

<b>INITIAL CLEAN-UP (1/2)</b>		
<i>Techniques used/objectives</i>	<i>Equipment needed</i>	<i>Factors to be considered</i>
<p><i>Prior operation:</i></p> <ul style="list-style-type: none"> <li>• <b>Development of the storage site</b></li> <li>- to facilitate sorting</li> <li>- to reduce volumes for evacuation</li> <li>- to stop the pollution from spreading (overflow, leaks, infiltration etc.)</li> </ul>	<p><i>(should be adapted to suit the pollutant and the site)</i></p> <ul style="list-style-type: none"> <li>- area, trenches, (watertight) bunds, skips, tanks</li> <li>- drainage (rainwater overflow)</li> <li>- screening, sorting</li> <li>- earthmoving equipment (digging)</li> <li>- protective membranes and geotextile</li> </ul>	<ul style="list-style-type: none"> <li>- ecological sensitivity and accessibility of the site</li> <li>- transfer of the pollution (watertight storage, decontamination of trucks)</li> <li>- traffic (should be channelled)</li> </ul>
<p><i>Prior operation:</i></p> <ul style="list-style-type: none"> <li>• <b>Recovering solid waste:</b> (removal or temporary movement to the upper beach where it will be out of the reach of the sea)</li> <li>- Mechanical recovery</li> <li>- Manual recovery</li> <li>- Waste disposal</li> </ul>	<ul style="list-style-type: none"> <li>- farm machinery (forks...)</li> <li>- earthmoving equipment (loader, shovel, bulldozer...)</li> <li>- forks, rakes, brushes, bins, bags</li> <li>- farm, earthmoving and mining equipment (loaders, skips, dumper, trailer etc.)</li> </ul>	<ul style="list-style-type: none"> <li>- accessibility of beach to mechanical machinery</li> <li>- organisation of workforce (large number of responders)</li> <li>- selectivity</li> </ul>
<p><b>1. Skimming/pumping</b></p> <p style="text-align: right;"><b>► Datasheets n°02 and 03</b></p> <p><i>Aim: to recover large accumulations of pollutant by promoting its concentration and improving selectivity and yield</i> (see also sand datasheet)</p> <ul style="list-style-type: none"> <li>- concentration of the slick using booms: prevent slicks from beaching on stones at all costs</li> <li>- if a slick has stranded on a stony beach, try to gather the oil in certain areas to facilitate pumping</li> <li>- contain and reconstitute the slick by the pumping/skimming means (trawling with sorbent booms, hosing, manual tools)</li> <li>- pump</li> <li>- store and transfer</li> </ul>	<ul style="list-style-type: none"> <li>- floating booms</li> <li>- shore-sealing booms</li> <li>- worksite booms</li> <li>- conditioned sorbents</li> <li>- small boats (possibility)</li> <li>- planks, scrapers, hoses</li> <li>- very powerful pump, compatible with great lengths of pipe</li> <li>- skimming/pumping equipment (skimmer, pump, vacuum truck or other transfer system)</li> <li>- grating, filter baskets</li> <li>- storage capacities and transfer means</li> </ul>	<ul style="list-style-type: none"> <li>- personal health and safety (protective clothing, masks)</li> <li>- nature and evolution of the oil, viscosity, weathering, thickness of the layer, adherence etc.</li> <li>- dangerousness of site: often exposed (waves, swell)</li> <li>- Accessibility of the coast: areas are often unworkable for ordinary machinery</li> <li>- tidal range (put equipment away daily)</li> </ul>
<p><b>2. Recovery</b></p> <p style="text-align: right;"><b>► Datasheet n°09</b></p> <p><i>Aim: to recover large accumulations of pollutant by promoting its concentration and improving selectivity and yield</i></p> <ul style="list-style-type: none"> <li>- Mainly manual recovery of accumulations and waste</li> <li>- Mechanical support where possible</li> </ul>	<ul style="list-style-type: none"> <li>- buckets, pails, earthmoving equipment</li> <li>- earthmoving equipment, quad bikes</li> </ul>	<ul style="list-style-type: none"> <li>- selectivity</li> <li>- potential presence of the pollutant under the surface: infiltration (fluid pollutant) and/or burying (viscous pollutant)</li> </ul>

<b>INITIAL CLEAN-UP (2/2)</b>		
<i>Techniques used/objectives</i>	<i>Equipment needed</i>	<i>Factors to be considered</i>
