# Preventing Stream Pollution From Oil Pipeline Breaks

*A GUIDEBOOK OF RECOMMENDED PRACTICE*

*Reference Data Publication of the*

**OHIO RIVER VALLEY WATER SANITATION COMMISSION**

# OHIO RIVER VALLEY WATER SANITATION COMMISSION

**An interstate agency representing Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia and West Virginia**




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# PREVENTING STREAM POLLUTION FROM OIL PIPELINE BREAKS

A guidebook of practice compiled by the
Ohio River Valley Water Sanitation Commission
from data submitted by the companies listed below:

Ashland Oil and Refining Company
The Buckeye Pipe Line Company
The Eureka Pipe Line Company
Gulf Refining Company
Interstate Oil Pipe Line Company
Magnolia Pipe Line Company
The Ohio Oil Company
Pure Transportation Company
Service Pipe Line Company
Shell Oil Company
Sinclair Refining Company
Sohio Pipe Line Company
Susquehanna Pipe Line Company
Standard Oil Company (Indiana)
Valvoline Pipe Lines

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# CONTENTS


DT
54

# WHY PIPELINE BREAKS COMPEL ATTENTION

OIL LOSSES from pipeline breaks compel the attention of pollution-control agencies as well as pipeline operators. Adoption of measures to minimize such occurrences will benefit public welfare and private enterprise.

Regulatory agencies must be concerned because oil in streams causes serious contamination of water supplies, destruction of fish and wild life and general impairment of all other water usages.

Pipeline operators should be concerned because breaks can result in a substantial economic loss, curtailment of transmission capacity and damage claims instituted by downstream water users.

Emergency procedures for handling pipeline breaks have been developed by some companies. But there seems to be no uniformity of practice or organization. And not enough emphasis has been placed on practices that minimize stream pollution. Consequently, the Ohio River Valley Water Sanitation Commission, representing eight states through which many pipelines pass, has compiled this guidebook of recommended practice.

In so doing, the Commission enlisted the aid of pipeline operators in the Ohio River valley territory. What follows is a compendium of experience and recommendations from many sources. It also includes the best thinking of the water-regulatory agencies signatory to the Ohio River compact.



***Stream crossings are the critical points in pipeline construction.***

# PREVENTION COMES FIRST

THERE IS no lack of agreement among pipeline operators that the prevention of breaks is the fundamental goal that should be sought. Economic consideration in terms of oil loss, damage-indemnity claims and cost of repairs provide eloquent arguments for minimizing the probability of breaks. Despite every precaution that can be taken in design, construction and operation of pipelines, there still remains the responsibility for organizing, training and equipping special crews to handle emergencies that inevitably occur. It is realistic, therefore, to recognize the need for: Adoption of preventive measures; and establishment of emergency procedures.

## GOOD CONSTRUCTION A PRE-REQUISITE

Prevention of pipeline breaks depends fundamentally upon careful design and sound construction. In this connection, attention should be directed first to the use of the proper grade of pipe and the most expert welding of joints. Since pipe specifications reflect local conditions and the particular needs of each operator, there can be no generalization on this score. Examination of joints with X-ray equipment is suggested as a desirable construction aid.

Stream crossings are perhaps the most critical points in pipeline construction from the standpoint of preventing leaks and breaks. Crossings are particularly vulnerable to breakage because of the danger of washouts after heavy rainfall and from damage that may be caused by the weight of driftwood or debris on exposed pipe near river banks. Stream crossings, therefore, require attention not only to the grade of pipe and soundness of joints, but also to the problem of providing firm anchorage.

Wherever vibration may introduce hazards, notably at railroad and highway crossings, increased protection may be provided by encasing the line with a larger size pipe. Encasement will not only serve to reduce the danger from vibration, but it will also facilitate repairs and replacement of the line whenever these become necessary.

*Engineering News-Record photo*

***Expert welding of joints in a pipeline is one of the prime requisites for the prevention of leaks.***

An obvious consideration in the construction of a pipeline is to make sure that the depth of cover on cultivated land and farm roads is sufficient to protect the line from punctures by plows and heavy equipment.

