ANATOMY OF AN OIL SPILL – A CASE HISTORY OF AN ONSHORE HEAVY FUEL OIL SPILL IN THE HIGHLANDS OF SCOTLAND

Based on an actual spill event, this case history was originally published in the Oil Spill Bulletin and Environmental Review (OSBER), a monthly journal published by Alba International Ltd., based in Aberdeen, Scotland. It was reprinted in the ISCO Newsletter during June 2012. One ISCO member, Brian O'Connor, of the Canberra and Regions Oil Industry Response Group in Australia found the article so useful that he had it reprinted as a booklet for training purposes.

The response action was a complete success, preventing the pollution of one of Scotland's greatest fishing rivers. A key feature of the response was the construction of a large interceptor dam which provided a 100% effective failsafe barrier for an extended time during which heavily overgrown watercourses were cleaned, removing all traces of fuel and and oiled vegetation.

Another interesting point was a successful co-operation between the experienced Alba team and several employees of the affected industrial premises during an extended and labour-intensive clean-up operation. When the clean-up operations were completed, a splendid Ceilidh (celebration) was held at the local inn. With fiddle and accordion music everyone had a great time and many drams were consumed. This was a spill response looked back on with good memories for everyone involved.

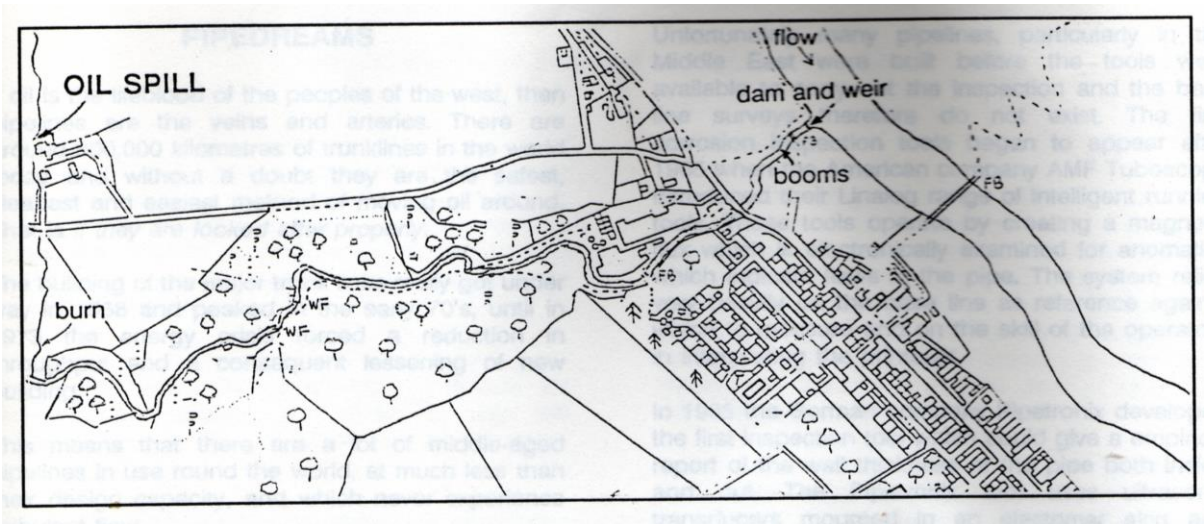
THE STORY AS IT HAPPENED

Sunday – 0800 – Somewhere in the Scottish Highlands

At an industrial site in a remote glen the night watchman completes his rounds. All appears well. Unknown to him a faulty weld in an old section of pipe carrying heavy heating oil from a storage tank is giving way even as he fills in his logbook.

1400

Because it's the weekend no one is around and the spill has gone unnoticed. The oil has been spreading across a concrete yard for six hours. It is already finding its way into the surface water drainage system. There are no interceptors fitted.



