Is that a COMPLETE Panel Number?
or Common Elevation Certificate Errors and What you can do to fix them… It’s a CRS thing.
Community Rating System

– Rewards Communities for Higher Standards with Insurance Premium Discounts

– 6 Basic Requirements for Class 9
  • In the NFIP Regular Phase for 1 year
  • Must be in full compliance with the NFIP regulations
  • Must maintain FEMA Elevation Certificates on new buildings or substantial improvements in the SFHA
  • Address repetitive loss properties in the community
  • Maintain flood insurance where required on community-owned properties
Why are Elevation Certificates (ECs) a PREREQUISITE???

- An accurate EC is the single most important source of information for flood insurance rating!
- NFIP Regs require elevation data, CRS requires ECs!
  - Communities must maintain a record of the lowest floor elevation for new or substantially approved buildings in SFHA [44CFR §60.3(b)(5)(iii)]
  - Communities must make building elevation data and related information available for public inspection and flood insurance rating. [44CFR §59.22(a)(9)(iii)]
The Sticky Wicket…

The Pesky Detail… Elevation Certificates must be CORRECT!

The CRS considers accurately completed Elevation Certificates to be evidence of a community’s full compliance with the minimum requirements of the NFIP. Therefore, Elevation Certificates that are not accurately completed are taken as an indication that the community may not be in full compliance, and continued participation in the CRS may be an issue. - CRS Coordinator’s Manual, Section 311
Credit

− ISO reviews all the ECs submitted using CRS EC Checklist.
− At Cycle Verification, credit is provided based on the first look.
− If only of a portion of submitted ECs are correct, *credit is prorated*.

Example:
38 possible points x (12 correct ECs ÷ 20 total ECs) = 22.8 points.

− No redo's on this. This is the score.
− Feedback is provided on all ECs – *CRS Elevation Certificate Evaluation Report*.

Compliance!!!

− To stay in the CRS, at least 90% of the community’s ECs MUST be correct, e.g. have no problems.
− *If less than 90% pass, the community MUST correct them to stay in the CRS.*
− ECs reviewed with each Annual Certification.
− Compliance evaluated at Cycle Verification
# CRS Elevation Certificate Evaluation Report

For internal use only. Protected by the Privacy Act of 1974

| Community: Denver | NFIP #: 080046 | Report Date: 6/7/2018 6:58:54 PM | Round: 1 |

<table>
<thead>
<tr>
<th>Codes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>C: Culled</td>
</tr>
<tr>
<td>R: Residential</td>
</tr>
<tr>
<td>NR: Non-Residential</td>
</tr>
<tr>
<td>NA: Not Applicable</td>
</tr>
<tr>
<td>P: Possible</td>
</tr>
</tbody>
</table>

## Error Key - Detailed Explanations

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>If Diagram# = 1, 1a, 1b, or 5, Area of Crawl must be blank</td>
</tr>
<tr>
<td>24</td>
<td>If Diagram# = 1a, 1b, 2, 5, or 7, Difference between C2a and C2b cannot be less than 5</td>
</tr>
<tr>
<td>47</td>
<td>Map/Panel Number is not the correct format.</td>
</tr>
<tr>
<td>58</td>
<td>C2a_TopOfBottomFloor must be lower than C2f_LowestAdjacent when A7_BuildingDiagramNumber = 2, 2A, 2B, 4, or 9.</td>
</tr>
<tr>
<td>153</td>
<td>C1_BuildingElevationLevels cannot be blank</td>
</tr>
</tbody>
</table>

## Non-Compliance Key - Detailed Explanations

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>The Lowest Floor for compliance is below B9. (Base Flood Elevation).</td>
</tr>
<tr>
<td>P11</td>
<td>C2.e. (machinery and/or equipment) is not elevated to at least the Base Flood Elevation level.</td>
</tr>
</tbody>
</table>
Common Errors

Can you believe how nitpicky that dang Panel Number is???
Common Errors - Is that a COMPLETE Panel Number???

Map Panel number must be 10 digits – 6 digit CID+ 4 digit Panel number
Common Errors – Building Diagram

- Double check the selected Building Diagram.

- Make sure the data entry makes sense based on the Building Diagram used.
  - For example on Diagram 2A, Item C2a, Top of Bottom Floor must be LOWER than Item C2f, Lowest Adjacent Grade.

- Diagrams 5 and 6 not common in Colorado. (Piers, Posts, Piles, Columns)
  - Exception: Manufactured homes with skirting that is only decorative are Diagram 5
Common Errors – Crawlspace, Garages, Flood Vents

− At Items A8 and A9, if one row is filled in, there should be answers for EVERY row.

− If Item A9 is completed, so must be Item C2d.

If you have engineered flood vents:
• Make sure to include the current certification from the engineer or the ICC Evaluation Service.
• Also make sure to include the actual coverage area in the notes (it’s usually more than 1 ft²!)
Common Errors – Machinery & Equipment, Building Address

– Item C2.e. must ALWAYS be completed unless the building has NO machinery. Include descriptions and locations in the Comments section.

– Provide the Building Street Address info on EVERY page.
Crikey, there’s an error…
The Community CAN fix some sections…

– Only Sections A & B
– Do not redline a signed form!
– Use the Correction Form, aka Memo for Correctness and Completion

But NOT others…

– Only the surveyor can change Section C
– Only the property owner or their rep can change Section E

https://crsresources.org/300-3/
Best Practices
Best Practices – Recommendations for Owners/Submitters

− Don’t pay the surveyor until the community approves the EC. There’s no leverage to get corrections once the surveyor has been paid.

− Submit a draft EC BEFORE its signed to community comments.

− ALWAYS include pictures; show the whole building, each side, equipment, vents.

− ALWAYS use the comments sections to provide additional details needed to clarify any.
Best Practices for Communities

− Get a draft copy of the EC before it’s signed. Provide comments and have them resubmit.
− Don’t submit ECs to ISO that you don’t need to submit!
  • Only submit ECs for insurable structures (not detached garages, sheds, etc.)
  • Only submit ECs for new construction or Substantial Improvement
  • ISO will review all ECs they receive; don’t set yourself up for more work.
− File management is important for your own sanity.
  • Keep ECs not needed for CRS separate.
  • Use a descriptive file naming convention.
− Sign up to get the NFIP/CRS Update Newsletter. [https://crsresources.org/100-2/newsletter/]
Let’s chat…

aka Questions???
May the EC review odds be ever in your favor!

Thank you!

Jeremy Hamer, PE, CFM
Floodplain Administrator
City & County of Denver, Public Works – Engineering and Regulatory
jeremy.hamer@denvergov.org

Kimberley Pirri, PE, CFM
Senior Engineer
AECOM
kimberley.pirri@aecom.com
Fluvial Hazard Zone Model
Land Use Regulations

Jeff Brislawn, CFM – Hazard Mitigation Lead, Wood

Amy Carr - Hazard Mitigation Planner, Wood

Kevin Houck, P.E, CM – Chief, Watershed and Flood Protection, CWCB
Background and Need
Foundational Question

What happens when streams are energized and how can we inform people of the hazard?
The Fluvial Hazard Zone (FHZ) is the area a stream has occupied in recent history, may occupy, or may physically influence as it stores and transports water, sediment, and debris.

