SAN MATEO COUNTY AIRPORTS

Levee Operations & Maintenance Manual

for the San Carlos Airport

County of San Mateo
620 Airport Drive
San Carlos, CA 94070

August 2010

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I. Purpose of Manual

The purpose of the "Levee Operations and Maintenance Manual for the San Carlos Airport" is to document the procedures for monitoring, inspection, operations, and maintenance of the perimeter levee improvements constructed by the City of Redwood City to protect the Redwood Shores peninsula from potential coastal flooding.

This manual serves as a guide for operating procedures before, during, and after a flood emergency, as well as for regularly scheduled maintenance. Operations and maintenance activities and responsible parties are identified in the manual for reference.

This manual is intended to be reviewed and updated on a regular basis with the latest revision date provided on the lower right-hand corner.

II. Background

The Federal Emergency Management Agency (FEMA) is updating and digitizing their Flood Insurance Rate Maps (FIRMs) for communities in San Mateo County. The new FIRMs will identify areas in the County that do not meet FEMA's new levee height requirements, which will trigger mandatory flood insurance for homeowners with federally backed mortgages within those communities.

Redwood Shores is one of the communities that would currently be placed in a flood zone under FEMA's new criteria. The city of Redwood City (City) has land use authority over the community and is working to upgrade the entire levee system surrounding the Redwood Shores peninsula, which includes the section of levee at the San Carlos Airport (Airport).

The levee at the Airport is owned by the County and is located within Redwood City limits and is also located inside the Redwood City General Improvement District 1-64 (GID-64), which was formed to finance the maintenance of levees within the district. The City has historically funded and constructed all of the levee improvements to the levee system protecting the Redwood Shores that are within its city limits and inside GID-1-64. The Airport has maintained the levee adjacent to the facility for several decades.

A small portion of the levee at the Airport is also within the Federal Aviation Administration (FAA) protected airport safety areas and cannot be raised at its existing location for flight safety reasons. The County is working with the FAA to study, design, and pursue funding for a more extensive long-term permanent solution that will reposition this portion of the levee away from the runway and into the adjacent slough in order to raise the height of the levee. These

improvements are expected to take many years to complete and will take place only if environmental and technical concerns can be met, and outside funding for the environmental studies, design, and construction of the improvements can be provided by the FAA. The County and City understand that the removable WaterGate Water Barrier is a permanent removable water closure device to be used on the levee until such time that a long-term permanent solution may be constructed.

Because of the FAA restrictions in the protected airport safety areas, the City initially planned to construct a bypass floodwall along Pico Boulevard between the Airport and Redwood Shores Parkway in order to meet the new FEMA flood requirements. However, the City later abandoned this approach and instead decided to pursue raising the levee protecting the Airport. City staff met with County staff in May 2009 and requested that the County allow the City to take the lead on the construction of a short-term interim improvement project. The short-term airport levee improvement project, which the City believed would be less difficult and less expensive to construct than the bypass floodwall, would include a removable barrier solution within the airport safety areas, which could be deployed in the event that a storm event was forecasted to top the levee. The County agreed to work cooperatively with the City towards the completion of the levee improvements.

The City's requirements related to the Levee Operations and Maintenance Manual at the San Carlos Airport are as follows:

- Purchase and provide the WaterGate Water Barrier and the required ancillary equipment necessary to maintain the WaterGate Water Barrier.
- Obtaining FEMA levee certification and ensuring that any future or on-going FEMA requirements are met, as may be needed to exclude Redwood Shores from the requirement of paying for flood insurance.
- Obtaining written FEMA approval for the use of WaterGate Water Barrier as an approved removable closure device if and when such time a permanent solution is constructed.
- Complete the construction of Airport levee improvements.
- County acceptance of the City's improvements to the Airport levee.

III. Location

The San Carlos Airport levee is located at the eastern side of the San Carlos Airport at the southeast corner of the Redwood Shores Peninsula. The levee is located within the city limits of the City of Redwood City and inside GID I-64. This Manual is intended to provide guidance only for the County-owned levee located at the San Carlos Airport. Refer to Appendix B for the location.

IV. Flood Emergency Operations and Procedures

The operations and maintenance of the County-owned airport levee during periods of expected flood emergency is separated into three phases as follows:

A. Initial Response Phase
B. Full Response Phase
C. Post Storm Phase

Activities for each phase are described in the following paragraphs. For operations and procedures of the WaterGate Water see Appendix A.

A. Initial Response Phase:

The Initial Response Phase occurs whenever the National Weather Service forecasts heavy rainfall of more than 4.0 inches within a 24-hour period and water levels are expected to be within 6" of the top of the levee. For further information, the National Weather Services can be reached at (831) 656-1727. Rainfall readings can be viewed at www.cnrfc.noaa.gov/mtr/rainfall.php. The major activities during this phase may include the following:

Mobilization - Mobilization is required as is necessary to carry out the operations under this phase and the WaterGate Water Barrier should be ready for deployment.

Patrolling and Preparation - During the Initial Response Phase, the facilities should be patrolled to inspect its condition. Preparation may include:

1. Checking that the WaterGate Water Barrier is ready for deployment and confirm that the appropriate vehicle is on standby.
2. Checking the availability of additional resources with agencies and private suppliers. Potential sources of equipment and supplies are listed in Appendix C.

Reporting – Memorandum reports, telephone, or verbal reports to the Public Works Director regarding condition of facilities and availability of equipment and supplies will be made when necessary and as conditions warrant or permit.

B. Full Response Phase:

The Full Response Phase should be initiated if the intensity of the storm as determined in the initial response phase presents a significant risk to levee protection. The major operations during this phase may include the following:

Mobilization – Full mobilization of all necessary equipment, supplies, and personnel. The WaterGate Water Barrier shall be deployed in this phase.

Patrolling and Response– During the full response phase, the levee should be patrolled and the appropriate safety precautions taken. Patrols may include:

1. Photographing Damage: Photographs locations where damage is occurring or has occurred, where damage has been repaired, where any unusual conditions are or have been encountered. Camera shall be available to the patrol or other personnel.
2. Resources: Contact agencies and private suppliers to obtain additional resources. Potential sources of equipment and supplies are listed in Appendix C.
3. Other activities: Any condition endangering flood control structures should be corrected as soon as possible.
4. Deploy the WaterGate Water Barrier.

Reporting – No written reports are necessary at this time. Radio, telephone, and verbal communications will be used where necessary. The Public Works Director will be advised of the condition of facilities when necessary and as conditions warrant or permit.

C. Post Storm Phase:

The Post Storm Phase begins when available hydrologic data indicates decreasing rainfall and slough are not anticipated to increase. The phase ends after rainfall has abated and after all the major operations indicated in the following subparagraphs have been completed.

Demobilization – Full demobilization is permitted during this phase. .

Patrolling and Repairs – During the Post Storm Phase the levees should be checked. The responsibility of the patrols may include the following:

1. Locating, Recording, and Photographing Damage: Damaged flood control facilities should be located, recorded, and photographed.

2. Initiating Repairs: Applicable temporary or permanent repair of damaged flood control facilities should be initiated and this phase shall include obtaining all necessary authorization for such repairs.
3. Inventorying equipment and materials: The WaterGate Water Barrier should be inspected and stored for subsequent storm periods.

Reporting – A report shall be made to the Public Works Director, including but not limited to a description of the various phases of the flood damage to flood control facilities, damage to public and private property, and any other pertinent data as necessary. The report shall also contain photographs showing high flows and any damage to project facilities.

V. Request for Flood Emergency Assistance

The levee improvements were constructed by the City of Redwood City to protect the Redwood Shores peninsula from potential coastal flooding. The City of Redwood City has an obligation, and has agreed to, provide resources to the County of San Mateo in the event that the WaterGate Water Barrier or the levee itself fails or is overwhelmed.

VI. Flood Fighting Methods

The main causes which may contribute to levee failure during periods of high water or flood flows are: seepage through or under the dikes of sufficient magnitude to cause a "boil", leaks through the levees caused by burrowing animals, erosion of the levees due to current or wave action, and overtopping as a result of adjacent water surface or wave elevations in excess of levee height. The various methods used to prevent levee failure are known as flood fighting methods. The flood fighting methods described in the following paragraphs are consistent with the practices by the California State Department of Water Resources and the U.S. Army Corps of Engineers. A copy of the Flood Fighting Methods, dated August 2003, by California State Department of Water Resources is attached as Appendix D for reference.

A. Boils

A boil is a condition whereby enough pressure is produced by a high water stage so that water is piped through or under the levee with sufficient velocity to carry earthen material to the landward side. These danger spots are serious if sand and other material are being carried in suspension by the discharging water. If not controlled, these particles of earthen material will be eroded from within the levee at an accelerated

pace, thus causing a local subsidence of the levee section. The continuation of this process will eventually result in a break in the levee by allowing the flood waters to flow directly over the crest or through the levee.

The common method of controlling boils consists of building up a watertight sack ring around the boil to a height necessary to reduce the velocity of flow in which earth material is no longer discharged from the boil. The flow of water should never be stopped completely, because this may cause the boil to "break out" in an area adjacent to the existing sack ring. The sack ring around the boil should be large enough to effectively encompass the defective area immediately surrounding the discharge spot. If several boils of sufficient force to displace sand or earth are observed, a sack sub-dike may be built around the entire nest of boils to such a height that none of the boils will discharge with enough velocity to move sand or other material from the levee foundation. If the boil is close to the levee, a U-shaped chimney may be built around the boil and sealed into the levee slope. This method may also be used to control flow through a rodent hole which is discharging water from the levee slope.

B. Wave Wash

Though this segment of levee does not exhibit wave action the potential for future improvements to create a fetch for waves to develop exists. Therefore wave wash flood fighting methods are presented here for future reference.

All levees adjacent to wide stretches of water should be watched during periods of high wind to detect the starting of wave wash. If the slope is protected by riprap revetment or is well sodded, a high wind of a limited duration should cause little damage. During periods of high wind and high water, ample labor should standby, and experienced personnel should observe where the washouts are beginning. If the current is slow and the slope not steep, the wave wash can be detected by wading along the submerged slope. During periods of high wave action, the wave wash may have to be located by sounding the dike face. A moveable type of wave wash protection consists of wood panels which can be built rapidly at any convenient place and easily installed. Another method of wave wash protection is the use of sections of cotton bagging adequately weighted and placed over the washed areas. A third method is the placement of sandbags directly in the eroded area. The bags should extend to sufficient height to give protection above the anticipated rise in water surface.

C. Current Scouring

A careful observation should be made of the bay-side slopes of levees to detect possible erosion due to current action. Trouble spots may occur at any location subjected to heavy wave action, road crossing ramps and locations where pipes and other structures penetrate the levees or obstruct the channel. If any indication of scour is observed, soundings should be taken to measure the amount and progress of the scour. An effective method to check scour on slopes or at the end of levees is to construct deflection dikes using brush, tree tops, or lumber. An effective deflection dike can be constructed by driving pairs of long stakes, wiring together and filling in between the stakes with brush and filled sacks or stone. Levee scour can also be alleviated by the use of the methods employed for wave wash prevention, if care is taken to see that scour does not take place under the protection thus afforded. In general, velocities within the Steinberger Slough are not expected to cause significant scouring.

D. Levee Topping

If any reach has an elevation lower than the anticipated high water elevation, steps should be taken to provide emergency topping to raise the levee grade to forecasted flood heights. The following is a brief description of the various methods that may be used to increase dike height.

1. Sack Topping – Sack topping may be used to raise the crown of the levee about three feet. The sacks should be laid stretch-wise or along the levee crest for the first layer, crosswise for the second layer, and so on. Sacks should be lapped at least one-third either way and well mauled into place. When properly sacked and tamped, one sack will give about three to four inches of topping.

2. Lumber and Sack Topping – A common method of raising low reaches during emergencies is by the use of lumber and sack topping. This method utilizes wooden panels on the watershed side of the levee crown. The panels are reinforced on the landward side of sandbags. Stakes, 2”x4”x6’ and spaced 6 feet apart, should be driven into the levee on the bayside of the crown. Panels shall then be attached to the side of the stakes facing away from the channel. The wall should then be backed with a sufficient number of sand bags to support the panels against the anticipated high water. In extreme cases, a three-foot topping may be provided if properly braced behind with sacks and

earth. In some instances, it may be practical to back up the panels with tamped earth, obtained in the vicinity, in lieu of sandbags.

VII. Operation and Maintenance

A. Maintenance

Maintenance activities for the levees are described here, while maintenance for the WaterGate Water Barrier are provided in Appendix A. All structural repairs shall be made upon consultation with an engineer and in accordance with standard engineering practice. No significant change or alteration shall be made to the levee which would adversely affect its stability and operational integrity without prior evaluation by a licensed engineer and authorization by the County.

B. Inspections

Levee inspections will include the following:

1. Levees will be visually inspected at a minimum every six months for signs of erosion, or settlement.
2. Levee tops will be inspected for areas requiring maintenance to ensure safe access for emergency vehicles and maintenance vehicles.

Other inspections may be made following each major high water period and at such intermediate times as may be necessary to ensure the best possible care of the levees.

Inspection of the levees may include signs of the following:

1. Unusual settlement, sloughing, or material loss of grade..
2. Caving has occurred on either the landward or the riverward of the levee which might affect the stability of the levee section.
3. Seepage or saturated areas are occurring.
4. Drainage system is in good working condition and that such facilities are not becoming clogged.
5. Crown of levee is shaped to drain readily.
6. Unauthorized vehicle on the levees.
7. Rodent damage along the levees.

C. Operation

During flood periods the levees shall be patrolled per Section V. Flood Emergency Operations and Procedures to locate possible sand boils, unusual wetness of the landward slope, or levee breaches. The inspector may look for indications of sliding or sloughing, that wave wash or

scouring action is not occurring, that no low reaches of levees exist which might be overtopped, and that no other conditions exist which might endanger the integrity of the structure.

VIII. Items to Look for During Inspection Activities

A. Erosion

1. Types of Erosion:

There are several types of erosion that affect the levees. For example, the slopes of any embankment can become eroded from rain runoff, as shown in Figure 1 or by embankment overtopping, as in Figure 2. Depending on the extent of the erosion, the level of protection provided by the levee can be significantly reduced. In cases of embankment overtopping during a flood, there may be a total failure of the structure.

A second type of erosion often observed on embankments is wave wash. Under high water conditions, wave action can form long terraces along the length of the embankment slopes. If additional material or bank protection is not provided, the embankment will continue to cave as the waves work their way farther into the slope.

A third type of embankment erosion is caused by the flow of water within a river or channel. These flows can erode a channel bank or levee, or undermine other flood control structures and cause them to cave into the water. Bank caving or stream bank erosion can be a very serious threat to the stability of a levee. It's critical that the riverward bank be inspected for bank caving or erosion. If the river or stream bank erosion or caving is observed to be moving in the direction of a levee or floodwall, immediate action should be taken to stabilize the banks.

Figure 1 UNACCEPTABLE erosion of levee slope. (TX)

Figure 2 Flood damage. (WA)

B. Slope Stability

Some earthen materials tend to become saturated with water very easily. When this happens, they loosen stability and can't support their own weight. If a stream or river embankment is composed of these materials, the embankment will slump off and move down the slope into the river, causing a bulge at the base of the slope. When river banks break down such as in Figure 3, they are said to have slope stability problems and need to be repaired. Slope failures can lead to serious problems, especially if the failure occurs near a levee or floodwall. Levees, like riverbanks, are subject to the same soil saturation effects during a flood or period of heavy rainfall. Levees are generally less susceptible to slope stability problems because of the materials they are made of and because of their shallow slopes. However, slope failures have occurred during prolonged periods of high water or heavy rainfall. Figure 4 shows an earthen embankment that failed as floodwaters receded. While slope

failures will generally occur on the riverward slope of a levee, be aware that slope failures on landward slopes are also possible. A levee should be carefully inspected for slope stability problems after these events. A related slope failure/stability problem involves trees growing on or near the levee slopes. It's very important to prevent tree growth near levee embankments, because when the roots of these trees decay they leave voids in the soil, which allow water to quickly saturate the slope and cause a slope failure. Trees can also be uprooted and deflect flood flows into the embankment, accelerating the erosion of the bank. The classic signs of slope stability problems are listed below, and you should watch for these signs during routine inspections.

a. Wide deep cracks that parallel the levee crest. These cracks may also extend down the slope of the levee.
b. Vertical movement of the material along the crack. Remember that this movement may be very obvious or very subtle if the stability problem is just starting to develop.
c. If the slope has slumped or is starting to slump, examine the area along the toe of the embankment. In many cases there will be a noticeable bulge in the slope. Deep seated sliding often requires the removal and replacement of that section of the levee, and the stabilization of the area with a soil or rock berm.

Figure 3 Slope failure on bank protection project. (WA)

Figure 4 UNACCEPTABLE earthen embankment failure. (MN)

C. Animal Control

Close attention must be given to the presence of burrowing animals, since they may not be readily detected without a thorough inspection. Burrows created by gophers, muskrats, opossums, badgers, and other animals can lead to rapid levee failures during floods. Inspections to detect the presence of burrowing animal activity are generally most effective immediately after the levee has been mowed. Animal burrows that are identified should be thoroughly excavated and inspected, backfilled with compacted soil that is similar to material of the levee, and reseeded. This will avoid the possibility of water piping through unfilled portions of the burrows during a flood.

D. Cracking

It's important to closely monitor and evaluate all visible areas of cracking on a levee, to ensure they don't develop slope stability problems. Cracks in a levee develop when the levee material is saturated with water and when it is overly dry. Clay, like most impervious materials, will shrink as it dries and re-expand when wet. Clay levee surfaces tend to shrink and expand slightly, and some cracks in the surface of the levee are to be expected. Shrinkage cracks are generally narrow and shallow, not extending more than a few inches into the levee, but during long periods of drought they may extend as much as two feet into the levee. These cracks can run longitudinally or transverse to the levee or may appear as blocks. If the cracking becomes excessive, it needs to be reviewed even if the levee appears to be stable.

E. Ruts and Depressions

Ruts and other depressions often develop along levees or patrol roads as a result of pedestrian or vehicular traffic, settlement, or because of an inadequate crown slope. Ruts and depressions are a problem because they allow water to pond on the levee crest or access road. If left uncorrected, the ponded water will seep into the levee's interior or into roadway embankment, saturating the foundation material, and making the levee more susceptible to failure during a flood. The levee should be inspected for ruts, pot holes, and areas of standing water after it rains.

F. Seepage/ Sand Boils

Sand boils and seepage problems are not generally identified during routine inspections because these problems typically only appear under high water conditions. However, if sand boils or continuously saturated soils (not caused by ponding water or poor drainage) are observed on the landward side of the levee or floodwall under low water conditions, regardless of their size, they will likely become serious problems under high water conditions. Sand boils and under-seepage is a serious problem.

IX. Safety Precautions

Personnel working at or on any portion of the levees, channel, and/or appurtenance shall at all times take all possible measures to ensure their safety. Specifically, all personnel shall observe the following:

1. Determine and observe all precautions in the use of any chemicals.
2. All work on any structure or appurtenance shall be done with necessary safely devices; i.e., ropes, cables, ladders, safety harness.
3. All debris removal from levee during flood stage shall be performed with assistance of at least one other person.
4. Proper instructions and training shall precede the operation of all equipment.

X. WaterGate Water Barrier

Maintenance and operation of the WaterGate Water Barrier shall be in accordance with the latest version of Appendix A.

SAN MATEO COUNTY
AIRPORTS

Appendix A: WaterGate Water Barrier

August 2010

MegaSecur INC
ENVIRONMENTAL SECURITY

Water barrier

WATER GATE™

User's guide

For categories: **WA, WL, WP** and **Water-Plug**

CE

May 2010 edition

Appendix A

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● **EXTREMELY IMPORTANT, MUST ABSOLUTELY BE READ**
◇ ***Important information based on your installation***
● *Interesting information to know about the product*

Instructions for all categories of barriers

Complementary instructions for the **WA** category – Designed for streams

Complementary instructions for the **WL** and **WP** categories – Designed for flood control

Instructions in case of manhole backup

Appendix A

IMPORTANT NOTICE TO READ

IT IS STRONGLY RECOMMENDED THAT YOU READ ALL INSTRUCTIONS IN RED TO ENSURE THE SAFE INSTALLATION OF THE BASE TO THE BARRIER.

Considering the length of the manual, a 3 code colour system has been devised based on the importance of the information required for proper installation.

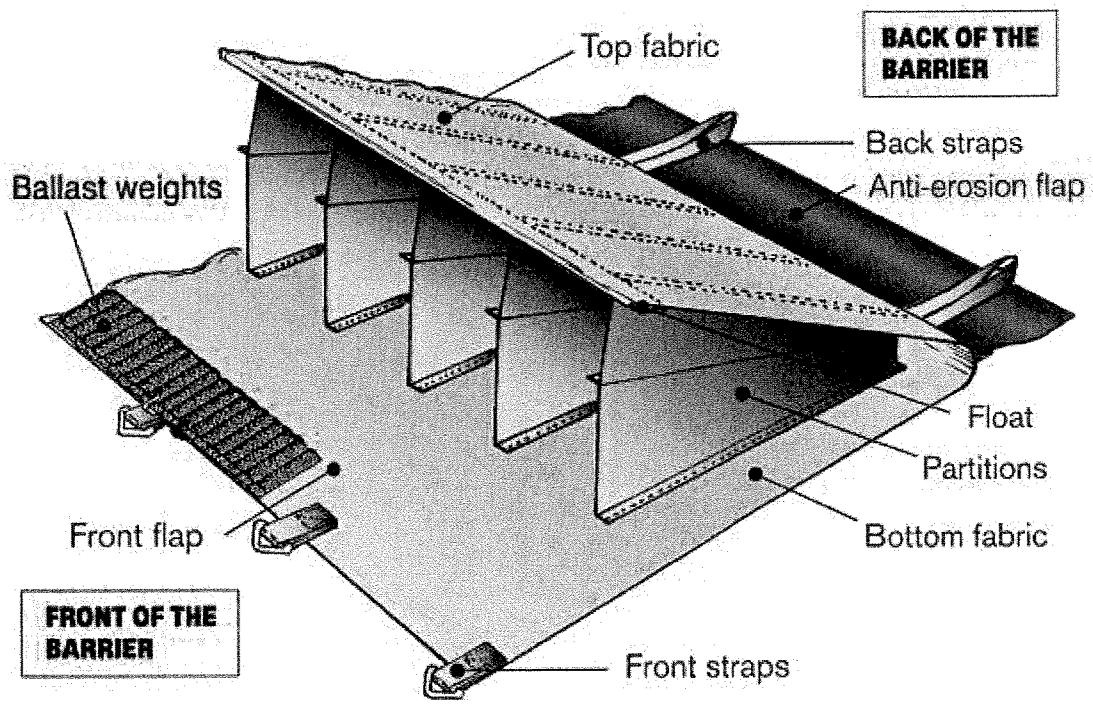
EXTREMELY IMPORTANT, MUST ABSOLUTELY BE READ

Important information based on your installation

Interesting information to know about the product

A trial installation is strongly recommended so as to be fully prepared in an emergency situation.

DESCRIPTIVE DIAGRAM



Appendix A

INTRODUCTION

Congratulations for acquiring the Water-Gate water barrier. All our products are manufactured with high quality materials and have been inspected to guarantee your safety.

RESPONSIBILITY

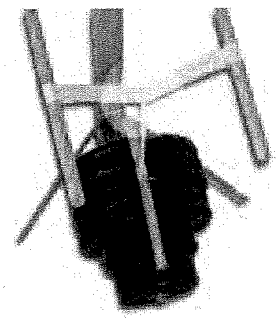
Before using your water barrier, it is essential to read the entire user guide and conduct at least one preliminary test. This is meant to ensure you master all the steps required for installing the water barrier. The vendor and manufacturer shall in no way be responsible for faulty installation and/or faulty use of the water barrier.