1624

The plant's surface water drainage system is a mixture of the original site drainage and new additions over the years as the plant has expanded. There are several dead end sections leading into the main drain, there are cracks and minor blockages. There has been little rain in the last few days. The oil moves slowly, but has already

started to run out of the pipe's end and into the burn. It has also started to seep into the ground at several places in the drainage system.

1740

The small burn falls steeply down between two fields and runs into a larger watercourse. This minor river descends for about two miles through woodlands and two ravines before joining a major river at the outskirts of a village. The big river is one of Scotland's foremost fishing rivers, and the area an outstanding one for tourism. The first globules of black oil are already heading down the minor river.

1800

A local villager walks her dog by the side of the river. It is only when the her dog bounds back up the river bank, not quite the same colour that he bounded down, that she realises that something is wrong. Oil, in the form of globules and patches, is now floating out into the river.

1839

The owner of the dog (the latter quite unconcerned) calls in at the police station on the way home and angrily tells the policeman that there is oil in the river. The river is fast flowing but the water level is low. Oil is being dispersed rapidly downstream, and is beginning to come ashore on one bank in several places. The banks of the small burn are vegetated and now heavily oiled. The banks of the small river are stony in places, overgrown in others, and there are many rocks exposed in mid stream.

1850

The policeman has contacted the local river board, and has gone down to investigate at the river bank. The watchman has discovered the oil leak, and is phoning the plant manager.

1855

The manager has been alerted and phones both the site engineer and the foreman. The policeman has tracked the oil in the river to the mouth of its tributary.

2010

The first attempt has been made to stem the flow of oil at source by closing the requisite valve. This is successful, but already some 20 tons of heavy oil has escaped. At this stage it is not realised at the plant that the spill has travelled so far. A call from the police puts them in the picture. The local river inspector has arrived at the village. He realises that action must be taken at once to contain the worst of the oil before the main river becomes seriously contaminated. It has begun to rain.

2130

The foreman and two others start to block the drain outflow. The river board inspector arrives at the plant. Oil continues to flow down the small river.

2242

The plant possesses two inflatable booms, which are deployed in a relatively slow moving stretch of the minor river, a hundred yards above its mouth. The drain has been temporarily blocked but it has been raining for an hour and water and oil is building up – and backing up – in the system. The inspector has advised the plant manager to contact a pollution control company at once. It is now dark.

2300

It has been fifteen hours since the leak began and ten hours since it was discovered. Only now has a pollution control company been contacted. Its managing director immediately calls out his duty on-call team by radiopager. Some oil is contained by the inflatable booms, but as it builds up there is a continual escape of oil under them. The rain is now heavy.

Monday – 0030

The pollution company's response truck, carrying a comprehensive inventory of oil spill response equipment, is on its way, accompanied by a vacuum tanker and a Land Rover towing an air compressor. Workers from the plant are manually scooping oil out of the stream above the booms into barrels. With the rainfall the burn and

small river are both rising. The rate of water flow has increased and more oil is piling up behind the booms and being carried away underneath them. However, they have significantly decreased the amount of oil escaping towards the main river.

0200

After a somewhat stormy journey over the hills, the pollution control company's vehicles and personnel have arrived on site. The first priority is to contain the spill completely. After a site survey, it is decided to build a sandbag dam and weir (interceptor dam) down at the mouth of the smaller river, and a smaller one at the mouth of the drain. The dams will have underpasses to allow water to flow through underneath, and the water levels will be kept above the levels of the underpasses by means of the weir barriers constructed immediately downstream of each dam. This way, the oil will be trapped behind the underpass dams but the water can flow freely. The underpass dams are constructed by building sandbag piers which are then bridged over with strong wooden planks, on top of which more sandbags are placed to create a low wall that will retain the oil[1]. The downstream weir, also constructed with sandbags[2], has the effect of locally raising the water level thus ensuring that the oil is held behind the underpass dams[3]. With the rise in water level due to the rain, oil has been carried up the banks in both the burn and the small river. The main river's level has risen slightly.

