

## Flood Risk Management Multnomah County

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US Army Corps of Engineers  
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## 6 Steps to Flood Fight Success

Develop and sustain your community's best flood damage reduction practices using the following 6 steps and your "Whole Community" will experience their "Favorite Flood" because the headlines will proclaim...

***"Multnomah County Wins the Flood Fight"***



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## Your Steps To Flood Fight Success

- Identify hazards
- Analyze vulnerabilities
- Determine mitigation
- Prioritize actions
- Prepare
- Respond



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## Begin with the End in Mind....

*The 7 Habits of Highly Effective People*

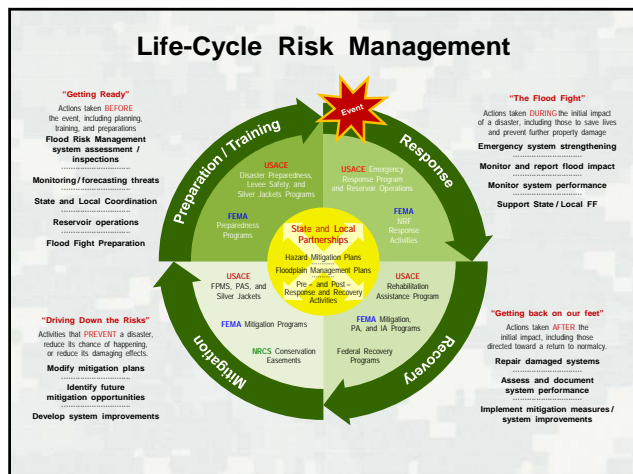
***Close your eyes, picture the following ...***



- *Your Family & Friends*
- *Home*
- *Personal Places*
- *Place of Employment*
- *Community....*



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## Multnomah County Flood Hazards

Multnomah County is subject to flooding from several distinct flood sources:

- 1) Overbank: Columbia, Willamette and Sandy River
- 2) Overbank: numerous smaller streams
- 3) Dam failures
- 4) Local storm water drainage systems

Flooding events from the above possible flood sources have very different characteristics.



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## Analyze Vulnerabilities

Flood Inundation Maps can be inaccurate or misinterpreted, so it is important to have the "Whole Community" check maps against their understanding and accuracy. Include anecdotal input from citizens, media, businesses and government agencies as a beginning to the following steps.



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## "Whole Community"

Includes anyone who wants to contribute. Strive to have everyone contribute, even if it is only more taxes....



- **Life**
- **Home**
- **Culture**
- **Economy**
- **Community**



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## Whatever you do... ...make it matter....

Hewlett Packard



US Army Corps of Engineers blow up a section of Levee in Mississippi to protect area residents from devastating loss, 2011.



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## Communicate Risk

<https://msc.fema.gov/webapp/wcs/stores/- NFIP Flood Maps>

Risk assessment is frequently updated for economic and insurance purposes.

Communicating **"Tolerable Risk"** to the "Whole Community" including County Agencies, informs everyone, they are essential....



NATIONAL  
FLOOD  
INSURANCE  
PROGRAM



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## Flood Risk Management Mitigation Laws, Regulations and Policy

This is arguably the most important step in the entire process, because the "Whole Community" determines:

- ▶ Tolerable Risks;
- ▶ Priorities;
- ▶ Schedules;
- ▶ Funding;
- ▶ Performance - "opening night";
- ▶ Sustainment - "Culturizing"



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## Culturize

This is a process through which flood damage prevention & reduction processes are incorporated into the "Whole Community"... eventually becoming routine practice....

- ▶ Living process
- ▶ Inclusive – individual to agency
- ▶ Uses existing community culture – home, schools and business
- ▶ Rewards healthy competition to reduce risk



## SMARTER Flood Risk Management

**S**pecific FRM actions: who, what, when, where, why, how

**M**easurable progress: "Whole Community"

**A**ttainable/Achievable expectations: people/organizations

**R**elevant/Realistic FRM: loss of life and property damage

**T**ime sensitive: independent and interdependent FRM actions and/or resources

**E**valuate and adjust: SMART goal/objective/task based on resources (change in priority)

**R**ewarding accomplishments: economically, intrinsically, socially and culturally (human and environment)



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## SMARTER FRM

Are all known sites, at risk of being flooded, specifically listed as a Flood Hazard Action Item in your Natural Hazard Mitigation Plan?

