Nanisivik Mine

ᓇᓂᓯᕕᒃ ᐅᔭᕿᒃᓂᐊᕐᕕᒃ

2004 Reclamation and Closure Plan

2004ᒥ ᓴᓗᖅᒪᕐᓴᖅᑕᐅᓂᒃᓴᖕᒐᓄᑦ ᐊᒻᒪ ᒪᑐᔭᐅᓂᒃᓴᖕᒐᓄᑦ ᐃᓱᒪᒋᔭᐅᔪᑦ

CanZinco Ltd.
March 2004

ᓄᓇᓕᐅᓂᖓᓂᒃ ᓇᓗᓇᐃᕐᓯᓂᖅ

ᓇᓂᓯᕕᒃ ᐅᔭᕐᓯᐅᖅᕕᒃ ᕿᑭᕐᑕᓗᒃᒥᑦᑐᖅ. ᓄᓇᐅᑦ ᐃᓗᐊᓂᑦ ᓴᕕᒃᓴᓂᒃ ᑯᓯᖅᓯᐊᒃᓴᓂᒃᓗ ᐅᔭᕐᑕᖅᕕᐅᔪᖅ ᐱᕐᑯᑎᒋᔭᐅᓪᓗᓂᓗ ᑲᓐᓯᓐᑯ-ᑯᓐᓂᒃ ᐅᔭᕐᓯᐅᕐᑎᑦ ᐊᒻᒪ ᑕᐃᒪᖓᑦ ᐱᒋᐊᕐᒥ ᐅᔭᕐᓯᐅᖅᑭᓐᓇᕐᓗᑎᒃ 1976-ᒥᑦ. ᓇᓂᓯᕕᒃ ᐅᔭᕐᓯᐅᕐᕕᒃ ᐅᔭᕐᑕᕆᓐᓂᓕᐅᕐᑐᖅ ᓴᕕᒃᓴᓂᒃ ᑯᓯᖅᓯᐊᒃᓴᓂᒃᓗ ᓯᑎᐱᕆ 2002-ᒥ ᐊᒻᒪ ᒫᓐᓇ ᒪᑐᕕᒃᓯᒪᓕᕐᓗᓂ. ᐱᕕᒃᔪᐊᖑᓚᖑᔪᖅ ᐊᕙᑎᖓ ᐅᑎᖅᑎᑕᐅᓗᓂ ᐊᑦᑕᕐᓇᖏᑦᑐᒥᒃ ᐃᓄᕐᑯᓪᓗᒋᑦ ᓄᓇᕗᒥᐅᑦ ᐊᒻᒪ ᓄᓇᖓ ᐊᕙᑎᖓ ᐃᓂᒋᔭᐅᔪᓐᓇᕐᓗᓂ ᐃᓄᖃᕐᕕᐅᔪᓐᓇᕐᓗᓂ ᐃᓄᖏᓐᓄᑦ ᓄᓇᖃᕐᑎᐅᔪᓄᑦ. Hᐊᒪᓚᒃᑯᑦ ᐃᒃᐱᐊᕐᔪᒃᒥ ᐃᓚᐅᖃᑕᐅᓂᐊᓚᓇᒃᓂᐊᕐᒪᑕ ᐅᔭᕐᓯᐅᕕᒃ ᒪᑐᔪᐅᓂᖓᓄᑦ ᐸᕐᓇᐅᑎᖏᓐᓄᑦ. ᑲᓐᓯᓐᑯ-ᑯᑦ ᐊᖏᕐᓯᒪᓪᓚᓇᒃᑐᑦ ᐃᓚᐅᖃᑕᐅᕐᑯᔨᓪᓚᓇᒃᓗᑎᒃ ᕿᒥᕈᔭᐅᓂᖏᓐᓄᑦ ᐸᕐᓇᐅᑎᐅᔪᑦ ᑎᒍᒥᐊᕐᑎᐅᔪᓪᓗ ᕿᒥᕈᖃᑕᐅᑦᑎᐊᕐᓗᑎᒃ ᐊᖏᕐᑕᐅᓂᐊᕐᓗᓂ ᓄᓇᕗᒥ ᐃᒥᓕᓇᐹᒃᑯᑦ ᑲᑎᒪᔩᖏᓐᓄᑦ, ᒐᕙᒪᑐᖃᒃᑯᓐᓄᓪᓗ ᐊᒻᒪ ᒐᕙᒪᒃᑯᑦ ᓄᓇᕗᒥ.

ᑕᒪᕐᒥᒃ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᑦ ᓴᓗᒪᕐᓴᐃᓕᕐᐸᑕ ᑎᑎᕋᕐᓯᒪᔪᑦ ᑕᕝᕙᓂ. ᓇᐃᒃᑎᕆᐊᕐᓯᒪᓪᓗᓂ ᑎᑎᕋᕐᑕᐅᔪᖅ ᓴᓗᒪᕐᓴᐃᓂᖓ ᖃᓄᐃᓕᖓᖕᒪᖔᑦ ᐅᑯᐊᖑᔪᑦ ᐊᑕᓂᑦᑐᑦ.

1. ᑕᒪᕐᒥᒃ ᓄᓇᐅᑦ ᐃᓗᐊᓂ ᐅᔭᕐᓯᐅᕈᑎᑦ ᐊᒻᒪ ᓄᓇᓯᐅᑎᕈᔪᐃᑦ ᐊᐅᓚᐅᑎᕈᔪᐃᑦ ᐊᐅᓪᓚᕐᑎᑕᐅᓗᑎᒃᓗᓐᓂᑦ ᐅᒥᐊᕐᔪᐊᒃᑯᑦ ᐅᕙᓗᓐᓂᑦ ᓄᓇᐅᑦ ᐃᓗᐊᓄᐊᖅᖃᕐᑕᐅᓗᑎᒃ. ᖁᐊᖑᐃᓐᓇᕐᓂᖓ ᓄᓇᐅᑦ ᐊᑦᑕᕐᓇᖏᑦᑐᒥᓪᓗᑎᒃ ᐃᓚᐅᖃᑕᐅᓂᐊᕐᑐᑦ ᐊᑐᕐᑕᐅᔭᐊᖏᑦᑐᖅ ᖁᔭᓇᕐᑕᐅᔪᑦ ᐱᕐᑯᑎᑦ. ᑕᒪᕐᒥᒃ ᐳᓚᑖᕐᕕᐅᑦ ᐸᖏᑦ ᒪᑐᔪᐅᓂᐊᕐᑐᑦ ᓯᒥᒃᑕᐅᕕᒃᓗᑎᒃ.

2. ᑲᓐᓯᓐᑯ-ᑯᑦ ᑲᑎᑦᑎᓯᒪᔪᑦ ᖃᐅᔨᓇᓱᒃᓯᒪᓪᓗᑎᒃᓗ ᖃᓄᐃᔪᑕᐅᔪᓐᓇᕐᓂᖏᓐᓂᒃ ᐅᔭᕐᓯᐅᖅᑕᐅᔪᑦ ᐊᕙᑎᑦᑎᓐᓄᑦ ᐊᒻᒪ ᖃᐅᔨᓇᓱᒃᑦᑕᐃᓐᓇᓕᒐᓪᓗᑎᒃ. ᒪᓐᓇᒎᑦ ᖃᐅᔨᓯᒪᔭᖏᑦ ᓇᓗᓇᐃᕐᓯᓯᒪᔪᑦ ᓇᒥᓚᖕᒪᖔᑦ ᓴᕕᒃᓴᕈᔪᐃᑦ ᐅᕐᓯᐊᓗᕈᔪᐃᓪᓗ ᓴᓗᒪᕐᑕᐅᔭᕆᐊᓕᑦ ᓄᓇᒥᑦᑐᑦ. ᑲᓐᓯᓐᑯ-ᑯᑦ ᑐᐊᕙᖓᓂᒃ ᐱᔭᐃᓗᑎᒃ ᓄᓇᐅᑦ ᐃᓗᐊᓄᐊᖅᐃᔪᒪᔪᑦ ᐃᓗᐊᓂᓗ ᖁᐊᖑᐃᓐᓇᕐᑐᒥᓗᓂ ᐊᑦᑕᕐᓇᔾᔭᐊᖏᒪᑦ ᐊᕙᑎᑦᑎᓐᓄᑦ.

3. ᐅᔭᕐᓯᐅᕐᑎᓪᓗᒋᑦ ᑯᕕᔪᐅᖅᑦᑕᕐᓯᒪᕗᖅ ᐃᒥᖅᓗᑯ ᑯᕕᔪᐅᕋᓪᓕᐊᓯᒪᕗᖅ ᑕᓯᓕᐊᕆᓯᒪᕗᒍᑦ. ᒪᑭᓪᓗᑎᒃ ᑯᕕᕝᕕᐅᖅᑦᑕᕐᓯᒪᕗᒃ. ᐱᖅᑕ ᐃᒥᖅᒍᑦ ᑯᕕᔪᐅᓪᓗᓂ ᐱᖅᑕ ᓄᓇᒍᑦ ᑯᕕᔪᐅᓪᓗᓂ. ᐃᒥᖅᒥᒃ ᖃᐅᔨᓴᕐᓗᑎᒃ ᑐᑭᓯᓚᐅᕐᑐᑦ ᐃᒥᐅᑦ ᐃᒥᑦᑎᐊᕙᐅᓂᖓᓂᒃ ᖃᐅᔨᓴᐅᑎᑦ ᑎᑎᕋᕐᑕᐅᓯᒪᕗᖅ ᒪᓕᒃᑕᐅᓂᖓᓂᒃ ᓄᓇᕗᒥ ᐃᒥᓕᓇᐹᒃᑯᑦ ᑲᑎᒪᔩᑦ ᐊᕐᑭᒃᓯᒪᔭᖓᓂᒃ.

4. ᑯᕕᔪᐅᓂᑯᐃᑦ ᐃᒥᖅᒍᑦ ᐃᒪᓂᖏᓐᓇᕐᓂᐊᕐᑐᑦ ᐊᒻᒪ ᓄᓇᒍᑦ ᑯᕕᔪᐅᓂᑯᐃᑦ ᓴᐅᔭᐅᓂᐊᕐᓗᑎᒃ 4-ᓂᒃ ᐃᓯᒐᓂᒃ ᐃᔪᑎᕆᔪᒥᒃ (1.25-ᒥᑕ) ᑐᐊᕙᒃᒥᒃ ᕿᕐᓂᕐᑕᒥᒃ ᐊᒻᒪ ᖃᒃᑲᓐᓂᐊᒍᑦ ᑐᐊᕙᑐᐃᓐᓇᕐᒥᒃ. ᑐᐊᕙᒃᑲᓐᓂᕐ ᐅᕐᕐᑯᓯᕙᓪᓕᐊᓂᖓ ᐃᓱᒪᒋᔭᐅᓪᓗᓂ ᐱᖅᓯᐅᑎᓯᒪᕗᖅ.

5. ᑐᓚᒃᑕᕐᕕᒃ ᐱᕐᑯᑎᒋᔭᐅᒃᒪᑦ ᐃᒪᕐᒥᐅᑕᓕᕆᔨᒃᑯᓐᓄᑦ. ᒐᕙᒪᑐᖃᒃᑯᑦ ᐱᔪᒪᒍᑎᒃ ᐊᑐᕐᑕᐅᖏᓐᓇᕐᓗᓂ ᐅᕐᓴᒃᓴᐃᕕᐅᓗᓂ. ᐅᕐᓱᖃᐅᑎᓪᓗ ᐊᑲᐅᓇᕐᔪᕐᒪᑕ ᑕᐃᒪᐃᑐᒪᒍᑎᒃ ᑭᓯᐊᓂ ᐊᕐᑭᒃᓯᔪᖃᓚᐅᖅᑐᖅ ᓱᓕ.

6. ᐊᖅᑯᑎᑦ ᒥᑦᑕᕐᕕᓕᐊᖓᔪᖅᑐ ᑐᓚᒃᑕᕐᕕᒃᒧᐊᖓᔪᖅᑐ ᐃᒃᐱᐊᕐᔪᒃᒧᑦ ᓇᓂᓯᕕᒃᒧᓪᓗ ᑕᓯᓕᐊᕆᓯᒪᔪᒧᑦᑐ ᐱᕐᑯᑎᒋᔭᐅᒃᒪᑦ ᓄᓇᕗᑦᒥ ᒐᕙᒪᒃᑯᓐᓄᑦ ᑕᐃᒪᐃᓂᖓᓄᑦ ᐃᓚᒋᔭᐅᖃᑕᐅᖏᑦᑐᑦ ᓇᓂᓯᕕᐅᑦ ᒪᑐᔭᐅᓂᖓᓄᑦ ᐸᕐᓇᐅᑎᒧᑦ. ᐊᑐᕐᑕᐅᓂᐊᕐᓂᖓ ᓯᕗᓂᒃᓴᑦᑎᓐᓂ ᐊᐅᓚᑕᐅᖏᑦᑐᖅ ᑲᓐᔨᓐᑯ-ᑯᓐᓂᑦ.

7. ᒪᑐᓯᒪᓕᕐᑎᓪᓗᒍ ᐊᔾᔨᕐᕆᖏᑦᑐᑦ ᐃᓱᒪᒋᔭᐅᓯᒪᔪᕕᒧᐊᑦ ᐊᑐᕐᑕᐅᔪᓐᓇᕐᑐᑦ ᐃᒃᓗᐃᓪᓗ ᐊᓯᖏᓪᓗ ᐱᕐᑯᑎᖏᑦ. ᒪᓐᓇᒧᑦ ᑎᑭᓪᓗᓂ ᓴᕐᕿᑐᖃᕐᓯᒪᖏᑦᑐᖅ ᐱᔪᒪᔪᑕᐅᔪᓂᒃ ᐊᖏᕐᑕᐅᓯᒪᔪᓂᒃ ᒐᕙᒪᒃᑯᓐᓄᑦ ᓄᓇᕗᑦᒥ ᐊᓯᖏᓐᓄᓪᓗ ᐱᔪᒪᓯᒪᔪᓄᑦ, ᑕᐃᒪᐃᓐᓂᖓᓄᑦ ᑲᓐᔨᓐᑯ-ᑯᑦ ᐱᖁᔭᑎᒍᑦ ᐱᔭᕆᐊᖅᑯᒥ ᕐᐱᔭᐃᓂᐊᕐᑐᑦ ᐃᒃᓗᓂᒃ ᑕᒪᕐᒥᒃ ᐃᒃᓗᐃᑦ ᕐᐱᔭᕐᑕᐅᓂᐊᕐᑐᑦ ᑭᓯᐊᓂ ᒐᕙᒪᒃᑯᑦ ᓄᓇᕗᑦᒥ ᐃᒃᓗᕐᑯᑎᖏᑦ ᐱᔭᕐᑕᐅᔭᐊᖏᑦᑐᑦ. ᐱᕆᐊᕐᓂᐊᕐᑐᑦ 2004-ᒥ.

8. ᓄᓇᓯᐅᑎᕈᔪᐃᑦ, ᓴᓇᕈᑎᕈᔪᐃᑦ ᐊᓯᖏᓪᓗ ᐊᑐᕈᓐᓇᕐᑐᑦ ᑕᐃᑲᓂᑦᑐᓐᓂᕐᓂᐊᕐᑐᑦ.

ᑲᓐᔨᓐᑯ-ᑯᑦ ᖃᐅᔨᓴᕐᓂᐊᕐᑐᑦ ᐊᕐᕿᒍᓄᑦ 7-ᓄᑦ ᐊᕙᑎᖓ ᖃᓄᐃᓕᕙᓪᓕᐊᖏᒃᑲᓗᐊᕐᒪᖔᑦ ᖃᐅᔨᓴᖃᑦᑕᕐᓗᑎᒃ. ᑲᓐᔨᓐᑯ-ᑯᓪᓗ ᖃᐅᔨᒪᑎᑦᑎᖃᑦᑕᕐᓂᐊᕐᑐᑦ Hᐊᒪᓚᒃᑯᓐᓂᒃ ᐃᒃᐱᐊᕐᔪᒃᒥ ᖃᐅᔨᓴᕐᓂᕐᒥᓂᒃ ᑎᑎᕋᕐᓯᒪᔪᓂᒃ. ᐊᕐᕿᒍ 7 ᐊᓂᒍᕐᐸᑕ ᖃᐅᔨᓴᖑᔪᑦ ᕿᒥᕈᔭᐅᓂᐊᕐᑐᑦ ᑕᐃᑲᓂ ᐊᕐᑭᒃᓯᓂᐊᕐᑐᑦ ᖃᐅᔨᓴᐃᓐᓇᕈᐊᕐᒪᖔᑦ. ᑲᓐᔨᒃᑯᑦ ᖃᓄᐃᖏᓐᓂᐊᕐᓯᒋᓐᓇᔪᑦ ᓄᓇᖓᓂᒃ ᐊᒻᒪᓗ ᓄᓇᕐᑯᑎᖓ ᐅᑎᕐᑎᑕᐅᓗᓂ ᒐᕙᒪᒃᑯᓐᓄᑦ.

ᑲᓐᔨᓐᑯ-ᑯᑦ ᖃᐅᔨᒪᖃᑎᕐᒋᒃᓂᐊᕐᑐᑦ Hᐊᒪᓚᒃᑯᑦ ᐃᒃᐱᐊᕐᔪᒃᒥ ᐊᒻᒪᓗ ᒐᕙᒪᒃᑯᑦ ᓄᓇᕗᑦᒥ ᐃᖃᓇᐃᔭᕐᑎᑦᑎᓇᓱᒃᓗᑎᒃ ᐃᒃᐱᐊᕐᔪᒃᒥᐅᓂᒃ ᓴᓗᒻᒪᖅᓴᐃᓕᕐᐸᑕ. ᐃᓚᖓᑦ ᐃᒃᐱᐊᕐᔪᒃᒥᐅᑦ ᖃᐅᔨᒪᒃᒪᑕ ᐅᔭᖅᓯᐅᕝᕕᒃᒥᓗ ᐃᖃᓇᐃᔭᖅᑕᑦᑕᕐᓯᒪᓪᓗᑎᒃ ᐃᑲᔪᕈᓐᓇᕐᑐᒃᓴᐅᕆᓪᓗᑎᒃᓗ ᐃᖃᓇᐃᔭᖅᑕᐅᓗᑎᒃ ᐱᔪᒪᒍᑎᒃ. ᐱᕕᖅᑐᐃᓐᓇᕆᐊᓕᑦ ᐅᓄᕐᑎᑦᑐᓚᐅᓗᐊᓂᒃ ᐃᓕᓐᓂᐊᕈᒪᔪᑦ ᐊᒻᒪᓗ ᑲᓐᔨᓐᑯ-ᑯᑦ ᐃᑲᔪᕐᓯᒃᓂᐊᕆᓇᕗᑦ ᐱᓕᕆᖅᑎᖅᑲᕐᓗᑎᒃ Hᐊᒪᓚᒃᑯᓐᓂᒃ ᐃᒃᐱᐊᕐᔪᒃᒥ ᐊᒻᒪ ᒐᕙᒪᒃᑯᓐᓂᒃ ᓄᓇᕗᑦᒥ.

ᐃᒃᐱᐊᕐᒧᒃᒥᐅᑕᕐᒥᒃ ᐃᖃᓇᐃᔭᕐᑐᖃᕐᓴᕐᒥᔪᖅ ᒐᕙᒪᒃᑯᓐᓂᑦ ᐃᖃᓇᐃᔭᕐᑎᑕᐅᓗᓂ ᑐᓴᐅᒪᑎᑦᑎᔨᐅᔪᒥᒃ. ᑐᓴᐅᒪᑎᑦᑎᔨ ᖃᐅᔨᒪᑎᑦᑎᕙᓪᓕᐊᓗᓂ ᒐᕙᒪᒃᑯᓐᓂᒃ ᑲᓐᔨᒃᑯᓐᓂᒃᓗ ᐃᖃᓇᐃᔭᒃᓴᕐᑕᖃᓕᕐᖓᑦ, ᐃᓕᓐᓂᐊᕐᑐᖃᕐᓂᐊᕐᖓᑦ ᐅᕙᓗᓂᑦ ᐊᑭᑦᑐᕐᑐᑎᔪᖃᕐᓂᐊᕐᖓ ᓂᐅᕕᐊᒃᓴᐅᔪᓂᒃ.

ᐅᖃᐅᓯᒃᓴᓪᓚᖏᒃᓂᖓᖅᑐᑦ ᓇᐃᒃᓕᒋᐊᖅᓯᒪᔪᑦ

ᓇᓂᓯᕕᒃ ᐅᔭᕐᓂᐊᕐᕕᒃ ᐱᒋᔭᐅᔪᖅ ᑳᓐᐹᓐᑯ-ᑯᓐᓂᒃ ᐱᖁᑎᒋᔭᐅᒥᓪᓗᑎᒃᓗ ᐸᓚᐃᒡᔫᐊᑐᒃᑯᓐᓂᒃ. ᑕᒪᕐᒥᒃ ᑳᐹᒃ-ᑯᒃ ᐱᖁᑎᖃᑎᖏᓪᓗ ᐸᓚᐃᒡᔫᐊᑐ-ᑯᑦ ᐱᖁᑎᖃᖅᓯᒪᑕ ᐊᐅᓚᑦᑎᓪᓗᑎᒃᓗ ᐊᓯᖏᓐᓂᒃ ᐅᔭᕐᓂᐊᕐᕕᒃᓂᒃ ᑲᓇᑕᒥ ᐊᒻᒪᓗ ᓄᓇᕐᔪᐊᒥᓗᓪᓚᒃᑐᑦ. ᑳᓐᐹᒃ-ᑯᑦ ᐱᖁᑎᖃᖅᓯᒪᓕᖅᑐᑦ ᑕᐃᒪᙵᑦ 1996-ᒥᑦ.

ᐅᔭᕐᓂᐊᕐᕕᐅᔪᖅ ᑲᓇᑕᐅᑦ ᐅᑭᐅᖅᑕᖅᑐᖓᓂ ᖁᑭᖅᑕᓗᒃᒥ. ᐅᔭᕐᑕᖅᕕᐅᔪᖅ ᐊᖏᖅᑐᑦ ᑲᖏᕐᓗᐊᑕ ᐃᓗᐊᓂᑦᑐᖅ ᓄᓇᕘᑉ ᐊᑎᖓᑦ 73-ᒥᑦᑐᖅ. ᐊᕙᑎᖓ ᐅᑭᐅᖅᑕᖅᑐᒥᑦᑐᑎᑐᑦ ᓂᒃᓚᔾᔪᒥᑦᓗᓂ, ᒪᓴᐅᓗᐊᖕᒋᓪᓗᓂ, ᖁᐊᖑᐃᓐᓇᕐᓂᖅᓗᓂ ᐊᒻᒪᓗ ᐊᖏᓂᕐᓴᐅᔪᖅ ᐱᕈᖅᑐᖃᒧᓂ ᓄᓇᑐᐃᓐᓇᐅᔪᖅ ᐅᔭᕐᖃᐅᕐᓗᓂ, ᑕᒫᓇ ᖃᓂᒋᔭᖓ ᐅᔭᕐᑕᕐᕕᐅᔪᑦ ᐱᕈᖅᑐᖃᖏᓗᐊᕐᓂᖓᓄᑦ ᐅᒪᔪᖃᑎᐊᖏᑦᑐᖅ.

ᐃᓄᐃᑦ ᓄᓇᖃᖅᑐᑦ Hᐊᒪᓚᒃᑯᑦ ᐃᒃᐱᐊᕐᔪᒃᒥ, ᐃᓄᒋᐊᒃᓂᖃᖅᑐᖅ 700-ᓂᒃ, ᐅᖓᓯᒃᓂᖃᖅᑐᖅ 25-ᑭᓚᒥᑕ-ᒥᒃ ᐊᖅᑯᑎᒃᑯᑦ ᓇᓂᓯᕕᒃᑯᑦ. ᑎᑭᑦᑐᖃᒃᑕᖅᑐᖅ ᐅᔭᕐᓯᐅᕐᕕᒃ ᐊᒻᒪᓗ ᐃᒃᐱᐊᕐᔪᒃ ᐅᑯᖃᖅᓗᓂ ᑎᑭᖃᒃᑕᖅᑐᖅ ᓱᐳᖅᑐᑦ ᖃᖓᑕᓲᖅ ᐃᖃᓗᒃᓂᑦ. ᐱᖁᑎᑦ ᐅᓯᒃᑕᖅᑕᐅᓱᑦ ᐅᒥᐊᕐᔪᐊᒃᑯᑦ ᐅᒥᐊᕐᔪᐊᖃᓴᐅᓂᖓᓂ ᐱᓇᓱᐊᕈᓯᑦ 14 ᐃᓗᐊᓂ ᐃᒪᐅᓕᕐᖓᑦ.

ᓇᓂᓯᕕᒃ ᐅᔭᕐᑕᓯᒋᐊᓚᐅᖅᑐᖅ 1976-ᒥ ᐊᒻᒪᓗ ᑕᒪᖓᑦ ᐅᔭᕐᑕᐃᓐᓇᖅᑐᓂ ᑎᑭᓪᓗᒍ ᓯᑎᐱᕆ 2002, ᑕ%ᕙᓂᓗ ᐅᓗᖕᓂ ᒪᑐᐃᓕᓚᐅᕆᓪᓗᓂ ᐱᔪᑎᕆᓪᓗᒍ ᐅᔭᕐᑕᖅᑕᐅᔪᓐᓇᖅᑐᑦ ᓴᕕᒃᓴᐃᑦ ᒥᑭᓗᐊᓕᖅᒪᑕ ᑭᓇᐅᔭᒃᓴᐅᑎᒋᓇᓱᒋᐊᖕᒐᓂᒃ. ᓴᕕᒃᓴᐅᓂᖓ ᐅᔭᕐᑕᖅᑕᐅᓚᐅᖅᑐᖅ ᓄᓇᐅᑦ ᐃᓗᐊᓂᑦ ᐸᓚᖅᑕᖅᑐᑎᒃ ᐊᒻᒪᓗ ᓯᖃᓕᔭᐅᓪᓗᓂ ᓴ=ᕿᔭᒃᓴᖅ ᐊᒻᒪᓗ ᑯᓯᕐᓯᐊᒃᓴᖅ ᓯᖃᓕᖑᕐᑎᑕᐅᓪᓗᓂ. ᓯᖃᓪᓕᕐᑎᕕᒃ ᓴᓗᒻᒪᖅᓴᐃᕕᒃ ᐅᕿᖕᒋᓐᓂᖃᖅᑐᒥᒃ 2,200 ᑕᓐᓴ-ᒥᒃ ᐅᓗᕐᒧᑦ ᓯᖃᓕᑎᑎᒃᑕᓚᐅᖅᑐᖅ. ᐃᖃᓇᐃᔭᖅᑎᐅᒧ}ᔪᑦ ᑕ%ᕙᓂ ᐃᓂᖃᕐᓗᑎᒃ ᓄᓇᓕᖕᒍᓂ, ᓴᓇᔭᐅᓂᑰᓗᓂ ᐅᔭᕐᓯᐅᕐᕕᐅᑦ ᐃᒃᓗᖁᑎᖏᓐᓄᑦ ᓴᓇᔭᐅᓕᖅᑎᓪᓗᒋᑦ. ᓄᓇᓕᖓᑕ ᐱᖁᑎᔭᖏᑦ ᐅᑯᐊᖑᔪᑦ ᑐᒃᓯᐊᖅᕕᒃ,ᑎᑎᕋᒃᑯᕕᒃ, ᐃᓕᓐᓂᐊᖅᕕᒃ,ᐱᖑᐊᖅᕕᒃ,ᓂᕆᔭᖅᑐᖅᕕᒃ, ᐊᖏᕋᕆᔭᐅᔪᓪᓗ. ᐅᔭᕐᓯᐅᕐᕕᒃ ᐃᖃᓇᐃᔭᖅᑎᖃᒃᑕᓚᐅᖅᑐᖅ 171-ᓂᒃ ᐊᐅᓚᑎᓪᓗᒍ ᒪᑐᓂᖓᓄᑦ ᑎᑭᓪᓗᓂ, ᐃᖃᓇᐃᔭᖅᑎᖃᓕᖅᑐᖅ ᐅᓄᖏᑦᑐᓂᒃ 4-ᒥᑦ 8-ᒧᑦ ᐃᓄᒋᐊᒃᑎᒋᔪᑦ ᐱᖁᑎᒋᔭᐅᒧᑦ ᑲᒪᒋᔭᐅᑎᐊᕐᓱᒃᓗᑎᒃ ᐊᒻᒪᓗ ᐊᕙᑎᖓᓂᒃ ᖃᐅᔨᓴᖅᐸᓪᓕᐊᓪᓗᑎᒃᓗ ᐱᔭᓐᓇᐅᑎᖓᓂ ᐃᒥᖅᒧᑦ ᐱᔭᕇᖅᑎᑕᐅᓂᖓ ᒪᓕᒃᓗᒍ.

ᐱᒋᐊᕐᓕᖅᑎᓪᓗᒍ ᐃᓚᖓ ᐊᑭᓕᖅᓱᖅᑕᐅᓚᐅᖅᑐᖅ ᒐᕙᒪᒃᑯᓐᓄᑦ ᓄᓇᖁᓯᐊᕐᒥ (ᒐᕙᒪᐅᓚᐅᖅᑐᑦ) ᐃᓚᖏᓪᓗ ᐃᒃᓗᐃᑦ ᐱᖁᑎᒋᔭᐅᓪᓗᑎᒃ ᒐᕙᒪᒃᑯᑦ ᓄᓇᕗᒥ (ᓄᓇᕗᒥ ᒐᕙᒪᐃᑦ). ᑕᒃᑯᐊ ᐱᖁᑎᒋᔭᖏᑦ ᐅᑯᐊᖑᔪᑦ ᐃᓚᖏᑦ, ᑐᒃᓯᐊᕐᕕᒃ, ᐃᒪᖃᐅᑎᒃᑯᕕᖓᑦ,ᑯᕕᖅᑕᕐᕕᒃᑯᕕᖓᑦ,ᐃᒃᓗᐃᑦ, ᐊᖅᑯᑎ ᑐᓚᒃᑕᕐᕕᒻᒥᑦ ᒥᑦᑕᕐᕕᒃᒧᑦ ᐃᒃᐱᐊᕐᔪᒃᒧᓪᓗ ᐊᓯᖏᓪᓗ ᐱᖁᑎᔭᖏᑦ. ᓴᓗᒻᒪᖅᓴᖅᑕᐅᓂᖏᑦ ᒐᕙᒪᒃᑯᑦ ᐱᖁᑎᖏᑦ ᑲᒪᒋᔭᐅᓂᐊᖅᑐᖅ ᒐᕙᒪᒃᑯᓐᓄᑦ ᓄᓇᕗᒥ.

ᑐᓚᒃᑕᕐᕕᒃ ᐱᖁᑎᖏᔭᐅᒃᒪᑦ ᐃᒪᖅᒥᐅᑕᓕᓐᓈᒃᑯᓐᓄᑦ. ᓴᓗᒻᒪᖅᓴᖅᑕᐅᓂᖓ ᑲᒪᒋᔭᐅᓂᐊᖅᑐᖅ ᒐᕙᒪᑐᖃᒃᑯᓐᓄᑦ.

ᒐᕙᒪᒃᑯᑦ ᓄᓴᕗᒥ ᐊᒻᒪᓗ Hᐊᒪᓚᒃᑯᑦ ᐃᒃᐱᐊᕐᔪᒃᒥ ᐃᓄᒃᓂᒃ ᑐᓴᐅᒪᑎᑦᑎᔪᑦ ᐱᖁᔭᓕᕆᒃᑲᓗᐊᕐᓗᑎᒃᓗ ᐊᑐᕐᑕᐅᖕᒋᓐᓴᖁᔭᓪᓗᑎᒃ ᐱᖁᑎᖕᒋᓐᓂᒃ ᐃᒃᓗᖁᑎᖕᒋᓐᓂᒃᓗ ᓴᓇᕕᕈᔭᐃᓪᓗ. ᕙᓐᒧᑦ ᑎᑭᓪᓗᒍ ᒐᕙᒪᒃᑯᑦ ᓄᓇᕗᒥ ᒪᑭᒃᓂᒃ ᐱᒋᐊᕐᑎᑦᑎᓯᒪᓕᖅᑐᑦ ᐱᖃᑕ ᖃᐅᔨᓴᕐᑎᑦᑎᓗᑎᒃ ᐃᓄᓯᖕᒋᓐᓄᑦ ᐊᒻᒪᓗ ᑭᓇᐅᔭᒃᓴᕐᓂᖕᒋᓐᓄᑦ ᖃᓄᐃᓕᐅᕙᓪᓕᕐᓯᒪᒃᒪᖓᑦ ᒪᑐᔭᐅᓂᖓ ᓇᓂᓯᕕᒃ ᐊᒻᒪᓗ ᐱᖃᑕ ᓇᓗᓇᐃᕐᓯᒪᒋᐊᕐᓗᑎᒃ ᖃᐅᔨᒪᐊᕐᓗᑎᒃᓗ ᐊᑐᕐᑕᐅᒃᑲᓂᕈᓐᓇ ᑲᓄᐃᓕᖓᓚᖓᔪᕐᒪᖓᑦ ᐊᑐᕐᑕᐅᒃᑲᓂᕈᓐᓇ. ᑳᓐᐹᒃ-ᑯᑦ ᐃᑲᔪᖅᑐᐃᑎᐊᕐᑐᑦ ᐊᑐᕐᑕᐅᒃᑲᓂᕈᓐᓇᕈᒪᓂᖓᓂᒃ ᖃᓄᖅᑐᖃᑎᒃᑲᓯᒪᓪᓗᑎᒃᓗ ᐊᔭᖃᑎᖃᕐᓯᐅᑉᐸᓪᓕᐊᓪᓗᑎᒃᓗ ᒪᓐᓇᒧᑦ ᐱᑕᖃᔭᐅᕙᓪᓕᐊᔭᓐᓇᕐᒪᖔᑕ ᐱᖁᑎᔭᖏᑦ. ᑕᒪᐃᒃᑲᓗᐊᕐᑎᓪᓗᒍ, ᑳᓐᐹᒃ-ᑯᑦ ᑲᔪᓯᔭᓇᐊᖃᕐᒪᑕ ᓴᓗᒻᒪᖅᓴᐃᓗᑎᒃ ᐊᑭᑭᓪᓚᒃᑯᖕᒐᔾᔪᒃᑯᑦ ᐃᓗᓕᖕᒋᓪᓗ ᓇᓗᓇᐃᕐᓯᒪᓕᖅᑎᐊᕐᓗᑎᒃ ᖃᓄᐃᓕᐅᕐᕿᔭᕐᒪᖔᑕ ᐸᕐᓇᐅᑎᒋᔭᖏᓐᓂ ᐊᔭᖃᑎᖃᐃᓐᓇᕈᓐᓇᓂᐊᕐᒪᑕ ᐊᖏᖃᑎᒋᓚᐅᖏᓐᓇᕐᒥᓂᒃ ᐊᖏᖃᑎᒋᑦᑎᐊᕈᑎᒃ ᑭᓯᐊᓂ.

ᑲᓐᔾᑯᒃ%ᑯᑦ ᖁᕕᐊᓱᒃᑐᑦ ᐃᒃᓗᒃᔪᐊᖅ ᓴᓇᕕᒃ ᓂᐅᕕᐊᕆᔭᐅᔪᓐᓇᕐᓂᖅᓯᓂᒃ ᐅᔭᕋᒃᓯᐅᕐᑎᓄᑦ ᐊᑎᖃᕐᑐᑦ ᑝᓪ%ᑎᓐ-ᒥᒃ. ᐱᔭᐃᔪᒪᔪᑦ ᓄᑎᒃᑎᕐᓗᑎᒃᓗ ᕿᑎᕐᒥᐅᓄᑦ ᐅᔭᕋᒃᓂᐊᖐᐅᔪᒧᑦ. ᓂᐅᕕᐊᖑᓂᖅ ᐃᑲᔪᑎᒃᒪᑦ ᓄᓇᕗᑦᒥᐅᓄᑦ ᐊᑐᑎᖃᕐᑐᒥᒃ ᐱᖁᑎᕐᔪᐊᒥᒃ ᐊᑐᕐᑕᐅᓂᐊᕐᓗᓂᓗ ᐅᑭᐅᕐᑕᕐᑐᒥᐅᓄᑦ. ᑲᒪᒋᔭᐅᓂᖅ ᓴᓗᒪᖕᓴᕐᑕᐅᓂᖅᓗ ᑐᐊᐸᖅ ᓱᕈᕐᓇᕐᑐᖃᕐᑐᖅ ᑲᒪᒋᔭᐅᓂᐊᕐᑐᖅ ᓇᓂᓯᕕᒃᑯᓐᓄᑦ, ᐱᖁᑎᖃᕐᑎᐅᓂᖕᒋᓐᓄᑦ ᐱᔪᓐᓇᐅᑎᖃᕐᓂᖕᒋᓐᓄᓪᓗ.

ᑖᓐᓇ ᐅᓂᑲᓪᓚᐊᕆᓯᒪᔪᖅ ᐊᑎᖃᕐᑐᖅ *ᓇᓂᓯᕕᒃᒥ 2004-ᒥ ᓴᓗᒻᒪᖕᓴᕐᑕᐅᓂᖅ ᐊᒻᒪᓗ ᒪᑐᔭᐅᓂᖅᓗᓄᑦ ᐸᕐᓇᐅᑎ,* ᑲᑎᑦᑎᓯᒪᔪᑦ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓯᒪᔪᓂᒃ ᐊᕙᑎᓕᕆᔪᓂᒃ, ᐃᓗᓕᖕᒋᓐᓂᒃ ᖃᐅᔨᓴᕐᓗᑎᒃ, ᐃᓗᓕᖕᒋᓐᓂᒃᓗ ᑲᑎᒪᐅᑎᖃᕐᓗᑎᒃ ᐊᒻᒪᓗ ᐊᖏᕐᑕᐅᓇᓱᒃᑎᓪᓗᒋᑦ ᐅᖃᐅᓯᐅᖃᑦᑕᕐᓯᒪᔪᑦ ᐱᒋᐊᕐᓗᓂ ᕕᕗᐊᓇ 2002-ᒥᑦ ᐸᕐᓇᐅᑎᑦ ᓯᕗᓪᓕᕐᐸᑦ ᓴᕿᑕᐅᓴᕐᑎᓪᓗᒋᑦ. ᑕᐃᒪᖓᓪᓗ ᑲᓐᔾᓐᑯ-ᑯᑦ ᐱᔭᕆᕐᓯᓯᒪᓪᓗᑎᒃ ᐊᖏᕐᑕᐅᓯᒪᓪᓗᑎᒃᓗ ᓄᓇᕗᒥ ᐃᒥᓪᓕᕆᔾᔪᑎᓐᓄᑦ ᖃᐅᔨᓴᕈᒪᓪᓗᑎᒃ ᐊᑎᖃᕐᑐᖅ *ᐊᕙᑎᖓᓂᒃ ᖃᐅᔨᓴᕐᓂᖅ* ᐱᒋᐊᕐᑕᐅᓚᐅᕐᓯᒪᔪᖅ ᑲᒪᒋᔭᐅᓪᓗᓂ ᑲᓐᓄᓪᓚᒃᑯᓐᓄᑦ ᐊᒻᒪᓗ ᐱᖃᑕ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᐊᑎᖃᕐᑐᖅ *ᐃᓄᐃᑦ ᑎᒥᖏᓐᓄᑦ ᐅᒪᔪᓄᓪᓗ ᐊᑦᑕᕐᓇᖅᑐᓂᒃ ᖃᐅᔨᓴᕐᓂᖅ* ᐱᒋᐊᕐᑕᐅᓯᒪᔪᖅ ᑲᒪᒋᔭᐅᓪᓗᓂᓗ ᔭᒃᓵ ᑝᐃᑝᑦᑯᓐᓂᑦ.

ᑕᒃᑯᐊ ᐅᓂᑲᓪᓚᐊᕆᓯᒪᔪᑦ ᐃᓗᓕᒃᑲᓐᓂᖏᓐᓂᒃᓗ ᑎᑎᕋᕐᑕᐅᓯᒪᓪᓗᑎᒃ ᓇᓗᓇᐃᑦᑎᐊᕐᓯᒪᓪᓗᑎᒃ ᐃᓗᓕᖏᓐᓂᒃ ᓴᓗᒻᒪᖕᓴᐃᓂᕐᒨᖓᔪᓂᒃ ᐊᒻᒪᓗ ᒪᓕᒃᓯᒪᓪᓗᑎᒃ ᐱᖁᔭᐅᔪᓂᒃ ᒪᓕᖁᔭᐅᔪᓂᒃ ᐃᒥᕐᒧᒃ ᐱᔪᓇᐅᑎᖓᓂ ᐅᖃᕐᓯᒪᔪᑦ. ᑲᑎᒪᔨᑦ ᐊᑐᕈᓐᓇᕐᑐᑦ ᑎᑎᕋᕐᓯᒪᔪᓂᒃ ᖃᐅᔨᓴᕐᑎᑦᑎᑲᓐᓂᕋᓱᒃᑯᑎᒃ ᐃᓗᓕᖏᓐᓂᒃ ᐊᒻᒪᓗ ᑕᒃᑯᐊ ᐸᕐᓇᐅᑎᑦ ᓇᒪᒃᑲᓗᐊᕐᒪᖔᑕ ᕿᒥᕈᔭᐅᓗᑎᒃ. ᐊᖏᕐᑕᐅᓇᓱᒃᓂᐊᕐᑐᑦ ᑲᓐᔾᓐᑯ-ᑯᑦ ᐸᕐᓇᐅᑎᒋᔭᕐᒥᓂᒃ ᐃᒥᓪᓕᕆᔾᔪᑎᓐᓄᑦ ᑲᔪᓯᒋᐊᕐᑎᑕᐅᓂᐊᕐᒪᑕ ᐸᕐᓇᐅᑎᒥᑦᑐᑦ ᐊᕿᑦᑎᐊᕐᓯᒪᔫᒃᑯᑦ ᕿᓪᓕᒥᐅᔫᒃᑯᓪᓗ.

ᖃᓐᔾᓐᑯ-ᑯᑦ ᓴᓗᒪᖕᓴᐃᔪᒪᔪᑦ ᐊᕿᑦᑎᐊᕐᓯᒪᔪᒥᒃ ᒪᓕᒃᓯᒪᔪᒥᒃᓗ ᐊᑐᐊᒐᐅᔪᒥᒃ ᐊᑎᖃᕐᑐᑦ *ᐅᔭᕋᒃᓂᐊᕐᕕᑦ ᓴᓗᒻᒪᖕᓴᕐᑕᐅᓂᖏᓐᓄᑦ ᐊᑐᐊᒐᖅ ᓄᓇᕗᒥ (2002)* ᐊᒻᒪᓗ ᐃᑲᔪᑎᓂᐊᕐᑐᒃᑯᑦ ᓄᓇᕗᑦᒥᐅᓄᑦ. ᑐᕋᒐᓇᔭᐅᔪᖅ ᓴᓗᒪᖕᓴᐃᓂᕐᒧᑦ ᒪᓕᒃᓯᒪᔪᖅ ᐊᑐᐊᒐᐅᔪᒥᒃ ᐅᖃᕐᓯᒪᔪᒥᒃ ᐃᒪᓐᓇ: ᐅᔭᕋᒃᓂᐊᕐᕕᑦ ᐊᕙᑎᑦᑎᓐᓄᑦ ᐃᓅᒃᓄᓪᓗ ᐊᑦᑕᕐᓇᕐᑕᐃᓕᒪᓗᑎᒃ.

ᓴᓗᒪᖕᓴᐃᓂᖓᑦ ᐊᑐᕐᓂᐊᕐᑐᑦ ᐊᕙᑎᖓᓂᑦᑐᓂᑦ ᐅᔭᕋᒃᓂᒃ ᑐᐊᐸᒃᓂᒃᓗ ᐊᑦᑕᕐᓇᖏᓐᓂᕐᓴᐅᕐᑯᓪᓗᒍ ᐊᒻᒪᓗ ᐊᑯᓂᐅᔪᒧᑦ ᒪᑐᓯᒪᐃᓐᓇᕐᓂᐊᕐᒪᑦ. ᓴᓗᒪᖕᓴᐃᔪᑎᕕᓂᑦ ᐃᒥᕐᓗᑯᐃᑦ ᐊᒻᒪᓗ ᓄᓇᐅᑦ ᐃᓗᐊᓂᖓᕐᓂᑯᐃᑦ ᐅᔭᕋᐃᓐᓇᐃᑦ ᓄᓇᐅᑦ ᐃᓗᐊᓄᐊᖅᑕᕐᑕᐅᓂᐊᕐᑐᑦ ᖁᐊᖑᐃᓐᓇᕐᑐᒧᑦ ᐅᑮᓗᓂᑦ ᓴᐅᔭᐅᓗᑎᒃ ᖁᐊᖑᐃᓐᓇᕐᑐᒥᓪᓗᑎᒃ. ᑕᐃᒪᓐᓇᑦᑕᐅᕐ ᐱᔭᐅᓂᐊᕐᒥᖅ ᐊᒃᑖᕕᒃ. ᖁᐊᖑᐃᓐᓇᕐᓂᖅᓗᓄᑦ ᓄᓇᐅᑦ ᖃᖓᓄᐊᖅᑲᑦᑐᐊᖏᒪᑦ ᓱᕈᕐᓇᕐᑐᖃᕐᑐᖅᑦ ᐃᒥᖅ. ᖃᒃᑲᓐᓂᐊᒍᑦ ᖃᓕᕐᓯᓂᖅᑦ ᐃᓱᒪᒋᔭᐅᓪᓗᓂ ᐅᖁᓯᕙᓪᓕᐊᕆᔭᕐᓂᖅ.

ᓴᓗᒪᖕᓴᐃᓂᖅ ᐃᓱᒪᒋᔭᐅᔪᖅ ᐱᔭᕆᕐᔭᕐᓱᕆᔭᐅᓪᓗᓂ ᐊᕐᕌᒍᓄᑦ ᒪᕐᕉᓂ 2004 ᐊᒻᒪ 2005. ᕿᓪᓕᒥᐅᓂᖕᓴᐅᑐᐃᓐᓇᕆᐊᓕᑦ, ᐊᒻᒪᓗ ᕿᓪᓕᒥᐅᓂᖕᓴᒃᑯᕋᓱᒃᓂᐊᕐᑐᑦ ᐊᔪᕐᓇᖏᒃᑲᖓᑦ. ᐊᑐᓂᖓᔪᑦ ᑎᑎᕋᕐᓯᒪᓪᓗᑎᒃ ᐃᓗᓕᖕᒋᓐᓂᒃ ᖃᓄᐃᓕᐅᕐᓂᐊᕐᓂᖏᓐᓂᒃ ᑕᕗᖓ ᐃᓚᖅᓯᐅᑎᔪᑦ ᒪᑐᔭᐅᓂᖅᓗᓄᑦ ᐊᑐᓂ ᖃᓄᐃᑦᑐᐅᓂᐊᕐᑐᑦ ᓱᕐᓗ ᑯᕕᑦᑦᕕᒃ ᖃᓄᕐ ᓴᓗᒪᖕᓴᕐᑕᐅᓂᐊᕐᒪᖔᑦ ᐊᒃᑖᕕᒃᓗ ᖃᓄᕐ ᓴᓗᒪᖕᓴᕐᑕᐅᓂᐊᕐᒪᖔᑦ. ᐱᓗᐊᕐᓂᕆᔭᖏᑦ 2004-ᒥ ᐊᒻ 2005-ᒥ ᐅᑯᐊᖑᔪᑦ:

1. ᑐᐊᐸᒃᒥᒃ ᕿᕐᓂᑦᒥᒃ ᐃᔪᓂᖃᕐᓗᓂ 1.0 ᒥᑕ ᐃᔪᑎᖃᕐᑐᖅ ᐃᓕᔭᐅᓗᓂ ᖃᖓᓄᑦ ᑯᕕᑦᑦᕕᐅᑦ ᐊᒻᒪᓗ ᑲᒃᑲᓐᓂᐊᒍᑦ ᐃᓕᕆᔭᐅᓗᓂ 0.25 ᒥᑕ ᐃᔪᓂᖃᕐᑐᕐ ᑐᐊᑐᐃᓐᓇᕐ ᓯᐅᕋᕐᓗ, ᓴᐃᔭᐅᒍᓂ ᖁᐊᖑᐃᓐᓇᓕᕐᓂᐊᕐᒪᑦ ᐊᒻᒪᓗ ᑲᒃᑲᓂᖅ ᐅᖁᓯᕙᓪᓕᐊᕙᓗᐊᕐᑎᓪᓗᒍ ᓯᓚ ᖃᓄᐃᖏᓇᕋᔭᕐᑐᖅ.

2. ᐃᒥᐊᓂᖅ 1 ᒥᑕᐅᓗᓂ ᐃᒪᓄᑦ ᑯᕕᔭᐅᖃᑦᑕᕐᓯᒪᔪᕐ ᑕᓯᓕᐊᕆᓯᒪᔪᒧᑦ ᐃᒥᐅᓂᖃᐃᓐᓇᕐᑎᑕᐅᓂᐊᕐᑐᖅ ᖃᖓᓂ.

3. ᓴᓇᔭᐅᓗᓂ ᑯᓕᐅᕐᑕᐅᓗᓂ ᐃᒥᕈᔪᒃ ᑯᕕᕐᑦᕕᕕᓂᕐᒧᑦ ᑯᕕᑎᑕᐅᑦᑕᐃᓕᒪᓗᓂ ᐃᓗᐊᓄᑦ ᐊᕙᑕᒍᑦ ᑯᓕᐅᕐᑕᐅᓗᓂ.

4. ᐅᔭᕋᑐᐃᓐᓇᐃᑦ ᓄᓇᐅᑦ ᐃᓗᐊᓂᖕᖓᕐᓯᒪᔪᑦ ᐃᓗᐊᓄᐊᕐᖃᕐᑕᐅᓗᑎᒃ ᐅᔭᓗᓂᑦ ᓴᐅᔭᐅᓗᑎᒃ

5. ᖃᐃᖃᒃᓴᕐᑕᐅᓗᓂ ᒪᓂᕋᖓ ᖃᓕᕐᑕᐅᓗᓂᓗ ᕿᕐᓂᕐᑕᒥᒃ ᑐᐊᐸᒃᒥᒃ ᐅᔭᕋᒃᑦᕕᐅᖃᑦᑦᕐᓂᑯᐃᑦ ᐃᓗᑦᑐᕐᓯᒪᔪᑦ ᐃᔪᓂᖃᕐᑐᒥᒃ 1.95-ᒥᑕᒥᒃ ᕿᕐᓂᕐᑕᒥᒃ ᐊᒻᒪᓗ 0.25-ᒥᑕ ᓯᐅᕋᕐᒥᒃ ᑲᒃᑲᓐᓂᖅᑲᓄᐊᕐᓯᓗᑎᒃ ᑕᒃᑯᐊ ᓄᓇᒥᖕᖓᕐᓯᒪᔪᑦ ᐅᔭᕋᑐᐃᓐᓇᐃᑦ ᕐᑯᐊᖑᐃᓐᓇᕐᑐᒥᑦᑎᑕᐅᓗᑎᒃ ᓴᐅᔭᐅᓗᑎᒃ.

6. ᖃᓕᕐᓯᓗᑎᒃ ᐃᔪᓂᖃᕐᑐᒥᒃ 1.95-ᒥᑕ ᐃᔪᓂᖃᕐᑐᒥᒃ ᕿᕐᓂᕐᑕᒥᒃ ᑐᐊᐸᒃᒥᒃ ᐊᒻᒪ 0.25-ᒥᑕᒥᒃ ᐃᔪᓂᖃᕐᑐᖅ ᓯᐅᕋᕐᒥᒃ ᖃᒃᑲᓐᓂᕆᓗᓂᐅᒃ ᐊᒃᑕᕐᕕᕕᓂᕐᒧᑦ

7. ᐱᔭᕐᑕᐅᓗᓂ ᓴᓇᕕᑦ ᐃᓄᒃᓄᓪᓗ ᐃᒃᓗᕆᔭᐅᔪᕕᓂᑦ ᐊᑐᕈᓐᓇᕐᑐᓪᓗ ᓂᐅᕈᑕᐅᔪᓐᓇᕐᐸᑕ ᓂᐅᕈᑕᐅᓗᑎᒃ ᓴᓂᐅᓂᖏᑦ ᓄᓇᐅᑦ ᓂᐅᕈᑕᐅᖏᑦᑐᑦ ᐊᐅᓚᕐᑎᑕᐅᓂᐊᕐᑐᑦ ᐃᓗᐊᓄᐊᕐᖃᕐᑕᐅᓗᑎᒃ.

8. ᐸᑦᑕᕐᓴᖏᑦᑐᑦ ᐱᕐᑯᑎᕕᓂᑦ ᓱᕈᕐᓇᕐᑐᖃᖏᑦᑐᑦ ᓴᓂᕈᔪᐃᓪᓗ ᓄᓇᐅᑦ ᐃᓗᐊᓄᐊᕐᖃᕐᑕᐅᓗᑎᒃ.

9. ᑐᐊᐸᐃᑦ ᐅᕐᓱᐊᓗᕈᔪᖃᕐᑐᑦ ᐱᔭᕐᑕᐅᓗᑎᒃᓗᓐᓂᑦ ᐅᕙᓗᓂᑦ ᓴᐅᔭᐅᓗᑎᒃ ᐅᔭᓗᓂᑦ ᓄᓇᐅᑦ ᐃᓗᐊᓄᐊᕐᖃᕐᑕᐅᓗᑎᒃ

10. ᖃᐅᔨᓴᐅᑎᓂᒃ ᐃᒃᓕᓇᒃᓯᓗᑎᒃ ᒪᓂᕋᐅᑦ ᐅᕐᑯᓂᖓᓂᒃ ᖃᐅᔨᓴᐅᑕᐅᓂᐊᕐᑐᓂᒃ ᖃᓄᑎᒋᓗ ᐊᐅᒃᐸᓪᓕᐊᑎᒋᒃᒪᖔᑦ ᖃᐅᔨᓴᐅᑎᑦ

11. ᐊᕙᑎᖓ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓗᓂ ᐊᑯᓂᐅᔪᒧᑦ ᑕᐃᒪᐃᖏᓐᓇᕐᓂᐊᕐᒪᖔᑦ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓗᓂ.

ᖃᐅᔨᓴᕐᑕᐅᓯᒪᓂᐊᕐᑐᖅ ᐊᕋᒍᓄᑦ 7-ᓄᑦ (ᒪᕈᒃ ᐊᕋᒍᒃ ᓴᓗᒻᒪᕐᓴᐃᓗᑎᒃ ᐊᒻᒪᓗ ᐊᕋᒍ ᑕᓪᓕᒪᑦ ᖃᐅᔨᓴᕐᓗᑎᒃ) ᐃᒋᐊᕐᓗᓂ 2004-ᒥᑦ 2010-ᒧᑦ. ᐱᖃᓯᐅᑎᓗᒋᑦ ᐃᒥᐅᑦ ᖃᐅᔨᓴᕐᑕᐅᓂᖓ, ᒪᓂᕋᐅᑦ ᐅᕐᑯᓂᖓ, ᐃᓗᐊᓗ ᓴᐅᔭᐅᓯᒪᔪᖅ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓗᓂ ᐅᕐᕐᑯᓂᖓ. Hᒃᑯᐊᓗ ᖃᐅᔨᓴᐅᑕᐅᔪᑦ ᐊᐅᓚᕐᑎᑕᐅᖃᑦᑕᕐᓗᑎᒃ ᓄᓇᕗᑦᒥ ᐃᒥᓕᕆᔩᒃᑯᖏᓄᑦ ᑕᕐᕿᑦ ᐱᖓ)ᑦ ᐊᓂᒍᕋᖓᑕ, ᐊᒻᒪᓗ ᐊᕋᒍᑕᒪᑦ ᓴᓇᒃᑲᓐᓂᕆᐊᓕᓪᓗ ᐱᔭᕆᕐᑕᐅᓗᑎᒃ. ᐊᕋᒍ 7 ᐊᓂᒍᕐᐸᑕ ᕿᒥᕈᔭᐅᓂᐊᕐᑐᖅ ᑕᒪᓐᓇ ᓴᓗᒻᒪᕐᓴᕐᑕᐅᓯᒪᔪᖅ ᖃᓄᐃᓕᕙᓪᓕᐊᖏᒃᑲᓗᐊᕐᒪᖔᑦ. ᕿᒥᕈᔭᐅᓂᖓ ᖃᓄᐃᓕᖓᓚᓚᔭᕐᒪᖔᑦ ᑎᑎᕋᕐᑕᐅᓯᒪᓗᓂ ᑐᓂᔭᐅᓂᐊᕐᑐᖅ ᒪᔫ 2007-ᒥ. ᑕᐃᑲᓂᓗ , ᖃᐅᔨᓂᐊᕐᑐᑦ ᖃᐅᔨᓴᐃᓇᓱᐊᖃᕐᒪᖔᑦ ᐅᕙᓗᓂᑦ ᓄᓇᖓ ᑐᓂᔭᐅᔪᓐᓇᕐᓯᒃᒪᖔᑦ ᓚᕙᒪᒃᑯᓐᓄᑦ

Community Summary

The Nanisivik Mine is located on northern Baffin Island. It is an underground zinc-lead mine which is owned by CanZinco Ltd. and has been in continuous operation since 1976. The Nanisivik Mine stopped producing zinc and lead concentrates in September 2002 and is now permanently closed. An important part of mine closure will be ensuring that the site is returned to a condition that protects the health and safety of Nunavut residents and permits the continued use of the land by local residents. The Hamlet of Arctic Bay will play an important part in the mine closure plan. CanZinco Ltd. is committed to ensuring that this occurs through the distribution of a Mine Closure Plan that will be reviewed by all stakeholders and ultimately approved by the Nunavut Water Board, DIAND and the Government of Nunavut.

All of the proposed mine reclamation work is described in this report. A short summary of the proposed work is listed below.

1. All underground equipment and machinery will be either shipped from the Nanisivik site for use elsewhere or disposed of in the underground mine. The continuous permafrost in the underground mine will provide a secure location for obsolete equipment. All mine entrances will be permanently sealed.
2. CanZinco has collected extensive information about the effects of the mine on the environment and will continue this information collection process into the future. So far, this information has identified some specific areas on the mine site where the soil is contaminated with metal and/or hydrocarbon (that is, diesel fuel). CanZinco has proposed to put this soil back into the underground mine where the permafrost will ensure that the soil will remain in isolation from the surrounding environment for all time.
3. The tailings generated from the milling operation at Nanisivik have been placed in a containment area at West Twin Lake. There are two tailings deposition areas. One area contains tailings that are underwater and the other area contains tailings that are above water. Water sampling by CanZinco has shown that water meets the water quality criteria set by the Nunavut Water Board.
4. The tailings that are now underwater will be kept underwater and tailings that are now above water will be covered with over 4 feet (1.25 m) of shale plus a gravel cap that will ensure permafrost formation in the tailings and the base of the cover. Extra shale will be included to protect the tailings from global warming.
5. The dock at Strathcona Sound is owned by the Department of Fisheries and Oceans (DFO). The Federal Government may choose not to remove the dock and to continue to use it as a refueling depot. The fuel tanks could also be a beneficial addition to this kind of operation but this has not yet been decided.
6. The roads connecting the airport, dock, Arctic Bay and Nanisivik to East Twin Lake are owned by the Government of Nunavut and are not part of Nanisivik's closure plan. The future use of the airport and the roads is not under the company's control.

7. There are many ideas for using Nanisivik and some other mine buildings after the mine closes. So far, these ideas have not been made into a plan that has been agreed to by the Government of Nunavut and others. Therefore, CanZinco is required by law to tear down the entire town and mine buildings except those that are owned by the Government of Nunavut. This will start in 2004.
8. Machinery, tools and other useful items at the mine will be removed.

CanZinco will monitor the Nanisivik site for 7 years to ensure there are no long term environmental problems. CanZinco will also keep talking to the Hamlet of Arctic Bay during this monitoring period. At the end of 7 years, the information will be closely examined and the need for continued monitoring will be decided. CanZinco expects that the mine site will be seen to be in a good condition and that the Surface Lease can be returned to the Government.

CanZinco will work with the Hamlet of Arctic Bay and the Government of Nunavut to find jobs for local residents to help with the reclamation work. Some residents have experience working at the mine site and might be able to help as soon as the work begins, if they wish. There might be opportunities for a few people to take training at the site and the company will try to help these people, working in cooperation with the Hamlet and the Government of Nunavut.

Levi Barnabas is hired by the GN to be a liaison officer. This means that Levi can help people to talk to the GN and to the company about jobs, training or bidding on mine items for sale.

Executive Summary

The Nanisivik Mine is owned by CanZinco Ltd., a division of Breakwater Resources Ltd. Both CanZinco and its parent company, Breakwater, own and operate mines elsewhere in Canada and around the world. CanZinco has owned the Nanisivik mine since 1996.

The mine site is located in the Canadian Arctic on northern Baffin Island. The mine site lies on the south shore of Strathcona Sound at approximately 73 degrees north latitude. The environment around the mine site is typical of the arctic region and is characterized by cold temperatures, low precipitation, continuous permafrost and largely barren surface soils, which render the mine area poor for vegetation coverage and wildlife use.

The Inuit Hamlet of Arctic Bay, population 700, is located approximately 25 kilometres by road west of Nanisivik. Access to the mine site and to Arctic Bay is via scheduled jet air service from Iqaluit. Freight is delivered to Nanisivik via ship during the 14-week open water season.

Nanisivik commenced operations in 1976 and operated continuously to September 2002, at which time the mine was permanently closed due to the depletion of economic ore reserves. Sulphide ore was mined primarily by underground methods and milled on-site to produce lead and zinc concentrates. The mill operated at a nominal 2,200 tonnes per day. Mine personnel resided in the town of Nanisivik, which was constructed as part of the mine facilities. The town facilities include a school, church, post office, recreation center, dining hall, houses and apartments. The mine employed 171 people when operating and, since closure, has employed a skeleton crew of 4 to 8 people to preserve the assets and conduct environmental monitoring work required by the Water Licence.

The development of the mine was partially funded by the Government of the Northwest Territories (as it then was) and some of the town facilities and infrastructure are currently owned by the Government of Nunavut ("GN"). These facilities include the church, town water supply, sewage treatment system, housing, the road from the dock to the airport and to Arctic Bay as well as other infrastructure. Reclamation of these GN-owned facilities is the responsibility of the GN.

The dock is owned by the Department of Fisheries and Oceans. Reclamation or continued use of the dock is the responsibility of the Federal Government.

The GN and the Hamlet of Arctic Bay have publicly expressed a strong interest in identifying and implementing plans for the continued use of the town of Nanisivik and some of the industrial buildings. To this end, the GN initiated two projects: to identify the possible socio-economic impacts of the mine closure on the Hamlet of Arctic Bay and to identify and evaluate alternatives for continued use of the Nanisivik mine facilities. CanZinco shares this interest in identifying alternatives for continued use and has contributed to these projects and is currently conducting negotiations with the GN for the possible transfer of ownership of some mine owned facilities. Nonetheless, CanZinco must proceed with reclamation of the mine facilities in a cost-effective manner as described in the Reclamation and Closure Plan and will continue to do so until formal agreements are in place to the contrary.

CanZinco is pleased to confirm that the Industrial Complex has been sold to another mining company, Woldfen Resources Inc. Wolfden intends to remove the facility from the Nanisivik mine site to its High Lake property in the Kitikmeot Region. This sale provides benefit to the Nanisivik site and to Nunavut by keeping a useful facility in service for the continued benefit of northerners. The liability for reclamation of the facility and any contaminated soils continues to reside with CanZinco, as the mine owner and licencee.

This report, *Nanisivik Mine 2004 Reclamation and Closure Plan*, is the culmination of an extensive sequence of environmental studies, technical reviews, technical meetings and report approvals that started with the submission, in February 2002, of the initial mine closure plan. Since that time, CanZinco has completed and received the Nunavut water Board's approval for an *Environmental Site Assessment* program conducted by Gartner Lee Limited and a *Human Health and Ecological Risk Assessment* developed by Jacques Whitford Environment Ltd.

This report, accompanied by its attendant appendices, provides detailed technical descriptions of all of the proposed reclamation activities and fulfills the specific requirements of the Water Licence in this regard. The Board should be able to use the information presented here to conduct a technical review of the proposed plans and to satisfy itself that the plans are appropriate and will accomplish the reclamation objectives. Ultimately, CanZinco requests the Board's approval of the plans so that they may be carried out in a timely and efficient manner.

CanZinco's approach to reclamation and closure of the Nanisivik site is to conduct the work in an efficient manner that follows the *Mine Site Reclamation Policy for Nunavut (2002)* and that promotes benefits to northern residents. The primary objectives of the proposed reclamation and closure work are in accordance with the Policy's objective to "ensure the impact of mining on the environment and human health and safety is minimized".

The reclamation work is focused on utilizing the natural conditions to provide for the secure, long-term closure of the mine site. Reactive mine wastes, such as tailings and mineralized waste rock, will be reclaimed by incorporating them into the permafrost regime either in the underground mine or beneath a cover of inert material. The same approach will be undertaken at the landfill facility. The freezing conditions will prevent contamination of surface water. The required thickness of inert cover to ensure permafrost formation has been calculated to include the estimated effects of climate warming.

The reclamation activities are anticipated to be completed in two years, 2004 and 2005. Options exist to potentially shorten this schedule and these will be pursued, where practical. A series of stand alone detailed design documents have been developed, which are appendices to this report, that describe the specific details of the closure designs for each of the mine facilities such as the tailings disposal area and the landfill facility. Some of the key reclamation measures that are proposed for 2004 and 2005 are:

1. Place a thermal insulation cover of shale (1.0 m) and a durable cap of sand gravel (0.25 m) over exposed tailings to ensure that the tailings remain frozen and isolated from the environment even under a worst-case prediction of climate warming.
2. Provide a minimum 1 m water cover over subaqueous tailings to prevent oxidation of tailings from affecting water quality.
3. Construct an engineered outflow spillway from the covered tailings area designed to provide environmental protection against an extreme flood (probable maximum flood).
4. Relocate mineralized waste rock to the underground mine or to open pits where backfilling is required.
5. Contour and backfill open pits and place a thermal insulation cover that is thicker than proposed for the tailings cap (1.95 m shale plus 0.25 m sand and gravel) to ensure that the waste rock and mineralized wall rocks remain frozen and isolated from the environment even under a worst-case prediction of climate warming.
6. Place a thermal insulation cover of shale (1.95 m) and a durable cap of sand gravel (0.25 m) over the landfill facility, in addition to the shale that is already in place from mining operations, to ensure that the tailings remain frozen and isolated from the environment even under a worst-case prediction of climate warming.
7. Dismantle industrial and residential buildings and salvage components of economic value for shipment off site or for sale locally.
8. Dispose of non-hazardous demolition debris and residual scrap materials in the underground mine or in open pits where backfilling is required.
9. Remediate contaminated soils by covering in-place or by excavation and disposal in either the underground mine or in open pits that require backfilling.
10. Install additional monitoring instruments to monitor ground temperature and depth of thaw in reclaimed areas.
11. Conduct environmental monitoring of the site to confirm long term stability and success of the reclamation measures.

Monitoring of the mine site is scheduled for a period of 7 years (a 2-year period of active reclamation work plus a 5-year post reclamation period) from 2004 to 2010. This will include water quality, ground temperatures, general reclamation inspections and geotechnical inspections. The results of the monitoring programs will be reported to the Nunavut Water Board quarterly and annually and any maintenance work that may be required will be completed. At the end of the 7-year period, the effectiveness of the reclamation work will be closely evaluated through a *Comprehensive Performance Review*, for which the terms of reference are required by the Nunavut Water Board in March 2007. At that time, a determination will be made regarding the need for continued monitoring or return of the property to the government.

Table of Contents

ᓄᓇᓕᐅᓂᖓᓂᒃ ᓇᓗᓇᐃᕐᓯᓂᖅ
ᐅᖃᐅᓯᒃᓴᓪᓚᕆᒃᓂᖓᕐᑐᑦ ᓇᐃᒃᓕᒋᐊᕐᓯᒪᔪᑦ
Community Summary
Executive Summary

Page

List of Tables

List of Figures (Back of Report)

Appendices

A. *Engineering Design of Reclamation Surface Covers*, BGC Engineering Inc., February 2004
B. *Assessment of Surface Cell and Test Cell Taliks,* BGC Engineering Inc., February 6, 2004
C. *Quarry Development and Reclamation Plan,* BGC Engineering Inc., February 6, 2004
D. *West Twin Disposal Area Surface Cell Spillway Design,* Golder Associates Limited, March 2004
E. *Nanisivik Mine Rock Piles and Open Pits Closure Plan,* Gartner Lee Limited, February 2004
F. *Nanisivik Mine Reclamation and Closure Monitoring Plan,* Gartner Lee Limited, February 2004
G. *2002 Phase II Environmental Site Assessment, Nanisivik Mine Nunavut*, Gartner Lee Limited, January 2003
H. *2003 Phase 3 Environmental Site Assessment, Nanisivik Mine Nunavut,* Gartner Lee Limited, February 2004
I. *Nanisivik Mine Human health and Ecological Risk Assessment,* Jacques Whitford Environment Ltd., October 2003
J. *West Twin Disposal Area Closure Plan,* BGC Engineering Inc., March 2004
K. *Nanisivik Mine Waste Disposal Plan,* CanZinco Ltd., March 2004
L. *Nanisivik Mine Landfill Closure Plan,* Gartner Lee Limited, February 2004
M. *Memorandum, Nanisivik Mine, Predicted Volumes of Contaminated Soil,* Gartner Lee Limited, February 2004

1. Introduction

1.1 Proponent Information

Nanisivik Mine is wholly owned by CanZinco Ltd. ("CanZinco"), which is a division of Breakwater Resources Ltd. CanZinco is the sole operator of the Nanisivik Mine. CanZinco has its corporate office in Bathurst, New Brunswick and that location is responsible for the administration of both the Nanisivik Mine and the Caribou Mine.

Breakwater Resources Ltd. ("BWR") is a Canadian company engaged in the acquisition, exploration, development and mining of mineral properties with mines and mining interests in Canada, Tunisia, Chile, and Honduras. BWR's principal product is zinc concentrate and it also produces lead, copper and gold concentrates, with silver as a by-product. The concentrates are sold to smelters throughout the world. Breakwater's head office is located in Toronto, Ontario.

1.2 Overview of Nanisivik Mine

The Nanisivik Mine is located on the Borden Peninsula on northern Baffin Island in the Canadian Arctic at 73º 02'N, 84º31"W (Figure 1). The mine site is located on the south shore of Strathcona Sound approximately 30 kilometres from Admiralty Inlet. The Hamlet of Arctic Bay, current population approximately 700, is located approximately 25 kilometres west of Nanisivik on the shore of Arctic Bay in Adam's Sound. The two communities are linked by a 33 kilometre all-weather road. An airport capable of handling jet aircraft is located approximately 9 kilometres south of Nanisivik. Heavy freight and non-perishable goods are delivered by ship during the annual ice-free season.

Pyrite mineralization in the area was known to the Inuit people and the area was called Nanisivik, "The Place Where People Find Things". Formal mineral exploration was first documented in 1910 by the Canadian Government. Claims were first staked in 1937. The Geological Survey of Canada conducted surface mapping in 1954 that documented the presence of galena and sphalerite with the pyrite. Advanced mineral exploration in the area began around 1957 by Texas Gulf Inc., which involved prospecting, diamond drilling and underground exploration. This exploration work outlined the future Nanisivik orebody.

The property was optioned by Mineral Resources International Limited in 1972 who subsequently hired Strathcona Mineral Services Limited to manage the property. Development of the mine facilities took place from 1974 to 1976. Mining and milling commenced in 1976. The property was sold to CanZinco in July of 1996, and they operated the mine to September 2002 when the mine was closed permanently.

The occupied land currently contains the dock/concentrate storage shed area, mill/industrial complex including diesel generating facility, administration offices, warehouse and storage yards, Townsite of Nanisivik, West Twin Lake Tailings Disposal Area, East Twin Lake fresh water supply, East Adit water treatment facility, open pits, rock dumps, landfill and roadways, as illustrated on Figure 2.

1.3 Licences and Mineral Title

Operations at the Nanisivik Mine are regulated by a Water Licence. The original Water Licence was granted by the Northwest Territories Water Board under the Northwest Territories Waters Act. The Nunavut Water Board assumed the responsibility for current Water Licences in 1996 under the mandate of the Nunavut Land Claims Agreement Act. The Nunavut Waters Act received Royal Assent in May 2002.

The current Nanisivik Water Licence came into effect October 1, 2002 and expires on May 1, 2008. The Licence is issued for the purpose of "*industrial water use and waste* d*isposal"* and is described as a '*reclamation and closure' Licence (as opposed to previous Licences which were described as"mining, milling and associated purposes").* Thus the current Licence contains the conditions under which reclamation and closure of the site must proceed.

The Nanisivik Mine occupies land leased from the Government of Canada under the Territorial Lands Act and the Territorial Lands Regulations.

Mineral title to the Nanisivik Mine is held under mineral leases. Mineral leases were issued for 21-year periods, with rights of renewal. The leases have historically been renewed as required, with the next renewal date being 2009.

In addition to the mineral title requirements, surface title is also required for certain operations. Essentially all of the surface title in the Nanisivik Mine area is controlled by the Federal Government. However, at mine start-up, the surface rights to one block, called the Block Transfer, were transferred to the Government of Nunavut (formerly the Government of the Northwest Territories). Within the Block Transfer, the mine negotiates land matters with the Government of Nunavut.

The development of the Nanisivik Mine proceeded under an agreement signed June 18, 1974 (the "Master Agreement") between Nanisivik Mines Ltd. (as assignee of Mineral Resources International Limited ("MRI")) and the Department of Indian Affairs and Northern Development ("DIAND"). Based upon the original mineral reserves and initial design capacity of the mine and mill, a mine life of 12 years was contemplated. Nanisivik has largely been in compliance with the Master Agreement governing operations at the Nanisivik Mine with the exception of a goal to employ a specified percentage of northern residents and the annual tonnage throughput of the operation. These areas of non-compliance existed for a number of years before CanZinco assumed ownership of the Mine and are known to the responsible officials of the Federal Government.

A list of the claims and leases pertaining to the Nanisivik Mine is presented in Table 1. A map of the claim/lease boundaries is presented in Figure 3.

Table 1. Listing of Mining Leases, Surface Leases and Mineral Claims

Disp Name	Disp Type	Clm Area	Project_Name	Owner
2451	Mining Lease	6833.88	NANISIVIK	CANZINCO LTD.
2452	Mining Lease	1060.94	NANISIVIK	CANZINCO LTD.
2799	Mining Lease	609	NANISIVIK	CANZINCO LTD.
2800	Mining Lease	51	NANISIVIK	CANZINCO LTD.
2801	Mining Lease	370	NANISIVIK	CANZINCO LTD.
2802	Mining Lease	66.2	NANISIVIK	CANZINCO LTD.
2803	Mining Lease	407	NANISIVIK	CANZINCO LTD.
2804	Mining Lease	278	NANISIVIK	CANZINCO LTD.
2875	Mining Lease	132.7	NANISIVIK	CANZINCO LTD.
2876	Mining Lease	342	NANISIVIK	CANZINCO LTD.
2877	Mining Lease	372.4	NANISIVIK	CANZINCO LTD.
2905	Mining Lease	861.1	NANISIVIK	CANZINCO LTD.
3268	Mining Lease	359.61	NANISIVIK	CANZINCO LTD.
3269	Mining Lease	227.42	NANISIVIK	CANZINCO LTD.
3317	Mining Lease	1356.9	NANISIVIK	CANZINCO LTD.
3379	Mining Lease	1853	NANISIVIK	CANZINCO LTD.
3383	Mining Lease	1038	NANISIVIK	CANZINCO LTD.
TOTAL	17 Min. leases	16219.15		

Disp Name	Disp Type	Clm Area	Project_Name	Owner
48-C/1-10-2	Surface Lease		NANISIVIK	CANZINCO LTD.
48-C/1-5-2	Surface Lease		NANISIVIK	CANZINCO LTD.
48-C/1-6-2	Surface Lease		NANISIVIK	CANZINCO LTD.
48-C/1-7-2	Surface Lease		NANISIVIK	CANZINCO LTD.
48-C/1-8-3	Surface Lease		NANISIVIK	CANZINCO LTD.
48-C/1-9-3	Surface Lease		NANISIVIK	CANZINCO LTD.
8008T	Surface Lease		NANISIVIK	CANZINCO LTD.
8677T	Surface Lease		NANISIVIK	CANZINCO LTD.
DL-40041T	Surface Lease		NANISIVIK	CANZINCO LTD.

Disp Name	Disp Type	Clm Area	Project_Name	Owner
DL-40042T	Surface Lease		NANISIVIK	CANZINCO LTD.
DL-40043T	Surface Lease		NANISIVIK	CANZINCO LTD.
DL-40044T	Licence		NANISIVIK	CANZINCO LTD.
DL-40163T	Licence		NANISIVIK	CANZINCO LTD.
TOTAL	13 Sur. Leases			

Disp Name	Disp Type	Clm Area	Project_Name	Owner
BB 1	Mineral Claim	2479.2	NANISIVIK	CANZINCO LTD.
BB 2	Mineral Claim	2479.2	NANISIVIK	CANZINCO LTD.
EB 1	Mineral Claim	2479.2	NANISIVIK	CANZINCO LTD.
EB 2	Mineral Claim	2479.2	NANISIVIK	CANZINCO LTD.
GULL	Mineral Claim	1267	NANISIVIK	CANZINCO LTD.
KL 1	Mineral Claim	1291.3	NANISIVIK	CANZINCO LTD.
KL 2	Mineral Claim	425	NANISIVIK	CANZINCO LTD.
NB 2	Mineral Claim	2479.2	NANISIVIK	CANZINCO LTD.
NB 4	Mineral Claim	2479.2	NANISIVIK	CANZINCO LTD.
TOTAL	9 Mineral claim	17858.5		

The dock at Strathcona Sound and a portion of the land in the immediate vicinity of the dock are administered under a lease issued by the Department of Fisheries and Oceans (DFO).

1.4 Breakwater Resources Ltd. Environmental Policy

Breakwater Resources Ltd. ("BWR"), its subsidiaries and employees are committed to protecting the surroundings in which we operate. As a mine development company, our business, by its very nature, is intrusive on the environment. This brings with it added risks and additional responsibilities. We accept that these responsibilities are part of the cost of doing business in the mining industry.

BWR is committed to the concept of sustainable development which requires balancing good stewardship in the protection of human health and the natural environment with the need for economic growth. Diligent application of technically proven and economically feasible environmental protection measures will be exercised throughout exploration, mining, processing and decommissioning activities to meet the requirements of legislation and to ensure the adoption of best management practices. To implement this policy, BWR will:

1. Access, plan, construct and operate its facilities in compliance with all applicable legislation providing for the protection of the environment, employees and the public.

2. In the absence of legislation, apply cost-effective best management practices to advance environmental protection and to minimize environmental risks.

3. Maintain an active, continuing, self-monitoring program to ensure compliance with government and Company requirements.

4. Foster research directed at expanding scientific knowledge of the impact of industry's activities on the environment, of environment/economy linkages and of improved treatment of technologies.

5. Work pro-actively with government and the public in the development of equitable, cost effective and realistic laws for the protection of the environment.

6. Enhance communications and understanding with governments, employees and the public.

2. Approach to the Reclamation and Closure Plan

2.1 Regulatory Requirements

The specific regulatory requirements for closure, decommissioning and reclamation of the Nanisivik Mine are outlined in the surface leases and the Water Licence.

CanZinco's approach to closure and reclamation of the Nanisivik site follows the "Mine Site Reclamation Policy for Nunavut" published by the Department of Indian Affairs and Northern Development in July 2002. The primary objectives of the Closure and Reclamation Plan are in accordance with the Mines Reclamation Policy to "ensure the impact of mining on the environment and human health and safety is minimized".

2.2 Objectives of the Plan

This document is intended to meet the Closure and Reclamation requirements of the Nanisivik Mine Water Licence, issued to CanZinco Ltd. by the Nunavut Water Board and for the surface leases authorized by the Government of Canada. This document provides updated information on the status of Nanisivik Mine and provides a plan of the work to be completed in the various stages of mine closure.

The ultimate objective for the land leases is to obtain the Ministerial release document upon completion of closure. To this end, a post closure environmental monitoring plan has been developed that will confirm the effectiveness of the reclamation work.

Specifically, the objectives for the Nanisivik Mine Closure and Reclamation Plan are:

1. To meet the closure and reclamation requirements of the Water Licence and Land Leases;
2. To return the site to a condition of similar environmental productivity and land use that existed prior to development of the mine facilities;
3. To provide a comprehensive document which presents the plans for closure and reclamation; and
4. To eliminate the requirements for long term post-closure care and maintenance.

2.3 Communications and Consultation

2.3.1 Community of Arctic Bay

A series of public meetings, beginning in January 2002, have been held in Arctic Bay on the specific topic of mine closure. Hamlet members have expressed their views and concerns regarding closure of the mine and these have been considered in the preparation of this Closure and Reclamation Plan. These meetings will continue throughout the mine closure process to provide information on the mine closure programs and to solicit additional thoughts from the community.

A liaison officer (Mr. Levi Barnabas) is employed by the Government of Nunavut and has been selected and appointed by the Hamlet of Arctic Bay to serve as a central community contact regarding issues and activities related to mine closure. Mr. Barnabas has taken part in sourcing field assistants to assist with the Environmental Site Assessment Field Programs, assisted with identifying and carrying out community interviews associated with the Human Health and Ecological Risk Assessment and has taken part in technical meetings on the closure plan.

Involvement of Hamlet members with the mine closure work to date has included field assistants and equipment operators from Arctic Bay who were employed for the Environmental Site Assessment field programs in 2002 and 2003. Also, a series of interviews were held in September 2002 with elders and others from Arctic Bay as part of the Human Health and Ecological Risk Assessment for the purpose of collecting information regarding historical and future land use activities.

2.3.2 Government of Nunavut

Meetings and consultations with the Government of Nunavut ("GN") have been undertaken throughout the closure planning process to date and will continue. The issues discussed have included how closure and reclamation of the mine may have social and economic effects for the Hamlet of Arctic Bay. Also, these meetings have discussed opportunities for continued use of some of the mine and town facilities through transfer of ownership to the GN or other parties.

The GN has recently sponsored two projects directly related to closure of the Nanisivik mine. One project was to investigate the social and economic impacts that mine's closure may have on Arctic Bay and the other project was to identify and evaluate other concepts for alternate uses of the mine facilities.

2.3.3 July 2002 Nunavut Water Board Hearing

A public hearing was convened by the Nunavut Water Board ("NWB") in Arctic Bay from July 22 to 24, 2002. The hearing provided opportunity for community members, regulators and CanZinco to express their views to the NWB on closure and reclamation of the mine.

A tour of the mine site was conducted by CanZinco during a recess in the hearing that provided attendees an opportunity to see the mine site and ask questions directly of mine environmental and management staff.

