



DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-2255

REPLY TO
ATTENTION OF

Planning Branch

Residents of Stehekin
Chelan County

Dear Residents:

As you may know we completed our Advanced Measures investigation and report in late August. Due to the high complexity and degree of uncertainty of the riverine system we determined the best course of action for the short term would be flood protection on individual landowner properties. In order to assist you in the planning or construction of these different flood protection measures, we have prepared the enclosed packet of information.

The enclosed packet contains generic drawings of several measures that can be implemented in suitable locations on individual properties. Each drawing or technique is supported by a fact sheet that explains the uses, risks, benefits, constructability, materials, etc. in constructing such a measure. The drawings are non-site specific and may be modified according to the individual characteristics of the property. Please be reminded that all flood protection measures are temporary and provide a limited level of protection.

To assist you in designing applicable measures on your property, a team of technical experts will be visiting the community the week of September 27. They will meet with individual and interested landowners at their property. Some materials will be provided to assist in the construction of these measures – more details will be provided at the public meeting. If you are interested and available, I recommend you take advantage of this opportunity.

On behalf of the Seattle District Army Corps of Engineers Advanced Measures Team, it has been a pleasure meeting with you and working towards a flood management solution. Your input and suggestions have been appreciated.

We hope you will find the contents of this package helpful in addition to the technical advice and assistance we can offer. If you have any questions please contact me (206) 764-5522, or alicia.m.austinjohnson@usace.army.mil.

Sincerely,

Alicia M. Austin Johnson, Program Manager

Encl.

Flow Deflector Fact Sheet

Fall 2004, Stehekin River Advance Measures Project

Offered measures should be monitored regularly to determine if there is need of repair, or to determine if there is risk of imminent failure.

- **Uses:** A Flow Deflector is a barrier that is intended to divert, but not stop, flow toward a structure. A typical situation where a flow deflector would be beneficial would be on a minimal to moderate slope that gets flow of a few inches or more of water and debris directed toward a home or structure.
- **Location and Form in Relation to Home or Property:** Flow deflectors should be placed a minimum of 20 feet from a structure. One or more flow deflectors can be used, depending on the situation.

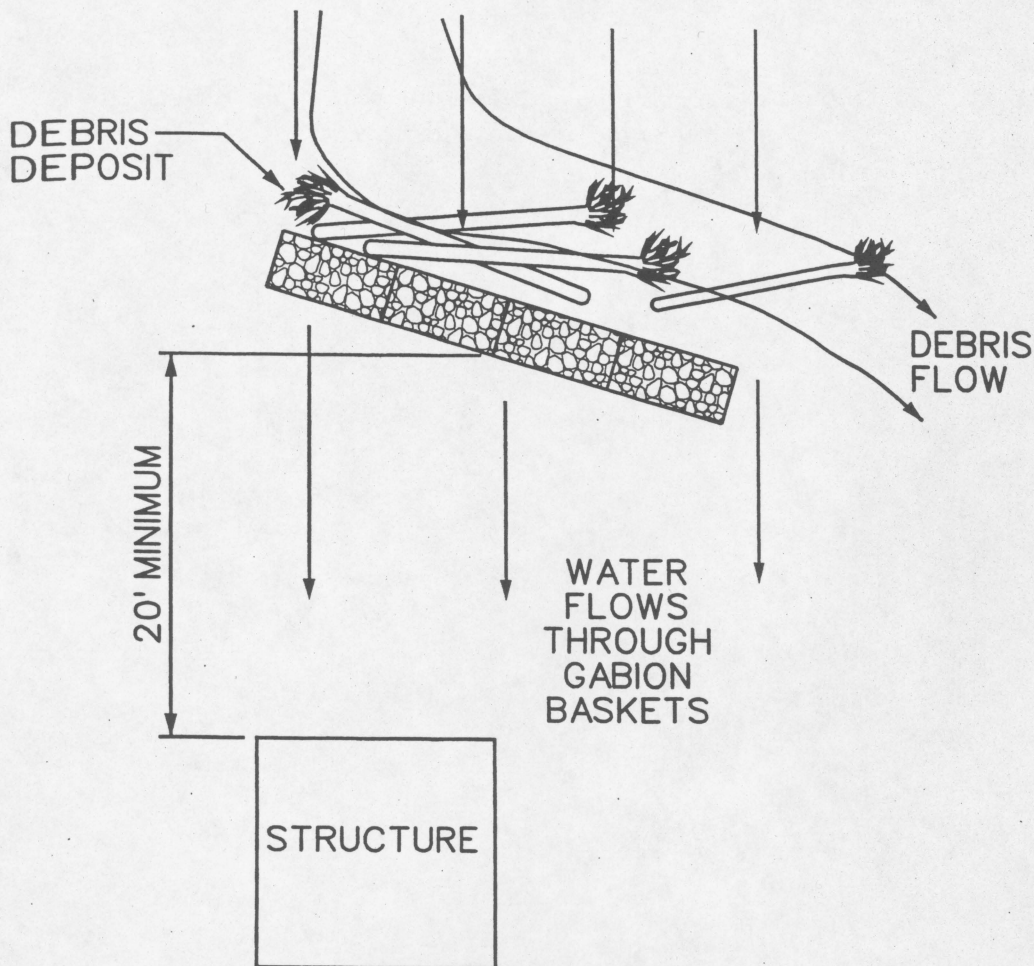
They should be placed at an angle that will divert water away from a structure. If more than one is necessary, then they should be angled and staggered apart.