Still another factor deserving attention is the installation of valves. Proper use of surge-relief valves will protect the line from breaks caused by momentary high pressures. In addition, attention should be given to the strategic location of cut-off valves. Concerning this, one company reports as follows: "Valves are placed at each side of an underwater section to permit isolation of this section in the event of an emergency; and in addition, valves are equally spaced on the cross-country run of the line in order that any section can be closed when desired.

## PROVIDE ADEQUATE MAINTENANCE

Adequate maintenance is second only to sound construction in preventing serious line breaks. A good maintenance program should provide for routine inspection of lines, corrosion control, and repairs or replacement of damaged pipe.

The importance of frequent inspections cannot be overemphasized. Inspections may be made either by aerial patrol or by line walkers. One company using airplanes states that their lines are inspected twice a week. Where line-walkers are used inspections are made at least once a week.

In a properly designed and constructed pipeline, corrosion is perhaps the most important cause of leaks and breaks. There are many unexplained factors influencing corrosion, but pipeline operators recognize the following general causes: subsurface soil conditions, stray electric currents, and action of oil on pipe.

Because of the economic importance of this problem, many companies have well-organized corrosion-control departments. One company reports that it has established a department consisting of "ten engineers who spend their full time in corrosion-control surveys, research, and the installation of corrosion-mitigation measures."

Corrosion-control measures employed by pipeline operators may be listed as follows:

1. Wrapping line with protective coating.
2. Encasing line in an asphalt-filled redwood or cypress box.
3. Coating inside of line with a coal-tar pipeline enamel.
4. Use of a "corrosion inhibitor."
5. Use of cathodic protective measures.

Concerning cathodic protection, several companies have reported that this method is particularly valuable in protecting

*Engineering News-Record photo*

***One of the most important causes of leaks and breaks is corrosion. Wrapping of pipes with protective coating, therefore, is a positive form of insurance.***

lines "near the banks of streams, where corrosion is usually more pronounced because of the rise and fall of the water level." This method is also being used on many lines for supplementary corrosion control in conjunction with other protective measures.

The third major function of a successful maintenance program is provision for prompt repair or replacement of damaged pipe. In many instances, major breaks can be prevented if damaged areas discovered in the course of routine inspections are promptly repaired.

## EMERGENCY ORGANIZATION

REGARDLESS of the adequacy of preventive measures, however, the fact remains that breaks do occur. It is with this contingency that the control authorities—and this guidebook—are primarily concerned.

To insure prompt response to an emergency, it is axiomatic that plans must be laid beforehand. And these plans must fully comprehend responsibility for control of stream pollution that might result from a line break as well as the more obvious task of repairing the break.

No emergency organiation for pipeline breaks can be considered adequate if it does not include personnel who are oriented, skilled and equipped to curb oil pollution.

Precise responsibility for establishment of a pollution-control unit must be assigned to a competent man, and he should be clothed with sufficient authority for this purpose. Under his direction a management-approved program can be formulated to train men and provide proper equipment.

Too frequently, in the opinion of the state regulatory agencies, there is a lack of understanding by repair crews of the reasons for stream-pollution control. Obviously, courses of orientation for such crews should include discussion of this responsibility as well as detailed instruction in techniques for minimizing oil pollution.

One company, in detailing its recognition of these necessities, says: "Only specialized personnel are assigned to emergency oil leaks and pipe breaks. These men are schooled in preventive and emergency measures and must pass tests for certain job classifications before assignments are made."

Properly trained men cannot be effective, however, if they lack the equipment to do their job. While the type and amount of equipment for pollution control is subject to wide variation, there are certain essentials. These are discussed separately further on. Suffice it to say at this point that the pollution-control officer must not only have access to equipment, but he must likewise be in a position to make certain that it can be promptly brought into service.