The public hearing and mine tour also provided opportunity for technical consultants working on behalf of the NWB, various government agencies and CanZinco to meet directly and discuss closure related technical issues.

Several documents were submitted to the NWB by CanZinco as a direct follow-up to information requests and commitments that were made at the public hearing. As the final follow up to the Public Hearing, the NWB issued a Water Licence in October 2002 that contained terms and conditions for continued environmental protection and for preparation of this Closure and Reclamation Plan.

2.3.4 Technical Meetings

A technical meeting was convened in August 2002 that was attended by technical consultants working on behalf of the NWB, various government agencies and CanZinco. The purpose of the meeting was to facilitate the communication of the available technical information and to identify any data gaps where there was the need for additional technical information. The meeting was successful in this regard and provided additional direction and confirmation of the planned technical studies that have been undertaken (as described in Section 6.1).

A technical meeting was held in Iqaluit in March 2003 that was attended by various Federal and Territorial government agencies, NWB staff and CanZinco. This meeting was held during the NWB review of the Phase 2 Environmental Site Assessment Report and the Human Health and Ecological Risk Assessment Report and allowed an update and exchange of technical information on those topics.

A technical meeting was held in September 2003 that was attended by various Federal and Territorial government agencies, their consultants, NWB staff and CanZinco. This meeting allowed for a final exchange of technical information on the Human Health and Ecological Risk Assessment Report and was subsequently followed by the NWB's approval of that report in November 2003.

2.4 Development of the Plan

Development of the Nanisivik Mine Closure and Reclamation Plan has followed the following progressive stages to date:

1. Completion of the 2001 Environmental Site Assessment (February 2002);

2. Preparation and filing with the NWB of the February 2002 Closure and Reclamation Plan under the Water Licence;
3. Representation of the Closure and Reclamation Plan at the July 2002 NWB Public Hearing (Arctic Bay);
4. Meeting with the technical advisors of the regulatory group to identify technical information needs (August 2002);
5. Issuance of Water Licence in October 2002, identifying required conditions under which the closure and reclamation would be permitted to proceed;
6. Conducting and reporting on a Phase 2 and Phase 3 Environmental Site Assessment program;
7. Completion of a Human Health and Ecological Risk Assessment (approved in November 2003);
8. Completion of remaining technical studies and investigations;
9. Continuation of the consultation process;
10. Continuation of environmental monitoring and care and maintenance activities at the mine site; and
11. Preparation and filing of this document, *Nanisivik Mine Closure and Reclamation Plan, March 2004*.

The closure planning process is intended to continue to develop according to the following stages:

12. NWB review and approval of the Mine Closure and Reclamation Plan;
13. Preparation for and execution of reclamation work; and
14. Conducting and reporting the reclamation performance monitoring program.

Some of these steps are described further in the following sections.

2.4.1 2001 Environmental Site Assessment

An assessment of environmental conditions and mine closure and reclamation issues was conducted in 2001 by Gartner Lee Limited ("Gartner Lee") as an initial stage of development of the Closure and Reclamation Plan. The complete Gartner Lee report is provided as Supporting Document A. This report highlighted critical closure and reclamation issues and supported the development of the February 2002 Closure and Reclamation Plan.

2.4.2 February 2002 Closure and Reclamation Plan

A Closure and Reclamation Plan was submitted to the NWB in February 2002 (according to the terms of the Water Licence) and described the following:

1. The environmental baseline setting of the mine site;
2. The current environmental conditions at the mine site;
3. The mine facilities and mine operations;
4. The proposed reclamation measures and rationales for their selection;

5. The proposed reclamation and closure monitoring plan; and
6. The anticipated reclamation schedule.

This document informed northern residents, the Nunavut Water Board, Territorial and Federal governmental agencies and other stakeholders of CanZinco's plans and schedule for closure and reclamation of the Nanisivik Mine and allowed these organizations and individuals to provide feedback specific to the Plan.

The schedule presented in the February 2002 plan also provided a timeframe for interested parties to work within as regards possible ongoing use of mine facilities.

2.4.3 July 2002 Water Board Hearing

A public hearing was convened in Arctic Bay in July 2002 as described in Section 2.3.

2.4.4 Meeting of Technical Consultants

A meeting of technical consultants was held in August 2002 as described in Section 2.3.

2.4.5 Issuance of the Water Licence

The current Nanisivik Water Licence was issued on October 1, 2002 and contains the conditions under which closure and reclamation of the site will be approved.

2.4.6 Environmental Site Assessment

A Phase 2 and Phase 3 Environmental Site Assessment ("ESA") program was conducted by Gartner Lee for CanZinco in 2002 and 2003. The NWB granted a conditional approval for the Phase 2 ESA Report in August 2002 and a Phase 3 ESA Report that addressed the NWB conditions was filed in February 2004.

The ESA program is described further in Section 6.1.

2.4.7 Human Health and Ecological Risk Assessment

A Human Health and Ecological Risk Assessment was conducted in 2002 and 2003 by Jacques Whitford Environment Ltd. for CanZinco ("JWEL") that followed standard and established protocols for this type of study and that included community interviews in Arctic Bay. The Nunavut Water Board approved the program report in November 2003.

2.4.8 Completion of Technical Studies

Section G of the Water Licence contains "Conditions Applying to Closure and Reclamation" and requires the submission, for approval, of a series of eleven separate technical reports to support the Closure and Reclamation Plan. The technical studies required for those reports were completed in December 2003. The summary findings are included in Section 6.2 of this report. The reports in their entirety are included as Appendices.

2.4.9 Continuation of Consultation Process

As identified in Section 2.3, consultations with the community of Arctic Bay as well as the various regulatory bodies and their attendant technical advisors have continued throughout the development of this plan.

2.4.10 Environmental Monitoring and Care and Maintenance Activities

Subsequent to the shut down of mining operations in September 2002, CanZinco has maintained a small workforce in Nanisivik to continue the environmental monitoring programs and perform care and maintenance work.

Environmental monitoring includes all aspects required under the Water Licence as well as the federal requirements under the Metal Mine Effluent Regulations. The work force has also assisted with execution of the field components of various technical studies that were completed for and are reported in this document.

Care and maintenance was focused on preserving the mine and town facilities in a safe condition while investigations into their possible future use continued.

2.4.11 Closure and Reclamation Plan, March 2004

The *Nanisivik Mine Closure and Reclamation Plan March 2004* (this document) presents the comprehensive plan for reclamation of the mine site as well as the monitoring program to measure the performance of those reclamation measures. Appended to this document are detailed technical reports on individual reclamation areas or topics as provided for in the Water Licence and described herein in Section 6.

2.4.12 NWB Review

CanZinco anticipates the NWB will initiate a technical review of this document upon receipt that will include review by various government and community agencies. CanZinco intends to cooperate fully with this review process and to make all reasonable efforts to address the NWB's information needs as quickly as possible.

2.4.13 Reclamation Work

The reclamation work will proceed upon receipt of authorizations and approvals.

The scheduling of some reclamation activities is limited by the short Arctic shipping season. For example, heavy equipment and other consumable materials in excess of the resources already on site may be required to complete certain tasks. It will be necessary to have this supplemental equipment and material delivered to the site during the shipping season and, therefore, the letting and awarding of contracts must take place early in the appropriate year.

2.4.14 Performance Monitoring

A Reclamation Performance Monitoring program has been designed to monitor the effectiveness of the reclamation measures. The monitoring program describes the location and frequency of monitoring activities, the nature and frequency of reporting to the NWB and contingencies. The monitoring program is described in Section 8.0.

3. Environmental Baseline

3.1 Available Information

Two progress reports were prepared by B.C. Research Inc. ("BCRI") in March 1975 that describes baseline environmental conditions in the mine area:

1. "*Progress Report No. 1*" describes the marine environment in Strathcona Sound based on surveys conducted in July and August 1974. This included bathymetry, shallow and deep current patterns, metal concentrations in sea water, numeration and metal concentrations in aquatic organisms and metal concentrations in marine sediments; and
2. *"Progress Report No. 2"* describes the terrestrial environment in the mine area based on studies conducted in July 1974. This included vegetation/ground cover mapping, soils descriptions, birds, mammals and metal concentrations in creeks and lakes.

A report authored by B. Fallis of the Department of Fisheries and Oceans (DFO) dated May 1982 and titled "*Trace Metals in Sediments and Biota from Strathcona Sound, NWT, 1974-1979"* includes background information concerning the marine environment in Strathcona Sound. This report describes studies of marine sediments and marine organisms conducted by Fisheries and Marine Service (FMS) in 1974, 1975 and 1976 and also references a marine sediment study that was conducted by the Geological Survey of Canada (GSC) in 1975. The regional area around Strathcona Sound is illustrated on Figure 4.

3.2 Climate

The climate at Nanisivik mine is typical of the Canadian Arctic with cold temperatures and relatively low precipitation.

Daily climate recordings were collected by Environment Canada at the Nanisivik airport from 1977 to 2001. The following data was reviewed and compiled for this document:

1. Maximum daily temperature;
2. Minimum daily temperature;
3. Mean daily temperature;
4. Daily snowfall;
5. Daily rainfall; and
6. Daily total precipitation.

Although there are gaps in the data collection, the compilation is of long enough duration to allow a confident calculation of averages and trends.

A 24-year record of the maximum and minimum monthly temperatures (averaged from the daily recordings) is illustrated on Figure 5. Over the period of record, the maximum daily temperature recorded was 23.0 degrees C, the minimum daily temperature recorded was -53.0 degrees C and the mean daily temperature recorded was –14.8 degrees C.

A 24-year record of the total monthly precipitation is illustrated on Figure 6. The greatest daily recording of snowfall was 68.4 centimetres and the greatest daily recording of rainfall was 36 millimetres.

Average monthly temperatures from 1977 to 2001 are illustrated on Figure 7. Average monthly snowfall and rainfall from 1977 to 2001 is illustrated on Figure 8.

3.3 Marine Environment

3.3.1 Bathymetry and Currents

BCRI observed in 1974 that the sea bottom inclined upwards to the east from the mouth of Strathcona Sound to a "sill" located approximately 8 kilometres from the mouth. The depth of the sill was not explicitly reported although it is inferred to range from 140 to 210 metres. The sea bottom was observed to drop steeply on the east side of the sill to a "hole" approximately 300 metres deep. The sea bottom in Strathcona Sound was reported to generally vary from approximately 50 metres to 250 metres. BCRI also makes reference to a "trench'" that runs WNW from a location just east of Twin Lakes Creek on the south shore of Strathcona Sound and towards the deep portion of the Sound.

Surface and intermediate depth currents were measured and were observed to extend consistently from 30 to 40 metres depth. Below this level, detectable currents were only measured at the location of the sill. BCRI noted that these measurements apply only to the period of measurement (August 1974) and that additional data would be required to demonstrate whether the indicated depth trends were consistent over time.

Observations reported by the Department of Fisheries and Oceans ("DFO") indicate that turbid water entering Strathcona Sound via Twin Lakes Creek in the summer of 1975 was observed to disperse along the south shore of the Sound towards the west and offshore for a distance of approximately 0.5 kilometres.

3.3.2 Intertidal Zone

BCRI noted that, in 1974, the intertidal zone was approximately 3 m deep and was devoid of any permanent flora or fauna. Additionally, no scavengers were observed attacking dead fish or meat placed in the tidal zone for several days. BCRI suggested that these conditions were typical of the High Arctic environment where tidal ice scouring, possibly in combination with low nutrient levels, inhibits faunal growth.

The maximum tidal interval recorded from August 5 to October 16, 1974 was 2.74 metres (9 feet) on August 19. Some sea ice was present in early August but had generally melted by August 10.

3.3.3 Seabirds

Observations of species and numbers were made by BCRI from air and ground surveys in July 1974. Overflights were made of the north and south shores of Adams Sound, the north and south shores of Strathcona Sound, Baillarge Bay and the east shore of Admiralty Inlet from Adams Sound to Elwin Inlet (Figure 4).

Glaucous and Thayer's Gulls were the most common seabird species observed. The majority of gulls (263) and the largest colony (150) were observed in Adams Sound. The second highest number of gulls (152) and the second largest colony (100) were observed in Strathcona Sound, located on the south shore approximately 5 kilometres west of Twin Lakes Creek. Other species that were observed included: Fulmars (up to 100,000), Eider Ducks (60), Ivory Gulls (5) and other unidentified species (10).

3.3.4 Aquatic Species and Benthos

Visual observations identified sea urchins and sculpins as common in Strathcona Sound. Planktonic organisms (primarily molluscs and crustaceans) and schools of Arctic Cod (up to about 3 inches in length) were also observed. A Greenland Shark was caught at 110 to 120 metres depth.

Benthos organisms were sampled using a horizontal scraper-type dredge at various depths and were found to be diverse. The most abundant organisms collected between 35 and 250 metres depth were brittlestars and coelenterate medusae. In depths of 10 metres or less, the most abundant invertebrate collected was sea urchins. The sampling also collected fish including various species of sculpins lumpsuckers and eelpouts, sea anemones, clams, scallops, whelks, snails, limpets, shrimp, barnacles, sea spiders, starfish, sunstars, sea feathers, sea cucumbers and polychaete worms.

Of the polychaetes, 24 distinct species were recognized and an additional 23 species were considered likely (identification of species was not possible due to physical damage caused to the specimens during sample collection). Other infauna collected included sipunculid worms, ostracods, copepods, clams and foraminifers. Plankton that was collected included primarily copepods, amphipods, coelenterate medusae, pteropods and arrow worms.

3.3.5 Sea Water Chemistry

Sea water chemistry was measured by BCRI at eight locations in Strathcona Sound up to 290 metres depth in August 1974. Sea water conductivity was relatively stable below depths of 5 metres to 10 metres and ranged from 24 to 27 mmho/cm. Conductivities near surface were slightly lower and ranged from 16 to 23 mmho/cm at 1 metre depth.

Temperatures generally declined with depth to approximately –1.5 degrees C at 100 metres depth. Below 100 metres depth, a reversal was observed and temperatures increased to as high as –0.6 degrees C near bottom at some deeper locations. Temperatures above 0 degrees C were not recorded below 30 to 50 metres depth.

Salinity was not measured directly during the 1974 study but was calculated by BCRI from established tables that interrelated salinity, temperature and conductivity. The calculated salinities indicated two ranges near surface with some locations indicating 14 to 15 ppt and other locations indicating 22 to 24 ppt at 1 metre depth. A general increase with depth was indicated to typically 31-33 ppt from 30 metres depth to bottom (up to 300 metres).

Maximum dissolved oxygen levels were observed between 5 metres and 30 metres depth and generally at around 10 metres depth. Dissolved oxygen levels generally declined to less than 5 ppm at 50 to 100 metres depth and to as low as 2 ppm near bottom at deeper locations. One monitoring station located in the vicinity of the "sill" reported a different trend with dissolved oxygen concentrations greater than 7 ppm throughout the water column.

Sea water pH was measured in a range from 7.5 to 8.2. A slight decreasing trend with depth was observed at one location.

Secchi disc visibility varied widely with location. Visibility was poorest (highest turbidity) at 6.0 and 6.5 metres depth near shore in the vicinity of the mine area. The greatest visibilities recorded were to 12.5 and 13.7 metres depth.

3.3.6 Metals in Sea Water

Water samples were collected by BCRI at various depths up to 290 metres at eight locations in Strathcona Sound in August 1974 and analyzed for concentrations of dissolved heavy metals.

Concentrations of lead, cadmium and nickel were uniformly less than the method detection limits of 5, 1 and 5 μg/L, respectively. Concentrations of arsenic, copper and iron were generally near or less than the method detection limits of 1, 1 and 2 μg/L, respectively. Concentrations of zinc ranged from 14 to 42 μg/L.

The metal concentrations in the 1974 study did not indicate any spatial or depth trends and did not suggest that concentrations were greater at the near shore location in the vicinity of the mine area.

3.3.7 Metals in Fish

Concentrations of lead, zinc, arsenic, cadmium, copper, iron and nickel were determined for fillets and livers of 14 shorthorn sculpins caught in August 1974 by BCRI.

Concentrations of lead, zinc, cadmium, copper, iron and nickel were determined for fillets and livers of 53 Shorthorn sculpins, 2 Arctic sculpins, 8 Fourhorn sculpins and 14 Arctic char caught in the summer of 1974 by Fisheries and Marine Service ("FMS"). The analyses were performed and reported by BCRI.

The following observations can be made from the data that was collected and summarized in Table 2.

1. The concentrations of all metals in all fish were uniformly greater in liver than in fillets with only a few exceptions for copper and iron;
2. The concentrations of lead, cadmium and nickel in fillets were uniformly (with only a few exceptions) less than the method detection limit and the concentrations of lead, cadmium and nickel in livers were primarily less than the method detection limit;
3. The concentrations of metals do not appear, on a preliminary basis, to have varied between fish species or between studies except that copper and iron in char livers were greater than in sculpins (statistical analysis has not been performed to verify significance of trends); and
4. The concentrations of metals do not appear, on a preliminary basis, to be directly related to weight or length of fish (statistical analysis has not been performed to verify significance of trends).

Analysis for zinc, lead, arsenic, cadmium, copper, iron and nickel was performed for samples of muscle, liver and kidney from one Greenland shark that was caught by BCRI in August 1974 at 110 to 120 metres depth. The concentrations of zinc, arsenic and nickel were greatest in the kidney at 56.0, 113 and 2.7 mg/kg, respectively. The concentrations of cadmium, copper and iron were greatest in the liver at 23.1, 12.3 and 385 mg/kg, respectively. The concentrations of lead were all below the method detection limits. The concentrations of metals in the shark muscle and liver appear to be generally similar to the ranges observed in fish with the exception of arsenic in shark muscle (102 mg/kg), which was greater than the range observed for sculpins (10.1 – 37.4 mg/kg).

3.3.8 Metals in Seaweed, Shrimp and Plankton

Six seaweed samples representing three varieties were collected by BCRI in 1974 and analysed for heavy metals. Samples were collected from four locations, one near shore in the vicinity of the mine area and three in a transect across the Sound just east of the mine area. The concentrations of zinc and lead were greatest at the near shore location (386 and 35.5 mg/kg, respectively) and decreased across the Sound to the north. The concentrations of arsenic, cadmium, copper, iron and nickel did not display any clear spatial trends (statistical analysis was not performed to identify significant trends). The concentrations of metals were generally greater in the seaweed *Fucus sp* as compared to *Agarum sp* and *Laminaria sp*. The identification of *Agarum sp* was not confirmed.

Table 2. Summary of 1974 Metals in Fish

Species	Sculpin	Shorthorn sculpin	Arctic sculpin	Fourhorn sculpin	Arctic char
Caught	Aug/74 BCRI	Summer 1974 FMS	summer 1974 FMS	summer 1974 FMS	summer 1974 FMS
Number	14	53	2	8	14
Length	16.5-30.8	21.7-39.3	23.9 (both)	25.6-35.5	21.0-64.4
Weight	0.08-0.51	0.155-0.920	0.200-0.220	0.240-0.720	0.078-2.480
Zinc – Fillet	28.1-100	28.9-85.7	42.9-46.9	32.9-67.5	13.7-37.0
Zinc – Liver	57.6-144	47.4-162	135-166	84.9-129	35.3-177
Lead – Fillet	<5-<16	<3.27-<8.01	<4.01-<4.20	<3.17-<7.07	<2.17-<8.13
Lead – Liver	4.6-<46	<2.82-<13.5	<6.42-<8.97	<3.64-<15.3	<3.61-<37.8
Arsenic – Fillet	10.1-37.4	Nr	nr	nr	Nr
Arsenic – Liver	14.2-64.8	Nr	nr	nr	Nr
Cadmium – Fillet	<0.5-1.6	<0.33-<0.80	<0.40-<0.42	<0.32-<0.71	<0.22-<0.81
Cadmium – Liver	<1.1-16.0	0.87-15.7	7.98-17.5	1.41-5.37	<0.36-2.30
Copper – Fillet	4.2-9.9	1.55-9.10	2.61-3.15	1.74-4.44	1.14-2.46
Copper – Liver	5.3-26.3	1.80-20.1	5.94-6.42	3.64-5.26	30.5-221
Iron – Fillet	27.3-176	26.4-347	87.8-131	31.3-82.7	16.1-34.3
Iron – Liver	39.4-312	33.6-196	117-225	75.6-167	639-6473
Nickel – Fillet	<3-<8	<1.63-<4.00	<2.00-<2.10	<1.58-<3.53	<1.08-<4.06
Nickel – Liver	<2-<19	<1.41-<6.75	<1.85-<3.21	<1.82-<7.65	<1.80-<18.9

BCRI = B.C. Research Inc.

FMS = Fisheries and Marine Service

All concentrations mg/kg dry weight

nr = not reported

Seaweed samples were collected by FMS in August 1976 at one location approximately 1.0 kilometre offshore from the mouth of Twin Lakes Creek. The concentrations of lead and zinc in washed whole plants were 2.1 and 88.4 µg/g in *Fucus* and 3.19 and 36.0 µg/g in *Laminaria*. These concentrations are lower than those reported for a similarly located station that was sampled by BCRI in 1974 although the BCRI station may have been closer to shore. Seaweed (*Fucus*) was also sampled by FMS near Arctic Bay in 1976 as a reference location. The concentrations of lead and zinc in this sample were 2.11 and 23.8 µg/g, which were similar for lead but less for zinc as compared to the sample location in Strathcona Sound.

Three species of shrimp were collected by BCRI in August 1974 at 165 to 250 metre depth from an east-west oriented “sled tow” just west of the mine area. Three species composite samples comprised of 8, 2 and 5 members of each species were analysed for heavy metal concentrations. The data does not indicate a clear trend in metal concentrations with respect to shrimp species.

Plankton samples were collected by BCRI in August 1974 from a “vertical tow” located adjacent to the shrimp sampling location. The concentration of zinc was greater in plankton than in the shrimp. The concentrations of arsenic and copper were less in plankton than in the shrimp. The concentrations of lead, cadmium, iron and nickel were similar for plankton and shrimp.

3.3.9 Metals in Sea Urchins, Molluscs and Invertebrates

The sea urchin *Strongylocentrotus droebachiensis* was collected by FMS on two occasions in 1976 (May and August) and analysed for heavy metals. One sample site in Strathcona Sound was located approximately 1.0 kilometre off shore from the mouth of Twin Lakes Creek. Group sizes containing from 1 to 8 individuals returned concentrations of zinc and lead that ranged from 33 to 65 µg/g, and from <0.23 to 2.09 µg/g, respectively. The concentrations of zinc and lead were similar in May and in August although the August concentration of zinc was slightly greater.

The same species of sea urchin was also collected by FMS in August 1976 from a reference location near Arctic Bay. The concentration of lead in this sample was greater than in Strathcona Sound (7.2 µg/g) and the concentration of zinc was similar (36 µg/g). Different techniques for pooling of organisms for analysis were used that make a direct comparison between the Arctic Bay and Strathcona Sound samples less certain.

Bivalve molluscs and gastropods were collected by FMS in August 1975 at a location in Strathcona Sound approximately 1.0 kilometre offshore from the mouth of Twin Lakes Creek. Concentrations of lead and zinc in 10 species ranged from <0.22 µg/g to 2.94 µg/g and from 51 µg/g to 872 µg/g, respectively.

3.3.10 Metals in Marine Sediments

Sea bottom sediments were observed to consist primarily of "compacted clay" except near stream mouths where gravel was predominant. Three suites of sediment samples were collected by different organizations in 1974 and 1975. The results of metal analyses are not directly comparable between studies because of differences in the size fraction analysed (whole sample versus one specific size fraction), sampling method (all used sample dredges of some type but different depths of sediment would have been collected by each), and variations in sampling locations. Nonetheless, the sample suites can be cross referenced in a broad sense to provide an indication of background metal concentrations.

Sediment samples were collected at 14 locations in Strathcona Sound in August 1974 by BCRI and were analysed for heavy metals. In this study, concentrations of zinc and lead were greatest at the near shore location in the vicinity of the mine at 171 and 19.3 mg/kg, respectively. Concentrations of arsenic, copper, iron and nickel were greatest at other off-shore locations at 7.9, 27.9, 34,000 and 25.7 mg/kg, respectively. Concentrations of cadmium were all less than the method detection limit of 0.4 mg/kg. Metal concentrations were uniformly lowest at one location near the south shore of the Sound in the vicinity of the "sill". The bottom sediments at this location were described to be sandy, which may relate to the lower metal concentrations as compared to clayey (i.e. finer grained) soils described elsewhere. BCRI does not indicate whether the analyses were on a fine fraction or whole sample basis.

Sediment samples were collected in September 1974 by FMS at a location approximately 1.0 kilometre offshore from the mouth of Twin Lakes Creek and the size fraction <180 μm was analysed for heavy metals. This sample returned concentrations of zinc and lead of 155 and 20 μg/g, respectively, which were similar to the results reported by BCRI for a similar location.

Sediment samples were collected in August 1975 by the Geological Survey of Canada (GSC) at numerous locations in Strathcona Sound and some of the results were reported by DFO where the sampling locations corresponded reasonably closely with the 1974 DFO location. The 1975 sediment sampling close to the FMS/DFO station located approximately 1.0 kilometre offshore from the mouth of Twin Lakes Creek returned zinc and lead concentrations of 175 and 18 μg/g, which were similar to those reported by DFO and BCRI in that area in 1974. The size fraction analysed was the same as that used by FMS/DFO in 1974 at <180 um.

The 1975 sediment sampling by GSC also included other locations in Strathcona Sound where samples were analysed variously on a whole samples basis, the finer than 2 um size fraction or the finer than 180 um size fraction. The results do not indicate any clear spatial trends. The greatest concentration of zinc (175 μg/g) was measured in the vicinity of the mouth of Twin Lakes Creek but the greatest concentrations of lead, cadmium, arsenic and copper were measured at other locations. This sampling program confirmed the general expectation that metals are concentrated in the fine fraction.

3.4 Terrestrial Environment

3.4.1 Vegetation

A field study of vegetation in the mine area was conducted in July 1974 by BCRI. Study sites were selected to be representative of the range of plant communities in the area. Quadrats measuring 0.5 X 2.0 metres were studied for elevation, aspect, percentage and types of ground cover and identification of vegetation species.

The plant community in the mine area was found to be predominantly contain of the following species:

1. *Salix arctic*a (Arctic Willow);
2. *Dryas integrif*olia (Arctic or Mountain Avens);
3. *Carex rupestris* (Sedge);
4. *Ploygonum viviparum* (Alpine Bistort);
5. *Saxifraga oppositifolia* (Purple Saxifrage);
6. *Eriphorum* (Cottongrass);
7. Moss (several species);
8. Lichen (several species); and
9. Other vascular, bryophyte, lichen and moss species were also identified during the ground surveys.

The ground surveys resulted in the definition of five classes of land areas based on vegetation density and species (Table 3). The study area and the land classifications are illustrated on Figure 9.

Table 3. Ground Cover Classifications

Land Classification	Percentage of Study Area
Dry Ridge	96.5%
Alluvial	1.9%
Meadow	0.9%
Mid Slope	0.4%
Moss-Lichen	0.3%

The Dry Ridge ground cover dominates the mine area (96.5%). This type of ground cover was characterized by sparse vegetation consisting of only a few species such as Arctic willow, Avens and purple saxifrage. The ground surface commonly showed evidence of frost heaving and rock polygons. The areas mapped as dry ridge can contain small isolated pockets of denser and more varied vegetation where finer soils or other factors are present, which allow surface moisture retention.

The Alluvial ground cover was found on sloping topography and was characterized as containing approximately 34% ground cover comprised primarily of Arctic willow and Avens. These areas were observed to appear “streaked” on air photos due to the linear distribution of vegetation.

The Meadow ground cover was found in flat areas or surface depressions where finer soils could accumulate and retain moisture. These areas were characterized as containing the densest vegetation cover observed (average 65%) comprised primarily of vascular species but no lichens.

The Mid Slope ground cover was identified as dryer than Alluvial but not as barren as Dry Ridge. The Mid Slope areas were characterized by low density of ground cover (average 10%) with the vegetation occurring in clumps separated by bare ground. Four species of vascular plants and moss were identified in these areas.

The Moss-Lichen ground cover was identified only on the north slope of Mount Fuji, west of the (future) townsite. This area was characterized by dense coverage comprised primarily of moss. Five species of lichen and five species of vascular plants were also identified in this area.

3.4.2 Soil Description

Soil studies were conducted by BCRI in conjunction with the 1974 vegetation mapping. Test pits were excavated at seven select vegetation sampling locations that were representative of four of the five types of ground cover (Table 3). The Alluvial area was not sampled. Four of the soil sample sites were within the Dry Ridge areas, which occupied 96.5% of the study area.

Soil moisture varied widely between the various types of ground cover. Soil in the Meadow area was wet with a water table near surface. Soil in the Mid Slope and Moss-Lichen areas was moist but no free water was observed. Soil in the Dry Ridge area was generally dry at surface although some isolated moist areas were also observed.

Soil texture was observed to vary widely based, primarily, on the underlying bedrock. Dolomitic rock was observed to produce a relatively small amount of fine material whereas shale was observed to produce abundant fine material. Sample sites were also noted as often having an unweathered surface “capping” overlying finer material.

Permafrost was identified in some of the test pits. The active layer was thinnest (25 cm) in the Moss-Lichen area on the north slope of Mount Fuji. At other locations, the thickness of the active layer varied from 60 cm to greater than 85 cm (i.e. permafrost not encountered).

3.4.3 Soil Geochemistry

Naturally occurring sulphide mineralization at surface is well documented throughout the mine area. For example, sands in the area, including the bottom of West Twin Lake, can be stained red due to oxidation. Further, natural exposures of mineralized, oxidized, weathered or gossan rock have been mapped in the area immediately north and northeast of the town, along the Area14 road, in Twin Lakes Creek and in other areas (including the Area14 and Oceanview mining areas).

An extensive survey of metal concentrations in surficial soils throughout the mine area was conducted as part of mineral exploration activities in 1985 and this survey is described fully in the Phase 3 ESA Report (Appendix H).

The 1985 soil geochemistry survey covered a broad area of approximately 336 km^2. The area of coverage is illustrated on Figure 10 and extended from just north of the airport to Strathcona Sound and from approximately 6 km west of Nanisivik to approximately 10 km east of Nanisivik. Over 1,300 soil samples were collected and analysed throughout this area. Samples were analysed for zinc, lead and copper at the on-site laboratory using a detection limit of 20 ppm. This data has documented the range of metal concentrations that were naturally present in surface soils.

Mining activities had been underway at the Nanisivik mine for approximately nine years prior to the 1985 soil survey that included: open pit mining at the West Open Pit; underground mining at the main lens; mining at Area 14; underwater tailings deposition in West Twin Lake; operation of the concentrator plant and associated facilities; operation of the concentrate storage shed and ship loading facility; operation of the town and ancillary facilities; and operation of the landfill. The effects of these mining activities on the 1985 data is considered to be negligible with the exception of soil sampling locations within the immediate driving and working areas of the industrial complex, the concentrate storage facility and the townsite.

The 1985 soil survey data is an important source of information that was directly relevant to both the ESA process and the Human Health and Ecological Risk Assessment (HHERA) process and its use in those processes is described fully in the ESA (Appendices G and H) and HHERA (Appendix I) Reports.

Metal concentrations over the entire 1985 Survey area are summarized in Table 4. For this summary, metal concentrations that were reported as “<20” were included into the summary calculations as 20 mg/kg (ppm), which is a conservative approach to managing data reported at a detection limit. The data set clearly shows that some sample concentrations are well above the generic federal guidelines for soil quality, which is in general agreement with well documented observations of natural mineralization. A full description of the data is provided in the Phase 3 ESA Report (Appendix H)

Table 4. Summary of 1985 Survey Metal Concentrations

	Entire Survey Area (1,304 samples)		
	Lead	Zinc	Copper
Maximum	12,154	2,545	1,974
Minimum	<20	<20	<20
% less than detection	40%	61%	26%
Average	108	112	74
CCME Generic Tier 1 Guideline for RL/PL Use (1999)	140	200	63

Notes: All units are mg/kg (ppm) unless stated otherwise.

3.4.4 Mammals

A quantitative evaluation of mammals in the mine area could not be undertaken by BCRI due to the low mammal density in the area. Small mammal traps were set near the (future) townsite and near the airport in late July 1974 but no animals were caught. Nonetheless, mammal observations were recorded during the course of the 1974 terrestrial studies.

Signs of four mammal species were observed: lemming, Arctic fox, Arctic hare and caribou.

Lemming signs consisted of small mammal runways, straw piles (winter shelters) and droppings. These were observed in the Meadow, Moss-Lichen and Dry Ridge areas (Table 3). Two Arctic fox scats were observed. Arctic hare pellets were observed in one location. Caribou were not seen in the study area but past presence was indicated by “very old” antlers located near the airport. BCRI reported that one resident of Arctic Bay (Isaac Attagutsiak) indicated that he had not seen caribou in the area since 1948.

Anecdotal evidence collected during mine operations indicates that Polar Bears have occasionally passed through the mine area enroute to feeding locations (in the order of once per 5-6 years). The bears did not stop in the mine area or make attempts to hunt or feed in the mine area.

3.4.5 Birds

Observations made by BCRI in late July 1974 reported seven migratory and one non-migratory species of birds in the mine area: snow bunting, ptarmigan, Baird’s sandpiper, snow goose, eider duck, semipalmated plover, jaeger and raven (non migratory). BCRI reported that the Borden Peninsula had previously been identified as an important breeding area for some migratory species including three of the species observed in the mine area ptarmigan, Baird’s sandpiper and snow goose.

The snow bunting was the most common species observed with 22 birds seen. The mine area was observed to include most of the typical types of habitat used by snow bunting including coastal areas, rough stony terrain and mossy areas.

Snow geese were observed in 1973 (mine personnel) and 1974 using Kuhulu Lake and some Meadow areas (Table 3). Droppings were generally observed in the Meadow areas. Seven eider ducks were observed in July 1974 on Twin Lakes and a total of 60 were seen during aerial census flights of seabird colonies. Ptarmigan droppings were observed in two locations in the study area. One pair of semipalmated plovers was observed in July 1974 on an alluvial fan west of Twin Lakes. One pair and one individual Baird's sandpiper were observed in Meadow and Dry Ridge areas (Table 3). One observation of long-tailed jaeger flying over Strathcona Sound was recorded in July 1974.

Four ravens were seen during the terrestrial studies. Raven was the only species observed in the mine area that was classified by BCRI as non-migratory.

3.4.6 Fresh Water Fisheries

Fresh water fisheries were studied by Fisheries and Marine Service (FMS) in 1974 but a report on this study was not available for inclusion into this current document. BCRI indicated that the FMS study identified a land-locked population of Arctic char in Kuhulu Lake and also found that no fish were present in East and West Twin Lakes.

3.4.7 Fresh Water Invertebrates

Invertebrate sampling was undertaken by BCRI in July 1974. Samples were collected at two locations in Twin Lakes Creek (in the upstream area just below East and West Twin Lakes and at the mouth), at the mouth of Kuhulu Creek and at the mouth of a reference Creek west of Twin Lakes Creek. Five samples were collected at each location.

Only a few individuals of three species were found, indicating "low productivity and low community stability".

3.4.8 Lake Bathymetry and Chemistry

Bathymetric maps were prepared by BCRI for Kuhulu Lake and West Twin Lake. Kuhulu Lake was found to be 204 feet (62 metres) deep with a somewhat symmetrical basin shape. West Twin Lake was found to include two internal basins that were 60 feet (18 metres) and 70 feet (21 metres) deep and that were separated by a "sill" at approximately 35 feet (11 metres) depth.

Water chemistry profiles were measured for Kuhulu Lake, East Twin Lake and West Twin Lake (three locations).

At the time of the lake sampling in July 1974, thermoclines were not observed in any of the lakes. Lake water temperatures were stable with depth in all lakes and ranged from 3 to 6 degrees C. Dissolved oxygen concentrations were also stable with depth in all lakes. Dissolved oxygen ranged from 12.8 to 13.4 ppm in West Twin Lake, from 11.6 to 11.7 ppm in East Twin Lake and from 12.1 to 12.8 ppm in Kuhulu Lake.

Lake water was relatively soft but varied slightly between lakes. Hardness was measured in a range from 22 to 29 mg/L $CaCO_3$ in West Twin Lake, from 11 to 13 mg/L $CaCO_3$ in East Twin Lake and from 76 to 91 mg/L $CaCO_3$ in Kuhulu Lake.

Total organic carbon was measured at 1 and 2 mg/L in all lakes with the exception of one sample near the bottom of Kuhulu Lake which measured 6 ppm. Nutrient concentrations in West Twin Lake were relatively low at 0.047 mg/L nitrogen (NO_3) and <0.005 mg/L phosphorus (PO_4).

Heavy metal concentrations in the lakes are described in Section 3. 4.10.

3.4.9 Stream Morphology and Chemistry

Twin Lakes Creek is the largest creek in the mine development area. Strathcona Creek is the largest creek in the regional study area but is located on the north shore of Strathcona Sound and is not affected by mine development. The creeks in the mine area are relatively steep with average gradients in excess of 5% and greater than 10% in some locations.

Twin Lakes Creek drains East and West Twin Lakes into Strathcona Sound and passes between the (present) townsite and mill/west adit areas. Twin Lakes Creek was reported by BCRI to have a length of 7.3 kilometres, an average gradient of 5.1 percent and a maximum gradient of 23.5 percent. Two steep cascades are present in the area of the (current) 09 and 02 portals. The bedload at the mouth of Twin Lakes Creek was measured to be very coarse and contains 55% pebble, 24% gravel, 21% med to coarse sand and <1% fine sand-silt-clay. This bedload sizing was similar to that observed in a reference creek located west of Twin Lakes Creek and in Kuhulu Creek although a greater proportion of fine sand (3%) was observed in these two creeks.

Chris Creek drains the area east of East Twin Lake to Strathcona Sound and collects drainage from the (current) Area14, K-Baseline, and east adit mining areas. Chris Creek was reported to have a length of 4.7 km, an average gradient of 7.7% and a maximum gradient of 20.0%.

The chemistry of water in various creeks in the mine area and in reference areas was analysed in late July 1974. Heavy metal concentrations were also determined and are described in Section 3. 4.10.

Some parameters were relatively uniform for all streams. Water temperatures ranged from 3 degrees C to 10 degrees C. Water pH as measured in the field was neutral and ranged from 7.4 to 8.3. Dissolved oxygen concentrations ranged from 10.6 to 13.5 ppm. Total organic carbon ranged from 1 to 10 ppm.

Hardness varied among the sampled streams. Hardness was less than 60 mg/L $CaCO_3$ in Twin Lakes Creek and in two reference creeks on the north shore of Strathcona Sound (including Strathcona Creek). Hardness was greater than 60 mg/L $CaCO_3$ (maximum 105 mg/L $CaCO_3$) in Chris Creek and in other unnamed creeks on the south shore of Strathcona Sound.

Conductivity on Twin Lakes Creek increased from 28 mmhos/cm just downstream of East and West Twin Lakes to 103 mmhos/cm at the mouth. Conductivities in all of the other creeks ranged from 69 to 301 mmhos/cm with no apparent differences between creeks in the mine area and reference creeks. The lowest conductivity (69 mmhos/cm) was recorded in a reference creek on the south side of Strathcona Sound east of the mine area. The maximum conductivity (301 mmhos/cm) was recorded in a tributary to Twin Lakes Creek north of the (future) townsite.

Turbidity varied from 0.4 ppm SiO_2 in upstream Kuhulu Creek near the outlet of Kuhulu Lake to 58 ppm SiO_2 in Strathcona Creek on the north side of Strathcona Sound. Turbidity in Twin Lakes Creek was relatively low at 6.9 ppm SiO_2 upstream and 4.3 ppm SiO_2 downstream.

There was a wide range in total suspended solids (TSS) among the creeks. Several creeks (including Twin Lakes Creek) contained very low TSS (less than 3 ppm). TSS was measured as high as 83 ppm in Strathcona Creek on the north side of Strathcona Sound. There was also a wide variation in total dissolved solids (TDS) among the creeks from a low of 27 ppm in upstream Twin Lakes Creek to a high of 178 ppm in a tributary creek to Twin Lakes Creek north of the (future) townsite.

3.4.10 Metals in Surface Water

A suite of surface water samples was collected by BCRI in late July 1974 from 12 locations that included Twin Lakes Creek, Chris Creek and other streams in the area on both the north and south shores of Strathcona Sound. Samples were also collected at two depths (surface and bottom) in Kuhulu Lake and at three depths (surface, middle and bottom) in East Twin Lake and at two locations in West Twin Lake. The samples were analysed for dissolved concentrations of zinc, lead, arsenic, cadmium and iron.

There were a number of sites where discolored water was observed flowing into creeks in the area of the future minesite. These sites included Chris Creek below the (future) east adit area, Twin Lakes Creek north of the (future) townsite and runoff entering the northwest side of West Twin Lake.

The metal concentration data generally indicates that metal concentrations in Twin Lakes Creek and Chris Creek were elevated above reference locations and that the metal concentrations in Chris Creek were generally greater than in Twin Lakes Creek. The greatest concentrations of zinc, arsenic and cadmium were alternately measured in a tributary to Twin Lakes Creek north of the (future) townsite and a tributary to Chris Creek near the (future) east adit area. The metal concentrations in Kuhulu Lake, East Twin Lake and West Twin Lake were similar to the reference locations.

Concentrations of arsenic were all less than the method detection limit of 5 μg/L.

Zinc concentrations at all reference locations (i.e. excluding Twin Lakes Creek and Chris Creek and their tributaries) ranged from 9.0 to 40 μg/L. This includes all of the samples from Kuhulu Lake, East Twin Lake and West Twin Lake. Strathcona Creek contained 90 μg/L zinc. One tributary to West Twin Lake on the northwest side contained 80 μg/L zinc.

The water samples from Twin Lakes Creek and Chris Creek and their tributaries contained greater concentrations of zinc than other locations. The highest concentration was measured in a tributary to Twin Lakes Creek north of the (future) town site and was 54,000 μg/L. The second greatest concentration of zinc measured was a tributary to Chris Creek near the (future) east adit area and was 15,000 μg/L. The concentrations of zinc at the mouths of Chris and Twin Lakes Creeks were 700 μg/L and 150 μg/L, respectively.

The spatial variability of lead concentrations was generally similar to that for zinc. The exception was the concentration of lead at the mouth of Twin Lakes Creek was the same as observed at the reference locations (range from 0.7 μg/L to 1.0 μg/L). The greatest concentration of lead measured was in the northwest tributary to West Twin Lake at 110 μg/L. Lead in Strathcona Creek was slightly elevated at 2.0 μg/L. The concentration of lead at the mouth of Chris Creek was slightly elevated at 1.6 μg/L.

The spatial variability of cadmium was generally similar to that for zinc and lead. The exception was that the concentration of cadmium in the northwest tributary to West Twin Lake was the same as at the reference locations (range from 0.1 to 0.3 μg/L). The greatest concentration of cadmium measured was in the tributary to Twin Lakes Creek north of the (future) townsite at 140 μg/L. The concentrations of cadmium at the mouths of Chris and Twin Lake Creeks were slightly elevated at 2.2 and 0.4 μg/L, respectively.

The spatial variability of iron was different than that for zinc, lead and cadmium in that all of the sample locations except two were within the range of 3.4 to 49.0 μg/L, including all of the lake samples. The highest concentration was measured in the tributary to Twin Lakes Creek north of the (future) townsite at 3,350 μg/L. Strathcona Creek was also slightly elevated at 100 μg/L.

Samples were also collected at the mouth of Twin Lakes Creek by FMS in 1974, 1975 and 1976. One sample was reported for each year that is assumed to have been collected in summer. These samples contained dissolved zinc concentrations of 223, 236 and 47 μg/L in 1974, 1975 and 1976, respectively. These concentrations are in general agreement with the sampling by BCRI as described above wherein the concentration of dissolved zinc at the mouth of Twin Lakes Creek was measured to be 150 μg/L in July 1974.

4. Description of Mining Process

4.1 Mine Development Sequence

Most of the mine facilities were constructed from 1974 to 1976 during the initial development of the mine. There were also some modifications and additions, however, to the facilities through the life of the mine and additional mining areas developed. Table 5 provides an outline of the sequence of construction, major modifications, mining sequence and major closure milestones that was initially provided in the Phase 2 ESA Report (Appendix G).

Table 5. Sequence of Major Events

1974-1976	Initial mine development including town housing, dome cafeteria, town centre, school, church, bunkhouse building, industrial complex, concentrate storage shed, tank farm, STOL air strip, freshwater supply system
1974	Begin operations at landfill site
1975	Begin flight operations at STOL air strip
1976	Begin tailings deposition in West Twin Lake
1976	Begin mine production underground
1976-1977	Jet airstrip/airport constructed
1980 – 1995	West Open Pit mined
1982	Ship loading conveyor enclosed
1983 – 1987	Area 14 mined
1985	Soil geochemistry survey
1986 – 2001	East Open Pit and East Trench mined
1987 – 1990	K-Baseline mined
1988	Tailings/waste rock geothermal profiling begins with testing of reclamation covers
1989	East Adit water treatment facility constructed
1990	PAMO apartment building constructed
1990	Construction of West Twin Dike and creation of the “Surface Cell”
2000-2002	Oceanview mined
2000/2001	Dense Media Separation (DMS) plant constructed
September 2001	Mine closure announced for September 2002
February 2002	February 2002 Closure and Reclamation Plan submitted to Nunavut Water Board
July 2002	Water Board Hearing in Arctic Bay
Summer 2002	Phase II Environmental Site Assessment
September 2002	Cessation of mining and milling operations

September 2002 – November 2003	Human Health and Ecological Risk Assessment
December 2003	Completion of technical studies for closure and reclamation planning
August 2003 – January 2004	Phase 3 Environmental Site Assessment
February 2004	Submission of Mine Closure and Reclamation Plan

4.2 Geology

The Nanisivik sulphide deposits are hosted in carbonate rocks within a Proterozoic sedimentary sequence. This sequence developed as a Neohelikian intracratonic basin, the Borden Basin, on a peneplaned gneiss complex of Archean-Aphebian age.

The present Borden Basin sequence consists of generally shallow water clastic and carbonate sediments up to 6,100 metres thick, called the Bylot Supergroup. The Supergroup is divided into three Groups, a lower clastic group (the Eqalulik Group), a middle carbonate group (the Uluksan Group) and an upper clastic group (the Nunatsiaq Group).

The Uluksan Group is made up of the lower Society Cliffs Formation and the upper Victor Bay Formation. The Society Cliffs Formation varies in thickness from 260 metres at Arctic Bay to 856 metres at Tremblay Sound. West of Tremblay Sound, it was deposited in a subtidal to intertidal environment. The Society Cliffs Formation is conformably overlain by the Victor Bay Formation, which consists of shales, siltstones, dolostones and coarse carbonate clastics and varies in thickness from 156 metres to 735 metres. The Victor Bay Formation is considered to have acted as a cap rock to mineralization in part of the mine area. All of the economic mineralization at the Nanisivik mine lies within the upper member of the Society Cliffs Formation.

The Nanisivik mine property is up to 7 km wide and up to 15 km long. Rocks cropping out on the property include small exposures of quartzite of the Adams Sound Formation on the southern edge of the lease area. The unit immediately below the Society Cliffs Formation, the Arctic Bay Formation, crops out in the area but is not exposed on the property. The main units exposed are the Society Cliffs Formation and the overlying Victor Bay Formation, together with Paleozoic sandstones of the Gallery Formation.

In the mine area, dips are usually quite shallow and the main structure is faulting. Major structures that are recognized in the mine include the South Boundary Fault, which marks the southern margin of sulfide mineralization, and the Keystone Graben Fault, which defines the southern margin of the Main Ore Zone horst.

The various massive sulphide deposits contain more than 50 million tonnes of which barren massive pyrite bodies occupy most of the area and contain the largest sulphide tonnages. Zones containing sphalerite are present within the massive pyrite bodies, but are confined to a restricted vertical interval. All of the known significant sphalerite deposits are in horsts adjacent to the Keystone Graben.

The South Boundary Zone is wedge-shaped and consists of massive pyrite. It is controlled by the South Boundary Fault. The Main Ore Zone is an elongated, sinuous, lenticular body, hosted in carbonate, with a nearly horizontal upper contact. A number of bodies are irregular subvertical veins, while some other bodies underlie gently dipping shale contacts. These variations in structural style occur both in the massive pyrite and in the sphalerite zones.

Each of the sphalerite-rich ore bodies is confined to a restricted vertical interval that varies in thickness and elevation from zone to zone. Flat sulphide contacts cut at low angles across dolostone bedding and sulphides rarely follow the beds.

The Main Zone deposit is about 3 km long. It is oriented east-west, although it is sinuous in plan. The deposit is broadly 'T' shaped, with a flat-topped upper section that is typically about 100 metres wide and 20 metres high. A remarkable feature of this deposit is the constant elevation of the top of the deposit over its entire length. The keel section of the deposit extends to about 80 metres below the upper section. While it is subvertical, no obvious controlling structures have been recognized to date. In places, flat-lying “wings” of sulfides extend out laterally from the keel zone.

Internal structures in the ore zones tend to be complex, and range from massive and banded to chaotic or brecciated. Banding tends to be subhorizontal in both the upper section of the Main Zone and the keel section of the deposit, but it may be parallel to dipping dolostone contacts in some areas. As well, the ore is porous in places and large irregular zones of ice are present in some faces underground.

The accepted geological model is that the Nanisivik deposits are Mississippi-Valley Type ("MVT"). By definition, these are post-depositional, carbonate hosted deposits. Typically, they are coarse-grained and mineralogically simple. They tend to be sphalerite-rich, may be very large and may contain high base metal grades. However, MVT deposits include quite diverse deposits, different in shape, grade and mineralogy. This diversity appears to result from source fluid chemistry, rocks through which the fluids pass prior to deposition, source fluid temperature and the nature of the depositional environment.

4.3 Mining

Open Pits

There are four small open pits on the property as follows:

- The Oceanview pit is located north and east of the East Adit area;
- The East Open Pit is located in the East Adit Area adjacent to the 39 portal that connects to the primary underground workings;
- The East Trench is located adjacent to and east of the 88 portal in the East Adit area. The East Trench is a relatively small trench with minor underground mining into the trench wall. This underground mining did not connect with the primary underground mine workings; and
- The West Open Pit is located in the West Adit Area, between the 00/01 portals and Twin Lakes Creek.

Underground Mines

Main Lens

The mining method was drill and blast in ore using standard trackless equipment (jumbo drills, remote scoop trams, and haulage trucks). Ore was hauled to an underground pass that controls ore flow to the primary and secondary crushers. All crushing takes place in the underground mine and the crushed ore was moved to surface via a conveyor system. Since the mine is located in permafrost, there is no water pumping requirement.

The primary underground mine workings are located immediately east of the mill. The workings extend in an approximate northeast-southwest direction. There are eight openings to surface:

1. 00 portal: West Adit area – ventilation;
2. 01 portal: West Adit area – primary vehicle access west side;
3. 09 portal: West Adit area – alternate (summer) vehicle access;
4. lower portal: West Adit area – ore conveyor to the mill;
5. 17N portal: currently unused vehicle access;
6. shale hill vent raise: East Adit area – ventilation;
7. 39 portal: East Adit area – no longer accessible (crown pillar mined); and
8. 88 portal: East Adit area – primary vehicle access.

The Main Lens mined at the Nanisivik Mine was flat lying and outcropped on surface at both ends of the zone. The geometry of the mineralized body and the presence of permafrost permitted large underground excavations and the use of large scale mining equipment. In the Main Lens, where the dimensions of the mineralized zone are up to 150 metres in width and 20 metres in height, the primary mining method was room and pillar. For the other zones adjacent to the Main Lens, the mining methods were drift and slash stoping with some cut and fill stoping. The same mining equipment was used in these zones as in the Main Lens. The extent of the undergound workings is shown on Figures 2 and 11.

Stope backfill consists of low grade material sourced from surface stockpiles, development waste or shale from surface. Water was applied to the surface of the backfill, which would freeze generally within two days to form a strong working surface.

Nanisivik was a unique mine in that dry drilling was used due to the permafrost (the rock temperature is minus 12°C). Dust collectors were required on drilling equipment in order to keep respirable dust within acceptable safety limits. Most blasting at Nanisivik was done using ANFO, non-electric delay detonators, and detonating cord, fired with an electric cap.

Other Underground Developments

Three small underground mines were developed at the K-Baseline, Oceanview and Area 14 sites. There is one entrance to each of these workings and the Oceanview workings has one ventilation raise to surface. There was also minor underground drift development at the East Trench. None of these workings connect with each other or with the Main Lens development workings.

4.4 Metallurgical Processing

The mill has a proven capability of processing 780,000 tonnes per year using conventional crushing, rod and ball mill grinding, differential lead and zinc flotation, and concentrate drying. The mill process flowsheet is presented in Figure 12. The mill is 26 years old. Waste heat from the diesel power generators heated the buildings and dried the concentrates.

Run-of-mine ore was crushed in an underground jaw and cone crusher circuit. The crushed ore was stored underground to prevent thawing. From the underground bin the ore was conveyed to the mill. Here it was pre-concentrated in a Dense Media Separation circuit to remove waste rock from the ore. Then the up-grade ore passed through a rod and ball mill circuit to liberate the contained minerals, prior to reagent addition and selective flotation.

Lead flotation was carried out in one rougher and three cleaning circuits, using conventional flotation reagents. Zinc flotation was carried out in a rougher/scavenger circuit using conventional zinc flotation reagents, with the final concentrate being produced from a three stage cleaning circuit. Since mid-1997, all zinc rougher concentrates were reground in a zinc regrind mill.

Lead and zinc flotation concentrates were thickened, filtered and dried in rotary dryers to about 5% moisture, using waste heat from the power plant. The concentrates were trucked approximately three kilometres to the 125,000 tonne capacity storage shed at the dock site.

Flotation tailings were pumped through a four kilometre pipeline to the West Twin Disposal Area ("WTDA"). Process water for the mill was recycled from the concentrate thickeners and the reservoir portion of the WTDA. Water from the WTDA was pumped to the mill in an overland insulated HDPE pipeline. The relatively small amount of freshwater that was required for processing was pumped from East Twin Lake using the same pumping system that provided fresh water to the town.

CanZinco commissioned a dense media separation (DMS) plant in July, 2001. The plant was designed to blend mine plan, grade ore with run-of-mine resources. The waste rock (gangue) is rejected from the DMS feed, so the product from the plant is an up-graded mill feed. Process results during February 2002 reported the DMS feed at 8.20% zinc and the subsequent mill feed grade at 11.5% zinc. The dry reject (gangue) from the plant was returned to the underground mine as backfill.

The grades of the mill feed lead and zinc circuits and the final tailings streams are continuously monitored by an on-stream XRF analyzer.

Chemicals that were used in the mill as process reagents were as follows:

1. Lime (2300 g/t) was used to modify the pH of the ore so that pyrite (iron sulphide) particles were not recovered in the marketable concentrates;
2. Copper Sulphate (500 g/t) was used to activate the surface of zinc (sphalerite) particles so that they could be selected and recovered in the zinc circuit;
3. Xanthate (100 g/t) was used in the flotation circuits as a collector to coat and select lead and activated zinc particles (galena and sphalerite) so that they were recovered to the concentrates; and
4. Methyl Isobutyl Carbinol (MIBC) (3 g/t) was used to stabilize the air bubbles (froth) in the flotation circuit so that the recoverable mineral would float.

The reagents were shipped to the site by ocean freighter and transferred to land for outdoor storage. The mill reagents were stored outside in a designated area adjacent to the concentrate storage shed. The reagents were transported to the mill in weekly allotments and mixed/dispensed from a controlled area inside the mill.

4.5 Tailings Disposal

Flotation tailings were deposited within the West Twin Disposal Area ("WTDA") located approximately 4 km to the south of the mill building.

Tailings were deposited sub-aqueously (underwater) during the first 14 years of operation in West Twin Lake. In 1990, the West Twin Dike was constructed, which divided West Twin Lake into two cells: the

Surface Cell in the western portion of the original lake; and the Reservoir in the eastern portion of the lake. Since 1990, tailings have primarily been placed sub-aerially (on surface) within the Surface Cell with a smaller quantity of tailings continuing to be deposited under water in the Reservoir. In 1998 a portion of the Reservoir known as the Test Cell (geothermal testing area) also began to receive surface tailings disposal as part of closure planning (to achieve desired drainage contours) (Figure 13).

The West Twin Dike is 18 m high at a nominal elevation of 388 m above sea level (“asl”). The dike was constructed of shale rock and tailings using an upstream construction method with small lifts being placed on an annual basis. As part of the operation of the WTDA, some tailings were placed along the toe of the dike to ‘push’ standing water away from the dike.

The operating plan for the Surface Cell was designed to encourage continuous freezing of the settled tailings and pore water by placing successive thin layers of tailings. The surface of the tailings has been contoured so surface runoff flows to the southern perimeter. Water was then syphoned from the Surface Cell into the Reservoir.

Water from the Surface Cell as well as runoff water from the West Twin watershed reported to the Reservoir. At closure the Reservoir remains a pond with tailings submerged below water, except in small littoral areas.

The Test Cell dike isolates one portion of the Reservoir that was developed as an area for testing covers for reclamation of tailings. This dike was constructed in a similar manner to the West Twin Dike. The nominal elevation of the dike is 375.5 m asl.

4.6 Manpower

Nanisivik Mine typically employed 200 people at the mine when it was operating. Most employees worked a rotation that allowed for eight weeks of work followed by four weeks of rest off site. While on site, employees worked a variety of five, six and seven day shift schedules, with most employees working either ten or twelve hours per day, depending upon operational requirements.

The care and maintenance manpower that was on site through 2003 employed approximately 10 persons at the site to perform maintenance and inspection work. Additional manpower is anticipated to be mobilized to site in 2004 to perform reclamation work.

5. Related Environmental Studies

Throughout the life of the project, numerous environmental studies were conducted by the Mine as part of their environmental management practices. Some of these studies were conducted to fulfill specific requirements of the Water Licence while others were completed as a means of progressively collecting information for closure planning. These studies have been filed with the Nunavut Water Board and are described below to provide additional relevant supporting information to this plan..

5.1 Hydraulic Confinement of West Twin Disposal Area

The report "*Hydraulic Confinement of the West Twin Disposal Area*", November 30, 2000 describes the results of an investigation of the potential for groundwater seepage from the West Twin Disposal Area (the "WTDA") to East Twin Lake. The environmental risk being investigated was the possible contamination of clean water in East Twin Lake with metals and other contaminants transported from the WTDA. The study confirmed that there is no subsurface hydraulic connection from WTDA to East Twin Lake.

The investigation was conducted from 1998 to 2000. The work included surface water quality monitoring, installation and monitoring of three thermocouple strings, geotechnical logging of boreholes cores.

An active sampling and monitoring program began in the spring of 1998 that demonstrated that the deltaic fan separating East Twin Lake and the WTDA does not conduct water. Water quality was monitored in East Twin Lake and a tributary watercourse; as well as the West Twin Reservoir and its discharge. Water quality was then compared to determine if evidence of the WTDA chemical signature appeared in East Twin Lake water.

Three thermocouple strings were installed within the delta that demonstrated that the existence of a permafrost barrier within the deltaic fan between East Twin Lake and West Twin Reservoir. Temperatures from the thermocouple strings were monitored on a monthly basis for a time to define the frozen and active (freeze/thaw) zones. In addition, core logging was conducted during the installation of the thermocouples (drilling) that did not identify a subterranean hydraulic connection.

The monitoring of ground temperatures also revealed that the elevation of the top of the permafrost is higher than the water elevations in either East Twin Lake or the WTDA. This means that there can be no flow within the active layer from one area to the other.

5.2 Acid Rock Drainage and Metal Leaching Assessment

The geochemical characterization of the potential for acid rock drainage to develop from various mine materials is essential to providing appropriate closure measures. Such a study was conducted from 1997 to 2001 and was filed with the Nunavut Water Board in two reports prepared by Lorax Environmental Services: *"Acid Generation Potential of Tailings and Shale Cover Material*" dated September 1999 and titled *"Acid Generation Potential of Soil, Waste Rock and Shale"* dated April 2001.

A total of 164 samples were collected from seventeen locations around the mine site to provide a representative suite of samples. The samples were categorized as: mine waste rock; open pit walls; roadway (Industrial Complex to West Adit area); shale; tailings; and natural ground covers (soil/till).

Acid-base accounting (ABA) was conducted on all samples to measure both total acid potential (TAP) and neutralizing potential (NP). These two determinations were then compared to guidelines for assessing acid generating potential "*Guidelines for Acid Rock Drainage Prediction in the North – DIAND, 1992"*.

The ABA determinations provided the following observations:

1. Soil and till samples have the lowest sulphur contents, typically <0.3 % S and are considered non-acid generating;
2. Shale samples are classified as acid consuming;
3. Due to the abundance of carbonate materials in the waste rock mass (up to 80%) only samples with very high total sulphur content are considered potentially acid generating;
4. Results for the 10 "rock" sampling areas (105 samples) varied from strongly to marginally acid generating. (The results are described fully in Appendix E, the Rock Piles and Open Pits Closure Plan; and
5. Tailings are classified as acid generating.

Samples of tailings and shale also underwent humidity cell testing that measured reaction rates and NP/TAP depletion over time at different temperatures. The results of the humidity cell and related testing provided the following conclusions:

1. The most mobile metal in the tailings sample was zinc. Zinc was leached from the tailings sample in greater concentration than other heavy metals of concern;
2. Copper, lead, nickel and cadmium were detectable in the tailings sample but were lower than zinc by two orders of magnitude;
3. Tailings material is potentially acid generating (i.e. neutralization potential was depleted at a faster rate than acid potential);

4. Shale is classified as acid consuming (i.e. acid potential was depleted at a faster rate than neutralization potential); and
5. "The covering of the tailings mass with shale of sufficient thickness to maintain the tailings interface below the active layer should obviate the potential for acid generation from the tailings and is, therefore, a prudent closure strategy" (Lorax 2001).

5.3 Chronic Toxicity Testing

In order to assess environmental effects in the receiving environment, a work plan that proposed to assess environmental effects by testing of water quality and chronic toxicity in Strathcona Sound was approved by the NWB in June 1999. The work was conducted in 2000 and rpeorted to the NWB in the report, "*Chronic Toxicity Testing Mouth of Twin Lakes Creek in Strathcona Sound"*, October 2000.

The study components included:

1. A sand dollar (Dendraster excentricus) fertilization test to determine any degree of inhibition of fertilization;
2. Microtox testing (Photobacterium phosphoreum); and
3. Full suite of physical and chemical characterization of the water.

Five water quality samples were collected in Strathcona Sound in the mouths of Twin Lakes Creek and Kuhulu Creek (control site).

In the Twin Lakes Creek estuary, samples were collected from the surface water (0.1 metre depth) at distances of 60 metres and 75 metres offshore, as well as at 5 metres depth, 75 metres offshore. Since the freshwater inputs are less dense than the receiving seawater, creek discharges would be expected to initially migrate at the sea surface and near-surface samples might therefore, show influences of the creek. Samples were collected during the low flow period when metal concentrations in Twin Lakes Creek were at a seasonal maximum to provide a worse case scenario of metal loadings into Strathcona Sound.

During the same period, samples were collected from the discharge of Kuhulu Creek to Strathcona Sound as a control site. Kuhulu Creek is located approximately 8 kilometres east of the mouth of Twin Lakes Creek in a separate drainage area. Water quality from this area is not influenced by mining activities. Samples were collected 25 metres offshore, at depths of 0.1 and 5 metres.

The conclusions of the study are as follows:

1. The surface water samples collected 60 metres off shore of the Twin Lakes Creek estuary reported elevated concentrations of some metals in comparison to both the 75 metres offshore sample and to

the reference site sample. The concentration of zinc at the 60 metres location exceeded USEPA marine chronic and acute criteria for the protection of aquatic life. At a distance of 75 metres, this exceedance was not present;

2. Toxicity test work on surface water samples 60 metres offshore of Twin Lakes Creek estuary showed sand dollar (Dendraster excentricus) had inhibited fertilization (50% decrease in fertilization rates). This fertilization rate result was not evident in any of the other samples; and
3. Microtox testing did not indicate a toxic response in any of the samples.

5.4 Environmental Assessment of the Landfill Facility (2000)

The landfill facility is located approximately 1 kilometre west of the town at the crest of a localized watershed. This location minimizes the surface run-off affecting the area. A two metre high berm on the uphill side of the landfill site diverts runoff water around the site. A second, two metre high berm at the toe of the landfill collects seasonal run-off and directs discharge through an absorbent boom placed upstream of a level control notch.

Waste was accepted from mining related activities, as well as the townsite, government offices, seaport and airport operations.

CanZinco conducted an environmental assessment of the landfill in 2000, and reported the findings to the NWB, that included the following:

1. Identification of the types and volumes of industrial wastes disposed of and buried over the life of the facilities;
2. Evaluation of potential significant environmental impacts given the geographical characteristics of the surrounding area and water courses;
3. An evaluation of the present disposal method, and recommendations for final reclamation and closure of the facility; and
4. A list of present and future monitoring plans.

The findings of the assessment are described in the Landfill Closure Plan (Appendix L) where they were incorporated into the Closure Plan for the facility.

5.5 Metal Loading Studies in Twin Lakes Creek

Twin Lakes Creek contained elevated metal concentrations prior to development of the mine due to natural exposures of mineralized rock. Mine activities subsequently added additional sources of metals along the creek. An understanding of the relative contributions of metals into the creek from various natural and mine related sources was investigated through a series of metal loading studies from 1995 to 2000. The studies have included water quality monitoring for key metals of concern and flow monitoring.

Water sampling stations were located at key features along the length of the creek. Samples were generally collected on a bi-weekly frequency through the ice-free season and analyzed for metal concentrations. These values were then correlated to water flow measurements to determine metal loading.

Spatial trends were identified along Twin lakes Creek which were attributed to two rock piles (02 & 09 South), natural sulphide outcroppings and the industrial complex area. Long term trends suggest an increase in metal loading from the area of the rock piles that roughly corresponded to the commencement of relocation of waste rock underground. This temporary trend is expected to reverse following the completion of waste rock relocation as part of the proposed reclamation activities.

5.6 Tailings Stabilization Study

A review of existing and potential methods of controlling tailings dust movement was conducted in 1998. The review listed the following practices that had been employed:

1. Water Cover
   Water coverage of the tailings was controlled through the scheduled two metre increment raising (construction) of the Surface Cell dike structure at the WTDA. This was done to maintain sufficient water volume for mill consumption, and recover volume lost to prior tailings disposal. A 2 m raise in water elevation covered 65,000 square metres or 40% of the exposed tailings surface thereby reducing the area of exposed tailings and possible dust movement;

2. Water Saturation
   A water cannon system was used to moisten the exposed surface tailings to eliminate dust movement during those periods when temperatures prohibit freezing/icing of the surface;

3. Ice Capping
   During freezing conditions, ice cover was used to control tailings movement from the surface deposit. A water cannon system was used to generate ice layers that capped the exposed tailings and eliminated dust movement;

4. Snow Cover
   Snow fencing was installed on the exposed tailings to control and collect snow that otherwise would have blown over and off the tailings surface. The snow covering and wind deflection eliminated dust movement; and

5. Shale Capping
   Shale cover was generally placed in areas where future disposal activities were not scheduled. The shale cover was generally placed to an intermediate depth of approximately 0.2 m.

The review also investigated the potential for dust suppression with chemical applications, including: calcium chloride; lignonsulphonate; sodium silicate; Soil Sement®(latex polymer), and DL10 (asphalt diluted with water and soap).

The summary of the review of these chemicals included:

1. The use of sodium silicates, was not economically feasible;
2. Calcium chloride was eliminated because it may depress the freezing point of water. This chemical attribute would be counter-effective on ice control methodologies and also raised long-term geotechnical stability questions regarding the frozen core dike structures;
3. Bench scale testing of lignonsulphonate produced negative impacts on metallurgical results; and
4. Field testing of Soil Sement® showed positive results. A thin rubbery coating was achieved on a test plot area that bound surface particles together preventing wind transport. The coating was UV degradable over a 4 month period – suitable for the interim period control. A one-year supply of product was ordered in 2002, but due to its late arrival was not applied. The product was shipped off-site in 2003.

5.7 Surface Cell Tailings Disposal Monitoring

A monitoring program for the surface tailings deposit and disposal practices was implemented in 1989. The program was updated in 1991 and 1998 as part of two Water Licence renewal processes. The basic components of the on-going monitoring program included:

1. Establishment of a thermistor and frost gauge network within the Surface Cell;
2. Water quality analysis from the Surface Cell;
3. Establishment of an air quality monitoring program which included "hi-volume" air samplers activated on a 6 day cycle;
4. Assessment of particle size distribution and chemical composition of air samples; and
5. Photo documentation of snow cover.

In addition, the 1998 update included consultation with the Hunters and Trappers Organization in Arctic Bay to develop the Terms of Reference for continued monitoring of the exposed tailings.

5.8 Waste Rock Disposal Plan

The Waste Rock Disposal Plan was updated annually to 2002 as a requirement of the Water Licence. Utilization of waste rock as backfill was an operational requirement of underground mining. The annual Plan provided the schedule for future years waste rock requirements as well as documentation of the past years material balance at each waste rock site. The mining methods instituted in 2001 (pillar recovery) required a substantial increase in the utilization of waste rock as backfill. As a result, reclamation of waste rock piles was substantially advanced by the time the mine closed in October 2002.

The residual volumes of rock on surface that remain to be reclaimed are fully described in the Rock Piles and Open Pits Reclamation Plan (Appendix E).

5.9 Stability Analysis of West Twin Disposal Area

BGC Engineering Inc. conducted a risk assessment of the physical stability of the West Twin Dike in June 2000. The terms of reference for the assessment were formulated in consultation with the NWB's geotechnical consultant. The final report entitled "*Risk Assessment of West Twin Disposal Area Dike*" dated September 7, 2000 was submitted to the NWB.

As part of the assessment, a review of possible failure modes was undertaken. This review assessed the frequency and consequences of possible events including seismic occurrences (earthquakes), structural design failure, erosion event failure, and foundation failure. The review also considered construction, operation, and historical data of the dike structure at the West Twin Disposal Area.

Follow up analytical work resulting from the risk assessment was performed and submitted to the NWB in the report, "*Follow-Up Analytical Work on West Twin Dike Stability*" dated November 20, 2000. These analyses focused on rigid block modelling, conventional slope stability issues, frost heave susceptibility of tailings, and the Factors of Safety analysis for the West Twin Dike. In addition, the analyses were extended to reflect potential increases in the height of the dike in the future.

The results are summarized as follows:

1. A review of thermocouple data confirmed the overall frozen nature of the dike;
2. Based on the frozen condition and the assumed rigid nature, the lowest factor of safety against sliding was 1.53 for the probable tailings friction angle of 27^{o} and worst-case foundation friction angle of 15^{o}. It should be noted that, at the location of the highest section of the WT dike, as analyzed, the foundation bedrock unit is actually the stronger dolostone unit. Hence, the friction angle value for the foundation material would actually be much higher. Therefore, both the current configuration of the

dike, and a subsequent raise by 2 metres, would meet or exceed current static design guidelines for the mechanism of sliding stability;

3. Based on the conventional slope stability analysis for a dry, frozen slope, the factors of safety vary from 1.6 to 2.6 for the current dike and 1.5 to 2.6 for the raised dike, which meet or exceed design guidelines for dams. For a seismic acceleration of 0.05g, the factors of safety vary from 1.3 to 2.2 for current dike and 1.2 to 2.1 for the raised dike geometry. Again, these values meet or exceed required guidelines for the factor of safety; and
4. The review of soils within the West Twin dike area and their relative susceptibility to frost heaving revealed that the susceptibility was high for the lakebed sediments, moderate to high for the tailings and low for the shale rock fill. The susceptibility of the soils to have frost heaving should be considered in light of the location of only 6 references to ice in 38 boreholes drilled in the area. If the materials are ice-poor, the creep of the dike and its foundation are of little concern.

5.10 Closure Cover Materials - Geotechnical Evaluation

Golder Associates Ltd. conducted testing of potential tailings cover and armouring materials and reported their findings in the report entitled "*Geotechnical Assessment of Cover Materials for West Twin Disposal Area, Nanisivik Mine, Baffin Island, NWT*". The results of the testing are summarized as follows:

1. Twin Lake sand and gravel appeared to be a competent material for capping and erosion protection. The shale appeared to have abrasion and freeze-thaw losses that make it less suitable for capping and erosion protection. The shale may be suitable to provide thermal insulation for underlying materials and to limit infiltration of runoff water into the subsurface; and
2. The Twin Lakes sand and gravel is suitable for upper drainage layer, the purpose of which would be to drain run off water laterally and minimize moisture loss from the infiltration barrier that can result from upward capillary suction. The material has superior freeze-thaw durability which makes it suitable for surface armouring.

5.11 Test Cell Evaluation Study

A series of test cells were constructed and operated in the WTDA to assess the effectiveness of various configurations of soil covers over tailings. The test cells were instrumented for thermal monitoring through the cover materials.

A review of test cell data indicates that there is no advantage to 'sandwich' layering of different materials at various depths to minimize the active layer thickness. Data indicated that compaction of the cover during placement will reduce the depth of the active layer immediately (i.e. first year). However, bulk placement of the cover will attain the same reduced depth of the active layer in two years.

The general observation from the test cell program information is that a single medium cover with uniformly sized materials permits water saturation and ice development reducing oxygen exchange and water migration through the cover. Further observations that are specific to Test Cell no. 1, upon which the design of the reclamation cover for the Surface Cell is based, are as follows:

1. Test Pad 1 was constructed of a nominal thickness of shale fill without controlled saturation or compaction;
2. Thaw depth in the 4 frost gauges in this pad (F3- F6) showed that the maximum depths of thaw improved continuously between 1991 and 1997 and were continuing to improve, albeit slowly, at the termination of the monitoring period. This is attributed to the gradual build-up of the ice layer at the bottom of the active zone;
3. Results in 1997 (end of program) showed thaw depths at each of the instruments measuring 0.73, 0.95, 1.05 and 0.97 metres respectively (or an average value of 0.92 metres); and
4. Direct comparison of the two pairs of frost gauges in Test Pad 1 (F3 vs. F4; and F5 vs. F6) indicates that areas with light surface coloured material (F3 and F6) experienced an average of 0.26 m less thaw depth than their darker coloured counter parts (F4 and F5).

The observations and conclusions of the test cell program are further described in the Reclamation Covers Report (Appendix A).

6. Closure and Reclamation Reports

6.1 February 2002 Closure Plan

In September 2001, CanZinco announced their intent to permanently close the Nanisivik mine in October 2002. This notification triggered a requirement in the Water Licence to submit, to the NWB, a Final Mine Closure Plan. The report, *February 2002 Closure Plan* was submitted to the NWB in February 2002.

That report presented the closure objectives and the reclamation concepts for each area of the mine site. Preliminary design of the reclamation covers over tailings, rock piles and the landfill facility were included. A preliminary engineering design for the Surface Cell spillway and an engineering stability assessment of the West Twin Dike were also included.

The report acknowledged that the earlier-than-expected mine shut down (by several years) had prevented the provision of detailed engineering designs for all of the proposed reclamation activities. Further, an Environmental Site Assessment process had been initiated to collect the information necessary for development of a mine closure plan but had not yet been executed.

The NWB's technical review of the February 2002 Closure Plan culminated in a Public Hearing that was held in Arctic Bay in July 2002. Subsequent to that Public Hearing, the NWB issued the current Water Licence which requires, among other conditions, the submission, for approval, of a "Reclamation and Closure Plan" and a series of attendant location-specific and topic-specific technical reports (as described in Section 6.2).

6.2 Water Licence Requirements

Part G of the Water Licence addresses "Conditions Applying to Closure and Reclamation" and requires the submission, for approval, of a "Reclamation and Closure Plan" and a series of attendant location-specific and topic-specific technical reports. These requirements are summarized in Table 6.

An overview of each of the reports required under Section G of the Water Licence is provided in the following sections. Each of these reports is appendix to this document as listed in Table 6.

Table 6. Water Licence Requirements for Closure and Reclamation Reports

Water Licence Reference	Report	Status
G1	Notification to the NWB of Recognized Closed Mine Status	Submitted
G2	Reporting Timetable	Submitted
G3	Reclamation and Closure Plan	Submitted (this document)
G4	Reclamation Cover Designs	Submitted as Appendix A (attached)
G5	West Twin Disposal Area Talik Investigation	Submitted as Appendix B (attached)
G6	Borrow Areas Development and Closure Plan	Submitted as Appendix C (attached)
G7	West Twin Disposal Area Surface Cell Spillway Design	Submitted as Appendix D (attached)
G8	Waste Rock and Open Pit Closure Plan	Submitted as Appendix E (attached)
G9	Reclamation and Closure Monitoring Plan	Submitted as Appendix F (attached)
G10	Append G4 to G9 to the Reclamation and Closure Plan (G3)	Submitted (this document)
G11	Revision submission timetable	To be determined by the NWB
G12	Annual Review of Reports G3 to G9 and Submission for Approval of Proposed Modifications	Future Requirement
G13	Environmental Site Assessment (ESA) Program	Conditionally approved (NWB) Submitted as Appendices G&H (attached)
G14	Human Health and Ecological Risk Assessment (HHERA)	Approved (NWB) Submitted as Appendix I (attached)
G15	West Twin Disposal Area Closure Plan	Submitted as Appendix J (attached)
G16	Underground Mine Waste Disposal Plan	Reviewed (NWB) Resubmitted as Appendix K (attached)
G17	Landfill Closure Plan	Submitted as Appendix L (attached)
G18	Implement Reclamation Plans as Approved	Future Requirement
G19	Revision of Reports	Future Requirement
G20	Annual Review of Reports G15 to G17 and Submission, for Approval, of Proposed Modifications	Future Requirement

Water Licence Reference	Report	Status
G21	Annual Reclamation Liability Cost Update	Future Requirement
G22	2007 Terms of Reference for Comprehensive Assessment of Mine Site Remediation	Future Requirement

6.3 G.3, Reclamation and Closure Plan

This document, *Nanisivik Mine Closure and Reclamation Plan March 2004* (the "Mine Closure Plan"), fulfills the reporting requirements of Part G, Item 3 of the Water Licence. This document, inclusive of the attendant appended technical reports, provides both the background information and the technical detail regarding the proposed reclamation measures. It is intended to provide the NWB with the necessary information to undertake a technical review of the proposed reclamation and closure plan and, ultimately, approve the Mine Closure Plan.

This document has been prepared by CanZinco with the technical support of Gartner Lee Limited, BGC Engineering Inc., Golder Associates Limited, Jacques Whitford Environment Ltd. and Lorax Environmental Services.

6.4 G.4, ᖃᖓ ᖃᓄᐃᓕᖓᓂᐊᕐᓂᖓ, Reclamation Cover Design

The report, *Engineering Design of Surface Reclamation Covers* (the "Covers Report"), provides the report requested under Part G, Item 4 of the Water Licence. The Covers Report was prepared by BGC Engineering and is provided in its entirety as Appendix A and the Executive Summary is provided below for ease of reference.

6.4.1 ᓇᐃᒃᓕᕆᐊᕐᓯᒪᔪᑦ ᐅᖃᐅᓯᒃᓴᐃᑦ

ᐃᒥᕐᒧᑦ ᐱᔪᓐᓇᐅᑎᒥ NWB1NAN0208 ᑐᓂᔭᐅᓯᒪᔪᖅ ᓄᓇᕗᒻᒥ ᐃᒥᓕᕆᔨᒃᑯᑦ ᑲᑎᒪᔨᖏᓐᓄᑦ, ᑲᓐᔨᓐᑯ-ᑯᑦ ᐱᖁᑎᖃᕐᑐᑦ ᓇᓂᓯᕕᒃᒥ ᑲᒪᒋᔭᖃᕐᒪᑕ ᓴᓗᒪᖅᓴᕐᑕᐅᓂᖓᓂᒃ ᖃᐅᔨᓴᕐᑕᐅᓂᖓᓂᒃᓗ ᐊᕿᒃᓱᐃᓗᑎᒃᓗ ᐸᕐᓇᐅᑎᐅᔪᒥᒃ ᐊᖏᕐᑕᐅᓇᓱᒃᓂᐊᕐᑐᒥᒃ.

ᓇᓂᓯᕕᒃᒥ 2004-ᒥ ᓴᓗᒻᒪᖅᓴᐃᓂᕐᒧᑦ ᐸᕐᓇᐅᑎ ᐊᕿᒃᑕᐅᓯᒪᔪᕐ ᐱᖁᔭᐅᓂᖓ ᒪᓕᒃᓗᒍ ᐃᒥᕐᒧᑦ ᐱᔪᓐᓇᐅᑎᖓᓂ ᐊᑐᓂᓗ ᖃᓄᐃᑕᐅᓂᐊᕐᓂᖏᓐᓂᒃ ᑎᑎᖅᓯᒪᓪᓗᑎᒃ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᑦ. ᑕᓐᓇ ᑎᑎᕋᕐᑕᐅᔪᖅ ᐱᖁᔭᐅᓯᒪᓂᖓ ᒪᓕᒃᓗᒍ ᐃᓚᖓᓂ 4 ᓴᓗᒻᒪᖅᓴᐃᓂᕐᒧᑦ ᖃᖓᑕ ᓴᓇᓯᒪᓂᖓ.