Another configuration is a classic "V". Where the point of the "V" is aimed upstream to catch and deflect flow and debris away from the home, the flow deflector should be at least 20 feet from the property the "V" should be further.

- **Typical Materials used to Construct:** A flow deflector could be constructed of one or more gabion baskets filled with various sizes of rock that lock together well. This will slow the amount of water that flows through the structure, and divert it away. A combination of gabion baskets and logs would also work. The baskets are made of steel mesh. They are 3 feet wide X 3 feet tall X 6 feet long. They can be wired together to make any desired length
- **Construction Methods:** If using logs and gabion baskets, place chain underneath the basket before filling with rock. Choose a length of chain long enough to run under the basket and anchor the logs to the baskets. The logs should be placed on the outside face, the direction the flow will come from. The logs should fit well enough to the ground surface so the flow will be diverted when it hits the logs.

The logs could also be chained to standing trees of sufficient girth to withstand uprooting. The log should be as long or longer than the distance between the trees. Place the log on the side of the trees the flow will be coming from, and make sure that the logs fit well to the ground surface.

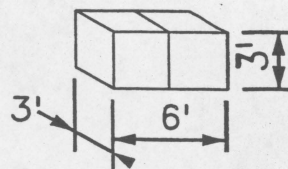
- **Typical Lifespan:** Gabion basket structure should last for years, log structures can be expected to rot after a few years.
- **Risks:** There is the risk with the gabion basket deflectors, gabion basket/log deflectors, and the log/tree deflectors that they could possibly fail and cause material and water to flow toward a structure.



PLAN VIEW

SCALE: 1" = 10'

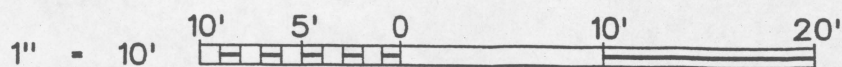
PLACE GABION BASKET AT APPROPRIATE ANGLE TO CATCH AND DEFLECT DEBRIS. FILL GABIONS WITH ROCK ON SITE.



BASKET DIMENSIONS

GABION BASKET DETAILS

NOT TO SCALE



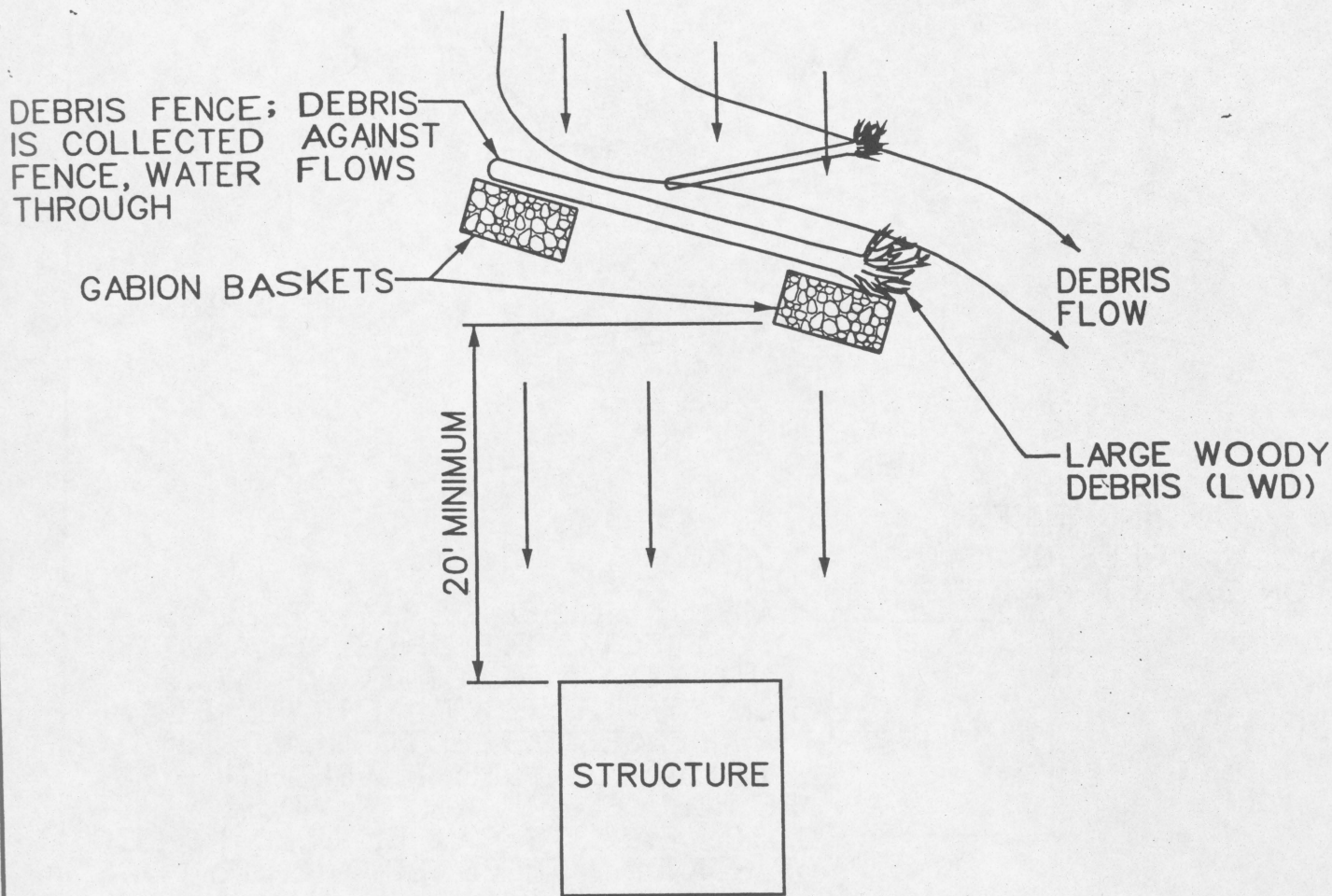
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STEHEKIN RIVER
FLOOD FIGHT OPTIONS
GABION BASKET OPTION

