Nanisivik Mine

Closure and Reclamation Plan

ᓇᓂᓯᕕᐅᑦ ᒪᑐᕙᓕᐊᓂᖅᑲᓄᑦ ᐊᒪᓗ ᓴᓗᒪᖅᓴᖅᑕᐅᓂᖅᑲᓄᑦ

CanZinco Ltd.
February 2002

Volume 1 of 2:
Closure and Reclamation Plan

CanZinco Ltd.
Nanisivik Mine
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Closure and Reclamation Plan

Prepared for

CanZinco Ltd.

Prepared by:

Gartner Lee Limited

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ᓇᓂᓯᕕᐅᑦ ᒪᑐᕙᓚᐊᓂᖓᓄᑦ ᐊᒻᒪ ᓴᓗᒪᖅᓴᖅᑕᐅᓂᖓᓄᑦ

ᓇᐃᒃᓕᒋᐊᖅᓯᒪᔪᑦ ᐅᖃᐅᓯᒃᓴᐃᑦ

ᓇᓂᓯᕕᒃᑯᑦ ᐅᔭᕋᒃᓂᐊᖅᑎᖕᒋᑦ ᐱᖁᑎᒋᔭᐅᔪᑦ CanZinco Ltd, ᐃᓚᒋᔭᐅᔪᑦ ᐅᑯᓄᖓ Breakwater Resources Ltd. ᐅᔭᕋᒃᑕᖅᐱᐅᔪᖅ ᑲᓇᑕᐅᑦ ᐅᑭᐅᖅᑕᖅᑐᖓᓂ ᐅᐊᒃᓇᖓᓂ ᕿᑭᖅᑕᓗᑦ. ᐅᔭᕋᒃᑕᖅᐱᐅᔪᖅ ᐊᖅᕙᖅᑐᑦ ᑲᖕᒋᖅᖢᐊᑕ ᐃᓗᐊᓂᑦᑐᖅ. ᐊᕙᑎᖓ ᓄᓇᖓ ᓂᒃᓚᓱᒃᑐᒥᑦᑐᖅ, ᖃᐅᓯᖅᓂᖅᑲᓗᐊᖕᒋᓗᓂᓗ, ᖁᐊᖑᐃᓇᖅᑦᑕᖅᑐᖅ ᒪᓂᕋᖅ ᐊᒻᒪ ᓄᓇᖓᑕ ᖃᖓ ᐱᕈᖅᑐᖅᑦᑎᐊᖕᒋᑦᑐᖅ, ᓂᖅᔪᑎᖅᑦᑎᐊᖕᒋᔪᑎᒋᔭᖓ ᐱᕈᖅᑐᖅᑦᑎᐊᖕᒋᓐᓂᖓᓄᑦ.

ᐃᓄᐃᑦ ᐃᒃᐱᐊᖅᔪᒃᒥᐅᑕᐃᑦ, ᐅᓄᖅᓂᖅᑐᑦ 700 ᖃᓂᒋᔭᓂᑦᑐᑦ ᐅᖓᓯᒃᒥᖅᑐᖅ 33 ᑭᓚᒥᑕᒥᒃ ᓇᓂᓯᕕᒃᒥᑦ. ᐃᖃᓇᐃᔭᖅᑎᑦ ᑎᑭᖃᑦᑕᖅᑐᑦ ᐊᒻᒪ ᐃᒃᐱᐊᖅᔪᒃᑯᐊᖃᑦᑕᖅᑐᑦ ᖃᖓᑕᓱᒃᑯᑦ ᐊᖅᑭᒃᓯᒪᔪᒃᑯᑦ ᐃᖃᓗᒃᓂᑦ. ᐅᓯᔭᐅᔭᓐᓇᐊᓚᑦ ᐱᖁᑎᑦ ᑎᑭᑎᑕᐅᖃᑦᑕᖅᑐᑦ ᐊᒻᒪ ᓴᕕᕋᔭᒃᓴᐃᑦ ᐅᓯᒃᑕᖅᑕᐅᖃᑦᑕᖅᑐᑦ ᐅᒥᐊᖅᔪᐊᒃᑯᑦ ᐃᒪᐅᓂᖓᓂ ᐱᓇᓱᐊᕈᓯᑦ 14 ᐃᓗᐊᓂ.

ᐅᔭᕋᒃᓂᐊᓯᒋᐊᓚᐅᖅᑐᑦ 1976ᒥ. ᓴᕕᕋᔭᒃᓴᐃᑦ ᐱᔭᖅᑕᐅᖃᑦᑕᖅᑐᑦ ᓄᓇᐅᑦ ᐃᓗᐊᓂᑦ ᐊᒻᒪ ᓯᖃᓕᔭᐅᓗᑎᒃ ᓴᕕᕋᔭᒃᓴᐅᓂᖕᒋᑦ ᐱᔭᖅᑕᐅᓗᑎᒃ. ᓴᓗᒪᖅᓴᐃᓂᖓ ᐅᖅᑭᖕᒋᓂᖃᑦᑐᓂᒃ ᐱᔭᓐᓂᖅᓯᖃᑦᑕᖅᑐᖅ 2,200 ᑕᓐ ᐅᓗᖅᒧᑦ. ᐃᖃᓇᐃᔭᖅᑎᑦ ᐃᓚᒋᓪᓗ ᓄᓇᖃᖅᑐᑦ ᓇᓂᓯᕕᒃᒥ, ᓴᓇᔭᐅᓂᑯᓪᓗᓂᓗ ᐅᔭᕋᒃᓂᐊᖅᓂᐅᑦ ᐃᓚᒋᓪᓗᓂᐅᒃ. ᓄᓇᓕᖓ ᐱᑕᖃᐅᖅᑐᖅ ᐃᓕᓐᓂᐊᖅᕕᒃᒥᒃ, ᑐᒃᓯᐊᖅᕕᒃᒥᒃ,ᑎᑎᕋᒃᑯᕕᒃᒥᒃ,ᐱᖑᐊᖅᕕᒃᒥᒃ,ᓂᕆᔭᖅᑐᖅᕕᒃᒥᒃ,ᐃᒃᓗᓂᒃ, ᐊᒻᒪ ᐃᒃᓗᕈᓯᖃᐅᖅᑐᓂᒃ.
ᒪᓐᓇᐅᔪᖅ ᐃᖃᓇᐃᔭᖅᑎᖃᖅᑐᑦ 171ᓂᒃ. ᒪᑐᓂᐊᖅᓂᖓ ᐊᖅᑭᒃᓯᒪᔪᖅ ᓯᑎᐱᕆ 30, 2002 ᐱᔪᑎᖃᖅᖢᑎᒃ ᐊᑭᑭᓗᐊᓕᖅᓂᖓᓄᑦ ᓴᕕᕋᔭᒃᓴᖅ.

ᐱᒋᐊᖅᑎᑕᐅᓂᑯᔪᖅ ᐃᑲᔪᖅᑕᐅᓗᑎᒃ ᒐᕙᒪᒃᑯᓐᓂᑦ ᓄᓇᑦᓯᐊᖅᒥᑦ (ᒐᕙᒪᐅᓚᐅᖅᓯᒪᒃᒪᑕ) ᐊᒻᒪ ᐃᓚᖕᒋᑦ ᐃᒃᓗᖁᑎᖕᒋᑦ ᐱᖁᑎᒋᔭᐅᓗᑎᒃ ᒐᕙᒪᒃᑯᓐᓂᒃ ᓄᓇᕗᒥ. ᐱᖁᑎᒋᔭᐅᔪᑦ ᐅᑯᐊ: ᑐᒃᓯᐊᖅᕕᒃ, ᐃᒪᖅᐅᑎᖓ,ᑯᕕᖅᑕᖅᕕᐅᑦ ᓴᓗᒪᖅᓴᐃᔨᖓ, ᐃᒃᓗᐃᑦ,ᐊᖁᑎ ᑐᓚᒃᑕᖅᕕᒃᒥᑦ ᒥᑦᑕᖅᕕᒃᒧᑦ ᐊᒻᒪ ᐃᒃᐱᐊᖅᔪᒃᒧᑦ ᐊᓯᖕᒋᓪᓗ ᐃᒃᓗᐃᑦ. ᓴᓗᒪᖅᓴᖅᑕᐅᓂᖕᒋᑦ ᐱᔭᐅᓂᖕᒋᓪᓗ ᑲᒪᒋᔭᐅᔪᑦ ᒐᕙᒪᒃᑯᓐᓂᑦ ᓄᓇᕗᒥ.

ᑐᓚᒃᑕᖅᕕᒃ ᐱᖁᑎᒋᔭᐅᔪᖅ ᐃᒪᖅᒥᐅᑕᓕᕆᔨᒃᑯᓐᓂᑦ. ᐊᑐᖅᑕᐅᖃᑦᑕᖅᖢᓂᓗ ᐅᖅᓴᒃᓴᐃᓇᓯᒃᑎᓪᓗᒥᑦ ᐊᒻᒪ ᓄᓇᓕᒃᓄᑦ ᐊᓯᖕᒋᓐᓄᑦ ᐱᖁᑎᒃᑯᕕᒋᔭᐅᓗᓂ (ᐅᖅᓯᖃᐅᑎᖕᒋᓪᓗ ᐊᑐᖅᑕᐅᖃᑦᑕᓇᓪᓗᑎᒃ).
ᓴᓗᒪᖅᓴᖅᑕᐅᓂᖓ ᐊᒻᒪ ᐊᐅᓚᑕᐅᓂᖓ ᑲᒪᒋᔭᐅᔪᖅ ᒐᕙᒪᑐᖃᒃᑯᓐᓂᑦ.

ᒐᕙᒪᒃᑯᑦ ᓄᓇᕗᒥ ᐊᒻᒪ Hᐊᒪᓚᒃᑯᑦ ᐃᒃᐱᐊᖅᔪᒃᒥ ᐃᓄᓕᒪᖅᑎᑦᑎᑲᑕᒃᖢᑎᒃ ᓇᓗᓇᐃᖅᓯᓯᒪᔪᑦ ᐊᑐᑎᒃᓴᖕᒐᓂᒃ ᕿᓂᖅᓂᐊᖅᓂᕋᖅᖢᑎᒃ ᐱᖁᑎᖕᒋᑦ ᐊᒻᒪ ᐃᒃᓗᖁᑎᖕᒋᑦ. ᒪᓐᓇᐅᔪᖅ ᒪᑭᒃᓂᒃ ᓇᓚᐅᑦᑕᕈᑎᒃᓂᒃ ᓴᕿᔭᖅᑐᖃᖅᓯᒪᓕᖅᑐᖅ ᖃᐅᔨᓴᖅᑕᐅᔪᑎᒃᓴᖕᒐᓂᒃ ᖃᓄᖅ ᐊᑐᑎᖅᓂᐊᖅᒪᖔᑕ ᐃᓄᓯᖕᒋᓐᓄᑦ ᐊᒻᒪ ᑭᓇᐅᔭᒃᓴᖅᓂᖓᓄᑦ ᓇᓂᓯᕕᒃ ᒪᑐᓯᒪᓕᖅᐸᑦ ᐊᒻᒪ ᖃᓄᖅ ᐊᖅᑭᒃᓯᒪᓂᐊᖅᒪᖔᑦ ᑲᔪᓯᑎᑕᐅᓇᒃᓯᒃᑯᓂ ᐊᑐᑎᒋᓂᐊᖅᑕᖔᓂᒃ. ᐅᔭᕋᒃᓂᐊᖅᑎᒃᑯᑦ ᐃᑲᔪᖅᑐᐃᔪᑦ ᖃᓄᖅ ᐊᑐᑎᒃᓴᖕᒐᓂᒃ ᓴᕿᑦᑐᖃᒃᑲᓂᕈᓐᓇᖅᒪᖔᑦ ᐃᑲᔪᖅᑐᐃᓂᐊᖅᓂᕋᖅᓯᒪᓗᑎᒃᑯ.
ᑕᐃᒪᐃᒃᑲᓗᐊᖅᑎᓪᓗᒍ ᓇᓂᓯᕕᒃᑯᑦ ᑲᔪᓯᓇᓇᐊᖅᓚᑕ ᒪᑐᕙᓚᐊᓂᖓᓂᒃ ᐸᖅᓇᐃᓯᒪᓗᑎᒃ ᐊᑭᑭᓚᒃᑯᖓᔪᒥᒃ ᐅᖃᐅᓯᐅᔪᑦ ᒪᓕᒃᓗᒋᑦ ᐸᖅᓇᐅᑎᖓ ᒪᑐᕙᓚᐊᓂᖓᓄᑦ ᐊᒻᒪ ᑲᔪᓯᓇᖅᓂᐊᖅᑐᑦ ᑭᓯᐊᓂ ᐊᖕᒋᖃᑎᒋᒃᓯᒪᔪᒥᒃ ᐱᑕᖃᓕᖅᐸᑦ.