ᑎᑎᕋᕐᓯᒪᔪᕐ ᐱᔭᕆᐊᖃᕐᓂᖓ ᒪᓕᒃᓗᒍ ᐃᒥᕐᒧᑦ ᐱᔪᓐᓇᐅᑎᖓᓂ ᖃᖓ ᖃᓄᐃᓕᖓᓂᐊᕐᒪᖔᑦ ᐃᓗᓕᖃᕐᑐᕐ ᐅᑯᓂᖓ

1. ᖃᓕᕐᓯᔪᑎᖃᕐᓂᐊᕐᒪᖔᑕ ᖃᓄᐃᑦᑐᒥᒃ ᑐᐊᐸᒥᒃ ᑎᑎᕋᕐᓯᒪᔪᖅ
2. ᖃᐅᔨᓴᖃᑦᑕᕐᓗᑎᒃ ᖃᐅᔨᓴᐅᑎᕆᖃᑦᑕᕐᓯᒪᔪᑦ ᖃᖓ ᑐᐊᐸ, ᐅᔭᕋᑐᐃᓐᓇᐃᓪᓗ ᐊᒃᑕᕐᕕᒃᒥᖓᕐᑐᓪᓗ
3. ᐸᕐᓇᐅᑎᓂᒃ ᖃᓄᐃᓕᖓᓚᐅᕐᒪᖔᑦ ᖃᓄᐃᓕᖓᓂᐊᕐᒪᖔᓪᓗ ᖃᓕᕐᑕᐅᓯᒪᓕᕈᓂ
4. ᖃᐅᔨᓴᕐᓯᒪᓗᑎᒃ ᖃᖓᓂᑦᑐᕐ ᑐᐊᐸ ᖃᓄᐃᑲᔪᕐᒪᖔᑦ ᐊᕋᒍᑦ 1-ᒥᑦ 100-ᒧᑦ ᐅᕐᑯᓯᕙᓪᓕᐊᓂᖓ ᒪᓕᒃᓗᒍ.
5. ᖃᖓᓄᐊᕐᓂᐊᕐᑐᑦ ᑐᐊᐸ ᐱᑕᖃᕋᓗᐊᕐᒪᖔᑦ ᖃᓂᒋᔪᓂᑦ ᓇᑭᖔᕐᓂᐊᕐᒪᖔᓪᓗ
6. ᐱᑎᓂᖓ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᓪᓗᓂ ᑯᕙᕐᑕᕐᕙᐅᔪᖅ ᐃᒥᕐᒧᑦ ᑯᕙᔪᐅᖃᑦᑕᕐᓯᒪᔪᖅ ᐃᑎᓂᖃᕐᑐᒥ 1.0-ᒥᑕ ᑭᒃᓕᖓᓗ ᒪᓕᒃᒧᑦ ᓱᕋᔪᐃᔪᕐᑕᐅᓗᓂ.
7. ᐱᐅᑎᕆᓂᖓ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᓗᓂ ᕿᓚᒻᒥᐅᔫᒃᑯᑦ ᐊᑯᓂᐅᔪᒥᓪᓗ
8. ᓇᓗᓇᐃᕐᓯᒪᔪᒥᒃ ᐃᔪᓂᕆᔭᕆᐊᖃᕐᑕᖓᓂᒃ ᓂᒃᓚᓱᒃᓂᖓ ᐅᕐᑯᓯᕙᓪᓕᐊᓂᖓᓗ ᒪᒃᓕᓗᒍ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᔪᑦ ᐅᕐᑯᓯᕙᓪᓕᐊᓂᖓᓄᑦ ᒪᓕᒃᓗᒍ.
9. ᖃᐅᔨᓴᕐᓗᑎᒃ ᐃᒪᖃᖕᕆᓂᕐᓴᐅᔫᓐᓇᕐᑐᒥᒃ ᑯᕙᕐᑕᕐᕙᐅᑦ ᐃᒪᖓᓂᒃ ᐊᒻᒪᓗ ᖃᐅᔨᓴᐃᓐᓇᕐᓗᑎᒃ ᐃᒥᐅᑦ ᐱᐅᓂᖓ ᑕᐃᒪᐃᖕᕆᓐᓇᕐᓂᐊᕐᒪᖔᑦ ᒪᓕᒃᒧᓪᓗ ᓱᕋᑦᑎᕙᓪᓕᐊᕗᐊᖕᕆᒃᑲᓗᐊᕐᒪᖔᑦ ᐅᕙᓗᓂ ᖁᐊᖃᑦᑕᕐᓗᓂ ᖃᓄᐃᔪᑕᐅᓂᐊᕐᒪᖔᑦ.
10. ᖃᐅᔨᓴᕐᓗᑎᒃ ᖃᖓᑕ ᐃᔪᓂᖓ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᔪᑦ ᐃᔪᓂᖓ ᒪᓕᒃᑕᐅᓗᑎᒃ

ᓇᐃᒃᓕᕆᐊᕐᓗᒍ ᐃᒪᐃᓕᖓᔪᖅ, ᑕᓐᓇ ᖃᓇᓂᐊᕐᑕᖓ ᑐᐊᐸ ᑎᑎᕋᕐᓯᒪᔪᓂᒃ ᐃᓗᓕᖃᐅᕐᑐᓂᒃ ᐊᕿᒃᓯᒪᓂᖓᓂᒃ ᐅᑯᓂᖓᓗ:

- ᕿᒥᕈᔪᐅᓗᑎᒃ ᖃᓇᔪᐅᓂᐊᕐᑐᑦ ᑐᐊᐸᐃᑦ ᑯᕙᕐᑕᕐᕙᒃᒧᑦ,ᐅᔭᕿᒃᑕᕐᓂᑯᕙᓂᕐᓄᑦ ᐊᒻᒪᓗ ᐊᒃᑕᕐᕙᒃᒧᑦ ᖃᓇᓂᐊᕐᑐᖅ
- ᐱᔪᑎᖓ ᖃᓄᐃᒻᒪᑦ ᓂᕈᐊᕐᑕᐅᒃᒪᖔᑦ ᑐᐊᐸ ᖃᓇᓂᐊᕐᑕᖓ ᐃᔪᓂᕆᓂᐊᕐᑕᖓᓗ
- ᖃᓪᓕᕐᐸᖑᓂᐊᕐᑐᖅ ᑐᐊᐸ ᒪᓂᕐᖄᒃᓴᕐᑕᐅᓗᓂ
- ᖃᐅᔨᕐᑕᐅᖏᓐᓇᕐᓗᓂ ᖃᓇᔪᖓ ᖃᓄᐃᓕᕙᓪᓕᐊᖏᒃᑲᓗᐊᕐᒪᖔᑦ
- ᖃᓄᕐᑐᕈᑎᒃᓴᒃᑲᓐᓂᑦ ᐸᕐᓇᐅᑎᕆᔭᖓᑦ ᑐᐊᐸᐅᑦ ᖃᖓ ᖃᓄᐃᓕᑲᓚᒃᑐᕙᓂᐅᒃᐸᑦ ᓂᓇᐅᓇᖏᑦᑐᒃᑯᑦ.

ᐸᕿᒃᓱᕐᑕᐅᓪᓗᓂ ᖃᓄᐃᓕᖓᓂᐊᕐᒪᖔᑦ ᑐᐊᐸ ᐃᓱᒪᒋᔭᐅᓚᐅᕐᑐᖅ ᓴᐅᔭᕆᐊᖃᕐᓂᖓᓂᒃ ᐅᔭᕋᐃᓐᓇᖅ ᒪᖏᕐᑐᕿᔭᕐᑐᖅ ᐊᒃᑕᕐᕕᒃᓗ ᓴᐅᔭᐅᒍᑎᒃ ᖁᐊᖑᓂᖓᓄᑦ ᑎᑭᐅᒪᒪᒐᔭᕐᒪᑦ ᖁᐊᖑᐃᓐᓇᕋᔭᕐᑐᑦ, ᐊᐅᒃᐸᓪᓕᐊᒐᔭᖏᓪᓗᓂᓗ . ᖁᐊᖑᓂᖓ ᖁᐊᖑᐃᓐᓇᓕᕈᓂ ᐊᓂᕙᓪᓕᐊᒐᔭᖏᕐᑐᖅ. ᓯᐅᕋᕐᒧᓪᓗ ᖃᓕᕐᑕᐅᒃᑲᓐᓂᕈᓂ ᒪᖏᕐᑐᓇᔭᓐᓂᖓ ᓴᕿᔭᕈᓐᓂᕈᓂ ᒪᖏᕐᑐᓇᕙᓪᓕᐊᒐᔭᖏᓪᒪᑦ. ᓯᐅᕋᕐ ᖁᐊᖑᐃᓐᓇᕐᑎᑦᑎᔪᓐᓇᕐᑐᖅ ᐱᑕᖃᕐᑐᓂᓗ ᓇᓂᓯᐅᕕᒃ ᖃᓂᒋᔭᖓ.

ᐅᔭᕿᒃᑕᕐᕕᐅᔪᖅ ᖁᐊᖑᐃᓐᓇᕐᑐᒥᑦᑐᖅ, ᓂᒃᓚᓱᓚᖓ -15. ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓯᒪᔪᑦ ᓂᒃᓚᓱᒃᓂᖓᓂᒃ ᐊᑐᕐᑕᐅᓚᐅᕐᑐᑦ ᐊᕿᒃᓯᔪᕐᑕᐅᓪᓗᑎᒃ ᐊᕋᒍᓄᑦ 100-ᓄᑦ ᐅᕐᑯᓚᖑᓂᖃᑦᑕᕐᑕᖓ ᒪᓕᒃᑕᐅᓪᓗᓂ *13. ᐅᕐᑯᓯᕙᓪᓕᐊᓂᖓ ᓄᓇᕐᔪᐊᕐ ᐃᓱᒪᒋᔭᐅᓯᒪᒃᒪᑦ ᐅᕐᑯᓯᕙᓪᓕᕐᓂᐊᕐᓴᓯᒋᔭᐅᓪᓗᓂ 2.8*ᒥᒃ ᐊᒻᒪᓗ 5.0-ᒥᒃ ᐅᕐᑯᓚᖑᓗᓂ, ᐊᕙᑎᓕᕆᔨᒃᑯᑦ ᑲᓇᑕᒥ ᐅᖃᕐᓯᒪᔪᖓᑦ.

ᐸᔨᒥᖕᒥᑦᑐᑦ ᖃᓄᒧᓐᓇᕐᑕᖕᒥᑦ ᕿᒥᕈᔭᐅᓚᐅᕐᑐᑦ, ᒪᓴᐅᖕᒥᓐᓇᕐᑎᑕᐅᓗᓂᓗ ᖃᐅᔨᓴᕐᑕᐅᓚᐅᓇᓪᓗᓂ ᐅᕙᓗᓂᑦ ᐸᓂᕐᑐᒥᓪᓗᓂ. ᐸᓂᕐᑐᒥᒃ ᖃᓕᕐᓂᐊᕈᓂ ᐱᑕᖃᕐᓂᖕᒥᓪᓗ ᓇᒥᒪᖓᑕ ᖃᐅᔨᔭᐅᓪᓗᑎᒃ ᑐᐊᒃᑕᕐᕕᐅᔪᓐᓇᕐᑐᑦ, ᒪᕋᒥᒃᓗ, ᓯᐅᕋᒥᒃᓗ ᕿᕐᓂᕐᑕᒥᒃᓗ ᑐᐊᒃᒥᒃ ᐱᑕᖃᐅᕐᑐᖅ ᖃᓂᒋᔭᓂ. ᐸᓂᕐᑐᒥᒃ ᖃᓕᕐᑕᐅᔪᒪᓪᓗᓂ ᐊᕐᖃᑎᒋᒃᓯᒪᔪᑦ ᐱᔪᑎᖃᕐᓗᑎᒃ ᐅᑯᓂᖓ:

- ᐱᑕᖃᐅᕐᓂᖓᓗᓄᑦ: ᕿᓂᕐᑕᖅ ᑐᐊᒃ ᓇᒪᒃᒪᑦ ᐊᖏᓂᖓ ᐱᑕᖃᕐᓂᖓ ᖃᓂᒋᔭᓂᑦᑐᖅ.
- ᓇᓇᔭᒃᓴᐅᓂᖓᓗᓄᑦ: ᕿᓂᕐᑕᖅ ᑐᐊᒃ ᐊᑐᕐᑕᐅᖏᓐᓇᖃᑦᑕᕐᓯᒪᒃᒪᑦ ᐅᔭᕿᒃᓯᐅᕐᑎᓪᓗᒥᑦ ᐊᕈᖕᒥᑦᑐᓄᑦ ᑐᐊᖃᓇᐊᓕᒃᓄᑦ ᐃᖃᓇᐃᔭᕐᑎᓪᓗ ᖃᐅᔨᒪᒃᒪᑕ ᖃᓄᕐ ᐱᐅᑎᕆᓂᖓᓂᒃ ᐊᑐᕐᑕᐅᔭᕐᓂᖓᓂᒃᓗ.

- ᓱᐳᕐᓇᕐᑐᖃᕐᖏᓐᓂᖓᓄᑦ: ᓱᐳᕐᓇᕐᑐᖃᕐᓂᕋᓗᐊᕐᒋᑦ ᐅᕙᖃᐃᑦ ᐃᓴᐅᑎᒐᔭᕐᒋᓪᒪᑕ ᑐᐊᕙᒃᑯᑦ.
- ᐊᖏᓂᖏᑦ ᓯᐅᕿᐅᓂᖓᑕ ᓇᒪᒃᒪᑕ ᓴᐅᓯᐊᑎᒋᓇᓱᒃᑐᒍ ᓯᖃᓚᐅᓂᖓ ᐊᖏᓂᖏᑦ ᓇᒪᒃᒪᑕ.

ᓯᐅᕋᕐ ᖃᖓᓄᐊᕐᓂᐊᕐᑐᖅ ᑐᐊᕙᐅᑦ ᕿᕐᓂᕐᑕᐅᑦ ᖃᖓᓄᐊᕐᓂᐊᕐᑐᖅ ᓯᐅᕋᖅ ᐃᒪᖃᕐᒋᐊᑎᒋᓂᐊᕐᒪᑦ. ᓯᐅᕋᕐ ᓂᑉᐊᕐᑕᐅᓚᐅᕐᑐᖅ ᐅᑯᓂᖓ ᐱᐊᑎᖃᕐᑐᑎᒃ.

- ᐊᑯᓂᐅᔪᓐᓇᕐᓂᖓ: ᓯᐅᕋᕐ ᑎᓯᐊᓂᒃ ᐊᓂᒍᓚᖃᕐᓂᖓᓄᑦ ᓄᖑᑉᐸᓪᓚᐊᒃᑲᐅᑎᒋᖏᓪᒪᑦ ᓯᓚᒍᓪᓗ ᓱᕋᒃᐸᓪᓚᐊᖏᓪᓗᓂ.
- ᐱᑕᖃᕐᓂᖓ: ᐊᖏᓇᕐᑐᓂ ᐱᑕᖃᐅᕐᑐᖅ ᖃᓂᒋᔭᓂ
- ᕿᓂᖏᓐᓂᖓ: ᖃᑯᔪᒃᓂᖓ ᐊᑲᐅᓇᕐᓯᒪᔪᖅ ᓯᕿᓂᐅᑦ ᖃᐅᒪᓂᖓᓂᒃ ᐃᓵᒃᑕᖏᓐᓂᕐᓴᐅᓂᖓᓄᑦ.

Hᒃᑯᐊ ᑎᑎᕋᕐᓯᒪᔪᑦ ᓇᓗᓇᐃᑦᑎᐊᕐᓯᒪᔪᑦ ᐃᓗᓕᖏᓐᓂᒃ ᐅᔾᕿᐅᓂᖓᓂᒃ ᑐᐊᕙᐅᑦ ᖃᖓᓄᐊᕐᓂᐊᕐᑐᖅ, ᖃᓄᑎᒋᓗ ᐊᖏᑎᒋᒃᒪᖓᑕ ᓯᐅᕿᐅᓂᖏᑦ, ᑎᓯᒃᑎᓴᕐᑕᐅᓯᒪᓗᓂᓗ, ᒪᓴᐅᓂᖅᑲᕐᓂᖓᓗ, ᐊᑯᓂᐅᔪᓐᓇᕐᓂᖓᓗ. ᕿᕐᓂᕐᑕᐅᑦ ᑐᐊᕙᐅᑦ ᐃᓗᓕᖏᑦ ᖃᓄᐃᑦᑐᓂᖏᑦ ᖃᐅᔨᓴᕐᑕᐅᓚᐅᕐᑐᑦ ᖃᐅᔨᓴᕐᑕᐅᓪᓗᑎᒃ ᒪᖏᕐᑐᓇᔪᓪᓚᐊᔪᓐᓂᖓ ᓄᖃᖓᑎᑦᑎᒐᔭᕐᒪᖓᑦ ᓱᐳᕐᓇᕐᑐᓂᖏᓐᓂᒃ. ᖃᐅᔨᓴᕐᒥᒃ ᑐᑭᓯᓚᐅᕐᑐᑦ ᓱᐳᕐᓇᕐᑐᓂᖓᓂᒃ ᐃᓴᐅᑎᕙᓪᓚᐊᓂᖓᓂᒃ. ᒪᓴᐅᓂᖓᓂᒃᓗ ᖃᐅᔨᓴᖃᑦᑕᕐᓯᒪᓪᓗᑎᒃ ᐱᓴᓱᐊᕈᓯᕐᓄᑦ 37-ᓄᑦ, ᖃᐅᔨᓇᓱᒃᑐᑎᒃ ᐃᓴᐅᑎᕙᓪᓚᐊᔪᕐ ᓴᕿᐸᓪᓚᐅᒐᔭᕐᒪᖓᑦ, ᖃᐅᔨᓚᐅᕐᑐᓂ ᓴᕿᐸᓪᓚᐊᖏᓐᓂᖓᓂᒃ ᓴᐅᔭᐅᓯᒪᓕᕐᑎᓪᓗᒍ.

ᖃᕆᓂᐊᕐᑕᖓ ᑐᐊᕙᒃ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᒃᒪᑦ ᖃᐅᔨᓴᕐᕕᐅᔪᒥ, ᐅᕐᕈᓂᖓᓂᒃ ᖃᐅᔨᓴᕐᕕᒃᒥ, ᓴᓇᕕᐅᔪᑦ 14 ᖃᓂᒋᔭᓂ. ᖃᕆᔭᐅᓂᐊᕐᑐᑦ ᖃᓄᐃᑦᑐᓂᖏᑦ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᐃᓐᓇᕐᑐᑦ ᑳᔮᖁ-ᖁᓐᓂᑦ ᑕᐃᒪᖓᑦ 1989-ᒥᑦ. ᑖᓚᒪᑦ ᖃᐅᔨᓴᕐᕕᐅᓚᐅᕐᑐᑦ ᐊᔾᔨᒋᖏᑦᑐᓂᒃ ᖃᓕᕐᓯᒪᐅᕐᑐᑎᒃ ᐃᔪᓂᖅᑐᑎᒃ 2-ᒥᑕᒥᒃ. ᖃᐅᔨᓴᕐᑕᐅᓪᓗᓂ ᐊᐅᒃᐸᓪᓚᐊᖅᑕᕐᓂᖓ ᐊᕋᒍᑕᒪᒃ ᐊᐅᒪᓂᖓ ᑖᕙᐅᖓᕐᐸᓪᓚᐊᓪᓗᓂ ᖁᐊᖑᓂᖓ ᖁᐊᖑᕐᐸᓪᓚᐊᔪᖅ ᖃᖓᓄᐊᕐᐸᓪᓚᐊᔪᖅ. ᖁᐊᕐᐸᓪᓚᐊᓂᖓ ᖃᐅᔨᓴᕐᑕᐅᓗᓂ ᑐᑭᓯᓚᐅᕐᑐᑦ ᐃᓗᓪᓗᒍᑦ ᖁᐊᕐᐸᓪᓚᐊᓂᖓᓂᒃ ᓴᐅᔭᐅᓯᒪᓕᕐᑎᓪᓗᒍ. ᐊᒻᒪᓗ ᖃᐅᔨᓴᕐᑕᐅᒐᒥ ᖃᕆᔭᖓ ᓇᓗᓇᐴᓂᓚᐅᕐᑐᖅ ᐃᓴᐅᑎᕙᓪᓚᐊᔪᒐᓗᐊ ᖁᐊᕐᐸᓪᓚᐊᓂᖓᓂᒃ. ᒪᓴᐳᔪᒃ ᑐᐊᕙᒃ ᖁᐊᕐᐸᓪᓚᐊᓗᓂ ᐃᓴᐅᑎᔪᓐᓂᕐᐸᓪᓚᐊᓚᒐᔪᖅ.

ᐅᕐᑯᓂᖓᓂᒃ ᖃᐅᔨᓴᕐᓂᖅ ᖃᖓᓂᒃ ᑐᐊᕙᒃᒥᒃ ᐊᔾᔨᒋᖏᑦᑐᒥᒃ ᐃᔪᓂᓕᑦ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓚᐅᑦᑐᑦ ᐊᐅᒪᓂᖓ ᖃᓄᑎᒋᕙᔪᕐᒪᖓᑦ ᖃᐅᔨᓴᕐᓗᑎᒃ ᓂᒃᓚᓱᒃᑐᒥᓐᓂᖓᓄᑦ. ᖃᐅᔨᓴᐅᑕᐅᔪᕐ ᐅᒃᑐᑎᖅᑕᕐᓗᑎᒃ ᐊᑐᕐᑕᐅᓚᐅᕐᑐᖅ ᐅᕐᑯᓯᕝᓚᐊᒐᔭᕐᓂᖓᓗ ᐃᓱᒪᒋᔭᐅᓪᓗᓂ ᖃᐅᔨᓴᕐᑕᐅᓚᐅᕐᒥᔪᖅ. ᖃᐅᔨᓴᖃᑦᑕᕐᓂᖏᑦ ᒪᓕᒃᓗᒋᑦ ᐃᒍᓂᖅᑐᓂ 1.0-ᒥᑕᒥᒃ ᓇᒪᒃᓂᕋᕐᑕᐅᔪᖅ ᖃᒃᑲᓐᓂᐊᒍᓪᓗ 0.25-ᒥᒃ ᓯᐅᕋᕐᒥᒃ ᖃᓚᕐᑕᐅᒃᑲᓐᓂᕐᓗᓂ. ᑕᐃᒪᓐᓇ ᐃᔪᑎᒋᓗᓂ ᐊᕋᒍᓄᑦ 100-ᓄᑦ ᐅᕐᑯᓯᕝᓚᐊᓂᖓ ᐃᓱᒪᒋᔭᐅᓪᓗᓂ ᐊᕿᒃᑕᐅᔪᖅ.

ᖃᐅᔨᓴᕐᑕᐅᓪᓗᓂ 14-ᒥᑦᑐᖅ ᑐᐊᕙᖓ ᖃᖓᓂᑦᑐᖅ ᒪᓴᐅᓂᕐᒥᑦᑐᖅ ᖁᕕᕐᑕᕐᕕᒃᒥᑦᑐᖅ ᐊᒻᒪᓗ ᐅᔾᕿᑐᐃᓐᓇᐅᓂᖓᓗ ᒪᓴᐅᖏᑦᑐᒥᑦᑐᖅ. ᐊᑕᓂᑦᑐᖅ ᒪᓴᐅᖏᓐᓂᖓᓄᑦ ᒪᓴᒃᑯᓂ ᖃᖓ ᐃᓗᒍᐊᑐᐃᓐᓇᕿᐊᖅᑐᖅ ᐅᔾᕿᑐᐃᓐᓇᐃᑦ ᐊᑯᓐᓂᖓᒍᕐᓗᓂ ᑕᐃᒪᐃᓂᖓᓄᑦ ᖃᖓᓄᐊᕐᑕᐅᔪᖅ ᑐᐊᕙᒃ ᐃᔪᓂᕐᓴᐅᓂᐊᕐᑐᖅ ᑲᖓᓄᑦ ᖁᕕᔭᐅᒃᑖᕐᑐᒥᑦ. ᖃᒃᑲᓐᓂᐊᒍᓪᓗ ᐃᓚᕆᔭᐅᒃᑲᓐᓂᕐᓗᓂ ᓯᐅᕋᕐᒥᒃ. ᖃᐅᔨᓴᕐᓗᑎᒃ ᐃᔪᓂᖃᕆᐊᖃᕐᑕᐅᔪᖅ 2.2-ᒥᑕᒥᒃ. ᕿᕐᓂᕐᑕᒥᒃ ᑐᐊᕙᒃᒥᒃ ᐱᒍᓂᖅᑐᓂ 195-ᒥᑕᒥᒃ ᐊᒻᒪᓗ 0.25-ᒥᑕᒥᒃ ᓯᐅᕋᒃᒥᒃ.

ᖃᖓᓂᑦᑐᖅ ᖁᕕᔭᐅᒃᑕᕐᓯᒪᔪᖅ ᖃᐃᒃᖃᒃᓴᕐᑕᐅᓪᓗᐅᕐᑐᓂ ᑐᐊᕙᓕᕐᑕᐅᓂᐊᕐᑐᖅ. ᖃᖓᓄᐊᖃᐃᓂᐊᕐᑐᑦ ᑐᐊᕙᒃᒥᒃ ᐊᖏᓂᖅᑐᒥᒃ 400,000 -ᒥᑕ ᑭᑉᐸᕆᒃᓯᓗᒍ ᕿᕐᓂᕐᑕᕐ ᑐᐊᕙᒃ ᐊᒻᒪᓗ 95,000 ᑭᐸᕆᒃᓯᓗᒍ ᓯᐅᕋᖅ ᐊᒻᒪᓗ ᑐᐊᕙᒃ.

ᐱᖃᑕᓗ ᓴᐅᔭᐅᓂᐊᕐᑐᕐ ᐊᖏᓂᖅᑐᒥᒃ 151,000 *ᒥᑕ ᐊᒻᒪᓗ 27,500*ᒥᑕ ᓯᐅᕋᖅ.

ᑐᐊᐸᐅᑦ ᖃᓄᐃᑦᑐᔭᕆᐊᖃᕐᓂᖓ, ᓴᓇᔭᐅᓂᖓᓗ, ᐱᐅᓂᖓᓗ ᓇᓗᓇᐃᑦᑕᐅᑦᑎᐊᕐᓯᒪᔪᖅ. ᓴᓇᔭᐅᓯᒥᐊᕈᓂ ᖃᐅᔨᓴᕐᑕᐅᕙᓪᓕᐊᓂᐊᕐᑐᖅ ᖃᓄᑎᒋ ᐃᔪᕐᑎᒋᓕᕐᒪᖔᑦ, ᓯᕕᖓᓂᖓᓗ ᖃᐅᔨᒪᔭᐅᕙᓪᓕᐊᓗᓂ ᐊᒻᒪᓗ ᒪᓴᐅᓂᖓ. ᐱᔭᕆᕐᐸᑕ ᓴᓇᔭᕆᕐᐸᑕ ᖃᐅᔨᓴᖃᑦᑕᐃᓐᓇᕐᓂᐊᕐᑐᑦ ᐅᕐᑯᓂᖓᓂᒃ, ᕐᑯᐊᕐᐸᓪᓕᐊᓂᖓᓂᒃ ᐃᒥᐅᓪᓗ ᐱᐅᓂᖓᓂᒃ, ᐊᒻᒪᓗ ᖃᖓ ᖃᓄᐃᐸᓪᓕᐊᒃᒪᖔᑦ ᖃᐅᔨᓴᕆᔭᐅᓗᓂ. ᕿᐅᔨᓴᕐᑕᐅᓗᓂ ᐊᕿᒍᓄᑦ 7-ᓄᑦ ᖃᓄᐃᓕᐅᖃᑦᑕᕐᓂᐊᕐᒪᖔᑕ ᑎᑎᕋᕐᓯᒪᔪᖅ ᑕᕙᓂ.

ᖃᓄᐃᓕᑲᓚᒃᑐᕕᓂᐅᒃᐸᑦ ᐸᕐᓴᐅᑎᖃᕐᒥᔪᑦ ᓱᕐᓗ ᓄᖑᐸᓪᓕᐊᓐᓂᕈᓂ ᑐᐊᐸᖓ ᖃᓄᐃᑕᐅᒐᔭᕐᒪᖔᑦ, ᐅᕙᓗᓐᓂᑦ ᖃᖓᑦ ᑐᐊᐸᒃ ᐃᓕᕿᓕᕙᓪᓕᐊᓂᕈᓂ, ᐅᕙᓗᓂᑦ ᐃᒥᐅᓂᖓ ᐱᐅᔪᓐᓂᕐᓂᕈᓂ. ᕿᓄᐃᒃᑯᔭᕐᓂᖓ ᖃᓄᐃᑕᐅᒐᔭᕐᓂᖓᓗ ᐸᕐᓇᐅᑎᐅᓪᓗᓂ ᑕᕙᓪᓚ ᑎᑎᕋᖃᓯᐅᑎᓯᒪᔪᖅ ᖃᓄᕐᓗ ᐱᒋᐊᕐᑕᐅᒐᔭᕐᒪᖔᑦ.

6.4.2 Executive Summary

Under the terms of Water Licence NWB1NAN0208 issued by the Nunavut Water Board (NWB), CanZinco Ltd., the current owner of the Nanisivik Mine is responsible for continuation of on-site environmental protection activities and developing for submission and approval of a Final Reclamation and Closure Plan ("RCP").

The Nanisivik Mine 2004 RCP has been developed, as per the terms of the Water Licence as a series of stand-alone documents, each addressing in detail the information and proposed closure measures for one specific component or topic area. This document and the information presented herein are provided in response to the requirements for report Part G, Item 4, the Reclamation Cover Designs.

In accordance with Part G, Item 4, of the Water Licence, this report provides the following requirements for the Cover Design:

1. A description of the proposed materials;
2. The results of field-testing and thermal modelling for covers over tailings, waste rock and landfill debris;
3. Plans showing the pre- and post-cover topography using sufficiently detailed contour intervals;
4. An assessment of cover performance under 1 in 100 year return period (warm year) and global warming scenarios;
5. Confirmation of availability of materials for cover construction;
6. The bathymetry of sub-aqueous tailings in West Twin Lake Reservoir which shows the extent of tailings located within 1.0 m of the water surface, and plans for mitigation of wave action on these tailings;
7. Quality Assurance/Quality Control measures for short and long term maintenance;
8. A verification of cover thickness against extreme annual temperature variation (i.e., 1:100 year warm event) verified within the boundaries already provided by global warming estimates;
9. n evaluation of alternatives for increasing minimum water depth in the Reservoir with emphasis on possible effects of waves and winter ice cover on long term water quality; and

10. An assessment of cover thickness with reference to cover result available for Area 14 as a case study.

In summary, this Cover Design Report provides details for the following components:

- Review of cover design options for various materials including tailings, waste rock, open pits and the landfill;
- The rationale for selecting the recommended cover materials and thicknesses;
- A detailed cover grading plan along with material quantities for the Surface Cell and Test Cell areas;
- A monitoring plan to assess the performance of the cover during closure; and
- A series of contingency plans that may be implemented should the cover perform in an unacceptable manner.

The conceptual review of cover design considers the requirements of covers for potentially acid generating mine wastes and for landfills. In cold regions, the purpose of the cover is to allow permafrost to develop within the waste and to restrict the depth of thawing to within the cover thickness. A frozen, ice saturated zone develops within the cover that will limit infiltration of water and air into the underlying waste materials. This provides a reduction in oxygen diffusion and prevents the generation of leachate and movement of contaminants. Since the purpose of the cover is to provide a thermal barrier to maintain frozen ground conditions, granular materials, such as sand and gravel and crushed rock can be used. These materials are abundant at Nanisivik.

The site is located within the continuous permafrost zone, with a Mean Annual Air Temperature (MAAT) of -15.1^{o} C. The long-term temperature trends from several weather stations in the vicinity of Nanisivik were used to estimate the 1:100 year warm annual temperature for Nanisivik of -13.3^{o} C. Climate change due to global warming is expected to increase the MAAT at Nanisivik by 2.8^{o} C by 2100 for the "Best Estimate" case and 5.0^{o} C for the "High sensitivity" case, as provided by Environment Canada.

Various cover types were reviewed, including wet cover and dry cover options. Dry cover options included geosynthetics and natural materials. Natural materials on site include marine silty clay, Airport sand, till, Twin Lakes sand and gravel and shale. A dry cover option using shale was selected as the main component of the cover for the following reasons:

- Availability: shale is available in sufficient quantities at locations proximal to the areas requiring covering;
- Workability: shale has been used for various purposes throughout the life of the mine and the site staff have a valuable knowledge base of quarrying and handling the material;
- Carbonate content: may provide buffering capacity should acidic leachate be produced by the underlying tailings; and

- Grain size characteristics the quarried grain size characteristics of the shale do not require additional mechanical breakdown to be used as cover material.

The Twin Lakes sand and gravel was selected as an armouring material to be placed above the shale to limit erosion from both wind and water. This material was selected as the armouring material based on the following factors:

- Durability: the material is composed of re-crystallized quartzite, which is characteristically highly durable and resistant to weathering;
- Availability: the material is available in sufficient quantity in an area proximal to the West Twin Disposal Area; and
- Light colour: the light colour of the material (tan to reddish) will reflect sunlight and provide less heat absorption than darker materials.

The report provides details of the geotechnical properties of the preferred cover materials, which included grain size distribution, compacted density, natural and saturated moisture content, durability and permeability. Samples of shale were tested to assess the acid generation and acid consumption potentials. As expected, the acid-base accounting analyses confirmed the general expectation that the shale is acid consuming. A humidity cell test was conducted for 37 weeks, which indicated that leachate remained neutral (pH > 7.5) throughout the test.

The design of the covers was based on an assessment of the ongoing Test Cell cover study, geothermal modelling and thermal assessment of the Area 14 waste rock cover. The Test Cell covers have been studied by CanZinco since 1989. Five test covers were constructed using various tailings materials and varying degrees of compaction and saturation with thicknesses of about 2 m. Monitoring of the depth of annual thaw in the covers indicated that the maximum depth of thaw decreased each year to a range of 0.73 m to 1.4 m. This trend indicated that the permafrost was developing within the base of the covers. In addition, examination of the covers in test pits indicated that a zone of ice had developed within the base of the cover due to seasonal infiltration and freezing of water. This ice saturated zone will form an effective barrier to the diffusion of oxygen and water between the tailings and the rest of the cover.

Geothermal modelling of the cover was carried out to evaluate the potential variations in the depth of the active layer thaw within the shale cover due to extreme temperature events. The thermal model was calibrated to the site test cover data and then extended for extreme warm years and for global warming scenarios over the next century. Based on this assessment, the design cover system for the tailings is comprised of 1.0 m of quarried shale fill, covered by 0.25 m of Twin Lakes sand and gravel. This proposed thickness appears adequate to resist both the 1 in 100 year warm event and the High Sensitivity estimate of global warming over the next 100 years.

Assessment of the Area 14 rock cover was done to compare the cover requirements for the tailings, which is saturated and waste rock, which is unsaturated. Since the underlying waste is not saturated, water that percolates through the cover may drain through the waste rock and not form an ice zone barrier whereupon the depth of the active zone will be greater than in the tailings covers. An additional thickness of cover is required to ensure freezing of the waste. Based on the actual field trial in Area 14 and results of thermal modelling, the total cover thickness was determined to be 2.2 m of shale or 1.95 m of shale and 0.25 m of Twin Lakes Sand and Gravel.

Regrading of the tailings surface will be done before any shale is placed. The proposed Surface Cell cover results in the placement of approximately 400,000 m^3 of shale and 95,000 m^3 of Twin Lakes sand and gravel. The proposed Test Cell cover requires approximately 151,000 m^3 of shale and 27,500 m^3 of Twin Lakes sand and gravel.

Material specifications, construction considerations, fill placement and quality control/quality assurance procedures are detailed for the shale and Twin Lakes sand and gravel cover materials. During construction, detailed information will be collected concerning cover thickness, grades and elevations, level of compaction, grain size analysis and moisture content. Upon completion of construction, performance monitoring will include collection of ground temperature, piezometric pressures and water quality information, as well as observing the physical condition of the covers. A monitoring schedule for the Reclamation and Closure Period (7 years) has been provided.

Several contingency plans have been developed that address potential performance issues, such as erosion of the armouring layer or underlying shale, deformation of the cover, excessive depth of thaw and poor quality of surface water runoff. The consequences of each issue and suggested mitigative approach are summarized in table format. Common to all suggested mitigation measures is identification of the root cause and appropriate reaction to limit environmental consequences of each concern.

6.5 G.5, ᑯᑲᐱᕐᑕᕐᑲᐱᐅᑦ ᖃᐅᔨᓴᕐᑕᐅᓂᖓ ᐊᐅᒪᐃᓐᓇᕐᑐᓂᖓ ᐃᒥᐅᕐ, West Twin Disposal Area Talik Investigation

The report, *Assessment of Surface Cell and Test Cell Talik* (the "Talik Report"), provides the report requested under Part G, Item 5 of the Water Licence. The Talik Report was prepared by BGC Engineering and is provided in its entirety as Appendix B and the Executive Summary is provided below for ease of reference.

6.5.1 ᓇᐃᒃᓕᒋᐊᕐᓯᒪᔪᑦ ᐅᖃᐅᓯᒃᓴᐃᑦ

ᐃᒥᕐᒧᑦ ᐱᔪᓐᓇᐅᑎᑕᕆᓯᒪᔭᖓ NWB1NAN0208 ᑐᓂᔭᐅᓯᒪᔪᖅ ᐃᒥᓕᕆᔩᒃᑯᑦ ᑲᑎᒪᔩᖏᓐᓄᑦ, ᑲᓐᔩᒃᑯ-ᑯᓐᓄᑦ, ᑖᒃᑯᐊᓗ ᐱᖁᑎᖃᕐᑎᐅᓪᓗᑎᒃ ᓇᓂᓯᕕᒃᒥᒃ ᐅᔭᕆᒃᓂᐊᕐᕕᒃᒥᒃ ᑲᒪᒋᔭᖃᕐᓗᑎᒃᓗ ᓴᓗᒻᒪᖕᓴᕐᑕᐅᓂᖓᓂᒃ ᐊᒻᒪᓗ ᖃᓄᐃᓕᐅᕐᓂᐅᓚᔪᕐᑐᓂᒃ ᐊᖏᕐᑕᐅᓇᓱᒃᓗᑎᒃ ᓴᓗᒻᒪᖕᓴᕐᓂᕐᒧᑦ ᒪᑐᕝᓕᐊᓂᖓᓄᓪᓗ ᐸᕐᓇᐅᑎᓂᒃ.

ᓇᓂᓯᕕᒃᒥ ᓴᓗᒪᖕᓴᐃᓂᐅᓂᐊᕐᑐᖅ 2004-ᒥ ᐊᕿᒃᑕᐅᓯᒪᓕᕐᒪᑦ ᐸᕐᓇᐅᑎᖓ ᐱᔭᕆᐊᖃᕐᓂᖓ ᒪᓕᒃᓗᒍ ᐱᒧᓐᓇᐅᑎᖓᓂ ᐊᑐᓂᓗ ᖃᓄᐃᓕᐅᕐᑕᐅᓂᐊᕐᓂᖏᑦ ᑎᑎᕋᕐᓯᒪᓪᓗᑎᒃ. ᑖᒃᑯᐊ ᑎᑎᕋᕐᑕᐅᔪᑦ ᐱᔭᕆᐊᖃᕐᓂᖓ ᒪᓕᒃᓗᒍ ᐱᔪᓐᓇᐅᑎᖓᓂ ᑯᕕᕐᑕᕐᕕᒃ ᖃᐅᔨᓴᕐᑕᐅᓂᖓ ᐊᐅᒪᐃᓇᕐᑐᓂᖓᓂᒃ.

ᒪᓕᒃᓗᑎᒃ ᐱᔪᓐᓇᐅᑎᖓᓂ ᐃᒥᕐᒧᑦ, ᑖᒃᑯᐊ ᑎᑎᕋᕐᓯᒪᔪᑦ ᓇᐃᒃᓕᒋᐊᕐᓯᒪᓪᓗᑎᒃ ᐃᒪᐃᓕᖓᔪᒥᒃ ᐅᖃᕐᓯᒪᔪᑦ:

ᐱᔪᓐᓇᐅᑎᖃᕐᑐᖅ ᑐᓂᓯᓂᐊᕐᐳᖅ ᐃᒥᓕᕆᔩᒃᑯᑦ ᑲᑎᒪᔩᖏᓐᓄᑦ ᐊᖏᕐᑕᐅᓇᓱᒃᓗᑎᒃ ᐅᓂᒃᑲᕐᓯᒪᔪᒥᒃ ᐊᐅᒪᐃᓐᓇᕐᓂᖓᓂᒃ ᖃᐅᔨᓴᐅᑎᓂᒃ ᑯᕕᕐᑕᕐᕕᒃᒥᑦ ᖃᐅᔨᓴᕐᕕᐅᓯᒪᔪᑦ ᐅᑯᐊᖑᓗᑎᒃᓗ:

1. *ᓂᐅᕐᑐᖃᑦᑕᕐᓂᖏᑦ ᖃᐅᔨᓴᖃᑦᑕᕐᓂᖏᓪᓗ ᖃᓄᑎᒋᖃᑦᑕᕐᓂᖓᓂᒃ ᐊᐅᒪᓂᖓᓂᒃ ᖃᐅᔨᓴᕐᓗᑎᒃ.*
2. *ᐳᕐᑯᓂᖓᓂᒃ ᑭᓯᑕᖃᕐᓂᖓᓂᒃᓗ ᑐᐊᐸᖓ ᐊᐅᒪᐃᓇᕐᓂᖓ*
3. *ᓇᓗᓇᐃᕐᓯᓗᑎᒃ ᖃᓄᑎᒋ ᕐᑯᐊᖑᓂᖓ ᑎᑭᐅᒪᑎᒋᖃᑦᑕᒪᖓᕐ,ᐃᒥᐅᑦ ᖃᓄᐃᑐᓂᖓ (ᐊᖏᓂᖓ, ᔅᑯᑎᒋᓂᖓᓗ) ᖃᑎᒃᓯᓕᕐᓂᐅᔪᓗ, ᐊᒻᒪᓗ ᖃᑎᒃᓯᓕᕐᓯᒪᔪᑦ ᕐᑯᐊᕐᒧᑦ, ᐊᒻᒪᓗ ᖃᓄᐃᑕᐅᔪᑕᐅᓂᐊᕐᒪᖓᑕ ᑖᒃᑯᐊ ᖃᐅᔨᒪᔭᐅᔪᑦ ᐃᒪᐃᓕᑐᐃᓐᓇᓇᐊᓕᑦ ; ᐊᒻᒪᓗ*
4. *ᐃᒥᐅᑦ ᐱᐅᓂᖓᓂᒃ ᖃᐅᔨᓴᕐᓯᒪᓗᑎᒃ ᒪᓕᒃᑕᐅᓗᑎᒃ ᐱᔭᕆᐊᓕᕐ.*

ᑕᓐᓇ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᐊᐅᒪᓂᖓᓂᒃ ᐅᓂᒃᑲᕐᓯᒪᔪᖅ ᐅᖃᕐᓯᒪᓂᖃᓪᓗᐊᕐᑐᖅ ᐅᑯᓂᖓ:

- ᓇᓗᓇᐃᕐᓗᓂ ᖃᓄᐃᑦᑐᓂᖓᓂᒃ ᐊᐅᒪᓂᖓ ᐊᒻᒪᓗ ᑭᓯᒧᑦ ᐊᐅᒪᔪᑎᖃᕐᒪᖓᑦ
- ᒪᑐᓯᒪᓕᕐᑎᓪᓗᒍ ᖃᓄᕐ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᒪᖓᑦ
- ᐸᕐᓇᐅᑎᖃᕐᓗᑎᒃ ᖃᓄᐃᓕᑲᓚᒃᑐᕕᓂᐅᑉᐸᑦ.

ᓇᓂᓯᕕᒃ ᕐᑯᐊᖑᐃᓐᓇᕐᑐᒥᒻᒪᑦ ᓄᓇᖓ. ᕐᑯᐊᖑᐃᓐᓇᕐᓂᖓ ᑎᑭᐅᒪᓪᓗᓂ ᐃᔪᓂᖃᕐᓗᓂ 430-ᒥᑕᒥᒃ, ᖃᐅᔨᓴᐅᓯᒪᔪᖅ ᓂᐅᕐᑐᖃᑦᑕᕐᓗᑎᒃ ᑐᐊᐸᖓᓗ ᒪᓴᐅᓂᖃᕐᓗᓂ 20-ᐳᓴᓐᒥᒃ ᐊᒻᒪᓗ ᓂᒃᓚᔅᑯᓂᖃᕐᓗᓂ -10-ᒥᒃ.

ᑯᕕᕐᑕᕐᕕᐅᔪᖅ ᐸᓂᓐᓂᖅᓴᐅᓗᓂ, ᑕᖏᓕᒃᑯᑦ ᐃᒥᕐᓗᑯᓄᑦ ᑯᕕᕐᑕᕐᕕᐅᓪᓗᓂ, ᐊᒻᒪᓗ ᐊᑦᑎᒃᓂᖅᓴᒥ, ᐃᒪᖃᐅᑎᖃᕐᓗᑎᒃ ᑕᓯᓕᐊᕆᓯᒪᔪᒥᒃ. ᑐᐊᐸᒃᒧᑦ ᐊᕙᓗᓯᒪᓪᓗᓂ, ᑕᓐᓇ ᑐᐊᐸᒃ ᖃᑎᒃᓯᓕᕐᓯᒪᓪᓗᓂ ᐊᕙᓗᐊ ᐊᕕᒃᓯᒪᔪᑕᐅᓪᓗᓂᓗ ᐃᒪᖃᐅᑎᖓ ᐊᒻᒪᓗ ᑯᕕᕐᑕᕐᕕᖓ. ᑕᒪᕐᒥᒃ ᖃᑎᒃᓯᓕᕐᓯᒪᔪᒃ ᕐᑯᐊᖑᐃᓐᓇᕐᓗᑎᒃ ᑐᐊᐸᒃᒥᒃ ᕿᕐᓂᕐᑕᒥᒃ ᖃᑎᒃᓯᓕᕐᓯᒪᔪᒃ.

ᓯᕗᓪᓕᕐ ᐊᕙᓗᐊ ᑐᐊᐸᒃ ᖃᑎᒃᓯᓕᕐᓯᒪᔪᖅ ᓴᓇᔭᐅᓚᐅᕐᑐᖅ 1991-ᒥ. ᖃᑎᒃᓯᓕᕐᓯᒪᔪᑦ ᐃᓚᔭᐅᒃᑲᓐᓂᕐᐸᓪᓗᓂᓗ ᐊᕐᕋ ᐃᓗᐊᓂ ᐃᒥᕐᐸᓕᐊᓂᖓ ᒪᓕᒃᑕᐅᓪᓗᓂ. ᐊᕐᕋᒍᑕᒪᓗ ᐃᓚᔭᐅᖃᑦᑕᕐᓗᓂ ᑕᐃᒪᖓᑦ ᐱᒋᐊᕐᓗᓂ 1991-ᒥᑦ 1999-ᒧᑦ ᑭᓯᐊᓂ ᐃᓚᔭᐅᓚᐅᖏᑦᑐᖅ 1994-ᒥ.

ᐱᖃᑦᑕᐅᕐ ᐊᕙᓗᓯᒪᔪᖅ ᕿᕐᓂᕐᑕᒥᒃ ᑐᐊᐸᒃᒥᑦ ᖃᑎᒃᓯᓕᕐᓯᒪᓪᓗᓂ. ᒪᑮᓕᖓᓪᓗᓂ ᓴᓇᔭᐅᓚᐅᕐᓯᒪᔪᖅ.

ᓯᕗᓪᓕᕐ ᓴᓇᔭᐅᓚᐅᕐᑐᖅ ᐳᕐᑐᓯᔭᐅᓪᓗᓂ 383.5-ᒥᑕᒥᒃ. ᑭᖑᕐᓕᕆᒃ ᓴᓇᔭᐅᒃᑲᓐᓂᕋᒥ ᐳᕐᑐᓯᒋᐊᕐᓗᓂ ᐳᕐᑐᓂᖃᓕᕐᓗᓂ 385.5-ᒥᑕᒥᒃ. ᑭᖑᓪᓕᕐᓗ ᑐᖓᕕᖃᕐᓗᓂ ᓯᕗᓪᓕᐅᑦ ᑐᐊᐸᖓᓂᒃ ᐊᒻᒪᓗ ᐃᓚᖓ ᑯᕕᕐᑕᕐᕕᒃᒥᓪᓗᓂ.

ᐊᐅᒪᐃᓐᓇᕐᓂᖓ ᖃᐅᔨᒪᓇᕐᑐᖅ ᒪᓕᒃᓯᒪᓂᖓᓂᒃ ᑯᕕᔭᐅᕙᓪᓕᐊᔪᒥᒃ.
ᑯᕕᓯᖃᑦᑕᓚᐅᕈᓗᐊᕐᒪᑕ ᐃᒥᕐᒧᑦ ᐃᖃᖓᓄᐊᕐᐸᓪᓕᐊᓪᓗᓂ ᑯᕕᔭᐅᕙᓪᓕᐊᔪᖅ 1977-ᒥ. 1988-ᒥ ᑕᑕᓗᐊᓕᓚᐅᕐᒪᑦ ᑯᕕᕐᑕᕐᕕᒃ ᐊᖏᕐᑕᐅᓚᐅᕐᓯᒪᒋᓪᓗᓂ ᓄᓇᕐᑎᐊᕐᒥ ᐃᒥᓕᓇᕗᒃᑯᑦ ᑲᑎᒪᔩᖏᓐᓄᑦ ᓄᓇᐅᑦ ᖃᖓᓄᑦ ᑯᕕᓯᖃᑦᑕᕈᒪᓕᕐᓗᑎᒃ. ᑕᐃᒪᓐᓇᐅᑎᓐᓇᓱᒃᓗᒍ ᓴᓇᔭᐅᒃᑲᓂᓇᐊᖃᓚᐅᕐᑐᖅ ᑯᕕᕐᑕᕐᕕᒃ ᒪᕈᓕᕐᑎᑕᐅᓪᓗᓂ ᐃᒪᖓ. Hᓕᕐᐱᒥᓐᓂᕐᓴᖅ ᐃᒪᖃᐅᑕᐅᓪᓗᓂ ᐃᒪᖓᓗ ᑕᐃᒪᐃᖏᓐᓇᕐᓗᓂ ᐃᒪᕐᕐᑯᕐᑐᓂᖓ ᓴᐅᒥᒃᒥᖓᓂᑦᑐᖅ ᑯᕕᕐᑕᕐᕕᒃ ᓄᓇᒧᑦ ᑯᕕᕕᐅᖃᑦᑕᕐᓗᓂ. ᑯᕕᔭᐅᕙᓪᓕᐊᔪᖅ ᐱᒋᐊᓚᐅᕐᓯᒪᔪᖅ 1990-ᒥ ᓄᓇᒧᑦ ᑯᕕᓯᖃᑦᑕᓕᕐᓗᑎᒃ. ᐃᒥᐅᓂᖓᓗ ᑲᑎᑕᐅᕙᓪᓕᐊᕆᓪᓗᓂ ᐃᒪᖃᐅᑎᖓᓄᐊᕐᑕᐅᔭᓪᓕᐊᓪᓗᓂᓗ. ᐳᕐᑐᓂᓇᓕᕐᑕᖓ ᒪᓐᓇ 388-ᒥᑕ ᑐᐊᐸᒃ ᖃᑎᒃᓯᓕᕐᓯᒪᔪᖅ ᐊᕙᓗᒋᔭᖓᖓ ᐱᔭᓇᕐᑕᐅᓚᐅᕐᑐᖅ 1999-ᒥ. ᑯᕕᕕᐅᖏᓇᖃᑦᑕᓚᐅᕐᑐᖅ ᒪᑐᓂᖓᓄᑦ ᑎᑭᓪᓗᓂ ᓯᑎᐱᓇ 2002-ᒧᑦ. ᓇᓚᐅᑦᑕᕐᑕᐅᓪᓗᓂ ᑯᕕᔭᐅᓯᒪᔪᕐ ᐊᖏᓂᖃᕐᑐ 6.5 ᒥᓕᐊᓐ ᑭᐸᓇᒃᓯᓗᒍ ᒥᑕ ᐊᑯᓂᖓᓂ 1978 ᐊᒻᒪ 2002.

ᐱᒪᖃᐅᑎᖓᓂ, ᑯᕕᔭᐅᖃᑦᑕᓯᒋᐊᓚᐅᕐᑐᖅ ᑕᓯᕐᒧᑦ 1976-ᒥ. ᕿᑎᐸᓗᐊᓄᑦ ᑯᕕᔭᐅᖃᑦᑕᕐᓗᓂ ᑕᓯᐅᑦ ᐊᒻᒪᓗ ᓂᒋᕐᐸᓗᒃᒧᑦ ᑎᒃᑕᐅᔭᓪᓕᐊᖃᑦᑕᕐᓗᓂ ᐊᒻᒪᓗ ᑯᕕᔭᐅᖃᑦᑕᕐᓯᒪᒋᓪᓗᓂ ᑭᒃᓕᖓᓄᑦ ᖃᑎᒃᓯᓕᕐᓯᒪᔪᑦ. 1988-ᒥ ᖃᑎᒃᓯᓕᕐᓯᒪᔪᖅ ᐊᑐᕐᑕᐅᖃᑦᑕᓕᓚᐅᕐᑐᖅ ᐃᒪᖃᐅᑎᖓᓂ, ᑯᕕᔭᐅᖃᑦᑕᓕᕐᒥᒃᒪᑦ ᑭᒃᓕᖓᓄᑦ ᖃᑎᒃᓯᓕᕐᓯᒪᔪᑦ ᓴᓇᔭᐅᓂᑯᓪᓗᓂᓗ 2000-2001-ᒥ, ᐊᖏᒃᓕᒋᐊᕈᑕᐅᓯᒪᓪᓗᓂ ᑯᕕᔭᐅᔫᓇᕐᑐᖅ ᑕᓯᕐᒧᑦ. ᐃᓚᖓᓗ ᓄᓇᐅᑦ ᖃᖓᓄᑦ ᑯᕕᔭᐅᖃᑦᑕᕐᓯᒪᓪᓗᓂ ᐃᒥᐅᓂᖓ ᐃᒪᖃᕐᕕᖓᓄᐊᖃᑦᑕᕐᓗᓂ. ᑲᑎᓗᒋᑦ ᑯᕕᔭᐅᖃᑦᑕᕐᓯᒪᔪᑦ 35 ᒥᓕᐊᓐ ᑭᒃᐸᓇᕐᓯᓗᒍ ᒥᑕ ᑕᐃᒪᖓᑦ 1978-ᒥᑦ ᐅᓪᓗᒥᒧᑦ.

ᑯᕕᔭᐅᖃᑦᑕᕐᑐᖅ ᓄᓇᐅᑦ ᖃᖓᓄᑦ ᓴᕿᔭᓕᕐᑎᓪᓗᒍ ᖁᐊᖑᐃᓐᓇᕐᑎᑕᐅᓇᓱᒍᓐᓂᓚᐅᕐᑐᖅ. ᖁᐊᕐᐸᓪᓕᐊᓂᖓ ᐊᔩᓕᓐᓂᕐᓗᓂᐅᒃ ᑯᕕᓇᔭᐅᕙᓪᓕᐊᖏᓐᓇᕐᓂᖓᓄᑦ ᐊᒻᒪᓗ ᐃᒥᐅᓂᖓ ᐃᓗᑐᓂᕐᒧᐊᕐᐸᓪᓕᐊᖃᑦᑕᕐᓇᓪᓗᓂ. ᑯᕕᔭᐅᖃᑦᑕᕐᓯᒪᔪᑦ ᑕᓯᕐᒧᑦ ᐊᐅᒪᐃᓐᓇᕐᓯᒪᓪᓗᑎᒃ, ᑕᒪᓐᓇᓗ ᖁᒻᒧᑦ ᐊᐅᒪᓂᖓ ᐱᕙᓪᓕᐊᓪᓗᓂ. ᑯᕕᔭᐅᖃᑦᑕᕐᓯᒪᔪᑦ ᓄᓇᐅᑦ ᖃᖓᓄᑦ ᖁᐊᕐᐸᓪᓕᐊᓂᖓᓄᑦ ᒪᓂᕿᐅᑦ ᒪᓕᒃᓯᒪᓪᓗᓂ ᑭᒃᓕᖓᓄᑦ ᑕᓯᐅᑦ ᑎᑭᓪᓗᒍ.

ᖃᐅᔨᓴᕐᓂᖃᓚᐅᕐᒥᔪᑦ ᐊᕿᒃᓯᐃᓪᓗᑎᒃ 2002 ᐊᒻᒪ 2003-ᒥ ᑐᑭᓯᔭᐅᒃᑲᓐᓂᕋᓱᒃᓗᓂ ᑯᕕᕐᑕᕐᕕᐅᔪᖅ ᖃᓄᐃᓕᕙᓪᓕᐊᒃᒪᖔᑦ. ᑲᑎᓪᓗᒋᑦ 44 ᓂᐅᕐᑐᕐᑕᐅᓚᐅᕐᑐᑦ ᑯᕕᕐᑕᕐᕕᐅᔪᒥ. ᖃᐅᔨᓴᕐᓗᑎᒃ ᐱᖃᓯᐅᑎᓚᐅᕐᑐᑦ ᐃᓕᓯᓪᓗᑎᒃ ᖃᐅᔨᓴᐅᑎᓂᒃ ᐅᖁᓂᖓᓂᒃ ᖃᐅᔨᓴᐅᑎᒥᒃ, ᐊᐅᒃᐸᓪᓕᐊᔪᒥᒃ ᖃᐅᔨᒐᖓᒥᒃ, ᐃᓕᓇᔭᐅᒃᑲᓐᓂᖃᑦᑕᕐᓗᓂ ᖃᐅᔨᓴᐅᑎᒃᑲᓐᓂᓂᒃ ᐃᒥᐅᑦ ᐱᐅᓂᖓᓂᒃ ᐃᒥᐅᓪᓗ ᐳᒪᖓᓂᒃ. ᐊᔩᖏᖏᑦᑐᑦ ᖃᐅᔨᓴᕐᕕᐅᔪᑦ ᐊᐅᓚᕐᑎᑕᐅᖃᑦᑕᕐᓯᒪᔪᑦ ᖃᐅᔨᓴᕐᕕᒃᒧᑦ.

ᖃᐅᔨᓴᖃᑦᑕᕐᓯᒪᔪᑦ ᐅᔭᕋᐅᑦ ᐊᖏᓂᖏᓐᓂᒃ, ᒪᓴᐅᓂᖓᓂᒃ, ᑐᐊᐸᐅᑦ ᐊᖏᓂᖓᓂᒃ, ᖁᐊᖑᓂᖓ ᓴᔪᑦ ᑎᑭᐅᒪᒃᒪᑦ, ᐅᖁᓯᕙᓪᓕᐊᓂᕐᒧᓪᓗ ᖃᐅᔨᓴᐅᑎᑦ. ᑯᕕᕐᑕᕐᕕᒃ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᓪᓗᓂ ᐊᒻᒪᓗ ᓄᓇᐅᑦ ᖃᖓ ᑕᓯᐅᑦ ᐊᕙᑕ. ᖃᐃᕐᓱᒃᒥᑦᑐᓪᓗ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᒋᓪᓗᑎᒃ ᖃᓄᐃᑦᑐᒃᒪᖔᑕ.

ᖃᐅᔨᓴᕐᓗᑎᒃ ᑐᑭᓯᓚᐅᕐᑐᑦ ᐊᐅᒪᐃᓐᓇᕐᓂᖅᑲᕐᓂᖓᓂᒃ ᑯᕕᔭᐅᖃᑦᑕᕐᑐᖅ. ᕿᒥᕈᔭᐅᓚᐅᕐᑐᑦ ᐊᐅᒪᐃᓐᓇᖃᑦᑕᕐᓂᖓ ᑭᓯᒨᒃᒪᖓ ᑯᕕᔭᐅᕙᓪᓕᐊᖏᓐᓇᕐᓂᖓᓄᓪᓗ ᖁᐊᕉᓐᓇᖏᓐᓂᖓᓄᑦ ᖃᓄᕐᓗ ᖁᐊᕋᔭᕐᒪᖔᑦ ᖃᐅᔨᓴᕐᑕᐅᕆᓪᓗᓂ. ᐃᒪᖃᕐᓂᖓ ᑕᓯᓕᐊᓇᓯᒪᔪᑦ ᖁᐊᔩᐊᕋᓱᒋᔭᐅᖏᑦᑐᖅ ᐃᓗᓪᓗᑦ ᐱᔪᑎᒋᓪᓗᒍ ᐃᒪᖃᐃᓐᓇᕐᓂᐊᕐᒪᑦ.

ᖃᐅᔩᓚᐅᕐᑕᖓᑦᑕᐅᕐ ᐊᐅᒪᐃᓐᓇᕐᓂᖓ ᑯᕕᔭᐅᖃᑦᑕᕐᑐᖅ ᓂᒃᓚᓱᒃᑲᓗᐊᕐᑎᓪᓗᒍ 0-ᒥᒃ. ᖃᐅᔨᓴᕐᑕᐅᖓᒥ ᐃᒥᐅᓂᖓ ᑐᑭᓯᔭᐅᓚᐅᕐᑐᖅ ᑕᓇᐅᖃᕐᓂᖓᓄᑦ ᖁᐊᖃᑦᑕᖏᔪᑎᒋᔭᖓ ᐊᖏᓂᖃᕐᓗᓂ 4-ᒥᒃ 1000-ᒥᑦ. ᖁᐊᕋᓱᒃᓗᓂ ᓂᒃᓚᓱᒃᑎᒋᔭᓇᐊᖃᕐᑐᖅ 0.2-ᒥᒃ. ᖃᐅᔨᓴᐅᑎᒃᑯᑦ ᖃᐅᔨᓴᕐᑕᐅᓪᓗᓂ ᖁᐊᕋᓱᒃᓗᓂ ᓂᒃᓚᓱᒃᓂᖃᓇᐊᖃᕐᑐᖅ 1.2-ᒥᒃ

ᓄᓇᒧᑦ ᑯᕕᔭᐅᖃᑦᑕᕐᑐᖅ, ᓂᒃᓚᓱᒃᓂᖓ ᒪᓕᒃᑕᐅᓪᓗᓂ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᔪᑦ. ᓇᓚᐅᑦᑕᕐᑕᐅᓯᒪᒃᒪᑦ ᐃᓗᓕᖃᕋᓱᒋᔭᐅᓪᓗᓂ 2-ᒥᓕᐊᓐ ᑭᐸᕆᒃᓯᓗᒍ ᒥᑕ ᐊᐅᒪᔪᒥᒃ ᑯᕕᕐᓗᑯᓯᒪᔪᒥᒃ, ᐊᒻᒪᓗ 1-ᒥᓕᐊᓐᑲᓐᓂᕐ ᑯᕕᔭᐅᓯᒪᓪᓗᓂ ᐃᒥᕐᒧᑦ. ᐃᒥᖃᕐᓂᖓ ᐃᓱᒪᒋᓪᓗᒍ 40-ᐳᓴᓐᒥᒃ ᒪᓴᐅᓂᖃᕐᑎᓪᓗᒍ ᐃᓱᒪᒋᔭᐅᓯᒪᔪᖅ ᐊᖏᓂᖃᕐᑐᖅ 104,000 ᑭᐸᕆᒃᓯᓗᒍ ᒥᑕ ᖁᐊᕆᐊᖃᕐᓂᖓᓂᒃ. ᐊᖏᓂᖓ ᓇᓚᐅᑦᑕᕐᑕᐅᓯᒪᔪᖅ ᐃᒪᖃᕐᓂᖓ ᐱᖃᓯᐅᑎᓪᓗᒍ.

ᖃᐅᔨᓴᕐᑕᐅᓚᐅᕐᑐᖅ ᖃᓄᑎᒋ ᖁᐊᕐᐸᓪᓕᐊᑎᒋᒐᔭᕐᒪᖓᑦ ᖁᐊᖑᓂᖓᓄᓪᓗ ᖃᓄᑎᒋ ᐃᓚᕘᓪᓕᐊᑎᒋᒃᒪᖓᑦ ᐊᐅᒪᓂᖓᓗ ᖃᓄᕐ ᐊᑯᓂᐅᑎᒋᔪᒥᒃ ᖁᐊᕐᐸᓪᓕᐊᖃᑦᑕᕐᒪᖓᑦ. ᖃᐅᔨᓴᖃᑦᑕᓚᐅᕐᒥᔪᑦ ᐊᔾᔨᖏᑦᑐᓂᖓ ᐊᒻᒪᓗ ᖃᓄᑎᕐᓂᖓ ᓄᓇᐅᑦ ᓂᒃᓯᓇᕐᓂᖓ ᐊᒻᒪᓗ ᓯᓚᐅᑦ ᐅᕐᑯᓯᕘᓪᓕᐊᓂᖓ, ᐊᐳᑎᖃᕐᓂᖓ, ᐊᒻᒪᓗ ᑐᐊᕝ ᕿᕐᓂᕐᑕᕐ ᓴᐅᓯᔪᑕᐅᓗᓂ ᖃᓄᐃᒃᑲᔭᕐᒪᖓᑦ. ᓂᒃᓯᓇᕐᓂᖓ ᓂᒃᓯᓇᕐᓂᖃᕐᓗᓂ 2.0. ᖃᐅᔨᓴᖃᑦᑕᓚᐅᕐᒥᔪᑦ ᐊᐅᒪᓂᖓ ᖁᐊᕋᓱᒃᓗᓂ ᖃᓄᕐ ᐊᑯᓂᐅᑎᒋᖃᑦᑕᕐᒪᖓᑦ ᐳᕐᑐᓂᖏᑦ ᐊᔾᔨᖏᑦᑐᑦ ᖃᐅᔨᓴᕐᑕᐅᓪᓗᑎᒃ.

- ᐳᕐᑐᓂᖃᕐᑐᖅ 371-ᒥᑕ - ᑭᒃᓕᖓᓂᑦ ᖃᑦᑎᒃᓯᓕᕐᓯᒪᔪᑦ. ᖃᐅᔨᓴᐅᑕᐅᔪᑦ ᑐᑭᓯᓇᕐᓯᓚᐅᕐᑐᑦ ᐊᕋᒍᓄᑦ 7 ᐅᕘᓗᓂᑦ 8-ᓄᑦ ᖁᐊᕋᓱᒃᑲᔭᕐᓂᖓᓂᒃ.
- ᐳᕐᑐᓂᖃᕐᑐᖅ 365-ᒥᑕ ᑕᓯᓕᐊᕆᓯᒪᔪᑦ ᑭᒃᓕᖓᓂᑦ, ᖁᐊᕐᑐᐃᓐᓇᐅᓇᓱᒃᓗᓂ ᐊᕈᒍᓄᑦ 13-ᓄᑦ ᐅᕘᓗᓂᑦ 15-ᓄᑦ.
- ᐳᕐᑐᓂᖃᕐᑐᖅ 353-ᒥᑕ ᐃᑎᓚᖑᓂᖓ ᑯᕕᕐᑕᕐᕖᐅᑦ. ᐊᕋᒍᓄᑦ 27-ᒥᑦ 32-ᓄᑦ ᖁᐊᖑᓂᖓᓄᑦ ᐃᓚᒋᓕᐅᑎᓇᓱᒃᑲᔭᕐᑐᖅ.

ᖃᐅᔨᓴᕐᓂᐅᔪᑦ ᐊᐅᒪᓂᖓ ᖁᐊᕐᐸᓪᓕᐊᓗᓂ ᖃᑦᑎᒃᑐᕐᑕᑐᐃᓐᓇᕿᐊᖃᕐᓂᖓᓂᒃ ᖁᐊᕐᐸᓪᓕᐊᓂᖓ ᒪᓕᒃᓗᒍ, ᐃᒥᕐᓗ ᐊᓂᐊᕘᓪᓕᐊᑐᐃᓐᓇᕿᐊᖃᕐᓂᖓᓂᒃ ᐊᒻᒪᓗ ᖃᑦᑎᒃᓂᖃᑐᐃᓐᓇᕿᐊᓕᒃ. ᖃᐅᔨᓴᕐᓂᖃᓚᐅᕐᒥᔪᑦ ᑕᒃᑯᐊ ᐊᔾᔨᖏᑦᑐᑦ ᖃᓄᐃᑲᔭᕐᕐᑯᔨᓂᖏᑦ ᕿᒥᕈᔭᐅᓚᐅᕐᑐᑦ ᖃᓄᕐᓗ ᑕᐃᒪᐃᖏᑦᑐᓐᓇᕐᒪᖓᑦ . ᕿᒥᕈᓚᐅᕐᓗᑎᒃ ᐊᕿᒃᓯᓚᐅᕐᑐᑦ ᐃᒪᓇ:

- ᖁᐊᖑᓂᖓ ᒪᓂᕈᐅᑦ ᖃᑦᑎᒃᓯᓕᑐᐃᓐᓇᕿᐊᖃᕐᓂᐊᕐᑐᖅ
- ᖁᐊᕐᐸᓪᓕᐊᒐᔭᕐᓂᖓ ᐊᐅᒪᓂᖓᓄᑦ
- ᓄᑎᒃᐸᓪᓕᐊᒐᔭᖏᑦᑐᖅ ᖃᖓ
- ᖃᑦᑎᒃᓂᕐ ᖁᐊᖑᓂᕐᒧᑦ ᐱᑕᖃᕈᐊᖏᑦᑐᖅ
- ᐊᐅᒪᐃᓐᓇᕐᓂᖃᑐᐃᓐᓇᖃᐊᓕᒃ ᑕᕆᐅᕈᔪᓂᖓᓄᑦ
- ᖁᐊᓚᑦᑕᕐᓯᒪᖏᑦᑐᖅ ᐊᐅᒪᕈᔫᓂᖓ ᑎᑭᐅᑎᑐᐃᓐᓇᕿᐊᓕᒃ ᐃᒪᖃᕐᕕᐅᔪᒧᑦ ᐊᑕᒍᕐᓗᓂ ᐊᕘᓗᒋᔭᖓᑕ.

ᖃᐅᔨᓴᕐᑕᐅᓯᒪᐃᓐᓇᕐᓂᐊᕐᑐᖅ ᐊᕿᒃᑕᐅᓯᒪᓪᓗᓂᓗ ᖃᓄᕐ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᒪᖔᑦᖁᐊᕐᐸᓪᓕᐊᓂᖓ ᐊᐅᒪᓂᖓᑕ. ᖃᐅᔨᓴᕐᓂᐅᑦ ᐊᐅᓚᓂᕆᓂᐊᕐᑕᖓ ᐅᓂᒃᑲᕐᓯᒪᔪᖅ ᑎᑎᕋᕐᑕᐅᓯᒪᒃᒥᔪᖅ (ᐃᒥᕐᒧᑦ ᐱᔪᓐᓇᐅᑎᖓᓂ ᐱᔭᕆᐊᖃᕐᑎᓯᒪᓂᖓᓄᑦ)

ᖃᐅᔨᓴᕐᑕᐅᓯᒪᐃᓐᓇᕐᓂᐊᕐᑐᖅ ᐊᕋᒍᓄᑦ ᒪᕈᒃᓄᑦ ᓴᓗᒻᒪᖅᓴᐃᑎᓪᓗᒋᑦ ᐊᒻᒪᓗ ᐊᕋᒍᓄᑦ 5-ᓄᑦ ᒪᑐᓯᒪᓕᕐᑎᓪᓗᒍ ᖃᐅᔨᓴᕐᑕᐅᖏᓐᓇᕐᓂᐊᕐᑐᖅ. ᖃᐅᔨᓴᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᑕᑯᔭᐅᖃᑦᑕᕐᓗᓂ, ᕿᖑᒥᒐᕐᑕᐅᓗᓂ, ᐃᓕᓯᓗᑎᒃ ᖃᐅᔨᓴᐅᑎᓂᒃ ᐊᐅᔭᖃᕐᑐᓂᒃ ᓂᒃᓚᓱᒃᓂᖓᓂᒃ ᖃᐅᔨᓴᐅᑎᒥᒃ, ᐃᒥᐅᓪᓗ ᖃᓄᐃᑦᑐᓂᖓᓂᒃ.

ᐸᔨᒋᖏᑦᑐᑦ ᖃᓄᐃᓕᑲᓚᒃᐸᑦ ᐸᕐᓇᐅᑎᒋᔭᖏᑦ ᐊᕿᒃᑕᐅᓯᒪᒋᓪᓗᑎᒃ ᓴᓗᒻᒪᖅᓴᐃᑎᓪᓗᒋᑦ ᐱᔭᐅᑐᐃᓐᓇᕿᐊᓕᑦ ᐃᓱᒪᒋᔭᐅᓪᓗᑎᒃ. ᐅᑯᐊᖑᑐᐃᓐᓇᕿᐊᓕᑦ ᖁᐊᕐᓇᓴᓗᐊᕐᐸ ᐊᐅᒪᓂᖓ, ᐊᐅᒪᓂᖓᓗ ᐊᖏᒃᓕᕘᓕᕐᐸ, ᐅᕘᓗᓂᓐᓂᑦ ᖃᑦᑎᒃᓯᓕᕐᓯᒪᔪᑦ ᓄᖑᐸᓪᓕᐊᒍᑎᒃ. ᐊᑐᓂ ᖃᓄᐃᑲᓚᒍᑕᐅᔪᓐᓇᕐᑐᑦ ᐸᕐᓇᐅᑎᕆᓯᒪᔪᑦ ᑭᓱᒧᓪᓗ ᐱᔪᑎᖃᕐᔭᕐᒪᖓᑦ ᐊᕘᑎᑦᑎᓐᓄᑦ ᖃᓄᐃᔪᑕᐅᖁᓇᒋᑦ.

6.5.2 Executive Summary

Under the terms of Water Licence NWB1NAN0208 issued by the Nunavut Water Board (NWB), CanZinco Ltd., the current owner of the Nanisivik Mine, is responsible for continuation of on-site environmental protection activities and developing for submission and approval of a Final Reclamation and Closure Plan (“RCP”).

The Nanisivik Mine 2004 RCP has been developed, as per the terms of the Water Licence as a series of stand-alone documents, each addressing in detail the information and proposed closure measures for one specific component or topic area. This document and the information presented herein are provided in response to the requirements for component report Part G, Item 5, the West Twin Disposal Area Talik Assessment.

In accordance with Part G, Item 5 of the Water Licence, this report provides the following requirements for the Talik Assessment:

The Licencee shall submit to the Board for approval a report assessing the postulated Talik in the surface tailings cell and the test cell, which shall include but not be limited to:

1. *The results of drilling and other investigations to characterize the extent of the Talik;*
2. *Thermal conditions and soil properties within the Talik;*
3. *Identification of the potential for and extent of frost heave, pore water expulsion (volume, rate and water quality) and Pingo formation, and measures to mitigate the effects of any of these processes should they be expected to occur; and*
4. *Water sampling requirements in conjunction with a water quality predictive model.*

In summary, the talik assessment report should provide for the following:

- Characterize the talik in the Surface Cell and Test Cell in terms of physical extent and geothermal conditions;
- Provide a basis for performance monitoring during closure; and
- Develop contingency plans should observed performance deviate from anticipated performance.

Nanisivik is located in the region of continuous permafrost. Permafrost has been observed to extend to a depth of at least 430 m, as observed in a borehole drilled from the underground workings. Ground conditions in the area have been characterized as having the potential for medium amounts of ground ice (as high as 20%) and mean annual ground temperatures colder than -10°C.

The West Twin Disposal Area is comprised of an upper, solids retention pond, the Surface Cell, and a lower, water retention pond, the Reservoir. An earthen dike, the West Twin Dike, separates the Surface

Cell and the Reservoir. The Reservoir is further divided by the Test Cell Dike, which separates the Reservoir and the Test Cell. Both dikes are constructed of frozen shale fill and are founded on frozen, settled tailings.

The first shale lift of the West Twin Dike was built in 1991. The dike has been raised in an upstream manner where each new lift begins on top of beached tailings material deposited previously and a sealing lift of frozen shale rockfill. The dike was raised every year between 1991 and 1999, except 1994.

The Test Cell Dike is also constructed of frozen shale fill overlying frozen tailings. The dike was constructed in two stages. The first stage increased the height of the Test Cell Dike to an approximate elevation of 383.5 m. The second stage increased the height of the Test Cell Dike to an approximate elevation of 385.5 m. The second stage of the dike is partially founded on the first stage dike and partially founded on the tailings in the Test Cell.

The development of the taliks within the tailings is closely associated with their depositional history. Tailings were initially deposited sub-aqueously into the bottom of West Twin Lake beginning in 1977. By 1988, the capacity of West Twin Lake to store tailings was exhausted and approval was received from the NWT Water Board to begin surface deposition of tailings. To accommodate this, West Twin Lake was divided into two sections by the West Twin Dike. The eastern portion of the lake, the Reservoir, remained at the original lake level. The western portion of the lake, the Surface Cell became the main deposition area for the tailings. The tailings in the Surface Cell, were deposited sub-aerially, commencing in 1990. The excess water from the tailings were collected in a depression upstream of the south end of the dike, then siphoned into the Reservoir. The ultimate raise of the dike to elevation 388 m was completed in 1999. Tailings continued to be placed into the Surface Cell until the mine closed in September 2002. In total, it is estimated that 6.5 million m^3 of tailings were deposited into the Surface Cell between 1978 and 2002.

In the Reservoir and Test Cell area, tailings deposition into West Twin Lake began in 1976. The discharge of tailings took place along the centreline of the West Twin Dike from the north end of the dike resulting in tailings spreading in a south-easterly direction into the Reservoir. Tailings were also placed along an east-west trending line from the centre of the West Twin Dike. By 1988 a tailings causeway was exposed in the Reservoir, which became the foundation for the east-west arm of the Test Cell Dike. Additional tailings deposition along a northwest-southeast trending line resulted in exposure of a second tailings causeway, which became the foundation for the north/south arm of the Test Cell Dike. The Test Cell Dike was constructed in 2000-2001, increasing the tailings storage capacity of the Test Cell. Tailings were also deposited along the toe of West Twin Dike, resulting in aerial exposure of tailings in the Reservoir. In total, it is estimated that 3.5 million m^3 of tailings have been deposited into the Reservoir and Test Cell since 1978.

Once the tailings became exposed above the level of West Twin Lake, the material was no longer protected from freezing. A complex freezeback process evolved in the Surface Cell as a result of the continuous placement of tailings and the presence of the water-filled depression. The tailings under the water continued in a thawed state, resulting in a vertical continuation of the original talik under West Twin Lake. Tailings that were placed sub-aerially were subjected to permafrost aggradation, primarily from the surface downwards and towards the margins of the surface pond.

A staged geotechnical investigation was conducted in 2002 and 2003 to gain a better understanding of the physical characteristics of the West Twin Disposal Area tailings deposits. A total of 44 boreholes were drilled in the Surface Cell, Test Cell Area and Dike and at the toe of the West Twin Dike. The investigations included installation of instrumentation to measure ground temperatures. If thawed ground conditions were encountered, monitoring wells and piezometers were installed to assess water quality and water pressures. Various samples collected from the boreholes were selected for laboratory testing. Tests included grain size, moisture content, bulk density, frozen bulk density, specific gravity and thermal conductivity. Tests were conducted on tailings and lake bed sediments. Bedrock core samples were tested for point load strength index.

The results of the geotechnical investigation programs, indicates that taliks exist within the tailings in the Surface Cell and Test Cell. This information, along with the historical tailings deposition practices in the West Twin Disposal Area, were reviewed and interpreted in order to characterize the geotechnical and geothermal properties as well as the extent and magnitude of the taliks. No permafrost aggradation is anticipated into the Reservoir tailings due to the water cover.

One of the significant findings of the investigations was the presence of thawed tailings at temperatures below 0^{o}C. Analysis of the water samples collected within the thawed zones indicated the presence of soluble salts, with an estimated concentration of 4 parts per thousand (ppt). This resulted in a freezing point depression of about 0.2^{o} C. Instrumentation installed in the Surface Cell indicates freezing pint depression values potentially as low as -1.2°C.

Within the Surface Cell, the estimated limits of the talik were based on drilling data and temperature measurements. It is estimated that the Surface Cell contains about 2,000,000 m^3 of thawed tailings. Additionally, some 1,000,000 m^3 of thawed tailings are located in the Test Cell Area. Using a volumetric water content of 40%, the total volume of pore fluid that may be expelled upon freezing within the Surface Cell and Test Cell tailings was estimated to be 104,000 m^3. This volume has been assumed within the water balance done for the contaminant loading of the West Twin Disposal Area.

Geothermal modelling of the Surface Cell talik was carried out to predict the rate of permafrost aggradation into the talik. Analyses were also conducted to assess the variability and sensitivity of the results to initial thermal conditions, global warming, snow cover and the placement of shale as a cover material. Analyses were done to estimate the time required for the talik to freeze back to several key elevations within the Surface Cell:

- Elevation 371 m - the approximate base elevation of the West Twin Dike. The model predicted a time period ranging between 7 to 8 years after the initial winter, depending on the modelled scenario;
- Elevation 365 m - the approximate base elevation of the tailings base beneath the West Twin Dike. Depending on the modelled scenario, the estimated time for permafrost aggradation ranged from 13 to 15 years after the initial winter; and
- Elevation 353 m – the approximate elevation of the deepest part of the tailings. The estimated time for permafrost aggradation was between 27 and 32 years after the initial winter, depending on the modelled scenario.

The geotechnical implications of permafrost aggradation into the taliks are the potential for frost heave, pore water expulsion and pingo formation. A review was undertaken of the various mechanisms associated with these issues in order to identify the potential effects and measures required to mitigate these processes, should they occur. Following a review of the information, the following determinations were made:

- Frost heave of the surface is likely;
- Cryoconcentration within the talik is likely;
- Hydrofracturing that reports to the surface is unlikely;
- Pingo formation is unlikely;
- Formation of a cryopeg, an isolated zone of saline permafrost, is likely within the Surface Cell talik; and
- Pore fluid from the Surface Cell cryopeg may possibly migrate towards the Reservoir area, under the frozen extent of the West Twin Dike.

A performance monitoring program was developed to provide a means of assessing the freezeback of the taliks and potential impacts that may occur. The monitoring requirements are fully detailed in the Monitoring Report (Water Licence requirement Part G, Item 9). The monitoring program provides for freezeback monitoring during the 2-year Reclamation Period and for a subsequent 5-year Closure Period. Monitoring will involve visual inspections, surveys, installation of new instrumentation and measurement of ground temperatures, water pressures and water quality.

Several contingency plans have been developed in order to address performance issues that may be identified during the reclamation and post-closure monitoring periods. These issues may include slower than anticipated freezeback of the taliks, elevated pore pressures in the taliks, poor Reservoir water quality, formation of pingos or frost mounds and dike instability. The consequences of each issue and suggested mitigation approach are identified. Common to all suggested mitigation measures is identification of the root cause and appropriate reaction to limit the environmental consequences of each issue.

6.6 G.6, ᑐᐊᐸᒃᑕᕐᕕᐅᔪᑦ ᒪᑐᔭᐅᓂᖓᓄᓪᓗ, Borrow Areas Development and Closure Plan

The report, *Quarry Development and Reclamation Plan* (the "Quarries Report"), provides the report requested under Part G, Item 6 of the Water Licence. The Quarries Report was prepared by BGC Engineering and is provided in its entirety as Appendix C and the Executive Summary is provided below for ease of reference.

6.6.1 ᓇᐃᓕᒋᐊᕐᓯᒪᔪᑦ ᐅᖃᐅᓯᒃᓴᐃᑦ

ᐃᒥᕐᒧᑦ ᐱᔪᓐᓇᐅᑎᑕᕆᓯᒪᔭᖓ NWB1NAN0208 ᑐᓂᔭᐅᓯᒪᔪᖅ ᐃᒥᓕᕆᔨᒃᑯᑦ ᑲᑎᒪᔨᖏᓐᓄᑦ, ᑲᓐᔨᒃᑯ-ᑯᓐᓄᑦ, ᑕᒃᑯᐊᓗ ᐱᕐᑯᑎᖅᑎᐅᓪᓗᑎᒃ ᓇᓂᓯᕕᒃᒥᒃ ᐅᔭᕋᒃᓂᐊᕐᕕᒃᒥᒃ ᑲᒪᒋᔭᖃᕐᓗᑎᒃᓗ ᓴᓗᒻᒪᖅᓴᖅᑕᐅᓂᖓᓂᒃ ᐊᒻᒪᓗ ᖃᓄᐃᓕᐅᕐᓂᐅᓚᔪᕐᑐᓂᒃ ᐊᖏᕐᑕᐅᓇᖁᒃᓗᑎᒃ ᓴᓗᒻᒪᖅᓴᕐᓂᕐᒧᑦ ᒪᑐᐸᓪᓕᐊᓂᖓᓄᓪᓗ ᐸᕐᓇᐅᑎᓂᒃ.

