DRAFT
PRELIMINARY DESIGN FOR BIOCELL TREATMENT FACILITY CAMBRIDGE BAY, NUNAVUT

PREPARED FOR:

KITNUNA CORPORATION

PREPARED BY:

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EXECUTIVE SUMMARY

Kitnuna Corporation (Kitnuna) has retained Komex International Ltd. (Komex) to design and prepare construction specifications for a biocell treatment facility near Cambridge Bay, Nunavut. The Nunavut Water Board is the responsible regulatory agency to approve the construction and operation of the facility.

The proposed biocell treatment site is approximately 200 m offshore from Cambridge Bay at approximately 7668100 Northing and 499000 Easting. The preliminary dimensions of the facility are 60 m x 40 m x 1 m (average depth); to treat an estimated 1,100 m^3 of hydrocarbon-impacted soil (mainly gasoline and jet fuel).

The biocell treatment design rationale is based on references obtained from the Government of Yukon, Department of Environment, Land Treatment Facilities (Guidelines for Construction, Operation, and Decommissioning), and the Alberta Environment Code of Practice for the Land Treatment and Disposal of Soil Containing Hydrocarbons – DRAFT.

The biocell treatment facility design is preliminary until the site can be confirmed as suitable

1. INTRODUCTION

Kitnuna Corporation (Kitnuna) has retained Komex International Ltd. (Komex) to design and prepare construction specifications for a biocell treatment facility near Cambridge Bay, Nunavut. The Nunavut Water Board is the responsible regulatory agency to approve the construction and operation of the facility.

The proposed biocell treatment facility site is approximately 200 m from the shore of Cambridge Bay at approximately 7668100 Northing and 499000 Easting. The preliminary dimensions of the facility are 60 m x 40 m x 1 m (average depth), to treat an estimated 1,100 m^3 of hydrocarbon impacted soil (mainly gasoline and jet fuel, fuel oil; Bryant Environmental Consultants Ltd., [2000]).

2. BIOCELL TREATMENT FACILITY DESIGN RATIONALE

The biocell treatment facility design rationale is based on references obtained from the Government of Yukon (2001), Department of Environment, Land Treatment Facilities (Guidelines for Construction, Operation, and Decommissioning), and the Alberta Environment (2001) Code of Practice for the Land Treatment and Disposal of Soil Containing Hydrocarbons – DRAFT.

There are no available guidelines for the Nunavut Territory on construction and/or operating land treatment facilities, therefore the above-mentioned references were used.

2.1 SITE INFORMATION

The information available for the biocell site includes:

- Contour map of the site location provided by the Government of Nunavut (File number: 410-2302);
- The location of the site was selected by the Kitnuna Corporation; and,
- Phase II Environmental Site Assessment of Fred Ross & Associates Ltd. Fuel Tank Farms at Cambridge Bay (Bryant Environmental Consultants Ltd., 2000).

2.2 BASIC DESIGN CONCEPT

Based on the above information and the references, the assumptions made for the biocell design were are summarised below.

- Fine-grained material (clayey or silty soil) is not readily available for construction. It is assumed that coarse-grained material such as gravel and cobbles are more readily available and can be produced (screened) to a specified grain size distribution.
- Conventional construction equipment and method would be used during construction.
- Geosynthetic materials will be installed by an experienced and qualified company who is familiar with the installation procedures, methods, and quality control of the specified material.

The biocell treatment facility design concept includes the following.

- The site topsoil and organic layer (in any) will not be removed and there will be no "cut" performed at the site. Pit run will be imported to fill and level the site. Levelling the site with pit run should prevent the thawing of permafrost that could potentially cause differential settlement.

- The berms will be constructed using coarse-grained material. The material will be compacted to the specified densities as indicated in the construction specifications and the drawings (Appendix I and II, respectively).
- Geosynthetic material will be used to line the biocell to prevent off-site and subgrade contamination. The biocell treatment facility is designed with a geomembrane, 30mil Arctic Liner® NT 30 (U) or 38 mil Arctic Liner (Layfield Plastics), protected above and below by non-woven geotextile. The Arctic Liner® is recommended for its compatibility with hydrocarbon liquids and suitability for cold regions usage. A layer of hydrocarbon impacted soil (approximately 300 mm) will placed over the geosynthetic surface as a protective layer.
- Since excavating an anchor trench is not practical in pit run fill, the geosynthetic layers will be placed on the outside slope of the berm and held in place with an anchor berm.
- The biocell floor slopes at a 1% grade to a collection sump. The bottom elevation of the sump will be constructed just above the existing grade.
- The access ramp will be constructed with clean fill outside of the biocell and with hydrocarbon impacted soil material inside of the biocell.