ᓇᓂᓯᕕᐅᑦ ᒪᑐᕋᓕᐊᓂᖓᓄᑦ ᐊᒪᓗ ᓴᓗᒪᕐᓴᕐᑕᐅᓂᖓᓄᑦ

ᒪᑐᔭᐅᓂᐊᕐᓂᖓ ᐊᒪᓗ ᓴᓗᒪᕐᓴᕐᑕᐅᓂᖓ ᐸᕐᓇᐅᑎᑦ ᑐᓂᔭᐅᓯᒪᔪᑦ ᓄᓇᕗᑦᒥ ᐃᒥᓕᕆᔩᒃᑯᑦ ᑲᑎᒪᔩᖏᓐᓄᑦ ᐱᔪᓇᐊᖃᕐᑎᑕᐅᓂᖏᓐᓄᑦ ᓚᐃᓯᓯᖓᓂ. ᐸᕐᓇᐅᑎ ᐅᓂᑲᕐᓯᒪᔪᕐ ᐅᔭᕋᒃᓂᐊᕐᑎᒃᑯᑦ ᖃᓄᐃᓕᐅᕐᓂᐊᕐᒪᖔᑕ ᒪᑐᔭᐅᕋᓕᐊᑎᓪᓗᒍ ᐊᒪᓗ ᒪᓕᒃᓯᒪᓗᑎᒃ ᐊᑐᕐᑯᔭᐅᔪᑦ ᕿᒪᐅᑎᓪᓗᒋᑦ ᐊᒪᓗ ᓴᓗᒪᕐᓴᐃᑎᓪᓗᒋᑦ ᐸᕐᓇᐅᑎᖏᓐᓂᒃ ᐅᔭᕋᒃᓂᐊᕐᓂᒃᒧᑦ ᓄᓇᑦᓯᐊᕐᒥ ᐅᓗᖃᕐᑐᑦ ᓯᑎᐱᓇ 1990 (ᐊᑐᕐᑕᐅᕐᑯᔭᐅᓯᒪᔪᑦ) ᓴᓗᒪᕐᓴᕐᑕᐅᑎᓪᓗᒍ ᓇᓂᓯᕕᐅᑦ ᐃᓂᒋᔭᖓ ᐊᑭᑭᓚᖑᔪᒃᑯᑦ ᐃᑲᔪᑎᒋᓚᖑᔪᒃᑯᓪᓗ ᐃᓄᒃᓄᑦ ᓄᓇᖃᕐᑐᓄᑦ. ᐱᔾᔪᑎᒋᓗᐊᑕᕐᑕᖓᓚ ᐸᕐᓇᐅᑎᐅᑦ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᕐ ᐊᑐᕐᑯᔭᐅᔪᑦ ᒪᓕᒃᓗᒋᑦ ᓄᓇᖓ ᐅᑎᕐᑎᑕᐅᓇᓱᒃᓗᓂ ᐃᓕᕐᑯᓯᖓᓄᑦ ᐅᔭᕋᒃᓂᐊᓚᐅᖏᑎᓪᓗᒋᑦ ᖃᓄᐃᓕᖓᓂᓇᓚᐅᕐᑕᖓᓄᑦ ᐊᒻᒪᓗ ᓴᐳᑎᓯᒪᓇᓱᒃᓗᒋᑦ ᖃᓂᒪᒃᑕᐅᓕᒪᓂᒃᑯᑦ ᐊᑦᑕᕐᓇᕐᑕᐃᓕᒪᓂᒃᑯᓪᓗ ᓄᓇᕗᑦᒥᐅᑕᐃᑦ ᐃᓄᐃᑦ.

ᓴᓗᒪᕐᓴᕐᑕᐅᓂᖓ ᐊᑐᕐᓂᐊᕐᑐᕐ ᐱᑕᖃᕐᐸᒋᕐᑐᑦ ᐊᑐᕐᑕᐅᓗᑎᒃ ᐊᑦᑕᕐᓇᕐᑕᐃᓕᒪᓇᓱᒃᓗᑎᒃ, ᐊᑯᓂᐅᔪᒥᒃᓗ ᒪᑐᔭᐅᕋᓕᐊᓗᓂ. ᐅᔭᕋᐃᑦ ᐊᑐᕐᑕᐅᖏᑦᑐᑦ ᐱᔭᕐᑕᐅᓂᑯᓪᓗ ᐃᓕᐅᖃᕐᑕᐅᓂᐊᕐᑐᑦ ᑯᐊᕐᑕᕐᓂᖓᓄᑦ ᒪᓂᕋᐅᑦ ᐅᕙᓗᓂᑦ ᓄᓇᐅᑦ ᐃᓗᐊᓄᐊᕐᑕᐅᕙᓕᐊᓗᑎᒃ ᐅᕙᓗᓂᑦ ᓴᐅᔭᐅᓗᑎᒃ. ᖁᐊᖑᐃᓇᕐᓂᖓᓄᑦ ᐊᑦᑕᕐᓇᔨᐊᖏᑦᑐᕐ ᐃᒥᕐᒧᐊᕐᑲᑦᑕᔨᐊᖏᑦᑐᕐ. ᐃᔪᓂᓇᔭᓇᐊᕐᑲᑦᑕᖓ ᑐᐊᐸᐅᑦ ᓴᐅᓯᔪᑕᐅᓂᐊᕐᑐᕐ ᖁᐊᖑᐃᓇᕐᑎᑕᐅᓇᓱᒃᓗᓂ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᔪᒃᑯᑦ ᐊᑐᕐᓗᑎᒃ ᐊᕿᒃᓱᕐᑕᐅᓂᐊᕐᑐᑦ ᐱᒋᐊᕐᓗᓂ ᐅᑐᐱᓇ 2002 ᐅᑯᐊᖑᔪᑦ:

1. ᐃᒥᐅᓂᖓ 1 ᒥᑕᒥᒃ ᐃᔪᓂᖃᕐᓗᓂ ᑯᕕᕐᑕᕐᕕᐅᓂᖓ;
2. ᓇᐅᔭᐅᓗᓂ ᑐᐊᐸᒃᒥᑦ 1.00 ᒥᑕᒥᒃ ᐃᔪᓂᖃᕐᑐᒥᒃ ᐊᒪᓗ 0.25 ᒥᑕᒥᒃ ᓯᐅᕿᒥᒃ ᑐᐊᐸᒃᒥᒃᓗ ᖃᖓᓄᐊᕐᓗᓂ;
3. ᐊᕿᒃᓱᕐᑕᐅᓗᓂ ᐊᕙᑕ ᐃᓗᑦᑐᕐᑎᑕᐅᓗᓂ ᐃᒥᕐ ᐃᓗᐊᓄᐊᕐᑲᑦᑕᔨᐊᖏᒪᑦ;
4. ᐱᔭᕐᑕᐅᓂᑯᐃᑦ ᐅᔭᕋᑐᐃᓇᐃᑦ ᐊᑐᕐᑕᐅᖏᑦᑐᑦ ᐃᓗᐊᓄᐊᕐᑕᐅᓗᑎᒃ ᓄᓇᐅᑦ ᐅᕙᓗᓂᑦ ᖃᖓᓄᑦ ᓴᐅᔭᐅᒃᑲᓂᕐᓗᑎᒃ;
5. ᓄᓇᐅᑦ ᐊᕿᒃᓯᒪᓂᖓ ᒪᓕᒃᓗᒍ ᓯᒪᑕᒍᑦ ᑯᒃᕕᕐᑦᑎᐊᕈᓐᓇᕐᓗᓂ;
6. ᓴᐅᔭᐅᓗᑎᒃ ᐅᔭᕋᐃᑦ ᐱᔭᕐᑕᐅᓯᒪᔪᑦ ᐃᓗᑐᔪᒧᑦ ᐊᒪᓗ ᐃᔪᓂᖃᕐᑐᒧᑦ 1.25 ᒥᑕᒥᒃ ᑐᐊᐸᒃᒧᑦ ᓴᐅᔭᐅᓗᑎᒃ;
7. ᐱᔭᕐᑕᐅᓗᑎᒃ ᐃᒃᓗᕐᔪᐊᖑᓂᖏᑦ ᐃᖃᓇᐃᔭᕐᕕᐅᓂᑯᑦ ᐃᒃᓗᒋᔭᐅᔪᕕᓂᓪᓗ ᐃᓚᖏᓪᓗ ᐊᐅᕐᑎᑕᐅᓗᑎᒃ ᑭᓇᐅᔭᕐᑕᐳᑕᐅᔪᓐᓇᕐᑐᑦ;
8. ᓱᐳᕐᓇᕐᑐᖃᖏᓐᓂᖏᑦ ᐱᖁᑎᑦ ᐃᓗᐊᓄᐊᕐᑕᐅᓗᑎᒃ ᓄᓇᐅᑦ ᐅᕙᓗᓂᑦ ᐃᓗᑦᑐᕐᓯᒪᔪᒧᑦ ᓴᐅᔭᐅᓗᑎᒃ;
9. ᐊᒃᑕᕐᕕᖓ ᓴᐅᔭᐅᓗᓂ ᑐᐊᐸᒃᒧᑦ ᐊᕙᑎᖓ ᐃᓗᑦᑐᕐᓯᒪᓗᓂ ᖃᖓᓂᑦᑐᕐ ᐃᔪᓂᖃᕐᓗᓂ 1.25 ᒥᑕᒥᒃ ᑐᐊᐸᒃᒥᒃ;
10. ᑐᐊᐸᒃ ᓱᐳᕐᓇᕐᑐᖃᕐᓂᖓ ᐱᔭᕐᑕᐅᓗᓂ ᐃᓕᐅᖃᕐᑕᐅᓗᓂ ᓄᓇᐅᑦ ᐃᓗᐊᓄᑦ ᐅᕙᓗᓂᑦ ᐃᓗᑦᑐᕐᓯᒪᔪᒧᑦ ᓴᐅᔭᐅᓗᓂ.
11. ᐃᓕᔭᐅᓗᑎᒃ ᖃᐅᔨᓴᐅᑎᑦ ᐅᕐᑯᓂᖓᓂᒃ ᒪᓂᕋᐅᑦ ᐅᕐᑯᓯᕋᓕᐊᓂᖓᓄᑦ ᖃᐅᔨᓴᐅᑕᐅᓂᐊᕐᑐᓂᒃ.

ᖃᐅᔨᓴᕐᑕᐅᓯᒪᐃᓇᕐᓂᐊᕐᑐᕐ ᓴᓗᒪᕐᓴᕐᑕᐅᕋᓕᐊᓗᓂ ᐊᒪᓗ ᐊᕿᒍᓄᑦ ᑕᓕᒪᓄᑦ (5) ᐱᔪᓇᕐᓯᒪᓕᕐᑎᓪᓗᒋᑦ. ᖃᐅᔨᓴᕐᑕᐅᕐᓯᐅᑎᓂᐊᕐᑐᑦ ᐃᒥᖓ, ᒪᓂᕋᖓ, ᖃᓄᐃᓕᕋᓕᐊᖓᓗ ᓄᓇᐅᑦ. ᖃᐅᔨᓴᕐᑕᐅᔪᑦ ᖃᓄᐃᓕᖓᓂᖓᓂᒃ ᐅᖃᐅᓯᐅᕐᑕᕐᓂᐊᕐᑐᑦ ᓄᓇᕗᑦ ᐃᒥᓕᕆᔩᒃᑯᑦ ᑲᑎᒪᔩᖏᓐᓄᑦ ᐊᒪᓗ ᖃᓄᐃᓕᐅᕐᓯᐅᑦᑕᕐᓂᐊᕐᒪᖔᑕ.

Executive Summary

The Nanisivik Mine is owned by CanZinco Ltd., a division of Breakwater Resources Ltd. 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 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 and concentrates are exported via ship during the 14-week open water season.

The mine commenced operations in 1976. Sulphide ore is mined primarily by underground methods and milled on-site to produce lead and zinc concentrates. The mill operates at a nominal 2,200 tonnes per day. Mine personnel reside 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. Currently, the mine employs 171 people. Closure of the mine is scheduled for September 30, 2002 due to depletion of economic ore reserves.

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. They use the dock as a refueling and storage depot (also utilizing the mine-owned tank farm). 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 has issued two Requests for Proposals 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. Nanisivik Mine shares this interest in identifying alternatives for continued use and has committed to contributing to these projects. Nonetheless, Nanisivik Mine must proceed with reclamation of the mine facilities in a cost-effective manner as described in the Closure and Reclamation Plan and will continue to do so until formal agreements are in place to the contrary.

This Closure and Reclamation Plan (the “Plan”) is being filed with the Nunavut Water Board in response to the requirements of the Water License. The Plan describes CanZinco’s approach to closure and reclamation of the Nanisivik site in an efficient manner that follows the “Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories" dated September 1990 (the "Guidelines") and that promotes benefits to northern residents. The primary objectives of the Plan are in accordance with the Guidelines, "to prevent progressive degradation and to enhance natural recovery in areas affected by mining".

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 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 global warming.

The reclamation activities are anticipated to be completed in two years following mine closure. Options exist to potentially shorten this schedule and these will be pursued, where practical. Some of the specific reclamation measures that will be implemented beginning in October 2002 are:

1. Maintain at least 1 metre water cover over subaqueous tailings.
2. Place a cover of 1.00 metres of shale (thermal insulation) plus 0.25 metres of sand and gravel (armour cap) over exposed tailings.
3. Construct an engineered outflow spillway from the covered tailings area.
4. Relocate mineralized waste rock to the underground mine or to open pits where backfilling is required.
5. Contour and backfill open pits as required to achieve positive surface drainage.
6. Cover residual mineralized material in rock piles or open pits with 1.25 metres of inert material.
7. Dismantle industrial and residential buildings and salvage components of economic value for shipment off site.
8. Dispose of non-hazardous demolition debris and residual scrap materials in the underground mine or in open pits where backfilling is required.
9. Reclaim the landfill with contouring to ensure positive surface drainage and place a 1.25 metre thick cover of inert material.
10. Remediate contaminated soils by covering in-place or by excavation and disposal in either the underground mine or in open pits that require backfilling.
11. Install additional thermistors to monitor ground temperatures in reclaimed areas.

Monitoring of the mine site will be conducted while reclamation activities are underway and for a period of five years following completion of reclamation work. 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 and any maintenance work that may be required will be completed.

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ᓄᓇᓕᖓᓄᑦ ᐅᖃᐅᓯᒃᓴᐃᑦ

ᓇᓂᓯᕕᒃ ᐅᔭᕿᒃᓂᐊᖅᕕᒃ ᐅᐊᒃᓇᖓᓂᑦᑐᖅ ᕿᑭᖅᑕᓄᑦ. ᓄᓇᐅᑦ ᐃᓗᐊᓂ ᐅᔭᕿᒃᑕᖃᑦᑕᖅᑐᑦ ᓴᕕᕿᔭᒃᓴᒥᒃ ᐱᖁᑎᒋᔭᐅᓗᓂᓗ CanZinco Ltd. ᐊᐅᓚᐃᓇᖅᓯᒪᓗᓂᓗ ᑕᐃᒪᖓᑦ 1976ᒥᑦ. ᓇᓂᓯᕕᒃᑯᑦ ᐅᔭᕿᒃᑕᕈᓐᓂᖅᓯᐊᖅᑐᑦ ᓯᑎᐱᕆ 2002ᒥ. ᐱᕕᒃᓴᐊᕆᔭᐅᓂᐊᖅᑐᖅ ᒪᑐᕋᓕᐊᑎᓪᓗᒍ ᑕᓇ ᐅᔭᕿᒃᑕᖅᕕᐅᔪᖅ ᐅᑎᖅᑎᑕᐅᒋᐊᖅᓗᓂ ᐃᓕᖅᑯᓯᕆᓚᐅᖅᑕᖓᓄᑦ ᓴᐳᑎᓯᒪᓗᒋᑦ ᐃᓄᖕᒋᑦ ᓄᓇᕗᑦᒥ ᖃᓂᒪᒃᑕᐃᓕᒪᓂᒃᑯᑦ ᐊᒪᓗ ᐊᑦᑕᖅᓇᖅᑕᐃᓕᒪᓂᒃᑯᑦ ᐊᑐᐃᓇᖅᑕᐅᕙᓐᓇᖅᓗᓂᓗ ᓄᓇᖕᒐ. Hᐊᒪᓚᒃᑯᑦ ᐃᒃᐱᐊᖅᔪᒃᒥ ᐃᑲᔪᖅᑐᐃᓂᐊᖅᑐᑦ ᒪᑐᔭᐅᕋᓕᐊᓂᖓᓂᒃ. CanZinco Ltd ᑲᔪᓯᑎᑦᑎᕙᖅᓂᐊᖅᑐᑦ ᑕᐃᒪᐃᑎᑦᑎᕙᖅᓂᐊᖅᓗᑎᒃ ᒪᑐᔭᐅᕋᓕᐊᑎᓪᓗᒍ ᐸᖅᓇᐅᑎᖕᒋᑦ ᐊᖕᒋᖅᑕᐅᓇᓱᒃᓂᐊᖅᑐᑦ ᓄᓇᕗᑦ ᐃᒥᓕᕆᓂᖅᒧᑦ ᑲᑎᒪᔩᖕᒋᓐᓄᑦ, ᒐᕙᒪᑐᖅᑲᒃᑯᓐᓄᑦ ᐊᒪᓗ ᓄᓇᕗᑦ ᒐᕙᒪᖕᒋᓐᓄᑦ.