*Service Pipe Line Company photo*

***Tell-tale blotch (center) of an oil pipeline break near the shoreline of a river crossing was spotted on an airplane inspection flight.***

# WHEN BREAKS OCCUR

ASSUMING that organization and equipment are ready for performance, here are the recommended procedures from a pooling of practices furnished by operators. Not all of these measures are in use by any single company. Taken together, however, they represent a practical course of action to be followed when breaks occur.

## ORGANIZE FOR DETECTION OF BREAKS

Early detection of a break is prerequisite to prompt action. A continuous material balance to account for all products pumped is an aid in this direction. Any loss of product may be determined by the use of flow meters on both discharge and receiving sides of pump stations. One company using such meters has installed remote control and recording devices in a central office, by means of which any otherwise unexplained difference in rate of flow can be translated instantaneously into a line loss. In addition, this company uses automatic electric gauges at all pump stations to provide instant check on the level of oil in station tanks and its relation to volumes being received and pumped.

Another operator states: "All products pumped are metered to an accuracy of 1/10 of one percent. Hourly checks are made from each pump station and transmitted to the dispatcher's office, via teletype, where computations are rapidly made to determine losses. If any indication of noticeable losses is being registered, maintenance headquarters are notified immediately."

## STOP PUMPING IMMEDIATELY

Pumps should be stopped whenever there is a drop in line pressure, and this is accomplished best by the use of automatic equipment. Quick action in this direction not only results in minimizing damages but also makes the job of recovering escaped oil easier.

One of the newest developments in the way of shutdown equipment is the use of FM radio facilities with special relays and other devices for automatically stopping pumps when trouble occurs. One company reports that it now has such equipment in an experimental stage. Operation of the equipment is described as follows:

"FM radio facilities with selective calling devices have been installed at each pump station. A flow meter, or flow rater, measures the rate of flow of the incoming stream at each pipeline station. In the event the rate of flow changes more than a few percent in either direction, the flow meter actuates a relay, which in turn automatically sends out a signal selectively directed to and received by the next preceding pipeline station. The radio receiving unit at the station which is doing the pumping, picks up the special signal which in turn operates another relay and shuts down the pumping equipment. Thus in the event a leak should occur thereby reducing the rate of flow at the receiving pump station, the automatic control equipment almost immediately shuts down the pumping equipment at the station which is delivering the oil."

## LOCATE THE BREAK

Since pumping stations may be as far as 50 miles apart, considerable time can be lost in locating a line break unless careful plans have been made and certain precautionary measures taken beforehand. Exact location of a break can be made by (1) walking the line, (2) using automobiles wherever roads permit, (3) using airplanes, or (4) by a combination of these methods. Not all operators are in the happy position to report, as did one company, that "any point on our lines may be reached within 1½ hours after receiving a report."

An invaluable aid in securing information on location of breaks is to have signs posted at road crossings giving the name of the company and the telephone number to be called when a break is observed. The same information might also be provided to each owner of property crossed by a pipeline, with the request that any evidence of a break or leak be reported immediately.