As indicated by the definition, fluvial geomorphic processes may occur gradually over years or acutely during a flood event. The primary objective of mapping the FHZ in Colorado is to identify areas vulnerable to fluvial geomorphic hazards, characterize these hazards, and reduce risk to life and property through awareness, avoidance, and mitigation.
Planning for erosion hazards is an essential component of effective river corridor management and the prevention of future flood damages.

Nationally, nearly 25% of flood insurance claims come from areas outside of the 100-year floodplain.

In Colorado, the figure is approximate 51% from the 2013 event alone, and 57% cumulatively, since 1978.*

*Only NFIP claims; meaning they came from people with flood insurance.
Step 1 – Mapping the Hazard

FHZ Mapping Pilot Program Goals

Goal 1. Develop a scientifically defensible set of standards for Colorado.

Goal 2. Implement fluvial hazard mapping throughout Colorado.

Goal 3: Reduce damage from future flood events by increasing awareness of fluvial (river-related) hazards thereby leading to better land use decisions.

Big Thompson River, Larimer County, Colorado
Photo Credit: Katie Jagt
How Maps Can be Used

- Prevent community from (re)investing services (e.g., schools, fire/rescue stations, water sanitation, etc.) in critical vulnerable areas.
- Provide information to landowners about existing risk
- Assist in transportation decisions where roads/rivers interact
- Inform land conservation planning
- Wildfire planning and response
- **Land use planning and regulations**

Jamestown, Colorado
Top: 2013 Flood, Civil Air Patrol
Bottom: 1969 Flood, Carnegie Branch Library/Boulder Historical Society
How can we better plan for this?
Project Scope and Process
Project Overview

- Develop model regulations for Fluvial Hazard Zones
- Stakeholder advisory committee provided state and local agency perspective, oversight and input into the regulatory framework process
- Developed between November 2018-June 2019
- 3 committee meetings
- Provide update of CO-DOLA Planning for Hazards website
Key Considerations

• What are the most important elements to be included in the regulations?
  – Existing and Future Development
  – Critical Facilities and Infrastructure
  – Crossings
  – Vegetation
  – Exempted and Prohibited Activities
  – Permits

• Interface with floodplain regulations
• Flexible, Adaptable and Realistic
Objective: Identify best practices for land use and development in fluvial hazard zones in Colorado that can be implemented by local and state agencies.

Organization
- National Standards and Federal Support
- State and Local Regulations
  - Notable State Programs and Community Case Studies
- Best Management Practices
- Appendices
  - Appendix A: State and Local Regulations
  - Appendix B: Legal Challenges to Mapped FHZs
Best Practices in other states

- Vermont
  - Implementation since 2011 Post Hurricane Irene
  - Promoted as “no adverse impact” standard
  - Incentivized implementation of regulations by prioritizing for FEMA Hazard Mitigation Grants
- Washington
  - Channel Migration Zones
## Existing Regulations in Colorado Communities

<table>
<thead>
<tr>
<th>Regulation</th>
<th>City of Fort Collins</th>
<th>Town of Estes Park</th>
<th>El Paso County</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Regulation</strong></td>
<td>Fort Collins Municipal Code and Charter – Chapter 10, Division 7 – <em>Erosion Buffer Zones</em>, Sec. 10-201</td>
<td>Estes Valley Development Code, Chapter 7 General Development Standards, Section 7.6 <em>Wetlands and Stream Corridor Protection</em></td>
<td>El Paso County Land Development Code - Prudent Line Setback</td>
</tr>
</tbody>
</table>
| **Standards** | • Erosion buffer zones for specific basins  
• Structural vs Nonstructural development  
• Erosion buffer zone waivers | • Stream or River Corridors setbacks  
• Building/Structures vs Parking Lot Setbacks  
• Landscape credit | • Buffer zone on either side of channel where development is prohibited  
• No build area  
• Maintenance Easement |
| **Relationship to other regulations?** | Sec. 10-19 Flood Hazard Area Designation | LDC Chapter 8 Subdivision Design, Improvements and Dedications, Section 8.4.5 Drainage Considerations and Standards |
Challenges

- FHZ mapping still in draft stages
- Preliminary FHZ areas can be narrower or wider than existing regulatory floodplains
- No guidelines for mitigation actions or building safety standards
- Balance between comprehensive vs realistic to implement
FHZ Overlay District Model Ordinance
Planning Mechanisms Considered

- Setback or Buffer Zone
- Conservation Easement
- 1041 Regulations
- Overlay District

Undermined house as a result of the 2013 flood. Constructed outside the setback boundary on Fish Creek in Estes Park, CO
Fluvial Hazard Zone Overlay District

- Zoning requirement corresponds with the mapped FHZ
- Permitted uses of base zone still apply
  - Requires a zoning amendment
- Gives a flexible starting point
General Layout of Model Ordinance

Article I: Title and Purpose

Article II: Definitions

Article III: General Provisions

Article IV: Administration
Article I Title and Purpose
Section 1.4 Statement of Purpose

1. **Protect** human life, health, and safety;

2. Ensure that the **selection, design, creation, and use of development** in stream corridors is accomplished in a manner that **minimizes the potential for loss of life and damage** to property due to fluvial hazards;

3. Ensure **critical stream functions are met for future generations** through the maintenance and protection of natural stream processes, connected floodplains, and space for streams to migrate as they store and transport sediments and debris;

4. **Minimize damage** to critical facilities; infrastructure and other public facilities such as water, sewer, and gas mains; electric and communications stations; and roads, bridges, culverts, and other transportation infrastructure located in Fluvial Hazard Zones (FHZ);

5. **Reduce public and private expenditures** on stream corridor maintenance and emergency flood responses and repairs through improved stream corridor management and planning;

6. Ensure that property owners are **aware** that property may be at risk of fluvial hazards.
Article III General Provisions
Article II General Provisions

Section 3.4 Minimum Development Standards

Exempted Activities

1. **Removal of structures.** The removal of a structure in whole or in part within the fluvial hazard zone.

2. Maintenance of existing structures. Any changes, redevelopment, maintenance, repairs, or renovations to an existing structure **that will not result in a change in footprint.**

3. Maintenance of existing sidewalks, roads, parking areas, or stormwater drainage that **does not include expansions in streambank armoring or channelization to protect these areas.**

4. **Maintenance** of existing bridges, culverts, and crossings.

5. **Subdivision** of land that does not involve or authorize development.
Section 3.4 Minimum Development Standards

Exempted Activities

6. Maintenance of existing diversion structures

7. Agricultural uses and activities

8. Certain utilities including gravity storm drainage infrastructure, sanitary sewage infrastructure, wastewater treatment facilities and municipal well fields

9. Protective measures may be applied for existing critical facilities and structures in imminent danger of the effects of fluvial hazards

10. Activities related to an existing or future conservation use including but is not limited to habitat or geomorphic restoration and enhancement
Article II General Provisions
Section 3.4 Minimum Development Standards

Prohibited Activities

1. **New Critical Facilities** construction, whose locations should be selected carefully to minimize risk from fluvial hazards.