Is there at least one emergency mitigation action which is carried out through Flood Fighting, listed for each Action Item?



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## Flood Fighting

Flood Risk Management emergency actions in advance and during high water events:

- ▶ dam & reservoir operations;
- ▶ evacuation of people, pets, live stock, vehicles, equipment and materials;
- ▶ elevation of the same;
- ▶ reinforcement and placement of inundation and erosion barriers



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## Prepare

- Permanent FRM Mitigation Sites
- Localized Flood Risk Management Sites
- Prepare
  - ▶ Design
  - ▶ Plan
  - ▶ Resource
  - ▶ Rehearse



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## Prepare Effectively – 3 Realities

- *“all disasters are local”*
- *“failing to prepare, you are preparing to fail.”* - Benjamin Franklin
- *“lack of planning on your part does not constitute an emergency on my part.”*



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## Prepare Effectively - Warning

<http://water.weather.gov/ahps/>



## Prepare Effectively - Rehearse

A rigidly-flexible approach is required to sustain rehearsals for an “opening night” performance, with the flexibility to move the performance to another facility...the night before....



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## Respond

Warning & Resources Aligned

Pre-event Measures Triggered by Risk & Resources

Choreographed Response Operations

Site-by-Site Response as Rehearsed



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*...when we're exhausted... we never forget...those we are helping have it much worse than we do....*



Jim Mullen  
Washington State  
Emergency Management Director  
2012 WSEMA Conference



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## Keys To Success

- **Inclusive** – Whole Community
- **Leadership** – Champions with “hand-offs”
- **Vision** – Realistic & Attainable
- **Strategy** – Culture & Patience
- **Tactics** – Specific & Accountable
- **Proactive** – Push, Pull & Persistent
- **Fun** – Award & Reward



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## Summary

*Sustain improvement until every citizen, resident, business, cultural entity and community agency successfully sustains their expected level of flood damage reduction, by these steps:*

- ✓ Identifying Hazards
- ✓ Analyzing Threats
- ✓ Communicating Risk
- ✓ Developing Policy for a continuously risk reducing culture
- ✓ Mitigating Risk Permanently
- ✓ Planning and rehearsing an “opening night” performance
- ✓ Responding as Rehearsed
- ✓ Recovering as Rehearsed
- ✓ Evaluating and improving the process



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## OPPORTUNITY or TOO LATE?

*"We are now faced with the fact that tomorrow is today. We are confronted with the fierce urgency of now. In this unfolding conundrum of life and history there is such a thing as being too late. **Procrastination is still the thief of time.** Life often leaves us standing bare, naked and dejected with a lost opportunity. The "tide in the affairs of men" does not remain at the flood; it ebbs. We may cry out desperately for time to pause in her passage, but time is deaf to every plea and rushes on. Over the bleached bones and jumbled residue of numerous civilizations are written the pathetic words: "**Too late.**"*

Martin Luther King Jr., New York Riverside Church, Beyond Vietnam , April 4, 1967



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## Break



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### Fighting Floods – "So what" Factor....



March 2008 Cape Girardeau, MO  
successful flood fight – raised levee  
height with sandbags

May 2001 Davenport, IA successful  
sandbagging flood fight of John O-  
Donnell Stadium

May 2002 Crystal City, MO successful  
sandbagging flood fight of Dairy  
Queen



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## Flood Fight Basics

Design

Plan

Rehearse



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### Basics

Why, where, what, when, how and who ....

- Right & legal priority
- Specific location & access (Real Estate agreements)
- Coordinated Emergency Operations
- Warning & triggering
- Collaborative design
- Identified Resources
- Assigned Responsibilities
- Remember to cover preparation, prevention, response and recovery
- Link it to permanent mitigation



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### Why a Rehearsed Flood Fight?