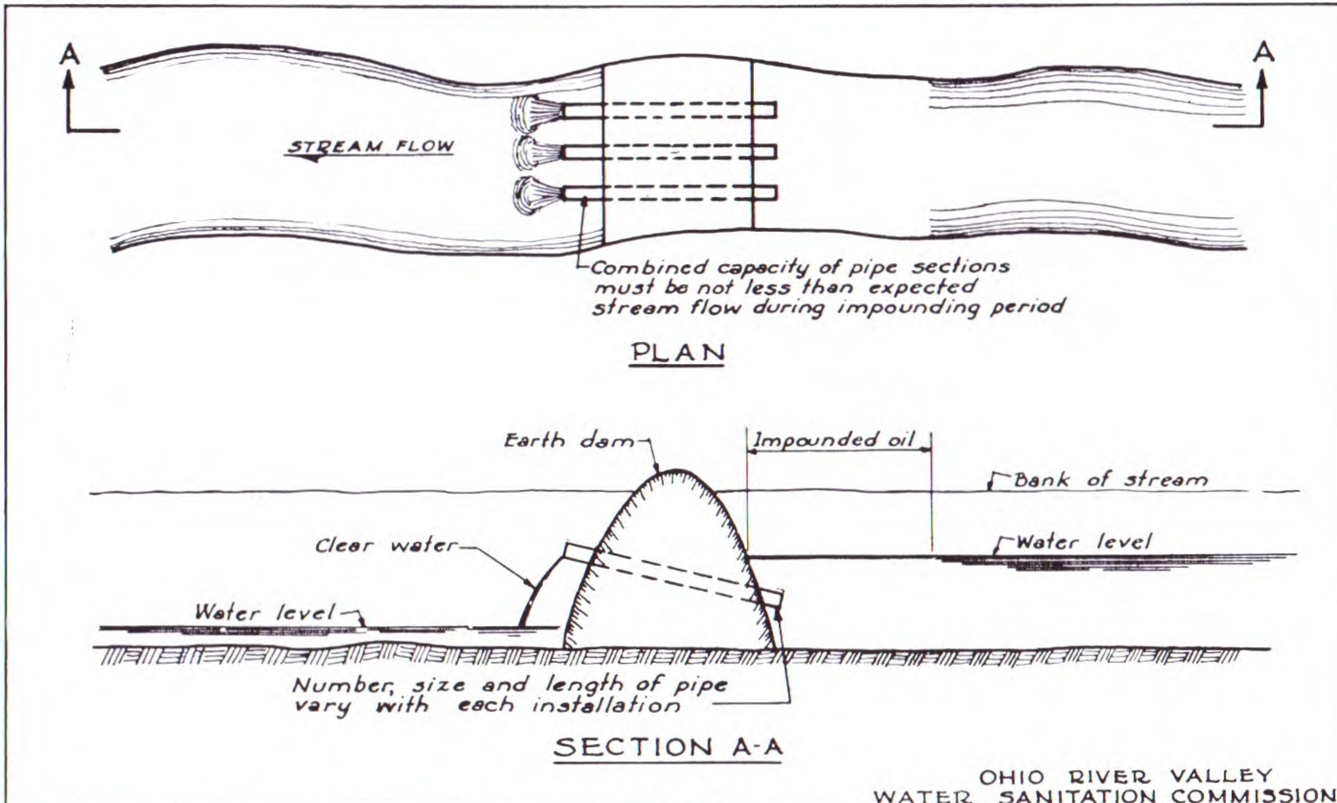
An early, accurate report on the location of a break can minimize the loss of product and greatly expedite repair work. Therefore, an effective communications network is invaluable. To quote one pipeline operator, "Too much emphasis cannot be placed on communications in reporting breaks. Too often vague, inaccurate reports are received from persons calling in to report a leak. Those persons to whom leaks are reported should make every effort to secure all the available information on the location of the spill."

## DISPATCH CREWS AND EQUIPMENT

Once a break is reported, action must be initiated to dispatch fully manned and properly equipped repair crews.

Again, good communications are essential. One company has reported that through its radio network it was able to save considerable time and oil, and to minimize stream pollution from a serious break by strategic movement of repair crews.

Large-scale county maps can be prepared to advantage for expediting the movement of repair crews to the scene of a break. In addition to showing the location of all pipelines and valves—with particular reference to roads, highways and capacity of bridges—these maps should indicate the location of all creeks and streams that may be subject to contamination from escaped oil.




*Suggested earth dam and siphon spillway arrangement for trapping escaped oil in a small stream.*

## NOTIFY STATE POLLUTION-CONTROL AGENCY

Coincident with the dispatch of repair crews contact should be made with the pollution-control agency of the state concerned to provide information on location of break, time of occurrence and other pertinent details.

The detrimental effect of oil on water supplies and other water usage necessitates early warning to all downstream users of the threat involved so that precautions may be taken. The state agency responsible for the sanitary quality of water sources is equipped to handle this. In addition, the state authorities may be in a position to provide assistance to the pipeline company in combating the pollution problem at the scene of a break.