ᓇᓂᓯᕕᒃᒥ ᓴᓗᒪᖅᓴᐃᓂᖅ 2004 ᐊᕿᒃᑕᐅᓯᒪᒃᒪᑦ ᐸᕐᓇᐅᑎᖓ, ᐱᔭᕆᐊᖃᕐᓂᖓ ᒪᓕᒃᓗᒍ ᐃᒥᕐᒧᑦ ᐱᔪᓐᓇᐅᑎᖓᓂ, ᐊᑐᓂᓗ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᑦ ᐅᓂᑲᓕᐊᕆᓯᒪᓪᓗᑎᒃ ᒪᑐᔭᐅᕙᓪᓕᐊᓗᓂ ᖃᓄᐃᓕᐅᕈᔭᕐᒪᖔᑕ. ᑕᒃᑯᐊ ᑎᑎᕋᐃᑦ ᑎᑎᕋᕐᑕᐅᓯᒪᔪᑦ ᐱᔭᕆᐊᖃᕐᓂᖏᑦ ᒪᓕᒃᓗᒋᑦ ᑐᐊᐸᒃᑕᕐᕕᐅᔪᑦ ᐊᒻᒪᓗ ᓴᓗᒻᒪᓴᐃᓂᕐᒧᑦ ᐸᕐᓇᐅᑎᑦ.:

WJ8Nstc3g6 giy/Exc3S6 vtmpk5 xq3bsnh4li siv3ymJi4 ttC3ymJi4 cspn3ymJi4 gxX4b3=sJi4 cEix3gu4, sfizl Wcysplt4:

1. *ᖃᓄᕐ ᑐᐊᐸᒃᒥᒃ ᐱᔭᐃᓂᐊᕐᒪᖔᑕ ᐊᒻᒪᓗ ᖃᓄᑎᒋ ᐱᔭᐃᑎᕆᓂᐊᕐᒪᖔᑕ*
2. *ᐸᒥᐊᑯᔪᑦ ᐱᔭᐅᖏᑦᑐᓪᓗᓐᓂᑦ ᖃᓄᐃᑕᐅᓂᐊᕐᒪᖔᑕ*
3. *ᖃᓄᐃᓕᐅᕐᓗᑎᒃ ᓴᓗᒻᒪᖅᑕᐅᓂᐊᕐᒪᖔᑦ ᐅᕙᓗᓂᑦ ᖃᐃᖃᒃᓴᖅᑕᐅᓂᐊᕐᒪᖔᑦ*
4. *ᓄᓇᖑᐊᖅ, ᐱᔭᕆᐊᖃᖅᖢᑕ, ᓇᓗᓇᐃᖅᓯᒪᓗᑎᒃ ᓇᑭᖕᖃᑦᑕᕐᒪᖔᑦ ᑐᐊᐸᒃ*

ᑕᓐᓇ ᑐᐊᐸᒃᑕᕐᓂᐅᔪᖅ ᓴᓗᒻᒪᕐᓴᐃᓂᕐᒧ ᐸᕐᓇᐅᑎᖓ ᑎᑎᕋᕐᓯᒪᔪᖅ ᐃᓗᓕᖏᓐᓂᒃ ᐅᑯᐊᖑᓪᓗᑎᒃ.

- ᑎᓴᒪᑦ ᑐᐊᐸᒃᑕᕐᕕᐅᓂᐊᕐᑐᑦ
- ᑐᐊᐸᒃᑕᕐᕕᐅᔪᑦ ᖃᐃᖃᕐᓴᕐᑕᐅᓂᖓ ᓴᓗᒻᒪᕐᓴᕐᑕᐅᓂᖓᓗ
- ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᐱᔭᕐᑕᐅᓯᒪᔪᖅ ᑐᐊᐸᒃ ᖃᓄᐃᐸᓪᓕᐊᒃᒪᖔᑦ
- ᑐᐊᐸᒃᑕᒃᑲᓂᕆᐊᖃᕈᑎᒃ ᐱᕕᐅᔪᓐᓇᕐᑐᑦ ᐸᕐᓇᐅᑎᒋᓯᒪᒃᒥᔪᑦ.

ᒪᓐᓇᐅᔪᖅ ᓇᓂᓯᕕᒃᑯᑦ ᐊᖏᕐᑕᐅᓯᒪᔪᑦ 7-ᓂᒃ ᑐᐊᐸᒃᑕᕐᕕᖃᕐᓗᑎᒃ::

- ᐊᒃᑕᕐᕕᐅᑦ ᖃᓂᒋᔭᓂᑦ
- ᐱᖑᐊᓗᑦ ᖃᓂᒋᔭᓂᑦ
- ᑯᕕᕐᑕᕐᕕᐅᑦ ᖃᓂᒋᔭᓂᑦ
- ᓯᕕᖕᖓᔪᑦ ᕿᕐᓂᕐᑕᒥᒃ ᑐᐊᐸᒃᑕᕐᕕᐅᔪᖅ

- ᐊᖅᑯᑎᐅᑦ ᖃᓂᒋᔭᓂᑦᑐᖅ
- ᓴᓇᕕᐅᑦ 14 ᖃᓂᒋᔭᓂᑦᑐᖅ
- ᑯᕕᕐᑕᕐᕕᐅᑦ ᖃᓂᒋᔭᓂᑦᑐᖅ

ᑐᐊᐸᒃᑕᕐᕕᐅᔪᑦ ᒪᓕᒐᖏᑦ ᐊᖏᒃᑕᐅᓯᒪᔪᑦ ᒐᕙᒪᒃᑯᓐᓄᑦ ᓄᓇᕗᑦᒥ ᐊᒻᒪᓗ ᒐᕙᒪᑐᖅᑲᒃᑯᓐᓄᑦ.

ᒪᑐᓯᒪᓕᕐᑎᓪᓗᒍ, ᑐᐊᐸᒃ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᖅ ᐅᑯᓄᖓ:

- ᑯᕕᕐᑕᕐᕕᒃ ᖃᓕᕐᑕᐅᓗᓂ
- ᖃᑦᑎᒃᓯᓕᕐᓯᒪᔪᑦ ᐃᓚᔭᐅᒃᑲᓐᓂᕐᓗᓂ
- ᐊᑕᓂᑦᑐᖅ ᑯᕕᕐᑕᕐᕕᐅᑦ ᐃᓕᓇᔭᐅᓗᓂ
- ᐃᒥᖅᑲᕐᕕᐅᔪᖅ ᑕᓯᓕᐊᓇᓯᒪᔪᖅ
- ᑯᕕᕐᑕᕐᕕᐅᔪᑦ ᖃᐅᔮᓴᕐᕕᑦ
- ᐊᒃᑕᕐᕕᒃ
- ᐳᓚᑕᕐᕕᒃ ᐊᑭᓐᓇᒥᑦᑐᖅ
- ᐳᓚᑕᕐᕕᒃ ᑲᓇᒃᓇᒥᑦᑐᖅ
- ᓴᓇᕕᒃ 14 ᐅᔭᕋᑐᐃᓐᓇᕐᓂᒃ ᑲᑎᑦᑎᕕᐅᔪᖅ (ᐱᖃᓯᐅᑎᓪᓗᒋᑦ ᖃᓕᕐᓯᒪᔪᖅ ᖃᒃᑲᓐᓂᐊᒍᑦ ᓯᐅᕋᕐᒥᒃ ᐃᓕᓇᔭᐅᓗᓂ)
- ᐳᓚᑕᕐᕕᒃ ᑕᓇᐅᕐᒥᑦ ᑕᑯᒃᓴᐅᔪᖅ
- ᐳᓚᑕᕐᐱᕕᓂᖅ
- ᐱᓗᑦᑐᕐᓯᒪᔪᖅ
- ᓴᓇᕕᐊᓗᒃ

ᐊᒻᒪᓗᑦᑕᐅᖅ ᕿᕐᓂᕐᑕᖅ ᑐᐊᐸᒃ ᖃᓄᔭᐅᓂᐊᕐᑎᓪᓗᒍ ᖃᒃᑲᓐᓂᐊᒍᑦ ᓯᐅᕋᕐᒥᒃ ᐊᑐᕐᓂᐊᕐᑐᑦ.
ᑖᓇ ᓯᐅᕋᖅ ᐱᔭᐅᓂᐊᕐᑐᖅ ᑯᕕᕐᑕᕐᕕᐅᑦ ᖃᓂᒋᔭᓂᖓᕐᓗᓂ. ᑲᑎᓕᒪᕐᓗᒋᑦ ᑐᐊᐸᒃ ᕿᕐᓂᕐᑕᖅ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᖅ ᖃᓕᕐᓯᔪᑕᐅᓂᐊᕐᑐᖅ ᐊᖏᓂᖃᕐᑐᖅ 794,000 ᑭᐸᓇᒃᓯᓗᒍ ᒥᑕ. ?ᑎᓕᒪᕐᓗᒍ ᓯᐅᕋᖅ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᖅ ᐊᖏᓂᖃᕐᑐᖅ 180,350 ᑭᐸᓇᒃᓯᓗᒍ ᒥᑕ. ᐸᖏᓂᖏᑦ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᑦ ᒪᓕᒃᓯᒪᔪᑦ ᓴᓇᓯᒪᓂᖓᓂᒃ ᖃᖓ ᕿᒥᕈᔭᐅᓯᒪᓂᖓ ᒪᓕᒃᓗᒍ ᐸᕐᓇᐅᑎᖓᓂ, ᐅᔭᕋᑐᐃᓐᓇᐃᑦ ᑲᑎᑕᐅᓯᒪᔪᓪᓗ ᐊᒻᒪᓗ ᐳᓚᑕᕐᕕᑦ ᐱᔭᓇᐊᖅᑲᕐᓂᖏᑦ ᐊᒻᒪᓗ ᐊᒃᑕᕐᕕᐅᑦ ᓴᐅᔭᐅᓂᓄᑦ.

ᑖᓇ ᑎᑎᕋᕐᓯᒪᔪᖅ ᐅᓂᒃᑲᒃᓴᖅ ᐅᖃᕐᓯᒪᔪᖅ ᑐᐊᐸᒃᑕᕐᕕᐅᓂᐊᕐᑐᒥᒃ ᓴᓗᒻᒪᖅᓴᐃᓂᕐᒥᒃᓗ ᐸᕐᓇᐅᑎᖓᓂ ᑎᓴᒪᓄᑦ ᑐᐊᐸᒃᑕᕐᕕᐅᔪᓄᑦ ᐱᑕᖃᕐᓗᓂᓗ ᐱᔭᓇᐊᓕᒃ ᐊᖏᓂᖓ 1,350,000 ᑭᐸᓇᒃᓯᓗᒍ ᒥᑕ, ᓯᐅᕋᖅ ᐊᖏᓂᖃᓪᓗᐊᕐᑐᖅ 375,000 ᑭᐸᓇᒃᓯᓗᒍ ᒥᑕ ᐱᑕᖃᕐᑐᖅ. ᖃᓂᒋᔭᓐᓂᖓᓄᑦ ᑯᕕᕐᑕᕐᕕᐅᔪᑦ ᐱᔭᐃᕕᐅᓂᐊᕐᑐᖅ ᑎᑭᓪᓗᒍ ᑭᒃᓕᖓ ᑯᕕᕐᑕᕐᕕᐅᔪᑦ ᐃᓗᑐᓂᖓ ᐳᕐᑐᓂᖃᓕᕐᓗᓂ 371 ᒥᑕ.

ᑕᒪᕐᒥᒃ ᑐᐊᐸᒃᑕᕐᑕᐅᔪᑦ ᒪᓕᒃᓯᒪᓂᐊᕐᑐᑦ ᐱᕐᑯᔭᓂᒃ ᒪᓕᒐᕐᓂᒃᓗ. ᑕᒪᕐᒥᒃᓗ ᐃᓚᐅᖃᑕᐅᓯᒪᓪᓗᑎᒃ ᐃᒥᕐᒧᑦ ᐱᔭᓐᓇᐅᑎᖓᓄᑦ ᐊᒻᒪᓗ ᐱᔭᓐᓇᐅᑎᖃᓪᓗᑎᒃ ᐊᑐᓂ ᑐᐊᐸᒃᑕᕐᕕᐅᔪᑦ. ᐊᑐᕐᑕᐅᔪᑦ ᒪᓕᒃᑕᐅᔪᑦ ᐱᕐᑯᔭᐃᑦ ᐅᑯᐊᖑᔪᑦ ᐃᓚᖏᑦ. *ᐊᑐᐊᒐᐃᑦ ᒪᓕᒐᐃᓪᓗ ᕿᒪᒃᑕᐅᔪᓄᑦ ᒪᑐᔭᐅᔪᓄᓪᓗ ᐅᔭᕋᕐᓂᐊᕐᕕᒃᓄᑦ ᓄᓇᕕᐊᕐᒥ. ᓴᓗᒻᒪᖅᓴᐃᓂᕐᒧᑦ ᒪᓕᒐᐃᑦ ᐅᑭᐅᕐᑕᑐᕐᒥ, ᐊᕙᑎᓕᕆᓂᕐᒧᑦ ᒪᓕᒐᐃᑦ ᐳᓚᑕᕐᕕᑦ ᑐᐊᐸᒃᑕᕐᕕᓪᓗ, ᐅᑯᐊᖑᔪᑦ ᒪᓕᒐᐃᑦ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᑦ ᓇᓂᓯᕕᒃᒧᑦ ᑐᐊᐸᒃᑕᕐᑎᓪᓗᒋᑦ:*

- ᑕᒪᕐᒥᒃ ᑐᐊᐸᒃᑕᕐᕕᐅᔪᑦ ᒪᓕᒃᓂᐊᕐᑐᑦ ᓄᓇᕗᑦᒥ ᐅᔭᖅᓂᐊᕐᓂᕐᒧᑦ ᐊᑦᑕᕐᓇᕐᑕᐃᓕᒪᓂᕐᒧᖓᔪᑦ ᐱᕐᑯᔭᐃᑦ
- ᐅᖓᓯᒃᓂᖅᓗᑎᒃ 30-ᒥᑕᒥᒃ ᐃᒥᐅᓂᐅᔪᒥᑦ

- ᐅᑭᐅᒃᑯᑦ ᓴᓇᔭᐅᓂᖓ ᐸᕐᓇᒃᑕᐅᓗᓂ ᑕᐃᒃᑯᐊ ᓄᓇᐃᑦ ᐅᐸᒃᓴᐅᖏᑦᑐᑦ ᐊᐅᔭᒃᑯᑦ
- ᐊᖅᑭᒃᓯᓗᑎᒃ ᑯᒃᐱᒃᓴᒥᒃ ᐊᒻᒪᓗ ᓄᒍᑉᐸᓪᓕᐊᔭᐃᒃᑯᑎᒥᒃ
- ᐳᕐᑐᓂᖃᕐᑐᒥᒃ 5-ᒥᑕᒥᒃ ᐊᒻᒪᓗ ᓴᓂᒧᑦ ᐊᖏᓂᖃᕐᑐᒥᑦ 5-ᒥᑕ ᐱᔭᐃᖃᑦᑕᕐᓗᑎᒃ
- ᑐᐊᐸᐅᑦ ᓯᕕᖓᓂᖓ 2 ᑐᑭᒧᑦ ᐊᒻᒪᓗ 1 ᖁᒻᒧᑦ
- ᐅᔭᕐᑭᐅᑦ ᓯᕕᖓᓂᖓ 1 ᑐᑭᒧᑦ ᐊᒻᒪ 1 ᖁᒻᒧᑦ
- ᐊᖅᑭᒃᓯᓗᑎᒃ ᐃᓚᒃᓴᓄᑦ ᓱᕈᕐᓇᕐᑐᓄᓪᓗ ᐱᕐᑯᑎᒃᑯᕕᐅᓂᐊᕐᑐᒥᒃ ᓴᓗᒻᒪᖅᓴᐅᑕᐅᓂᐊᕐᑐᓂᒃᓗ
- ᓴᓗᒻᒪᖅᓴᐃᓗᑎᒃ ᓴᓂᖏᓐᓂᒃ ᖃᕈᑎᕕᓂᕐᓂᒃᓗ
- ᐸᕐᓇᐅᑎᖃᕐᓗᑎᒃ ᕿᒪᐃᓂᕐᒧᑦ ᒪᑐᔭᐅᓂᕐᒧᓪᓗ.
- ᖃᐃᒃᖃᒃᑕᐅᓗᓂ ᑐᐊᐸᒃᑕᕐᕕᐅᕙᖅ
- ᒪᑐᓯᒪᓕᕐᑎᓪᓗᒍ ᖃᐅᔨᓴᕐᑕᐅᓗᓂ

ᑐᐊᐸᒃ ᕿᕐᓂᕐᑕᖅ ᖃᓂᒋᔭᓂᑦᑐᖅ ᕿᕐᓂᕐᑕᐅᓪᓗᓂ ᕿᕐᓇᖓᓪᓗᓂᓗ ᐅᔭᕐᖏᑦ ᐃᕙᓂᖃᕐᑐᖅ 180 ᒥᑕᒥᒃ. ᓯᐅᕐᖅ ᑯᕕᕐᑕᕐᕕᐅᑦ ᖃᓂᒋᔭᓂᑦᑐᖅ ᓯᐅᕿᐅᓗᓂ ᓯᐅᕿᐅᓂᖓᓗ ᐊᓕᒍᓚᖃᕐᓗᓂ ᐊᐅᐸᔪᕐᑐᒥᒃ ᑕᕐᓴᖃᕐᓂᕐᓴᐅᓪᓗᓂ.

ᐊᖏᓂᖓ ᑐᐊᐸᐅᑦ ᕿᕐᓂᕐᑕᖅ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᕙᖅ ᐅᒃᑐᕐᕿᕐᑕᐅᓪᓗᓂ ᖃᖓᓂᑦᑐᕐ ᐊᒻᒪᓗ ᓂᐅᕐᑐᕐᑕᐅᓪᓗᓂ ᐃᓗᒻᒧᑦ ᖃᐅᔨᔭᐅᓇᖕᒃᓗᓂ ᖃᓄᑎᒋ ᐃᕙᑎᒋᒃᒪᖓᑦ. ᓂᐅᕐᑐᒃᑲᓂᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᓴᓗᒻᒪᖅᓴᐃᓂᖏᓐᓂ ᐊᒥᒐᖏᑦᑎᐊᕐᑲᓗᐊᕐᒪᖓᑦ ᖃᐅᔨᒪᔭᐅᓇᖕᒃᓗᓂ. ᑐᐊᐸᒃᑕᕐᓂᕐᒧᑦ ᐸᕐᓇᐅᑎᒋᔭᖓ ᐊᖏᓂᖃᕐᑐᒥᒃ 1,350,000 ᐱᔭᐃᕕᐅᓂᐊᕐᑐᖅ ᖃᓇᔭᐅᓂᐊᕐᑐᒥᒃ ᐊᖏᓇᕐᓂᕐᓴᐅᓪᓗᓂ ᓇᓴᕐᑕᐅᓯᒪᕙᖅ. ᐊᖏᓂᕐᓴᒥᒃ ᖃᓕᕐᓯᔭᕆᐊᖃᕈᑎᒃ ᐱᕙᓐᓇᕐᓂᐊᕐᒥᕙᑦ ᐊᓯᖓᖓᓂᒃ ᑐᐊᐸᒃᑕᕐᕕᐅᕙᒥᑦ.

ᖃᖓᓂᑦᑐᒥᑦ ᐊᒻᒪᓗ ᐃᓗᐊᓂᑦᑐᒥᑦ ᖃᐅᔨᓴᕐᓯᒪᕙᑦ ᓱᕈᕐᓇᕐᑐᖃᕐᓂᖓ ᖃᐅᔨᔭᐅᓇᖕᒃᓗᓂ. ᑐᑭᓯᔭᐅᓚᐅᕐᑐᖅ ᕿᕐᓂᕐᑕᖅ ᑐᐊᐸᒃ ᐃᓴᒃᐸᓪᓕᐊᖏᓐᓂᖓᓂᒃ ᓱᕈᕐᓇᕐᑐᐃᓪᓗ ᓄᖃᖓᑎᑕᐅᕙᓐᓇᕐᓂᖏᓐᓂᒃ.

ᐊᖏᓂᕐᓴᐅᕙᖅ ᑐᐊᐸᒃ ᐱᔭᐅᓂᐊᕐᑐᖅ ᐱᖑᐊᓗᑦ ᖃᓂᒋᔭᓂᑦᑐᒥᑦ ᐊᒻᒪᓗ ᑯᕕᕐᑕᕐᕕᐅᑦ ᖃᓂᒋᔭᓂᑦᑐᒥᑦ. ᑕᒃᑯᐊ ᒪᕈᕐ ᑐᐊᐸᒃᑕᕐᕕᐅᕙᒃ ᓇᒻᒪᒃᓂᐊᕐᒪᑎᒃ ᐊᖏᓂᖓᓂᒃ ᐱᓇᓱᒃᓗᑎᒃ. ᑯᕕᕐᑕᕐᕕᐅᑦ ᖃᓂᒋᔭᖓᓂᒃᑲᓂᕐᑐᑦ ᐱᕕᐅᑐᐃᓐᓇᕿᐊᖃᕐᒥᕙᖅ, ᑭᓯᐊᓂ ᒪᓂᕐᖅ ᖁᐊᖑᓕᕐᑎᓪᓗᒍ ᐱᔭᐃᕕᐅᒥᐊᕐᔭᕐᒪᑦ.ᐊᒃᑕᕐᕕᐅᑦ ᖃᓂᒋᔭᓂᑦᑐᕐ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᖅ ᖃᓕᕈᑕᐅᓗᓂ ᐊᒃᑕᕐᕕᒃᒧᑦ.

ᑐᐊᐸᒃᑕᕐᕕᐅᕙᒃ ᐊᖅᑭᒃᓯᖃᑦᑕᕐᓂᐊᕐᑐᑦ 5-ᒥᑕᒥᒃ ᐃᕙᓂᓕᒃᒥᒃ ᐱᔭᐃᕕᐅᕚᓪᓕᐊᓗᓂ . ᒪᑐᓯᒪᓕᕐᐸᑦ ᓯᕕᖓᕙᓐᓂᕐᑎᑕᐅᒐᔪᕐᑐᖅ. ᐊᒻᒪᓗ ᐱᔭᐃᕕᐅᓇᖕᒃᓗᓂ ᖃᕐᑎᑕᐅᖃᑦᑕᕐᓗᓂ ᓴᓕᒍᕐᑕᐅᕚᓪᓕᐊᓗᓂᓗ.

ᐃᓱᒪᒋᔭᐅᓪᓗᓂ ᖃᓄᑎᒋ ᑐᐊᐸᒃᑕᖃᑦᑕᕐᓂᐊᒪᖓᑕ ᓄᓇᓯᐅᑎᑦ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᑦ ᐊᖏᓂᖏᑦ, ᖃᖓᒃᑯᕐᓂᖏᑦ ᐊᒻᒪᓗ ᐅᓯᕙᓐᓇᕐᓂᖏᑦ ᒪᓕᒃᓗᕆᑦ. ᖃᐅᔨᓴᕐᑕᐅᓪᓗᓂ ᐊᑐᕐᑕᐅᖃᑦᑕᕐᓯᒪᕙᑦ ᒪᓕᒃᓗᕆᑦ ᖃᓄᑎᒋ ᑐᐊᐸᒃᑕᖃᑦᑕᕐᒪᖓᑕ ᐅᓪᓗᕐᒧᑦ ᒪᓕᒃᑕᐅᓂᐊᕐᑐᖅ. ᑕᒃᑯᐊᒃ ᑕᒪᕐᒥᒃ ᑐᐊᐸᒃᑕᕐᕕᐅᕙᒃ ᐊᑕᐅᑦᑎᒃᑯᑦ ᑐᐊᐸᒃᑕᕐᕕᐅᒍᑎᒃ ᐱᔭᐃᖃᑦᑕᕐᔪᕐᑐᑦ 2,436 ᒥᑕᒥᒃ ᐅᓪᓗᕐᒧᑦ ᐃᑲᕐᓂᒃ 20-ᓂᒃ ᐃᖃᓇᐃᔭᕐᑐᖃᖃᑦᑕᕐᓗᓂ. ᑕᓐᓇᓗ ᐊᖏᓂᖓ ᐱᔭᕐᑕᐅᒐᔪᕐᑐᖅ ᐱᔭᕆᐊᖃᕐᓂᖓ ᒪᓕᒃᓗᒍ. ᐃᓱᒪᒋᔭᐅᒋᓪᓗᓂ ᓂᐅᕐᑐᖅᖃᑦᑕᕐᓗᑎᒃ ᖃᕐᑎᑦᑎᖃᑦᑕᕐᓗᑎᒃᓗ ᐱᔭᐃᑦᑎᐊᕐᓯᒪᓂᐊᕈᑎᒃ ᑐᐊᐸᒥᒃ.

ᐱᓚᖓᑦ ᑐᐊᐸᒃᑕᕐᕕᐅᒐᔪᕐᑐᖅ ᑭᓯᐊᓂ ᑕᒃᑯᐊ ᑕᒪᕐᒥᒃ ᑐᐊᐸᖃᖏᓗᐊᓕᕈᑎᒃ. ᐃᓱᒪᒋᔭᐅᕙᖅ ᑕᓐᓇ ᖃᓇᒃᓇᒥᑦᑐᖅ ᑐᐊᐸᒃᑕᕐᕕᐅᕙᖅ ᐱᔭᐃᕕᐅᖃᑦᑕᕐᔪᕐᑐᖅ ᐊᖏᓂᖃᕐᑐᒥᒃ 2,947 ᒥᑕ ᑭᑉᐸᓇᒃᓯᓗᒍ ᐅᓪᓗᕐᒧᑦ, ᐊᒻᒪᓗ ᖃᓇᐊᖃᕐᑐᑦ ᑭᓯᐊᓂ ᐱᔭᓇᕐᐸᑕ ᓯᐅᕐᕿᕐᒥᒃ ᖃᓕᕐᓯᑕᐅᓐᓇᕐᔪᕐᒪᑕ ᐊᖏᓂᖃᕐᑐᒥᒃ 2,526-ᒥᑕᒥᒃ ᓯᐅᕐᕿᕐᒥᒃ ᐱᔭᐃᒐᔪᕐᑐᑦ ᐅᓪᓗᕐᒧᑦ.

ᐱᓚᑦᑕᓕᕐᐸᑕ ᒥᑭᓐᓂᕐᓴᒥᒃ ᐱᔭᐃᖃᑦᑕᕐᔪᕐᑐᑦ ᐅᑯᐊ ᐱᕙᑎᒋᓪᓗᒋᑦ:

- ᑐᐊᐸᒃᑕᕐᓂᐅᑦ ᖃᖓᒃᑯᒐᔾᓂᖓ ᓇᒥᓐᓂᖓᓗ ᒪᓕᒃᓗᒍ
- ᓄᓇᓯᐅᑎᑦ ᐊᑐᕐᑕᐅᔪᑦ ᒪᓕᒃᓗᒋᑦ
- ᓯᓚᐅᑦ ᖃᓄᐃᓕᖓᓂᖓ ᒪᓕᒃᓗᒍ

ᑐᐊᐸᒃᑕᕐᑎᓪᓗᒋᑦ, ᖃᐅᔨᓴᕐᑎᐅᔪᑦ, ᐊᖏᔪᖃᖓᓪᓗ ᐅᐸᒃᓯᒪᖃᑦᑕᕐᓂᐊᕐᑐᑦ. ᑐᐊᐸᒃᑕᕐᑎᓪᓗᒋᑦ ᑕᒃᑯᐊ ᐃᖃᓇᐃᔭᕐᑎᑦ ᖃᐅᔨᓴᖃᑦᑕᕐᓂᐊᕐᒪᑕ ᓇᕈᒋᔭᐅᔪᓪᓗ ᐱᔭᐅᖃᑦᑕᐳᐊᖏᓪᓗᑎᒃ ᓱᕐᓗ ᐅᔭᕋᐃᓐᓇᐅᓗᐊᕐᑐᑦ. ᖃᐅᔨᒪᓇᕐᒪᑦ ᐅᔭᕋᐃᓐᓇᐅᓂᖏᑦ ᖃᐅᒪᓂᖅᓴᐅᒃᒪᑕ ᑕᕐᓴᖏᑦ. ᐊᒻᒪᓗ ᖃᐅᔨᓴᕐᑎᐅᔪᑦ ᖃᐅᔨᒪᓇᓱᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᐊᖏᔪᑕᐅᓗᐊᖏᒃᑲᓗᐊᕐᒪᖓᑕ ᑐᐊᐸᖏᑦ ᐊᒻᒪᓗ ᑐᐊᐸᒃ ᒪᓕᒃᓯᒪᒐᓗᐊᕐᒪᖓᑦ ᒪᓕᒐᕐᓂᒃ ᖃᓄᐃᑦᑐᔭᕆᐊᖃᕐᑎᑕᐅᔪᒥᒃ.

ᖃᐅᔨᓴᕐᑎ ᐊᖏᔪᖃᖓᓪᓗ ᐃᖃᓇᐃᔭᕐᑎ ᖃᐅᔨᓇᓱᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᖃᕐᑎᑕᐅᕚᓪᓕᐊᔪᖅ ᐊᕙᑕ ᖃᓄᐃᖏᒃᑲᓗᐊᕐᒪᖓᑦ ᐊᒪᓗ ᓯᕕᖓᓂᖓ ᓇᒪᒃᑲᓗᐊᕐᒪᖓᑦ.

ᑐᐊᐸᒃᑕᕐᑎᓪᓗᒋᑦ, ᕿᖑᒥᒐᕐᑕᐅᓯᒪᔪᓇᐊᖃᕐᓂᐊᒥᐅᖅ ᓯᕕᖓᕙᓪᓕᐊᓂᖓ ᖃᐅᔨᒪᔭᐅᓇᓱᒃᓗᓂ ᐊᒻᒪᓗ ᓂᐅᕐᑐᖃᑦᑕᕐᓂᐊᕐᒥᐅᑦ ᐱᔭᐃᖏᓐᓂᕐᒥᓂᒃ ᑐᐊᐸᖓ ᖃᓄᑎᒋ ᐃᓗᑦᑐᕐᑎᒋᓗᓂ ᐱᔭᕐᑕᐅᔪᓐᓇᕐᒪᖓᑦ.

ᓇᓗᒻᒪᕐᓴᐃᓂᕐᒍᑦ ᐸᕐᓇᒃᓯᒪᔪᑦ ᖃᐅᔨᓴᕐᑕᐅᖏᓐᓇᕿᐊᖃᖏᓐᓇᓱᒃᓗᑎᒃ. ᐱᕈᕐᑐᖃᑦᑎᐊᖏᓐᓂᖓᓄᑦ ᐱᕈᕐᑐᓂᒃ ᐊᕿᒃᓱᐃᔨᐊᖏᑦᑐᑦ. ᓯᕕᖓᓂᖓ ᖃᑎᒃᓂᖏᓪᓗ ᐱᔭᕆᕐᓯᒪᓕᕐᑎᓪᓗᒋᑦ ᑎᑎᕋᕐᑕᐅᓂᐊᕐᒥᔪᑦ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᒪᑕ ᒪᑐᓯᒪᓕᕐᑎᓪᓗᒍ.

6.6.2 Executive Summary

Under the terms of Water Licence NWB1NAN0208 issued by the Nunavut Water Board (NWB), CanZinco Ltd., the current owner of the Nanisivik Mine is responsible for continuation of on-site environmental protection activities and developing for submission and approval a Reclamation and Closure Plan ("RCP").

The Nanisivik Mine 2004 RCP has been developed, as per the terms of the Water Licence as a series of stand-alone documents, each addressing in detail the information and proposed closure measures for one specific component or topic area. This document and the information presented herein are provided in response to the requirements for report Part G Item 6, the Quarry Development and Reclamation Plan.

In accordance with Part G Item 6 of the Water Licence, this report provides the following requirements for Quarry Development and Reclamation Plan:

The Licencee shall submit to the Board for approval a report assessing all quarries required for shale cover construction, which shall include but not be limited to:

1. *Description of extraction method and rate of production;*
2. *Identification of waste/overburden volumes and disposal sites;*
3. *Description of final quarry geometry and reclamation measures; and*

4. *Maps, where appropriate, showing sources and stockpile locations of all borrow materials.*

In summary, this Quarry Development and Reclamation Plan report provides details for the following components:

- Development plans for four quarries;
- A detailed reclamation and grading plan for the developed quarries at closure;
- A monitoring plan to assess the extracted material used for closure; and
- A series of contingency plans that may be implemented should the need for more material arise.

At the current time, Nanisivik Mine has permits for seven shale quarries:

- Landfill Quarry;
- Mt. Fuji Quarry;
- West Twin Quarry;
- Shale Hill Quarry;
- Road Quarry;
- Area 14 Quarry; and
- East Twin Quarry.

Quarry permits for these sites are regulated either by the Government of Nunavut or Indian and Northern Affairs Canada.

At closure, shale cover will be required for the following facilities around the mine site:

- Surface Cell tailings and crest of West Twin Dike;
- Downstream face of West Twin Dike (including completion of shale cover for consistent grade);
- Tailings at the toe of West Twin Dike;
- Transition zone tailings at toe of West Twin Dike;
- Test Cell tailings and Test Cell Dike;
- Transition zone tailings at the toe of Test Cell Dike;
- Landfill;
- West Open Pit;
- East Open Pit;
- Area 14 Waste Rock Pile (including completion of existing cover with armouring sand & gravel);
- Oceanview Pit;
- Oceanview Portal Site (former ore stockpile pad);
- East Trench; and
- Mill Area.

In addition to the shale cover at these locations, a top layer of sand and gravel armouring will be required. This material will be obtained from the Twin Lakes sand and gravel deposit, located between West Twin Lake and East Twin Lakes. The total in-place volume of shale required for the covers is estimated to be about 794,400 m^3. The total in-place volume of sand and gravel armouring required is estimated to be about 180,350 m^3. The volumes are based on the designs, as reviewed in detail in the Cover Design Report, (Part G, Item 4), the Rock Piles and Open Pits Report (Part G, Item 8) and the Land fill Closure Report (Part G, Item 17).

This report describes the quarry development and reclamation plan for four quarries, which have the potential to provide a total in-situ volume of 1,350,000 m^3 of shale cover material. The Twin Lakes sand and gravel Quarry contains an estimated volume of 375,000 m^3 of material within the upper 2 m. Due to the proximity of West Twin and East Twin Lakes, sand and gravel extraction will be limited to the portion of the deposit above the average level of West Twin Lake (elevation 371 m).

All quarries will be operated and reclaimed according to the relevant guidelines and regulations. In general, most of these requirements are embodied within the conditions of the Water Licence and the individual quarry permits. Relevant guidelines include “Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories”, “Reclamation Guidelines for Northern Canada” and “Environmental Guidelines, Pits and Quarries”. The following operational and design related guidelines have been applied to the Nanisivik quarries:

- All quarrying to be done in accordance with Territorial Mining Safety Act;
- Maintain 30 m buffer distance from adjacent water bodies;
- Plan winter operations in areas where access on firm ground is not possible to avoid rutting;
- Implement drainage and erosion control measures;
- Working benches of 5 m high and minimum 5 m wide;
- Soil slopes $\leq$ 2 Horizontal : 1 Vertical (2H:1V);
- Final rock slopes $\leq$ 1H:1V;
- Implement chemical and hydrocarbon storage, disposal and spill control program;
- Clean up all debris, garbage and unused explosives;
- Prepare plans for eventual abandonment and restoration;
- Re-contouring of excavations wherever practicable; and
- Post-closure monitoring.

The shale quarries are all located within the Lower Victor Bay Formation, comprising an interbedded sequence of fissile, dark grey to black shale and light-grey, planar-bedded dolomitic mudstone, approximately 180 m thick. The Twin Lakes sand and gravel consists of quartz sand, gravel and cobbles derived from quartzite. This unit is characteristically stained a reddish colour by hematite and was deposited as reworked glacial material by local streams.

The quantities of shale in each quarry were estimated on the basis of the exposures of shale in the existing working faces, supplemented by several shallow drill holes to confirm the depth of cover and lateral extent of the deposit. More drilling will be carried out during quarrying operations to help delineate the final quarry limits. The quarry development plans provide for 1,350,000 m^3 (in-situ) of shale cover material, which is about 1.5 times the estimated volume required. If the cover quantity needs to be increased, additional volumes are available from the other quarries at the mine.

Core samples and surface grab samples from existing stockpiles were analyzed for Acid-Base Accounting (ABA) and long-term kinetic testing. The test results determined that the shale has significant neutralizing potential and did not release dissolved metals.

The majority of the shale production will come from the Mt. Fuji Quarry and the West Twin Quarry. These two quarries have sufficient resources to supply all the shale required. The East Twin Quarry may be used to provide shale as well, however access is limited to periods of time when the ground is frozen. The Landfill Quarry will be used to provide shale for the landfill cover due to its proximity to the area.

Quarries will be developed using 5 m high benches with a working face of 84^o (1H:10V). Upon closure, the benches will be reduced and the final overall rock slope will be 33^o (1.5H:1V). Final soil slopes will be 18^o (3H:1V). The quarry floors will be sloped at a final grade of 1% to promote drainage. The shale benches will be broken by drilling and blasting or ripping, as required.

The theoretical maximum extraction rate was calculated for each quarry based on the available mine fleet, cycle times, and loads per truck. The calculation was based on actual on-site productivity and equipment data provided by CanZinco for extraction and placement of shale at the West Twin Disposal Area. Assuming the Mt. Fuji Quarry and the West Twin Quarry are both operated simultaneously, the maximum extraction rate is 2,436 m^3/day, based on a 20-hour day. This volume is the in-situ volume in the quarry material. It was assumed that drilling, blasting and ripping production would be able to match this extraction rate.

To estimate a maximum extraction rate for the East Twin Quarry, it was assumed that the other two quarries were exhausted. The maximum extraction rate in this case was estimated to be 2,947 m^3/day. Similarly, the Twin Lakes sand and gravel Quarry was assumed to be in operation only after completion of shale quarry operations. The maximum extraction rate was estimated to be 2,526 m^3/day.

In reality, the actual extraction rates may be less than the above theoretical estimates due to the following factors:

- Scheduling of quarrying and material placement at various locations;
- Equipment availability; and

- Weather conditions and access.

During quarrying, technical monitoring personnel, in combination with the Site Supervisor will be present. In the quarry, these personnel will be responsible for visually assessing the material to reject unsuitable rock units such as pyrite, rocks containing sulphides and dolostone rock units. These materials can easily be distinguished from the dark-grey to black shale on the basis of colour and physical characteristics. In addition, monitoring personnel will ensure that the material does not contain oversize pieces or excessive fines and that the extracted material conforms to the required specifications. Monitoring and supervisory personnel will also inspect the blasted quarry walls, determining scaling requirements and ensuring that the overburden slopes are graded to the appropriate angle for a safe work area.

During excavation, survey control will be required to lay out pit geometry and grades, as well as permitted boundaries. The locations of all boreholes drilled to verify shale quantities will be recorded.

Reclamation measures have been developed to ensure minimal ongoing maintenance. Due to the sparse vegetation and limited growing season at the mine site, re-vegetation will not be carried out. Final pit slopes and grades will be established and surveyed. Inspection personnel will locate the final configuration of any berms and erosion control requirements. A detailed survey of the area will be undertaken to provide as-built drawings of the final closure of the quarries.

6.7 G.7, ᖃᖓᓗᓐ ᑯᕕᔭᐅᖃᑦᑕᕐᓯᒪᔪᑦ ᐊᑭᓐᓇᒥᑦᑐᖅ ᑯᕕᕐᑕᕐᕕᐅᑦ ᖃᓂᒋᔭᒧᑦ ᑯᓕᐅᕐᓂᖅ, West Twin Dike Spillway Design

The report, *Engineering Design of the West Twin Dike Spillway* (the "Spillway Report"), provides the report requested under Part G, Item 7 of the Water Licence. The Spillway Report was prepared by Golder Associates and is provided in its entirety as Appendix D and the Executive Summary is provided below for ease of reference.

6.7.1 ᓇᐃᒃᓕᒋᐊᕐᓯᒪᔪᑦ ᐅᖃᐅᓯᒃᓴᐃᑦ

ᐳᓚᐃᒃᐹᐊᑐᒃᑯᑦ ᑎᓕᓯᓚᐅᕐᒪᑕ ᐃᖃᓇᐃᔭᕐᑎᑦᑎᔪᑎᒃ ᖃᐅᔨᓴᕐᑎᐅᔪᓂᒃ ᑯᓪᑐ ᐃᓚᖏᓪᓗ ᐊᕿᒃᓯᓂᐊᕐᔪᑎᒃ ᓴᓇᓂᐊᕐᔪᑎᒃᓗ ᑯᓕᐅᕐᑕᐅᓂᖓ ᓇᓂᓯᕕᒃᑯᑦ. ᑕᓐᓇ ᐅᓂᑲᓕᐅᕐᑕᐅᔪᖅ ᒪᓕᒃᑕᐅᓪᓗᓂ ᐱᔭᕆᐊᖃᕐᓂᖓ ᐃᒥᕐᒧᑦ ᐱᔪᓐᓇᐅᑎᖓᓂ ᐊᕿᒃᓯᔭᕆᐊᖃᕐᑎᑕᐅᒃᒪᑕ ᑯᒃᕕᒃᒥᒃ.

ᒪᑐᔭᐅᓂᖓᓄᑦ ᑐᕋᒐᐅᓂᐊᕐᑐᖅ ᐱᔪᑎᖃᓗᐊᕐᓗᓂ ᑯᕕᕐᑕᕐᕕᒃ ᐊᑯᓂᐅᔪᒧᑦ ᐊᕙᑎᑦᑎᓐᓄᑦ ᐊᑦᑕᕐᓇᖏᓪᓗᓂ ᐊᒻᒪᓗ ᓄᓇᖓ ᐅᑎᕐᑎᑕᐅᓗᓂ ᐃᓕᖁᓯᕆᓚᐅᑕᖓᓄᑦ ᐅᔭᖅᑲᓂᐊᖏᑎᓪᓗᒋᑦ. ᒪᑐᔭᐅᓂᖓᓄᑦ ᐸᕐᓇᐅᑎᑦ ᐊᕿᒃᓯᒪᒃᒪᑕ ᓴᐅᔭᐅᒍᓂ ᐊᓂᕐᓂᖃᕐᓇᖏᑎᑕᐅᒋᐊᕐᓗᓂ ᓴᕕᒃᓴᐅᓂᖏᑦ ᐊᓯᐊᓄᐊᕐᑕᐃᓕᒪᑎᑕᐅᓗᑎᒃ. ᒪᑐᓯᒪᓕᕐᑎᓪᓗᒍ ᑯᕕᖅᑕᓚᐅᑲᓕᕙᖅ ᐃᒻᒥᓂᒃ ᓱᕐᓗ ᒥᓪᓗᐊᕐᑕᐅᖏᒃᑲᓗᐊᕐᓗᓂ ᑯᕕᖅᑕᓕᕙᖅ. ᑕᐃᒪᐃᓐᓂᖓᓄᑦ ᑯᓕᐅᕐᑕᐅᓂᐊᕐᑐᖅ ᐃᒥᐅᓂᖓ ᒪᕐᑯᒃᒥᖓᕐᑐᖅ

ᐊᐅᒃᐸᓪᓕᐊᓂᖓᓄᓪᓗᓐᓂᑦ ᑯᖃᑦᑕᕐᓂᐊᕐᒪᑦ ᓯᓚᑕᔪᕐᓗᓂ ᐃᒪᖃᕐᕕᒃᑯᑦ. ᑯᓕᐅᕐᑕᐅᔪᖅ ᓴᓇᔭᐅᓯᒪᔪᖅ ᓯᓚᑦᑎᐊᕙᐅᖏᒃᑲᓗᐊᕐᑎᓪᓗᒍ ᐊᑐᐃᓐᓇᕈᓐᓇᕐᓗᓂ. ᑯᕕᔭᐅᖃᑦᑕᕐᓯᒪᔪᖅ ᐃᒪᓄᑦ ᒪᓐᓇ ᓴᕿᔭᕐᒪᑦ ᓴᐅᔭᐅᓂᐊᕐᑐᖅ ᐅᕙᓗᓐᓂᑦ ᐃᒪᐃᔭᕐᑕᐅᒃᑲᓐᓂᕐᓗᓂ ᐃᒪᓪᓚᕿᐅᓂᖓ ᖁᓚᓂᖓᓕᕐᓗᓂ ᐃᒪᓪᓚᑦᑕᖑᓂᖓ ᐃᓂᖃᕐᓗᓂ 1.0 ᒥᑕᒥᒃ. ᑕᐃᒪᓐᓇᓗ ᑯᕕᕙᓪᓕᐊᓚᔪᖏᒻᒪᑦ ᐊᑕᓂᑦᑐᖅ ᑯᕕᔭᐅᖃᑦᑕᕐᓯᒪᔪᖅ.

ᑯᓕᐅᑕᐅᔪᖅ ᐊᖁᑎᒋᔭᖓᓗ ᓴᓇᓯᒪᔪᖅ ᓯᕕᖓᓂᖓᓂᒃᓗ ᒪᓕᒃᓯᒪᓪᓗᓂ. ᐊᔨᒋᖏᑦᑐᑦ ᐃᓱᒪᒋᔭᐅᓚᐅᕐᑐᑦ ᑭᓯᐊᓂ ᑕᓐᓇ ᓂᕈᐊᕐᑕᐅᓚᐅᕐᑐᖅ. ᖃᐅᔨᓴᕐᓗᑎᒃ ᐃᓂᒋᓂᐊᕐᑕᖓᓂ ᓂᐅᕐᑐᖃᑦᑕᕐᓗᑎᒃ, ᖃᐅᔨᓴᕐᕕᖃᕐᓗᑎᒃ, ᐅᕐᑯᓂᖓᓂᒃᓗ ᖃᐅᔨᓴᐅᑎᖃᕐᓗᑎᒃ ᐊᒻᒪᓗ ᖃᐃᕐᓱᓚᖑᓂᖓᓂᒃ ᖃᐅᔨᓴᕐᓯᒪᓪᓗᑎᒃ. ᖃᓄᐃᑦᑐᓂᖓ ᖃᐅᔨᓚᐅᕐᑐᑦ ᕐᑯᐊᖑᓂᖓ ᖃᐃᕐᓱᓚᕐᒥᑦᑐᖅ ᓯᖃᓕᔪᑕᐅᓯᒪᓪᓗᓂ ᐊᒻᒪᓗ ᐊᐅᒪᓂᖓ ᖃᐃᕐᓱᓚᕐ ᐃᓗᐃᑦᑐᓇᕐᓗᑎᒃ.

ᑯᓕᐅᕐᑕᐅᔪᖅ ᑯᖃᑦᑕᕐᓂᐊᕐᑐᖅ ᖄᖓᓂᑦ ᐃᒪᖃᕐᕕᐅᔪᒧᑦ. ᖄᖓ ᑯᕕᑦᑕᕐᕕᕕᓂᐅᑦ ᖃᐃᖃᒃᓴᕐᑕᐅᓂᐊᕐᑐᖅ ᐃᒥᐅᓂᖓ ᑕᐅᓄᖓ ᑯᖃᑦᑕᕐᑎᑕᐅᓗᓂ. ᐳᕐᑐᓂᖃᕐᑐᖅ 384 ᒥᑕᒥᒃ ᐊᒻᒪᓗ ᐃᒪᖃᕐᓂᖓ ᐃᒪᕐᑐᓂᖃᕐᓂᐊᕐᑐᖅ ᐃᒪᖃᐅᑎᖓᑕ 369 ᒥᑕᒥᒃ. ᑯᓕᐊᕐᑕᐅᔪᖅ ᐊᕿᒃᑕᐅᓯᒪᔪᖅ ᐃᔨᒪᒋᔭᐅᓪᓗᓂ ᐃᑲᕋᓄᑦ 24-ᓄᑦ ᒪᕐᑯᐃᓐᓇᕋᓗᐊᕐᑎᓪᓗᒍ 140 ᒥᓕᒥᑕᒥᒃ ᒪᕐᑯᒃᑲᓗᐊᕐᓂᕈᓂ ᐃᑲᕋᓄᑦ 24-ᓄᑦ.ᖃᐅᑕᒪᓪᓗ ᐊᐅᒃᐸᓪᓕᐊᔪᒧᑦ ᑯᓕᖃᑦᑕᕋᔭᕐᓂᖓ ᐃᔨᒪᒋᔭᐅᓪᓗᓂ 155 ᒥᓚᒥᑕᒥᒃ ᐊᐅᒃᐸᓪᓕᐊᓚᔭᕐᓂᖓᓂᒃ ᑭᓯᐊᓂ ᒥᑭᓐᓂᕐᓴᐅᓚᔭᕐᑐᒃᓴᐅᔪᖅ ᐊᐅᒃᐸᓪᓕᐊᓂᖓ ᐊᑯᓂᐅᓂᕐᓴᐅᒃᒪᑦ. ᒪᓴᐅᓚᖑᓗᓂ ᐃᒪᖃᕋᔭᕐᓂᖓ ᐃᔨᒪᒋᔭᐅᔪᖅ 5.2 ᒥᑕᒥᒃ ᑯᒃᐱᐅᓚᔭᕐᓂᖓᓂᒃ. ᑯᓕᐊᖑᔪᓪᓗ ᐃᑎᓚᖑᓂᖓ 0.52 ᒥᑕ ᐊᒻᒪᓗ ᐃᒃᑲᓚᖑᓂᖓ 0.31 ᒥᑕᓯᕕᖓᓂᕐᓴᐅᔪᒥ.

ᑯᓕᐊᖑᔪᖅ ᓯᓕᒃᓂᖃᕐᑐᖅ 6 ᒥᑕᒥᒃ ᐱᒋᐊᕐᕕᖃᕐᓗᓂᓗ ᖃᐃᖑᒥᑦᑐᒥᒃ. ᐱᒋᐊᕐᕕᒋᔭᖓ ᖃᐃᕐᓱᓂᖓ ᓯᕐᑯᒪᐅᓪᓗᓂ ᐅᕙᓗᓂᑦ ᖃᑦᑎᒃᓂᕐᒥᑦ, ᓄᖑᐸᓪᓕᐊᔭᐃᒃᑯᑎᒥᒃ ᖃᓕᕐᑕᐅᓂᐊᕐᑐᖅ ᑐᐊᐸᖃᕐᑐᒥᒃ ᐊᖏᓂᖃᕐᓗᑎᒃ 300ᒥᓚᒥᑕᒥᒃ ᐃᑎᓂᖓ 0.6ᒥᑕᐅᓗᓂ. ᖃᓕᕐᑕᐅᓂᐊᕐᒥᔪᖅ ᓄᖑᔭᐃᑯᓯᕐᑕᐅᓗᓂ ᐊᑕᓄᑦ ᑐᐊᐸᒃ ᐃᓕᔭᐅᖏᓐᓂᖓᓂ ᐊᑕᓂᑦᑐᕐ ᒪᓂᕋᕐ ᑐᐊᐸᒃᓗ ᐊᐅᓚᔭᒃᑲᓗᐊᕐᐸᑦ. ᑯᓕᐅᕐᑕᐅᔪᒧ ᑕᓯᕐᔫᐊᖃᖃᑦᑕᕐᓂᐊᕐᑐᖅ ᐃᒪᖃᕐᕕᐅᔪᔫᐊᖏᓐᓂᖓᓂ ᐊᒻᒪᓗ ᐃᓱᐊᒍᑦ ᐊᖏᓂᓴᒥᒃ ᓯᓕᒃᓂᓴᒥᒃ ᐸᖃᕐᓗᓂ ᑯᒃᐸᓪᓕᐊᔪᖅ ᐃᒃᐱᒃᓇᓗᐊᕐᑕᐃᓕᒪᓇᓱᒃᓗᓂ ᖃᖓᓄᑦ.ᓄᖑᐸᓪᓕᐊᔪᑎᒃᓴᖓᓂᒃ ᓴᓇᔪᖃᖅᐊᖏᑦᑐᖅ ᐱᒋᐊᕐᕕᖓᓂ ᖃᐃᕐᓱᓚᖑᓂᕐᒥᖓᓄᑦ ᓄᖑᐸᓕᐊᓚᔭᖏᒻᒪᑦ.

ᓴᓇᔭᐅᓗᓂ ᐃᔨᒪᒋᔭᐅᔪᖅ ᐊᖏᓂᖃᕐᑐᒥᒃ 48,800 ᒥᑕᒥᒃ ᐱᔭᐃᓂᐊᕋᓱᒋᓪᓗᑎᒃ ᐊᒻᒪᓗ 400 ᒥᑕᒥᒃ ᐊᖏᓂᓕᒃᒥᒃ ᓴᐅᓯᓗᑎᒃ ᓄᖑᔭᐃᑯᑎᒃᓴᖓᓂᒃ. ᓴᓇᔭᐅᕙᓪᓕᐊᓕᕐᐸᑦ ᑲᒪᒋᔭᐅᑦᑎᐊᕆᐊᖃᕐᓂᐊᕐᑐᖅ ᒪᓕᒃᓯᒪᓚᓗᐊᕐᒪᖔᑦ ᐸᕐᓇᐅᑎᐅᔪᒥᒃ ᐊᕿᒃᑲᓂᕆᐊᖃᑐᐃᓐᓇᕿᐊᖃᕐᒪᑦ ᒪᓂᕋᐅᑦ ᐊᕿᒃᓯᒪᓂᖓ ᒪᓕᒃᓗᒍ. ᓴᓇᔭᐅᕙᓪᓕᐊᑎᓪᓗᒍ ᖃᐅᔨᓴᕐᑕᐅᕙᓪᓕᐊᖃᑦᑕᕆᐊᖃᕐᓂᐊᕐᑐᖅ ᑐᐊᐸᒃ ᓴᐅᓯᔪᑕᐅᔪᖅ ᐊᒻᒪᓗ ᑯᓕᐅᕈᑕᐅᔪᖅ.

ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕆᐊᖃᕐᓂᐊᕐᒥᔪᖅ ᓯᑯᒧᑦ ᓯᒥᒃᑕᐅᖏᒃᑲᓗᐊᕐᒪᖔᑦ ᖃᐅᔨᓴᕐᑕᐅᕙᓪᓕᐊᓗᓂ ᐅᕙᓗᓂ ᑯᑦᑎᐊᕈᓂᕐᒪᖔᑦ. ᐊᖑᑎᓕᐅᕐᑕᐅᓂᐊᕐᒥᔪᖅ ᐊᑐᐊᖓᔪᒥᒃ ᕿᒥᕈᔭᐅᔫᓐᓇᕐᓂᐊᕐᒪᑦ ᑕᒪᓐᓇ ᑯᓕᐅᕐᓯᒪᔪᖅ ᐅᕙᓗᓂᑦ ᓴᓇᔭᐅᔭᕆᐊᖃᕐᓂᕈᓂ ᓯᒥᔭᐃᕐᑕᐅᖃᑦᑕᕐᓗᓂᓗ.

6.7.2 Executive Summary

Breakwater Resources Ltd. (Breakwater) has retained Golder Associates Ltd. (Golder) to provide geotechnical and hydrological design support for the Nanisivik Mine Closure. This report provides part of the required documentation to support the Reclamation and Closure Plan (RCP) proposed by CanZinco Ltd., the operators of the mine.

Production of lead and zinc concentrates took place at the Nanisivik Mine between 1976 and 2002, when production ceased. The current owner of the mine, CanZinco Ltd., has been in possession of the mine since 1996. Since 2002, Nanisivik Mine has been operating under Nunavut Water Board Licence No. NWB1NAN0208, which provides for the continuation of on-site environmental protection activities during the development and submission, for approval, of a Final RCP. The Nanisivik Mine 2004 RCP has been developed, per the terms of the Water License, as a series of stand alone documents with each document providing, in detail, information and proposed closure measures for one specific component or topic area. This report specifically addresses Part G, Item 7 of the Water Licence, the design of the West Twin Dike Spillway.

The principle closure objectives for the West Twin Disposal Area (WTDA) are to mitigate the potential long term environmental impacts and to return the land to a condition similar to pre-mining development. The closure concept is to restrict the transfer of oxygen to the tailings, and also to minimize the transport of any available metals. At closure, drainage from the WTDA will occur passively, without the need of manpower to operate siphons. For this reason, a dike spillway and drainage channel will be constructed at closure to drain seasonal runoff from the Surface Cell to the Reservoir. The spillway has been designed to safely pass severe storm events. Tailings, which are currently exposed in the Reservoir will either be covered or re-located below a minimum water cover depth of 1.0 m. This will limit the potential for scouring of tailings at the outlet of the spillway.

The location of the spillway inlet, the spillway invert elevation and the tailings cover are intrinsically linked. Several options were considered before selecting the proposed configuration. Subsurface investigations done at the proposed location included boreholes, test pits, thermocouple installation, and laboratory testing of soil and bedrock samples. The geologic conditions are inferred to comprise till overlying frost-shattered bedrock overlying competent bedrock.

The spillway will convey run-off from the Surface Cell to the Reservoir. The Surface Cell will be graded and covered to direct runoff to the spillway. The spillway invert will be Elev. 384.0 m, and the normal water level in the Reservoir will be 370.2 m. The spillway has been designed to convey a 24-hour Probable Maximum Precipitation (PMP) storm event estimated to produce 140 mm of rainfall in 24 hours. The extreme daily snowmelt is estimated to produce 155 mm of runoff but the peak flow would be less due to a more even distribution over the event period. The estimated peak flow over the West Twin Dike Spillway is approximately 5.2 m^3/s, resulting in an peak water depth of approximately 0.52 m at the spillway inlet. The flow depth would decrease to about 0.31 m in steeper portions of the spillway.

The spillway will consist of a 6 m wide open channel with the base founded generally in intact bedrock. Where the base is located in frost-shattered bedrock or overburden, erosion protection consisting of rip rap stone with mean size 300 mm will be provided to a flow depth of 0.6 m. Rip rap bedding and filter layers will be provided beneath the rip rap to prevent the movement of soil through the coarse rip rap. The spillway outlet structure includes a plunge pool to force a hydraulic jump and a flared outlet channel so calm flows report to the Reservoir with minimal energy. Erosion protection will not be required where the channel base will be in intact bedrock.

The construction is estimated to involve about 48,800 m^3 of excavation and approximately 400 m^3 of fill for erosion protection. Construction supervision will be important to ensure compliance with design assumptions as design revisions may have to be implemented to accommodate variations in ground conditions. During construction, sampling and laboratory testing of both in situ materials and fill materials is required.

Routine surveillance is required to identify ice blockage or damming that could affect the performance of the spillway or result in a reduced freeboard to the crest of the West Twin Dike. A service road will be provided along the full length of the spillway to allow for periodic inspection and maintenance which may include removal of soil resulting from slope movements and regrading due to settlement from thawing.

6.8 G.8, ᐅᔭᕋᑐᐃᓐᓇᐃᑦ ᓄᓇᐅᑦ ᐃᓗᐊᓂᖓᕐᓯᒪᔪᑦ ᐅᔭᕋᒃᑕᕐᕕᐅᔪᓪᓗ ᒪᑐᔭᐅᓂᖏᑦ, Rock Piles and Open Pits Closure Plan

The report, *Nanisivik Mine Rock Piles and Open Pits Closure Plan* (the "Rock Piles and Pits Plan"), provides the report requested under Part G, Item 8 of the Water Licence. The Rock Piles and Pits Plan was prepared by Gartner Lee and is provided in its entirety as Appendix E and the Executive Summary is provided below for ease of reference.

6.8.1 ᓇᐃᒃᓕᕆᐊᕐᓯᒪᔪᑦ ᐅᖃᐅᓯᒃᓴᐃᑦ

ᐅᔭᕋᒃᓂᐊᕈᓐᓂᓚᐅᕐᑐᑦ ᓇᓂᓯᕕᒃᒥ 2002-ᒥ. ᑲᓐᐳᓐᑯ-ᑯᑦ ᐱᕐᑯᑎᖅᑎᐅᔪᑦ ᑐᓂᓯᔪᑦ ᓴᓗᒻᒪᖅᓴᐃᓂᕐᒧᑦ ᒪᑐᔭᐅᓂᖓᓄᓪᓗ ᐸᕐᓇᐅᑎᓂᒃ ᓄᓇᕗᒥ ᐃᒥᓕᕆᓂᕐᒧᑦ ᑲᑎᒪᔨᖏᓐᓄᑦ ᒪᓕᒃᑕᐅᓪᓗᓂ ᑎᑎᕋᕐᓯᒪᔭᕆᐊᖅᓂᖏᑦ ᐱᔪᓐᓇᐅᑎᖓᓂᑦᑐᑦ. ᑖᓐᓇ ᐅᓂᒃᑲᕐᓯᒪᔪᖅ ᐅᔭᕋᑐᐃᓐᓇᐃᑦ ᑲᑎᑕᐅᓯᒪᔪᑦ ᐊᒻᒪᓗ ᐅᔭᕋᒃᑕᕐᕕᐅᓂᑯᐃᑦ ᒪᑐᔭᐅᓂᖏᑦ ᐸᕐᓇᐅᑎ ᒪᓕᒃᓯᒪᔪᖅ ᐱᔭᕆᐊᖅᑎᑕᐅᓂᖓ ᐃᒥᕐᒧᑦ ᐱᔪᓐᓇᐅᑎᖓᓂ ᑐᓂᖅᓯᐅᑎᓯᒪᔪᖅ ᐸᕐᓇᐅᑎᒧᑦ.

ᓄᓇᐅᑦ ᐃᓗᐊᓂ ᐊᒻᒪᓗ ᖄᖓᓂ ᐅᔭᕋᒃᑕᖃᑦᑕᕐᓯᒪᒃᒪᑕ ᑲᑎᑕᐅᕙᓪᓕᐊᓯᒪᓪᓗᑎᒃᓗ ᐅᔭᕋᑐᐃᓐᓇᐅᓂᖏᑦ ᓴᕕᒃᓴᖅᖏᓐᓂᖏᑦ. ᐊᔾᔨᖏᑦᑐᓪᓗ ᐅᕙᖃᐃᑦ ᑕᕙᓂᓪᓗᑎᒃ ᐅᔭᕋᒃᑕᕐᑕᐅᖃᑦᑕᕐᓯᒪᔪᑦ ᓄᓇᐅᑦ ᐃᓗᐊᓂ ᐊᒻᒪᓗ ᖄᖓᓂᑦ. ᐊᔾᔨᖏᑦᑐᑦ ᐅᕙᖃᐃᑦ ᑕᕕᓂᑦᑐᑦ ᐃᓚᖏᓪᓗ ᒪᖏᕐᑐᓇᔭᑦᑐᑦ ᐃᓚᖏᓪᓗ ᓴᕕᒃᓴᐅᔭᖅᑐᑦ. (ᕿᓪᓕᕐᑕᐃᑦ ᓴᕕᕋᔭᐅᕐᑯᔨᔪᑦ).
ᐅᔭᕋᖏᑦ ᒪᖏᕐᑐᓇᔭᑦᑐᑦ ᐊᔾᔨᖏᒃᑭᓪᓗᑎᒃ ᐃᓚᖏᑦ ᒪᖏᕐᑐᓇᓗᐊᕐᓇᕐᓂᕐᓴᐅᓪᓗᑎᒃ ᐃᓚᖏᓪᓗ ᒪᖏᕐᑐᓇᓗᐊᕐᓇᖏᓐᓂᕐᓴᐅᓪᓗᑎᒃ. ᑕᒪᕐᒥᒃ ᐅᕙᖃᑐᐃᓐᓇᐅᒍᓗᐊᑦ ᒪᖏᕐᑐᓇᔪᓐᓇᕐᑐᓄᑦ ᐃᓚᖅᓯᐅᑎᓯᒪᒃᒪᑕ ᐱᖅᓯᐅᑎᓯᒪᓪᓗᑎᒃᓗ ᒪᖏᕐᑐᓇᔪᓐᓇᕐᑐᒥᖅᑕᐅᒃᒪᑕ.

ᑲᓐᐳᓐᑯ-ᑯᑦ ᐱᕆᐊᕐᓯᒪᕙᕆᓪᓕᕐᑐᑦ ᓴᓗᒻᒪᖅᓴᐃᓂᕐᒥᒃ ᐊᕋᒍᓄᑦ 10-ᓄᑦ ᐅᖓᑖᓄᓪᓗ ᐅᔭᕋᑐᐃᓐᓇᐃᑦ ᓄᓇᐅᑦ ᐃᓗᐊᓄᐊᕐᖃᑦᑕᕐᓯᒪᓪᓕᕐᑐᑦ ᐃᓚᖏᑦ. ᐊᑐᕐᑕᐅᖏᑦᑐᑦ ᐅᔭᕋᑐᐃᓐᓇᐃᑦ ᓴᕕᒃᓴᖃᐅᖏᓐᓂᖏᑦ ᑲᑎᑕᐅᕙᓪᓕᐊᖃᑦᑕᕐᑐᑦ ᐊᒻᒪᓗ ᐃᓗᐊᓄᐊᕐᖃᑦᑕᐅᕙᓪᓕᐊᓗᑎᒃ ᓄᓇᐅᑦ ᐊᒻᒪᓗ ᑕᐃᒪᖓᑦ 2000-ᒥᑦ ᐳᓛᑕᕐᕕᐅᔪᒧᐊᕐᑕᐅᖃᑦᑕᕐᓯᒪᓪᓗᑎᒃ ᑕᓇᐅᒥ ᓴᕐᕿᔭᕐᑐᒧᑦ.

ᑕᒪᕐᒥᒃ ᓴᓗᒻᒪᕐᓴᕐᑕᐅᓯᒪᔪᑦ ᐅᔭᕿᒃᓂᐊᕐᑎᓪᓗᒋᑦ ᑲᒪᒋᔭᐅᖃᑦᑕᕐᓯᒪᓪᓗᑎᒃ, ᑲᑎᑕᐅᓯᒪᔪᓪᓗ ᐊᑐᕐᑕᐅᖃᑦᑕᓇᓪᓗᑎᒃ ᖃᓕᕐᓯᔪᑕᐅᓗᑎᒃ ᐅᔭᕿᒃᓂᐊᕐᑎᓪᓗᒋᑦ ᓴᓗᒻᒪᕐᓴᐃᕙᓪᓕᐊᓗᑎᒃᓗ ᐊᑐᕐᑕᕙᓪᓕᐊᓯᒪᓪᓗᑎᒃ ᓄᓇᐅᑦ ᐃᓗᐊᓂ, ᐅᔭᕿᒃᓂᐊᕐᐸᓪᓕᐊᓪᓗᑎᒃ ᐊᑐᖃᑦᑕᕐᓯᒪᔪᑦᑦ ᐊᖏᓂᖃᕐᑐᒥᒃ 178,000 ᒥᑕᒥᒃ, (ᑲᑎᓪᓗᒍ 70-ᐳᓴᖓᓂᒃ) ᑲᑎᑕᐅᓯᒪᔪᑦ ᐅᔭᕋᑐᐃᓐᓇᐃᑦ ᖃᖓᓂᑦᑐᑦ. ᐃᓱᒪᒋᔭᐅᔪᖅ ᐊᒥᐊᑯᔪᑦ ᐱᔭᕐᑕᐅᔭᓇᐊᓕᑦ ᓱᓕ ᐊᖏᓂᖃᕐᑐᖅ 69,641 ᒥᑕᒥᒃ.

ᓄᓇᐅᑦ ᖃᖓᓂ ᐅᔭᕿᒃᑕᕐᕕᐅᓯᒪᔪᑦ ᓴᕿᔭᕐᒪᑕ ᒪᖑᕐᑐᓇᔭᓐᓂᖏᓪᓗ ᓴᕿᔭᕐᓗᑎᒃ. ᑖᒃᑯᐊᓗ ᓴᕿᔭᕐᓂᖏᑦ ᐱᓗᐊᕐᓂᕆᖏᑕᕋᓗᐊᖏᑦ ᒪᖑᕐᑐᓇᔪᑦᑐᑦ. ᐊᖏᓂᕐᓴᐅᔪᖅ ᓴᓗᒻᑕᐅᔭᓇᐊᓕᒃ ᐱᔭᓂᕐᑕᐅᓯᒪᔪᖅ ᐅᔭᕿᒃᑕᕐᕕᐅᖃᑦᑕᕐᓯᒪᔪᑦ ᑕᕆᐅᕐᒧᑦ ᓴᕿᔭᕐᑐᒥ ᐱᖃᑕᓂᓗ ᐅᔭᕿᒃᑕᕐᕕᐅᓯᒪᔪᒥ.

ᐊᑐᕐᑕᐅᓂᐊᕐᑐᑦ ᓴᓗᒻᒪᕐᓴᐃᓕᕐᐸᑕ ᐅᔭᕋᑐᐃᓐᓇᕐᓂᒃ ᐊᒻᒪᓗ ᐅᔭᕿᒃᑕᕐᕕᐅᖃᑦᑕᕐᓯᒪᔪᒥᒃ ᐅᑯᐊᖑᓂᐊᕐᑐᑦ:

1. ᒥᑭᓪᓚᖑᔪᒃᑯᑦ ᒪᖑᕐᑐᓇᔪᑦᑐᑦ ᐅᔭᕋᑐᐃᓐᓇᐃᑦ ᐊᕿᒃᑕᐅᓗᑎᒃ ᐱᑕᖃᖏᓐᓂᑎᑕᐅᖏᐊᕐᓗᑎᒃ
2. ᐊᑦᑕᕐᓇᖏᑦᑐᒥᒃ ᒪᓂᕋᖃᕐᓗᓂ ᐃᓕᕐᑯᓯᓇᓚᐅᕐᑕᖑᑐ ᐊᕿᒃᓯᒪᓗᓂ.

ᕿᒥᕈᔭᐅᓪᓗᓂ ᒪᖑᕐᑐᓇᔪᑦᑐᑦ ᐅᔭᕋᐃᑦ ᐊᕕᒃᑐᕐᑕᐅᔪᓐᓇᓚᐅᕐᑐᑦ ᐅᔭᕋᑐᐃᓐᓇᐃᑦ ᑲᑎᑕᐅᓯᒪᔪᑦ ᐊᒻᒪᓗ ᐅᔭᕿᒃᑕᕐᕕᐅᖃᑦᑕᕐᓯᒪᔪᑦ ᓇᓗᓇᐃᕐᑕᐅᓪᓗᑎᒃ ᖃᓄᑎᒋ ᐊᑦᑕᕐᓇᕐᑎᒋᒃᒪᖔᑕ:

1. ᐊᑦᑕᕐᓇᒪᖑᔪᑦ: ᑭ ᐅᔭᕿᒃᑕᕐᕕᕕᓂᕐᒥᑦᑐᑦ ᑲᑎᓯᒪᔪᑦ ᐊᒻᒪᓗ 09 ᓂᒋᕐᒥᑦᑐᑦ ᑲᑎᓯᒪᔪᑦ.
2. ᐊᑦᑕᕐᓇᐸᓗᒃᑐᑦ: ᐊᑭᓐᓇᒥᑦᑐᑦ 02-ᒥ ᑲᑎᓯᒪᔪᑦ, ᑲᓇᒃᓇᒥᑦᑐᑦ ᑲᑎᓯᒪᔪᑦ;
3. ᐊᑦᑕᕐᓴᑐᐃᓐᓇᓇᐊᓕᑦ: ᑲᓇᒃᓇᒥᑦᑐᖅ ᑲᑎᓯᒪᔪᑦ ᐅᔭᕋᐃᑦ, 14-ᒥᓗ ᑲᑎᓯᒪᔪᑦ ᐊᒻᒪᓗ ᓴᓗᒻᒪᕐᓴᐃᕕᐅᑦ ᖃᓂᒋᔭᓂᑦᑐᑦ.
4. ᐊᑦᑕᕐᓇᓗᐊᖏᑦᑐᑦ: ᐊᑭᓐᓇᒥᑦᑐᑦ ᓴᕿᔭᕐᑐᒥ ᐅᔭᕿᒃᑕᕐᕕᒃ; ᐊᒻᒪᓗ
5. ᐊᑦᑕᕐᓇᖏᑦᑐᑦ: ᐊᕐᖁᑎᒥᑦᑐᑦ, ᑕᕆᐅᕐᒧᓪᓗ ᓴᕿᔭᕐᑐᖅ ᐅᔭᕿᒃᓂᐊᕐᕕᒃ ᑲᑎᓯᒪᔪᑦ ᐅᔭᕋᑐᐃᓐᓇᐃᑦ.

ᓴᓗᒻᒪᕐᓴᐃᓇᓱᒃᓗᑎᒃ ᐊᑐᕐᑕᐅᔪᒪᔪᑦ ᐱᕐᑯᓚᖑᔪᒃᑯᑦ ᓴᓗᒻᒪᕐᓴᐃᓂᐊᕈᑎᒃ ᑲᑎᓪᓗᒋᑦ ᐅᔭᓗᓂᑦ ᐃᓚᖏᑦ ᐊᑐᕐᓂᐊᕐᑐᑦ ᐅᑯᐊᖑᔪᑦ:

1. ᐃᓗᐊᓄᐊᕐᖃᕐᑕᐅᓗᑎᒃ ᐅᔭᕋᑐᐃᓐᓇᐃᑦ ᐃᓂᒋᔭᖓ ᓴᓗᒻᒪᕐᓴᕐᑕᐅᓗᐊᓇᐊᖃᔮᐊᖏᓪᒪᑦ.
2. ᓴᐅᔭᐅᓗᓂ ᐅᔭᕿᒃᑕᕐᕕᐅᓯᒪᔪᑦ ᓇᓕᓇᓕᕐᑎᑕᐅᓗᓂ ᒪᓂᕋᕐᔫᑦ ᐃᒥᕐᔫᓪᓗ ᐃᒪᖃᔭᐃᕐᑕᐅᓗᓂ ᖃᖓᓗ ᐊᑦᑕᕐᓇᖏᓪᓗᓂ ᐃᓂᒋᔭᐅᔭᓇᐊᖓ.
3. ᖃᒃᑲᓐᓂᐊᕈᑦ ᓯᐅᕋᕐᒥᒃ ᖃᓕᕐᓯᔪᑎᖃᕐᓗᑎᒃ ᐊᑕᓂᑦᑐᑦ ᑐᐊᐸᒃ ᕐᑯᐊᕿᓐᓇᕐᑎᓐᓇᓱᒃᓗᒍ
4. ᖃᐅᔨᓴᕐᓗᑎᒃ ᖁᓄᐃᔪᑕᐅᔪᓐᓇᕐᑐᓂᒃ ᐊᑯᓂᐅᔪᒧᑦ ᓴᓗᒪᐃᓐᓇᕐᑎᑕᐅᑭᐊᕐᓗᓂ ᐊᒻᒪᓗ
5. ᖃᐅᔨᓴᕐᑕᐅᔪᑎᒃᓴᖓᓂᒃ ᐸᕐᓇᐅᑎᖃᕐᓗᑎᒃ ᖁᓄᐃᓕᐅᕈᑕᐅᖃᑦᑕᕐᓂᐊᕐᑐᒥᒃ.

ᖃᒃᑲᓂᖓᓂᒃ ᐃᓕᓯᓂᐊᕈᑎᒃ ᐅᔭᕋᑐᐃᓐᓇᕐᒧᑦ ᖃᒃᑲᓂᖁᔭᖓᓗ ᓯᐅᕋᕐ ᐊᑐᕐᑕᐅᓂᐊᕐᒥᔪᖅ ᐊᒃᑕᕐᕕᒃ ᓴᐅᔭᐅᓕᕐᐸᑦ ᐅᑯᐊᖑᓂᐊᕐᑐᑦ ᐊᒃᑕᕐᕕᒃᒧᑦ ᓴᓇᔭᐅᔪᑦ:

1. ᓯᕗᖓᓂᖓ 3 ᒥᓪᓗᓂ
2. ᒪᕈᒃᓂᒃ ᖃᒃᑲᕐᓗᓂ ᐃᔪᓂᖃᕐᓗᓂ ᑲᑎᓪᓗᒍ 2.20 ᒥᑕᒥᒃ.
3. ᖃᓪᓕᐸᖑᔪᖅ ᓯᐅᕋᕐ ᐃᓕᔭᐅᓗᓂ ᓄᖑᓴᕋᐃᖏᑦᑐᓗᓂ ᐃᔪᓂᖃᕐᓗᓂᓗ 0.25ᒥᑕᒥᒃ. ᑯᕕᕐᑕᕐᕕᐅᑦ ᖃᓂᒋᔭᓂᑦ ᓯᐅᕋᕐᑕᕋᔭᕐᑐᑦ.

4. ᐊᓪᓚᐅᓂᕐᓴᖅ ᖃᓇᔭᖕᒐ ᕿᓂᕐᑕᕐ ᑐᐊᐸᒃ ᐃᔪᓂᖃᕐᑐᖅ 195 ᒥᑕᒥᒃ ᑲᑎᑐᒋᑦ ᐃᔪᓂᖕᒐ 2.20 ᒥᑕᐅᑐᓂ.
5. ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᒥᔪᖅ ᐊᕿᑦᑎᐊᕐᒪᖕᖓᑦ ᒪᓕᒃᓯᒪᒐᓗᐊᕐᒪᖕᖓᓪᓗ ᐊᑐᕐᑯᔭᐅᔪᓂᒃ ᐱᔭᕆᐊᖃᕐᑐᓂᒃᓗ ᑎᑎᕋᐅᔭᕐᑕᐅᓯᒪᔪᓂᒃ. ᖃᐅᔨᓴᖃᑦᑕᕐᓂᐊᕐᑐᑦ, ᕿᒥᕈᓗᑎᒃ, ᐊᐅᓚᕐᑎᑦᑎᖃᑦᑕᕐᓗᑎᒃᓗ ᑐᐊᐸᖕᖓᓂᒃ, ᓴᓇᔭᐅᓂᖕᖓᓂᓗ ᖃᐅᔨᓴᕐᑕᐅᕙᓪᓚᐊᒃᒥᓗᓂ.

ᑐᕋᖓᓗᐊᕐᓂᐊᕐᑕᖕᖓ ᖃᐅᔨᓴᕐᒧᑦ ᖃᐅᔨᓴᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᖃᖕᖓ ᖃᓄᐃᓕᕙᓪᓚᐊᖕᒋᒃᑲᓗᐊᕐᒪᖕᖓᑦ ᐊᑐᓂᓗ ᐱᖕᖓᓯᔪᑦ ᖃᐅᔨᓴᕐᐱᐅᖃᑦᑕᕐᓂᐊᕐᓗᑎᒃ (ᐃᒥᕐ ᐊᓂᕙᓪᓚᐊᖕᒋᒃᑲᓗᐊᕐᒪᖕᖓᑦ, ᓄᓇᐅᑦ ᐅᕐᑯᓂᖕᖓ, ᐊᒻᒪᓗ ᑐᐊᐸᖕᖓ ᓱᕋᖕᒋᒃᑲᓗᐊᕐᒪᖕᖓᑦ) ᐅᖃᐅᓯᐅᖃᑦᑕᕐᓗᑎᒃᓗ ᖃᐅᔨᓴᐅᑕᐅᔪᑦ. ᐊᑐᕐᑕᐅᒋᐊᕐᓂᐊᕐᑐᖅ ᓴᓗᒻᒪᕐᓴᐃᑎᓪᓗᒋᖅ ᐊᕋᒍᒃᓄᑦ ᒪᕚᒃᓄᑦ ᐊᒻᒪᓗ ᖃᐅᔨᓴᕐᑕᐅᓂᐊᕐᓗᓂ ᐊᕋᒍᓄᑦ 5-ᒧᑦ ᒪᑐᓯᒪᓕᕐᑎᓪᓗᒍ.

ᑐᐊᐸᒃ ᖃᓇᔭᖕᒐ ᖃᓄᐃᓕᑲᓚᒃᑐᕕᓂᐅᒃᐸᑦ ᐅᕙᓗᓂᑦ ᓴᓇᓯᒪᓂᖕᒐ ᐊᓯᓕᑲᓚᒃᑐᕕᓂᐅᒃᐸᑦ, ᐊᑐᕐᑕᐅᓕᕐᔭᕐᑐᖅ ᐸᕐᓇᐅᑎᒋᔭᖕᒐ. ᐸᕐᓇᐅᑎᒋᔭᖕᒐ ᐊᑐᓕᕐᔭᕐᑐᖅ ᓂᕆᐅᓇᖕᒋᑦᑐᒃᑯᑦ ᖃᓄᐃᓕᖕᒐᓕᑲᓚᒃᓂᕈᓂ ᐅᑯᐊᖕᒍᔪᑦ:

- ᕿᓚᒥᐅᓂᕐᓴᒃᑯᑦ ᖃᐅᔨᓴᖕᒍᕙᓪᓚᐊᓗᓂ ᖃᐅᔨᓴᔪᓄᓪᓗ ᐱᓚᕆᐊᖕᒍᓗᓂ;
- ᓴᓇᔭᐅᓗᓂ ᐃᓚᕐᕿᓪᓚᔪᖅ
- ᖃᒃᑲᓐᓂᐊᒍᑦ ᑐᐊᐸᓚᕐᑕᐅᓗᓂ ᐃᔪᕐᑎᒋᐊᕐᑕᐅᓗᓂ ᑐᐊᐸᖕᒐ
- ᖃᐅᔨᓴᕐᓂᖕᒐ ᐊᑯᓂᐅᓂᕐᓴᐅᓚᕐᑎᓪᓗᒍ

6.8.2 Executive Summary

Mining operations at the Nanisivik mine permanently ceased in 2002. CanZinco Ltd., the mine owner, is submitting a Reclamation and Closure Plan to the Nunavut Water Board in the format specified in the Water Licence. This report, the Rock Piles and Open Pits Closure Plan, fulfills the requirements for Part G, Item 8 of the Nanisivik Water Licence and represents one component of the Closure and Reclamation Plan submission.

Underground and open pit mining operations necessitated the development of surface stockpile areas for development waste rock. The rock types represented in the surface rock piles are a mixture of the various rock types encountered in the underground and open pit mines. This mixture includes a range of rock types from the host carbonaceous rock types to massive sulphide waste containing predominantly pyrite (iron sulphide) mineralization. The acid rock drainage characteristics of the waste rock varies from strongly potentially acid generating to acid consuming. All of the waste rock contains substantial neutralizing potential, due to the carbonaceous host rocks, and the acid generation potential is largely controlled by the sulphur content.

CanZinco has undertaken progressive reclamation of the surface rock piles for more than decade. Waste rock and rejects from the dense media separation plant have been relocated from surface into, primarily, the underground workings mine and, since approximately 2000, into the East Pit and Oceanview open pits. This work was linked to both mine operations, where waste rock was required as backfill for mining, and to progressive reclamation of the open pits as the placement of waste rock contributed to backfilling of the pits. The progressive reclamation of rock piles has effectively relocated in the order of 178,000 m^3 (approximately 70%) of the total volume of waste rock that was on surface. The current volume of waste rock remaining in the various rock piles is estimated to be 69,641 m^3.

The open pits contain exposures of massive and disseminated sulphides (predominantly represented by pyrite mineralization) in the walls and floors. These exposures are largely discreet zones within the carbonaceous host rocks that generally form the bulk of the exposed rock. A large portion of the backfilling requirement at the East Open Pit and Oceanview Pit was completed during the progressive reclamation program.

