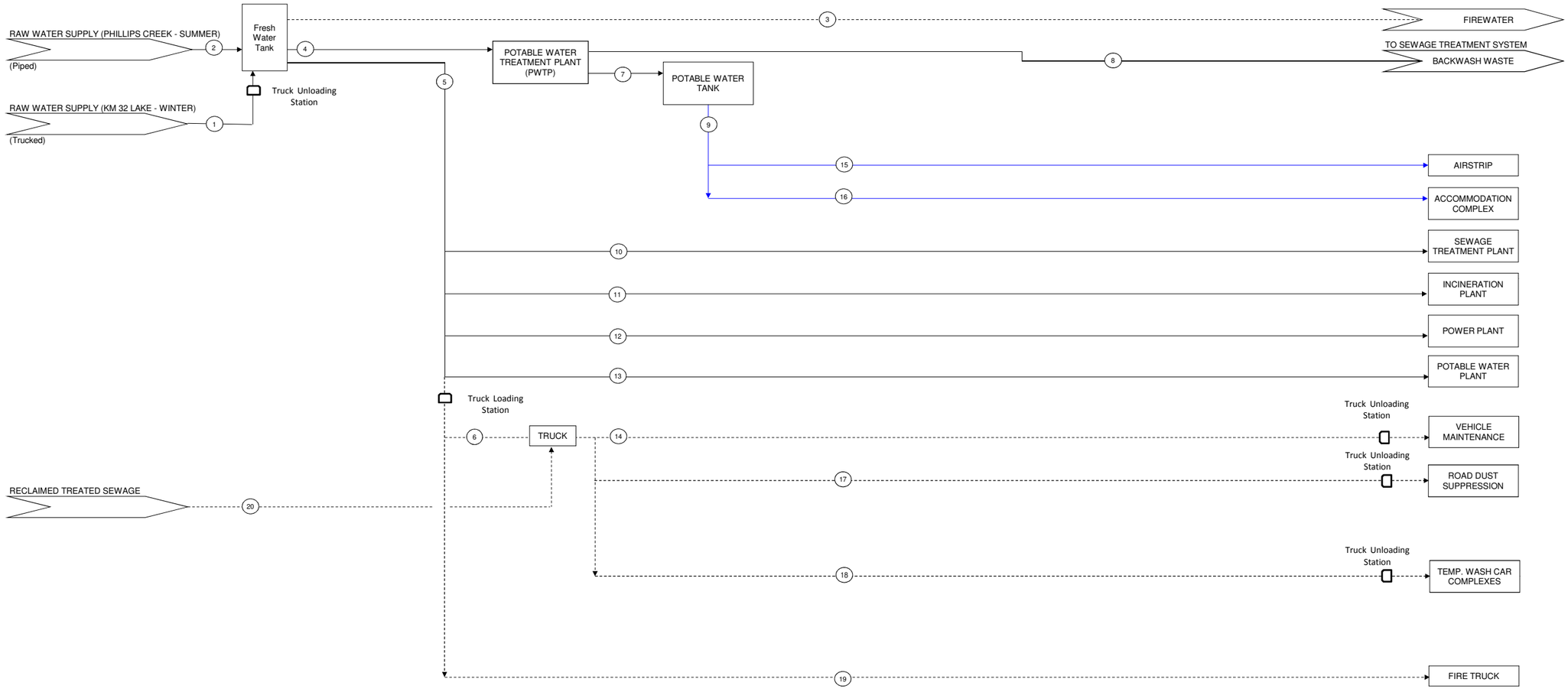
# APPENDIX C - Figures




**NOTES:**

1) The peak flows for the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Bottled water distribution by pickup truck is not shown but will be in use to provide potable water to some remote facilities.

LEGEND:

———— CONTINUOUS FLOW.

---------- INTERMITTENT FLOW.

| Stream No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Stream Description | WINTER RAW WATER SUPPLY | SUMMER RAW WATER SUPPLY | FIREWATER | FEED TO POTABLE TREATMENT SYSTEM | PIPED FRESH WATER | TRUCKED FRESH WATER | POTABLE SYSTEM PRODUCT FLOW | POTABLE SYSTEM WASTE FLOW | PIPED POTABLE WATER | WASH WATER TO STP |
| Construction Phase - Design ($m^3/h$) | 5.1 | 5.1 | 300 | 4.2 | 46.9 | 42.9 | 4.2 | 0.0002 | 16.7600 | 1.0000 |
| Construction Phase - Nominal ($m^3/h$) | 4.1 | 4.1 | . | 3.4 | 0.2 | 0.5 | 3.4 | 0.0002 | 3.3600 | 0.0598 |
| Operation Phase - Design ($m^3/h$) | 3.9 | 3.9 | 300 | 3.3 | 4.0 | 42.9 | 3.3 | 0.00016 | 8.34500 | 1.00000 |
| Operation Phase - Nominal ($m^3/h$) | 3.1 | 3.1 | . | 2.6 | 0.2 | 0.2 | 2.6 | 0.00013 | 2.62500 | 0.05983 |

| Stream No. | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|
| Stream Description | WASH WATER TO INCIN. PLANT | WASH WATER TO POWER PLANT | WASH WATER TO PWTP | WASH WATER FOR VEHICLE MAINT. SHOP | POTABLE WATER TO AIRSTRIP | POTABLE WATER TO ACC. COMPLEX | FRESH WATER FOR DUST SUPPRESS | FRESH FOR TEMP. WASH CAR COMPLEXES | FIRETRUCK | RECLAIMED WATER |
| Construction Phase - Design ($m^3/h$) | 1.0 | 1.0 | 1.0 | 42.86 | 0.5 | 16.28 | 42.9 | 42.9 | 42.9 | 42.9 |
| Construction Phase - Nominal ($m^3/h$) | 0.0 | 0.14 | 0.0 | 0.25 | 0.0 | 3.35 | 0.2 | 0.0 | 0.0 | 0.5 |
| Operation Phase - Design ($m^3/h$) | 1.0 | 1.0 | 1.0 | 0.00 | 0.48000 | 7.87 | 42.9 | 42.9 | 42.9 | 42.9 |
| Operation Phase - Nominal ($m^3/h$) | 0.0 | 0.14 | 0.0 | 0.00 | 0.01250 | 2.61 | 0.2 | 0.0 | 0.0 | 0.2 |

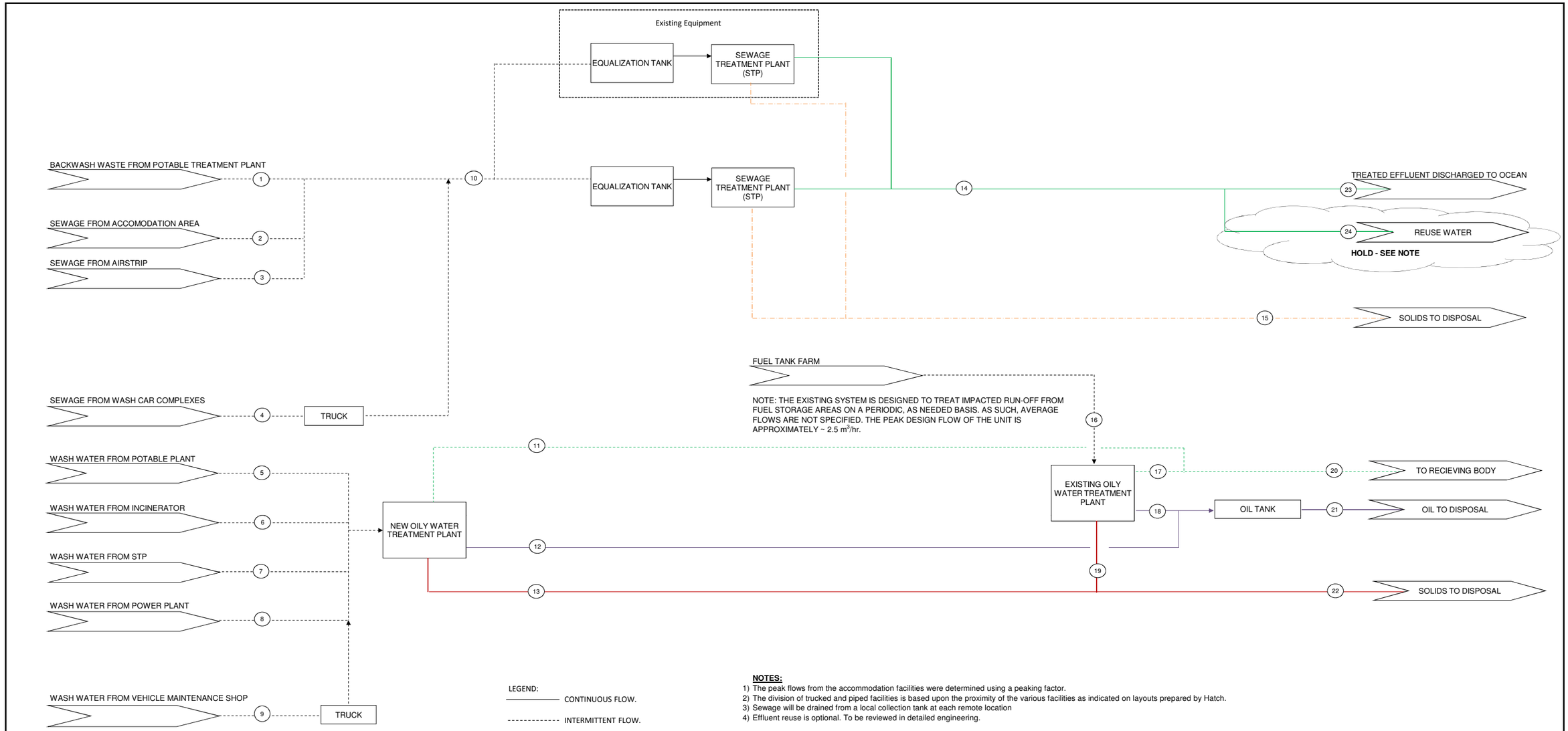
HATCH™ Baffinland Iron Mines Corporation

| | |
|---|---|
| DESIGNED BY R. KAPADIA Date: 12/03/2013 | DRAWN BY R. KAPADIA Date: 12/03/2013 |
| CHECKED BY Date: 12/03/2013 | DISCIP ENGR. R. KAPADIA Date: 12/03/2013 |
| PROJ. DES. COORD. | PROJ. ENGR. Date: 12/03/2013 |
| PROJECT MANAGER Date: 12/03/2013 | |

**MILNE INLET - MARY RIVER PROJECT**
**BLOCK FLOW DIAGRAM**
**WATER SUPPLY BALANCE**

Drawing No. H337697-7000-10-002-0001
SHEET 1 OF 2

Rev. E




**NOTES:**

1) The peak flows from the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Sewage will be drained from a local collection tank at each remote location
4) Effluent reuse is optional. To be reviewed in detailed engineering.

| Stream No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Description | BACKWASH WASTE FROM PWTP | SEWAGE FROM ACC. COMPLEX | SEWAGE FROM AIRSTRIP | SEWAGE FROM WASH CAR COMPLEXES | WASH WATER FROM PWTP | WASH WATER FROM INCIN. PLANT | WASH WATER FROM STP | WASH WATER FROM POWER PLANT | WASH WATER FROM VEHICLE MAINT. | FEED TO STP | NEW WWTP EFFLUENT | NEW WWTP OIL WASTE |
| Construction Phase - Design ($m^3/h$) | 0.0002 | 18.7 | 0.5 | 42.9 | 1.0 | 1.0 | 1.0 | 1.0 | 42.9 | 19.1 | 0.5 | 0.0 |
| Construction Phase - Nominal ($m^3/h$) | 0.0002 | 3.3 | 0.01 | 0.04 | 0.01 | 0.04 | 0.1 | 0.1 | 0.2 | 3.4 | 0.4 | 0.0 |
| Operation Phase - Design ($m^3/h$) | 0.00016 | 9.0 | 0.5 | 42.9 | 1.0 | 1.0 | 1.0 | 1.0 | - | 9.5 | 0.3 | 0.0 |
| Operation Phase - Nominal ($m^3/h$) | 0.00013 | 2.6 | 0.01 | 0.04 | 0.01 | 0.04 | 0.1 | 0.1 | - | 2.6 | 0.2 | 0.0 |

| Stream No. | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Description | NEW WWTP SOLIDS WASTE | STP EFFLUENT | STP SOLIDS TO DISPOSAL | WWTP FEED | WWTP EFFLUENT | WWTP OIL WASTE | WWTP SOLIDS | COMBINED WWTP EFFLUENT | COMBINED WWTP OIL | COMBINED WWTP SOLIDS | STP EFFLUENT TO OCEAN | RECLAIMED WATER |
| Construction Phase - Design ($m^3/h$) | 0.108 | 4.17 | 0.03 | 202.00 | 1.4 | 0.0 | 0.306 | 1.9 | 0.00 | 0.414 | 4.167 | 42.857 |
| Construction Phase - Nominal ($m^3/h$) | 0.087 | 3.33 | 0.03 | 1.40 | 1.2 | 0.0 | 0.245 | 1.6 | 0.00 | 0.332 | 2.877 | 0.457 |
| Operation Phase - Design ($m^3/h$) | 0.0538 | 3.26 | 0.026 | 202.000 | 1.4 | 0.0 | 0.306 | 1.7 | 0.003 | 0.360 | 3.256 | 42.857 |
| Operation Phase - Nominal ($m^3/h$) | 0.0431 | 2.60 | 0.021 | 1.400 | 1.2 | 0.0 | 0.245 | 1.4 | 0.003 | 0.288 | 2.396 | 0.208 |

HATCH™ Baffinland Iron Mines Corporation

| | |
|---|---|
| DESIGNED BY R. KAPADIA Date: 12/03/2013 | DRAWN BY R. KAPADIA Date: 12/03/2013 |
| CHECKED BY Date: 12/03/2013 | DISCIP ENGR. R. KAPADIA Date: 12/03/2013 |
| PROJ. DES. COORD. | PROJ. ENGR. Date: 12/03/2013 |
| PROJECT MANAGER Date: 12/03/2013 | Drawing No. H337697-7000-10-002-0001 SHEET 2 OF 2 |

**MILNE INLET - MARY RIVER PROJECT**
**BLOCK FLOW DIAGRAM**
**WASTE WATER BALANCE**

Rev. E


| Stream No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Stream Description | RAW WATER FEED | PIPED FRESH WATER | FIRE-WATER | FEED TO POTABLE SYSTEM | FEED TO TEMP. PWTP | FEED TO EXISTING PWTP | WASH WATER TO STP | WASH WATER TO INCIN. PLANT | WASH WATER TO SERVICES BLDG. | WASH WATER TO POWER PLANT |
| Construction Phase - Design ($m^3/h$) | 10.3 | 61.2 | 300.0 | 2.6 | 4.9 | 1.88 | 1.00 | 1.0 | 0.0 | 1.0 |
| Construction Phase - Nominal ($m^3/h$) | 8.2 | 8.2 | 0.0 | 2.1 | 3.9 | 1.50 | 0.06 | 0.0 | 0.0 | 0.1 |
| Operation Phase - Design ($m^3/h$) | 4.7 | 62.8 | 300.0 | 2.1 | 0.0 | 1.88 | 1.00 | 1.0 | 11.0 | 1.0 |
| Operation Phase - Nominal ($m^3/h$) | 3.7 | 3.7 | 0.0 | 1.7 | 0.0 | 1.50 | 0.06 | 0.0 | 0.3 | 0.1 |
| Stream No. | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Stream Description | WASH WATER TO BOILER PLANT | WASH WATER TO PWTP | FRESH TO TEMP. STP | FRESH TO TEMP. INCIN. PLANT | FRESH TO TEMP. POWER PLANT | FRESH TO TEMP. PWTP | FRESH WATER FOR FIRE TRUCK | WATER FOR FRESH WATER TRUCK | WATER FOR MINE WATER TRUCK | RECLAIMED WATER |
| Construction Phase - Design ($m^3/h$) | 1.0 | 1.0 | 1.0 | 1.00 | 1.0 | 1.0 | 42.9 | 42.9 | 42.9 | 42.9 |
| Construction Phase - Nominal ($m^3/h$) | 0.0 | 0.01 | 0.06 | 0.04 | 0.1 | 0.0 | 0.00 | 10.5 | 0.0 | 10.3 |
| Operation Phase - Design ($m^3/h$) | 1.0 | 1.0 | 0.0 | 0.00 | 0.0 | 0.0 | 42.9 | 42.9 | 42.9 | 42.9 |
| Operation Phase - Nominal ($m^3/h$) | 0.0 | 0.01 | 0.00 | 0.00 | 0.0 | 0.00 | 0.00 | 1.52 | 0.00 | 1.52 |

**NOTES:**

1) The peak flows for the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Bottled water distribution by pickup truck is not shown but will be in use to provide potable water to some remote facilities.

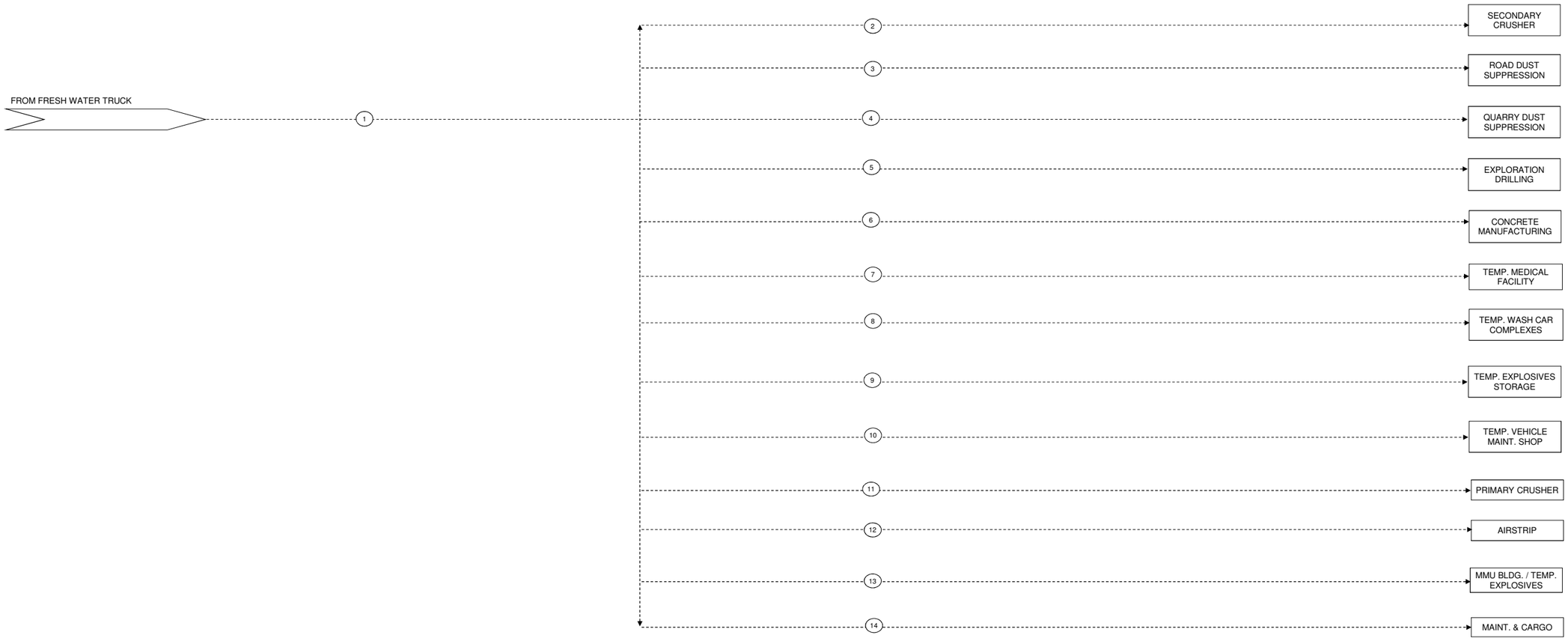
HATCH™ Baffinland Iron Mines Corporation

| | |
|---|---|
| DESIGNED BY R. KAPADIA Date: 12/03/2013 | DRAWN BY R. KAPADIA Date: 12/03/2013 |
| CHECKED BY Date: 12/03/2013 | DISCIP ENGR. R. KAPADIA Date: 12/03/2013 |
| PROJ. DES. COORD. | PROJ. ENGR. Date: 12/03/2013 |
| PROJECT MANAGER Date: 12/03/2013 | |

**MINE SITE - MARY RIVER PROJECT**
**BLOCK FLOW DIAGRAM**
**WATER SUPPLY BALANCE**

Drawing No. H337697-4210-10-002-0001
SHEET 1 OF 5

Rev. H




LEGEND:

---------- CONTINUOUS FLOW.

_____ INTERMITTENT FLOW.

**NOTES:**

1) The peak flows for the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Dust suppression will occur in summer period only.

| Stream No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Stream Description | TRUCKED FRESH WATER | FRESH TO SECONDARY CRUSHER | FRESH FOR ROAD DUST SUPPRESS | FRESH FOR QUARRY DUST SUPPRESS | FRESH FOR EXPLORATION DRILLING | FRESH FOR CONCRETE MFG. | FRESH FOR TEMP. MEDICAL FACILITY |
| Construction Phase - Design ($m^3/h$) | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 |
| Construction Phase - Nominal ($m^3/h$) | 10.5 | 0.0 | 0.4 | - | 8.2 | 0.8 | 0.1 |
| Operation Phase - Design ($m^3/h$) | 42.9 | 42.9 | 42.9 | 42.9 | - | - | - |
| Operation Phase - Nominal ($m^3/h$) | 1.5 | 0.04 | 0.4 | - | - | - | - |
| Stream No. | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Stream Description | FRESH FOR TEMP. WASH CAR COMPLEXES | FRESH FOR TEMP. EXPLOSIVES | FRESH FOR TEMP. VEHICLE MAINT. SHOP | FRESH WATER FOR PRIMARY CRUSHER | FRESH WATER FOR AIRSTRIP | FRESH WATER FOR MMU BLDG. | FRESH WATER FOR MAINT. & CARGO BLDG. |
| Construction Phase - Design ($m^3/h$) | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 |
| Construction Phase - Nominal ($m^3/h$) | 0.2 | 0.5 | 0.3 | 0.05 | 0.16 | 0.00 | 0.01 |
| Operation Phase - Design ($m^3/h$) | - | - | - | 42.9 | 42.9 | 42.9 | 42.9 |
| Operation Phase - Nominal ($m^3/h$) | - | - | - | 0.05 | 0.16 | 0.84 | 0.01 |

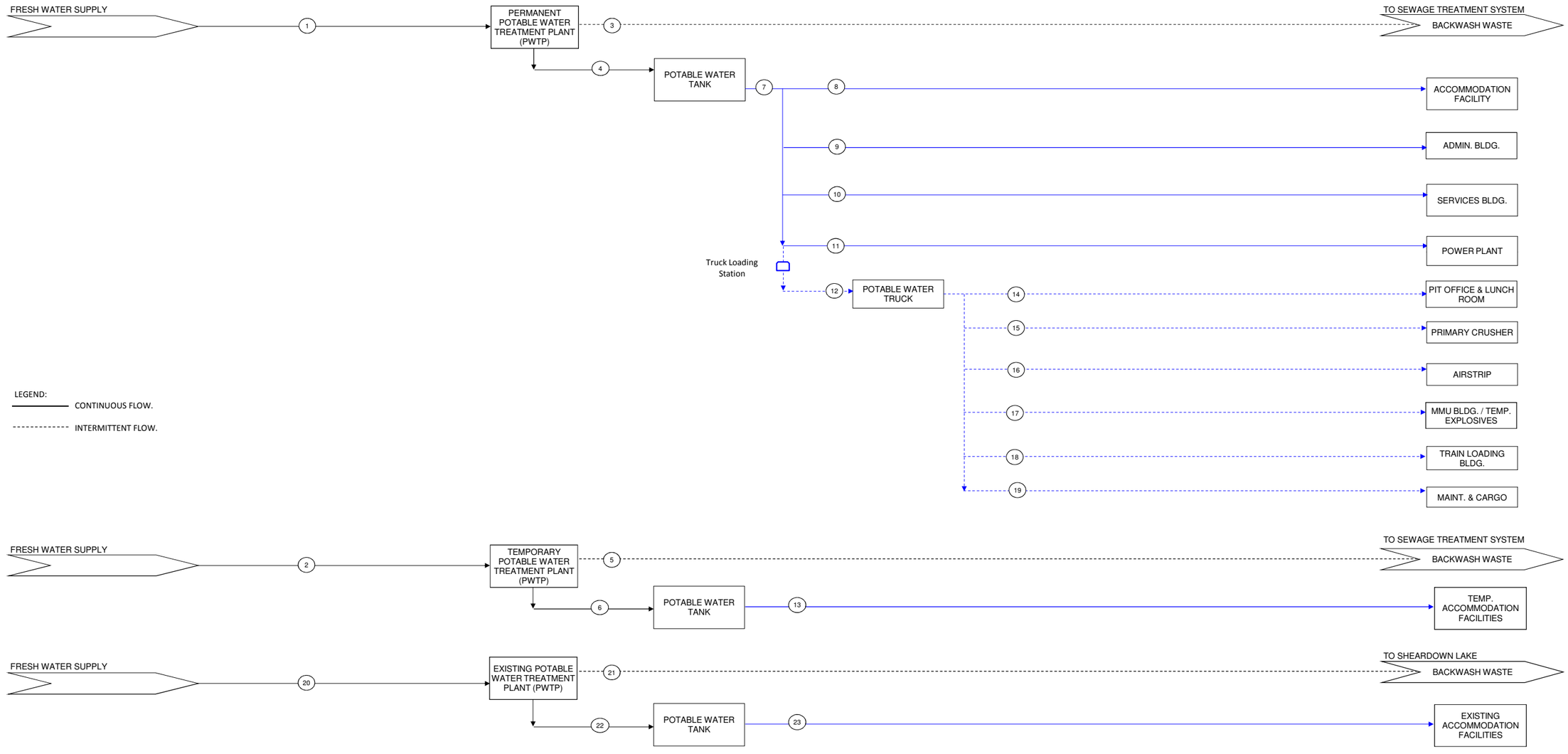
HATCH™ Baffinland Iron Mines Corporation

| | |
|---|---|
| DESIGNED BY R. KAPADIA Date: 12/03/2013 | DRAWN BY R. KAPADIA Date: 12/03/2013 |
| CHECKED BY Date: 12/03/2013 | DISCIP ENGR. R. KAPADIA Date: 12/03/2013 |
| PROJ. DES. COORD. | PROJ. ENGR. Date: 12/03/2013 |
| PROJECT MANAGER Date: 12/03/2013 | |