[1] An alternative to building a bridge type underpass dam is to use a few lengths of large diameter pipe to enable water to flow through. Pipes should be installed in the sandbag wall a little above the bottom of the watercourse. The number/size of pipes used must be enough to provide a sufficient safety margin to allow unobstructed flow of water even in spate conditions otherwise water will back up, the level will rise and trapped oil will lost over the top of the underpass dam. The bridge type underpass dam requires fewer sandbags and can be constructed more quickly than an underpass dam using pipes.

[2] It is recommended that heavy duty plastic sheeting be used to line the inner side of the weir dam and arranged to drape over the top of the dam. This protects the top of the weir dam from erosion caused by water flow over an extended period of time. Plastic sheeting can also be used to help to ensure that the upper part of the underpass dam makes an oil tight seal.

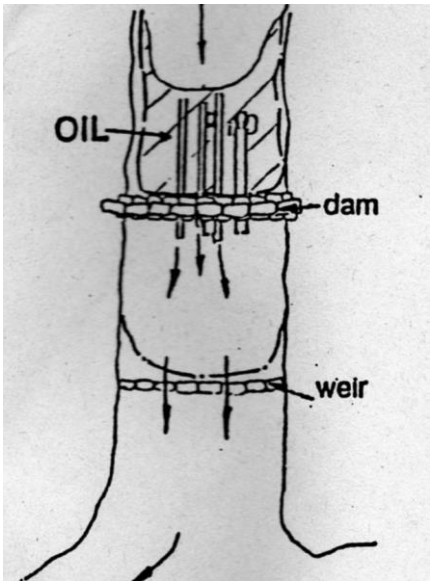
[3] The height of the weir dam needs to be such that the underpass dam has sufficient freeboard to retain trapped oil.

O230

Fortunately, there is a pile of sand in a corner of the plant's premises. There is enough to fill sufficient sandbags to build both dams and weirs. All hands are set to work to fill bags and, with the aid of portable floodlights, construction starts. Again, fortunately there is good vehicle access to the dam site. This will be important later when oil recovery operations start.

0600

It's now daylight but still raining. Almost 1,000 bags have been filled and built up into the dams and weirs. Solidly built, they will last throughout the coming clean-up operations. No more oil can escape into the main river. No more oil can run into the burn. The first phase – CONTAINMENT – is complete.



The story so far - A leak of heavy oil from an industrial plant in the Scottish Highlands has resulted in pollution of a local burn, a larger stream / minor river and the main river into which it runs.

A pollution response company has been called out and the spill has been contained both at source and where the stream flows into the river. The next phases, RECOVERY and CLEAN-UP are about to begin.

In this sketch, the underpass dam illustrated is a pipeline underpass rather than a bridge type underpass dam, but the principle of operation is the same.

Monday – 0630

Patches of thick black oil are now piling up steadily behind the underpass dam near the point where the stream flows into the river. Personnel from the pollution control company are setting up oil recovery equipment[4] on the bank of the stream, ready to recover oil into the vacuum tanker. Senior members of the team are carrying out an inspection of the small burn, the larger watercourse and the river. It is no longer raining.

[4] *In the initial phase of recovery when there is a lot of oil to pick up it would be practical to suck off the oil directly into the vacuum tanker using a floating suction head on the hose. One disadvantage is that quite a lot of water will be collected with the oil.*

10.00

The preliminary inspection has discovered extensive oiling along the burn and minor river, although vagaries in the current have also left many sections of the banks uncontaminated. Fortunately, the rise in water levels due to the rainfall have not resulted either in a heavy "tide mark" or much spreading out of the oil where the banks are low. Along the main river, there is some oiling of the banks on the village side, but due to the currents no pollution at all has been found on the opposite shore. However, as the river is relatively low at this time of year, there are areas exposed of boulders and stones and some oil has fetched up where the water runs through these. A narrower section of river at the end of the village seems to mark the limits of oiling, with only isolated patches noted in waterside vegetation, and one accumulation discovered in an eddy under a small cliff further downstream.

