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OIL SPILL

Training Handbook

STATE OF CONNECTICUT
ENVIRONMENTAL PROTECTION

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OIL SPILL TRAINING COURSE HANDBOOK

Introduction

The State of Connecticut, Department of Environmental Protection's Oil and Chemical Spill Unit received 1,326 spill reports for Fiscal year1981-1982, which represents an increase of 33% over the previous year, and nearly twice the number of incidents reported in Fiscal 79-80.

A spill, as defined by State Statutes is the uncontrolled loss or intentional discharge of any solid, liquid, or gaseous chemical or petroleum products regardless of quantity. Quite simply stated, if it is escaping from the container or system by which it was supposed to be contained it would be classified a spill. Also included are fires (industrial, commercial, or agricultural), train wrecks, truck wrecks, marine vessel accidents, and incidents where the threat of a spill is great or imminent.

Basically, spills occur in very few environmental settings but, depending on the material, combinations of materials, wind, tides, or the presence of incendiary situation, clean-up techniques vary widely. Spills usually occur in four possible settings which are:

1) Large rivers, harbors or open or coastal areas.
2) Small streams and ditches.
3) Storm drains, sanitary sewers and septic sewers.
4) Surface and subsurface spills.

If we include gaseous releases or releases of liquified gases which readily volatilize, a fifth scenario can be added. The methods of handling spills and/or leaks vary considerably from case to case, and when incidents consist of a combination of settings, containment and clean-up techniques become combined as well.

In our discussions in this course and manual, we will try to advise the student in the basic techniques used to contain spills; safety precautions which would be followed by first responders, and the basic equipment used in containing various kinds of incidents.

Naturally, no single text can cover all contingencies or even attempt to and some students may develop their own techniques superior to those givenin this manual. With the wide variety of conditions which can be encountered, containment and clean-up techniques will vary, and in some cases, techniques will have to be developed at the time of the incident.

This text is designed only as a guide. Conditions at the time of the incident will dictate the course of action which will bring the situation under control in a timely fashion and to a successful conclusion.

Tools of the Trade

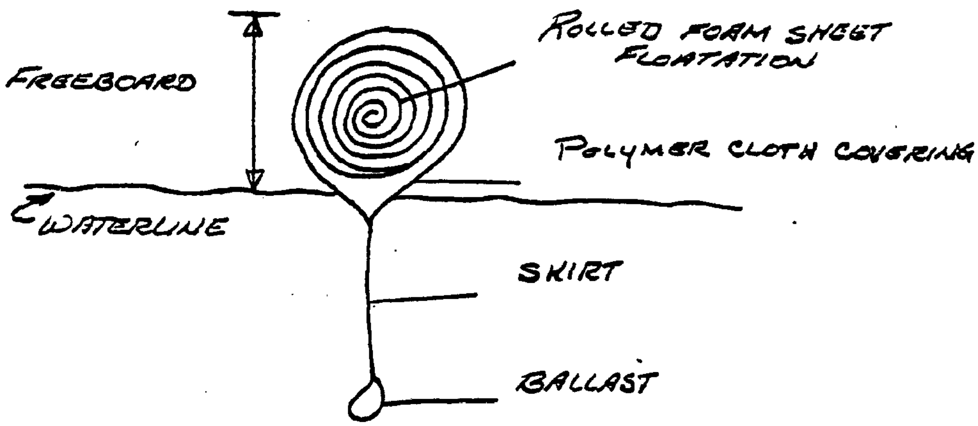
1. "Boom" or floating containment barrier.

Boom is designed with a buoyant or pliable flat surface affixed to the floating collar. To hold the boom in the proper attitude, which is perpendicular to the surface, ballast must be used. Ballast can consist of a series of lead washers affixed to the bottom of the skirt, chain, cable, brass weights, almost any high density material which will hold the skirt down.

Boom

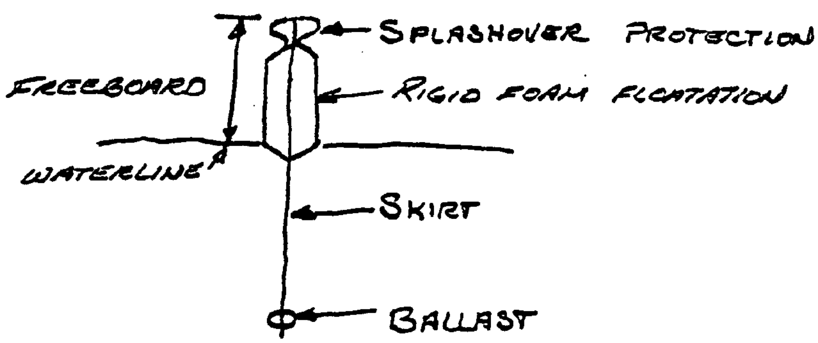
Type 1

Enclosed Floatation



Type 2

Exposed Floatation



Two of the most common types of segmented floatation barrier (Boom) Segments usually 3' to 4' in length in 50', 100', 250', and 500' segments

The most common types of boom are made of foam floatation covered with a reinforced plastic fabric which also makes up the skirt material. Ballast may be affixed to the skirt directly or enveloped at the skirt base.

Boom can be used to contain floating contaminants in many ways. In some instances, the source may be surrounded; in other cases boom can be used to contain contaminants along a shoreline, or to deflect or "pump" contaminants to an area where they may be easily removed.

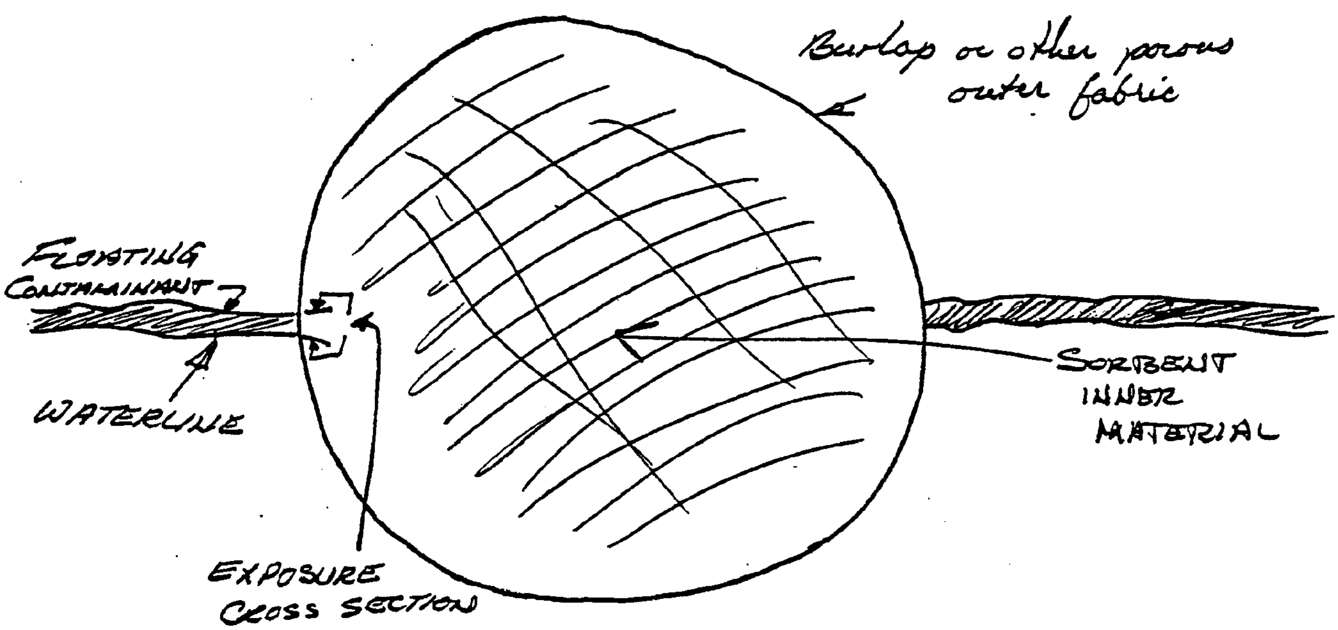
It should be noted, that since boom is made of synthetic materials, and is most often used to contain fuels, some organic solvents will attack it and in some cases dissolve the structure, thereby rendering it useless.

2. Sorbent Boom, commonly referred to as sausage, is another type of containment barrier, with a special added feature, it also adsorbs the floating liquid.

Sausage is comprised mainly of two components; a porous outer shell containing floating particulate absorbent materials. Since this type of boom has no skirt at all, it cannot be used to deflect or pump the floating material and is useful only under the most quiescent conditions, usually backed up by free floating particulate absorbent.

You will find this material used in areas where wind and wave action have essentially no impact on the spilled material.

Because the sorbent is exposed only to the cross section of floating product which it intersects, the absorption rate is very slow.(See Diagram)


Burlap or other porous outer fabric
FLOATING CONTAMINANT
WATERLINE
SORBENT INNER MATERIAL
EXPOSURE CROSS SECTION

Sausage

Although most types of sausage repel water and adsorb the floating oils, some brands do adsorb water causing them to sink and create more problems than they solve. This should be of primary concern in selection of the product.

3. Floating sorbent materials - These materials are floating, water repellent, oil absorbent materials used to physically pick up small quantities of oils from waterways. To be effective, they must be used only in confined areas such as behind (upstream of) a boom, sausage or other containment device. The materials range from sophisticated man made materials to ground up corn cobs. The man made fibers have superior absorbent characteristics, are slightly more expensive, and do not attract rodents, an important fact to consider if storage is in a building for human habitation.

Floating sorbent materials are available in several different forms. Free floating small particulate is available in 20 pound bags and a good rule of thumb is that two pounds can usually absorb 1+ gallons of oil, depending on viscosity.

This material is also available in 18" x 18" square pads, 24" x 24" pads and 48" x 100 foot rolls or blankets. Larger sizes are also available, but not generally used except under unusual circumstances (mud, snow, etc.) These pads and rolls are also available with a strong synthetic inner liner, so they may be wrung out and reused.