2.3 ADDITIONAL INFORMATION REQUIRED

It is crucial to confirm that the site location is suitable for locating the biocell. In general the site location should meet the following criteria (Government of Yukon, 2001):

- the land shall not have a slope greater than 6%;
- the land shall not have groundwater level less than 3 m above the seasonal high water table of an aquifer which serves as a source of potable water;
- the land shall not be within 100 m of a surface water body.;
- the land shall not be within the 25-year floodplain.;
- the land shall not be within 60 m of residential property lines or buildings.;
- no significant alterations to surface water flow should occur; and,
- no ponding of surface water shall result as a consequence of the construction.

Based on preliminary observation, the proposed land treatment site meets most of the above criteria. However, the required 100 m separation from surface water bodies will need to be confirmed as there is a marsh area with a small pond to the west of the proposed site that appears to be about 100 m away. It should also be determined if the site is located within the 25-year floodplain.

3. CONSTRUCTION SPECIFICATIONS AND DRAWINGS

The preliminary construction specifications and drawings are attached in Appendix I and II respectively. The construction specifications identify the types of material, construction methods, and quality control procedures. The construction drawings show the details of the facility. The construction specifications and drawings can be finalised and "Issued for Construction" after completion of the site investigation and in advance of construction.

4. CLOSURE

We trust that the contents of this report meet your requirements. Should you have any questions or require further information, please contact the undersigned.

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5. REFERENCES

Alberta Environment, 2001. Code of Practice for the Land Treatment and Disposal of Soil Containing Hydrocarbons – DRAFT.

Bryant Environmental Consultants Ltd., 2000. Phase II Environmental Site Assessment of Fred Ross & Associates Ltd. Fuel Tank Farms at Cambridge Bay. Prepared for Nunasi Corporation, Cambridge Bay, Nunavut.

Government of Yukon, 2001. Land Treatment Facilities (Guidelines for Construction, Operation, and Decommissioning). http://environmentyukon.gov.yk.ca/epa/landtrecod.shtml

6. DISCLAIMER

The information presented in this document was compiled and interpreted exclusively for the purposes stated in section 1.0 of the document. Komex International Ltd. provided this report for Kitnuna Corporation solely for the purpose noted above.

Komex has exercised reasonable skill, care and diligence to assess the information acquired during the preparation of this report, but makes no guarantees or warranties as to the accuracy or completeness of this information. The information contained in this report is based upon, and limited by, the circumstances and conditions acknowledged herein, and upon information available at the time of its preparation. The information provided by others is believed to be accurate but cannot be guaranteed.

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Any questions concerning the information or its interpretation should be directed to Juliana Tang or Wayne Bryant.

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APPENDIX I
PRELIMINARY CONSTRUCTION SPECIFICATIONS

SECTION 02222 - EARTHWORK AND RELATED WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section includes the following items of work associated with the construction of the biocell treatment system:

1. Placement and compaction of biocell floor, and retention berms.

1.2 REFERENCES

A. American Society for Testing Materials, ASTM D698-91, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3) (600 kN-m/m^3).

B. ASTM D422-63 (1990), Method of Particle-Size Analysis of Soils.

1.3 REGULATIONS

A. Shore and brace excavations, protect slopes and banks and perform all work in accordance with Federal, and Municipal regulations whichever is more stringent.

1.4 TESTS AND INSPECTIONS

A. Testing of materials will be carried out by qualified testing laboratory designated by Engineer.

B. Compaction testing of fill will be carried out by qualified and approved company as determined prior to the commencement of the project.

C. Do not begin backfilling or filling operations until material has been approved for use by the Engineer.

D. The following testing program will be followed for backfilling:

Specification	Test (ASTM)	Frequency
Grain size as specified in Part 2	Particle Size Analysis for Soils (D422-63)	1 per 4000 m^3
Standard Proctor Density	Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m^3)	As required by Engineer
Moisture Content as specified in Part 3	Water content of Soil and Rock in Place by Nuclear Methods (D3017-96)	1 per 500 m^3
Compaction as specified in Part 3	Density of Soil and Soil Aggregate in Place by Nuclear Methods (D2922)	1 per 500 m^3

E. No later than 48 hours before filling with approved material, notify Engineer so that compaction tests can be carried out.

F. Do not place a new lift of fill until the Site Supervisor has conducted compaction tests and approved the placement of a new lift.

G. Before commencing work, conduct, with Site Supervisor, condition survey of existing structures, trees and other plants, lawns, fencing, service poles, wires, rail tracks and paving, survey bench marks and monuments which may be affected by work.

1.5 BURIED SERVICES

A. Before commencing work establish the location of all buried services on and adjacent to the site.

B. Arrange with appropriate authority for relocation of buried services that interfere with execution of work.

C. Remove obsolete buried services within 2 m of biocell treatment area.

1.6 PROTECTION

A. Keep excavations clean, free of standing water, and loose soil.

B. Where soil is subject to significant volume change due to change in moisture content, cover and protect to Site Supervisors's approval.

C. Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.

D. Protect buried services that are required to remain undisturbed.

PART 2 – PRODUCTS

2.1 MATERIALS SOURCES

A. Owner's approval shall be obtained prior to excavation of any types of material.

B. Bedding/protective sand, 20 mm minus crush material, and the pit-run gravel (150 mm diameter minus crushed gravel) shall be processed from material obtained from sources approved by the Owner. Processing of the material will be required to achieve the specified grain size distribution and gradation.

C. If material is not readily available, the parent rock from which all fill materials are derived shall consist of sound, hard, durable material free from soft, thin, elongated or laminated particles and shall contain no unsuitable substances. The processed material shall be approved and inspected by the Engineer to ensure the final product meets the requirements.

PART 3 – EXECUTION

3.1 GENERAL

A. Refer to Section 02224.

3.2 GRADING

A. The biocell shall have final lines and grades constructed in accordance to the elevations as shown on the drawings.

SECTION 02224 - EMBANKMENT AND COMPACTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section includes the following items of work associated with the construction of the biocell treatment system:

1. Placement and compaction of biocell floor, and retention berms.

1.2 RELATED SECTIONS

A. Section 0222 Earthwork and Related Work.

1.3 REFERENCES

A. American Society for Testing Materials, ASTM D698-91, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,000 ft-lbf/ft^3) (600 kN-m/m^3).

1.4 DEFINITIONS

A. Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

B. Waste material: material unsuitable for use in embankment or surplus to requirements.

C. Borrow material: material obtained from areas outside right-of-way and required for construction of embankments or for other portions of work.

D. Unsuitable materials:

1. Very weak and compressible materials under excavated areas to depths as indicated.

2. Frost susceptible materials under excavated areas to depths as indicated by the Engineer.

A. Embankment: material derived from usable excavation and placed above original ground.

B. Subgrade elevation: elevation immediately below biocell treatment facility structure.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. Adhere to regulations of authority having jurisdiction if blasting is required.

1.6 TRAFFIC PROVISIONS

A. Provide and maintain roadways, walkways and detours, for vehicular and pedestrian traffic.

PART 2 - PRODUCTS

2.1 Materials

A. Embankment materials require approval by Engineer.

B. Material used for embankment not to contain organic matter, frozen lumps, weeds, sod, roots, logs, stumps or any other unsuitable material.

C. Borrow material:

1. Obtain from sources as indicated or as designated by Engineer.

PART 3 - EXECUTION

3.1 COMPACTION EQUIPMENT

A. Compaction equipment must be capable of obtaining required densities in materials on project.

B. Compaction equipment:

1. Smooth drum vibrating roller shall be used to compact the 20 mm minus crushed gravel and the pit run.

C. Compaction equipment not specified herein is to be efficiency proved at no extra cost and written approval must be received from Engineer before use.

3.2 WATER DISTRIBUTORS

A. Apply water with equipment capable of uniform distribution.

3.3 BASE PREPARATION

A. The existing ground surface should be inspected by the Engineer for soft and/or loosened areas. The footprint of the biocell treatment shall be placed with pit run material for a level surface base.

B. The base shall be proof-rolled and upon inspection, soft/loose and ice-rich material shall be removed to expose competent soil and/or bedrock at the discretion of the Engineer.

C. Remove unsuitable materials found during work. Replace with material approved by Engineer.

3.4 EMBANKMENTS

A. The embankment shall be constructed with pit run. The inside slopes and biocell floor will be compacted with a 150 mm thick of 20 mm minus crushed gravel in preparation for placing geosynthetic material.

B. Do not place material which is frozen nor place material on frozen surfaces.

C. Maintain crowned surface during construction to ensure ready run-off of surface water. Do not place material in free standing water.

D. With material containing less than 25% by volume of stone or rock fragments larger than 100 mm:

1. Place and compact to full width in uniform layers not exceeding 150 mm loose thickness. Engineer may authorize thicker lifts if specified compaction can be achieved.

2. Compact to density of not less than 95% maximum dry density in accordance with ASTM D698.

3. Bring moisture content of soil to level required to achieve specified compaction. Add water or aerate as required.

E. Remove surface stones, roots and other debris and leave surface in uniform condition.

3.5 FINISHING AND TOLERANCES

A. Shape and compact entire biocell treatment area to within 100 mm of design elevations but not uniformly high or low.

B. Finish back and side slopes of common material to neat condition true to lines and grades.

C. Remove any soil material that is not specified herein.

D. The liner bedding surfaces shall be relatively smooth with no protruding rocks.

3.6 PROTECTION

A. Maintain finished surfaces in condition conforming to this section until acceptance by Engineer.