WARRANTY

Each barrier was manufactured and inspected according to strict quality standards. A registration number is printed on the ends of each barrier, which is warranted against all manufacturing defects.

SAFETY STANDARDS AND RESISTANCE

Above all, the water barrier is a working tool that must be reliable, safe and durable. Based on the standards set by MegaSecur, the Water-Gate water barrier will remain 3 times more resistant than required for a minimum water retention period of 3 days. For example, if 2 out of 3 partitions of the water barrier have come off when the barrier is filled to its fullest capacity, it will still retain its entire water volume for 3 or more days.



WATER BARRIER MANUFACTURING

The manufacturing of the Water-Gate water barrier is done by experienced workers with industrial sewing machines. The stitching used on the product is called "lockstitch". This type of stitch does not break even if the main stitch has been severed. A broken stitch does not affect the following stitches.

On top of using such secure stitching, we also provide a second parallel stitch on all partitions of the barrier (except the WL-06 model). The final stage of manufacturing consists in making a rigorous inspection of each barrier.

MAIN MATERIALS

For the WA and WL categories, PVC coated polyester canvas is used. The main advantage of this type of canvas is its resistance to abrasion. In other words, if the barrier is dragged along the ground, the risk of tearing is minimal.

For the WP category, woven polyethylene fabric is used. This fabric also resists well to tearing but is a little more vulnerable to abrasion.

All partitions in each category are manufactured with woven polyethylene fabric.

The sewing thread used is 100% polyester for all categories.

For the WL category, galvanized steel plates are used for the ballast weights.

Appendix A

DURABILITY

Considering that the water barrier is entirely made of polymer, the estimated longevity of the product can be over 20 years if the product is used occasionally and/or for short periods. Ultraviolet rays remain the most harmful factor for the components of the water barrier. However, the polymer canvas has been treated to counter the harmful effects of ultraviolet rays.

Since the barrier is entirely made of polymer, there are no risks of damage by humidity.

The barrier's materials resist temperatures of +50°C/+120°F to -40°C/-40°F. Even when stored for several years at these temperatures (maximum certification of 10 years depending on material manufacturers), the Water-Gate remains as effective.

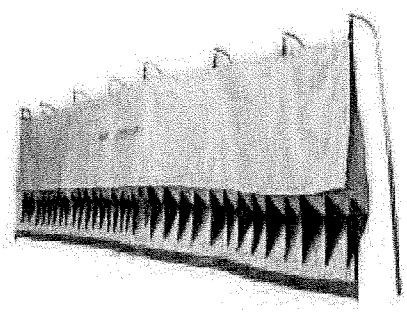
MAINTENANCE

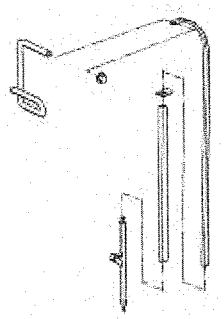
It is strongly recommended to wash and dry the water barrier before storing it. This allows you to check for any damages that may have occurred during use. Cleaning the product with a pressure washer is strongly recommended. Dirt and trapped in humidity do not affect the quality or the resistance of the barrier, but could lead to unpleasant smells when the barrier is used again.

To clean the barrier, hang it by the rear since it is equipped with at least one rear strap every 1.52 m/5 feet. A fence or side of a garage are excellent places to wash and dry the barrier. You simply have to install hooks on the top of your fence or on the edge of the garage. One hook will be required for each rear strap.

If you plan on making continuous intensive use of the barrier, you will need to have the right equipment for proper maintenance. Adjustable poles are available for barriers with a water retention level of less than 71 cm/28 inches. These poles make it easier to hang up the barrier. All you need to do is fasten the back of the barrier at shoulder height, and then extend the poles above your hands. One pole will be required for each strap.

To measure the exact distance required to install the hooks or the adjustable poles, we suggest unrolling the barrier next to the place you've chosen for washing and placing a hook facing each rear strap.

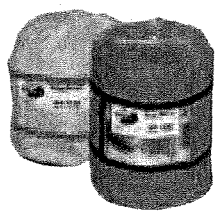




STORAGE BAGS

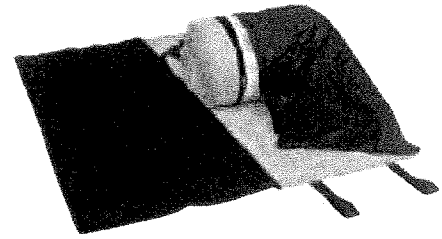
Three types of storage bags are available depending on the barrier category and model.
The "drawstring" type is the most popular because it is easy to use and less expensive.
The "handbag" type provides quick access to the barrier and is easy to handle.
Finally, the "blanket" type bag is used for heavier barriers that may require handling by more than one person.

Model		WA-1525	WA-1550	WA-2130	WA-2150	WA-2835	WA-2850	WA-3930	WA-3950	WA-5030	WA-5050	WA-6030	WA-6050	WA-7830	WA-7850	WL-0630	WL-1430	WL-1450	WL-2030	WL-2050	WL-2630	WL-2650	WL-3950	WL-5050	WL-6050	WL-7850	Entire WP category
Storage bags	Drawstring bag	●	●	●																							●
	Handbag															●	●	●	●		●						
	Blanket				●	●	●	●	●	●	●	●	●	●	●					●		●	●	●	●	●	



Drawstring bag

Handbag



Blanket

REPAIRS

In the event that your barrier is damaged in any way, we suggest you get it repaired by professionals who are used to working with this kind of material. Take your barrier to a business that usually works with canopies, canvas truck covers, tents or car shelters. This could even be your local shoe repair store. Repairs can vary in cost depending on the damages incurred.

1. For the WA and WL categories, if there's a tear or perforation in the PVC canvas, several methods can be used. These include contact cement for PVC, ultrasonic or thermal gluing, or sewing to another piece of material.
2. For the WP category and the partitions of all categories, if there's a tear or perforation in the polyethylene fabric, repairs are limited to sewing to another piece of fabric or applying adhesive tape specially made for that purpose.
3. If one or more partitions are torn along the seams, it could be very difficult and maybe even impossible to repair such damages. However, for the WA and WL categories, you can cut your barrier in half, pull out the ripped or damaged partitions, and glue your barrier back together.

STORAGE

The barriers can be piled one on top of the other, upright or flat, without this hampering their deployment. However, storing the barrier in a vertical position is highly recommended to maintain its shape when rolled up. We don't recommend setting the barrier directly on a damp surface. It is best to lay it on a wooden pallet.

If there is water trapped inside the barrier during storage, this will not affect product longevity as long as the water is dirt free. Fallen leaves and other waste material left inside the barrier can damage and dry up the fabric, thus reducing the useful life of the barrier. When the barrier is properly washed and stored, it does not emit any smells. However,

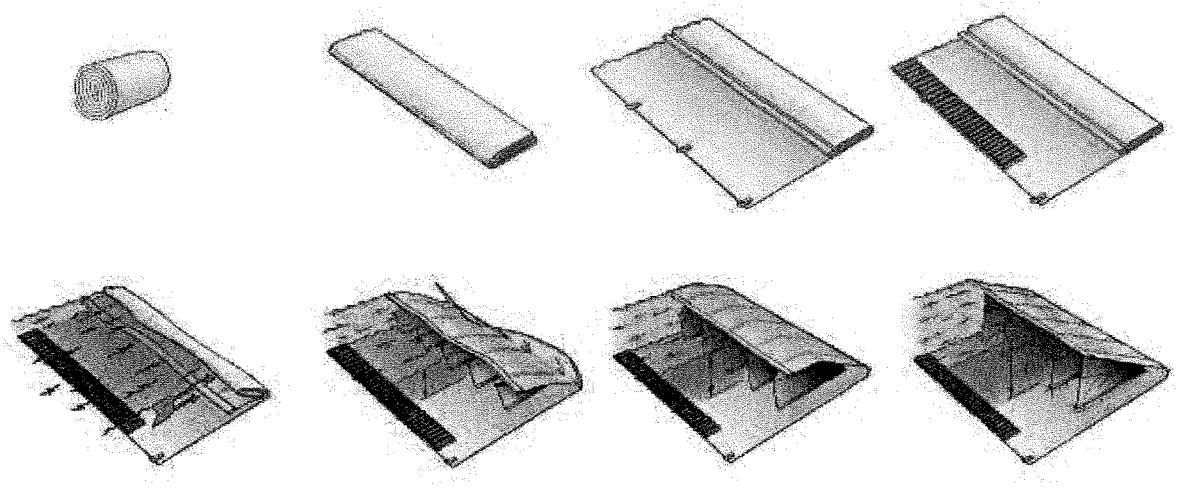
improper cleaning and storage may lead to some unpleasant smells when the barrier is deployed once again.

Every barrier should be kept in its storage bag or crate for protection against UV rays, dirt, and damages, as well as easier handling during transport.

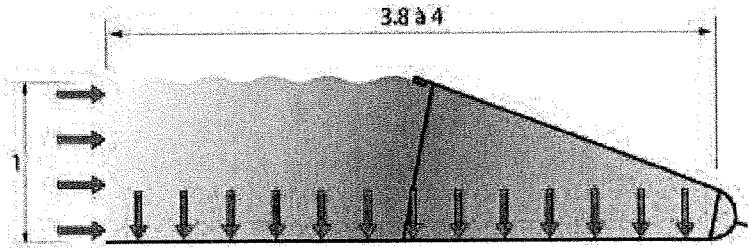
As far as rodents are concerned, they are not attracted to polymer canvas and will not chew this type of material.

● HOW THE WATER BARRIER WORKS

The principle is simple: water accumulates inside the barrier and exerts pressure on the bottom of the fabric, which keeps the barrier in place. The speed or direction of the incoming water is not important, as it is the water pressure that causes the barrier to open up.



◇ WATER HOLDING BACK WATER



The surface of the barrier on the ground is 4 times greater than its water retention height, which means it has 4 times more vertical thrust (toward the ground) than horizontal thrust, allowing for good adherence. In order for water to be able to hold back water on most surfaces such as asphalt or grass, a ratio of 1 to 2½ is generally sufficient to ensure safety. With a ratio of 1 to 4, the Water-Gate barrier is obviously very safe and the chances of it slipping are very slim. The wider the barrier is, the less likely it is to slip. To conclude, the Water-Gate water barrier is 33% safer than required.

Appendix A

RESISTANCE TO CHEMICALS

The materials were tested by an independent professional chemist using commercial solvents. The table below shows the results of trials made with the materials constituting the barrier. If a single element (such as the sewing thread or other) proved unsatisfactory during the trials, the results as a whole were rejected. It should be taken into consideration, however, that the physical properties of some solvents can be altered when they are mixed with water, creating a thermal reaction that can cause the barrier materials to melt.

	Solvent	Categories WA and WL	Category WP
Inorganic Acids	Hydrochloric acid or Aqueous hydrogen chloride	12 hours resistant	12 hours resistant
	Hydrofluoric acid or Hydrogen fluoride	12 hours resistant	12 hours resistant
	Anhydrous hydrobromic acid or Hydrogen bromide	12 hours resistant Discoloration	12 hours resistant
	Nitric acid or Hydrogen nitrate	Not recommended	12 hours resistant
	Phosphoric acid or Orthophosphoric acid	12 hours resistant	12 hours resistant
	Sulfuric acid	Not recommended	Not recommended
Bases	Sodium hydroxide or Caustic soda	12 hours resistant Major repairs	12 hours resistant Major repairs
Hydrocarbons	Gasoline, Diesel, Oil	12 hours resistant	12 hours resistant
Non-polar Solvents	Petroleum ether or Petroleum benzine or Light ligroin or Rubber solvent or Naphtha	12 hours resistant Major repairs	12 hours resistant
	n-Hexanes or Dipropyl	12 hours resistant Major repairs	12 hours resistant
	p-Xylene or Thinner fast dry TY25635	12 hours resistant	12 hours resistant
	Toluene or Toluol	12 hours resistant	12 hours resistant
	Chloroform or Trichloromethane	Not recommended	12 hours resistant
	Dichloromethane or Methylene chloride	Not recommended	12 hours resistant
Polar Solvents	Acetone or Methyl ketone	Not recommended	12 hours resistant
	Acetic acid (glacial)	12 hours resistant	12 hours resistant
	Ethanol or Ethyl alcohol	12 hours resistant	12 hours resistant
	Methanol or Methyl alcohol	12 hours resistant Inspection	12 hours resistant
	Formaldehyde or Formic aldehyde	12 hours resistant Inspection	12 hours resistant
	Methyl ether ketone or Ethyl methyl ketone	Not recommended	12 hours resistant
	Tetrahydrofuran or Butane	Not recommended	12 hours resistant
Others	Ethyl acetate or Acetic acid ethyl ester	Not recommended	12 hours resistant
	Acetic anhydrous or Acetic acid anhydrive	12 hours resistant	12 hours resistant
	Paint thinner	12 hours resistant Inspection	12 hours resistant
	Ammonium hydroxide or Ammonia solution	12 hours resistant	12 hours resistant
	Hydrogen peroxide or Hydrogen dioxide	12 hours resistant	12 hours resistant
	Calcium hydroxide	12 hours resistant	12 hours resistant
	Ferric chloride (anhydrous) or Iron trichloride	12 hours resistant	12 hours resistant
	Sodium hypochlorite (5%) or Bleach	12 hours resistant	12 hours resistant

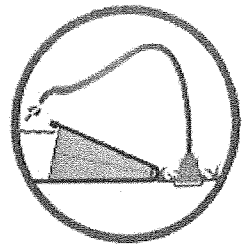
12 hours resistant:	The Water-Gate will resist for 12 hours
Not recommended:	The Water-Gate is not resistant to this fluid
Inspection:	Check for possible alterations of the containment shell (appearance, rigidity)
Major repairs:	Degradation of the containment shell

Appendix A

FOUR GOLDEN RULES TO FOLLOW FOR ALL CATEGORIES

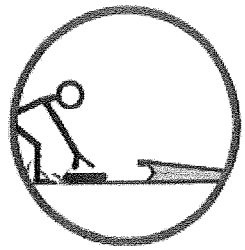
1. Pump the water at the back of the barrier

It's important to leave a reasonable amount of space between the building and the back of the barrier in order to install a water pump and be able to move freely. The water seeping underneath the barrier should not be left to accumulate behind the barrier. This is why the area should be kept dry using one or more water pumps.



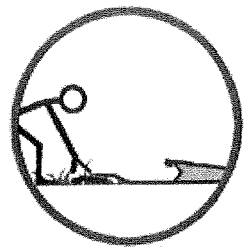
2. Place an even amount of weight at the front

Do not tie the barrier to the ground, as it uses the weight of the water to stop oncoming water. However, it is very important to place even weights along the entire length of the front flap to minimize water infiltrations underneath the barrier and keep it on the ground. Depending on the required application, MegaSecur offers models with integrated ballast weights for quick installation. Make sure these weights are well secured to the front flap and cannot come loose.



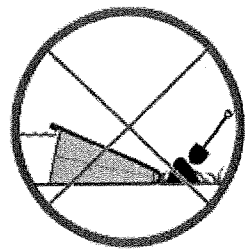
3. Prevent water from accumulating under the barrier

Remove all objects likely to create water infiltrations under the barrier flap. The barrier is designed to stay in place on all surfaces such as asphalt, gravel, lawns, and concrete paving blocks, but if there is too much water under the flap, the barrier will not adhere as well and may slip. It is thus important to make sure that the ground is free of objects that could cause water to accumulate under the barrier.



4. Never try to contain a leak at the back of the barrier

If there are leaks, stop the water from coming in at the front of the barrier. In most cases, such problems are caused by water infiltrations at the front. Trying to contain a leak at the back of the barrier will create a pool of water and make the barrier unstable.



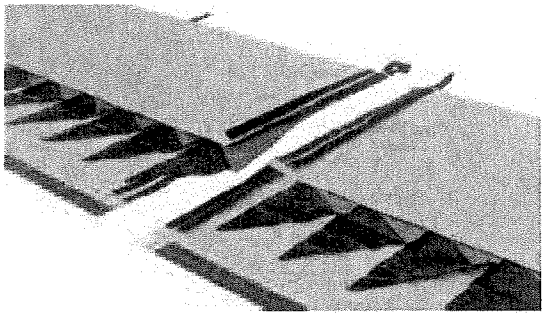
TYING TOGETHER TWO WATER BARRIERS

To tie together two water barriers, **BOTH BARRIERS MUST BE COMPLETELY UNFOLDED AT THE ATTACHMENT JOINTS.**

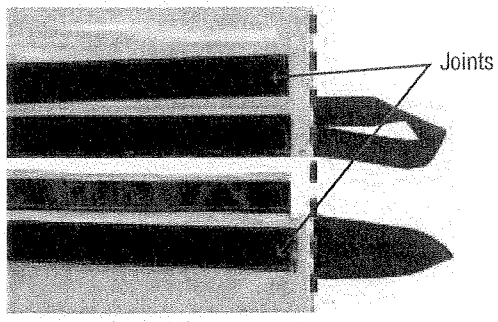
All our barriers, regardless of category or size (water retention), can be tied together, except for the smallest 6"/15 cm model, which can only be tied to barriers of the same size.

To tie together two water barriers, a straight surface is required, especially under the joint where the two barriers will be attached. Do not tie barriers together in moving water. If the temperature is below freezing, the water in the velvet strips and hooks may freeze, making it impossible to tie the barriers together.

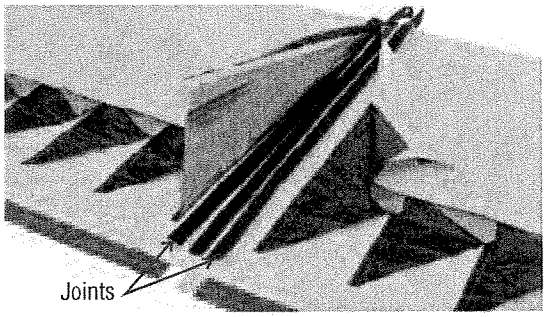
Appendix A



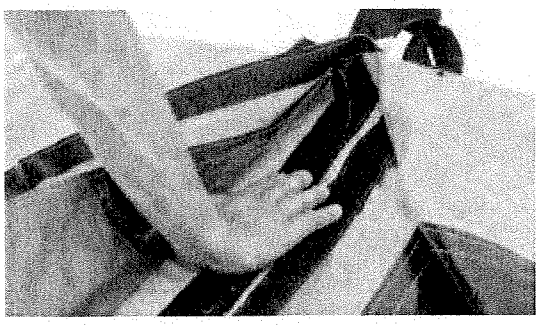
1. The first step consists in completely unrolling and unfolding the two barriers and laying them one next to the other.



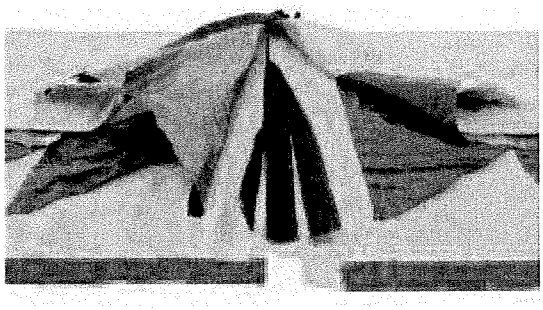
2. Both barriers must be aligned at the back. Make sure the joints are open.



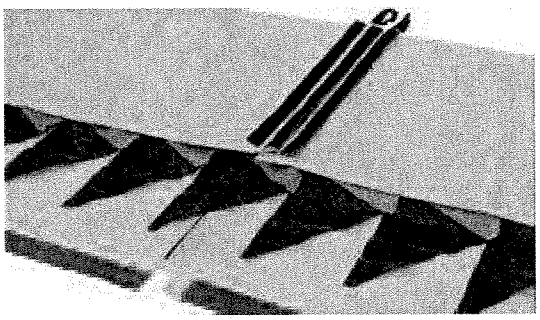
3. Open the top fabrics on each side to uncover the bottom joints and insert the barrier on the right into the one on the left.



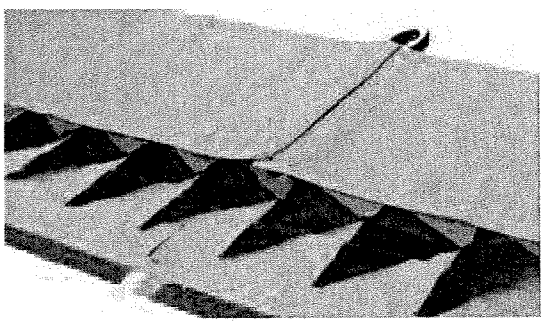
4. Close up the velvet strips and hooks by laying them one on top of the other from the back. Good dexterity is required to close up the back.



5. Keep closing up the velvet strips and hooks from the back until you end at the front.



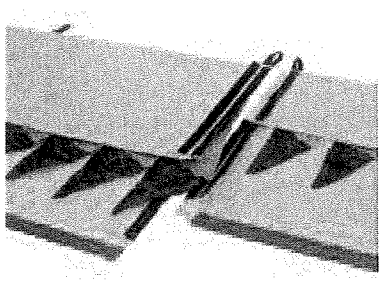
6. When you are done with the joint at the bottom, insert the partition of the barrier on the left in the partition of the barrier on the right and close off the top parts.



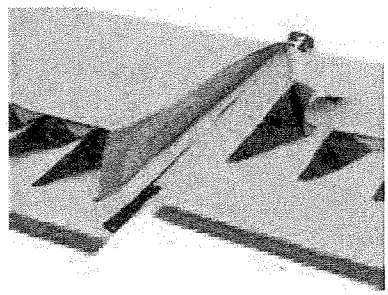
7. Close up the velvet strips and hooks by laying them one on top of the other, the same as you did for the bottom joint.

Appendix A

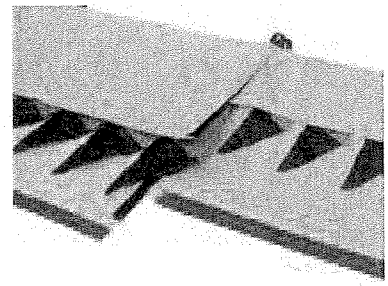
Use the same method to tie together two barriers of different sizes. Make sure the two barriers are aligned at the back.



Follow the same directions as in steps **1 to 5** above.



Follow the same directions as in step **6** above.



Follow the same directions as in step **7** above.

The two barriers are now attached. Refer to the category of barrier you possess to know how to proceed with the configuration you require.

● IDENTIFICATION NUMBER

To properly identify its barriers, MegaSecur assigns them a number identifying their category and size. The first two letters represent the category and the two numbers after the dash designate the maximum water retention height in inches. The last two numbers show the length of the barrier in feet.

Example: WA-2130 model
- WA = Identifies the barrier category. *(See "Applications for the Three Different Categories" below)*
- 21 = Water retention height: 21 inches or 53 cm
- 30 = Length of the barrier: 30 feet or 9.1 m

◇ APPLICATIONS FOR THE THREE DIFFERENT CATEGORIES

MegaSecur developed the water barrier to control floods. In time, users found it could also be used for other applications. This enabled the development of new barrier categories based on these applications.

1. WA category : This category is mainly designed for use in waterways. It can also be used to control floods but does not meet standards for this type of application.

a. Firefighters find it ideal for gathering water from streams that are too small to collect water from using a suction hose.
b. Contractors find it very useful for doing dry work in streams and rivers while respecting the environment.

2. WL category : This category is specifically adapted to flood control. It is made for intensive use and can be set up in record time.

3. WP category : This category is also designed for the control of floods. It is as sturdy as the other categories but is more vulnerable to abrasion, which explains its lower cost.