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

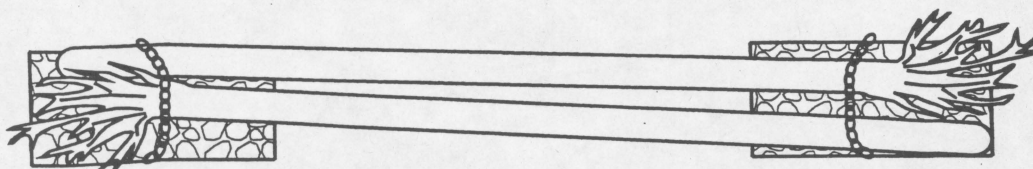
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PLAN VIEW

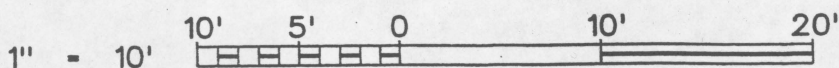
SCALE: 1" = 10'



WRAP CHAINS AROUND GABION BASKETS BEFORE FILLING AND SECURELY ANCHOR LWD TO BASKET FACES. LOGS CAN ALSO BE CHAINED TO STANDING TREES TO ACT AS DEBRIS FENCE.

GABION BASKET AND LWD DETAIL

NOT TO SCALE



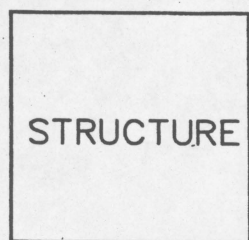
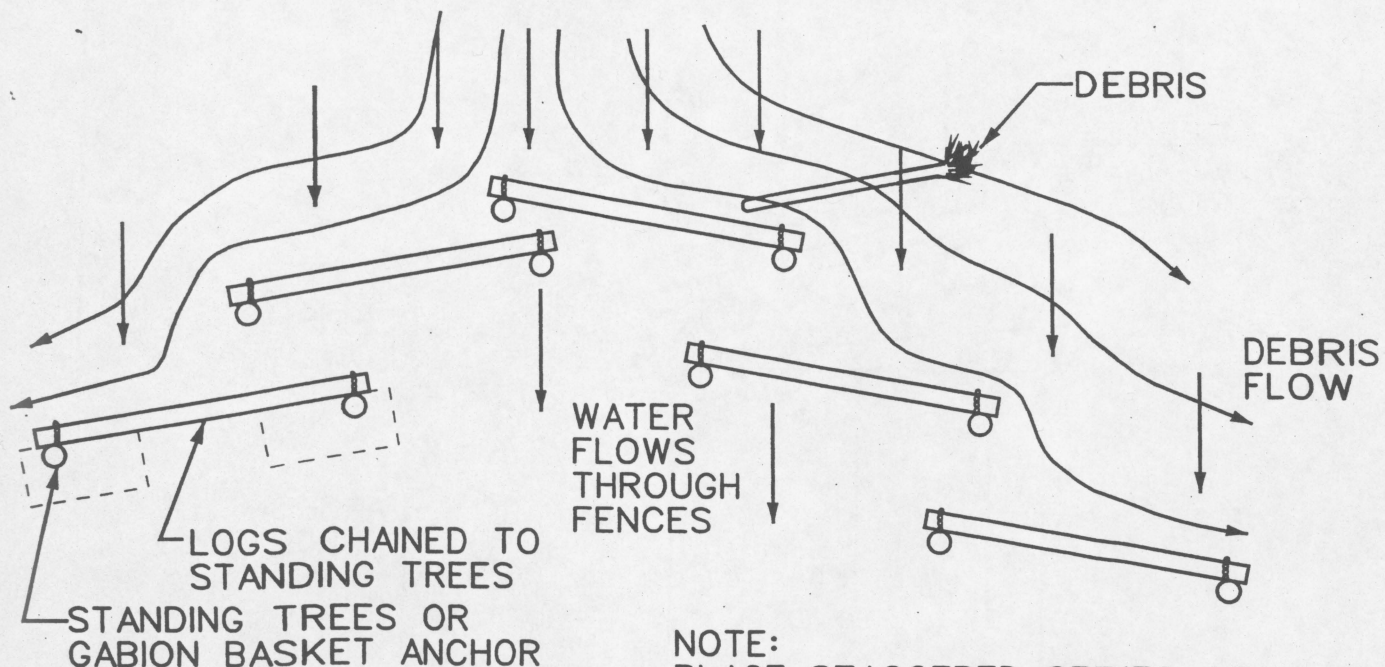
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STEHEKIN RIVER
FLOOD FIGHT OPTIONS
GABION BASKET AND LWD
DEBRIS DEFLECTOR OPTION

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SEATTLE, WASHINGTON

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Drawn by: MCARDY
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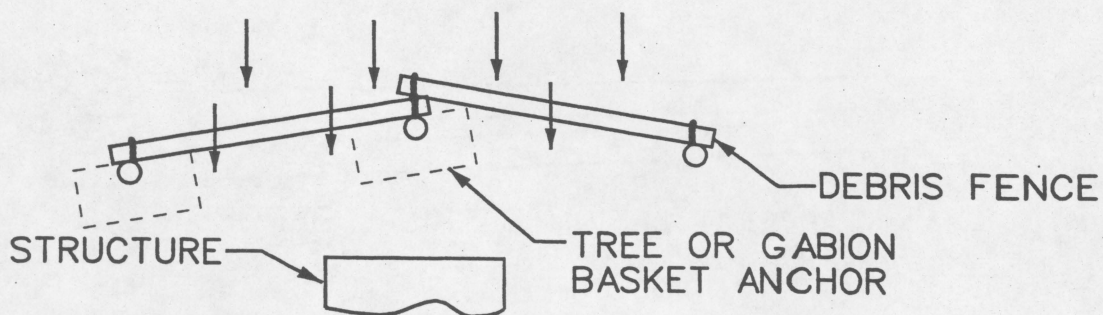
SHEET
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NOTE:
PLACE STAGGERED SERIES OF LOGS
TO COLLECT/DEFLECT DEBRIS AND
CONTINUOUSLY DIRECT FLOW AWAY
FROM STRUCTURES. WATER WILL FLOW
THRU FENCES. DEFLECTORS AND RING
DIKES MAY BE USED IF VELOCITIES
ARE REDUCED ENOUGH. INDIVIDUAL
GABION BASKETS CAN BE USED IN LIEU
OF STANDING TREES TO ANCHOR LOGS.

PLAN VIEW

SCALE: 1" = 10'



ALTERNATE PLACEMENT OPTION

NOT TO SCALE

COMPUTER
AIDED
DESIGN &
DRAFTING

1" = 10' 10' 5' 0 10' 20'



US Army Corps
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STEHEKIN RIVER
FLOOD FIGHT OPTIONS
FLOW DEFLECTOR OPTION

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

Sheet: ABE A
Part of: 07 SEP 04
Designed by: DELAND
Drawn by: MEANY
Checked by: FISCHER

SHEET
5 OF 7

Ring Dike Fact Sheet

Fall 2004, Stehekin River Advance Measures Project

Offered measures should be monitored regularly to determine if there is need of repair, or to determine if there is risk of imminent failure.

- **Description of Feature:** A ring dike is an arc or circular structure made of sandbags.
- **Uses:** To keep flood waters out of structures.
- **Location and Form in relation to Home or Property:** The ring dike should be constructed approximately 8 feet away from the structure to be protected if pumping is planned. The ring dike should be constructed in a circular shape.

If pumping isn't planned, then sandbags can be placed against or near the structure to be protected. If there is high ground to tie into on each side, then an arc shaped structure can be used.