**MINE SITE - MARY RIVER PROJECT**
**BLOCK FLOW DIAGRAM**
**WATER SUPPLY BALANCE**

Drawing No.
H337697-4210-10-002-0001
SHEET 2 OF 5

Rev.
H




| Stream No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Description | FEED TO POTABLE SYSTEM | FEED TO TEMP. PWTP | POTABLE SYSTEM WASTE FLOW | POTABLE SYSTEM PRODUCT FLOW | WASTE FROM TEMP. PWTP | PRODUCT FROM TEMP. PWTP | PIPED POTABLE WATER | POTABLE FOR ACC. COMPLEX | POTABLE FOR ADMIN. BLDG. | POTABLE FOR SERVICES BLDG. | POTABLE FOR POWER PLANT |
| Construction Phase - Design ($m^3/h$) | 2.6 | 4.9 | 0.0 | 2.6 | 0.0 | 4.88 | 82.85 | 33.8 | 1.9 | 3.8 | 0.5 |
| Construction Phase - Nominal ($m^3/h$) | 2.1 | 3.9 | 0.0 | 2.1 | 0.0 | 3.90 | 2.10 | 0.5 | 0.3 | 0.6 | 0.0 |
| Operation Phase - Design ($m^3/h$) | 2.1 | 0.0 | 0.0 | 2.1 | 0.0 | 0.00 | 80.93 | 33.8 | 1.9 | 1.9 | 0.5 |
| Operation Phase - Nominal ($m^3/h$) | 1.7 | - | 0.0 | 1.7 | 0.0 | 0.00 | 1.68 | 1.0 | 0.3 | 0.3 | 0.0 |

| Stream No. | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Description | TRUCKED POTABLE WATER | POTABLE WATER TO TEMP. ACC. COMPLEX | POTABLE FOR PIT OFFICE | POTABLE FOR PRIMARY CRUSHER | POTABLE FOR AIRSTRIP | POTABLE FOR MMU BLDG. | POTABLE FOR TRAIN LOADING BLDG. | POTABLE FOR MAINT. & CARGO | FEED TO EXIST. PWTP | WASTE FROM EXIST. PWTP | EXIST. PWTP PRODUCT | POTABLE TO EXIST. ACC. |
| Construction Phase - Design ($m^3/h$) | 42.9 | 33.8 | 42.9 | 42.86 | 42.9 | 42.9 | 42.86 | 42.9 | 1.9 | 0.0 | 1.9 | 9.0 |
| Construction Phase - Nominal ($m^3/h$) | 0.7 | 3.90 | 0.18 | 0.02 | 0.3 | 0.1 | 0.02 | 0.0 | 1.5 | 0.0 | 1.5 | 1.5 |
| Operation Phase - Design ($m^3/h$) | 42.9 | 0.0 | 42.9 | 42.86 | 42.9 | 42.9 | 42.86 | 42.9 | 1.9 | 0.0 | 1.9 | 9.0 |
| Operation Phase - Nominal ($m^3/h$) | 0.1 | 0.00 | 0.02 | 0.01 | 0.0 | 0.01 | 0.01 | 0.00 | 1.50 | 0.00 | 1.50 | 1.50 |

**NOTES:**

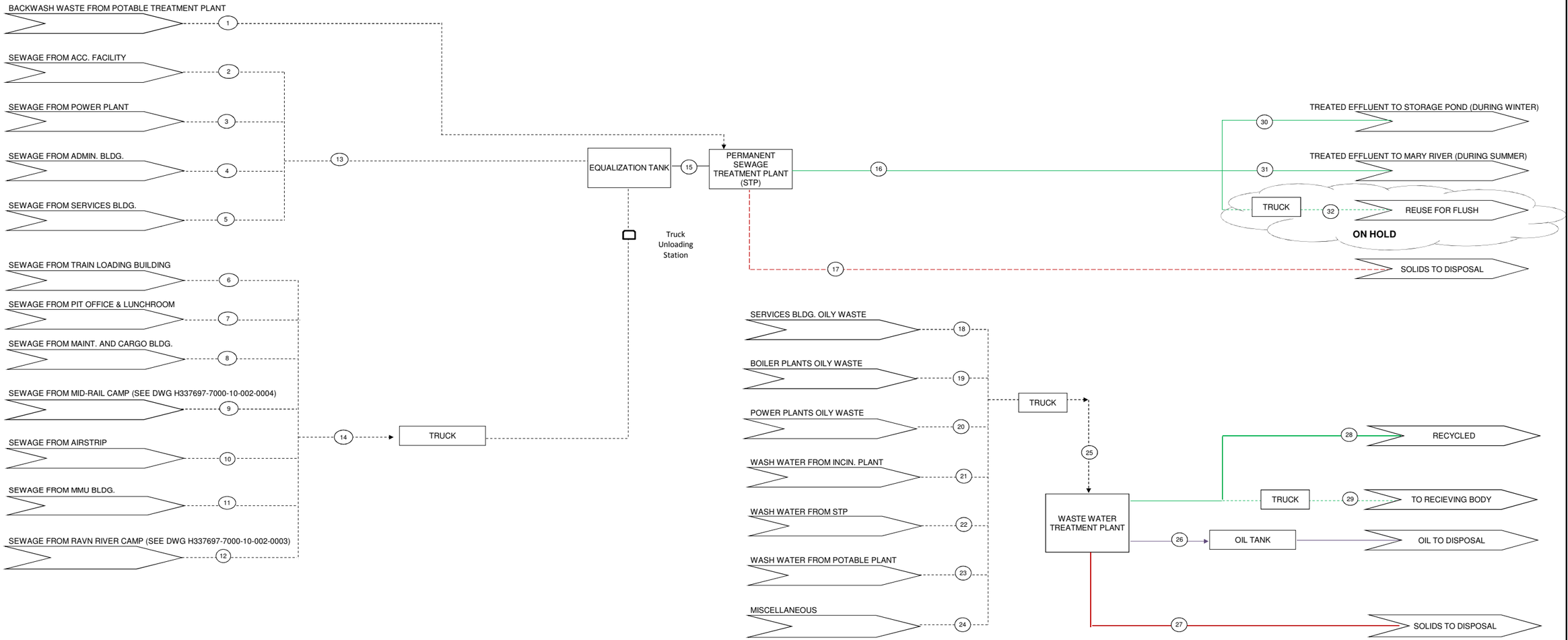
1) The peak flows for the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Bottled water distribution by pickup truck is not shown but will be in use to provide potable water to some remote facilities.

HATCH™ Baffinland Iron Mines Corporation

| | |
|---|---|
| DESIGNED BY R. KAPADIA Date: 12/03/2013 | DRAWN BY R. KAPADIA Date: 12/03/2013 |
| CHECKED BY Date: 12/03/2013 | DISCIP ENGR. R. KAPADIA Date: 12/03/2013 |
| PROJ. DES. COORD. | PROJ. ENGR. Date: 12/03/2013 |
| PROJECT MANAGER Date: 12/03/2013 | Drawing No. H337697-4210-10-002-0001 SHEET 3 of 5 |

**MINE SITE - MARY RIVER PROJECT**
**BLOCK FLOW DIAGRAM**
**WATER SUPPLY BALANCE**

Rev. H




| Stream No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Description | BACKWASH WASTE FROM PWTP | SEWAGE FROM ACC. COMPLEX | SEWAGE FROM POWER PLANT | SEWAGE FROM ADMIN. BLDG. | SEWAGE FROM SERVICES BLDG. | SEWAGE FROM TRAIN LOADING BLDG. | SEWAGE FROM PIT OFFICE & LUNCHROOM | SEWAGE FROM MAINT. AND CARGO BLDG. | SEWAGE FROM MID-RAIL CAMP | SEWAGE FROM AIRSTRIP | SEWAGE FROM MMU BLDG. | SEWAGE FROM RAVN RIVER CAMP | PIPED SEWAGE | TRUCKED SEWAGE | FEED TO STP | TREATED EFFLUENT |
| Construction Phase - Design ($m^3/h$) | 0.001 | 40.5 | 0.5 | 1.9 | 3.8 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 46.7 | 42.9 | 11.3 | 11.2 |
| Construction Phase - Nominal ($m^3/h$) | 0.000 | 1.4 | 0.0 | 0.3 | 0.6 | 0.0 | 0.2 | 0.01 | 3.0 | 0.3 | 0.12 | 3.0 | 2.4 | 6.6 | 9.0 | 8.9 |
| Operation Phase - Design ($m^3/h$) | 0.000 | 40.5 | 0.5 | 1.9 | 1.9 | 42.9 | 42.9 | 42.9 | - | 42.9 | 42.9 | - | 44.8 | 42.9 | 6.0 | 6.0 |
| Operation Phase - Nominal ($m^3/h$) | 0.000 | 4.1 | 0.0 | 0.3 | 0.3 | 0.01 | 0.02 | - | - | 0.01 | 0.01 | - | 4.75 | 0.05 | 4.80 | 4.76 |

| Stream No. | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Description | STP SOLIDS TO DISPOSAL | MAINT. SHOP - OILY WASTE | BOILER PLANT - OILY WASTE | POWER PLANT - OILY WASTE | WASH WATER FROM INCIN. PLANT | WASH WATER FROM STP | WASH WATER FROM PWTP | MISC. OILY WASTE | TOTAL FEED TO WWTP | OIL TO DISPOSAL | WWTP SOLIDS TO DISPOSAL | RECYCLED WASH WATER | WWTP EFFLUENT TO DISPOSAL | EFFLUENT TO STORAGE POND | STP EFFLUENT TO MARY RIVER | STP EFFLUENT FOR REUSE |
| Construction Phase - Design ($m^3/h$) | n/a | - | 42.9 | 42.85714 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 0.0005 | n/a | 0.2382 | 0.060 | 11.2 | 11.2 | 42.9 |
| Construction Phase - Nominal ($m^3/h$) | 0.1 | - | 0.01 | 0.14768 | 0.04 | 0.1 | 0.01 | 0.03 | 0.29 | 0.0005 | 0.05 | 0.1906 | 0.048 | 1.68 | 0.84 | 6.41 |
| Operation Phase - Design ($m^3/h$) | n/a | 11.0 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.86 | 42.9 | 0.0009 | n/a | 0.491 | 0.123 | 6.0 | 6.0 | 42.9 |
| Operation Phase - Nominal ($m^3/h$) | 0.0 | 0.3 | 0.01 | 0.1 | 0.04 | 0.06 | 0.01 | 0.05 | 0.6 | 0.0009 | 0.10 | 0.393 | 0.098 | 2.2 | 1.1 | 1.5 |

**NOTES:**

1) The peak flows from the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Sewage will be drained from a local collection tank at each remote location
4) Effluent reuse is optional. To be reviewed in detailed engineering.
5) Miscellaneous refers to potential oily water flow from the bermed tank farm areas only if sampling indicates that additional treatment of this run-off is necessary.
6) The explosives plant will come complete with it's own evaporation system such that no liquid waste will be generated.

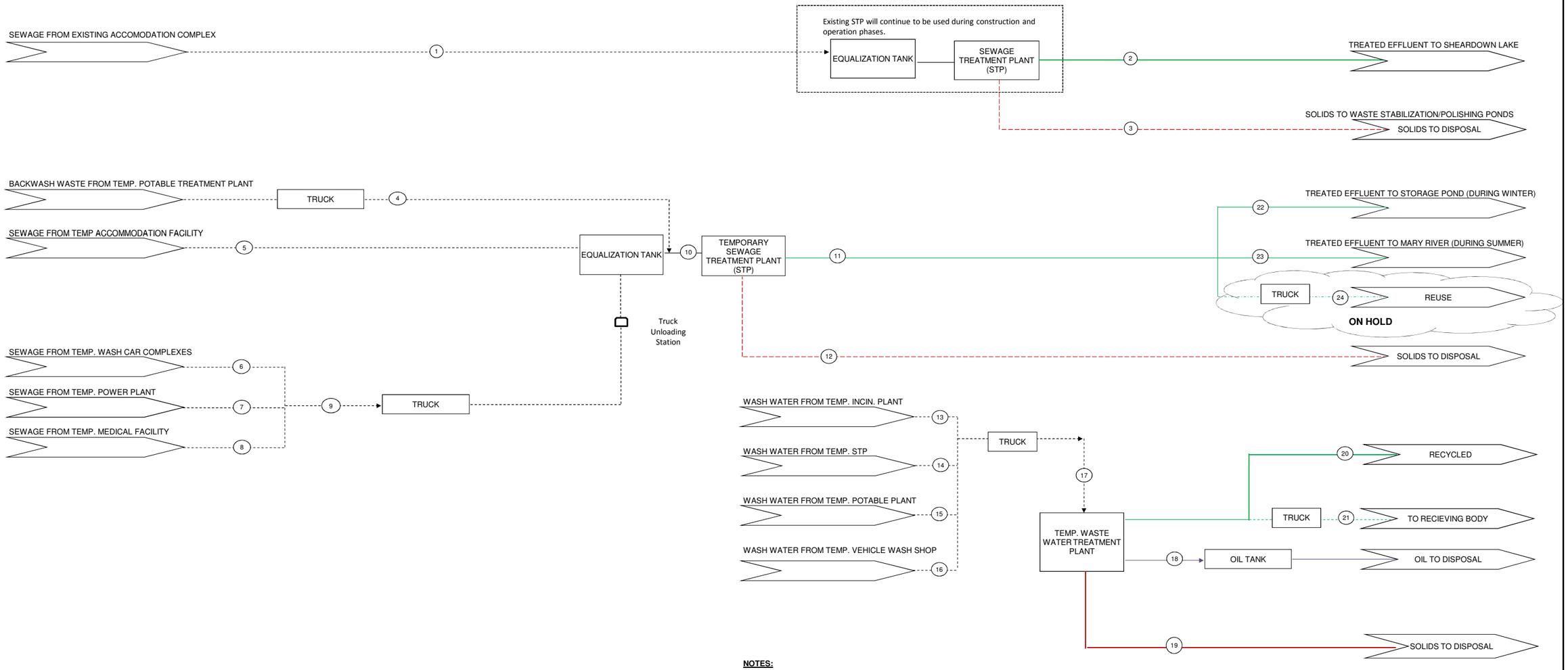
HATCH™ | Baffinland Iron Mines Corporation

| | |
|---|---|
| DESIGNED BY R. KAPADIA Date: 12/03/2013 | DRAWN BY R. KAPADIA Date: 12/03/2013 |
| CHECKED BY Date: 12/03/2013 | DISCIP ENGR. R. KAPADIA Date: 12/03/2013 |
| PROJ. DES. COORD. | PROJ. ENGR. Date: 12/03/2013 |
| PROJECT MANAGER Date: 12/03/2013 | |

**MINE SITE - MARY RIVER PROJECT**
**BLOCK FLOW DIAGRAM**
**WASTE WATER BALANCE**

Drawing No. H337697-4210-10-002-0001
SHEET 4 of 5

Rev. G




**NOTES:**

1) The peak flows from the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Sewage will be drained from a local collection tank at each remote location
4) Effluent reuse is optional. To be reviewed in detailed engineering.
5) Miscellaneous refers to potential oily water flow from the bermed tank farm areas only if sampling indicates that additional treatment of this run-off is necessary.
6) The explosives plant will come complete with it's own evaporation system such that no liquid waste will be generated.

| Stream No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Description | SEWAGE FROM EXIST. ACC. | EXIST. STP EFFLUENT | EXIST. STP SOLID WASTE | BACKWASH FROM TEMP. PWTP | SEWAGE FROM TEMP. ACC. COMPLEX | SEWAGE FROM WASH CAR COMPLEX 001 | SEWAGE FROM TEMP. POWER PLANT | SEWAGE FROM TEMP. MEDICAL FACILITY | TRUCKED SEWAGE | FEED TO STP | TREATED EFFLUENT | SOLIDS TO DISPOSAL |
| Construction Phase - Design ($m^3/h$) | 9.0 | 1.9 | n/a | 42.86 | 40.5 | 42.9 | 42.9 | 42.9 | 42.9 | 4.9 | 4.9 | n/a |
| Construction Phase - Nominal ($m^3/h$) | 1.50 | 1.5 | 0.01 | 0.001 | 3.90 | 0.16 | 0.02 | 0.02 | 0.05 | 3.95 | 3.92 | 0.03 |
| Operation Phase - Design ($m^3/h$) | 9.0 | 1.9 | n/a | - | - | - | - | - | - | - | - | - |
| Operation Phase - Nominal ($m^3/h$) | 1.50 | 1.5 | 0.01 | - | - | - | - | - | - | - | - | - |

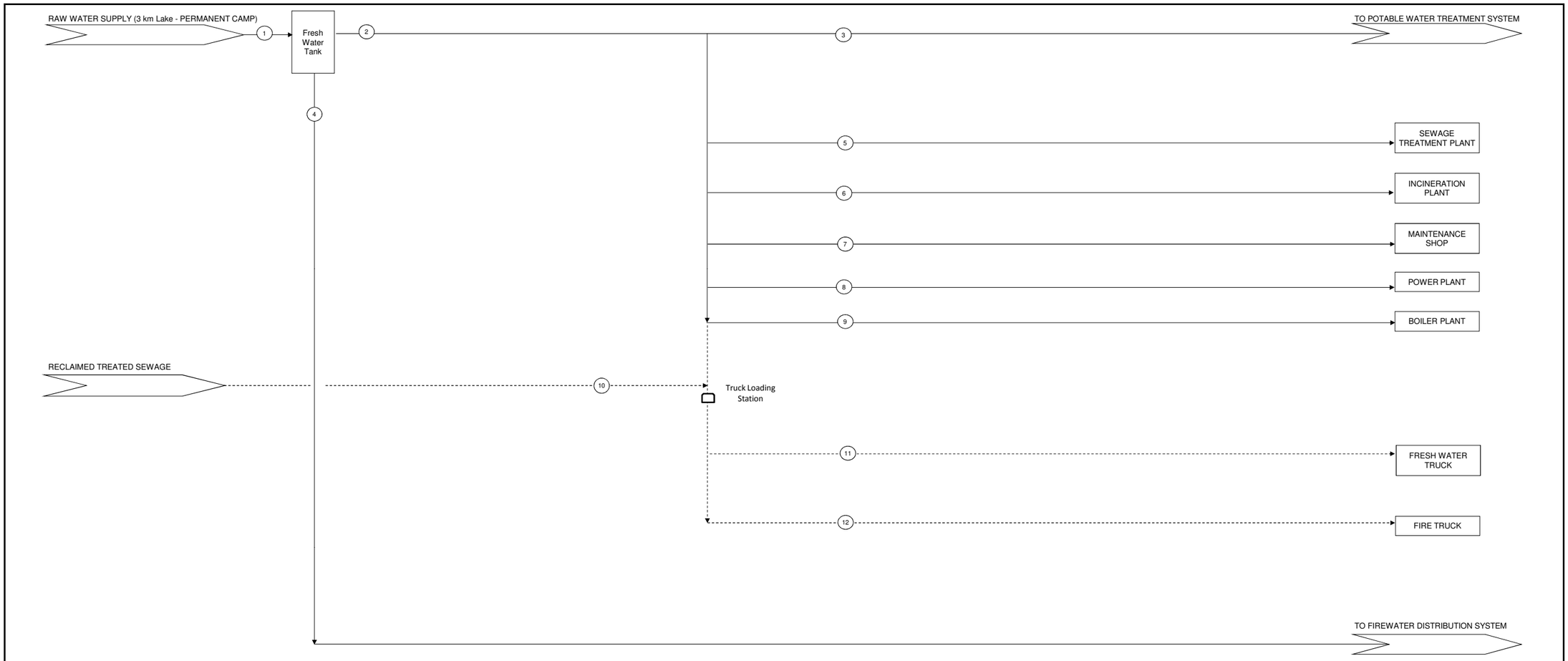
| Stream No. | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Description | WASH WATER FROM TEMP. INCIN. PLANT | WASH WATER FROM TEMP. STP | WASH WATER FROM TEMP. PWTP | WASH WATER FROM TEMP. VEHICLE WASH | FEED TO WWTP | WWTP OILY WASTE | WWTP SOLIDS WASTE | RECYCLED EFFLUENT | TO MARY RIVER OR STORAGE POND | EFFLUENT TO STORAGE POND | STP EFFLUENT TO MARY RIVER | STP EFFLUENT FOR REUSE |
| Construction Phase - Design ($m^3/h$) | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 0.001 | 0.064 | 0.4 | 0.00 | 4.9 | 4.9 | 42.9 |
| Construction Phase - Nominal ($m^3/h$) | 0.04 | 0.06 | 0.01 | 0.26 | 0.4 | 0.001 | 0.064 | 0.3 | 0.00 | 0.00 | 0.00 | 3.9 |
| Operation Phase - Design ($m^3/h$) | - | - | - | - | - | - | - | - | - | - | - | - |
| Operation Phase - Nominal ($m^3/h$) | - | - | - | - | - | - | - | - | - | - | - | - |

HATCH™ | Baffinland Iron Mines Corporation

| | |
|---|---|
| DESIGNED BY R. KAPADIA Date: 12/03/2013 | DRAWN BY R. KAPADIA Date: 12/03/2013 |
| CHECKED BY Date: 12/03/2013 | DISCIP ENGR. R. KAPADIA Date: 12/03/2013 |
| PROJ. DES. COORD. | PROJ. ENGR. Date: 12/03/2013 |
| PROJECT MANAGER Date: 12/03/2013 | Drawing No. H337697-4210-10-002-0001 SHEET 5 of 5 |

**MINE SITE - MARY RIVER PROJECT**
**BLOCK FLOW DIAGRAM**
**WASTE WATER BALANCE**

Rev. G




LEGEND:

CONTINUOUS FLOW.

INTERMITTENT FLOW.

**NOTES:**

1) The peak flows for the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Bottled water distribution by pickup truck is not shown but will be in use to provide potable water to some remote facilities.

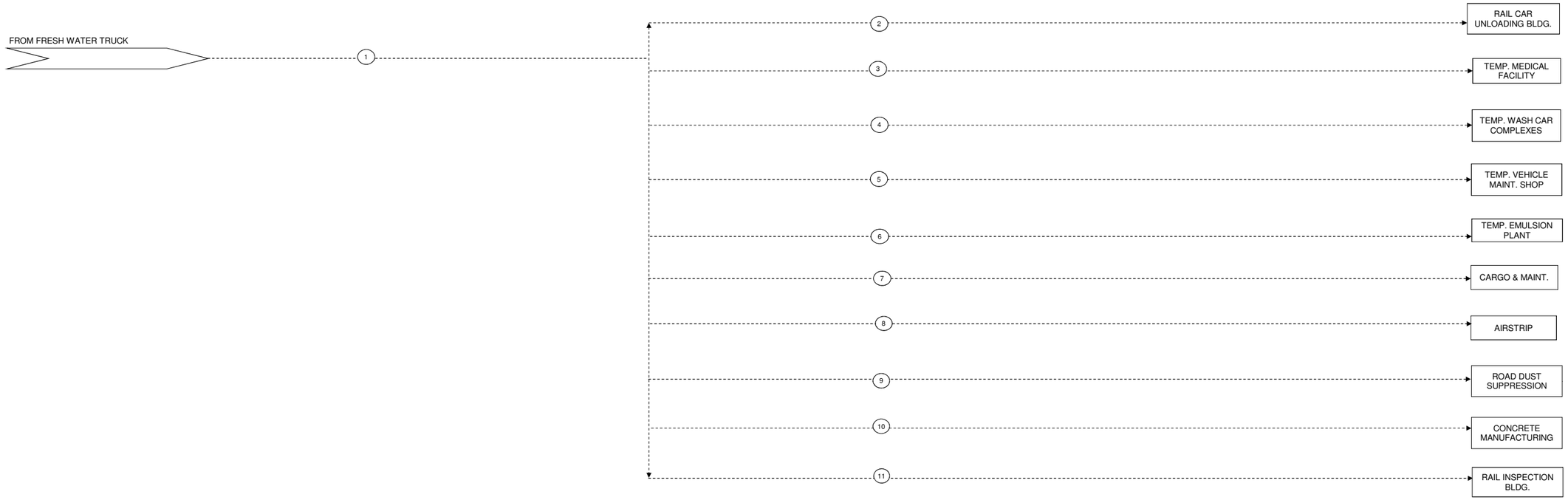
| Stream No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Stream Description | RAW WATER SUPPLY | PIPED FRESH WATER | FEED TO PWTP | FIREWATER | WASH WATER TO STP | WASH WATER TO INCIN. PLANT |
| Construction Phase - Design ($m^3/h$) | 6.5 | 10.6 | 6.6 | 300.0 | 1.0 | 1.0 |
| Construction Phase - Nominal ($m^3/h$) | 5.2 | 5.2 | 4.5 | 0.0 | 0.0 | 0.0 |
| Operation Phase - Design ($m^3/h$) | 7.1 | 21.6 | 6.6 | 300.0 | 1.0 | 1.0 |
| Operation Phase - Nominal ($m^3/h$) | 5.7 | 5.7 | 4.5 | 0.0 | 0.0 | 0.0 |
| Stream No. | 7 | 8 | 9 | 10 | 11 | 12 |
| Stream Description | WASH WATER TO MAINTENACE SHOP | WASH WATER TO POWER PLANT | WASH WATER TO BOILER PLANT | RECLAIMED WATER | TRUCKED FRESH WATER | FIRE TRUCK WATER |
| Construction Phase - Design ($m^3/h$) | 0.0 | 1.0 | 1.00 | 42.86 | 42.9 | 42.9 |
| Construction Phase - Nominal ($m^3/h$) | 0.0 | 0.1 | 0.01 | 2.54 | 3.0 | 0.00 |
| Operation Phase - Design ($m^3/h$) | 11.0 | 1.0 | 1.00 | 42.86 | 42.9 | 42.9 |
| Operation Phase - Nominal ($m^3/h$) | 0.7 | 0.1 | 0.01 | 0.00 | 0.3 | 0.00 |

HATCH™ Baffinland Iron Mines Corporation

| | |
|---|---|
| DESIGNED BY R. KAPADIA Date: 12/21/2011 | DRAWN BY R. KAPADIA Date: 12/21/2011 |
| CHECKED BY R. RADAKOVIC Date: 12/21/2011 | DISCIP ENGR. R. KAPADIA Date: 12/21/2011 |
| PROJ. DES. COORD. | PROJ. ENGR. J. CASSON Date: 12/21/2011 |
| PROJECT MANAGER H. CHARALAMBU Date: 12/21/2011 | Drawing No. H337697-4510-10-002-0001 SHEET 1 OF 5 |

**STEENSBY - MARY RIVER PROJECT**
**BLOCK FLOW DIAGRAM**
**PERMANENT CAMP - WATER SUPPLY BALANCE**

Rev. F




LEGEND:

CONTINUOUS FLOW.

INTERMITTENT FLOW.