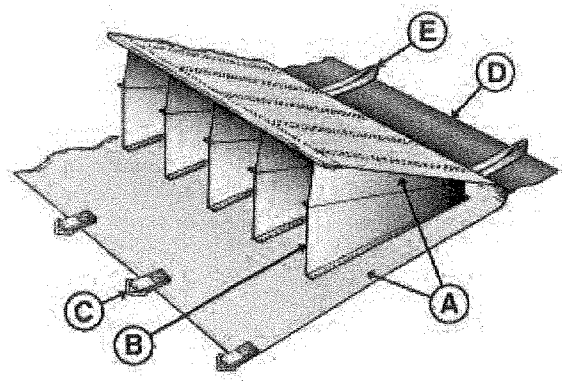
Refer to the appropriate instructions based on the category of barrier you have acquired.

----- WA Category -----

● MAIN FEATURES OF THE WA CATEGORY

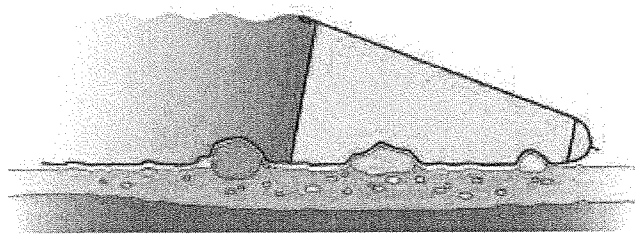
Designed for streams.

A - Polyester fabric coated with super heavy-duty, abrasion-resistant PVC suitable for use in streams with doubtful bottoms.
B - Compact partitions leaving the front flap free to stand or walk on for pumping water and crossing the stream more safely.
C - Metallic rings or polypropylene front straps to facilitate installation in some situations.
D - Anti-erosion flap to keep the bottom of the stream from eroding if the water flows over the barrier.
E - Heavy duty polypropylene back straps to facilitate handling.



◇ TWO PRINCIPLES OF ADHESION OF THE BARRIER INSTALLED IN STREAMS

1st principle: The pressure of the water on the bottom fabric of the barrier makes the barrier stick closely to the uneven bottom of the stream. Itís as if there were studs holding down the bottom of the entire water filled surface of the barrier. The more the bottom of the stream is uneven, the more the barrier adheres perfectly well.



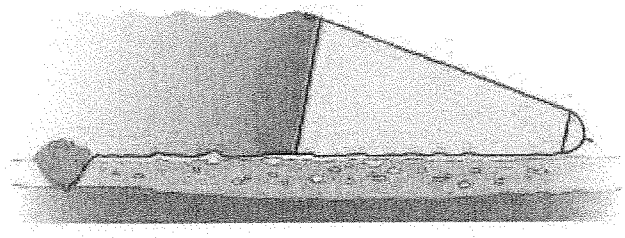
The water barrier will adhere very well in the great majority of streams and rivers. However, the bottom of some streams may cause problems if they mainly consist of sand or hard and smooth clay. Here are 3 types of bottoms that you are likely to come across:

A. Bottom of a normal stream composed of gravel: ± 95%
B. Bottom of a stream only covered with sand: ± 3%
C. Bottom of a stream composed of clay: ± 2%

A. Bottom of a normal stream composed of gravel: This type of bottom is found in the great majority of streams and rivers (± 95% based on our estimate). It consists of small gravel and/or big rocks. The barrier responds very well in this case. However, if the gravel is very thick, water infiltrations are likely to occur. To keep water from flowing under the barrier, make a trench across the stream and bury the front flap of the barrier.

B. Bottom of a stream only covered with sand: This type of ground is rarely found in streams (± 3% based on our estimate). The barrier adheres well to a sandy bottom, but you have to make sure that there are no water infiltrations under the barrier during installation. If this occurs, what may start out as a small leak can become difficult to control it and especially to stop. After some time, the leak can become so big that the barrier will sink into the hole made by the water and end up slipping. This phenomenon is called ìpipingî. Setting up the barrier in this type of stream is not

recommended. However, if it has to be done, the following precautions should be taken: 1) Bury the front of the barrier flap in the sand at a depth of more than 15 cm / 6 inches. 2)†Place sandbags along the entire length of the front flap of the barrier. 3) Insert a plastic tarp under the joints if 2 barriers have to be tied together in order to prevent infiltrations that could lead to piping.



Front flap buried in the bottom of the stream.

C. Bottom of a stream composed of clay: Certain streams are completely covered with clay (± 2% based on our estimate). The clay can be either solid and very slippery or unsteady and viscous. This type of bottom is rather rare, but when encountered, caution should be taken by better insulating the front of the barrier.

The WaterGate water barrier adheres to this type of ground. However, as soon as the water level reaches the full capacity of the barrier, the danger of slipping is increased because of the slippery surface. The following precautions should be taken in these conditions: 1) Place stakes behind the barrier so that it can lean against these stakes if it starts to slip. 2) Put ballast weights along the full length of the front flap to prevent water infiltrations under the barrier or bury the front flap.

2nd principle: The adhesion of the water barrier in a stream also depends on the following factors:

A. Overflow of water over the barrier
B. Surplus of water at the back of the barrier
C. Overflow of water over the barrier with a surplus of water behind it

The examples below are based on an installation in a stream with a bottom covered with medium size rocks and gravel. The result can be very different if the surface on which the barrier rests is more uneven or smoother.

A. Overflow of water over the barrier: The situation shown in Figure 1 is not likely to occur because there is no accumulation of water behind the barrier. In this case, the barrier can hold a surplus of water of up to about 33% on top. This approximate percentage represents the point at which the barrier will slip.

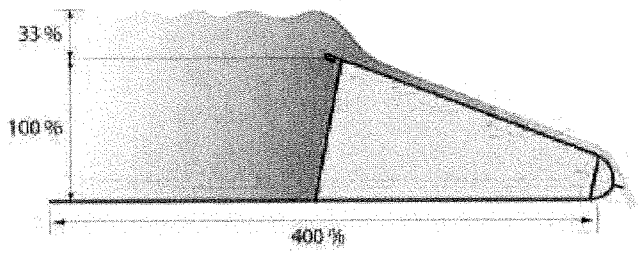


Fig : 1

B. Surplus of water at the back of the barrier: The situation shown in Figure†2 is the opposite of that in the previous figure. The risk of slipping is the same as in Figure†1, as the maximum acceptable amount of water behind the barrier is also ± 33%.

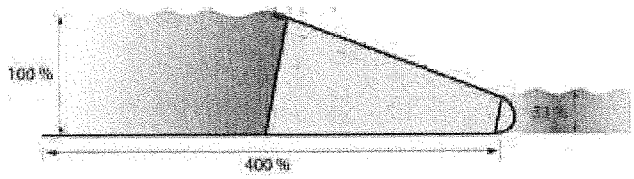


Fig : 2

Appendix A

C. Overflow of water over the barrier with a surplus of water behind it: The situation shown in Figure 3 occurs regularly. The water over the barrier added to the water behind it adds up 33%. Based on the slope and the flow of the stream, the surplus upstream can vary but the total amount of excess water cannot exceed 33%.

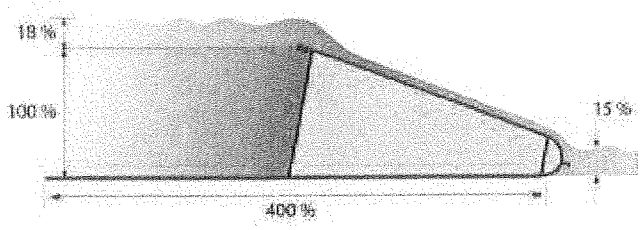
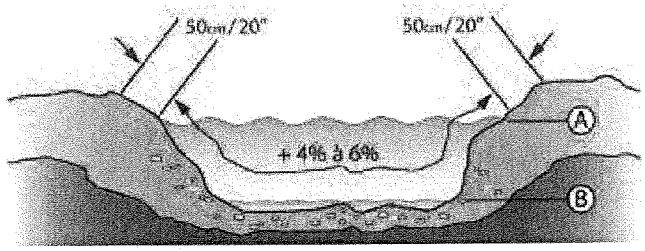


Fig : 3

◇ IDENTIFYING THE MINIMUM BARRIER LENGTH REQUIRED FOR A STREAM

Before deploying and installing the water barrier in a stream, it is important to determine the required barrier length.

Start by identifying the maximum water level Ⓐ that can be reached by the water as it accumulates where the barrier will be installed Ⓑ = water level before the installation of the dam) and add an additional distance of about 50 cm / 20 inches on each side. When the distance is determined, add another 4% to 6% to your initial measurement. This additional length will compensate for the fact that the fabric is stretched over an uneven surface and has to go around the large rocks at the bottom of the stream.

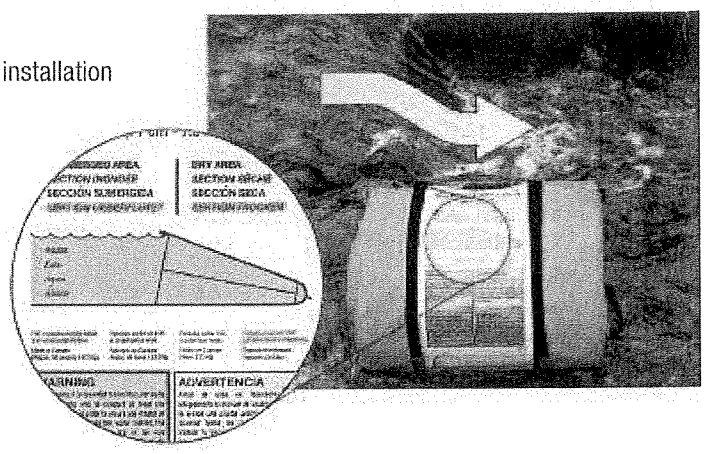


The barrier must be long enough to prevent the water from flowing out at the sides, otherwise it is almost sure to slip. On the other hand, it can't hurt if the barrier is longer than required. The opposite illustration shows the perfect efficiency of the halfdeployed barrier in this situation.

Appendix A

PREINSTALLATION ADVICE

Here is some practical advice for a successful installation right from the first try.

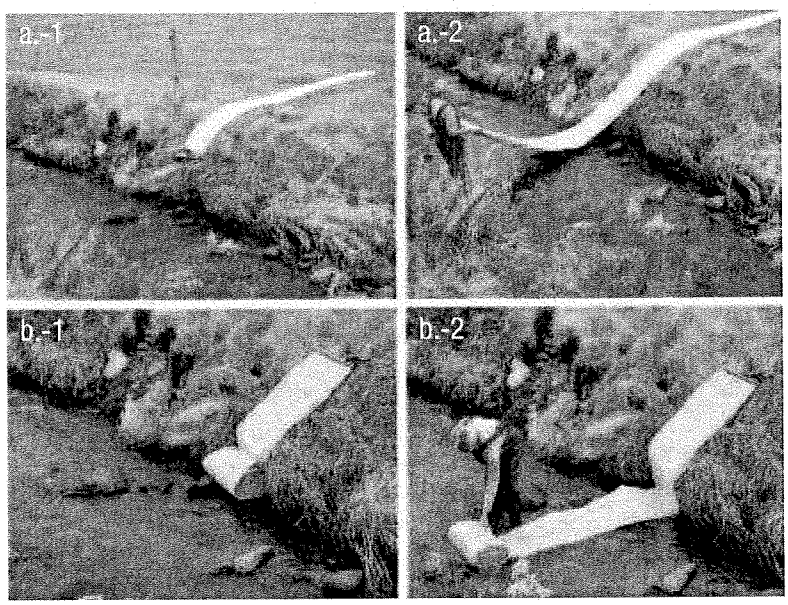


1. Make sure that the barrier is facing in the right direction based on the pictogram and instructions on the barrier.

2. Here are two good comparable methods to install the water barrier across a stream.

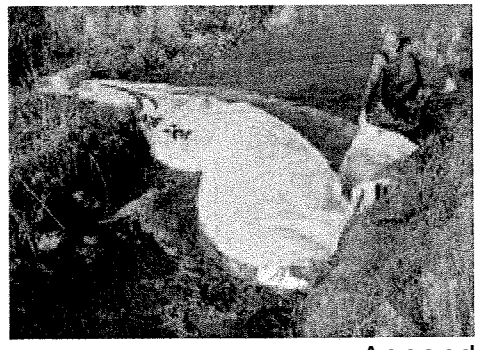
a. From one side of the stream, unwind the barrier flat on the ground and pull it across the stream.

b. Unwind the barrier directly in the water. This method can only be applied from one side of the stream because of the direction of the stream and the direction of the rolled up barrier.



The speed of the current in a stream does not generally affect the installation of the barrier. The unwound barrier will float if the current is very weak; if it is strong, the water barrier will sink to the bottom of the stream. There is little chance of the barrier drifting away with the current or being automatically deployed.

3. One last word of advice before installing the barrier: think about the possibilities for easy removal. There are various ways to remove the barrier but the most used is the fast method of removal. To do this, identify the side where the water has to be released from the barrier. This side will have its end slightly above the limit of the level of the accumulated water. By proceeding this way, the barrier becomes as easy to remove as it is to install.



Appendix A

◈ INSTALLATION OF THE WATER BARRIER IN A STREAM

After the water barrier has been unwound across the stream, make sure that the water does not go over the sides because the barrier is not long enough. (See the section entitled "Identifying the Minimum Barrier Length Required for a Stream" on p.12)

The following step is crucial for the successful installation of the barrier. Based on our estimates, we recommend having one person for every 3 m / 10 feet of stream width.

- Stream 3 m / 10 feet wide: 1 person is generally sufficient
- Stream 6 m / 20 feet wide: 2 people are strongly recommended
- Stream 9 m / 30 feet wide: 3 or more people are required

Of course, having an extra person will always be useful, especially if the current is strong.

1 – Plan to put ballast weights or rocks the size of your fist and even 3 times as large upstream from where the barrier will be installed. Use at least one rock or set of ballast weights for every foot or 30 cm / 1 foot along the part of the front barrier flap that will be underneath the water.

2 – After identifying the exact location for your installation, begin to deploy the front flap and MAKE SURE THAT NO WATER ENTERS THE BARRIER by lifting up the front flap.

3 – Quickly push the front flap of the barrier to the bottom of the stream. Once this step has been completed, no more adjustments can be made.

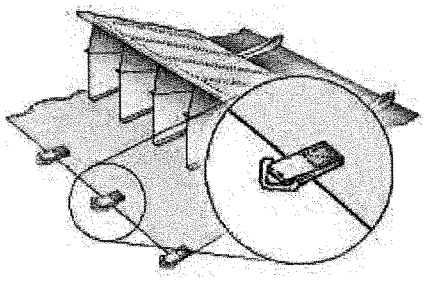
4 – At the same time, place your feet on the front flap to weigh it down temporarily while you put your previously gathered ballast weight, rocks, or sandbags in place.

5 – Continue to place other ballast weights along the entire front flap. It is easier to use rocks already available in the stream to place them on the front part of the front flap.

6 – To prevent water from seeping under the barrier, remove long pieces of grass, branches and any other objects that are likely to create infiltrations.

N.B. : The water tightness of the barrier will mainly depend on how much water gets underneath it. No barrier installed in a stream can be completely watertight because the bottom of the stream is generally covered with rocks and gravel. However, if you make a groove at the bottom of the stream, you can use it to bury the front flap of the barrier and obtain very good water tightness.

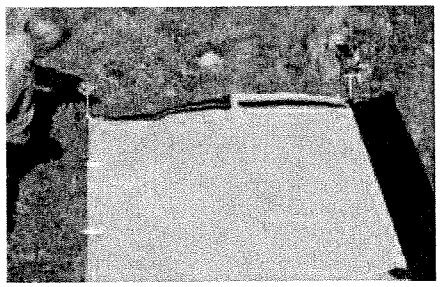
◇ USES FOR THE FRONT STRAPS



Here are the main uses for the front straps:

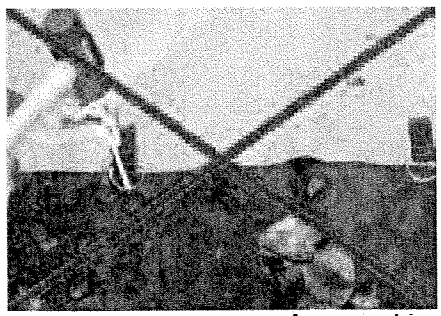
1. Attaching our model of ballast weights to make sure they stay fastened to the front flap of the barrier. (See the section entitled "Converting a WA Category Barrier into a WL Category Barrier" on p. 17)

2. Dividing up the water in a lake or pond. In this situation, unwind the barrier on the water and attach the front straps of the barrier to the bottom of the lake or pond. Then add evenly distributed ballast weights along the entire length of the front flap and pump the water behind the barrier. Attaching the barrier with stakes at the bottom of the lake or pond will prove very helpful when you begin to install the barrier, as the posts will hold it in place until the back is almost dry.

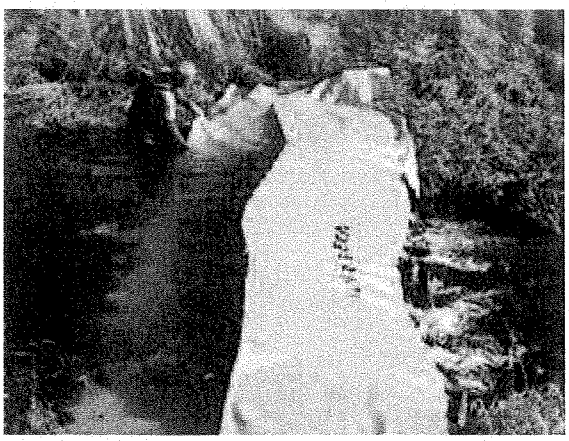


3. Holding back the ends of the barriers when there are steep slopes on the side of the stream.

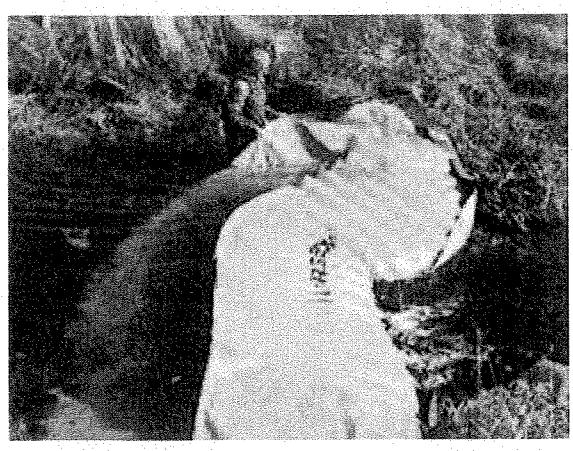
4. The front straps should never be used to attach the barrier with posts at the bottom of a stream to create a pool of water. Keeping the barrier down with posts can lead to water infiltrations under the barrier, as the posts will prevent the front of the fabric from being pressed tightly against the bottom of the stream. As time goes on, more and more water can seep under the barrier and cause it to slip.



REMOVING THE BARRIER

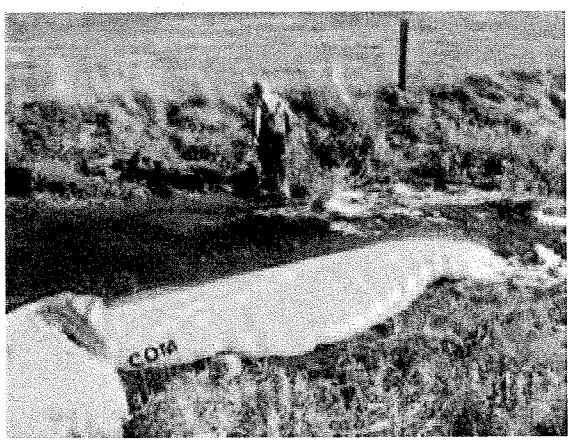


1 – After removing the ballast weights, lift the corner of the front flap and let the water flow under the barrier.

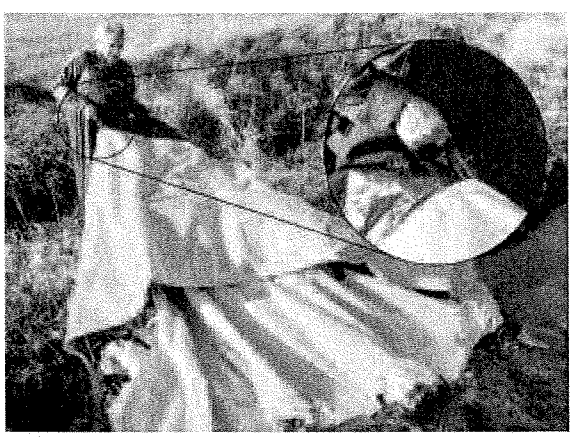


2 – Continue by lifting a wider part of the front flap until the barrier begins to slip.

3 – Move forward with the slipping barrier and support the front flap to keep it out of the water. This precarious operation is recommended to prevent the barrier from rolling up and make it easier to take it out of the stream.



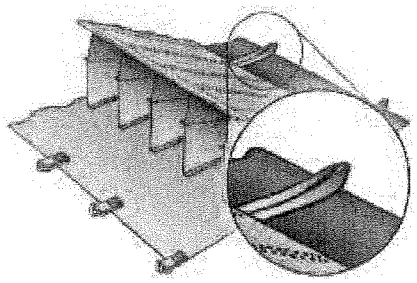
4 – As soon as the barrier is stabilized, allow the water in the stream to flow normally.



5 – To remove the water barrier, pull toward the back. Use the handles specially provided for this operation.

USE OF THE BACK STRAPS

The back straps are mainly designed to remove the barrier from the water and hang it up to facilitate cleaning and drying. Do not pull on the back straps if the weight to be supported is no more than 150 kg / 330 lbs. The solidity of every back strap was tested at 200 kg / 440 lbs. Although the straps resisted at that level of tension, the material was slightly deformed.



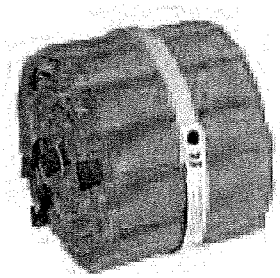
In certain conditions, the back straps can also be used to hold back the fabric of the barrier when there is a steep slope or prevent the barrier from drifting if the water is flowing toward the back of the barrier.

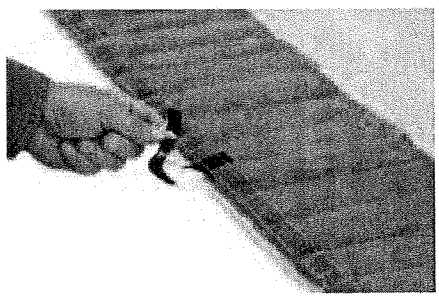
CONVERTING A WA CATEGORY BARRIER INTO A WL CATEGORY BARRIER

If you are using the WA category for the control of floods, refer to the instructions for the **WL** and **WP** categories, as the **WA** category will not adhere as well to some surfaces.

To convert the **WA** category barrier into an anti-flood barrier **(WL),** you must place ballast weights on the front flap. These ballast weights must be heavy enough so that it won't be carried away by the current. Furthermore, they must be properly fastened to the front flap so that they cannot slip away from this area of the barrier. Otherwise, the barrier will be very likely to slip. The ballast weights must be evenly distributed along the entire length of the barrier front flap.

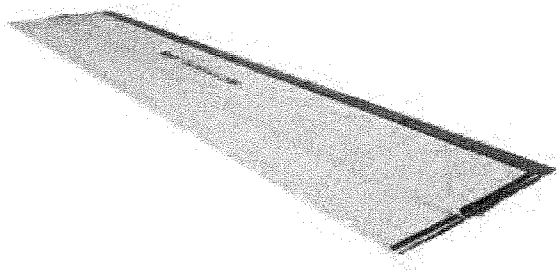
MegaSecur innovated by creating ballast weights designed to be fastened using the front straps of the barrier flap. These ballast weights are made from polyester filled with fine gravel.