- **Typical Materials used to Construct:** Typically, ring dikes are made of sandbags; treated burlap bags 14 inches by 24 inches and filled with sand $\frac{1}{2}$ to $\frac{2}{3}$ full (approximately 40 lbs.).
- **Construction Methods:** This is the preferred construction method for a ring dike and will withstand up to a one-foot rise in water. If pumping out the ring dike, the ring dike should be constructed about 8' from the structure to be protected. Fill in the low spots with sandbags before starting to build the ring dike. The sandbags should be placed in a pyramid structure with three bags across the base, 2 bags on the second layer and one bag on top. The seams of the sandbags should be staggered so they aren't placed over the layer above, below or beside each other.
- **Typical Lifespan:** A ring dike will typically last a few months until the sandbags begin to decompose.
- **Risks:** There is a possibility that the ring dike will overtop if not built high enough. It is a great deal of work to raise the dike any significant height. For instance, to protect against 2 feet of water, 2,100 sandbags would be required for a 100 foot long ring dike where only 600 bags would be required for a one foot height.

**Note: Ring dikes will leak, and if the intention is to keep the area dry, pumping will be necessary. Plan ahead and place the pump in a low spot. Pump downstream away from other structures. Ring dikes should be used only in areas where there is standing water. They are not appropriate to use with moving water. Use this sandbag method where water won't rise above one foot.*

Debris Fence Fact Sheet

Fall 2004, Stehekin River Advance Measures Project

Offered measures should be monitored regularly to determine if there is need of repair, or to determine if there is risk of imminent failure.

- **Physical Description of Feature:** Chain link fence, continuous row of gabion baskets, logs chained or cabled to standing trees or spaced gabion baskets.
- **USES:** A Debris Fence prevents debris flow toward a structure.
- **Location and Form in Relation to Home or Property:** The fence should be placed a minimum of 20 feet from structure at an angle to deflect debris away from the structure and toward a swale or channel. A debris fence should be placed where debris is expected to be carried by floodwaters.
- **Typical Materials Used to Construct:** materials include chain link fence, gabion baskets, a combination of gabion baskets and logs, or possibly logs anchored to large standing live trees.
- **Construction Methods:** A gabion basket is a steel mesh basket used to hold rock. The rock used should be material found on site. Downed logs with diameters of 12" to 24" can be chained between gabion baskets or standing timber to restrain the debris.

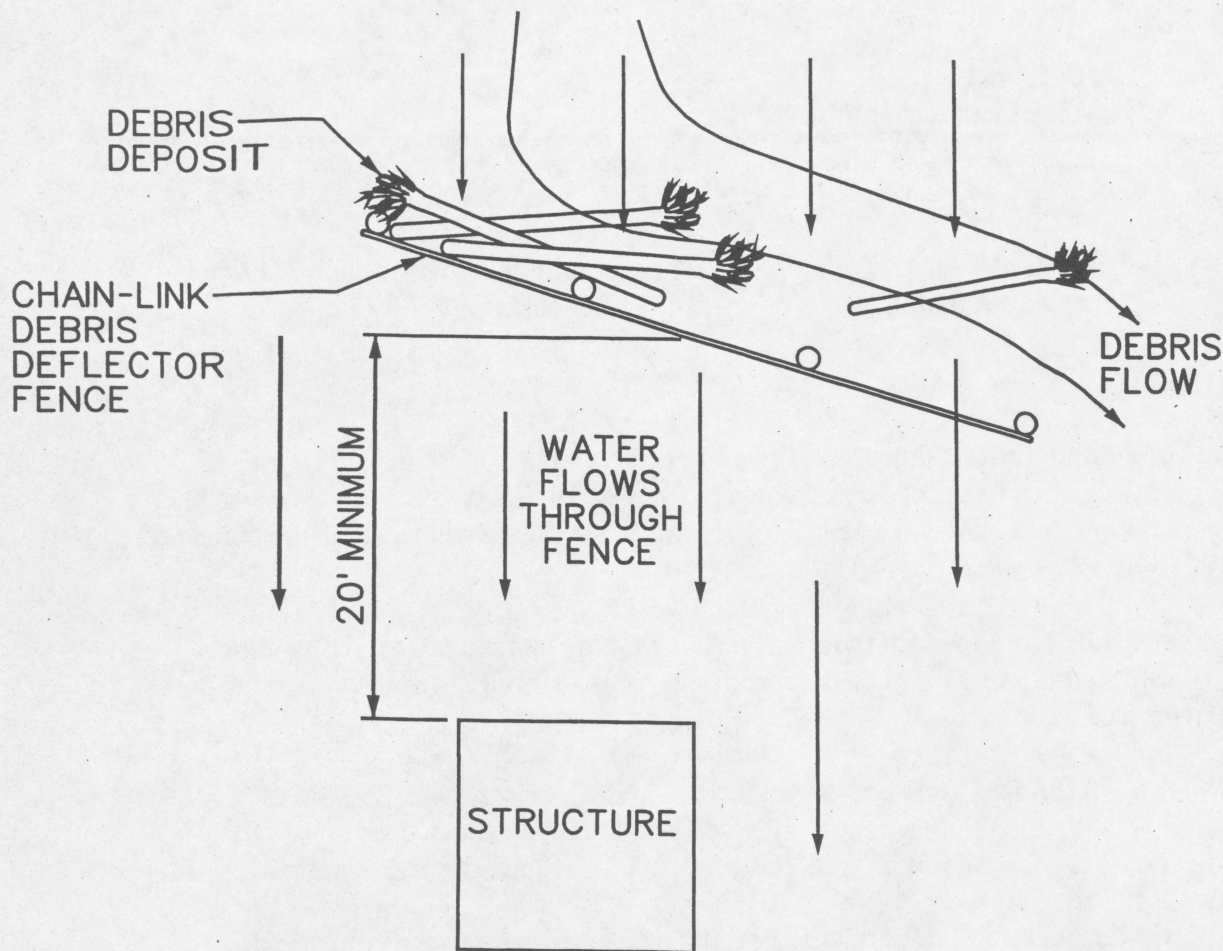
Assemble baskets and place on a relatively flat surface, fill with rock from site. If anchoring logs to baskets, place chain underneath the basket before filling. Choose a length of chain long enough to run under the basket and anchor the logs to the baskets. The logs should be placed on the outside face, the direction the debris flow will come from.