To insure that prompt notice is given when a break occurs, each company should maintain an up-to-date record of the name, address and telephone number of the proper agency official for every state in which it operates. Such information for the eight-state area represented by this Commission is included in this booket.

## IMPOUND LOST OIL

Except for those infrequent occurrences where the volume of lost material is so small and of such a nature (gasoline, kerosene and light distillates) that it has evaporated or been absorbed by the ground before crews have reached the scene, impoundment of oil from breaks is essential.

Therefore, impoundment operations to prevent pollution should be delegated as a primary responsibility to certain members of the emergency crew. Their task includes prevention of further spread of escaped oil and removal of as much of the oil as possible to minimize damages. The desire to get a broken line back into service at the earliest possible moment suggests that the repair crews should be of sufficient size to permit simultaneous pursuit of pollution-abatement measures as well as repair operations.

Each break presents a different set of problems. Therefore, quick decisions must be made concerning the most effective method of confining pollution to the smallest possible area. These decisions will be based on equipment and personnel available, type of product lost, terrain, size and proximity of water courses.

In situations where oil has not yet reached a stream, it is relatively simple to throw up an earth wall or dike to prevent this possibility. Another procedure is to dig a sump hole into which the oil may be directed. By either method the lost oil is contained until recovery or disposal measures can be taken.

The problem is much more difficult when the oil has already reached a stream. If the stream is small, most companies report that the best procedure is to construct an earth dam in order to form an oil trap (see sketch). The dam-site is selected downstream from the entry point of oil. A siphon piping arrangement permits normal stream flow while oil is accumulating on the surface behind the dam.

When oil has reached a large stream, or one in which the velocity of flow is high, complete damming may not be practicable. Here experience has shown that the most effective method of controlling the spread of oil pollution is by construction of a surface barrier or boom across the waterway. This boom should be built of floating material that can be held in place by means of a cable or chain, such as logs, timbers and bales of hay. The boom will serve to trap oil on the surface without obstructing stream flow.

Where the amount of floating oil is large, some companies consider it advisable to install more than one boom, with the second placed 200 to 300 feet below the first. This precautionary measure permits capture of oil that has escaped below the first boom.

## REMOVE IMPOUNDED OIL

After the spread of oil has been curbed by impounding, steps should be taken to remove as much of the oil from the site as possible. Clean-up procedures include one or more of the following measures: Pumping into a tank truck; pumping directly into the line after repairs have been made; and burning.

A common method of salvaging escaped oil is to pump it into a tank truck. After such recovery, the oil may be hauled to the nearest pumping station where it is put back into the pipeline.

The type of equipment used for this purpose varies with the operator and depends upon location of break, volume of oil lost and local factors. One company, for example, uses special tank trucks with permanently mounted pumps. Other companies have made arrangements whereby tank trucks regularly used by the sales department are made available whenever recovery operations are instituted. In some cases, particularly where the volume of lost oil is small, it is pumped into barrels or drums mounted on flat-body trucks.

Where pumping is required, portable centrifugal units are favored. Since required pump capacity depends on the size and nature of the break, most companies find it advisable to stock pumping units of varying capacities. The most useful appear to be those in the 100-150 gpm range.

Two of the companies that were canvassed said that they do not attempt to transport escaped oil by truck, but prefer the more immediate method of returning the oil directly to the line after repairs have been completed. Injection of oil into the line is accomplished by means of portable high-pressure pumps.

After recovery operations have been completed, burning of the oil residue is in order. Burning is generally a final clean-up procedure following recovery operations, but it may also be used as the sole method of removal. In some instances impounding and recovery of oil are impractical because of the size of stream, small volume of oil lost, or the difficulty of bringing in necessary equipment. Under these circumstances burning seems to be the most practical method for ultimate disposal.