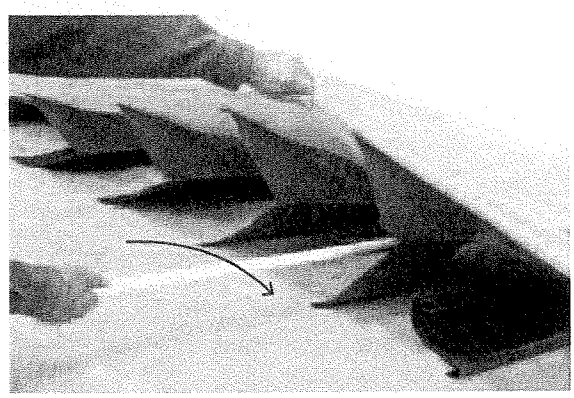


◇ FOLDING THE BARRIER FOR STORAGE

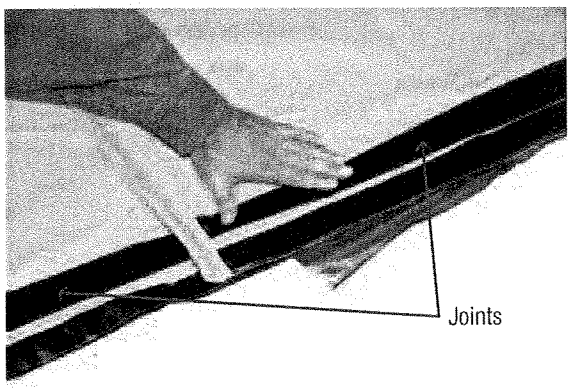
It is very important to fold the fabric correctly before the water barrier is stored. Improper folding may jeopardize the installation of the barrier when it is reused.



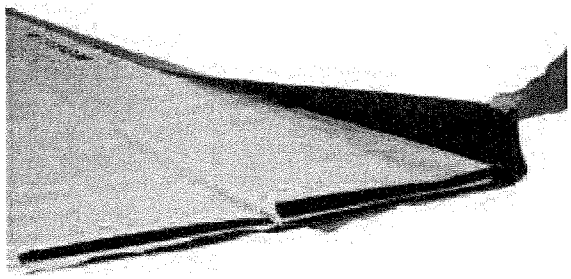
1 - After cleaning and drying the barrier, lay it on a large smooth surface.



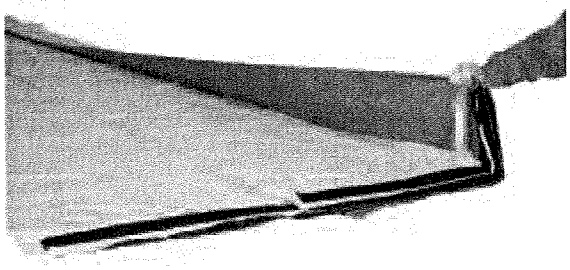
2 – With the help of a stick, make sure that all the partitions of the barrier are smoothed out.



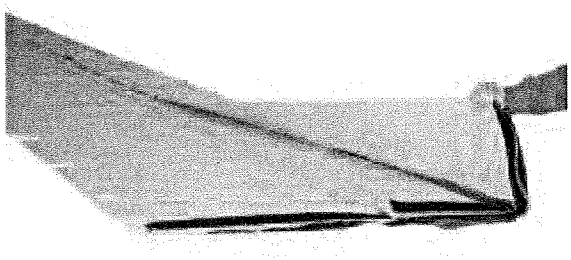
3 - Before folding the barrier, keep all the joints open to make it easier to attach another barrier if required.



4 – To begin, fold the anti-erosion flap.

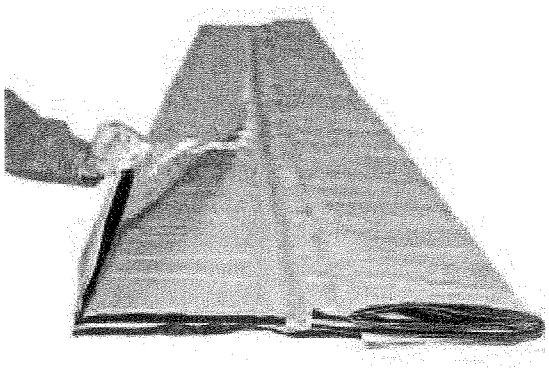


5 – Fold a first part of the back of the barrier by following the folds already appearing in the fabric.

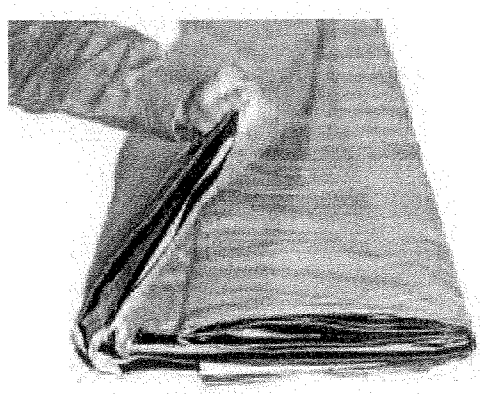


6 – Based on the barrier model, a second fold is often necessary. You have finished folding the back of the barrier when you reach the barrier float.

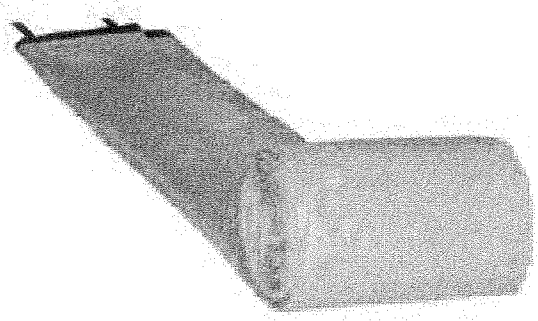
Appendix A



7 – Next fold a first part of the front flap following the folds on the fabric.



8 – Finish folding the front flap by folding it over the back of the barrier as a whole.



9 – Roll up the barrier on the opposite site of the banner.

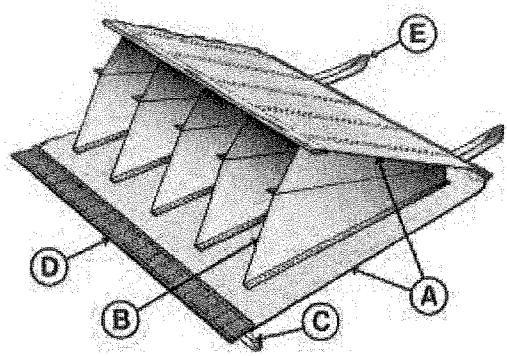
10 – When properly rolled up, the barrier should look like this.

----- WL and WP Categories -----

MAIN FEATURES OF THE WL CATEGORY

Designed for flood control – For industrial use.

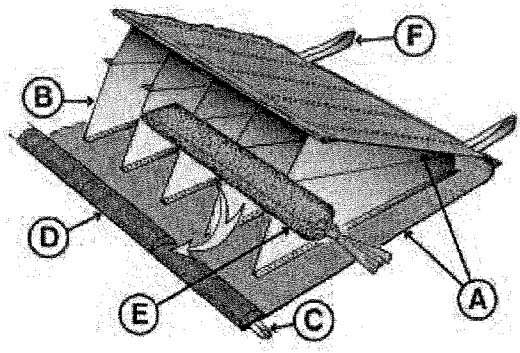
A – Polyester fabric coated with super heavy-duty, abrasion-resistant PVC suitable for use on all types of surfaces.
B – Stretched partitions providing better adherence to smooth surfaces.
C – Polypropylene straps to lift up the ends during specific installations.
D – Galvanized metal plate ballast weights held in polyester netting sewn to the water barrier.
E – Extra resistant polypropylene straps to facilitate handling.



MAIN FEATURES OF THE WP CATEGORY

Designed for flood control – For occasional use.

A – Very resistant polyethylene fabric with the same high quality standards as the other models.
B – Stretched partitions providing better adherence to smooth surfaces.
C – Polypropylene straps to lift up the ends during specific installations.
D – Polyester netting sewn to the water barrier allowing the insertion of weights or small sandbags to be used as ballast.
E – Small polyethylene bags that can be filled with sand.
F – Extra resistant polypropylene straps to facilitate handling.



DIFFERENCES BETWEEN THE WL AND WP CATEGORIES:

Both categories are compatible, but there are significant differences between the two.

1. Folding: Each of these categories is folded differently. When the WL category is deployed, the ballast weights immediately drop to the ground, while the WP category is folded in such a way as to enable the ballast weights to be inserted on top of the barrier flap.
2. Materials: The strength and safety standards of the two categories are comparable although they are made from different materials. The WL category is made from yellow PVC fabric that's very resistant to abrasion while the WP category is made from very lightweight, orange polyethylene fabric.
3. Ballast weights: Ballast weights are already included with the WL category. With the WP category, however, ballast weights must absolutely be inserted.
4. Applications: The WL category is mainly designed to be put in a crate from which it can quickly be deployed to cover great distances while the WP category is packaged individually and intended for targeted protection.

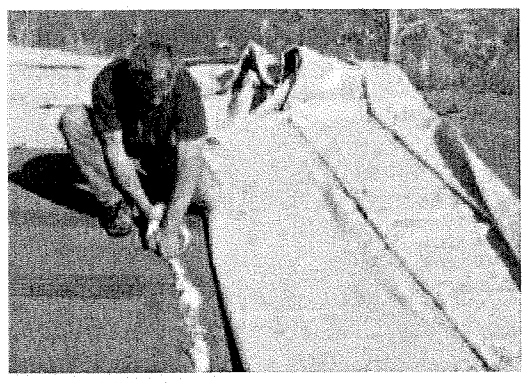
ADHERENCE OF THE BARRIER WHEN INSTALLED ON A SMOOTH SURFACE

The water pressure exerted on the fabric at the bottom of the water barrier is 4 times that of the pressure exerted on the side (see **"WATER HOLDING BACK WATER", p.6)**, which is amply sufficient to hold down the barrier on most surfaces found outdoors (asphalt, lawn, gravel, concrete paving blocks, etc.). However, some exceptionally smooth surfaces, such as tarred asphalt or polished cement, require particular attention. What happens with this type of surface is that the water stays trapped between the fabric at the bottom of the barrier and the smooth surface. The result is the same as driving with completely worn down tires.

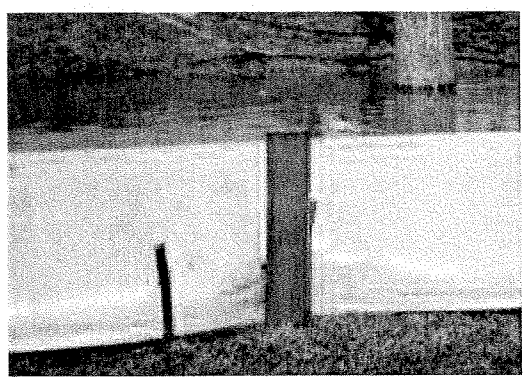
It is very important to understand what it takes to ensure that the barrier adheres properly to the ground: **AT NO TIME SHOULD WATER ACCUMULATE UNDERNEATH THE BARRIER.** When deployed on regular asphalt, the barrier is very safe due to the presence of small cracks in the asphalt that enable the water to drain through to the back of the barrier.

If the barrier has to be installed on an **EXTREMELY SMOOTH** surface, you need not worry about its stability. All you have to do is simply take some additional precautions. Here are a few solutions:

1. Apply a food substance such as molasses, caramel or even bread dough underneath the ballast weights and along the entire length. This substance will fill in the spaces between the bumps on your surface (asphalt, paving blocks, etc.) and will also stick very well to the fabric of the barrier. This process is ideal to eliminate water infiltrations and also improves adherence. This efficient technique is also environmentally safe! If the barrier is installed on a lawn, you can make a trench and bury the front part (or ballast weights) of the barrier.



2. Place stakes at the back of the barrier at a reasonable distance (1 to 3 metres/3 to 10 feet) or even have the sides of automobiles rest against the back of the barrier. This technique ensures that the barrier will not slip. Should the barrier begin to slip, it would gently be stopped by the stakes, posts or automobiles and would hold back the flood without damaging anything.



Usually none of these precautions are necessary, but we believe that if you use one or two of these methods at the same time, it would be impossible for the barrier not to stay in place.

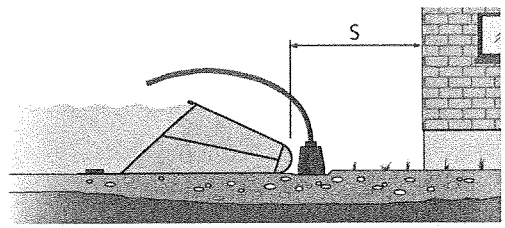
DETERMINING THE HEIGHT AND LENGTH OF REQUIRED BARRIERS

Straight lines are easy to determine, but we recommend adding 1% to 3% of extra barrier length. This slight addition is necessary due to the imperfections of the surface and because the material may have undergone a small amount of shrinkage during manufacturing.

To go around a building, the calculations are somewhat more complex, but our instructions will help simplify your installation.

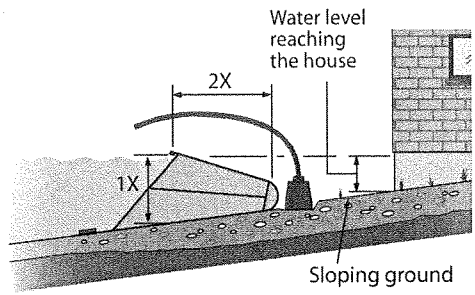
1. Keep an adequate amount of space between the protective barrier and the building:

No matter where you decide to set up your protective dam, you need to have an adequate amount of space (S) to be able to move around and place pumps of appropriate capacity to remove all the water at the back of the barrier. The barrier should never rest against the wall of the building. To maximize protection, set up the barrier as far as possible from the location you want to protect.



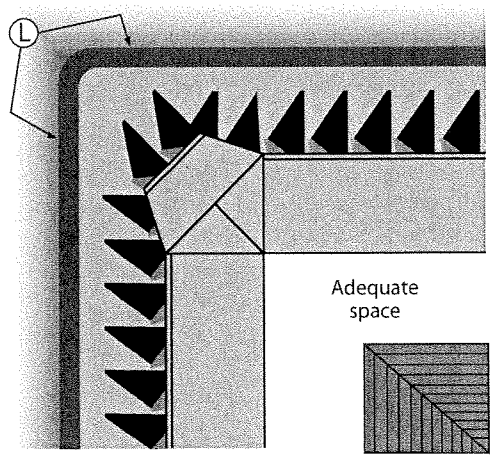
2. Determine the water level of the flood:

It is important to choose barriers that are not smaller than required for the expected water level. Be careful on sloping ground, as the water level reaching the house will certainly be lower than the water level where your barrier will be installed. As soon as you have chosen the barrier with the right water retention capacity, calculate 2 times its water retention to determine where to place the back of the water barrier.



3. Determine the length of the barriers:

To determine the required lengths, you must absolutely measure the distance to the outermost point Ⓓ on the barrier and also consider the relief of the ground. You must also add 1% to 3% in length to cover the imperfections on the ground. In the opposite illustration, the red line Ⓛ (or ballast weights) determines the length of the required barriers.

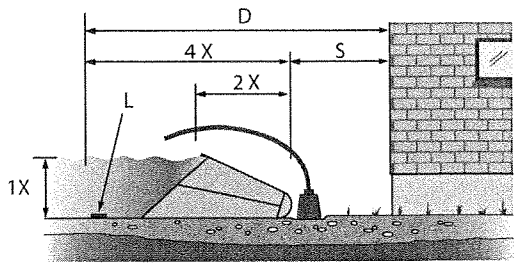


View from above

Reference table, if required

Model	Water retention **1 X**	Half-width **2 X**	Total width **4 X**
WL-14 and WP-14	35 cm / 14"	56 cm / 22"	1,5 m / 60"
WL-20 and WP-20	50 cm / 20"	1 m / 39"	1,8 m / 71"
WL-26 and WP-26	67 cm / 26½"	1,3 m / 50"	2,5 m / 98"
WL-39	1 m / 39"	2,3 m / 90"	4 m / 160"

S = Adequate space at the back of the barrier
1 X = Size of water retention
2 X = Size 2 times the water retention size
4 X = Size 4 times the water retention size
D = Calculation distance for barrier length
L = Required barrier length



Side view

Appendix A

MAKING A CORNER OR CURVING THE WATER BARRIER

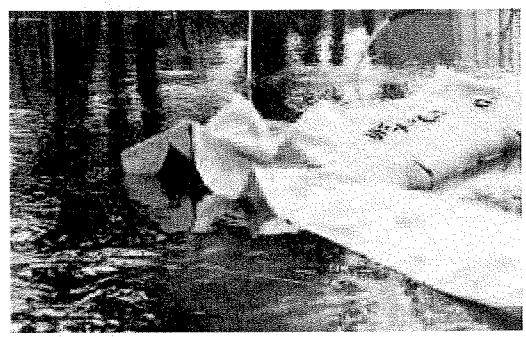
To make a corner or curve the barrier, the entire corner or curved section **MUST BE COMPLETELY UNFOLDED.**

As explained previously, the furthest edge of the barrier must always be taken into consideration to determine the length of the required barriers. The green dotted line on the photograph shows the required barrier length. The barrier can be curved to any given angle, however, we recommend curving it in such a way as to repel the water. If you use the opposite method, making corners to contain the water, chances are that a lot of water will seep through under these corners and too much water seeping through can cause the water barrier to slip. This is why we do not recommend curving the barrier to contain water, even if this method can work very well.

Method used to contain water
(Not recommended)

The barrier is better adapted to and safer for repelling water, as the ballast weights at the front remain evenly seated against the ground and do not fold over, keeping water leaks under the barrier down to a minimum.

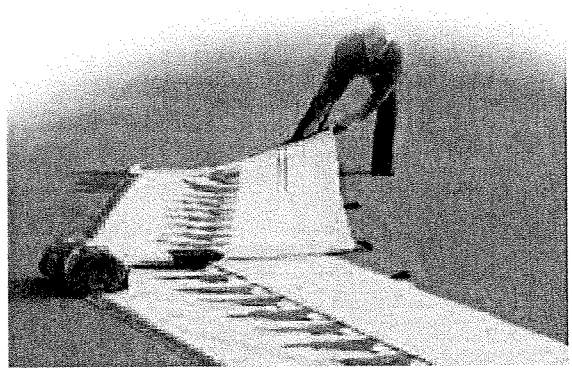
Here are 4 installation methods that you will find useful. You donít have to worry about the deployment of the water barrier, as the pressure from the water will force the corner to be deployed properly.



Method used to repel water
(Recommended)

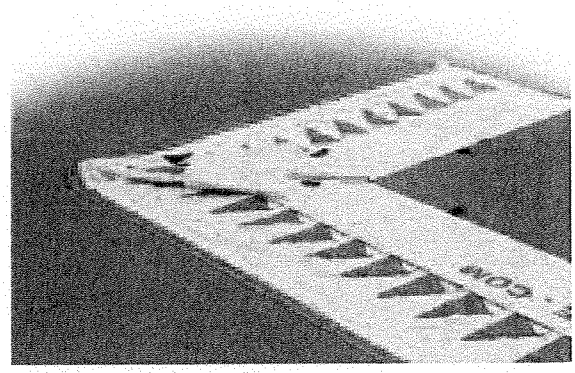
1. Square corner to repel the water: This method is the one most often used to protect a building. The barrier can be curved to all angles, including angles greater than 90°.

1 – Completely unfold the water barrier.



2 – Place ballast weights on the front flap of the barrier and turn to the desired angle.

3 – Pull the material closer and smooth out the top fabric.

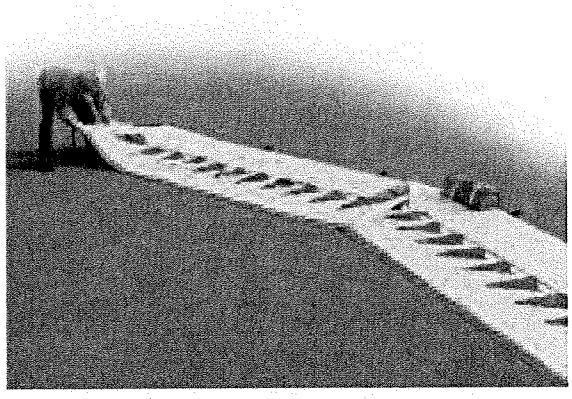


4 – You can remove the ballast weights used to make the corner. The water barrier should now look like this.

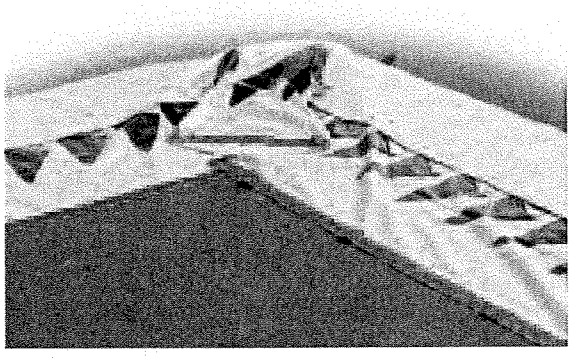
---

2. Square corner to contain the water: This method is rarely used and is not recommended, but can work very well if you are able to eliminate the infiltrations at the front and especially at the corner of the barrier.

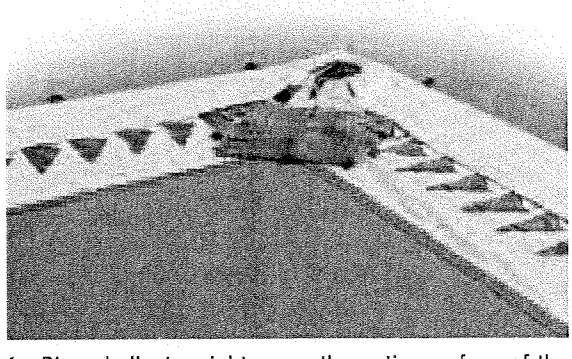
1 - Completely unfold the water barrier.



2 – Place ballast weights at the back of the barrier and curve the barrier to the angle required to contain the water.

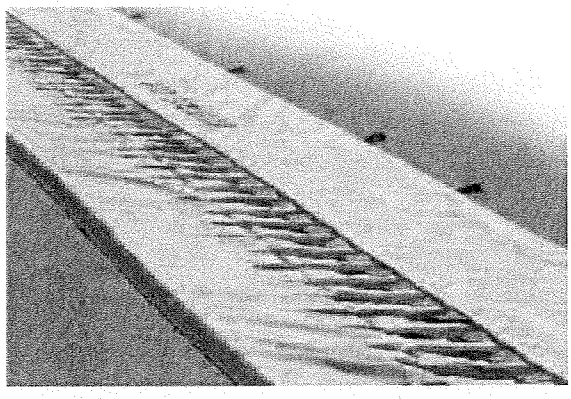


3 – Pull the material closer and smooth out the upper fabric.

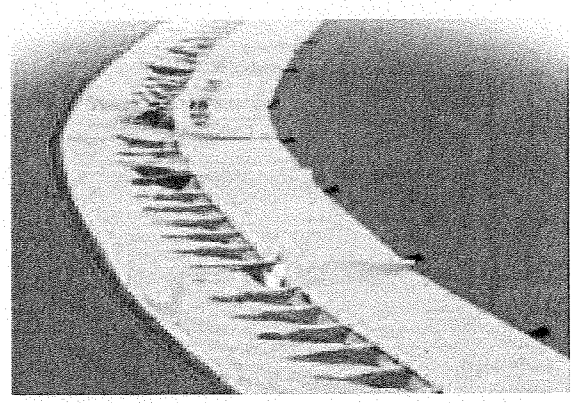


4 – Place ballast weights over the entire surface of the front flap to prevent infiltrations at the joints.