2. **Storage or processing** of hazardous materials or other substances. Specific exemptions related to this activity that are permitted in the {Community’s name} Floodplain Regulations shall also apply to this ordinance.

3. Any other activity that is not listed as exempt in subsection 3.4.1 or requires an FHZ permit as described in subsection 3.4.3, which could cause or contribute to the risk of fluvial hazards and does not meet the criteria in section 3.3.
Article II General Provisions

Section 3.3 Fluvial Hazard Zone Permit

- Required for all future development within the FHZ Overlay Zone

Any activity that will disturb, remove, fill, drain, dredge, clear, destroy, or alter any FHZ area including but not limited to the following activities, require a permit in accordance with section 3.3.1 (Permit Approval Criteria)

- 11 criteria for approval
- Waivers, Variances and Appeals Procedures
Section 3.4 Minimum Development Standards

Activities Requiring an FHZ Permit

1. Construction of any new structure, including new buildings, accessory structures or additions to existing buildings

2. Construction of new non-habitable buildings for the purpose of supporting conservation practices or recreation uses including restrooms, picnic shelters and similar activities or for the purposes of supporting agricultural operations including storing equipment

3. Trails. New and reconstructed hard surface paths, natural trails, walkways may be allowable with a permit

4. Recreational uses. Activity related to an existing or future recreational use is allowable with a permit. Recreational use activities include, but is not limited to, the development of recreational fields, and playground areas
Activities Requiring an FHZ Permit

5. Stream Restoration and Channel Improvements

6. Diversion structures. **New** diversion structures or the **reconstruction** of diversion structures

7. **Long term protective measures** for structures and critical facilities at risk

8. **New utilities** including both main and service line which service new structures are subject to the following requirements:
Article IV Administration
Article IV Administration
Section 4.1 Administrative Office & Appropriate Community Panel

- Review Procedures
  - Administrative Officer (local floodplain manager recommended)
  - Appropriate Community Panel
  - Option to tie permitting processes together with local floodplain regulations

- Review Triggers
  - New development
  - Subdivision of land
  - Change of Use (zone)
  - Preliminary Subdivision Plat
  - Site Plan
  - Construction or on-site wastewater treatment permit
Summary and Key Community Considerations

- Draft regulations provide a starting point for communities to formally consider fluvial hazards in their land use planning
- *Suggested* model code
- Can inform and tie in with other planning mechanisms and regulations
Questions?
LOMA’s for the Masses
A quick guide to multiple LiDAR LOMAs

Tim Benenati – AECOM
Terri Fead – Mile High Flood District
Thuy Patton – Colorado Water Conservation Board
- Junction Creek in Durango
- Steamboat Springs
- Niver Creek Tributary M in Federal Heights
- Evaluated other Denver, Lakewood and Wheat Ridge streams but found no potential LiDAR LOMA structures
Pilot Program Goals

- Select different area types within Colorado to create a streamlined process for FEMA’s new LiDAR LOMA
- Submit LiDAR LOMAs for pilot areas where structures are out of floodplains
- Create a step by step guide for Communities to repeat process in their floodplains
  - Help communities easily find potential homes for a LOMA
  - Obtain information that will help with outreach and mitigation
Process

- Create DEM using LiDAR data
- Create WSEL TIN using XS, BFEs
- Identify impacted structures
- Extract Ground and WSEL for structures
- Subtract 2ft from LAG to satisfy guidance
- Compare with new hydraulics
Further Refinement

- Check for basements
- Building footprints generated off different datasets
- Footprint vs aerial
- Verified against LiDAR
Verify Fill

- Check building permits
- Pre vs post build conditions
- Enclosed contours around structures
LOMA Verify

- Verify against existing approved or denied LOMAs
  - Removed if already being approved
  - Some not identified with LiDAR method had an existing LOMA

- Example:
  - LAG from DEM is 6,738.7
  - LAG after adjustment 6,736.7 (LiDAR method)
  - WSEL 6738.3
Comparing Structures with New Hydraulics

- LAG from DEM 5,417.1
- Grade contour 5,417
- Subtract 1 contour interval 5,416
- Effective WSEL 5,414.6
- New Hydraulic Study WSEL 5,418
Junction Creek Building

- LAG from DEM 6,598.4
- Grade contour 6,598
- Subtract 1 contour interval 6,597
- WSEL 6,592.8
Niver Creek Tributary M LOMA Structures
Junction Creek LOMA Structures
## Results

<table>
<thead>
<tr>
<th>Pilot Area</th>
<th>Structures in Floodplain</th>
<th>Structures above WSEL</th>
<th>Structures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Niver Creek Tributary M</td>
<td>231</td>
<td>25</td>
<td>In FEMA Review</td>
</tr>
<tr>
<td>Steamboat Springs</td>
<td>446</td>
<td>24</td>
<td>In Process</td>
</tr>
<tr>
<td>Junction Creek</td>
<td>96</td>
<td>9</td>
<td>Approved LOMA</td>
</tr>
<tr>
<td>Clear Creek</td>
<td>451</td>
<td>0</td>
<td>None Submitted</td>
</tr>
<tr>
<td>Harvard Gulch</td>
<td>304</td>
<td>0</td>
<td>None Submitted</td>
</tr>
<tr>
<td>Lakewood Gulch</td>
<td>75</td>
<td>0</td>
<td>None Submitted</td>
</tr>
</tbody>
</table>
LOMA Process

- Work with communities to obtain Deed information as well as verify if structure is on fill
- Create data driven pages map
- Use FEMA’s FIRMette link
- LiDAR information – link to CWCB pilot site
  • Coordinated with Durango for LAS file use on website
- FIS profile
- Memo
Modification to Process

- Manufactured Homes
  - Property Deed
  - Title Deed
Benefits from Results

Effective Removal of Structures

– Multiple Structures Removed with Single LOMA
– Reduced Costs for Individual Property Owner
– No Mandatory Flood Insurance Purchase Requirement
– Reduced Flood Insurance Premiums for Property Owner
– FEMA Saves Processing Costs of Individual LOMAs
Benefits from Results Without Removal

– Follow-up
  • Focused outreach to potential homeowners
  • Potential mitigation areas
– CRS credits
  • Flood depth data (322d), 20 points

322d Flood depth data (MI4)  20 pts

MI4 credit is for providing information about how deep flood waters can be anticipated to be in given areas of the community. The depth of expected flooding gives the inquirer a better concept of the flood hazard than does the base flood elevation alone. Depth data must be conveyed to inquirers. There are usually two ways to provide flood depth data. Either one is acceptable for credit:

- Staff can provide information from a map that shows the depth of flooding at different flood recurrence levels.
- Staff can provide data on both the flood elevation and the ground or building elevation at a site. This can be obtained from the FIRM or flood elevation profile and a topographic base map or Elevation Certificate.
Outreach

- LAG from DEM matched WSEL
- LiDAR LOMA guidance puts LAG 2 ft below WSEL
- Street view shows FFE could be several feet higher
- Elevation Certificate could help obtain LOMA
LiDAR LOMA Pilot Area
Harvard Gulch Area