10.30

The vacuum tanker is now full and leaves to deliver its load to a waste oil reprocessing company. Because a considerable volume of water was recovered with the oil, the contents of the tanker have been "cut" several times, by simply releasing the water layer beneath the oil inside the tanker back into the stream – above the dam. This allows the maximum amount of oil to be taken away.

While the tanker is away, recovery continues using the air compressor to operate a skimmer, with the recovered oil being passed into a portable tank on the bank[5]. This too is "cut" from time to time.

[5] *The skimmer must be of a type that can recover heavy oil. A small weir skimmer ("Dragonfly" or similar) can be used with a section of floating hose. A suitable pump would be an air-operated double-diaphragm type (Wilden or similar). By regulating the air supply to the pump, the height of the weir of the skimmer can be "tuned" to minimise the amount of water recovered with the oil. A suitable portable tank would be a 10 ton capacity Fastank or equivalent.*

Oil has also been collecting in the "mini" interceptor dam where the factory drain exits into the small burn. Here, the amount of oil is not large and can be manually scooped into open top drums.

The clean-up operation has also started by now, with the primary objective of tackling the banks of the river. Booms are set out extending from the bank to approximately mid-stream to catch some of any oil dislodged during bank cleaning, and help to channel it back towards the shore. However, because of the heavy nature of the oil and the speed of the current, these measures can only be partially successful. Therefore booms will be set out at several locations in the smoothest sections of water found. Cleaning up is carried out manually – No dispersants or other chemicals are used. Oiled vegetation on the bank is slashed down and bagged; oily gravel and small stones are dug out and bagged – oil on larger rocks is cleaned off as much as possible with sorbent sheets. Patches of oil or emulsion are similarly mopped up. Progress is slow, but painstaking.

11.30

The oil pollution in the stream above the dam, and its tributary, the small burn that runs past the factory, has not been neglected. Although no more pollution can escape past the underpass dam, there is always the danger that heavy rain will raise the level in the watercourses and spread the oil further up and down the banks, or even cause a spate that could threaten the dam and weir. Accordingly, the sooner the clean-up is completed the better. Since any oil released will be contained downstream, the cleaning process is commenced at the uppermost point of the polluted part of the watercourse and progress downstream to the dam location.

Two cleaning teams work in tandem – one removing oiled vegetation[6], the other equipped with a portable low pressure washing pump[7] in order to flush as much oil as possible from the banks and from between rocks and tree roots.

[6] *For clearing oiled vegetation from heavily overgrown watercourses a variety of hand tools are needed – small bushman saws, machetes, sickles, pruning shears – plus a plentiful supply of large heavy-duty plastic bags for bagging up oiled materials.*

[7] *A lightweight petrol (gasoline) engined centifrugal pump can be used and can be carried on a lightweight frame (like a hospital stretcher). A four-person washing team is recommended – two carrying the pump, one looking after the suction hose (fitted with a bottom strainer) and the fourth directing the delivery hose (fitted with a fire nozzle).*

2030

The team working on the main river have reached a point slightly past a foot bridge. There are oil stains still on many of the stones, and it is likely that a few pockets of oil are lying out of sight here and there, but generally the banks now appear clean.

The teams working on the small burn below the factory have reached the larger watercourse and covered a couple of hundred yards downstream

The oil skimming team at the dam site are doing well but small twigs and leaves need to be constantly cleared away from the skimmer's weir in order to maintain a good rate of oil recovery.