**NOTES:**

1) The peak flows for the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Bottled water distribution by pickup truck is not shown but will be in use to provide potable water to some remote facilities.

| Stream No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Description | FROM FRESH WATER TRUCK | FRESH WATER TO RAIL CAR UNLOAD BLDG. | FRESH TO TEMP. MEDICAL FACILITY | FRESH TO TEMP. WASH CAR | FRESH TO TEMP. VEHICLE SHOP | FRESH TO EMULSION PLANT | FRESH TO CARGO & MAINT. BLDG. | FRESH TO AIRSTRIP | FRESH FOR ROAD DUST SUPPRESS | FRESH FOR CONCRETE MFG. | FRESH FOR RAIL INSPECTION BLDG. |
| Construction Phase - Design ($m^3/h$) | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 |
| Construction Phase - Nominal ($m^3/h$) | 3.01 | 0.01 | 0.0 | 0.1 | 1.1 | 0.5 | 0.0 | 0.0 | 0.1 | 0.9 | 0.1 |
| Operation Phase - Design ($m^3/h$) | 42.9 | 42.9 | - | - | - | - | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 |
| Operation Phase - Nominal ($m^3/h$) | 0.33 | 0.01 | 0.04 | - | - | - | 0.01 | 0.01 | 0.13 | - | 0.12 |

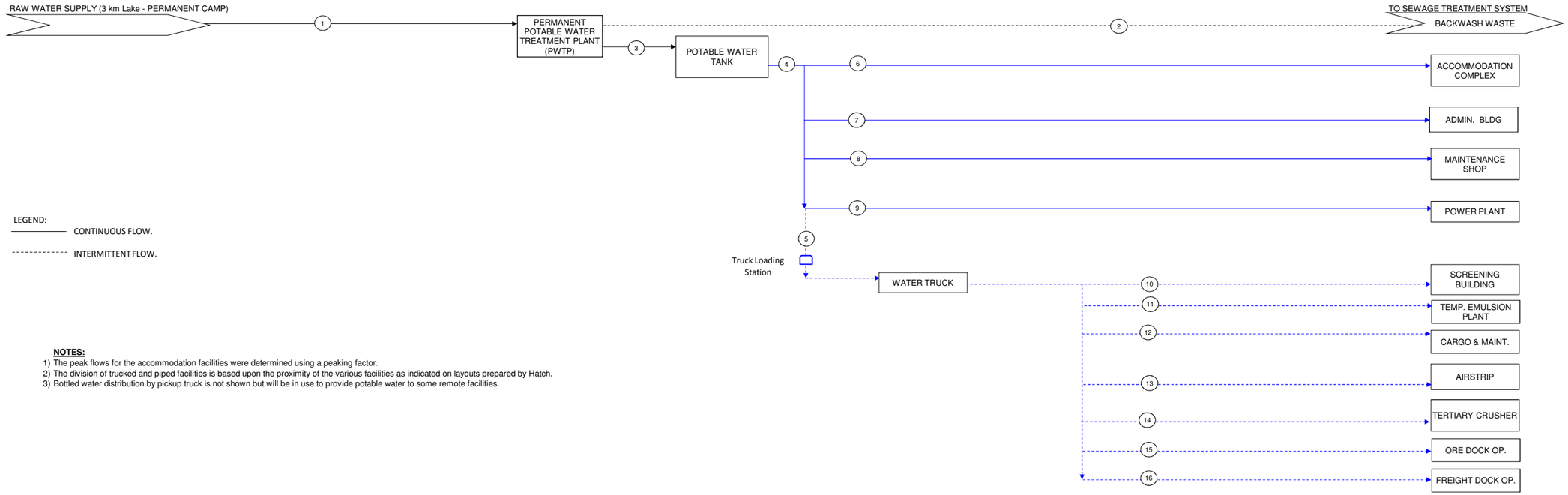
HATCH™ Baffinland Iron Mines Corporation

| | |
|---|---|
| DESIGNED BY R. KAPADIA Date: 12/21/2011 | DRAWN BY R. KAPADIA Date: 12/21/2011 |
| CHECKED BY R. RADAKOVIC Date: 12/21/2011 | DISCIP ENGR. R. KAPADIA Date: 12/21/2011 |
| PROJ. DES. COORD. | PROJ. ENGR. J. CASSON Date: 12/21/2011 |
| PROJECT MANAGER H. CHARALAMBU Date: 12/21/2011 | |

**STEENSBY - MARY RIVER PROJECT**
**BLOCK FLOW DIAGRAM**
**TEMPORARY CAMP - WATER SUPPLY BALANCE**

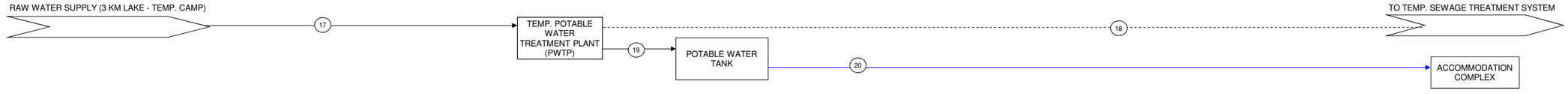
Drawing No. H337697-4510-10-002-0001
SHEET 2 OF 5

Rev. F




**NOTES:**

1) The peak flows for the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Bottled water distribution by pickup truck is not shown but will be in use to provide potable water to some remote facilities.




| Stream No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Stream Description | FEED TO PWTP | WASTE FROM PWTP | PRODUCT FROM PWTP | PIPED POTABLE WATER | TRUCKED POTABLE WATER | POTABLE TO ACC. COMPLEX | POTABLE TO ADMIN. BLDG. | POTABLE TO MAINTENANCE SHOP | POTABLE TO POWER PLANT | POTABLE TO SCREENING BLDG. |
| Construction Phase - Design ($m^3/h$) | 6.6 | 0.003 | 5.6 | 72.8 | 42.9 | 22.3 | 3.8 | 3.8 | - | 42.9 |
| Construction Phase - Nominal ($m^3/h$) | 4.5 | 0.002 | 4.5 | 4.5 | 0.8 | 0.9 | 1.3 | 1.5 | - | 0.1 |
| Operation Phase - Design ($m^3/h$) | 6.6 | 0.003 | 5.6 | 61.5 | 42.9 | 14.9 | 1.4 | 1.9 | 0.5 | 42.9 |
| Operation Phase - Nominal ($m^3/h$) | 4.5 | 0.002 | 4.5 | 4.5 | 0.2 | 3.1 | 0.4 | 0.7 | 0.1 | 0.1 |
| Stream No. | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Stream Description | POTABLE TO EMULSION PLANT | POTABLE TO CARGO & MAINT. BLDG. | POTABLE TO AIRSTRIP | POTABLE TO TERTIARY CRUSHER | POTABLE TO ORE DOCK OP. | POTABLE TO FREIGHT DOCK OP. | FEED TO TEMP. PWTP | WASTE FROM TEMP. PWTP | PRODUCT FROM TEMP. PWTP | POTABLE TO TEMP. ACC. COMPLEX |
| Construction Phase - Design ($m^3/h$) | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 27.0 | 0.003 | 27.00 | 27.00 |
| Construction Phase - Nominal ($m^3/h$) | 0.3 | 0.03 | 0.05 | 0.05 | 0.2 | 0.2 | 4.5 | 0.002 | 4.50 | 4.50 |
| Operation Phase - Design ($m^3/h$) | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 0.0 | 0.000 | 0.00 | 0.00 |
| Operation Phase - Nominal ($m^3/h$) | 0.03 | - | 0.001 | 0.05 | 0.04 | 0.0 | 0.0 | 0.000 | 0.00 | 0.00 |

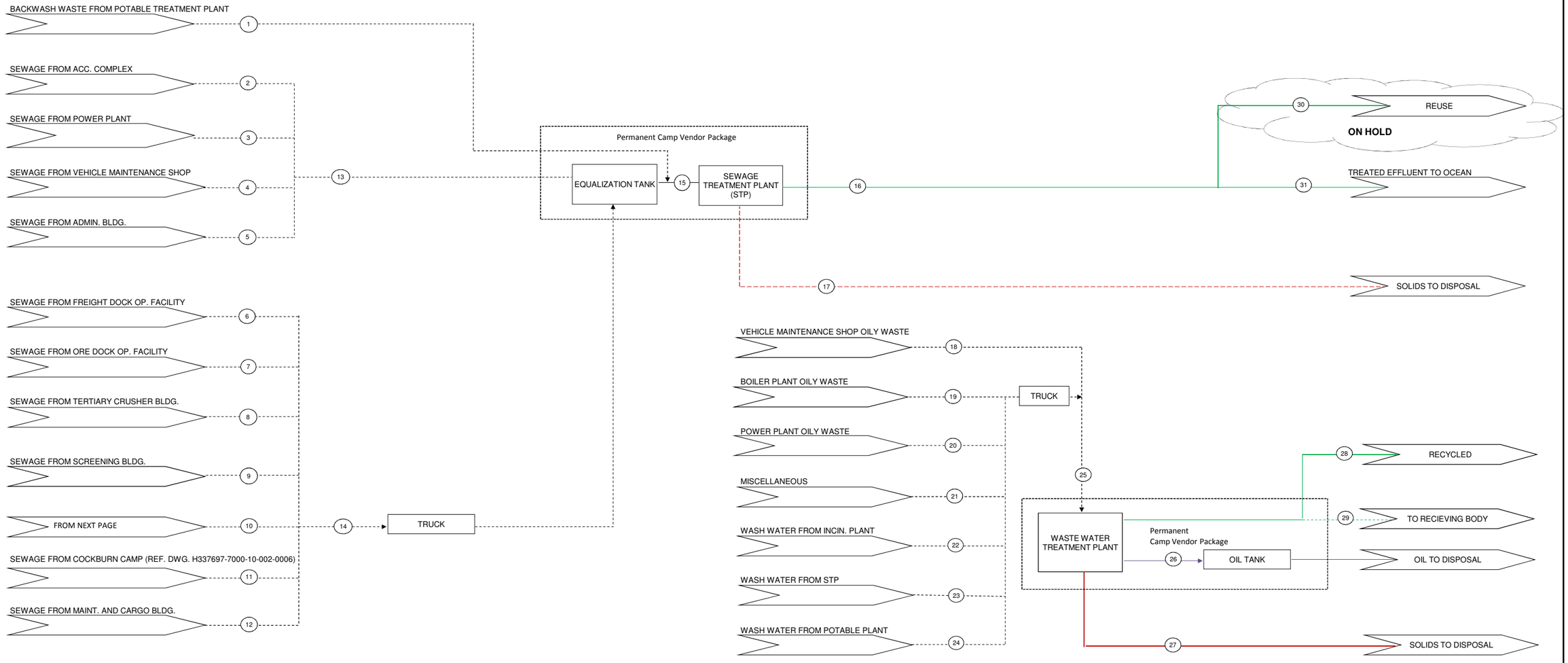
HATCH™ Baffinland Iron Mines Corporation

| | |
|---|---|
| DESIGNED BY: R. KAPADIA Date: 12/21/2011 | DRAWN BY: R. KAPADIA Date: 12/21/2011 |
| CHECKED BY: R. RADAKOVIC Date: 12/21/2011 | DISCIP ENGR.: R. KAPADIA Date: 12/21/2011 |
| PROJ. DES. COORD. | PROJ. ENGR.: J. CASSON Date: 12/21/2011 |
| PROJECT MANAGER: H. CHARALAMBU Date: 12/21/2011 | |

**STEENSBY - MARY RIVER PROJECT**
**BLOCK FLOW DIAGRAM**
**PERMANENT CAMP - WATER SUPPLY BALANCE**

Drawing No. H337697-4510-10-002-0001
SHEET 3 OF 5

Rev. F




**NOTES:**

1) The peak flows from the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Sewage will be drained from a local collection tank at each remote location
4) Effluent reuse is optional. To be reviewed in detailed engineering.
5) Miscellaneous refers to potential oily water flow from the bermed tank farm areas and fuel refilling station run-off only if sampling indicates that additional treatment of this run-off is necessary.
6) The explosives plant will come complete with it's own evaporation system such that no liquid waste will be generated.

| Stream No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Description | BACKWASH WASTE FROM PWTP | SEWAGE FROM ACC. COMPLEX | SEWAGE FROM POWER PLANT | SEWAGE FROM VEHICLE MAINTENACE SHOP | SEWAGE FROM ADMIN. BLDG. | SEWAGE FROM FREIGHT DOCK OP. | SEWAGE FROM ORE DOCK OP. | SEWAG E FROM TERTIARY CRUSHER BLDG. | SEWAGE FROM SCREENING BLDG. | FROM NEXT PAGE | SEWAGE FROM COCKBURN SOUTH | SEWAGE FROM MAINT. & CARGO BLDG. | PIPED SEWAGE | TRUCKED SEWAGE | FEED TO STP |
| Construction Phase - Design ($m^3/h$) | 0.003 | 22.3 | 0.0 | 3.8 | 3.8 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 30.0 | 42.9 | 17.5 |
| Construction Phase - Nominal ($m^3/h$) | 0.002 | 2.5 | 0.0 | 1.5 | 1.3 | 0.19 | 0.19 | 0.05 | 0.05 | 0.67 | 7.50 | 0.03 | 5.33 | 8.67 | 14.00 |
| Operation Phase - Design ($m^3/h$) | 0.003 | 20.4 | 0.5 | 1.9 | 1.4 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 0.00 | 42.9 | 24.2 | 42.9 | 3.8 |
| Operation Phase - Nominal ($m^3/h$) | 0.002 | 1.6 | 0.1 | 0.7 | 0.4 | 0.04 | 0.04 | 0.05 | 0.05 | 0.00 | 0.00 | 0.00 | 2.82 | 0.18 | 3.00 |

| Stream No. | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Description | STP EFFLUENT | SOLIDS TO DISPOSAL | VEHICHLE MAINT. SHOP OILY WASTE | BOILER PLANT OILY WASTE | POWER PLANT OILY WASTE | MISCELLANE OUS | WASH WATER FROM INCIN. PLANT | WASH WATER FROM STP. | WASH WATER FROM PWTP | TOTAL FEED TO WWTP | OILY WASTE | OILY SOLIDS TO DISPOSAL | RECYCLED WWTP EFFLUENT | WWTP EFFLUENT TO OCEAN | REUSE | STP EFFLUENT TO OCEAN |
| Construction Phase - Design ($m^3/h$) | 17.4 | 0.1 | - | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.86 | 42.86 | 0.0004 | n/a | 0.2 | 0.05 | 42.9 | 17.4 |
| Construction Phase - Nominal ($m^3/h$) | 13.9 | 0.1 | - | 0.01 | 0.1 | 0.01 | 0.04 | 0.04 | 0.01 | 0.25 | 0.0004 | 0.04 | 0.2 | 0.04 | 2.5 | 11.3 |
| Operation Phase - Design ($m^3/h$) | 3.7 | 0.03 | 11.0 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.86 | 42.86 | 0.0015 | n/a | 0.9 | 0.23 | 42.9 | 3.7 |
| Operation Phase - Nominal ($m^3/h$) | 3.0 | 0.02 | 0.65 | 0.01 | 0.1 | 0.1 | 0.04 | 0.0 | 0.01 | 0.96 | 0.0015 | 0.04 | 0.7 | 0.18 | - | 3.0 |

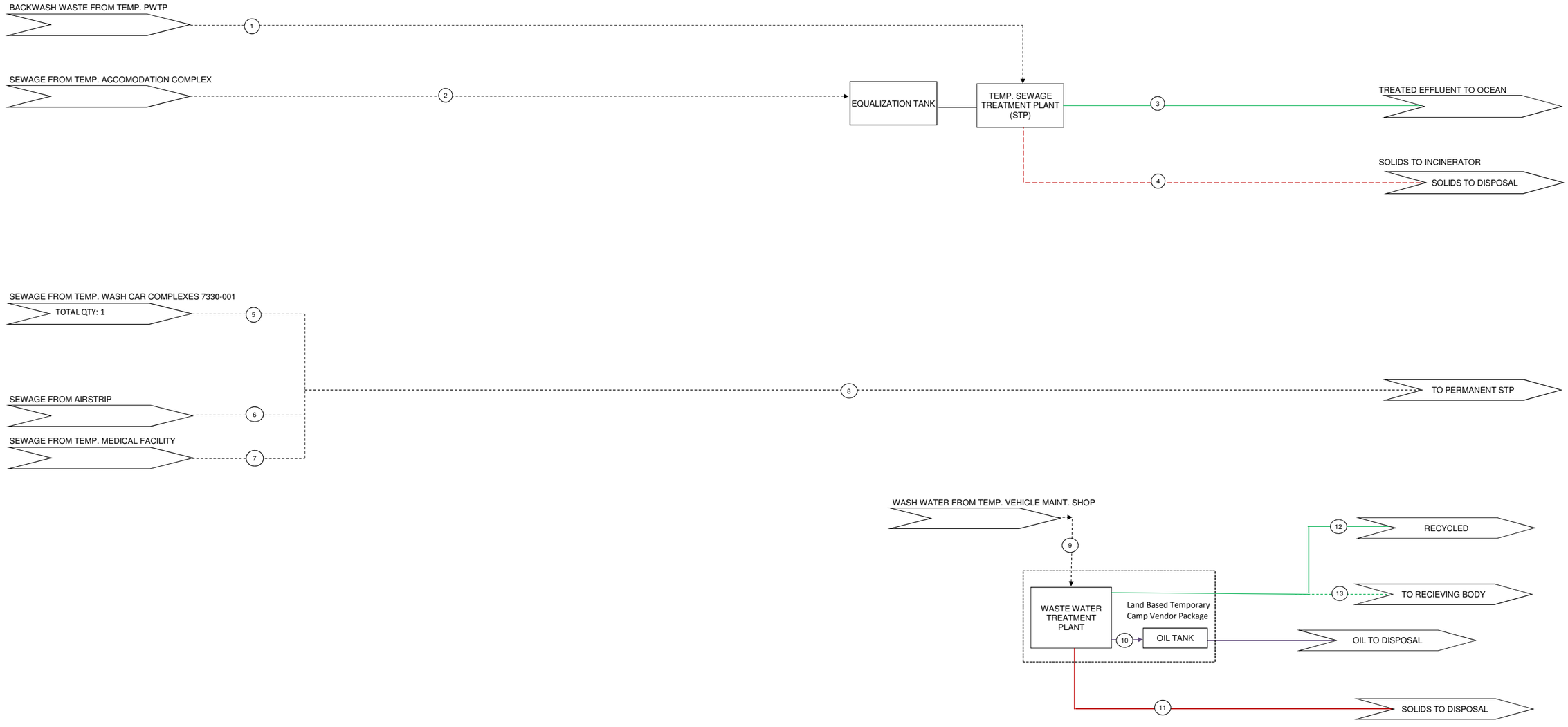
HATCH™ Baffinland Iron Mines Corporation

| | |
|---|---|
| DESIGNED BY R. KAPADIA Date: 12/21/2011 | DRAWN BY R. KAPADIA Date: 12/21/2011 |
| CHECKED BY R. RADAKOVIC Date: 12/21/2011 | DISCIP ENGR. R. KAPADIA Date: 12/21/2011 |
| PROJ. DES. COORD. | PROJ. ENGR. J. CASSON Date: 12/21/2011 |
| PROJECT MANAGER H. CHARALAMBU Date: 12/21/2011 | |

**STEENSBY - MARY RIVER PROJECT**
**BLOCK FLOW DIAGRAM**
**PERMANENT CAMP - WASTE WATER BALANCE**

Drawing No. H337697-4510-10-002-0001
SHEET 4 of 5

Rev. F




**NOTES:**

1) The peak flows from the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Sewage will be drained from a local collection tank at each remote location
4) Effluent reuse is optional. To be reviewed in detailed engineering.

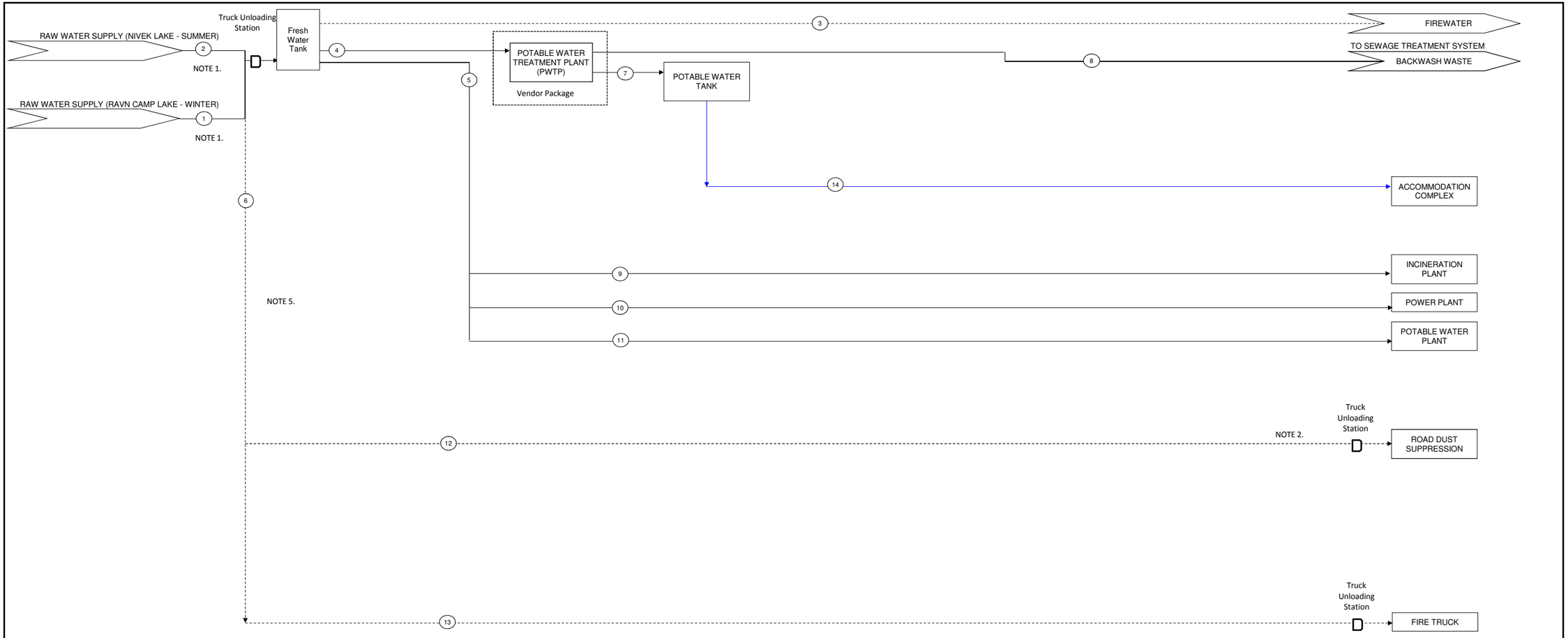
| Stream No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Description | WASTE FROM TEMP. PWTP | SEWAGE FROM TEMP. ACC. COMPLEX | TEMP. STP EFFLUENT | TEMP. STP SOLIDS | SEWAGE FROM TEMP. CAR WASH | SEWAGE FROM AIRSTRIP | SEWAGE FROM TEMP. MEDICAL FACILITY | TRUCKED SEWAGE TO STP | WATER FROM TEMP. VEHICLE SHOP | OIL WASTE | WWTP SOLIDS WASTE | RECYCLED EFFLUENT | WWTP EFFLUENT TO OCEAN |
| Construction Phase - Design ($m^3/h$) | 0.003 | 27.0 | 27.0 | 0.04 | 42.9 | 42.9 | 42.9 | 42.86 | 42.86 | 0.00 | n/a | 1.18 | - |
| Construction Phase - Nominal ($m^3/h$) | 0.002 | 4.5 | 4.46 | 0.04 | 0.1 | 0.05 | 0.5 | 0.6740 | 1.1426 | 0.0018 | 0.2000 | 0.9408 | - |
| Operation Phase - Design ($m^3/h$) | 0.000 | 0.0 | 0.0 | 0.00 | - | 42.9 | - | 42.9 | - | - | - | - | - |
| Operation Phase - Nominal ($m^3/h$) | 0.000 | 0.0 | 0.0 | 0.00 | - | 0.001 | - | 0.001 | - | - | - | - | - |

HATCH™ Baffinland Iron Mines Corporation

| | |
|---|---|
| DESIGNED BY R. KAPADIA Date: 12/21/2011 | DRAWN BY R. KAPADIA Date: 12/21/2011 |
| CHECKED BY R. RADAKOVIC Date: 12/21/2011 | DISCIP ENGR. R. KAPADIA Date: 12/21/2011 |
| PROJ. DES. COORD. | PROJ. ENGR. J.I. CASSON Date: 12/21/2011 |
| PROJECT MANAGER H. CHARALAMBU Date: 12/21/2011 | Drawing No. H337697-4510-10-002-0001 SHEET 5 of 5 |

**STEENSBY - MARY RIVER PROJECT**
**BLOCK FLOW DIAGRAM**
**TEMPORARY CAMP - WASTE WATER BALANCE**

Rev. F




**NOTES:**

1) The system will have a different raw water source for winter from summer. As such the flows for these two streams are indicative of the summer or winter period only.
2) The flows for these streams will occur in the summer time only.
3) The flow values on this water balance have been derived from previous consultants documentation produced during the earlier phase of the project. Where values were missing Hatch estimations are used.
4) The peak flows for the accommodation facilities were determined using a peaking factor.
5) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
6) Potable water will be supplied from the accommodation complex to the STP, Incineration Plant, Power Plant and PWTP using bottles.

LEGEND:

CONTINUOUS FLOW.

INTERMITTENT FLOW.

| Stream No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Stream Description | WINTER RAW WATER SUPPLY | SUMMER RAW WATER SUPPLY | FIREWATER | FEED TO POTABLE TREATMENT SYSTEM | PIPED FRESH WATER | TRUCKED FRESH WATER | POTABLE SYSTEM PRODUCT FLOW |
| Construction Phase - Design ($m^3/h$) | 42.9 | 42.9 | 300.0 | 2.8 | 10.2 | 42.9 | 2.8 |
| Construction Phase - Nominal ($m^3/h$) | 3.3 | 3.3 | - | 2.8 | 0.4 | 0.1 | 2.8 |
| Operation Phase - Design ($m^3/h$) | - | - | - | - | - | - | - |
| Operation Phase - Nominal ($m^3/h$) | - | - | - | - | - | - | - |
| Stream No. | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Stream Description | POTABLE SYSTEM WASTE FLOW | WASH WATER TO INCIN. PLANT | WASH WATER TO POWER PLANT | WASH WATER TO PWTP | ROAD DUST SUPPRESS | FIRETRUCK WATER | POTABLE WATER TO ACC. COMPLEX |
| Construction Phase - Design ($m^3/h$) | 0.002 | 3.4 | 3.4 | 3.4 | 42.9 | 42.9 | 21.3 |
| Construction Phase - Nominal ($m^3/h$) | 0.001 | 0.1 | 0.1 | 0.1 | 0.1 | - | 2.8 |
| Operation Phase - Design ($m^3/h$) | - | - | - | - | - | - | - |
| Operation Phase - Nominal ($m^3/h$) | - | - | - | - | - | - | - |

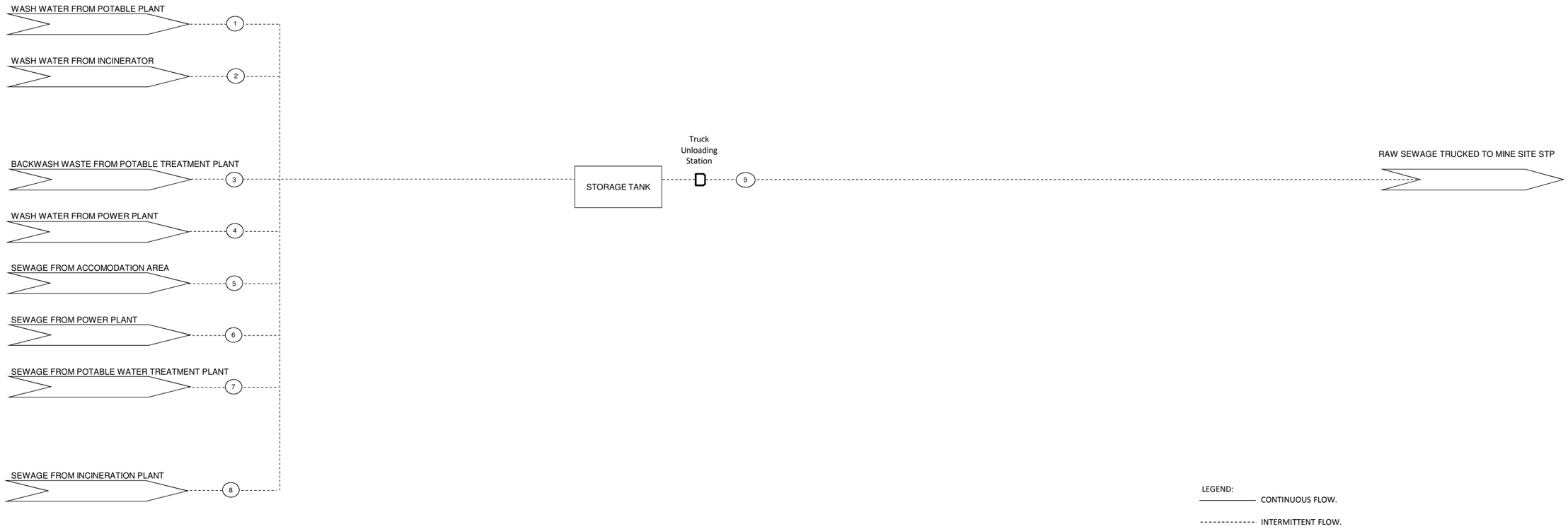
HATCH™ Baffinland Iron Mines Corporation

| | |
|---|---|
| DESIGNED BY R. KAPADIA Date: 8/22/2011 | DRAWN BY R. KAPADIA Date: 8/22/2011 |
| CHECKED BY A. ZLATIC Date: 8/22/2011 | DISCIP ENGR. A. ZLATIC Date: 8/22/2011 |
| PROJ. DES. COORD. | PROJ. ENGR. J. CASSON Date: 8/22/2011 |
| PROJECT MANAGER H. CHARALAMBU Date: 8/22/2011 | |