NOTE: No Structures were found high enough to submit a LiDAR LOMA in this pilot area.
Pilot Study Documentation

Coloradohazardmapping.com/riskMap/lidarLomaPilot
- How to Guide for Processing LiDAR LOMAs
- How to Guide for Submitting LiDAR LOMAs
- Pilot Area data
- Outreach template
- LiDAR LOMA Fact Sheet
Questions?
Veteran’s Memorial Park
Detention Pond
Mesa County, Colorado

How Water Brings People Together
Project History and DHSEM Grant
History

2000 Williams Engineering
Proposed condition mapping
Did not include floodplain modeling, base flood elevations, or Flood Insurance Rate Maps (FIRM’s)

August 2009 - PDM Application
Study and application was completed by Ayres
Estimated cost to complete all upgrades: $4,154,630
100-yr anticipated flood damage cost was $7.6 million
Remove 115 acres from the floodplain
2000 Williams Engineering
Proposed condition mapping
Did not include floodplain modeling, base flood elevations, or Flood Insurance Rate Maps (FIRM’s)

August 2009 - PDM Application
Study and application was completed by Ayres
Estimated cost to complete all upgrades: $4,154,630
100-yr anticipated flood damage cost was $7.6 million
Remove 115 acres from the floodplain

HDR Grant Consultant in 2014

FEMA and DHSEM Application
Awarded May 2016
Mesa County Fairgrounds
$1,049,474.00
Design
Design Drivers Detention Storage → Reduce Flooding
Design Drivers
County Fairgrounds Facility ➔ Event Space, Multi-Use Park
Public Outreach

- **Long Family Memorial Park**
  - Total area = 12 acres

- **Orchard Mesa Detention Pond**
  - Total Area = 42 acres
  - Total Turf area = 5 acres

- **Eagle Rim Park**
  - Total area = 7 acres

- **Orchard Mesa Detention Pond**
  - Total Area = 42 acres
  - Total Turf area = 5 acres

- **Lions Club Park**
  - Total area = 2 acres

- **Dixon Park**
  - Total area = 3 acres

Design Options
B-¼ Drain Converted to Open Channel
Design

12 Acre Site
30 AC-FT Capacity
Berm separates northern chamber from southern chamber
At 5-year event, water spills from northern native chamber to southern turf area
Underdrain System
Design

- Existing B-1/4 Drain to be daylighted
- Meandering storm water channel with wetland plantings
- Secondary nature trails around constructed wetlands
- Existing C-Cvert
- Overlook and interpretive areas for wetland and stormwater education
- Walking trail through native area
- Existing bus track
- Terraces built into slope for seating and play
- Future restroom facility
- ADA accessible trails to multi-purpose field
- Future playground and gazebo area
- Shade trees
- Primary path / walking trail 6'6" width
- Future vending area with power supply

Conceptual Site Plan Option 2
Orchard Mesa Detention Pond / Veterans Park
December 2016
Contract

Base Bid: $829,227.70 (split 87.5% DHSEM/12.5% MC Engr. C.I.P.)
(included detention basin, wetlands, drainage work including converting B-1/4 Drain to open channel, and irrigation of seeded areas)

Alt. A: $225,712.25 (100% MC Facilities Dept.)
(included trees, shrubs, hardscape and furnishings for park)

Alt. B: $29,800.00 (100% MC Engr. C.I.P.)
(included extension of existing sewer thru B-1/4 Drain area)

Total Contract Awarded: $1,089,740.95
Vendor Area Change Order

$79,185.50 (100% MC Facilities Dept.)
(included vendor area w/ electrical & water hook-ups)
Topsoil issue
1,800 CY of Mesa Magic compost added.

Donated by Mesa County Landfill in exchange for 9,600 CY of excess fill from project.

Additional cost: over $55,000
Fighting to establish good grass cover
Gravel/cobbles issue
Additional Cost: $29,000 plus Facilities/inmate labor time
Takeaways

Embrace a creative approach

Spend $$ on Geotech

Use your resources!
Inmate labor can be a good thing

Good communication is key
How Water Brings People Together
A Special Thanks To:

Ayres Associates
DHM Design
HDR
AMEC
Mesa County Facilities Department
Orchard Mesa Irrigation District
Sorter Construction
Clark and Co
Andy Herb with Alpine Eco
Bureau of Reclamation

DHSEM
Deanna Butterball
Scott Baldwin
City of Grand Junction
Colorado Department of Transportation
Multiple subconsultants
Austin Civil Group
U.S. Army Corp of Engineers
Completed Site

Welcome
INTERMOUNTAIN
VETERANS MEMORIAL PARK
Planning for Hazards: Implementing Flood-Specific Tools and Strategies to Reduce Risk and Build Resilience

CASFM 2019- Floodplain Management Track
Crested Butte, CO
September 26, 2019

FEMA
252 NFIP Communities

47 in CRS Program

Source: Raven Maps & Imaging
Why is Planning for Hazards Important?

Billion-Dollar Disaster Event Types by Year (Unadjusted)

Number of Events

Year

All Disasters
Planning as a Form of Flood Mitigation

Mitigation aims to break the cycle of disaster damage, reconstruction, and repeated damage.

- Structural
- Non-Structural

It reduces loss of life and property, minimizes financial impacts, enables more rapid recovery.
The Challenge: How do we execute?

- The Facts- Most Communities:
  - Have the data to guide risk reduction activities
  - Have tried and true processes
  - Understand their risk

- Implementation is where they need support

- Other factors influencing success:
  - Size
  - Geography
  - Capabilities
  - Time/Resources
  - Financial Capacity
  - Technical Support
  - Community Goals
  - Political Will
  - Legal Authority
  - Recent disasters
The Answer: Planning for Hazards

The Guide

The Website

planningforhazards.org
Planning for Hazards

Types of Tools
Explore planning tools that help reduce risk

- Addressing Hazards in Plans and Policies
- Strengthening Incentives
- Protecting Sensitive Areas
- Improving Site Development Standards
- Improving Buildings and Infrastructure
- Enhancing Administration and Procedures

- Avalanche
- Earthquake
- Flood
- Severe Winter Storm
- Wildfire
- Drought
- Extreme Heat
- Soil Hazards
- Wind Hazards
- Natural Resources
- Landslide, Mud/Debris Flow, and Rockfall
Planning for Hazards

**ENHANCING ADMINISTRATION AND PROCEDURES**
- Application Submittal Requirements
- Post-Disaster Building Moratorium

**IMPROVING BUILDINGS AND INFRASTRUCTURE**
- Building Code
- Critical Infrastructure Protection
- Wildland-Urban Interface (WUI) Code

**IMPROVING SITE DEVELOPMENT STANDARDS**
- Stormwater Ordinance
- Site-Specific Assessment
- Subdivision and Site Design Standards
- Use-Specific Standards

**STRENGTHENING INCENTIVES**
- Community Rating System
- Density Bonus
- Development Agreement
- Transfer of Development Rights

**PROTECTING SENSITIVE AREAS**
- 1041 Regulations
- Cluster Subdivision
- Conservation Easement
- Land Acquisition
- Overlay Zoning
- Stream Buffers and Setbacks

**ADDRESSING HAZARDS IN PLANS AND POLICIES**
- Comprehensive Plan
- Climate Plan
- Community Wildfire Protection Plan (CWPP)
- Hazard Mitigation Plan
- Parks and Open Space Plan
- Pre-Disaster Planning
**Planning for Hazards**

**Stream Buffers and Setbacks**

Stream buffers or setbacks are defined areas along a watercourse that are protected from development for the purpose of preserving the natural benefits and reducing hazards of such areas. They are implemented in a similar manner and often in concert with buffers for wetlands and other sensitive areas such as dunes, slopes, and wildlife habitat. They are intended to protect the many functions—hydrologic, biological, ecological, aesthetic, recreational, and educational—that riparian areas provide to communities. They help preserve stream banks and natural vegetation.