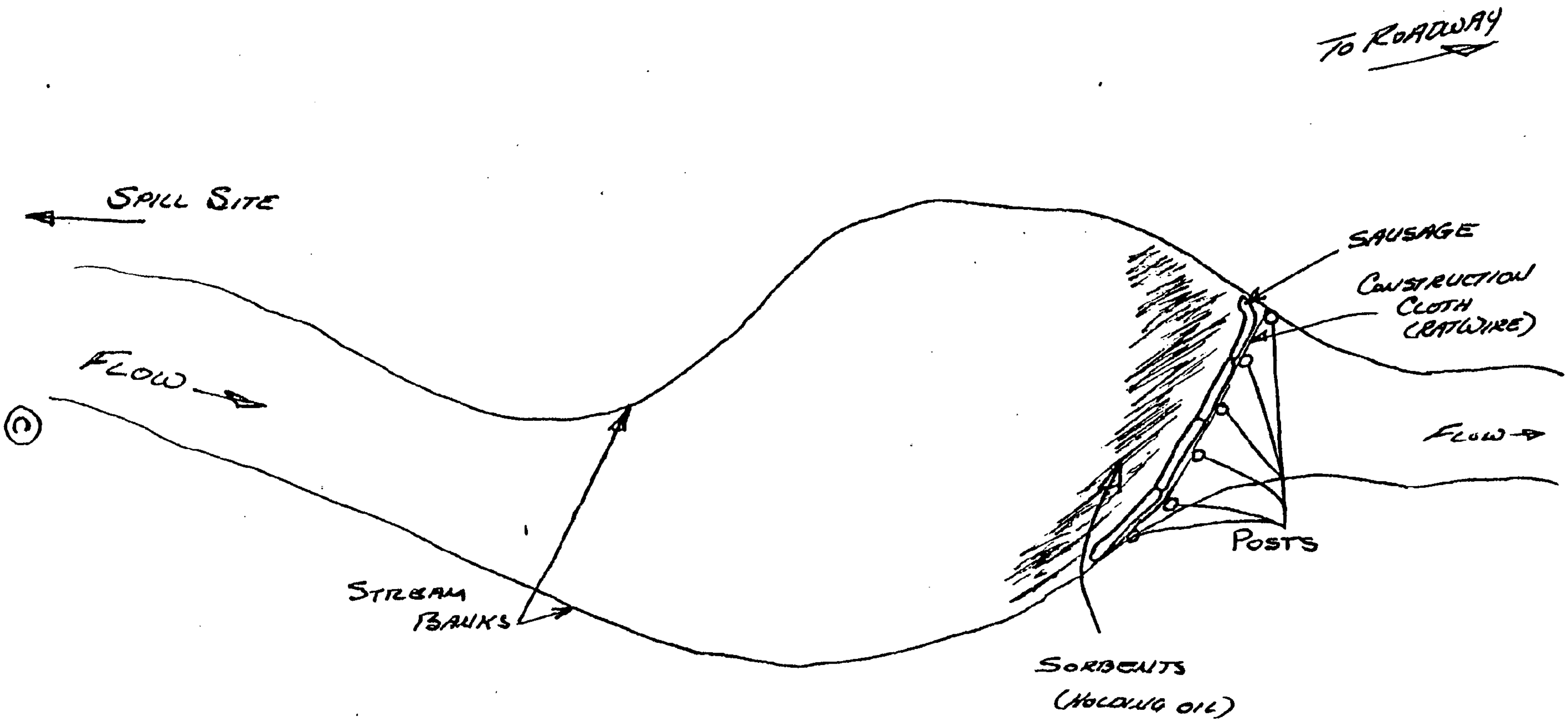
Several closed cell foam products are also available, but are quite bulky to store, transport, deploy and most important, to retrieve. On occasion, however, foam pads are used to soak up floating oils, wrung out and reused with fairly good results, especially with light oils and fuels.

It must be noted that the floating adsorbents are almost useless when dealing with heavy residual oils and should not be used. Several products introduced recently for the purpose of universal absorption of all hazardous materials spills generally do not work well as surface adsorbents because they often absorb water and sink. They may then release whatever oils or water soluble materials they have trapped from below the water surface, thereby creating another problem for clean-up crews.

4. Filter fences are usually employed in quiet areas of streams or along calm river coves to contain or prevent oils from entering the waterway. The fence is constructed perpendicular or diagonal to the current, utilizing fence posts and common construction cloth (1/2 inch mesh screening) tied to the upstream side of the post. However, for purposes of this course, the recommended method of fence construction will be perpendicular to streambed .

Behind this fence is placed well shaken hay or, more commonly, sausage boom. Several bags of loose particulate absorbent material are then placed in the waterway some distance upstream and allowed to drift into position behind the sausage.

The effectiveness of a filter fence in containing oil depends upon the location in which the fence is placed. Naturally, the device should be as close to the spill source as possible. The area chosen should be the downstream end of a pool area which allows 1' to 2' depth of water behind the fence. This allows maximum contact time between the sorbents and oil and minimizes the effects of flow surge on the fence.(Keep the fence in a readily accessible location, i.e. diagonally allowing oil to collect at the shoreline).



GENERAL FILTER FENCE CONSTRUCTION

A filter fence is most effective in minor spill situations, but large fences (almost filter dams) have been employed in major spills.

5. Vacuum tank truck - This is a tank vehicle equipped with a vacuum pump, which is used to remove contaminants from the ground or water surface. Hoses attached to the truck are used to actually vacuum up the spilled liquid. The vacuum eliminates the problem of losing pump prime as is the case with gear, diaphragm, or other types of pumps. An oil/water mix can be loaded onto this truck, allowed to settle and then be dewatered, permitting oil recovery operations to continue immediatley after dewatering. When the truck is full of clean oil, the load is transferred to a conventional tanker for transportation to a storage site.

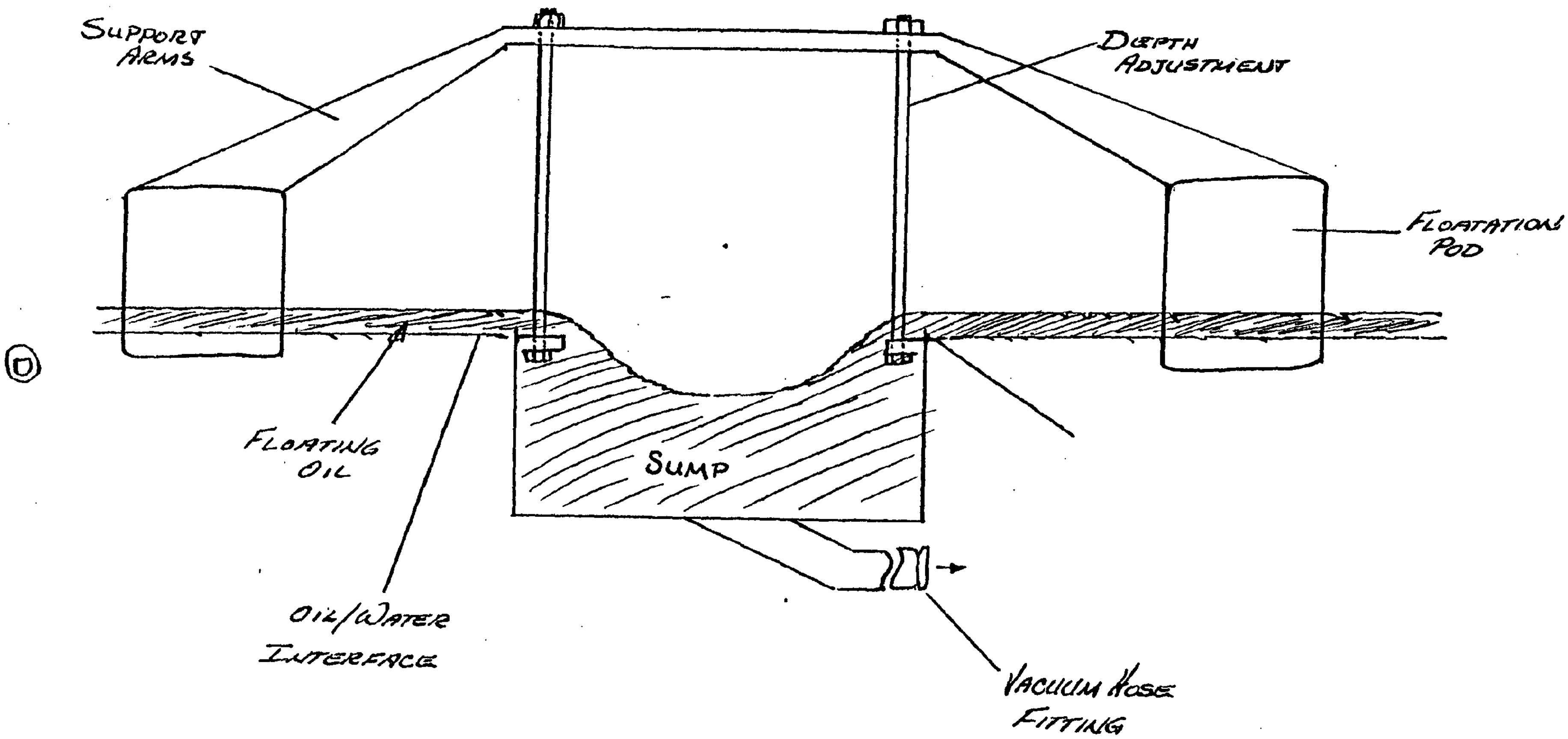
Vacuum trucks work exceptionally well when removing or transferring a wide variety of products. However, there are several instances when they should not be used: 1) When extremely volatile solvents are involved in an incident, the vapor pressure inside a vacuum tank can be low enough to cause these liquids to boil, leading to an extremely hazardous situation resulting in a fire or explosion. 2) The second case involves liquified gases under pressure or cryogenic gases. Never attempt to transfer a load of liquified gases under any circumstances unless specialized equipment designed for this purpose is used, and personnel with special training are directing the operations.

6. Skimmers - These are devices primarily used with vacuum equipment to maximize the amount of floating oil removed from the water by reducing the amount of water sucked up along with the oil.

Attached to the end of a vacuum hose, the skimmer floats a weir or dam just below the oil/water interface, allowing the oil to accumulate in a sump, to be vacuumed into the truck tank. Many types and shapes of skimmers are available but the reasons they function as they do are generally the same.(illustration D)

7. Hydro-laser or high pressure washers are used to remove oils from hard-to-get-at areas, porous areas, or to remove heavy residual oils from rocks and hard-to-clean areas. These pressure washers develop 1000 psi to 15,000 psi nozzle pressures and can be extremely dangerous to use. Pressures are great enough to actually cause the outer faces of rock to be removed.

These tools, along with an assortment of hand tools and pumps, are probably the basic spill clean-up tools. Combinations of the above tools whether land-borne or water-borne are for the most part made up of these basic pieces of equipment.