**MID-RAIL CAMP - MARY RIVER PROJECT**
**BLOCK FLOW DIAGRAM**
**WATER SUPPLY BALANCE**

Drawing No. H337697-7000-10-002-0004
SHEET 1 OF 2

Rev. E




| Stream No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Stream Description | WASH WATER FROM POTABLE PLANT | WASH WATER FROM INCIN. | PWTP BACKWASH WASTE STREAM | WASH WATER FROM POWER PLANT |
| Construction Phase - Design ($m^3/h$) | 3.4 | 3.4 | 0.002 | 3.407 |
| Construction Phase - Nominal ($m^3/h$) | 0.1 | 0.1 | 0.001 | 0.142 |
| Operation Phase - Design ($m^3/h$) | - | - | - | - |
| Operation Phase - Nominal ($m^3/h$) | - | - | - | - |

| Stream No. | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|
| Stream Description | SEWAGE FROM ACC. COMPLEX | SEWAGE FROM POWER PLANT | SEWAGE FROM PWTP | SEWAGE FROM INCIN. PLANT | RAW SEWAGE TO MINE SITE STP |
| Construction Phase - Design ($m^3/h$) | 24.40 | 0.02 | 0.02 | 0.01 | 42.9 |
| Construction Phase - Nominal ($m^3/h$) | 2.39 | 0.02 | 0.02 | 0.01 | 2.9 |
| Operation Phase - Design ($m^3/h$) | - | - | - | - | - |
| Operation Phase - Nominal ($m^3/h$) | - | - | - | - | - |

**NOTES:**

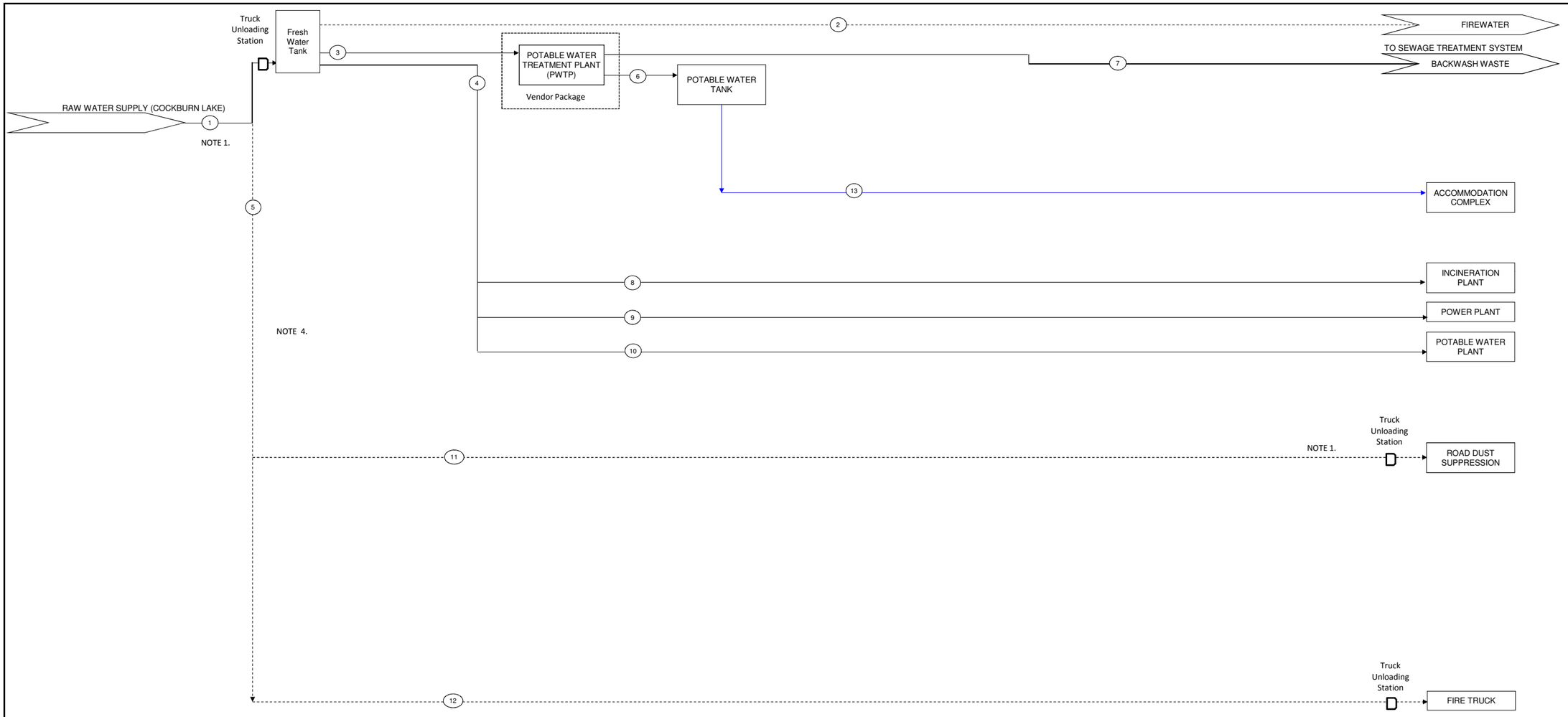
1) The flow values on this water balance have been derived from previous consultants documentation produced during the earlier phase of the project. Where values were missing Hatch estimations are used.
2) The peak flows for the accommodation facilities were determined using a peaking factor.
3) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
4) It has been assumed that relative sewage flows will be distributed through different facilities in the same proportions as the relative potable water flows.

HATCH™ Baffinland Iron Mines Corporation

| | |
|---|---|
| DESIGNED BY R. KAPADIA Date: 8/22/2011 | DRAWN BY R. KAPADIA Date: 8/22/2011 |
| CHECKED BY A. ZLATIC Date: 8/22/2011 | DISCIP ENGR. A. ZLATIC Date: 8/22/2011 |
| PROJ. DES. COORD. | PROJ. ENGR. J. CASSON Date: 8/22/2011 |
| PROJECT MANAGER H. CHARALAMBU Date: 8/22/2011 | Drawing No. H337697-7000-10-002-0004 SHEET 2 OF 2 |

**MID-RAIL CAMP - MARY RIVER PROJECT**
**BLOCK FLOW DIAGRAM**
**WASTE WATER BALANCE**

Rev. E




**NOTES:**

1) The flows for these streams will occur in the summer time only.
2) The flow values on this water balance have been derived from previous consultants documentation produced during the earlier phase of the project. Where values were missing Hatch estimations are used.
3) The peak flows for the accommodation facilities were determined using a peaking factor.
4) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
5) Potable water will be supplied from the accommodation complex to the STP, Incineration Plant, Power Plant and PWTP using bottles.

| Stream No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Stream Description | RAW WATER SUPPLY | FIREWATER | FEED TO POTABLE TREATMENT SYSTEM | PIPED FRESH WATER | TRUCKED FRESH WATER | POTABLE SYSTEM PRODUCT FLOW |
| Construction Phase - Design ($m^3/h$) | 42.9 | 300.0 | 4.1 | 10.2 | 42.9 | 4.1 |
| Construction Phase - Nominal ($m^3/h$) | 4.7 | 0.0 | 4.1 | 0.4 | 0.1 | 4.1 |
| Operation Phase - Design ($m^3/h$) | - | - | - | - | - | - |
| Operation Phase - Nominal ($m^3/h$) | - | - | - | - | - | - |

| Stream No. | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|
| Stream Description | POTABLE SYSTEM WASTE FLOW | WASH WATER TO INCIN. PLANT | WASH WATER TO POWER PLANT | WASH WATER TO PWTP | FRESHWATER TRUCK | FIRETRUCK WATER | POTABLE WATER TO ACC. COMPLEX |
| Construction Phase - Design ($m^3/h$) | 0.0 | 3.4 | 3.4 | 3.4 | 42.9 | 42.9 | 23.3 |
| Construction Phase - Nominal ($m^3/h$) | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 4.1 |
| Operation Phase - Design ($m^3/h$) | - | - | - | - | - | - | - |
| Operation Phase - Nominal ($m^3/h$) | - | - | - | - | - | - | - |

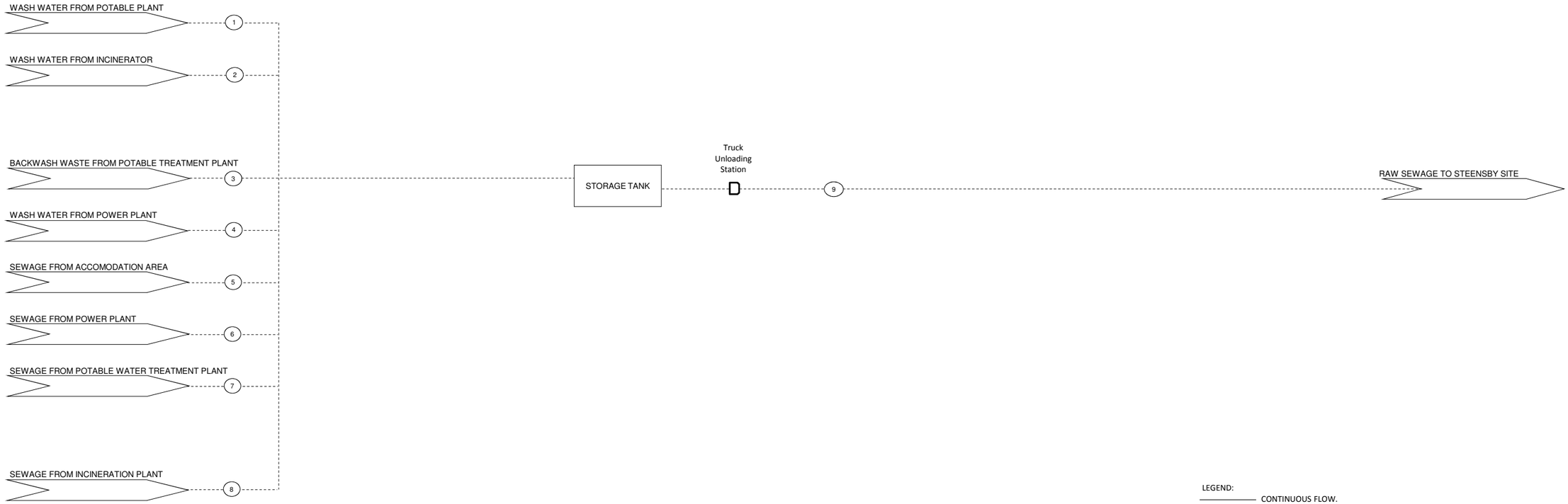
HATCH™ Baffinland Iron Mines Corporation

| | |
|---|---|
| DESIGNED BY R. KAPADIA Date: 11/10/2011 | DRAWN BY R. KAPADIA Date: 11/10/2011 |
| CHECKED BY R. RADAKOVIC Date: 11/10/2011 | DISCIP ENGR. R. KAPADIA Date: 11/10/2011 |
| PROJ. DES. COORD. | PROJ. ENGR. J. CASSON Date: 11/10/2011 |
| PROJECT MANAGER H. CHARALAMBU Date: 11/10/2011 | |

**COCKBURN SOUTH CAMP - MARY RIVER PROJECT**
**BLOCK FLOW DIAGRAM**
**WATER SUPPLY BALANCE**

Drawing No. H337697-7000-10-002-0006
SHEET 1 OF 2

Rev. E




| Stream No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Stream Description | WASH WATER FROM POTABLE PLANT | WASH WATER FROM INCIN. | PWTP BACKWASH WASTE STREAM | WASH WATER FROM POWER PLANT |
| Construction Phase - Design ($m^3/h$) | 3.4 | 3.4 | 0.001 | 3.4 |
| Construction Phase - Nominal ($m^3/h$) | 0.1 | 0.1 | 0.001 | 0.1 |
| Operation Phase - Design ($m^3/h$) | - | - | - | - |
| Operation Phase - Nominal ($m^3/h$) | - | - | - | - |

| Stream No. | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|
| Stream Description | SEWAGE FROM ACC. COMPLEX | SEWAGE FROM POWER PLANT | SEWAGE FROM PWTP | SEWAGE FROM INCIN. PLANT | RAW SEWAGE TO STEENSBY |
| Construction Phase - Design ($m^3/h$) | 26.70 | 0.04 | 0.04 | 0.02 | 42.9 |
| Construction Phase - Nominal ($m^3/h$) | 3.78 | 0.04 | 0.04 | 0.02 | 4.3 |
| Operation Phase - Design ($m^3/h$) | - | - | - | - | - |
| Operation Phase - Nominal ($m^3/h$) | - | - | - | - | - |

**NOTES:**

1) The flow values on this water balance have been derived from previous consultants documentation produced during the earlier phase of the project. Where values were missing Hatch estimations are used.
2) The peak flows for the accommodation facilities were determined using a peaking factor.
3) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
4) It has been assumed that relative sewage flows will be distributed through different facilities in the same proportions as the relative potable water flows.
5) Effluent reuse is optional. To be reviewed in detailed engineering.

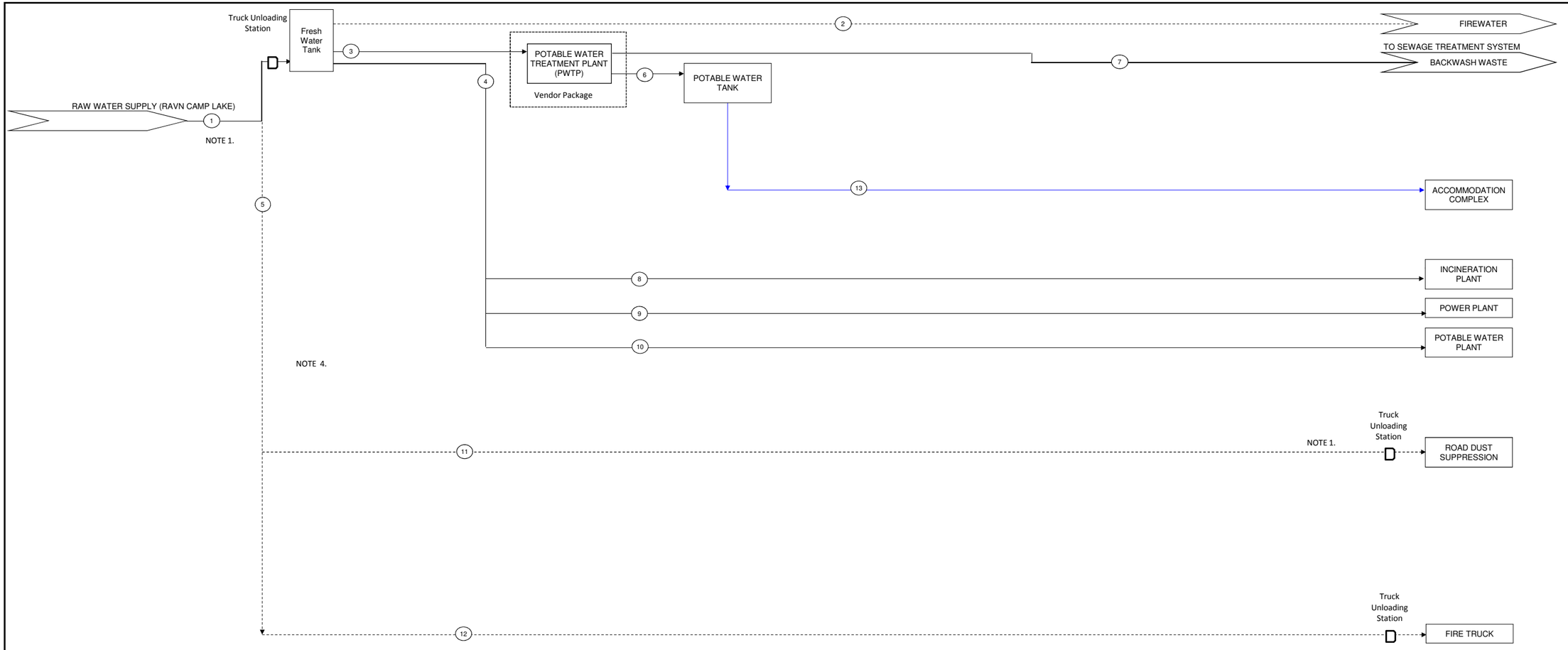
HATCH™ Baffinland Iron Mines Corporation

| | |
|---|---|
| DESIGNED BY R. KAPADIA Date: 11/10/2011 | DRAWN BY R. KAPADIA Date: 11/10/2011 |
| CHECKED BY R. RADAKOVIC Date: 11/10/2011 | DISCIP ENGR. R. KAPADIA Date: 11/10/2011 |
| PROJ. DES. COORD. | PROJ. ENGR. J. CASSON Date: 11/10/2011 |
| PROJECT MANAGER H. CHARALAMBU Date: 11/10/2011 | |

**COCKBURN SOUTH TUNNELS CAMP - MARY RIVER PROJECT**
**BLOCK FLOW DIAGRAM**
**WASTE WATER BALANCE**

Drawing No. H337697-7000-10-002-0006
SHEET 2 OF 2

Rev. E




**NOTES:**

1) The flows for these streams will occur in the summer time only.
2) The flow values on this water balance have been derived from previous consultants documentation produced during the earlier phase of the project. Where values were missing Hatch estimations are used.
3) The peak flows for the accommodation facilities were determined using a peaking factor.
4) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
5) Potable water will be supplied from the accommodation complex to the STP, Incineration Plant, Power Plant and PWTP using bottles.

LEGEND:

CONTINUOUS FLOW.

INTERMITTENT FLOW.

| Stream No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Stream Description | RAW WATER SUPPLY | FIREWATER | FEED TO POTABLE TREATMENT SYSTEM | PIPED FRESH WATER | TRUCKED FRESH WATER | POTABLE SYSTEM PRODUCT FLOW |
| Construction Phase - Design ($m^3/h$) | 42.9 | 300.0 | 5.5 | 10.2 | 42.9 | 5.5 |
| Construction Phase - Nominal ($m^3/h$) | 6.1 | - | 5.5 | 0.4 | 0.1 | 5.5 |
| Operation Phase - Design ($m^3/h$) | - | - | - | - | - | - |
| Operation Phase - Nominal ($m^3/h$) | - | - | - | - | - | - |

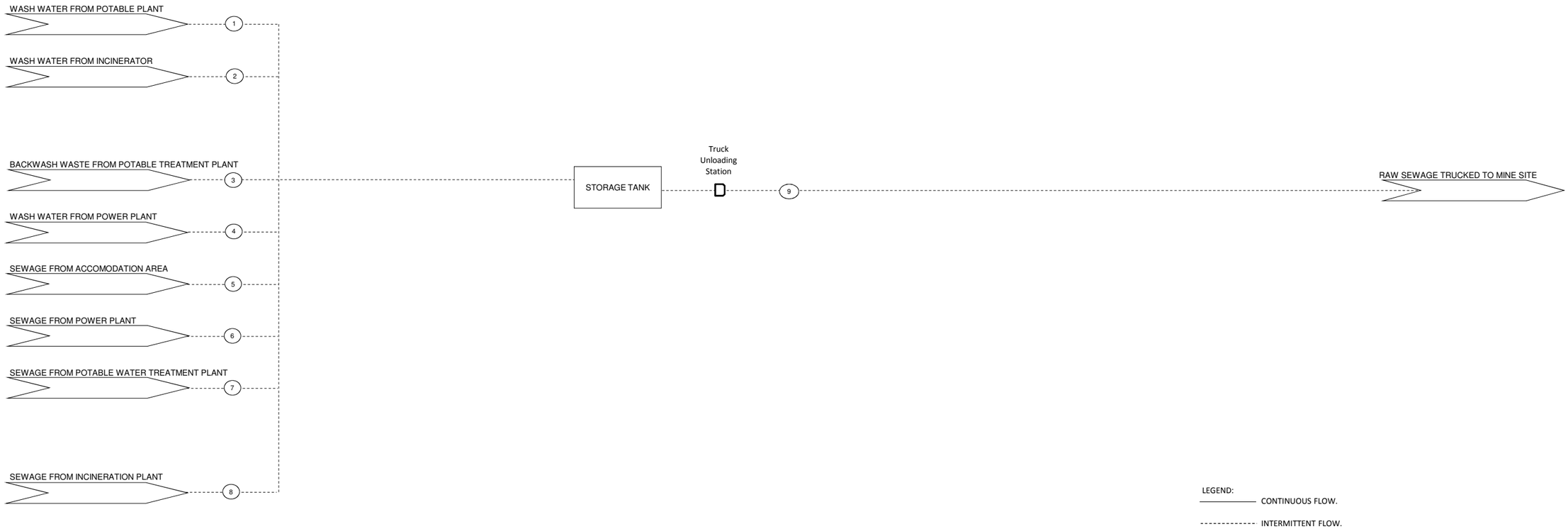
| Stream No. | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|
| Stream Description | POTABLE SYSTEM WASTE FLOW | WASH WATER TO INCIN. PLANT | WASH WATER TO POWER PLANT | WASH WATER TO PWTP | ROAD DUST SUPPRESS | FIRETRUCK WATER | POTABLE WATER TO ACC. COMPLEX |
| Construction Phase - Design ($m^3/h$) | 0.002 | 3.4 | 3.4 | 3.4 | 42.9 | 42.9 | 31.1 |
| Construction Phase - Nominal ($m^3/h$) | 0.001 | 0.1 | 0.1 | 0.1 | 0.1 | - | 5.5 |
| Operation Phase - Design ($m^3/h$) | - | - | - | - | - | - | - |
| Operation Phase - Nominal ($m^3/h$) | - | - | - | - | - | - | - |

HATCH™ Baffinland Iron Mines Corporation

| | |
|---|---|
| DESIGNED BY R. KAPADIA Date: 11/10/2011 | DRAWN BY R. KAPADIA Date: 11/10/2011 |
| CHECKED BY R. RADAKOVIC Date: 11/10/2011 | DISCIP ENGR. R. KAPADIA Date: 11/10/2011 |
| PROJ. DES. COORD. | PROJ. ENGR. J. CASSON Date: 11/10/2011 |
| PROJECT MANAGER H. CHARALAMBU Date: 11/10/2011 | Drawing No. H337697-7000-10-002-0003 SHEET 1 OF 2 |

**RAVN RIVER CAMP - MARY RIVER PROJECT**
**BLOCK FLOW DIAGRAM**
**WATER SUPPLY BALANCE**

Rev. E




| Stream No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Stream Description | WASH WATER FROM POTABLE PLANT | WASH WATER FROM INCIN. | PWTP BACKWASH WASTE STREAM | WASH WATER FROM POWER PLANT |
| Construction Phase - Design ($m^3/h$) | 3.4 | 3.4 | 0.0017 | 3.4 |
| Construction Phase - Nominal ($m^3/h$) | 0.1 | 0.1 | 0.0014 | 0.1 |
| Operation Phase - Design ($m^3/h$) | - | - | - | - |
| Operation Phase - Nominal ($m^3/h$) | - | - | - | - |

| Stream No. | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|
| Stream Description | SEWAGE FROM ACC. COMPLEX | SEWAGE FROM POWER PLANT | SEWAGE FROM PWTP | SEWAGE FROM INCIN. PLANT | RAW SEWAGE TO MINE SITE |
| Construction Phase - Design ($m^3/h$) | 35.60 | 0.05 | 0.05 | 0.03 | 42.9 |
| Construction Phase - Nominal ($m^3/h$) | 5.76 | 0.05 | 0.05 | 0.03 | 6.3 |
| Operation Phase - Design ($m^3/h$) | - | - | - | - | - |
| Operation Phase - Nominal ($m^3/h$) | - | - | - | - | - |

**NOTES:**

1) The flow values on this water balance have been derived from previous consultants documentation produced during the earlier phase of the project. Where values were missing Hatch estimations are used.
2) The peak flows for the accommodation facilities were determined using a peaking factor.
3) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
4) It has been assumed that relative sewage flows will be distributed through different facilities in the same proportions as the relative potable water flows.

HATCH™ Baffinland Iron Mines Corporation

| | |
|---|---|
| DESIGNED BY R. KAPADIA Date: 11/10/2011 | DRAWN BY R. KAPADIA Date: 11/10/2011 |
| CHECKED BY R. RADAKOVIC Date: 11/10/2011 | DISCIP ENGR. R. KAPADIA Date: 11/10/2011 |
| PROJ. DES. COORD. | PROJ. ENGR. J. CASSON Date: 11/10/2011 |
| PROJECT MANAGER H. CHARALAMBU Date: 11/10/2011 | Drawing No. H337697-7000-10-002-0003 SHEET 2 OF 2 |

**RAVN RIVER CAMP - MARY RIVER PROJECT**
**BLOCK FLOW DIAGRAM**
**WASTE WATER BALANCE**

Rev. E

# APPENDIX D – Sewage Plant Sample Manual

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

# newterra MicroClear™ MBR Wastewater Treatment Plant

# OPERATION AND MAINTENANCE MANUAL

| | |
|---|---|
| **System:** | **newterra Standard MBR WWTP (MC-75)** |
| **Location:** | **Alberta, Canada** |
| **Client:** | |
| **Project:** | **Sample** |
| **Rev.:** | **0** |
| **Date:** | **March 14, 2013** |

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

## TABLE OF CONTENTS

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

## 1.0 INTRODUCTION

The purpose of this manual is to provide necessary information for the Installation, Operation and Maintenance of the equipment.

| | |
|---|---|
|   | **The newterra MicroClear™ MBR wastewater treatment plant (WWTP) functions optimally if the operating procedures described in this manual are followed. If you have any questions after reading through this manual, please contact newterra ltd.** |

- This O&M Manual must be kept on-site and available to employees at all time.
- It is IMPERATIVE that employees read the manual BEFORE working in the plant.
- Employees' attention has to be drawn to the Health and Safety in *Section 2* of this manual.

 **WARNING:** ***Failure to comply with the instr uctions provided in this manual can cause equipment & property damage or severe personal injury, and will render the warranty null and void.***

## 2.0 SAFETY

1. This manual **must** be read thoroughly before system installation and operation.
2. Installation and servicing **must** only be carried out by suitably **trained or qualified** personnel.
3. Normal safety precautions must be taken.
6. The electrical wiring **must** be carried out by **licensed** electricians.
7. Installation of piping should be carried out by licensed plumbers.
8. For safety of service technicians, avoid trees or shrubs larger than two meters in close proximity to the plant buildings.

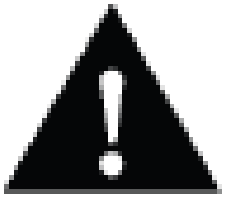
### DEFINITION OF SAFETY AND WARNING SIGNS


**ATTENTION SYMBOL**

Special attention is required to ensure compliance with instructions concerning correct operating sequences to prevent damage to the plant or its function.

**GENERAL WARNING SIGN**

This symbol accompanies all important instructions or warnings associated with risks of injury as well as damage to equipment.



**WARNING**

**CRITICAL WARNING SIGN**

Warns against an unsafe situation or practice associated with severe injury as well as damage to equipment.

## Responsibility for Safety

**Management:**

Management is responsible for providing a safe working environment. This is accomplished partly by:

- Ensuring that all facilities and equipment are built and maintained in accordance with the appropriate safety standards
- Providing adequate funds for equipment and plant maintenance
- Establishing, promoting, and enforcing a *safety policy*
- Establishing a safety training program

**Worker:**

- To develop a positive and professional attitude towards safety.
- To avoid mistakes caused by indifference to safety, poor work habits, lack of attentiveness, rushing the job, failure to observe established safety procedures and poor physical condition.


***Remember the "ABC" of accident prevention*:**
**ALWAYS BE CAREFUL!!!**

In addition to *"being careful*", it is the responsibility of all workers to:

- ✓ Work in accordance with established safety procedures
- ✓ Follow the established safety rules
- ✓ Wear appropriate safety equipment
- ✓ Report all accidents, no matter how minor
- ✓ Report potential safety hazards
- ✓ Participate in safety programs

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

## Plant Safety – Simple Rules to Follow


**Common sense plays a very important part in the safe operation of any type of plant!**

- Wear the appropriate personal protective equipment at all times. This may include protective clothing, goggles, rubber gloves, hard hat, steel-toed shoes.
- Keep walkways clear of snow and ice, and loose objects such as pails, shovels, tools, etc.
- Clean up spills of oil, grease, chemicals, or other substances immediately.
- Keep all tools and similar equipment clean, in good condition, and properly stored when not in use.
- Replace all manhole covers, access trap doors, etc. as soon as possible. Erect a safety barrier if it is necessary to leave the opening uncovered.
- Use the proper tools when removing or replacing a manhole cover.
- Wear a safety belt whenever there is the possibility of falling even a short distance, or when working over water.
- Lock out and tag electrical equipment before working on it or the associated equipment
- Ensure that moving machinery is properly guarded. Wear ear protection in noisy environments.
- Ensure that fire-fighting equipment is in good working condition.