If using logs chained to standing trees of sufficient girth to withstand uprooting, place the logs on the outside face and anchor between trees.

Install chain link fence at an angle to deflect debris.

- **Typical Lifespan:** The chain link fence and gabion baskets should last for years, with regular maintenance to clear trapped debris and sediment, unless destroyed by large debris volume.
- **Risks:** There is a possibility of catastrophic failure if a large debris flow takes out the debris fence. The resulting flow could destroy the structure it was intended to protect.
- **Applicability to Stehekin River Site Locations:** The debris fences can be used at McGreagor Meadows.

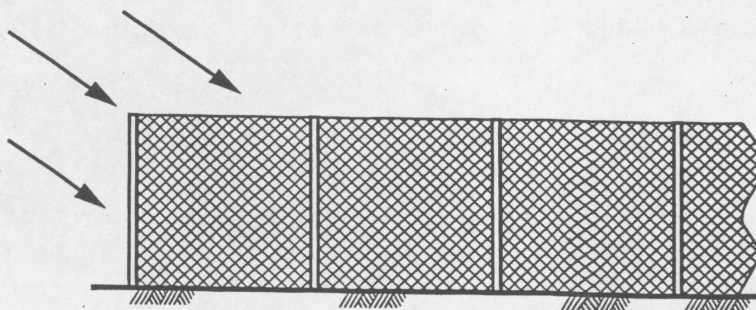
**Note: debris fences will deflect debris, but not necessarily slow the flow of water unless constructed as a flow and debris deflector.*



PLAN VIEW

SCALE: 1" = 10'

PLACE CHAIN-LINK FENCE AT APPROPRIATE ANGLE TO CATCH AND DEFLECT DEBRIS.



FENCE DETAIL

NOT TO SCALE

*SEE OTHER OPTIONS

COMPUTER
AIDED
DESIGN &
DRAFTING

1" = 10' 10' 5' 0 10' 20'



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STEHEKIN RIVER
FLOOD FIGHT OPTIONS
CHAIN-LINK DEBRIS
DEFLECTOR FENCE OPTION*

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

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Drawn by: MCARDY
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SHEET
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Grade Control Fact Sheet

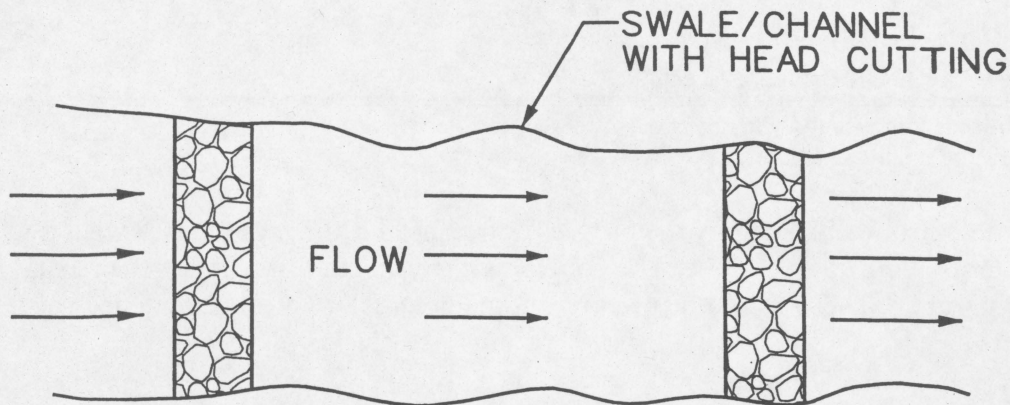
Fall 2004, Stehekin River Advance Measures Project

Offered measures **should** be monitored regularly to determine if there is need of repair, or to determine if **there** is risk of imminent failure.