FLOATING SKIMMER

CHAPTER 1

Open Water - (Large Rivers, Harbors, Long Island Sound)

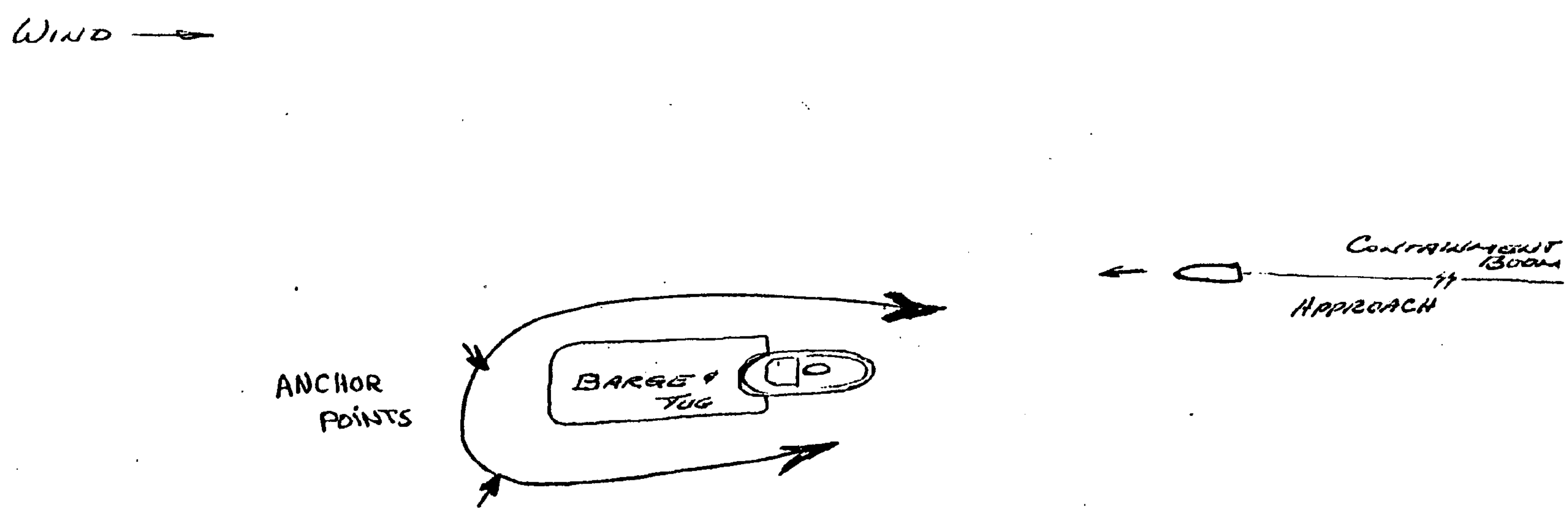
Oil containment boom is a floating mechanical barrier designed to contain and redirect floating oil or chemicals to a suitable clean-up location. At the same time, the boom allows water to pass freely underneath it. The combined action of water and air currents causes the boom to effectively skim the spilled material and concentrate it for later removal. The configurations shown here are only a small fraction of those available, but demonstrate the most common forms in use.

When an open water spill occurs, as from a bulk vessel, the primary use of the boom is to encircle the leaking vessel. This entails completely surrounding the vessel and joining the ends of the boom, allowing sufficient distance from the hull to permit the oil to be accumulated, while not allowing the product to be entrained under the boom or washing over the top of it. This may require the use of a deep skirted boom, anchors, and buoys and should be attempted only during calm periods. In situations involving highly flammable cargos (gasoline, solvents, etc), caution should be exercised due to the safety risk to personnel involved. Sufficient time has to be allowed to perform this operation, as hundreds of feet of boom must be delivered to a site, deployed, and towed to the spill area. Two or more boats will be employed in this activity as well, with at least two people per boat. Deployment tactics are shown in example #1, but should not be interpreted as the only mechanism possible.

Example (1 A) illustrates one mechanism for encircling a leaking vessel taking advantage of the wind, assuming there is no tide or current. If a tide change or current were present, these would also have to be taken into consideration when determining the approach and encirclement route, if encirclement is indeed possible.

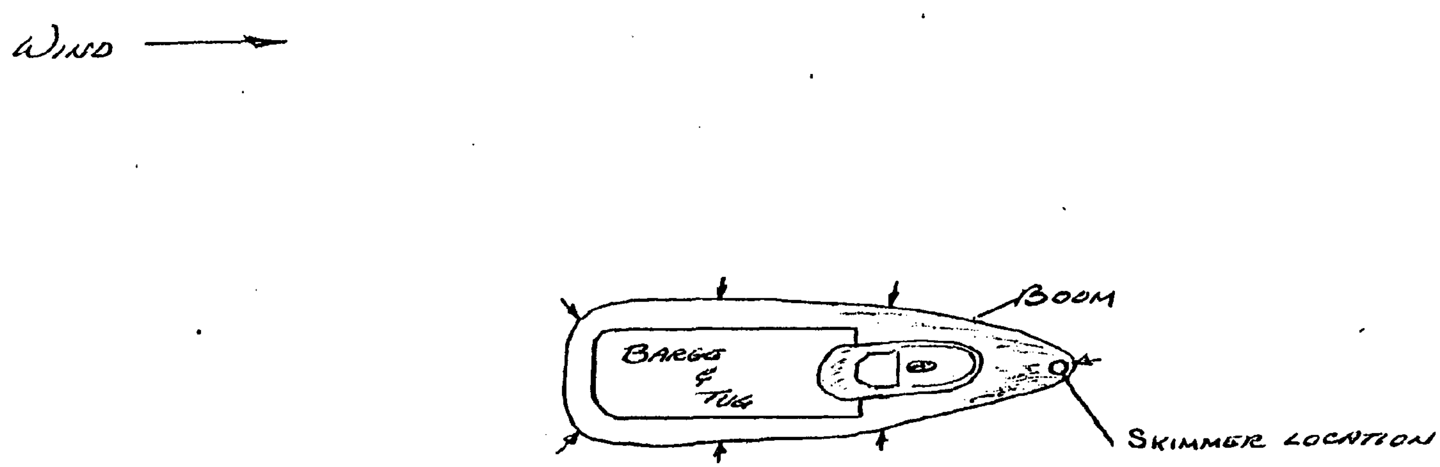
Once the vessel is surrounded by boom, the boom must be kept away from the hull to allow a corral area where oil volume can be contained for retrieval.(Example 1 B) This is accomplished by attaching one end of a line (preferably floating polyethylene) to the clevis located at the aluminum joints where two sections of boom are connected; the other end of the line attached to a buoy. This line should be no shorter than 10' to allow flexing of the boom and not longer than 15' to prevent over-flexing and collapsing. The buoy is then attached with a second line to an anchor. This technique compensates for wave action, allowing the boom to float freely yet holding it in a predetermined attitude with respect to the vessel. Although other techniques are used, this method has proven to be most effective in open water situations.(Example 1 C)

So far we have discussed isolated sources in open water, that is, not attached to land or in close proximity thereto. But what if the source is from land or perhaps a vessel attached to a docking facility?



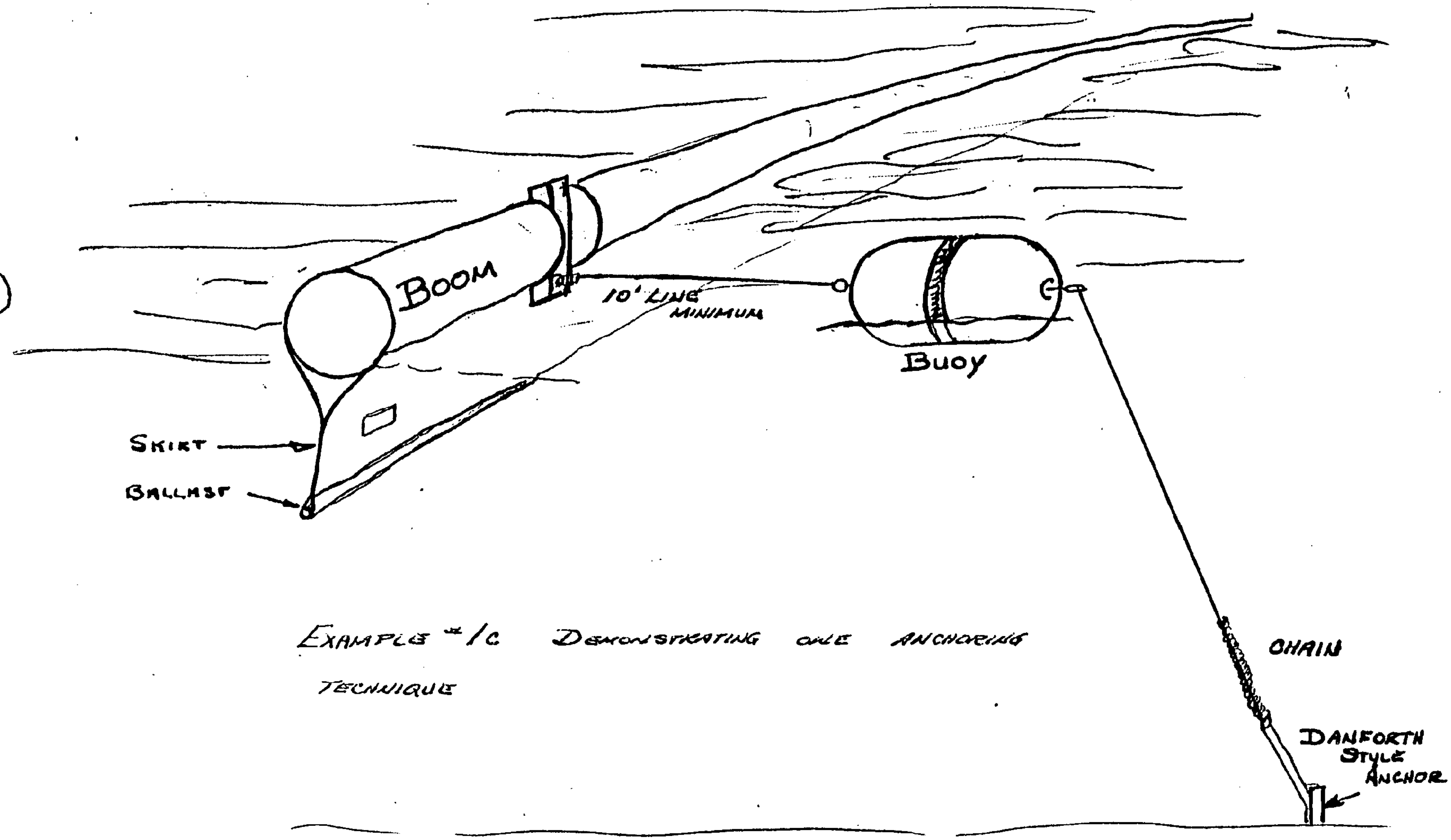
EXAMPLE #1A SHOWING APPROACH AND ENCIRCLEMENT UTILIZING THE WIND TO ASSIST IN DEPLOYMENT. IN OTHER CIRCUMSTANCES, WHERE WIND ISN'T A FACTOR, THE CURRENT CAN BE TAKEN ADVANTAGE OF IN ASSISTING IN DEPLOYMENT.