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

## Hazard Warning Signs/Symbols

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

## 3.0 WASTEWATER TREATMENT PLANT DESIGN BASIS

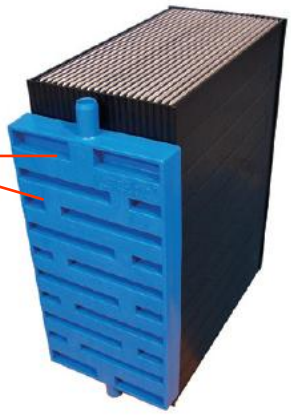
The newterra MicroClear™ Membrane Bioreactor (MBR) Wastewater treatment Plant (WWTP) is designed to meet effluent discharge criteria of BOD < 5 mg/L and TSS < 1 mg/L.

**newterra MicroClear™ MBR (MC-75) Specification**

| **Design loading** | unit | Value |
|---|---|---|
| Design Hydraulic Load | $m^3/d$ | 75 |
| Organic Load | [kgBOD/d] | 30.0 |
| Ammonia Nitrogen Load | [$kgNH_4$ -N /d] | 4.88 |
| Phosphorus Load | [kgTP/d] | 0.75 |
| **Membrane Bioreactor** | | |
| Design Capacity - Effective Volume | $m^3$ | 36.45 |
| Hydraulic Retention Time (HRT) | h | 11.66 |
| Sludge Age | d | 15 |
| Activated Sludge Return Ratio | - | 3 - 5 x |
| Design flux (average) | LMH | 18 |
| **Min design operating temp** | $^oC$ | 15 |
| **MicroClear® MB3-1 membrane modules** | | |
| MB3-1 modules in MC-75 MBR | nr | 2 |
| MCXL cassettes in each MB3-1 module | nr | 15 |
| Total Area of each MB3-1 module | $m^2$ | 105 |
| MB3-1 Module Dimension (L x W x H) | m | 1.3 x 0.7 x 1.85 |
| Housing materials | | Stainless steel |
| **Effective Volume of each Individual Membrane Tank** | m3 | 4.049 |
| **MicroClearTM MCXL membrane cassette** | | |
| Membrane Material | | Polyethersulfone (PES) |
| Individual Cassette Area | $m^2$ | 7 |
| Pore Size | µm | 0.04 |
| Cut Off | kDalton | 150 |
| Filtration Pressure | bar | 0.1 - 0.25 |
| Backwash Pressure | bar | 0.07 - 0.1 |
| Cassette Dimension | m | 0.416 x 0.209 x 0.490 |

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

**MicroClear™ MB3-1 Membrane Module**



**MicroClear® MCXL Membrane**

## newterra MicroClear™ MBR WWTP SPEC SHEETS

| Parameters | Unit | Value |
|---|---|---|
| Total design population | person | 300 |
| Average water usage | L/person/day | 250 |
| Average design flow (ADF) | $m^3/d$ | 75 |
| Peak hourly flow | $m^3/h$ | 12.5 |
| Duration of peak flow | h | 5 |
| Maximum frequency of peak events per day | time | 2 |
| Ambient temperature | °C | Min. - 40˚C, Max. + 40 ˚C |
| Water temperature for biological treatment | °C | Min. +7 ˚C, Max. + 35 ˚C |

**Influent Wastewater/Treated Effluent Characteristics:**

| Parameters | Unit | Influent | Effluent |
|---|---|---|---|
| pH | s.u. | 6 - 9 | 7 - 9 |
| Fat, Oil, Grease (FOG) | mg/L | < 30 | - |
| Biological Oxygen Demand (BOD) | mg/L | 400 | < 5 |
| Total Suspended Solids (TSS) | mg/L | 350 | < 1 |
| Total Kjeldahl Nitrogen (TKN) | mg/L | 70 | - |
| Total Ammonia Nitrogen (TAN) | mg/L | 65 | - |
| Total Phosphorus (TP) | mg/L | 10 | - |
| Fecal Coliform / *E-Coli* | CFU/100mL | - | < 200* |
| Alkalinity (assumed) | mg/L as $CaCO_3$ | > 200 | - |
| Total Dissolved Solids(TDS) | mg/L | < 1,200 | - |

**after UV disinfection*

## Prohibited Items

The raw wastewater should not contain any of the following substances:

- Hydrocarbons – lubricants, gasoline, diesel, etc.;
- Paints, solvents, silica, silicones and polymers;
- Antibacterial solutions, and products with quaternary ammonia;
- Large quantities of chemicals such as water softener, disinfectants, strong acids & alkalis, pesticides or photographic chemicals;
- Silicone based de-foamers;
- Non-biodegradable solid waste (plastic, rubber products, disposable diapers, etc.);
- High amount of metals, such as iron, magnesium, calcium, barium and strontium.

**TOXIC MATERIAL SHOULD NOT BE THROWN INTO THE DRAIN.**

The raw wastewater should also comply with the following compatibility chart. The lipophilic substances concentration must be lower than **50 mg/L.**

**MicroClear™ Membrane Compatibility Chart**

| Group | Substances | SP-Type Membrane |
|---|---|---|
| Chlorinated solvents | Methylene Chloride, Chloroform, Carbon Tetrachloride, Chlorobezene, Trichloroethane (<1%) | -- |
| Esters | Ethyl Acetate, Butyl Acetate, Butyl Acrylate (<1%) | -- |
| Ethers | Ethyl Ether, Polyethylene Oxide (<1%) | -- |
| $H_2O_2$ | <2000 ppm | ++ |
| Inorganic acids | HF, HCI, $H_2SO_4$ | pH 0 - 14 |
| Ketones | Acetone, Methyl Ethyl Ketone | -- |
| NaOCI | 100,000 ppmxh | ++ |
| Organic acids | Sulfamic Acid, Formic Acid, Oleic Acid, Sulfonic Acid, Acetic Acid, Acrylic Acid, Latic Acid | pH 0 - 14 |
| Phenols | | -- |
| Silicones | | -- |
| Alcohols | Ethanol, Butanol, Isopropranol (<50%) | + |
| Aldehydes | Formaldehyde (<1%) | ++ |
| Alkali | | pH 0 - 14 |
| | Dimethyl Formamide, Dimethyl, Acetamid Dioxane, N-Methyl, Pyrrolidone, Tetramethyl Acetamide | -- |
| Aprotic Solvents | Benzene, Toluene, Xylene, Anthracene, Naphatalene, Gasoline | -- |
| Aromatic hydrocarbon | Methoxyethanol, Ethoxyethanol, Buthoxyethanol | ? |

**(**++ = Very good, + = good, - = fair, -- = not recommended)

## Removal of Oily Materials

The wastewater must pass through a grease trap (or similar facility for grease/fat removal), if there is kitchen usage onsite. The large amount of oil and fat from food preparation in the camp kitchen can harm treatment facility (e.g., clogging pumps and piping and cause foaming in the aeration tank). To avoid membrane failing, maximum FOG (fats, oil, and grease) concentrations should not exceed 30 mg/L.

## 4.0 PLANT INSTALLATION, INSPECTION, AND TESTING

The **newterra** MicroClear™ MBR WWTP is a packaged plant which comes complete with containerized inlet screen tank, equalization tank, aeration tank, membrane tank and a UV disinfection system. The plant is housed inside multiple 40-ft modified high-cube shipping containers - completely pre-assembled, pre-piped, pre-wired and pre-tested, ready for a quick site installation and start-up. The standard containerized design also allows for modular expandability, portability and quick deployment, particularly beneficial features for work camp applications.

### 4.1 Site Conditions Requirements

- Installation site for the **newterra** MicroClear™ MBR WWTP should be close to the sewer drain and have a sufficient power source (refer to Electrical Drawings in **Appendix A**).
- Location must permit easy access for equipment capable of transporting, offloading, and handling of the designed loads.
- There should be adequate space around the containers for safe operation and maintenance.
- The firm base (foundation) must be built to support the full operating weight of the plant to prevent buildings from shifting and pipe/electrical conduit connection failure – pilings or rig mats are recommended.

| | |
|---|---|
|   | **The firm base for the container must be level and must be capable of supporting the operating weight.** |

**WARNING:** ***Always check with the local utility companies for the location of water lines, electrical and telephone cables, or any additional hazards below grade, prior to excavation. Failure to do so could result in severe bodily injury or death.***

### 4.2 Inspection upon Delivery

The **newterra** MicroClear™ MBR WWTP is carefully manufactured, checked, and tested at the manufacturing plant. All equipment is pre-wired, pre-piped, mounted inside the enclosures and factory tested. Upon receiving the system, please perform the following:

- Place the containers onto the prepared firm base to avoid sagging, equipment vibration, and shifting. When lifting the containers, ensure that lifting equipment is clear of overhead obstructions such as power lines, trees or rooftops. Be careful during this procedure!
- Be careful when offloading the containers to prevent damage to the internal pipe work.
- Check the containers for any signs of shipping damages.
- Inspect the containers to ensure that no components or parts are missing (refer to the Packing List). Also, inspect for visual damage of the tanks, pumps, blowers, piping, and control panel.
- If the containers, equipment inside and any parts shipped loose are free of damage, proceed with the installation.

For any damages or loss of equipment, **please notify newterra ltd. at (800) 420-4056 immediately.**

### 4.3 Plant Initial Set up

**WARNING:** ***The installer must ensure that the installation site is safe from hazards. These could include excavations left open overnight, debris left lying around, and tanks & equipment not properly blocked. Provisions must be made to eliminate the potential hazards by roping off and proper shoring around the excavations, cleaning up at the end of each workday, and proper storage of equipment. Failure to do so could result in severe injury or death.***

Enclosure Shipping Weights, Dimensions and Connection Specifications

| | |
|---|---|
| **Estimated Dry shipping weight for each enclosure** | BLD-7901 – 25 000 lb<br>BLD-7902 – 37 000 lb |
| **Dimensions** | BLD-7901 - 8' x 40' (2.44m x 12.2m)<br>BLD-7902 - 8' x 53' (2.44 x 16.15m) |
| **Influent supplied head pressure** | 3.0 m (10') |
| **Treated effluent discharged head pressure** | 1.5 m (5') |
| **Inlet pipes** | 2 - 2" PVC inlet pipe with 2" flange connection. |
| **Discharge pipe** | 2" PVC discharge pipe with 2" NPT connection. |

## Enclosures Specifications:

| | |
|---|---|
| **System Enclosures** | newterra MicroClear™ MBR WWTP consists of (2) cMET certified, built to NEC standards, enclosures. |
| Enclosures #1<br>(BLD-7901) | **Room #1 -** Class 1 Div 2<br>Contains Inlet Screen Module with Rotary Brush Screen (SCR-201) and screen discharge tank with pumps.<br><br>**Room #2** - General Purpose<br>Contains Membrane Tanks, Permeate withdrawal system, membrane tank blowers, control panel, UV lights, aeration tank blowers, chemical injection system and control & power panels. |
| Enclosures #2<br>(BLD-7902) | General Purpose<br>Contains the equalization tank with blowers and pumps and aeration tank with pumps. |

Verify site power per system design criteria.

**System Electrical Specifications:**

| | |
|---|---|
| System Power | 480-V, 3-Phase |
| Main Disconnect / FLA Amperage | 200 A / 98 A |
| Panel Approval and Classification<br>System Approval and Classification | cMET certified to cUL 508A<br>cMET (GP) & C1D2 |
| Telemetry Setup | Included (Static IP required by customer) |

**Please refer to the as-built electrical drawings in Appendix A of this manual.**

| | |
|---|---|
|  | **Only trained and certified electricians should make the electrical connections.** |

**Installation Instructions:**

1. Ensure system is placed on a level surface.
2. Connect all interconnecting piping.
3. Remove hatch covers from the interconnecting ports.
4. Place containers tight against each other with the interconnecting ports lining up.
5. Connect electrical power to the Main Switch Panel located inside the enclosure **(BLD-7901, General purpose room)** 3 phase, 480 V from available source ensuring correct phase rotation.
6. Terminate all electrical connections between buildings.
7. Ensure that proper electrical grounding and lightning protection is available.
8. Switch Main Switch Panel's isolator to the ON position.
9. Check all internal lighting and heating for correct operation.
10. Install packed external lighting into brackets above the doorways, route the cables to the inside of the containers through the ports provided and plug into sockets provided (check for correct operation).
11. Ensure that a potable water supply is available (used for hydraulic testing during start-up, membrane cleaning, washing hands and for performing onsite testing).
12. Ensure availability of an emergency eyewash station and personal protection equipment.
13. Verify membrane modules are secure within the membrane tanks – i.e. verify wheel chocks are in the correct location and that there is no lateral movement (less than an inch) of the membrane modules on the wheel tracks in the tanks.

## 4.4 Plant Initial Testing

The newterra MicroClear™ MBR WWTP (except the membrane modules) undergoes electrical and leakage tests in our manufacturing facility prior to shipment; however, fittings could shift during shipment, so it is our standard practice to perform plant initial testing including **dry and hydraulic tests.**

### 4.4.1 Dry Test

The following tasks have to be performed **before** potable water is introduced into the system:

- Ensure that all tanks are clean and free of any dirt or debris (this is to prevent obstruction or damage to the piping, pumps, and membranes).
- Ensure that all connections have been provided and joints have been tightened.
- Check the placement of the air diffuser in the equalization tank (TNK-301**)** and the aeration tank (TNK-501) if incorrectly positioned, proper adjustment has to be performed.
- Ensure that a functional check of the electrical and control system has been performed (please refer to the newterra **Pre-commissioning Test Checklist** presented in Appendix B).

### 4.4.2 Hydraulic Test

The hydraulic test is performed using potable water to:

- Check for and fix any leakage;
- Check the setting of level switches/transmitters;
- Check the hydraulic flow through the plant;
- Check if all the ancillary equipment and controls of the plant function as per design;
- Recalibrate instruments (if applicable);
- Perform clean water test on membranes.

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

## Performing the Hydraulic Test

- Fill the system with potable water, run the pumps and check for any signs of leakage.
- Perform electrical and instrumentation (E&I) functional checks and adjustment of level switches if required.
- Turn on the air blowers B-301 and B-302 for the equalization tank and blowers B-501 and B-502 for aeration tank, and check for:
    - Buoyancy of air diffusers and if this occurs, empty the tank and fix;
    - Air leakages: if this occurs, tighten up the fittings;
    - Manually check water temperature and DO (dissolved oxygen): with a hand-held DO meter and adjust air flow to keep it up to 0.5 – 1 mg/L for equalization tanks (TNK-301) and 2 - 3 mg/L for aeration tanks (TNK-501); check the DO readings on the touch screen.
    - DO Control System: check automatic ON/OFF of Aeration Tank air blowers at low and high settings of DO without the return of aerated water from the membrane tanks to aeration tanks, and record blower ON/OFF duration.

### Membrane Tanks (TNK-601 / TNK-602):

- Enable membrane operation.
- Start the pumps P-501/P-502 and fill the membrane tanks with potable water.
- Start the air blowers B-601/B-602 and check for an even distribution of air across the membrane filter area and air bubble uniformity above the membrane module/cassette.
- Check hydraulic flow pattern through the membranes and between membrane module/ cassette and tank wall.
- Start the permeate (vacuum) pumps P-701/P-702
- Record the vacuum (TMP) on gauges PI-701/PI-702 [for clean water could be 0.05 to 0.07 bar (20” to 29” WC)].
- Record water temperature and dissolved oxygen with a hand-held DO meter.
- Gradually increase the permeate flow while recording the vacuum (TMP) on the gauges up to the anticipated peak wastewater flow.

**Caution: Once wetted, the membrane should remain wet, and not be allowed to dry out to prevent irreversible damage to the membrane.**

## 5.0 OPERATION of newterra MicroClear™ MBR

MBR (Membrane Bioreactor) treatment technology is an effective combination of an activated sludge biological treatment process with MicroClear MBR membrane filtration technology. The MBR operates at MLSS concentrations between 8,000 to 15,000 mg/L.

This section provides a brief description of the treatment process and how it is controlled. Most of the equipment in the **newterra** WWTP can be operated in either manual or automatic mode. The system is designed to always run in auto mode. The manual option is provided mainly for maintenance purposes. Equipment and instrumentation identification numbers are referenced from the **Process & Instrumentation Diagram** and **System Layouts** presented in Appendix A.

### Automatic Operation

The PLC-based control system is the default operation mode for the **newterra** MicroClear™ MBR. The system operates as a programmable computer that:

- Receives analog and digital input signals from the switches and transmitters being controlled;
- Processes this information using the structure and rules entered into the program;
- Generates outputs that control the equipment - turn equipment OFF or ON.

Under normal operation, all switches are set in the AUTO position on the HMI.

All alarms are visually indicated on a beacon stack on the roof of the exterior of the container:

- Green – System OK
- Green Flashing – System Auto Restart
- Red Solid – Warning Alarm
- Red Flashing – Critical Alarm
- No Light – Loss of Power

The MBR will always remain in auto run mode, unless the kill switch is pressed or power is down.

The MBR will automatically restart after power failure.

**All high high level alarms (identified as LSHH on P&ID) indicate a critical situation for imminent tank overflow and could result in pump(s) shutting off to avoid overflow situations and requires immediate operator attention.**

**Manual Operation**

The manual mode of operation is provided for maintenance purposes and for emergency operation of the plant in the unlikely event of a failure of the automatic control system (default operation mode). Operators **must be present when equipment is operated in the manual mode.**

A HAND-OFF-AUTO (H-O-A) switch is provided on the touch screen of the control panel for each PLC controlled motor. The HAND position on the switch allows the equipment to be operated in the manual mode. For safety reasons, a motor in the HAND position will only run for two minutes before it will be automatically stopped.

### 5.1 WWTP Design/Control Narrative

The plant is comprised of 2 buildings: BLD-7901 and BLD-7902. The main control panel is located in the General Purpose room 2 of building BLD-7901.

#### 5.1.1 Buildings/Utilities

Power Supply

A power monitor has been installed in the main power distribution panel to ensure proper power and phase rotation is delivered to the system.

**E-STOP**
An emergency stop button, wired to a common system kill circuit (KILL-7901), is located at the main control panel in Room 2 BLD-7901 and at the entrances of Room 1 BLD-7901 and BLD-7902

Building Temperature Control

For building BLD-7901 (Room #1- Screen Room), temperature is controlled manually. The operator is required to set the desired building temperature set point in $^{o}$F at the temperature switch (TSL-7911). If the building temperature falls below the temperature switch setting the wall mounted electric heaters (H-7921 and H-7931) will turn on. The building room is also equipped with a low low temperature switch TSLL-7911. The operator must manually set the low low temperature limit set point. **CAUTION: The temperature switch units are in $^{o}$F.**

For building BLD-7901 (Room #2) and BLD-7902 the building heat is controlled manually at the local thermostats for the wall mounted electric heaters.

**Alarms**
If the building temperature in BLDG-7901 Room 1 drops below the low low temperature set point, the low low temperature switch (TSLL-7911) will trip and after a delay of 15 minutes a building low low temperature alarm will register on the HMI and the red beacon light will illuminate.

If the building temperature in BLDG-7902 drops below the low low temperature set point, the low low temperature switch (TSLL-7922) will trip and after a delay of 15 minutes a building low low temperature alarm will register on the HMI and the red beacon light will illuminate.

Building Ventilation

Exhaust Blower B-7901 provides constant ventilation for the Inlet Screen Module and Building BLD-7901 Room #1 (Electrical Classification – CLASS 1/DIV2 area). The air from the blower is passed through a heat recovery system prior to discharging outside. The blower vents air at a rate of ~12 air changes per hour. This blower runs at all times to ensure the requirements of the electrically classified location is met.

A single exhaust fan (F-7921) is located in BLD-7902. The purpose of the fan is to prevent the building temperature from climbing higher than desired room set point temperature. The desired room temperature must be set by the operator using at the building high temperature switch TSH-7911 ($^{o}$F). If this switch is tripped the exhaust fan will run until the temperature drops below the set point.
NOTE: The fan is to be used primarily during the summer months - freezing cold air in to the building can lead to condensation/potential freezing risks for critical pieces of process equipment.

**Alarms**
If the blower motor stops running, a critical alarm signal will be sent to the HMI from the PLC and the flashing red beacon light will illuminate.

Building Sumps

BLD-7901 Room 1 is equipped with a sump reservoir and sump pump P-7901. In the event the high high sump level switch is tripped P-7911 will be turned on and water will be pumped to the Equalization Tank. The pump will continue to pump 15 seconds after the high high condition clears.

P-7911/P-7912/P-7921 are controlled by local piggy back high level switches (LSH-7911/LSH-7912/LSH-7921 which turn each respective pump on. The floor water is pumped to the equalization tank (TNK-301) or Aeration Tank (TNK-501).

Note: The PLC program will turn off P-503 (Aeration Tank Re-circulation Pump) in the event the high high level switch associated with sump pump P- 7922 turns on.

**Alarms**
Each sump is equipped with a High High level switch that if tripped generates a warning alarm that is visible on the HMI and causes the red beacon light to illuminate.

### 5.1.2 Wastewater Influent

Flow Control

Refer to Section 3.0 for system design capacity.

Flow Rate Monitoring and Volume Totalizer
The wastewater piping to the Inlet Screen Module (SCR-201) is equipped with a flow transmitter (FT-301) which is used to measure the influent flow rate and provides a signal to the PLC to track the overall volume through the system. FT-301 is used to turn on the screen when flow is detected.

### 5.1.3 Screen Module

A screening process is provided to remove hair, and fibrous materials from wastewater supplied from the Lift Station and includes:

- A rotary brush (SCR-201) and screen with 2-mm perforation openings
- Burlap Bags for screening collection
- Discharge tank (TNK-201) for collection of the screened wastewater.
- External pumps (P-201 & P-202) to transfer screened wastewater to equalization tank (TNK-301)
- Overflow drain to container sump

Rotary Brush Control
The rotary brush (SCR-201) rotates when flow is detected by the flow-transmitter (FT-301) on the influent pipeline. If the flow rate is between 10 GPM to 50 GPM the PLC will turn the screen on for 2 minutes every 30 minutes. If the flow rate is 50 GPM or higher, the screen will run continuously.

**Alarms**
In the event the SCN-201 motor trips off on overload an alarm will register on the HMI and the red beacon light will flash.

Discharge Pump Control
The screen discharge tank (TNK-201) has two (2) external pumps (P-201Duty, P-202 Standby). After the completion of 4 cycles the standby pump will run for 1 cycle. A cycle refers to the amount of time it takes to empty TNK-201 (cycling between LSH-201 and LSL-201). Both pumps are equipped with a discharge pressure indicator (PI-201, PI-202).

**Alarms**
In the event the screen tank discharge pump motor current switch trips an alarm will register on the HMI and the red beacon light will flash.

Level Control
If the screen clogs, the rotary brush basin will start to fill and will eventually trip a level switch (LSHH-201).

**Alarms**
If the LSHH-201 level switch is tripped an alarm will be generated and will remain visible on the HMI until the alarm condition has cleared. The red beacon light will flash for the duration of the alarm.

The screen discharge tank (TNK-201) is equipped with a low level switch (LSL-201) which turns off the screen discharge tank pump (P-201/P-202) and a high level switch (LSH-201) that turns on the screen discharge tank pump.

If tripped, the high high level switch (LSHH-202) will send a signal to the PLC which will cause the influent isolation valve to close. The system will indicate an alarm on the HMI and the red flashing light will illuminate. Operator intervention is required in the event of this alarm.

### 5.1.4 Equalization Tank

***Function*:** Buffers influent variable flow to prevent concentration fluctuations in (i.e. BOD, TSS etc.) through the MBR treatment system.

Screened wastewater is received by one Equalization Tank (TNK-301) located in building BLD-7902. The effective volume is 18.9 $m^3$, providing a hydraulic retention time of 6 hours. TNK-301 contains 8 fine bubble air diffusers for mixing and assisting the elimination of potential odour. The equalization tank (TNK-301) contains a magnesium anode which acts as the tank ground and will be sacrificially eroded as a means of prolonging the tank life.

Coarse Air Diffuser Control
Blowers (B-301, B-302) supply air to the coarse air diffusers installed in the bottom of the equalization tank. The blowers run at the same time. A pressure indicator (PI-301) and switch (PLS-301) is installed on the discharge side of the blowers.

**Alarms**
If the blower air pressure drops below set point, the low pressure switch (PLS-301) will trip and a low pressure alarm will be activated through the PLC. The flashing red beacon light will illuminate.

Temperature Control
The EQ tank is heated via an electric immersion heater (H-301). Temperature in the tank is controlled via a local thermostat.

Recommended temperature setting – 10$^{o}$C to 15$^{o}$C

**Alarms**
If the Temperature Switch Low Low (TSLL-301) is tripped an alarm signal will register on the HMI and the flashing red beacon light will illuminate.

The Level Switch Low Low LSLL-301 is installed to protect the immersion heaters and if tripped will shut the tank heater off and initiate and alarm signal from the PLC.

Transfer Pump/Level Control

The equalization tank (TNK-301) has two (2) external pumps (P-301, P-302) with one of the pumps acting as a standby. P-301 operates for 4 cycles, P-302 for 1. This pump transfers the wastewater from the equalization tank (TNK-301) to the aeration tank.

A level transmitter (LT-301) is used to indicate the liquor level in the equalization tank (TNK-301). As long as the level in the tank is above set point the PLC will allow the operation of either EQ tank discharge pump (P-301 or P-302). If the high level in the EQ tank is met the screen tank supply pumps will be turned off.

**Alarms**
The Level Switch High High (LSHH-301) if tripped will send a signal to the PLC to warn of imminent overflow in the equalization tank (TNK-301).

### 5.1.5 Aeration Tank (Biological Treatment)

***Function:*** **Oxygen is added to the wastewater to ensure microorganism concentration is at optimum levels to metabolize contaminants. (i.e.** oxidation of carbonaceous BOD; nitrification (conversion of TKN to $NO_3$-N)).

One aeration tank (TNK-501) located in BLD-7902 has an overall effective volume of 28.35 $m^3$, providing a hydraulic retention time of 9 hours. TNK-501 receives wastewater from the equalization tank and return flow from the membrane tanks. Blowers supply air to the submerged fine-bubble diffusers to ensure biological oxidation (aeration) and to keep solids in the water suspended. Mixed liquor is constantly re-circulated from the bottom of the tanks to the top through spray nozzles. This recirculation process is in place for foam suppression. A caustic and alum chemical metering system is in place to ensure regulation of aeration tank water pH and phosphorus levels.

The Aeration tank is equipped with:

- Level, temperature, pH, and dissolved oxygen (DO) monitoring and control equipment.
- 2 electric immersion heaters to keep the temperature of the biological process above 15-20° C.
- Blowers (B-501, B-502) equipped with VFD's supply air to the fine-bubble air diffusers in (TNK-501).
- Tank recirculation pumps (P-503)
- Tank discharge pumps (P-501, P-502) to membrane tanks (TNK-601, TNK-602)
- Chemical Metering System - caustic dosing pumps (P-6101) and alum dosing pumps (P-6102)

**Alarms**

Temperature Control
The Aeration tank is heated via 2 electric immersion heaters (H-501/H-502). Temperature in the tank is controlled via a local thermostat.

Recommended temperature setting – 15$^{o}$C to 20$^{o}$C

**Alarms**
If the Temperature Switch Low Low (TSLL-501) is tripped an alarm signal will register on the HMI and the flashing red beacon light will illuminate.

