1.0 Purpose

The purpose of this Guideline is to provide a framework for environmentally safe beneficial reuse of combined or separated sludge from pulp mills in B.C.

2.0 Application of Guideline

Large quantities of primary and secondary sludge are produced in the pulp and paper industries. Sludge is currently landfilled or incinerated.

Sludge, mainly consisting of residual organic matter (cellulose), can be used as a soil amendment that will improve the soil structure and crop production in agriculture, forestry, and land reclamation. The two main sludge streams are primary sludge, primarily cellulose fibre, and secondary sludge, from the biological reactor. Secondary sludge is stabilized more and contains significant levels of nutrients such as nitrogen, phosphorus and potassium. Sludge may include lime residue or fly ash.

Application of sludge to land has proven to be beneficial for soil and plant growth. Added organic matter improves soil water holding capacity, adds structure to the soil, increases levels of soil organisms, and, through mineralization, provides nutrients. This improved "tilth" is advantageous to crops grown on amended soils. Secondary sludge can be used as a source of slow release nutrients.

This Guideline applies to the beneficial reuse of clean sludge as a soil amendment in agriculture, forestry, mine site reclamation, and park land. Under this Guideline, reuse is allowed without a permit under the Waste Management Act for sludge to be applied to land.

The Guideline sets forth conditions for Ministry of Environment involvement in monitoring and reporting based on the sludge characterization and land classification. The Guideline also indicates when a permit is required for land application and beneficial reuse.

The Guideline covers waste water processing sludges as they are produced by all pulp and paper mills in B.C. Any pre-treatment required
to prepare the sludge for land application such as composting, mixing, and combining does not change the intent of the Guideline and its conditions and restrictions. Under the Guideline, sludge is classified for use before any pre-treatment takes place that is not normally part of the process generating the sludge; e.g. blending or composting will not change the classification of the sludge. Where a pre-treatment process is covered by an Act or Regulation, following this Guideline will not exclude the process from those Acts or Regulations.

The application of sludge under this Guideline does not constitute pollution of the environment. The Waste Management Act, and other Acts and Regulations remain in force.

Sludge from pulp mills can be used in beneficial land application projects under three classifications based on the sludge characteristics as outlined in this section:

- Class 1 - Unrestricted Use
- Class 2 - Monitored Use
- Class 3 - Permitted Use

Class 1 sludge can be applied on all land for all purposes, including residential distribution. Large scale applications must follow agronomic application rates. It is recognized that Class 1 sludge could be used as a straight growing medium. Classification and product standards are based on this use.

Reporting, approval, or permit requirements are not required. Notification to the Regional Manager is required for any application of sludge greater than 100 tonnes to any single application site. For residential distribution programs, notification is not required.

Class 2 sludge can be applied to certain lands using agronomic application rates. Class 2 product is allowed on agricultural land for all uses, on forest land, in mine reclamation projects, and on park land. A monitoring program is required. Monitoring includes:

Pottinger Gaherty Group
File: 9457-02.03

- preparation and submission of an operational plan to the Regional Manager;
- public notification;
- monitoring; and
- reporting to the Regional Manager.

Class 3 sludge application must be permitted under the Waste Management Act for discharge into the environment.

3.0 Product

The level of contaminants in the sludge determines its classification for use. To obtain the proper classification, the sludge must be analyzed and results from the analyses must be compared with the values in Table 1 in this section.

The classification of sludge is based on its general characteristics. The sludge stream is sampled to obtain these characteristics prior to stockpiling etc. Samples of sludge must be taken as follows: over a three month period, five composite samples must be taken from the sludge stream to be assessed for beneficial reuse. Each composite consists of 10 equal grab samples taken over a three day period. Analyses must be performed by a certified analytical laboratory.

Additional agronomic parameters are required in order to obtain guidance for application rates. These parameters include the Total and available N, P, K, Ca, Mg, and Fe; and pH and EC.

The classification of sludge is based on the standards for agricultural land, as outlined in the Contaminated Sites Regulation (CSR) Schedule 4 and 5, or in the Draft Municipal Organic Matter Recycling Regulation Standards (MOMRR), and include the most sensitive soil use for the land to be used for sludge applications. While recognizing that the sludge is not a "contaminated site" or "contaminated soil", the CSR limits were incorporated in the Guideline because the sludge may be applied as sole growing medium on the site (e.g. as a mulch or top dressing). Sludge is not mixed with mineral soil and should be looked at as a growing medium. Where no limits are available in the CSR, the applicable limits from the MOMRR were selected. Standards for Class 2 sludge bracket...
the most sensitive environmental use and the limits for municipal biosolids.

The following table describes the product characteristics and the product use.