IB



ARROWS SHOW ANCHOR POINTS

EXAMPLE #1B SHOWING ENCIRCLEMENT COMPLETE, ANCHORS DEPLOYED; SKIMMER LOCATED AT APEX OF BOOM FOR MAXIMUM EFFICIENCY.



Example #1C Demonstrating one anchoring technique

How do our techniques differ from the offshore scenario? We will attempt to demonstrate in this section, techniques which can be used to contain oil in these situations.

Imagine a tanker tied up at a dock at an oil terminal in one of the harbors in this state. The date is December 24, Christmas Eve. The weather is cold and windy. One of the deck hands notices oil on the water adjacent to the hull. Boom is deployed since the vessel is offloading #6 fuel oil, a heavy, black, residual oil. The boom used was a shallow skirt boom, but thought to be sufficient to contain the amount of oil noted on the water.

A marine inspection diver is contacted to inspect the hull for damage. The first inspection report indicated a crack in the hull about 6 to 8 inches long approximately 1/4 inch in width in one of the port tanks.

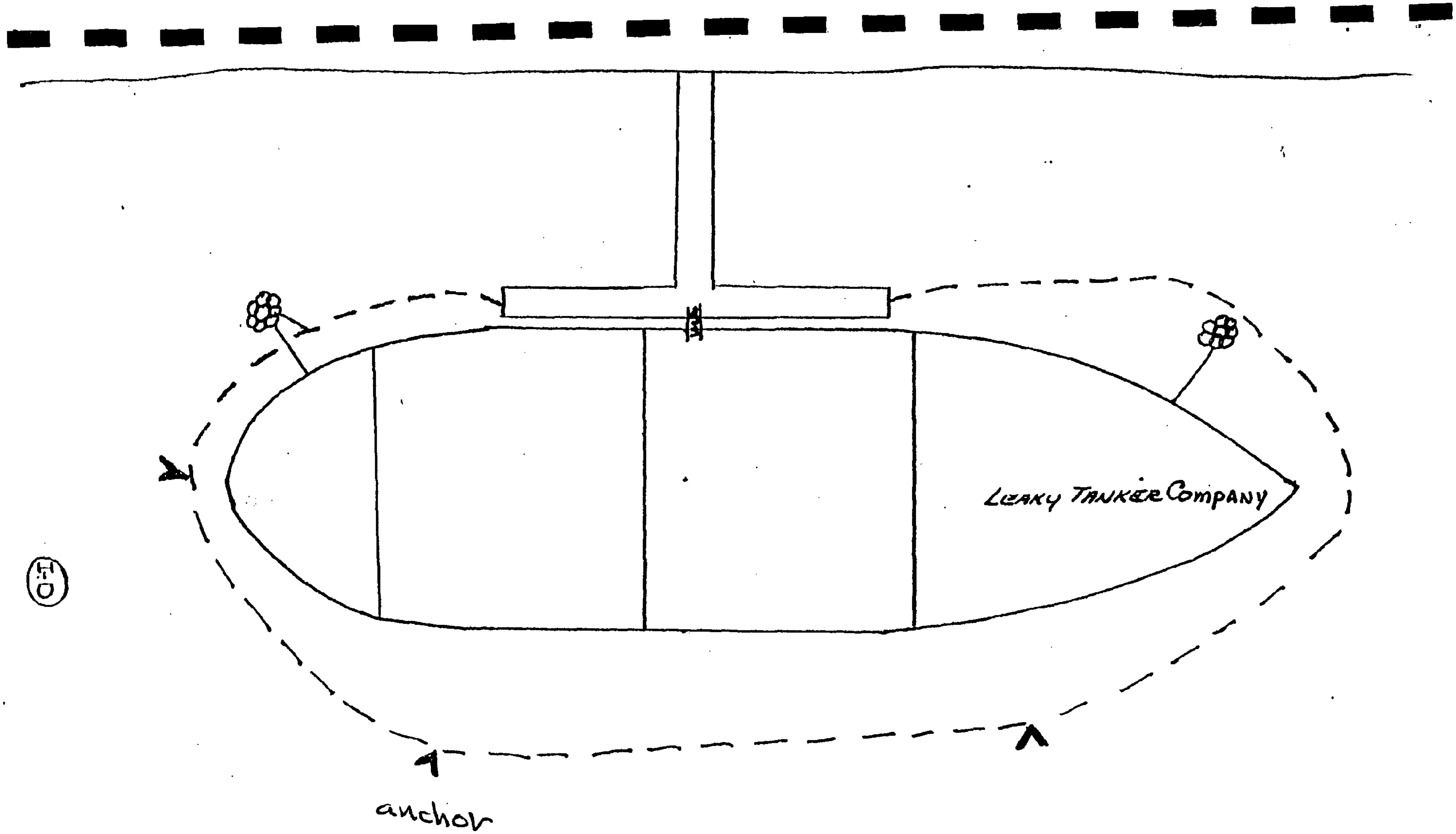
It was decided to offload this tank immediately. During the next hour while the fractured compartment was being pumped, the boom was monitored and the quantity of oil was found to be increasing. A later inspection found the crack, due to flexing, had increased in size to 8 feet in length and 8 to 10" in width, discharging oil in large spurts. Over 8,000 gallons had been lost and the small boom could not contain it. Thick black oil washed over the boom and into the rocky shore covering over a mile of shoreline. The weather turned windy with 4 foot seas and the temperature dropped to below zero. The clean-up, needless to say, became of long duration, a tedious job involving the use of thousands of feet of boom and thousands of man hours to accomplish.

How could this have been prevented or minimized? The selection of the proper type of boom at the outset would most probably have minimized the spread and made for more successful (positive) containment. The use of shallow skirted boom in calm waters is fine, but never depend on such a device to contain petroleum especially where tidal or weather changes are a factor.

One factor we didn't discuss in depth is the effects of tides. Tides can create havoc in oil spill clean-up; changing the directions of flow, raising boom too high in the water, or leaving boom high and dry on shore on an outgoing tide, essentially ineffective. Incoming tides can also totally negate a containment scheme which had been very effective at low or slack tides.

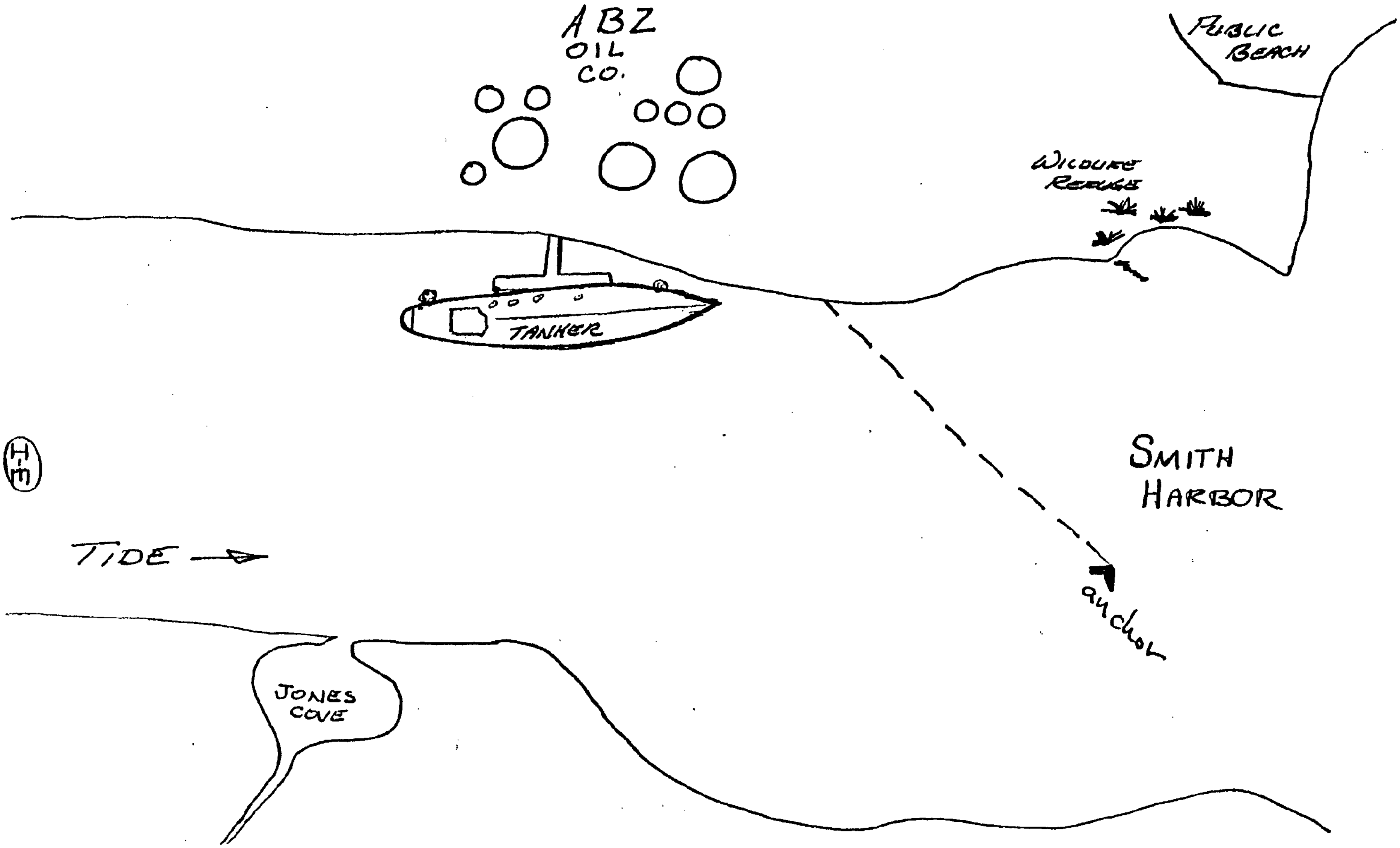
Compensation for tidal action is accomplished by allowing slack in anchor lines and tie-off lines for boom, and positioning boom so that one section catches oil on an outgoing tide, and a second catches it on an incoming tide. When establishing a "deflection-and-pump boom," consider the deflection angle which will accomplish the desired goal on an out-going tide regardless of the tide situation.

Some oil terminals have devices known as tide risers, built into their seawalls which allow boom lines to be tied off to cleats which rise and fall with the tide. The seal between the boom and headwall remains relatively tight regardless of tide.