<p><b>3. Surfwashing</b> <span style="float: right;">▶ <b>Datasheet n°10</b></span></p> <p><i>Aim: to use the sea's energy to separate the pollutant from stones and ensure initial clean-up</i></p> <ul style="list-style-type: none"> <li>- move polluted stones to the lower foreshore</li> <li>- recover the freed pollutant in the water or on the upper foreshore</li> </ul>	<ul style="list-style-type: none"> <li>- earthmoving equipment: tractor-loader, loader on wheels, bulldozer, trucks</li> <li>- recovery equipment: nets (heavy fuel oil) + mooring, sorbent materials, manual recovery, rollers</li> </ul>	<ul style="list-style-type: none"> <li>- accessibility of beach to mechanical machinery</li> <li>- geomorphological risk (erosion): sensitivity of back beach in the absence of temporary protection (consult an expert geomorphologist)</li> <li>- tidal conditions</li> </ul>
<p><b>4. Flushing</b> <span style="float: right;">▶ <b>Datasheet n°12</b></span></p> <p><i>Aim: to dislodge clusters of pollutant stuck to surfaces or trapped in crevices or under boulders</i></p> <ul style="list-style-type: none"> <li>- low pressure, high speed washing with water</li> </ul>	<ul style="list-style-type: none"> <li>- pump unit (3 to 8 bar individual pump, 25 to 30 m<sup>3</sup>/h)</li> <li>- hoses, connectors</li> </ul>	<ul style="list-style-type: none"> <li>- seawater supply: tidal range, agitation of the water body</li> <li>- solidity of substrates (especially old stonework), risk of scouring</li> <li>- risk of emulsification of the pollutant</li> <li>- risk of penetration of the pollutant into the depths of the substrate</li> </ul>
<p><b>5. Flooding</b> <span style="float: right;">▶ <b>Datasheet n°13</b></span></p> <p><i>Aim: to flood a section of the shingle bar in order to reduce vertical infiltration of pollutant into the sediment during flushing</i></p> <ul style="list-style-type: none"> <li>- create a laminar flow</li> </ul>	<ul style="list-style-type: none"> <li>- perforated tube</li> <li>- high speed pump (100m<sup>3</sup>/h)</li> </ul>	<ul style="list-style-type: none"> <li>- seawater supply: tidal range, agitation of the water body</li> </ul>
<p><i>Systematic complementary operation:</i></p> <ul style="list-style-type: none"> <li>• <b>effluent recovery</b></li> </ul> <p><i>Aim: to stop the pollution from spreading by installing a recovery system</i></p> <ul style="list-style-type: none"> <li>- on the water <span style="float: right;">▶ <b>Datasheet n°14</b></span></li> <li>- on the foreshore <span style="float: right;">▶ <b>Datasheet n°15</b></span></li> </ul>	<p><i>(should be adapted to suit the pollutant and the site)</i></p> <ul style="list-style-type: none"> <li>- containment equipment: floating or shore-sealing booms, bunds, pits etc.</li> <li>- recovery and evacuation means: pump, sorbents etc.</li> <li>- storage means</li> </ul>	

<b>FINAL CLEAN-UP (1/2)</b>		
<i>Techniques used/objectives</i>	<i>Equipment needed</i>	<i>Factors to be considered</i>
<p><b>1. Flushing</b> <span style="float: right;">▶ <b>Datasheet n°12</b></span></p> <p><i>Aim: to wash the shingle bar in a large quantity of water to dislodge residual pollutant (liquid pollutant) and recover it at a collection point</i></p> <ul style="list-style-type: none"> <li>- prepare a collection area, channel the effluents</li> <li>- wash</li> <li>- recover freed waste</li> </ul>	<ul style="list-style-type: none"> <li>- pump unit (4 to 8 bar individual pump, 25 to 30 m<sup>3</sup>/h)</li> <li>- fire or impact hose</li> <li>- hoses, connectors</li> <li>- shovels</li> <li>- worksite boom (floating, shore-sealing)</li> <li>- skimmer, pump, sorbents</li> <li>- storage tanks, settling of recovered products</li> </ul>	<ul style="list-style-type: none"> <li>- dangerousness of site: often exposed (waves, swell)</li> <li>- ecological sensitivity of site</li> <li>- accessibility of the coast</li> <li>- water supply</li> <li>- tidal range (put equipment away daily)</li> <li>- nature and evolution of the oil (viscosity, weathering, thickness of the layer, adherence etc.)</li> </ul>
<p><b>2. Washing in specialised installations</b></p> <p><i>Aim: to remove oil from polluted stones</i></p> <p><i>Operations prior to washing</i></p> <ul style="list-style-type: none"> <li>• <b>Manual scraping</b> <i>Aim: remove the bulk of residual layers (viscous pollutant) before pressure washing to increase effectiveness</i></li> <li>• <b>Effluent recovery</b> <span style="float: right;">▶ <b>Datasheets n°14 and 15</b></span> <i>Aim: to recover effluents at a collection point, to prevent the pollution from spreading to the lower beach</i></li> </ul> <ul style="list-style-type: none"> <li>- should be set up before washing begins</li> <li>- make the most of natural run-off channels, line them wherever possible</li> <li>- should be constructed in the washing area</li> </ul>	<ul style="list-style-type: none"> <li>- scrapers, brushes</li> <li>- bin bags etc.</li> <li>- flexible geotextile sheeting, possibly with stakes</li> <li>- boom, skimmer, sorbent, filter</li> <li>- shovels</li> <li>- filtering geotextile</li> <li>- recovery means (absorption, pumping, landing nets etc.)</li> </ul>	<ul style="list-style-type: none"> <li>- possible spreading of pollution: migration in the sediment</li> <li>- possible recontamination by remobilised oil</li> <li>- potential presence of the pollutant under the surface: infiltration (fluid pollutant) and/or burying (viscous pollutant)</li> </ul>
