Historic Bisbee Completes Multiple Mitigation Projects for Flood Protection

Full Mitigation Best Practice Story

Cochise County, Arizona

Bisbee, AZ - With the discovery of this ore-rich area of southeastern Arizona in 1877, hundreds of people joined the quest for wealth and moved to rugged Bisbee. Incorporated on January 9, 1902, Bisbee was the largest city in the territory with over 25,000 residents by 1910. For more than 70 years, the City of Bisbee served as a major source of copper, silver, gold, zinc, lead, and manganese extracted from the mines, hills, and waterways of the Bisbee area. In the 1970s Bisbee's mining days came to an end, but became the seed for the city's rebirth as an artists' colony and tourist mecca as the city had carefully preserved its mining-era architecture. Recently, the city has been renovating its infrastructure to serve and protect its residents, businesses, and visitors.

With the help of several Community Development Block Grants and FEMA's Hazard Mitigation Grant Program (HMGP) Bisbee upgraded its stormwater management infrastructure throughout the city after years of damaging flooding problems. Bisbee's normal annual rainfall is 12 1/2 - 13 1/2 inches per year with most of it falling during the month of September. Rainwater falling on the Bisbee side of the Mule Mountains drains through Mule Gulch, right through downtown Bisbee - through flumes, ditches, culverts and box channels, then out into the old Lavender Pit copper mine south of town. In 1906 Bisbee suffered from both a catastrophic fire and flood. After that flood, the city constructed a box channel to direct water under streets and buildings, but made the opening at the lower end of the main box channel smaller than the opening at the upper end, causing backups and overflows.

To eliminate this problem, the city applied Hazard Mitigation Grant Program (HMGP) funds to develop the Mule Gulch Drainage project from 2001 to 2003, increasing the size of the box channel as well as the downstream opening.

Bisbee also used HMGP funds to complete the High Road Retaining Wall project. The original wall was rotating away from the road it supported. Rather than use standard soil nails to anchor the concrete wall to the side of the hill, engineers opted for using E-bow anchors. Not only were the E-bow anchors more effective, they offered a 40% cost savings over soil nails. The engineers attached the anchors to a wire grid, and then sprayed shotcrete (Mortar or concrete conveyed through a hose and projected pneumatically at high velocity onto a surface; shotcrete can be dry-mix (gunite), or wet-mix) onto the grid. This project protected both the road and access for 60 homes above it.

The Brewery Wall project repaired severe erosion on the bank below the historic Muheim House. The project took six weeks from start to finish, and the money saved from using E-bow anchors (along with lower labor costs) allowed the project to have color added in the shotcrete, providing a more natural look to blend in with the natural rock outcroppings occurring throughout the city.

The 22-B Broadway project replaced a mostly dry-stack stone wall which collapsed, causing minimal damage to the house below. The biggest challenge of the project was the excavation process in the tight quarters between the wall and the house at the foot of the wall. Excavation alone took months of manually carrying out ruble. The project engineers constructed the new wall in two-foot high sections with steel reinforcements running through them.

In total, this series of HMGP projects replaced 17 miles of 100-year-old redwood sewer pipe, strengthened retaining walls, and renovated the storm drainage system to carry more runoff. In 2006, the improvements were tested when storms brought rains totaling 22 inches One storm alone dumped five inches of rain on Brewery Gulch in a 24-hour period. The particularly rainy season caused no flooding in the city, due to the improved drainage system.

Activity/Project Location

Geographical Area:	**Single County in a State**
FEMA Region:	**Region IX**
State:	**Arizona**
County:	**Cochise County**
City/Community:	**Bisbee**

Key Activity/Project Information

Sector:	**Public**
Hazard Type:	**Flooding**
Activity/Project Type:	**Flood Control**
Structure Type:	**Wood Frame; Masonry, Un-reinforced/Plain**
Activity/Project Start Date:	**06/2001**
Activity/Project End Date:	**10/2006**
Funding Source:	**Environmental/Historical Preservation; Hazard Mitigation Grant Program (HMGP)**
Funding Recipient:	**Local Government**
Funding Recipient Name:	**City of Bisbee Public Works Dept.**
Application/Project Number:	**9999**

Activity/Project Economic Analysis

Cost:	**$787,390.00 (Actual)**

Activity/Project Disaster Information

Mitigation Resulted From Federal Disaster?	**Yes**
Federal Disaster #:	**977 , 01/19/1993**
Federal Disaster Year:	**1993**
Value Tested By Disaster?	**Yes**
Tested By Federal Disaster #:	**No Federal Disaster specified**
Year First Tested:	**2006**
Repetitive Loss Property?	**Yes**

Reference URLs

Reference URL 1: **http://www.dem.state.az.us/**

Reference URL 2: **http://www.fema.gov/government/grant/hmgp/**

Main Points

- With the help of several Community Development Block Grants and FEMA's Hazard Mitigation Grant Program (HMGP) Bisbee upgraded its stormwater management infrastructure throughout the city after years of damaging flooding problems.
- Bisbee also used HMGP funds to complete the High Road Retaining Wall project.
- In total, this series of HMGP projects replaced 17 miles of 100-year-old redwood sewer pipe, strengthened retaining walls, and renovated the storm drainage system to carry more runoff.
- In 2006, the improvements were tested when storms brought rains totaling 22 inches

The visible part of the new wall (with the guard rail) is indicated within the yellow lines.

Arizona Highway 80 winds through Bisbee and the Mule Pass.

The Muheim Heritage House Museum, a Registered National Historic site.

High Road Wall in Bisbee, AZ. Evidence of the point of past “rotation” is marked by arrow.

View of the Mule Gulch Drainage project

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