ᐅᑯᐊᖕᒍᔪᑦ ᓇᐃᒃᓕᒋᐊᖅᓯᒪᓗᑎᒃ ᐅᖃᐅᓯᒃᓴᐅᔪᑦ ᐸᖅᓇᐅᑕᐅᔪᑦ ᓴᓗᒪᖅᓴᐅᑎᖓᓄᑦ ᓇᓂᓯᕕᒃ:

1. ᐅᔭᕿᒃᑕᕈᓐᓂᖅᐸᑕ ᓄᓇᓯᐅᑎᖅᔪᐊᖕᒍᔪᑦ ᐱᖁᑎᖕᒋᓪᓗ ᐊᐅᓚᖅᑎᑕᐅᓂᐊᖅᑐᑦ ᐊᓯᐊᓄᑦ ᐅᔭᕿᒃᓂᐊᖅᕕᒃᑯᑦ ᐅᕙᓗᓂᑦ ᐃᓗᐊᓄᑦ ᓄᓇᐅᑦ ᓴᐅᔭᐅᓂᐊᖅᑐᑦ. ᖁᐊᖕᒍᐃᓇᖅᓂᖓᓄᑦ ᓄᓇᐅᑦ ᐃᓗᐊᓂ ᐱᖁᑎᑦ ᓴᐅᔭᐅᔪᑦ ᐊᑦᑕᖅᓇᖕᒋᑦᑐᒥᓐᓂᐊᖅᑐᑦ. ᐃᓯᕆᐊᖅᕕᓕᒪᖕᒋᑦ ᓄᓇᐅᑦ ᐃᓗᐊᓄᑦ ᒪᑐᔭᐅᓂᐊᖅᑐᑦ.
2. CanZinco Ltd. ᖃᐅᔨᓴᖅᑲᑦᑕᖅᓯᒪᔪᑦ ᑎᑎᕿᖅᓯᒪᔪᒃᑯᑦ ᖃᓄᐃᖅᑲᑦᑕᖅᒪᖕᒐᑦ ᐅᔭᕿᒃᓂᐊᖅᓂᖅ ᐊᕙᑎᑦᑎᓄᑦ ᐊᒪᓗ ᐱᔭᕆᖅᓯᓂᐊᖅᑐᑦ ᖃᐅᔨᓴᖅᓂᖅᒥᓂᒃ ᐊᐅᔭᖕᒐᓂ 2002. ᖃᐅᔨᓴᐅᑎᐅᔪᑦ ᖃᐅᔨᓴᖅᓯᒪᔪᑦ ᓴᕕᕿᔭᒃᓴᐅᓂᖕᒐᓂᒃ ᐊᒪᓗ ᓱᕈᓇᖅᑐᖅᑲᖅᓂᖕᒋᓐᓂᒃ ᐊᒪᓗ ᖃᓄᑎᒋ ᓴᓗᒪᖅᓴᖅᑎᕆᔭᓇᐊᖅᑲᖅᒪᖕᒐᑦ ᐊᕙᑎᖕᒐᓄ ᐊᒪᓗ ᐃᓄᒃᓄᑦ ᐊᑦᑕᖅᓇᕈᓐᓂᑦᑎᓐᓇᓱᒃᓗᒍ. ᐸᖅᓇᒃᑕᐅᔪᖅ ᓱᕈᓇᖅᑐᖅᑲᖅᓂᖕᒋᑦ ᑐᐊᐸᐃᑦ ᓴᐅᔭᐅᓗᑎᒃ ᓄᓇᐅᑦ ᐃᓗᐊᓂ ᐅᐸᒃᑕᐅᔪᓐᓇᐃᓕᑎᓯᒪᒋᐊᖅᓗᓂ ᐊᒪᓗ ᐊᑦᑕᖅᓇᖕᒋᓇᓱᒃᓗᓂ ᐊᕙᑎᑦᑎᓄᑦ.
3. ᑯᕕᖅᑕᖅᕕᐅᔪᖅ ᓴᓗᒪᖅᓴᐅᑕᐅᖃᑦᑕᖅᑐᖅ ᑕᓯᕋᐊᕆᓯᒪᔪᒧᑦ ᑯᕕᔭᐅᕋᓕᐊᖃᑦᑕᖅᑐᑦ. ᒪᕈᔪᒃ ᑯᕕᖅᑕᖅᕕᐅᔪᒃ. ᐱᖃᑕ ᑯᕕᖅᑕᖅᕕᐅᔪᖅ ᐃᒪᐊᑦ ᐊᑕᓂᑦᑐᖅ ᐱᖃᑕᓗ ᐃᒪᐅᑦ ᖃᖓᓂᑦᑐᖅ. CanZinco Ltd. ᖃᐅᔨᓴᖅᑲᑦᑕᖅᓯᒪᔪᑦ ᐃᒪᖓᓂᒃ ᖁᕕᖅᑕᖅᕕᐅᔪᑦ ᐊᒪᓗ ᑐᕿᓯᓇᖅᖢᓂ ᑐᖓᓂᖅᑲᑦᑕᖅᓂᖓᓂᒃ ᑭᒃᓕᒋᑎᑕᐅᔪᑦ ᐊᑦᑕᖅᓇᖅᑐᓂᖄᖅᑕᐅᔪᑦ ᐃᒥᓕᕆᓃᒃᑯᑦ ᑲᑎᒪᔩᖕᒋᓂᑦ.
4. ᑯᕕᖅᑕᖅᕕᐅᔪᖅ ᐃᒪᐅᑦ ᐊᑕᓂᑦᑐᑦ ᐊᑕᓂᖕᒋᓐᓇᖅᓂᐊᖅᑐᑦ ᐊᒻᒪ ᑯᕕᖅᑕᖅᕕᐅᔪᑦ ᐃᒪᐅᑦ ᖃᖓᓂᑦᑐᖅ ᓴᐅᔭᐅᓂᐊᖅᑐᖅ ᑐᐊᐸᒃᒥᒃ ᐃᔪᓂᖓ ᒪᓕᒃᓯᒪᓗᓂ ᖁᐊᖕᒍᐃᓇᕈᖅᓇᖅᑐᒥᒃ. ᖃᒃᑲᓂᐊᒍᑦ ᓴᐅᔭᐅᒃᑲᓂᖅᓂᐊᖅᑐᖅ ᐅᖁᓯᕋᓕᐊᒐᓗᐊᖅᐸᑦ ᐊᐅᒃᐸᓕᐊᕈᐊᖕᒋᒪᑦ.
5. ᑐᓚᒃᑕᖅᕕᒃ ᐱᖁᑎᒋᔭᐅᔪᖅ ᐃᒪᖅᒥᐅᑕᓕᕆᔩᒃᑯᓐᓄᑦ. ᒐᕙᒪᑐᖅᑲᒃᑯᑦ ᐊᖅᑭᒃᓱᐃᓇᕆᐊᓕᑦ ᐊᑐᐃᓇᕈᑎᒃᓴᖕᒐᓂᒃ ᐅᖅᓯᐊᓄᖅᑲᐅᑕᐅᔪᓂ. ᐅᖅᓯᐊᓗᒃᑯᕕᑦ ᐊᑐᑎᖅᑲᕈᓐᓇᖅᑐᑦ ᑕᐃᒪᓐᓇ.
6. ᐊᖅᑯᑎᑦ ᑐᓚᒃᑕᖅᕕᒃᒥᑦ ᒥᑦᑕᖅᕕᒃᒧᑦ ᐊᒪᓗ ᐃᒃᐱᐊᖅᔪᒃᒧᑦ ᐱᖁᑎᒋᔭᐅᔪᖅ ᓄᓇᕗᑦ ᒐᕙᒪᒃᑯᖕᒋᓐᓄᑦ ᐸᖅᓇᐅᑕᐅᓯᒪᖕᒋᑦᑐᑦ ᓇᓂᓯᕕᐅᑦ ᒪᑐᓂᐊᖅᓂᖓᓄᑦ. ᓯᕗᓂᒃᓴᒥ ᐊᑐᖅᑕᐅᓂᖓ ᒥᑦᑕᖅᕕᐅᑦ ᑲᒪᒋᔭᐅᔮᖕᒋᑦᑐᖅ ᓇᓂᓯᕕᒃᑯᓄᑦ.

ᓇᓂᓯᕕᐅᑦ ᒪᑐᕙᓕᐊᓂᖓᓄᑦ ᐊᒪᓗ ᓴᓗᒪᕐᓴᕐᑕᐅᓂᖓᓄᑦ

7. ᐃᓱᒪᒃᓴᕐᓯᐅᕈᑎᑦ ᐅᓄᕐᓯᔪᑦ ᖃᓄᕐ ᐊᑐᕐᑕᐅᓂᐊᕐᒪᖓᑦ ᐱᕐᑯᑎᖏᑦ ᐃᒃᓗᕐᑯᑎᖏᓪᓗ ᒪᑐᓯᒪᓕᕐᑎᓪᓗᒍ ᓇᓂᓯᕕᒃ. ᑕᒪᒃᑯᐊ ᐃᓱᒪᒋᔭᐅᔪᑦ ᐱᒋᐊᕐᑕᐅᓚᐅᖏᓐᓂᖏᓐᓂ ᓇᓂᓯᕕᒃᑯᑦ ᐱᔭᕆᐊᖃᕐᑎᑕᐅᒃᒪᑕ ᐱᕐᑯᔭᑎᒍᑦ ᐱᔭᐃᔭᕆᐊᖃᕐᓗᑎᒃ ᐱᕐᑯᑎᒥᒃᓂᒃ ᑭᓯᐊᓂ ᒐᕙᒪᒃᑯᑦ ᐱᕐᑯᑎᖏᑦ ᐱᔭᐅᖏᓪᓗᑎᒃᐱᒋᐊᕐᓂᐊᕐᑐᕐ 2002ᒥ.
8. ᓄᓇᓯᐅᑎᕈᔪᐃᑦ ᓴᓇᕈᑎᕈᔪᐃᓪᓗ ᐱᔭᐅᓂᐊᕐᑐᑦ.
9. CanZinco Ltd. ᖃᐅᔨᓴᕐᓯᒪᓂᐊᕐᑐᑦ ᐊᕋᒍ ᑕᓕᒪᑦ (5) ᒪᑐᓯᒪᓕᕋᓗᐊᕐᑎᓪᓗᒍ ᐊᒪᓗ ᓴᓗᒪᕐᓴᐃᓂᐊᕐᑐᑦ ᐊᕙᑎᑦᑎᓄᑦ ᐊᑦᑕᕐᓇᕐᑕᐃᓕᒪᓇᓱᒃᓗᑎᒃ. CanZinco Ltd. ᖃᐅᔨᒪᑎᑦᑎᓂᐊᕐᑐᑦ Hᐊᒪᓚᒃᑯᑦ ᐃᒃᐱᐊᕐᔪᒃᒥ ᖃᐅᔨᓴᕐᐸᓕᐊᑎᓪᓗᒋᑦ.

CanZinco Ltd. ᐃᖃᓇᐃᔭᖃᑎᖃᕐᓂᐊᕐᑐᑦ Hᐊᒪᓚᒃᑯᑦ ᐃᒃᐱᐊᕐᔪᒃᒥ, ᒐᕙᒪᒃᑯᑦ ᓄᓇᕗᑦᒥ ᐊᒪᓗ ᒐᕙᒪᑐᖃᒃᑯᓐᓂᒃ ᑲᔪᓯᓇᕐᑎᑦᑎᓇᓱᒃᓗᑎᒃ ᒥᑦᑕᕐᕕᒃ, ᑐᓚᒃᑕᕐᕕᒃ ᐊᒪᓗ ᓄᓇᓕᖓ ᐃᒃᓗᖏᓪᓗ ᐊᑐᑎᒃᓴᖓᓂᒃ ᕿᓂᕐᑎᓪᓗᒋᑦ.

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 will stop producing zinc and lead concentrates in September 2002. 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 preparation of a Mine Closure Plan that will be approved by the Nunavut Water Board, DIAND and the Nunavut Government.

The following is a summary of some of the planned reclamation measures for the Nanisivik Mine:

1. Upon completion of mining 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 complete this information collection process in the summer of 2002. These studies will identify areas of metal and/or hydrocarbon contamination and determine what degree of cleanup is required to protect both the environment and Inuit people. It is proposed that contaminated soil be put underground where both the location and 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 analyses by CanZinco in the containment area have been consistently within the limits 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 a thickness of shale that will ensure permafrost formation in the tailings and the base of the cover. Extra shale will be placed 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 and the concentrate storage shed could be a beneficial addition to this kind of operation.