- **Uses:** Grade control will help slow the progression of head cutting in an area where there is water flowing down a slope. The control will consist of digging a trench and filling it with riprap. These would be used if a home or structure were threatened by erosion.
- **Location and Form in Relation to Home or Property:** This form of prevention will be used where erosion occurs and creates flow that resembles a creek and causes erosion that keeps cutting back and eroding deeper taking more soil.
- **Typical Materials used to Construct/ Construction Methods:** Typically an excavator or backhoe can be used to dig a trench approximately 6 feet deep, a bucket wide, and as long as necessary. The trench is then filled with riprap to act as a hardened structure. As the material in front of the rock erodes away, the riprap will fall to that elevation and slow the progression of head cutting.

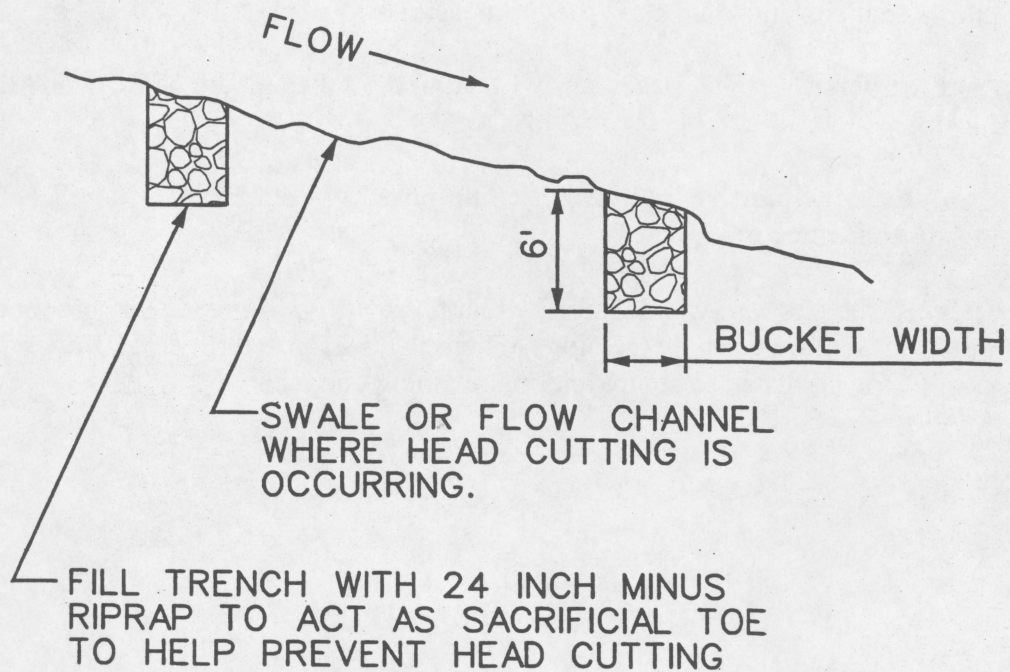
The number of trenches necessary will depend on the amount of flow and the angle of the slope.

- **Typical Life Span:** These trenches could possibly last a few years before having to be supplemented or replaced.
- **Risks:** There is always a possibility that there will be a great deal of concentrated flow that will erode away the slope. There is also a possibility that flow will divert around the hardened structure and make a new channel.



PLAN VIEW

SCALE: 1" = 10'



ELEVATION VIEW

SCALE: 1" = 10'

COMPUTER
AIDED
DESIGN &
DRAFTING

1" = 10' 10' 5' 0 10' 20'



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STEHEKIN RIVER
FLOOD FIGHT OPTIONS
GRADE CONTROL

U. S. ARMY ENGINEER DISTRICT, SEATTLE
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SEATTLE, WASHINGTON

Drawn by: JWB A
Plot date: 07 SEP 04
Designed by: DELMAR
Drawn by: MCARDY
Checked by: FISCHER

