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THE WATER SURE LOOKS MUDDY THIS YEAR

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**THE STORY OF SOIL EROSION
AROUND
THE CHESAPEAKE BAY**



Virginia Department of Conservation & Historic Resources - Division of Soil & Water Conservation



name _____

county/city _____

The Water Sure Looks Muddy this year
The Story of Soil Erosion Around The
Chesapeake Bay

by

Barry W. Fox
Extension Specialist
4-H Marine/Aquatic Education
Virginia State University
Virginia Cooperative Extension Service
1890 Program

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The purpose of this project is to help intermediate age youth understand how erosion and sedimentation affect the Chesapeake Bay and the surrounding watershed. Youth will also learn how they can help reduce this form of pollution by completing an erosion control project.

"The Story of Soil Erosion Around the Chesapeake Bay" was developed with the much appreciated assistance of the following individuals: Paul Davis, Education Coordinator - Chesapeake Bay Program; Dr. Scott Newton, Virginia State University Cooperative State Research Service; Ralph Mendenhall, Soil Scientist - Chesterfield County Engineering Department; Lee Hill, Senior Environmental Engineer - Shoreline Erosion Advisory Service; Ken Carter, Soil Conservationist - Soil Conservation Service; and Clifton Davis, Extension Agricultural Agent - Virginia Tech. Special appreciation is also expressed to Helen Jeter, Public Affairs Specialist - USDA and Steve Hawks, Information Officer - Virginia Division of Soil and Water Conservation for editorial comments; and to Penny Risdon, Extension 4-H Agent - Virginia Tech for typing the final document. Finally, appreciation is expressed to Lilly J. Faison for typing drafts of this publication.

What caused the muddy water?

A Virginia river known for "sweetness of tastes"...and "so stored with sturgeon and other sweet fish as no man's fortune has ever possessed the like. We got good store of mussels and oysters which lay on the ground as thick as stones. We opened some and found in many of them pearls."

Although the language sounds a bit odd, this is the writing of a Virginia colonist, the date -- April, 1607, the place -- Lynnhaven Bay or what is now Virginia Beach. Visit the same area today and the description hardly fits. Long gone are the sturgeon (a fish), now an endangered species, facing extinction. There are few oysters or mussels along the shore and eating them would be risky because of the polluted water. The water is anything but sweet now. Drink a cup full and you may end up in bed with an upset stomach.

The early colonists discovered a rich, unpolluted land upon arriving in the "New World". Native Indians had lived in harmony with nature for thousands of years prior to the colonists arrival, taking only what they needed and not abusing the resources. It is well documented that the major reason for European colonization of the America's was exploitation of natural resources, mainly gold and other valuable minerals. When these were not found, the colonists turned their attention to other resources of export value.



Tobacco and the Colonies

In order to make the colonies profitable for European backers, the colonists needed to find a valuable export item. This came with an immigrant, John Rolfe, and the tobacco plant. Tobacco became the rage of fashionable Europeans and a booming market for the dried leaves was established. By 1640 the land along the lower James River was being used for tobacco farming. While further inland, wheat and other grains became important crops. Forests were cleared, the soil tilled, and crops planted and harvested with little thought to soil conservation. River shores were the best place for farms. Rivers offered easy access to docks for shipping crops to European markets.

So began the slow but steady destruction of forests along rivers flowing into the Chesapeake Bay. The bare, cultivated fields allowed wind and rain to erode top soil. Colonists noted erosion and muddy waters as early as the late 1600's. And by 1800, sediments had filled in waterways (once 8-15 feet deep) around towns like Marlboro and Joppatown in Maryland. These and other shipping towns became separated from the shipping channels that were once their very livelihood.