The specific reclamation objectives for rock piles and open pits are:

1. Minimize the risk of ARD or metal leaching; and
2. Provide a safe surface environment that matches the natural conditions.

A review of the ARD characterization information led to the following relative risk classification of the rock piles and open pits:

1. Highest Risk: K-Baseline and 09-South rock piles;
2. Moderately High Risk: West Adit/02 South rock pile, East Open Pit and (assumed) East Adit Trench;
3. Moderate Risk: East Adit rock pile, Area 14 rock pile and (assumed) DMS rejects storage area;
4. Low Risk: West Open Pit; and
5. Lowest Risk: West Adit Access Road, Oceanview rock pile and (assumed) Oceanview Open Pit.

The overall approach to achieving the reclamation objectives is to apply the most appropriate combination of one or more of the following reclamation measures:

1. Relocate waste rock to eliminate or reduce the requirements for surface reclamation at the pile location;
2. Fill open pits to achieve a smooth surface contour that prevents surface ponding and provides a safe surface environment;
3. Provide a thermal cover such that the covered materials freeze into permafrost;
4. Assess the net negative effects of intrusive reclamation work against the potential long term environmental risk; and
5. Institute a monitoring and contingency program.

Where a thermal barrier cover is to be placed, the proposed cover design is the same as proposed for the landfill facility as follows:

1. The maximum slope of a cover will be 3H:1V or 18 °;

2. A two-layer thermal cover with a total thickness of 2.20 m will be placed above the waste;
3. The upper erosion-resistant capping layer shall consist of a durable, erosion resistant material with a thickness of 0.25 m. The selected material is the Twin Lakes sand and gravel;
4. The underlying layer will be shale with a thickness of 1.95 m to provide a minimum total thermal cover thickness (in combination with the surface layer) of not less than 2.20 m; and
5. A quality control program will be implemented to ensure that cover materials meet the design specifications and are constructed in accordance with the design drawings. This program will include survey control, materials testing, construction monitoring and documentation.

The main objective of the performance monitoring program is to monitor the reclamation cover's performance in each location under three areas (seepage water quality, ground temperature, and physical stability) and to report the results. The program is to be conducted during the 2-year reclamation period and the 5-year closure period.

In the event that the covers do not perform as expected, then some or all items of the contingency plan should be implemented. The components to the contingency plan that should be considered for implementation depending on the specific circumstances include:

- increased frequency of sampling/monitoring and data review by the technical professional;
- repair of any erosion of the cover;
- placement of additional cover material to increase the cover thickness; and
- extension of the period of performance monitoring.

6.9 G.9, ᓴᓗᒻᒪᖅᓴᐃᓂᖅ ᐊᒻᒪᓗ ᒪᑐᓯᒪᓂᕐᒧᑦ ᖃᐅᔨᓴᕐᑕᐅᓂᖓᓄᑦ ᐸᕐᓇᐅᑎ, Reclamation and Closure Monitoring Plan

The report, *Nanisivik Mine Reclamation Performance Monitoring Plan* (the "Monitoring Plan"), provides the report requested under Part G, Item 9 of the Water Licence. The Monitoring Plan was prepared by Gartner Lee and is provided in its entirety as Appendix F and the Executive Summary is provided below for ease of reference.

6.9.1 ᓇᐃᒃᓕᒋᐊᕐᓯᒪᔪᑦ ᐅᖃᐅᓯᒃᓴᐃᑦ

ᓇᓂᓯᕕᒃᒥ ᓴᓗᒻᒪᖅᓴᐃᓂᑦ ᒪᑐᐁᓪᓕᐊᓂᕐᓗ ᐸᕐᓇᐅᑎᖓ 2004-ᒥ ᐊᕿᒃᓯᒪᓕᕐᒪᑦ, ᒪᓕᒡᓗᒍ ᐱᔨᑦᐊᖃᕐᓂᖓ ᐃᒥᕐᒧᑦ ᐱᔪᓇᐅᑎᖓᓂ, ᐊᑐᓂᓗ ᑎᑎᕋᕐᑕᐅᓯᒪᔪᑦ ᑕᑯᔭᐅᔪᓇᓂᓪᓗᑎᒃ ᑭᓯᓕᑎᓂᖓ ᒪᓕᒡᓗᒍ. ᒪᑐᔭᐅᓂᖓᓄᑦ ᓴᓗᒻᒪᖅᓴᐃᓂᕐᒧᓪᓗ ᖃᐅᔨᓴᕐᑕᐅᓂᖓᓄᑦ ᐸᕐᓇᐅᑎ, ᑖᓇ ᑎᑎᕋᕐᓯᒪᔪᖅ ᐱᔨᑦᐊᖃᕐᓂᖓ ᒪᓕᒡᓗᒍ ᐱᔪᓇᐅᑎᖓᓂ ᐊᕿᒃᓯᒪᔪᖅ. ᒪᑐᔭᐅᓂᖓᓄᑦ ᓴᓗᒻᒪᖅᓴᕐᑕᐅᓂᖓᓄᓪᓗ ᖃᐅᔨᓴᕐᑕᐅᓂᖓᓄᓪᓗ ᑎᑎᕋᐃᑦ ᐃᓗᐃᑦᑐᓇᕐᓗᒋᑦ ᐅᖃᓕᒪᕐᑕᐅᔪᓇᕐᒥᔪᑦ ᖃᓄᐃᓕᐅᕐᓂᐊᕐᓂᖏᓐᓂᒃ ᐅᓂᑲᑦᑎᐊᕐᓯᒪᓪᓗᑎᒃ.

ᖃᐅᔨᓴᐃᓐᓇᕐᓂᕐᒧᑦ ᐸᕐᓇᐅᑎ ᐊᕿᒃᓯᒪᔪᖅ ᑐᑭᓯᔭᒃᓴᐅᕐᑯᓪᓗᒍ ᒪᕈᒃ ᐱᓕᕆᐊᖑᓂᐊᕐᑐᒃ ᐅᑯᐊᖑᔪᒃ:

1. ᓇᓗᓇᐃᕐᑕᐅᓂᖏᑦ ᐱᔭᕆᐊᖅᑲᑲᐅᑎᒋᔪᑦ ᑲᒪᒋᔭᐅᔪᑕᐅᓂᐊᕐᑐᑦ ᓇᓂᓯᕕᒃᒧᑦ ᐊᒻᒪᓗ ᐊᕙᑎᑦᑎᓐᓄᑦ ᓴᐳᒥᓇᓱᒃᑐᓂ ᖃᓄᐃᓕᐅᕐᑕᐅᔭᕆᐊᓕᕐ; ᐊᒻᒪᓗ

2. ᖃᐅᔨᓴᕐᑕᐅᓂᖏᑦ ᓴᓗᒻᒪᓴᕐᑕᐅᔪᑦ ᖃᓄᐃᓕᕚᓪᓕᐊᒃᒪᖔᑕ.

ᓴᓗᒻᒪᓴᐃᓂᐅᔪᖅ ᐅᔭᕿᒃᓂᐊᕐᕕᒃᒥᒃ ᐊᕿᒃᑕᐅᓯᒪᔪᑦ ᑕᓐᓇ ᓄᓇᖓ ᖃᓄᐃᓕᒃᑲᓐᓂᕐᑕᐃᓕᒪᑎᑕᐅᓇᓱᒃᑐᓂ (ᐃᓚᒃᓴᐅᓂᒃᑯᓪᓗ ᑕᑯᒃᓴᐅᔪᒃᑯᓪᓗ) ᐊᒻᒪᓗ ᐃᓕᕐᑯᓯᕆᓇᓚᐅᕐᑕᖓᑐᑦ ᐊᕿᒃᑕᐅᓇᓱᒋᐊᕐᑐᓂ ᐅᔭᕿᒃᓂᐊᖏᑎᓪᓗᒋᑦ ᖃᓄᐃᓕᖓᓂᕆᓇᓚᐅᕐᑕᖓᓄᑦ. ᑕᐃᒪᓐᓇ ᐃᓱᒪᒋᓪᓗᒍ ᑕᓐᓇ ᖃᐅᔨᓴᐃᓐᓇᕐᓂᕐᒧᑦ ᐸᕐᓴᐅᑎᐅᔪᖅ ᖃᐅᔨᒪᔪᑕᐅᔪᓐᓇᕐᓂᐊᕐᑐᖅ ᐱᔭᕆᕐᐸᓪᓕᐊᒃᒪᖔᑕ ᑐᕿᓇᔭᖏᓐᓂᒃ.

ᖃᐅᔨᓴᐃᓐᓇᕐᓂᕐᒧᑦ ᐸᕐᓇᐅᑎ ᐊᕿᒃᓯᒪᔪᖅ ᒪᕈᓪᖓᓪᓗᓂ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᖅ ᓴᓗᒻᒪᓴᐃᓂᖏᓐᓂ ᐊᒻᒪᓗ ᒪᑐᓯᒪᓕᕐᑎᓪᓗᒍ.

ᓴᓗᒻᒪᓴᐃᑎᓪᓗᒋᑦ ᖃᐅᔨᓴᕐᓂᖅ ᖃᖏᐅᑎᓂᐊᕐᑐᖅ ᓴᓗᒻᒪᓴᐃᑎᓪᓗᒋᑦ ᐊᒻᒪᓗ ᐱᔭᕆᕐᓯᒪᓕᕐᑎᓪᓗᒋᑦ. ᑕᓐᓇ ᓴᓗᒻᒪᓴᐃᓂᕐ ᐃᓱᒪᒋᔭᐅᔪᖅ ᐊᕐᕋᒍᓄᑦ ᒪᕈᒃᓄᑦ ᓴᓗᒻᒪᓴᐃᓂᐊᕐᒪᖔᑕ: 2004-ᒥᑦ 2005-ᒧ. ᓴᓗᒻᒪᓴᐃᑎᓪᓗᒋᑦ ᐃᖅᑲᓇᐃᔭᕐᑐᖅᑲᕐᓂᐊᕐᑐᖅ ᖃᐅᔨᓴᕐᓂᐊᕐᑐᒥᒃ.

ᒪᑐᓯᒪᓕᕐᑎᓪᓗᒍ ᖃᐅᔨᓴᐃᓐᓇᕐᓂᖅ ᐱᕆᐊᑲᐅᑎᕆᒐᔭᕐᑐᖅ ᓴᓗᒻᒪᓴᐃᓂᖓ ᐱᔭᕆᑐᐊᕐᐸᑦ. ᒪᑐᓯᒪᓕᕐᑎᓪᓗᒍ ᐱᔭᕆᐊᖅᑐᑐᐊᖑᓂᖏᑦ ᓴᓇᔭᐅᖃᑦᑕᓕᒐᔪᑦ ᖃᐅᔨᓴᐃᓐᓇᕐᓂᐊᕐᑐᑎᒃᑯ ᖃᓄᐃᑉᐸᓪᓕᐊᒃᒪᖔᑕ ᓴᓗᒻᒪᓴᕐᑕᐅᓯᒪᔪᖅ. ᖃᐅᔨᓴᕐᑕᐅᖏᓐᓇᕐᓂᖓ ᐊᕐᕋᒍᓄᑦ ᑕᓪᓕᒪᓄᑦ ᐊᑐᕐᓂᐊᕐᑐᖅ ᐱᕆᐊᕐᑐᓂ 2006-ᒥᑦ 2010-ᒧᑦ. ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᑐᖅ ᐅᕿᒃᑕᐅᔪᕿᖓᑦ ᓇᓂᓯᕕᒃ ᐊᒻᒪᓗ ᐊᔪᕐᓇᖏᓐᓂᖓ ᒪᓕᒃᑐᒍ ᐃᓕᓐᓂᐊᕐᓯᒪᔪᒥᒃ ᐃᒃᐱᐊᕐᔪᒃᒥᐅᑕᕐᒧᑦ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᑐᖅ.

ᖃᐅᔨᓴᕐᑕᐅᓂᖓ ᓴᓗᒻᒪᓴᐃᑎᓪᓗᒋᑦ ᐊᒻᒪᓗ ᒪᑐᓯᒪᓕᕐᑎᓪᓗᒍ ᐅᑯᐊᖑᓂᐊᕐᑐᑦ:

- ᐃᒥᐅᑦ ᐱᐅᓂᖓ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᑐᓂ
- ᐅᕐᑯᓯᕚᓪᓕᐊᓂᖓ ᑐᐊᐸᐅᑦ
- ᒪᓕᒃᓯᒪᒐᓗᐊᕐᒪᖔᑕ ᑐᐊᐸᒃ ᖃᓄᐃᑦᑐᓂᖔᓂᒃ
- ᓴᓇᓯᒪᔪᑦ ᒪᓂᕿᕐᒥᑦᑐᑦ ᖃᓄᐃᑉᐸᓪᓕᐊᒃᒪᖔᑕ

ᐃᒥᐅᑦ ᐱᐅᓂᖔᓂᒃ ᖃᐅᔨᓴᕐᓂᖅ ᑐᕋᖅᓯᓂᐊᕐᑐᖅ ᐃᒪᐃᓕᖓᔪᒥᒃ:

1. ᐃᒥᕐᒧᑦ ᐱᔪᓐᓇᐅᑎᖓ ᒪᓕᒃᑐᒍᖃᐅᔨᓴᕐᑕᐅᑐᓂ
2. ᐊᑐᓇᐊᖅᑐᑦ ᑐᕋᖓᐅᔪᑦ ᓴᓗᒻᒪᓴᐃᓂᕐᒧᑦ ᐸᕐᓇᐅᑎᖓᓂᒃ ᐊᑐᓕᕐᑎᑕᐅᓇᓱᒃᑦᑕᕐᓂᐊᕐᑐᑦ ᐃᒪᐃᓕᐅᕐᓗᑎᒃ:
(ᐃ) ᑲᑎᑦᑎᓗᑎᒃ ᖃᐅᔨᓴᐅᑎᑦ ᑎᑎᕋᕐᑕᐅᔭᓪᓕᐊᔪᑦ ᐊᑐᓂ ᖃᓄᐃᓕᕚᓪᓕᐊᒃᒪᖔᑕ ᐊᒻᒪᓗ;
(ᐱ) ᑎᑎᕋᕐᑕᐅᔭᓪᓕᐊᓗᑎᒃ ᖃᐅᔨᓴᐅᑕᐅᔪᑦ ᐃᒥᐅᑦ ᐱᐅᓂᖔᓂᒃ ᖃᓄᐃᑦᑐᓂᖔᓂᒃᓗ ᐃᒥᕐ ᑯᒃᐸᓪᓕᐊᔪᖅ ᑕᕆᐅᕐᒧᑦ ᖃᐅᔨᒪᔭᐅᓂᐊᕐᒪᑦ.
3. ᐱᓕᕆᓂᖅᑳᕐᓗᑎᒃ ᖃᐅᔨᓴᕐᓂᖅᑳᕐᓗᑎᒃ ᐱᕐᑯᔭᐅᔪᑦ ᒪᓕᒐᐅᔪᓪᓗ ᒪᓕᒃᑐᒋᑦ ᒐᕙᒪᑐᖅᑯᓐᓂᑦ ᐊᕿᒃᑕᐅᓯᒪᔪᑦ; ᐊᒻᒪᓗ;}
4. ᖃᐅᔨᓴᕐᑕᐅᔪᑦ ᒪᓐᓇᒧᑦ ᐊᑐᕐᑕᐅᔪᑦ ᑲᔪᓯᓐᓇᕐᑎᑕᐅᓗᑎᒃ ᒪᑐᓯᒪᓕᕋᓗᐊᕐᑎᓪᓗᒍ ᑐᑭᓯᕚᓪᓕᕈᑕᐅᔪᓐᓇᕐᓂᐊᕐᒪᑕ

ᐃᒥᐅᑦ ᐱᐅᓂᖔᓂᒃ ᖃᐅᔨᓴᕋᓱᒃᑐᑎᒃ ᖃᐅᔨᓴᕐᕕᒃᓂᒃ 25-ᓂᒃ ᐊᕿᒃᓯᓂᐊᕐᑐᑦ. ᑕᒃᑯᐊ ᖃᐅᔨᓴᕐᕕᐅᔪᑦ ᐃᒥᐅᑦ

ᐊᖅᑯᑕᓂᓐᓂᐊᕐᑐᑦ ᑲᑎᑕᐅᕙᓪᓚᐊᓂᐊᕐᒪᑕ. ᐊᒻᒪᓗ ᐊᑐᓂ ᖃᐅᔨᓴᕐᓂᑦ ᐃᒥᐅᓂᖓᓂᒃ ᖃᐅᔨᓴᖃᑦᑕᕐᓂᐊᕐᒥᔪᑦ ᑕᒪᕐᒥᒃ ᓴᓗᒻᒪᕐᓴᕐᑕᐅᓯᒪᔪᑦ ᐃᒪᖃᐅᕐᓂᖏᑦ ᖃᐅᔨᓴᕐᑕᐅᓗᑎᒃ.

ᓴᐱᒃᓴᖅᓂᖏᑦ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᔪᑦ ᐊᒻᒪᓗ ᐅᓂᑲᓕᐅᕐᑕᐅᓯᒪᔪᑦ ᐅᔭᕿᒃᓂᐊᕐᑎᓪᓗᒋᑦ ᑲᔪᓯᓇᕐᓂᐊᕐᑐᑦ ᓴᓗᒪᕐᓴᐃᓕᕐᐸᑕ ᐊᒻᒪᓗ ᒪᑐᓯᒪᓕᕋᓗᐊᕐᑎᓪᓗᒍ. ᑕᒃᑯᐊ ᖃᐅᔨᓴᕐᓂᑦ ᑲᔪᓯᔪᑦ ᐊᑐᕐᑕᐅᓂᐊᕐᒪᑕ ᐃᒥᐅᑦ ᐱᐅᓂᖓᓂᒃ ᖃᐅᔨᒪᔪᑕᐅᓂᐊᕐᒪᑕ ᓴᐱᒃᓴᖅᓂᖏᓪᓗ ᑯᖕᒥᑦᑐᕐ ᐃᒪᒐ ᓴᐱᒃᓴᖅᒪᖕᖓᑦ ᓇᑭᑭᓗᔪᕐ ᑯᒃᑕᐅᕙᓪᓚᐊᓗᓂ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᒪᑦ.

ᓇᓂᓯᕚᒃᒥᑦᑐᖅ ᖃᐅᔨᓴᐅᑎ ᐃᒥᕐᒧᑦ ᖃᐅᔨᓴᕐᕕᒃᒥᑦᑐᕐ ᐊᑐᕐᑕᐅᔪᓐᓂᕐᓂᖕᖓᓄᑦ ᐊᓯᖕᖓᖕᖓᓄᑦ ᐊᐅᓚᕐᑎᑦᑎᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᐃᒥᕐᒥᒃ ᖃᐅᔨᓴᕐᑕᐅᔭᕆᐊᓕᒃᒥᒃ. ᐊᐅᓚᕐᑎᕚᐅᔭᕐᓗ ᐃᓕᓴᕆᔭᐅᓯᒪᑦᑎᐊᕐᓗᓂ ᑲᓇᑕᒥ ᖃᐅᔨᓴᕐᕕᒃᓄᑦ ᑲᑐᔾᖃᑎᒋᖕᒋᖕᓄᑦ. ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᑐᓕ ᑕᖕᒋᖃᕐᑐᑦ ᓇᓂᓯᕚᒃᒥ ᖃᐅᔨᓴᕐᑕᐅᔭᕆᐊᓕᑦ.

ᐅᖅᑯᓂᖓᓂᒃ ᓂᒃᓚᓱᒃᓂᖓᓂᒃᓗ ᖃᐅᔨᓴᐅᑎᑦ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᑦ ᐅᑯᓄᖓ:

1. ᐱᔭᓇᐊᖃᕐᓂᖓ ᐱᔦᓐᓇᐅᑎᖓᓂ ᐃᒥᕐᒧᑦ ᐅᖃᕐᓯᒪᔪᖅ ᒪᓕᒃᓗᒍ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᑐᑦ
2. ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᑐᕋᖓᔪᑦ ᐸᕐᓇᐅᑎᕆᓯᒪᔪᑦ ᒪᓕᒃᓗᒋᑦ ᐱᕐᓯᖃᑦᑕᕐᓗᑎᒃ ᐊᐅᓚᕐᑎᑦᑎᖃᑦᑕᕐᓗᑎᒃᓗ ᖃᐅᔨᓴᕐᑕᐅᔭᕆᐊᓕᒃᓂᒃ ᐊᑐᓂ ᖃᐅᔨᓴᕐᕕᐅᔪᑦ ᖃᓄᐃᓕᕙᓪᓚᐊᒃᒪᖔᑕ
3. ᒪᓕᒃᓗᒋᑦ ᐊᑐᓂ ᖃᐅᔨᓴᕐᕕᐅᔪᑦ ᐱᔭᓇᐊᖃᑦᑕᖏᑦ
4. ᖃᐅᔨᓴᕐᑕᐅᔪᑦ ᒪᓐᓇᓗᑦ ᐊᑐᕐᑕᐅᔪᑦ ᑲᔪᓯᓐᓇᕐᑎᑕᐅᓗᑎᒃ ᒪᑐᓯᒪᓕᕋᓗᐊᕐᑎᓪᓗᒍ ᑐᑭᓯᕙᓪᓕᑭᑕᐅᔪᓐᓇᕐᓂᐊᕐᒪᑕ.

ᐊᑐᕋᓱᒃᓗᑎᒃ ᑐᕋᒐᓇᔭᖓᓂᒃ 78-ᓂᒃ ᖃᐅᔨᓴᐅᑎᓂᒃ ᐃᓕᓇᒃᓯᓯᒪᓂᐊᕐᑐᑦ ᐊᕋᒍ ᒪᑭᒃ ᐃᓗᐊᓂ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᑐᓂᒃ ᐊᒻᒪᓗ ᐊᕋᒍᓄᑦ ᑕᓪᓕᒪᓄᑦ ᒪᑐᓯᒪᓕᕐᑎᓪᓗᒍ. ᑎᓴᒪᐃᑦ ᐊᔾᔨᖕᒋᖕᑐᑦ ᖃᐅᔨᓴᐅᑎᑦ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᑦ: ᓂᒃᓚᓇᕐᓂᖓᓂᒃ ᖃᐅᔨᓴᐅᑎᑦ, ᖁᐊᖑᓂᖓᓂᒃ ᖃᐅᔨᓴᐅᑎᑦ. ᑕᒃᑯᐊ ᖃᐅᔨᓴᐅᑎᑦ ᐊᑐᕐᑕᐅᖃᑦᑕᕐᓯᒪᔪᑦ ᑕᐃᒪᖓᑦ ᐅᔭᕿᒃᓂᐊᓕᕐᑎᓪᓗᒋᑦ.

ᒪᓕᒃᓯᒪᒃᒪᖕᖓᑕ ᖃᐅᔨᓴᐅᑎᑦ ᑐᐊᐸᖕᖓᓂᒃ ᐊᑐᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᒪᓕᒃᑕᐅᔪᓇᐊᓕᑦ ᐅᖃᕐᓯᒪᔪᑦ ᒪᓕᒃᑕᐅᓚᓗᐊᕐᒪᖕᖓᑕ. ᑐᕋᒐᓇᔭᖕᖓᓕ ᑐᐊᐸᐅᑦ ᖃᐅᔨᓴᕐᑕᐅᓂᖓ ᐱᓪᓚᑦᑕᕐᓗᑎᒃ ᓱᓕᓪᓗᑎᒃᓗ. ᑐᕋᖓ 95-ᐳᓴᖓᓂᒃ ᓱᕈᕐᓇᕐᑐᐃᑦ ᐱᔭᕐᑕᐅᓂᐊᕐᑐᑦ ᑎᑎᕋᕐᓯᒪᔪᓂᒃ ᐃᒪᐃᑦᑐᔭᓇᐊᖃᕐᓂᖕᖏᓂᒃ ᒪᓕᒃᑕᐅᓗᓂ. ᓱᕈᕐᓇᕐᑐᖃᕐᑐᐃᑦ ᑐᐊᐸᐃᑦ ᐅᖓᑕᓄᐊᖃᑦᑕᓲᖏᑦᑐᖅ ᒪᑭᐃᕐᓱᕐᓗᓂ ᑭᒃᓕᖏᔭᖓ ᑎᑎᕋᕐᓯᒪᔪᖅ ᐱᔭᓇᐊᖃᕐᓂᖓᓂᒃ.

ᓴᓗᒻᒪᕐᓴᐃᓕᕐᐸᑕ, ᓴᓗᒻᒪᕐᓴᕐᑕᐅᔪᖅ ᓴᓇᔭᐅᔪᕐᓗᓐᓂᑦ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᑐᕐ ᑭᒃᓕᓕᐅᕐᓯᒪᓗᑎᒃ ᑐᑭᓯᐅᒪᔭᐅᓂᐊᕐᒪᑦ ᖃᓄᑎᒋ ᓴᓗᒻᒪᕐᐸᓪᓕᐊᒃᒪᖕᖓᑦ. ᐱᔭᕐᑕᐅᔪᑦ ᑐᐊᐸᐃᑦ ᓱᕈᕐᓇᕐᑐᖃᕐᑐᑦ ᖃᐅᔨᓴᕐᑕᐅᖕᒋᓇᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᑭᓯᐊᓂ ᐱᔭᕐᑕᐅᔪᐃᓐᓇᐅᒃᐸᑦ ᓱᕈᕐᓇᕐᑐᓂᖓ ᑕᐃᒪᕐᑕᐅᑕᐃᓐᓇᕐᓗᓂ. ᐱᔭᓇᕐᐸᑕ ᒪᓕᒃᓯᒪᒃᒪᖕᖓᑕ ᖃᐅᔨᓴᖃᑦᑕᕐᓂᐊᕐᑐᑦᐊᐅᓚᕐᑎᑕᐅᓗᓂᓗ ᖃᐅᔨᓴᕐᕕᒃᒧᑦ. ᐅᔭᕿᒃᑕᕐᕕᐅᓯᒪᔪᑦ ᓴᐅᔭᐅᓕᕐᐸᑕ ᐅᕙᓗᓂᑦ ᐊᓯᖕᒋᑦ ᐱᓕᕆᐊᖑᓂᐊᕐᑐᑦ ᐱᔭᕐᑕᐅᓂᐊᕐᑐᑦ ᐱᒋᐸᕐᑕᐅᑕᐃᓐᓇᕐᓂᐊᕐᑐᑦ ᖃᐅᔨᓴᐅᑎᑦ ᑐᑭᓯᔭᐅᓯᒪᓕᕐᐸᑕ ᑭᓯᐊᓂ ᖃᐅᔨᓴᕐᕕᒃᒥᑦ.

ᓄᓇᐅᑦ ᖃᖓᓂᑦᑐᑦ ᓴᓇᓯᒪᔪᑦ ᖃᓄᐃᐸᓪᓕᐊᒃᒪᖕᖓᑕ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᖅ ᐊᕐᒍᑕᒪᑦ ᑕᑯᓇᒃᑕᐅᖃᑦᑕᕐᓗᑎᒃ ᐃᓕᓯᒪᔪᓄᑦ ᓄᓇᕚᑦᒥ. ᑕᑯᓇᒃᑕᐅᔪᑦ ᕿᒥᕈᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᖃᐅᔨᓇᓱᒃᑕᕐᓗᑎᒃᓗ ᓴᓗᒻᒪᕐᓴᕐᑕᐅᔪᕕᓂᕐᓂᒃ ᓄᓇᒥᑦᑐᑦ ᓴᓇᔭᐅᔪᕕᓂᑦ, ᐃᒥᕐᒧᑦᓗ ᐊᕐᑯᓯᐅᕐᑕᐅᔪᑦ, ᓯᕚᖓᔪᒥᑦᑐᑦ ᐊᒻᒪᓗ ᖃᑭᔭᐅᔪᑦ.ᖃᐅᔨᓴᖃᑦᑕᕐᓂᐊᕐᒥᔪᑦ ᐊᐅᔭᒃᑯᑦ ᐊᐅᒃᐸᓪᓚᐊᓂᖓ ᖃᓄᐃᔪᑕᐅᒃᒪᖕᖓᑦ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᒪᑦ.

ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᓴᓇᓯᒪᔪᑦ ᐅᑯᐊᖑᔪᑦ:

- ᐊᑭᓐᓇᒥᑦᑐᖅ ᑯᕙᕐᑕᕐᕙᒃ ᖃᐅᔨᓴᕐᕙᐅᔪᕐᓗ
- ᑯᓪᓚᐅᕐᑕᐅᓯᒪᔪᖅ
- ᐃᒪᖃᕐᕙᐅᔪᕐᓗ
- ᖃᖓᓗ ᑯᕙᕐᑕᕐᕙᐅᑦ ᑐᐊᐸᒃ
- ᑯᒃᐸᓪᓕᐊᔪᕐᓗ ᐃᒪᖃᕐᕙᒃᒥᑦ
- ᐊᒃᑕᕐᕙᐅᑦ ᖃᖓ
- ᐅᔭᕆᒃᓯᐅᕐᕙᕙᓂᑦ 14-ᒥᑦᑐᖅ, ᐊᓯᖏᓪᓗ ᐅᔭᕆᒃᓂᐊᕐᕙᕙᓂᑦ
- ᑕᓇᐅᕐᒧᑦ ᓴᕿᔭᕐᑐᖅ ᐅᔭᕆᒃᓯᐅᕐᕙᒃ

ᐅᖃᕐᓯᒪᓂᖃᕆᓗᐊᕐᑎᓪᓗᒍ ᐊᕆᒍᓄᑦ 5-ᓄᑦ ᖃᐅᔨᓴᕐᑕᐅᓂᐊᕐᓂᖓᓂᒃ (ᑎᑭᓪᓗᒍ 2010) ᑭᓯᐊᓂ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᐃᓱᓕᕚᓪᓚᑦᑕᖃᖏᒻᒪᑦ. ᐊᕙᑎᖓᓂᒃ ᖃᐅᔨᓴᕐᓂᕐ ᑲᔪᓯᓂᐊᕐᒪᑦ ᑭᓯᐊᓂ ᖃᐅᔨᓴᐅᑕᐅᔪᑦ ᑐᑭᓯᓇᕐᓯᒃᐸᑕ ᐊᑯᓂᐅᔪᒥᒃ ᖃᓄᐃᓕᕗᓪᓕᐊᔨᐊᖏᓐᓂᖓᓂᒃ.

ᖃᐅᔨᓴᕐᓂᕐ ᑲᔪᓯᑦᑎᐊᕆᓱᒃᓗᒍ, ᑲᑎᑕᐅᕙᓪᓕᐊᔪᑦ ᖃᐅᔨᓴᐅᑕᐅᔪᑦ ᕿᒥᕐᕈᔭᐅᖃᑦᑕᓇᐊᖃᕐᓂᐊᕐᑐᑦ ᐊᒻᒪᓗ ᐊᔪᕐᓇᖏᒃᑲᖓᑦ ᖃᓄᐃᒋᐊᕐᑕᐅᖃᑦᑕᕐᓗᑎᒃ ᐱᒋᐊᕐᑕᐅᖃᑦᑕᕐᓗᑎᒃ ᐱᒋᐊᕐᑕᐅᔭᓇᐊᖃᕆᖓᑦ. ᕿᒥᕐᕈᓂᐅᔪᖅ ᖃᓄᐃᒋᐊᕈᑎᓪᓗ ᑲᓐᓂᓐᑯ-ᑯᓐᓂᑦ ᕿᒥᕐᕈᔭᐅᖃᑦᑕᕐᓗᓂ ᐊᒻᒪᓗ ᓄᓇᕗᒥ ᐃᒥᓪᓗᓂᕐᒧᑦ ᑲᑎᒪᔨᖏᑦ ᕿᒥᕐᕈᖃᑕᐅᓗᑎᒃ ᒪᓪᓕᒃᓯᒪᔭᓇᐊᖃᕐᓂᖓᓄᑦ ᐃᒥᕐᒧᑦ ᐱᔪᓐᓇᐅᑎᖓᓂ.

ᑕᕿᑦ ᐱᖓᓱᑦ ᐊᓂᒍᕆᖓᑕ ᐅᓂᒃᓯᒪᔪᓂᒃ ᑎᑎᕋᕐᓯᒪᔫᒃ ᑐᓂᓯᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᓄᓇᕗᒻᒥ ᐃᒥᓪᓗᓐᓂᒃᑯᓐᓄᑦ ᒪᓕᒃᓯᒪᒃᒪᖓᑕ ᒪᓕᒋᐊᖃᕐᑕᖏᓐᓂᒃ ᐱᔪᓐᓇᐅᑎᖓᓂ ᐅᖃᕐᓯᒪᔪᑦ. ᐃᓱᒪᒋᔭᐅᕗᓗᐊᖅ ᑕᒃᑯᐊ ᑎᑎᕋᕐᑕᐅᔪᑦ ᓴᕿᔭᕐᑎᑕᐅᔫᓇᕐᓗᑎᒃ ᐃᓄᒃᓄᑦ ᑕᑯᔭᐅᔫᓇᕐᓗᑎᒃᓗ ᐃᓚᐅᖃᑕᐅᕐᑯᓪᓗᒋᑦ ᐃᓄᐃᑦ ᑐᑭᓯᐅᒪᖃᑕᐅᕐᑯᓪᓗᒋᓪᓗ.

ᐊᕆᒍᑕᒪᑦ ᐅᓂᒃᑲᓪᓚᐅᖃᑦᑕᕐᓗᑎᒃ ᑎᑎᕋᕐᓯᒪᔪᓂᒃ ᐊᕙᑎᖓ ᖃᓄᐃᓕᕗᓪᓕᐊᓂᖓᓂᒃ ᑐᓂᔭᐅᖃᑦᑕᕐᓗᑎᒃᓗ ᓄᓇᕗᒥ ᐃᒥᓪᓗᓐᓂᒃᑯᓐᓄᑦ ᐱᔭᕆᐊᖃᕐᓂᖓ ᒪᓕᒃᓗᒍ ᐱᔪᓐᓇᐅᑎᖓᓂ. ᑕᓐᓇᓗ ᐅᓂᒃᑲᓯᒪᔪᖅ ᕿᒥᕐᕈᓂᐅᔪᓂᒃ ᐱᖃᓯᐅᔨᓗᓂ ᐊᒻᒪᓗ ᐊᕆᓂ ᖃᓄᐃᓪᓚᐅᕐᒪᖓᑦ ᖃᐅᔨᒪᔪᑕᐅᓗᓂ ᐊᒻᒪᓗ ᓇᓗᓇᐃᕐᓯᔪᑕᐅᓗᓂ ᐊᕿᒃᑲᓐᓂᕆᐊᖃᕐᑐᓂᒃ. ᐃᓱᒪᒋᔭᐅᔪᖅ ᑕᓐᓇ ᑎᑎᕋᕐᓯᒪᔪᖅ ᑕᑯᔭᐅᕐᑯᓪᓗᒍ ᐃᓚᐅᔪᓪᓚᒪᓄᑦ ᓴᓗᒻᒪᖕᓴᕐᓯᒪᔪᖅ ᖃᓄᐃᓪᓕᕗᓪᓕᐊᒃᒪᖓᑦ ᖃᐅᔨᒪᔭᐅᓂᐊᕐᒪᑦ.

ᐃᓗᓪᓕᖏᓐᓂᒃᓗ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᐅᓂᒃᑲᓯᒪᔪᖅ ᑐᓂᔭᐅᖃᑦᑕᕐᓂᐊᕐᑐᖅ ᐃᒥᓪᓗᓐᓂᒃᑯᓐᓄᑦ ᐊᕆᒍᐃᑦ ᖃᐅᔨᓴᕐᑕᐅᔪᑦ ᖃᓄᐃᑉᐸᓪᓕᐊᓯᒪᒃᒪᖓᑕ ᑎᑎᕋᕐᓯᒪᓗᑎᒃ ᑐᓂᔭᐅᓂᐊᕐᒥᔪᑦ 2010-ᒥ ᐃᒥᓪᓗᓐᓂᒃᑯᓐᓄᑦ. ᑕᓐᓇᓗ ᐅᓂᒃᑲᓯᒪᔪᕐ ᐱᔭᕆᐊᖃᕐᑎᑕᐅᒃᒪᑦ ᐃᒥᕐᒧᑦ ᐱᔪᓐᓇᐅᑎᖓᓂ ᑕᓐᓇᓗ ᐅᓂᒃᑲᓯᒪᔪᖅ ᖃᐅᔨᒪᔪᑕᐅᓂᐊᕐᑐᖅ ᓄᓇᖓ ᖃᓄᐃᓕᔭᓪᓕᐊᒃᒪᖓᑦ ᐃᓚᐅᔪᓪᓗ ᖃᐅᔨᒪᑲᖃᑕᐅᓗᑎᒃ. ᑲᑎᑕᐅᓯᒪᓪᓕᕐᐸᑕ ᖃᐅᔨᓴᕐᓂᐅᔪᑦ ᐊᕿᒃᓱᐃᔪᑕᐅᓂᐊᕐᒪᑕ ᓯᕗᓂᒃᓴᒧᑦ ᐊᑯᓂᐅᔪᒧᑦ ᖃᓄᐃᖓᓂᐊᕐᒪᖓᑦ. ᕿᒥᕐᕈᓚᐅᕐᓗᑎᒃ ᑐᑭᓯᒍᑎᒃ ᖃᓄᐃᓕᕗᓪᓕᐊᖏᓐᓂᖓᓂᒃ ᑲᓐᓂᓐᑯ-ᑯᑦ ᖁᔭᓇᕐᓯᔪᓐᓇᕐᓯᓂᐊᕐᑐᑦ ᑲᒪᒋᓯᒪᔭᕐᒥᓂᒃ.

6.9.2 Executive Summary

The Nanisivik Mine 2004 Reclamation and Closure Plan ("RCP") has been developed, per the terms of the Water Licence, as a series of stand alone documents, with each document providing, information and proposed closure measures for one specific component or topic area. The Reclamation and Closure

Monitoring Plan, this document, is provided in response to the requirements of Part G, Item 9 of the Licence. The Closure and Reclamation Monitoring Plan ("Monitoring Plan") is a full description of the rationale for the proposed monitoring activities and detailed descriptions of the proposed activities.

The Monitoring Plan is designed to provide information related to two fundamental objectives:

1. Identification of the immediate needs for site management and the provision of diligent environmental protection activities; and
2. Assessment of the overall performance of reclamation measures.

The proposed mine reclamation in the activities in the RCP, are designed to stabilize the site (both chemically and physically) and provide for land use similar to the pre-mining conditions. With this in mind, the Monitoring Plan should provide the means of assessing when the site has achieved, as nearly as possible, those conditions.

The Monitoring Plan has been developed in the context of two time periods: the Reclamation Period; and the Closure Period.

The **Reclamation Period** encompasses the period of active physical reclamation of the mine site and the completion of the major activities proposed in the Mine Closure Plan. This period is currently anticipated to be of two-years duration: 2004 and 2005. During the Reclamation Period, sufficient manpower will be present at the site to follow a rigorous monitoring schedule.

The **Closure Period** immediately follows the Reclamation Period. During the Closure Period, only relatively minor maintenance work is planned at the mine site and monitoring will be focused on providing information for assessing the performance of the reclamation measures. The Closure Period is designed for a duration of 5 years subsequent to the Reclamation Period, from 2006 to 2010. As there will not be a continuous manpower presence at the mine site during the Closure Period, the monitoring programs will be carried out during discreet site visits and, to as great a degree as practical, by trained, local technical assistants from the community of Arctic Bay.

Monitoring throughout both the Reclamation Period and the Closure Period will include the following components:

- Water quality monitoring;
- Geothermal monitoring;
- Confirmatory sampling of soils; and
- Physical stability of earth structures.

Water quality monitoring objectives are intended to:

1. Fulfill the requirements of the Water Licence;
2. Fulfill the general objectives of the Reclamation Performance Monitoring Plan by:
   (a) collecting location-specific information to monitor the success of location-specific reclamation measures; and
   (b) collecting general information to assess the quality of water entering Strathcona Sound;
3. Work in concert, as appropriate, with the monitoring provisions of the MMER as enforced by Environment Canada; and
4. Carry forward existing monitoring locations such that trends spanning the mine-closure milestone can be assessed.

In order to meet the water quality monitoring objectives a total of 25 water sampling stations have been identified. These stations are located in discreet flowpaths where water collects and can be sampled at a consistent location. In addition, each sampling event will also include sampling of ephemeral surface seeps that may be observed and that appear to relate directly to any of the reclaimed areas of the mine site.

The metal loading studies that were conducted and reported during mine operations will also be continued through the Reclamation Period and Closure Periods. These continued studies will use the information collected through the water quality monitoring program to estimate the loading of metals in Twin Lakes Creek from various sources and to characterize temporal and spatial trends.

The on-site laboratory is no longer equipped to perform water analyses and, therefore, this will be conducted at an off-site laboratory. The laboratory that is used will be accredited by the Canadian Association of Environmental Analytical Laboratories. Analyses for total suspended solids will continue to be conducted on-site.

Geothermal monitoring objectives are intended to:

1. Fulfill the requirements of the Water Licence;
2. Fulfill the general objectives of the Reclamation Performance Monitoring Plan by collecting location-specific information to monitor the success of location-specific reclamation measures;
3. Fulfill the objectives of the location-specific closure plans; and
4. Carry forward existing monitoring locations that meet the current needs such that trends spanning the mine-closure milestone can be assessed.

To accomplish these objectives a total of 78 geothermal instruments will be monitored on a regular basis throughout the 2-year active reclamation period and the 5-year post closure period. Four types of monitoring instruments will be used: thermistors; thermocouples; frost gauges; and vibrating wire piezometers. These instruments have been successfully used on-site through mine operations for their various specific purposes.

Confirmatory soil sampling will be performed to confirm the success of contaminated soil remediation. The objectives of the soil remediation plan are realistic and achievable. The objectives are to capture at least 95% of soil containing contaminants in excess of the SQRO's in each remediation area. Contaminant concentrations in any residual soils will not exceed twice the SQRO's.

During remediation, on-site screening will be undertaken in a consistent grid-based basis to provide an indication of remedial progress. Excavation of contaminated sols will proceed until the on-site screening procedures indicate that the excavation objectives have been achieved. At that time, a suite of confirmatory samples will be collected and analysed at an off-site laboratory. Backfilling of excavated areas or other similar work in the areas of excavation will proceed only subsequent to the receipt of results from the off-site laboratory confirming that the objectives have been met.

The **physical stability of earth structures** will be determined via annual inspections by a professional geotechnical engineer registered in Nunavut. These inspections will examine all existing and reclaimed earth structures, water diversions, rock slopes and soil covers. The inspection will be conducted during later summer such that thaw conditions are observed.

Areas targeted, as part of the physical stability assessments will include:

- West Twin and Test Cell Dikes;
- West Twin Dike Spillway;
- West Twin Reservoir Outlet;
- West Twin Tailings Cover;
- East twin Lakes outlet area;
- Landfill Cover;
- Area 14, East Open Pit and West Open Pit covers; and
- Oceanview and K-Baseline areas.

Despite the fact that the closure monitoring period is defined as 5 years (until 2010), it is understood that the overall timeframe for the Monitoring Plan is somewhat "open-ended". Environmental performance monitoring will continue until sufficient data has been collected to confirm that long term behaviour of the site will meet the reclamation objectives.

In order for the Monitoring Plan to be successful, the information that is collected must be reviewed and, where necessary, acted upon in a timely manner. This includes review and action by CanZinco for site management purposes and review and action by the NWB or CanZinco regarding compliance with the terms of the Water Licence.

A quarterly data report will be filed with the NWB in compliance with *Part H, Item 30* of the Water Licence. It is anticipated that the file would then be posted, thus providing public access and an appropriate level of transparency into the monitoring process.

An annual environmental report will also be filed with the NWB in compliance with *Part B, Item 16* of the Water Licence. This report will include a review and comparison of the information with previous year's data and will identify any developing spatial or temporal trends. It is anticipated that this report will also be posted and will allow all parties to assess the performance of the reclamation actions to that date

A Comprehensive Assessment Report that summarizes information garnered from the data will be filed with the Nunavut Water Board in 2010. The report will follow the Terms of Reference which are required under Part G, Item 22 of the Water Licence. This report will assess the "environmental stability" of the site in consultation with the appropriate communities, agencies and organizations. Based on the collected data, long term projections will be made on the expected behaviour of the site. If this review demonstrates that the site is currently stable and is expected to stay stable in the long term, then CanZinco will anticipate a release from further monitoring obligations.

6.10 G.13, ᐊᐸᑎᙵᓂᒃ ᖃᐅᔮᓵᓂᖅ, Environmental Site Assessment

The report, P*hase II Environmental Site Assessment, Nanisivik Mine* (the "Phase 2 ESA Report") was prepared by Gartner Lee and is provided in its entirety as Appendix G. A conditional approval on this report was provided by the Nunavut Water Board based on a number of conditions.

The report, *2003 Phase 3 Environmental Site Assessment, Nanisivik Mine* (the "Phase 3 ESA Report"), provides the report requested under Part G, Item 13 of the Water Licence. The Phase 3 ESA Report was prepared by Gartner Lee and is provided in its entirety as Appendix H and the Executive Summary is provided below for ease of reference. The conditions of approval for the Phase 2 ESA Report are all individually addressed in this report.

6.10.1 ᓇᐃᒃᓕᒥᐊᕐᓯᒪᔪᑦ ᐅᖃᐅᓯᒃᓴᐃᑦ

ᐱᒋᐊᕐᓂᖓ

ᓇᓂᓯᕕᒃ ᓄᓇᖓ ᑲᖏᕐᓗᒃᒥᑦᑐᖅ ᐊᕐᕌᑦ ᑲᖏᕐᓗᐊᓂ ᓄᓇᓕᖓᑕ ᐃᒃᐱᐊᕐᔪᑦ ᖃᓂᒋᔭᓂᑦᑐᖅ ᐅᐊᒃᓇᖓᓂ ᕿᑭᕐᑕᓗᑦ, ᐅᔾᕋᒃᑕᖃᑦᑕᕐᓯᒪᔪᖅ ᓴᕕᒃᓴᒥᒃ ᐊᒻᒪᓗ ᑯᓯᕐᓯᐊᒃᓴᒥᒃ 1976-ᒥᑦ 2002-ᒧᑦ. ᓇᓂᓯᕕᒃ ᐅᔾᕋᒃᓂᐊᕐᕕᒃ ᒪᑐᕕᓚᐅᕐᑐᖅ 2002-ᒥ ᐱᑕᖃᑦᑎᐊᕈᓐᓂᕐᓂᖓᓄᑦ ᐅᔾᕋᑦᑕᐅᔪᓐᓇᕐᑐᖅ ᐊᒻᒪᓗ ᐊᑭᑭᓗᐊᓕᕐᓂᖓᓄᑦ ᓴᕕᒃᓴᖅ.

ᒪᑐᔾᐅᓂᖕᒐᓄᑦ ᓴᓗᒻᒪᕐᓴᕐᑕᐅᓂᖕᒐᓄᓪᓗ ᐸᕐᓇᐅᑎᖃᕐᓘᑎᒃ, ᑲᓐᓃᓐᑯ-ᑯᑦ ᐅᔾᕿᒃᓯᐅᕐᑎᑦ ᐱᖁᑎᓕᑦ ᖃᐅᔨᓴᕐᑎᑦᑎᓚᐅᕐᒪᑕ ᐊᕙᑎᖕᒐᓂᒃ ᓇᓗᓇᐃᕐᔭᓇᓱᒃᓗᑎᒃ ᖃᓄᐃᑦᑐᑎᒋᒃᒪᖕᒐᑕ ᖃᓄᑎᒋᕐᒪᖕᒐᑕᓗ ᓱᕈᕐᓇᕐᑐᔪᑦ ᓄᓇᖕᒐᓂᑦᑐᑦ. ᑭᖑᓕᐅᔪᖅ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᐱᒋᐊᕐᑕᐅᓚᐅᕐᓯᒪᔪᖅ ᔪᓚᐃ 2002-ᒥ ᑲᒪᒋᔾᔪᐅᓪᓗᓂ ᑲᓐᓄ ᓕ-ᑯᓐᓄᑦ, ᐊᖏᕐᑕᐅᓚᐅᑲᓚᐅᕐᑐᑦ ᐃᒥᓕᕆᔩᒃᑯᓐᓄᑦ ᑭᓯᐊᓂ ᒪᓕᒃᓂᐊᐳᑎᒃ ᐅᖄᕐᓯᒪᔪᓂᒃ 15-ᖑᔪᓂᒃ ᐱᔭᕆᐊᖃᕐᑐᓂᒃ ᑐᓴᕐᑕᐅᔪᒪᔪᓂᒃᓗ ᑐᑭᓯᐊᒋᐊᕈᑕᐅᔪᓂᒃᓗ. ᐊᑐᓂ ᐱᔭᕆᐊᖃᕐᑐᑦ ᑕᕙᓂ ᑎᑎᕋᕐᓯᒪᔪᑦ.

ᐱᖓ)ᖓᑦ ᖃᐅᔨᓴᕐᓂᖅ ᐱᒋᐊᕐᑕᐅᓚᐅᕐᑐᖅ ᐊᒋᓯ 2003-ᒥ ᐅᖃᐅᓯᒃᓴᐅᔪᓪᓗ ᐱᖃᓯᐅᔾᔪᐅᓯᒪᓪᓗᑎᒃ ᑲᑎᑕᐅᓯᒪᔪᑦ ᐃᓚᐅᖃᑕᐅᔪᓄᑦ ᓄᓇᕗᑦᒥ ᐃᒥᓕᕆᔩᒃᑯᑦ ᑲᑎᒪᔩᖏᓐᓄᑦ ᐅᖄᕐᓯᒪᔪᑦ. ᐱᖓᔪᖓᓐᓂᒃ ᖃᐅᔨᓴᕐᓂᐅᔪᕐ ᐃᓗᓕᖏᑦ ᑕᕙᓚ ᑎᑎᕋᕐᓯᒪᔪᑦ.

ᑲᑎᓪᓗᒋᑦ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᔪᑦ 267 ᑐᐊᐸᖕᒐᓂᒃ ᑲᑎᑕᐅᓯᒪᔪᑦ ᐊᒻᒪᓗ 90-ᓂᒃ ᖃᐅᔨᓴᕐᑕᐅᔪᕕᓂᕐᓂᒃ. ᐊᒻᒪᑦᑕᐅᖅ 15-ᖑᔪᑦ ᐃᒥᕐᒧᑦ ᖃᐅᔨᓴᐅᑕᐅᔪᕕᓂᑦ ᖃᖓᓂᑦᑐᒧᑦ ᐊᒻᒪᓗ ᐃᓗᐊᓂᑦᑐᑦ. ᓴᕕᒃᓴᖃᕐᓂᖕᒐᓗ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᔪᑦ ᐅᕐᓱᐊᓗᒃᓴᖃᕐᓂᖕᒐᓗ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᔪᑦ ᖃᐅᔨᓴᕐᕕᒃᒥ.

ᐱᓕᕆᐊᖑᓚᐅᕐᑐᑦ ᐱᖓᔪᖓᓐᓂ ᖃᐅᔨᓴᕐᑕᐅᔪᑦ ᐱᔭᕆᕐᓂᕋᕐᑕᐅᔪᑦ ᐸᕐᓇᐅᑎᐅᔪᓐᓇᕐᓯᓪᓗᑎᒃᓗ ᓴᓗᒻᒪᓴᐃᓂᕐᒧᑦ ᐊᕙᑎᖕᒐᓗ ᖃᐅᔨᓴᒃᑲᓂᕆᐊᖃᕈᓐᓂᕐᑎᑕᐅᓪᓗᓂ.

ᑭᖑᓕᕐᐸᖓ

ᑭᖑᓕᕐᐸᖓ ᑎᑎᕋᕐᓯᒪᔪᒥ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐱᖓᔪᖓᓐᓂ ᐅᑯᐊᖑᔪᑦ:

ᑐᓚᒃᑕᕐᕕᒃ

- ᓱᕈᕐᓇᕐᑐᖃᕐᓂᖓ ᖃᓄᕐ ᐊᖏᑎᒋᒃᒪᖓᑦ ᖃᐅᔾᒪᔾᔪᓕᕐᓗᓂ ᑐᑭᓯᔾᔪᐅᓪᓗᓂ ᐅᕐᓱᖃᐅᑎᑦ 40-ᒥᑕᒥᑦ ᐅᖓᑕᓄᐊᕐᓯᒪᖏᓐᓂᖓᓂᒃ ᑕᕙᖓᑦ ᖃᑦᑎᒃᓯᓕᕐᓯᒪᔪᑦ ᐊᕙᓗᐊᓄᑦ ᑭᒃᓕᖃᕐᓘᓂ ᐅᕐᓱᖃᐅᑎᒥᑦᑐᖅ.
- ᓱᕈᕐᓇᕐᑐᖃᕐᓂᖓ ᑐᐊᐸᐅᑦ ᑐᓚᒃᑕᕐᕕᒃᒥᑦᑐᖅ ᐅᓯᓕᕐᓱᕐᕕᒃᒥᑦᑐᖅ ᐅᖓᑕᓐᓂᕋᕐᑕᐅᔪᖅ ᓴᓇᐅᑎᒃᑯᑦ ᖃᐅᔨᓴᐅᑕᐅᖃᑦᑕᕐᑐᒥᑦ ᐃᒪᕐᒥᐅᑕᐃᑦ ᓴᐳᑎᓯᒪᓇᓱᒃᓗᒋᑦ ᓴᓗᒻᒪᕐᓴᕐᑕᐅᓂᐊᕐᑐᖅ ᑐᐊᐸᖓ.
- ᖃᖓᓂᑦᑐᑦ ᓄᓇᐅᑦ ᓱᕈᕐᓇᕐᑐᖃᕐᑐᑦ ᐅᕐᓴᒃᓴᐃᕕᐅᑦ ᖃᓂᒋᔭᓂᑦᑐᑦ. ᑖᓇᓗ ᓱᕈᕐᓇᕐᑐᖃᕐᓂᖓ ᑕᒪᓂᑐᐊᕐ ᓱᕐᓗ ᐅᕐᓱᖃᐅᑎᑦ ᖃᓂᒋᔭᐃᓐᓇᖓᓂᑦᑐᖅ.
- ᓱᕈᕐᓇᕐᑐᖃᕐᓂᖓᓗ ᖃᐅᔨᓴᕐᑕᐅᓚᐅᕐᒥᔪᖅ ᓱᓪᓗᓕᑯᖓᔪᖅ ᐅᕐᓱᐊᓗᖃᐅᑎ ᑐᑭᓯᕙᐅᓚᐅᕐᑐᖅ ᓱᕈᕐᓇᕐᑐᓂᖓ ᖃᓂᒋᔭᐃᓐᓇᖓᓂᓐᓂᖓᓂᒃ ᓱᓗᓕᒃᒥᑦ ᐅᖓᓯᒃᓂᖃᕐᑐᖅ 40-ᓯᓐᑕᒥᑕᒥᒃ.
- ᓴᕕᒃᓴᕈᔪᓂᖓ ᐱᑕᖃᕐᓂᕋᕐᑕᐅᓪᓗᓂ ᑐᓚᒃᑕᕐᕕᒃᒥ ᐱᒋᐸᕐᓘᓂ ᐸᖓᓂᑦ ᐃᒃᑯᐊᓗᑦ ᐅᓯᓕᕐᓱᕐᕕᒃᒧᑦ ᐊᒻᒪᓗ ᐅᓱᖅᖃᐅᑎᒧᑦ. ᐊᑕᐅᓯᕐᒥᒃ ᓇᓗᓇᐃᕐᔭᓯᒪᓪᓗᑎᒃ ᐱᑕᖃᕐᓂᖓᓂᒃ ᓴᕕᒃᓴᖃᕐᓂᖓᓂᒃ. ᑯᓯᕐᔭᐊᒃᓴᕐ ᐱᑕᖃᕐᓂᕋᕐᑕᐅᒋᓪᓗᓂ ᐸᖓᓂᑦ ᐃᒃᑯᐊᓗᑦ ᐊᑭᓇᖓᓄᑦ ᑎᑭᓪᓗᖑ. ᖃᐅᔨᓴᐅᑎᒃᑯᑦ ᓇᓴᐅᑎᒃᑯᑦ ᑎᑭᐅᒪᔾᔭᖓ ᐅᖓᑕᒃᑲᓄᐊᕐᓯᒪᖏᑦᑐᖅ ᐃᓚᒃᓴᒃᑯᕕᐅᔪᒥ ᐃᓗᒻᒧᓪᓗ ᖃᐅᔨᓴᕐᑕᐅᒐᒥ ᑐᑭᓯᔾᔪᓚᐅᕐᑐᖅ ᐃᑎᓂᖃᕐᑐᒥᒃ 0.4 ᒥᑕᓂᒃ ᐃᓴᐅᑎᓯᒪᓂᖓᓂᒃ.
- ᓇᕕᒃᓴᒃ ᐅᖓᑕᓂᑦᑐᕐ ᓇᓴᐅᑎᒃᑯᑦ, ᑐᐊᐸᖓ ᓴᓗᒻᒪᕐᓴᕐᑕᐅᓂᐊᕐᑐᖅ, ᓴᕕᒃᓴᖃᕐᓂᖓ ᑕᒪᕐᒥᒃ ᓴᓗᒻᒪᕐᓴᕐᑕᐅᓂᐊᕐᑐᖅ ᑐᐊᐸᖓᓗ ᐃᔾᔭᕐᑕᐅᓗ.

ᒥᑦᑕᕐᐱᕕᓂᖅ

- ᐅᕐᓱᐊᓗᒃᑕᖃᕐᓂᖏᓐᓂᒃ ᓇᓗᓇᐃᕐᓯᓚᐅᕐᑐᑦ ᑭᖑᓪᓕᕐᒥᒃ ᖃᐅᔨᓴᕐᑎᓪᓗᒋᑦ ᐊᕙᑎᖓᓂᒃ ᐊᑭᓐᓴᖓᓂ ᒥᑦᑕᕐᐱᕕᓂᐅᑦ. ᐅᕐᓱᐊᓗᖃᕐᓂᖓ ᐅᖓᑕᓂᖕᒋᑦᑐᖅ 45-ᒥᑕ ᐱᑕᖃᕐᓂᕆᔭᖓᑕ. ᐳᕐᓱᐊᓗᒃᑕᖃᕐᓂᖏᓐᓂᒃ ᐃᓗᑦᑐᕐᓯᒪᔪᒥ ᖃᐅᔨᒪᔪᑎᖃᓚᐅᕐᒥᔪᑦ ᑭᓯᐊᓂ ᖃᐅᔨᒋᐊᕐᑕᐅᒐᒥ ᓇᓴᐅᑎᒃᑯᑦ ᑐᖓᓂᓚᐅᕐᑐᖅ ᑭᒃᓕᒋᔭᕆᐊᖃᕐᑕᖓᑕ. Hᓐᓇᓗ ᖃᐅᔨᓴᐅᑎ ᐅᖓᓯᒃᓂᖃᓚᐅᕐᑐᖅ 45-ᒥᑕᒥᒃ ᐱᑕᖃᕐᓂᖏᓐᓂᑦ.
- ᑯᓯᕐᓯᐊᒃᓴᖅ ᓇᓴᐅᑎᒃᑯᑦ ᐅᖓᑕᓂᓚᐅᕐᑐᖅ ᑭᖑᓪᓕᕐᒥᒃ ᖃᐅᔨᓴᕐᑎᓪᓗᒋᑦ ᐊᕙᑎᖓᓂᒃ ᓂᒋᖓᓂ ᒥᑦᑕᕐᐱᕕᓂᐅᑦ. ᖃᐅᔨᓴᕐᑕᐅᓚᐅᕐᑐᖅ ᖃᓄᑎᒋ ᐱᑕᖃᕐᑎᒋᒃᒪᖓᑦ ᐃᓗᑐᔪᒧᑦ ᐊᑦᒪᓗ ᓴᓂᒧᑦ ᖃᖓᓂᑐᐃᓐᓇᕐᓂᕋᕐᑕᐅᔪᖅ ᓄᓇᐅᑦ ᑐᐊᕙᖓᓂ.

ᓄᓇᓕᖕ, ᕿᔪᓕᕆᕕᒃ

- ᐅᕐᓱᐊᓗᒃᑕᖃᕐᓂᖏᓐᓂᒃ ᕿᔪᓕᕆᕕᒃᒥ ᖃᐅᔨᔭᐅᓯᒪᓪᓗᓂ ᑐᐊᕙᖓᓂ ᐅᖓᑕᓂᖕᒋᑦᑐᖅ 50-ᒥᑕ ᐃᒃᓗᒥᑦ. ᑯᖓᓂ ᖃᓂᒋᔭᓂᑦᑐᕐ ᖃᐅᔨᓴᕐᑕᐅᒍᓗᐊᕐᒥ ᐅᕐᓱᐊᓗᒃᓯᐊᕐᕕᐅᓚᐅᖕᒋᑦᑐᖅ ᐃᒪᖓᓂ.

ᓴᓇᕕᐊᓗᒃ ᐃᒃᓗᐊᓗᒃ

- ᑐᐊᕙ ᖃᓂᒋᔭᖓ ᐅᕐᓱᐊᓗᒃᑕᖃᐅᕐᑐᖅ ᐅᕐᓱᖃᐅᑎᐅᑦ ᖃᓂᒋᔭᖓᓂ. ᐳᕐᓱᐊᓗᖃᕐᓂᖓ ᐅᖓᑕᓂᓚᐅᖕᒋᑦᑐᖅ 0.95-ᒥᑕᒥᒃ ᐊᑕᓂᑦ ᑭᓯᐊᓂᓗ ᐱᑕᖃᓚᐅᕐᑐᖅ 15-ᒥᑕᒥ ᐃᓗᑐᓂᓕᒃᒥ.
- ᐅᕐᓱᐊᓗᒃᑕᖃᕐᓂᖏᓐᓂᒃ ᓇᓗᓇᐃᕐᓯᓚᐅᕐᑐᑦ ᑭᓂᕐᑐᖃᐅᑎᒥᑦ, ᑯᖓᑕ ᐊᒻᒪᓗ ᐃᒃᓗᐊᓗᑦ ᐊᑯᓐᓂᖏᓐᓂᑦᑐᖅ ᑭᓂᕐᑐᒃᑯᕕᒃ. ᖃᐅᔮᓚᐅᕐᑐᑦ ᖃᓂᒋᔭᐃᓐᓇᖓ ᑭᓂᕐᑐᕐᑕᖃᐅᕐᓂᖏᓐᓂᒃ ᑯᒃᒧᐊᕐᓯᒪᖕᒋᑦᑐᖅ ᑭᓂᕐᑐᓂᖓ
- ᐅᕐᓱᐊᓗᒃ ᖃᐅᔨᔭᐅᓯᒪᔪᖅ ᑐᐊᕙᖓᓂ ᓴᓗᒻᒪᖅᓴᐃᕕᒃᒥ ᖃᓂᒋᔭᖓᓂ ᑭᓯᐊᓂ ᐅᖓᑕᓂᖕᒋᑦᑐᖅ 50-ᒥᑕ.
- ᓴᕕᒃᓴᖃᕐᓂᖕᒋᑦ ᑐᐊᕙᒃ ᖃᓂᒋᔭᓂᑦᑐᑦ. ᖃᐅᔨᓴᕐᓗᑎᒃ ᑐᑭᓯᓚᐅᕐᑐᑦ ᐱᑕᖃᕿᓗᐊᕐᑎᓪᓗᒋᑦ ᓴᕕᒃᓴᐃᑦ ᑯᓯᕐᓯᐊᒃᓴᐃᓪᓗ ᑭᓯᐊᓂᓕ ᖃᖓᓂᑦ ᐅᖓᑕᓄᐊᖃᑦᑕᖕᒋᑦᑐᖅ 0.4-ᒥᑕ ᐊᒻᒧᑦ.

ᐱᖁᑎᒃᑯᕕᒃ

- ᐅᕐᓱᐊᓗᖃᕐᓂᖓ ᖃᐅᔨᔭᐅᓚᐅᕐᑐᖅ ᐊᖓᓂ ᑐᐊᕙᖓᑕ, ᑕᑯᒃᓴᐅᓪᓗᓂᓗ ᐅᕐᓱᐊᓗᖃᕐᓂᖓ, ᐅᕐᓱᐊᓗᖃᓚᕆᒃᓂᖓ (ᖃᐅᔨᓴᕐᑕᐅᓗᓂ ᕿᖑᓪᓕᕐᒥᒃ ᐊᕙᑎᖓ ᖃᐅᔨᔭᐅᓚᐅᕐᑐᖅ ᐱᑕᖃᕐᓂᖏᓐᓂᒃ ᐅᓯᐊᓗᒃᑕᖃᕐᓂᖏᓐᓂᒃ) ᐅᖓᑕᓄᐊᖓᓪᓗᓂᓗ ᖃᐃᕐᓯᕋᖑᓂᖓᓄᑦ ᑕᐅᓄᖓ ᐃᓗᒻᒧᑦ ᐃᑎᓂᖃᕐᑐᒥᒃ 0.8-ᒥᑕᒥᒃ ᐅᖓᑕᓄᐊᖕᒋᑦᑐᒐᓗᐊᕐ ᖃᐃᕐᓱᓚᖑᓂᖓᑕ ᕿᒃᓕᖓᓄᑦ ᐃᑎᓂᖃᕐᑐᒥ 0.4-ᒥᑕᒥᒃ ᐊᑕᓂ ᑐᐊᕙᖓᑕ.

ᐱᖁᑎᒃᑯᕕᐅᔪᖅ ᐃᓂᓕᐅᕐᓯᒪᔪᖅ

- *ᖃᐅᔨᓴᕐᑕᐅᓪᓗᓂ ᐅᕐᓱᐊᓗᖃᕐᓂᖓ ᑐᐊᕙᒃᒥ 25-ᐳᓴᖓ ᑐᐊᕙᐅᑦ ᐃᔭᕐᑕᐅᓂᐊᕐᑐᖅ ᐅᖓᑕᓂᖕᒋᓐᓂᖏᓐᓂᒃ ᓇᓴᐅᑎᒃᑯᑦ ᖃᐅᔨᒪᔪᑕᐅᔪᒧᑦ.*

ᐊᒃᑕᕐᕕᒃ

- ᐅᕐᓱᐊᓗᒃᑕᖃᕐᒪᖔᑦ ᖃᐅᔮᓚᐅᖕᒋᑦᑐᑦ ᑐᐊᕙᖓᓂ ᐊᒻᒪᓗ ᐃᒥᕈᔪᓂᖓᓂ ᐊᑕᓂ ᐊᒻᒪᓗ ᓇᓚᓂ ᐊᒻᒪᓗ ᐱᑕᖃᕐᓗᐊᕐᖓᑦ ᑐᖓᓂᓗᐊᕐᓗᑎᒃ ᓇᓴᐅᑎᒃᑯᑦ ᑭᒃᓕᒋᔭᕆᐊᖃᕐᑕᖓᑕ
- ᓴᕕᒃᓴᖃᓚᐅᖕᒋᑦᑐᑦ ᑐᐊᕙᖓᓂ

ᓴᓇᕕᒃ *K-Baseline*

- ᐅᕐᓱᐊᓗᒃᑕᖃᕐᓂᖏᓐᓂᒃ ᖃᐅᔮᓚᐅᕐᑐᑦ ᑐᐊᕙᖏᓐᓂᒃ. ᐊᐅᓚᐅᓯᕆᕕᐅᑦ ᖃᓂᒋᔭᖓ. ᐃᓗᑦᑐᕐᓯᓪᓗᑎᒃᓗ ᖃᐅᔨᓴᕐᓂᖓ ᖃᐅᔮᓚᐅᕐᑐᑦ ᐅᖓᑕᓄᐊᕐᓯᒪᖕᒋᓐᓂᖏᓐᓂᒃ ᑯᖓᑕ ᖃᓂᒋᔭᓄᑦ ᑭᒃᓕᖃᕐᓗᓂ

- ᖃᐅᔨᓴᕐᓂᒃᑯᑦ ᐱᖓᔪᖓᓐᓂ ᖃᐅᔨᓚᐅᕐᑐᑦ ᓄᓇᐅᑦ ᖃᖏᓐᓇᖓ ᐅᕐᓱᐊᓗᒃᑕᖃᕐᓂᖓᓂᒃ ᐃᓗᒻᒧᒃᓯᒪᖏᓐᓂᖓᓂᒃ.

ᐊᖅᑯᑎᑦ

- ᐅᕐᓱᐊᓗᒃᑕᖃᕐᓂᖏᑦ ᖃᐅᔨᓴᐅᓚᐅᕐᑐᑦ ᐊᖅᑯᑎᑦ ᑭᒃᓕᖏᑦ ᐱᕐᑯᑎᖃᕐᕕᕕᓂᑦ, ᑕᓱᒪᓗ ᖃᓂᒋᔭᐃᓐᓇᖓ ᐅᕐᓱᐊᓗᖃᐅᕐᓗᓂ.
- ᓴᕕᒃᓴᖃᕐᓂᖓ ᖃᐅᔨᔭᐅᓚᐅᕐᑐᖅ ᐅᔭᕿᒃᑕᕐᕕᐅᓯᒪᔪᑦ ᖃᓂᒋᔭᓂᑦᑐᖅ ᐊᖅᑯᑎ ᑕᕆᐅᕐᒧᑦ ᐅᔭᐅᒪᔪᖅ ᐳᓚᑕᕐᕕᒃ.
- ᓴᕕᒃᓴᖃᕐᑐᕐ ᐃᓚᖓ ᐊᖅᑯᑎ ᓄᓇᓕᖓᓂᑦ ᓴᓇᕕᐊᓗᒃᑯᐊᖓᔪᖅ ᐊᑭᓐᓇᖓᓂ ᐃᑲᕈᑎᐅᑦ ᑯᕕᕐᓗᑯᒧᑦ ᓴᓗᒻᒪᕐᓴᐃᕕᐅᑦ ᖃᓂᒋᔭᓂ.. ᐱᑕᖃᓚᐅᖏᑦᑐᖅ 0.4 ᒥᑕ ᐅᖓᑕᓂ ᐊᒻᒧᑦ.
- ᓇᕕᒃᓴᖃᕐᓂᖓ ᐱᑕᖃᐅᕐᑐᖅ ᖃᖓᓂ ᓄᓇᐅᑦ ᐊᖅᑯᑎᒥ ᓴᓇᕕᐊᓗᑦ ᐊᒻᒪᓗ ᓴᓗᒻᒪᕐᓴᐃᕕᐅᑦ ᐊᑯᓐᓂᖓᓂ, ᐃᓂᖃᕐᑐᖅ ᐅᖓᓯᒃᓂᖃᕐᑐᒥᒃ 1.5 ᑭᓇᒥᑕ ᐅᐊᒃᓇᖓᓂ. ᓱᕈᕐᓇᕐᑐᖃᕐᓂᖓ ᐅᖓᑕᓄᐊᓚᐅᖏᑦᑐᖅ 0.4 ᒥᑕ ᐊᒻᒧᑦ.

6.10.2 Executive Summary

Introduction

The Nanisivik Mine, located on the south shore of Strathcona Sound near the community of Arctic Bay in the North Baffin region, produced lead and zinc mineral concentrates from 1976 to 2002. The mine was permanently shut down in 2002 due to depleted ore reserves and poor economic forecasts.

As part of the closure and reclamation planning process, CanZinco Ltd., the mine owner, commissioned an Environmental Site Assessment ("ESA") to identify the nature and distribution of contaminants in soil. A Phase 2 ESA was undertaken in July 2002 by Gartner Lee Limited ("Gartner Lee"). Conditional approval was given by the NWB for the Phase 2 ESA Report based on fulfillment of 15 specified conditions regarding information requests and requests for clarifications. Each of those conditions is addressed herein.

A Phase 3 ESA investigation was conducted in August 2003 that incorporated as many of the comments that were brought forward through the NWB review of the Phase 2 ESA Report as allowed by timelines and practicalities. The Phase 3 ESA investigations are reported on herein.

A total of 267 soil samples were collected from 90 test pits during the Phase 3 ESA. Additionally, 15 water samples were collected from groundwater monitors and surface seeps. Analyses for metals and petroleum hydrocarbon concentrations were conducted at an accredited laboratory for a select subset of the soil samples and all of the water samples.

The work performed for the Phase 3 investigations is considered to complete the needs for preparation of a remedial plan for the Nanisivik site and no further ESA investigations are deemed necessary.

Conclusions

The conclusions drawn from Phase 3 program, as presented herein in Section 5, are provided below.

Dock Area

- The downgradient extent of hydrocarbon contaminated soil at the fuel tank farm has been delineated. Testing has shown that it does not extend beyond 40 m from the berm of the tank farm;
- Concentrations of hydrocarbons in the soil within the dock cell containing the ship loader facility exceed the generic PHC CWS IL for the protection of aquatic life, the site soil quality remediation objective;
- Surficial hydrocarbon contamination is present at the AST adjacent the refuge station. The contamination appears to be isolated to the immediate area surrounding the AST;
- Hydrocarbon contamination was detected in a test pit which exposed the fuel line from the dock to the tank farm. Results indicate that contamination is localized and has migrated less than 40 cm from the line;
- Zinc concentrations greater than the SQRO for the dock area have been identified on surface adjacent the door to the concentrate shed on the west side, at the load out dock and adjacent the refuge station. One isolated incidence is documented on the east side of the concentrate shed. Lead concentrations also exceed the SQRO adjacent the door of the concentrate shed on the west side. No lead or zinc contamination greater than the SQROs is indicated in the reagent storage area. Analytical results indicate that the metal contaminated soil does not extend to 0.4 m below surface; and
- Silver exceeds the generic CEQG IL, the site soil quality remediation objective. Elevated silver results were returned in samples with zinc concentrations that were indicative of zinc concentrate and several times greater than the SQRO and therefore silver is contamination would be remediated during the remediation of the zinc contaminated soils.

STOL Airstrip

- Hydrocarbon contaminated soil detected during the Phase 2 ESA at the east end of the airstrip has been delineated. The contaminated soil does not extend 45 m from the point of origin as indicated by surface staining. Hydrocarbon contaminated seepage water was encountered in test pit TP03-373, however soil quality results from this test pit met the PHC CWS RL criteria. Test pit TP03-373 was excavated approximately 45 m from the point of origin; and
- Lead concentrations greater than the SQRO detected during the Phase 2 ESA on the apron on the south side of the airstrip were investigated. The lead contamination has been delineated vertically and laterally and it is confined to the soils on surface at the apron.

Town, Carpenter Shop

- The downgradient extent of hydrocarbon contaminated soil at the Carpenter Shop has been delineated. It does not extend 50 m downgradient of the building. No impact of hydrocarbon contamination on the surface water was detected in the water flowing in a ditch adjacent to the Carpenter Shop.

Industrial complex

- Soils beneath the surface water runoff pathway, downgradient of the fuel day tanks, are contaminated with hydrocarbons. Contamination did not extend to 0.95 m beneath surface at test pit TP03-331, but was present at 1.5 m below surface at the upgradient test pit TP02-88;
- Hydrocarbon contaminated soil has been delineated at the waste oil tank, located between Twin Lakes Creek and the industrial complex. Results indicate that it is isolated to the downhill side of the tank and does not extend to the creek;
- Hydrocarbon contaminated soil is present at the oil water separator. Analytical results obtained from test pit TP03-330 indicated that the contaminated soil does not extend 50 m downgradient of the oil water separator; and
- Metal contaminated soil is present in the soil surrounding the industrial complex. Analytical results to date indicate that concentrations of cadmium, lead and zinc greater than the SQROs do not generally extend to 0.4 m below surface.

Warehouse Yard

- Hydrocarbon contamination is present in surficial soils with patchy, visible staining. Hydrocarbon contamination at an area of heavy staining (initially identified and sampled during the Phase 2 ESA) extends into the fractured bedrock to at least 0.8 m depth. It does not extend into the weathered, fractured bedrock, encountered 0.4 m, beneath lightly stained surface soils.

Landfarm Cell

- Based on analytical results obtained to date, it is estimated that approximately 25% of the hydrocarbon contaminated soil being remediated in the landfarm cell at the landfill currently meets the generic PHC CWS RL criteria.

Landfill

- No hydrocarbon contamination was detected in soil or water samples down gradient or cross gradient of the landfill and all analyses were less than the method detection limits; and
- No elevated metals were encountered in the soils.

K-Baseline

- Hydrocarbon contamination of soil has been detected at the former AST and maintenance shop at K-Baseline. Analytical results from test pits excavated northwest of the former AST and maintenance shop indicated that the contaminated soil does not extent to intermittent tributary of Chris Creek; and
- Analytical results from the Phase 3 ESA illustrate that the hydrocarbon contaminated soil is isolated to the top of the active layer.

Roads

- Surficial hydrocarbon contamination is present at the ASTs adjacent the refuge stations at the side of the roadways. The contamination appears to be isolated to the immediate area surrounding the ASTs;
- Metal contamination of soil is present adjacent the former Oceanview mine workings;
- Iron contaminated soil is present on the surface of the roadway between the townsite and the industrial complex at the west side of bridge near the sewage treatment plant. The contamination did not extent to 0.4 m below surface; and
- Metal contaminated soil is present on the surface of the roadway between the industrial complex and the screening plant, located approximately 1.5 km to the north. The contamination did not extend to 0.4 m below surface and was not detected in soils adjacent to the roadway.

6.11 G.14, ᐸᑎᑦᑎᓐᓄᑦ ᐊᑦᑕᕐᓴᖃᔅᑐᑦ ᖃᐅᔨᕐᓴᑦᑕᐅᓂᖏᑦ, Human Health and Ecological Risk Assessment

The report, *Human Health and Ecological Risk Assessment, Nanisivik Mine* (the "HHERA Report"), provides the report requested under Part G, Item 14 of the Water Licence. The HHERA Report was prepared by Gartner Lee and is provided in its entirety as Appendix I and the Executive Summary is provided below for ease of reference. This report was approved by the Nunavut Water Board.

6.11.1 ᓇᐃᒃᑯᒋᐊᕐᓯᒪᕙᑦ ᐅᖃᐅᓯᒃᓴᐃᑦ

ᐅᑯᓐᓂᖓᓂ ᓯᑎᐱᕆ 10 ᐊᒻᒪᓗ ᓄᕕᐱᕆ 29, 2002 ᐊᑎᖃᕐᑐᖅ ᔭᒃᓴ ᕗᐃᑦᕗᑦ ᐊᐸᑎᓕᕆᓂᕐᒧᑦ ᖃᐅᔨᓴᓚᐅᕐᒪᑦ ᑎᒥᒧᑦ ᐊᒻᒪᓗ ᐊᐸᑎᑦᑎᓐᓄᑦ ᐊᑦᑕᕐᓇᖅᑐᕐᑐᑦ ᖃᐅᔨᓴᓚᐅᕐᑐᖅ ᐱᔨᑎᕆᓪᓗᓂᐅᒃ ᓇᓂᓯᕕᒃ ᐅᔭᕋᒃᓂᐊᕐᕕᐅᓚᐅᖅᓯᒪᕙᖅ ᕿᑭᖅᑕᓗᒃᒥᑦᑐᖅ, ᓄᓇᕗᑦᒥ. ᐱᔪᑎᖃᓗᐊᓚᐅᕐᑐᖅ ᖃᐅᔨᓴᕐᓗᑎᒃ ᑐᑭᓯᓇᓱᒃᓗᑎᒃ ᖃᐅᔨᒪᔭᐅᔪᑦ ᓴᕕᒃᓴᐃᑦ ᓴᕕᒃᓴᕈᔪᐃᓪᓗ ᒪᓂᖏᕐᒥᑦᑐᑦ ᐅᔭᖅᓯᐅᕕᐅᔪᒥ ᐊᑦᑕᕐᓇᖅᓯᒪᖕᒐᑕ ᑎᒥᑦᑎᓐᓄᑦ ᐅᕕᐸᓗᓐᓂᑦ ᐊᐸᑎᑦᑎᓐᓄᑦ ᓯᕗᓂᒃᓴᒥ ᐃᓂᒋᔭᐅᕙᔭᕐᓂᖓ ᐅᔭᖅᓂᐊᕈᓐᓂᕐᓯᒪᓕᕐᑎᓪᓗᒋᑦ. ᓯᕗᓂᒃᓴᒥ ᐊᑐᕐᑕᐅᒃᑲᓐᓂᕈᑎᒃᓴᖏᑦ ᐱᔭᕇᕐᓯᒪᓕᐅᖏᑦᑐᑦ ᐅᖃᐅᓯᐅᓯᒪᓕᐅᖏᑦᑐᑦ ᐊᒻᒪᓗ ᑕᓐᓇ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᑕᑯᓇᓱᓕᐅᕐᑐᖅ ᐱᖓᓱᓕᕐᓯᒪᔪᓂᒃ ᐊᔾᔨᖏᖏᑦᑐᓂᒃ ᑭᓱᒧᑦ ᐊᑐᕐᑕᐅᒐᔭᕐᓂᖓ ᒪᓕᒃᓗᒍ ᓯᕗᓂᒃᓴᒥ; ᑭᓐᓇᐅᔭᒃᓴᕐᕕᐅᓗᓂ, ᐊᖏᕐᕋᕆᔭᐅᓗᓂ ᓄᓇᓕᐅᓗᓂ, ᐊᒻᒪᓗ ᐱᖑᐊᕐᕕᐅᓗᓂ ᐊᖑᓇᓱᒃᑐᓄᓪᓗ.