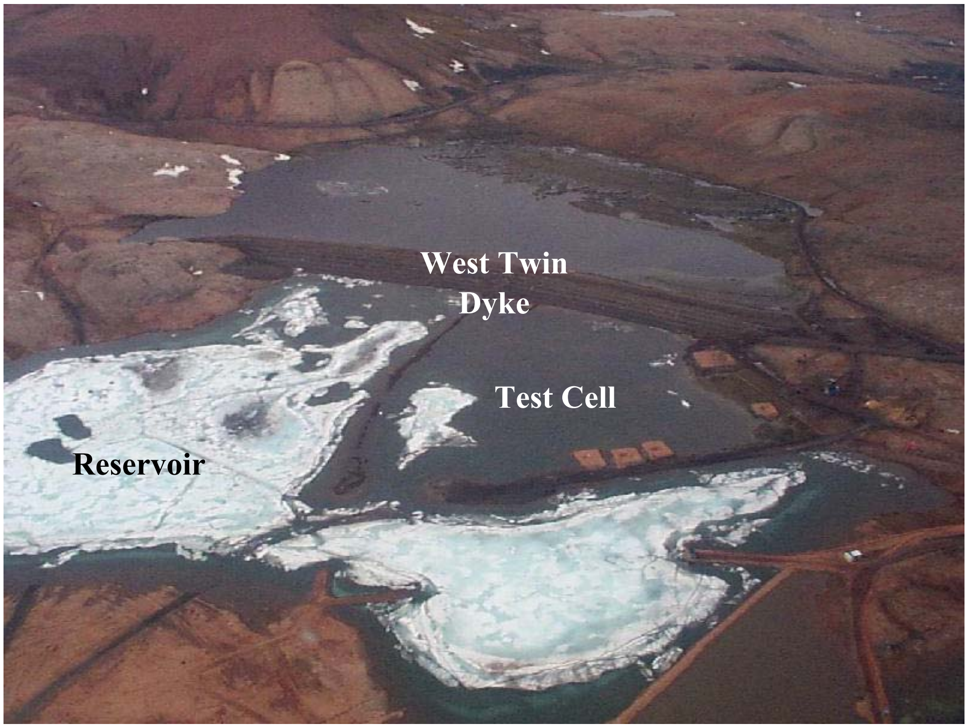
6. The roads connecting the airport, dock, Arctic Bay and Nanisivik to East Twin Lake are owned by the Government of Nunavut and are not part of Nanisivik's closure plan. The future use of the airport and the roads is not within the company's jurisdiction.
7. There are many ideas for using Nanisivik and some other mine buildings after the mine closes. Until these ideas are formalized by the interested stakeholders, CanZinco is required by law to dismantle the entire town and mine buildings except those that are owned by the Government of Nunavut. This will commence in 2002.
8. Machinery, tools and other useful items at the mine will be removed.
9. CanZinco will monitor the Nanisivik site for 5 years after the tear-down and clean-up work is finished to ensure there are no on going environmental problems. CanZinco will also consult with the Hamlet of Arctic Bay during this monitoring period.

CanZinco will work with the Hamlet of Arctic Bay, the Government of Nunavut and DIAND to ensure that all opportunities to keep the airport, dock, town and industrial buildings are explored.

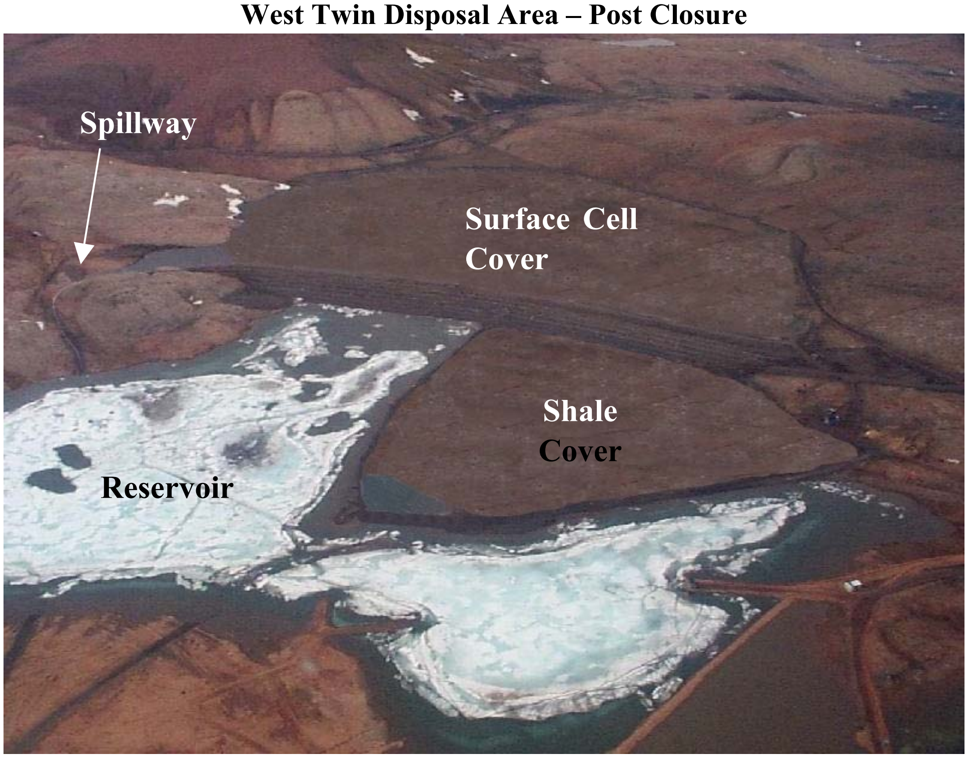
Mine Site – Current

Mine Site – Post Closure

West Twin Disposal Area - Current



West Twin Disposal Area – Post Closure



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B. Reclamation Cover Design for Nanisivik Mine West Twin Disposal Area Surface Cell, Report, Gartner Lee Limited/BGC Engineering Inc., February 2002.
C. Rigid Block Stability Analysis (sliding and overturning) and Conventional Slope Stability Analysis BGC Engineering Inc., January 2002.
D. Hydrological Study Nanisivik Spillway Design, Golder Associates Ltd., February 2002.
E. Preliminary Design of the West Twin Spillway for Closure, BGC Engineering Inc., February 2002.

1. Introduction

1.1 Proponent Information

Nanisivik Mine is wholly owned by CanZinco Ltd., which is a division of Breakwater Resources Ltd. CanZinco Ltd. is the sole operator of the Nanisivik 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 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 1-1). 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 and have continued since. The property was sold to CanZinco Ltd., a division of Breakwater Resources Ltd., in July of 1996, and they have operated the mine since.

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 1-2.

1.3 Licenses and Mineral Title

Operations at the Nanisivik Mine are governed by a Water License. The original Water License was granted by the Northwest Territories Water Board under the Northwest Territories Waters Act. The Nunavut Water Board assumed the responsibility for current Water Licenses in 1996 under the mandate of the Nunavut Land Claims Agreement Act. The Nunavut Waters Act is not promulgated.

The current Nanisivik Water License came into effect July 1, 1997. The initial expiry date of the License was June 30, 2002. However, the expiry date was extended to September 30, 2002 following CanZinco's announcement of mine closure in September 2002. The extension of the term of the License also stipulated that a Closure and Reclamation Plan be filed with the Nunavut Water Board by February 28, 2002.

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 operation of the Nanisivik Mine is governed by 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") which provided for the development and operation of the Nanisivik Mine. 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 been in compliance with the Master Agreement governing operations at the Nanisivik Mine except with the goal to employ a specified percentage of northern residents and the annual tonnage throughput of the operation. CanZinco was advised by the former owner in connection with the acquisition of the Nanisivik Mine that these areas of non-compliance have existed for a number of years 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 1-1. A map of the claim/lease boundaries is presented in Figure 1-3.

Table 1-1: 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		NANISIVIK	CANZINCO LTD.

	Lease			
DL-40041T	Surface Lease		NANISIVIK	CANZINCO LTD.
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		

2. Approach to the Closure and Reclamation Plan

2.1 Objectives of the Plan

This document is intended to meet the Closure and Reclamation requirements of the Nanisivik Mine Water License, issued to CanZinco Ltd. by the Nunavut Water Board and for the surface leases authorized by the Government of Canada. This document is intended to provide updated information on the status of Nanisivik Mine and to provide 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 License 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.
4. To minimize the requirements for post reclamation care and maintenance.

2.2 Regulatory Requirements

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

CanZinco's approach to closure and reclamation of the Nanisivik site follows the "Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories" dated September 1990 (the "Guidelines"). The primary objectives of the Closure and Reclamation Plan are in accordance with the Guidelines, "to prevent progressive degradation and to enhance natural recovery in areas affected by mining".

2.3 Community Consultation

A liaison officer has been appointed by the Hamlet of Arctic Bay to maintain communications in matters of interest and guidance with respect to Nanisivik infrastructure. Discussions will continue with interested stakeholders for possible continued use of the mine facilities.

A meeting was held with Arctic Bay residents in January 2002, where Hamlet members expressed a strong interest in the mine facilities. They want everything to remain in place for on-going use.

2.4 Government Consultation

Consultations with the Government of Nunavut ("GN") will continue and social and economic inputs will be encouraged in relation to the closure of the Nanisivik Mine and how they will affect the Hamlet of Arctic Bay.

The Government of Nunavut has recently issued two Requests for Proposals (RFP's). One will investigate the social economic impacts that mine's closure may have on Arctic Bay and the other project will identify and evaluate other concepts for alternate uses of the mine facilities. Nanisivik can use the services of the GN liaison person to answer questions from the Hamlet of Arctic Bay in reference to the Closure and Reclamation Plan and its implementation.

2.5 Traditional Knowledge Person

Nanisivik will contract a local, Traditional Knowledge person from the Hamlet of Arctic Bay to liaise about traditional matters related to the Closure and Reclamation Plan and its implementation.

2.6 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.

2.7 Implementation of the Plan

Implementation of the Nanisivik Mine Closure and Reclamation Plan in accordance with the following progressive stages:

1. Commission the 2001 Environmental Site Assessment.
2. Prepare and submit the Closure and Reclamation Plan.
3. Conduct a Phase 2 Environmental Site Assessment and Ecological and Human Health Risk Assessment.
4. Develop an Ecological and Human Health Risk Assessment.
5. Solicit and respond to Hamlet and Regulatory Feedback.
6. Prepare for and perform reclamation work.
7. Conduct and report on, long term monitoring programs.

2.7.1 2001 Environmental Site Assessment

An assessment of environmental conditions and mine closure and reclamation issues was conducted in 2001 by Gartner Lee Limited as the initial stage of implementation of the Plan. The complete Gartner Lee report is provided as Supporting Document A. This report highlighted critical closure and reclamation issues and was used to develop of the Closure and Reclamation Plan.

2.7.2 Closure and Reclamation Plan

The second stage of implementation of the Plan is the submission of this Closure and Reclamation Plan and describes 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.
6. The anticipated reclamation schedule.

This document will inform 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 will allow these organizations and individuals to provide feedback specific to the Plan.

The schedule presented in this plan will provide a timeframe for parties who are interested in the ongoing use of mine facilities.

2.7.3 Phase 2 Environmental Site Assessment and Ecological and Human Health Risk Assessment

Nanisivik Mine has collected a great deal of information related to identifying and quantifying contaminants in the environment around the mine site that may be related to mining activities or to local natural conditions. Information on contaminant concentrations and characterization includes various environmental media:

1. Surface road soil.
2. Marine sediments.
3. Marine biota.
4. Surface Soil.
5. Air particulates.
6. Surface water.
7. Bulk roadfill (with respect to potential for acid rock drainage).

Nanisivik Mine intends to complete the quantification and characterization of contaminants in the local environment by commissioning a Phase 2 Environmental Site Assessment ("ESA") in the summer of 2002. The Phase 2 ESA will utilize the information compiled by Nanisivik Mine so a comprehensive analysis and presentation can be made.

A description of the proposed Phase 2 ESA prepared by Gartner Lee Limited is in Supporting Document A. When the Phase 2 ESA report is complete it will be submitted to the Nunavut Water Board for review.

An Ecological and Human Health Risk Assessment will be completed in conjunction with the Phase 2 ESA, which will identify the most sensitive environmental receptors. This information will be used to develop site specific soil quality remediation objectives (SQRO's) according to the procedures described in the Federal guidelines for protection of the environment (CCME, 1996). The risk assessment report will also be submitted to the Nunavut Water Board for review.

2.7.4 Hamlet and Regulatory Feedback

Feedback from community organizations, government agencies and other stakeholders will be incorporated into revisions of the Closure and Reclamation Plan. Feedback is anticipated from the Nunavut Water Board, public meetings and hearings convened by the Nunavut Water Board, and community meetings with residents of the Hamlet of Arctic Bay.

2.7.5 Reclamation Work

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 tasks. It will be necessary to have this supplemental equipment and material shipped to the site during the shipping season and, therefore, the letting and awarding of contracts must take place early in the appropriate year.

2.7.6 Long Term Monitoring

A long term monitoring program has been designed to monitor the effectiveness of the reclamation measures. The monitoring program describes the location and frequency of monitoring activities and the nature and frequency of reporting to the Nunavut Water Board. 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.
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 3-1.

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.
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 3-2. 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 3-3. 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 3-4. Average monthly snowfall and rainfall from 1977 to 2001 is illustrated on Figure 3-5.

3.3 Marine Environment

3.3.1 Bathymetry and Currents

B.C. Research Inc. (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 metres 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 3-1).

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 3-1.

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).
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 3-1: 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).
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 3-2). The study area and the land classifications are illustrated on Figure 3-6.

Table 3-2 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 3-2). 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

Nanisivik Mine conducted an extensive mineral exploration program in 1985 that included sampling of surface soils over a wide area that extended from the South Boundary Zone Fault (just north of the airport) to Strathcona Sound and from Footprint Hill (approximately 6 kilometres west of Nanisivik) to Foreshore Flats (approximately 10 kilometres east of Nanisivik). Surface soils were sampled extensively (approximately 100 metre grid) over this area and were analysed for zinc, lead, copper and silver at the on-site laboratory using a detection limit of 20 ppm.

This data is relevant to closure and reclamation planning because it clearly illustrates the levels of natural mineralization in the surface soils in the mine area. Tailings were being deposited underwater at that time and, therefore, contamination of surface soils by wind blown tailings is not a concern with the data set.

In the area east of Kuhulu Lake, lead and zinc concentrations was commonly in the 50 to 150 ppm range. The greatest concentrations of lead and zinc measured in this area were 185 ppm and 174 ppm, respectively. A wide variation in metal concentrations was observed in the Foreshore Flats Valley with maximum concentrations of lead and zinc of 324 ppm and 198 ppm, respectively.

The area southeast of Kuhulu Lake also contained a wide variation in metal concentrations. The maximum concentrations of lead and zinc in this area were 789 ppm and 1,199 ppm, respectively.

