MANAGERS   DESIGNERS.CONSULTANTS

13 July 1999

New York State Dept. of
  Environmental Conservation
Bureau of Remediation and
  Hazardous Site Management
50 Wolf Road
Albany, NY 12233

W.O. #03886-143-002

Attn: Mr. Kent Johnson

Re: Calculation of Preliminary Remediation Goals for Boron and Lithium
      Former Lake Ontario Ordnance Works – LOOW
      Remedial Design for Interim Removal Action for Areas A & B – Component 1
      Phases II and III

Dear Mr. Johnson:

The U.S. Army Corps of Engineers Baltimore District (CENAB) has retained Roy F. Weston, Inc. (WESTON®) to develop the Remedial Design for Interim Removal Actions (IRAs) for Areas A & B at the former Lake Ontario Ordnance Works (LOOW) located in Niagara County, New York. WESTON is currently completing the Supplement to the 60% Design for Areas A & B. In completing this design submittal the issue was identified of soil clean-up criteria for constituents detected in Areas A & B that are not listed in the NYSDEC TAGM 4046 and 3028. These constituents include lithium and boron. In the absence of listed soil clean-up criteria, it is proposed to use risk-based remediation goals for those two constituents. The following is a summary of the method and assumptions used to determine the criteria and the results of the calculations.

Risk-based preliminary remediation goals (PRGs) (milligrams of chemical per kilogram of soil) were calculated for boron and lithium for site soils to be remediated in Areas A & B at LOOW. General guidance on which the PRG calculations were based was the *Soil Screening Guidance* (EPA, 1996) and *Risk Assessment Guidance for Superfund* (EPA, 1989).

Tables 1 and 2 provide the exposure algorithms and input used for the boron and lithium PRG calculations. PRGs were developed at a target hazard quotient (THQ) of 1. Boron and lithium are not classified as carcinogens (EPA, 1999a). It was assumed that an adult maintenance worker would be exposed to site soils over a period of 25 years, 40 hours per week, 50 weeks per year through incidental soil ingestion, dermal contact with soil, and inhalation of fugitive dust generated at the site. This exposure scenario is based on the current and expected future use of the site as a permitted RCRA facility.

Default exposure assumptions were generally obtained from the *Standard Default Exposure Factors* guidance (EPA, 1991) as updated by the *Exposure Factors Handbook* (EPA, 1997a) and the interim *Dermal Guidance for Risk Assessment* (EPA, 1998). For dermal exposure, exposed surface area for the workers was based on the 50th percentile averages for males and females (EPA, 1998; Table C.3) for the face, hands and forearms. An activity- and surface area-weighted soil adherence factor was calculated for a "utility worker" (No. 2) according to EPA dermal guidance (EPA, 1998; Table C.4). The particulate emissions factor (PEF) was developed based on guidance in the *Soil Screening Guidance* (EPA, 1996) using default parameters. The dispersion model coefficient (Q/C) was based on data from Hartford, CT which was the closest geographic location to the LOOW.

Reference doses (RfDs) were obtained preferentially from the *Integrated Risk Information System* (IRIS) (EPA, 1999a) or the *Health Effects Assessment Summary Tables* (HEAST) (EPA, 1997b). For boron, there was a verified oral RfD and a provisional inhalation RfD from HEAST (EPA, 1997b). For lithium, a provisional oral reference dose (RfD) developed by the National Center for Environmental Assessment (NCEA), as obtained from the *EPA Region III Risk-based Concentration Table* (EPA, 1999b), was used in the absence of verified criteria. This RfD was extrapolated to the inhalation route. Dermal RfDs for both boron and lithium were developed as recommended by EPA (1989) assuming 100% gastrointestinal (GI) absorption factors (EPA, 1998) and dermal absorption factors of 0.01 (EPA, 1998).

Tables 1 and 2 show that the soil boron PRG was 131,319 mg/kg (HQ=1) and the lithium PRG was 29,262 mg/kg. Assuming a THQ of 0.1 to account for additive effects of boron and lithium, the PRGs would be 13,320 mg/kg and 2,926 mg/kg for boron and lithium, respectively. However, the critical toxic effects appear to be different for boron (reproductive) and lithium (CNS, cardiovascular), so the higher PRG values (i.e., HQ of 1) can be used.

It is therefore proposed that these PRGs for boron and lithium be used for the soil clean-up criteria for the Interim Response Action for Areas A & B. Please call me at (610) 701-7550 with any questions on this letter.

                          Very truly yours,

                          ROY F. WESTON, INC.