**Where It's Been Done**

**Advantages and Key Talking Points**

- Helps to preserve natural and beneficial functions of the floodplain.
- Protects the water resource from the impacts of neighboring and upstream land uses.
- Helps reduce flood vulnerability both at the site as well as the surrounding area and downstream.
- Promotes habitat preservation of aquatic and adjacent riparian environments.
- Helps preserve water quality by limiting point-by-point pollutants.

**Challenges**

Some of the challenges associated with stream buffer and setback regulations include:

- Political will and community support is required to implement limitations on development locations.
- Difficulty in implementing along corridors where properties are already developed unless the property is then turned into a park.

**Model Code Language and Commentary**

In drafting model code language for buffer and setback requirements, four issues should be considered:

- Purpose and intent
- Applicability and exemptions
- Development standards
- Procedures

Each of these is described in further detail below, including model language. It was drafted for consideration. Commentary is located in italics in the column at the right. The model language used in this document is based on several existing ordinances from varying communities around the state, including municipalities and counties. The language is illustrative only, and local counsel should be consulted for your jurisdiction.

**Purpose and intent**

This section should describe the jurisdiction's intent in adopting buffers, setbacks, and other riparian protection standards. Common purposes include:

A. To promote, preserve, and enhance the hydrologic, biological, ecological, aesthetic, recreational, and educational functions that stream and riparian corridors, riparian areas, and wetlands provide;
B. To identify flood hazards and avoid development within those flood hazards to the extent practicable;
C. To establish regulations seeking maximum protection of all streams of the jurisdiction;
D. To avoid development activity within buffer zones;
E. To minimize the adverse impacts of development activity within buffer zones;
F. To maintain habitat diversity within buffer zones; and
G. To protect development within buffer zones to the extent practicable.
Planning for Hazards

Key Facts

Administrative Capacity
Experienced planners with city or county attorney to write regulations and normal capability to administer the standards once adopted.

Mapping
Mapping is strongly recommended. Can be coupled with open space, FEMA or floodplain overlay, or regular land use mapping.

Regulatory Requirements
Local regulations are generally adopted as part of land use or zoning codes or as part of other regulations (such as stormwater management regulations).

Maintenance
Minimal. Generally part of development review once regulations are adopted.

Adoption Required
Yes.

Statutory Reference
General land use authority is found in C.R.S. § 29-20-101. Colorado's 1041 Regulations further describe the administration of natural hazard areas as they pertain to floodplains. 1041 Regulations are addressed in a separate model.

Associated Costs
Ordinance development or amendment costs and staff time to review development for compliance with regulations and monitor for enforcement.

Additional Resources


Pitkin County River and Stream Corridors and Wetlands Pitkin County Land Use Code, Section 7-20-80.

City of Boulder Stream, Wetland, and Water Body Regulations.

Town of Estes Park and Estes Valley Wetlands and Stream Corridor Protection Estes Valley Development Code, Section 7.6.

City of Fort Collins Natural Habitats and Features and Establishment of Buffer Zones Land Use Code, Division 3.4, and Section 3.4.1.E.

San Miguel County Wetland Areas Land Use Code, Section 5-22.

For More Information
Colorado Water Conservation Board: Watershed Protection and Restoration.

Conservation Tools.org.

Protecting Stream and River Corridors: Creating Effective Local Riparian Buffer Ordinances.
# Planning for Hazards

## Where in CO are these tools working?

<table>
<thead>
<tr>
<th>Location</th>
<th>Tool or Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crested Butte</td>
<td>Area Plan</td>
</tr>
<tr>
<td>Canon City</td>
<td>Property Acquisition</td>
</tr>
<tr>
<td>Larimer County</td>
<td>Property Acquisition</td>
</tr>
<tr>
<td>Chaffee County</td>
<td>Overlay Zoning</td>
</tr>
<tr>
<td>Pitkin County</td>
<td>Stream Buffers</td>
</tr>
<tr>
<td>Routt County</td>
<td>Cluster Subdivision</td>
</tr>
<tr>
<td>Pagosa Springs</td>
<td>Site Design Stds</td>
</tr>
<tr>
<td>Summit County</td>
<td>TDRs</td>
</tr>
<tr>
<td>Boulder County</td>
<td>Building Moratorium</td>
</tr>
<tr>
<td>Denver</td>
<td>Higher Standards</td>
</tr>
</tbody>
</table>

---

Community Achievements in Planning for Hazards  
Dale Case, Boulder County Land Use Department Director

[https://planningforhazards.org/video-resources](https://planningforhazards.org/video-resources)
**Goal:** Communities that participate will be able to implement a land use mitigation strategy within one year of attending the workshop.

**Overview:** Two separate workshops intended to assist communities with selecting, developing, and adopting hazard mitigation actions relating to land use.

**Contributing Partners:** DOLA, DHSEM, FEMA

<table>
<thead>
<tr>
<th><strong>June 7, 2018- Eagle, CO</strong></th>
<th><strong>Sept 6, 2018- Longmont, CO</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Eagle County</td>
<td>City of Brighton</td>
</tr>
<tr>
<td>Jefferson County</td>
<td>City/County of Denver</td>
</tr>
<tr>
<td>Mineral County</td>
<td>City of Fort Collins</td>
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<tr>
<td>Park County</td>
<td>Town of Larkspur</td>
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<td></td>
<td>City of Longmont</td>
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<td></td>
<td>Town of Lyons</td>
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<tr>
<td></td>
<td>City of Thornton</td>
</tr>
</tbody>
</table>
Workshop Process

- **Roadmap Chapter 1**: Community Background & Strategy Analysis
- **Roadmap Chapter 2**: Tool/Strategy Confirmation
- **Roadmap Chapter 3**: Applicability & Process
- **Roadmap Chapter 4**: The Nitty Gritty
- **Roadmap Chapter 5**: Implementation & Next Steps
Longmont- Updating Floodplain Development & Use Regulations

• Made Progress? YES
  • Identified select higher standards
  • Alignment with other city documents: Drainage Design Manual, Drainage Criteria Manual, Land Development Code

• Benefits
  • Involving City Council
  • Insights into CRS/Improving Rating

• Challenges
  • Staff time/resources
  • Lack of support from other departments
  • Lack of public support