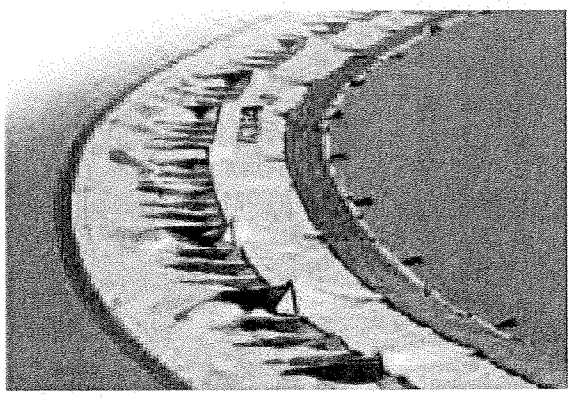
3. Marking a round curve to REPEL the water: Mainly used for winding roads, this type of deployment is generally made using several barriers contained in a crate and tied together. If the curve is pronounced, it is better to completely unfold the rounded section of the barrier to make sure the ballast weights are evenly distributed on the ground.



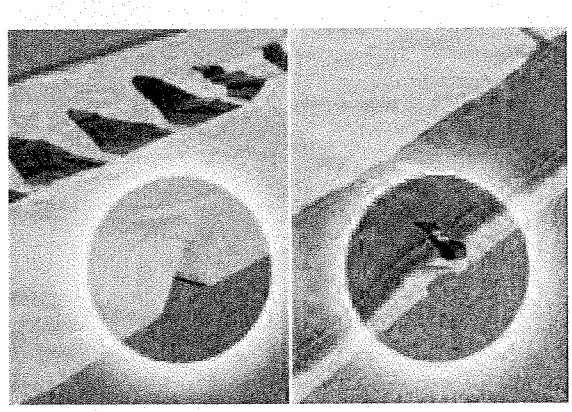
1 - Completely unfold the water barrier.



2 – Give the barrier the desired curve.



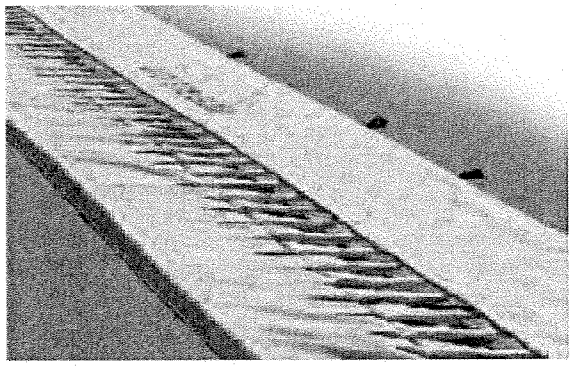
3 – Keep the ballast weights at the back evenly distributed to keep the fabric on the ground and prevent the wind from lifting up the barrier.



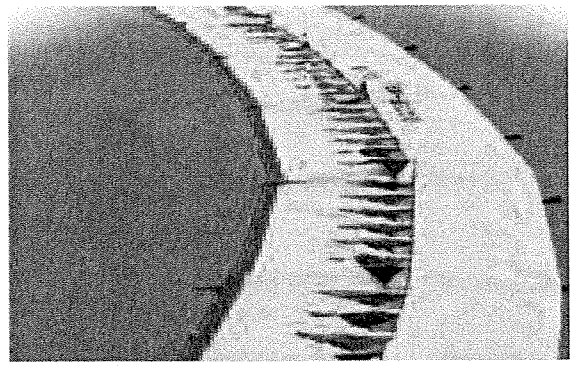
4 – Without ballast weights, the folds in the fabric are ex posed to the wind. This opening may cause the barrier to be lifted, jeopardizing the installation.

---

4. Making a round curve to CONTAIN the water: Used on winding roads, but in the opposite direction as that shown in the previous figure. If the curve is somewhat pronounced, the rounded section of the barrier must be completely unfolded. Such particular attention is required to make sure that the barrier is not stretched and to prevent water infiltrations from underneath the steel plates, which will tend to compress and lift up.



1 - Completely unfold the water barrier.



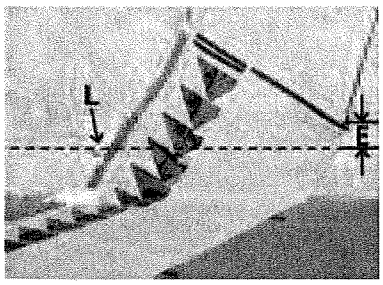
2 – Curve the barrier as needed, making sure the back of the barrier is not stretched.

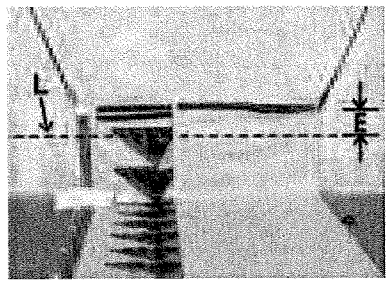
3 – Place a second series of ballast weights along the entire length to prevent water infiltrations.

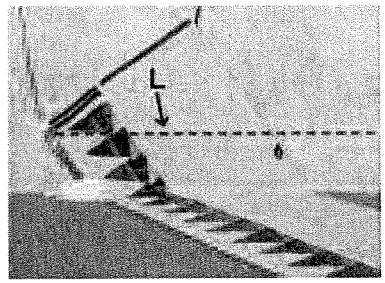
4 – Sandbags can also be used to close off the spaces formed by the barrier ballast weights.

◇ HOW THE ENDS OF THE WATER BARRIERS SHOULD BE PLACED

The ends of the water barriers are not closed off, as they must rise up higher than the level of the flood. Since the water flows freely inside the water barrier, the front and/or back sides of the barrier must be higher than the maximum flood water level. The 3 photographs below show that it is important for the barrier to be sufficiently longer than the wall or ledge so that no water will flow out from the ends. Extra barrier length will also provide maximum safety.





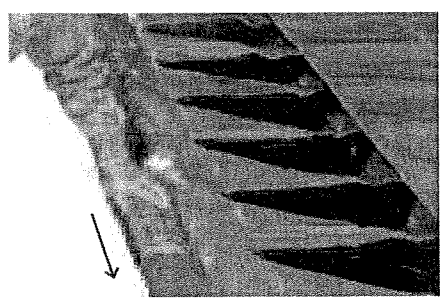


L = Flood water level or maximum water barrier opening.
E = Extra barrier length. We recommend a minimum extra length of up to 50%, depending on the flood water level.

In addition, every time the barrier is abruptly lifted against a wall, a space is created and water will infiltrate from the corner. We strongly recommend placing one or more sandbags on that corner. The water pressure exerted on the barrier stretches the fabric, thus creating a wider opening promoting infiltration in that corner.

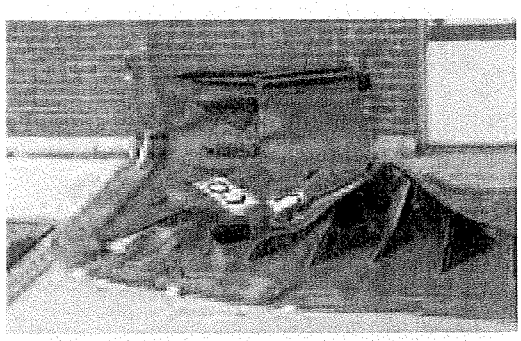
● THE WP CATEGORY REQUIRES BALLAST WEIGHTS

The main advantage of the WP category is that it is lightweight and compact. However, since it is not equipped with ballast weights (very important), it must be folded differently than the WL category. With the WP category, you must completely unfold the barrier, then unfold the front flap of the barrier and insert a sandbag specially designed for that purpose. The instructions for filling our sandbags that have been specially adapted for the WP category are printed on these bags.



◇ PROTECTING AN ENTRANCE

The water barrier is not designed to be installed in a door frame. For adequate protection, you must go around the door and lift up the ends of the barrier on each side of the wall. This type of protection requires extensive barrier length based on a calculation of the exterior barrier contour.

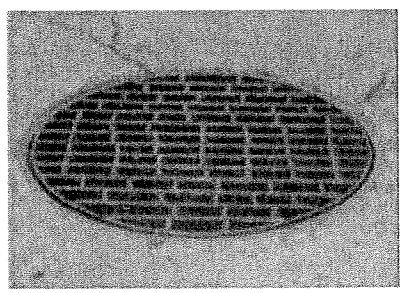


Using Water-Gate water barriers for your doors will give you better protection, as you will be able to pump up any water infiltrations before they reach your door. You will also maintain access to the exits of your building at all times.

If you decide to only protect the entrances instead of all the walls of your building, make sure that no water can seep in through the walls. The opposite photograph shows an air hole in a brick wall. Such holes are found on all insulated brick walls. Make sure you fill in these small holes before the flood and clear them again after the flood.

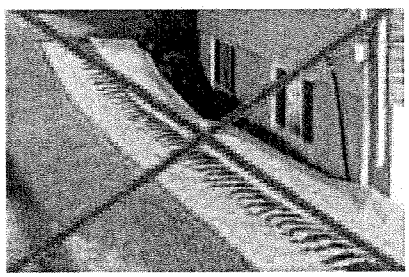
◇ INSTALLATION ON A MANHOLE

Under no circumstances should you install your water barrier on a manhole, unless you are absolutely sure that it will not overflow during the flood. If your water barrier has to be set up in a location where there is a manhole, you must absolutely find a way around the manhole and choose another path. The simplest solution is to install the barrier behind the manhole. You can also set it up in front. If you choose this second solution, you will have to close up the manhole. We also have a product designed for manhole backup. For more information, see our section entitled **"INSTRUCTIONS IN CASE OF MANHOLE BACKUP".**

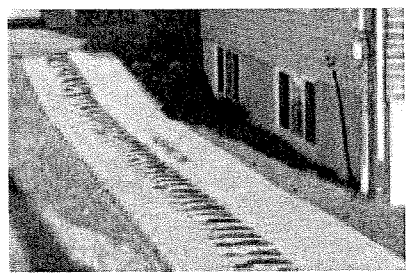


● NEVER SET THE BACK OF THE WATER BARRIER AGAINST A WALL

If you set the back of the water barrier against a wall, water will slowly accumulate between the wall and the barrier. The water gathered at the back of the barrier will then seep into your building. This will also have the effect of destabilizing the barrier.

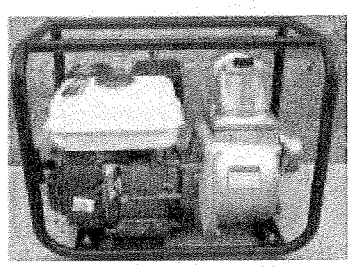


Wrong method



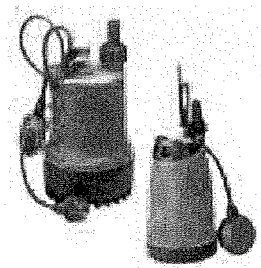
Right method

IMPORTANCE OF HAVING WATER PUMPS



No matter what type of protective dam you use, a certain amount of water will almost always flow into the protected area. Water pumps are as important as your protective barrier. Make sure that if a flood occurs you will be able to use your pumps and they will be in good operating condition. We strongly recommend having a generator to power all your water pumps or having gas operated pumps. Without these water pumps, the accumulated water leaks will invade your protected area and your protective dam will be useless. These leaks can be due to a number of different factors:

- Wet ground that becomes permeable
- Small cracks under or through the dam
- Sewage pipes
- Unbalanced water pressure due to the flood

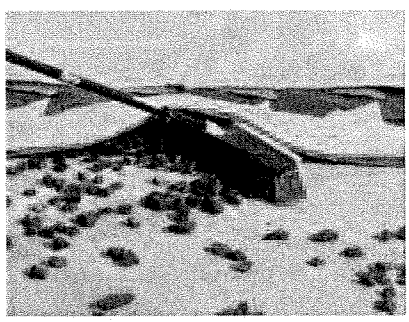


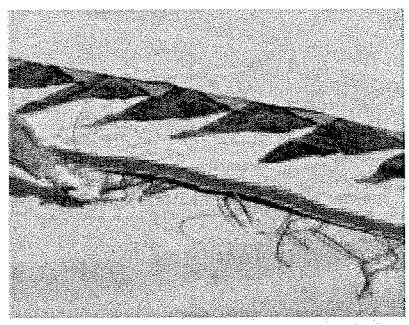
When you install one or more water pumps, it is important to leave enough space between the building and the back of the barrier to allow you to move freely and regularly check the pumps. Make sure your pumps have enough power to pump up all the water flowing under the barrier and prevent this water from reaching the wall of the building.

It is hard to determine the number of pumps needed and their required capacity, but we do recommend having a minimum of 2 pumps, one for the basement and the other to put between the wall of the building and the protective dam. For water getting through your dam, you will need a pump with a capacity of 2 to 14 litres/minute for each linear metre of dam. The required pump capacity mainly depends on the type of ground involved and where the dam is installed.

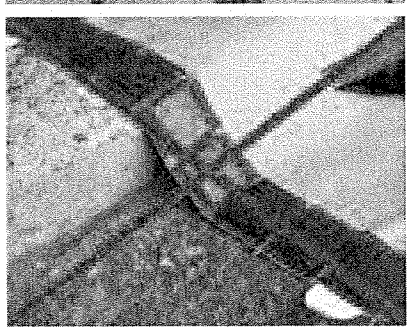
ELIMINATION OF WATER INFILTRATIONS UNDER THE BARRIER

The secret of a safe water barrier installation starts by reducing water infiltrations under the barrier to a minimum. To do this, it is important to remove any object underneath the barrier in order to evenly place ballast weights on top.





You should note that should the barriers traverse a sudden rise in terrain such as a curb, it is important to sandbag the corner of that rise to prevent water infiltration at that point.



Wrong method

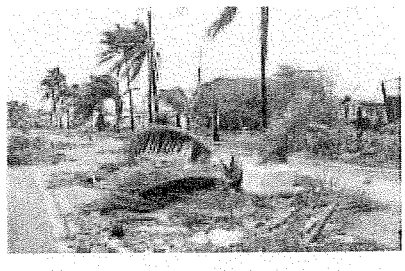
Right method

Be careful: When the flood water enters the barrier, the fabric could contract and create new spaces allowing the water to flow under the barrier. You must always keep an eye out to make sure this doesn't happen.

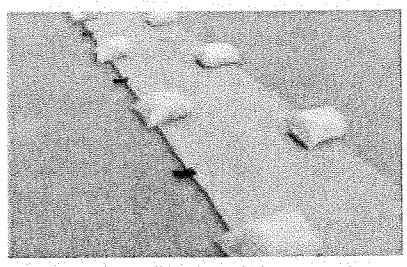
Appendix A

◇ BARRIER REACTION TO THE WIND

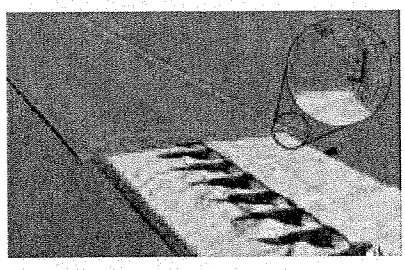
The water barrier can be installed fairly easily, even in high wind. The wind's strength isn't on the ground. Everything higher up that gets taken away by the wind ends up on the ground and eventually comes to a standstill. Since the water barrier gets unrolled on the ground, it is less exposed to the wind than objects further up!



The barrier can easily be kept on the ground in very strong wind, however, some additional precautions do have to be taken. Although the wind is less strong on the ground, a vacuum can be created on top of the barrier and cause it to lift up.

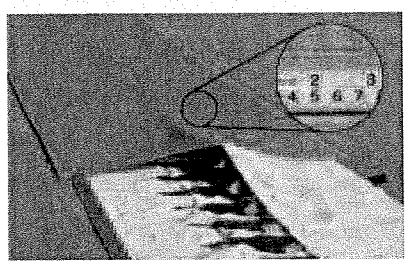


If possible, to minimize the effect of gusting wind, keep the barrier folded and add a sufficient number of ballast weights to keep it tight against the ground. When the flood water arrives, the barrier can be unfolded and will automatically deploy based on the position of the ballast weights. To ensure the barrier is properly deployed, push off any ballast weights that are in the way.



Increase the number of sandbags if the wind gets too high. Their weight as well as the pressure of the wind blowing on the surface of the fabric and against these sandbags will reduce the vacuum effect.

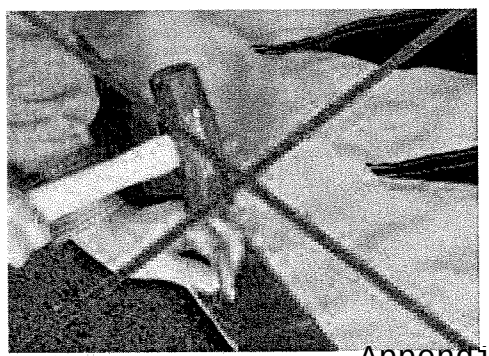
Another solution that we believe will make our water barriers capable of resisting the worst winds known up to now would be to place a net on the deployed barriers. This net would be attached to the ground at the front and back of the barriers. When the flood water arrives, it will go through the net and gather in sufficient quantity inside the barriers to ensure a protection of several centimetres. After this is done, you can remove the net to allow the barrier to be fully deployed. The water already in the barrier will weigh enough to maintain the barrier on the ground.



◇ IMPORTANCE OF NOT TYING THE WATER BARRIER TO THE GROUND

We do not recommend tying the water barrier to the ground for 2 reasons:

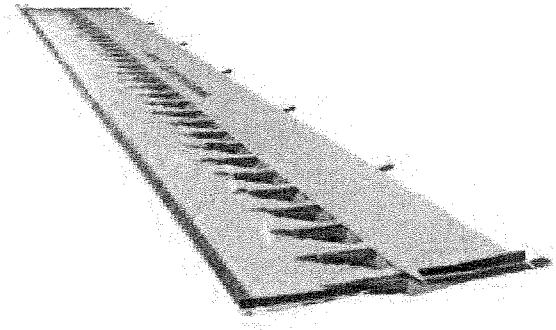
- The barrier tends to contract as it fills up with water. Tying down the barrier will put tension on the front flap, which will create spaces for the water to flow through since the fabric cannot remain tightly against the ground.
- Tying the barrier to the ground can complicate things if a new configuration is required.



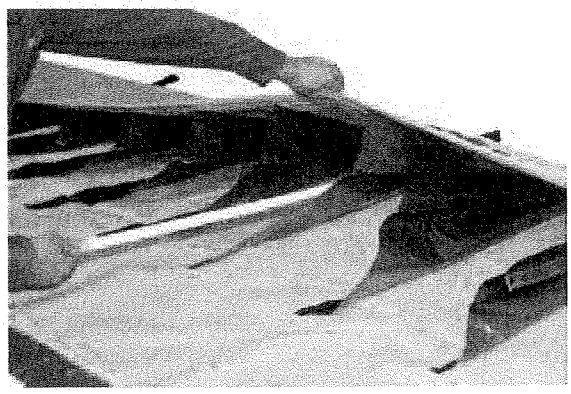
◇ FOLDING UP THE WATER BARRIER FOR STORAGE

Folding the WL category is different from folding the WP category. It is very important to fold each category of water barrier as it should be. When the WL water barrier is deployed, the ballast weights sewn on the flap immediately weigh down the barrier, contrary to the WP category, which requires the insertion of ballast weights. This is why the folding of the 2 categories of barriers is different.

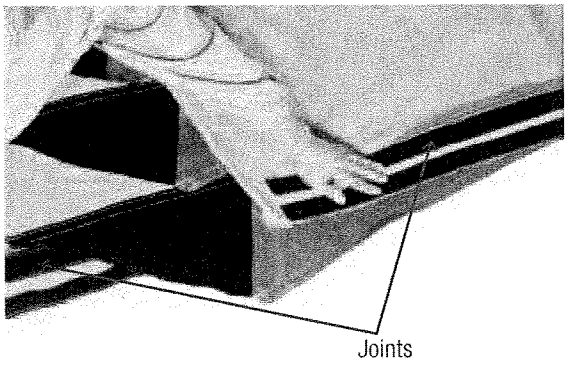
Folding of the WL category (model WL-1430 illustrated)



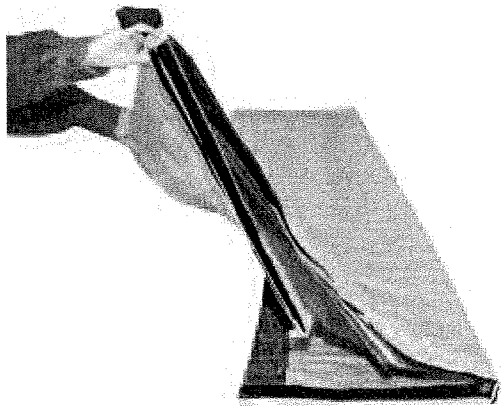
1 – After cleaning and drying the barrier, stretch it out on a large flat surface.



2 – Using a stick, make sure all partitions are smoothed out to enable you to fold up the barrier tightly so that it can easily be inserted in its bag once rolled up.



3 – Before folding the barrier, keep all the joints open to make it easier to tie a second barrier to it, if need be.



4 – Start folding from the back so that the ballast weights will be positioned in the middle and under the barrier. Use the folds already appearing on the fabric as a reference.

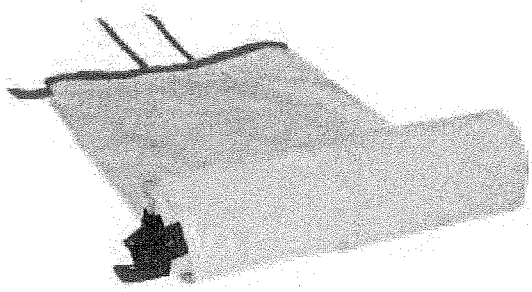
Please note that the folding pattern and number of folds differ for each size of barrier.

WL-06 and WL-14 Model
1 fold only

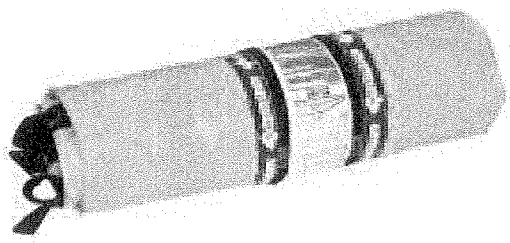
WL-20 and WL-26 Model
2 folds

WL-39 Model
3 folds

Appendix A

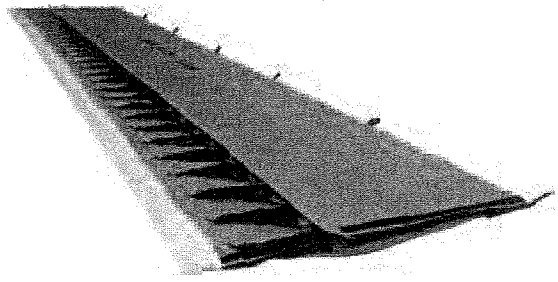


5 – Roll up on the side opposite to that of the instruction banner.

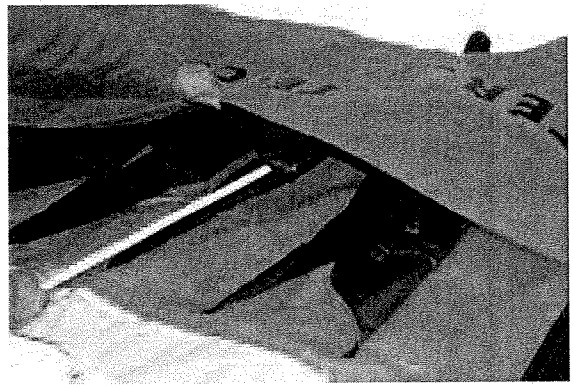


6 – After being properly rolled up, the barrier should look like this.