In most cases burning is accomplished without any difficulty. But under some conditions, particularly where the material lost is heavy and a large part of the volatile components have evaporated, burning may not be a simple matter. Several companies report successful use of "pressurized fire" from specially designed torches in such cases. Because of the possibility of fire damage to structures and other property the burning operations call for careful supervision.

Burning is sometimes facilitated by prior absorption with hay, sawdust or burlap. Spread on the surface of the stream after a dam or surface barrier has been constructed, these materials become oil-soaked after which they are raked off and burned.

Removal of traces of floating oil is said to be possible by the application of a substance known as Carbosand, distributed by Carbosand Corporation, 915 I Street, Washington, D. C. The Commission is in no position to endorse this product and

Service Pipe Line Company photo

***Burning an oil slick. Pressure burners facilitate final clean-up operations of this kind.***

is acting simply to report its availability. Furthermore, the Commission understands that oil deposited with Carbosand will remain toxic to aquatic life and its use, therefore, should recognize this limitation.

Carbosand is finely divided sand which has been processed to provide a carbon coating. Applied to the surface by means of a compressed air sprayer, the carbonized sand floats until it comes in contact with oil to form a heavier-than-water compound. An oil slick treated in this way settles to the bottom and is reported to remain there permanently. Materials reported to be successfully precipitated by Carbosand include crude oil, diesel oil, motor oil, gasoline, kerosene and other petroleum distillates.

# EQUIPMENT AND MATERIALS REQUIRED

EACH pipeline break presents a different set of conditions. For this reason there is wide variation in the type and amount of equipment and materials required to cope with emergencies. Therefore, the following comments are simply suggestive as an aid in formulating a list of specific needs.

It will be appreciated, of course, that the use of airplanes will expedite the task of locating a break for the guidance of ground crews. Many operators who use airplanes for routine operation say that they are invaluable during times of emergency. Companies that do not own airplanes point to the possibility of renting planes at nearby airports. If this scheme is adopted, advance arrangements should be completed whereby planes (and pilots) can be made available on short notice. Help in this direction can be obtained from the CAA. This agency has issued lists of some 2,000 concerns doing contract flying. These concerns are prepared to do routine pipeline patrolling, as well as provide special flying service at the time of an emergency. Pipeline operators interested in hiring fliers for these purposes can obtain the lists from the Civil Aeronautics Administration, office of information, in Washington.

The possibility of using helicopters for transporting personnel and equipment is under consideration by some companies. But to date there have been no reports of their use in connection with pipeline breaks.

## MAJOR CONSIDERATIONS

Communications equipment is important. Once a break is spotted, immediate reporting is required to advise maintenance headquarters of the exact location of the break and extent of damages. Therefore, airplanes as well as ground contacts should have adequate radio equipment. If line walkers are used instead of airplanes for locating breaks, then it is desirable that these men carry portable two-way radio sets with them.

Automotive equipment for transporting personnel, equipment and materials is the next requirement. Trucks, pickups, jeeps and other types of standard-design vehicles are widely used. However, several operators state they have simplified their transportation needs by using trucks specifically adapted for pipeline operations. In most cases these trucks are of medium-duty capacity, and not only do they carry equipment for repairing broken lines, such as winches and welding generators, but they also include equipment for impounding and recovering lost oil.

Aside from a good supply of hand tools for the construction of dikes, the need for quick action frequently dictates the advisability of using mechanized earth-moving equipment. In this connection one company reported that its equipment includes a "4/10 yd. back-hoe mounted on a truck for rapid dispatch to the scene of a break." In order to avoid stocking heavy equipment of this type, it may be possible for some operators to make arrangements with (or at least make a list of the names of) local contractors who would be in a position to supply bulldozers, drag-lines, or other types of construction equipment.

For impounding operations certain materials in addition to earth-moving equipment will be required. For example, pipe should be carried for placement in earth dams that are built to serve as oil traps. The size of pipe and number of pieces required in any particular situation cannot be known beforehand; however, with the knowledge of those streams crossed by a pipeline the approximate requirements should then be easy to estimate.