<table>
<thead>
<tr>
<th>Element</th>
<th>Class 1</th>
<th>Class 2</th>
<th>Class 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>(mg/kg dry weight)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antimony</td>
<td>&lt;20(b)</td>
<td>20-40</td>
<td>&gt;40(d)</td>
</tr>
<tr>
<td>Arsenic</td>
<td>&lt;13(a)</td>
<td>13-75</td>
<td>&gt;75(d)</td>
</tr>
<tr>
<td>Barium</td>
<td>&lt;500(b)</td>
<td>500-2000</td>
<td>&gt;2000(d)</td>
</tr>
<tr>
<td>Beryllium</td>
<td>&lt;4(b)</td>
<td>4-8</td>
<td>&gt;8</td>
</tr>
<tr>
<td>Boron (hot water)</td>
<td>&lt;2(b)</td>
<td>&gt;2</td>
<td></td>
</tr>
<tr>
<td>Cadmium</td>
<td>2.6-20</td>
<td></td>
<td>&gt;20(e)</td>
</tr>
<tr>
<td>Chromium (table)</td>
<td>&lt;210(c)</td>
<td>210-1060</td>
<td>&gt;1060(c)</td>
</tr>
<tr>
<td>S.L.U.</td>
<td>&lt;150(b)</td>
<td>150-500</td>
<td>&gt;500(c)</td>
</tr>
<tr>
<td>Copper</td>
<td>&lt;100(b)</td>
<td>100-2200</td>
<td>&gt;2200(c)</td>
</tr>
<tr>
<td>Cyanids (WAD)</td>
<td>&lt;0.5(b)</td>
<td>0.5-100</td>
<td>&gt;100(k)</td>
</tr>
<tr>
<td>Lead</td>
<td>&lt;150(k)</td>
<td>150-500</td>
<td>&gt;500(c)</td>
</tr>
<tr>
<td>Mercury</td>
<td>&lt;0.8(b)</td>
<td>0.8-15</td>
<td>&gt;15(e)</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>&lt;5(b)</td>
<td>5-20</td>
<td>&gt;20(c)</td>
</tr>
<tr>
<td>Nickel</td>
<td>&lt;50(k)</td>
<td>50-180</td>
<td>&gt;180(c)</td>
</tr>
<tr>
<td>Silver</td>
<td>&lt;2(v)</td>
<td>2-14</td>
<td>&gt;14(c)</td>
</tr>
<tr>
<td>Selenium</td>
<td>&lt;3(b)</td>
<td>3-300</td>
<td>&gt;300(i)</td>
</tr>
<tr>
<td>Tin</td>
<td>&lt;3(15)</td>
<td>315-1850</td>
<td>&gt;1850(c)</td>
</tr>
<tr>
<td>Zinc</td>
<td>&lt;5(15)</td>
<td>315-1850</td>
<td>&gt;1850(c)</td>
</tr>
<tr>
<td>Dioxin/Furans</td>
<td>&lt;5(d)</td>
<td>5-10</td>
<td>&gt;10(c)</td>
</tr>
<tr>
<td>TEO pg/l</td>
<td>&lt;1.0(b)</td>
<td></td>
<td>&gt;1.0(b)</td>
</tr>
<tr>
<td>Total PAH</td>
<td>&lt;0.6(b)</td>
<td></td>
<td>&gt;0.6</td>
</tr>
<tr>
<td>Phenols total</td>
<td>&lt;0.9(b)</td>
<td></td>
<td>&gt;0.9</td>
</tr>
<tr>
<td>Chlorophenols total</td>
<td>&lt;1.3(b)</td>
<td></td>
<td>&gt;1.3</td>
</tr>
<tr>
<td>Hydrocarbons (total)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VPH</td>
<td>&lt;200(b)</td>
<td></td>
<td>&gt;200</td>
</tr>
<tr>
<td>LePH</td>
<td>&lt;1000(b)</td>
<td></td>
<td>&gt;1000</td>
</tr>
<tr>
<td>HEPH</td>
<td>&lt;1000(b)</td>
<td></td>
<td>&gt;1000</td>
</tr>
<tr>
<td>Element</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(mg/kg dry weight)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benzene</td>
<td>&lt;0.04(b)</td>
<td></td>
<td>&gt;0.04</td>
</tr>
</tbody>
</table>

*Guideline for use of Pulp Mill Combined Biosolids in Land Application*

February 23, 1998
File: 9457-02.03
Guidelines for use of Pulp Mill Combined Biosolids in Land Application -