ᖃᓄᐃᓕᖓᓕᕆᐊᕐᕕᖓ ᖃᐅᔨᓴᕐᑕᐅᔪᑦ

ᓇᓂᓯᕕᒃ ᐅᔭᖅᓂᐊᕐᕕᒃ ᐅᐸᓂᑦᑐᖅ ᕿᑭᖅᑕᓗᑦ ᐃᓚᖓᓂ ᐅᐊᒃᓇᖓᓂ ᐅᑭᐅᖅᑕᖅᑐᒥ ᐅᐸᓂᑦᑐᖅ ᓄᓇᖑᐊᑎᒎᑦ 73-02 ᐅᐊᒃᓇᖅ, 84-31 ᐊᑭᓐᓇᖅ. ᐅᔭᖅᓂᐊᕐ/ᐅᕙᖅ ᓯᒃᔭᖅᐸᓯᒃᒥᑦᑐᖅ ᖃᓪᓗᓇᑎᑐᑦ (ᓯᑐᓚᒃᑯᓇ ᓴᐅᓐ) ᐃᓱᒃᑎᑐᑦ ᐊᖅᐸᕐᑐᑦ ᑲᖏᕐᓗᐊᓂ. ᖃᓂᓪᓚᖑᕙᖅ ᓄᓇᓕᐅᕙᖅ ᐃᒃᐱᐊᕐᕙᖅ (ᑐᓄᓂᕈᓯᖅ) (ᐊᑎᒃᐸᐃ) ᐅᖓᓯᒃᓂᖃᕐᑐᖅ 25 ᑭᓚᒥᑕ ᐊᑭᓐᓇᖓᓂᑦᑐᖅ ᓇᓂᓯᕕᐅᑦ ᐊᒻᒪᓗ ᐅᐸᒃᑕᐅᕙᓐᓇᕐᓗᓂ 33ᑭᓚᒥᑕᒥᒃ ᑕᑭᓂᖃᕐᑐᖅ ᐊᕐᑯᑎᒃᑯᑦ. ᒥᑦᑕᕐᕕᖓ ᐅᖓᓯᒃᓂᖃᕐᑐᖅ 9ᑭᓚᒥᑕᒥᒃ ᖃᓇᒃᓇᖓᓂ ᓇᓂᓯᕕᐅᑉ ᐊᒻᒪᓗ ᐅᐸᒃᑕᖃᑦᑕᕐᓗᓂ ᖃᖓᑕᓪᓗᑎᒃ ᐅᖓᒻᒧᑦ ᐅᑎᒧᓪᓗ ᐊᑐᐸᒧᑦ, ᐃᖃᓗᒃᓄᑦ, ᖃᐅᔨᐃᑦᑐᒧᓪᓗ. ᓇᓂᓯᕕᒃ ᐅᔭᖅᓂᐊᕐᕕᒃ ᓄᓇᐅᑦ ᐊᑕᓂᑦ ᐅᔭᖅᑕᖃᑦᑕᕐᑐᖅ ᓴ/ᒃᓴᒥᒃ ᕿᕐᓂᕐᑕᒥᒃ ᐅᔭᖅᓯᐅᕐᕕᒋᔭᐅᓗᓂᓗ ᐅᑯᓄᖓ ᐱᕐᑯᑎᒋᔭᐅᓚᐅᕐᑐᖅ ᑲᓐᔫᑯ

ᓕᒥᑕᑦᑯᓐᓂ, ᐱᖁᑎᒋᔭᐅᒃᒥᔪᖅ ᐳᓚᒃ ᕗᐊᑐᒃᑯᓐᓄᑦ . ᐅᔭᕿᑕᐃᓐᓇᕐᓯᒪᔪᑦ ᑕᐃᒪᖓᑦ 1976-ᒥᑦ. ᐱᑕᖃᖕᒋᓗᐊᓕᕐᓂᖓᓄᑦ ᑭᓇᐅᔭᒃᓴᐅᑕᐅᔪᓐᓇᕐᑐᑦ ᓴᕕᒃᓴᖅ, ᐅᔭᕿᓂᐊᕈᓐᓂᓚᐅᕐᑐᑦ ᓴᕕᒃᓴᒥᒃ ᓯᑎᐱᕆ 2002ᒥ.

ᑕᓐᓇ ᐅᓂᑲᕐᓯᒪᔪᖅ ᐊᕿᒃᓱᕐᑕᐅᓚᐅᕐᑐᑦ ᒪᓕᒃᑐᑎᒃ ᐃᓚᖓᓂᒃ ᐱᔭᓇᐊᖅᑎᑕᐅᔪᒥᒃ ᒪᑐᔭᐅᓂᖓᓄᑦ ᓴᓗᒪᖅᓴᕐᑕᐅᓂᖓᓄᓪᓗ ᐸᕐᓇᐅᑎᒥ, ᐊᕿᒃᑕᐅᓚᐅᕐᑐᖅ ᒪᓕᒃᑐᑎᒃ ᐊᑐᐊᒐᓂᒃ ᕿᒪᒃᑕᐅᓂᖏᓐᓄᑦ ᓴᓗᒪᖅᓴᕐᑕᐅᓂᖏᓐᓄᓪᓗ ᐅᔭᕿᓂᐊᕐ/ᐅᔪᓂ ᓄᓇᑦᓯᐊᕐᒥ (ᓯᑎᐱᕆ 1990). ᑕᓐᓇ ᐊᑦᑕᕐᓇᕐᑐᓂᒃ ᑎᒥᒧᑦ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᒪᓕᒃᓯᒪᓚᐅᕐᑐᖅ ᐊᖏᕐᑕᐅᓯᒪᔪᓂᒃ ᖃᐅᔨᓴᐅᑕᐅᔪᓂᒃ ᐊᑦᑕᕐᓇᕐᓂᖏᓐᓂᒃ ᐊᑐᐊᒐᐃᑦ ᐱᖃᓯᐅᑎᓪᓗᑎᒃᓗ ᑎᑎᕋᕐᑕᐅᓯᒪᔪᑦ ᐊᓐᓂᐊᖃᕐᓇᖏᑦᑐᓕᕆᔨᒃᑯᓐᓂᑦ ᒐᕙᒪᑐᖃᒃᑯᓐᓂᑦ, ᑲᓇᑕᒥ ᑲᑎᒪᔩᑦ ᒥᓂᓯᑕᐅᔪᑦ ᐊᕙᑎᓕᕆᓂᕐᒧᑦ, ᐊᒻᒪᓗ ᐊᒥᐊᓕᒃᑲᒃᑯᑦ ᐊᕙᑎᓕᕆᓂᕐᒧᑦ ᐱᓕᕆᕝᕕᖕᓂᑦ.

ᑎᑎᕋᕐᑕᐅᔪᑦ ᐊᕿᒃᓯᒪᓂᖏᑦ

ᑐᐊᐸᒃᒥᑦ ᒪᓂᕋᕐᒥᑦ ᑲᑎᑦᑎᓚᐅᕐᑐᑦ ᖃᐅᔨᓴᕐᑕᐅᓪᓗᑎᒃ ᑎᑎᕋᕐᑕᐅᓪᓗᑎᒃᓗ ᐱᖓᓱᓂᖓᕐᑐᓂᒃ; ᐊᕙᑎᖓᓂᒃ ᖃᐅᔨᓴᕐᓂᒥᑦ ᒪᕈᒋᔭᖓᓂᒃ ᑲᒪᒋᔭᐅᓚᐅᕐᑐᑦ ᐊᑎᖃᕐᑐᓄᑦ ᑲᓐᑦᓄ ᓕ ᓕᒥᑕᑦ, ᑭᒐᕐᑐᐃᓪᓗᑎᒃ ᑲᓐᐳᑯᒃᑯᓐᓂᒃ ᔪᓚᐃ 2002ᒥ, ᓄᓇᐅᑉ ᖃᖓᓂᑦ ᑲᑎᑦᑎᕙᓪᓕᐊᓚᐅᕐᑐᑦ ᖃᐅᔨᓴᑐᑎᒃᓗ ᐊᑎᖃᕐᑐᑦ ᐃᐱᐊᐃ ᖃᐅᔨᓴᕐᑎᑦ ᑭᒐᕐᑐᐃᓪᓗᑎᒃ ᒐᕙᒪᒃᑯᓐᓂᒃ ᓄᓇᕗᑦᒥ ᔪᓂ 2002ᒥ; ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓯᒪᔪᑦ ᓴᕕᕋᔭᐅᓂᖏᑦ (ᑲᔪᐃᑦ,ᕿᕐᓂᕐᑕᑦ ᐊᒻᒪᓗ ᓴᕕᒃᓴᐃᑦ) ᐱᑕᖃᐅᕐᓂᖏᑦ ᓄᓇᐅᑦ ᖃᖓᓂᑦᑐᑦ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓯᒪᔪᑦ ᓇᓂᓯᕕᒃᑯᓐᓂᑦ ᕿᓂᕐᑎᓪᓗᒋᑦ ᐅᔭᕿᑕᒐᒃᓴᓂᒃ 1985ᒥ. ᑕᐃᑲᓂ ᖃᐅᔨᓴᕐᑎᓪᓗᒋᑦ 1985ᒥ, ᑯᕕᕐᑕᕐᓂᖏᑦ ᑯᕕᓯᖃᑦᑕᓚᐅᕐᑐᑦ ᐃᒪᐅᑉ ᐊᑕᓄᑦ ᑕᓯᓕᐊᓇᓯᒪᔪᒧᑦ ᑕᐃᒪᐃᓂᖓᓄᑦ ᐃᑉᐱᓇᐅᑎᓚᐅᖏᑦᑐᖅ ᐊᓄᕆᒧᑦ ᑎᒃᑕᐅᖃᑦᑕᕐᓂᖏᑦ ᓴᕕᒃᓴᕈᔪᒃ (ᐱᒋᐊᓚᐅᕐᓯᒪᔪᑦ ᓄᓇᐅᑦ ᖃᖓᓄᑦ ᑯᕕᓯᖃᑦᑕᓕᕐᓗᑎᒃ 1991ᐸᓗᒃᒥ) ᖃᐅᔨᖏᓐᓄᑦ ᐊᓯᓪᓕᐅᑎᓚᐅᖏᑦᑐᖅ.

ᖃᐅᔨᓴᕐᑕᐅᔪᑦ ᑎᑎᕋᕐᓯᒪᓂᖏᑦ ᒪᓕᒃᓯᒪᓚᐅᕐᑐᑦ ᒪᓐᓇᐅᔪᖅ ᑎᑎᕋᕐᑕᐅᔪᕕᓂᕐᓂᒃ ᐊᒻᒪᓗ ᑎᑎᕋᕐᑕᐅᖃᑦᑕᕐᓯᒪᔪᓂᑦ (1985ᒥ) ᑭᒡᓕᓯᔭᐅᓪᓗᓂ 95 ᐳᓴᒥᑦ ᑕᒪᖏᓐᓂᖅᓗᓂ ᐊᑐᓂ ᖃᓄᑎᒥᓕᕐᓂᖓ ᑎᑎᕋᕐᑕᐅᓯᒪᔪᖅ ᖃᐅᔨᓴᕐᕕᐅᔪᓂ. ᐱᔪᑎᖃᓚᐅᕐᑐᑦ ᖃᐅᔨᓇᓱᒃᑐᑎᒃ ᖃᓄᑎᒥ ᐱᑕᖃᕐᑎᒥᒃᒪᖕᖓᑦ ᐊᒻᒪᓗ ᑭᖑᓂᖓᑦᑎᓐᓂ ᖃᓄᐃᓕᖓᓂᕆᓚᐅᕐᑕᖏᑦ ᑐᐊᐸᐅᑦ. ᐱᑕᖃᕐᓂᖏᑦ ᐊᖏᓂᖏᑦ ᓇᓗᓇᐃᒃᑯᑕᐅᔪᖅ ᐱᑕᖃᕐᕕᒋᓚᐅᕐᑕᖓ ᑭᒡᓕᓯᔭᐅᓪᓗᓂ ᓴᕕᒃᓴᖃᓕᕐᓂᖓ ᓇᓗᓇᐃᕐᑕᐅᔪᖅ ᓄᓇᐅᑦ ᖃᖓᓂᑦᑐᖅ ᑐᐊᐸᒃᒥ.

ᓇᓗᓇᐃᕐᑕᐅᓂᖏᑦ ᓱᕋᕐᓇᕐᑐᑦ ᐃᓱᒪᓗᒃᓇᖅᔭᕐᑐᑦ

ᓴᕕᒃᓴᐃᑦ ᖃᐅᔨᓴᕐᑕᐅᔪᑦ ᑕᒪᕐᒥᒃ ᓇᓗᓇᐃᕐᑕᐅᓯᒪᔪᑦ ᖃᐅᔨᓴᕐᑎᐅᔪᓂᑦ ᐅᖓᑕᓂᑦᑐᑦ ᐊᑐᐊᒐᐅᑉ ᐅᖃᕐᓯᒪᓂᖓ ᐊᖏᑎᒋᔪᒥᒃ ᐱᑕᖃᕐᑐᓂ ᐱᕐᑯᖏᓂᕋᕐᑕᐅᒐᔭᕐᓂᖓ, (ᐊᕿᒃᑕᐅᓯᒪᔪᖅ 1999ᒥ). ᐊᑐᐊᒐᐃᑦ ᐊᕿᒃᓯᒪᔪᑦ ᐊᑐᕐᑕᐅᔪᓐᓇᕐᑐᑦ ᐊᕙᑎᑦᑎᓐᓄᑦ ᐅᕙᓗᓐᓂᑦ ᑎᒥᑦᑎᓐᓄᑦ ᐊᑦᑕᕐᓇᕐᔭᕐᑐᑦ ᖃᐅᔨᓴᕐᑕᐅᓂᖏᑦ ᑐᑭᓯᒋᐊᕐᓯᕐᑕᐅᓗᑎᒃ ᓄᓇᖅ ᖃᓄᐃᑦᑐᑎᒥᒃᒪᖕᖓᑦ. ᑎᒥᒧᑦ ᐊᑦᑕᕐᓇᕐᑐᑦ ᖃᐅᔨᓴᕐᑕᐅᓂᖓ, ᓴᕕᒃᓴᐃᑦ ᓇᓗᓇᐃᕐᑕᐅᓚᐅᕐᑐᑦ ᐊᒻᒪᓗ ᐊᕙᑎᑦᑎᓐᓄᑦ ᑐᕋᖓᔪᑦ ᖃᐅᔨᓴᕐᑕᐅᓚᐅᕐᒥᔪᑦ. ᖃᐅᔨᒪᔭᐅᓂᐊᕐᒪᑦ ᑕᒃᑯᐊ ᐊᑐᐊᒐᐃᑦ ᒪᓕᒃᑕᐅᔪᑦ ᐊᕿᒃᑕᐅᓯᒪᔪᑦ ᐊᓐᑎᐅᓕᐅᒥᑦ ᐊᒥᐊᓕᑲᒃᑯᓐᓂᑦᓗ.

ᖃᐅᔨᓴᕐᑕᐅᔪᑦ ᓇᓗᓇᐃᕐᓯᓚᐅᕐᑐᖅ ᓴᕕᕋᔭᐅᓂᖏᓐᓂᒃ ᖃᓄᑎᒥᓕᕐᓯᒪᒃᒪᖕᖓᑦ ᐅᑯᐊᖑᔪᑦ ᑲᒥᐊᓪ,ᕿᕐᓂᕐᑕᖅ,ᕿᓪᓕᕐᑕᖅ ᓴᕕᒃᓴᐃᓪᓗ. ᑲᔪᖅ ᓴᕕᕋᔭᒃᓴᖅ ᐊᒻᒪᓗ ᕿᓪᓕᕐᑕᖅ ᕿᓂᕐᑕᐅᓚᐅᕐᑐᑦ ᐊᕙᑎᑦᑎᓐᓄᑦ ᖃᐅᔨᓴᕐᑎᓐᓄᑦ ᐅᖅᑲᓯᒃᓴᕐᑎᐊᓐᓇᓕᕐᒪᑦ ᐊᖏᓂᖓ ᑐᐊᐸᖃᕐᓂᖓ ᓴᕕᒃᓴᐅᐊᒥᒃ ᑐᖓᓂᑦ ᑎᒥᒧᑦ ᐊᑦᑕᕐᓇᕐᑐᒥᑦ ᐊᑐᐊᒐᖏᓐᓂᑦ.

ᓴᕿᔭᕐᓂᖏᑦ ᐃᓱᒪᒋᔭᐅᔪᑦ

ᖃᐅᔨᓴᕐᑕᐅᔪᒪᓚᐅᕐᑐᑦ ᓇᑭᖕᖓᕐᓂᐊᕐᒪᖕᖓᑦ ᒪᓕᒃᓯᒪᓚᐅᕐᑐᑦ ᓇᓂᓯᕕᐅᑉ ᓄᓇᖅᑯᑎ ᐊᑐᓯᒪᔭᕐᑐᓂᒃ. ᑕᓐᓇ ᓄᓇᐅᓂᖓ ᐊᕕᒃᑐᕐᓯᒪᒪᐅᔪᖅ ᐱᖓᓱᖃᕐᓗᓂ ᖃᐅᔨᓴᕐᕕᐅᔪᑦ ᓯᕗᓂᒃᓴᒥ ᐊᑐᕐᑕᐅᒐᔭᕐᓂᖓ ᒪᓕᒃᑕᐅᓪᓗᓂ. ᐊᔾᔨᖏᑦᑐᑦ

ᖃᓄᐃᓕᖓᒐᓚᕐᓂᖏᑦ ᐃᓱᒪᒋᔭᐅᓪᓗᑎᒃ ᐊᑐᓂ ᓴᕿᔭᕋᔭᕐᓂᖓ ᓄᓇᐅᓪᓗ ᐊᑐᕐᑕᐅᓂᖓᓄᑦ ᐃᓱᒪᒋᔭᐅᓪᓗᑎᒃ. ᓄᓇ ᓇᓂᓯᕕᐅᑉ ᐃᓗᐊᓂᑦᑐᖅ ᖃᐅᔨᓴᕐᑕᐅᔪᖅ ᐊᖏᓂᖃᕐᑐᖅ 29Hᐃᒃᑎᐊ ᐊᒻᒪᓗ ᑕᐃᔭᐅᓪᓗᓂ ᓄᓇᓕᒋᔭᖓᓂᒃ. ᓄᓇᖓ ᐊᖏᓂᖓ ᖃᐅᔨᓴᕐᑕᐅᔪᖅ ᑐᓚᒃᑖᕐᕕᒃᒥ ᐊᖏᓂᖃᕐᑐᖅ 24 Hᐃᒃᑎᐊ ᑕᐃᔭᐅᓪᓗᓂ ᑐᓚᒃᑖᕐᕕᒃᒥᒃ ᐊᒻᒪᓗ ᓄᓇ (ᐱᖅᑯᓯᐅᑎᖏᓪᓗᓂ ᓄᓇᓕᖓ ᐊᒻᒪᓗ ᑐᓚᒃᑖᕐᕕᒃ) ᐊᖏᓂᖃᕐᑐᖅ 4400Hᐃᒃᑎᐊ ᑕᐃᔭᐅᓪᓗᓂ ᐅᔭᕋᒃᑖᕐᕕᐅᔪᑦ. ᐊᑐᓂ ᖃᐅᔨᓴᕐᑕᐅᓚᐅᕐᑐᑦ ᖃᓄᑎᒋᓕᕐᓯᒪᒃᒪᖓᑕ.

ᓄᓇᓕᖓ ᐃᓱᒪᒋᔭᐅᓚᐅᕐᑐᖅ ᐃᓄᒃᓂᒃ ᓄᓇᒋᔭᐅᖏᓐᓇᕐᓂᐊᕐᒪᖓᑦ, ᑐᓚᒃᑖᕐᕕᒃ ᑭᓇᐅᔭᒃᓴᕐᑐᓄᑦ ᐊᑐᕐᑕᓕᕐᓗᓂ, ᐊᒻᒪᓗ ᐅᔭᕋᒃᓯᐅᕐᓂᕕᓂᑦ ᐱᖑᐊᓗᒃᕕᐅᓕᕐᓗᑎᒃ ᐊᖑᓇᓱᒃᕕᐅᓗᑎᒃᓗ. ᑕᐃᒪᓐᓇ ᓄᓇᖓ ᐊᑐᕐᑕᐅᖑᐊᕐᑎᑕᐅᓪᓗᓂ ᐃᓱᒪᒋᔭᐅᓪᓗᓂ ᖃᐅᔨᓴᐅᑎᖃᓚᐅᕐᑐᑦ ᐃᒪᓐᓇ:

ᑎᒥᒧᑦ

ᑭᒃᓕᒋᔭᐅᔪᑦ ᐱᑕᖅᑲᓇᐊᖅᑲᕐᓂᖓ ᐅᖓᑕᓄᐊᓇᐊᖅᑲᖏᓐᓂᖓ ᑎᒥᒧᑦ ᑐᐊᐸᒃᒥᑦᑐᖅ ᐱᑕᖅᑲᓇᐊᖅᑲᕐᓂᖓᑕ ᑭᒃᓕᒐᔭᕐᑕᖓ ᐊᕿᒃᑕᐅᓯᒪᔪᖅ ᐅᑯᓂᖓ ᒪᓕᒃᓗᑎᒃ:

- ᓄᑕᕋᓚᖅ ᑕᕿᖅᑐᒥᑦ 6ᒥᑦ ᑎᑭᓪᓗᒍ ᑎᓴᒪᓂᒃ ᐊᕋᒍᖅᑐᒧᑦ ᓂᕆᓐᓂᕈᓂ ᐊᒻᒪᓗ ᐅᕕᓂᖓᓄᑦ ᐊᒃᑐᑎᓐᓂᕈᓂ ᓄᓇᐅᑦ ᖃᖓᓂᑦᑐᒥᒃ ᓴᕕᒃᓴᒥᒃ ᓱᕈᕐᓇᕐᑐᖃᕐᑐᒥᒃ.

- ᓄᑕᕋᓚᖅ ᑕᕿᖅᑐᖅ 6ᒥᒃ ᑎᑭᓪᓗᒍ ᑎᓴᒪᓂᒃ ᐊᕋᒍᖅᑐᒧᑦ ᓂᕆᓐᓂᕈᓂ ᓂᕿᓪᓚᑦᑕᕐᒥᒃ ᐊᖑᓇᓱᒃᑕᐅᔪᕕᓂᕐᓂᒃ. ᑖᓐᓇ ᐊᖑᓇᓱᒃᑕᐅᔪᕕᓂᖅ ᓂᕆᔪᕕᓂᐅᒍᓂ ᐊᒻᒪ/ᐅᑲᓗᓐᓂᑦ ᐃᒥᕐᓂᕈᓂ ᓴᕕᒃᓴᕈᔪᒃᒥᒃ ᓱᕈᕐᓇᕐᑐᖃᕐᑐᒥᒃ.

- ᑭᓇᑐᐃᓐᓇᖅ ᓇᓂᓯᕕᒃᒥ ᓄᓇᖃᕐᓗᓂ ᐃᓄᓂᕐᒥᓂᑦ 75ᓄᑦ ᑎᑭᓪᓗᒍ ᐊᒻᒪᓗ ᓱᕈᕐᓇᕐᑐᐃᑦ ᓇᔪᐃᓐᓇᕐᖑᐊᕐᓗᓂᒋᑦ.

ᐊᕙᑎᕐᑎᓐᓄᑦ

ᖃᐅᔨᓴᕐᑕᐅᔪᑦ ᑐᕋᖓᓂᕐᓴᐅᒍᓗᐊᕐᑎᓪᓗᒍ ᐊᕙᑎᕐᑎᓐᓄᑦ ᑭᓯᐊᓂ ᐅᒪᔪᐃᑦ ᐃᓱᒪᒋᔭᐅᖅᑯᓯᐅᔭᐅᓯᒪᔪᑦ ᐃᒥᑐᐃᓐᓇᓇᐊᖅᑲᕐᓂᖏᓐᓄᑦ ᓄᓇᖓᓂᑦ. ᐃᓱᒪᒋᔭᐅᔪᖅ ᐃᒥᕐᕕᐅᒐᔭᕐᒪᖓᑦ ᑕᓯᕐ ᑯᕕᕐᑕᕐᕕᐅᔪᖅ ᑯᖓᓗ.

ᓴ/ᒃᓴᒥᒃ ᑎᒥᖓᓄᐊᕐᕋᔭᕐᑐᖅ ᓂᕆᔭᐅᒍᓂ ᐃᒥᕐᒥᖓᕐᑐᖅ ᑐᐊᐸᒃᒥᖓᕐᑐᕐᓗ ᐊᒻᒪᑦᑕᐅᖅ ᓴᕕᒃᓴᖃᕐᓂᖏᑦ ᐱᕈᕐᑐᒥᖓᕐᑐᒥᑦ ᐅᒪᔪᖃᑎᖏᓐᓄᓪᓗ ᓂᕿᒋᔭᐅᒍᓂ. ᐃᓱᒪᒋᔭᐅᓗᐊᓚᐅᕐᑐᕐᓕ ᓂᕆᔭᐅᒍᓂ ᖃᓄᐃᔪᑕᐅᓚᐅᕐᒪᖓᑦ. ᓂᐅᕐᓯᑕᐅᓗᓂ ᐊᒻᒪᓗ ᐅᕕᓂᒃᒧᐊᕐᓂᖓ ᐃᒃᐱᒃᓴᐅᑎᓚᐅᕐᑎᓪᓗᒋᑦᑕᐅᖅ ᑭᓯᐊᓂ ᒥᑭᓐᓂᕐᓴᐅᒃᒪᑦ ᐊᕐᑕᕐᓇᕐᓂᖓᑕ ᓂᕆᔭᐅᔪᒥᑦ, ᖃᐅᔨᓴᕐᑕᐅᔪᑕᐅᖏᑦᑐᓕ. ᑐᐊᐸᒃᒥᖓᕐᑐᑦ ᓂᐱᖃᑦᑕᕐᑐᑦ ᒥᖅᑯᕐᒧᑦ, ᐊᒥᕐᒧᓪᓗ ᐃᓱᒪᒋᔭᐅᔪᖅ ᐊᓗᒃᑕᐅᓗᓂ ᓂᕆᔭᐅᖃᑦᑕᕋᔭᕐᒪᖓᑦ.

ᓂᕆᑐᐃᓐᓇᕆᐊᖃᕐᑐᑦ ᓴᕕᒃᓴᕈᔪᒃᒥᒃ ᐅᒪᔪᐃᑦ ᐅᑯᐊᖑᔪᑦ, ᑭᒐᕕᐊᕐᔪᐃᑦ, ᑎᕆᒐᓂᐊᑦ, ᐊᕿᒋᑦ, ᐊᕕᖓᐃᑦ. ᑖᒃᑯᐊ ᓂᕆᑐᐃᓐᓇᕆᐊᓕᑦ ᐅᒪᔪᐃᑦ ᐱᑕᖃᕐᓂᖏᓐᓄᑦ ᓇᓂᓯᕕᒃᒥ.

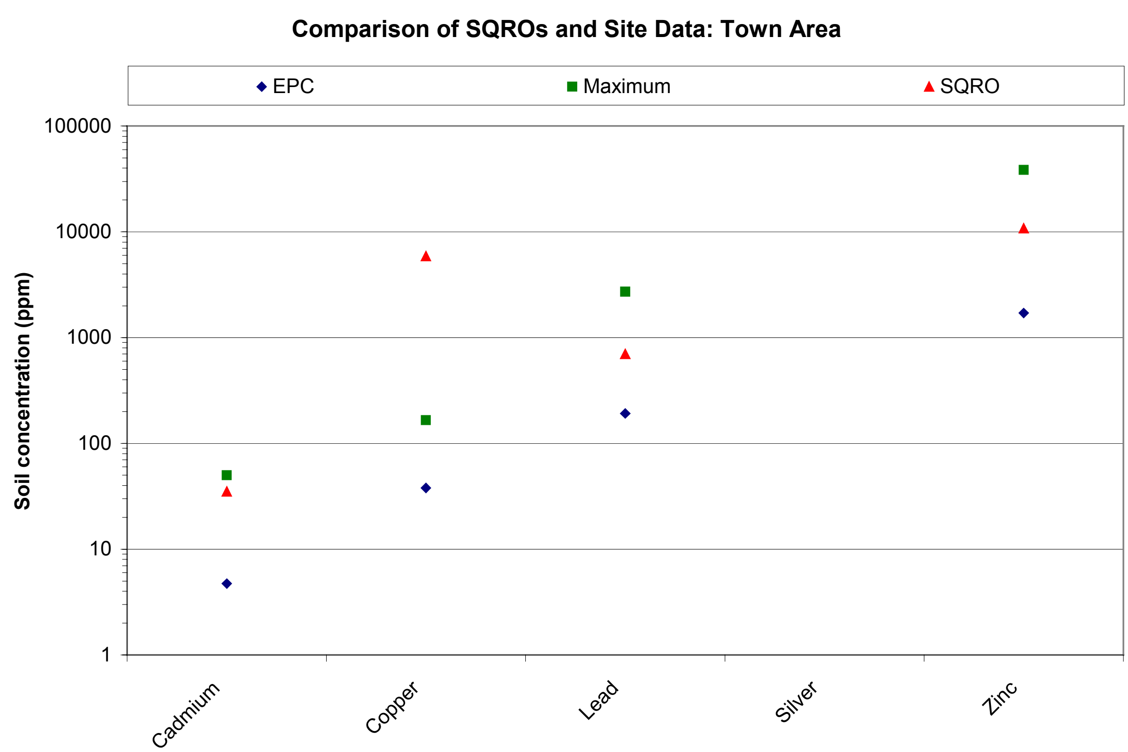
ᐊᑦᑕᕐᓇᕐᓂᖓᑕ ᓇᓗᓇᐃᒃᑯᑕᖏᑦ

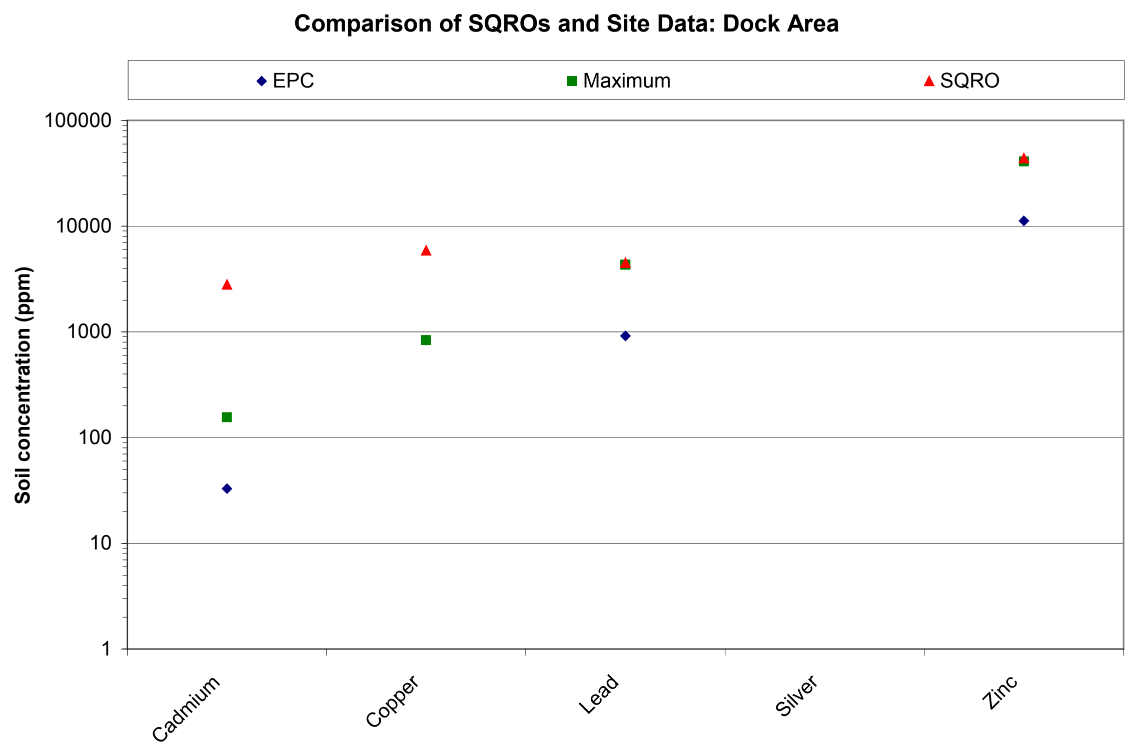
ᖁᓚᓂ ᐅᖅᓯᒪᔪᑦ ᐃᓱᒪᒋᔭᐅᓪᓗᑎᒃ ᖃᐅᔨᓴᐅᑕᐅᓚᐅᕐᑐᑦ ᖃᓄᕐ ᑎᒥᑦᑎᓐᓄᑦ ᐊᒻᒪᓗ ᐊᕙᑎᑦᑎᓐᓄᑦ ᐃᒃᐱᒃᓇᐅᑎᒐᔭᕐᒪᖓᑦ ᐊᑦᑕᕐᓇᕐᑎᒋᔭᕐᒪᖓᓪᓗ ᐃᒪᐃᓕᖓᔪᒥᒃ ᓇᓗᓇᐃᕐᓯᔪᑦ:

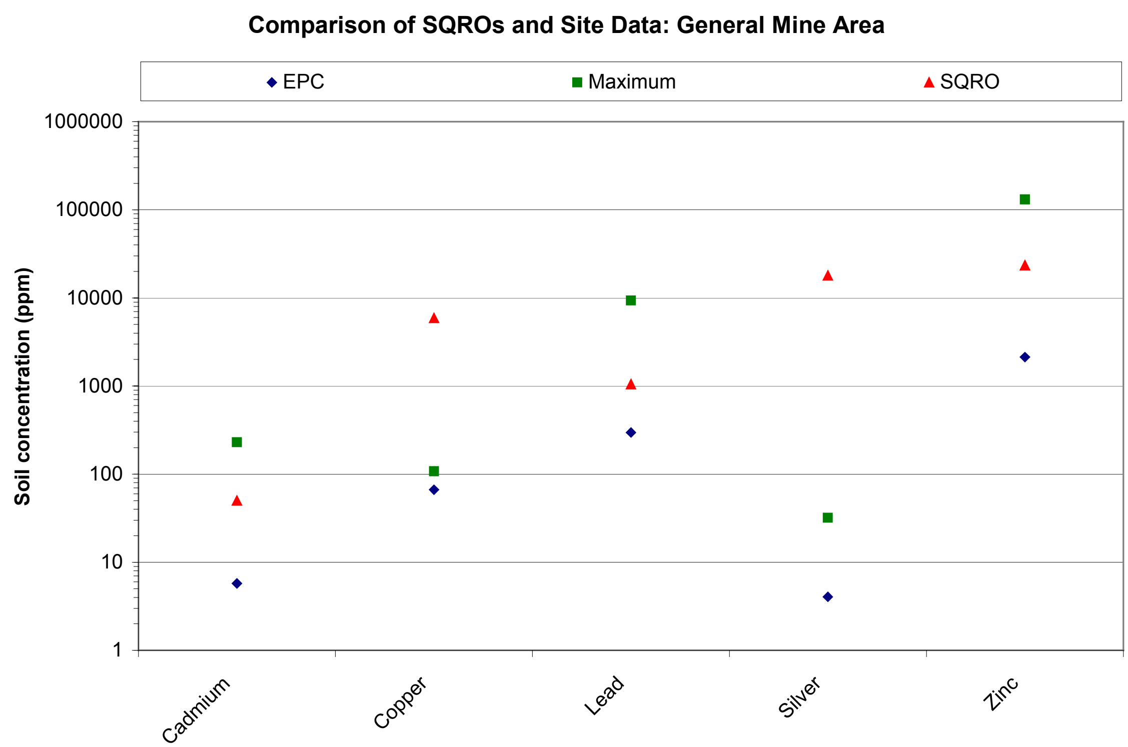
- ᓄᓇᐅᑉ ᖃᖓ ᑐᐊᐸᖓ ᓴᕕᒃᓴᐅᓂᖓ ᓴᕕᒃᓴᖃᕐᓂᖓᓗ ᐃᓱᒪᒋᔭᐅᔪᖅ ᐃᒃᐱᒃᓇᐅᑎᓗᐊᔨᐊᖏᓐᓂᖓᓂᒃ ᐊᕙᑎᑦᑎᓐᓄᑦ ᐊᒻᒪᓗ ᐱᔭᐅᒐᔭᕐᓂᖏᑦ ᐃᓱᒪᒋᔭᐅᓪᓗᑎᒃ.

- ᓄᓇᐅᑉ ᖃᖓ ᑐᐊᐸᖓ ᓴᕕᒃᓴᖃᕐᓂᖓ ᓴᕕᕋᔭᒃᓴᖃᕐᓂᖓ ᐃᓱᒪᒋᔭᐅᔪᖅ ᑎᒥᑦᑎᓐᓄᑦ ᐃᒃᐱᒃᓇᐅᑎᓗᐊᔨᐊᖏᓐᓂᖓᓂᒃ.

ᓄᓇᐅᑦ ᖃᖓᓂ ᑐᐊᐸᒃ ᓴᓗᒪᕐᑕᐅᔭᕆᐊᖃᕐᓂᖓ ᐊᕿᒃᑕᐅᓚᐅᕐᒥᔪᖅ ᐊᑐᓂ ᓴᕕᕋᔭᐅᓂᖏᑦ ᒪᓕᒃᑕᐅᓪᓗᑎᒃ ᑎᒥᑦᑎᓐᓄᑦ ᐊᒻᒪᓗ ᐊᕙᑎᑦᑎᓐᓄᑦ ᖃᓄᑎᒌᕐᓗᑎᒃ ᐃᒃᐱᒃᓇᐅᑎᒐᔭᕐᒪᖔᑕ. ᖃᓄᐃᑕᐅᔪᑎᒃᓴᖏᑦ ᐃᓱᒪᒋᔭᐅᓪᓗᓂ. ᖃᓄᐃᓕᖓᓂᖏᑦ ᓇᐃᒃᓕᒋᐊᕐᔨᒪᓪᓗᑎᒃ ᓇᓗᓇᐃᕐᔨᒪᔪᑦ ᑎᑎᕋᐅᔭᕐᔨᒪᔪᒥ ᐊᑕᓂᑦᑐᒥ ᓄᓇᓕᖓᓄᑦ, ᑐᓚᒃᑕᕐᕕᒃᑯᑦ ᐊᒻᒪᓗ ᐅᔭᕋᒃᑕᕐᕕᐅᕙᑦᑕᕐᔨᒪᔪᑦ.




Comparison of SQROs and Site Data: Dock Area
EPC
Maximum
SQRO
100000
10000
1000
100
10
1
Soil concentration (ppm)
Cadmium
Copper
Lead
Silver
Zinc


Comparison of SQROs and Site Data: General Mine Area
EPC
Maximum
SQRO
1000000
100000
10000
1000
100
10
1
Soil concentration (ppm)
Cadmium
Copper
Lead
Silver
Zinc

ᐊᖏᓚᒥᒃ ᐱᑕᖃᕆᐊᖃᕐᓂᖓ ᓱᕋᕐᓇᕐᑐᖅ, ᑲᔪᖅ ᓴᕕᕋᔭᒃ ᐊᒻᒪᓗ ᕿᓪᓕᕐᑕᖅ ᓴᕕᕋᔭᒃᓴᖅ ᑐᐊᐸᒃᒥᓐᓂᖓ ᐊᖏᓂᖓ ᒥᑭᓐᓂᕐᓴᐅᓚᐅᕐᑐᖅ ᑐᐊᐸᑦᑎᐊᕚᐅᓂᕐᓯᒪᔪᑦ, ᑐᑭᓯᓇᕐᓯᓪᓗᓂ ᓴᓗᒪᕐᓴᕐᑕᐅᖏᒃᑲᓗᐊᕐᓗᑎᒃ ᑕᒃᑯᐊ ᓴᕕᒃᓴᐃᑦ ᐱᑕᖃᖏᓗᐊᕐᓂᖏᓐᓄᑦ.

ᓴᕕᒃᓴᖅ ᕿᕐᓂᕐᑕᖅ ᑐᐊᐸᖓ ᐱᑕᖃᕐᓂᖓ ᓄᓇᓕᖓᓂ ᐊᒻᒪᓗ ᐅᔭᕋᒃᑕᕝᕕᐅᖃᕐᑕᕐᓯᒪᔪᓂ ᐊᖏᓂᕐᓴᐅᔪᖅ ᐱᑕᖃᕆᐊᖃᕐᓂᖓᑕ ᑭᒃᓕᖓᓂᑦ, ᓇᓗᓇᐃᕐᓯᓪᓗᓂ ᑕᒪᕐᒥᐊᓗᒃ ᓴᕕᒃᓴᖃᕐᑐᐃᓐᓇᐅᖏᑦᑐᖅ ᑭᓯᐊᓂᓕ ᐊᖏᓇᕐᑎᖅᓯᒪᓂᖏᑦ ᑲᒥᔭᐅᔭᕆᐊᓕᑦ. ᑐᓕᒃᑕᕝᕕᒃ ᓴᓗᒪᕐᓴᕐᑕᐅᔭᕆᐊᖃᖏᑦᑐᖅ.

6.11.2 Executive Summary

Jacques Whitford Environment Limited (JWEL) has performed a human health and ecological risk assessment (HHERA) of the Nanisivik Mine site on Baffin Island, Nunavut. The primary objective of this study was to evaluate whether known concentrations of elements in surface soil at the site would present a significant risk to human or ecological health based on future use of the property after mine closing. Despite protracted discussions and numerous exchanges of proposals and ideas, future site re-development plans have not been finalized and the risk assessment considers three alternate scenarios for future land use: commercial, residential, and recreational/hunting.

Study background

Nanisivik Mine was an underground zinc-lead mine that was owned and operated by CanZinco Ltd. (CanZinco), a division of Breakwater Resources Ltd. The mine is located on the Borden Peninsula on northern Baffin Island in the Canadian Arctic at 73° 02' N, 84° 31' W. The mine site is located on the south shore of Strathcona Sound approximately 30 km from Admiralty Inlet. The nearest community is Arctic Bay, located approximately 25 km west of Nanisivik and linked by a 33 km all-weather road. The airport is located approximately 9 km south of Nanisivik and accommodates commercial flights to and from Ottawa, Iqaluit and Resolute, as well as charter and other unscheduled aircraft. Mining and milling at the site has been ongoing since 1976. Due to depleted levels of economically recoverable reserves, the mine stopped producing zinc and lead concentrates in September 2002.

This report was prepared in partial fulfillment of the requirements of the Site Closure and Reclamation Plan, which was developed in accordance with the "Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories" (NWTWB 1990). This HHERA was based on accepted risk assessment standards including those published by Health Canada, the Canadian Council of Ministers of the Environment (CCME), and the United States Environmental Protection Agency (US EPA).

Data Compilation

The soil data selected for use in the risk assessment were compiled from three sources: a Phase II Environmental Site Assessment conducted by Gartner Lee Limited (GLL), on behalf of CanZinco in July 2002; a surface soil sampling program conducted by EBA Engineering Consultants Ltd. (EBA), on behalf of the Government of Nunavut in June 2002; and an extensive survey of metal (copper, lead, and zinc) concentrations in surficial soils throughout the mine area conducted by Nanisivik Mine Limited (Nanisivik) as part of their mineral exploration activities in 1985.

Statistical analyses were run on both the current and background (1985) data sets to determine 95% upper confidence limits (UCLs) for each element in each study area. The primary purpose of these analyses was to determine representative exposure point concentrations (EPCs) for each area and background soil concentrations (BSCs), for deriving potential risks associated with the identified soil concentrations. The EPC is considered to be a reasonable estimate of area-wide exposure of receptors to metals in surface soil.

Screening of Potential Chemicals of Concern

Elements included for consideration were all elements identified in the review of the GLL and EBA data at concentrations exceeding the generic CCME soil quality guidelines (CCME 1999). Generic CCME guidelines may be based on either ecological or human health protection and provide a protective initial screening of the site data. For the human health risk assessment, these elements were screened specifically against human health based generic guidelines and for the ecological risk assessment, they were screened specifically against ecologically based generic guidelines. In order of preference, these guidelines are taken from CCME (CCME 1999), Ontario Ministry of the Environment (OMOE 1996a), or the United States Environmental Protection Agency (US EPA).

Based on this screening, the elements carried forward to the quantitative risk assessments were the metals cadmium, copper, lead, silver, and zinc. Silver (general mine area only) and copper were only carried forward for the ecological risk assessment because maximum soil concentrations for these metals were less than human health based generic guidelines.

Exposure Scenarios

The area of interest for the risk assessment was governed by the Nanisivik inferred lease and claim boundaries, which largely coincide with topographical features and the shoreline of Strathcona Sound to the north. This area (approximately 4,500 ha) was subdivided into three smaller study areas based on probable future land use. This was done to allow for separate receptor, exposure, and land use scenarios. The area encompassing the town of Nanisivik covered approximately 29 ha and was referred to as the 'town area'. The area encompassing the dock covered approximately 24 ha and was referred to as the 'dock area'. The remaining land (not including the town area and dock area) covered an area of approximately 4400 ha and was referred to as the 'general mine area'. Separate EPCs and exposure estimates were calculated for each area independently.

Local consultation was conducted in Nanisivik and Arctic Bay to accurately depic the traditional, current and expected future use of the lands. For the purposes of this risk assessment the town area was assumed to continue as residential land use, the dock area as commercial/light industrial land use, and the general mine area as recreational/hunting land use. Based on these land uses, the following conceptual models were developed:

Human Health

The conceptual model that forms the basis for the derivation of the human health soil quality site-specific threshold limits is as follows:

- A toddler aged six months to four years ingests and comes into dermal contact with surface soil contaminated with cadmium, lead, and zinc;
- A toddler aged six months to four years ingests drinking water from the Nanisivik town water supply;
- A toddler aged six months to four years ingests wild game from hunting in the area. The wild game may have ingested or come into contact with surface soil and/or water contaminated with cadmium, lead, and zinc; and
- A person lives in Nanisivik from birth to 70 years of age and is exposed to cadmium by inhalation of soil-derived dust throughout their lifetime.

Ecological Health

Although risks of exposure to contaminated soils are the focus of this ERA, wildlife on the site may also take in metals when they drink surface water from the site. The main sources of drinking water to wildlife were assumed to include the Twin Lakes, Twin Creek and Chris Creek.

The potential exposure media for intake of metals include direct ingestion of surface water and soils, as well as metal uptake from eating plant material and animal (bird/mammal) prey at the mine site. The major exposure pathway considered was ingestion. Inhalation and dermal absorption are also possible exposure pathways, but these are considered to be relatively minor by comparison to ingestion, and are not included as direct pathways in this ERA. Soil that adheres to fur or feathers is, for the most part, ingested by preening/licking activity and is included in the estimate of direct soil ingestion.

The selected receptors in the model are Gyrfalcon, Arctic fox, Ptarmigan and lemming. These receptors are considered to be representative of indigenous wildlife for Nanisivik.

Risk Characterization

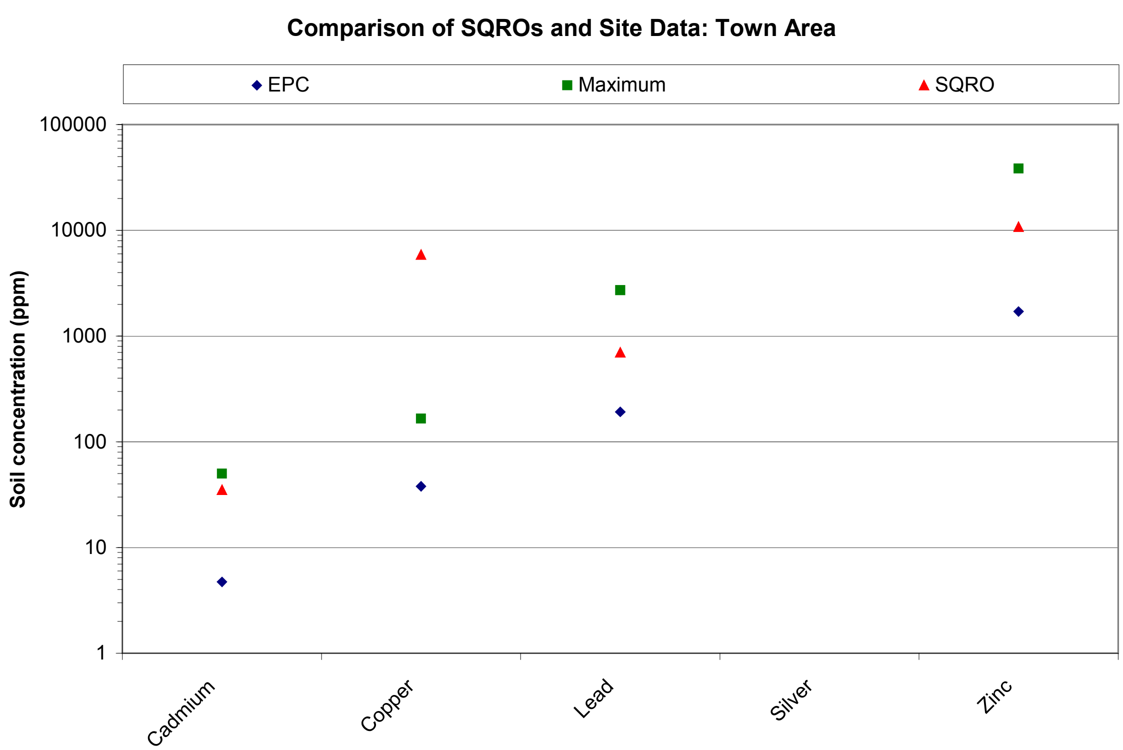
The above noted exposure scenarios were evaluated to identify the potential for adverse effects to human or ecological receptors, with the following outcomes:

- Surface soil EPCs of the identified elements are not anticipated to produce any adverse effects in the ecological receptors and exposure scenarios included in this risk assessment; and
- Surface soil EPCs of the identified elements are not anticipated to produce any adverse effects in the human receptors and exposure scenarios included in this risk assessment.

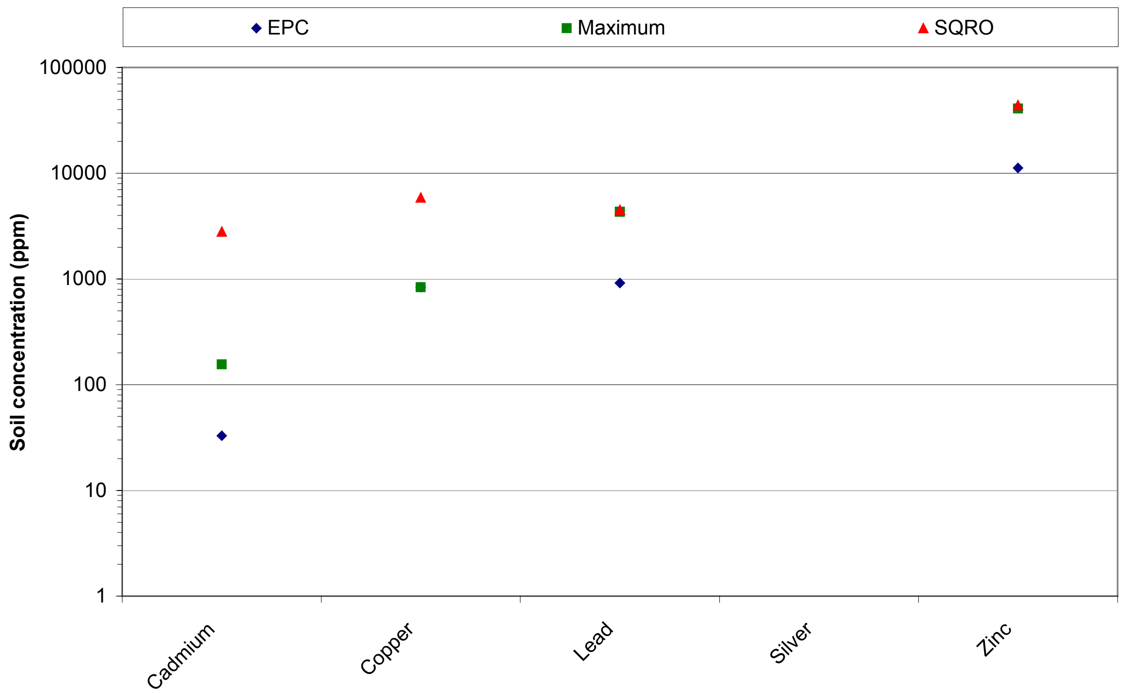
Soil Quality Remedial Objectives (SQROs) were then developed for each metal in each exposure area as the lowest of the ecological or human health site-specific threshold limits developed in this risk assessment. The SQROs were compared to current site conditions (EPCs, BSCs, and maximum concentrations). Results are summarized in graphs below for the town area, the dock area, and the general mine area.

Cadmium, lead and zinc EPCs in the town area and general mine area are less than their SQROs, indicating that there is no unacceptable area-wide impact. However, a limited number of sample concentrations exceeded the SQROs, indicating that isolated "hot spots" may require risk management. JWEL's consultations with CanZinco indicate that isolated "hot spots" that are not natural mineralized areas will be targeted for remediation

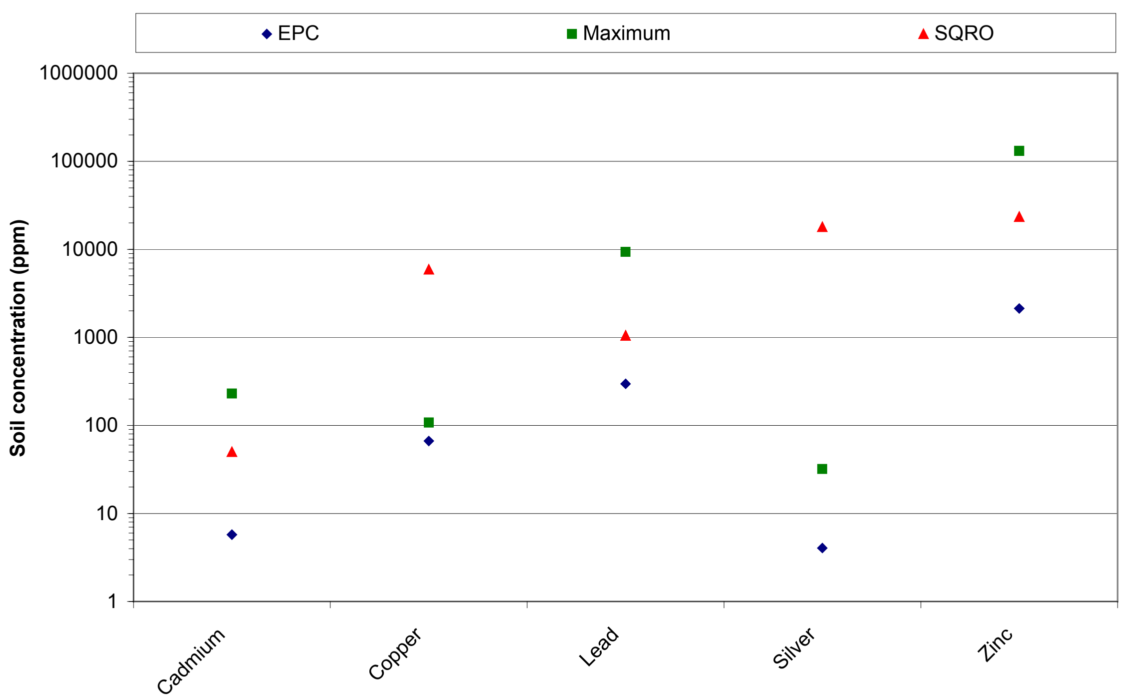
Maximum copper and silver surface soil concentrations were less than their SQROs, indicating that no.



Comparison of SQROs and Site Data: Dock Area



Comparison of SQROs and Site Data: General Mine Area



In the dock area, the EPCs for Cd, Pb and Zn for the dock area are less than their SQROs. Therefore, no remedial action is required for this area. However, it should be noted that CanZinco has publicly committed to remediation in the dock area.

6.12 G.15, ᑯᕕᖅᑕᖅᕕᒃ ᓴᓗᒻᒪᖅᓴᖅᑕᐅᓂᖓ ᒪᑐᔪᐅᓂᖓᓄ ᐸᕐᓇᐅᑎ, West Twin Disposal Area Closure Plan

The report, *West Twin Disposal Area Closure Plan* (the "WTDA Closure Plan"), provides the report requested under Part G, Item 15 of the Water Licence. The WTDA Closure Plan was prepared by BGC Engineering, in conjunction with Gartner Lee and Golder Associates, and is provided in its entirety as Appendix J and the Executive Summary is provided below for ease of reference.

6.12.1 ᓇᐃᒃᑕᕆᐊᖅᓯᒪᔪᑦ ᐅᖃᐅᓯᒃᓴᐃᑦ

ᐃᒥᖅᒧᑦ ᐱᕙᓐᓇᐅᑎᖓᓂ ᑐᓂᔭᐅᓯᒪᕗᖅ ᐃᒥᓕᕆᓂᖅᒧᑦ ᑲᑎᒪᔨᖏᓐᓄᑦ, ᑕᒃᑯᐊ ᑲᓐᓰᓐᑯ-ᑯᑦ ᐱᖁᑎᖃᖅᑎᐅᕗᑦ ᓇᓂᓯᕕᒃᒥᒃ, ᑲᒪᒋᔭᖃᖅᒪᑕ ᐱᔭᒃᓴᖃᖅᓗᑎᒃᓗ ᐊᕙᑎᖓᓂᒃ ᓴᓗᒻᒪᖅᓴᐃᓂᖅᒥᒃ ᐊᒻᒪᓗ ᐊᖅᑭᒃᓯᔭᕆᐊᖃᖅᓗᑎᒃ ᑐᓂᓯᓗᑎᒃᓗ ᐸᕐᓇᐅᑎᓂᒃ ᓴᓗᒻᒪᖅᓴᐃᓂᖅᒧᑦ ᒪᑐᔪᐅᓂᖓᓄᓪᓗ.

ᓇᓂᓯᕕᒃᒥ ᓴᓗᒻᒪᖅᓴᐃᓂᖅᒧᑦ ᐸᕐᓇᐅᑎᒥᒃ ᐱᔭᕆᖅᓯᓯᒪᓕᖅᒪᑕ ᐱᔭᕆᐊᖅᑎᑕᐅᓂᖏᑦ ᒪᓕᒃᓗᒋᑦ ᐱᕙᓐᓇᐅᑎᖏᓂ, ᐊᒻᒪᓗ ᑕᒃᑯᐊ ᐊᑐᓂ ᐊᑐᖅᑕᐅᕙᒪᔪᑦ ᓴᓗᒻᒪᖅᓴᐃᓂᐅᕙᓪᓗ ᐅᓂᒃᑳᖅᑕᐅᓯᒪᓪᓗᑎᒃ ᐸᕐᓇᐅᑕᐅᓯᒪᓕᓪᓗᑎᒃ ᐊᑐᓂᓗ ᐅᖃᓕᒪᖅᑕᐅᕙᓐᓇᖅᑐᑦ. ᑕᓐᓇ ᑎᑎᕋᖅᓯᒪᕗᖅ ᓴᖅᑭᑎᑕᐅᓯᒪᕗᑦ ᐱᔭᕆᐊᖃᕐᓂᖓ ᒪᓕᒃᓗᒍ ᐱᕙᓐᓇᐅᑎᖓᖓᓂ ᑯᕕᖅᑕᖅᕕᐅᑦ ᓴᓗᒻᒪᖅᓴᖅᑕᐅᓂᖓᓄᑦ ᒪᑐᔪᐅᓂᖓᓄᓪᓗ ᐸᕐᓇᐅᑎᑦ.

ᒪᓕᒃᓗᒍ ᐱᔭᕆᐊᖃᕐᓂᖓ ᐃᒥᖅᒧᑦ ᐱᕙᓐᓇᐅᑎᖓᓂ, ᑕᓐᓇ ᑎᑎᕋᖅᑕᐅᕗᖅ ᐅᑯᓂᖓ ᐃᓗᓕᖃᖅᐳᖅ:}

1. ᐅᓂᒃᑳᖅᑕᐅᓪᓗᓂ ᖃᓄᖅ ᐊᐅᓚᓂᖅᑳᖅᓂᑯᒃᒪᖔᑦ ᖃᓄᖅᓗ ᐃᒥᖅ ᐊᐅᓚᓂᖅᑲᖅᒪᖔᑦ ᐊᒻᒪᓗ ᖃᓄᖅ ᑐᖅᑕᐅᖃᑦᑕᓚᐅᖅᒪᖔᑦ ᑯᕕᖅᑕᖅᕕᒃ.
2. ᕗᑕᖑᔪᑦ ᐃᒪᖅᑯᑐᓂᖔᓂᒃ ᓇᓄᓇᐃᖅᓯᒪᔪᑦ
3. ᖃᐅᔨᓴᖅᑕᐅᓯᒪᔪᑦ ᐃᓗᓕᖏᑦ ᑭᓱᒻᒪᖔᑕ ᑯᕕᔭᐅᖃᑦᑕᖅᓯᒪᔪᑦ (ᓴᕕᒃᓴᖅᓂᖓ, ᖃᓄᑎᒋᖅᓂᖔᓗ) ᐊᒻᒪᓗ ᓂᒃᓇᒍᒃᓂᖔᓂᒃ ᖃᐅᔨᓴᖅᓯᒪᔪᖅ ᐊᕙᓗᖔᓂᒃ ᑐᐊᐸᒃᒥᑦᑐᖅ ᐃᒪᖅᑲᖅᕕᐅᔪᒥᓗ
4. ᖃᓇᓂᐊᖅᑕᖓ ᐊᒻᒪᓗ ᖃᓄᐃᓕᖓᓂᓇᓂᐊᖅᑕᖓ ᓴᓇᔪᐅᓗᓂ ᐸᕐᓇᐅᑎᒥᑦᑐᑦ ᒪᓕᒃᓗᒋᑦ, ᖃᓄᐃᓕᓂᐊᖅᓱᒋᔪᐅᓂᖓᓗ, ᐃᒥᐅᓪᓗ ᐱᐅᓂᖓ ᖃᐅᔨᓴᖅᑕᐅᓯᒪᓂᖓ.
5. ᖃᓄᐃᓕᑲᓚᒃᑐᕕᓂᐅᒃᐸᑦ ᐸᕐᓇᐅᑎᖓ ᓂᕆᐅᓇᖏᑦᑐᒃᑯᑦ ᖃᓄᐃᓕᑲᓚᒃᑐᕕᓂᐅᒃᐸᑦ ᐸᕐᓇᐅᑎᖃᖅᓯᒪᓗᑎᒃ ᖃᐅᔨᓴᖅᑕᐅᑎᓪᓗᒍ ᖃᓄᐃᑕᐅᒐᔭᖅᒪᖔᑦ. ᐸᕐᓇᐅᑎᓪᓗ ᐅᖃᖅᓯᒪᔪᓇᐊᓕᑦ ᖃᓄᖅ ᑕᐃᒪᐃᓕᒐᔭᖅᒪᖔᑦ.
6. ᖃᐅᔨᓴᐃᓐᓇᖅᓂᖅᒧᑦ ᐸᕐᓇᐅᑎᖃᖅᓗᑎᒃ ᐱᖃᓯᐅᑎᓗᒍ: ᖁᐊᖑᓂᖓᓂᒃ ᖃᐅᔨᓴᖅᓂᖅ, ᖃᓄᐃᓕᕈᓪᓕᐊᓂᖓ ᖃᐅᔨᓴᖅᑕᐅᓗᓂ ᑐᐊᐸᒃ ᖃᓇᔭᖓ ᐊᒻᒪᓗ ᐃᒥᐅᑦ ᐱᐅᓂᖓ; ᐊᒻᒪᓗ
7. ᑎᑎᕋᖅᓯᒪᔪᑦ ᐸᕐᓇᐅᑎᑦ ᖃᓄᐃᑦᑐᓂᒃ ᐊᑐᖅᓂᐊᖅᒪᖔᑕ, ᖃᐅᔨᓴᐅᑕᐅᓂᐊᖅᑐᓪᓗ ᐊᒻᒪᓗ

ᑎᑎᕋᐅᔭᕐᓯᒪᔪᑦ ᓇᕿᑕᐅᓯᒪᓗᑎᒃ ᐃᓕᓴᕆᔭᐅᓯᒪᔪᒧᑦ ᖃᐅᔨᓴᕐᑎᒧᑦ.

ᐊᒻᒪᑦᑕᐅᖅ, ᐱᔭᕆᐊᖃᕐᑐᑦ ᐱᔪᓐᓇᐅᑎᒥ (ᖃᖓᓂᒃ ᖃᓄᐃᑦᑐᓂᖓᓂᒃ ᐅᓂᑲᕐᓯᒪᔪᖅ) ᐃᒪᖃᐃᓐᓇᕐᑐᖅ ᑯᕕᕐᑕᕐᕕᒃ ᐃᒪᖄᕐᕕᖓᓂ ᐸᕐᓇᐅᑎᒥᑦᑐᑦ ᒪᓕᒃᑕᐅᒍᓗᐊᕐᒪᖔᑕ. ᒪᕈᒃ ᐱᕐᑯᔭᐅᓯᒪᔫᒃ ᐅᑯᐊᖑᔫᒃ:

6. ᐅᕐᕐᑯᓂᖓᓂᒃ ᖃᐅᔨᓴᕐᓂᖅ ᐃᒪᓂᑦᑐᑦ ᑯᕕᔭᐅᓯᒪᔪᑦ ᐃᒪᖃᕐᕕᖓᓂᑦᑐᖅ ᐃᒪᓂᑦᑐᖅ 1.0 ᓂᑕᒥᒃ ᐊᑕᓂ ᐃᒥᐅᑦ ᐊᒻᒪᓗ ᖃᓄᕐ ᐸᕐᓇᐅᑎᕆᔭᐅᒃᒪᖓᑦ ᒪᓕᒃᒧᑦ ᓄᖑᐸᓪᓕᐊᔪᑕᐅᓂᐊᕐᑐᖅ ᐊᒻᒪᓗ
9. ᖃᐅᔨᓴᕐᑕᐅᓗᓂ ᐃᒪᑭᒃᓕᕆᐊᕐᑕᐅᓂᖓ ᐃᒪᖃᕐᕕᐅᔪᒥ ᐃᔪᑎᖃᕐᓗᓂ ᒪᓕᒃᒧᑦ ᐊᒻᒪᓗ ᓯᑯᒧᑦ ᖃᓄᐃᔪᑕᐅᓂᐊᕐᒪᖔᑦ.

ᑎᑎᕋᕐᓯᒪᔪᖅ ᑕᓐᓇ ᓇᓗᓇᐃᕐᓯᕆᐊᕐᓯᒪᔪᖅ ᓴᓗᒻᒪᕐᓴᐃᓂᐅᔪᒥᒃ ᑯᕕᕐᑕᕐᕕᒃ ᒪᑐᔭᐅᓂᖓᓄᑦ. ᐅᑯᐊ ᑎᑎᕋᕐᓯᒪᔪᑦ ᓇᐃᒃᓕᕆᐊᕐᓯᒪᔪᑦ ᐃᓗᓕᖕᖏᓐᓂᑦᑐᓂᑦ.

- ᖃᖓᓄᑦ ᑯᕕᔭᐅᖃᑦᑕᕐᓯᒪᔪᖅ ᐊᒻᒪᓗ ᖃᐅᔨᓴᕐᕕᒃᒥ ᖃᕆᓂᐊᕐᑕᖓ ᖃᓄᐃᓕᖓᓂᖓ
- ᐊᐅᒪᐃᓐᓇᕐᓂᖓ - ᐊᐅᓚᐃᓐᓇᕐᓂᖓ ᐅᓂᑲᓕᐊᖑᓯᒪᔪᖅ
- ᐊᑐᕐᑕᐅᓂᐊᕐᑐᑦ ᑐᐊᐸᐃᑦ ᖃᓄᐃᑦᑐᒃᒪᖓᑕ - ᓴᐅᓯᔪᑕᐅᓂᐊᕐᑐᖅ
- ᑯᓕᐅᕐᑕᐅᔪᖅ - ᓴᓇᓯᒪᓂᖓ ᖃᓄᐃᓕᖓᒃᒪᖓᑦ
- ᓯᒃᔭᖓ ᐃᒪᖃᕐᕕᐅᔪᑦ ᓴᓇᔭᐅᓂᖓ
- ᖃᑦᑎᒃᓯᓕᕐᓯᒪᔪᑦ ᐊᔭᓗᐊ ᑐᐊᐸᒃ ᐅᓂᑲᖓ
- ᓴᓇᔭᐅᓂᖓ ᑯᕕᕐᑕᕐᕕᐅᓂᖓ ᑯᒃᐸᓪᓕᐊᓂᖓᓗ ᐊᒻᒪᓗ
- ᓄᖑᑉᐸᓪᓕᐊᔭᐃᒃᑯᑎᒃᓴᖅ ᓴᓇᓯᒪᓂᖓ ᑐᐊᐸᖓᑕ.

ᐅᖃᖃᐅᓚᑦᑕ, ᑕᓐᓇ ᑎᑎᕋᕐᓯᒪᔪᖅ ᐅᓂᑲᕐᓯᒪᔪᖅ ᓇᒪᔪᓂᒃ ᐃᓗᓕᖃᐅᕈᓗᔭᕐᑐᓂᒃ.

ᑯᕕᕐᑕᕐᕕᒃ ᓴᓗᒻᒪᕐᓴᕐᑕᐅᓂᖓ ᐅᑯᐊᖑᓂᐊᕐᑐᑦ ᖁᑦᑎᒃᓂᕐᓴᒥᑦᑐᖅ ᑯᕕᕐᑕᕐᕕᒃ ᖃᒻᒪᓗ ᖃᑦᑎᒃᓂᕐᓴᒥᑦᑐᖅ ᑯᕕᕐᑕᕐᕕᒃ. ᖃᑦᑎᒃᓯᓕᕐᓯᒪᔪᑦ ᐊᕙᓗᐊ ᑐᐊᐸᒃ, ᐊᕕᒃᓯᓚᔪᑕᐅᔪᖅ ᑕᓯᕐᒧᑦ ᐃᓚᖓ ᐃᒪᖃᕐᕕᐅᓪᓗᓂ ᐃᓚᖓ ᑯᕕᕐᑕᕐᕕᐅᓪᓗᓂ, ᖃᐅᔨᓴᕐᕕᒃᑕᖃᕐᓗᓂᓗ, ᑕᓐᓇᓗ ᖃᐅᔨᓴᕐᕕᐅᔪᕐ ᐊᑐᕐᑕᐅᖃᑦᑕᕐᓯᒪᔪᖅ ᖃᐅᔨᓴᕐᕕᐅᓪᓗᓂ ᖃᕆᔭᖓ ᖃᓄᐃᓕᕙᓪᓕᐊᓂᐊᕐᒪᖔᑦ. ᑕᒪᕐᒥᒃ ᖃᑦᑎᒃᓯᓕᕐᓯᒪᔫᒃ ᓴᓇᓯᒪᔫᒃ ᕿᕐᓂᕐᑕᒥᒃ ᑐᐊᐸᒃᒥᑦ ᖁᐊᖑᐃᓐᓇᕐᓗᑎᒃᓗ. ᑕᓐᓇ ᐳᕐᑐᓂᖓ ᖃᑦᑎᒃᓯᓕᕐᓯᒪᔪᑦ 388 ᒥᑕ. ᖃᐅᔨᓴᕐᕕᐅᔪᖅ ᒪᕈᐃᕐᔪᕐᓗᓂ ᐳᕐᑐᓯᕆᐊᕐᓯᒪᔪᖅ, ᓯᕗᓕᕐᒥᒃ ᐳᕐᑐᓯᑎᑕᐅᓪᓗᓂ 383.5 ᒥᑕᒥᒃ ᑭᖑᓕᕐᒥᒃ ᐳᕐᑐᓯᑎᑕᐅᓪᓗᓂ 385.5. ᓴᓇᔭᐅᒃᒪᑦ ᖃᑦᑎᒃᑐᖅ ᓯᕙᖓᓂᖃᓕᓚᐅᕐᑐᖅ ᐃᒪᖃᕐᕕᐅᔪᑦ ᓴᓚᒍᑦ

ᐃᒪᕐᕐᑯᑐᓗᐊᓕᕋᖓ ᑯᕕᕐᑕᕐᕕᒃ ᑯᕕᑎᑕᐅᖃᑦᑕᕐᑐᑦ ᐃᒪᖃᕐᕕᒃᒧᑦ ᒥᓪᓗᐊᕐᑎᑕᐅᓪᓗᓂ ᐃᒪᕐᕐᑯᕐᑐᓂᖓᓂᒃ ᐊᐅᓚᑦᑎᔪᑕᐅᔪᖅ. ᐃᒪᖃᕐᕕᐅᔪᖅ ᖃᐅᔨᓴᕐᕕᐅᔪᕐᓗ ᑕᓯᕐ ᐊᕕᒃᓯᒪᔫᒃ ᖃᑦᑎᒃᓯᓕᕐᓯᒪᔪᒧᑦ ᑐᐊᐸᒃᒧᑦ ᐊᑯᓐᓂᖓᒍᑦ ᐊᒻᒪᓗ ᒪᑐᑦᑕᕐᑐᒥᒃ ᑯᕕᔭᐃᒃᑯᑎᖃᕐᓗᓂ. ᑕᕙᖓ ᐊᓪᓕᕐᐸᖓᓐᓂᑦ ᑕᓯᓕᐊᕆᓯᒪᔪᒥᑦ ᑯᒃᑎᑕᐅᖃᑦᑕᕐᑐᖅ ᑯᖓᓄᑦ ᐊᕐᑯᓴᕐᓗᓂ ᑕᓯᓕᐊᕆᓯᒪᔫᒃᑲᓐᓂᕐᒧᑦ ᑯᒃᒧᐊᓚᐅᖏᓐᓂᖓᓂ ᐳᕐᑐᓂᖃᕐᑐᒥᒃ 3ᒥᑕ-ᒥᑦ 5-ᒥᑕ-ᒧᑦ ᖃᑦᑎᒃᓯᓕᕐᓯᒪᔪᒥᒃ ᕿᑎᐊᒍᑦ ᐃᓕᕆᓯᒪᓪᓗᓂ. ᑕᑕᓗᐊᓕᕋᖓᑦ ᐃᒪᖓ ᑯᕕᑎᑕᐅᖃᑦᑕᕐᑐᖅ ᑕᒃᑯᐊ ᑕᓯᓕᐊᕆᓯᒪᔪᑦ ᐊᑐᕐᑕᐅᓪᓗᑎᒃ ᑯᕕᑎᑕᐅᖃᑦᑕᕐᑐᑦ ᑯᒃᒧᑦ ᔪᓚᐃ-ᒥᑦ ᓯᑎᐱᕆᒧᑦ ᐊᑯᓐᓂᖓᓂ.

ᐊᑦᑕᕐᓇᕐᓂᖅᓚᓂ ᑯᕕᕐᑕᕐᕕᐅᑦ ᐱᓗᐊᕐᑐᒥᒃ ᐅᔭᕋᑐᐃᓐᓇᐃᑦ ᒪᖕᒋᕐᑯᓇᕙᓐᓇᕐᑐᑦ ᐊᒻᒪᓗ ᑯᕕᕐᓗᑯ ᑕᒪᐅᖓᑐᐃᓐᓇᕐ ᑯᕕᓚᔭᕐᓂᖅᓚ ᐊᒻᒪᓗ ᒪᑐᐃᕐᑕᕐᑐᒥᒃ ᑯᕕᑎᑦᑎᕙᑎᖅᑲᓐᓂᕐᓂᐊᕐᓂᖅᓚ.
ᑐᕋᓚᓇᔭᖕᒋᓪᓕ ᑯᕕᕐᑕᕐᕕᐅᑦ ᓴᓗᒻᒪᕐᓴᕐᑕᐅᓂᖅᓚᓄᑦ ᓴᓇᔭᐅᓂᖅᓚᓄᓪᓗ ᐅᑯᐊᖑᕙᑦ:

1. ᒪᖕᒋᕐᑐᓇᒍᓐᓇᕐᓂᖕᒋᑦ ᐅᔭᕋᑐᐃᓐᓇᐃᑦ ᐱᑕᖅᑭᓐᓂᕐᑎᑕᐅᓗᑎᒃ ᐊᕚᑎᑦᑎᓐᓄᑦ ᐊᑦᑕᕐᓇᖕᒋᓕᕐᑎᑕᐅᒋᐊᕐᓗᓂ
2. ᐃᒪᖕᓚᓗ ᐊᐅᓚᔭᓗᐊᕐᑕᐃᓕᒪᑎᑕᐅᓗᓂ
3. ᐸᑦᑕᕐᓇᖕᒋᑦᑐᒥᒃ ᐊᑐᓚᒃᓴᐅᕙᒥᒃᓗ ᒪᓂᕋᖅᑎᑕᐅᓗᓂ.

ᐊᑐᓂ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᑦ ᐅᑯᐊᖑᕙᑦ:

- ᒥᑭᓐᓂᕐᓴᐅᑎᒋᕐᓗᒍ ᐊᓂᕐᓂᖅᑲᕐᓇᕐᑐᒧᑦ ᒪᖕᒋᕐᑐᓇᔮᓂᖕᒋᑦ ᓴᕿᔭᕈᓐᓂᕐᑎᑕᐅᓗᑎᒃ ᓴᐅᔭᐅᓗᓂ ᕿᕐᓂᕐᑕᒧᑦ ᑐᐊᐸᒧᑦ ᐊᒻᒪᓗ ᖃᒃᑲᓐᓂᐊᒍᑦ ᐃᓕᓇᔭᐅᓗᓂ ᓯᐅᕋᕐᒥᒃ. ᖃᓇᔭᖕᓚ ᑐᐊᐸ ᐃᑲᕙᑎᓂᐊᕐᒪᑦ ᕐᑯᐊᖑᐃᓐᓇᕐᑎᑦᑎᓗᓂ ᕐᑯᐊᕐᐸᓪᓕᐊᑎᑦᑎᓗᓂᓗ. _ᐅᕋᐅᓂᖕᓚ ᐊᐅᒃᐸᓪᓕᐊᔭᐃᒃᑯᑕᐅᓂᐊᕐᑐᖅ. ᖃᖕᓚ ᑐᐊᐸ ᐱᒍᓂᖕᓚ ᐊᖅᑭᒃᓯᒪᕙᖅ ᕐᑯᐊᖑᐃᓐᓇᕐᑎᑦᑎᓂᐊᕐᓗᓂ ᐊᑕᓂᑦᑐᓂᒃ ᐅᕐᑯᓯᕓᓕᐊᓚᓗᐊᕐᐸᑦ ᐊᕈᒍᓄᑦ 100-ᓄᑦ ᐊᐅᒃᑲᔭᖕᒋᑦᑐᖅ.
- !ᑭᓐᓂᕐᓴᐅᑎᑕᐅᒋᐊᕐᓗᓂ ᐊᓂᕐᓂᖅᑲᕐᓇᕐᓂᖕᓚ ᐃᒥᕐᒧᑦ ᑯᕕᕐᑕᕐᕕᐅᕙᖅ ᖃᖕᓚ ᐃᒪᖅᑲᕐᓗᓂ ᐃᕙᓂᖅᑲᕐᑐᒥᒃ 1 ᒥᑕᒥᒃ. ᓄᖑᔭᐃᒃᑯᑎᒥᒃ ᓯᒃᔭᖕᓚ ᓴᓇᔭᐅᓚᔭᕐᑐᖅ ᐃᓗᐊᓂᑦᑐᖅ ᑯᕕᔭᐅᓂᑯ ᓴᕿᑎᑕᐅᑦᑕᐃᓕᒪᓗᓂ ᒪᓕᒃᒧᑦ ᓯᑯᒧᓪᓗᓐᓂᑦ. ᐃᒪᕐᕐᑯᕐᑐᓂᓇᓚᐅᕐᑕᖕᓚ ᐅᑎᕐᑎᑕᐅᓂᐊᕐᑐᖅ ᐅᔭᕋᒃᓂᐊᖕᒋᑎᓪᓗᒋᑦ ᐃᒪᕐᕐᑯᑐᓂᓇᓚᐅᕐᑕᖕᓚᓄᑦ;
- ᐃᒥᐅᓂᖕᓚ ᐊᕐᑯᓯᐅᕐᑕᐅᓗᓂ ᑯᖅᑦᑕᓕᕐᓗᓂ ᐃᒪᖅᕕᒃᒧᑦ ᑯᓕᐅᕐᑕᐅᓗᓂ. /ᓕᐅᕐᑕᐅᕙᕐᓗ ᐊᖅᑭᒃᓯᒪᕙᖅ ᒪᕐᑯᒃᕙᐊᕋᓗᐊᕐᑎᓪᓗᒍ ᐊᑐᐃᓐᓇᕈᓐᓇᕐᓗᓂ.
- ᖃᑦᑎᒃᓯᓕᕐᓯᒪᕙᑦ ᐃᓕᓯᒪᐃᓐᓇᕐᓂᐊᕐᑐᖅ ᓯᕕᖕᓚᓂᖕᓚᓗ ᖃᐃᖅᑲᒃᓴᕐᑕᐅᓗᓂ ᐃᒥᕐ ᑯᖅᑦᑕᕐᓂᐊᕐᒪᑦ ᐃᓗᐊᓄᐊᖕᒋᓪᓗᓂ ᓯᐅᕋᕐᒥᒃᓗ ᖃᓕᕐᑕᐅᓂᐊᕐᓗᓂ
- ᖃᐅᐳᓴᕐᕕᒃ ᖃᑦᑎᒃᓯᓕᕐᓯᒪᕙᖅ ᐃᓕᓯᒪᐃᓐᓇᕐᓂᐊᕐᑐᖅ ᖃᖕᓚᒍᓪᓗ ᐃᓕᓇᔭᐅᓂᐊᓇᓪᓗᓂ ᓯᐅᕋᕐᒥᒃ ᓴᐅᔭᐅᓗᓂ.
- /ᒃᐸᓪᓕᐊᕙᑎᖕᓚ ᒪᑐᐃᕐᑕᐅᖅᑦᑕᓚᐅᕐᑐᖅ ᐅᔭᕋᒃᓂᐊᕐᑎᓪᓗᒋᑦ ᑕᑕᓗᐊᔭᐃᒃᑯᑎᖕᓚ ᐱᔭᕐᑕᐅᓂᐊᕐᑐᖅ ᐊᓯᖕᓚᖕᓚᓂᒃ ᓴᓇᒧᖅᑲᕐᓗᓂ ᒪᑐᐃᖕᓚᐃᓐᓇᓕᕐᓗᓂᓗ. ᑯᒃᕕᖕᓚ ᐃᓂᖅᑲᕐᓂᐊᕐᑐᖅ ᐳᕐᑐᓂᖅᑲᕐᑐᒥ 370.2 ᒥᑕᒥᒃ. ᑯᒃᓂᖕᓚᓗ ᑯᓕᐊᓇᓯᒪᕙᒧᑦ ᑯᖅᑕᐅᓂᐊᕐᑐᖅ. ᑖᓐᓇᓗ ᒪᑐᐃᕐᑕᐅᑎᖕᓚ ᐃᓕᓯᒪᐃᓐᓇᓚᐅᒃᑲᓂᐊᕐᑐᖅ ᑭᓯᐊᓂ ᓴᓗᒻᒪᕐᓴᐃᔭᓇᕐᓯᒪᓕᕐᐸᑕ ᐱᕐᑕᐅᑕᐃᓐᓇᕐᓂᐊᕐᓗᓂ ᐃᒪᖕᓚ ᖃᐅᐳᓴᕐᑕᐅᓚᐅᕐᓗᓂ ᓴᓗᒻᒪᕐᓴᓇᐊᖅᑲᖕᒋᐸᑦ ᒪᑐᐃᕐᑕᐅᓗᓂ.

ᐊᑐᓂ ᓴᓇᔭᐅᓂᐊᕐᑐᑦ ᓴᓗᒻᒪᕐᓴᐃᑎᓪᓗᒋᑦ ᐅᓂᑲᕐᓯᒪᕙᑦ. ᖃᓄᐃᑦᑐᓪᓚᕿᐅᓂᖕᓚ ᕿᕐᓂᕐᑕᖅ ᑐᐊᐸ ᐅᓂᑲᕐᑕᐅᓯᒪᕙᖅ ᑎᑎᕋᕐᑕᐅᓯᒪᕙᒥ ᐊᑎᖅᑐᖅ ᖃᐅᐳᓴᕐᑎᑦ ᐊᖅᑭᒃᓯᒪᖕᓚᔭᑦ ᓴᓇᔭᐅᓂᖕᓚ ᖃᖕᓚ ᖃᓄᐃᑦᑐᒃᒪᖕᓚᑦ.