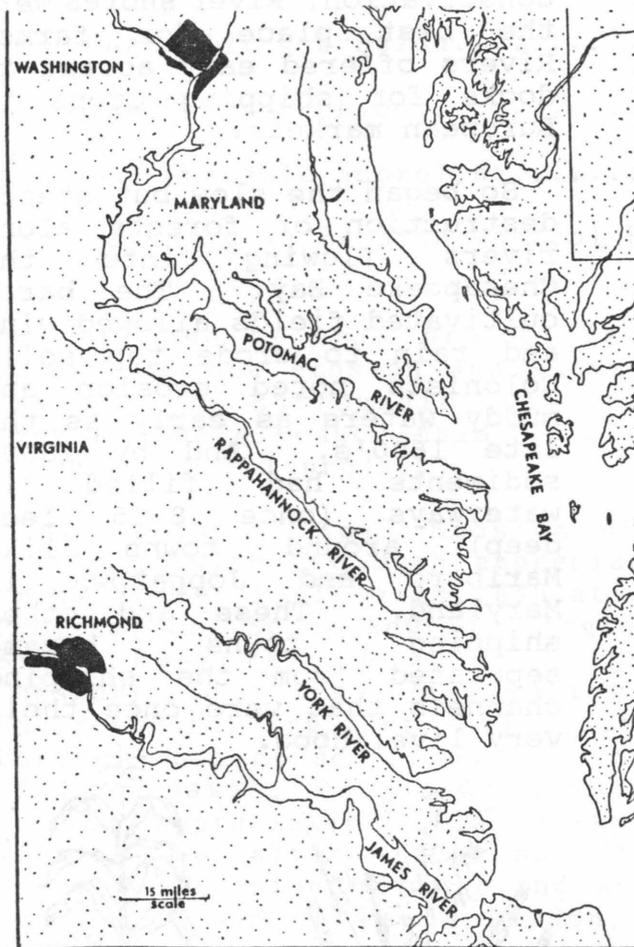
The American colonists did not understand the concept of soil conservation. The vastness of the new lands led to a "use and move on" attitude. As one colonist said, "You can't tell me how to farm, I've already worn out two farms."

With the tremendous increase in population, soil erosion has become a major environmental

problem of the Chesapeake Bay area. Water quality has steadily declined, land has been lost and waterways filled, farmlands have become unproductive, and plants and animals living in the water have been affected. The problem has worsened and now threatens the health of the greatest estuary in the U. S. -- the Chesapeake Bay.

Things to do

On the map of the Chesapeake Bay identify these early settlements: Alexandria, Annapolis, Cambridge, Jamestown and Virginia Beach.



Search through old magazines and newspapers for pictures of pristine (natural) and severely eroded lands. Attach the pictures and describe how erosion has affected the land.

Pristine Land

Eroded Land

What are erosion and sedimentation?

Erosion is the natural process by which soil material is moved on the earth's surface. This occurs when loose, unprotected soil is blown or washed away by wind or water. Rock material must first be "aged" before it can be eroded. The aging process is called weathering.

There are several ways that weathering occurs. Rocks can be dissolved by flowing water, a process called dissolution. Freezing and thawing causes weathering, slowly contracting and expanding the rock. This causes it to eventually weaken, crack, and break apart. Ever notice plants growing in an old sidewalk? The chemical action of lichens and mosses also weakens the surface of rock causing it to crumble.

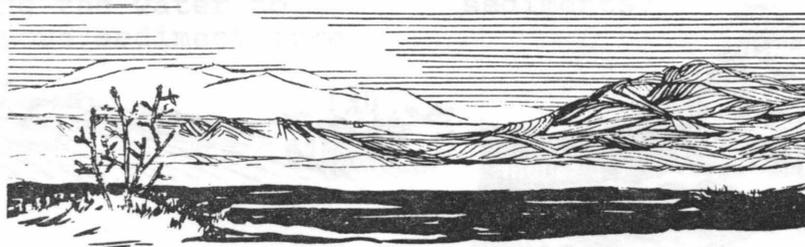
Finally, abrasion results when wind or water grinds rock particles against each other-- a type of natural sand blasting and rock polishing. Once rock has been weathered, it is ready to be transported or eroded by wind or water. The weathering process is slow but erosion can be very rapid, especially when soil has been disturbed.

Loss of soil and soil fertility is not the only problem caused by erosion. Soil particles moved by erosion result in sedimentation - the settling of soil particles out of water or air. The particles, called sediment, can

consist of clay, silt, sand, humus or any combination of these elements. The particles may be organic (from living organisms) or inorganic (from non-living matter). It has been estimated that 10 to 50 percent of eroded soil in the U.S. ends up in waterways, lakes, and reservoirs each year. That is nearly four billion tons of soil. Of this, nearly one billion tons end up in the ocean. This makes sediment the single largest source of pollution in our nation's waters.