- Permanent flood mitigation takes years to complete
- Because “spontaneous” flood fight efforts do not meet expectations



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### Tough Decisions

- Warn and Evacuate Only
- Flood Fight Priorities
  - ▶ Safety
  - ▶ Benefits
  - ▶ Impacts
  - ▶ Capability
- Assumptions



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### Flood Fight Tools

- Sandbags
- Baskets
- Geotechnical Grids
- Impervious Fabrics
- Water Filled Bladders
- Water Weighted Floaters
- Barricades
- Agricultural Products and Containers
- Managing Leakage/Seepage
- Web Sites



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## Flood-Fighting Structures Demonstration and Evaluation Program

- US Army Corps of Engineers
- Engineering Research and Development Center
- Laboratory and Field Testing in Vicksburg, Mississippi
- ERDC Online Reports
- Evaluated 4 foot high level of protection



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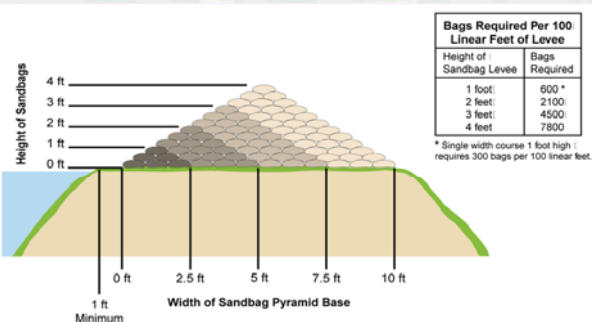
## Sandbags

- Most flexible method
- Standard size is 14"x26"
- Three stage operation: fill, transport & place
- Corps test results:
  - ▶ Labor intensive
  - ▶ Results contingent upon trained people
  - ▶ 10 ft. wide foot print (4' high structure),
  - ▶ Very stable on uneven and soft terrain
  - ▶ Low seepage
  - ▶ Quick removal by equipment



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## Typical Pyramid Sandbag Placement



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## Sandbagging Task Force Concept

- Incident Command System (ICS)
- 100 Person Organization
  - ▶ 1 Leader and 1 Assistant
  - ▶ 2 Safety and Health Specialists
  - ▶ 1 Logistics Specialist
  - ▶ 5 Crews of 19 people
  - ▶ 18 Crew members = 6 Buddy Groups of 3 people
  - ▶ Crew Boss
- Estimate: 90 minutes, 2' High, 100' Long Sandbag Structure with Plastic Barrier = 2,200 bags
- Volunteer Health & Safety



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## Fargo North Dakota - 2009



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## Fargo - 2009



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## Cul-de-sac Kit Fargo, North Dakota

- •24 Shovels • 3 Express Baggers
- •4-pallets
- •10,000 Empty bags
- •5 buckets
- •Tarp
- •3 Rolls Poly
- •Sand delivered to kit
- •20 Twist tie tools
- •5000 rebar ties
- location
- •Instructions



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## Advanced Sandbagging Fargo - 2009



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## EZ Bagger

- Sandbag filling tool
- One person
- Quickly hooks and releases
- Scoop sand
- Weighs 14 ounces



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## Flood Fighter

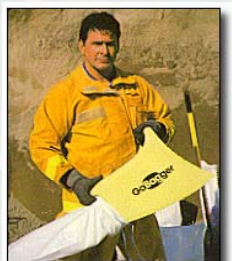
- Sandbag filling tool
- One person
- Sandbag slides on
- Slip tool out of bag
- Bag is two thirds full
- Tool weighs 2.2 pounds



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## GoBagger

- Sandbag filling tool
- One person
- Hold sandbag on the tool
- Scoop sand
- Weighs 5 lbs.



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## Bucket Bagger

- Sandbag filling tool
- Two people
- Bucket fills 47-56 bags
- Auger - sticky soils
- Hydraulic or electric powered
- Bobcat loaders



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## Sanding Truck Attachment

- Sandbag filling machine
- One person
- Place on road sanding truck
- truck's existing power and hydraulics
- Controls and bag table ergonomically designed



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## MEGGA BAGGER

- Sandbag filling machine
- Loader and chute operator
- Single/double chute motorized - manual controls
- Single/double chute motorized - auto control



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## Sandbagger - Multibagger

- Sandbag filling machines
- Loader and chute operators
- Gravity feed
- Motorized **auger** & agitator
- Multibagger
- Transportable in a pickup truck



