of Marfa, Presidio County

Discussion on Flood Risk: The City of Marfa is an incorporated area in Presidio County. On June 28, 2021, a car was swept away while attempting to pass the Alamito Creek low water crossing (LWC) at Neville Street in Marfa, Texas, resulting in the death of the driver. A non-structural FMP is proposed (FMP ID: 143000007) in the Regional Flood Plan to add flood gates to four low water crossings in Marfa and install an upstream flood gage at the Highway 17 crossing of North Alamito Creek. While the FMP would prevent drivers from crossing LWCs during floods, and the upstream gage would provide additional warning time for Emergency Management to deploy, a more robust Early Warning System could provide even more warning time and aid in preparing for evacuations, if needed. This strategy aims to develop an Early Warning System for the City of Marfa and improve Presidio County Emergency Management warning times for road closures and evacuations.

Flood Management Strategy Scope of Work:

A proposal prepared by aem and Vieux & Associates (July 2022) for the purposes of the Regional Flood Plan is attached, which describes the SOW and costs associated with this strategy. While the FMP ID: 143000007 also affects early warning in the City of Marfa, the FMP does not require recurring costs, and this FMS includes a system that does have recurring costs. While this FMS would supplement early warning times associated with the FMP, it is not required to be implemented before or after this FMP is constructed.

Estimated Cost for FMS:

The attached bid estimate prepared by aem and Vieux & Associates (July 2022) includes both fixed and recurring costs. The equipment/construction costs were adjusted from July 2022 dollars to September 2020 dollars using the Construction Cost Index, while the non-construction costs associated with services and installation were converted to September 2020 dollars using the Consumer Price Index. The fixed and recurring costs for each option are provided in the following cost table.

Total FMS Cost	
Subtotal 1.1 – View/aem Construction/Equipment Cost (July. 2022)	\$ 1,060
Subtotal 1.2 – RFP Construction/Equipment Cost (September 2020, using CCI)	\$ 926
RFP Total Construction/Equipment Cost (Sept. 2020)	\$ 1,000
Subtotal 1.3 – View/aem Services/Installation Cost (July 2022)	\$ 41,580
Subtotal 1.4 - RFP Services/Installation Cost (September 2020, using CPI)	\$ 36,736
RFP Total Non-Construction Cost (September 2020, using CPI)	\$ 37,000
Total Fixed FMS Cost	\$ 38,000
Total Recurring FMS Cost (Annually)	\$ 12,000