• Where do you need support?
  • Drafting ordinance language
  • Providing background/context for changes
  • Example communities for specific standards
Denver - Development of a Property Acquisition Program

- Made Progress? **YES**
  - Property acquisition plan & recommendations
  - Coordination with Parks & Rec department
  - CIP funding considerations

- Benefits
  - Involving City Council
  - Increasing awareness of property acquisition as an approach to flood mitigation

- Challenges
  - Staff time/resources
  - Distance from the workshop led to progress slow-downs
  - Some conflicts of priorities - acquisition vs. infrastructure projects

- Where do you need support?
  - More support following workshop from SMEs
Key Takeaways…so far

- Education is key.
- Consider dedicated staff or consultant help.
- Try to set realistic milestones.
- Get community officials on-board
- State/regional planning sponsorship
- **Communities need continued support**
Planning for Hazards - Taking Action in YOUR Community

Take Action! New guidance for initiating Planning for Hazards in your community

Work Session 1 - Provide Introduction and Framework, and Assess Community Vulnerability

Work Session 2 - Assess Capabilities and Develop Planning Strategies

Work Session 3 - Prioritize Planning Implementation Tools

Work Session 4 - Review and Refine Draft Planning Implementation Tools

Work Session 5 - Establish Implementation and Maintenance Procedures
<table>
<thead>
<tr>
<th>Tasks and Work Sessions</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Work Session 1</strong> - Provide Introduction and Framework, &amp; Assess Community Vulnerability</td>
<td>✴️</td>
<td></td>
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<tr>
<td><strong>Prepare Risk Assessment/HIRA; Prepare Stakeholder Engagement Strategy</strong></td>
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</tr>
<tr>
<td><strong>Work Session 2</strong> - Assess Capabilities and Develop Planning Strategies</td>
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<td>✴️</td>
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<tr>
<td><strong>Prepare Assessment Memo</strong></td>
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<tr>
<td><strong>Work Session 3</strong> - Prioritize Planning Implementation Tools</td>
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<td></td>
<td></td>
<td></td>
<td>✴️</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Refine Assessment Memo; Develop Implementation Tools</strong></td>
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</tr>
<tr>
<td><strong>Work Session 4</strong> - Review and Refine Draft Planning Implementation Tools</td>
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<td>✴️</td>
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</tr>
<tr>
<td><strong>Work Session 5</strong> - Establish Implementation and Maintenance Procedures</td>
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<td></td>
<td></td>
<td></td>
<td>✴️</td>
<td></td>
</tr>
</tbody>
</table>

**KEY:** ✴️ = work session   ■ = ongoing work
Planning for Hazards - Taking This Show on the Road!

- Critical Success Factors
  - Knowledgeable instructors/SMEs
  - Good Facilitators to keep the process moving and focused
  - Strong State/Regional Partners
  - Time/Resources/Capabilities
  - Readiness to take action
  - Localized/Regionalized hazard and tool information
  - Consistent and thorough support through implementation
For More Information

Matthew Buddie- Matthew.Buddie@fema.dhs.gov
Ryan Carroll- rcarroll@mbakerintl.com
Anne Kuechenmeister- Anne.Kuechenmeister@mbakerintl.com
Planning for Hazards: Implementing Flood-Specific Tools and Strategies to Reduce Risk and Build Resilience

CASFM 2019- Floodplain Management Track
Crested Butte, CO
September 26, 2019

FEMA
LOCALIZED FLOODPROOFING TECHNIQUES AND CAPITAL PROJECTS FOR RESIDENTIAL COMMUNITIES

Suleyman Akalin, PE, CFM, PhD
Michael Lopes, EI, CFM
Emily Villines, CPSM, MA
INTRODUCTION

[Images of floodwater and flooded vehicles]

July 23, 2018
1.3 inches in 10 min.
2.7 inches in < 1 hr.

July 24, 2018
1 inch in 10 min.
1.7 inches in < 1 hr.

Source: City of Englewood
INTRODUCTION
Complex hydraulic requirements on the inlet structures for the box culvert pointed towards the need for a model study to define the hydraulics dimensions of the inlet. The inlet had to accelerate the water from very slow flow to supersonic velocities of 35 feet per second, and yet limit the total flow into the box so that it would never quite flow completely full, and thus never under any pressure. The model was built and tested through wide ranges of operation. The test results permitted safe design with large economies realized in the construction.

Upstream from the box culvert, elevation changes and velocity requirements mandated a stilling basin, a baffle chute to keep water from increasing its velocity at one place, and another chute to purposely spread it up in another.

While all design criteria were aimed at hydraulic adequecy, in addition to the planning and design aspects of the engineer's work, we planned the scheduling of the entire work so as not to create an undue hazard should it occur prior to completion. Reviewing of the two rail roads tracks, while costly, was accomplished train service interruptions.

The resulting project will provide a three and a mile roadway, channel, and underground conduit to guard the Howard Gulch area of southeast Denver from future flooding. The job, constructed within the $4.5 million budget, will cause increased property valuations as people feel they can safely improve their lots. The park-like lands will provide play areas for neighborhood children. Last, but not least, recording rate and flood gauges will provide necessary design with needed data on storm runoff from urban areas.
Life Safety and Flood-Proofing

- Identify homes in danger
- Engage owners
- Determine methods and costs
- Budget for improvements and implement

OSP Update and Prioritization

- Data gathering
- Project verification & mapping
- Prioritization
- Budget and implement

Pipe Conditions Assessment

- Investigation & review
- Conditions assessment
- Evaluation of repair methods
- Recommendations

CALIBRE STUDY
1999 OSP Study
Hydrologic Data

Hydraulic Study

Updated Hydrographs

Updated Flood Boundary

Colorado Urban Hydrograph Procedure
Version 2.0.0 - Release Date: 9/9/2016
Urban Drainage and Flood Control District
Denver, Colorado

Storm Water Management Model
Version 5.1

HEC-RAS
River Analysis System
HEC-RAS 5.0.7 March 2019
Flood Area Comparison

Hydraulic Study
Hydraulic Study

2D Hydraulic Model with Obstructions
South Basin - Areas of

- 100-yr Flood Boundary with Existing Stormwater Management
- 25-yr Flood Boundary with Existing Stormwater Management
- 10-yr Flood Boundary with Existing Stormwater Management
- 5-yr Flood Boundary with Existing Stormwater Management
- Buildings within 100-yr Flood Boundary

Interactive Flood Boundary Maps

Hydraulic Study

Calibre

Englewood
Interactive Maps

5-year Flood Depths

25-year Flood Depths

100-year Flood Depths

Hydraulic Study
Hydraulic Study

5-year Flood Depths at Buildings

- 0-0.5 Foot Depth of Flooding
- 0.5-1 Foot Depth of Flooding
- 1-2 Foot Depth of Flooding
- 2-3 Foot Depth of Flooding
- Greater Than 3 Foot Depth of Flooding
Hydraulic Study

100-year Flood Depths at Buildings
Capital Improvement Project Segments

Hydraulic Study
Number of Habitable Buildings Flooded for Different Storm Sewer Designs

- Proposed 25-Yr Storm Sewer: 709
- Proposed 10-Yr Storm Sewer: 930
- Proposed 5-Yr Storm Sewer: 997
- Existing Conditions: 1081

# of Habitable Buildings in 100-Year Flood Boundary
Local Floodproofing
Local Floodproofing

NOTE: OCCUPANCY OF AN INUNDATED AREA IS A LIFE SAFETY HAZARD. YOU SHOULD CONSIDER TAKING THE SAFEST COURSE OF ACTION, WHICH IS TO ABANDON USE OF THE BASEMENT OR GARAGE FOR OCCUPANCY, ESPECIALLY AS SLEEPING QUARTERS.