The Level Switch Low Low LSLL-501 is installed to protect the immersion heaters and if tripped will shut the tank heater off. An alarm signal will register on the HMI and the flashing red beacon light will illuminate.

Discharge Pump/Level Control

The aeration tank (TNK-501) has two (2) external transfer pumps (P-501, P-502). Pump P-501 transfers wastewater to membrane TNK-601 and P-502 transfers wastewater to membrane tank TNK-602.

Level transmitter (LT-501) indicates the liquor level in the aeration tank (TNK-501). As long as the level in the tank is above set point the PLC will allow the operation of both Aeration Tank discharge pumps (P-501 or P-502).

The aeration tank discharge pumps (P-501/P-502) have pressure indicators (PI-502/PI-503) to measure discharge pressure. The discharge pressure can be used to determine an estimation of the flow rate based on the pump curve.

**Alarms**
If the Level Switch High High (LSHH-501) is tripped an alarm will register on the HMI, the flashing red beacon light will illuminate and the equalization discharge pumps will be shut down or disabled from running for the duration of the high high level condition.

Dissolved Oxygen Control

The Aeration Tank is equipped with a dissolved oxygen (DO-501) sensor. The PLC is programmed to ensure the level of DO remains above 2mg/L. If the level of DO falls below the set point value a 4-20 mA signal is sent to the VFD (VFD-501) that controls the speed of the blowers (B-501, B-502).The speed of the blowers is regulated to maintain the DO at set point level.

**Alarms**
In the event the Dissolved Oxygen level set point cannot be achieved within 15 minutes of the detection of the level being outside of the set point range a low DO alarm will register on the HMI and the red beacon warning light will illuminate.

pH Control
A chemical dosing pump (P-6101) is provided to inject sodium hydroxide into the aeration tank to maintain the pH at desired pH set point. If the pH measured by pH probe (PH-501) falls below set point, the PLC will turn the pump on for 30 seconds, turn the pump off for 30 seconds and repeat this cycle until tank pH has regained desired set point. The pump stroke must be set by the MBR system operator.

**Alarms**
In the event the pH level set point cannot be achieved a low or high pH alarm will register on the HMI and the red beacon warning light will illuminate. The system will continue to adjust and achieve set point pH throughout the duration of the alarm.

Phosphorus Concentration Control
A chemical dosing pump (P-6102) is provided to inject alum (aluminum sulfate). Alum is used to remove phosphorus from the influent. The alum dosage rate is manually set locally at the metering pumps by adjusting the pump strokes. MBR system operator must determine what the dosage rate needs to be and manually set the stroke at the pump and enter influent flow rate setpoint through the HMI.

Foam Suppression
The aeration tank is equipped with an external pump (P-503) and a spray nozzle system for foam suppression. The pump (P-503) has a pressure indicator (PI-504) measuring its discharge pressure. The flow is controlled by opening a manual gate valve installed in the foam suppression line. The foam suppression line is equipped with a de-ragger unit to prevent spray nozzles from plugging.

Sludge Concentrator Supernatant Return

Supernatant can be returned to the Aeration Tank if the MBR system is operating in conjunction with a Sludge Concentrator System. Supernatant will be returned as long as the Aeration Tank level is below the High Level set point. The PLC will shut down P-503 for the duration of the return cycle.

Sludge Removal

A sludge removal port has been provided, off of the recirculation line for the Aeration Tank. The manual isolation valve must remain closed at all times. Provisions have been made in the PLC for future sludge removal options. When sludge is being removed P-503 will stop running.

### 5.1.7 Membrane Tanks

***Function:*** *M*ixed liquor filtration and supplemental biological oxidation.

Each membrane tank contains one MicroClear™ submerged membrane module (membrane cassettes are complete with stainless steel housing and permeate piping with header). Each tank is equipped with air diffusers for the purpose of scouring the membranes to assist in the prevention of clogging.

Mixed liquor from the membrane tanks (TNK-601, TNK-602) is constantly recycled back to the aeration tank (TNK-501) by external pumps (P-601, P-602) to maintain even biomass inventory within the aeration tank and membrane tanks. Each of the respective pumps (P-601, P-602) are equipped with pressure indicators (PI-603, PI-604) to measure the discharge pressure of the pumps.

The membrane tanks are also equipped with gravity overflow lines that recycle mixed liquor back to the aeration tanks.

Positive Displacement pumps (P-701, and P-702) draw the water through the membranes under a low vacuum of 0.07 to 0.2 bar.

The vacuum transmitters (VT-701, VT-702) indicate trans-membrane pressure (TMP). Calculated permeability is displayed on the touch screen.

Permeate Discharge Pump/Level Control

The tanks contain high level switches (LSH-601, LSH-602) which activate the permeate pumps (P-701, P-702) to start pulling permeate out of the membrane tank. Each of the permeate discharge pumps (P-701, P-702) will run continuously as long as the high level switch (LSH-601, LSH-602) in the respective membrane tank (TNK-601, TNK-602) is activated.

There are two vacuum set points for the permeate withdrawal system:

- Normal vacuum rate to pull the clean water out at a preset flux rate (typically 18 LMH). Permeate withdrawal requires a vacuum of 0.07 to 0.2 bar (28" to 80" WC) at the membrane tank discharge. This vacuum is transmitted by VT-701, VT-702 and indicated locally at PI-701/PI-702.

- If the equalization tank level is higher than the high level set point for more than 5 seconds, permeate pumps P-701, P-702 start increasing the vacuum, to the secondary vacuum set point level, by increasing the pump motor frequency through the variable frequency drives (VFD-701/VFD-702). The MBR will run at a higher flux to keep up with the incoming water.

**Alarms**
If the Level Switch High High is tripped a signal is sent to the PLC followed by a level high high alarm which informs the operator of an imminent overflow. It also shuts off the aeration tank pumps (P-501/P-502) to prevent more mixed liquor from entering the membrane tank.

Permeate Flow Control/Monitoring

FT-701/ FT-702 are used to measure the effluent flow from each membrane tank.

Blower Control

The membrane air scouring blowers (B-601 to B-605 for TNK-601 and B-606 to B-610 for TNK-602) are connected to the air diffusers in the membrane tanks (TNK-601, TNK-602) respectively. The blower's operate 24/7. The common air line to the membrane tank is equipped with a discharge pressure indicator (PI-601/PI-602) and a pressure switch (PSL-601/ PSL-602).

Each blower is also equipped with an electrically actuated three-way valve (MV-601, MV-602) to direct the flow of air through medium air diffusers or coarse air diffuser. Under normal operation, air is directed through the medium air diffusers at the base of the membrane housing.

| | |
|---|---|
|  | **Blower for scouring air must be on 24/7, as failure of air supply can lead to clogging of the air diffusers and membranes.** |

**Alarms**
If the pressure switch (PSL-601/PSL-602) is tripped a signal will be sent to the PLC which will generate an alarm indicating a potential blower malfunction which will cause the corresponding membrane permeate tank discharge pump to stop. This interlock is in place to prevent damaging the membranes. The flashing red beacon light will illuminate. The permeate pumps will automatically restart when the low pressure condition is cleared.

**Relax Cycle**
After every 9 minutes of permeate flow the permeate discharge vacuum pumps (P-701, P-702) will stop and the electrically actuated solenoid valve (SV-701/SV-702) will open. The resulting removal of vacuum in the system allows the membranes to relax for 1 minute.

The duration of the relax time is adjustable by changing the set point on the HMI screen to meet the particular plant operating conditions.

**Coarse Air Diffuser Cycle**
If the level switch high in the membrane tank (LSH-601, LSH-602) has not been reached in 30 minutes (i.e. permeate has not been pulled for 30 minutes, MV-601/MV-602 will change direction to allow air flow to the coarse air diffusers. Changing where air enters into the membrane tank (TNK-601, TNK-602) changes the direction of scouring, helping remove debris on the membrane cassette. The air will be directed to the coarse air diffusers for the time interval set point entered through the HMI. The duration of the coarse air diffuser cycle time is adjustable up to 15 minutes, by changing the set point on the HMI screen to meet the particular plant operating conditions.

**Membrane Backwash Cycle**
When necessary conditions have been met the backwash tank sump pump (P-801) will be activated, P-701/P-702 shut off and the backwash supply valves MV-701/MV-702 open, to allow the reversal of flow over the membrane surface.

During the entire backwash cycle, the scouring of the membranes is continuous. Air blowers (B-601 & B-602) supply air to the fine air diffusers placed beneath the membrane modules.

Note: Maximum head required for backwashing is one meter.

The duration of the backwash cycle is adjustable by changing the set point on the HMI screen to meet the particular plant operating conditions.

**Backwash Tank**
The backwash tank (T-801) has 3 level switches (LSL-801, LSH-801, LSHH-801). When the low level switch LSL-801 is tripped this indicates a low water level in the backwash tank. Solenoid valve (SV-801) will open to fill the tank to the high level switch (LSH-801).

**Alarms**
LSHH-801 indicates imminent overflow. An alarm signal will register on the HMI and the flashing red beacon light will illuminate. Operator intervention is required.

**CIP Cleaning**

Note: At design flow when the membrane discharge vacuum exceeds 0.2 bar (80" WC), as transmitted by VT-701, VT-702 and indicated locally at PI-701, PI-702, it is necessary to take the membrane tank offline for CIP cleaning. [Please note: 1 bar = 401.65 inches].

### 5.1.8 Disinfection System

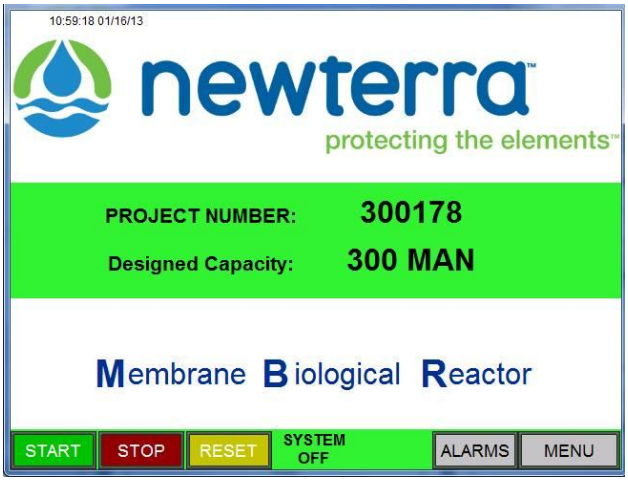
The MBR permeate lines are run through UV systems for final effluent disinfection. Each disinfection system consists of two high intensity UVmax Lights (UV-751/ UV-752) installed in series. The UVmax lights provide disinfection with a UV dosage of 40 mJ/cm$^2$ and a flow rate of 303 L/min. **NOTE: The UV system cannot be energized without being full of water.**

### *5.2 Control System Touchscreen Operation*

**Note: The screenshots in this section may not be identical to this system and are presented for example only.**

The MicroCleaTM® MBR system is designed to be fully automatic. The following pages provide a description of the control system. Since the unit operates through a touchscreen, press the screen in an area where a button or text appears.

#### 5.2.1 Main Control Screen




**System Operation**

- (SYSTEM ON/SYSTEM OFF) Indicates whether the system is currently in the **RUN** mode or turned off
- **START** button puts the system in **RUN** mode
- **STOP** button stops the system operation
- **RESET** button is used to clear alarms after they have been addressed
- Some equipment continues to run even after the **STOP** button has been pressed, however the **E-STOP** button (located on the panel front) will stop all equipment

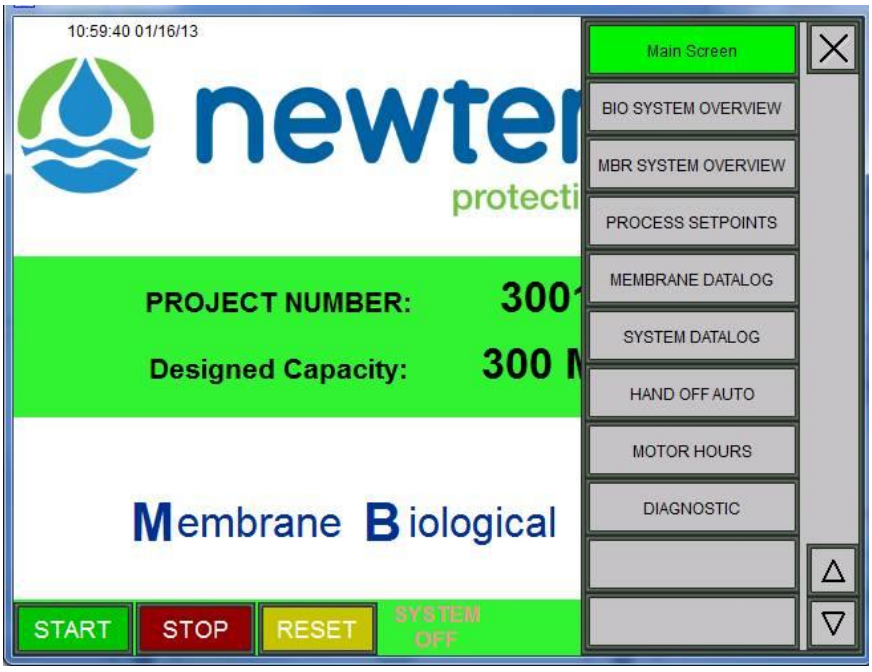
**Alarm Indication**

- When the **ALARMS** button is flashing red, it indicates an alarm is present in the system. Press the **ALARMS** button to be routed to the alarm screen.
- To clear alarms, first press the yellow **RESET** button then press the flashing **ALARMS** button. Finally press the **CLEAR ALL** button to clear the alarms.

### 5.2.2 Menu Screen

- When the **MENU** button is pressed, it shows a list of individual screens with a scroll bar as shown below.
- To go to any of the listed items, touch the icon.
- To go back to the main screen, touch the **X** button.

**Menu**



### 5.2.3 Process Screens

The main process screens are accessed from the main menu by pressing either the “Bio System Overview” button or the “MBR System Overview” button.

On the main process screens, switches are displayed as **grey** when **OFF, green** when **ON** and **RED** when in alarm condition.

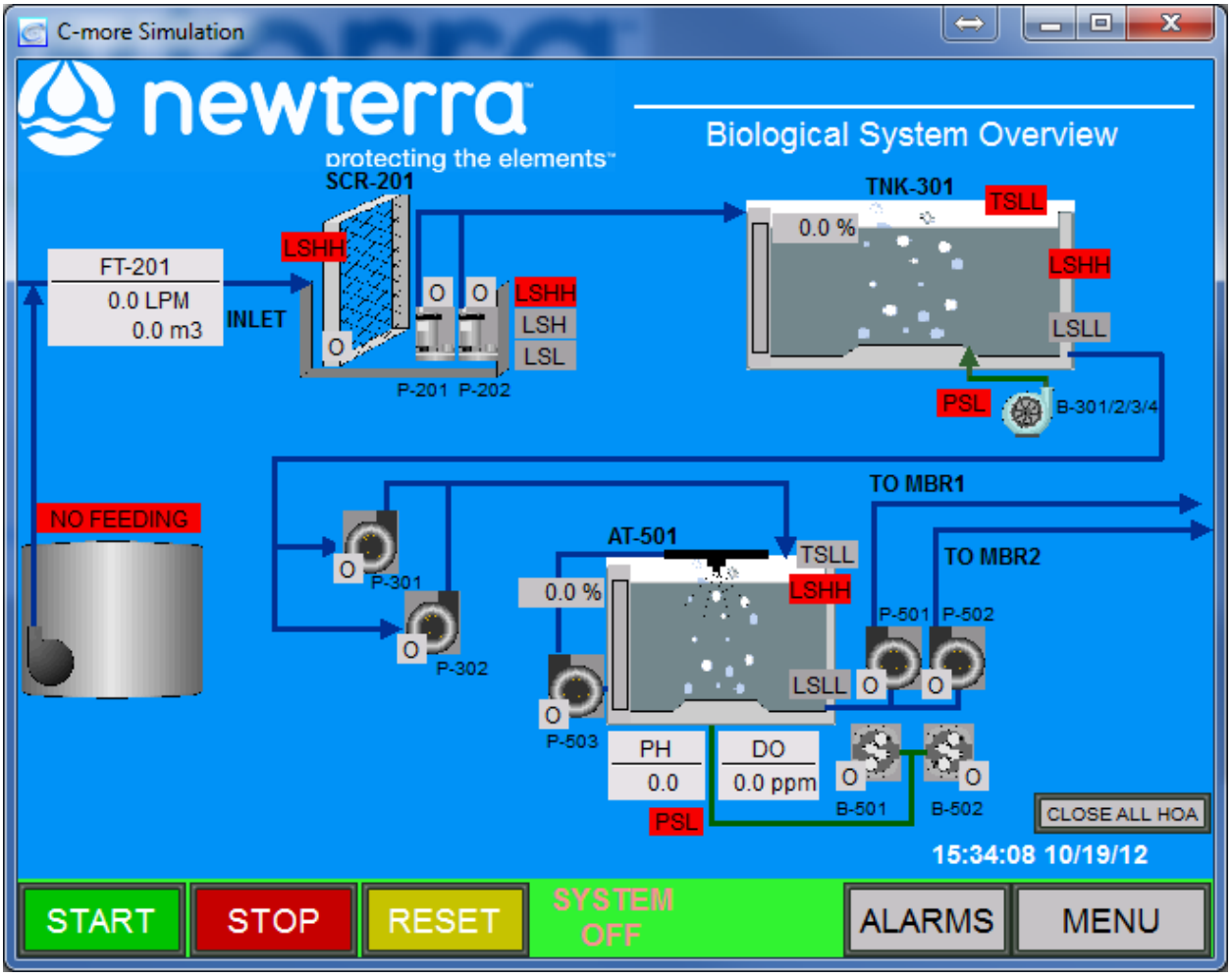
- LSHH – level switch high high
- LSH – level switch high
- LSLL – level switch low low
- TSLL – temperature switch low low
- LSL – level switch low
- PSL – pressure switch low

Individual devices can be monitored and controlled from the process screens.

- The letter indicated beside a device shows the current operational status of that device (H for hand, O for off, A for automatic).
- Touching a device on the process screen will open an HOA popup for that device.
- Devices are shown in green if they are currently running.

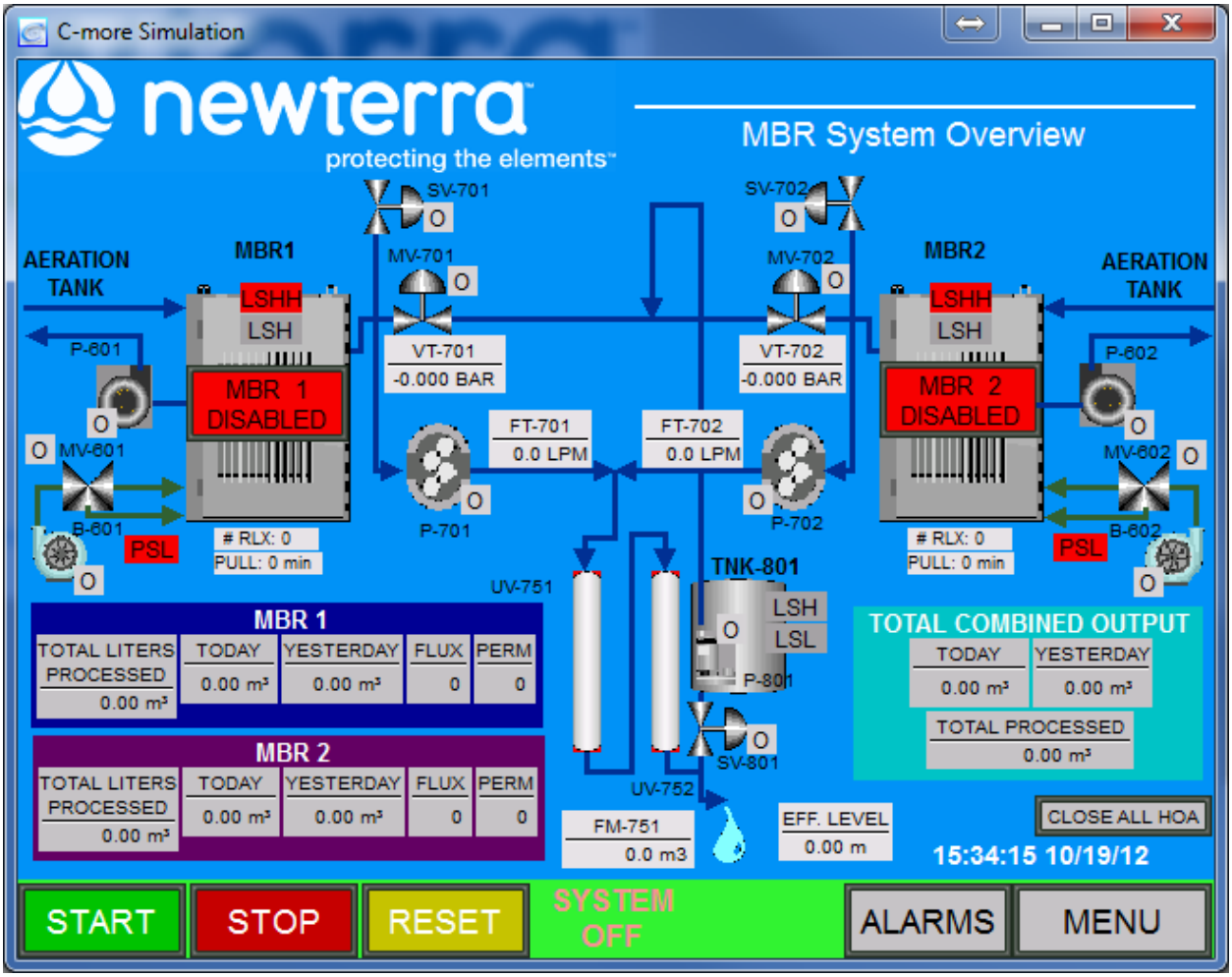
On the Biological System Overview screen:

- Inlet flow is displayed.
- Tank levels are displayed in % for the equalization and aeration tanks.
- Screen module is displayed
- Dissolved oxygen and pH are displayed for the aeration tank.
- The waste receiving system is shown on this screen if it is present in the system.



On the MBR System Overview screen:

- Permeate flow and vacuum are indicated for both membrane trains.
- The number of relaxes performed in the current cycle is displayed.
- The time on the current pull cycle is displayed.
- A summary of the membrane performance for each train is displayed.
- Turbidity will be displayed if the system is equipped with a turbidity transmitter.

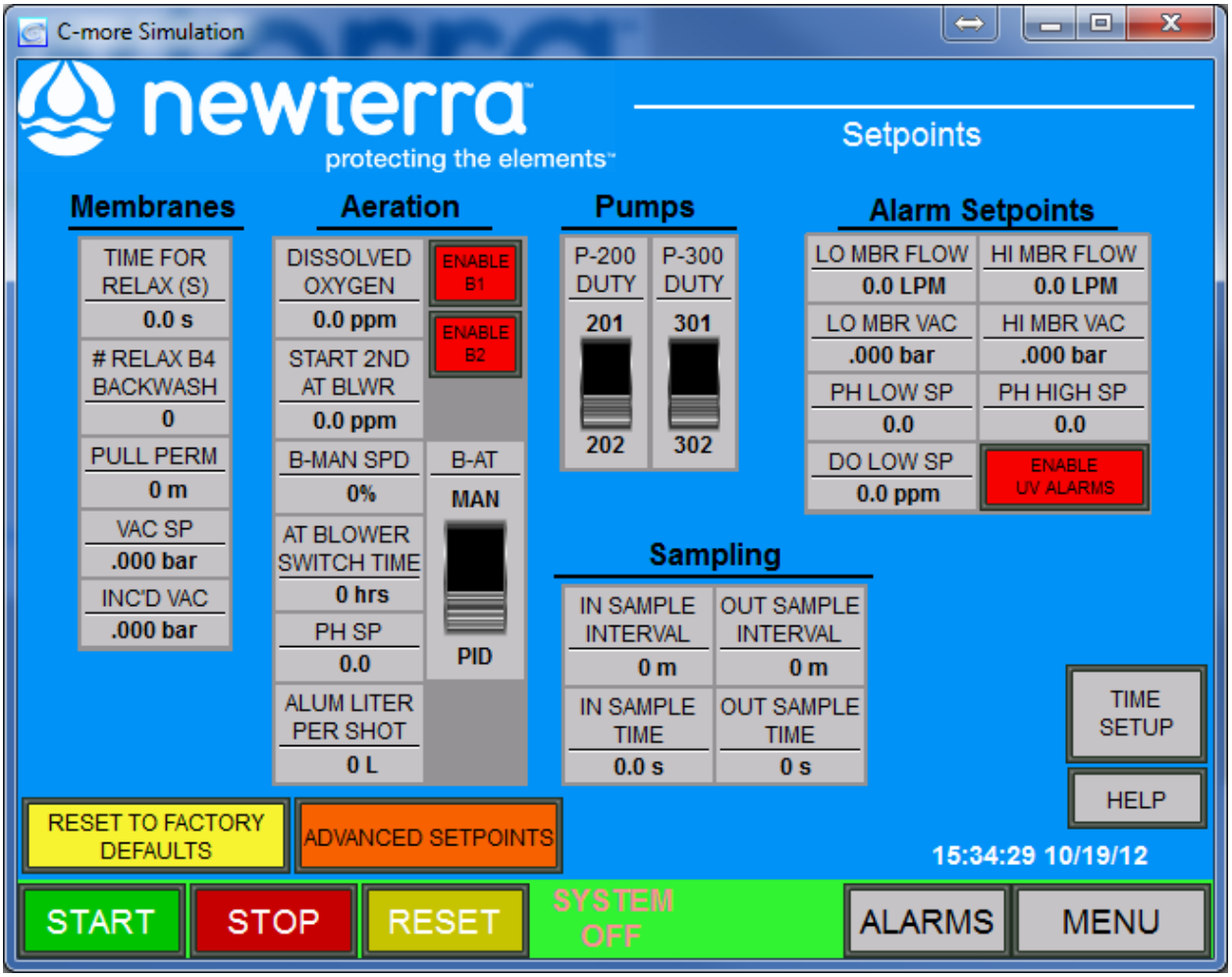


**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

### 5.2.4 Process Setpoints

The Setpoints screen is accessed from the main menu by pressing the “Process Setpoints” button.

This screen allows optimization of the system operation. Once the system is correctly set up, these values **should not need to be changed**.




