An Overview of Retrofitting Residential and Commercial Buildings for Flood Mitigation

- Lowest floor elevation at or above DFE
- Openings allow floodwaters to enter enclosed area below floor (such as a basement or crawlspace)
- Attached garage
- Flood damage-resistant materials below the DFE
- Floor framing
- Foundation wall
- Lowest floor at or above DFE
- Openings allow floodwaters to enter garage
Two nationally recognized methods for modifying an existing home or commercial building

- Wet floodproofing – view FEMA documents
- Dry floodproofing – view FEMA documents

While these measures can minimize damage to individual homes or commercial buildings, they do not:

- address impacts to public and private streets, bridges and other public infrastructure.
- eliminate the need to evacuate in certain flooding conditions.
Wet Floodproofing

How does it work:

- Modifies existing portions of the house (such as a crawlspace, basement, garage or other uninhabited enclosures) so that floodwaters will enter the space but not cause significant damage to the rest of the home and its contents.

- By equalizing internal and external water pressure on the house, the likelihood of wall failures and structural damage to the home is reduced.
Wet Floodproofing

Considerations:

- Typically not viable for commercial buildings.
- Only practical in a limited number of residential situations.
- Requires relocation of duct work and service equipment such as furnaces or other utility equipment.
- Requires installation of drainage and/or pump system.
- Loss of storage space under the house
- Requires ongoing maintenance.
- After a flood event, areas below the house (such as the crawlspace) may require extensive clean-up.
- Still need to evacuate in certain flood events.
Dry Floodproofing

Benefits of method:

- Installation/construction of barriers, shields and impermeable membranes around the building.
- Reduces the risk of flood damage to a building and its contents.
- Does not require additional land for flood barriers.
- Appropriate for structures of reinforced concrete or masonry.
Dry Floodproofing

Considerations:

- “Only non-residential buildings can use dry floodproofing techniques.” – FEMA, March 2018

- Not recommended for wood-frame buildings (typical construction type for Marin homes).

- Intended to remain watertight for a limited duration, generally a few hours, and a flood depth typically less than 3 feet.

- Changes appearance of building due to extensive work to make building watertight, including impermeable membranes and supplemental layers of concrete. Additionally, waterproof shields must be installed over windows and doors.

- National guidelines require annual maintenance, updating and testing.

- Requires adequate warning time to allow for manual preparation for flood event.
San Anselmo Townhall (approximately 17,000 square feet)
- Underwent dry floodproofing in 2008
- Required floodwalls, floodgates, pumps and other modifications.
- Initial design budgeted at $230,000
- Final cost was $365,775
  - Additional needs were discovered during construction to bring building to current standards for flood proofing.
  - Equates to approximately $30 per square foot (adjusted to 2018 dollars).
- Important to note that this does not include design and project management costs.
Cost example of dry floodproofing

Ross Valley’s FEMA Special Flood Hazard Area

- 680 commercial buildings in the area
- Assume an average of 1,200 SF per building
- Estimated cost of $30 per SF (SA Townhall)
- Estimated cost of $36,000 per building

- $24,480,000 to dry floodproof all 680 commercial buildings in the Ross Valley

- This does not include design costs of $5,000 to $10,000 per building, which would add $3.4 million to $6.8 million to the total cost.
- Assumes no major structural changes or other modifications are needed