Area14 and the Ocean View area displayed generally greater metal concentrations with numerous concentrations of lead and zinc in excess of 1,000 ppm. These areas were subsequently developed as active mining areas.

The area south of East and West Twin Lakes generally contained relatively low metal concentrations. Nonetheless, several concentrations of lead and zinc of approximately 300 ppm were observed and one extremely high concentration of lead was recorded at 11,500 ppm.

In the area between the underground mine and Strathcona Sound, metal concentrations were consistent and moderately elevated with few samples in the very low range (<20 ppm). Lead concentrations generally ranged from 50 ppm to 150 ppm with a maximum concentration of 1,624 ppm. Zinc concentrations generally ranged from 100 ppm to 250 ppm with a maximum concentration of 1,227 ppm.

Four samples were collected approximately 200 metres from the town of Nanisivik along the north side. These samples returned lead/zinc concentrations of 110/641 ppm, 1,459/1,404 ppm, 85/660 ppm and 2,296/93 ppm from west to east, respectively.

The area west of the airport and the STOLport contained relatively low metal concentrations and a relatively small variability. Numerous samples in this area contained <20 ppm metals. Metal concentrations appeared to increase in a northerly direction (i.e. towards Strathcona Sound). The majority of the samples that contained >100 ppm metals were located within approximately 2 kilometres of the Sound. The greatest concentrations of lead and zinc in this area were 213 ppm and 405 ppm, respectively.

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 3-2). 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 en-route 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 3-2). 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 3-2). 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 West Twin Lake.

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 kilometres, 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 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 Mine Facilities and Operations

4.1 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.

4.2 Mining

The Main Lens being mined at the Nanisivik Mine is flat lying and outcrops on surface at both ends of the zone. The geometry of the mineralized body and the presence of permafrost permit 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 is room and pillar. This zone has been largely mined out, but post pillars remain that will be recovered. First pass mining recovery has been approximately 80%. For the other zones adjacent to the Main Lens, the mining methods are drift and slash stoping with some cut and fill stoping. The same mining equipment is used in these zones as in the Main Lens.

Stope backfill consists of low grade material sourced from surface stockpiles, development waste or shale from surface. Water is applied to the surface of the backfill which freezes generally within two days to form a strong working surface and also reduces dilution.

At Nanisivik, the continuous permafrost contributes to mine stability.

Nanisivik is a unique mine in that dry drilling can be used due to the permafrost. The rock temperature is minus 12°C and the silica content of the rock is low. Respirable dust limits are maintained below 5 mg/cm3 using Atlas Copco DCT 160 dust collectors on all drilling equipment.

Most blasting at Nanisivik is done using ANFO, non-electric delay detonators, and detonating cord, fired with an electric cap.

Primary ventilation of the Main Lens is up to 175 m3/s (375,000 cfm). There is no direct mine air heating. With the ambient rock temperature of minus 12°C, the incoming ventilation air is warmed by the rock in the winter months and cooled in the summer months.

Since the mine is located in permafrost, there is no water pumping requirement.

4.3 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 4-2. The mill is 26 years old. Waste heat from the diesel power generators heats the buildings and dries the concentrates.

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

Lead flotation is carried out in one rougher and three cleaning circuits, using conventional flotation reagents. Zinc flotation is 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 are reground in a zinc regrind mill.

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

Flotation tailings are pumped through a four kilometre pipeline to the West Twin Disposal Area ("WTDA"). Process water for the mill is recycled from the Reservoir portion of the WTDA.

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

Chemicals used in the mill as process reagents are as follows:

1. Lime (2300 g/t) is used to modify the ground ore so pyrite (iron sulphide) particles are not recovered in the marketable concentrates.
2. Xanthate (100 g/t) is used in the flotation circuits to coat the selective particles (galena or sphalerite) so that they are recovered in the flotation process.
3. Methyl Isobutyl Carbinol (MIBC) (3 g/t) is used to stabilize the air bubbles (froth) in the flotation circuit so that the recoverable mineral will float.
4. Copper Sulphate (500 g/t) is used to activate the surface of a sphalerite particle so that it can be floated and recovered in the zinc circuit.

The reagents are shipped to the site by ocean freighter and transferred to land for outdoor storage. The mill reagents are stored outside in a designated area adjacent to the concentrate storage shed. The reagents are transported to the mill in weekly allotments and are mixed/dispensed from a specific area in the mill where all spills are collected in a designated sump for subsequent reuse in the milling operation.

4.4 Manpower

Nanisivik Mine employs 171 people at the mine of which 9 percent are First Nations persons. Most employees work a rotation that allows for eight weeks of work followed by four weeks of rest. While on site, employees work 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.

5. Recent Environmental Studies

An extensive series of environmental studies have been completed by Nanisivik Mine in response to specific requirements of the Water License. These studies were filed with the Nunavut Water Board. Comments from the Nunavut Water Board requesting a response were answered.

5.1 Hydraulic Confinement of West Twin Disposal Area

A study to confirm that water for the West Twin Disposal Area (WTDA) does not enter East Twin Lake (potable water source) was conducted from 1998 to 2000.

An active sampling and monitoring program began in the spring of 1998 to demonstrate the deltaic fan separating the East and West Twin water bodies 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.

Further, in order to quantify the existence of a permafrost barrier within the deltaic fan between East Twin Lake and West Twin Reservoir, three thermocouple strings were installed within the delta. Temperatures from the thermocouple strings were then monitored on a monthly basis to define the frozen and active (freeze/thaw) zones. In addition, core logging was conducted during the installation of the thermocouples (drilling) to monitor for indications of a subterranean hydraulic connection.

On November 30, 2000, a report entitled "*Hydraulic Confinement of the West Twin Disposal Area*" was submitted to the NWB. Salient findings in the study indicated the following:

1. Based on the data collected during the period of the monitoring program, water chemistry within East Twin Lake showed no contact with water from the WTDA.
2. Thermocouple data collected during the monitoring period shows that, at depth, ground temperatures remain below freezing year round.
3. Core logging/monitoring provided no evidence of a subterranean hydraulic connection between the two water bodies.
4. Water transport through the active layer in the deltaic fan appears improbable as the elevation of the continuous permafrost zone surrounds each lake.

5.2 Acid Rock Drainage and Geochemical Characterization

A study to determine acid rock drainage (ARD) potential and geochemical characteristics of surface materials created or impacted by mining operations was conducted by Lorax Environmental Services from 1997 to 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 classified into the following categories: mine waste rock, open pit walls, roadway, 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"*.

Significant conclusions from the Acid-Base Accounting Report are as follows:

1. Soil and till samples have the lowest sulphur contents, typically <0.3 % S and are considered non-acid generating.
2. Shale samples are net 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. Of the 10 "rock" sampling areas (105 samples), the samples from 09 South and K-Baseline consistently showed NP/TAP ratios which are considered potentially acid generating.
5. Tailings are potentially acid generating.

Additional analyses on samples of tailings and shale included total metal scans, mineralogy and grain-size determinations, and humidity cell testing that measured reaction rates and NP/TAP depletion over time at different temperatures.

Conclusions from the humidity cell tests, are as follows:

1. The metal of most importance 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 acid consuming (i.e. acid potential was depleted at a faster rate than neutralization potential).
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

A work plan to assess any water quality in the local receiving environment, Strathcona Sound, was approved by the NWB in June 1999. The plan identified the details of a "*Chronic Toxicity Study"*, which was conducted in 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).
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.
3. Microtox testing did not indicate a toxic response in any of the samples.

5.4 Environmental Site Assessment of Landfill Site (2000)

The landfill site 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.

The landfill area is approximately 16,000 square metres. Waste is accepted from mining related activities, as well as the townsite, government offices, seaport and airport operations.

As per Part G, Item 4 of the License, the assessment included the following:

1. 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.
4. A list of present and future monitoring plans.
5. An implementation schedule.

Conclusions and recommendations on the ESA report are as follows;

1. A field "screening" analysis of 25 soil samples identified one sample had returned a high response. However, laboratory analysis of a later sample collected from the same location returned a result well within Territorial and Federal remediation guidelines.
2. A water sample collected inside the landfill water retention berm, analyzed for oil and grease, indicated levels well within the License guidelines.
3. A water sample collected by DIAND in July 2000 (identified as Dump Leachate) indicated zinc metal values which exceeded the maximum allowable grab concentration in the Water License. Testing by Nanisivik in June and July 2000 for the same parameters indicated values within compliance.
4. Further testing is required for both hydrocarbons and metal parameters to substantiate preliminary results.

A response from the NWB in August 2001 on the 2000 ESA submissions has requested further sampling for metal leaching and more extensive hydrocarbon analysis of soil. Nanisivik will conduct the required sampling in 2002.

In addition, the Phase 2 Environmental Site Assessment scheduled for 2002 is proposed to include investigations at the landfill.

5.5 Metal Loading Study - Twin Lakes Creek

The objective of the Metal Loading Study along the length of Twin Lakes Creek is to monitor and differentiate (wherever possible) between metal loading from natural sulphide outcrops and from mining activities (i.e. waste rock piles, ore handling points, mill/industrial complex).

Water sampling stations are located at key features along the length of the creek. Samples are collected on a bi-weekly frequency and analyzed for metal parameters. These values are then correlated to water flow measurements to determine metal loading.

Spatial trends have been identified in the creek which correspond to the two waste rock piles (02 & 09 South), a natural sulphide outcropping, and the mill/ industrial complex area.

Annual temporal trends have been identified. During the initial thaw and runoff, the two waste rock piles appear to be the primary contributors of metals to the creek. As the season advances, metal loadings decrease substantially. Increases in metal loading are again observed during the latter part of August and into September originating from the area of the sulphide outcrops.

Long term trends suggest an increase in metal loading from the area of the rock dumps roughly corresponding to the commencement of relocation of waste rock underground. This temporary trend is expected to reverse following waste rock closure and reclamation work scheduled in 2002 and 2003.

Monitoring of metal loading in Twin Lakes Creek will continue through the post closure monitoring period to assess the effectiveness of reclamation efforts.

5.6 Tailings Stabilization Study

A review of existing and potential methods of controlling tailings dust movement was prepared in 1998 and submitted to the Nunavut Water Board.

The review, listed the following practices that have been employed:

1. Water Cover
   Water coverage of the tailings is controlled through the scheduled two metre increment raising (construction) of the Surface Cell dyke structure at the WTDA. This is done to maintain sufficient water volume for mill consumption, and recover volume lost to prior tailings disposal. A two metre raise in water elevation will cover 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 is used to spray/moisten on 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 is used to control tailings movement from the surface deposit. The same water cannon system is used to generate ice layers that cap the exposed tailings and eliminate dust movement.

4. Snow Cover
   Snow fencing is installed on the exposed tailings to control and collect snow that would otherwise blow over and off the tailings surface. The snow covering and wind deflection eliminate dust movement.

5. Shale Capping
   Shale cover is generally placed in areas where future disposal activities are not scheduled. The shale cover is placed to an intermediate depth of 15-20 centimetres.

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

Summary on the chemical review is as follows:

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 dyke structures.
3. Bench scale testing of lignonsulphonate produced negative impacts on metallurgical results.

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 License renewal processes. The basic components of the on-going monitoring program include:

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 includes "hi-volume" air samplers activated on a 6 day cycle.
4. Assessment of particle size distribution and chemical composition of air samples.
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

This plan has been updated annually. The new mining plan that developed in 2001 requires the utilization of waste rock as backfill. An aggressive campaign is underway to reclaim waste rock dumps. This will eliminate the majority of the waste rock inventory before closure.

5.9 Stability Analysis of West Twin Disposal Area

BGC Engineering Inc. conducted a risk assessment of the West Twin Dyke 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 Dyke*" dated September 7, 2000 was submitted to the NWB on October 23, 2000.

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 dyke structure at the West Twin Disposal Area.

Analytical work resulting from the risk assessment recommended and performed by BGC Engineering Inc. was submitted separately as "*Follow-Up Analytical Work on West Twin Dike Stability*" dated November 20, 2000. These analyses focused on rigid block modeling, conventional slope stability issues, frost heave susceptibility of tailings, and the Factors of Safety analysis for the West Twin Dyke. In addition, the analyses were extended to reflect potential increases in the height of the dyke in the future.

The analytical and investigative work centred on the stability of the West Twin (WT) dyke, which is an upstream-constructed, frozen shale dyke. As such, conventional stability analyses undertaken for typically thawed slopes were not directly applicable to this dyke. The following three analytical methods or issues were reviewed in order to confirm the Factor of Safety for dyke stability:

1. Rigid block stability analyses.
2. Conventional slope stability analyses (assuming thawed conditions).

3. Frost heave susceptibility and ice lense formation in the WT dike materials.

The results are summarized, as follows:

1. A review of thermocouple data confirmed the overall frozen nature of the dyke.
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 dyke, 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 dyke, and a subsequent raise by 2 metres, 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 dyke and 1.5 to 2.6 for the raised dyke, 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 dyke and 1.2 to 2.1 for the raised dyke geometry. Again, these values meet or exceed required guidelines for the factor of safety.
4. The review of soils within the West Twin dyke 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 dyke and its foundation are of little concern.

5.10 Test Cover 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 appears to be a competent material for capping and erosion protection. The shale appears 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 the underlying frozen tailings and to limit infiltration of runoff water into the subsurface.
2. The results of the laboratory geotechnical tests on the selected samples indicate that the shale is suitable as an infiltration barrier. The Twin Lakes sand and gravel is suitable for upper drainage layer (rip rap). The purpose of this layer is to drain run off water laterally and minimize moisture loss from the infiltration barrier that can result from upward capillary suction.

5.11 Test Cell Evaluation Study

Current data indicates that local shale materials will provide suitable thermal insulation as well as an added benefit of net neutralization potential overlying potentially acid generating tailings. The shale and tailings materials were tested by Lorax Environmental Services Ltd under Part G, Item 2, of the License. Applying shale as cover material will permit the aggradation of permafrost above the tailings/shale interface, thereby isolating the tailings from oxygen exchange.

A review of test cell data indicates that there is no advantage to 'sandwich' layering of different materials at various depths to speed-up the reduction in the active layer thickness. A single medium cover with uniformly sized materials permits water saturation and ice development reducing oxygen exchange and reduces the active layer thickness.

Data indicated that compaction of the shale layer will enhance the reduction in depth of the active layer to one year while random placing and spreading of the shale layer will attain the same reduced depth of the active layer in two years.