**See the table on the following page for a description of the setpoints.**

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

## Newterra MBR Setpoint Descriptions

| Process Location | Setpoint | Description |
|---|---|---|
| Membranes | TIME FOR RELAX | Setpoint for the amount of time the membrane relaxes between pulls, in seconds. |
| | # RELAX B4 BACKWASH | Setpoint for the number of relaxes before a backwash is triggered. |
| | PULL PERM1 | Setpoint for the amount of time (in minutes) the system pulls permeate from TNK-601 before relaxing. |
| | PULL PERM2 | Setpoint for the amount of time (in minutes) the system pulls permeate from TNK-602 before relaxing |
| | VAC 1 SP | Setpoint for the vacuum in TNK-601 (in BAR) the system will put on the membrane under normal operating conditions. |
| | VAC 2 SP | Setpoint for the vacuum in TNK-602 (in BAR) the system will put on the membrane under normal operating conditions. |
| | INC'D 1 VAC | Setpoint for the vacuum in TNK-601 (in BAR) the system will put on the membrane when the system is experiencing a high flow (typically controlled by a high level in the EQ tank). |
| | INC'D 2 VAC | Setpoint for the vacuum in TNK-602 (in BAR) the system will put on the membrane when the system is experiencing a high flow (typically controlled by a high level in the EQ tank). |
| Aeration | DISSOLVED OXYGEN | Setpoint for the amount of dissolved oxygen in ppm in the aeration tank. |
| | START 2ND AT BLWR | Dissolved oxygen setpoint for starting the second aeration tank blower. |
| | B-MAN SPD | Manual adjustment of the aeration tank blower speed. |
| | AT BLOWER SWITCH TIME | Setpoint for switching between aeration tank blowers under normal operation. The switch time is usually 500hrs. |
| | PH SP | Setpoint for the pH level in the aeration tank. |
| | ALUM LITER PER SHOT | This setpoint is for the liters of influent flowing into the system that will trigger one dose of the alum metering pump. The dosage rate of the pump is set manually on the metering pump. |

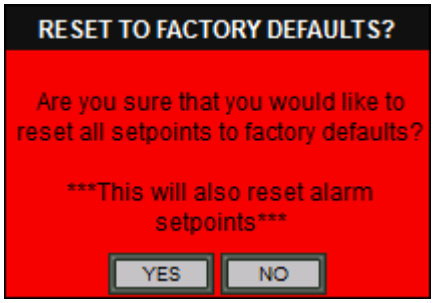
**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

| Process Location | Setpoint | Description |
|---|---|---|
| Alarm Setpoints: | LO MBR FLOW | If the discharge flow is below this setpoint for more than 5 minutes, an alarm will be initiated. |
| | LO MBR VAC | If the vacuum on the membrane is below this setpoint for more than 60 seconds, an alarm will be initiated. |
| | PH LOW SP | If the pH in the aeration tank is below this setpoint for more than 15 minutes, an alarm will be initiated. |
| | DO LOW SP | If the dissolved oxygen in the aeration tank is below this setpoint for more than 15 minutes, an alarm will be initiated. |
| | HI MBR FLOW | If the discharge flow is above this setpoint for more than 5 minutes, an alarm will be initiated. |
| | HI MBR VAC | If the vacuum on the membrane is above this setpoint for more than 60 seconds, an alarm will be initiated. |
| | PH HIGH SP | If the pH in the aeration tank is above this setpoint for more than 15 minutes, an alarm will be initiated. |
| Receiving (If Applicable): | INFL. ON TIME | This setpoint determines how long (in minutes) the pump in the receiving station pumps liquid to the MBR system. |
| | INFL. OFF TIME | This setpoint determines how long (in minutes) the pump in the receiving station is off for before pumping liquid to the MBR system again. |
| Wasting (If Applicable): | WASTE VOL | The % daily flow to be wasted |
| | SLUDG REM. V | This displays the volume remaining in the sludge settling tank (TNK-901) below P-902 after the decanted water is pumped back to the MBR system. |
| | CALCULATED WASTE VOL | The calculated waste volume shows the calculated volume of sludge that is planned to be wasted over the next 24 hours. It can be set to A which automatically calculates the volume to waste and M which will allow the operator to enter a manual volume. |

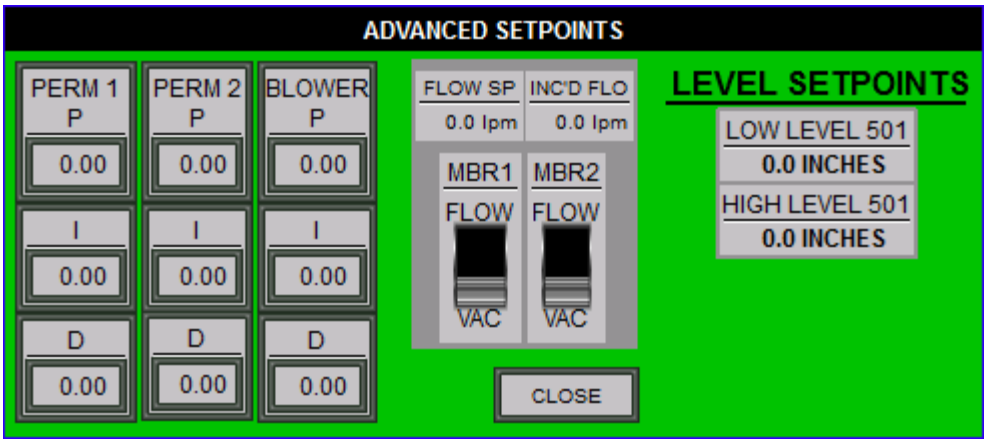
### 5.2.5 Screen Accessed Through The Set Up Screen

There are several buttons across the bottom of the Setpoints screen:
Reset to Factory Default, Advanced Set Points, Sludge Wasting,
Level SW Setup, Temp Setup and Time Setup.

**RESET TO FACTORY DEFAULTS** – Pressing this button will reset all process and alarm setpoints to the default values set at the factory.




**ADVANCED SETPOINTS** – Pressing this button will open the advanced setpoints screen. The advanced setpoints screen is password protected and these values should not be required to be modified under normal system operation.



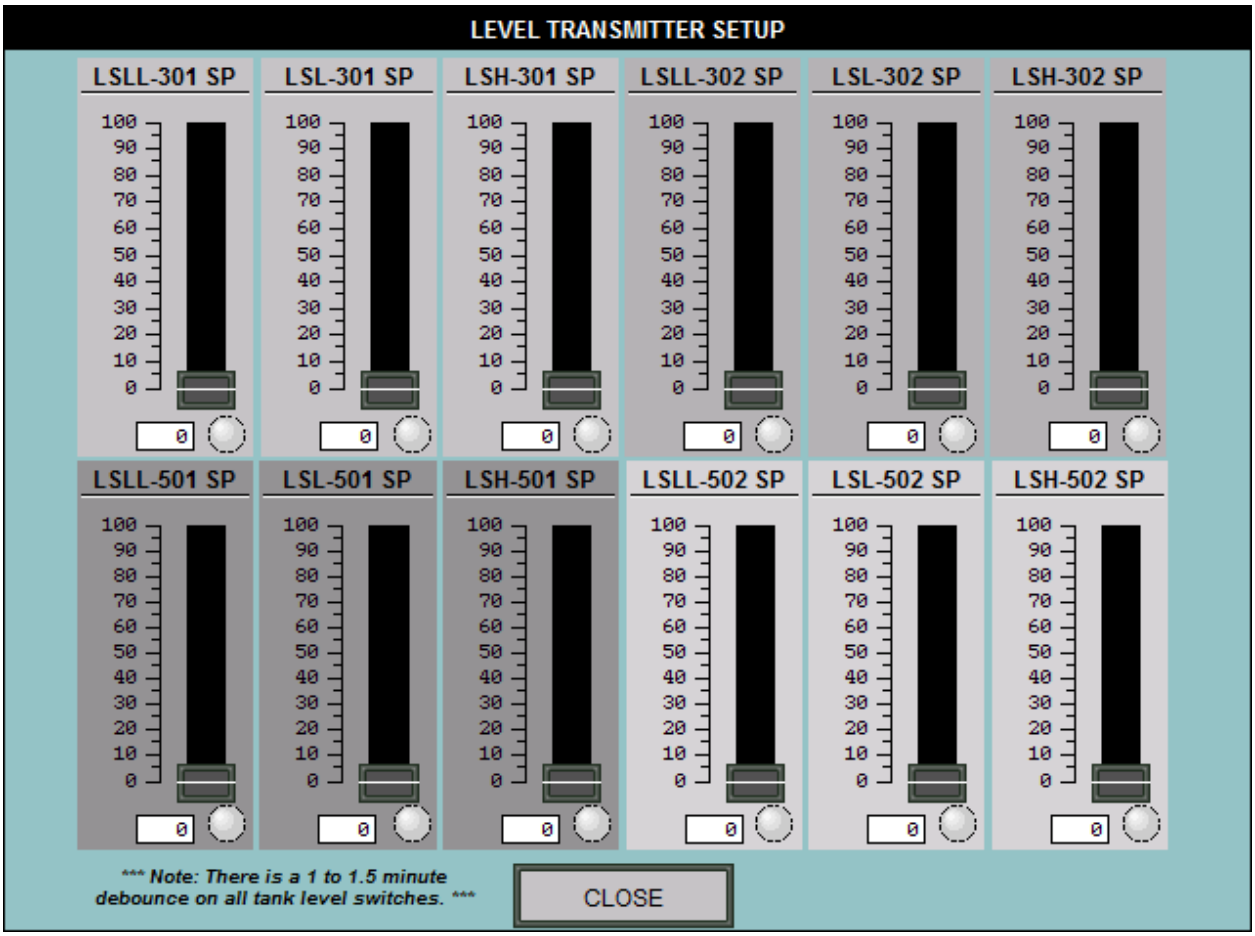

Starting from the left hand side of the screen, the three columns contain the PID control sequence used for permeate pump 1, permeate pump 2 and the aeration tank blowers.

The right hand side of the screen is used to modify the MBR permeate removal rates. These values should only be modified under the direction of a **newterra** engineer to prevent damaging the membranes.

**DUTY SELECTION** – Pressing this button will open the Select Pump Duty screen.


This screen gives you the ability to select which pump is on duty and which pump is on standby. Please note that the pump on duty runs four (4) times more than the pump on standby.

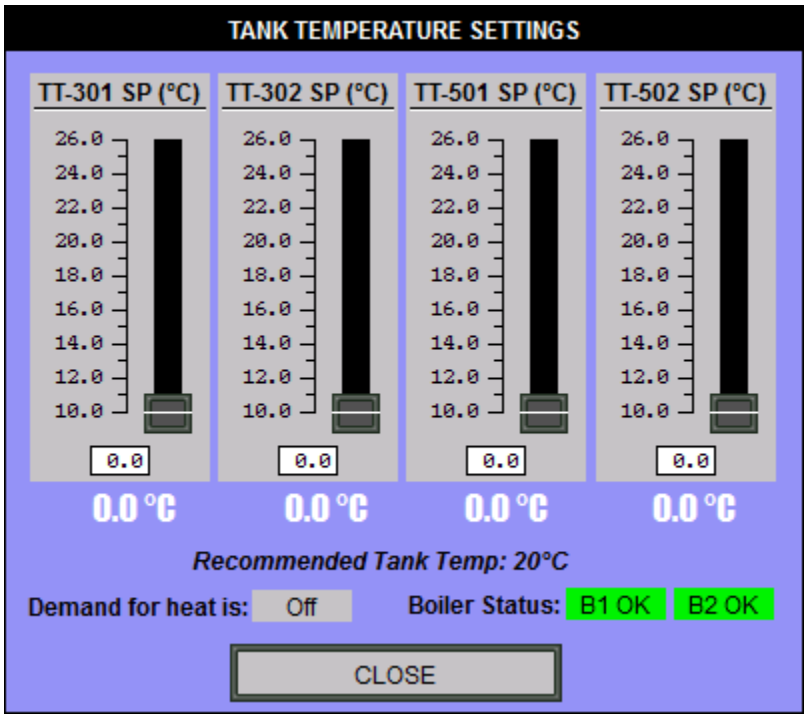
**LEVEL SW SETUP** - Pressing this button will open the Level Transmitter Setup screen.




The level switch setup is used to control the level transmitters for both the aeration and equalization tanks. The levels for low, low and high can be set for each tank using the appropriate control. Note: If the indicator light is on, this means the tank level is above set point.

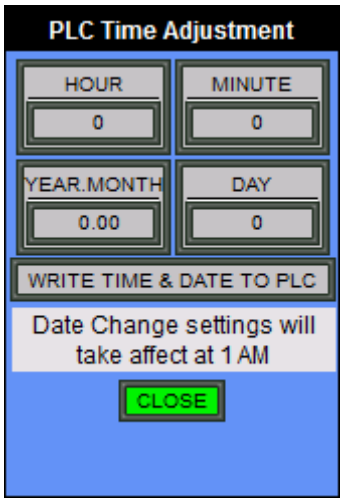
The scale is in % and 100% will correspond with approximately 74” of liquid depth.

**TEMP SETUP** – Pressing this button will open the Tank Temperature Settings screen.




The temperature setup is used to control the temperature for both the aeration and equalization tanks. Current tank temperature is displayed at the bottom of each temperature scale bar. Demand for heat status and boiler/heater status is also displayed.

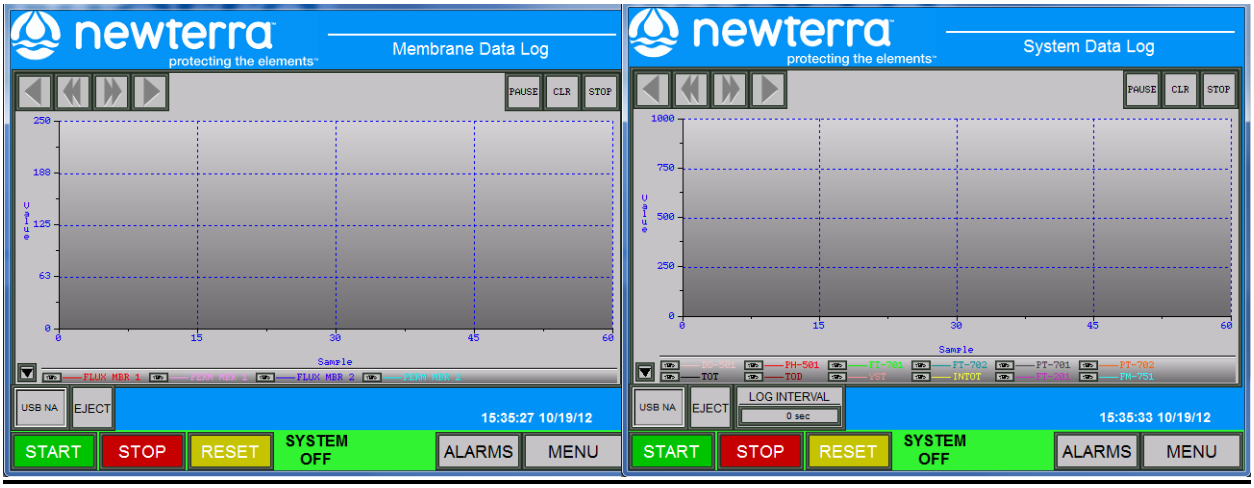
**TIME SETUP** Pressing this button will open the PLC Time Adjustment screen.




The PLC Time Adjustment is used to set the time on the PLC. Date change settings take effect after 1AM.

### 5.2.6 Membrane Data Log and System Data Log

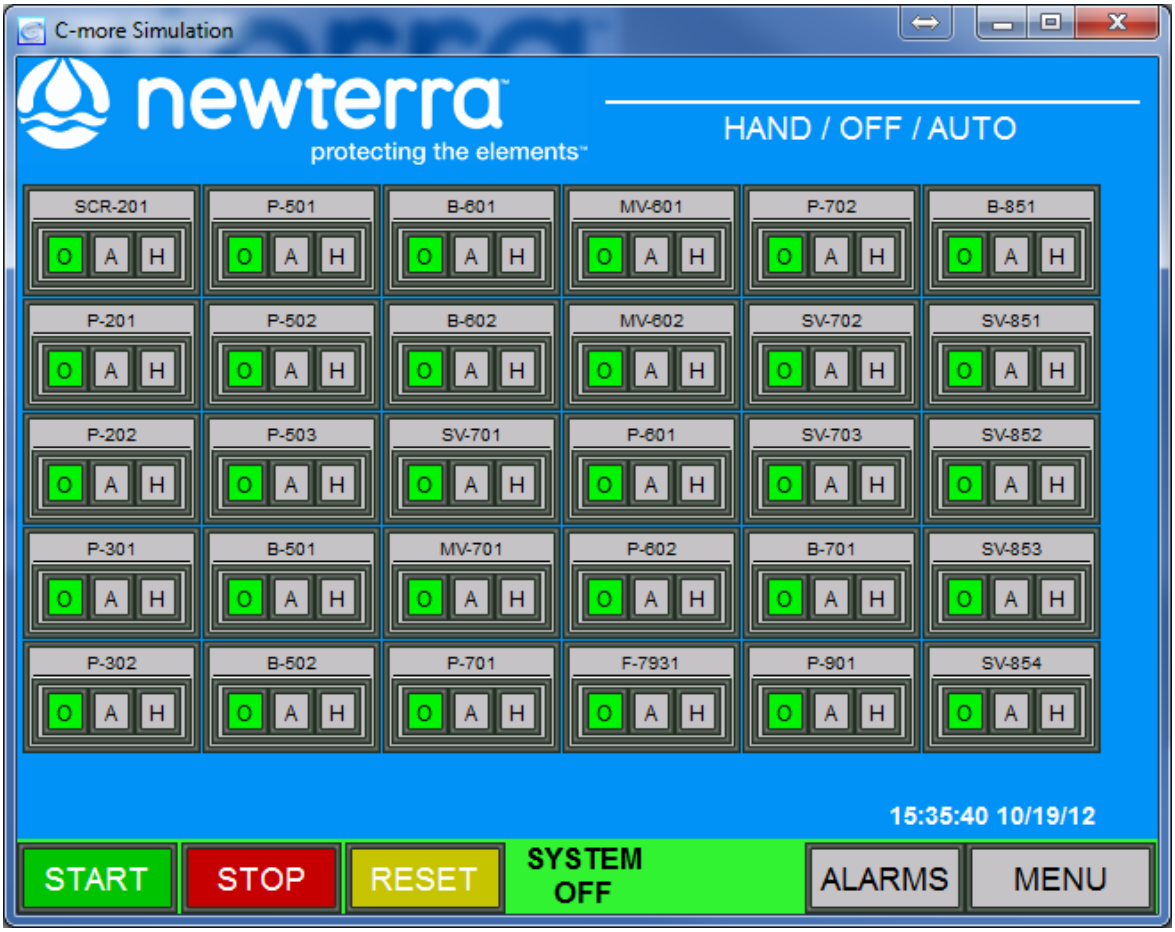
The data log screens are accessed from the main menu by pressing either the “Membrane Datalog” button or the “System Datalog” button.




- This system is setup with an extensive data log system to keep a history of the performance. It shows real time datalog of critical process operating parameters.
- This information is saved on a USB Stick that is located on the front of the control panel.
- The LOG INTERVAL setting determines how often data points are stored. The factory default setting is 600 seconds.
- The operator can control which variables display on each screen by pressing the eye next to the variable in the list below the graph.

### 5.2.7 System HAND / OFF / AUTOs (HOA's)

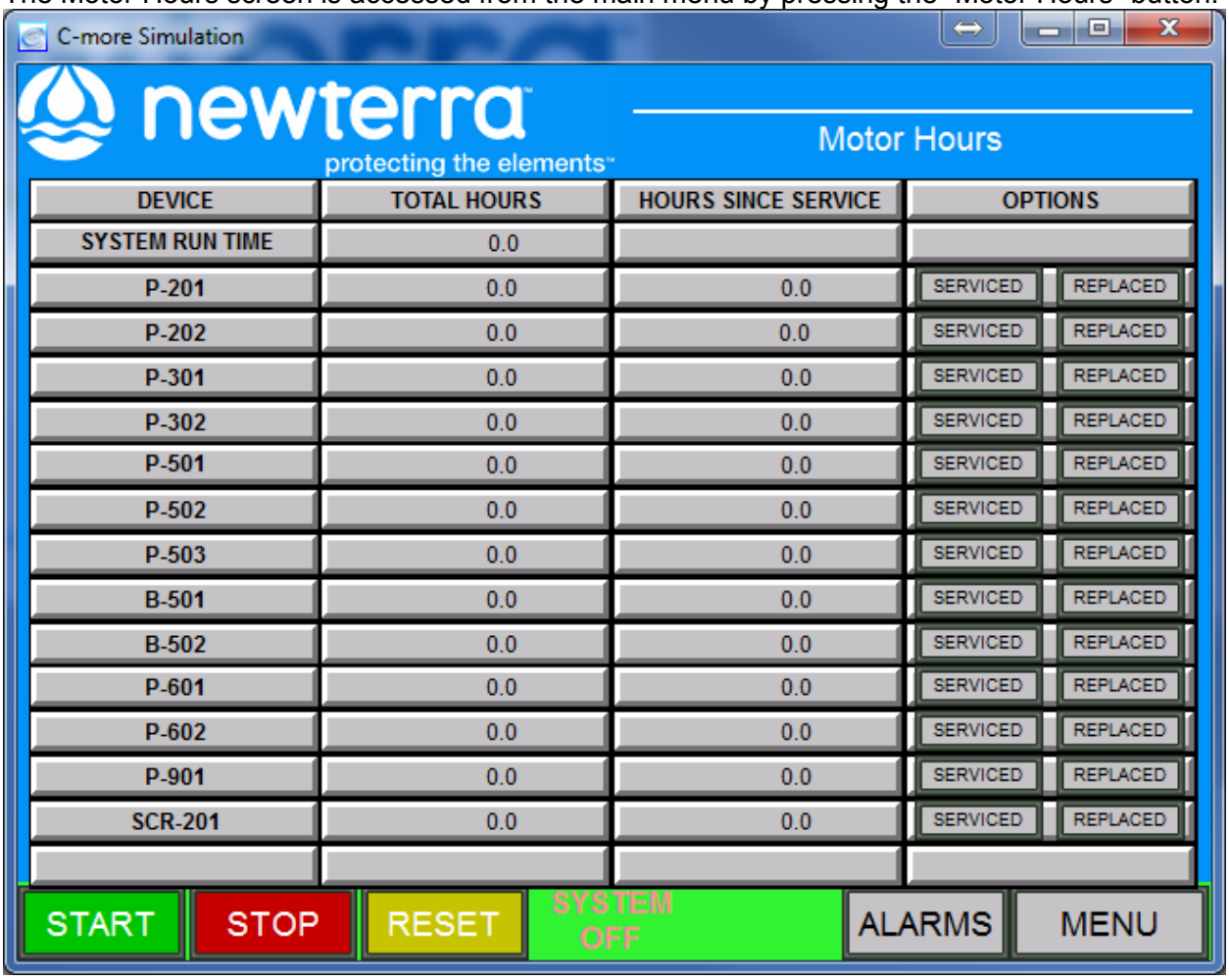
The Hand / Off / Auto screen is accessed from the main menu by pressing the "Hand Off Auto" button.




- Each PLC controlled motor or valve in the system has a Hand/Off/Auto (HOA) Switch to control its operation. This screen displays all the system HOA's.
- For normal operation, all switches should be in the AUTO (A) position.
- The HAND (H) position of a switch is used for testing and troubleshooting of the system. As a safety precaution to prevent damage to equipment, the equipment will operate for two minutes in hand mode and will then return to the OFF (O) position.

### 5.2.8 Motor Hours

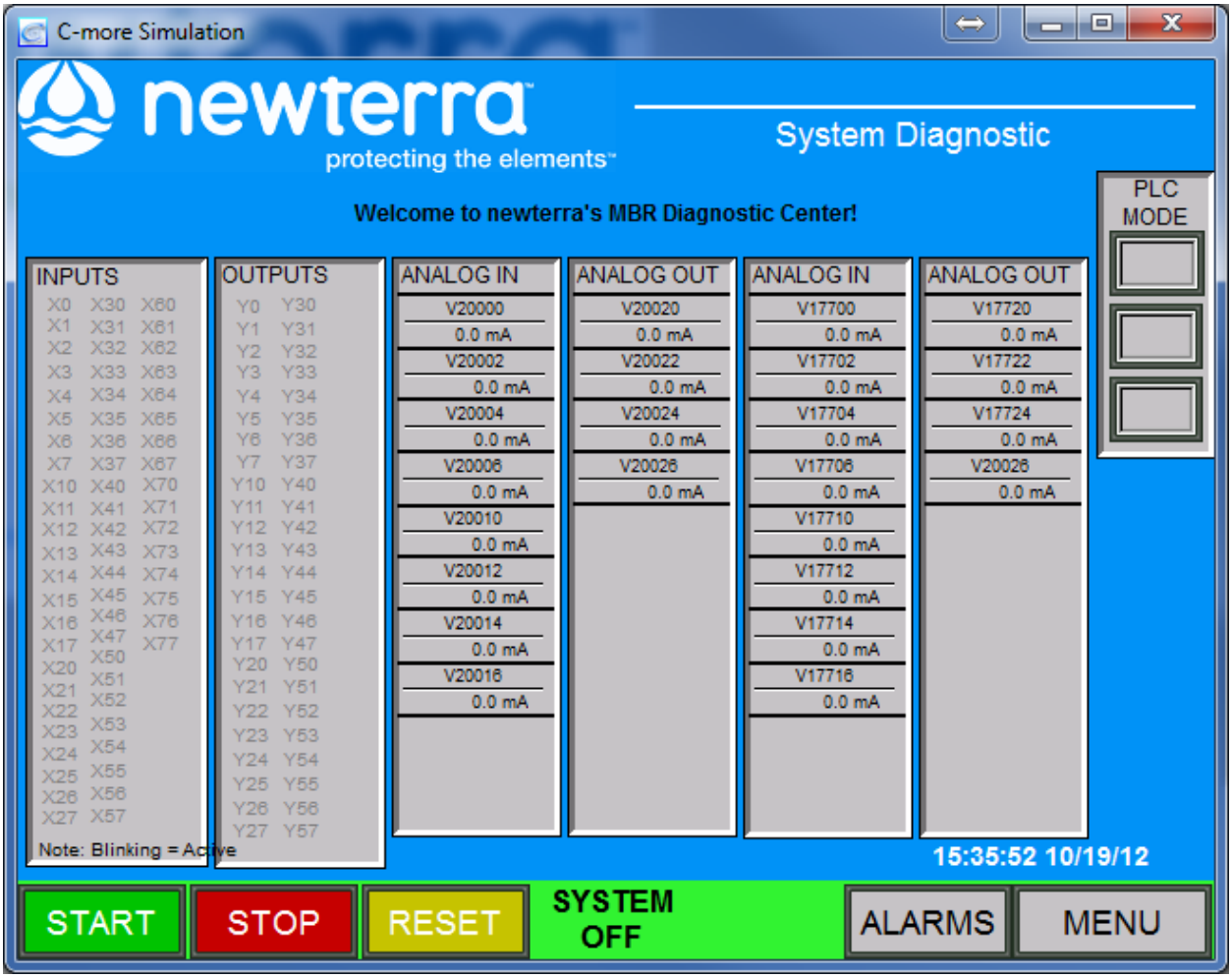
The Motor Hours screen is accessed from the main menu by pressing the “Motor Hours” button.




- This screen shows the total number of hours that each motor has run. When the SERVICED button is pressed, it resets the hours since service to zero (0). When the REPLACED button of a motor is pressed, it resets the total hours to zero (0).

### 5.2.9 System Diagnostic Screen

The System Diagnostic screen is accessed from the main menu by pressing the "Diagnostic" button.




- This screen shows the status of each PLC input and output signal in the system as well as the mode that the PLC is in.
- The PLC screen is generally used for trouble shooting when speaking to a **newterra** representative.
- It is tested and programmed by **newterra** engineers, and modification can only be made by **newterra** engineers.