ᐃᒥᕐ ᑯᕕᑎᑕᐅᕙᓪᓕᐊᕙᖅ ᐱᐅᓂᖕᓚ ᐊᕋᒍᓄᑦ 25-ᓄᑦ ᓱᕋᕗᐊᕋᓱᒋᔭᐅᖕᒋᑦᑐᖅ, ᐱᑕᖅᑲᕐᓂᖕᓚ ᓴᕕᒃᓴᖅᑲᕐᓂᖕᓚ ᓇᓴᐅᑎᒃᑯᑦ0.07. ᐱᓕᕐᑯᓯᓇᓚᐅᕐᑕᖕᓚᑐᑦ ᐱᕐᑯᓂᖅᐸᓗᒃᑐᖅ ᓇᓴᐅᑎᒃᑯᑦ 0.56. ᐃᒥᕐᐸᓪᓕᐊᖅᑲᑦᑕᕐᓗᓂ ᓴᕕᒃᓴᖅᑲᕐᓂᖕᓚ ᓄᖑᐸᓪᓕᐊᓂᐊᕐᑐᖅ.

ᓴᓇᓯᒪᓂᖕᒋᑦ ᐊᖅᑭᑦᑎᐊᕐᓯᒪᔭᓇᐊᖅᑲᕐᓂᐊᕐᒪᑕ ᓴᓇᔭᐅᕓᓪᓕᐊᑎᓪᓗᒋᑦ ᑯᕕᕐᑕᕐᕕᒃ ᐅᑯᐊᖑᓂᐊᕐᑐᑦ:

- ᐃᓗᑐᓂᖏᓐᓄᑦ ᓴᐃᓯᐋᑕᐅᓂᐊᕐᑐᖅ
- ᑐᐊᐸᒃᑕᖅᕕᐅᓂᐊᕐᑐᖅ
- ᐅᔭᕐᑐᐃᓐᓇᕐᓂᒃ ᐱᔭᕐᑕᐅᓂᖏᑦ
- ᓂᐅᕐᑐᕐᑕᐅᔪᑦ ᐃᓗᑦᑐᓯᑎᑕᐅᔪᓪᓗ
- ᕿᑯᕐᑎᑕᐅᔪᑦ
- ᓄᖑᔭᐃᑯᓯᕐᑕᐅᔪᑦ
- ᕿᖑᒥᒐᕐᑕᐅᔪᑦ
- ᖃᐅᔨᓴᐅᑎᓂᒃᓗ ᐃᓕᓇᒃᓱᐃᓂᖅ

ᐊᑯᓂᐅᔪᒧᑦ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᖅ ᖃᐅᔨᓴᕐᓂᖅ ᖃᓄᐃᐸᓪᓕᐊᓂᖓᓂᒃ ᐊᕿᒃᑕᐅᓂᐊᕐᑐᖅ. ᖃᐅᔨᓴᕐᓂᕐᓗ ᓇᓗᓇᐃᕐᓯᓂᐊᕐᒥᔪᖅ ᓴᓇᔭᕆᐊᓕᒃᓂᒃ ᐊᕿᒃᑲᓐᓂᕆᓕᒃᓂᒃᓗ. ᖃᐅᔨᓴᕐᓂᕐ ᐅᑯᓂᖓ ᐃᓗᓕᖃᕐᓂᐊᕐᑐᖅ

- ᒪᓂᕋᐅᑦ ᐅᕐᑯᓂᖓᓂᒃ ᖃᐅᔨᓴᕐᓂᕐ
- ᖁᐊᕐᐸᓪᓕᐊᓂᖓ ᒪᓂᕋᐅᑦ ᑐᐊᐸᐅᑦ ᐊᑕᓂᑦᑐᖅ
- ᐃᒥᕐ ᑯᒃᑎᑕᐅᔭᓪᓕᐊᔪᖅ ᐱᕐᑯᓂᖓᓂᒃ
- ᓯᓚᐅᑦ ᖃᓄᐃᑦᑐᓂᖓᓂᒃ ᖃᐅᔨᓴᕐᓂᖅ
- ᑕᑯᓇᒃᑕᐅᓗᑎᒃ ᓴᓇᓯᒪᔪᑦ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓗᑎᒃ ᐃᓕᓯᒪᔪᓄᑦ
- ᐅᓗᖃᕐᓗᑎᒃ ᑕᑯᓇᖃᑦᑕᕐᓗᑎᒃ ᕿᒥᕈᓗᑎᒃᓗ ᖃᓄᐃᓕᕙᓪᓕᐊᖏᒃᑲᓗᐊᕐᒪᖔᑦ

ᖃᐅᔨᓴᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᓴᓗᒻᒪᖅᓴᐃᑎᓪᓗᒋᑦ ᐊᕐᕌᒍᒃᓄᑦ ᒪᕆᒃᓄᑦ ᐊᒻᒪᓗ ᐊᕐᕋᒍᓄᑦ ᑕᓪᓕᒪᓄᑦ ᒪᑐᓯᒪᓕᕐᑎᓪᓗᒍ. ᓴᓗᒻᒪᖅᓴᐃᑎᓪᓗᒋᑦ ᐃᖃᓇᐃᔭᕐᑎᑦ ᖃᐅᔨᓴᖃᑦᑕᕐᓂᐊᕐᑐᑦ. ᐃᖃᓇᐃᔭᕐᑎᑦ ᖃᐅᔨᓴᖃᑦᑕᕐᓂᐊᕐᒪᑕ ᒪᓕᒃᑕᐅᒍᓐᓇᕐᒪᖔᑕ ᐸᕐᓇᐅᑎᖏᑦ ᐊᕙᑎᓕᓇᔨᒧᓪᓗ ᐊᕿᒃᑕᐅᕙᓪᓕᐊᓗᑎᒃ. ᒪᑐᓯᒪᓕᕐᑎᓪᓗᒍ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᑐᖅ ᖃᓄᐃᑉᐸᓪᓕᐊᒃᒪᖔᑦ ᓴᓇᓯᒪᔪᑦ. ᐃᖃᓇᐃᔭᕐᑐᒥᒃ ᐅᐸᒃᑕᐅᓯᒪᐃᓐᓇᕈᐊᖏᑦᑐᖅ ᒪᑐᓯᒪᓕᕐᑎᓪᓗᒍ, ᖃᐅᔨᓴᓇᐊᕐᑐᖃᑦᑕᕐᓂᐊᕐᑐᖅ ᑎᑭᑦᑐᖃᑦᑕᕐᓗᓂ ᐊᒻᒪᓗ ᐃᑲᔪᕐᑎᖃᑦᑕᕐᓗᓂ ᐃᒃᐱᐊᕐᔪᒃᒥᐅᒥᒃ ᐃᓕᓐᓂᐊᕐᓯᒪᔪᒥᒃ.

ᑲᓐᓛᓐᑯ-ᑯᑦ ᐊᓯᖏᓪᓗ ᐃᓕᓯᒪᔪᑦ ᐃᖃᓇᐃᔭᕐᑎᖏᓪᓗ ᐱᔭᕆᐊᖃᕋᖓᑕ ᕿᒥᕈᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᖃᐅᔨᓴᐅᑕᐅᔪᓂᒃ. ᑲᓐᓛᓐᑯ-ᑯᑦ ᐱᔭᕆᐊᖃᕋᖓᑦ ᓴᓇᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᐅᕙᓗᓂᑦ ᐊᕿᒃᓯᖃᑦᑕᕐᓂᐊᕐᑐᑦ. ᖃᐅᔨᓴᐅᑕᐅᔪᑦ ᑎᑎᕋᕐᓯᒪᔪᑦ ᑐᓂᔭᐅᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᐃᒥᓕᕆᓃᒃᑯᓐᓄᑦ ᐊᒻᒪᓗ ᐃᓄᒃᓄᑦ ᑕᑯᔭᐅᔪᒃᓴᐅᑕᐅᓗᑎᒃ.

ᐸᕐᓇᐅᑎᖃᕐᓯᒪᒃᒥᔪᑦ ᖃᓄᐃᓕᑲᓚᒃᑐᕕᓂᐅᒃᐸᑦ ᓂᕈᐅᓇᖏᑦᑐᒃᑯᑦ ᖃᓄᐃᓕᐅᕋᔭᕐᒪᖔᑦ ᓴᓗᒻᒪᖅᓴᐃᑎᓪᓗᒋᑦ. ᐊᑐᓂ ᖃᓄᐃᓕᑲᓚᑐᐃᓐᓇᕿᐊᓕᑦ ᐸᕐᓇᐅᑕᐅᓯᒪᒃᒥᔪᑦ ᖃᓄᕐᓗ ᑲᒪᒋᔭᐅᒋᐊᖃᔭᕐᒪᖔᑦ. ᖃᐅᔨᓇᓱᒃᑕᖃᔭᕐᒥᔪᑦ ᐱᐊᑎᖓᓂ ᖃᓄᐃᒻᒪᑦ ᑕᐃᒪᐃᓕᕿᑎᒋᔭᖓᓂᒃ. ᐊᔨᖏᖏᑦᑐᑦ ᐱᔭᐅᒋᐊᖃᔭᕐᑐᑦ ᐃᓚᖏᓪᓗ ᖃᖏᓐᓇᖏᑦ ᐊᕿᒋᐊᕐᓯᓂᐅᓪᓗᑎᒃ ᐊᓯᖏᓪᓗ.

2010-ᒥ ᓇᓯᒪᔪᒥᒃ ᑎᑎᕋᕐᓯᒪᔪᒥᒃ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᔪᓂᒃ ᑎᑎᕋᖃᔭᕐᑐᑦ ᐅᓂᑲᓕᐅᕐᓗᑎᒃ ᑕᒃᑯᐊ ᓴᓇᔭᐅᔪᑦ ᖃᓄᐃᓕᕙᓪᓕᐊᒃᒪᖔᑦ ᐊᒻᒪᓗ ᓴᓇᔭᐅᔪᑦ ᐊᕿᑦᑎᐊᕐᒪᖔᑦ.

6.12.2 Executive Summary

Under the terms of Water Licence NWB1NAN0208 issued by the Nunavut Water Board (NWB), CanZinco Ltd., the current owner of the Nanisivik Mine is responsible for continuation of on-site environmental protection activities and developing for submission and approval of a final Reclamation and Closure Plan ("RCP").

The Nanisivik Mine FCRP has been developed, as per the terms of the Water Licence as a series of stand-alone documents, each addressing in detail the information and proposed closure measures for one specific component or topic area. This document and the information presented herein are provided in response to the requirements for report Part G, Item 15, the West Twin Disposal Area (WTDA) Reclamation and Closure Plan.

In accordance with Part G, Item 15, of the Water Licence, this report provides the following requirements for the WTDA Plan:

1. A brief description of historical operating practices, water movement and overall function of the system;
2. An updated water balance for the system;
3. Current site assessment including characterization of all tailings both for physical properties (gradation, density, mineralogy) and thermal conditions in the surface cell dike and possibly the reservoir;
4. Cover design and description of all construction activities associated with the closure plan, predictions of site stability and water quality with details of analyses that support the plan;
5. Contingency plans for dealing with uncertainties and adverse performance during the post-closure monitoring period. These plans need to include a discussion of events that trigger their implementation;
6. A monitoring program that includes: permafrost stability, deformations of both the dike and soil cover as well as water quality determinations; and
7. An appendix that constitutes a construction plan with material specifications, a quality control plan and as-built drawings stamped by an engineer.

Additionally, requirements 6 and 9 of Part G, Item 4 (the Covers Report), which apply to the water covered tailings in the Reservoir, are addressed within the context of the closure plan provided herein. Those two requirements are as follows:

6. The bathymetry of sub-aqueous tailings in West Twin Lake Reservoir which shows the extent of tailings located within 1.0 m of the water surface, and plans for mitigation of wave action on these tailings; and

9. An evaluation of alternatives for increasing minimum water depth in the Reservoir with emphasis on possible effects of waves and winter ice cover on long term water quality.

The report provided herein attempts to be comprehensive in its treatment of the elements and technical information and issues with regards to the closure of the WTDA. The following list provides guidance on the closure elements covered in this report, as opposed to other submitted reports:

- Surface Cell and Test Cell cover design – covered in Cover Designs Report (Part G, Item 4);
- Talik characterization – covered in Talik Report (Part G, Item 5);
- Reclamation materials – covered in the Quarry Report (Part G, Item 6);
- West Twin Dike spillway design – covered in the Spillway Report (Part G, Item 7);
- Reservoir water cover and submerged tailings – covered in current report;
- Reservoir shoreline protection design – covered in current report;
- Breaching of baffle dike in Reservoir and access road berm at Polishing Pond – covered in current report;
- Breaching of Polishing Pond Outlet Structure and design of Outlet Channel and Overflow Weir – covered in current report; and
- Erosion protection for East Twin Diversion Dam and channel – covered in current report.

As noted, the current report attempts to be comprehensive on the topic, without repeating all applicable detail from each of the individual component reports.

The WTDA consists of an upper solids retention pond, known as the Surface Cell and a lower water retention pond, known as the Reservoir. An earthen dike, the West Twin Dike, separates the Surface Cell and Reservoir. The Reservoir is further divided by the Test Cell Dike, which separates the Reservoir and the Test Cell. The Test Cell was used to evaluate the performance of several test cover designs. Both dikes are constructed of frozen shale fill and are founded on frozen, settled tailings. The current crest elevation of the West Twin Dike is about 388 m. The Test Cell Dike was raised in two stages. The first stage was raised to elevation 383.5 and the second stage was to about elevation 385.5. The staged construction resulted in the formation of a bench on the Reservoir side of the dike.

Excess water from the Surface Cell is transferred to the Reservoir by pumping or a siphon system that controls water levels. The Reservoir and a final Polishing Pond are separated by a causeway and stop log structure, which controls the water level in the Polishing Pond. Water from the Polishing Pond is discharged to Twin Lakes Creek through the West Twin Outlet Structure, a 3 to 5 m high earth fill dam with a valve controlled, concrete lined spillway. Excess water from the WTDA is then discharged to the environment via the West Twin Outlet Structure between July and September of each year.

The primary risks posed by the WTDA facilities are related to the potential for acid rock drainage, the potential for the physical movement of tailings to the environment and the loss of surface land use values. The specific reclamation objectives for the WTDA reclamation plan are as follows:

1. Isolate potentially acid generating tailings from the atmosphere to minimize the risk of acid rock drainage;
2. Minimize the risk of physical movement of tailings to the environment; and
3. Provide a safe and usable surface environment that corresponds to the natural surroundings.

Specific reclamation measures described in the report include:

- Minimization of oxygen exchange in the Surface Cell and Test Cell tailings by placing a cover of shale and sand and gravel over the exposed tailings. The cover will provide thermal insulation, to maintain frozen conditions and allow for permafrost aggradation. The sand and gravel surface layer will provide a durable cap of local material. The cover will be thick enough to maintain continuous frozen conditions within the underlying tailings during mean annual and warmer conditions, even with a worst case estimate of future climate change predictions over the next 100 years;
- Minimization of oxygen exchange in the Reservoir tailings by means of a minimum 1 m water cover. Erosion protection will be placed over the tailings within the shoreline area to minimize the risk of re-suspension of tailings due to wave and ice action. The final water level in the Reservoir and Polishing ponds will be the same as the original, pre-mining elevation of West Twin Lake;
- Transfer of water flow from the Surface Cell to the Reservoir via a new spillway and outlet channel around the south end of West Twin Dike. This structure will be designed to safely pass seasonal run-off and the routed 24-hour probable maximum precipitation (PMP) storm event;
- West Twin Dike will remain in place during closure for permanent retention of the Surface Cell tailings. The outer slope of the dike will be graded smooth to a flatter slope and covered with Twin Lakes sand and gravel to prevent erosion;
- The Test Cell Dike will remain to retain the tailings solids. The crest of the Test Cell Dike will be graded as a portion of the grading plan for the entire cell; and
- The water control outlet structure that was used to release water in a controlled manner during mine operations will be removed and replaced with an open outlet channel and overflow weir. The new outlet channel will be located at the natural, original elevation (370.2 m) of the outlet of West Twin Lake. Water passing through the outlet channel will join with water flowing from East Twin Lake and flow into Twin Lakes Creek. This structure will not be removed until after the main work is done to ensure that WTDA water can be managed in the unlikely event that treatment is required.

Design details are presented for each of the areas to be reclaimed. Specific design details for the shale covers on the Surface Cell and Test Cell are provided in the report “Engineering Design of Surface Reclamation Covers” (Water Licence Part G, Item 4).

Discharge water quality from the Polishing Pond is predicted to remain constant over the next 25 years, at about 0.07 mg/L zinc. This is similar to the natural background level of 0.056 mg/L zinc. Over time, the volume of water passing through the Polishing Pond is projected to decrease marginally due to decreasing rates of porewater expulsion from the tailings.

Construction quality control and quality assurance requirements are included for all aspects of construction associated with the WTDA reclamation. These include:

- Fill placement;
- Soil excavation;
- Rock excavation;
- Drilling and grouting;
- Concrete;
- Rip rap;
- Surveying; and
- Instrumentation.

A comprehensive program for evaluating the long-term performance of the proposed reclamation measures is to be implemented. The monitoring program will also identify areas where maintenance, repairs or contingencies may be required in the short term. The monitoring information to be collected includes:

- Ground temperatures within the cover, the tailings and the natural ground;
- Subsurface water pressures related to the freezing of the taliks;
- Quality of water entering the environment;
- Climate data;
- Regular inspections of surface conditions by trained technical staff; and
- Scheduled inspections of surface conditions by a professional geotechnical engineer.

In general, the monitoring program provides for performance monitoring during the 2 year Reclamation Period and for a subsequent 5 year Closure Period. During the Reclamation Period, worker presence at the mine site is anticipated for construction monitoring and general reclamation activities. This presence will enable the proposed monitoring programs to be carried out by the on-site personnel under the direction of an Environmental Coordinator and geotechnical engineer. During the Closure Period, performance monitoring will be conducted to evaluate the success of the reclamation measures. Continuous worker presence at the mine site is not planned during the closure period and environmental monitoring programs will be carried out during scheduled site visits and possibly utilizing trained, local field assistants and staff hired from nearby Arctic Bay.

CanZinco and other technical experts, as required, will review the information obtained from the monitoring program. CanZinco will take appropriate action to maintain or repair the reclaimed areas. The data obtained from the monitoring program will be forwarded to the Nunavut Water Board for their review and public posting.

Several contingency plans have been developed in order to address performance issues that may be identified during the reclamation and closure monitoring periods. For each issue, the consequences and suggested mitigation approaches are also identified. Common to all suggested mitigation measures is identification of the root cause and appropriate reaction to limit the environmental consequences. The mitigation measures range from performing localized maintenance of the covers to treatment of Reservoir water.

In 2010, a comprehensive, all encompassing assessment of the monitoring information is to be conducted that will determine whether the reclamation objectives have been achieved and whether the WTDA is considered to be successfully reclaimed.

6.13 G.16, ᓄᓇᐅᑦ ᐃᓗᐊᓄᑦ ᐃᓗᐊᓄᐊᕐᑲᐃᓂᖅ ᐊᑐᕐᑕᐅᔮᐊᖅᑎᑦᑐᓂᒃ, Underground Mine Waste Disposal Plan

The report, *Nanisivik Mine Waste Disposal Plan* (the "Waste Disposal Plan"), was submitted to the NWB on August 1, 2003 in fulfillment of the report requested under Part G, Item 16 of the Water Licence. The NWB conducted a technical review of the report and requested, in a letter dated January 6, 2004, a number of clarifications and revisions to the report prior to its approval. The NWB's review letter is included in Appendix K.

The Waste Disposal Plan has been revised to address the clarifications and revisions requested by the NWB and has been resubmitted, for approval, as Appendix K to this submission.

6.13.1 ᓇᐃᒃᑐᑎᐊᕐᓯᒪᔪᑦ ᐅᖅᑲᐅᓯᒃᓴᐃᑦ

ᓇᓂᓯᕕᐅᑦ ᒪᑐᓂᖓ, ᐊᓯᖏᑦᑕᐅᕐ ᐅᔭᕋᒃᓂᐊᕐᕕᑦ ᒪᑐᖃᑦᑕᕐᒥᒃᒪᑕ, ᓴᕿᑎᑦᑎᓯᒪᒃᒪᑕ ᐅᔭᕋᒃᓂᐊᕐᑎᓪᓗᒋᑦ ᐱᔭᐅᖃᑦᑕᕐᓯᒪᔪᓂᒃ ᐃᒋᑕᐅᔭᕆᐊᓕᒃᓂᒃ ᓴᓗᒻᒪᕐᓴᕐᑕᐅᔭᕆᐊᓕᒃᓂᒃᓗ. ᐱᒍᑎᖓᓕ ᓄᓇᐅᑦ ᐃᓗᐊᓄᐊᕐᑲᐃᓂᕐᒧᑦ ᐸᕐᓇᐅᑎᖓ ᓇᓗᓇᐃᕐᓯᔪᑕᐅᓗᓪᓂ ᖃᓄᐃᑦᑐᑦ ᐃᒋᑕᐅᓂᐊᕐᒪᖓᑕ ᖁᔭᓇᕐᑕᐅᓂᐊᕐᒪᖓᑕᓗ, ᐱᖃᓯᐅᑎᒐᔭᕐᓗᑎᒃ ᓄᓇᓯᐅᑎᕕᓂᑦ, ᐊᐅᓚᐅᑎᕕᓂᑦ, ᐅᔭᕆᐃᓐᓇᐃᑦ, ᑐᐊᐸᐃᑦ ᓱᕈᕐᓇᕐᑐᖃᕐᑐᑦ ᓴᓂᑦ ᐊᓯᖏᓪᓗ ᐊᑐᕐᑕᐅᔮᖏᑦᑐᑦ ᖁᔭᓇᕐᑕᐅᔪᑦ.
ᐸᕐᓇᐅᑎᒥ ᐅᓂᒃᑲᕐᓯᒪᔪᑦ ᖃᓄᕐ ᐃᓗᐊᓄᐊᕐᑲᕐᑕᐅᓂᐊᕐᒪᖓᑕ ᐊᒻᒪᓗ ᓇᒧᖓᕐᑲᕐᓂᐊᕐᒪᖓᑕᓗ.

ᑐᕌᖓᓂᔭᖓᓕ ᐸᕐᓇᐅᑎᐅᑦ ᐃᒋᑕᐅᔪᑦ ᖁᔭᓇᕐᑕᐅᔪᓪᓗ ᐃᑎᐅᕐᑲᕐᑕᐅᓗᑎᒃ ᓄᓇᐅᑦ ᐃᓗᐊᓄᑦ ᐃᓄᒃᓄᑦ ᐊᕙᑎᑦᑎᓐᓄᓪᓗ ᐊᑦᑕᕐᓇᕐᑯᓂᕐᓂᐊᕐᒪᑕ. ᑕᐃᒪᓐᓇ ᒪᕈᓕᖓᓗᓂ ᐱᓕᕆᐊᖑᓂᐊᕐᑐᖅ ᐃᒪᓐᓇ:

1. ᓄᓇᐅᑦ ᐃᓗᐊᓄᑦ ᐃᓗᕝᓂᖓᓄᑦ ᐃᓕᐅᖃᑦᑕᐅᓗᑎᒃ ᐃᒋᑕᐅᔪᑦ ᓄᓇᐅᑦ ᖃᖓᓄᑦ ᐃᓴᐅᑎᔪᓐᓇᐃᓕᑎᒋᐊᕐᓗᒋᑦ ᐸᙱᓪᓗ ᒪᕝᔭᐅᓗᑎᒃ ᐃᓯᕐᑕᐅᔪᓐᓇᐃᓕᓗᑎᒃ.

2. ᐳᔭᕆᒃᑦᑖᕕᕙᓂᕐᓄᑦ ᐃᓗᑦᑐᕐᓯᒪᔪᓄᑦ ᓴᐅᔭᐅᓗᑎᒃ ᖃᖓᓗ ᖃᐃᖅᑲᒃᑕᐅᓗᓂ ᐃᒥᕉᔪᓂᖓ ᖃᖓᓄᐊᖅᑦᑕᔥᐊᕐᒋᒻᒪᑦ ᐊᒻᒪᓗ ᖁᐊᖑᓂᖓᓄᐊᕈᓂ ᖁᐊᖑᐃᓐᓇᓕᕿᔭᕐᒪᑦ.

ᑭᓱᓂᕐᒋᑦ ᓇᓗᓇᐃᕐᑕᓚᐅᕐᓗᑎᒃ ᖁᔭᓇᕐᑕᐅᔪᑦ, ᐸᕐᓇᐅᑎᖓᓂᒃ ᖃᓄᐃᑕᐅᔪᑎᒋᓂᐊᕐᑦᖓᓂᒃᓗ ᑎᑎᕋᕐᑕᐅᓗᑎᒃ ᓇᒧᓪᓗ ᐃᓕᔭᐅᓂᐊᕐᒪᖔᑦ. ᐃᓂᒋᓂᐊᕐᑦᖓ ᒪᓕᒃᓯᒪᓂᐊᕐᑐᖅ ᐊᑦᑕᕐᓇᕐᓂᖓ ᐱᖁᑎᐅᑦ ᒪᓕᒃᓗᒍ ᐊᒻᒪᓗ ᐊᖏᓂᖓ ᐃᓗᐊᓄᐊᓈᐊᓕᒃ ᒪᓕᒃᓗᒍ.

ᓴᓂᓪᓗ ᑲᒪᒋᔭᐅᓂᕐᒋᑦ ᑎᑎᕋᕐᑕᐅᔭᓪᓚᐊᓗᑎᒃ ᕿᒥᕈᔭᐅᔪᓐᓇᕐᓂᐊᕐᒪᑕ ᖃᐅᔨᓴᕐᑕᐅᓕᕈᑎᒃ. ᑎᑎᕋᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᖃᓄᐃᑦᑐᓂᕐᒋᑦ ᐃᒋᑕᐅᔪᑦᒪ, ᑭᓱᓂᕐᒋᓪᓗ, ᓴᓗᒻᒪᕆᐊᖅᑲᕐᓂᖓᓗ, ᐃᓂᒋᓂᐊᕐᑦᖓᓗ ᐊᒻᒪᓗ ᖃᓄᑎᒋ ᐊᕐᒋᑎᒋᒃᒪᖔᑦ.

ᓇᓗᓇᐃᕐᓯᒪᔪᒥᒃ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᖅ ᐅᓇ ᑎᑎᕋᕐᓯᒪᔫ ᖃᐅᔨᒪᔪᑕᐅᓂᐊᕐᑐᖅ ᖃᓄᐃᑦᑐᒃᒪᖓᑦ ᐃᒋᑕᐅᓂᐊᕐᑐᖅ.

ᖃᓄᐃᑦᑐᓂᖓ ᓴᓂᖅ	ᖃᓄᐃᓕᖓᓂᖓ	ᐱᔭᕇᐊᖅᑲᕐᓂᖓ ᓇᓴᐅᑎᒃᑯᑦ
ᓄᓇᓯᐅᑎᕕᓂᑦ ᐊᐅᓚᐅᑎᕈᔪᐃᓪᓗ	1- ᐱᑕᖃᐅᕐᑐᖅ ᐱᖁᔭᑎᒍᑦ ᑲᒪᒋᔭᕆᐊᓕᒃᓂᒃ ᓱᕐᓗ ᕙᑐᓕᖓ ᐃᒪᖓ ᐊᐅᓚᑎᖓᑕᓗ ᐃᒪᕐᒋᑦ 2- ᐃᓗᐊᓄᐊᕐᑕᐅᔪᓐᓇᕐᑐᖅ	ᐊᐃ1 ᐊᐃ2
ᐃᒃᓗᕕᓂᑦ ᓴᓂᕐᒋᑦ	1- ᐃᓗᐊᓄᐊᕐᑕᐅᔪᓐᓇᕐᑐᖅ ᐅᕙᓗᓂᑦ ᐃᑭᑕᐅᓗᓂ	ᑎᑎ1
ᑐᐊᐸᒃ	1-ᓴᕕᒃᓴᖃᕐᑐᖅ 2- ᐅᕐᓱᐊᓗᖃᕐᑐᖅ	ᓴ1 ᓴ2

ᐸᕐᓇᐅᑎᑦ ᐃᒋᑕᐅᓂᐊᕐᑐᓄᑦ ᐊᕐᒋᓂᖓᓂᒃ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᒃᒪᑕ ᐅᑯᐊᖑᔪᑦ:

1. ᑐᓚᒃᑕᕐᕖᒃ: ᐊᕐᒋᓂᖃᕐᑐᖅ 3,750 ᑭᐸᓇᒃᓯᓗᒍ ᒥᑕ
2. ᐱᖁᑎᒃᑯᕖᒃ: ᐊᕐᒋᓂᖃᕐᑐᖅ 1,500 ᑭᐸᓇᒃᓯᓗᒍ ᒥᑕ
3. ᓇᓇᕖᐊᓗᒃ ᐃᒃᓗᐊᓗᒃ: ᐊᕐᒋᓂᖃᕐᑐᖅ 3,700 ᑭᐸᓇᒃᓯᓗᒍ ᒥᑕ
4. ᓄᓇᓕᖓ: ᐊᕐᒋᓂᖃᕐᑐᖅ 4,600 ᒥᑕ
5. ᓴᓗᒻᒪᕐᓴᐃᕖᒃ: ᐊᕐᒋᓂᖃᕐᑐᖅ 1,000
6. ᓄᓇᓯᐅᑎᕈᔪᐃᑦ: ᐊᕐᒋᓂᖃᕐᑐᑦ 4,150 ᑭᐸᓇᒃᓯᓗᒍ ᒥᑕ

ᑲᑎᓕᒪᕐᓗᒋᑦ ᐃᒋᑕᐅᓂᐊᕐᑐᑦ ᐃᓚᒃᑳᓂᕐᓗᒍ 25->ᓴᓐᒥᒃ ᐊᕐᒋᓂᖃᕐᑐᑦ 23,500 ᑭᐸᓇᒃᓯᓗᒍ ᒥᑕ.

ᓴᓂᑦ ᐃᒃᓗᓂᖓᕐᑐᑦ ᐱᕐᑯᑎᕕᓂᓪᓗ ᒥᑭᒡᑎᑕᐅᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᐊᔪᕐᓇᖏᑦᑐᐊᕋᖓᑦ ᐃᓗᐊᓄᐊᕐᑕᐅᖏᓐᓂᖏᓐᓂ. Hᐃᒪᓐᓇᒃᐸᓪᓗ ᐅᑎᕐᑕᑲᑕᓗᐊᖏᓐᓂᕐᓴᐅᒐᔭᕐᒪᑕ ᐅᓯᓚᕐᓱᒐᓴᐅᓂᕐᓴᐅᒐᔭᕐᓗᑎᒃᓗ. ᐱᕕᖃᕐᓂᖓᓄᑦ ᓄᓇᐅᑦ ᐃᓗᐊᓂ ᐊᑕᐅᓯᐊᑐᐃᓐᓇᕐᓗᓂ ᐃᓗᐊᓄᐊᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᐅᓯᔭᐅᒃᑲᓐᓂᖏᓪᓗᑎᒃ. ᓄᓇᓯᐅᑎᕐᔪᐸᑦ ᐊᑐᕐᑕᐅᓗᑎᒃ ᐃᓗᐊᓄᐊᖃᐃᖃᑦᑕᕐᓂᐊᕐᑐᑦ. ᐱᕕᖃᖏᓐᓂᕐᓴᒍᐊᕐᑕᐅᔪᑦ ᐊᔮᒃᑕᐅᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᐃᓗᐊᓄᑦ ᐱᕕᖃᕐᓂᖓ ᐊᑐᕐᑕᐅᔪᐃᓐᓇᐅᓇᓱᒃᓗᓂ.

ᐊᔨᒋᖏᑦᑐᑦ ᓇᓗᓇᐃᕐᑕᐅᓯᒪᔪᑦ ᐃᓂᒋᔭᐅᔪᓐᓇᕐᓂᖏᓐᓂᒃ. ᑕᒃᑯᐊ ᐃᓂᒋᔭᐅᒍᒪᔪᑦ ᖃᓂᒋᔭᓂᓪᓗᑎᒃ ᐃᓚᐅᖃᕆᐊᓚᒃᓄᑦ. ᑲᑎᓚᒪᕐᓗᒋᑦ 315,000 ᑭᐸᕆᕐᓯᓗᒍ ᓯᑕᒥᒃ ᐃᓂᒃᓴᖃᕐᑐᑦ ᐃᓗᐊᓄᐊᕆᐊᓚᓪᓗ ᐊᖏᓂᖅᕐᓗᑎᒃ 23, 500-ᒥᒃ.

6.13.2 Executive Summary

The closure of Nanisivik Mine as with any mine creates a considerable amount of material that requires disposal. The purpose of the waste disposal plan is to identify and classify the waste, which may include derelict equipment, contaminated soil, waste rock, demolition debris, and regulated or hazardous material. The plan will also provide information on how and where the waste will be disposed of.

The objective of the plan is to dispose of all waste in such a manner as to eliminate the pathway by which exposure to humans or the environment is possible. This will be done in two ways:

1. Deposit the material underground, in locations where gravity will prohibit migration of contaminants to surface openings and permafrost aggradation will effectively seal the waste in place; and

2. Deposit the material into pits, cover with rock fill and contour to allow for surface drainage and the prevention of pooling. The natural aggradation of permafrost will then effectively isolate the waste.

A simple classification system is used to differentiate the types of waste.

Type of Waste	Criteria	Classification
Abandoned Equipment	1 – Purged of regulated materials prior to storage (free phase liquids, batteries, etc.)	AE1
	2 – Can be stored directly	AE2
Demolition Debris (inert solids)	1 – Can be stored directly or burned (wood debris)	DD1

Type of Waste	Criteria	Classification
Soil	1 – Contains Metals above the SQRO[1]	S1
	2 – Contains Hydrocarbons above the SQRO	S2

[1]SQRO = Soil Quality Remediation Objective

After the material is classified, an action plan for that particular material is followed and a storage location is selected. The storage location depends on the associated risk with the particular material as well as the volume required to facilitate the disposal.

Waste handling procedures will be recorded and documentation will be kept on site for review during the reclamation and post-closure monitoring periods. Records will include a description of the waste, classification, any decontamination required, storage location and estimated storage volume.

Disposal plans and waste volume estimates for the major component areas of the site are included in the Plan. These include:

- Dock Area: Total volume of 3,750 m^3;
- Warehouse Yard: Total volume of 1,500 m^3;
- Industrial Complex Area: Total volume of 3,700 m^3;
- Town Site: Total volume of 4,600 m^3;
- WTDA: Total volume of 1,000 m^3; and
- Mobile Equipment: Total volume of 4,150 m^3.

The grand total of all waste with a 25% contingency added is 23,500 m^3.

Demolition debris and abandoned equipment volume will be reduced as much as possible prior to being placed in a storage location. This will minimize the number of trips and will better facilitate the loading of haulage trucks. The large amount of space available underground will make it possible to avoid handling the material more than once. In most cases trucks will dump directly into the allotted storage area and no further handling will be required. In areas where the height is limited, the material will be pushed up so that 60 to 75 percent of the space is utilized.

Several areas in the mine have been identified as potential storage areas. The areas selected for storage are in close proximity to the main haulage roads. A total of 345,000 m^3 of space is available for the storage of waste underground. There is clearly far more capacity than is required for the identified solid waste (23,500 m^3).

There are three areas available on surface, totaling 120,000 m^3, for the deposition of waste material. The East Open Pit and East trench will be filled with waste rock and metal contaminated soil, and the West Open Pit will be filled with a combination of Waste Rock, metal contaminated soil and inert demolition debris.

Demolition debris or abandoned equipment that is scheduled to be deposited in the West Open pit will be cut into pieces of size and shape that will minimize void spaces as fill material is layered over top.

6.14 G.17, ᐊᒃᑕᕐᕕᒃ ᒪᑐᔪᐅᓂᖓ ᐸᕐᓇᐅᑎ, Landfill Closure Plan

The report, *Nanisivik Mine Landfill Closure Plan* (the "Landfill Closure Plan"), provides the report requested under Part G, Item 17 of the Water Licence. The Landfill Closure Plan was prepared by Gartner Lee and is provided in its entirety as Appendix L and the Executive Summary is provided below for ease of reference.

6.14.1 ᓇᐃᒃᑖᕆᐊᕐᓯᒪᔪᑦ ᐅᖃᐅᓯᒃᓴᐃᑦ

ᒪᑐᔪᐅᓂᖓ ᓴᓗᒻᒪᖅᓴᕐᑕᐅᓂᖓᓗ ᐊᒃᑕᕐᕕᐅᑦ ᐃᒪᐃᑦᑎᖓᓂᐊᕐᑐᖅ:

- ᖃᓇᓂᐊᕐᑕᖓ ᓇᒪᕐᑎᐊᕐᓗᓂ ᐊᒃᑕᕐᕕᒃᒥᑦᑐᑦ ᐃᓗᑦᑎᖏᑦ ᖁᖓᓄᑦ ᓄᓇᒧᑦᓗ ᓱᕈᐸᓪᓚᐊᑦᑕᐃᑦᒪᑎᑕᐅᓗᓂ ᐊᑉᐱᑦᑎᓄᑦ
- ᖃᐅᔨᓴᕐᑕᐅᓗᓂ ᖃᖓ ᖃᓄᐃᑦᓕᓐᑦᑎᐊᖏᒃᑲᓗᐊᕐᒪᖓᑦ ᐊᑐᑎᖃᕐᑎᐊᕐᒪᖓᑦᓗ
- ᓂᕆᐅᓇᖏᑦᑐᒃᑯᑦ ᐸᕐᓇᐃᑎᖓ ᖃᓇᔭᖓ ᖃᓄᐃᑦᑲᓪᓚᒃᑐᕕᓂᐅᒃᐸᑦ.

(ᕿᒪᓇᒃᑳᓂᕐᒥᔭᖓ ᐃᓱᒪᓗᑎᑭᔭᐅᖃᑦᑕᕐᑐᑦ ᐃᓄᒃᓄᑦ ᐊᒃᑕᕐᕕᒃᒥᑦᑐᓄᑦ. ᐃᓄᐃᑦ ᑲᑎᒪᑎᑕᐅᑎᓪᓗᑭᑦ ᐃᒃᐱᐊᕐᔪᒃᒥ ᐃᓱᒪᓗᑎᖃᖃᑦᑕᓚᐅᕐᒪᑕ ᐊᒃᑕᕐᕕᐅᑦ ᑭᓱᑕᖃᕐᓂᖓᓂᒃ. ᐱᓗᐊᕐᑐᒥᒃ ᐃᓱᒪᓗᑎᑭᔭᐅᓪᓗᓂ ᐊᐳᑎᕐᑎᓈᓄᑦ ᐊᑦᑕᕐᓇᕐᑐᓂᒃ ᐱᑕᖃᕿᓱᑭᔭᐅᓪᓗᓂ. ᑕᒃᑯᐊ ᐃᓱᒪᓗᑎᑭᔭᐅᔪᑦ ᐱᔪᑕᐅᓗᑎᒃ ᖃᐅᔨᓴᕐᑕᐅᓚᐅᕐᑐᖅ ᐱᖓᔪᖓᓂ ᐊᐳᑎᖓᓂᒃ ᖃᐅᔨᓴᕐᑎᓪᓗᑎᑦ 2002 ᐊᒻᒪ 2003-ᒥ ᐊᒻᒪᓗ ᐅᖃᐅᓯᐅᒃᑳᓂᖔᓪᓗᑎᒃ ᑕᐳᓂ.

ᓇᓂᓯ%ᒃᒥᑦᑐᖅ ᐊᒃᑕᕐᕕᒃ ᐊᑲᐅᓇᕐᓯᒪᔫᒃᑯᑦ ᐊᒃᑕᕐᕕᐅᔪᖅ ᐊᑐᐃᓐᓇᕐᑕᐅᓯᒪᓪᓗᓂᓗ ᑕᐃᒪᖓᑦ ᐅᔭᕿᓂᐊᓕᓚᐅᕐᒪᑕ ᓄᓇᓕᖓᓗ ᓴᓇᔭᐅᑎᓪᓗᒍ 1975-ᒥᑦ. ᐊᒃᑕᕐᕕᒃ ᐅᖓᓯᒃᓂᖃᕐᑐᖅ 4-ᑭᓚᒥᑕᒥᒃ ᑕᓇᐅᕐᒥᑦ ᐊᑯᓐᓂᖓᓂᓪᓗᓂᓗ ᑯᒃᕕᐅᔪᑦ. ᐊᒃᑕᕐᕕᒃ ᓂᕈᐊᕐᑕᐅᓚᐅᕐᓯᒪᔪᖅ ᒪᓴᐅᖏᓐᓂᖓᓄᑦ. ᑯᖓ ᖃᓂᒋᔭᓂᑦᑐᖅ ᑕᐅᓄᖓ ᑯᒃᑐᓂ ᑕᓇᐅᕐᒧᑦ. ᐱᖃᑕᓗ ᑯᒃᑳᓂᖓ ᑕᓇᐅᕐᒧᐊᖓᒋᓪᓗᓂ ᑯᖓᓗ ᓴᓇᔭᐅᓯᒪᒋᓪᓗᓂ ᓴᕿᕐᑯᓯᒪᑭᐊᕐᓗᓂ ᐊᒃᑕᕐᕕᒃᒥᒃ.

ᐊᒃᑕᕐᕕᒃ ᐊᖏᓂᖃᕐᑐᖅ 4 Hᐃᒃᑕᐃᐅᒥᒃ ᐃᔪᓂᖃᕐᓗᓂ 2-ᒥᑕᒥᑦ 10-ᒥᑕᒧᑦ.

ᐅᔭᕿᒃᓯᐅᕐᑎᓪᓗᑭᑦ 1975-ᒥᑦ 2002-ᒧᑦ ᐊᒃᑕᕐᕕᒃ ᐊᑐᕐᑕᐅᖃᑦᑕᕐᓚᐅᕐᑐᖅ ᐃᓄᖏᓐᓄᑦ ᓴᓇᕕᒃᓄᑦ ᐊᓯᖏᓐᓄᓪᓗ ᐃᒥᑕᐅᔪᓄᑦ. ᐊᒃᑕᕐᑕᐅᕙᓪᓕᐊᔪᑦ ᓴᓕᒍᕐᑕᐅᕙᓪᓕᐊᖃᑦᑕᕐᓗᑎᒃ ᑭᒃᓕᖓᓄᑦ ᐃᑭᑕᐅᓚᐅᕐᓗᑎᒃ ᓯᓚᕐᑕᐅᓚᐅᕐᓗᑎᒃᓗ ᐊᒻᒪᓗ ᐊᑲᐅᓇᖅᖓ ᓴᐅᔭᐅᖃᑦᑕᕐᓗᑎᒃ ᑐᐊᐸᒃᒧᑦ ᕿᕐᓂᕐᑕᒧᑦ ᐊᑦᑕᕐᓇᖏᑎᑕᐅᓇᓱᒃᓗᓂ. ᖃᐅᔨᓴᕐᑕᐅᓚᐅᕐᑐᖅ ᑳᐳᖁ%/ᓅᑦ 1999-ᒥ ᐊᒻᒪᓗ

ᐃᓱᒪᒋᔭᐅᓪᓗᓂ ᐊᖏᓂᖃᕐᑐᒥᒃ 1,150 ᑭᐸᓇᒃᓯᓗᒍ ᒥᑕᒥᒃ ᐊᕋᒍᑕᒪᑦ ᐃᑭᓯᒪᓕᕐᑎᓪᓗᒍ. ᐊᖏᓂᕐᓴᐅᔪᖅ ᓴᓂᑦ ᓴᓇᕕᒃᒥᖓᕐᓯᒪᔪᑦ ᐊᒻᒪᓗ ᐃᒃᓗᒋᔭᐅᔪᓂᑦ.

1990-ᒥ ᐊᕿᒋᐊᕐᑕᐅᓚᐅᕐᑐᖅ ᐊᒃᑕᕐᕕᒃᒧᐊᕐᑕᐅᖃᑦᑕᕐᑐᑦ ᓱᕐᓗ ᑭᓂᕐᑐᐃᑦ ᐅᕐᓱᐊᓗᐃᑦ ᐅᕙᓗᓂᑦ ᓱᕈᕐᓇᕐᑐᐃᑦ ᐊᒃᑕᕐᕕᒃᒧᐊᕐᑕᐅᖃᑦᑕᕐᕈᓐᓂᕐᓗᑎᒃ ᑕᐃᒪᖓᑦ 1990-ᒥᑦ.

ᑐᐊᐸᒃᑕᕐᕕᐅᔪᖅ ᐊᕿᒃᑕᐅᓚᐅᕐᒥᔪᖅ ᖃᓂᒋᔭᓂᑦᑐᖅ ᐊᒃᑕᕐᕕᐅᑦ 2000%ᒥ ᑕᒪᒃᑯᐊ ᒪᖏᕐᑐᓇᔭᑦᑐᑦ ᓴᐅᔭᐅᖃᑦᑕᕐᓗᑎᒃ ᕿᔪᓕᓇ% ᒃᒥᖓᕐᑐᖅ ᑐᐊᐸᒃ ᐅᕐᓱᐊᓗᖃᕐᑐᖅ ᓴᐅᔭᐅᓚᐅᕐᓯᒪᔪᖅ. 2003- ᐱᖓᔪᖓᑦ ᖃᐅᔨᓴᕐᓂᕐ ᐊᕙᑎᖓᓂ ᐱᓕᓇᐊᖑᓚᐅᕐᑐᖅ ᖃᐅᔨᓴᕐᑎᓄᑦ ᐅᖃᓚᐅᕐᓗᑎᒃᓗ ᑐᐊᐸᒃ ᒪᓕᒃᓯᒪᓂᕋᕐᑕᐅᓪᓗᓂ ᒪᓕᒐᑎᒍ ᐅᕐᓱᐊᓗᖃᖏᓐᓂᓇᔭᓇᐊᖃᕐᑕᖓᓂ ᓇᓴᐅᑎᒃᑯᑦ

ᖃᐅᔨᓴᕐᑎᑦ ᖃᐅᔨᓴᓚᐅᕐᑐᑦ ᑭᖑᓕᕐᒥᒃ ᖃᐅᔨᓴᕐᓗᑎᒃ ᐊᕙᑎᖓᓂ 2002-ᒥ ᐸᕐᓇᐅᑎᐅᑦ ᐃᓚᖏᓪᓗᓂᐅᒃ. ᖃᐅᔨᓴᒃᑲᓐᓂᓚᐅᕐᒥᔪᑦ ᐱᖓᔪᖓᓐᓂᒃ ᐊᕙᑎᖓᓂ 2003-ᒥ. ᑲᑎᓪᓗᒋᑦ 14 ᖃᐅᔨᓴᕐᕕᐅᓚᐅᕐᑐᑦ. ᐃᓴᐅᑎᕙᓪᓕᐊᒻᒪᖓᓗ ᖃᐅᔨᓴᕐᑕᐅᓚᐅᓇᓪᓗᓂ 6-ᖑᔪᑦ ᖃᐅᔨᓴᐅᑕᐅᓗᓪᓗᑎᒃ. ᖃᐅᔨᓴᕐᓂᓇᓚᐅᕐᑕᖏᑦ ᐅᑯᓂᖓ ᑐᑭᓯᓚᐅᕐᑐᑦ:

1. ᐅᕐᓱᐊᓗᖃᓚᐅᖏᑦᑐᖅ ᑐᐊᐸᖓᓂᒃ ᐊᒻᒪᓗ ᐃᒥᖓᓂᒃ ᐊᒪᓗ ᐱᑕᖃᕐᓂᕋᓗᐊᖏᑦ ᒥᑭᓗᐊᕐᓗᑎᒃ ᒪᓕᒐᑎᒍᑦ ᑭᒃᓕᒋᔭᓇᐊᖃᕐᑕᖓ ᑐᖓᓂᓪᓗᑎᒃ.
2. ᓴᕕᒃᓴᕐᑕᖃᓚᐅᖏᑦᑐᖅ ᑐᐊᐸᖓᓂ.

ᐊᒃᑕᕐᕕᒃ ᐊᑐᕐᑕᐅᖏᓐᓇᕐᓂᖓᓄᑦ ᑕᐃᒪᖓᑦ 1975-ᒥ, ᑕᒃᑯᐊ ᖃᐅᔨᓴᕐᑕᐅᔪᑦ ᑐᑭᓯᓇᕐᑐᑦ ᓱᕈᕐᓇᕐᑐᕐᑕᖃᓗᐊᖏᓐᓂᖓᓂᒃ ᐊᒻᒪᓗ ᓱᕈᕐᓇᕐᑐᓚᓗᐊᑦ ᐊᓯᐊᓄᐊᕐᐸᓪᓕᐊᖏᓪᓗᑎᒃ.

ᓂᕈᐊᓇᔭᐅᓯᒪᔪᕐ ᓴᓇᒧᒪᓪᓗᑎᒃ ᖃᓕᕐᑕᐅᓗᓂ ᑐᐊᐸᒃᒥᒃ ᕿᕐᓂᕐᑕᒥᒃ ᓴᐅᔭᐅᓗᓂ ᖁᐊᖑᐃᓐᓇᕐᑎᑕᐅᓇᓱᒃᓗᓂ ᐃᓗᐊ ᐊᒃᑕᕐᕕᐅᑦ. ᓴᐃᓯᖃᑦᑕᕐᓯᒪᔪᑦ ᐊᓯᖏᓐᓂᒃ ᐅᕋᒃᓂᐊᕐᕕᒃᓂ ᖃᐅᔨᒪᔪᑕᐅᒃᒪᑕ ᖁᐊᖑᐃᓇᓱᖑᓂᖓᓂᒃ ᓴᐅᓯᒪᓕᕋᖓᑕ ᑕᒪᓂ ᐅᑭᐅᕐᑕᕐᑐᒥ. ᕈᐊᖑᐃᓐᓇᕐᓂᐊᕐᓂᖓᓄᑦ ᐊᓂᕙᓪᓕᐊᔪᓐᓇᕐᐳᐊᖏᑦᑐᕐ ᓱᕈᕐᓇᕐᑐᓂᖓ ᐊᒃᑕᕐᕕᒃᒥᑦ.

ᐊᕿᒃᓱᕐᑕᐅᓪᓗᓂ ᖃᒃᓴᖓ ᐅᑯᐊ ᐃᓱᒪᒋᔭᐅᓚᐅᕐᑐᑦ.:

- ᐃᔪᓂᖓ ᖃᖓᑕ/ ᓂᒃᓕᓇᐃᓐᓇᕐᑎᑦᑎᔪᓐᓇᕐᓂᖓᓗ
- ᐱᑕᖃᕐᓂᖓ ᑐᐊᐸᒃ
- ᐱᓴᐅᑎᕙᓪᓕᐊᓚᔭᕐᓂᖓ
- ᓯᕕᖓᓂᖓ
- ᓄᖑᐸᓪᓕᐊᓂᖓᓗ

ᑕᒃᑯᐊ ᐃᓱᒪᒋᔭᐅᓪᓗᑎᒃ, ᐊᕿᒃᓯᓚᐅᕐᑐᑦ ᖃᓄᐃᓕᖓᓂᐊᕐᒪᖓᑦ ᖃᖓ ᐅᑯᓂᖓᓗ ᒪᓕᒃᓂᐊᕐᑐᑦ:

1. ᓯᕕᖓᓂᖓ 2-ᒥᓪᓗᓂ
2. ᒪᑭᒃ ᖃᓇᓗᑎᒃ ᑐᐊᐸᒃ ᐊᐳᒋᖏᑦᑐᒃ ᐱᖃᑕ ᕿᕐᓂᕐᑕᖅ ᐱᖃᑕᓗ ᓯᐅᕋᖅ
3. ᖃᖓᓂᓚᖑᔪᕐ ᓯᐅᕋᕐ ᓄᖑᔭᖏᓪᓗᓂ ᓄᖑᐸᓪᓕᐊᖏᓪᓗᓂᓗ ᐃᔪᓂᖃᕐᓗᓂ 0.25-ᒥᑕᒥᓂᒃ
4. ᐊᑕᓂᓐᓂᕐᓴᕐ ᕿᕐᓂᕐᑕᕐ ᑐᐊᐸᒃ ᐃᔪᓂᖃᕐᑐᖅ 1.95-ᒥᑕᒥᒃ ᑲᑎᓗᒍ ᖃᖓ ᐃᔪᓂᖃᓕᕐᓗᓂ 2.20-ᒥᑕᒥᒃ. ᐅᔭᕋᐅᓂᖏᓪᓗ ᐊᖏᓂᖏᑦ ᒥᑭᑦᑐᑎᐅᓪᓗᑎᒃ.

ᐱᓕᕆᐊᖑᒃᑲᓂᕐᓂᐊᕐᑐᑦ ᐊᒃᑕᕐᕕᒃ ᒪᑐᔭᐅᓇᓱᒃᑐᓂ ᐅᑯᐊᖑᔪᑦ.

1. ᑐᐊᐸᒃ ᐅᕐᓱᐊᓗᖅᑐᑦ ᓴᐅᔭᐅᓗᓂ ᓄᓇᐅᑦ ᐃᓗᐊᓄᐊᕐᖅᑕᐅᓗᓂ.

2. ᐊᕿᒃᓱᕐᓗᑎᒃ ᖃᐅᔨᓴᕐᓂᐅᓂᐊᕐᑐᒥᒃ.

3. ᖃᐃᖅᑲᒃᓴᕐᑕᐅᓗᓂ ᖃᖓ ᒪᓴᐅᖅᑲᑦᑕᕈᓐᓂᕐᑎᑕᐅᓗᓂ.

4. ᐃᓕᔭᐅᓗᓂ ᕿᕐᓂᕐᑕᕐ ᑐᐊᐸᒃ

5. ᐱᓕᔭᐅᓗᓂ ᓯᐅᑫᕐ ᖃᖓᓄᑦ

6. ᐳᓂᑲᕐᓯᒪᔪᓂᒃ ᓴᓇᔭᐅᓂᖓᓂᒃ ᑎᑎᕋᕐᓗᑎᒃ.

ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᒪᑐᓯᒪᓕᕐᑎᓪᓗᒍ ᖃᓄᐃᓕᖏᓪᓕᐊᒃᒪᖓᑦ ᖃᐅᔨᓴᕐᑕᐅᖅᑦᑕᕐᓗᓂ ᐊᕋᒍᒃᓄᑦ ᒪᕈᒃᓄᑦ ᓴᓗᒻᒪᕐᓴᐃᑎᓪᓗᒋᑦ ᐊᒪᓗ ᐊᕋᒍᓄᑦ ᑕᓪᓕᒪᓄᑦ ᖃᐅᔨᓴᕐᑕᐅᓗᓂ.

ᖃᕆᔭᖓ ᖃᓄᐃᓕᑲᓪᓚᒃᑐᕕᓂᐅᒃᐸᑦ ᐸᕐᓇᐅᑎᖅᑭᔪᑦ ᖃᓄᐃᑦᐅᓚᔪᕐᓂᖓᓂᒃ ᖃᓄᕐᓗ ᑲᒪᒋᔭᐅᒋᐊᖃᔪᕐᒪᖓᑦ ᐅᑯᐊᖑᔪᑦ:

- ᖃᐅᔨᓴᕐᓂᖓ ᕿᓚᒻᒥᐅᓂᖅᓴᐅᓕᕐᓗᓂ ᕿᒥᕈᔭᐅᓂᖓᓗ ᕿᓚᒻᒥᐅᓂᖅᓴᐅᔪᒃᑯᕐᓗᓂ
- ᓴᓇᔭᐅᓗᓂ ᐱᐅᔫᓂᕐᑐᖅ
- ᖃᓕᕐᑕᐅᒃᑳᓂᕐᓗᓂ ᑐᐊᐸᒃᒥᒃ
- ᖃᐅᔨᓴᕐᑕᐅᓂᖓ ᐅᖓᕙᓂᐊᒃᑳᓂᕐᓗᒍ

ᓯᓚᒻᒧᑦ ᐊᓂᐊᕙᓪᓕᐊᓚᔪᕐᓂᖓ ᖃᐅᔨᓴᕐᑕᐅᓂᐊᕐᑐᖅ. ᐊᓂᐊᕙᓪᓕᐊᑲᓪᓚᒃᓂᕐᐸᑦ ᓇᓗᓇᐃᕐᑕᐅᓗᓂᓗ ᖃᐅᔨᓴᐅᑎᒃᑯᑦ ᐅᑯᓂᖓ ᐱᒋᐊᒃᑳᓂᕋᔪᕐᑐᑦ:

- ᐱᔪᕐᑎᑕᐅᒃᑳᓂᕐᓗᓂ ᖃᖓ ᑐᐊᐸᒃᒥᒃ ᐃᓕᕆᔭᐅᒃᑳᓂᕐᓗᓂ
- ᐊᓂᐊᕙᓪᓕᐊᓂᖓ ᐊᕿᒋᐸᕐᑕᐅᓗᓂ
- ᖃᐅᔨᓴᐅᑎᓂᒃ ᐃᓕᕆᒃᓱᕐᓗᑎᒃ
- ᐊᓱᐊᓄᓪᓗᓐᓂᑦ ᐃᓕᐅᖅᑕᐅᓗᓂ
- ᖃᐅᔨᓴᕐᑕᐅᕙᓪᓕᐊᒃᑳᓂᕐᓗᓂ ᐊᓂᐊᕙᓪᓕᐊᓂᖓ

6.14.2 Executive Summary

The technical objectives of the landfill closure plan are to provide:

- A closure cover design that satisfies the overall objective of isolating landfill material from the environment;

- A performance monitoring plan that allows the ability to assess the effectiveness of the landfill cover; and
- A contingency plan in the event the landfill cover does not perform in an acceptable manner

A further objective of the Landfill Closure Plan is to address community concerns and perceptions. During the public consultation process for mine closure, the Community of Arctic Bay raised concerns regarding the status and closure of the landfill facility. Specifically, the concerns focus around the potential for environmental contamination from the waste materials contained within the facility. These concerns were considered in the Environmental Site Assessment investigations that were conducted in 2002 and 2003 and are addressed further herein.

The Nanisivik landfill is a conventional landfill facility that has been in operation since the mine and town were constructed in 1975. The facility is located approximately 4 km south of Strathcona Sound on a local topographic high/divide (approximately 350 masl) between two drainage directions, northeast and northwest. This site location was selected to minimize drainage through the facility. The northeast drainage path is intermittent in nature and reports to Strathcona Sound via Twin Lakes Creek. The northwest drainage path reports to Strathcona Sound via a small meadow/marsh area. Drainage from the facility naturally preferentially drains to the northwest and this flowpath is promoted by the presence of a water diversion berms designed to divert water in this direction.

The landfill facility occupies an area of approximately 4 ha and ranges in thickness from about 2 m to approximately 10 m.

During the period of mine operations from 1975 to 2002, the facility received waste from residential, institutional, industrial, and other miscellaneous waste streams. Waste materials were typically end dumped and pushed over the advancing crest after burning and crushing, as appropriate, and were subsequently covered with shale rock to maintain a safe working area and to minimize wind dispersion. An assessment conducted by CanZinco in 1999 estimated the waste stream volume to be 1,150 m^3 per year (after burning). The majority (75%) of the waste stream was characterized as institutional and domestic.

In 1990, a substantial amendment to the operating practices of the landfill was instituted that eliminated the disposal of any used oils, glycols or lead-acid batteries as had been common practice at industrial and municipal landfill facilities prior to 1990.

A landfarm cell, internal to the landfill facility was established in 2000 as a means of remediating hydrocarbon contaminated soil that had been excavated from a spill of diesel fuel at the carpenter shop in the town area. The 2003 Phase 3 Environmental Site Assessment ("ESA") conducted by Gartner Lee for CanZinco indicated that approximately 25% of the soil in the landfarm cell met current federal guidelines for petroleum hydrocarbons in soil.

Gartner Lee Limited conducted a Phase 2 ESA of the mine property for CanZinco in 2002 as part of the closure planning activities. This work was followed up with a Phase 3 ESA in 2003. A total of 14 test pits were excavated in the landfill area. Seepage sampling wells were installed in six of these test pits that encountered water. One seep that emerged at the toe of the landfill in the vicinity of the southwest berm was sampled. The Phase 3 ESA provided the following conclusions regarding the landfill:

1. No hydrocarbon contamination was detected in soil or water samples down gradient or cross gradient of the landfill and all analyses were less than the method detection limits; and
2. No elevated metals were encountered in the soils.

Given that the landfill has been in operation since 1975, these results are considered to provide a positive indication that contaminants have not migrated from the landfill facility.

The selected approach to closure of the Nanisivik landfill is to construct a thermal barrier cover of locally available, natural materials that makes use of the natural thermal regime at the mine site to achieve the reclamation objectives. This design approach has been successfully used for landfill closures at other northern mine sites in the Canadian Arctic. Since the waste will be permanently frozen, there will be no opportunity for contaminants to migrate from the landfill.

The geotechnical issues considered in the design include:

- cover thickness/thermal performance;
- availability of materials;
- infiltration;
- durability;
- gradation/filtration;
- slope stability; and
- erosion.

Based on these considerations, the proposed design of the cover for the landfill facility is as follows:

1. The top slope of the final landfill surface will be about 2 ° and the maximum sideslope of the landfill will be 18 ° (3H:1V);
2. A two-layer thermal cover with a total thickness of 2.20 m will be placed above the landfill waste;
3. The upper erosion-resistant capping layer shall consist of a durable, erosion resistant material with a thickness of 0.25 m. The selected material is the Twin Lakes sand and gravel; and
4. The underlying layer will be shale with a thickness of 1.95 m to provide a minimum total thermal cover thickness (in combination with the surface layer) of 2.20 m. A grain size guideline (grain size

distribution ranging from well-graded gravel to fine to medium sand) has been provided. It is recommended that the shale material be durable under freeze-thaw conditions.

Activities to be completed as part of the landfill closure are outlined below.

1. Relocate soil in the landfarm cell that exceeds the remedial objectives for petroleum hydrocarbons to the underground mine according to the Underground Mine Waste Disposal Plan;
2. Develop and implement a construction quality control program, which should include materials testing, survey control, and construction monitoring;
3. Grade the existing surface according to the design drawings to prepare a reclamation surface that does not exceed 3H:1V slope;
4. Construct the lower (shale) layer of the final cover;
5. Construct the upper (Twin Lakes sand and gravel) layer of the cover over the shale and groom the final surface to avoid potential surface channelization of runoff water; and
6. Prepare an as-built report.

Performance monitoring to monitor the effectiveness of the closure design will be conducted throughout the 2- year active reclamation period and the 5-year post-closure period. Components of that monitoring will include surface and ground water sampling and analyses, geothermal monitoring, and physical geotechnical inspections.

In the event that the cover does not perform a number of contingencies have been developed. These include:

- increased frequency of sampling/monitoring and data review by the technical professional;
- repair any erosion of the cover;
- place additional cover material to increase the cover thickness; and
- extend the period of performance monitoring.

The risk that contaminated leachate will be observed at the reclaimed landfill facility is considered to be small. Nonetheless, in the unlikely event that contaminated leachate is observed and confirmed by increased sampling and other investigations, the mitigative measures that would be considered would include:

- increasing the cover thickness over all or parts of the facility;
- passive treatment along the seepage flowpath;
- installation of a geosynthetic or GCL liner over all or portions of the facility;
- relocation of portions of the waste materials; and, ultimately
- installation and operation of a leachate collection system.

6.15 Contaminated Soil Volumes

An estimate of the volume of contaminated soil that requires remediation has been developed by Gartner Lee. A technical memorandum summarizing the estimates is provided in Appendix M.

This information is also incorporated into the descriptions of reclamation activities provided in Section 7.

7. Proposed Reclamation Activities

7.1 West Twin Disposal Area

7.1.1 Objectives and Approach

The West Twin Disposal Area (WTDA) is the tailings containment facility located in the previous West Twin Lake.

The specific reclamation objectives for the WTDA are:

1. to minimize the risk of acid rock drainage and metal leaching from the tailings; and
2. to provide for a safe surface environment that resembles the natural conditions.

The general approach to achieving the first reclamation objective for the WTDA is to provide a thermal barrier cover over tailings in the Surface Cell and Test Cell areas such that they become frozen into permafrost and to provide a water cover over tailings in the Reservoir such that they are safely protected from oxidation.

The general approach to achieving the second reclamation objective for the WTDA is to utilize local, natural materials for reclamation and to return the Reservoir pond to the original elevation of West Twin Lake.

The proposed reclamation plan for the WTDA provides the required environmental protection and land use values. The reclamation plan uses natural northern elements that do not require the presence, and long term maintenance, of water retention dams or water treatment facilities as many other mine sites must do.

The proposed reclamation activities and rationales for specific components of the WTDA are described in the following sections:

1. Surface Cell and Test Cell Areas;
2. West Twin Dike Spillway;
3. West Twin and Test Cell Dikes;
4. Reservoir / Polishing Pond;
5. East Twin Lake; and
6. Other Facilities.

A Water Quality projection for water exiting the Reservoir into Twin Lakes Creek has been developed and is also described below.

The primary reference documents for detailed technical support of the information presented in the following sections are the WTDA Closure Plan (G.15) and the Spillway Report (G7). Several other reports also contain specific technical support information that is also directly relevant to reclamation of the WTDA: the Covers Report (G.4); the Talik Report (G.5) and the Quarries Report (G.6).

7.1.2 Surface Cell and Test Cell Areas

Current Conditions

The operating plan for tailings deposition in the Surface Cell was designed to encourage continuous freezing of the settled tailings and pore water by placing successive thin layers of tailings behind the West Twin Dike. The "end-of-pipe" locations for deposition of tailings were managed in such a manner that surface runoff flowed to a depression near the southeast corner of the Surface Cell where a syphon was used to transfer water into the Reservoir.

At the end of the 2003 decant season, a limited amount of ponded water remained on the Surface Cell. This is a combination of residual water from the tailings deposited during operations in 2002 and runoff water which collects in the low points on the surface. Some of this accumulated water was syphoned and pumped to the Reservoir in 2003, thereby reducing the heat sink in the Surface Cell and promoting frost penetration. However, a decision was made to preserve two small ponded areas until the talik freezeback modelling was completed. In this way, unforeseen pore pressure build-up would have an outlet. Modeling is now complete (per the Talik Report) and all remaining water will be removed from the Surface Cell in 2004.

The majority of the sub-aerial (surface) tailings in the Surface Cell is covered by a layer of shale that was applied as part of the mine operating procedures to provide dust control. This shale was not placed with the intent of being part of the long term reclamation cover and although it will remain in place, it will not be considered as part of the required closure cover thickness. It will however provide a clean working base for the cover installation (as opposed to working directly on tailings). It should also be noted, that this shale will impart additional insulating capacity to the cover and provides an additional factor of safety not included in the design intent.

The operating plan for tailings deposition in the Test Cell Area used the same "thin successive layer of placement" methodology as was used in the Surface Cell. In later operating years, a pump was used to transfer water into the Reservoir.

The Test Cell area is currently largely covered (2/3 of the surface area) with a shallow water pond behind the Test Cell Dike. The tailings surface is undulating but generally slopes inwards to form a shallow pool. Runoff water that accumulates in this shallow pool evaporates and infiltrates into the tailings such that there is no surface outflow from the area. Runoff water can more easily infiltrate into the tailings in this area because much of this area have been under a shallow water cover for in excess of 5 years which has prevented their freezing.

The specific reclamation objective for the Surface Cell and Test Cell areas is to provide a thermal barrier cover that maintains the tailings in a frozen and isolated state using natural materials.

Surface Cell Talik

A talik exits within a portion of the Surface Cell that extends through the original lake bed sediments to bedrock. The size of the talik has been determined from drill information gathered in 2002 and 2003 and by ongoing monitoring of geothermal instrumentation (thermistors, thermcouples and frost gauges). The presence of the talik is due to the mine operating activities and, specifically, the need for a water filled depression to collect water from the tailings slurry in one depression for syphoning into the Reservoir.

Given the cessation of mine operating activities, the talik is expected to freeze back. Freezeback is anticipated to progress primarily from the surface downwards although some lateral permafrost aggradation will also occur. The reclamation issues related to freezeback of the talik are the possible increases on pore pressure that may cause pingos or other deformations on surface or in the West Twin Dike and the possible expulsion of tailings porewater. The Talik Report provides an assessment of the potential for these occurrences.

The potential for pingo formation during freezeback of the talik is considered unlikley because of the rapid downward progression of permafrost (observed in the geothermal instruments in the Surface Cell). Other, more minor, surface deformations may occur, however, during the early stages of freezeback of the shallow saturated materials. These would be identified and repaired.

Excess pore pressures (from expulsion of porewater) that will be developed as the talik freezes could possibly migrate to the Reservoir or the Reservoir talik if a hydraulic connection developed in this direction at depth. However, there are currently no indications of such a connection and it is considered more likely, given the general absence of any likely hydraulic connections at depth, that the pore pressures and associated freezing point depression may result in the formation of a *cryopeg* at depth. A cryopeg is defined as a talik zone which has high solute concentration and associated depressed freezing point.

Observations from site geothermal instrumentation indicates freezeback of the tailings to a depth of 4 to 5 metres occurs after one year. The timeframe for freezeback of the talik to various depths has been modelled and documented in the Talik Report. The projected timeframe for freezeback suggests that freezing from the active layer to a depth equivalent to the base of the West Twin Dike will require in the order of 7 to 8 years. Freezing of the talik to this depth is suggested as representing substantive reduction of the risks to the West Twin Dike. The projected timeframe for complete freezing from surface to the old lake bottom is in the order of 28 to 30 years.

Test Cell Area Talik

A talik is assumed to exist beneath much of the Test Cell area to bedrock. Inaccessibility caused by the shallow water cover prevented a drilling investigation, as was done for the Surface Cell talik. However, the presence of a talik is considered likely given the proportionally greater area covered by water as compared to the Surface Cell. This talik is considered to have a direct hydraulic connection with the Reservoir because of the known thawed zone directly beneath the containment dikes.

Freezeback of the Test Cell talik is anticipated to occur subsequent to reclamation. The projected timeframe for freezeback of the Test Cell talik following reclamation is assumed to follow the same trends described above for the Surface Cell talik.

The risk of excess pore pressures during freezeback causing pingo formation or other deformations of the Test Cell surface cover or the Test Cell Dike is considered very low. This is because of the hydraulic connection to the Reservoir pond talik at depth, which will serve as a pressure release pathway. This also suggests that porewater from the Test Cell talik is most likely to be expelled into the Reservoir during freezeback.

Reclamation Activities

The Surface Cell and Test Cell areas are proposed to be reclaimed in the same manner, given their similarities. Fundamentally, both areas contain tailings that have been deposited, as allowed for in the Water Licence, at an elevation that precludes water cover. In fact, the proposed thermal barrier cover is suggested as being superior to a water cover at closure in that water retention structures are not required in the long term.

The sequence of activities proposed for these areas is as follows:

1. Removal of residual surface water.
   This will be accomplished by pumping and syphoning water to the Reservoir.
2. Preparation of the tailings surface.
   This will create a smoother surface approximate the design final surface contour and provide positive drainage to the Surface Cell spillway. This will be accomplished by grading the existing tailings surface and/or infilling surficial depressions with select native materials (including strippings from construction and borrow areas or bulk shale).
3. Placement of a minimum thickness of 1.0 m of shale.
   The surface of the shale will achieve the design surface contours, designed to provide positive drainage to the Reservoir.

4. Placement of a minimum thickness of 0.25 m of Twin Lakes sand & gravel.
   The final capping surface will achieve the final design surface contours, to provide positive drainage to the Reservoir.
5. Installation of geothermal monitoring instrumentation.
   The performance monitoring network has been strategically designed to collect information on the performance of the cover.

The final surface contours for each area are illustrated on Figure 13 and presented more fully in the Covers Report. In summary, final contours provide positive drainage at a minimum grade of 0.5% from all areas of the Surface Cell to the southeast corner, the proposed location of the spillway inlet. The design final contours for the Test Cell provide positive drainage at a minimum grade of 0.5% to the Reservoir.

The rationale for the design thickness and configuration of the thermal barrier cover (1.0 m of shale overlain by 0.25 m of Twin Lakes sand & gravel) is fully described in the Covers Report. In summary, shale is preferred for use as the bulk of the thermal barrier and Twin Lakes sand & gravel is preferred for use as a durable surface “cap”. The thermal properties of the two materials are similar and the full cover thickness (1.25 m) is designed to ensure that the tailings remain frozen and isolated even under the worse-case 100-year climate warming projection (Environment Canada) and the 100-year return period warm year.

In addition to providing for continual subzero ground temperatures within the tailings, a saturated frozen zone is anticipated to form at the base of the active layer such that the tailings will be physically isolated from atmospheric oxygen and runoff water. This phenomenon has been directly observed in the long term test covers that have been operated at the mine site, as described in the Covers Report.

The availability and source of reclamation materials is described in the Quarries Report. The proposed source locations for shale are the West Twin, Mt. Fuji and East Twin Quarries. The Twin Lakes sand & gravel deposit, located between East and West Twin Lakes, is the sole source of Twin Lakes sand & gravel.

The performance monitoring program is described fully in the WTDA Closure Plan and in the Monitoring Plan. In summary, a network of boreholes containing thermistor and thermocouple monitors will be installed to track the freezeback of the taliks, and to monitorthe West Twin Dike and the general thermal performance of the cover. Vibrating wire piezometers will be installed to monitor porewater pressures. Groundwater monitoring wells equipped with heat trace will be installed to monitor groundwater quality and piezometric pressures as the talik freezes. Some of the current network of monitoring instrumentation is also useful for these purposes and provides the added benefit of continuity across the reclamation period. Select instrumentation is identified and efforts will be made to preserve these instruments in an operable condition throughout the reclamation activities.

7.1.3 West Twin Dike Spillway

A spillway to safely convey surface flow from the Surface Cell into the Reservoir is required. This was not a requirement while the mine was operating because water in the Surface Cell was pumped or syphoned over the West Twin Dike. For closure of the WTDA, however, a passive system that does not require long term maintenance or operation will be constructed.

The specific objective for the spillway is to convey surface water from the Surface Cell into the Reservoir pond, with consideration of long term flood events and physical stability of the structure. The proposed location of the spillway is illustrated on Figure 13.

The proposed engineering design of the spillway, as prepared by Golder Associates, is described fully in the Spillway Report. In summary, the key design features are as follows:

1. Sized to safely pass the Probable Maximum Flood (PMF) event;
2. Bottom width is a nominal 6 m;
3. Depth ranges from 1 m to 7 m;
4. Total length is 565 m;
5. The length seated in bedrock has been maximized (+90%);
6. Rip rap protection, with bedding and filter layers, is provided; and
7. Energy dissipation plunge pool at the bottom of the spillway.

Construction of the spillway will involve the excavation of soil and rock “strippings”, including overburden, frost shattered bedrock and bedrock. These strippings may be used as fill in other reclamation areas, if they meet the material specifications for those areas. For example, the strippings may be suitable for use as bulk fill for filling surficial depressions in the Surface Cell prior to placement of the shale cover or as rip rap. Alternately, the strippings may be reclaimed in a proximal, shallow-graded pile.

Construction of the upper section of the spillway will be scheduled to commence subsequent to completion of the grading of the tailings surface in the Surface Cell. This sequencing of events will allow the elevation of the inlet into the spillway to be field verified as corresponding with the final tailings surface that is achieved in the field.

Construction of the lower section of the spillway will be scheduled for the period when the Reservoir pond water level has been drawn down to below its final design elevation. This will allow construction of the outlet area to be completed in the dry and will also serve as a construction mitigation measure. Construction of the spillway is likely to result in the temporary generation of suspended sediment into the

Reservoir. However, with the Reservoir pond level drawn down to below overflow, increased retention time will be provided for settlement of suspended sediments prior to the controlled release of effluent.

7.1.4 West Twin and Test Cell Dikes

The West Twin and Test Cell Dikes are constructed of tailings and shale and were designed for permanent retention of the tailings solids. Both dikes contain geothermal monitoring instruments. Thermocouples and thermistors have and will continue to be used to monitor the subsurface geothermal regime of the dikes and their foundations. The WTDA Closure Plan contains a full description of the physical configuration of the dikes and their current geothermal conditions.

The WTDA Closure Plan also includes a professional assessment of the physical stability of the West Twin Dike, the Test Cell Dike and the associated sloped reclamation cover. The assessment is an update to a similar stability assessment that was presented in the February 2002 Closure Plan. The current assessment considers both static and seismic loading conditions for the 1 in 1,000 year earthquake event. Additionally, artesian pore pressures at depth were considered for the assessment of the West Twin Dike. For all cases considered, both of the dikes and the sloped reclamation cover had Factors of Safety greater than required guideline values for long term safety.

The dikes are not required to retain water for the closure and, therefore, do not require any design modifications from their current configurations. The reclamation work that is proposed for the dikes is to slope the downstream faces to a grade not steeper than 3H:1V. It should be noted however that progressive reclamation work to date has graded the West Twin Dike to 3.7H:1V, flatter than the closure design specification.

All dike faces will be capped with a minimum 0.25 m of Twin Lakes sand & gravel. This surface will serve the same design purpose for long term physical durability as is proposed for the thermal barrier covers over tailings in the Surface Cell and Test Cell areas.

The sloping and capping work can be scheduled at any time during the reclamation period when equipment and other requirements are available.

7.1.5 Reservoir / Polishing Pond

Current Conditions

The Reservoir pond contains both sub-aerial (surface) and sub-aqueous (underwater) tailings. A portion of the sub-aqueous tailings are covered with less than 1 m of water (littoral areas). However, there are also deeper areas in the Reservoir which have water depths of 8 to 9 m (Figure 13). Throughout the operations history, this configuration has not resulted in chronic problems of suspended tailings solids from ice effects (scour or ice pluck), wave actions or frost effects in the littoral area.

The Polishing Pond is located immediately downstream of the Reservoir pond, and is separated by the East Twin Lake access road causeway.

The Reservoir pond and the Polishing Pond are hydraulically connected via culverts in the access road causeway. A primary decant structure equipped with stop logs is located upstream of the culverts into the Polishing Pond to provide additional treatment if required. This system was used regularly prior to 1990 (the construction of the Surface Cell) to address marginal water quality, but has not been used since. This is because the Surface Cell configuration, with its primary decant system, greatly improved water quality after its commissioning in 1990.

The water level in the Reservoir and Polishing Pond is currently manually controlled at the Polishing Pond outlet. The nominal and typical water level in the ponds is 371 m asl (+/- 0.5 m), approximately 1 m above the natural elevation of the outlet of West Twin Lake.

A baffle dike is located immediately upstream of the Polishing Pond inlet, constructed of end-dumped rock fill. The baffle was constructed to act as a flow through structure that would enhance retention and improve water quality. This was constructed prior to 1990 to address marginal water quality issues, but became redundant after the construction of the Surface Cell and was breached. The crest of the baffle is approximately 372 m asl.

Approach to Reclamation

The reclamation objectives for the Reservoir are to maintain water cover over tailings in a passive system that does not require long term maintenance, such as water retention dams or manually operated outlet structures.

The Reservoir/Polishing Pond area will be reclaimed by restoring the water level to the natural outlet elevation and relocating tailings within the Reservoir to greater than 1 m below the ultimate water elevation, to as great a degree as practical, as described below under the heading "Reclamation of Reservoir Pond Perimeter". This approach continues to provide the long term benefits of water cover without the need for water retention dams or manually operated outlet structures.

The baffle dike will remain in place, but will be further breached to 0.5 m below the ultimate pond water level. The dike will not obstruct flow within the reclaimed pond but will provide the possible additional benefit of increased retention of solids in the unexpected event of a sudden influx of high suspended sediment loads into the pond. It may also prevent ice pans from entering the Reservoir outlet area.

The East Twin Lake access road causeway will be substantially breached to the degree where free flow between the Reservoir and Polishing Pond portions of the area is unobstructed. The only purpose for this access road was to provide vehicle access to the East Twin Lake fresh water pumping station and this access is no longer required.

The existing Polishing Pond outlet structure and the East Twin Lake access road causeway will remain in place while the primary reclamation activities are completed (i.e., contouring and construction of covers, spillway construction, relocating tailings, etc.). This will provide the opportunity to retain water in the reservoir and Polishing Pond, as a contingency provision in the unlikely event that additional retention or treatment is required.

After completion of the primary reclamation activities in the 3rd quarter of 2005, water quality trends will be reviewed. If trends are as expected and the potential need for water treatment is determined to be unlikely, then the "operating" outlet structure with its water retention capacity will be removed and construction of the "closure" outlet will proceed. At this time, the access road causeway will be breached to 0.5 m below the normal water level. This will allow unimpeded flow between the Reservoir and the Polishing Pond.

Reclamation Sequence

The Reservoir/Polishing Pond area will be reclaimed as a surface water pond returned to the original outlet elevation of West Twin Lake. Tailings will be submerged to greater than 1 m depth, except on certain perimeter areas as described below, which is a proven technology for prevention of oxidation of tailings. The 1 m water cover will provide protection of the tailings from wave action as the greatest wave depth has been calculated to be 0.4 m under extreme conditions. The pond level has been estimated to increase by 0.6 m under an extreme (PMF) flood event.

The sequence of activities proposed for this area is as follows:

1. Lower Reservoir and Polishing Pond water level to approximately 368 m asl (i.e., >2 m below the ultimate water level and >1 m below the design maximum elevation of tailings);
   This will be accomplished by pumping to the decant structure.
   Activities 2 through 8, below, are to be completed while the water level is lowered.
2. Relocate tailings “high spots” in the Reservoir to below 369.2 m asl;
   This may be accomplished by hydromonitoring and/or concussive blasting of peaks in the tailings profile using the lowered water elevation as the benchmark.
3. Relocate tailings in littoral areas to below 369.2 m asl;
   This may be accomplished by pushing the tailings from shore with a bulldozer or excavation/pushing with a smooth edged bucket.
4. Place rip rap cover over tailings in perimeter areas below the toes of the West Twin and Test Cell Dikes;
   This will be accomplished using heavy equipment to place and spread materials.
5. Breach the baffle dike to 0.5 m below the normal pond water level;

This will allow unimpeded flow across the dyke.

6. Construct the lower section of the West Twin Dike Spillway and inlet structure;
   This task is described above under West Twin Dike Spillway.
7. Allow natural runoff to fill the pond to overflow at 370.2 m asl; and
   Water quality will be monitored to ensure compliance with Water Licence guidelines.
8. Construct the Reservoir/Polishing Pond outlet channel and breach the East Twin Lake access road causeway to 0.5 m below the normal pond water level.
   The outlet channel is to have a 7m wide base at 370.2 m asl and safely pass the PMF flood.
   The causeway breach will allow unimpeded flow between the Reservoir and Polishing Ponds.
   This task will be completed after acceptable water quality has been demonstrated, requiring lowering of the pond water level a second time for construction.

Reclamation of Reservoir Pond Perimeter

The perimeter of the Reservoir pond could be viewed, for the purpose of the reclamation activities, in three sections: the toe of the Test Cell Dike, the toe of the West Twin Dike; and the remainder of the perimeter.

For the perimeter other than the toe of the dikes, it is possible that some tailings are present above or near the ultimate water level of 370.2 m asl. In these areas, tailings will be pushed, by bulldozer or backhoe, to below 369.2 m asl to provide at least 1 m water cover. This will ensure that tailings in these areas will not be susceptible to mobilization by wave action, calculated to reach a depth of 0.4 m under extreme conditions as reported in the WTDA Closure Plan.