Are you expected to have more than 2-3 feet of inundation at the exterior of the building?

In the past (including the July 2018 flood), has your home experienced flood water touching the building or flood water above the window wells? OR is flood water touching the building or above the window wells expected in the future?

NOTE: ALL HOMES SUBJECT TO INUNDATION SHOULD HAVE FLOOD INSURANCE

Do you have a basement?

Is the level of inundation at the exterior of the building less than 2-3 feet?

Add floodproofing if you feel you are at risk. Consider flood insurance if you feel you are at risk, particularly if you have assets at lower levels such as in a garage or basement that might get damaged.

NOTE: ALL HOMES THAT ARE SUBJECT TO INUNDATION SHOULD HAVE FLOOD INSURANCE

Floodproofing is an option. Consult Floodproofing ideas on this website, as well as floodproofing options from FEMA, the US Army Corps of Engineers, and other resources. Consult the City of Englewood Public Works Department before implementing any floodproofing on the exterior of your home.

Floodproofing Options: CR, SP, FDM, AF, P

Floodproofing may not be effective at levels above 2-3 feet of inundation. Consider raising the level of your house. While this is costly, any more than 2-3 feet of inundation at the exterior of the building risks collapse of the structure.

Floodproofing Options: CR, SP, FDM, RH
Local Floodproofing

- Egress Windows
- Flood Shields
- Flood Vents
- Sump Pumps
- Component Relocation
- Flood Resistant Materials
- Inflatable Floodproofing

Calibre
City of Englewood
Egress Windows

Description:
Egress windows are operable emergency escape and rescue openings in basements or below grade habitable space (International Residential Code R310).

Applicable to homes and buildings where flooding of a basement is possible and multiple exits are needed, that is, any basement where rooms are separated from the stairway or exit by a door. Must include an exterior wall that is above expected flood level.

Characteristics:
- Creates a means of exit in the case water enters a basement and water pressure does not allow the opening of an exit door.
- Greatly increases safety in enclosed spaces during flood or fire.
- Below-grade or at-grade egress windows can add value to the equity of a home.
- Egress windows encourage ventilation and circulation.
- Allows more natural light to enter a basement.
- An egress window can help make a room ‘habitable’ under current Colorado Code of Regulations.
- More expensive life safety technique than other options.
- Requires structural engineer for consulting.
- Requires construction on walls and a larger hole for window well.
- Egress windows typically require permitting and City clearance.
- Egress windows may require utility coordination.

Average Price for Egress Windows

<table>
<thead>
<tr>
<th>Type</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Average</td>
<td>$3500</td>
</tr>
<tr>
<td>Low</td>
<td>$700</td>
</tr>
<tr>
<td>High</td>
<td>$7500</td>
</tr>
</tbody>
</table>
CLOSURE PANELS, WELL RAISING & FLOOD SHIELDS

DESCRIPTION:
Flood shields or panels are structural installations, often watertight, that close or cover openings in a building (i.e. doors or windows) (FEMA P-259). In the same line of thought, existing window wells can be raised/replaced to above flood levels.

Applicable to most homes that are in danger of water levels above foundation openings.

CHARACTERISTICS:
- Extremely effective at keeping water from entering doors and windows
- Space-savvy
- Minimal disturbance to existing homes
- Can be less expensive than elevation changes or relocation options
- Flood panels/shields are removable and can be stored elsewhere (garage, shed, etc.)
- No or low maintenance
- If panel/shield covers a window, less natural light will enter the structure
- Sealant of outer façade is required up to BFE (or slightly above for best protection)
- Structures with this type of flood prevention may require analysis of buoyancy force
- If installed with permanent panel are fairly maintenance free.
- Can be installed as removable, but this requires replacement of shield during storm runoff so is much less reliable.

<table>
<thead>
<tr>
<th>Type</th>
<th>Low Price</th>
<th>High Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Cover</td>
<td>$100</td>
<td>$1500</td>
</tr>
<tr>
<td>Well Cover</td>
<td>$10</td>
<td>$570</td>
</tr>
<tr>
<td>Well Cover</td>
<td>$200</td>
<td>$275</td>
</tr>
<tr>
<td>Door Shield</td>
<td>$87/ft</td>
<td>$1500</td>
</tr>
<tr>
<td>Door Shield</td>
<td>$250</td>
<td>$1000</td>
</tr>
<tr>
<td>Door Shield</td>
<td>$100/ft</td>
<td></td>
</tr>
</tbody>
</table>
FLOOD DAMAGE RESISTANT MATERIALS

DESCRIPTION:
Facades and exterior faces on the outside of a structure (or in a space expected to be flooded) can either be sealed with liquid sealant or built with flood damage resistant materials in order to reduce damage caused by floods.

Applicable to any home where flood levels are above the concrete foundation.

CHARACTERISTICS:
- Liquid sealants can be applied to most surfaces; bricks, wood, concrete. The sealant reduces or eliminates water seepage or inundation into these materials.
- Liquid sealants can be used to seal facades and faces of structures below the BFE.
- Flood damage resistant materials such as treated wood, sturdy plastics and treated metals can replace existing items below the BFE to reduce or eliminate damage and replacement costs for these items after a flood.
- Decks can be rebuilt using these materials, bases of houses can be sealed, or barricades can be built using these materials to reduce flood damages.
- If installed incorrectly, these items will not have full effectiveness.
- Flood damage resistant materials do tend to be more costly, and may require some reconstruction of the items being waterproofed.

Average Price for Flood Damage Resistant Materials

<table>
<thead>
<tr>
<th>Type</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Average</td>
<td>$500</td>
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<tr>
<td>Low</td>
<td>$15</td>
</tr>
<tr>
<td>High</td>
<td>$1500</td>
</tr>
</tbody>
</table>
**ALLOWING FLOODING W/O STRUCTURAL DAMAGE**

**FLOOD VENTS**

**DESCRIPTION:**
A Wet flood proofing utilizes entry points and openings in the structure to allow floodwaters to enter the enclosed area of the home (FEMA P-312.)

Applicable to homes where flood waters exceed 1.5’ in depth, with floodproof crawl spaces, or empty basements with multiple entries. Not recommended for most basements due to possibility of occupation.