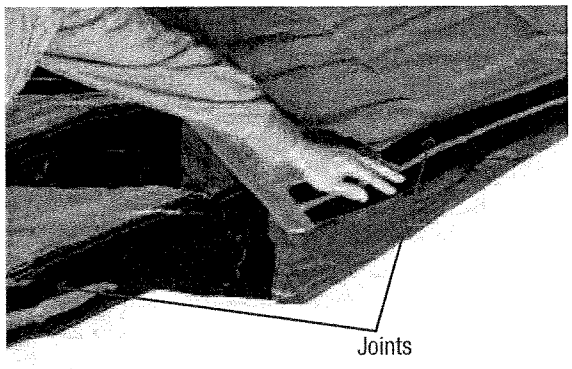
Folding of the WP category (model WP-2030 illustrated)



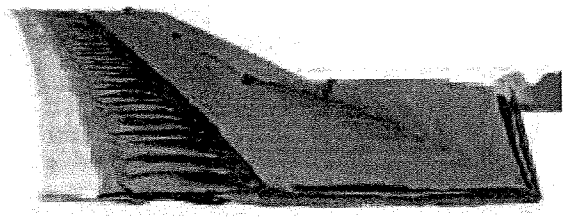
1 – After removing the ballast weights and properly cleaning and drying the barrier, stretch it out on a large flat surface.



2 – Using a stick, make sure all partitions are smoothed out to enable you to fold up the barrier tightly so that it can easily be inserted in its bag once rolled up.



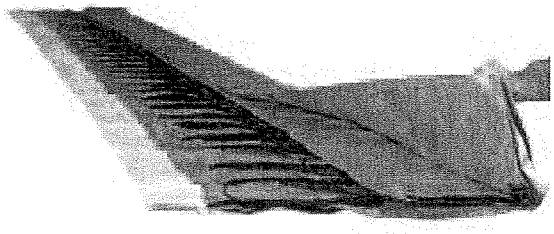
3 – Before folding the barrier, keep all the joints open to make it easier to tie a second barrier to it, if need be.



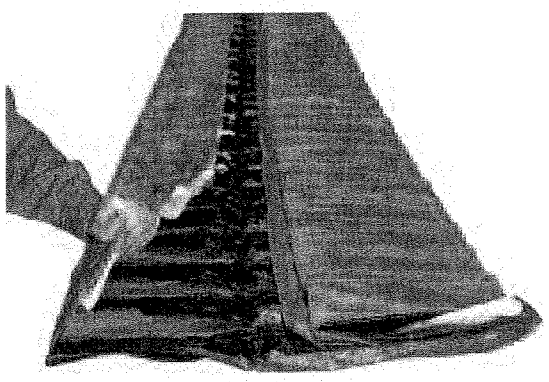
4 – Start folding a first section of the barrier at the back. Use the folds already appearing on the fabric as a reference.

Please note that the folding pattern and number of folds differ for each size of barrier.

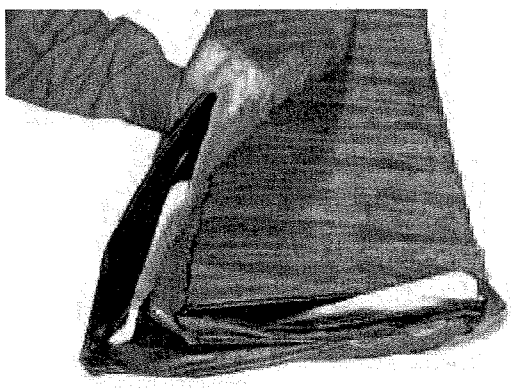
WP-14 Model	**WP-20** Model	**WP-26** Model
1 fold at the back	2 folds at the back	2 folds at the back
2 folds at the front	2 folds at the front	2 folds at the front
Total width: 48 cm / 19"	Total width: 48 cm / 19"	Total width: 64 cm / 25"



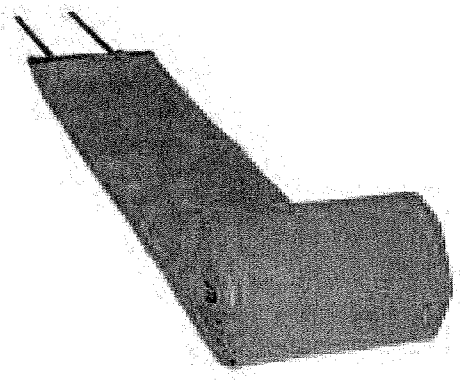
5 – If required by the model, fold a second section of the barrier at the back. Folding ends at the barrier float.



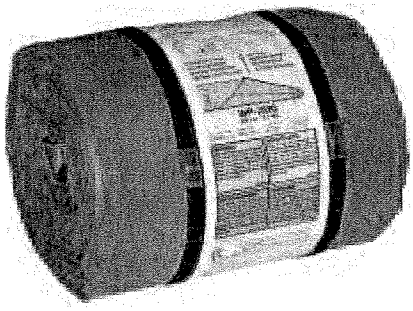
6 – Next fold a first section of the front flap using the folds already appearing on the fabric as a reference.



7 – Finish folding the front fold by folding it over the back section as a whole.



8 – Roll up on the side opposite to that of the banner.

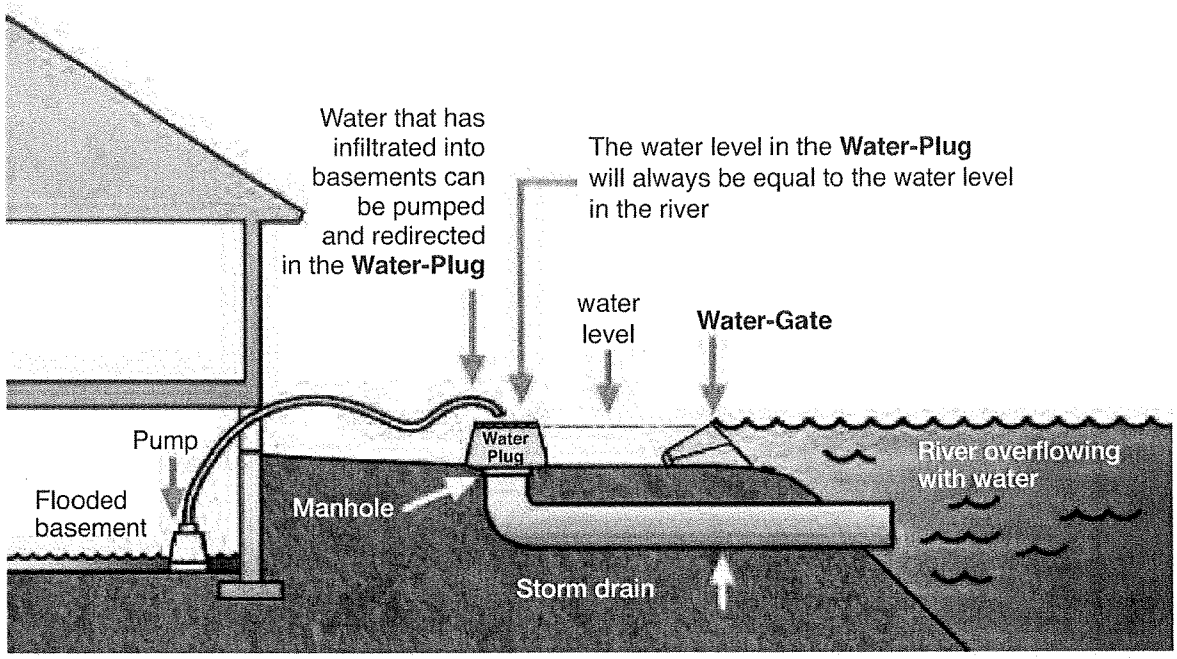


9 – After being properly rolled up, the barrier should look like this.

INSTALLATION OF THE WATER-PLUG

To solve manhole backup problems, we developed a product called the Water-Plug. This product is very quick and easy to install. All you have to do is deploy the Water-Plug and position it over the manhole. The cone shape of the Water-Plug enables it to deploy automatically even if the manhole has already started backing up.

Another advantage of using the Water-Plug from MegaSecur is that water from different infiltrations due to a flood can be diverted to the closest Water-Plug, as shown in the illustration below.

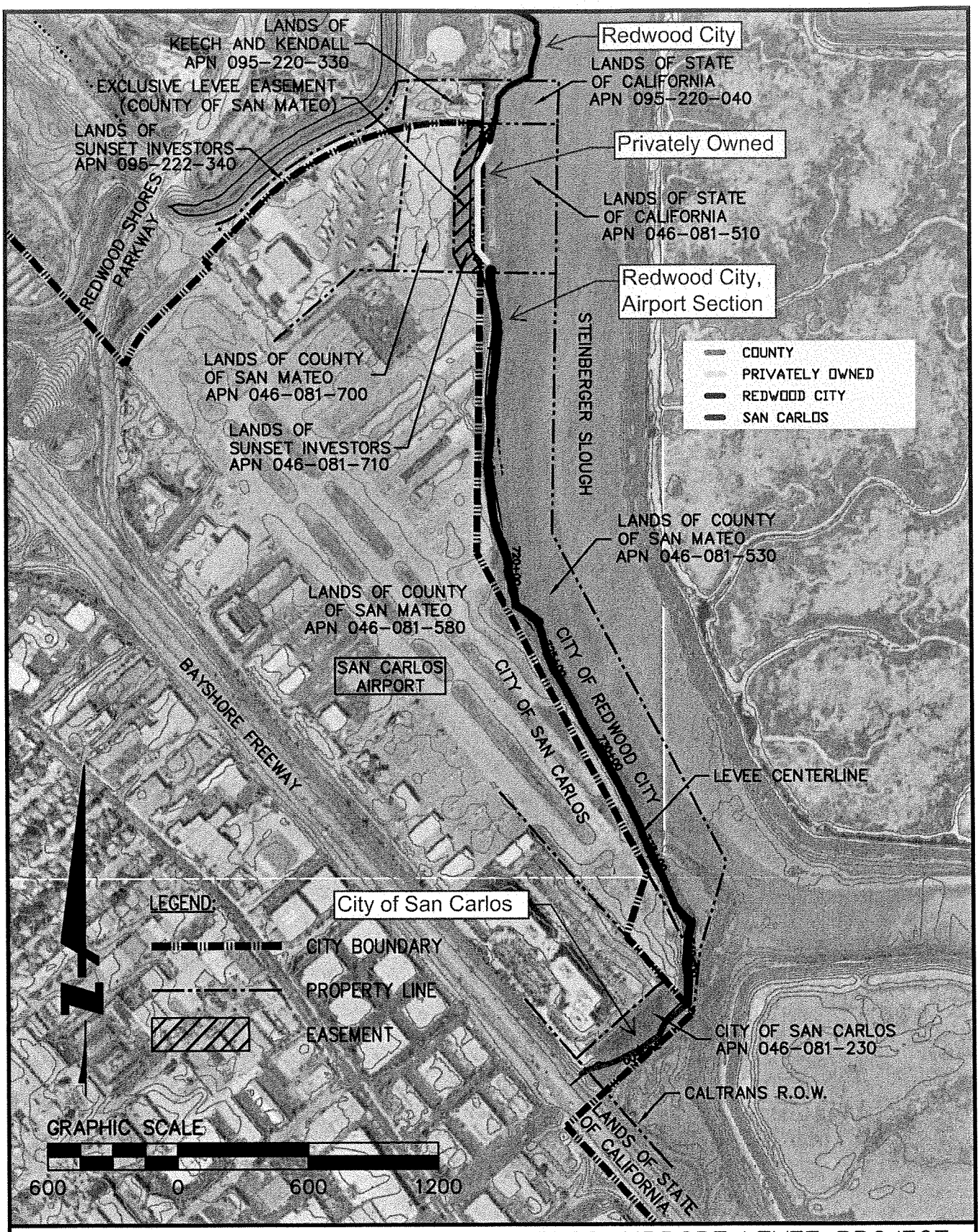


SAN MATEO COUNTY
AIRPORTS

Appendix B: San Carlos Airport Levee Map

August 2010

Appendix B



DRAWING NAME: C:\Documents and Settings\kdowdy\Desktop\Jurisdictional and Ownership Exhibit\Jurisdictional and Ownership Exhibit_2007.dwg
PLOT DATE: 03-04-10 PLOTTED BY: kdowdy

BkF ENGINEERS/SURVEYORS/PLANNERS

255 SHORELINE DRIVE SUITE 200
REDWOOD CITY, CA 94065
650/482-6300
650/482-6399 (FAX)

SAN CARLOS AIRPORT LEVEE PROJECT
JURISDICTIONAL AND OWNERSHIP

Appendix B

Drawn CT | Checked JM | Approved JM
Job No. 20090032 | Date 10-12-2009 | Sheet 1 of 1

SAN MATEO COUNTY
AIRPORTS

Appendix C: Sources of Equipment, Labor, & Materials List

August 2010

SOURCES OF EQUIPMENT, LABOR, AND MATERIALS

Equipment Rental Services

San Mateo Rentals
1414 E. 3rd Ave, San Mateo, CA 94401
(415) 342-8941

A-1 Rental Center
1125 Arguello, Redwood City, CA 94063
(415) 369-2992

Clementina
1140 E. 19th Ave, San Mateo, CA 94403
(800) 932-1055
(800) 843-1662

Sources of Labor

Bay Span
Fairfield Office
260 Link Rd, Suite D, Fairfield, CA 94585
(800) 246-2202 fax: (800) 575 4943

San Mateo County Central Labor Council, AFL-CIO
1153 Chess Dr, Ste. 200, Foster City, CA 94404
(415) 572-8848

Plumbers-Steam Fitters Union Local 467
1519 Rollins Rd., Burlingame, CA 94010
(415) 692-4730

Contractors Labor Pool
61 Airport Blvd., So San Francisco, CA 94128
(415) 447-9302

Quarries for Rock and Sand

Granite Rock
330 Blomquist St., Redwood City, CA 94063
(650) 482-4100

Pilarcitos Quarry
Pilarcitos Creek Rd at Hwy 92
Half Moon Bay, CA 94019
(650) 726-5286

SYAR Industries, Inc.
2301 Napa-Vallejo Hwy, Napa, CA 94558
(707) 252-8711

Quarries for Rock and Sand (cont)

Langley Hill Quarry
Redwood City, CA 94061
(650) 851-0126

BoDean Company, Inc.
1060 N. Dutton Ave, Santa Rosa, CA 95401
(707) 576-8205; fax (707) 576-8204

- Mark West Quarry (707) 573-9733
- Asphalt Plant (707) 576-8205

Lyngso
19 Seaport Blvd, Redwood City, CA 94063
(650) 364-1730

Tools and Supplies

Roberts & Brune
939 Broadway, Redwood City, CA,
(650)366-3833

Peninsula Building Materials Company
109 Seaport Blvd, Redwood City, CA 94063
(650) 365-8500

Home Depot (San Carlos #628)
1125 Old County Rd, San Carlos, CA 94070
(650) 592-9200

Bayside Building Materials and Hardware
2075 S. Norfolk, San Mateo, CA 94403
(650) 349-5141

San Mateo Lumber Company
501 South Claremont, San Mateo, CA 94402
(415) 342-6400

Grainger
401 Quarry Rd., San Carlos, CA 94070-6218
Phone: (650) 591-7200

WECO Industries, Inc.
630 Eubanks Ct. #K, Vacaville, CA 95688
(707) 446-6661

Services

Waterworks Industries, Inc.
8733 Lakewood Dr., Ste. 205,Windsor, CA 95492
(707) 837-7900 FAX (707) 837-7997

SAN MATEO COUNTY
AIRPORTS

Appendix D: Flood Fighting Methods

August 2010

STATE OF CALIFORNIA / THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

FLOOD FIGHTING METHODS

Division of Flood Management
Flood Operations Branch

Revised August 2003

Appendix D

FLOOD FIGHTING METHODS ON LEVEES AND ALONG RIVER BANKS

The main causes of levee failure during periods of high water are:

1. Seepage through or under the levee heavy enough to cause a "boil". This can be caused by burrowing animals or decomposing tree roots.

2. Erosion of the levee due to swift moving water or wave action.

3. Overtopping resulting from river water-surface elevations higher than the levee.

The emergency measures used to prevent levee failure from these causes are known as "Flood Fight Methods." The flood fight methods described in this booklet have proven effective during many years of use by the Department of Water Resources, Division of Flood Management and the United States Army Corps of Engineers. However, all measures shown are temporary and cannot be expected to last for extended periods of time.

Structures other than levees may also require flood protection.

Levee Patrol

When water levels reach a predetermined height (Monitor Stage), two person mobile patrols should be assigned to those areas for observation. Patrols should look for wavewash, boils, seepage, cracks, or sloughing. Personnel should maintain communications with the local Incident Command Post (ICP) and report problem areas too large or time consuming to repair with the minimal amount of flood fight equipment and material carried in patrol vehicles.

Filling Sandbags

When filling sandbags you should work in pairs, with one person holding the bag while the other shovels in the fill material. The first shovel of fill should be placed on the lip of the bag to help hold the bag open. The bag holder should find the most comfortable position while holding the bag open.

Figure 1

•The most common mistake made is overfilling bags. The shoveler should use rounded scoops of fill until the bag is approximately 1/3 full. While shoveling or holding, avoid extra movements (turning or twisting of the back) to prevent injury.

Sandbag Construction

The use of sandbags is a simple but effective method of preventing or reducing damage from floodwater and debris. (see Figure 2) Suggestions for constructing sandbag structures are:

1. Close weave burlap bags are recommended for all sandbag construction when available.

2. Fold the empty top of the bag at a 45-degree angle to keep sand from leaching out.

3. Place each bag over the folded top of the preceding bag and stomp into place.

4. Stagger the second layer of bags over the preceding layer seams.

5. Stomp all bags to form a tight seal.

6. The last sandbag in a line is referred to as a Key Sack. This bag is folded under and stomped into place.

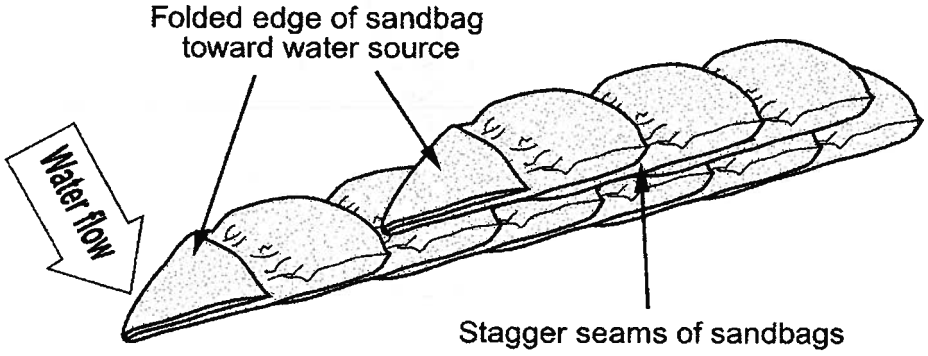


Figure 2
Fill sandbags 1/3 full, folded edge of sandbag toward water source, stagger seams of sandbags.

Tying Sandbags

Most sandbags are used with the open end folded. In some cases sandbags will have to be tied. Fill the bag 1/4 to 1/3 full of material. Hold one open corner (see Figure 3).

Figure 3

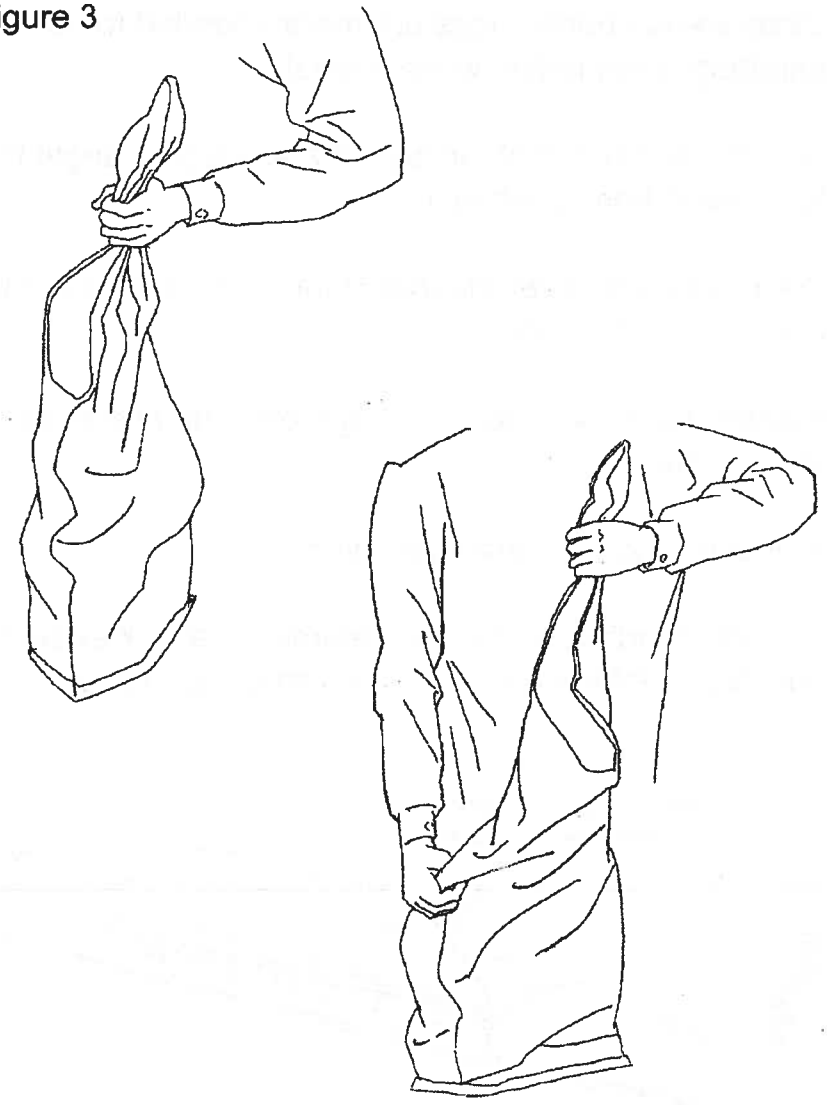


Figure 4

With your other hand take the lower portion of the opposite side and spin it

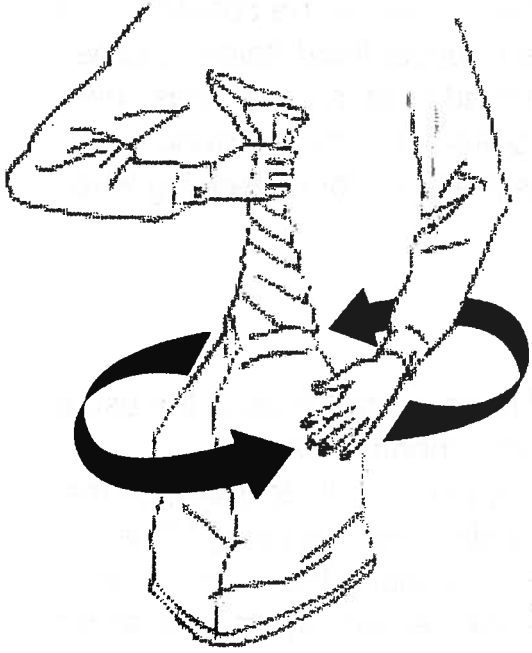


Figure 5

The long tail should be twisted tightly and look like a piece of rope.