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## Super Sacks

- Plastic fabric bag
- 1.4 yard bag - foot print (4' high protection)
  - 16' wide using side casting equipment
  - 26' wide with front end loader
- Usually stable on uneven and soft terrain
- Low seepage,



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## Super Sacks



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## Folded Plastic Barrier – Filled with Sand



Sand Hot Dog  
Woodland, Wash.  
Feb. 1996

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## CONTINUOUS SAND FILLED TUBES

- Sand filled continuous fabric tube
- Two people with heavy equipment
- Pyramid stacking
- 15' wide Foot print (4' high structure)
- Very stable on uneven and soft terrain
- Low seepage



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## HESCO Bastion Concertainer®

- Soil filled semi rigid container
- Steel mesh framework
- Containers unfold by hand
- Filled by heavy equipment
  - ▶ 16ft wide foot print (4' high structure)
  - ▶ 26' wide filled with loaders
- Corps test results:
  - ▶ Easy & quick to construct and fill
  - ▶ Not recommended for sloping or uneven or soft terrain
  - ▶ Easy to dismantle,
  - ▶ High seepage,



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### Hesco Baskets – Jamestown, ND - 2009



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### Rapid Deployment Flood Wall

- Soil filled grid
- Plastic grids unfold and place by hand
- Units are stacked to desired height
  - ▶ 20 ft wide foot print (4' high structure) filling with side casting equipment like a concrete mixing truck
  - ▶ 30' wide, filled loaders
- Corps test results:
  - ▶ Easy & quick to construct
  - ▶ Stable on sloping or uneven or soft terrain
  - ▶ Time consuming to remove, Units fold flat for storage
  - ▶ Very low seepage



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### RDFW w/ Sandbag Raise Jamestown, ND - 2009



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## Sandbags, Hesco Baskets & RDFW Jamestown North Dakota - 2009



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## Break



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## Portadam Portable Cofferdam Systems

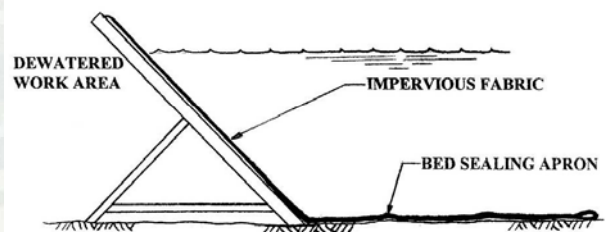
- Steel structure with impervious liner
- Assemble in place by trained crew
  - ▶ 9 ft wide foot print (4' high structure)
  - ▶ 15 ft wide, for monitoring and seepage management
- Corps test results:
  - ▶ Easy & quick to construct
  - ▶ Very stable except on soft terrain
  - ▶ Easy & quick to remove
  - ▶ Very low seepage



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## Portadam

Hydrostatic Loading Creates Seal to Stream Bed



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## AquaFence

- Anchored wall panel system
- Trained crew
- 8 ft wide foot print (3.9' high structure)
- Rapidly deployed and removed
- Not recommended for sloping or uneven or soft terrain
- Nearly no seepage



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## Aqua Dam Water Inflated Flood Barriers

- Uses any water source
- Two polyethylene liners contained by a single woven geo-tech outer tube
- 100% protection for back-water type sites
- For flowing water and/or waves 67% to 86% of filled height
- Rapidly deployed and removed
- 16 ft wide foot print (4.5' high protection)
- Very stable, even on soft soils
- Very low seepage



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## FloodWalls™ Water Inflated Flood Barriers



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## Tiger Dam Systems Water Inflated Flood Barriers

- Uses any water source
- Single tube
- Stack like a pyramid
- Rapidly deployed
- 3 tubes high: 10 ft wide foot print (4' high protection)
- Very stable, even on soft soils
- Easily removed
- Nearly no seepage



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## Tiger Dam System



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## Water-Gate™ Self-inflating Barrier



- Rapidly deployed and removed
- 30 - 50 ft long
- ½ ft - 6 ½ ft high
- 8 ft wide foot print (4' high barrier)
- Very stable except on porous soils
- Very low seepage