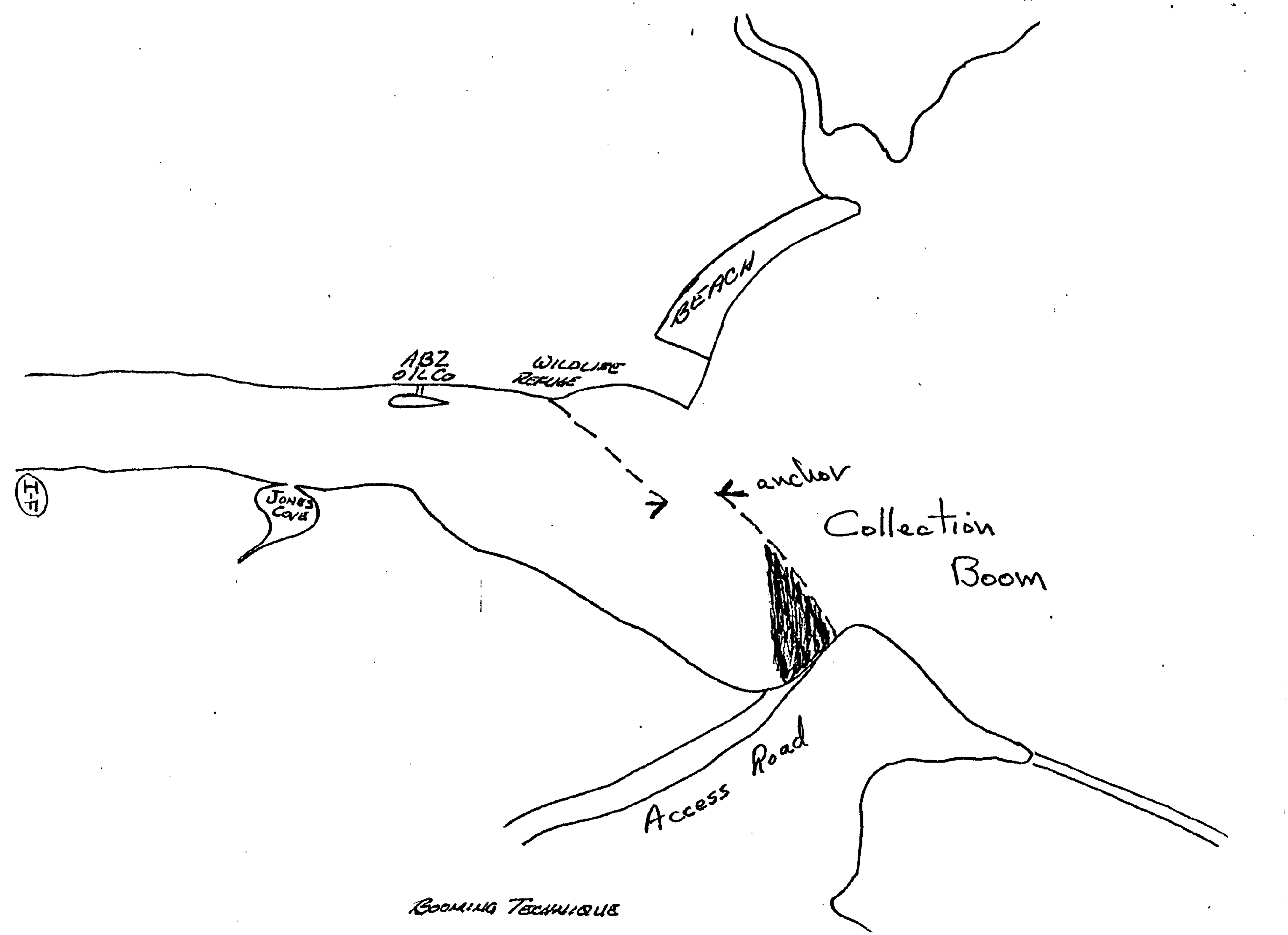
BOOMING TECHNIQUES

I-D



I-E

BOOMING TECHNIQUES



BOOMING TECHNIQUE

Once the oil is contained it must be removed, and removal is accomplished in many ways.

In instances where a large area is involved, a vessel designed for skimming is employed. The concept of a weir just below the oil/water interface can be employed as previously discussed, but is attached to, or an integral part of the bow of the vessel. Extensions, either rigid or is flexible, are attached to the weir opening to guide more oil into the skimmer thus improving efficency. The skimmed oil retained in the skimmer sump is removed either by direct pumping to onboard storage tanks, or removed by means of an endless belt to which the oil adheres. The belt picks up the oil from the sump (or directly from the water at the vessel's bow in some cases) and a squeegee (sometimes referred to as a doctor blade) scrapes the oil from the belt directly into a storage tank. The belt then returns to the oil supply and the process continues.

Other removal methods allow a skimming vessel to be directly attached to a containment boom for removing oil. A skimmer, as previously described, is often placed inside the boom to remove oil also. This operation would have to be carried out adjacent to shoreline access, because of the necessity of a vacuum tank truck to pump the contained oil. When the heavy oils have been removed, the light residual sheen can be further reduced by using sorbent pads and/or blanket materials.

Finally, one last aspect has to be addressed before an incident is considered closed; the disposal of contaminated materials, debris, possible sand or stone, and of materials used to clean equipment. This aspect can be more time consuming than the entire clean-up. People have a tendency to overlook disposal so long as the clean-up progresses, and when clean-up is complete they consider the whole job to be complete. Disposal is someone else's problem. This can be a very difficult and expensive proposition and should be handled concurrently with the clean-up. The State of Connecticut treats each incident individually and attempts to co-operate with local authorities to dispose of debris in an environmentally safe manner, which is best determined at the time of the incident. Sampling and analysis, temporary staging or even pre-treatment may be required before final disposal.

Local landfills, incinerators, and treatment facilities are given first consideration. If none of these is suited, nearby facilities are scrutinized. If ultimately there are no facilities for disposal located within the state, facilities located out of state are considered. This usually means a secure hazardous waste landfill, and can increase overall costs dramatically.

At any rate, in severe cases where hundreds of cubic yards of debris are involved, disposal can create quite a problem. Fortunately, as a potential first responder you will probably not become involved in any large-scale debris disposal problems. However, your ability to bring a spill under control quickly can have a great affect on the quantity of material contaminated by the spill and also on associated clean-up and disposal costs. Your preventative actions may also make the clean-up much faster and more complete than would otherwise be possible.

To conclude this chapter, let us review those factors which influence the containment activities needed to bring an environmental emergency to a safe conclusion.

1) Type of product
2) Weather factors
3) Time of year
4) Time of day
5) Tidal and current influence
6) Equipment readily available
7) Resources to be protected
8) Access for removal
9) Disposal of debris

CHAPTER II

Small Rivers, Streams and Ditches

Most of the spills reported occur either into or in close proximity to the smaller waterways located throughout the state. While the majority of the spills discussed previously consisted of fuel oils or motor fuel, spills encountered in the smaller waterways can be almost any oil, fuel, chemical, or other materials. The primary sources will be vehicular accidents or discharges from industrial, commercial, and governmental facilities. Less common sources might include industrial and commerical fires or explosions, or possibly agricultural accidents. Problems arise in containment not only because a spill has occurred, or because of a particular characteristic of the waterway but also because of the nature of the material involved.

When we are dealing with relatively safe fuel oils (#1, #2, #4, or #6 oils), the containment is pretty straightforward.The two primary tools which are employed to contain spills on the smaller waterways are the filter fence, as described in Chapter 1 or the boom, also discussed.

A small dimension boom ("mini boom") available in 50' lengths has been designed and made available to the co-op to control this type of spill. The floatation collar has been reduced to 4" diameter, and the ballasted skirt shortened to 6". This reduces the bulk and weight, permitting the boom to be easily deployed by 1 or 2 people.

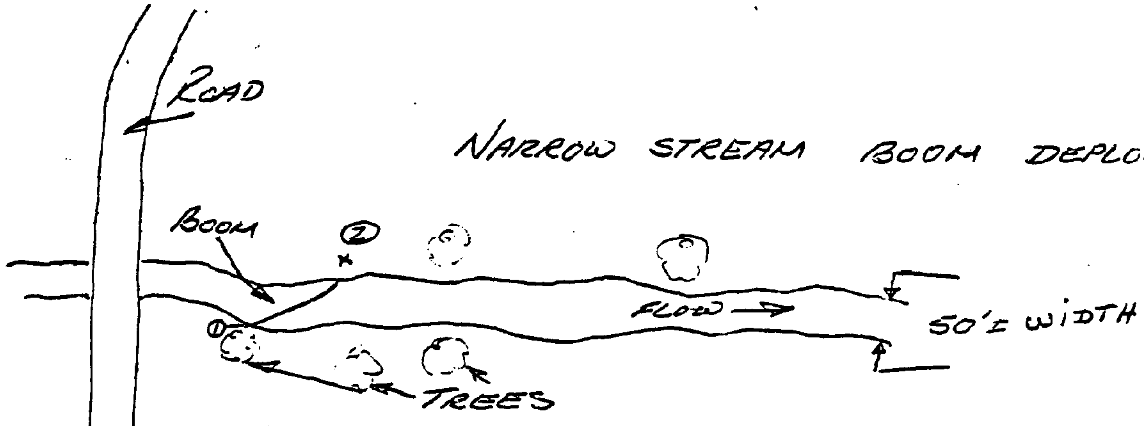
The shortened mini skirt allows this boom to be deployed in relatively shallow waters in a minimum amount of time. Deployment of "miniboom" can be accomplished in much shorter time than that required to construct a filter fence, and a boom can be set at various angles to facilitate easy removal of the floating product. Changing the angle of the miniboom after deployment is also a simple matter, by simply setting one end of the boom free from its anchor point, and allowing it to drift with the current, then re-anchoring when the desired angle is achieved. You can imagine the difficulty which would be encountered in changing the angle of a filter fence. Mini-boom can also be backed up with sorbents, creating a filtering device of sorts, but this practice may not be advisable for large spills or in strong currents.

Vacuum equipment, skimmers, and hand tools may also be required to complete the clean-up.

To retrace the footsteps we made in Chapter 1, as far as containment of petroleum products is concerned, let us review the basic steps in using these techniques.

When deploying boom, whether it be the standard 12"-18" type or the mini boom, it is always wise to anchor the upstream end first. This can be performed by simply tieing the end of the anchor line to any available tree, boulder, or by driving a pipe stake into the ground and tieing the line off to it. This establishes a firm swing point or fulcrum from which the boom can be deployed. The boom can then be fed out and, when sufficient boom has been deployed, the downstream end can be anchored in the same fashion.