<table>
<thead>
<tr>
<th>Substance</th>
<th>Parameter</th>
<th>Unit 1</th>
<th>Unit 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzopyrene</td>
<td>&lt;0.1 (b)</td>
<td></td>
<td>&gt;0.1</td>
</tr>
<tr>
<td>Ethyl benzene</td>
<td>&lt;0.1 (b)</td>
<td></td>
<td>&gt;0.1</td>
</tr>
<tr>
<td>PCB</td>
<td>&lt;0.5 (b)</td>
<td></td>
<td>&gt;0.5</td>
</tr>
<tr>
<td>Toluene</td>
<td>&lt;0.1 (b)</td>
<td></td>
<td>&gt;0.1</td>
</tr>
<tr>
<td>TCE</td>
<td>&lt;0.1 (b)</td>
<td></td>
<td>&gt;0.1</td>
</tr>
<tr>
<td>Xylene</td>
<td>&lt;0.1 (b)</td>
<td></td>
<td>&gt;0.1</td>
</tr>
<tr>
<td>Phthalate Esters</td>
<td>&lt;30 (b)</td>
<td></td>
<td>&gt;30</td>
</tr>
<tr>
<td>NPE</td>
<td>&lt;10 (c)</td>
<td>10-200</td>
<td>&gt;200</td>
</tr>
</tbody>
</table>

a = draft municipal organic matter recycling regulation; levels for soil product
b = Contaminated Sites Regulation B.C. Reg. 375/96: lowest environmental standard
c = Draft Municipal Organic Matter Recycling Regulation: Level in sewage sludge
d = estimated soil background level
e = preliminary data National Water Research Institute
f = CSR agricultural soil standard
g = CSR industrial soil standard
h = Production and Use of Compost Regulation B.C. Reg. 334/93m

Concentration code 1, unlimited use.

4.0 Land

The physical setting of a site is important in assessing potential impacts from the application of mill sludge. Parameters of concern include features such as slope and proximity to water features. Soil characteristics and land forms are used to determine whether restrictions are required on the application of the sludge.

The following soil buffer and buffer zones will be taken into account:
Guideline for use of Pulp Mill Combined Biosolids in Land Application

<table>
<thead>
<tr>
<th>Feature</th>
<th>Class 1</th>
<th>Class 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water courses, open water</td>
<td>5m</td>
<td>15m</td>
</tr>
<tr>
<td>Drinking wells</td>
<td>10m radius</td>
<td>30m radius</td>
</tr>
<tr>
<td>Residential zoned property</td>
<td></td>
<td>30 m</td>
</tr>
<tr>
<td>Farm dwellings</td>
<td></td>
<td>30 m</td>
</tr>
</tbody>
</table>

February 23, 1988
File: 9457-02.03

5.0 Notification and Public Information

The application of mill combined sludge requires the following notification and public information.

5.1 Class 1

Prior to beneficial use of Class 1 sludge, the Regional Manager will be notified in writing regarding the intended application of 100 tonnes or more to an individual site. No ministerial approval is required. The notification includes:

- type and origin of material applied;
- sludge characterization as outlined in Section 3.0; and
- pre-treatments.

In case of a residential distribution program:
- the general distribution area.

In case of non-residential application:
- site address;
- description of site;
- soil characteristics; and
- agronomic application rates.

5.2 Class 2
Guideline for use of Pulp Mill Combined Biosolids in Land Application

February 23, 1988
File: 8457-02.03

Prior to application of sludge, an operational plan must be submitted to the Regional Manager for information and review. Inter-agency consultation and input is not required. Public notification is required.

5.2.1 Operational Plan

The operational plan includes:

- type and origin of material applied;
- sludge characterization as outlined in Section 3.0;
- sludge agronomic characteristics;
- pre-treatments;
- site address;
- site plan, indicating residences, streams and ditches, and wells;
- soil characteristics;
- representative soil levels of metals and dioxins/furans conform to Section 3.0;
- cropping plan;
- agronomic application rates and expected number of applications;
- expected cumulative loading for each parameter that caused the sludge to be classified as Class 2.

Operational plan must be prepared and certified by a qualified professional licensed to practice in B.C.
5.2.2 Public Notification

Public notification is required. The operator must post a notification at the proposed site and advertise his or her intentions in an appropriate local newspaper. Individuals who have previously expressed interest in the issue and those who live adjacent to the site on which it is proposed to apply sludge must be personally notified by the operator. No sludge will be applied to the site for at least 45 days following the date of posting advertising or notification, whichever is latest. Concerned persons have 30 days from posting advertising or notification to inform the Regional Manager in writing of his or her concerns prior to sludge applications being made. This allows the Regional Manager to address public concerns, and to review the operational plan for environmental risk. The Regional Manager will inform the operator of any outstanding issues within the 45 days delay period. When no notification of issues is received from the Regional Manager within the 45 day period, the operator can apply sludge to the site.

5.3 Class 3

Application for Permit follows the requirements of the Waste Management Act.

6.0 Monitoring, Record Keeping, and Reporting

Monitoring, record keeping, and reporting are required by the operator. Monitoring includes product monitoring and post-application monitoring, depending on the classification of the sludge applied. All records are kept on the premises, and results are reported to the Regional Manager where required. Monitoring, record keeping, and reporting requirements are as follows.

