Contrary to popular opinion, wet areas down
stream from dams are not usually natural
springs, but seepage areas. Even if natural
springs exist, they should be treated with suspicion
and carefully observed. Flows from ground-water
springs in existence prior to the reservoir would prob-
ably increase due to the pressure caused by the pool
of water behind the dam.

All dams have some seepage as the impounded water
seeks paths of least resistance through the dam and its
foundation. Seepage must, however, be controlled to
prevent erosion of the embankment or foundation or
damage to concrete structures.

Detection
Seepage can emerge anywhere on the downstream
face, beyond the toe, or on the downstream abutments
at elevations below normal pool. Seepage may vary in
appearance from a "soft," wet area to a flowing "spring." It
may show up first as an area where the vegetation
is lush and darker green. Cattails, reeds, mosses, and
other marsh vegetation often become established in
a seepage area. Another indication of seepage is the
presence of rust-colored iron bacteria. Due to their
nature, the bacteria are found more often where water
is discharging from the ground than in surface water.
Seepage can make inspection and maintenance dif-
ficult. It can also saturate and weaken portions of the
embankment and foundation, making the embankment
susceptible to earth slides.

If the seepage forces are large enough, soil will be
eroded from the foundation and be deposited in the
shape of a cone around the outlet. If these "boils" ap-
pear, professional advice should be sought immediately.
Seepage flow which is muddy and carrying sediment
(soil particles) is evidence of "piping," and will cause
failure of the dam. Piping can occur along a spillway
and other conduits through the embankment, and these
areas should be closely inspected. Sinkholes may
develop on the surface of the embankment as internal
erosion takes place. A whirlpool in the lake surface
may follow and then likely a rapid and complete
failure of the dam. Emergency procedures, including
downstream evacuation, should be implemented if this
condition is noted.

Seepage can also develop behind or beneath concrete
structures such as chute spillways or headwalls. If the
concrete structure does not have a means such as weep
holes or relief drains to relieve the water pressure, the
cement structure may heave, rotate, or crack. The
effects of the freezing and thawing can amplify these
problems. It should be noted that the water pressure
behind or beneath structures may also be due to infil-
tration of surface water or spillway discharge.

A continuous or sudden drop in the normal lake
level is another indication that seepage is occurring.
In this case, one or more locations of flowing water
are usually noted downstream from the dam. This
condition, in itself, may not be a serious problem, but
will require frequent and close monitoring and profes-
sional assistance.

Control
The need for seepage control will depend on the quan-
tity, content, and location of the seepage. Reducing
the quantity of seepage that occurs after construction
is difficult and expensive. It is not usually attempted
unless the seepage has lowered the pool level or is en-
dangering the embankment or appurtenant structures.
Typical methods used to control the quantity of seepage
are grouting or installation of an upstream blanket. Of
these methods, grouting is probably the least effective
and is most applicable to leakage zones in bedrock,
abutments, and foundations. These methods must be
designed and constructed under the supervision of a
professional engineer experienced with dams.
Controlling the content of the seepage or preventing seepage flow from removing soil particles is extremely important. Modern design practice incorporates this control into the embankment through the use of cut-offs, internal filters, and adequate drainage provisions. Control at points of seepage exit can be accomplished after construction by installation of toe drains, relief wells, or inverted filters.

Weep holes and relief drains can be installed to relieve water pressure or drain seepage from behind or beneath concrete structures. These systems must be designed to prevent migration of soil particles but still allow the seepage to drain freely. The owner must retain a professional engineer to design toe drains, relief wells, inverted filters, weep holes, or relief holes.

**Monitoring**

Regular monitoring is essential to detect seepage and prevent dam failure. Knowledge of the dam's history is important to determine whether the seepage condition is in a steady or changing state. It is important to keep written records of points of seepage exit, quantity and content of flow, size of wet area, and type of vegetation for later comparison. Photographs provide invaluable records of seepage.

All records should be kept in the operation, maintenance, and inspection manual for the dam. The inspector should always look for increases in flow and evidence of flow carrying soil particles, which would indicate that a more serious problem is developing. Instrumentation can also be used to monitor seepage. V-notch weirs can be used to measure flow rates, and piezometers may be used to determine the saturation level (phreatic surface) within the embankment.

Regular surveillance and maintenance of internal embankment and foundation drainage outlets is also required. The rate and content of flow from each pipe outlet for toe drains, relief wells, weep holes, and relief drains should be monitored and documented regularly. Normal maintenance consists of removing all obstructions from the pipe to allow for free drainage of water from the pipe. Typical obstructions include debris, gravel, sediment, and rodent nests. Water should not be permitted to submerge the pipe outlets for extended periods of time. This will inhibit inspection and maintenance of the drains and may cause them to clog.

Any other questions, comments concerns, or fact sheet requests, should be directed to:

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