Whenever surface barriers or booms are to be constructed, materials required will include chains or cables and some floating material such as logs, timber or bales of hay. In nearly all cases the type of impounding to be employed can be decided only after crews have reached the break. Therefore, it seems expedient that materials for both earth dams and booms should be sent to the site at the same time crews are dispatched.

The type of equipment needed for recovering lost oil will depend upon whether oil is pumped back into the repaired line or into tank trucks. Pumping back into the line will require a tapping machine and high-pressure pumps. Low pressure pumps are used for pumping into tank trucks.

The final phase of pollution control following a break involves removal of oil residue by burning. Although in many cases no equipment is required, every crew should be equipped with pressure torches for use when burning is difficult. In addition crews should be supplied with some material such as hay, sawdust or burlap, which when used to absorb impounded oil will facilitate burning.

## A TYPICAL LIST

One company supplied the following typical list of equipment required for a major break at a stream crossing:

- Pipe of proper size to lay a new crossing.
- Electric welding machine and acetylene cutting torches at both sides of the stream.
- Acetylene and oxygen for cutting torches.
- Adequate supply of proper welding rod.
- Side-boom tractors at both sides of the stream.
- Back-hoe or dragline for use on the stream bank.
- Boat (14 ft.) with outboard motor.
- Line-up clamps for laying the line.
- Skids to facilitate pipe handling.
- Pipe-line cutter on each side of stream.
- Pumps, suction hose, discharge line and fittings, tap-in nipples and gate valves to aid in pumping oil back into the line.
- Hand tools — shovels, mattocks, picks, diamond-point chisels, sledges, punches, etc.
- Materials for dam construction.
- Gasoline and lubricating oil to operate machines.

## IN CONCLUSION

Possibilities of a pipeline break are always present. Sound construction, proper maintenance and frequent inspection will minimize the number of breaks. However, when breaks do occur it is essential that prompt and adequate action be taken to protect water courses from oil pollution. It is to this end that this guidebook of recommended practice is directed.

***See next page for list of stream pollution-control officials.***

# WHOM TO NOTIFY

STREAM pollution-control officials in the states represented by the Ohio River Valley Water Sanitation Commission who should be notified when pipeline breaks occur are:

| | |
|---|---|
| ILLINOIS | CLARENCE W. KLASSEN<br>Chief Sanitary Engineer<br>Department of Public Health<br>Springfield, Illinois<br>Telephone - 6611 - Extension 671 |
| INDIANA | BLUCHER A. POOLE<br>Technical Secretary<br>Indiana Stream Pollution Control Board<br>Indianapolis 7, Indiana<br>Telephone - Lincoln 8434 |
| KENTUCKY | F. C. DUGAN, Chief Engineer<br>Department of Health<br>620 South Third Street<br>Louisville 2, Kentucky<br>Telephone - Clay 0271 |
| NEW YORK | EARL DEVENDORF, Director<br>Bureau of Environmental Sanitation<br>New York State Department of Health<br>Gov. Alfred E. Smith Office Bldg.<br>Albany, New York<br>Telephone - 355-11 - Extension 528 |
| OHIO | F. H. WARING, Chief Engineer<br>Ohio Department of Health<br>301 Ohio Departments Building<br>Columbus 15, Ohio<br>Telephone - Main 1265 |
| PENNSYLVANIA | H. E. MOSES, Consulting Chief Engineer<br>Pennsylvania Department of Health<br>Harrisburg, Pennsylvania<br>Telephone - 5151 - Extension 614 |
| VIRGINIA | RICHARD MESSER, Director<br>Division of Engineering<br>Virginia Department of Health<br>Richmond 19, Virginia<br>Telephone - 24791 |
| WEST VIRGINIA | ROBERT F. ROCHELEAU<br>Acting Executive Secretary-Engineer<br>West Virginia Water Commission<br>212 California Avenue<br>Charleston 1, West Virginia<br>Telephone - Charleston 36151 |

OHIO RIVER VALLEY WATER SANITATION COMMISSION

AN INTERSTATE AGENCY

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