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## Jersey Barriers with Plastic Mount Prospect, Illinois - 2007

- Rigid concrete barricade
- Place by heavy equipment
- Sandbags and plastic required
- 6 ft wide foot print (2.5' high barrier)
- Requires firm and even foundation
- Moderate seepage



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## Mount Prospect, Illinois - 2007



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## Muscle Wall Water Filled Flood Barricades

- Water filled rigid container
- Interlocked on site manually
- Empty container weighs 110 pounds
- Each container is 6 ft. long, 4 ft. high and 2.5 ft wide
- Minimum foot print is 20 ft wide to accommodate a 10' apron, barricade and monitoring/seepage management area
- Designed for even and firm terrain
- Easily and quickly disassembles
- Minor seepage on impervious surfaces



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## Expedient Earthen Levee Construction



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## RDFW & Earthen Levee Jamestown, ND - 2009



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## Break

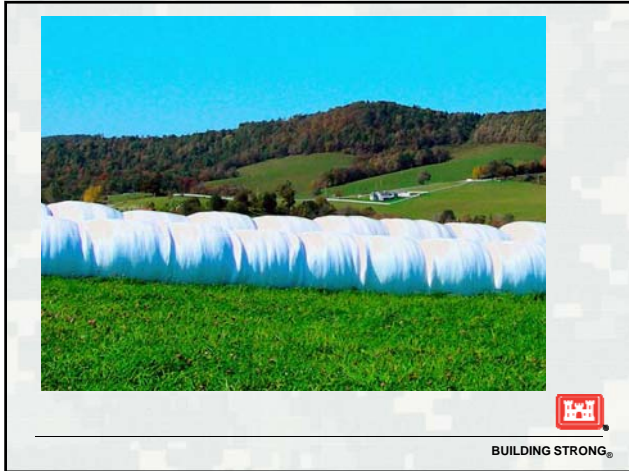


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## Flood Barriers using Agricultural Products



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## Leakage Management – Sandbags & Pumps Jamestown, ND - 2009



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## Crisafulli Pumps



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## Corps Information - Web Sites

- [http://www.metalithh2o.com/assets/pdfs/USACE\\_Non\\_Fed-Levee-Owners-Manual\\_Mar06.pdf](http://www.metalithh2o.com/assets/pdfs/USACE_Non_Fed-Levee-Owners-Manual_Mar06.pdf)
- <http://chl.erdc.usace.army.mil/ffs>



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## Sandbagging Tools - Web Sites

(In order of presentation)

- <http://www.freedomssafetyproducts.com/>
- [http://bagladyinc.net/Flood\\_Fighter.html](http://bagladyinc.net/Flood_Fighter.html)
- <http://www.gobagger.com/>
- <http://www.bucketbagger.com/>
- [http://bagladyinc.net/Sanding\\_Truck\\_Attachment.html](http://bagladyinc.net/Sanding_Truck_Attachment.html)
- [http://bagladyinc.net/Megga\\_Bagger.html](http://bagladyinc.net/Megga_Bagger.html)
- <http://www.thesandbagger.com/>
- <http://www.onetonbag.com/>
- <http://www.slingers.com>



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## Flood Fight Technology - Web Sites

(In order of presentation)

- <http://hesco-bastion.com/>
- <http://www.geocellsystems.com/index.htm>
- <http://www.portadam.com/index.html>
- <http://www.aquafence.com/index.html>
- <http://www.aquadam.com/index.htm>
- <http://www.usfloodcontrol.com>
- [http://www.hydroresponse.com/flood\\_barrier.htm](http://www.hydroresponse.com/flood_barrier.htm)
- <http://www.hydroresponse.com/watergate.htm>
- <http://www.hydroresponse.com/floodgate.htm>
- <http://www.musclewall.com>



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## Seepage Management Pumps

- <http://www.wackerneuson.com/en-prod-utility.php>
- <http://www.waterpumpsdirect.com/TrunkPump-TP-4PTR/p4468.html>
- <http://crisafullipumps.com/>
- <http://www.gator-pump.com/>



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## Feed Back!



- **Questions**
- **Information**
- **Suggestions**
- **Recommendations**
- **Way forward....**



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## Portland District Contacts

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