The sources of sediment are wide spread and are called non-point sources of pollution. Point sources of pollution, such as factory waste pipes and sewage drainage pipes, can be easily pinpointed. Non-point sources, however, are harder to identify. Farms, housing projects, and cities located along a waterway can be sources of sediment pollution.

Like other bodies of water, the Chesapeake Bay is suffering from sedimentation. The amount and intensity of rainfall, land topography, agriculture, and urban development, all affect the amount of sediment (called sediment load) entering the bay. Little is known about the actual amount of sediments entering the bay. However, scientists agree that sediment load is a serious problem.

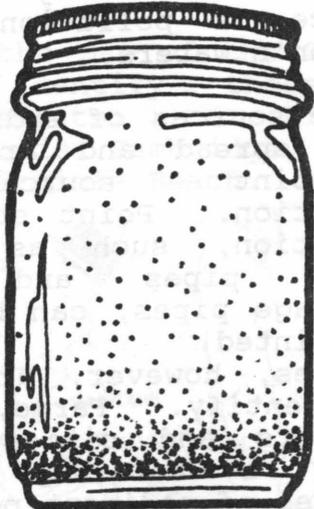


Things to do

Locate and identify in your area one or more of the erosion or weathering processes described on page 3. Make a drawing or attach a picture and describe what is happening. Be sure to obtain permission from the property owner.

PROCESS _____

PROCESS _____



Sediment load - Following a rainy period visit a stream, lake, or river muddied by eroded soils. Collect a water sample using a quart jar (or larger) being careful not to collect any bottom sediments with your sample. Allow the sample to sit undisturbed for three days and make the following observations each day. For comparison collect an equal amount of water from a wooded, undisturbed stream.

Turbidity - (cloudiness), rate the water as 1) very turbid, 2) turbid, 3) slightly turbid, or 4) clear.

Color - describe as shades of brown or other colors.

Sediment - by examining the bottom of the jar, describe the sediment layer as 1) heavy, 2) medium, or 3) light.

DAY	TURBIDITY	COLOR	AMOUNT OF SEDIMENT
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____

How erosion affects land and water

Although erosion isn't always a natural process, it does occur naturally. Mountains are eroded by wind and water over long periods of time. Low lying areas are filled with sediments. Beaches are worn away and built up by wave action. Even glaciers have had an important part in shaping the land. The natural erosion process is usually slow, but the rate of erosion increases when soil is disturbed from its natural state. This can occur when a field is plowed or land is cleared for a building site. Erosion also occurs when livestock are allowed to overgraze or when trees are cut for timber.

Soil erosion is usually classified into three types: sheet or splash, rill, and gully erosion. Splash or sheet erosion results from rain drops falling on unprotected soil. Rain drops cause small bits of soil to be thrown in the air. The larger the rain drops, the greater the splash. If the rain falls too fast to seep into the ground, it begins to flow over the soil's surface and a thin layer of soil or sheet is carried away. Because it often goes unnoticed, sheet erosion is sometimes called "invisible erosion". The amount of rainfall, the length of time it falls, the type of soil, and the slope of the land determine how the erosion process precedes.

Once sheet erosion starts, rill erosion is the next step in the process. Small channels form allowing the water to carry away more sediment more

quickly. If left unchecked, rill erosion can quickly lead to the severest type of erosion - gully erosion. Large gullies or ravines make the land unfit for many uses; and although gully control methods are known, the land can be severely damaged.

Soil scientists (called agronomists) estimate that under proper management, one inch of new topsoil can form every 100 to 1000 years, depending on climate, vegetation, and other factors. There are places in the U.S. where as much as eight inches of topsoil have been lost in only 50 to 100 years. Erosion not only results in the loss of land, but also loss of the land's fertility. Just to replace plant nutrients lost to soil erosion each year costs land owners more than \$1.5 billion.