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6 OF 7

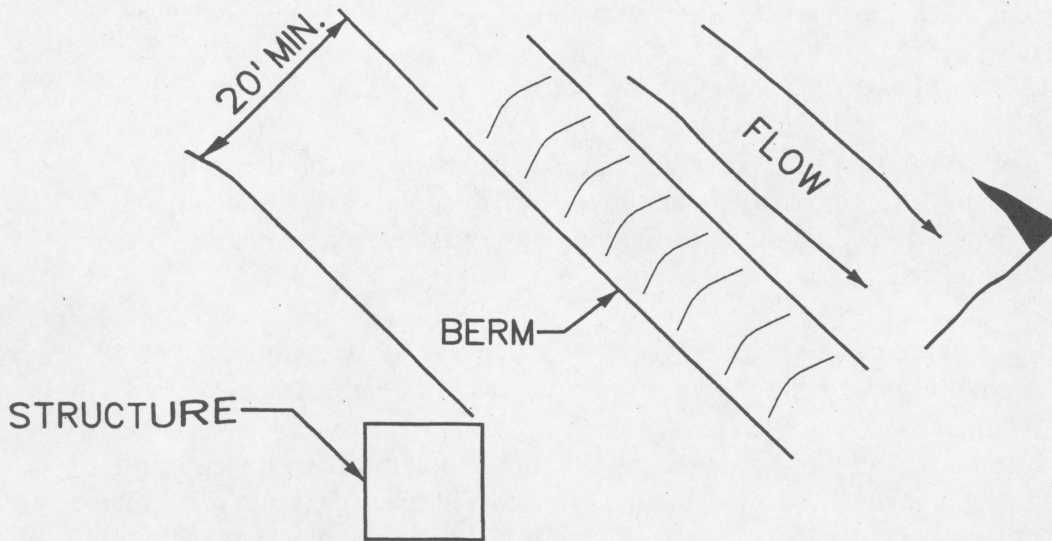
Scour Protection Fact Sheet

Fall 2004, Stehekin River Advance Measures Project

Offered measures should be monitored regularly to determine if there is any threat of imminent failure.

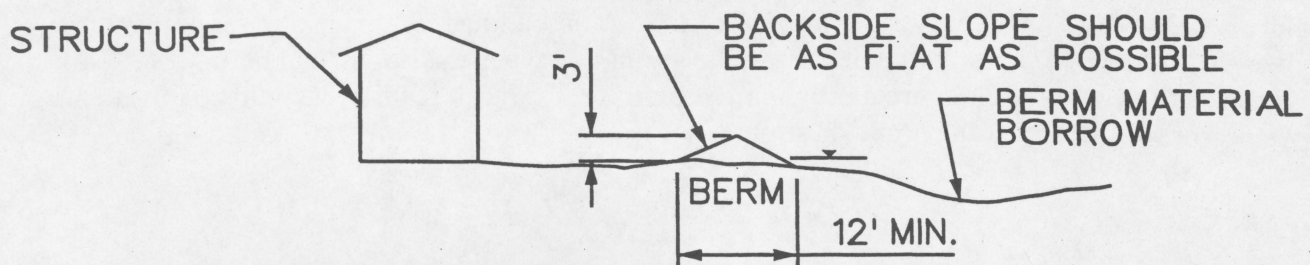
- **Physical Description of Feature:** A long narrow mound of rock and soil called a berm.
- **Location and Form in relation to Home or Property:** The berm would generally be placed parallel to the direction of downstream flow. A berm could also be used as an overflow channel. This would keep the water flowing downstream away from the home or structures to be protected.
- **Uses:** Berms would be appropriate in areas where water rises and flows across the property toward structures, and where there isn't a great deal of debris expected.
- **Construction Methods:** A berm used for scour protection would be constructed using a bulldozer to push up native material into a mound or narrow strip a minimum of 12 feet wide (footprint) at the base, 3 feet high and the length necessary to prevent water flow from damaging the property. Typically, the bulldozer would push material up from the outside of the berm, or the side that would be facing the water. The transition between the slope and the bottom would be gentle, and the side slopes of the berm would not be steep, this should help prevent scour.
- **Typical Lifespan:** A berm constructed of native material consisting of a mix of rock and soil with vegetation such as grass on the slopes and top should last indefinitely. It would be considered a permanent feature.

A berm made of a single type of material may not hold up well. One made of a mixture of rock, soil and sand should hold up against scour quite well. If the berm overtops, it is important the backslope (the side nearest the home or structure) is not steeper than 3 horizontal (H) to 1 vertical (V). A slope of 5 to 1 would be ideal; otherwise water coming over the top will erode away the berm and the ground between the house and berm. These flatter slopes will require a much larger berm footprint. If it fails, it could channel water to flow directly at the home or structure.



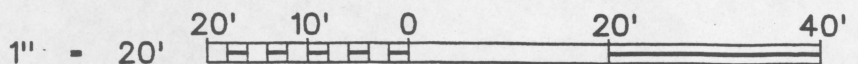
PLAN VIEW

SCALE: 1" = 20'



ELEVATION VIEW

SCALE: 1" = 20'



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US Army Corps
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Seattle District

STEHEKIN RIVER
FLOOD FIGHT OPTIONS
SCOUR PROTECTION

U. S. ARMY ENGINEER DISTRICT, SEATTLE
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SEATTLE, WASHINGTON

Sheet: ABB A
Plot date: 07 SEP 04
Designed by: DESMORIN
Drawn by: MCNAVY
Checked by: FISHER

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