6. Closure and Reclamation Activities

6.1 West Twin Disposal Area and Associated Facilities

6.1.1 West Twin Disposal Area

The West Twin Disposal Area (WTDA) consists of the following features: Surface Cell, Reservoir, Test Cell Area, West Twin Dyke, Polishing Pond, water control structures and decant station.

Mill tailings are deposited within the WTDA located approximately 3 kilometres to the south of the mill building. They were deposited sub-aqueously for the first 14 years of operation, and sub-aerial since. Construction of the West Twin Dyke divided West Twin Lake into two cells: the sub-aerial cell (Surface Cell) in the western portion of the original lake; and the sub-aqueous cell (Reservoir) in the eastern portion of the lake. The reservoir receives and stores water decanted from the Surface Cell and runoff water from the watershed and the Test Cell areas.

The West Twin Dyke is currently 18 metres high at a nominal elevation of 388 m.a.s.l. A number of studies associated with the West Twin Dyke have been conducted that address Stability Analyses for static and seismic conditions. Resurfacing of the dyke's downstream face, construction of the Test Cell Dyke, and pouring of tailings along the toe of the dyke to 'push' standing water away from the dyke have been carried out to address some of the anticipated closure requirements within the WTDA.

In 2000 and 2001, the Test Cell dyke was completed to isolate this area from the Reservoir. The water in this area was then pumped to the reservoir and mill tailings were discharged into the Test Cell area. The nominal elevation of the dyke is 375.5 m.a.s.l., which is approximately four metres above the water elevation within the reservoir. No further construction or tailings deposition is planned for this area.

The operating plan for the 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. The surface of the tailings has been contoured so surface runoff flows to the southern perimeter (future spillway area.).

The principle closure objectives for the Surface Cell are to mitigate the potential long term impacts and returning the area land use to its natural state. The potential environmental impacts associated with the surface tailings in their current state are related to chemical stability and the potential for metals in solution to exit the containment area, as described in the report "*2001 Environmental Site Assessment*" prepared by Gartner Lee Limited that is provided as Supporting Document A. The mine tailings have been identified as potentially acid generating. The closure concept for the WTDA is illustrated on Figures 6-1 and 6-2.

The closure concept is to restrict the transfer of oxygen to the tailings as well as minimize the transport of any available metals. For reclamation, the exposed tailings will be covered with shale (that will provide thermal insulation, acid neutralizing potential and moisture retention) and sand and gravel (that will provide surface durability).

Test cell data from onsite research indicates a total cover of one metre depth will prevent the tailings from thawing. Geothermal modeling calibrated to the field observations indicates that an additional 0.25 metres of cover will maintain frozen conditions in the tailings under a high-estimate (i.e. conservative) estimate of global warming for the next century. A cover design report that describes this information is provided as Supporting Document B.

The sub-aerial (exposed) tailings in the Test Cell area will be covered for closure and reclamation in the same manner as the tailings in the Surface Cell.

The sub-aqueous (underwater) tailings in the Reservoir are covered with more than one metre of water and will remain so after closure.

The West Twin Dyke was designed for permanent retention of the tailings solids. The dyke and the tailings form a single frozen mass which provides it's stability. Thermocouples have and will continue to be used to monitor the subsurface geothermal regime of the dyke and it's foundation. After reclamation and contouring is complete, no standing water will remain on the Surface Cell upstream of the dyke. Stability modeling of the dyke and the tailings solids in the Surface Cell was conducted by BGC Engineering Inc. and included Rigid Block Stability Analyses (sliding and overturning) and Conventional Slope Stability Analyses. The BGC Engineering Inc. document is attached as Supporting Document C.

Based on the Rigid Block Stability Analyses, the current dyke configuration meets or exceeds current static design guidelines for the mechanism of sliding stability. Based on the Conventional Slope Stability Analysis for a dry frozen slope, the factors for safety for both static and seismic conditions (PGA=0.059) also meet or exceed the required values. For closure, the dyke will be contoured with shale and covered with Twin Lakes sand and gravel to prevent erosion. This work has been partially completed as part of Nanisivik Mine's program of progressive reclamation.

A dyke spillway and an outlet drainage channel will be constructed at closure for control of seasonal runoff and severe storm events. A hydrological assessment for the closure spillway design was completed by Golder Associates in 2002 and is attached in Supporting Document D. BGC Engineering Inc. has been contracted to provide the engineered design of the spillway. A preliminary spillway design has been prepared by BGC Engineering Inc. and is included as Supporting Document E.

At mine closure, the Test Cell Area Dyke will be breached to prevent ponding of water. The Polishing Pond water level will be lowered and treatment sediments will be excavated and placed in the Surface Cell prior to placement of the reclamation cover. The culvert and stop logs that separate the Reservoir from the Polishing Pond will be removed. The concrete decant station will be removed, which will return the water level in the Reservoir to it's historic elevation.

6.1.2 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 metres of the tailings pipeline, which is made of steel to withstand the high pumping pressure. The reclaim water pipeline is 3,150 metres in length, while the tailings pipeline can be up to 4,000 metres depending on the location of the deposition. A four metre 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. 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.

6.1.3 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 are utilized to drain sections for the tailings line during emergency shutdowns and maintenance operations. The ponds are each about 10 metres by 30 metres in area, formed by pushed up gravel berms about 1.5-2.0 metres high, and are lined with impermeable Hypalon liners.

For closure of the dump pond the liners will be disposed underground. The gravel berms will then be graded and contoured to prevent water accumulation.

6.2 Solid Waste Disposal Sites

6.2.1 Landfill Site

The landfill site is located approximately one kilometre west of the town at the crest of its watershed, thereby minimizing the surface runoff affecting the area. A berm upgrade of the landfill diverts runoff around the landfill. A two metre high berm downgrade of the landfill allows collection of seasonal runoff from the active landfill. The water discharge from the collection area must flow through an absorbent boom placed upstream of a level control notch in the berm.

Industrial, institutional, residential, and other miscellaneous waste streams are received at the Nanisivik landfill site. A description of the typical composition of each waste stream is as follows:

1. Industrial wastes include crushed drums, waste steel, scrap vehicles, and discarded mechanical equipment.
2. Institutional wastes include wastes from food services, offices, day care, airport operations, and general housekeeping services.
3. Typical residential wastes include food waste, packaging materials, clothing, and other household commodities.

The landfill will remain active until all operations and activities have been completed on-site. At that time, the landfill site will be covered and contoured to prevent erosion and pooling of seasonal runoff. In addition a 1.25 metre cover of shale will be placed on the landfill surface to allow permafrost to aggrade into the waste and base of cover. At the time of closure, thermocouples will be installed to verify permafrost conditions.

6.2.2 Bone Yards

The 'bone yards' are used for the temporary storage of repairable and unrepairable equipment and other materials.

The bone yard is located at the industrial site adjacent the Maintenance Shop, and is used for short-term storage of equipment/parts for salvage and repair. At closure, everything remaining will be decontaminated (if required) and disposed of underground.

6.3 Mined Areas

6.3.1 Main Underground and Satellite Areas

In addition to the main underground mine, several satellite areas (Ocean View, K-Baseline, and Area14) have operated during the mine life. There are eight openings to the main underground workings. In addition, there are portals at the Ocean View, K-Baseline and Area14 sites. These portals have not been utilized since mining activities ceased. There is also a ventilation raise to surface at Ocean View.

All underground workings are in dolostone host rock. This is a massive crystalline unit, similar to limestone in chemical composition and physical characteristics. 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 buried with inert 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 Ocean View. These raises will be sealed.

Non-hazardous solid waste material such as: discarded pipe, mill and mine equipment, mobile equipment, and building materials will be decontaminated and taken underground to mined out stopes for final disposal before the mine entrances are permanently closed. Final sealing of the mine portals will be one of the last actions at the site.

6.3.2 Open Pits

West Open Pit

The West Open Pit is adjacent to the north bank of Twin Lakes Creek, about 500 metres east of the Industrial Plant. The south side of the pit is along the bank of Twin Lakes Creek adjacent to the West Adit of the main underground mine.

For closure, the West Open Pit will be filled to cover exposed sulphides and contoured to conform to local topography. It is expected that the cover material will consist of local overburden materials acquired directly upslope of the open pit. The cover material will be contoured to prevent pooling of surface runoff. Backfilling materials may also include non-hazardous demolition debris produced from teardown of the industrial complex.

East Open Pit

The East Open Pit is at the east end of the underground workings adjacent to the East Adit. The north and east limits of the pit are defined by the surface contours where mining intersected the moderately sloping topography. The south and west sides are vertical walls containing some sulphides. The west pit wall connects to the primary underground workings.

For closure, the open pit will be backfilled with waste rock then covered and contoured with a suitable capping material to a sufficient thickness that permafrost aggradation will incorporate sulphides in the open pit. The East Open Pit has a northeasterly exposure and is shielded from the sun during the warmer part of the day. This orientation minimizes surface thaw during the summer.

Runoff from the surrounding topography in the vicinity of the East Adit and open pit drains to the East Adit Treatment Pond. The water treatment system will operate through the Reclamation Period (i.e. the duration of reclamation activities). For reclamation, treatment sediments will be removed and placed in the underground workings. The East Adit Water Treatment Facilities (East Adit Treatment Pond, water treatment equipment, and retention pond) will go underground and the dams will be breached and contoured so natural surface drainage patterns will be restored.

Oxidation and leaching of insitu sulphide from sub-croppings beneath the overburden outside the open pit limits and reclamation area are expected to continue as they were prior to mining activities, even after the open pit disturbance effect has stabilized.

Ocean View Pit

The Ocean View deposit is a flat lying sulphide zone about 5 kilometres east of the Industrial Plant. When mining is completed, overburden will be pushed back into the pit and contoured to prevent pooling of surface water. Waste sulphides will remain in the pit floor and these will be covered with overburden or clean waste rock to ensure that they remain within the permafrost, isolated from surface transport mechanisms.

The site slopes gently north and solar heating effects are considered moderate. The Ocean View area in general contains high metal concentrations in the overburden. Geochemical soil sampling of the area, prior to any mining activity, outlined a broad zone containing high metal levels in the overburden. The metals originate from numerous, small sub-cropping mineral occurrences.

6.4 Waste Rock Storage Areas

6.4.1 Disposal Plan

Sulphide bearing waste rock generated by mining activity in the earlier years of operations was stored in several areas on surface close to the underground mine entrances. Historic waste piles are located at: 02 South Portal, 09 South Portal, 39 North Portal, Area 14, K-Baseline and Ocean View. Currently, the mine operations utilize all waste rock that is produced.

A waste rock recovery program (proactive reclamation) has been implemented to support pillar recovery and general backfilling operations underground. The relocation of waste rock underground will continue post-closure, as required. Waste rock dump material, will also be used for the reclamation of the open pits. Designated sections of the closed, open pits could be filled with this material prior to contouring and cover/capping.

In any waste dump area, where complete removal of the waste rock is not practical; the waste rock area will be covered and capped to prevent sulphide oxidation/leaching by providing for permafrost aggradation in the area.

6.4.2 02 South Dump

A large part of this dump was removed during mining of the West Open Pit, and the only remnant is along the south side of the pit on the bank of Twin Lakes Creek. The reclamation plan is to recover this remnant and move it into the West Open Pit for backfilling and then to contour, cover and cap the area.

Any uncovered waste rock that has the potential to be acid generating will be covered and capped to enhance permafrost aggradation.

6.4.3 09 South Dump

This dump is the most extensive in terms of ground area, because the waste rock was used to form the base for the access road in the area. The dump is along the north bank of Twin Lakes Creek but the topography is not severe, so full recovery will be possible. This dump has been the focus of summer recovery operations for several years and will continue for reclamation in 2002.

6.4.4 39 North Dumps - East Adit Area

At the 39 North (East Adit) area, there is a North and a South dump. The former waste dumps that occupied this area were removed during mining of the East Open Pit, with a large part of the waste material recovered and processed in the mill. Recovery of the current North and South dumps as backfill underground (proactive reclamation) is on going. Some of the waste rock will be used to backfill the East open pit and nearby underground mine entrances.

6.5 Borrow Areas, Ore Storage Stockpiles, and Other Disturbed Areas

6.5.1 Borrow Areas

Nanisivik Mine has worked a number of borrow areas on both Territorial lands, administered by Nunavut's Community Government and Transportation (CG&T), and on crown land, administered by DIAND. These have provided construction material, mainly shale, for building foundation backfill, road beds, stockpile pads, and earthen dams including the West Twin Dyke.

The principal borrow areas used by Nanisivik Mine are: Road Quarry located 900 metres 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 metres east of the dock.

The method used to recover this borrow material is to push-up the thawed (0.5 to 0.75 metre) surface material (active layer) by dozer into a pile that can be subsequently loaded and hauled to its destination. After the dozer has removed the active layer, the area is left ideal so another layer of borrowed material can thaw and subsequently be removed. The dozer tends to leave a smooth contoured surface so minimal reclamation is required. Since natural vegetation is sparse, the disturbed areas are not conspicuously different from their surroundings. Some areas exhibit evidence of thermokarsting and will be recontoured during reclamation.

6.5.2 Stockpile Pads

Stockpile pads were constructed adjacent to the portals at Area 14, K-Baseline, and Ocean View for temporary broken ore storage. The pads are partially made of dolostone waste from the access drifts, and shale. During mining in these satellite areas, the ore was stored on the pads until it was hauled by truck to the underground crushing facility. Any sulphide content material remaining on the stockpile pad will be removed and hauled underground during reclamation.

6.5.3 Roadbeds

The roads servicing the dock, airport, East Twin Lake, and the town site belong to the Government of the Nunavut Territory. Service roads in the mine area and at the West Twin Disposal Area are the responsibility of the Mine. These include the road from the mill to the East Adit, K-Baseline, Ocean View, and Area 14. Portions of the roads near 02 South, 09 South, and the East Open Pit were constructed with mine waste. Samples will be collected from the roadbed areas and will be assessed as part of the Phase 2 Environmental Site Assessment that is scheduled for 2002. Areas identified as contaminated will be excavated and removed underground for disposal. Elsewhere, the roadbeds will only be contoured. Any section of a roadbed, which may cause interruptions to natural drainage, will be breeched and contoured. All culverts will be removed.