Sedimentation results in land formation, usually where it does little good. Sediment damages important aquatic habitats, and fills reservoirs and navigable waterways. Sediments containing fertilizers and rich sewage may cause algal blooms that reduce water quality. Pesticides, herbicides, heavy metals and other toxic chemicals contained in sediments either dissolve in the water or become part of bottom sediments. In addition, plants, oysters, mussels and other organisms that can not move are smothered and killed by heavy sediments.



Sediment in turbid water prevents light from reaching the bottom in shallow water where plants could grow. Also, sediment particles absorb heat energy from sunlight and make the water warmer. Decaying sediment particles also use up the oxygen or sediment particles take the place of oxygen in water.

The additional sediment load in the water puts a tremendous strain on sewage and water treatment plants. Sediment left by flood waters causes damage, and there is the never ending need to dredge ship channels and harbors. Hundreds of millions of dollars are spent each year to pay for these and other damages caused by sedimentation.

Things to do

Identify one major erosion site in your area and describe the possible causes. Observe the site twice a month for at least two months and record any changes that may occur. Attach a picture or sketch of the erosion site showing the changes in two months. Be sure to obtain permission from the property owner.

Location: _____

Possible Causes: _____

Observation 1

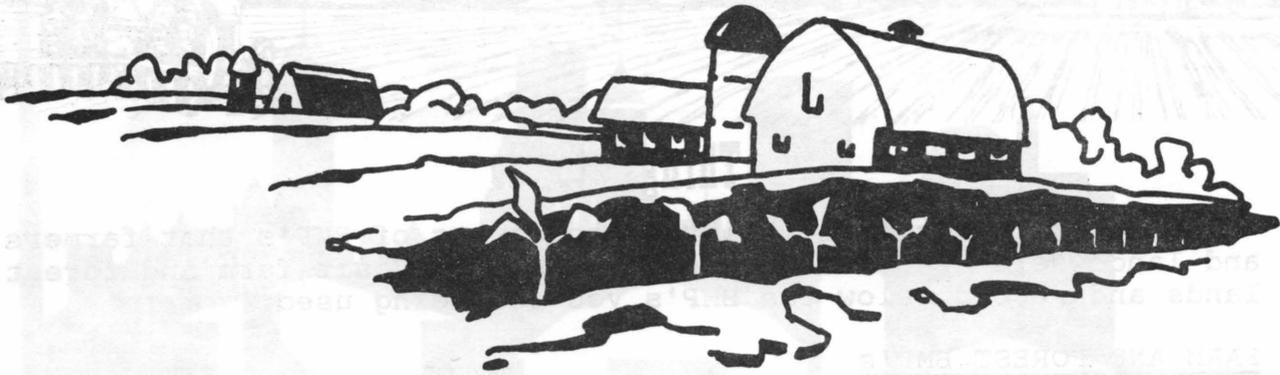
Observation 2

Observation 3

Observation 4

Erosion process - Obtain a cardboard box at least 12 inches long and two inches deep. Cut a V-shaped notch in the middle of one end. Line the inside with plastic and fill with a one inch layer of soil. Place the box outdoors and elevate the un-notched end one inch. Using a garden hose set for a fine spray, apply a constant spray of water on the soil from a distance of three feet. Observe and record the soil's reaction to the water and measure the time it takes for a bare spot to appear in the box. Repeat the experiment twice by elevating the box two then four inches, using the same amount of soil and the same fine water spray. Place a bucket under the notch to collect and compare the amount of water applied each time.

Elevation	Time For Bare Spot To Appear	Observation
1 inch	_____	_____
2 inch	_____	_____
4 inch	_____	_____



Controlling erosion

Soil erosion is a world-wide problem that has influenced human society for thousands of years. Once lush, fertile valleys of the Nile, Tigris, and Euphrates Rivers in the Middle East are now eroded wastelands. Although it is hard to imagine parts of Virginia turning into wasteland, it can happen without proper erosion control.

To better manage our land and soils, state and federal agencies have developed an erosion control plan. This plan is called the Best Management Practice Program or BMP Program. The BMP Program assists farmers and land owners in developing erosion control plans and helps pay the costs of putting the plans into action. The BMP's help control erosion in a number of ways.