6.1 Class 1

Annual product monitoring is required to confirm the quality of the sludge. Monitoring sampling consists of one 10-part composite sample taken over a three day period. Samples will be analyzed for those parameters only with nominal levels of 50% or more of the limits for

Pottinger Gaherty Group

Received: 03/02/98 02:35:02 From: 250 953 3856
Guideline for Use of Pulp Mill Combined Biosolids in Land Application

February 23, 1998
File: 9457.02.03

Class 1 as determined during the initial characterization. This excludes unnecessary analyses of compounds with values near the detection limits.

Additional sampling and analyses of all parameters is required after major changes in the production process have been made.

Post-application monitoring of soil is not required.

Product monitoring reports and records that include volumes of product distributed to the public for residential use, site information for sites with applications of greater than 100 tonnes total for that site, and loading rates for these applications are required. Reports are kept at the premises for up to three years to allow inspection by Ministry officials. Submission of monitoring reports to the Regional Manager is not required.

6.2 Class 2

Quarterly monitoring is required to confirm the quality of the product. Monitoring consists of one 10-part composite sample taken over a three day period. The sample will be analyzed for those parameters whose values in the initial characterization caused the Class 2 designation and those with nominal levels of 50% or more of the limits for Class 1, as determined during the initial characterization.

Additional sampling of all parameters is required after major changes in the production process have been made.

Post-application monitoring is required for each application site considered for re-application. Representative samples are taken for the 0-15cm layer of the site. Post-application monitoring includes analyses of the collected soil samples for those parameters whose values in the initial characterization caused the Class 2 designation. Post-application monitoring data are compared with the applicable standards for agricultural soils as listed in the CSR (Schedule 4 and 5). A trigger value of 80% of the CSR standards is to be used as a cut-off level for application of sludge to a site. Soil levels of parameters listed in Section 3.0 must not exceed 80% of the CSR trigger value after application.

Pottinger Gaherty Group
Guidelines for the use of Pulp Mill Combinol Biosolids in Land Application

February 23, 1999
File: 8457-02.03

Annual reports will be submitted to the Regional Manager before January 31. Annual reports include:

- product monitoring reports;
- post-application monitoring reports where required;
- a site plan indicating applied areas, and
- loading rates for each applied area.

Reports will be prepared and certified by a qualified professional licensed to practice in B.C.

6.3 Class 3

Monitoring, record keeping, and reporting as required under the Permit.

7.0 Management Practices

Managing sludge for both unrestricted and restricted use must include the following management practices.

7.1 Pollution Prevention

All beneficial reuse of sludge will be conducted to prevent pollution. All current regulations regarding discharge of deleterious substances in surface water, and effects on fisheries and aquatic systems apply to this use of sludge.

7.2 Application Rates

Application rates of mill sludge are based on the plant nutrient requirements. This includes nitrogen, phosphorus, potassium, and micronutrients. Not more nutrients can be applied in each application of sludge than are required to supply crops at agronomic rates for a maximum of three years for crop land, five years for forest land and seven years for mine reclamation sites, considering the mineralization rate of the sludge and the release of these nutrients.

Pottinger Gaherty Group
7.3 Supervision

Class 2 and 3 application programs for beneficial reuse of sludge will be supervised by a qualified professional licensed to practice in B.C. The professional will ensure that proper application rates are used and that the programs are executed in an environmentally safe manner.

8.0 Allowance

The Regional Manager can provide allowance on two specific issues dealing with land application of pulp mill sludges. These include the use of sludge as a fertilizer and sludge application in areas with high back ground levels for metals. Other allowances requested by operators are referred to the Approval of Permit process under the Waste Management Act.

8.1 Use as Fertilizer

Some of the parameters listed in Section 3.0, notably B, Co, Cu, Mo, Zn, and Se, are essential plant nutrients. Application to soil of each of these plant nutrients can have agronomic benefits.

Should the sludge classification be based on the level of one or more of these plant nutrients, the operator may apply for a change in sludge classification. Upon application, the Regional Manager may allow an upgrade in classification from Class 2 to Class 1 or from Class 3 to Class 2, based on proven plant requirements for these nutrients at the designated beneficial reuse site as outlined in the operational plan. Sludge with upgraded classification can only be applied at agronomic rates for that parameter on which the upgrade is based. Such application should be based on scientific grounds and be well documented to show minimal environmental and human health risk.

Pottinger Gahery Group
B.2 High Background Levels

Some areas of the Province have high background levels for specific metals. This high background level may not allow the application of Class 2 sludge as the 80% trigger value of the CSR limits have been reached. In that case, the operator can apply to the Regional Manager to lift the restriction of Section 6.2 of this Guideline and to establish a mutually agreeable loading of the soil. Such application should be based on scientific grounds and be well documented to show minimal environmental and human health risk.