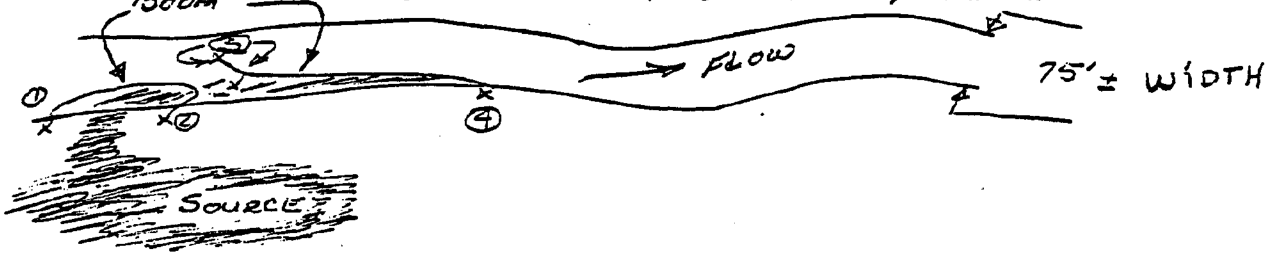
NARROW STREAM BOOM DEPLOYMENT



① UPSTREAM ANCHOR POINT - ANCHOR LINE TIED TO TREE

② DOWNSTREAM ANCHOR POINT - ANCHOR LINE TIED TO STAKE

WIDE STREAM BOOMING TECHNIQUES



①② UPSTREAM & DOWNSTREAM - ANCHOR LINE TIED TO STAKES

③ UPSTREAM - ANCHOR LINE TIED TO DANFORTH STYLE ANCHORS TO KEEP MOUTH OF SECONDARY BOOM OPEN

④ DOWNSTREAM - ANCHORED TO STAKE TO CLOSE TAIL OF BOOM

If a narrow waterway is to be boomed, it is also wise to have a person on either bank, with the trailing line in the control of the downstream person. In a wide stream booming situation where a boom is deployed parallel to a shoreline, it is still advisable to use two or more people to deploy the boom. One is the upstream person, at the first anchor point, and the second as a downstream person. A third man should observe the first two and provide assistance as needed. Where a strong current is encountered, three or four people may be required to tie off the trailing or downstream segment.

We must also be aware that the effectiveness of a boom decreases greatly when the current is in excess of 2 knots. This is the case with any boom available on the market today regardless of size or structure.

In establishing an open mouth or funnel booming arrangement a boat will be needed. This can be an extremely dangerous operation especially during cold seasons or in a strong current, and unless trained personnel are available, should not be attempted. Diagonal or even perpendicular booming will suffice until such time as trained clean-up crews arrive on site. The thrust of this manual is not to involve fire, police, public works departments or other local response people in the actual clean-up, just the initial containment.

If neither miniboom nor sorbent materials are avilable to the first responders several other options are suggested below:

1) A log laid across a stream and backed up by loose leaves will create a containment area, buying time until clean-up crews arrive and retaining the surface materials, while allowing the water to flow unobstructed.

2) Conversion sleeve skirt material and fittings are available to adapt an old section of fire hose into an inflatable section of containment boom. The sleeve skirt is attached over the outside of the hose while fittings reduce the size of the coupling sufficiently to adapt to conventional air fittings. The hose is then inflated with air to create the floating collar. This conversion allows departments with small budgets to avail themselves of boom at a very minimal cost.

3) Foam rubber from an old mattress which has been cut into strips and tied end to end provides a plausible sorbent boom which can be wrung out and reused. The strips should be at least as wide as the original pad was thick to provide sufficient cross sectional area to be effective.

4) Sand can be used to dike very small streams or drainage ditches, weather permitting. When using sand to contain a chemical spill, remember to always use unsalted sand. The salt added to sand for use in the winter season may create problems by reacting with the spilled material, a variable which we would rather not have occur.

REMEMBER: WHEN A MAJOR SPILL OCCURS, WE ARE ONLY TRYING TO CONTAIN THE SPILL (TEMPORARILY), UNTIL PROFESSIONAL CLEAN-UP CONTRACTORS ARRIVE ON SITE.

For smaller spills, or persistent nuisance discharges, sorbent material may be all that is required to eliminate pollution of the environment. These materials, in addition to hundreds of feet of containment boom, are now available through the Co-op.

CHAPTER III

Containment in Storm Drainage and Sanitary Sewer Systems

Each year, hundred of spills are reported involving storm or sanitary sewers, with storm drainage being one of the primary routes allowing spilled materials to enter waterways. Whether the spill originates from a motor vehicle accident or a land based fixed facility, it seems that there is always a catch basin, floor drain, footing drain, or other drain handy. Most fire departments historically flushed any spilled materials into the nearest drain and that was the end of the problem. Out of sight, out of mind.

Today, however, more and more fire departments are discovering that out of sight is not out of mind, but rather, out of control. By flushing flammable materials into catch basins and storm sewers, we create an environment in which trapped fumes are allowed to collect. Suddenly, someone in a passing car, possibly many blocks away tosses a lit cigarette out the window. This ignition source ignites these trapped vapors and we have an explosion. One cup of gasoline completely vaporized in a confined area has as much explosive energy as nine sticks of dynamite. If a small quantity of material is to be flushed, use enough water to thoroughly flush the entire system. Water is cheap when compared to the damage created by an explosion. A cigarette needn't be considered the only source of ignition, What about the faulty automobile ignition system or a simple static electricity discharge? If floor drains are connected to the system, ignition sources become limitless when venting to basements occurs. Boilers, furnaces, household appliances, ad infinitum, become sources of ignition over which we have no or little control. A flammable vapor explosion can cause loss of life and severe property damage. The same is true of sanitary sewers although flushing materials to sanitary sewers in most communities is almost impossible, since there are very few open access points in the outdoors.

More common in sanitary sewers is the seepage or infiltration of flammable liquids from buried storage tanks (gasoline and some solvents for example). We recall the repeated evacuation of a large section of the city of New Britain in 1974 due to gasoline seepage to the sanitary sewer system. The gasoline fumes vented into basements via untrapped basement floor drains. Similar situations have occurred in New London and Bristol, Connecticut, with results in Bristol earlier this year being quite devastating. A residential building exploded because of the build-up of gasoline fumes venting into the building along an unauthorized sump discharge pipe and then up through cracks in the foundation. The source of ignition, was a simple spark created when the thermostat on the first floor called for heat. A secondary explosion apparently occurred when the boiler fired, sending a fireball up the chimney. Luckily, nobody was injured. Why? The house was vacant at the time, one of the very few in a residential neighborhood of several hundred homes, any of which could have been potentially affected.

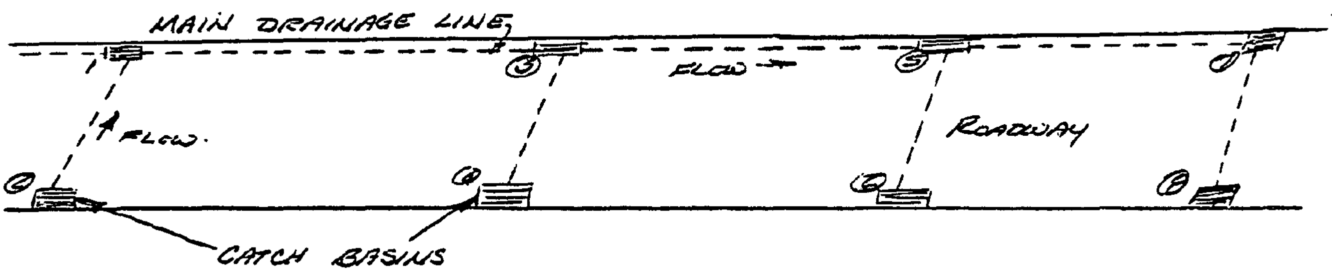
How do we, as emergency response personnel, handle this type of incident? Obviously we can't use boom in a pipe. In most cases, access is too restricted to even attempt to use sorbent materials.

Let us first look at some of the tools available to us;

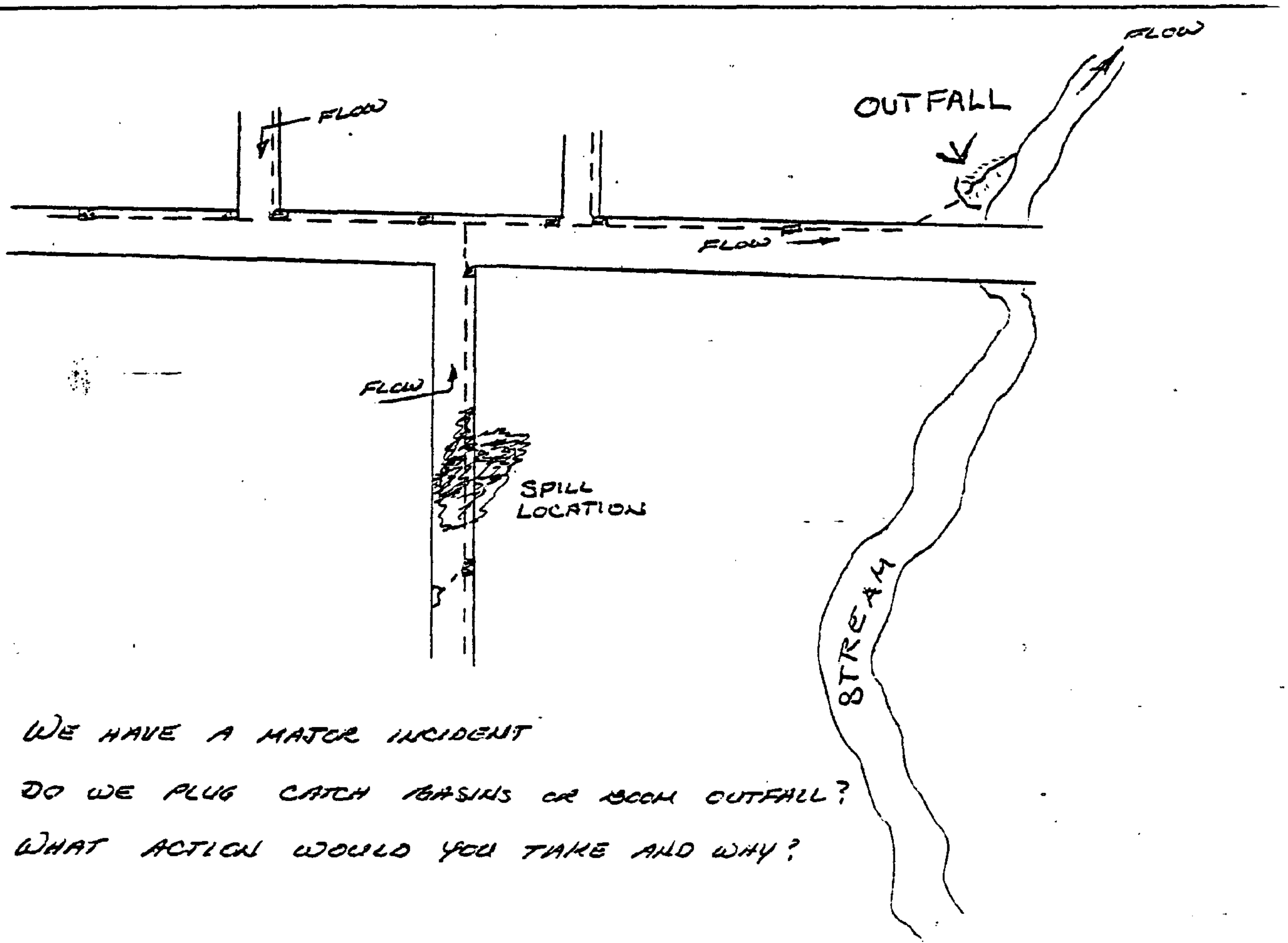
A) Most municipal sewer plants have inflatable sewer plugs, used to slow or stop the flow in sections of sewer pipes while construction or maintenance are performed downstream. These plugs can also be used for other purposes to inhibit the flow of contaminants in storm drains providing the flow is not so great as to cause overflowing, of course. The proper size plug is merely inserted into the pipe and inflated with air. This type of blockage or flow reduction should be initiated only on the downstream side of a manhole or catch basin to facilitate product removal.