One way to prevent erosion is by diverting and controlling runoff. This can be accomplished with strip cropping (planting different crops in alternating rows), or terracing (flattening the slope of the land with terraces),

Also contour plowing, where the farmer plows with the slope of the land, not up and down hills, is often used.

Another way erosion can be controlled is by keeping soils covered with vegetation, such as, maintaining natural plant growth along river and stream banks (called riparian zones), or using cover crops like winter grasses and other crops to protect the soil. Even planting without plowing (no till) will help the erosion problem.

Other BMP's include regrading, reforestation and replanting eroded lands to slow down erosion. A final preventive measure involves reducing sediments in run off with erosion control structures such as: dams, basins, dikes, and wind breaks. Fencing, pasture rotation, and reseeding pastures have been shown to be effective methods of controlling erosion, along with providing grassy waterways to filter runoff.



Things to do

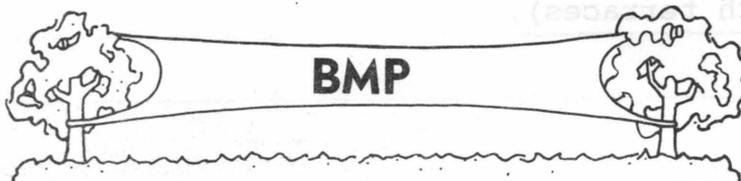
The following is a checklist of the types of BMP's that farmers and landowners use to reduce soil erosion. Visit farm and forest lands and record below the BMP's you see being used.

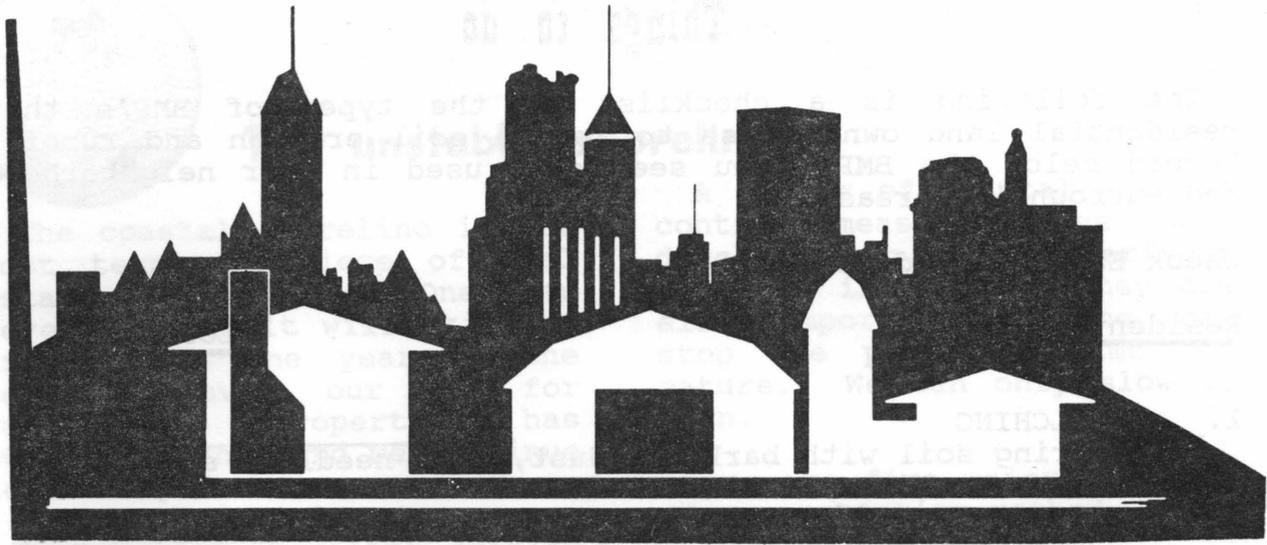
FARM AND FOREST BMP's

Check each BMP identified.