**CHARACTERISTICS:**
- Is cost effective if below grade level is flood-ready (i.e. not a living space)
- Allows floods to pass through the building preventing structural damage to home. Does not require sealant, although sealant is suggested for all flooded surfaces
- Not recommended for houses with basements or main floors below the BFE
- Requires a sump pump to get rid of excess water that may have seeped near foundation
- Requires that all items be removed from floodable space, and may interfere with radon detection systems
- Not practical to be used for living spaces
- Requires an exit method (such as a sump pump)
- May require modifying uninhabited areas to allow water entry without damage
- Does not reduce flood insurance premium rates for residential structures

**Preparation Home for Flood Allowance**

<table>
<thead>
<tr>
<th>Height</th>
<th>Cost Range</th>
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</thead>
<tbody>
<tr>
<td>2 ft</td>
<td>$1.40 - $1.80/sq ft</td>
</tr>
<tr>
<td>4 ft</td>
<td>$3.45 - $3.70/sq ft</td>
</tr>
<tr>
<td>8 ft</td>
<td>$10.60/sq ft</td>
</tr>
</tbody>
</table>

If below grade level is NOT flood-ready (i.e. slab and vents need to be installed)

Range: $25,000 - $42,000
CITY OF ENGLEWOOD FLOODPROOFING TECHNIQUES

SUMP PUMP

DESCRIPTION:
Sump pumps will pump excess water from a low lying area such as a basement into a drain or outside a home.

Sump pumps are applicable to homes where water will be allowed to enter crawl spaces, or where ground water has historically risen into the basement during high rainfall times.

CHARACTERISTICS:
- Cost effective (valves are relatively inexpensive)
- Can alleviate hazardous contamination of floodwaters, and therein can help create a safer and cleaner post-flood cleanup
- Can be used as a standalone improvement or with any other floodproofing method
- Will not stop floodwaters or flood damage to property

<table>
<thead>
<tr>
<th>Sump Pump Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Typical range is from $600 - $2000 WITH installation.</strong></td>
</tr>
<tr>
<td>Extremely complicated sump pump installation can be up to $5000.</td>
</tr>
<tr>
<td>Pedestal Sump Pump</td>
</tr>
<tr>
<td>Submersible Sump Pump</td>
</tr>
<tr>
<td>Installation</td>
</tr>
</tbody>
</table>

Local Floodproofing

**Calibre**

**Englewood**
COMPONENT RELOCATION/ELEVATION

DESCRIPTION:
Any electrical boxes, water heaters, A/C units, transformers, or other gas and electric utility components can be raised or relocated to be out of or above flood water levels.

Applicable to homes where these utilities are below flood level.

CHARACTERISTICS:
- Major items such as water heaters can be placed on raised stands or blocks.
- Relocation and or elevation of components can be done inside a structure or outside: for example, a transformer or electrical box outside the home can be raised on a pole above flood levels, while a water heater unit can be raised on a stand or scaffold within the basement or ground floor of a building, and AC can be placed on roof.
- Building scaffolding or elevated blocks/stands is cost effective; raising electric or gas components on poles or existing fences is also cost effective.
- By raising these components, the home/business owner mitigates the cost of replacing or repairing these components after a flood.

<table>
<thead>
<tr>
<th>Average Price for Component Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
</tr>
<tr>
<td>National Average</td>
</tr>
<tr>
<td>Low</td>
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<tr>
<td>High</td>
</tr>
</tbody>
</table>
INFLATABLE AND REMOVABLE FLOOD CONTROL

DESCRIPTION:
This type of flood control methods inflates or is removable or movable at will. This includes sand bags, inflatable bags, plastic barriers, etc. Applicable for small areas of residential lots where flood protection is desired and permanent walls or berms are not practical. Also in public streets where diversion has been deemed appropriate and beneficial.

CHARACTERISTICS:
- Removable – can be stored and placed before a flood occurs
- Can fully or partially block flows or control releases
- Can be used for commercial and residential buildings
- Large flood flows risk movement of removeable devices
- Can be easily damaged or moved by debris
- Requires the fast action of homeowner or agency, so physical presence onsite is needed while high runoff is occurring. Most storm runoff events come and go within one or two hours so timing is critical, limiting their use in cases where homeowner may not be present during a storm or when the agency does not have staff to install during storm events.

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Quick Dam</td>
<td>$25</td>
</tr>
<tr>
<td>Watergate Flood Barrier</td>
<td>$1000</td>
</tr>
<tr>
<td>HydraBarrier</td>
<td>$109</td>
</tr>
<tr>
<td>Watergate QuickDam</td>
<td>$1300</td>
</tr>
<tr>
<td>Watergate QuickDam</td>
<td>$3800</td>
</tr>
</tbody>
</table>
ELEVATING MAIN FLOOR LEVEL OF BUILDING (JACKING)

DESCRIPTION:
If a house has high floodwaters that present structural risk (3’ or more of inundation), one option is to raise the elevation of the finished floor of the building, either on stilts, columns, or piers. Any basement present will be filled in and compacted with soils. This below-home area can be used for storage only.
Applicable to any home where flood levels are high enough to potentially cause structural risk of collapse.

CHARACTERISTICS:
- Houses can be raised above projected flood levels using piers, columns, or stilting.
- The area beneath the home may be used for parking, storage, and must be open to the air, i.e. no walls may be built and this area may not be enclosed.
- This option is rather expensive, however it will fully remove a home from the area of probable flooding.

### Average Price for Elevating the Home*

<table>
<thead>
<tr>
<th>Type</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property Fill</td>
<td>$7 per cubic yard</td>
</tr>
<tr>
<td>Piles, posts, piers, walls</td>
<td>$7 per square foot of space</td>
</tr>
<tr>
<td>Raising structures</td>
<td>$4 - $13 per square foot, depending on material</td>
</tr>
<tr>
<td>Extending utilities</td>
<td>$4 per square foot</td>
</tr>
<tr>
<td>Erosion protection</td>
<td>$22 per cubic yard</td>
</tr>
<tr>
<td>Subfloor drainage</td>
<td>$3 per square foot</td>
</tr>
<tr>
<td>Periphery drainage modifications</td>
<td>$26 per linear foot</td>
</tr>
<tr>
<td>Approximate total for raising a home</td>
<td>$5,000 - $30,000</td>
</tr>
</tbody>
</table>

Note that some houses in extreme cases can cost up to $100,000 to raise/jack.

*Dependent on many factors, including size of home, height of elevation, if a basement is present, and soil conditions.
Floodproofing Guidance for Citizens

1. Consult Flood Maps
2. Consult Floodproofing Flowchart
3. Consult City of Englewood
4. Develop an Emergency Plan
5. Get Flood Insurance
The National Flood Insurance Program

Español: Programa del Seguro Nacional de Inundación

The National Flood Insurance Program aims to reduce the impact of flooding on private and public structures. It does so by providing affordable insurance to property owners, renters and businesses and by encouraging communities to adopt and enforce floodplain management regulations. These efforts help mitigate the effects of flooding on new and improved structures. Overall, the program reduces the socio-economic impact of disasters by promoting the purchase and retention of general risk insurance, but also of flood insurance, specifically.

For more information, visit www.FloodSmart.gov. Watch this short informative video, Why do I Need to Rethink Insurance?
Questions?

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Emily Villines, CPSM, MA