B) If sewer plugs are not readily available, as in most rural areas, clean sand can be used to fill a catch basin, thus stopping or greatly restricting the flow. This course of action should be attempted at least one catch basin downstream from the visible flow of contaminant. The sand can be easily removed from a storm drain utilizing a vacuum device called a Vac-All or Vactor.

When a small spill into a catch basin occurs, usually less than 30 gallons in volume, sorbent pads can be used to soak up and remove the oil or gasoline. Sorbents should not be left in sewer lines unless



	SUPPOSE SPILL IS AT	BUT HASN'T REACHED	WHICH BASIN DO WE PLUG?
A.	BASIN #2	BASIN #3	
B.	BASIN #1	BASIN #3	
C.	BASIN #4	BASIN #3	
D.	BASIN #3	BASIN #5	



WE HAVE A MAJOR INCIDENT

DO WE PLUG CATCH BASINS OR BOOM OUTFALL?

WHAT ACTION WOULD YOU TAKE AND WHY?

anchored or a blockage may result in the line when they become saturated and sink. Sorbent pillows or booms are often better than pads because they can be securely anchored with rope.

In dealing with storm drainage systems, occasionally spills of large volume are encountered, or spills of smaller quantities but longer duration may occur. It may be neccessary to locate the terminus or downstream discharge point of the storm drain system and take appropriate action there. Storm drain systems usually discharge into a waterway, drainage ditch, or pond, and quick deployment of containment materials at these locations is critical to prevent contamination of these water courses. In the case of a watercourse or pond, parallel booming, or a filter fence constructed parallel to the shoreline and cutting off the storm drain discharge channel may be most effective.

On the previous page you encountered two sketches showing incidents into two drainage systems. In the first scenario, several case questions are asked to which you may supply the answers. In scenarios A, B, and C, Basin #5 would be a fairly good choice to plug, and in scenario D, Basin #7 would be a good choice. Do your choices agree with the manual? if not, why?

If you choose a basin which allows enough working time, containment should be satisfactory. An important point to remember is that you must be sure there are no floor drains connected to the drain line from adjacent housing, as venting to the basements can intensify. This is especially true when the pollutant is gasoline. If this should occur and vapors begin to approach the Lower Explosive Limit(LEL), discontinue the block immediately.

The discharge end of a storm drain consists of a headwall or open pipe. However, in a sanitary sewer system, a multimillion dollar sewage treatment plant, with its own inherent problems is connected to the discharge end of the sewer pipe. Often, several pumps or lift stations are located in the sanitary systems, with sumps which allow spilled materials to accumulate and volatilize. But the most important attachments to any sewer systems are the many occupied buildings which discharge to it. Problems in the sewer system can cause basement venting much the same as storm drain vents.

Illegal industrial discharges and leaking underground storage tanks provide the most common sources of sanitary sewer problems. The discharge whether intentional or accidental, generally enters the system through existing piping. liquids from buried petroleum storage tanks may enter by seeping through the pipe joints from the outside. Sewer pipes are joined using a neoprene gasket forced into a bell-and-sleeve joint. This type of gasket is susceptible to attack by gasoline and many solvents. The gasoline or solvents extract chemical binders called plasticizers from the rubber, causing it to swell and become very soft, pliable, and porous. Eventually the gasket no longer seals the joint, and allows the gasoline to seep into the pipe. The water and other wastes in the system are warm, causing the gasoline to rapidly volatilize, filling the pipe with explosive gasoline vapors. These vapors immediately seek a means of escape and are carried along on air currents in the sewer much the same as the smoke from a woodstove follows the stovepipe to the chimney, eventually escaping to the atmosphere.

The "chimneys" in a sewer system may be manholes, floor drains, or residential discharge connections. Since most toilet, sink and bathtub connections are wet-trapped, the fumes cannot escape through these pipes. Floor drains, however, are not usually trapped or, if they are, the traps are dry, allowing the vaporized gasoline to enter building basements.

The basement gradually fills with the fumes until the lower explosive limit (L.E.L.) is surpassed. We are now operating in the danger zone. One spark and we have serious problems.

When a problem such as this manifests itself, it may be with a violent incident. Either a 300 pound cast steel manhole cover blows off, pump houses or homes experience violent fires, or entire sewer systems, plant included, go offline or are disabled.

First responders are urged to exercise extreme caution when responding to these calls or in entering buildings effected by fume build-up. Vapors can build to a level higher than the upper explosive limit (U.E.L.), in effect, becoming too rich to ignite even if a source is available. Some explosion meters or LEL meters will register zero under these circumstances, falsely leading inexperienced personnel into a fire trap. Venting a building will cause the vapors to dissipate to an extent which lowers the concentration of fumes back into the explosive range. When attempting to vent such a condition, all ignition sources must be extinguished and the source of fumes entering the building must be plugged. Any nonporous medium can be used to secure floor drains (rubber plugs, water soaked rags, ready mix cement, sand, etc). Once the drain is secure and ignition sources nullified, rapid venting is suggested to dissipate all vapors as quickly as possible.

In dealing with the problem of gasoline or other flammable liquids in sewers, locating and removal of the source is of paramount importance. Dealing with the situation as it exists in the sewerage system or impacted buildings is comparable to treating the symptoms of a disease while the disease itself rages unchecked. If we do not remove the pressure of the liquid in the leaking system, the product will continue to leak into the sewer, regardless of what we attempt to do downstream.

Several quite simple methods can be employed to locate sources of contamination in these situations.

Requesting assistance from the sewer, engineering, or public works departments to obtain detailed plans and profiles of the sewer system is always a good first step, along with getting personnel from this department on site.

Starting from the known location, we can then start tracing the problem back to its source. This can be done visually or with metering devices used to detect the presence of hydrocarbons. Although tracing the visible surface contamination is the best method to locate any source, often contaminants are of insufficient quantities or the flow is too turbid to permit visual observations.

If this is the case, then we must use the metering devices commonly referred to as "explosion meters". This method is the best second choice only if metering can be accomplished at or very near the surface of the flow in the sewer. Erroneous information due to the chimney effect can be obtained by taking readings too near the top of the manhole. Many times this chimney effect has led personnel to inconclusive results, or worse, to conclude that the wrong facility is the source of the problem.

The last method which should be considered is reliance on the human sense of smell. While human olfactory systems are very sensitive, they are usually unreliable. Humans can detect (on the average) concentrations of 2 parts per million of gasoline in air but this ability varies widely between individuals. You can surely understand why confusion over the source will arise if two or more people are involved in the tracing activities. Outside sources will also provide interference as will pyschosomatic sources (attitudes or emotions). That is why this method should be used as a last resort only.

Things to remember when dealing with this type of situation.

1) attempt to identify product if it is unknown, and familiarize yourself with its characteristics.
2) exercise extreme caution when entering affected buildings or when removing manhole covers or catch basin grates from their seats.
3) check buildings adjacent to storm and sanitary sewers for effects of spillage, making sure basements are not being charged with vapors from chimney effect.

4) make sure metering devices are in proper working order, properly calibrated, and are equipped with fresh, well-charged batteries.

5) prepare a section in your department's emergency operations plan outlining the steps to be taken to contact local sewer, public works, engineering departments and other authorities.

CHAPTER IV

Surface and Subsurface Land Spills

Almost all spills, with the possible exception of deep water spills from vessels, impact the ground in some manner. Whether the oil washes onto a beach from an offshore spill, or seeps into the ground from a leaking buried storage tank, the ground is impacted to some degree. Removal of contaminates from topsoil, while sometimes labor intensive and tedious, is usually pretty straight forward. In other words, we can see when the job is complete.

Subsurface spills or spills which percolate to subsurface waters present another problem altogether. It is impossible, or at least impractical, to know in all cases what is actually happening underground. Product losses which penetrate the ground surface from surface spills and subsurface spills will dominate our discussions here.

First of all, why worry at all about underground spills? How long do contaminates persist in the soil? What can they hurt? These and other questions crop up daily when dealing with this type of incident.

Residents in the State of Connecticut rely on groundwater supplies for 60% of the potable water consumed daily. With such a valuable resource in such inaccessible locations, if contamination threatens, prompt remedial action has to be taken.

Other problems which arise from ground contamination are:

1) seepage of fumes and/or product into basements
2) seepage of fumes and/or product into storm or sanitary sewers
3) seepage of product to surface water bodies
4) destruction of agricultural cropland or residential landscaping plants including lawns
5) loss of property values from any of the above

Soil contamination problems arising from a catastrophic incident such as a vehicular accident, fire, large loss of gasoline from a service station due to tank collapse etc. are recognizable at the time they occur. But what about the slow constant loss from a buried tank; or a transfer line from a home heating tank to the boiler, or from a hole in the tank itself. These may not be recognized, may exist for a long time and may show themselves in ways which make the source almost undentifiable. In some cases, irreversible damage can occur, rendering drinking water wells useless, and prohibiting the drilling of new wells.

What do we do then, as first responders when thrust into this type of situation? What actions can we take, for instance, when we are advised that gasoline is seeping through the basement wall at a large shopping center?