LOCATION

1. NO TILL CROPS
(planting without plowing) _____
2. RIPARIAN ZONES
(natural areas along rivers and streams) _____
3. STABILIZING ERODED AREAS
(regrading & replanting eroded areas) _____
4. REFORESTATION
(planting trees to control erosion) _____
5. STRIP CROPPING
(planting different crops in alternating rows) _____
6. TERRACING
(flattening the slope of land with terraces) _____
7. CONTOUR PLOWING
(plowing with the slope of the land) _____
8. EROSION CONTROL STRUCTURES
(dams, basins, dikes, windbreaks, etc.) _____
9. SOD WATERWAYS
(grassy strips which direct runoff) _____
10. GRAZING LAND PROTECTION
(fencing, pasture rotation, reseeding pasture) _____
11. COVER CROPS
(winter grasses & other protective crops) _____
12. GRASS FILTER STRIPS
(grassy areas along rivers and streams) _____





The urban problem

Farms are not the only site of soil erosion. Construction sites and residential areas also add a great deal of sediment to runoff. Urban areas have nine times more runoff than rural areas because so much land is covered with concrete, asphalt, and buildings. These prevent water from seeping into the ground and as much as 60 percent of urban runoff eventually ends up in the Chesapeake Bay. While erosion in rural areas removes an average of 7-11 tons of soil per acre each year, urban areas lose 12-17 tons. In Virginia and neighboring southeastern states, nearly two million acres of prime farmland have been lost to development since 1960. That means there has been increasing amounts of runoff and erosion from growing urban areas.

Urban and residential landowners can do much to control the amount of rainwater

runoff and soil erosion on their lands. Landscaping is one of the most efficient means of controlling erosion and runoff. Not only do well placed trees, shrubs, and flowering plants make the property more attractive, but they hold soil in place, trap runoff, provide wildlife habitat, and increase property values. Mulching exposed soil traps water, holds soil in place, and improves soil fertility. Using porous materials for walkways and driveways allows water to seep into the ground instead of becoming unneeded runoff. In addition, grading and seeding bare ground helps retain valuable moisture and soil.

By law, construction contractors must submit erosion control plans with their application for building permits. This insures excessive erosion and runoff are controlled during the construction process.



Things to do

The following is a checklist of the types of BMP's that residential land owners use to reduce soil erosion and runoff. Record below the BMP's you see being used in your neighborhood and surrounding areas.

Check Each BMP Identified

Residential BMP's

Location

1. **MULCHING**
(covering soil with bark, sawdust, pine needles, etc.)
2. **GRADING AND SEEDING**
(smoothing land and planting grass)
3. **TREE, SHRUB, OR FLOWER PLANTING**
4. **USE OF GRAVEL AND POROUS PAVING**
5. **TERRACING**
(flattening a sloping yard with terraces)
6. **DRAINAGE STRUCTURES**
(splash blocks, perforated pipe, etc.)
7. **MANAGEMENT FOR HOME GARDENS AND LAWNS**
(controlling erosion, over-fertilizing, etc.)
8. **COMPOSTING**
(using plant & animal matter for natural fertilizer)





The unstable shoreline

The coastal shoreline is the most temporary piece of real estate available. One can never tell if it will still be around from one year to the next. However, our love for waterfront property has outweighed this and we continue to develop these areas.

Coastal or shoreline erosion is caused by wave action and currents. The size and energy of waves determine how much erosion occurs. Winter storm waves tend to erode beaches, while gentle summer waves tend to build them up. Currents caused by strong tides can move large amounts of beach material. Ocean currents (called long shore currents) flow along the coast, and can cause serious coastal erosion. With rising sea level and wave and current action, Virginia is losing an average of eight inches of shoreline per year. In some places as much as 20 feet a year is lost. Since 1850, Virginia has lost more than 28,000 acres of shoreline around the Chesapeake Bay and the rivers that flow into the bay.

Coastal erosion is a natural process. However, the erosion rate has been increasing due to shoreline construction, dune and beach damage, and even wakes from power boats. Submerged aquatic vegetation (called SAV), once abundant throughout the Bay, has nearly disappeared in many areas. The shoreline sediments, once protected by the plants, are now easily washed away.

A number of coastal erosion control measures have been developed to keep waterfront property in place. They are all temporary, nothing can stop the power of time and nature. We can only slow it down.

There are five major types of shore protection methods.

Vegetation - Planting marsh and beach grasses provides a natural trap for sand and sediment and reduces erosion. The plants absorb some wave energy; however, storm waves can severely damage shoreline vegetation.