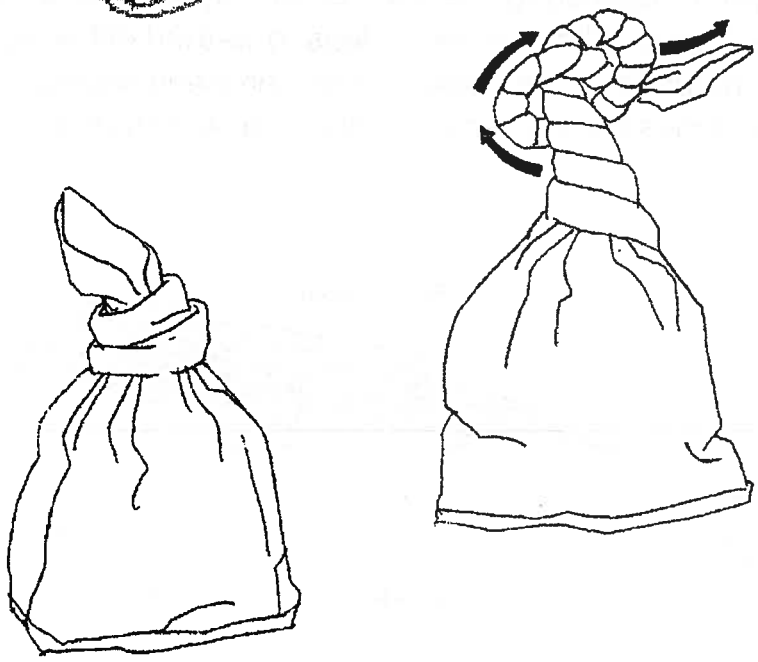


Figure 6

Tie an overhand knot (pretzel knot) as low as possible on the bag.

CONTROL OF LEVEE OVERTOPPING

If any levee reach is lower than the anticipated high water elevation, an emergency topping should be constructed to raise the levee grade to the forecast flood height. Levee topping may be required at road or stock crossings, low levee sections, or railroad crossings. The following paragraphs discuss various methods for increasing levee elevation.

Sack Topping

The most common form of flood control work is the use of sandbags for construction of temporary walls (see Figure 7). The use of sandbag walls to increase the height of a levee section is called "sack topping." The sacks are laid "stretcherwise," or along the levee for the first layer, crosswise for the the second layers, and so on. The sacks should be lapped at least one-third either way and stomped firmly into place. When properly sacked and tamped, one sack will provide about 3 to 4 inches of topping.

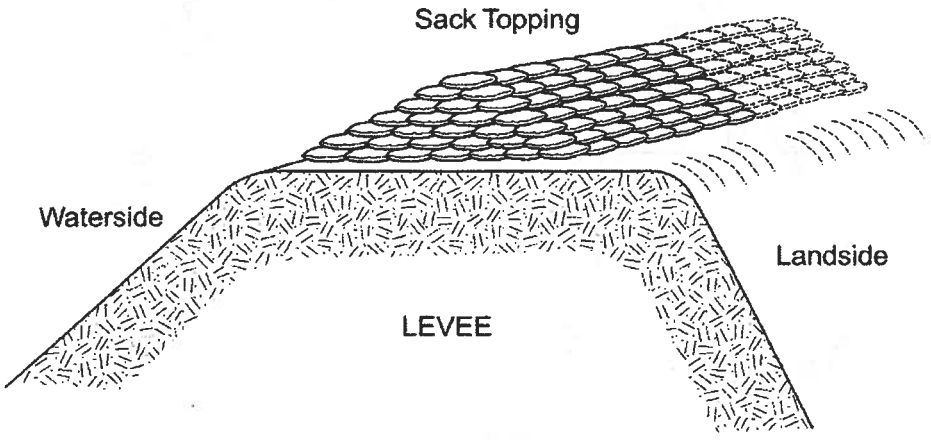


Figure 7

CONTROL OF BOILS (Away from Levee)

A boil is a condition that occurs when water is "piped" through or under a levee and resurfaces on the landside. These weak points are generally caused by burrowing rodents or decomposed tree roots. High water pressure can begin to erode the interior of the levee and weaken the structure. Levee material will deposit around the exit point as the water discharges on the landside. If the boil is determined to be **"carrying material"** then corrective action is required to control the situation. If left unattended the material that makes up the levee can be eroded at an accelerated pace, causing subsidence and overtopping of the levee. This could result in a levee break.

The common method for controlling a boil is to create a watertight sack ring around it. The sandbag structure should be high enough to slow the velocity and prevent further discharge of material from the boil (see Figure 8 and 8A). The flow of water should never be stopped completely, since this may cause the boil to "break out" in an area near the existing sack ring. A spillway must be constructed to direct water away from all boil sites.

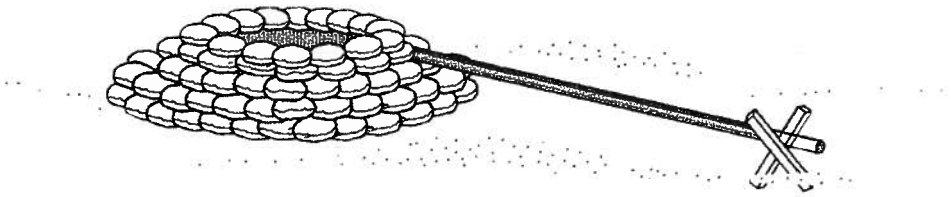


Figure 8
Bottom width should be at least $1^{1/2}$ times the height. Do not sack boils that are not carrying material, but continue to monitor. Boils can begin to carry material after first located.

The sack ring should be large enough to encompass the area immediately surrounding the discharge point (3 to 4 feet diameter). If several boils carrying material are found, a single large sack ring may be constructed around the entire "nest" of boils.

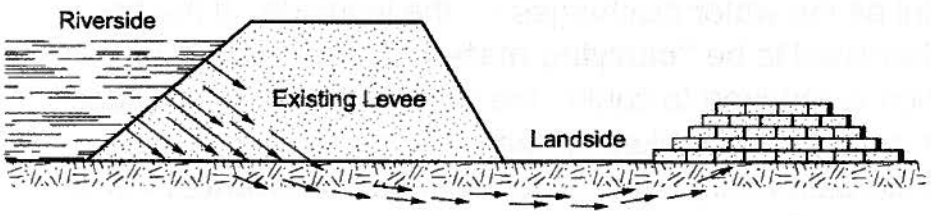


Figure 8A
NEVER completely stop the flow from a boil. This may cause the boil to "break out" in an adjacent area. ALWAYS control the boil to a point where it ceases to carry material and the water runs clear.

CONTROL OF BOILS (On Levee Slope)

If the boil is close to or on the levee slope, a U-shaped sack ring may be built around the boil and sealed into the slope (see Figure 8B). Construction of this method can be difficult and requires substantial shoring up of the U-shaped sack ring structure.

A spillway must be constructed to direct water away from all boil sites.

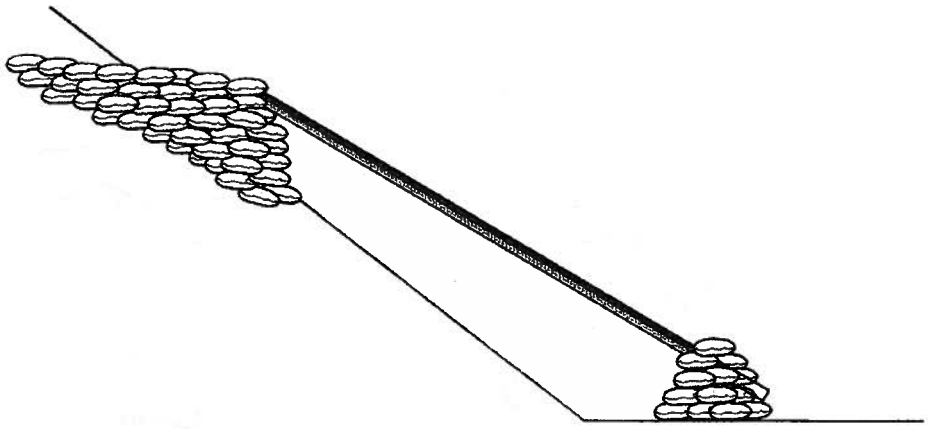


Figure 8B
Spillways can be constructed by nailing
two 2"x 6" boards together to form a V notch;
PVC pipe; two parallel sandbag rows; visquine, etc.

Waterside Boil Inlet Detection

Water running through a levee and carrying material can sometimes be stopped on the waterside, thus eliminating the building of sack rings on the landside (see Figure 9). A six foot long section of 2" diameter pipe secured to a 5'x 6' foot piece of plastic or canvas can be rolled over the inlet hole on the waterside. Drive 1"x 3"x 2' stakes into the shoulder of the levee. Suspend half filled sandbags on top of rolled-out material with twine and tie off to stakes. It can be difficult to locate the waterside inlet of boils. Sometimes a swirl is observed at the water's edge.

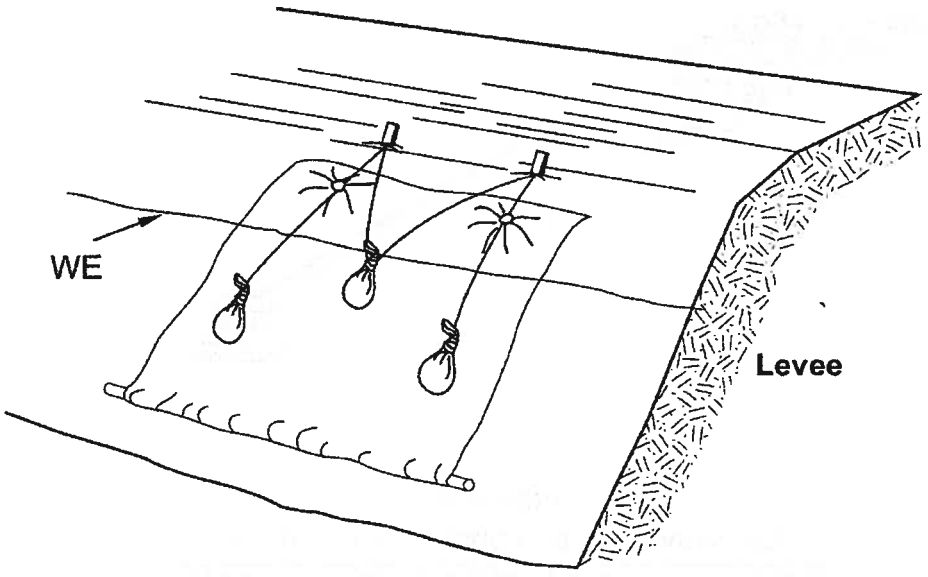


Figure 9

WAVEWASH PROTECTION

Wavewash

All levees adjacent to wide stretches of water should be watched during periods of strong wind to detect the early stages of wavewash erosion. If the slope is well sodded, short periods of high wind should cause little damage. However during sustained periods of strong wind and high water, ample labor should stand by, and experienced personnel should observe and monitor the effected areas.

Wavewash Protection

Envelope Method

When used correctly, plastic sheeting (Visquine) is useful for wavewash protection. Visquine should be purchased in rolls; 10 mil, 20 feet wide by 100 feet long. 1"x3"x2' wooden stakes are driven into the ground just above the levee shoulder on the side you wish to protect. Place the stakes 4 feet apart and staggered 1 foot as shown in Figure 10.

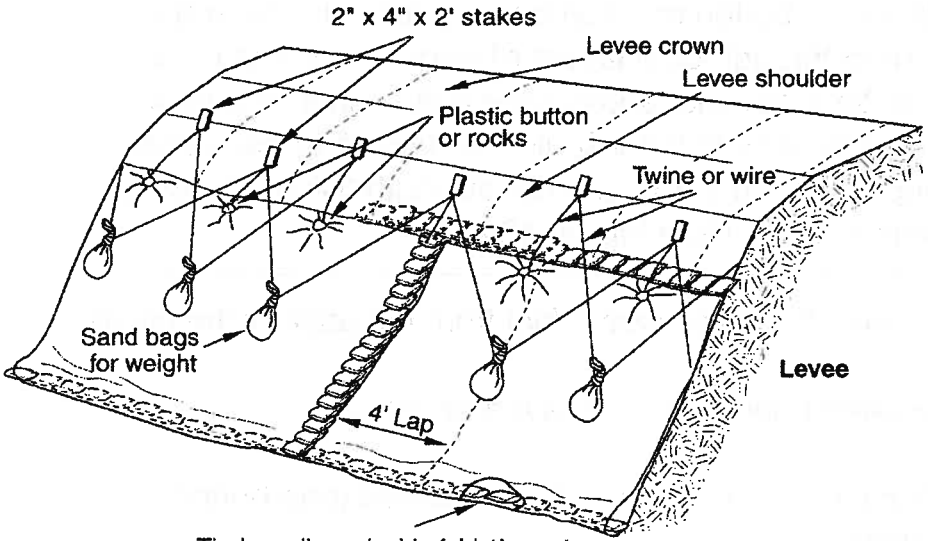


Figure 10
Wavewash Protection

Avoid driving stakes in a straight line; this tends to cause cracking and sloughing of the slope. To provide added strength and leverage, drive stakes at a slight angle away from the water source with the wide (3") side facing the water. Be sure the stakes are well into the ground and are secure.

When rolling out the plastic sheeting it is helpful to use a shovel or similar long-handled tool. Eight to ten people should assist in shaking out the folds of the envelope. Be sure that both layers are held while the envelope is shaken out. Hold on tight! Use caution in strong winds. If the wind catches the plastic it could billow out and pull you along with it.

While flood workers hold the plastic securely, toss tied sandbags into the envelope. The tied sandbags are thrown into the bottom of the envelope with a one-foot gap between bags. The tied bags provide weight to hold the plastic against the levee slope.

A tie-down button or small stone (preferably round) is secured through both layers of visquine. (If a stone is used, tie a slip knot and double half-hitch to secure it.) Fasten buttons to the visquine and tie off to the stakes using a minimum 250 lb tensil strength twine with these points in mind: (See Figure 10A.)

1. Fasten button at least 1 foot from the edge of the plastic.

2. Fasten buttons to both layers of plastic.

3. Fasten buttons directly below stakes (one button per stake).

4. Tie twine low on stake for strength and to prevent a tripping hazard.

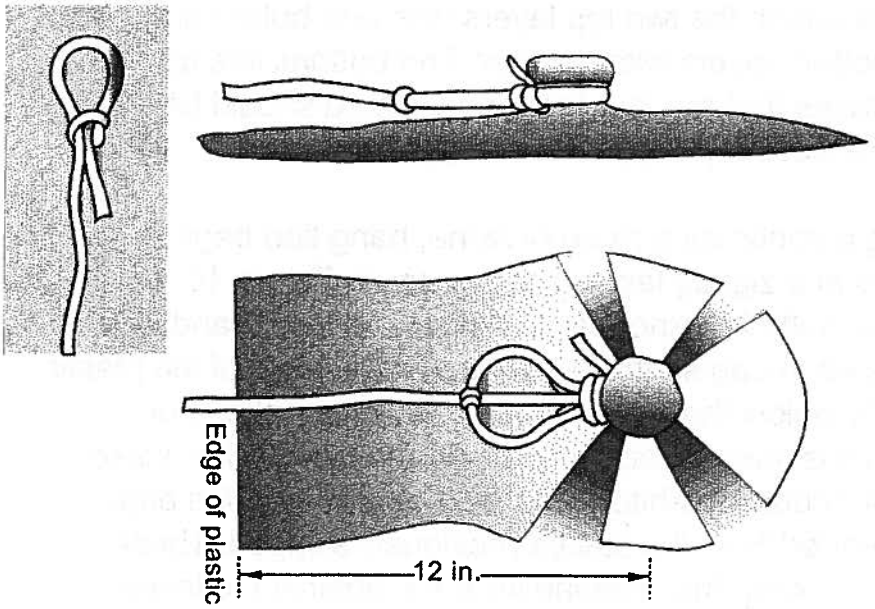


Figure 10A
Elimanate slipknot insert

Visquene is secured using tie down buttons. To attach plastic buttons to the visquene, tie a slipknot on the end of the twine; slip loop over button and plastic and draw tight. Tie two half hitch knots around the throat of main body. Extend twine to large end of main body, tie a half hitch knot around the end, and secure twine to stake. (see figure 10A)

With the visquine secured to the stakes, punch a small hole between each tied bag in the envelope, (a pencil works well). These holes release water trapped in the envelope. DO NOT use a knife because a slice or slit will tear and spread in the plastic.

If further slope protection is necessary insert an additional envelope into the existing wavewash protection overlapping at least four feet. To secure the overlap to the

stakes attach the two top layers with one button and the two bottom layers with another. The buttons line up with the stakes that are four feet apart. There should be four buttons securing the two envelopes.

Using a continuous piece of twine, hang tied-bags from stakes in a zigzag fashion as shown, in Figure 10. Tie a double half-hitch knot below the knot in each sandbag. Place each bag so that it hangs at the middle of the plastic directly below the stake between the two stakes from which it is suspended. Attach twine to every other stake with a double half-hitch. Add a second row of tied bags suspended from the stakes previously skipped. These bags will keep the visquine lying flat against the levee slope in windy conditions.

If the upper portion of the slope needs protection, use an additional envelope. Be sure to place the upper layer over the lower layer by 2 to 3 feet. Finally place sandbags along all seams to prevent wind and water from entering the envelope. To prevent slippage, make sure the top seam cap is half on the plastic and half on the levee as shown in Figure 10. If the levee slope is too steep, some of the bags on the seam may be tied off with twine to the stake above the envelope for support.

Remember, wind is your worst enemy. When using visquine, be sure all seams are secured with sandbags, and make needed repairs as soon as possible.

Protection of Slopes

Raincoat Method

The raincoat method is used to prevent further saturation of levee or hillside slopes. Visquine is laid out flat on the slope, and stakes are driven into the ground just above the area to be protected. The stakes are 4 feet apart with a 1-foot stagger. The visquine is secured to the stakes with tie-down buttons or small round rocks (see Figure 11).

Use a crisscross method of placing the sandbags (Figure 11) on the plastic. Place a solid row of sandbags on all edges of the visquine (half on ground, half on the visquine).

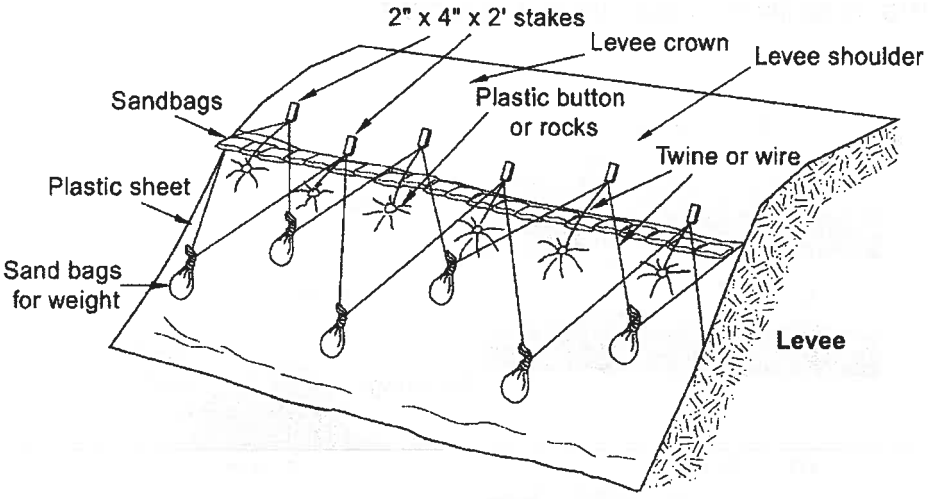


Figure 11

Temporary Levee

This method is used to raise low areas using plastic sheeting and fill material (sand, gravel, dirt, etc.) to prevent overtopping of levees, stream, river banks, small earthen dams, roadways etc. To raise low areas, unfold a 20'x100'x10 mil roll of visquine and lay out flat (see Figures 12).

Lay plastic flat on area to be raised. Place fill material (dirt, sand, gravel, etc.) on plastic. Fold plastic over material, lay a single row of sandbags on the backside lip of plastic and on all seams. Place fill material on the visquine using dump bed trucks, front-end loaders, or manually.

When this method is used in overtopping of small earthen dams, a spillway must be constructed.

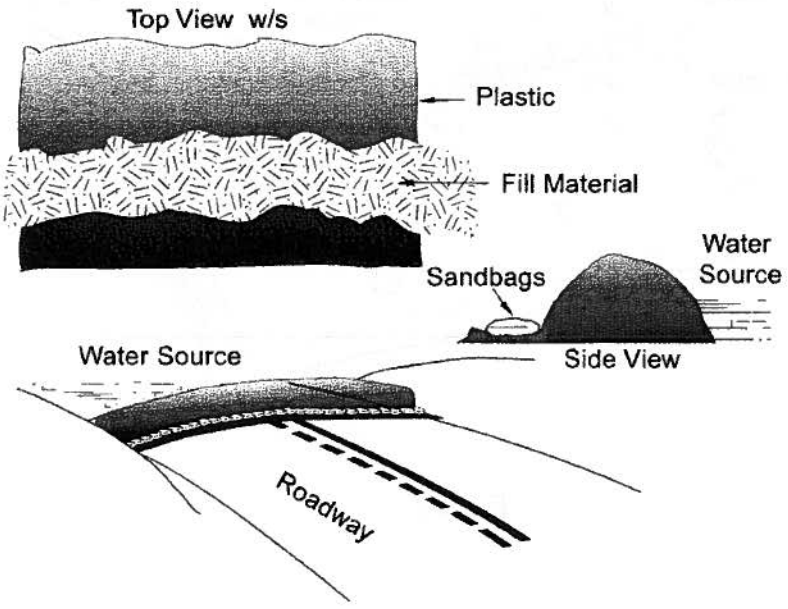


Figure 12

Wooden Panels

Many tools and materials are used in flood control efforts. A very versatile material is the wooden panel (see Figure 13). Wooden panels can be used for wavewash protection, lumber and sack toppings, and mud boxes. Wooden panels should be prefabricated and can be easily transported to the work site. The panels are generally 3 feet high with a minimum length of 12 feet. They are made of 1" x 12" x 12' boards The boards are nailed to 1" x 4" x 3' slats at 6-foot intervals. A 1/4 inch gap is left between each board in the panel.