<p><b>2a. Washing on cages</b> <span style="float: right;">▶ <b>Datasheet n°20</b></span></p> <ul style="list-style-type: none"> <li>- hot water is needed whereas use of a washing agent (for preference a solvent) is not systematically necessary</li> <li>- adjust pressure according to the size of the stones, use mesh bags (such as oyster bags) for small stones</li> </ul>	<ul style="list-style-type: none"> <li>- thermal washer (50 to 150 bars, 0° to 90°C) which can use seawater</li> <li>- washing “cage” (wire mesh structure mounted on a stand)</li> <li>- hoses, pipes, connectors</li> <li>- (possibly) selected washing agents</li> <li>- horticultural spreading means</li> </ul>	<ul style="list-style-type: none"> <li>- recovery is easier in the absence of a washing agent</li> <li>- accept the temporary presence of an oily film after washing (destroying in the long run by UV rays)</li> <li>- choose a product tested by a recognised organisation (Cedre keeps an up-to-date list) and conduct a test to confirm effectiveness onsite.</li> <li>- fragility of stones</li> </ul>

<b>FINAL CLEAN-UP (2/2)</b>		
<i>Techniques used/objectives</i>	<i>Equipment needed</i>	<i>Factors to be considered</i>
<p><b>2b. Washing in a concrete mixer</b>                      ► <b>Datasheet n°22</b></p> <ul style="list-style-type: none"> <li>- hot water can facilitate washing whereas use of a washing agent (for preference a solvent) is not systematically necessary</li> </ul> <p><b>2c. Washing in a concrete mixer drum</b>                      ► <b>Datasheet n°23</b></p> <ul style="list-style-type: none"> <li>- hot water can facilitate washing</li> <li>- the use of a washing agent (for preference a solvent) is not generally necessary</li> </ul> <p><b>2d. Washing at a Polmar plant</b>                      ► <b>Datasheet n°24</b></p> <ul style="list-style-type: none"> <li>- ready-to-use installation (complex logistics)</li> </ul>	<ul style="list-style-type: none"> <li>- <u>concrete mixer</u></li> <li>- system for rinsing over grating</li> <li>- effluent recovery system</li>   <li>- <u>concrete mixer drum</u></li> <li>- washing agents (solvent)</li> <li>- system for rinsing over grating</li> <li>- effluent recovery and settling system</li> <li>- storage of effluents and pollutants</li>   <li>- <u>washing plant</u> from the Brest's Polmar stockpile</li> </ul>	<ul style="list-style-type: none"> <li>- sensitivity of the back beach in the temporary absence of protection, previously ensured by the stones</li> <li>- available area</li> <li>- efficiency and toxicity of the washing agent</li> </ul>
<p><b>3. Surfwashing</b>      ► <b>Datasheet n°10</b></p> <p><i>Aim: to use the sea's cleaning power to complete the washing of stones or cleaning of lightly polluted stones</i></p> <ul style="list-style-type: none"> <li>- throw lightly oiled stones by hand down to the lower beach or deposit washed stones</li> <li>- recovery is in principle unnecessary</li> </ul>	<ul style="list-style-type: none"> <li>- loader, skip trucks, wheelbarrows</li> <li>- possibly nets (for heavy fuel oil)</li> </ul>	<ul style="list-style-type: none"> <li>- sensitivity of the back beach in the temporary absence of protection, previously ensured by the stones</li> </ul>
<p><b>4. Bioremediation</b>      ► <b>Datasheet n°29</b></p> <p><i>Aim: to accelerate natural breakdown of oil by bacteria and other micro-organisms</i></p> <ul style="list-style-type: none"> <li>- assess the opportunity for implementation</li> <li>- spread bioremediation agents</li> <li>- set up a monitoring initiative</li> </ul>	<ul style="list-style-type: none"> <li>- expert</li> <li>- bioremediation agent + spreader</li> </ul>	<ul style="list-style-type: none"> <li>- only on very light or residual pollution on a sheltered site</li> <li>- feasibility (assess according to procedures defined by experts)</li> <li>- efficiency and toxicity of the product</li> </ul>