Replenishment - Many beach resort areas truck in sand to fill in eroded beaches. This is a very expensive and only temporary solution to beach erosion.

Breakwaters - These are solid or floating structures placed offshore parallel to the shoreline. If properly built and located, they allow the beach to build up by reducing wave energy.

Groins and Jetties - These are permanent walls, constructed of rock, concrete, or pilings, placed perpendicular to the shore (groin) or at the entrance of harbors or inlets (jetty). They trap sand moved by long shore currents.

Retaining walls - One type, called a revetment, is constructed of rock or other solid material sloped along the shoreline. In addition,

bulkheads and seawalls are vertical walls built directly against the shoreline. All three protect the underlying shoreline by absorbing wave energy.

Shore protection methods can be expensive. Water front property owners may pay \$10 to \$40 per foot to install shoreline protection measures. A major problem is that most efforts are done haphazardly and adjacent landowners may use different protective methods, making most of them ineffective. Groins may build

up one beach area but cause an adjacent one to erode more quickly. Grass plantings are not effective over large areas and poorly designed structures can actually increase shoreline erosion.

A new approach to shoreline erosion control is the REACH. A REACH is a shoreline unit where there are well defined erosion forces at work. Because the REACH may include several property owners, an erosion control plan can be developed for the entire area that can benefit everyone within reach..

Things to do

Visit a beach or other coastal area during winter and summer months. Describe the shoreline and any changes that occur. And try to identify the forces at work (waves, tides, etc.). Identify any shoreline erosion control methods you may see.

SUMMER _____

WINTER _____

Identify in your area two or more sites of erosion.

LOCATION	CAUSE OF EROSION	EFFECTS OF EROSION
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Planning an erosion control project

Now that you have completed the activities in this project guide, you are ready to plan and conduct an erosion control project. Follow the steps below for a successful project.

- 1) Select one or more sites you have already identified as erosion problems. Obtain permission from the property owner to conduct your project. For your site selection, consider ease of access, extent of the erosion problem, and the resources you have available to complete the project.

Describe the Location of Project Site.

- 2) Describe the erosion problem and possible causes. What may happen if the erosion is left unchecked?

- 3) Review the BMP's described in this publication and select one or more that can be used in your project. You might consider grass seeding, mulching, terracing, or tree planting as BMP's which do not require much investment. Describe the BMP(s) you choose to use:



4) For assistance in completing your project or for additional information, contact one or more of the following local (county or city) agencies;

- Agriculture Extension Agent (Virginia Cooperative Extension Service),
- Agriculture Stabilization and Conservation Service,
- Soil and Water Conservation District,
- District Forester,
- Soil Conservation Service.

Agency Contacted:

Resource Person:

Information or Assistance received:

5) Describe what you plan to do for your project. List the equipment and materials and describe the work to be done.