Being methodical at this point, we first try to secure the building and identify the product. If we determine that it is indeed gasoline, and we know the characteristics, we take the primary remedial actions necessary to bring the situation under control. With minor quantities, or very light odor, we may choose to work very discretly to locate the source.

To accomplish this, we first have to know why the gasoline chose this location to manifest itself, and how it got here. A major infiltration, or a constant seepage of longer duration will course require more immediate reactions. Evacuation of the facility may be in order in severe cases. Electrical power may have to be partially or completely shut off to eliminate ignition sources. In order to stop the flow, the pressure behind the contaminant must be relieved and to do this the source must be identified. Where a serious problem exists, we might obtain a back-hoe and excavate an area opposite the seepage on the outside wall. This will relieve some of the pressure and we can gain access to remove the gasoline prior to its entering the building.This may help protect the building, but without source identification, it is only a temporary expedient

Our friends at the sewer, public utilities, public works, and engineering departments again can play a very important role in determining where utilities are located. Often contaminates will flow in the uncompacted bedding and fill surrounding sewer, water and power lines.

If filling stations are located in close proximity to the area, thorough inspection of their dispensing equipment can be rapidly done by trained personnel. An inspection of the pumping mechanism located in the base of the dispenser, and of as submersible pumps on top of storage tanks may sometime turn up the sourceof the problem. If all dispensers and pumps check out favorably, then a request for product inventory records is made. A proper inventory will show sales vs. storage quantities and should balance to within 1/2 of 1% daily.

If a suspect station is turned up in this manner, two courses of action are open to us; the first, requiring an NFPA 329 TANK TIGHTNESS TEST be performed on the storage facility; or the second, causing all product to be removed from all tanks until such time as the station can demonstrate that the tanks and piping are tight.

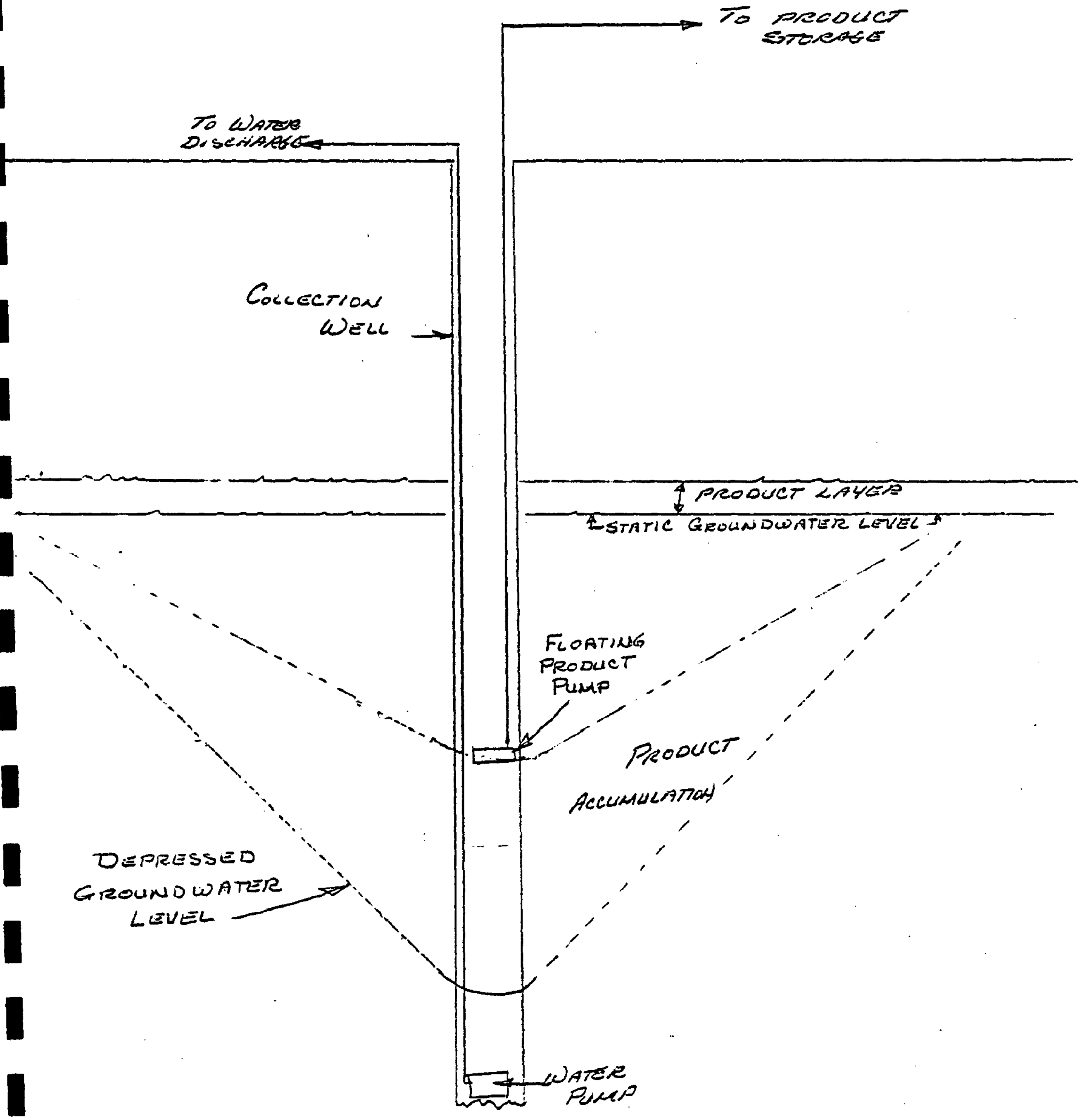
These methods address the immediate crisis, but what about the residual product in the ground, which may continue to cause problems over a long period of time? How do we address this?

Once the initial crisis is resolved, and depending on several factors, we may require the owner of the tanks (the oil company or other owner of the facility documented to be the source) to engage the services of a hydrogeological consultant and/or clean-up contractor. The consultant will evaluate the size of the area contaminated and propose a method of retrieving the product from the groundwater. Limiting factors would include the quantity of product lost, depth to ledge, or the feasibility of recovering any of the product.

If quantities are sufficient, contamination is located, and retrieval is deemed feasible, then a recovery well is drilled, or in some cases dug, and a product collection system is installed. This system creates an artificial depression in the ground water table by removing large quantities of water, thereby drawing the gasoline into this depression. As gasoline accumulates in the collection well, it is pumped to the surface storage tanks by specially designed pumps. In the more elaborate systems when the tank becomes full, the pump shuts off automatically until the product is removed, thus preventing an overflow. Recovery rates of 50% are deemed successful, with the highest recovery rates being about 75% of the total quantity lost.

This method would constitute a universal collection system for almost all low density, floating, water insoluble products. When we look at other products, such as agricultural chemicals, mineral acids, alkalis, poisons, and a multitude of the materials which may contaminate groundwater supplies, treatment methods become somewhat more sophisticated and tedious. Several collection systems may be employed in series to reduce the impact of contaminants. The systems are almost always custom-designed and constructed and are not normally handled by emergency response personnel.

We would like to emphasize here that ground and groundwater contamination by petroleum products or chemicals can be serious and very long lived. While there are some actions which can be taken to minimize the impact of a spill, a major incident will require a substantial amount of time and money to correct. Even the most extensive recovery operation will not recreate the quality of resources which existed prior to the spill. Only time and nature may be able to do that. Appropriate and timely actions, however, may prevent tragic well contaminations or the penetration of explosive vapors into residential or non-residential buildings.


TO PRODUCT STORAGE
TO WATER DISCHARGE
COLLECTION WELL
PRODUCT LAYER
STATIC GROUNDWATER LEVEL
FLOATING PRODUCT PUMP
PRODUCT ACCUMULATION
DEPRESSED GROUNDWATER LEVEL
WATER PUMP

IV A

It is of primary importance therefore to be able to rapidly identify the type of product involved in a spill incident and to have a knowledge of the properties of that product. Several publications have been produced by government agencies and private organizations during the past several years to assist first responders in identifying products.

The most thorough attempt at identifying chemical products in transit is the program initiated by the U.S. Government, Department of Transportation involving numbered placards affixed to transport vehicles. The product contained in the vehicle is clearly identified by a specific four-digit number corresponding to the product. Code Numbers are cross-referenced in a publication entitled "Hazardous Materials Emergency Response Guidebook", available from the Superintendant of Documents, U.S. Government Printing Office, Washington D.C. by ordering publication number DOT-P-5800.2. This same manual is available in quantities from Labelmaster Inc., Chicago Ill. and probably other printing houses as well.

While this volume is an excellent resource aid, problems inherent in its format do exist. The single largest problem is the failure to list the physical characteristics of the materials given. Information on the materials is confined to broad-based generalizations regarding evacuation, flammability, etc., but for specific information, one must look elsewhere. This publication is designed only as a quick reference to identify materials and to suggest actions to take in the event of a spill or other emergency.

For more detailed information, it is suggested that the National

Fire Protection Association, Hazardous Materials Handbook be available. This volume is available through the N.F.P.A.,Boston Mass., and is an almost indispensable reference manual for product identification and a description of its physical and chemical properties.

These two volumes provide an excellent basic reference library for almost any fire, police, or emergency response unit.

We have discussed product identification and reference manuals, but one further point must be stressed very strongly at this point.
UNTIL WE KNOW THE NATURE OF THE MATERIAL, WE MUST TAKE ALL PRECAUTIONS TO PROTECT OURSELVES, WHEN ESTABLISHING OUR APPROACH, ENTRY, AND RESCUE OPERATIONS.

The average firefighter or line officer may never encounter a major incident of the type described, but will undoubtedly encounter many minor incidents requiring a few of the following basic skills to handle.

1. Containment - By surrounding the source with speedy dry or a sand dike, we can prevent the spread of contamination. For fast immediate containment, build an earthdike. When the dike is constructed, highly flammable materials can be foamed (high expansion type) if necessary to minimize chances of ignition.
2. Trenching - By creating a diversion ditch, we can direct materials to a containment area. Again, foaming the surface of flammable materials inhibits ignition if an area can't be established away from potential ignition sources. Unnecessary foaming should be avoided, not only because the foam may be wasted but also because it may contaminate virgin product and thereby complicate clean-up and disposal problems.

3. Neutralizing - In some cases, the spilled material can be neutralized and rendered harmless on the spot. This step should be undertaken only under the direction of trained personnel thoroughly familiar with the material involved.

These processes will cover most of the spills encountered during an average year.

In conclusion, we would like to thank you for your participation in this course. We hope that you will keep a copy of this manual handy with other emergency reference materials and that you will find it a useful guide not only to your activities in responding to spills, but to other hazardous materials incidents as well.