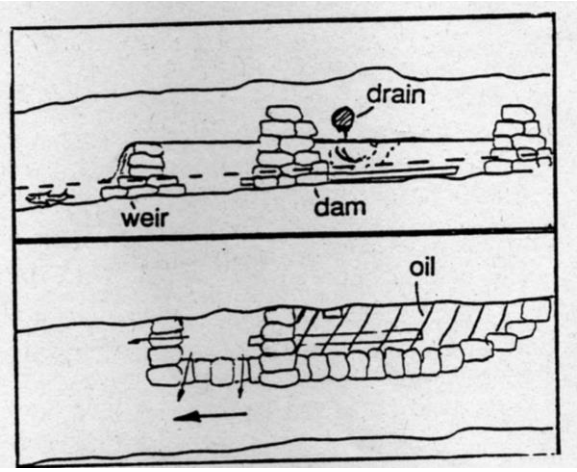
2130

It is now getting dark and, as the pollution is well contained, a decision is taken to stop work until the next day.

In case there is rain during the night and a rise in water level, it is decided to maintain a night watch at the dam site. This decision meets with the full approval of the local midge population who have turned out in force during the evening. (Midges are small biting insects and will be familiar to anyone who has visited the Scottish Highlands).

The story so far – A leak of heavy oil from an industrial plant in the Scottish Highlands has resulted in major pollution of a local burn, a larger stream and some minor pollution of the river into which they flow. A pollution response company has been called out, and the CONTAINMENT phase has been completed. The RECOVERY and CLEAN-UP work is continuing.

This sketch shows a "mini" interceptor dam that can be built to catch and retain oil entering a watercourse via a water drain. The advantage is that an oily drain can be decontaminated (flushing or cleaning with a high pressure retrojet) without risk of oil entering the watercourse.



Tuesday, Wednesday and Thursday

The washing down of the stream continues and the bank cleaning squad is working its way down from the factory. Most of the river cleaning team carry on where they left off, while three people head downstream to tackle the isolated patches of oil below the village.

The vacuum tanker returns and commences by emptying the portable holding tank at the underpass dam. Open top barrels used for holding recovered oil at the "mini" interceptor where the factory drainage system exits to the small burn also have to be emptied.

Thursday evening

Clean-up work on the main river has been completed. Inspections carried out at an earlier stage found no other traces of oiling downstream of the parts that have been cleaned. It is apparent that the decision to build a failsafe interceptor dam in the stream just before it flows into the river was correct. The amount of oil that oil that entered the main river was very small.

The washing-down squad has almost reached the dam, and the clean-up team is almost 2/3 of the way down the stream. Skimming operations at the underpass dam have been continuing throughout.

Friday evening

With both the washing-down and bank cleaning completed, the main phase of the response has been completed. All oiled vegetation has been removed for disposal and now there are no signs that an oil spill has occurred apart from some stains on rocks and tree roots. Over time, natural biodegradation will take care of this problem.

The interceptor dams will be left in place for a further three weeks to collect any final traces of oil. They will be inspected daily by factory personnel and weekly by a representative of the response contractor.

For security reasons, the skimmer, pump, hoses and portable tank are recovered and the recovery site is tidied.

Three weeks later

No problems have been found during inspections and, over the period, only a small amount of oil has accumulated at the dams.

The contractor's team returns with a pick-up truck and necessary equipment. A final oil skimming operation is carried out, oily twigs and leaves behind the dam are collected and bagged for disposal. The large dam is dismantled and sandbags emptied. Equipment and dam building materials are loaded on the truck. A final site tidy-up is carried out.

There may still be pockets of oil in the factory drainage system and, for this reason, it was decided to leave the "mini" interceptor in place until such time drains have been cleaned and the possibility of any further oil seepage can be discounted.

Together with the factory manager the response contractor's team leader makes a final inspection to ensure that all work has been carried out to the client's complete satisfaction.

Throughout the duration of the work phase the team leader has been keeping the factory manager regularly informed on progress and forward plans. The client has also been kept informed on costs being incurred.

Back at the response base, equipment will be cleaned and serviced ready for the next spill.