                          David H. Pohl, Ph.D., P.E.
                          Project Manager

DHP/kmp
cc: A. Warminski (CENAB)
        R. Pilon (Buffalo District)

Table 1
Noncarcinogenic Soil RG for Boron for Site Maintenance Worker
Lake Ontario Ordnance Works

$$RG \ (mg/kg) = \frac{THQ \times BW_a \times AT_n}{EF_a \times ED_a \times [(1/RfD_o \times IRS_a / CF) + (1/RfD_d \times SA_a \times ABS \times AF_a / CF) + (1/RfD_i \times IRA_a / PEF)]}$$

Where:

THQ = Target hazard quotient (1).

BW_a = Adult body weight (70 kg) (EPA, 1989).

AT_n = Averaging time (9,125d) (EPA,1989).

EF_a = Adult exposure frequency (250 d/y) (Professional judgement).

ED_a = Adult exposure duration (25 yrs) (EPA, 1991).

RfD_o = Oral reference dose for boron (9E-02 mg/kg-d) (EPA, 1999).

IRS_a = Adult soil ingestion rate (50 mg/d) (EPA, 1997).

SA_a = Adult skin surface area - face, hands, and forearms. 50th percentile, average male/female (2,480 cm^2/d);
Table C.3; (EPA, 1998)

RfD_d = Dermal reference dose for boron (9E-02mg/kg-d); RfD_o X 1.0 (EPA, 1989).

AF_a = Activity-, surface area-weighted soil-to-skin adherence factor, 95th percentile, utility worker no. 2 (0.8mg/cm^2);
Table C.4; (EPA, 1998)

ABS = Dermal absorption factor (0.01) (EPA, 1998).

RfD_i = Inhalation reference dose for boron (5.7E-03 mg/kg-d) (EPA, 1999).

IRA_a = Adult inhalation rate (13.3 m^3/day) (EPA, 1997).

CF = Conversion factor (1E+06 mg/kg).

PEF = Particulate emissions factor (1.316E+09 m^3/kg) (EPA, 1996).

Boron RG = 131319 mg/kg (HI = 1)

Notes: 1 Fraction of contaminated soil ingested is 1

2 PEF (m^3/kg) = Q/C x 3600sec/hr / 0.036 x (1-V) x (Um/Ut)^3 x F(x)

- Default assumes 50% vegetative cover. no significant on site disturbances like traffic and excavation.

Table 2
Noncarcinogenic Soil RG for Lithium for Site Maintenance Worker
Lake Ontario Ordnance Works

$$RG \text{ (mg/kg)} = \frac{THQ \times BW_a \times AT_n}{EF_a \times ED_a \times [(1/RfD_o \times IRS_a / CF) + (1/RfD_d \times SA_a \times ABS \times AF_a / CF) + (1/RfD_i \times IRA_a / PEF)]}$$

Where:

THQ = Target hazard quotient (1).

BW_a = Adult body weight (70 kg) (EPA, 1989).

AT_n = Averaging time (9,125d) (EPA,1989).

EF_a = Adult exposure frequency (250 d/y) (Professional judgement).

ED_a = Adult exposure duration (25 yrs) (EPA, 1991).

RfD_o = Oral reference dose for Lithium (2E-02 mg/kg-d) (EPA, 1999).

IRS_a = Adult soil ingestion rate (50 mg/d) (EPA, 1997).

SA_a = Adult skin surface area - face, hands, and forearms, 50th percentile, male/female average (2,480 cm²/d);
Table C.3; EPA, 1998

RfD_d = Dermal reference dose for Lithium (2E-02 mg/kg-d); RfDo x 1.0 (EPA, 1999).

AF_a = Activity-, surface area-weighted soil-to-skin adherence factor; 95th percentile, utility worker no. 2 (0.8 mg/cm²)
Table C.4; EPA, 1998

ABS = Dermal absorption factor (0.01) (EPA, 1998).

RfD_i = Inhalation reference dose for Lithium (2E-02 mg/kg-d) (EPA, 1989)(route-to-route, oral to inhalation).

IRA_a = Adult inhalation rate (13.3 m³/day) (EPA, 1997).

CF = Conversion factor (1E+06 mg/kg).

PEF = Particulate emissions factor (1.316E+09 m³/kg) (EPA, 1996).

Lithium RG (mg/kg) =   29262 (HI = 1)

Notes: 1 Fraction of contaminated soil ingested is 1

2 $PEF \text{ (m}^3\text{/kg)} = Q/C \times 3600\text{sec/hr} / 0.036 \times (1-V) \times (Vm/Vt)^3 \times F(x)$

- Default assumes 50% vegetative cover, no significant on site disturbances like traffic and excavation.