6.5.4 Other Disturbed Areas

There are several other areas of disturbance that relate to the Nanisivik operations; they are as follows:

1. Storage areas:
   a) the dock lay down (utilized for shipping transfers, storage of mill reagents, ammonium nitrate and various materials during the year).
   b) warehouse yard by the mill (used for storage of all the various supplies used in mine, mill, and maintenance operations).
   c) temporary lay down areas near the mill and ANFO factory.

   Any spills that occur during handling and/or delivery are generally cleaned-up. These areas will be assessed as part of the Phase 2 ESA.
2. Vehicle parking spaces and small building foundations are made of shale or local overburden and are not potentially acid generating. These areas may be assessed for surface contamination as part of the Phase 2 ESA.
3. Specific roadbeds will be sampled. If the road fill is potentially acid generating, then it will be removed to the underground mine or covered to allow permafrost aggradation.

6.6 Surface Structures

6.6.1 Industrial Building/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 cladded building and cement block interior dividing walls. It was built on bedrock and reinforced concrete foundation. When no longer needed, the industrial building will be dismantled and disposed of underground if no alternate usage can be found. The foundation will be left in place and covered with contoured fill to eliminate hazards and make the area aesthetically similar to the natural surroundings. There are warm and cold storage buildings and the compressor house from which salvageable equipment will be removed and the remaining equipment, steel building structure and services will be dismantled and hauled underground. Surface soil in these areas will be sampled as part of the Phase 2 ESA scheduled for 2002. Any contaminated soil exceeding the site-specific guidelines will be excavated and removed underground.

Process and office equipment or supplies with salvage value will be sold or shipped to other CanZinco projects. This may include electric power generators, tailings pumps, shop machinery, tools, computers, and similar items. The remaining equipment and materials will be dismantled and hauled underground for final disposal.

6.6.2 Industrial Buildings Outside of Industrial Building/Complex

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 taken underground for disposal.

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. When the last production concentrates are shipped the conveyers and the truck scale will be removed and placed underground. The Concentrate Storage Shed will be dismantled and taken underground. The foundation will then be cleaned and covered with local materials. The second option is to use the facility for another purpose. Discussions with various government agencies may result in a transfer of ownership after decontamination. In either case, surface soils will be assessed for contamination as part of the Phase 2 ESA and any material exceeding the site specific criteria will be excavated and placed underground.

Others

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 dismantled before underground deposition.

6.6.3 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 15 of the original 56 housing units. Reclamation of these structures is the responsibility of the GN, which has already moved 10 housing units, in 1998, to Arctic Bay. 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. Their reclamation is the responsibility of the Federal Government and the GN.

The bunkhouse, Pamo building, and the housing units (single and multi-occupancy) belonging to CanZinco are all scheduled to be destroyed (burned and/or hauled underground) when no longer needed. There is a possibility that several government agencies (territorial and federal) may want these units.

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.

6.6.4 Tank Farm – Dock Areas

The tank farm comprises 19 steel tanks of various sizes located in a lined and dyked enclosure, which is adjacent to the Concentrate Storage Shed. There is sufficient storage for 13.9 million litres of P60 diesel, 1.1 million litres of Jet A1, 0.6 million litres of gasoline and a waste products tank for motor oil, glycol, etc.

There are several options for the Tank Farm reclamation. It has been identified as potentially useful for storage and transshipment of fuel for marine activities and for northern communities. One of the following options will be exercised during the reclamation period.

1. Transfer of ownership to government department responsible for supplying fuel to northern hamlets.
2. Transfer of ownership to the Coast Guard for support of their Arctic marine activities.
3. When empty, dismantle the tanks and piping system for use in other northern hamlets, i.e. Arctic Bay, Pond Inlet, etc.
4. When empty, decontaminate and discard underground. Remove the liner and dispose underground and then flatten the berm to prevent accumulation of water.

6.6.5 Intermediate Day Tanks and Fuelling Station

The Intermediate Day Tanks consist of: two 105,000 litre diesel tanks and one 47,000 litre gasoline tank are located in a dyked and lined enclosure adjacent to the industrial building.

Reclamation work and decommissioning of the day tanks cannot commence until the majority of reclamation work is completed and the power plant is shut down. The fuel tanks and associated supply pipelines will be removed, decontaminated and taken underground for permanent disposal, or shipped out for use elsewhere. Gasoline is delivered by truck from the Tank Farm to the day tanks and pumped into the gasoline storage tank. From there, it is dispensed at the main fueling station, mostly as a convenience to private users. All of the facility will be emptied, removed and, if not sold, decontaminated and disposed of underground.

6.6.6 End User Tankage

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 are located at the following locations:

1. Mine production equipment is fuelled at a station adjacent to the West Open Pit.
2. WTDA near tailings shack for refueling mobile equipment.
3. ANFO facility.
4. A portable tank is moved between Ocean View and East Adit depending on where mining activities are taking place.
5. Refuge stations, tailings shack and each building/residence in the town site have an independent small tank, approximately 900 litres capacity, for heating purposes.
6. Larger tanks are provided at the Dome, transient centre, Pamo building, and carpenter shop.
7. Occasionally, jet fuel is delivered from the Tank Farm to the small tanks at the Stolport for chartered aircraft, and helicopters.

All of the tankage listed will be emptied, removed, sold or decontaminated and disposed of underground. Any secondary containment structures that are equipped with liners will have the liner removed and disposed of underground; then contoured to prevent accumulation of water. Petroleum storage tanks located at the Nanisivik Airport, government garage, and government buildings are not the responsibility of Nanisivik Mine.

6.6.7 Other Petroleum Products

Other petroleum products include lubricants, solvents, and minor specialty products. They can be stored in large containers outside or small containers indoor. Access to these containers areas is restricted to warehouse personnel and qualified equipment operators. Reclamation will include salvage (return to supplier) or incineration of excess stock.

6.7 Chemicals

6.7.1 Mill Reagents

The mill concentrator requires a number of bulk chemicals for efficient recovery of metals from the ore fed to the mill. Hydrated lime is used to control the process pH (as well as water treatment at the East Adit Treatment Facility), copper sulphate and xanthates control the flotation grade and recovery of final concentrates.

Most of the mill reagents are placed in a storage area near the dock with small lots transferred as required to storage areas in or near the mill. Spills are cleaned up when they occur. This area will be assessed as part of the Phase 2 ESA and will be appropriately remediated based on these findings. Excess reagents will be returned to the supplier or sent to other operations.

6.7.2 Explosives and Calcium Chloride

Bulk ammonium nitrate is supplied in 750 kg tote bags and is 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 are stored in the dock area until delivered to the ANFO facility.

Bulk calcium chloride salt is 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 is required for diamond drilling as the drill flushing water. For reclamation, the mixing tank will be removed and taken underground.

Accidental spills of ammonium nitrate and calcium chloride are cleaned up when they occur, so little reclamation of these storage sites is expected. Surplus inventory at closure will be returned to the supplier or sent to other operations. This area will be assessed as part of the Phase 2 ESA and will be appropriately remediated based on these findings.

6.7.3 Other Chemicals

Paints are kept and mixed in the carpenter shop and any minor spills are promptly cleaned. Janitorial supplies and kitchen cleaning agents are kept in the warehouse or near the point of use and consumed in the recommended manner. The use of shop supplies like starting fluid is controlled. All these items are unlikely to cause any particular concerns for reclamation. Surplus inventory will be returned to supplier.

Specialty chemicals used in the assay and metallurgical laboratories are stored in the work areas. As part of the reclamation plan the unused stocks will be neutralized, destroyed, or removed from site as appropriate.

6.8 Potentially Contaminated Areas

6.8.1 Stolport

The Stolport was used during the exploration and construction phases of the project as an airstrip for small-chartered 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 somewhat flattened, requiring little reclamation. The runway lights posts will be removed.

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 to the site.

6.8.2 Landfarm

Monitoring and remediation of the diesel fuel spill at the carpenter shop in 2000 continues. It was originally intended that the impacted soils excavated from the carpenter shop would be bio-remediated in the landfarm, built for this purpose as described in the submission made in August 2000, “Soil Bioremediation Proposal”. Treatment of the contaminated soil would have involved aerating the soil and seeding it with ammonium nitrate to accelerate the growth of the hydrocarbon-consuming microorganisms. Due to the time constraints imposed by the announced early closure of Nanisivik Mine, it is highly unlikely that there will be sufficient time to properly bio-remediate the stockpiled material.

Soils containing residual hydrocarbons, and not exhibiting signs of free phase product, will be disposed of underground. Additional monitoring of the carpenter shop area will be undertaken during final reclamation/monitoring period to determine the hydrocarbon content of soils beneath the building foundation.

6.8.3 Dock

The dock at Nanisivik was constructed by the mine for the Federal Government. The reclamation of the dock infrastructure continues to be their responsibility. Nanisivik will clean up any accessible concentrate spills in the vicinity of the dock and remove any concentrate or contaminated soil from the same area. Further investigations and sampling are to be conducted to fully define the impacted areas, as part of the Phase 2 ESA that is scheduled for 2002.

6.8.4 Areas Affected by Wind Blown Tailings

Some tailings solids from the Surface Cell have, on occasion, became airborne during severe windstorms. The area most affected is the north side of the Surface Cell, the hill north of the WTDA due to the direction of prevailing winds.

This area will be assessed as part of the Phase 2 ESA that is scheduled for 2002 and will be appropriately remediated based on these findings.

7. Northern Community Benefits

7.1 Closure and Reclamation

The Closure and Reclamation Plan will provide benefits and opportunities to northern businesses and residents and, particularly, to businesses and residents the Hamlet of Arctic Bay. These will include:

1. Sale of tools, equipment, computers, furniture and other items.
2. Jobs for tear down and reclamation work.
3. Jobs for environmental monitoring work.
4. Training opportunities related to work and contract services.

At a community meeting in the Hamlet of Arctic Bay in January 2002, community members expressed a strong interest in acquiring tools, furniture and other small items. Nanisivik Mine will communicate directly with the Hamlet of Arctic Bay through the liaison officer throughout the closure and reclamation process.

Some of the required reclamation work may be undertaken directly by Nanisivik Mine and some of the work may be contracted. In either event, it is likely that qualified local residents will have opportunities to work in various capacities for Nanisivik Mine or for contractors during the performance of the reclamation work. Depending on specific qualifications that may be required for specialized work, northern contractors will be invited to provide competitive bids on contracted work.

7.2 Possible Continued Use of Mine Facilities

Nanisivik Mine 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.

At a community meeting in the Hamlet of Arctic Bay in January 2002, community members expressed a strong interest in having the mine facilities remain in place. The concept of a regional training centre for equipment operation, trades and other jobs was expressed by numerous community members as a positive concept.

The Government of Nunavut has recently released two Requests for Proposals (RFP's) regarding the Hamlet of Arctic Bay and Nanisivik. One project will investigate the social and economic impacts that closure of the Nanisivik Mine may have on the Hamlet of Arctic Bay. The other project will identify and evaluate concepts that would allow for the continued use of some or all mine facilities. Nanisivik Mine will contribute to these projects as available resources allow and as requested by the Government of Nunavut.

Regardless of the initiatives mentioned above or others that may be developed, Nanisivik Mine is required to proceed with tear down and reclamation activities on an efficient and timely schedule to begin immediately upon mine closure. Until appropriate releases and indemnities for on-going use of mine facilities are in place, tear down and reclamation activities will proceed for the following reasons:

1. Legal requirements of the Water License.
2. Extra costs that would be borne by Nanisivik Mine if reclamation activities were delayed.
3. Environmental liabilities that might accumulate if reclamation activities were delayed.

8. Closure and Reclamation Monitoring Program

8.1 Concept

The monitoring plan is intended to collect sufficient information to assess the effectiveness of the remediation measures.

The monitoring program provides for environmental monitoring during the two year reclamation period and for a subsequent five year closure period.

8.1.1 Monitoring Periods

The monitoring plan is described in two time periods: 1) Reclamation and 2) Closure.

The Reclamation Period refers to the performance of reclamation work and is currently anticipated to be of approximately two years duration. During the Reclamation Period, a manpower presence at the mine site is anticipated for monitoring and maintenance purposes and this presence will enable the proposed monitoring programs to be carried out by the on-site personnel under the direction of an environmental coordinator.

The Closure Period refers to the period following the completion of the active reclamation work. During this time, environmental monitoring will be conducted to determine the success of the reclamation measures. This plan proposes that environmental monitoring be carried out for a period of approximately five years. Continuous manpower presence at the mine site is not planned during the Closure Period and environmental monitoring programs will be carried out on site visits and, possibly, utilizing local field assistants.

8.1.2 Reporting

During the Reclamation Period, monitoring will be conducted in accordance with the terms of the Water License at that time. It is anticipated that monthly 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. The reports would not present an interpretation of the data.

During the Closure Period, monthly water quality data reports would be submitted to the Nunavut Water Board for months during which water quality sampling was required or conducted.

During both periods, an annual environmental report would be prepared and submitted to the Nunavut Water Board by March 31 of the subsequent year. The report would provide an interpretation of all data collected during the previous year including: water quality, ground temperatures, geotechnical inspection, and other reclamation and closure monitoring studies.

8.2 Reclamation Period Monitoring

Monitoring during the Reclamation Period will focus on monitoring the environmental effects of the reclamation activities, which include covering of tailings, reclamation of waste rock dumps and pits, excavation and/or covering of contaminated soils and operation of the east adit water treatment plant. Monitoring will largely follow the existing Surveillance Network Program (SNP) and other requirements of the existing Water License (No. NWB1NAN9702).

Water quality monitoring will be conducted according to the schedule presented in Table 8-1 and locations illustrated on Figures 8-1 and 8-2. Some summary comments regarding this table are as follows.

1. Continued monitoring of the "159" series of stations on a daily (during decant), weekly, bi-weekly or monthly schedule according to Table 8-1. Stations 159-1 and 159-2 will be excluded from sampling because there will be no production of tailings from the mill (159-1) and no recycle of water from the WTDA (159-2). Water quality data will be submitted to the Nunavut Water Board monthly.
2. Detailed monitoring of water quality and flows in Twin Lakes Creek per the established annual "Metal Loadings Study" ("200" series) will be conducted during the ice free season and will be reported in the annual environmental report. Details regarding scheduling and locations may be amended slightly on an on-going basis at the discretion of the environmental coordinator.
3. Sampling during the ice free season at Ocean View ("OV" series) and other surface water locations ("NML" and "OLD" series) will be conducted. The exact schedule and locations may be amended by the environmental coordinator so they better represent water quality in those areas.
4. Location NML26, drainage from the landfill site, is to continue to be monitored on a monthly basis.