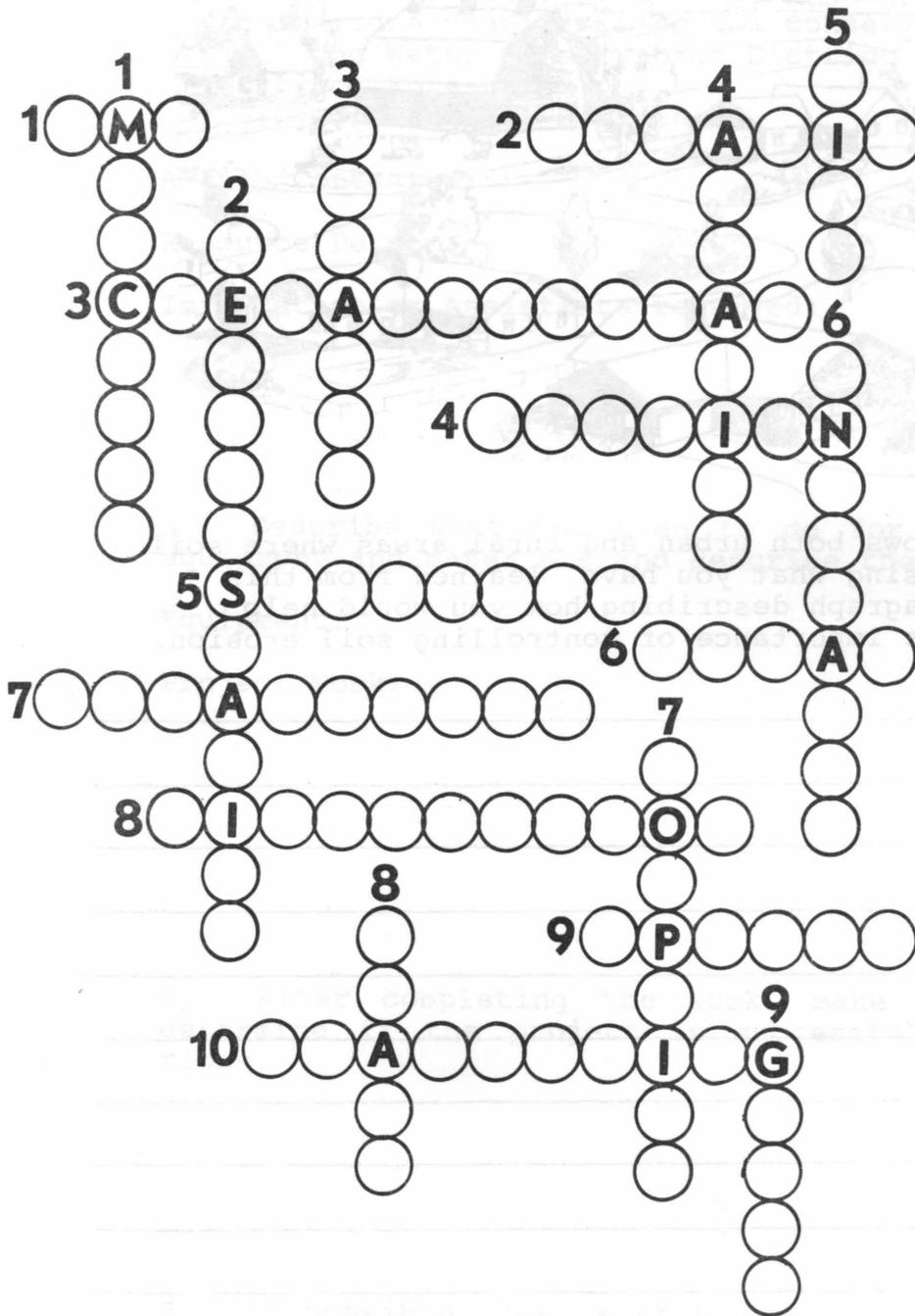
Equipment:

Project Work:

6) After completing the work, make frequent observations to determine if the project is successful. Record your observations.

7) If possible, keep a photographic record of the project from start to finish. Attach the photographs to an additional page with captions and include them in this project guide.

Crossword Puzzle



Across

1. Best Management Practice
2. From living matter
3. Largest estuary in N.A.
4. Movement of soil
5. Stuff that settles
6. Where most erosion occurs
7. Controls coastal erosion
8. Dissolving rock
9. Same as sheet erosion
10. Aging of rock

Down

1. An urban BMP
2. A rural BMP
3. Virginia's first export
4. Natural sand blasting
5. Small channel erosion
6. From nonliving matter
7. Wide spread pollution source
8. A shoreline unit
9. Severest erosion

NOTES

THE WATER CURF LOOKS MUDDY AND TURBID

ALONG
June 1987



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AROUND
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Virginia Department of Conservation and Historic Resources
Division of Soil and Water Conservation
1500 Lakeside Parkway, Suite 100, Charlottesville, Virginia 22902
Telephone: (804) 924-3300
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Across

1. Soil Management Practice
2. Farm machinery
3. Largest dairy in VA
4. Movement of soil
5. Stuff that settles
6. Where most erosion occurs
7. Controls coastal erosion
8. Discharge of water
9. Type of sheet

10. 1987-1988

Down

1. An urban soil
2. A rural soil
3. Virginia's major export
4. Natural sand deposit
5. Small channel erosion
6. Soil erosion
7. Soil erosion
8. Soil erosion
9. Soil erosion

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