An observational approach is planned to monitor for any physical movement of tailings from the shoreline areas by ice action. This was not an environmental issue of concern through the life of the mine and is not considered to represent an environmental concern for reclamation. The pond perimeter will be specifically monitored as part of the annual inspection by the geotechnical engineer such that remedial actions can be implemented, if necessary, to maintain acceptable water quality flowing from the Reservoir/Polishing Pond.

For the perimeter below the West Twin and Test Cell Dikes, tailings are exposed substantially above the ultimate water level (370.2 m asl). In the case of the Test Cell Dike area, tailings rise to an elevation of approximately 371 m asl, the nominal elevation of the tailings beach upon which the Test Cell Dike is seated. In the case of the West Twin Dike, tailings are present in a relatively flat-sloped beach that extends from the pond edge to the toe of the dike, a distance of some 150 m. Within these two areas, it is estimated that there are more than 100,000 m^3 of tailings above the closure water elevation in the Reservoir. Therefore, it is impractical to consider removing all of this material.

In the long term, permafrost aggradation is anticipated to progress towards the perimeter of the Reservoir pond to the point where permafrost forms around the pond shoreline proximal or below the pond water level. This phenomenon is commonly observed in natural conditions in the north where a lake has a shallow sloping shoreline (MacKay 1962). Permafrost can generally form to a shoreline depth under water equivalent to approximately 2/3 of the typical thickness of ice. In the summer thaw season, the shoreline at the waters edge does not thaw and the lake bottom sediments may not thaw until a depth greater than 2/3 of the typical ice thickness is reached. Should this occur around the perimeter of the Reservoir Pond, as is expected, littoral tailings will be subject to permafrost aggradation. However, given that the timeline for this to occur is currently unknown, reclamation efforts are required to protect against oxidation of tailings and transport of contaminants during the interim period.

The reclamation measures should promote and facilitate the aggradation of permafrost, as well as minimize potential transport of leached metals. Therefore, the pond perimeter areas below the West Twin and Test Cell Dikes will be treated as follows, per the WTDA Closure Plan:

1. The thermal barrier cover (1.25 m thickness) will be constructed to 1 m below the normal water level (i.e., to 369.2 m asl), which is also below the drought water level plus 1.5 times the extreme wave height;
2. Rip rap, with a bedding layer over shale, will be placed over the thermal cover below the ultimate water level to 369.2 m asl to provide physical protection to a depth greater than the extreme conditions of drought plus 1.5 time the calculated maximum wave height; and
3. Rip rap, with a bedding layer over shale, will be placed over the thermal cover above the ultimate water level to 370.8 m asl to provide physical protection against wave action under extreme conditions (PMF flood or 1.5 times the calculated extreme wave height).

The WTDA Closure Plan provides a full rationale and description of the proposed reclamation activities, including engineering drawings, in these perimeter areas.

7.1.6 East Twin Lake

Pump Station and Access Road

A fresh water pumping station is located at East Twin Lake that was used to provide fresh water for domestic and industrial use. This water supply is no longer required and, therefore, the pumping equipment (pumps, pipelines, power installations and pumphouse) will be removed.

The East Twin Lake access road will be breached as described above under Reservoir/Polishing Pond.

The removal or pumping equipment will immediately precede breaching of the access road and will be scheduled accordingly.

Outlet Channel

The outlet from East Twin Lake is directed to the east of the Polishing Pond via a channel/diversion berm constructed prior to mine start-up in 1975. This diversion prevents the East Twin Lake outflow from following its natural flowpath through the northeast corner of the Polishing Pond. The diversion berm is armoured with riprap and has required only minor maintenance during the 26-year life of the mine.

The diversion berm will remain in place after closure, so that flood waters from East Twin Lake do not enter the Reservoir and disturb tailings or contact tailings dike structures. The existing rip rap will be assessed in the field by the geotechnical engineer during the reclamation work and additional rip rap will be placed to provide long term stability. Based on the performance of the structure to date, it is anticipated that any requirements for additional rip rap protection will be minor.

7.1.7 Other Facilities

West Twin Piping Facilities

The West Twin piping system consists of two pipelines: one transfers tailings from the mill to the disposal area; and the other transfers reclaim water to the mill from the Reservoir. The pipelines are fitted with electrical heat tracing and insulated, armoured, and supported by wooden blocking. Pipelines are constructed of flanged lengths of PVC pipe, except for the first 1,200 m of the tailings pipeline, which is made of steel to withstand the high pumping pressure. The reclaim water pipeline is 3,150 m in length, while the tailings pipeline can be up to 4,000 m depending on the location of the deposition. A four m wide gravel right-of-way was constructed along for the complete length of the pipeline.

Reclamation of the tailings system will require removal of the tailings and reclaim water pipelines and associated equipment. Equipment and pipelines not sold will be placed underground according to the Waste Disposal Plan. Built-up portions of the pipeline right-of-way will be scarified and contoured, or breached to return natural drainage patterns.

Scheduling of the reclamation of the tailings pipelines, and dump ponds will be coordinated with reclamation of the West Twin Disposal Area.

Emergency Dump Ponds

The tailings disposal system includes two dump ponds: one below the mill near Twin Lakes Creek; and another east of the town site along the pipeline right of way. Dump ponds were utilized to drain sections of the tailings line during emergency shutdowns and maintenance operations. The ponds are each about 10 m by 30 m in area, formed by perimeter gravel berms about 1.5-2.0 m high. The ponds are lined with impermeable liners.

For reclamation of the dump ponds, the liners will be disposed underground according to the Waste Disposal Plan. The gravel berms will then be graded and contoured to prevent water accumulation.

7.1.8 Water Quality

Background

The outflow from the Polishing Pond (station 159-4) is a defined "Final Discharge Point" in the Water Licence to which the effluent discharge criteria apply. This location is included in the Reclamation and Closure Monitoring Plan and will continue to be sampled throughout the closure monitoring period. This will provide a measure of the success of the reclamation measures implemented in the WTDA as regards water quality.

The outflow from the Polishing Pond immediately mixes with outflow from East Twin Lake, which is unaffected by mine activities. The combined water, Twin Lakes Creek, flows approximately 8 km to Strathcona Sound, receiving runoff from natural sulphide outcrops, the West Adit area, the town site, the Industrial Complex and the concentrate haulage road along the flow path. It is well documented that Twin Lakes Creek typically carries high concentrations and high loads of heavy metals and that this was the case both pre-mining and during mine operations. This is documented, for example, in the Phase 3 ESA Report (Appendix H).

Twin Lakes Creek does not support fish due to the poor habitat characteristics.

Water Quality Projection – Inputs

A Water Quality Projection has been developed for the WTDA that considers the potential effects of natural runoff, porewater expelled during freezeback of the Surface Cell and Test Cell taliks and runoff over areas of the Reservoir perimeter. The Water Quality Projection is described in the WTDA Closure Plan and is summarized below.

The fundamental assumptions that form the basis of the Water Quality Projection are summarized as follows:

1. Natural runoff over the Surface Cell and Reservoir cachment areas contains 0.056 mg/L zinc ("Zn") as background;
   This is based on the long term data for East Twin Lake and other unaffected sampling locations.
2. The reclamation covers placed on the Surface Cell and Test Cell areas is effective in maintaining the tailings in a frozen and isolated condition;
   This is based on the design rationale for the reclamation cover (detailed in the Covers Report).
3. Porewater from the Surface Cell talik is expelled into the Reservoir pond during freezeback at rates estimated in the Talik report;

This is considered to be a conservative approach, per the Talik Repor.

4. Porewater from the Test Cell talik is expelled into the Reservoir pond during freezeback at rates estimated in the Talik report;
   This is considered likely, per the Talik Report.
5. During years 1-5, porewater expelled from the taliks contains 0.025 mg/L Zn;
   This is based on 2003 groundwater quality samples from monitoring wells in the Surface Cell.
6. Over each successive 5-year period, only 10% of the Zn in the unfrozen porewater freezes into ice and 90% concentrates in the residual unfrozen porewater, due to cryoconcentration;
   This is considered to be a reasonable approach to cryoconcentration.
7. Reclamation measures at the pond perimeter below the West Twin and Test Cell dikes reduce runoff contact with tailings to an estimated factor of 0.15;
   This is considered a reasonable approach given the physical properties of the cover materials and the small contact area.
8. Neutral pH tailings release 0.3 to 24 mg/L Zn;
   This is based on column studies conducted by Dr. Elberling of the University of Copenhagen on samples of Nanisivik tailings.
9. The site hydrology follows the trends and values determined for the WTDA Comprehensive Plan; and
   Long term hydrology records have been analysed and water flows for the WTDA were determined by Golder Associates.
10. The typical flow season extends from May through September and any assumed constant (365-day) inflows into the Reservoir Pond are stored as ice for release with surface flow in the runoff season.
    This is based on long term hydrology records, long term site records and long term site observations.

The Water Quality Projection is in the form of a spreadsheet that can provide projections for the Polishing Pond outflow based on various input values. Table 7 shows summary results from the Water Quality Projection for input values that are based on the assumptions listed above and estimated normal climate conditions. The summary results are presented in 5-year increments to capture the influence of changing rates and concentrations of porewater expelled from the Surface Cell and Test Cell taliks.

Table 7. Summary of Water Quality Projections for Zinc

Timeframe	Porewater Expulsion					Natural Runoff		Reservoir Perimeter		Polishing Pond Outflow			
	Surface Cell talik		Test Cell talik		% of	Conc.	% of	Conc.	% of	Conc.	Volume	Load	% of
	Volume	Conc.	Volume	Conc.	annual load		Annual load		Annual load		(m3)	(kg)	annual load
Years 1-5	32400	0.025	18000	0.025	0.6%	0.056	79%	0.3 - 24	20%	0.072	496,000	35	100%
Years 5-10	12960	0.033	9900	0.041	0.3%	0.056	80%	0.3 - 24	20%	0.073	491,000	35	100%
Years 10-15	11160	0.051	3600	0.101	0.4%	0.056	80%	0.3 - 24	20%	0.073	490,000	35	100%
Years 15-20	10440	0.141	0	-	0.9%	0.056	79%	0.3 - 24	20%	0.073	489,500	35	100%
Years 20-25	2844	0.291	0	-	0.5%	0.056	80%	0.3 - 24	20%	0.073	488,000	35	100%

Notes: all concentrations in mg/L.
Volumes in m^3.
Zn concentrations for "Reservoir Perimeter" increase monthly through the summer season.
Normal annual climate conditions applied.

The following observations are drawn from the results summarized in Table 7:

1. Natural runoff is projected to represent a dominant controlling factor (80% of Zn load) for Polishing Pond outflow;
2. Porewater expulsion is projected to represent a small contributing factor (less than 1% of Zn load) to Polishing Pond outflow;
3. Runoff over the Reservoir Perimeter is projected to represent a moderate contributing factor (20% of Zn load) to Polishing Pond outflow;
4. The quality of Polishing Pond outflow is not anticipated to vary on an annual basis; and
5. The volume of water passing through the Polishing Pond is projected to decrease slightly over time due to the decreasing rate of porewater expulsion.

In summary, the annual quality of water passing through the Polishing Pond (0.07 mg/L Zn) is projected to remain similar to natural conditions (0.056 mg/L).

7.2 Landfill Facility

The landfill site, approximately one km west of the town, contains waste materials from the town, the mine and the airport. The facility was operated from 1975 to present according to the standards in effect at those times. Generally, waste volume was reduced by burning and crushing prior to being pushed over the advancing (northwards) crest and buried with native shale. The upper surface was also finished with shale to provide a safe working environment.

ESA programs conducted at the facility in 1999 and 2000 (CanZinco) as well as in 2002 and 2003 (Gartner Lee Limited) provided a comprehensive investigation of the landfill facility. Investigations included water samples from subsurface monitors, excavation of numerous test pits and analysis of soil and water samples for metals and hydrocarbon concentrations. The ESA investigations demonstrated that there is no hydrcarbon or metals contamination downgradient of the facility.

The results of the ESA investigations suggest that a passive natural approach to remediation of the facility, such as the soil cover that has been consistently planned for to date, is appropriate. The proposed cover of shale capped with more durable Twin Lakes Sand and Gravel is designed to permanently freeze the waste materials in permafrost. In this way, and with the additional formation over time of a permanent ice-rich zone within the cover, the risk of any water infiltration contacting the buried waste materials and transporting contaminants outside the facility is extremely low (as observed during the operation phase of the facility).

The proposed reclamation activities are described fully in the Closure Plan report and the essential steps are summarized as follows:

1. Relocate soil in the landfarm cell that exceeds the remedial objectives for petroleum hydrocarbons to the underground mine according to the Underground Mine Waste Disposal Plan;
2. Implement a construction quality control program, to include material testing, survey control, and construction monitoring;
3. Grade the existing surface according to the design drawings to prepare a reclamation surface that does not exceed 3H:1V slope;
4. Construct the lower (shale) layer of the final cover;
5. Construct the upper (Twin Lakes sand and gravel) layer of the cover over the shale and groom the final surface (Figure 14) to avoid potential surface channelization or pooling of runoff water; and
6. Prepare an as-built report.

The work would be conducted under the direction of an on-site geotechnician who is working under a qualified engineer.

The design thickness of the cover on the landfill facility is 2.2 m. This is thicker than the cover proposed for the WTDA because the design is based on an assessment of the observed field performance of the test shale cover at Area 14. The Area 14 cover overlies waste rock and this makes it more relevant to the landfill facility because of the similarities between the (assumed) porous, unsaturated landfill waste and the coarse-grained, unsaturated waste rock. (In comparison, the WTDA Test Cells overly relatively fine-grained, saturated tailings.) The cover design incorporates the worse-case 100-year climate warming projections published by Environment Canada.

The proposed monitoring program, through the 7-year Reclamation and Closure Period, will assess:

- water quality below the landfill to ensure that the quality of the runoff water is known;
- ground temperatures within the cover and within the waste to bedrock to confirm that the cover is keeping the waste materials below zero; and
- physical condition of the cover so that any initial settlement is quickly identified and repaired.

7.3 Rock Piles and Open Pits

7.3.1 Overview

The Rock Piles and Open Pits Closure Plan includes, for each rock pile and open pit, a description of the current status, an assessment of the risk of acid rock drainage, the proposed reclamation activities, and a performance monitoring plan. The proposed reclamation activities and rationales are summarized below.

The specific reclamation objectives for the rock piles and open pits are to:

1. Minimize the risk of ARD or metal leaching; and
2. Provide a safe surface environment that matches the natural conditions.

The general approach proposed for reclamation of the remaining rock piles and the open pits is to consolidate waste rock into discreet areas, such as the open pits, and provide a thermal barrier cover designed to the same specifications as that proposed for the landfill facility (i.e., 2.2 m thick consisting of shale with a durable surface cap of Twin Lakes Sand and Gravel). In this way, the areas requiring remediation are minimized and the waste rock is permanently frozen in permafrost. The risk of acid rock drainage will then have been negated.

A substantial portion of this work has already been accomplished through the Mine's progressive waste rock reclamation program from 1997 to 2003. During this annual program, a substantial portion of the waste rock in surface rock piles was relocated into the underground mine, where it will freeze in permafrost.

The proposed monitoring program, through the 7-year Reclamation and Closure Period, will assess:

- water quality in Twin Lakes Creek and Chris Creek to identify any observable influence in the creeks from reclaimed areas;
- water quality in any direct seeps from the reclaimed areas;
- ground temperatures within the covers and within the waste to bedrock to confirm that the covers are keeping the waste materials below zero; and
- physical condition of the covers so that any initial settlement is quickly identified and repaired.

7.3.2 West Adit Area

The West Adit Area encompasses all of the developments from the Industrial Complex to the 09S rock pile. Specifically, this includes:

- the West Open Pit;
- the 01S Portal area;
- the previous temporary storage area for rejects from the Dense Media Separation (DMS) plant;
- the 02S rock pile;
- the 09S rock pile; and
- the road from the Industrial Complex to the 09 portal.

The reclamation activities proposed for these individual developments are linked and presented as a single group, below.

The end result of the proposed reclamation activities will be a safe slope over the West Open Pit, extending from the brow overlooking the 01S portal to the crest overlooking the steep slope to Twin Lakes Creek, that is covered with the same 2.2 m thick thermal barrier cover as proposed for the landfill. In this way, waste rock and demolition debris fill materials will be frozen into permafrost and both of the reclamation objectives are achieved.

The specific reclamation activities that are proposed are summarized as follows:

1. Relocate all remaining waste rock from the 09S rock pile (est. 7,571 m^3) plus a sufficient volume of inert demolition debris from the tear down of buildings and equipment into the deepest portions of the West Open Pit to fill it approximately to the elevation of the general area (total fill volume est. 22,500 m^3) with positive drainage;
2. Map the geology of the north pit wall to locate and delineate the sulphide exposures;
3. Conduct a geochemical assessment of the road fill from the Industrial Complex to the West Open Pit and from the West Open Pit to the 09 Portal and determine whether remedial measures are necessary for these areas based on the criteria described below;
4. Strategically place all safely retrievable waste rock from the 02S rock pile (est. 14,090 m^3) plus inert demolition debris from the tear down of buildings and equipment at the toe of the north wall of the West Open Pit such that a filled surface is achieved that conforms to the concept illustrated on Figure 15 and that provides for safe covering of all identified sulphide exposures at a maximum slope angle of 3H:1V;
5. Construct the thermal barrier cover as described herein over the filled surface from north wall of the West Open pit to the crest of the slope overlooking Twin lakes Creek, as illustrated on Figure 15;

6. Complete any necessary mitigative work that may be determined necessary from the geochemical assessment of the road fill materials; and
7. Integrate a light vehicle access road into the final surface that allows light vehicle access through the area but that does not compromise the thickness of the cover using the design as a guide and the judgement of the on-site geotechnician.
8. Execute all activities according to a quality control program; and
9. Conduct a performance monitoring program.

The acid rock drainage assessment of the road from the Industrial Complex to 09 Portal suggests that this material is not an environmental risk that requires mitigation. However, CanZinco recognizes specific concerns raised during the licensing review process and will, therefore, conduct further investigations to increase confidence in this assessment (item no. 5 above).

The proposed investigation would be undertaken in 2004 and would involve geological logging of test pits and drill cuttings augmented by laboratory analyses of metal content and acid rock drainage characteristics. A detailed description of the proposed investigation is provided in the Rock Piles and Open Pits Closure Plan. Ultimately, the geological and laboratory classifications would be assessed against a common benchmark for ARD assessment following from the British Columbia Government as follows:

- Ratio greater than 4: acid consuming material for which no mitigation is required;
- Ratio between 2 and 4: likely acid consuming or inert, use geological observations and judgement as a reference for determination;
- Ratio between 1 and 2: possibly acid generating, mitigation measures or further investigation required; and
- Ratio less than 1: potentially acid generating material for which mitigation is required.

In this way, a more confident determination of the necessity for mitigative work will have been developed and any areas requiring mitigation will be reclaimed to the West Open Pit area during the second year of reclamation.

The steepness of the natural slope between the West Open pit and Twin Lakes Creek and the fact that the slope extends right to Twin Lakes Creek may preclude the retrieval of a relatively small quantity (est. 1,500 m^3) of waste rock. The effects of increased disturbance to the natural ground and to the creek, through sedimentation and in-stream work, that would result from retrieval of this material are considered to outweigh any environmental benefits. The residual rock is likely to be a mixture of various rock types, including acid-consuming dolostone, in an area with abundant natural sulphide exposures to the degree where it is unlikely that the residual rock would have an observable effect on the environment. Therefore, an observational approach will be adopted to investigate whether the “remnant” rock is having an observable effect.

The coordinated placement of demolition debris and waste rock in the West Open Pit will require some special considerations that are described in the Waste Disposal Plan. The specifications for the reduction in size and for cleaning of demolition debris will be the same for disposal underground as for the West Open Pit. However, placement into the West Open Pit, either into the deep hole or against the toe of the north wall, will require fill material in the voids of the debris for physical stabilization during construction and covering. To this end, CanZinco will ensure that, for the West Open Pit location, demolition debris and waste rock are placed jointly in lifts no greater than 1 m thick and that adequate fine material from the waste rock is present to stabilize the pile to the satisfaction of the on-site geotechnician. If sufficient fines are not available from the waste rock, then an alternate source of bulk fine material will be identified, likely to be shale.

The inclusion of demolition debris into the bulk fill of the West Open Pit is provides the same level of environmental protection and several other benefits. The demolition debris will provide a necessary source of fill for the West Open Pit without the need for further development of quarries. This will enable the covering, and freezing into permafrost, of sulphide exposures on the north wall of the pit with attendant reduction of environmental risks.

Activity nos. 1, 2 and 3 plus parts of activity nos. 4 and 5 can be undertaken at any time and are scheduled to be undertaken during the first year of reclamation (2004). Activity nos. 4 and 5 can not be completed until the disposal of solid waste into the underground mine is complete as it is likely that the main underground entranceway (01S portal) will be covered as part of these activities. Activity no. 6, if required, can not be undertaken until the second year of reclamation (2005) and would also need to precede the completion of activity no. 5. Activity nos. 7, 8 and 9 are general activities to be carried out on an ongoing basis.

7.3.3 East Adit Area

The East Adit Area includes:

- the East Open Pit (EOP);
- the 39N/S rock pile; and
- the East Trench.

The reclamation activities proposed for these individual developments are linked and presented as a single group, below. As noted above, progressive reclamation of the rock piles at 39N/S to the underground workings has been on-going throughout mining operations since the 1980's and reported on annually to the NWB. Beginning in 2002, this process was accelerated when waste rock was relocated from the rock piles into the EOP (shorter haulage distance). As such, the EOP has been substantively filled and the majoirty of the original rock pile volume has been reclaimed (Figure 16).

The reclamation activities in the East Adit area are to reclaim the remaining waste rock from the 39N/S rock pile, to fill the East trench, and to complete backfilling of the East Open Pit. The two filled areas can then be covered with the same 2.2 m thick thermal barrier cover as proposed for the landfill. In this way, both of the reclamation objectives are achieved and no additional waste rock is required to be placed underground.

The specific reclamation activities that are proposed are summarized as follows:

1. Reclaim approximately 4,500 m^3 from the 39N/S rock pile into the East Trench to recreate the original surface contours (which are considerably flatter than rock pile cover design grade of 3H:1V) (Figure 17);
2. Reclaim the remainder of the 39N/S rock pile (est. 31,680 m^3) to the East Open Pit, which has already substantively filled, to create a smooth surface up to 3H:1V grade (also incorporating material relocated from K-Baseline) (Figure 16);
3. Cover both slopes with a cover thickness of 2.2 m comprised of a thermal barrier cover of shale with a durable cap of Twin Lakes Sand and Gravel;
4. Provide for continued use of the East Adit roadway for through traffic of light vehicles (Kuhulu Lake access);
5. Execute all activities according to a quality control program; and
6. Conduct the performance monitoring program as laid out in the Closure Performance Monitoring Plan.

In this way, all waste rock will have been consolidated into two discreet locations, with the added benefit of providing fill in areas that require backfilling. Ultimately, both areas are covered and frozen into permafrost.

These activities can be undertaken at any time and are proposed to be undertaken during the first year of reclamation (2004).

7.3.4 Oceanview

The Oceanview area includes:

- The Oceanview Open pit;
- The Oceanview rock pile; and
- The Oceanview portal site.

The reclamation activities proposed for these individual developments are linked and presented as a single group, below. Beginning in 2002, waste rock has been relocated from the rock pile into the pit, as part of the Mine's progressive waste rock reclamation program, such that all but a remnant quantity of waste rock remain and the pit has been backfilled to provide positive drainage. The portal site was previously used as a temporary ore storage area and residual mineralized material was identified at the site in the ESA program.

The end result of the proposed reclamation activities will be to reclaim the remnant waste rock from the rock pile into the pit and to consolidate residual mineralized material at the portal site such that they can then be covered with the a 2.2 m thick thermal barrier cover (Figure 18). In this way, both of the reclamation objectives are achieved.

The specific reclamation activities that are proposed are summarized as follows:

1. Reclaim the remnant waste rock from the rock pile into the pit;
2. Consolidate residual mineral contaminated soil at the portal site into one discreet area;
3. Cover the pit and consolidated pile at the portal with a thermal barrier cover of shale with a durable cap of Twin Lakes Sand and Gravel;
4. Execute all activities according to a quality control program; and
5. Conduct performance monitoring as laid out in the Closure Performance Monitoring Plan.

These activities can be undertaken at any time and are proposed to be undertaken during the first year of reclamation (2004).

It is important to recognize that the Oceanview area, similar to the Area 14 area, contained an unusually high amount of fine grained surficial material that was mineralized with sulphides. This is well documented in geochemical profiling conducted in 1985. With this in mind, the reclamation activities proposed for the site, target all mine related disturbances, but do not attempt to alter any natural pre-mining impacts. It is suggested, that attempts to do so can result in prolonged and increased impacts due to additional disturbances created while attempting to remove the natural sources.

7.3.5 K-Baseline

The majority of the waste rock and other residual mineralized materials (ore) that were previously located at the K-Baseline site were relocated underground prior to closure of the portal. However, a relatively small volume (est. 4,000 m^3) remains at the site as identified through the ESA program. This material will be reclaimed to the East Open Pit, where it will be frozen into permafrost under the thermal cover planned for the East Open Pit.

The ESA investigations also identified an estimated 7,400 m^3 of hydrocarbon contaminated soil at the previous fuel tank area. This soil will be relocated into the underground mine via the East Portal, following the requirements of the Waste Disposal Plan.

These activities can be undertaken at any time and are scheduled to be undertaken during the first year of reclamation (2004).

7.3.6 Area 14

A large portion of the waste rock at Area 14 was reclaimed under a test cover of shale in 1988. As described in the Covers Report and the Rock Piles and Open Pits Plan, the field observations gathered from this instrumented test cover confirm its effectiveness and provided the basis for the design of thermal barrier covers over other coarse-grained, unsaturated materials (i.e., the landfill facility and other rock piles).

An additional 1,440 m^3 of loose, mineralized material has been identified in the immediate area of the portal (already sealed). This material will be consolidated into a pile abutting the existing, reclaimed pile at a grade not steeper than 3H:1V. A thermal cover will then be placed over the pile with a thickness of 2.2 m consisting of shale overlain by a durable cap of Twin Lakes Sand and Gravel. In this way, the material will be frozen into permafrost.

The existing shale test cover does not have a durable cap layer and has a short sideslope (west side) that is steeper than 3H:1V. The existing cover will be completed according to the current design specifications for other locations by placement of additional shale and the durable cap layer.

The ESA investigations also identified an estimated 300 m^3 of hydrocarbon contaminated soil at the previous fuel tank area. This soil will be relocated into the underground mine, following the requirements of the Waste Disposal Plan.

These activities can be undertaken at any time and are proposed to be undertaken during the first year of reclamation (2004).

The Area 14 surface area, similar to the Oceanview area, was identified as containing an unusually high amount of fine grained mineralized material prior to mining (mine geological information). As such it can be expected that mineralized traces will remain after CanZinco has completed appropriate reclamation efforts.

7.4 Borrow Areas

CanZinco has worked a number of borrow areas on both Territorial lands, administered by Nunavut's Community Government and Transportation and, on crown land, administered by the Department of

Indian and Northern Development. These have provided construction material, mainly shale, for building foundation backfill, road beds, stockpile pads, and earthen dams including the West Twin Dike.

The principal borrow areas used by the mine have been:

- Road Quarry located 900 m north of the industrial site, which was a source of rip-rap for the dock and most likely used as a source of backfill during construction of the industrial building;
- Landfill Quarry located along the road between the town site and the Industrial Site;
- Shale Hill;
- Mount Fuji;
- Area 14;
- East Twin; and
- a small clay pit 1,500 m east of the dock.

Not all of these borrow areas have been recently used and not all are proposed for use as part of the reclamation activities. The quarries that are proposed for reclamation use are:

- Road Quarry, for reclamation of the Industrial Complex area;
- Landfill Quarry, for reclamation of the landfill facility;
- Shale Hill, for reclamation of the East Adit, K-Baseline and Oceanview areas;
- Mount Fuji, for reclamation of the WTDA;
- Area 14, for reclamation of the Area 14 area;
- West Twin, for reclamation of the WTDA;
- East Twin, for reclamation of the WTDA; and
- East/West Twin Delta, for supply of Twin Lakes Sand and Gravel to all reclamation areas.

The Quarry Development and Reclamation Plan provides a description of the development and reclamation plan for all borrow areas used in the reclamation activities.

In general, the method used to recover the borrow material is to utilize a combination of ripping and drilling/blasting to unconsolidate the material for excavation. The material will then be loaded and hauled via mobile heavy equipment to its destination.

Reclamation activities focus on the physical aspects of the borrow sites. The areas will be cleaned of debris, garbage, wire, and unused explosives upon closure. Temporary water control berms will be removed. Unused quarried material will be flattened, and used to re-grade uneven surfaces within the quarry. The quarry floors will have a minimum slope of 1% to allow for adequate drainage.

All the rock slopes will have a final slope of 33^{o} (1.5H : 1V), while all soil slopes will have a final slope of 18^{o} (3H : 1V).

Erosion by surface water will be controlled with a combination of re-contouring, swales and berms. The final locations of the swales and berms will be determined in the field, during the reclamation work. All culverts will be removed.

7.5 Industrial Structures

7.5.1 Industrial Complex

The industrial complex contains the concentrator, DMS circuit, power plant, maintenance shops, warehouse, administration and technical offices, and associated facilities. It is steel framed with metal exterior cladding and cement block interior dividing walls. It was built on a bedrock and reinforced concrete foundation.

The Industrial Complex building, and all fixed internal equipment with the exception of the DMS plant, has been purchased by a third party, Wolfden Resources Inc. ("Wolfden"). Wolfden has also purchased the concentrate loading facility as shiploading equipment as detailed below. The industrial complex building, and all fixed internal equipment are scheduled to be dismantled and prepared for shipping off site in 2004/5. Wolfden's obligations also extend to dismantling of the DMS plant for CanZinco for shipment to another BWR site.

In the event that Wolfden has not finalized arrangements to receive the equipment at the intended destination in 2004, the dismantled equipment will be stored at the staging area at the Nanisivik dock. This area has been used during operations as a staging area for storage/furtherance of sealift materials throughout the operation of the mine.

The overall liability for reclamation of the industrial complex area resides with CanZinco. While Wolfden is obliged to CanZinco to reclaim the complex according to the approved Closure and Reclamation Plan, CanZinco will ultimately be responsible for this undertaking.

The warm and cold storage buildings and the compressor house (from which salvageable equipment will be removed) will be dismantled and hauled underground by CanZinco. Office equipment and warehouse supplies with salvage value will be sold, or shipped to other Breakwater properties. This may include electric power generators, tailings pumps, shop machinery, tools, computers, and similar items. Any remaining equipment and materials will be dismantled and hauled for final disposal as per the Underground Waste Disposal Plan.

Concrete foundations will be swept clean and remain in place. All concrete footwalls which interfere with final grading of the surface covers will be collapsed. The foundations will then be covered with 2.2

metres of shale and armouring material as per the landfill closure cover design to induce permafrost aggradation and immobilize contaminant migration . The areas will then be contoured similar to the natural surroundings and will be appropriately graded to provide for drainage.

7.5.2 ANFO Facility

Two concrete block buildings are associated with the ANFO explosives facility. A 1,000 litre fuel tank is also part of this infrastructure. These facilities will be dismantled, decontaminated and then disposed in the mine per the requirements of the Underground Waste Disposal Plan.

7.5.3 Concentrate Storage Building

The concentrate storage building in the dock area includes truck weigh scale, several conveyors and the ship loader which was used to transfer concentrates from the storage building to the ships. As mentioned previously, this infrastructure has also been purchased by Wolfden Resources Inc. The building, shiploading equipment, feed conveyors and all associated equipment will be dismantled and shipped off site in 2004/5. Similar to the industrial complex equipment, in the event that Wolfden has not finalized arrangements to receive the equipment at the intended destination in 2004, the dismantled equipment will be stored at the staging area at the dock.

The concrete floor will be swept clean such that the SQRO's are met. The floor will then be covered with 0.5 m of shale, contoured to be similar to the natural surroundings and to provide positive drainage.

7.5.4 Other Industrial Buildings

Steel shipping containers are currently used for storage. If in good condition, they will be shipped off site and, if in a degraded condition, they will be hauled underground for disposal. Other small wooden buildings utilized in mine operations include the dock lunchroom, furniture storage building, core shack, mine rescue station, mine refuge stations, and tailings shack will be reduced by burning before underground disposal.

7.6 Town Site

Features which make up the town site are the houses, bunkhouse, Pamo building, ice rink, church, Dome, carpenter shop/food storage building, town site generating station, NorthwesTel equipment trailers, government garage, and central government buildings/recreation centre.

The government garage and central government building belong to the Government of the Nunavut Territory, along with the potable water system, utilidor and sewage systems, and 5 of the original 56 housing units. Reclamation of these structures is the responsibility of the GN. The central government building contains many community services, including the school, nursing station, RCMP office, fire hall, gym and swimming pool, government maintenance shop, and space leased to the post office. Reclamation of these facilities is the responsibility of others (the Federal Government and/or the GN).

The bunkhouse, Pamo building, and the housing units (single and multi-occupancy) belonging to CanZinco are all scheduled to be dismantled. Reduced by burning and hauled underground when no longer needed.

The carpenter shop/food storage building and the town site emergency power plant are steel construction. They will be dismantled and sold or disposed underground. Useful electric generating equipment, shop tools, freezer containers, and materials and supplies will be removed.

The Dome and the ice rink are prefabricated structures. They will be dismantled, burnt and/or disposed of underground.

The church is a small wood building, which will be dismantled and removed.

An alternative approach, for ongoing use of some or all of the town facilities for other purposes, is under consideration by a number of parties. Discussions with various government agencies may result in a transfer of ownership after decontamination.

The ESA investigations identified hydrocarbon contaminated soils (7,500 m^3) in the town area, primarily related to the home heating oil storage tanks. The contaminated soil will be reclaimed to the underground mine according to the requirements of the Waste Disposal Plan. The town area will be scarified and natural drainage channels through the area restored.

7.7 Hydrocarbon Storage and Dispensing Facilities

7.7.1 Tank Farm, Dock Area

The tank farm comprises 15 steel tanks of various sizes located in a lined and diked enclosure, which is adjacent to the concentrate storage shed. There is sufficient storage for 13.9 million L of P60 diesel, 1.1 million L of Jet A1, 0.6 million L of gasoline and a waste products tank for motor oil, glycol, etc. The Government of Nunavut is currently leasing storage space for fuel in the tank farm.

It is anticipated that ownership of the facility will be transferred to a third party such that it will not be dismantled and remediated as part of this reclamation plan. Should this transfer not develop in the short term, the tanks and associated infrastructure will be cleaned, purged and dismantled by a contractor specializing in this field. Any free phase waste products produced in the decontamination process will be shipped for refining/disposal at an approved facility in southern Canada. The containment berm liner would be removed and disposed underground according to the Waste Disposal Plan.

CanZinco is responsible for remediation of hydrocarbon contaminated soils that were identified in the ESA investigations at the tank farm and dock areas. An estimated 7,500 m^3 of hydrocarbon contaminated soils have been identified from previous operations in these areas. This soil will be reclaimed to the underground mine according to the requirements of the Waste Disposal Plan. Areas disturbed during reclamation will be backfilled and contoured to their surroundings.

7.7.2 Intermediate Day Tanks and Fueling Station

The Intermediate Day Tanks consist of: two 105,000 L diesel tanks and one 47,000 L gasoline tank located in a diked and lined enclosure adjacent the industrial complex. The fuel tanks and associated supply pipelines will be removed, decontaminated and taken underground for disposal, or shipped out for use elsewhere.

Gasoline was delivered by truck from the tank farm at the dock to the day tanks and pumped into the gasoline storage tank. From there, it was dispensed at the main fueling station at the industrial complex, largely as a convenience to private users. All components of the facility will be emptied, removed and, if not sold, decontaminated and disposed underground.

7.7.3 End User Tanks

Numerous end user tanks are located around the mine site for a variety of purposes. All satellite tanks of more than 1,000 litres capacity have secondary containment.

End user tanks have been located at the following locations:

1. Adjacent to the West Open Pit (fueling station);
2. WTDA near tailings shack (fueling station);
3. ANFO facility;
4. A portable tank was moved between Ocean View and East Adit depending on where mining activities were taking place;
5. Refuge stations, tailings shack and each building/residence in the town site have small independent tanks (900 litre) for heating purposes;
6. Dome, transient centre, Pamo building, and carpenter shop (larger tanks for heating);
7. Stolport (occasionally, jet fuel was delivered from the tank farm to the small tanks at the Stolport for chartered aircraft); and
8. The Area 14 mining area.

All of the tanks listed will be emptied, removed, sold or decontaminated and disposed in the underground mine. Any secondary containment structures that are equipped with liners will have the liner removed and disposed underground and will then be contoured to prevent accumulation of water. Petroleum storage tanks located at the Nanisivik Airport, government garage, and government buildings are not the responsibility of CanZinco.

The ESA investigations identified hydrocarbon contaminated soils at some of these locations, which will be reclaimed to the underground mine according to the requirements of the Waste Disposal Plan. The individual areas and estimates of soil volumes are listed in section 7.11. Any excavations for removal of contaminated soil will be backfilled with local materials and contoured to prevent ponding of water.

7.7.4 Other Petroleum Product Storage

Other petroleum products include lubricants, solvents, and minor specialty products. They may be stored in large containers outside or small containers indoors. Access to these storage areas continues to be restricted. Reclamation will include salvage (return to supplier), on-site incineration or shipment off site for destruction/recycling as appropriate.

7.8 Industrial Complex Yard Area

The Industrial Complex yard area includes all of the developed area in the immediate vicinity of the Industrial Complex, including the bone yard, the cold and warm storage buildings and the outdoor warehouse yard.

The ESA investigations identified soil contaminated with both hydrocarbon and metals (est. 24,150 m^3) in this area which will be removed to the underground mine following the requirements of the Waste Disposal Plan. An additional 2,500 m^3 of hydrocarbon contaminated soil is considered possible beneath the floors of the maintenance shop and the powerhouse.

The ‘bone yard’ was used for the temporary storage of repairable and unrepairable equipment and other materials. All remaining equipment will be decontaminated (if required) and disposed of into the underground mine according to the Waste Disposal Plan.

The ESA investigations also identified soil contaminated with metals (est. 7,150 m^3) in this area. This soil will be consolidated into the area occupied by the concrete slab floors of the Industrial Complex, subsequent to the required leveling of footwalls and tall pedestals. That area will be covered with the same thermal barrier cover proposed for the landfill facility and the rock piles. That is, a 2.2 m thick cover consisting of shale overlain by a durable cap of Twin Lakes Sand and Gravel. In this way, the metal contaminated soil and any contaminants that may be present under the concrete slabs will be frozen into permafrost. The alternate approach of breaking these thick slabs into relatively small pieces for disposal into the underground mine is not considered to provide any substantive environmental benefits to outweigh the extra time and effort required to conduct the work.

A roadway capable of providing safe passage of heavy equipment and fuel haulage trucks through the Industrial Complex area is required and the grading/covering work will be done in such a manner that road access is preserved.

7.9 Other Disturbed Areas

7.9.1 Stolport

The Stolport was used during the construction phase of the project and more recently during exploration activities as an airstrip for small aircraft. Little remains of the original installations other than the runway strip and a number of runway light posts. The strip is an area where the ground has been smoothed out and requires little reclamation. The runway lights posts will be removed.

The ESA program identified small quantities of hydrocarbon (est. 2,250 m^3) and metal (est. 450 m^3) contaminated soil at the STOLport, which will be relocated into the underground mine per the requirements of the Waste Disposal Plan.

Telecommunications equipment is installed adjacent to the old Stolport airstrip. The equipment comprises satellite dish antennas, small electrical equipment buildings, and radio antennas, which belong to NorthwesTel. NorthwesTel will be responsible for removal of all their equipment and structures and to complete adequate reclamation of these areas.

7.9.2 Dock Area

The dock at Nanisivik was constructed by the mine for the Federal Government and, therefore, reclamation of the dock infrastructure is the responsibility of the Federal Government.

The ESA program identified hydrocarbon (est. 10,300 m^3) and metal (est. 9,000 m^3) contaminated soil in the dock area which is the responsibility of CanZinco to remediate. This soil will be relocated into the underground mine per the requirements of the Waste Disposal Plan.

Reclamation of the tank farm, the concentrate storage shed and the ship loader, which are also in the dock area, is described elsewhere.

7.9.3 Roadbeds

The roads servicing the dock, airport, East Twin Lake, and the town site belong to the Government of the Nunavut Territory. The ESA program identified metal contaminated soil (est. 15,750 m^3) on the road surface between the Industrial Complex and the dock area. This soil will either be relocated into the underground mine, per the requirements of the Waste Disposal Plan, or reclaimed as part of the Industrial Complex yard area as described elsewhere.

A roadway capable of providing safe passage of heavy equipment and fuel haulage trucks to the dock area is required and the soil remediation work will be done in such a manner that road access is preserved.

Service roads in the mine area and at the West Twin Disposal Area are the responsibility of the Mine. These roads were investigated as part of the ESA program and, except for small discreet areas near mining areas, were found to be free of mineralized rock. The proposed remediation for those discreet areas is incorporated into the Rock Piles and Open Pits Plan.

Any section of a roadbed that causes an interruption to natural drainage will be breached and contoured. All culverts will be removed. However, this will be done is such a manner to provide safe light vehicle access to each of the mining areas for environmental monitoring purposes.

7.9.4 Underground Openings

In addition to the main underground mine, several satellite areas (Oceanview, K-Baseline, and Area 14) have operated during the mine life. There are eight openings to the main underground workings. In addition, there are portals at the Oceanview, K-Baseline and Area 14 sites. These portals have not been utilized since mining activities ceased. There is also a ventilation raise to surface at Oceanview.

All underground portals are in competent native rock. Support culverts at three portals (09 South, 17 North, and K-Baseline) will be taken out before the portals are buried. All other portals will be, or already have been, buried with rock cover to prevent access and contoured to conform to the local topography.

There are two raises that come to the surface: one raise comes to surface near Shale Hill from the main underground mine and the second comes from underground workings at Oceanview. These raises will be backfilled and sealed.

Ventilation, safety and access to the waste disposal areas in the main underground workings will be maintained throughout the period of active reclamation and building tear down work and, therefore, final sealing of the openings necessary for this work will be one of the last activities at the site.

These activities will conform to all applicable requirements of the Mines Act.

7.9.5 East Adit Treatment Facility

The East Adit treatment facility contains residual metal contaminated soil for the lime treatment of runoff water. A soil volume of 600 m^3 was identified in the ESA investigations. This soil will be removed into the underground mine following the requirements of the Waste Disposal Plan.

Ultimately, the two dikes that form the treatment ponds will be breached such that natural drainage patterns are restored to the area. This will occur subsequent to the Water Board's approval that the facility is no longer required as a contingency against non-compliant runoff water.

7.10 Chemicals

7.10.1 Mill Reagents

The mill concentrator required a number of bulk chemicals for efficient recovery of metals from the ore fed to the mill. For example, hydrated lime is used to control the process pH (as well as water treatment at the East Adit Treatment Facility) and copper sulphate and xanthates were used to control the flotation grade and recovery of final concentrates.

The on site supply of mill reagents was stragically managed to minimize the volume remaining on-site at mine closure in 2002. The relatively small amount of residual reagents that represent an environmental risk will be shipped off site for re-use or destruction.

7.10.2 Other Chemcials

Bulk ammonium nitrate was supplied in 750 kg tote bags and mixed with diesel fuel at the ANFO facility to make the explosive used for most of the blasting operations in the mine. The tote bags were stored in the dock area until delivered to the ANFO facility. Surplus inventory at closure will be returned to the supplier or sent to other operations.

Bulk calcium chloride salt was delivered in 1,000 kg tote bags and stored in the dock area until delivered to temporary storage near the mill or in the mine. Calcium chloride brine was required for diamond drilling as the drill flushing water. For reclamation, the mixing tank will be removed and taken underground. Surplus inventory at closure will be returned to the supplier or sent to other operations.

Paints were kept and mixed in the carpenter shop. Janitorial supplies and kitchen cleaning agents were kept in the warehouse or near the point of use and consumed in the recommended manner. The use of shop supplies like starting fluid was controlled. Surplus inventory will be returned to supplier or otherwise disposed off site.

Specialty chemicals used in the assay and metallurgical laboratories were stored in the work areas. The unused stocks will be neutralized, destroyed, or removed from site as appropriate.

7.11 Contaminated Soil Volumes

The ESA investigations identified hydrocarbon and metal contaminated soil in various locations around the mine site (Figure 19). The locations identified were largely as anticipated give the mine operating activities that took place.

The determination of hydrocarbon contamination is based on the Canada Wide Standards for Petroleum Hydrocarbon Contamination published by the Canadian Council of Ministers of the Environment, as updated in 2001. The determination of metal contaminated soil is based on the site-specific SQRO's that were developed for and are described fully in the HHERA Report.

For the purposes of compiling the estimated soil volume estimates for this reclamation plan, soil that was identified as being co-contaminated with both hydrocarbons and metals was considered to be hydrocarbon contaminated soil.

The total estimated volumes of contaminated soil, based on the ESA investigations, are:

- Contamination with hydrocarbon and with both hydrocarbons plus metals: 56,950 m^3; and
- Contamination only with metals: 32,950 m^3.

A breakdown of the estimated volumes of contaminated soil is provided in Appendix M and summarized as follows:

- Dock area, including tank farm: 10,300 m^3 with hydrocarbons and 9,000 m^3 with metals;
- Road surface from the Industrial Complex to the dock: nil with hydrocarbons and 15,750 m^3 with metals;
- Industrial Complex: 26,650 m^3 with hydrocarbons and 7,150 m^3 with metals;
- Town site: 7,500 m^3 with hydrocarbons and nil with metals;
- Landfarm cell: 750 m^3 with hydrocarbons and nil with metals;
- STOLport: 2,250 m^3 with hydrocarbons and 450 m^3 with metals;
- East Adit Treatment Facility: nil with hydrocarbons and 600 m^3 with metals; and
- Day tanks and storage areas in mining areas: 9,500 m^3 with hydrocarbons and nil with metals;

The proposed remedial activities for these areas are described in the appropriate subsections of Section 7.

8. Northern Community Benefits

Implementation of the Closure and Reclamation Plan will continue to provide benefits and opportunities to northern businesses and residents and, particularly, to businesses and residents of the Hamlet of Arctic Bay. These will include:

1. Improved access to and across the mine site;
2. Local sales of tools, computers, furniture and other items;
3. Employment during tear down and reclamation work;
4. Employment during period environmental monitoring work;
5. Training opportunities related to work and contract services; and
6. Possible transfer of infrastructure to GN for continued use.

8.1 Land Use Benefits

The reclamation activities that are described in this report are intended to return the mine site to a condition that is safe both for the environment and for people. Local residents and visitors to the area will be able to safely pursue the same land use activities that existed prior to the mine's construction.

Even in its reclaimed state, some additional land use benefits may be available to local residents. For example, the public road from Arctic Bay to the mine site and the mine road towards Kuhulu Lake will provide easier access to the Kuhulu Lake area than there was previously.

8.2 Sale of Goods

Arctic Bay community members have consistently expressed a strong interest in obtaining surplus goods from the site. This includes small tools, furniture, computers, appliances and other goods that are not practical to ship off-site for use at other CanZinco mine sites but have some usefulness nonetheless.

CanZinco will communicate directly with the Hamlet of Arctic Bay through the liaison officer throughout the closure and reclamation process to provide opportunities for obtaining such goods.

8.3 Employment and Contracting

Arctic Bay community members have consistently expressed a strong interest in participating in the reclamation activities that will be undertaken at the mine site. CanZinco will ensure that all opportunities for employment with CanZinco or with on-site contractors are brought to the community for their potential involvement.

It is anticipated, at this time, that a large portion of the job opportunities that would be available through the 2-year reclamation period would involve heavy equipment operators, shipping and freight assistants, technical field assistants, administrative staff and the like. It is likely that these positions could be filled by residents of Arctic Bay who have already received training and experience from previous employment at the Nanisivik mine.

Some of the reclamation work will be undertaken directly by CanZinco and some of the work may be contracted. Depending on specific qualifications that may be required for specialized work, northern Inuit contractors will also be invited to provide competitive bids on contracted work. CanZinco will encourage all on-site contractors to maximize the opportunities provided to local residents.

8.4 Training

Many residents of Arctic Bay will already be trained and experienced at some of the required jobs through previous work at the mine or at other industrial sites. However, there may be some job opportunities which could be filled by residents of Arctic Bay but for which they are not already trained and experienced.

CanZinco will be mindful of these types of opportunities and will work with the liaison officer and the Government of Nunavut to provide training for local residents who are interested and qualified to enter training programs.

It is anticipated, at this time, that a large portion of the training opportunities will be for jobs that will carry on past the immediate needs of the 2-year reclamation period and last through the following 5-year period of environmental monitoring. Directing the training at jobs that have a long term requirement would make the most beneficial use of the time and effort put into the training and would provide the most benefit to the local people involved. In this event, the types of jobs to which training would be directed might include:

- Environmental monitoring (collecting, analysing and shipping water samples or reading ground temperatures);
- Industrial first aid (this will be a requirement for any field work);

- Surveying (grade control or environmental monitoring for ground stability);
- Construction quality assurance and control (sample collection and field condition records);
- Photo documentation (records of reclamation stages or underground disposal record); and
- Post-closure site inspections.

Once the 2-year period of active reclamation is complete, CanZinco does not plan to have personnel at the site full time. For this reason, it will be CanZinco's interest to participate in the training of interested and qualified people for jobs that are required at the mine site. This may, ultimately, reduce the number of trips that CanZinco personnel need to make to Nansivik. However, the community of Arctic Bay and the Government of Nunavut will also have leading roles to play in any long term training program. Therefore, CanZinco will work in partnership with these groups, and with the individuals involved, to make any training programs a success for all involved.

8.5 Possible Continued Use of Mine Facilities

CanZinco believes the on-going use of Nanisivik mine facilities would provide benefits to northern residents and is committed to working collaboratively with organizations and individuals who are interested in developing concepts for continued use of some or all of the mine facilities.

Community members have consistently expressed a strong interest and desire in having some or all of the mine facilities remain in place. The road network is one example of mine infrastructure that has been specifically put forward by the community as a desirable element to remain after mine reclamation. The concept of a regional training centre for equipment operation, trades and other jobs has been expressed by community members as a positive concept.

The Government of Nunavut is conducting two projects regarding the Hamlet of Arctic Bay and Nanisivik. One project has investigated the social and economic impacts that closure of the Nanisivik mine will have on the Hamlet of Arctic Bay. The other project has identified and evaluated concepts that would allow for the continued use of some or all mine facilities. CanZinco has and will continue to contribute to these projects as available resources allow and as requested by the Government of Nunavut.

Even in light of these studies, CanZinco is required to proceed with closure and reclamation activities in an efficient and timely manner. This is because of:

1. Legal requirements of the Water Licence;
2. Additional "care and maintenance" costs which are borne by CanZinco while reclamation activities are delayed; and
3. Increased risk of impact from environmental liabilities if remediation activities are delayed.

All of the reclamation work is scheduled to be undertaken in 2004 and 2005. Discussions with interested parties will continue through this period, but the opportunities for ongoing use of facilities will rapidly diminish once the reclamation activities are underway. For this reason, CanZinco has made all parties who have been involved in discussions to date aware of the timeframes and implications.

9. Closure and Reclamation Monitoring

The Closure and Reclamation Monitoring Plan, Appendix F, provides a full description of the rationale for the proposed monitoring activities and detailed descriptions of the proposed activities. This information is summarized below.

9.1 Introduction

9.1.1 Objectives

The Monitoring Plan is designed to provide information related to two fundamental objectives:

1. Identification of the immediate needs for site management and the provision of diligent environmental protection activities; and
2. Assessment of the overall performance of reclamation measures.

The proposed mine reclamation activities are designed to stabilize the site (both chemically and physically) and provide for appropriate land use. Monitoring information should also provide the means of assessing when the site has achieved, as nearly as possible, "walk-away" status. This approach is environmentally and economically superior to those sites that require routine long term maintenance or perpetual water treatment.

9.1.2 Monitoring Periods

The Monitoring Plan, therefore, has been developed in the context of two time periods: the Reclamation Period; and the Closure Period.

The **Reclamation Period** encompasses the period of active physical reclamation of the mine site and the completion of the major activities proposed in the Mine Closure Plan. This period is currently anticipated to be of two-years duration: 2004 and 2005. During the Reclamation Period, sufficient manpower will be present at the site to follow a rigorous monitoring schedule. The monitoring activities will be carried out by the on-site personnel under the direction of an environmental coordinator. The rigorous schedule will satisfy the need for rapid feedback of environmental information to the reclamation managers. This will be an important means of managing the reclamation activities and ensuring appropriate protection of the environment is maintained.

The **Closure Period** immediately follows the Reclamation Period. During the Closure Period, only relatively minor maintenance work is planned at the mine site and monitoring will be focused on providing information for assessing the performance of the reclamation measures. The Closure Period is designed for a duration of 5 years subsequent to the Reclamation Period, from 2006 to 2010. As there will not be a continuous manpower presence at the mine site during the Closure Period, the monitoring programs will be carried out during discreet site visits and, to as great a degree as practical, by trained, local technical assistants from the community of Arctic Bay. The use of local assistants, working under the direction of an environmental manager, is anticipated to increase throughout the Closure Period as training increases the technical capabilities of the assistants.

Despite the fact that the closure monitoring period is defined as 5 years (until 2010), it is understood that the overall timeframe for the Monitoring Plan is somewhat "open-ended". Environmental performance monitoring will continue until sufficient data has been collected to confirm that long term behaviour of the site will meet the reclamation objectives.

9.1.3 Review and Reporting of Information

In order for the Monitoring Plan to be successful, the information that is collected must be reviewed and, where necessary, acted upon in a timely manner. This includes review and action by CanZinco for site management purposes and review and action by the NWB or CanZinco regarding compliance with the terms of the Water Licence.

The initial review of monitoring information will be made by CanZinco immediately upon receipt of the information. Where appropriate, CanZinco will consult with expert consultants and will take proactive actions to maintain compliance with the Water Licence. This will include the immediate implementation of contingency plans which are aimed at addressing deficiencies in the plan as well as any unforeseen events. (Contingencies for each of the major components of the Closure and Reclamation Plan are included with the specific reports for these areas which are appended to this document.)

A quarterly data report will be filed with the NWB in compliance with *Part H, Item 30* of the Water Licence. It is anticipated that the file would then be posted, thus providing public access and an appropriate level of transparency into the monitoring process.

An annual environmental report will also be filed with the NWB in compliance with *Part B, Item 16* of the Water Licence. This report will include a review and comparison of the information with previous year's data and will identify any developing spatial or temporal trends. It is anticipated that this report will also be posted and will allow all parties to assess the performance of the reclamation actions to that date

A Comprehensive Assessment Report that summarizes information garnered from the data will be filed with the Nunavut Water Board in 2010. The report will follow the Terms of Reference which are required under Part G, Item 22 of the Water Licence. This report will assess the "environmental stability" of the site in consultation with the appropriate communities, agencies and organizations. Based on the collected data, long term projections will be made on the expected behaviour of the site. If this review demonstrates that the site is currently stable and is expected to stay stable in the long term, then CanZinco will anticipate a release from further monitoring obligations.

9.1.4 Metal Mine Effluent Regulations (MMER)

The MMER (under the Fisheries Act and enforced by Environment Canada) came into effect in June 2002. Nanisivik Mine was in operation when the MMER came into effect and is therefore bound by the regulations. Additionally, as part of the Nanisivik Water Licence the NWB has included the monitoring stipulations required by the MMER.

In accordance with the *Fisheries Act*, all mines regulated under the MMER are required to conduct periodic Environmental Effects Monitoring (EEM) studies. Given that Nanisivik ceased production in September 2002, and notified Environment Canada in July 2003 of its intention to achieve "*Closed Mine Status*" the Mine falls under Part 4 of the *MMER*, which deals specifically with closed mines. As described in Part 4 of the *MMER*, the mine is required to conduct a Final Monitoring study within a three year period (i.e. July 2006).

Nanisivik submitted an EEM program design in February 2003 for approval. Once approved, the study will be carried out and reported on. The EEM program work is anticipated to focus primarily on receiving water in Twin Lakes Creek and Strathcona Sound.

Although the objectives of the EEM program will differ somewhat from those of this reclamation performance monitoring program, the information that is generated from the EEM program will clearly be of interest to the ongoing assessment of the performance of the reclamation plan. The information generated from the EEM program will be incorporated into each annual report submitted to the NWB.

9.2 Water Quality Monitoring

9.2.1 Approach

The general approach taken to the design of the water quality monitoring plan is to:

1. fulfill the requirements of the Water Licence;
2. fulfill the general objectives of the Reclamation Performance Monitoring Plan by:
   (a) collecting location-specific information to monitor the success of location-specific reclamation measures; and
   (b) collecting general information to assess the quality of water entering Strathcona Sound;

3. work in concert, as appropriate, with the monitoring provisions of the MMER as enforced by Environment Canada; and
4. carry forward existing monitoring locations such that trends spanning the mine-closure milestone can be assessed.

In the context of this Reclamation Performance Monitoring Plan, the following locations are proposed as being considered Final Discharge Points:

1. Outflow from the West Twin Reservoir (referenced in the Licence as station 159-4); and
2. Outflow from the East Adit Treatment Facility (referenced in the Licence as station 159-12.

The outflow from the West Twin Reservoir is anticipated to flow continuously through the summer season (anticipated mid-May to mid-September). This outflow will include runoff from the reclaimed Surface Cell, Test Cell and Reservoir areas. The flow immediately mixes with outflow from East Twin Lake and passes into Twin Lakes Creek, which reports to Strathcona Sound.

The East Adit Treatment Facility is scheduled to remain in place until runoff from the disturbed areas has returned to pre-mining conditions, which are known to have contained elevated metal concentrations. At that time, and subject to the NWB's approval, the treatment facility will be dismantled and the two ponds removed. The proposed monitoring stations will not be altered except that location 159-12 will be representative of runoff from the reclaimed East Open Pit area, rather than a "Final Discharge Point".

All of the proposed water sampling stations (Figure 20) are located in discreet flowpaths where water collects and can be sampled at a consistent location. Each sampling event will also include sampling of ephemeral surface seeps that may be observed and that appear to relate directly to any of the reclaimed areas of the mine site. It is anticipated that such seeps will only be present during freshet or immediately following a substantial rainfall event.

9.2.2 Reclamation Period

Monitoring during the Reclamation Period will focus on the environmental effects of the reclamation activities, which include covering tailings, relocating tailings, reclamation of rock piles and open pits, covering of the landfill facility, remediation of contaminated soils and possible operation of the east adit water treatment plant, if necessary.

The on-site laboratory is no longer equipped to perform metal analyses and, therefore, these parameters will be determined at an off-site laboratory. The laboratory that is used will be accredited by the Canadian Association of Environmental Analytical Laboratories. Analyses for total suspended solids will continue to be conducted on-site.

Table 8 lists the proposed frequencies of sampling and parameters to be determined during the Reclamation Period.

Table 8. Water Quality Monitoring – Reclamation Period

Station	Description	Field Parameters[1]	Flow[2]	Laboratory Parameters[3,4]
Twin Lakes Creek Watershed				
NML-23	Outflow from East Twin Lake	W	2W	2W – T, S,TSS
159-4	Outflow from West Twin Disposal Area	D	D	W – T, S,TSS
159-9	Twin Lakes Creek stream crossing	W	-	2W – T, S, TSS
200-7	Twin Lakes Creek upstream of waste rock piles	W	-	2W – T, S, TSS
159-11	Twin Lakes Creek downstream of waste rock piles	W	-	2W – T, S, TSS
200-3	Twin Lakes Creek downstream of natural sulphide outcrop	W	-	2W – T, S, TSS
159-10	Twin Lakes Creek upstream of west townsite tributary	W	-	2W – T, S, TSS
159-6	Outlet of Twin Lakes Creek into Strathcona Sound	W	2W	2W – T, S,TSS
Chris Creek Watershed				
159-15	Chris Creek upstream of Area 14	W	-	2W – T, S, TSS
159-16	Chris Creek downstream Area 14	W	-	2W – T, S, TSS
159-14	Chris Creek downstream of K-Baseline	W	-	2W – T, S, TSS
159-13	Chris Creek downstream of East Adit	W	-	2W – T, S, TSS
159-17	Chris Creek outlet into Strathcona Sound	W	-	2W – T, S, TSS
East Adit Treatment Facility (prior to reclamation of the facility)				
159-12B	Upstream flow into East Adit Retention Pond	W	-	2W – T, S, TSS
159-12	Discharge from East Adit Retention Pond	D	D	W – T, S,TSS
159-12A	East Portal Creek flow into East Adit Catchment Pond	W	-	2W – T, S, TSS
East Adit Treatment Facility (subsequent to reclamation of the facility)				
159-12B	Upstream flow into East Adit Retention Pond	W	-	2W – T, S, TSS
159-12	Discharge from East Adit Retention Pond	W	W	2W – T, S,TSS
159-12A	East Portal Creek flow into East Adit Catchment Pond	W	-	2W – T, S, TSS

Station	Description	Field Parameters[1]	Flow[2]	Laboratory Parameters[3,4]
Oceanview Watershed				
159-18	Run off from Oceanview Open Pit area	W	-	2W – T, S, TSS
159-19	Discharge from Oceanview sump	W	-	2W – T, S, TSS
Landfill Watershed				
NML-26	Surface flow at toe of Landfill	W	2W	2W – T, S, TSS
NML-30	Downstream of Landfill – west drainage system	W	2W	2W – T, S, TSS
NML-29	Downgradient of Landfill – east drainage system (intermittent surface flow)	W	2W	2W – T, S, TSS
TP02-95	Groundwater well downgradient of the Landfill	2A	-	2A – D, S, TDS
TP02-97	Groundwater well downgradient of the Landfill	2A	-	2A – D, S, TDS
TP02-102	Groundwater well downgradient of the Landfill	2A	-	2A – D, S, TDS
TP03-387	Groundwater well downgradient of the Landfill	2A	-	2A – D, S, TDS

Notes: D=daily; W-weekly; 2W=every 2 weeks; M=monthly; 2A=twice per year (early/late summer).

1. Field Parameters include: pH, conductivity, temperature.
2. Flow measurement may be by velocity measurement, staff gauge or other direct measurement.
3. All metals analyses to include hardness.
   T=total metals, D=dissolved metals; S=sulphate; TSS=total suspended solids; TDS=total dissolved solids.
4. TSS determinations may be conducted at the on-site laboratory; other determinations to be made an accredited off-site laboratory.

9.2.3 Closure Period

Water quality monitoring through the Closure Period will focus on collecting information necessary to evaluate the effectiveness of the reclamation measures. The monitoring schedule is reduced through the Closure Period in anticipation of monitoring results that confirm the effectiveness of the reclamation measures. If this is not the case, then the monitoring schedule would be amended to collect the appropriate information.

There will not be a continuous manpower presence on the mine site during this period and sampling will be conducted during discreet site visits. The on-site laboratory is no longer equipped to perform metal analyses and, therefore, these parameters will be determined at an off-site laboratory. The laboratory that is used will be accredited by the Canadian Association of Environmental Analytical Laboratories. Analyses for total suspended solids will continue to be conducted on-site or in Arctic Bay.

Tables 9 and 10 list the proposed frequencies of sampling and parameters to be determined during the Closure Period for Years 1-2 and Years 3-5, respectively.

Table 9. Water Quality Monitoring – Closure Period Years 1 and 2

Station	Description	Field Parameters[1]	Flow[2]	Laboratory Parameters[3,4]
Twin Lakes Creek Watershed				
NML-23	Outflow from East Twin Lake	W	2W	2W – T, S,TSS
159-4	Outflow from West Twin Disposal Area	W	W	2W – T, S,TSS
159-9	Twin Lakes Creek stream crossing	W	-	2W – T, S, TSS
200-7	Twin Lakes Creek upstream of waste rock piles	W	-	2W – T, S, TSS
159-11	Twin Lakes Creek downstream of waste rock piles	W	-	2W – T, S, TSS
200-3	Twin Lakes Creek downstream of natural sulphide outcrop	W	-	2W – T, S, TSS
159-10	Twin Lakes Creek upstream of west townsite tributary	W	-	2W – T, S, TSS
159-6	Outlet of Twin Lakes Creek into Strathcona Sound	W	2W	2W – T, S,TSS
Chris Creek Watershed				
159-15	Chris Creek upstream of Area 14	W	-	2W – T, S, TSS
159-16	Chris Creek downstream Area 14	W	-	2W – T, S, TSS
159-14	Chris Creek downstream of K-Baseline	W	-	2W – T, S, TSS
159-13	Chris Creek downstream of East Adit	W	-	2W – T, S, TSS
159-17	Chris Creek outlet into Strathcona Sound	W	-	2W – T, S, TSS
East Adit Treatment Facility (prior to reclamation of the facility)				
159-12B	Upstream flow into East Adit Retention Pond	W	-	2W – T, S, TSS
159-12	Discharge from East Adit Retention Pond	W	W	2W – T, S,TSS
159-12A	East Portal Creek flow into East Adit Catchment Pond	W	-	2W – T, S, TSS
East Adit Treatment Facility (subsequent to reclamation of the facility)				
159-12B	Upstream flow into East Adit Retention Pond	W	-	2W – T, S, TSS
159-12	Discharge from East Adit Retention Pond	W	-	2W – T, S,TSS
159-12A	East Portal Creek flow into East Adit Catchment Pond	W	-	2W – T, S, TSS

Station	Description	Field Parameters[1]	Flow[2]	Laboratory Parameters[3,4]
Oceanview Watershed				
159-18	Run off from Oceanview Open Pit area	W	-	2W – T, S, TSS
159-19	Discharge from Oceanview sump	W	-	2W – T, S, TSS
Landfill Watershed				
NML-26	Surface flow at toe of Landfill	W	2W	2W – T, S, TSS
NML-30	Downstream of Landfill – west drainage system	W	2W	2W – T, S, TSS
NML-29	Downgradient of Landfill – east drainage system (intermittent surface flow)	W	2W	2W – T, S, TSS
TP02-95	Groundwater well downgradient of the Landfill	2A	-	2A – D, S, TDS
TP02-97	Groundwater well downgradient of the Landfill	2A	-	2A – D, S, TDS
TP02-102	Groundwater well downgradient of the Landfill	2A	-	2A – D, S, TDS
TP03-387	Groundwater well downgradient of the Landfill	2A	-	2A – D, S, TDS

Notes: D=daily; W-weekly; 2W=every 2 weeks; M=monthly; 2A=twice per year (early/late summer).

1. Field Parameters include: pH, conductivity, temperature.
2. Flow measurement may be by velocity measurement, staff gauge or other direct measurement.
3. All metals analyses to include hardness.
   T=total metals, D=dissolved metals; S=sulphate; TSS=total suspended solids; TDS=total dissolved solids.
4. TSS determinations may be conducted at the on-site laboratory; other determinations to be made an accredited off-site laboratory.

9.2.4 Twin Lakes Creek Metal Loading Studies

The metal loading studies that were conducted and reported during mine operations will be continued through the Reclamation Period and Closure Periods. These continued studies will use the information collected through the water quality monitoring program to estimate the loading of metals in Twin Lakes Creek from various sources and to characterize temporal and spatial trends. The metal loading studies will be reported as a part of the Annual Environmental Reports filed with the NWB.

Table 10. Water Quality Monitoring – Closure Period Years 3 to 5

Station	Description	Field Parameters[1]	Flow[2]	Laboratory Parameters[3]
Twin Lakes Creek Watershed				
NML-23	Outflow from East Twin Lake	2W	2W	2W – T, S,TSS
159-4	Outflow from West Twin Disposal Area	2W	2W	2W – T, S,TSS
159-9	Twin Lakes Creek stream crossing	2W	-	2W – T, S, TSS
200-7	Twin Lakes Creek upstream of waste rock piles	2W	-	2W – T, S, TSS
159-11	Twin Lakes Creek downstream of waste rock piles	2W	-	2W – T, S, TSS
200-3	Twin Lakes Creek downstream of natural sulphide outcrop	2W	-	2W – T, S, TSS
159-10	Twin Lakes Creek upstream of west townsite tributary	2W	-	2W – T, S, TSS
159-6	Outlet of Twin Lakes Creek into Strathcona Sound	2W	2W	2W – T, S,TSS
Chris Creek Watershed				
159-15	Chris Creek upstream of Area 14	2W	-	M – T, S, TSS
159-16	Chris Creek downstream Area 14	2W	-	M – T, S, TSS
159-14	Chris Creek downstream of K-Baseline	2W	-	M – T, S, TSS
159-13	Chris Creek downstream of East Adit	2W	-	M – T, S, TSS
159-17	Chris Creek outlet into Strathcona Sound	2W	-	M – T, S, TSS
East Adit Treatment Facility (prior to reclamation of the facility)				
159-12B	Upstream flow into East Adit Retention Pond	2W	-	M – T, S, TSS
159-12	Discharge from East Adit Retention Pond	2W	2W	2W – T, S,TSS
159-12A	East Portal Creek flow into East Adit Catchment Pond	2W	-	M – T, S, TSS
East Adit Treatment Facility (subsequent to reclamation of the facility)				
159-12B	Upstream flow into East Adit Retention Pond	2W	-	M – T, S, TSS
159-12	Discharge from East Adit Retention Pond	2W	-	2W – T, S,TSS
159-12A	East Portal Creek flow into East Adit Catchment Pond	2W	-	M – T, S, TSS
Oceanview Watershed				
159-18	Run off from Oceanview Open Pit area	2W	-	M – T, S, TSS

Station	Description	Field Parameters[1]	Flow[2]	Laboratory Parameters[3]
159-19	Discharge from Oceanview sump	2W	-	M – T, S, TSS
Landfill Watershed				
NML-26	Surface flow at toe of Landfill	2W	2W	M – T, S, TSS
NML-30	Downstream of Landfill – west drainage system	2W	2W	M – T, S, TSS
NML-29	Downgradient of Landfill – east drainage system (intermittent surface flow)	2W	2W	M – T, S, TSS
TP02-95	Groundwater well downgradient of the Landfill	A	-	A – D, S, TDS
TP02-97	Groundwater well downgradient of the Landfill	A	-	A – D, S, TDS
TP02-102	Groundwater well downgradient of the Landfill	A	-	A – D, S, TDS
TP03-387	Groundwater well downgradient of the Landfill	A	-	A – D, S, TDS

Notes: D=daily; W-weekly; 2W=every 2 weeks; M=monthly; 2A=twice per year (early/late summer).

1. Field Parameters include: pH, conductivity, temperature.
2. Flow measurement may be by velocity measurement, staff gauge or other direct measurement.
3. All metals analyses to include hardness.
   T=total metals, D=dissolved metals; S=sulphate; TSS=total suspended solids; TDS=total dissolved solids.
4. TSS determinations may be conducted at the on-site laboratory; other determinations to be made an accredited off-site laboratory.

9.3 Geothermal Monitoring

9.3.1 Approach

The general approach taken to the design of the geothermal monitoring plan is to:

1. fulfill the requirements of the Water Licence;
2. fulfill the general objectives of the Reclamation Performance Monitoring Plan by collecting location-specific information to monitor the success of location-specific reclamation measures;
3. fulfill the objectives of the location-specific closure plans; and
4. carry forward existing monitoring locations that meet the current needs such that trends spanning the mine-closure milestone can be assessed.

In addition to existing instruments, additional geothermal monitoring instrumentation is anticipated to be installed as part of the reclamation activities.

Four types of monitoring instruments are proposed: thermistors; thermocouples; frost gauges; and vibrating wire piezometers. These instruments have been successfully used on-site through mine operations for the various specific purposes described below.

Thermistors and thermocouples are variants of one another but provide an actual temperature measure at the location of the thermistor or thermocouple node. The frost gauge does not provide actual temperature data but the depth of the thaw/frozen interface can accurately and easily be determined. Vibrating Wire Piezometers measure pore water pressures.

9.3.2 Reclamation Period

Monitoring during the Reclamation Period will focus on continuing the monitoring record at existing instrumentation and collecting the initial readings from new instrumentation as it is installed. New instrumentation will be incorporated into the monitoring schedule as they become available.

The numbers of instruments to be monitored and the frequency of monitoring for the Reclamation Period are shown in Table 11.

9.3.3 Closure Period

Geothermal monitoring through the Closure Period will focus on collecting information necessary to evaluate the effectiveness of the reclamation measures. The monitoring schedule is reduced through the Closure Period in anticipation of monitoring results that confirm the effectiveness of the reclamation measures. If this is not the case, then the monitoring schedule would be amended.

There will not be a continuous manpower presence on the mine site during this period and monitoring will be conducted during discreet site visits. The numbers of instruments to be monitored and the frequency of monitoring for the Closure Period are shown in Table 12.

9.4 Confirmatory Sampling of Soils

The remediation of contaminated soils is anticipated to involve the excavation of soils in some locations. In these areas, on-site screening and confirmatory sampling will be conducted.

On-site screening will be utilized to finalize and refine, where necessary, delineation of the boundaries of contamination to be remediated. A contaminant concentration confirmation procedure will be implemented that will ensure that the remedial objectives are achieved in an efficient and timely manner. The objective will be to capture at least 95% of soils containing contaminants in excess of the SQRO's in each remediation area. Contaminant concentrations in any residual soils will not exceed twice the SQRO's. This objective provides a realistic and achievable goal.

9.5 Physical Stability of Earth Structures

An annual inspection of earth structures, water diversions, rock slopes and soil covers by a professional geotechnical engineer will continue, as per the established practice, through the Reclamation and Closure Periods.

The inspection will be conducted during later summer (August/September) such that thaw conditions are observed. The engineer's report will be filed, in its entirety, with the Nunavut Water Board as a component of the annual environmental report.

The specific components of the mine site that will be explicitly included into the engineer's inspection for an assessment of physical stability will include:

- West Twin and Test Cell Dikes;
- West Twin Surface Cell Spillway;
- West Twin Reservoir Outlet;
- West Twin Tailings Cover;
- East twin Lakes outlet area;
- Landfill Cover;
- Area 14, East Open Pit and West Open Pit covers; and
- Oceanview and K-Baseline areas.

The engineer's report will include a professional review and assessment of all thermal monitoring information and flow information relevant to a physical stability assessment. The engineer will provide recommendations for any necessary physical maintenance work and for any necessary amendments to the instrumentation monitoring schedule.

Additionally, on-site or local personnel will be trained by the geotechnical engineer to conduct more frequent inspections of key components of the mine site. An inspection protocol will be prepared by the geotechnical engineer and provided to the inspection personnel such that the inspections are conducted in a consistent manner and provide the most useful information for review by the engineer.

Table 11. Geothermal Monitoring – Reclamation Period

Area	Instruments	Frequency
West Twin Dike	16 existing thermocouples	Monthly
	3 existing thermistors	Monthly
	1 new VW piezometer	Monthly
Surface Cell Area	4 existing thermocouples	Monthly
	9 existing thermistors	Monthly
	3 new thermistors	Monthly
	5 existing VW piezometers	monthly
	4 new shallow and 4 new deep VW piezometers	monthly
	2 new monitoring wells	twice per summer
	6 new frost gauges	biweekly from June to Sept.
Toe of West Twin Dike	2 existing thermocouples	monthly
	1 existing thermistor	monthly
	1 new thermistor	monthly
Test Cell Area	1 existing thermocouple	monthly
	2 new thermistors	monthly
	4 new shallow and 4 new deep VW piezometers	monthly
	2 new monitoring wells	twice per summer
	2 new frost gauges	biweekly from June to Sept.
Test Cell Dike	2 existing thermistors	monthly
And Toe Area	2 new thermistors	monthly
	1 VW piezometer	monthly
	2 new frost gauges	biweekly from June to Sept.
Landfill	1 existing thermocouple	Monthly
	2 new thermistors	Monthly
	2 new frost gauges	biweekly from June to Sept.
West Open Pit	1 existing thermocouple	Monthly
	1 new thermistor	Monthly
	2 new frost gauges	biweekly from June to Sept.
East Open Pit	1 existing thermocouple	Monthly
	1 new thermistor	Monthly
	1 new frost gauge	biweekly from June to Sept.
Area 14	2 existing thermocouples	Monthly
	1 new frost gauge	biweekly from June to Sept.

Table 12. Geothermal Monitoring – Closure Period

Area	Instruments	Frequency
West Twin Dike	5 thermocouples 2 thermistors 1 VW piezometer	Quarterly Quarterly Quarterly
Surface Cell Area	6 thermistors 9 VW piezometers 2 monitoring wells 6 frost gauges	Quarterly Quarterly or until frozen Once per summer Biweekly from June to Sept. for Years 1 to 3
Toe of West Twin Dike	1 thermistor	Quarterly
Test Cell Area	2 thermistors 4 VW piezometers 2 monitoring wells 2 frost gauges	Quarterly Quarterly or until frozen Once per summer Biweekly from June to Sept. for Years 1 to 3
Test Cell Dike and Toe Area	2 thermistors 1 VW piezometer 2 frost gauges	Quarterly Quarterly or until frozen Biweekly from June to Sept. for Years 1 to 3
Landfill	1 thermocouple 2 thermistors 2 frost gauges	Quarterly Quarterly Biweekly from June to Sept. for Years 1 to 3
West Open Pit	1 thermocouple 1 thermistor 2 frost gauges	Quarterly Quarterly Biweekly from June to Sept. for Years 1 to 3
East Open Pit	1 thermocouple 1 thermistor 1 frost gauge	Quarterly Quarterly Biweekly from June to Sept. for Years 1 to 3
Area 14	2 thermocouples 1 frost gauge	Quarterly or until frozen Biweekly from June to Sept. for Years 1 to 3

9.6 Reporting to Nunavut Water Board

During the Reclamation and Closure Periods, monitoring will be conducted in accordance with the Reclamation Performance Monitoring Plan and the terms of the Water Licence. It is anticipated that quarterly water quality data reports will continue to be submitted to the Nunavut Water Board. These reports would be submitted prior to the end of the subsequent month and would include water quality data and a description of significant activities at the mine site.

An Annual Environmental Report would be prepared and submitted to the Nunavut Water Board by March 1 of the subsequent year. The report would provide a review and interpretation of all data collected during the previous year including: water quality, ground temperatures, geotechnical inspection, and other reclamation and closure monitoring studies. The report will also include a comparison with pre-closure data, where relevant and available, to establish longer term temporal trends and an indication of the “direction” that the results are heading. This report will include the complete report of the Geotechnical Engineer on their annual inspection.

The Annual Environmental Report will also include any proposed amendments to the Reclamation Performance Monitoring Program that are considered beneficial based on the current monitoring information.

9.7 2008 Comprehensive Performance Review

The proposed Terms of Reference for a Comprehensive Performance Review will be submitted to the Nunavut Water Board by March 1, 2007, as required by the Water Licence. The intent for these terms of Reference will be to describe a study that will provide a comprehensive review of all of the reclamation performance monitoring information that describes the environmental status of the mine site as compared to the reclamation objectives and that also describes the projected environmental conditions into the future. The overriding purpose of the study would be to allow an assessment of the overall success of the reclamation measures against the objectives and whether the Reclamation Performance Monitoring Program can be safely discontinued at the end of 2010, as proposed.

It is anticipated that the Terms of Reference will undergo a technical review by the Nunavut Water Boardd and that this review would be completed in 2007. This would ensure that any proposed field studies could be performed in 2008 and included into the study, to be concluded and submitted to the Nunavut Water Board by the end of 2010.

10. Schedule

The schedule for the completion of mine reclamation work can be broadly summarized as follows:

Timeframe	Activity
2002 (September)	Mine Closure
2003	Care and Maintenance Only
2004	Reclamation Activities
2005	Reclamation Activities
2006 to 2010	Environmental Monitoring

10.1 Activities Completed Prior to Mine Closure

Mining and milling operations were halted permanently on September 30, 2002.

Progressive Reclamation was undertaken prior to the cessation of mining and milling in order to take advantage of the benefits of a fully staffed operation and, thereby, reduce the post-closure work requirements. These activities included:

1. Partial recovery of 09 rock pile to underground;
2. Partial recovery of 39 rock piles to East Open Pit;
3. Partial reclamation of Ocean View pit;
4. Partial reclamation of East Open Pit;
5. Partial reclamation of West Open Pit;
6. Continued placement of a shale cover on tailings in the Surface Cell;
7. Management of tailings pours to work towards achieving the desired closure contours for surface drainage;
8. Shipment of surplus reagents and other hazardous materials off-site;
9. Shipment of surplus equipment off-site;
10. Initiation of the Environmental Site Assessment program;
11. Initiation of the Human Health and Ecological Risk Assessment process;
12. Response to regulator comments on Closure and Reclamation Plan;
13. Liaise with Hamlet of Arctic Bay; and
14. Continued discussions with interested stakeholders regarding alternatives for continued use of mine facilities.

10.2 Reclamation Period

All of the proposed reclamation activities are scheduled to be completed during 2004 and 2005.

CanZinco will continue to work diligently and collaboratively with all interested parties to identify, develop and implement plans that would allow for the on going use of mine facilities. However, these opportunities will rapidly diminish once the reclamation activities are underway.

Some of the reclamation activities are sequential. For example, relocation of tailings high spots in the Reservoir Pond will be completed subsequent to the pond water level being drawn down.

10.3 Closure Period

Activities related to the Closure Period monitoring program, as described in Section 9, will be completed during this period.

This will include the collection and reporting of monitoring information as well as any required maintenance to reclaimed areas.

Figures

Appendices

Appendix A

Engineering Design of Reclamation Surface Covers

BGC Engineering Inc., February 2004

Appendix B

Assessment of Surface Cell and Test Cell Taliks

BGC Engineering Inc., February 6, 2004

Appendix C

Quarry Development and Reclamation Plan

BGC Engineering Inc., February 6, 2004

Appendix D

West Twin Disposal Area Surface Cell Spillway Design

Golder Associates Limited, March 2004

Appendix E

Nanisivik Mine Rock Piles and Open Pits Closure Plan

Gartner Lee Limited, February 2004

Appendix F

Nanisivik Mine Reclamation and Closure Monitoring Plan

Gartner Lee Limited, February 2004

Appendix G

2002 Phase II Environmental Site Assessment, Nanisivik Mine Nunavut
Gartner Lee Limited, January 2003

Appendix H

2003 Phase 3 Environmental Site Assessment, Nanisivik Mine Nunavut
Gartner Lee Limited, February 2004

Appendix I

Nanisivik Mine Human Health and Ecological Risk Assessment

Jacques Whitford Environment Ltd., October 2003

Appendix J

West Twin Disposal Area Closure Plan

BGC Engineering Inc., March 2004

Appendix K

Nanisivik Mine Waste Disposal Plan

CanZinco Ltd., March 2004

Appendix L

Nanisivik Mine Landfill Closure Plan

Gartner Lee Limited, February 2004

Appendix M

Memorandum, Nanisivik Mine, Predicted Volumes of Contaminated Soil

Gartner Lee Limited, February 2004