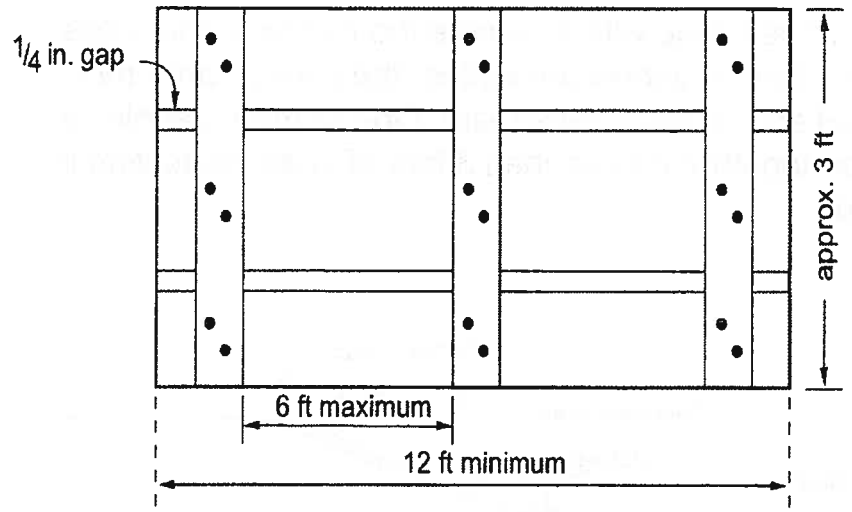
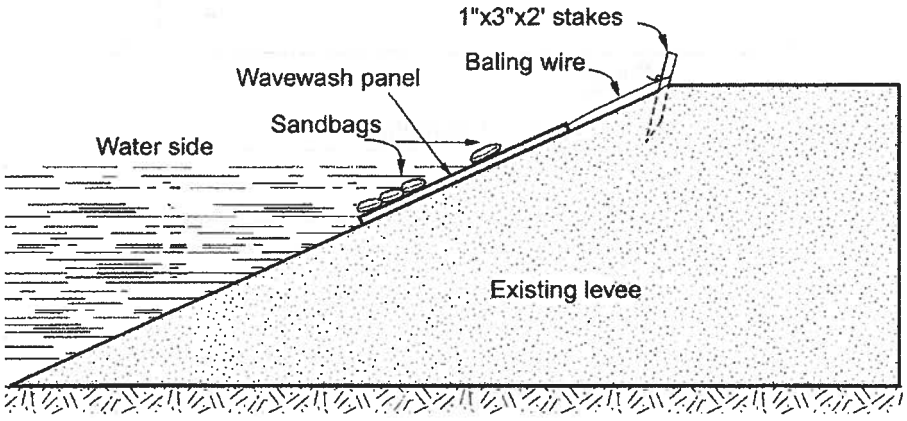


Figure 13

Wooden Panel Wavewash Protection

Although visquine is the preferred method of wavewash protection, wooden panels can be used (see Figure 14). When the water current is very fast or swift, wooden panels will hold up better than plastic sheeting. Drive wooden stakes (1" x 3" x 2') into the levee shoulder in the same manner as visquine (4 ft apart with a stagger of 1 ft between rows).

Baling wire is tied to the wooden panels through the 1/4 inch gap between the 1"x 12" boards. Sandbags are wired to the bottom half of the panels to weigh them down. Push the panels into the water with pike poles. The baling wire is then tied to the stakes as low as possible. Adjust the length of the baling wire to secure the panels in the proper position. If more panels are added, the overlap area must be 1 foot and facing downstream. One or more panels can be wired together if more than 3 feet of slope protection is needed.



NOTE: Panels may be placed in a vertical position, depending on existing conditions.

Figure 14

Lumber and Sack Topping

With this method, wooden panels are used on the waterside shoulder and reinforced on the opposite side with sandbags. The method is used to raise low reaches during high water (see Figure 15). Stakes 2"x 4"x 6' should be driven on the waterside shoulder 6 feet apart. Dig a shallow trench and line it with empty sandbags to provide a seal. Pre-constructed wooden panels are placed in the trench and nailed to the landside of the stakes. This wall should then be backed with enough sandbags to support the panels against the expected high water. In some cases, it may be practical to back the panels with tamped earth in lieu of sandbags. Attach 2"x 4"x 10' lumber kickers to the stakes that support the panels, and drive 2' stakes into the levee crown. Use at least two nails at each joint to ensure rigid construction.

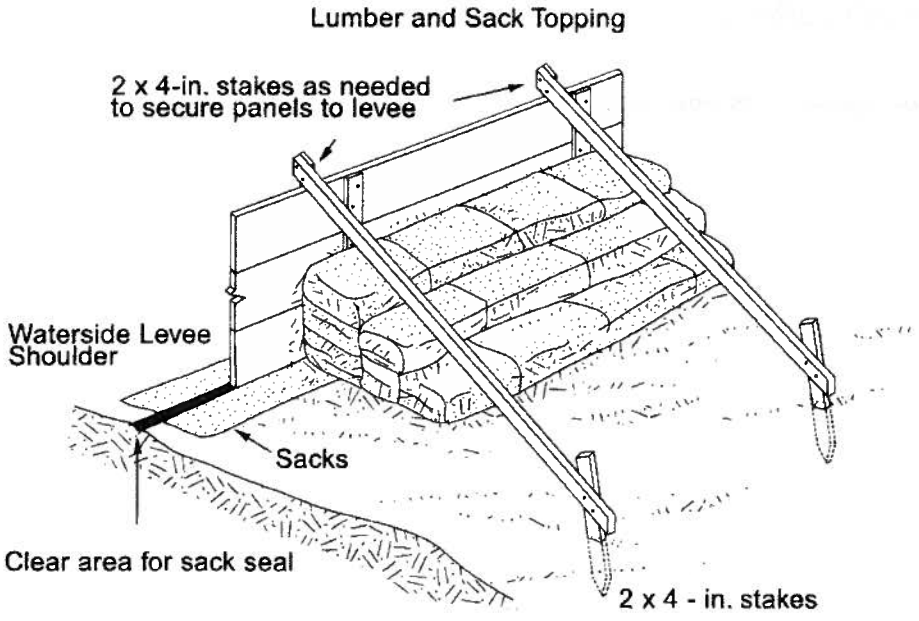


Figure 15

Mud Boxes

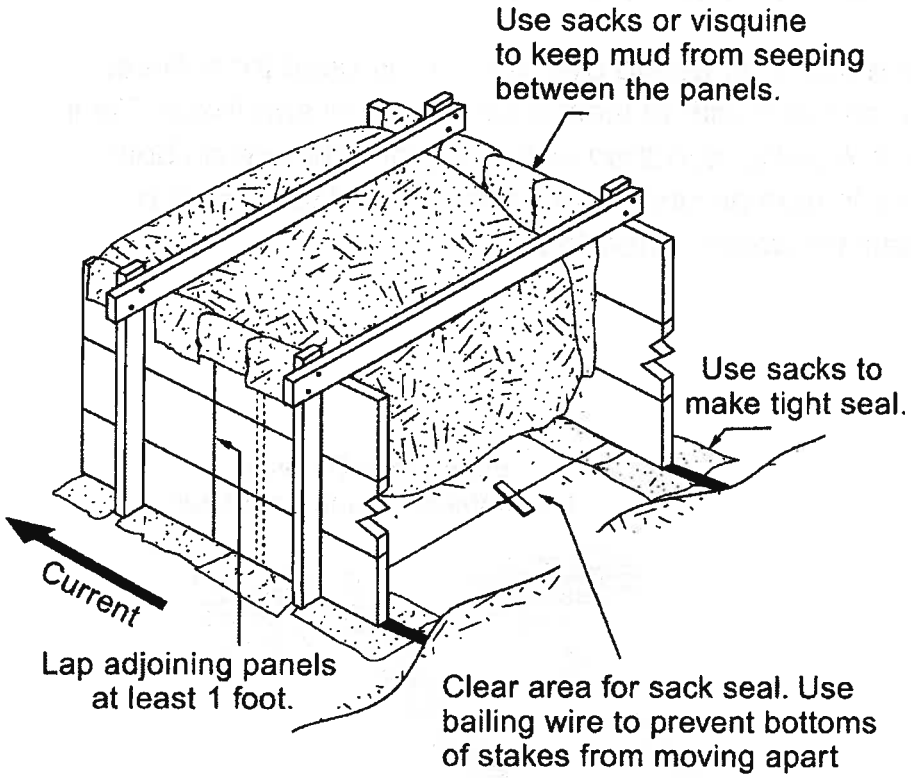
With this method, two parallel wooden walls are placed and supported near the waterward levee shoulder and filled with available material (see Figure 16). Spacing of the walls will vary with height but should be proportional to a box 3 feet high and 30 inches wide.

Mud boxes may be used when the available fill material is too wet for a sandbag sack topping, providing the boxes are lined with canvas, visquine, or burlap. If visquine is used, punch pencil-size holes in the bottom of the visquine to allow water to seep out. Close the open ends of the mud box with sandbags and tie into high ground.

NOTE

Mud boxes can also be used to divert mud flows from structures. If it is used for this purpose, plywood should be nailed to the face of the mud box, thereby creating a smooth surface.

(See Figure 16 on next page)


Use sacks or visquine
to keep mud from seeping
between the panels.
Use sacks to
make tight seal.
Current
Lap adjoining panels
at least 1 foot.
Clear area for sack seal. Use
bailing wire to prevent bottoms
of stakes from moving apart

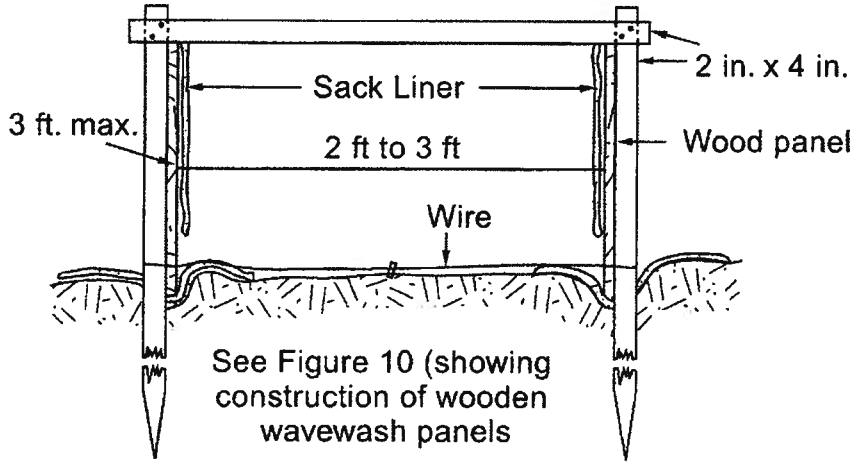

2 in. x 4 in.
Sack Liner
3 ft. max.
2 ft to 3 ft
Wood panel
Wire
See Figure 10 (showing
construction of wooden
wavewash panels

Figure 16

Emergency Spillway Using Visquine and Sandbags

Place plastic sheeting over area to be used for spillway. Line all sides with at least a single row of sandbags. Tie in *Sack Topping* sandbag wall at top of structure on both sides to high ground. Use additional tied sandbags on plastic for weight if needed.

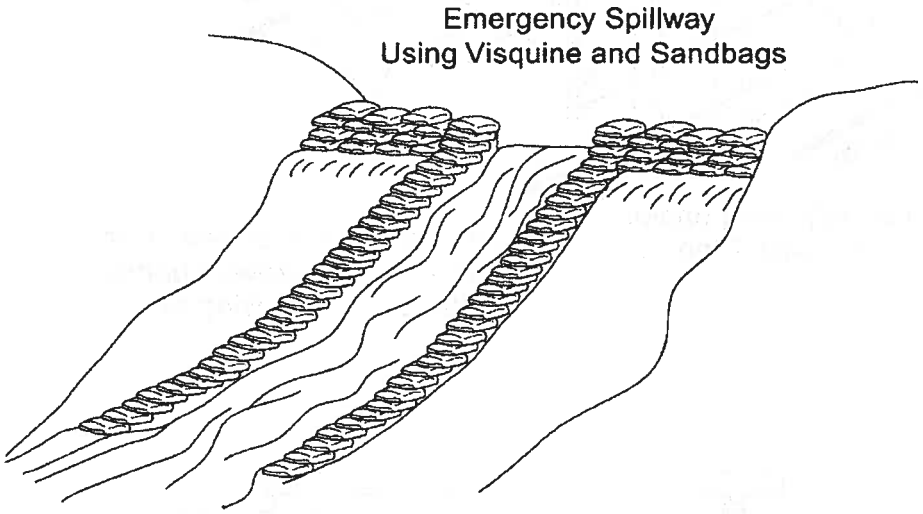


Figure 17

METHODS OF FLOOD FIGHTING AROUND STRUCTURES

The main causes of damage to structures, homes and property during heavy rains or flood flows are:

1. Flood water from overwhelmed storm drains and urban diversions, particularly on sloping streets.

2. Flood flows onto property through driveway openings, and low spots in curbs.

3. Debris flow from hillsides that have been cleared of vegetation by fire or real estate development.

The flood fighting methods described in the following paragraphs have proved effective in combating floodwaters and flood flows.

Diverting Water Away from Homes

To prevent or reduce property damage, the following methods can be effective.

Homes and structures can be protected from floodwater by redirecting the water flow as shown in Figure 18. Sandbag or wooden barriers must be placed at an angle and must be long enough to divert the flowing water away from all structures.

Barriers constructed of sandbags or lumber can also be used to channel mud and debris away from property improvements.

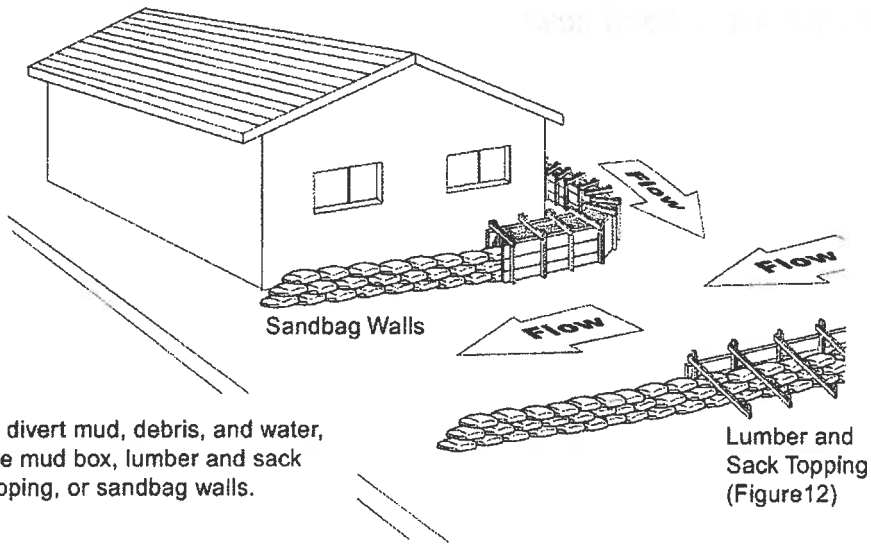


Figure 18

Home / Structure Protection

The following method is used for protection of buildings and other structures along lake shores and in similar situations where water is rising with little or no current.

Lay plastic sheeting on the ground and up the building walls to a point at least 1 foot above the predicted water elevation, and far enough out on the ground to form a half pyramid of sandbags (see Figure 19). Secure plywood over doors and vents. Overlap visquine and sandbags at corners of buildings.

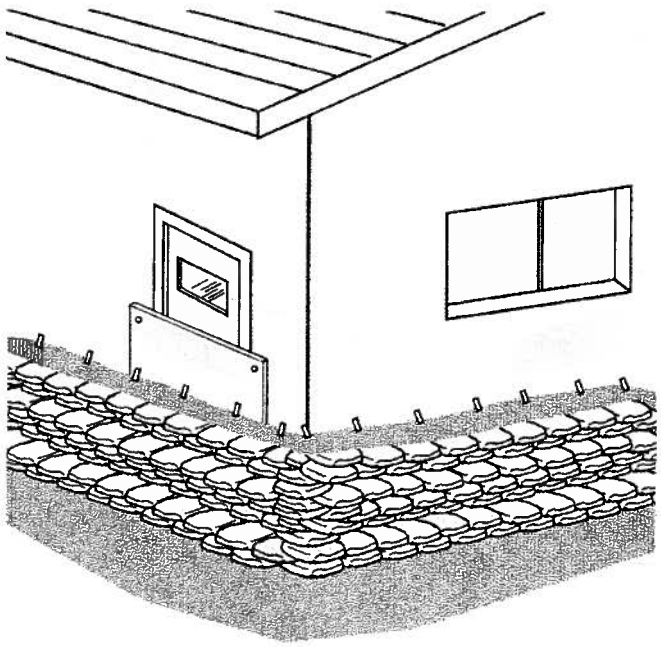
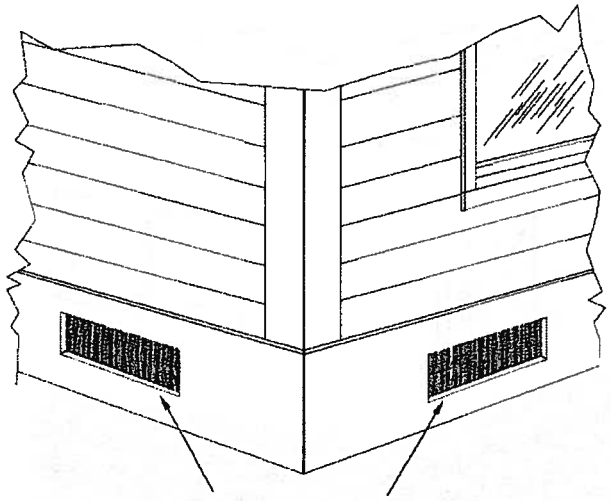


Figure 19

Wet Flood Proofing Requirements for Structures Located Within Special Flood Hazard Areas

National Flood Insurance Program regulations require that buildings on extended wall foundations or that have enclosures below the base flood elevation must have foundation or enclosure wall openings. These openings prevent the foundation or enclosure walls from weakening or collapsing under pressure from hydrostatic forces during a 100 year flood event. The openings allow flood waters to reach equal levels on both sides of the foundation or enclosure wall and minimize the potential for damage from hydrostatic pressure.



Foundation or wall openings must be kept open within special flood hazard areas

Figure 20

<u>These Openings Must Not Be Blocked If The Building Is Located Within A Special Flood Hazard Area.</u>

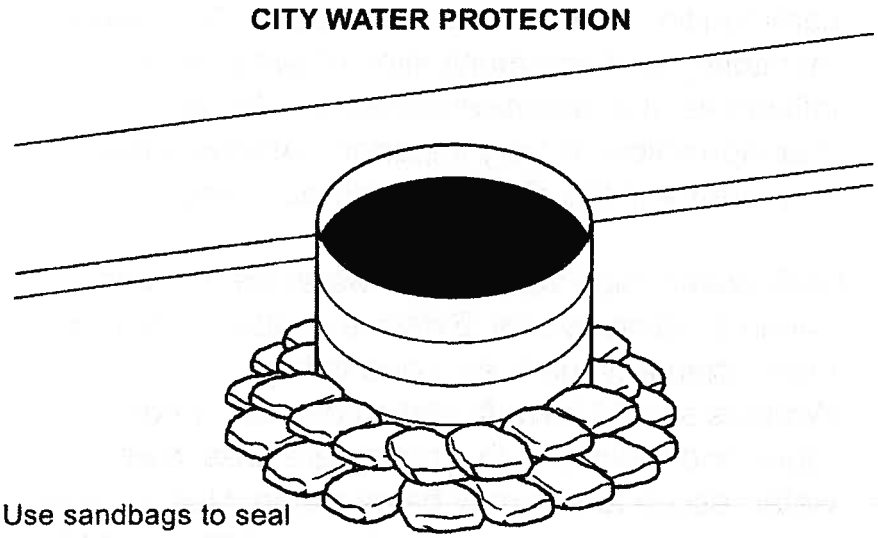
For details refer to FEMA Technical Bulletins TB1-93 and TB-7. These bulletins may be obtained from the FEMA web site at: *http://www.fema.gov*

For additional information contact DWR Floodplain Management at (916) 653-9902.

Protection of Water or Sewer System

Water or sewer systems can be protected by placing corrugated metal pipe (CMP) over the manhole (see Figure 21). Lay visquine up the walls of the CMP and place sandbags in the form of a half pyramid around the CMP to seal it to the pavement. This method will prevent mud and debris from entering the system and also act as a surge chamber.

Using corregated metal pipe (CMP) over manhole to isolate sewer line or prevent contamination of water system.



Using corregated metal pipe (CMP) over manhole to isolate sewer line or prevent contamination of water system.

Figure 21

FLOODFIGHT SAFETY

Numerous potential hazards exist during flood events. These hazards are manageable if identification and communication occurs on an ongoing basis. Personal safety requires a conscious effort that every flood fighter must consider in their various duties and activities.

- Changing Weather Patterns: This occurrence can affect existing conditions and create more serious situations. Always know the forecast and how it affects vulnerable areas, workers and the public.

- Changing Water Patterns: The rise and fall of water can occur gradually or very quickly. Knowledge of high water and how it relates to levees, communities and workers is essential. Continuous monitoring and communication of water level influences, (i.e. reservoir releases, tides and drainage inflow) is very important. Always know your area and the *flood history* around you.

- Swift Water: High velocities of water are common during flooding events. Extreme caution should be used when anyone is exposed to high water. Workers should have floatation devices, throw ropes and lifelines in the immediate area. Swift water rescue teams may be available. Use common sense and sound judgement around swift water. Know your resources and how to activate them prior to the event.

FLOODFIGHT SAFETY

- Climate Related Illness: During a flood fight, weather patterns can change constantly. Climate changes present the potential for hypothermia and heat prostration. Flood fighters should know the signs of distress for these types of illnesses and how to treat them. During cold, wet weather it is recommended that workers layer clothing, stay warm and dry. A dry blanket and warm clear fluids should be on the work site for emergency use. In warm, hot weather lightweight clothing is recommended. If skin is exposed, a sun block agent may need to be applied. Plenty of drinking water should be on site and consumed regularly. In both hot and cold situations headgear is recommended.

- Insect/Animal Exposure: Flooded areas force a variety of animals to evacuate to high ground. Workers in these areas should be aware of these animals or reptiles and not handle them. If animal removal is needed, contact a local professional. Stinging and biting insects are prominent in certain flood prone areas. Chemical repellents can be useful as a deterrent. A complete first aid kit should be on site.

- Sandpile Safety: When shovels are used for filling bags a safe distance for workers is essential. Sandbags and sand may contain contaminates. Have disinfectant available. Safety glasses or goggles are recommended for protection from blowing sand particles.

FLOODFIGHT SAFETY

- Contamination: Flooded areas can potentially carry high levels of contaminants. Local Haz-Mat teams should be contacted if needed. Always wear protective clothing to help limit contact with water. Carry antibiotic hand soap and wash thoroughly after working around floodwater.

- Exhaustion: Stress combined with long, physically demanding hours can have an adverse effect on the flood worker. It is very important to recognize exhaustion or sleep deprivation and treat them immediately. Operation of vehicles, machinery or equipment should be avoided. A shift rotation of personnel will help eliminate fatigue factors.

- Body Mechanics: Proper body mechanics while working on floods is very important. The body is expected to work long, physical, hours during the event. Each individual most make a conscious effort to use safe lifting and weight distribution techniques. Watch your footing, surfaces can be slippery and cluttered with tripping hazards.

- Construction Equipment: There are times when equipment and people will occupy the same work area. Workers should wear safety vests, hard hats and be aware of their surroundings. Safety warning devices, (i.e. backup alarms and lights) should be in-tact and working on all equipment. Communication and alertness is vital! All operators must be certified for their equipment.

FLOODFIGHT SAFETY

- Boat travel: Materials and/or personnel will sometimes need to be transported to work sites by boat. Operators of the watercraft must be certified. Floatation devices must be available for every passenger. Extreme care should be taken while loading and off loading. Watchful eyes are needed.

- Patrolling: Patrolling is the key to effective floodfighting. Patrols will identify, initiate control and monitor trouble spots in affected areas. Vehicle patrols should travel in two person teams with dependable communication devices. Lifelines, floatation devices and a blanket should be in the vehicle for possible water related accidents. Foot patrols should also have the same considerations. Extreme caution should be exercised when travelling saturated, cracking or sluffing areas.

- Vehicle Placement: Vehicles in work areas along the levee should remain parked on high ground. This is usually the crown roadway. Vehicles should also be parked facing their access point. An escape plan should be communicated to all flood workers.

- Structure Considerations: When working around structures, be aware of downed power lines, natural gas or propane leaks and unstable structure supports. Communicate with the structure owner if possible.

- Safety Gear: Rain gear, warm clothing, handheld lights, gloves, goggles, hardhat, boots, first aid kit, ropes, floatation devices, hip boots.

FOR ADDITIONAL INFORMATION CONTACT:

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