Water samples will be collected according to appropriate sampling protocols. Preservatives will be added in the field for metal determinations. Sampling will be coordinated with transport schedules in order to minimize sample travel time to the external laboratory. Field determinations of pH, temperature and conductivity will be recorded. Laboratory determinations of total zinc, total lead and total cadmium will be obtained from an accredited laboratory.

In addition to water quality monitoring, the following monitoring programs will also be undertaken:

1. Monitoring of ground temperatures at the established thermistor strings as listed in Table 8-2 and illustrated on Figure 6-1 will be monitored on a monthly basis and the data will be reported in the annual environmental report.

2. In addition to the established network of thermistors, other instrumentation will be installed during the course of reclamation activities to monitor areas of specific interest. This may include: the landfill, West Open Pit, East Open Pit, Ocean View Pit, covered rock dumps and piles as listed in Table 8-2. Monitoring of "new" thermistors at these locations will commence upon their installation and will be incorporated into the monthly monitoring schedule.
3. An annual inspection of earth structures and the (future) West Twin spillway by a professional geotechnical engineer will continue as per the established practice and Water License requirement. This engineer's report will be submitted in its entirety to the Nunavut Water Board as a component of the annual environmental report.
4. Water Levels in East and West Twin Lakes will be recorded on a monthly basis during the ice-free season.

Confirmatory monitoring of soil quality will be conducted in areas where contaminated soils are to be excavated as part of the remedial measures. This sampling will be designed to confirm that the soil quality remediation objectives have been achieved.

8.3 Closure Period Monitoring

Monitoring through the Closure Period will focus on collecting information necessary to evaluate the effectiveness of the reclamation measures. This will include the collection of water quality, and ground temperature data. The monitoring schedule is planned to be reduced through the Closure Period in anticipation of the data verifying the effectiveness of the remediation measures. In years one, two, and three of the Closure Period, monthly monitoring will take place. Following a comprehensive review of information a sampling schedule for years four and five of the Closure Period will be determined. This is anticipated, at this time, to be spring and fall monitoring.

Water quality monitoring will be conducted according to the schedule presented in Table 8-1 and locations illustrated on Figures 8-1 and 8-2.

Monitoring during the summer season at a modified list of the "159", "200", "OV" and "OLD" series of stations and at the two established locations at the landfill (including NML 26) or a monthly basis during years one, two and three and on a twice per year basis in years four and five.

Water quality monitoring will be collected according to appropriate sampling protocols. Preservatives will be added in the field for metal determinations. Sampling will be coordinated with transport schedules in order to minimize sample travel time to the accredited laboratory. Field determinations of pH, temperature and conductivity will be recorded. Laboratory determinations of total zinc, total lead and total cadmium will be done.

In addition to water quality monitoring, the following monitoring programs will also be undertaken:

1. Monitoring during the summer season of ground temperatures in the established network of thermistors as listed in Table 8-2 and illustrated on Figure 6-1 on a monthly basis during years one, two and three and on a twice per year basis in years four and five.
2. An annual inspection of the site by a professional geotechnical engineer as per the established practice. This inspection will include an assessment of earth structures, the West Twin spillway, the tailings cover and the stability of rock/soil slopes in reclaimed areas.
3. Submission to the Nunavut Water Board of an annual environmental report, which will include the geotechnical engineering inspection report in its entirety.

Any maintenance or repair work that might be required in the reclaimed areas will be completed. It is possible that some maintenance will be required in the first year following reclamation due to ground settling in reclaimed areas.

Table 8-1: Reclamation and Closure Water Quality Monitoring

Sample	Location	Reclamation Period	Closure Period	Closure Period
159-1	Tailings	No	No	No
159-2	Reclaim water	No	No	No
159-4	West Twin decant	Weekly during decant	Monthly	Spring/Fall
159-6	West Twin Creek at Sound	Weekly	Monthly	Spring/Fall
159-9	West Twin Creek at Duck Pond	Bi-Weekly	Monthly	Spring/Fall
159-10	West Twin Creek below Mill	Weekly	Monthly	Spring/Fall
159-11	West Twin Creek below 02 Portal	Bi-Weekly when safe	Monthly	Spring/Fall
159-12	East Adit Retention Pond discharge	Daily	Monthly	Spring/Fall
159-12(a)	East Adit Catchment Pond feed	Weekly	No	No
159-12(p)	East Adit Retention Pond	Bi-Weekly	No	No
159-13	Chris Creek/East Adit (downstream)	Bi-Weekly	No	No
159-14	Chris Creek/East Adit (upstream)	Bi-Weekly	Monthly	Spring/Fall
159-15	Chris Creek/Area 14 (south side)	Bi-Weekly	Monthly	Spring/Fall
159-16	Chris Creek/Area 14 (north side)	Bi-Weekly	No	No
159-17	Chris Creek/Eskimo Beach	Bi-Weekly	Monthly	Spring/Fall
159-18	Ocean View Open Pit Runoff	Bi-Weekly	Monthly	Spring/Fall
159-19	Ocean View Open Pit – Sump	Bi-Weekly until reclaimed	No	No
NML-1	Area 14 waste pile drainage	Monthly	Monthly	Spring/Fall
NML-2	East Open Pit drainage	Monthly	Monthly	Spring/Fall
NML-3	East Open Pit drainage	Monthly	Monthly	Spring/Fall
NML-4	East Open Pit drainage	Monthly	Monthly	Spring/Fall
NML-5	East Open Pit drainage	Monthly	Monthly	Spring/Fall
NML-8	Ocean View drainage	Monthly	No	No
NML-9	Ocean View drainage	Monthly	No	No
NML-10	Access road to Kuhulu (north side)	Monthly	No	No
NML-11	Access road to Kuhulu (north side)	Monthly	No	No
NML-12	Drainage into Kuhulu	Monthly	No	No
NML-13	Drainage into Kuhulu	Monthly	No	No
NML-14	Drainage from Kuhulu	Monthly	No	No
NML-15	Drainage from Kuhulu	Monthly	No	No
NML-16	Drainage from Kuhulu	Monthly	No	No
NML-23	East Twin Lake (wet well)	No	No	No
NML-24	Drainage into East Twin Lake	Monthly	No	No
NML-25	Drainage from East Adit waste piles	Monthly	Monthly	Spring/Fall
NML-26	Drainage from Landfill Site	Monthly	Monthly	Spring/Fall
NML-27	Return Water	No	No	No
NML-28	Townsite drainage	Bi-Weekly	Monthly	Spring/Fall
NML-29	Potable water in Lab.	No	No	No

Sample	Location	Reclamation Period	Closure Period	Closure Period
OLD – 1	Creek @ Town south of Ball Park	Bi-Weekly	Monthly	Spring/Fall
OLD – 2	East Drainage from hillside @ House 906	Bi-Weekly	Monthly	No
OLD – 3	West Drainage from hillside to Duck Pond	Bi-Weekly	Monthly	Spring/Fall
OLD – 4	South Drainage from hillside to meadow	Bi-Weekly	Monthly	No
OLD – 5	South Drainage from Mt Fuji to Str. Sound	Bi-Weekly	No	No
OLD – 6	South Drainage from airport to Arctic Bay	No	No	No
200-1	Twin Lakes Creek @ Mill	Bi-Weekly	Annually	Annually
200-2	Twin Lakes Creek @ Mill – Upstream	Bi-Weekly	Annually	Annually
200-3	Twin Lakes Creek @ Mill – Upstream	Bi-Weekly when safe	Annually	Annually
200-4	Twin Lakes Creek @ Mill – Upstream	Bi-Weekly when safe	Annually	Annually
200-5	Twin Lakes Creek @ Mill – Upstream	Bi-Weekly when safe	Annually	Annually
200-6	Twin Lakes Creek @ 09 South	Bi-Weekly	Annually	Annually
200-7	Twin Lakes Creek 09 South – Upstream	Bi-Weekly	Annually	Annually
200-8	Twin Lakes Creek 09 South – Upstream	Bi-Weekly	Annually	Annually
200-9	Twin Lakes Creek 09 South – below 159-9	Bi-Weekly	Annually	Annually
200-10	Small Stream from Nanisivik Townsite	Bi-Weekly	Annually	Annually
OV – 1	South - Upstream from Portal area	Annually	No	No
OV – 2	Southwest - Upstream from Pit area	Annually	No	No
OV – 3	Southwest - Upstream from Pit area	Annually	No	No
OV – 4	South – Upstream from Pit area	Annually	No	No
OV – 5	Southeast – Upstream from Pit area	Annually	No	No
OV – 6	Downstream - East of Pit area	Annually	No	No
OV – 7	Downstream - North of Pit area	Annually	No	No

Table 8-2: Reclamation and Closure Monitoring of Existing and Expected Future Thermocouple Installations

Station	Location	Reclamation Period	Closure Period Years 1,2,3	Closure Period Years 4,5
T1	South dyke, chainage 00+75	Monthly	Monthly	Spring/Fall
T2	North dyke, chainage 03+25	Monthly	Monthly	Spring/Fall
T3	Test Pad #1	Monthly	Monthly	Spring/Fall
T4	Test Pad #5	Monthly	Monthly	Spring/Fall
T6	West Twin Lake - East shore	Monthly	Monthly	Spring/Fall
T7	Area 14 - shale pad	Monthly	Monthly	Spring/Fall
T8	Area 14 - shale pad	Monthly	Monthly	Spring/Fall
T9	09 South Portal	Monthly	Monthly	Spring/Fall
T10	09 South Portal	Monthly	Monthly	Spring/Fall
T11	East Adit waste pile	Monthly	Monthly	Spring/Fall
T12	South dyke, chainage 01+30	Monthly	Monthly	Spring/Fall
T13	South dyke, chainage 01+50	Monthly	Monthly	Spring/Fall
T13A	South dyke, chainage 01+50	Monthly	Monthly	Spring/Fall
T14	South dyke, chainage 02+25	Monthly	Monthly	Spring/Fall
T15	North dyke, chainage 02+88	Monthly	Monthly	Spring/Fall
T15A	North dyke, chainage 03+00	Monthly	Monthly	Spring/Fall
T16	North dyke, chainage 03+75	Monthly	Monthly	Spring/Fall
T16A	North dyke, chainage 03+75	Monthly	Monthly	Spring/Fall
T17	North dyke, chainage 04+25	Monthly	Monthly	Spring/Fall
T17a	North dyke, chainage 04+50	Monthly	Monthly	Spring/Fall
T18	North dyke, chainage 04+75	Monthly	Monthly	Spring/Fall
T19	Downstream dyke, chainage 01+25	Monthly	Monthly	Spring/Fall
T20	Downstream dyke, chainage 03+75	Monthly	Monthly	Spring/Fall
T21	Surface Cell - 13,730 N, 17,340 E	Monthly	Monthly	Spring/Fall
T22	Southern Delta Fan	Monthly	Monthly	Spring/Fall
T23	Central Delta Fan	Monthly	Monthly	Spring/Fall
T24	Northern Delta Fan	Monthly	Monthly	Spring/Fall
T25	Test Pad #2	Monthly	Monthly	Spring/Fall
T26	Test Pad #3	Monthly	Monthly	Spring/Fall
T27	Test Pad #4	Monthly	Monthly	Spring/Fall
T28	South dyke, chainage 02+25	Monthly	Monthly	Spring/Fall
T29	North dyke, chainage 04+25	Monthly	Monthly	Spring/Fall
T31	South dyke, 01+50, 378 m elev.	Monthly	Monthly	Spring/Fall
T32	South dyke, 01+50, 382 m elev.	Monthly	Monthly	Spring/Fall
T33	South dyke, 01+50, 386 m elev.	Monthly	Monthly	Spring/Fall

Expected Future Installations

Station	Location	Reclamation Period	Closure Period Years 1,2,3	Closure Period Years 4,5
T 38	South Surface Cell WTDA	Monthly	Monthly	Spring/Fall
T 39	North Surface Cell WTDA	Monthly	Monthly	Spring/Fall
T 40	Test Cell North Reservoir	Monthly	Monthly	Spring/Fall
T 41	Test Cell South Reservoir	Monthly	Monthly	Spring/Fall
T 42	West Open Pit	Monthly	Monthly	Spring/Fall
T 43	East Open Pit	Monthly	Monthly	Spring/Fall
T 44	Ocean View Open Pit	Monthly	Monthly	Spring/Fall
T 45	Landfill Cover Materials	Monthly	Monthly	Spring/Fall
T 46	09 South Cover	Monthly	Monthly	Spring/Fall
T 47	East Adit Cover Materials	Monthly	Monthly	Spring/Fall

Notes: 1.: Frequency of monitoring is monthly during the summer season only.

9. Schedule

9.1 Mine Closure

The scheduled date for the cessation of mining activities is September 30, 2002. A schedule of closure and reclamation activities illustrated on Figure 9-1.

9.2 Activities Prior to Mine Closure

These Progressive Reclamation activities are scheduled to be completed prior to the cessation of mining activities:

1. Complete reclamation of 09 rock pile to underground.
2. Partial reclamation of 39 rock pile to East Open Pit.
3. Partial reclamation of Ocean View pit.
4. Continue shale cover on tailings.
5. Tailings pours directed to fill all areas in Surface Cell to minimum 384 m.a.s.l.

These Closure Planning activities are scheduled to be completed prior to the cessation of mining activities:

1. Conduct Phase 2 Environmental Site Assessment.
2. Develop Ecological and Human Health Risk Assessment: Summer/Fall 2002.
3. Respond to regulator comments on Closure and Reclamation Plan.
4. Liaise with Hamlet of Arctic Bay.
5. Continue discussions with interested stakeholders re. alternatives for continued use of mine facilities.

9.3 Reclamation Period

All mine reclamation work and Reclamation Period monitoring activities described in Sections 6 and 8 of this Closure and Reclamation Plan will be completed in this period.

CanZinco Ltd. believes that reclamation of the site they must commence as early as practical following closure due to the remoteness of the site and the inherently high operating costs. Therefore, until the start of reclamation activities, CanZinco will continue to work diligently and collaboratively with all stakeholders and interested parties to identify, develop and implement plans that would allow for the on going use of mine facilities.

9.4 Closure Period

Activities related to the Closure Period Monitoring Plan as described in Section 8 of this Closure and Reclamation Plan will be completed during this period. This will include regular submission of environmental monitoring reports to the Nunavut Water Board and could include, at the discretion of the Nunavut Water Board, meetings with regulators to present the results of the monitoring programs.

Figures