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

### *5.3 ALARM TROUBLESHOOTING LIST*

| Alarm Code | Alarm Name | Alarm Location | Alarm Description | Beacon Status | Troubleshooting Recommendation | Remedy Action |
|---|---|---|---|---|---|---|
| C100 | PLC ALM | CP | SHUTDOWN PLC Fault | FLASH | Please contact newterra - PLC problem | Please contact newterra -PLC problem |
| C101 | PWR FAIL ALM | CP | WARNING, Power Fail | FLASH (Green) | Power has failed to the unit | Press Reset |
| C102 | LAHH-301 | EQ Tank | Level Alarm High High, EQ Tank | FLASH | Investigate if pump P-301, P-302 has failed, or system is receiving higher than design level, or membrane is fouling | Replace pump, divert flow, perform mem-brane chemical cleaning |
| C103 | TALL-301 | EQ Tank | Temperature alarm low low | FLASH | Check if the EQ tank heater (H-301) are operating normally. Check temperature setpoint. | Replace EQ Tank Heater |
| C104 | LALL-301 | EQ TANK | Low Low Level Alarm | WARN | Check for level transmitter operation or upstream pipe obstruction or pump failure. | Clear obstructio n or repai/ replace faulty equipt |
| C105 | BCKWSH FILL FAIL | BACKWASH | Backwash tank failed to fill | WARN | This alarm only comes on when SV-801 and P-701/702 are running and LSH-801 is not on for 15 minutes | Check if SV-801 works |
| C106 | LAHH-501 | AERATION TANK | High High level alarm in Aeration Tank | FLASH | Check pump P-501 for failure. | Replace pump P-501. |

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

| Alarm Code | Alarm Name | Alarm Location | Alarm Description | Beacon Status | Troubleshooting Recommendation | Remedy Action |
|---|---|---|---|---|---|---|
| C107 | LALL-501 | AERATION TANK | Low Low Level Alarm | WARN | Check for level transmitter failure or upstream pipe obstruction or pump failure. | Clear obstruction or repair/ replace faulty equipt |
| C110 | TALL-501 | AERATION TANK | Low low temperature alarm in Aeration Tank | WARN | Check setpoint temperature. Check the hydronic water heating system to ensure it is working | Adjust set point temperature. Repair hydronic water heating system. |
| C111 | PHAL-501 | AERATION TANK | Low pH Alarm | WARN | Check if caustic injection system is working and or needs refill. Check if the pH probe is fouled or if the probe requires calibration. | Replace caustic injection system or refill. Clean pH probe. Calibrate pH probe. |
| C112 | PHAH-501 | AERATION TANK | High pH alarm | WARN | Check if caustic injection system is malfunctioning or if PH probe is calibrated or fouled | Replace caustic soda injection. Calibrate pH probe or clean sensor. |

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

| Alarm Code | Alarm Name | Alarm Location | Alarm Description | Beacon Status | Troubleshooting Recommendation | Remedy Action |
|---|---|---|---|---|---|---|
| C113 | DOAL-501 | AERATION TANK | Dissolved Oxygen Alarm low | WARN | Investigate if there is septic smell & check the mixing pattern. If system smell septic with no uniform mixing, air diffuser might be clogged, blowers may not work or plant is overloaded. Ensure DO probe is calibrated and clean | Increase aeration rate to maintain DO above 1.5 mg/L, or replace clogged diffuser, or change blower, or calibrate or clean DO probe. |
| C114 | TALL-7901 ALM | BLDG-7901 | Low low Temperature alarm for building | WARN | Check if electric heaters have failed or if BLDG door is open | Repair or replace heater(s) if required. |
| C115 | P-301 FAIL | EQ PUMP | Pump P-301 has potentially failed | FLASH | Check pump P-301 for failure. | Replace pump P-301 |
| C116 | P-302 FAIL | EQ PUMP | Pump P-302 has potentially failed | FLASH | Check pump P-302 for failure. | Replace pump P-302 |
| C117 | P-501 FAIL | AERATION TANK | Pump P-501 has potentially failed | FLASH | Check pump P-501 for failure. | Replace pump P-501 |
| C120 | P-503 FAIL | EQ2 | High high temperature alarm in EQ Tank 2 | WARN | Check the heating loop valve to tank 302. Check temperature setpoint. | Replace valve |
| C121 | P-502 FAIL | AERATION TANK | Pump P-502 has potentially failed | FLASH | Check pump P-502 for failure. | Replace pump P-502 |
| C122 | OLA-B-501 | EQ AERATION | Blower motor tripped off on overload. | WARN | Check blower air line equipment and blower motor. | Replace faulty equip-ment. |

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

| Alarm Code | Alarm Name | Alarm Location | Alarm Description | Beacon Status | Troubleshooting Recommendation | Remedy Action |
|---|---|---|---|---|---|---|
| C123 | OLA-B-502 | EQ AERATION | Blower motor tripped off on overload. | WARN | Check blower air line equipment and blower motor. | Replace faulty equip-ment. |
| C125 | FLTA-701 | VFD PERM1 | VFD Fault | Flashing | Check VFD fault and Pump | Replace pump and VFD |
| C126 | FLTA-702 | VFD PERM2 | VFD Fault | Flashing | Check VFD fault and Pump | Replace pump and VFD |
| C127 | PAL-601 | MEMBRANE TANK 1 | Pressure Alarm low on air inlet to Membrane Tank 1 | FLASH | Check if blower B-601 has failed. | Replace blower if required. |
| C130 | PAL-602 | MEMBRANE TANK 2 | Pressure Alarm low on air inlet to Membrane Tank 2 | FLASH | Check if blower B-602 has failed. | Replace blower if required. |
| C131 | LAHH-601 | MEMBRANE TANK 1 | High High level alarm in Membrane Tank 1 | FLASH | Check pump P-601 for failure. | Replace pump P-601. |
| C132 | LAHH-602 | MEMBRANE TANK 2 | High High level alarm in Membrane Tank 2 | FLASH | Check pump P-602 for failure. | Replace pump P-602. |
| C133 | VTAL-701 | PERM 1 | Low vacuum alarm on permeate line from MBR1 | FLASH | Check for vacuum leak or pump failure. | Repair and replace as required. |
| C134 | VTAH-701 | PERM 1 | High vacuum alarm on permeate line from MBR1 | FLASH | Check for closed valve on permeate side or check membranes for severe fouling. | Open valve or clean mem-branes. |
| C135 | VTAL-702 | PERM 2 | Low vacuum alarm on permeate line from MBR2 | FLASH | Check for vacuum leak or pump failure. | Repair and replace as required. |

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

| Alarm Code | Alarm Name | Alarm Location | Alarm Description | Beacon Status | Troubleshooting Recommendation | Remedy Action |
|---|---|---|---|---|---|---|
| C136 | VTAH-702 | PERM 2 | High vacuum alarm on permeate line from MBR2 | FLASH | Check for closed valve on permeate side or check membranes for severe fouling. | Open valve or clean mem-branes. |
| C137 | FTAL-701 | PERM 1 | Low permeate flow alarm on permeate line from MBR1 | FLASH | Check for closed valve or permeate pump failure | Open valve or repair/ replace permeate pump. |
| C140 | FTAH-701 | PERM 1 | High permeate flow alarm on permeate line from MBR1 | FLASH | Check for vacuum leak and operation of permeate pump | Repair and replace as required. |
| C141 | FTAL-702 | PERM 2 | Low permeate flow alarm on permeate line from MBR2 | FLASH | Check for closed valve or permeate pump failure | Open valve or repair/ replace permeate pump. |
| C142 | FTAH-702 | PERM 2 | High permeate flow alarm on permeate line from MBR2 | FLASH | Check for vacuum leak and operation of permeate pump | Repair and replace as required. |
| C143 | PWRAL-8201 | MCP1 | AC Power Loss to MCP1 | FLASH | Check system power. | Repair as required. |
| C145 | P-201 FAIL | SCREEN PUMP | Pump P-201 has potentially failed | FLASH | Check pump P-201 for failure. | Replace pump P-201 |
| C146 | P-202 FAIL | SCREEN PUMP | Pump P-202 has potentially failed | FLASH | Check pump P-202 for failure. | Replace pump P-202 |
| C147 | B-305 FAIL | EQTANK | Blower B-305 has potentially failed | FLASH | Check blower for failure. Check breaker. | Replace blower B-305 |

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

| Alarm Code | Alarm Name | Alarm Location | Alarm Description | Beacon Status | Troubleshooting Recommendation | Remedy Action |
|---|---|---|---|---|---|---|
| C150 | SCN-201 FAIL | SCREEN | Potential screen paddle wheel motor failure. | FLASH | Check screen paddle wheel motor for failure. | Replace paddle wheel motor. |
| C151 | B-7901 FAIL | AIR EXCHANGE | Potential blower failure | FLASH | Check motor breaker | Turn breaker on |
| C152 | KILLA-SYS | System | This alarm comes on when the E-Stop button is engaged | FLASH | Inspect E-Stop buttons. | Pull out E-Stop Switch |
| C155 | LAHH-7922 | FLOOR SUMP | Sump Pump P-7922 has potentially failed | FLASH | Check pump P-7922 for failure. | Replace pump P-7922 |
| C156 | LAHH-201 | SCREEN DISCHARGE | High high level alarm in Screen Module discharge tank. | FLASH | Potential discharge tank pump P-201 P-202 failure | Replace pump. |
| C157 | LAHH-202 | SCREEN DISCHARGE | High high level alarm in Screen Module discharge tank. | FLASH | Potential discharge tank pump P-201 P-202 failure | Replace pump. |
| C160 | LAHH-7911 | SUMP BLDG 7911 | Sump Pump P-7911 has potentially failed | FLASH | Check pump P-7911 for failure. | Replace pump P-7911 |
| C161 | PAL-301 | EQ TANK | Pressure Alarm low on air inlet to EQ Tanks | FLASH | Check if blower B-301 or B-302 have failed. | Replace blowers if required. |
| C162 | PAL-501 | AERATION TANK | Pressure Alarm low on air inlet to EQ Tanks | FLASH | Check if blower B-501 or B-502 have failed. | Replace blowers if required. |
| C164 | UVA-751 ALM | PERM 1 | UV-light UV-751 has failed | WARN | Check if UV lamp has failed | Change UV lamp |
| C165 | UVA-752 ALM | PERM 2 | UV-light UV-752 has failed | WARN | Check if UV lamp has failed | Change UV lamp |

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

| Alarm Code | Alarm Name | Alarm Location | Alarm Description | Beacon Status | Troubleshooting Recommendation | Remedy Action |
|---|---|---|---|---|---|---|
| C166 | UVA-BOTH | PERM1 and PERM2 | UV-light 751 and UV-752 have failed | WARN | Check if UV lamp has failed | Change UV lamp |
| C171 | BACKWASH1 FAILED | BACKWASH | Backwash to TNK-601 Failed | WARN | Backwash did not complete – system skips backwash | Check function of back-wash pump and valve. |
| C172 | BACKWASH2 FAILED | BACKWASH | Backwash to TNK-602 Failed | WARN | Backwash did not complete – system skips backwash | Check function of back-wash pump and valve. |
| C173 | WWR-101 ALM | WASTE WATER RECEIVING STATION | Alarm received from WWR. | WARN | Go to WWR control panel to determine what alarm has been initiated. | Respond accordingly. |
| C174 | SDW-901 ALM | SLUDGE CONCENTRATOR | Alarm received from SC. | WARN | Go to SC control panel to determine what alarm has been initiated. | Respond accordingly. |
| C176 | LAHH-7912 ALM | SUMP BLDG 7912 | Sump Pump P-7912 has potentially failed | FLASH | Check pump P-7912 for failure. | Replace pump P-7912 |
| C177 | LAHH-7921 ALM | SUMP BLDG | Sump Pump P-7921 has potentially failed | FLASH | Check pump P-7921 for failure. | Replace pump P-7921 |
| C203 | P-601 FAIL | MEMBRANE TANK 1 | Pump P-601 has potentially failed | FLASH | Check pump P-601 for failure. | Replace pump P-601 |
| C204 | P-602 FAIL | MEMBRANE TANK 2 | Blower B-602 has potentially failed | FLASH | Check blower for failure. Check breaker. | Replace blower B-602 |

## 5.4 PLANT START-UP

**Mechanical & Electrical Start-up Procedure:**

1. If the system is being started for the first time, work your way through the **newterra** Pre-Commissioning Test Checklist presented in AppendixB of this O&M Manual.

2. If the kill switch on panel (red mushroom shaped button) is pulled out, then push it in to confirm that the MBR system is off.

4. Push the reset button on the operator interface to reset all alarms.

5. Make sure there are no obstructions over any moving parts, for example a jacket laying on a belt drive.

6. Put all hand/off/auto switches to Auto.

7. Pull the kill Button (red button on panel) out to start the process.

8. Push the start button on the Operator Interface.

**Process Start-up:**

**Seeding**

The procedure for determining the amount of seed sludge required for process start-up, and methods for seeding the system are as follows:

1. Calculate the volume of seed sludge required to ensure that there is a minimum of 3,000 mg/L MLSS in the membrane tank. The volume of seed sludge required can be calculated with the following formula.

$$V_s = \frac{3000 \times V_t}{MLSS_s}$$

$V_s$: Total volume of seed sludge for aeration and membrane tanks ($m^3$)
$V_t$: Total volume of aeration and membrane tanks ($m^3$)
$MLSS_s$: MLSS concentration of seed sludge from a similar treatment system (mg/L)

2. Arrange for delivery of fresh seed sludge from an activated sludge system employing a suspended growth type process. If it is possible, obtain seed sludge from a facility treating a similar wastewater and operated with similar processes (nitrification etc).

3. Drain the water used for clean water testing from the reactor, if the returned activated sludge (MLSS<10,000 mg/L) is used. Do not drain the water after clean water testing, if the dewatered sludge is used.

4. **Screen all seed sludge with the 2 mm basket screen** before the sludge is transferred to the aeration or membrane tanks **to remove gross solids and rags and hair**.

5. Remove grit from the screen if required.

6. Once the tanks are fully seeded in aeration tank and membrane tank is turned on, the system can start to work. Do not waste sludge, as membrane filtration continues, until the MLSS in the aerobic or membrane tank becomes concentrated to the targeted concentration. The system will be started at a reduced design flow/loading initially per **newterra** start-up schedule.

7. Foaming may occur during start-up, which is normal. However, after a period of time (1 week), the foam should disappear. Foaming can be addressed by water spraying, food based defoamer **(silicone based defoamer is strictly prohibited**) addition, or aeration minimization in the membrane tank.

8. If a defoamer is required, contact **newterra ltd**. for recommendation of an acceptable antifoaming agent and dosing quantities.

9. Process start-up and adaptation periods can last for two or three weeks.

## Seeding with Dry Cultured Bacteria

When fresh activated seed sludge is not available, **newterra** can supply dry cultures bacteria (a consortia group of different kinds of bacteria) for start-up. In order to reach the desired 2,000 to 3,000 mg/L MLSS to prevent premature membrane fouling, substrate addition can be carried out for a week or so. The procedure for seeding the system is as follows:

1. Introduce site flows into MBR
2. Once site flow reaches the Aeration Tank, dry bacteria is to be added on a daily basis into Aeration Tank (TNK-501) as per following:

    - 40 lb (18 kg) – 1st Day
    - 40 lb (18 kg) – 2nd Day
    - 20 lb (9 kg) - 3rd Day
    - 20 lb (9 kg) - 4th Day

Co-substrate can be added to the EQ tank as food source for speeding up the start-up process if needed. Please consult newterra Ltd.
Quantities of dry bacteria and procedure of seeding will be confirmed by **newterra** technical representative during commissioning / start-up period.

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

| | |
|---|---|
|   | It is advisable to start the MBR system with a minimum MLSS concentration of 3,000 mg/L to minimize foaming. The seed sludge should come from a plant which has a screen of 2 mm. It is critical to screen the seed sludge with 2 mm perforated screen prior to seeding for membrane protection. |

| | |
|---|---|
|   | No untreated wastewater should enter the membrane tank. Make sure wastewater is completely biologically treated before it gets to the membrane tank |

## *5.5 SYSTEM OPERATING GUIDELINES AND MONITORING*

### 5.5.1 Operating Guidelines

The operators are expected to run the MBR system at all times in accordance with the maintenance, operational procedures and details specified in this manual. The following two tables provide operating parameters that can be easily maintained, and define the range of operating values.

**There may be situations where the system needs to operate outside of the conditions covered in this manual. If these conditions develop, please consult newterra ltd. to discuss operation and methods to optimize performance.**

Generally, the following points can be used to operate the MBR system properly:

1. The MBR system is designed to treat wastewater from the work/mining camp with specified influent characteristics.
2. Never operate the MBR tank below the minimum membrane submerged level. It is necessary to maintain a minimum of 250 mm liquid level above the membrane aggregates to ensure they are wet at all times and to allow for proper filtration.
3. Always supply the required amount of air for scouring to the membrane module
4. Always filter wastewater at or below design flow rate.
5. Periodically, relax the membranes by ending filtration while allowing the membrane aeration scour to operate continuously and initiate backwash operation during membrane relaxation (default relaxation mode preset in PLC - permeation continues for 9 min and stops for 45 sec, and backwash the membrane).
6. Always operate the MBR in accordance with the parameters listed in the following tables.
7. Clean the membranes in-place with a dilute chemical in accordance with Section 6.1.

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

## Membrane Filtration Operational Conditions

| Parameter | Recommended Value | Notes |
|---|---|---|
| **Diffuser Relaxation** | 10 minutes/day | Effluent filtration must be turned off, blower shuts down for 10 mins/day |
| **Relax Time** | 1 min/10 min | Filtration must be off and blower are operating continuously |
| **Backflusing** | 60 cycles-- | Built-in backwash mode during relaxation mode |
| **In-situ backwash (with or without chemicals)** | 240s/60 cycles | Requires 60L to fully backwash one MB3-1 module. .Actual time may vary pending membrane fouling severity. If chemicals are used, refer to Membrane Cleaning Section 6.1. |
| **Avg Flux Rate** | 15 LMH (9 gpd) | Average flux rate with permeation 9 minutes out of 10 minutes |
| **TMP** | > 0.2 bar (2.9 psi) | Membranes to be cleaned once the TMP exceeds 0.2 bar (2.9 psi) |

## MBR – Recommended Biological Operational Conditions

| Parameter | Recommended | Range | Notes |
|---|---|---|---|
| **MLSS (mg/L)** | 10,000 | 8,000 – 15,000 | Never operate the membranes if MLSS < 3,000 mg/l. Sludge wasting should be undertaken as required to maintain target MLSS |
| **Temperature (°C)** | 15 - 35 | 10 – 35 | Avoid sudden changes in temperature. Minimum operating temperature is 15 °C |
| **pH (s.u.)** | 6.8 - 8.5 | 6.0 – 9.0 | Membrane aggregate can handle a change in pH, however it is recommended to keep pH between 6.8 - 8.5 |
| **DO (mg/L)** | ≥ 2.0 (in aeration tank) | 0 – 8.0 | This can be maintained by adjusting the volume of air supplied to the aeration tank |
| **Viscosity (mPa-s)** | Not applicable | 0 – 300 | – |
| **F:M (kg BOD/kg MLSS/d)** | 0.1 | 0.03 – 0.2 | F:M = [Flow ($m^3$/d) x BOD conc (mg/l)] / [Process volume ($m^3$) x MLSS conc (mg/l)] |
| **F:M (kg COD/kg MLSS/d)** | 0.15 | 0.05 – 0.3 | F:M = [Flow ($m^3$/d) x BOD conc (mg/l)] / [Process volume ($m^3$) x MLSS conc (mg/l)] |

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

### 5.5.2 Sampling

To ensure accurate system monitoring and the validity of laboratory test data, samples must be collected as outlined below. These are only recommended guidelines. It is imperative that scheduled testing protocols are performed in compliance with local regulatory agency requirements. Composite samples of the MBR systems may need to be sent out to a certified laboratory for testing, based on the local regulatory requirements.

**Monitoring and Testing Requirements**
**Legend: D = daily; W = weekly; M = monthly; AR = as required.**

| Parameter*** | Influent | Aeration Tank | Membrane Tank | MBR Effluent |
|---|---|---|---|---|
| **Flow rate** | D (PLC) | | | D (PLC) |
| Fat, Oil and Grease (FOG) | AR | | | AR |
| Alkalinity | AR | | | |
| Biological Oxygen Demand (BOD) | W | | | W |
| Total Suspended Solids (TSS) | W | | | W |
| Total Kjeldahl Nitrogen / Total Nitrogen (TKN / TN) | M | | | AR |
| Ammonia Nitrogen($NH_3$-N) | | | | AR |
| Nitrate Nitrogen ($NO_3$-N) | | | | AR |
| Total Phosphorus (TP) | W | | | W |
| Mixed Liquor Suspended Solids (MLSS) | | | W | |
| Mixed Liquor Volatile Suspended Solids (MLVSS) | | | AR* | |
| Temperature | | D (PLC) | | |
| pH | AR | D (PLC) | | W |
| Dissolved Oxygen (DO) | | D (PLC) | | |
| Filterability | | | W | |
| Turbidity | | | | AR** |
| Fecal Coliform / *E-Coli* | | | | W |

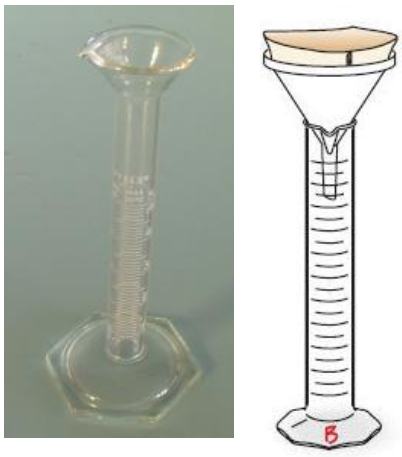
* If MLVSS /MLSS ratio of a minimum of 0.7 is detected, MLVSS testing can be done periodically, on an "as required" basis.
**The effluent should be routinely checked for any signs of problem. Normally, the effluent is reasonably clear, colourless, and odourless. If the effluent becomes turbid, testing should be carried out required.
*** Explanation and definition of abbreviations, acronyms and terms used in the manual are presented in **Appendix D**.

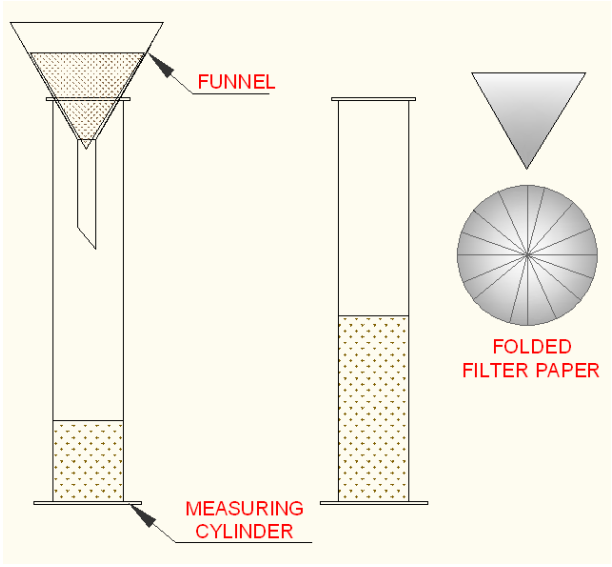
**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

## Filterability Test

The objective of the filterability test is to evaluate the condition of the working biomass. This is assessed by measuring the volume of filtrate passing through the filter paper. If filtrate is greater than 10 mL/10 min, then biomass filterability is acceptable; however, if it is less than 10 mL/10 min, modifications to the plant operating condition are required to prevent premature membrane fouling.

## Laboratory Glassware and Filter Paper






## Apparatus:

- Filter paper distributed by newterra Ltd.. Model # NO5C18.5CM);
- Funnel (75 mm diameter recommended);
- 2 - 50 mL graduated cylinder;
- Stop watch.

**Measurement Procedure:**

1. Pleat filter paper by folding in half, quarters etc.
2. Line the funnel with pleated filter paper and place the funnel in the graduated cylinder.
3. Collect 50 mL of activated sludge sample in a beaker and stir.
4. Pour the 50 mL sample into the funnel.
5. Start timer when the first drop of water filtered through the filter paper.
6. After 10 minutes of filtration, record the level of filtrate in the graduated cylinder.

| Filterability (FT) | Action | State of urgency |
|---|---|---|
| > 10 ml | Excellent, no action req' | |
| 5 - 10 ml | Tweak process operation | |
| < 5 ml | Process adjustment req | **Contact newterra ltd.** |

### 5.5.3 Record Keeping

An essential component of quality control in any facility is sound record keeping. A log book covering the entire treatment system performance should be maintained, updated, and readily accessible to all operators. The log book should be used to record observations, set point alterations, and unusual conditions.

For each wet chemistry parameter analysis, a separate work-sheet has to be prepared. Work-sheet data for at least the previous year should be kept for possible consultation.

The second step in quality control is to train all operators to follow an established procedure for each test.

Identical samples should be periodically tested for any parameter by different operators, and the variability among results should be compared. Consistent variability in results may lead to the technique improvement of operators.

Duplicate analysis of a sample should also regularly be done.

And, split samples should regularly be sent to an outside accredited laboratory and analysis results should be compared with those done in-house.

In addition to summary sheets, it is highly recommended that data should be entered into prepared Excel spread-sheets. Spread-sheets greatly aid in the data presentation and manipulation, and would be of immeasurable value when report writing is required.

### 5.5.4 Process Trending

Other than pre-planned process changes or major upsets, process modifications should be based on trends shown in the process data. A trend is nothing more than an indication of real change in a process parameter over time. A trend chart is simply a graph of data being trended.

As the graph changes, upward or downward trends are detectable. Smoothing trends by graphing the 3-, 7-, or 30-day average of the data allows the trend to be shown more clearly. Because the individual data point may be questionable, the actual value of data point are less important compared with the trend regarding the process monitoring.

Trend graphs are a part of the Excel data spread-sheet; the operator can trend and analyze many parameters in just a few minutes in order to assess process performance.
When a trend is identified, its indication to the process can be evaluated, and corrective action may be carried out, if needed. Statistically, the more data points there are in a trend chart, the more reliable the trend.

### 5.5.5 Troubleshooting Chart

**Process Issues:**

***Aeration and Membrane Tanks:***

| APPEARANCE | COMMENTS | CONDITION | Remedy |
|---|---|---|---|
| **Wastewater with chocolate brown color, little or no foaming** | Plant is properly adjusted | Good operation | None |
| **Excessive white foam accumulating over the liquid surface** | Influent inhibition/biomass toxicity | Excessive foaming | Check the quality and contents of the flow into the MBR unit for any abnormal or prohibited substances |
| | System overloading | Excessive foaming | Check the flow rates, BOD/COD loading, MLSS concentrations (F:M ratio) and reduce flow/loading accordingly and/or increases MLSS concentration. |

| | | | |
|---|---|---|---|
| | Plant start-up | Excessive foaming | Normal - continue operation, increase MLSS; ensure sprayer pump is running at all time, may also use approved defoamer if required (consult **newterra** Ltd). |
| **Black or dark brown color of wastewater** | Aeration rate is too low, and/or plant is under loaded | Insufficient aeration or MLSS is too high | Increase aeration rate and keep it between 2 and 3 mg/L, waste more sludge, increase feed rate if required |
| **Tanks contents are black and no mixing taking place** | Blowers failure | No rising air - blower not running | Check for electrical/blower failure. Replace blower |
| **Unpleasant odor from the MBR system** | Mechanical/electrical/process failure | Blower and air piping are not operating correctly | Check the maximum flow and BOD loading rate to the MBR unit to see whether it is within the normal limits as per design specification. Ensure good order of mechanical/electrical components. |

***Permeate:***

| APPEARANCE | COMMENTS | CONDITION | Remedy |
|---|---|---|---|
| **Clear** | Process stabilizes | Clear permeate with no particles | None |
| **Turbid or dirty** | Cross-contamination of the permeate | Permeate has fine particles or turbid | Isolate problematic membrane permeate line. When time permits open problematic membrane system and visually inspect the individual membrane sheets |

***Mechanical / Electrical Issues:***

| Problem | Possible Cause | Remedy |
|---|---|---|
| **Indicator light at the control panel is on.** | Air intake is blocked | Clean intake screens on blower housing. Check air filter on blower for blockage |
| | Air discharge or vent line is blocked | Check discharge line and vent line visually or with drain cleaning equipment for obstructions |

| | | |
|---|---|---|
| | MicroClear® MBR is flooded | Determine cause of flooding (e.g., line obstruction, high flows, etc.) and fix |
| | Blower has failed | Determine if blower failure was caused by an obstructed intake or discharge line. |
| | | Investigate overheating (i.e. internal thermal overload protection), short-circuiting, or other electrical failure, and mechanical failure (i.e. bearing failure) and correct. |
| **Wastewater is backing up** | Obstruction in the incoming sewer | Visually check the inlet pipe leading to the MBR , or with drain cleaning equipment |
| | Obstruction in the discharge from the MBR system | Check the permeate piping and later field piping visually or with drain cleaning equipment |
| | Pump has failed | Check the operation of pump as per pump manufacturer's specifications |
| | Flow rate to the MBR is too high | Check the maximum flow rate to the MBR system to see whether it is within the normal limits as per design specification. |
| **Wastewater is backing up** | Membrane fouling | Check membrane modules; may require cleaning |
| | Tank requires cleaning and/or pump out is required | Check sludge depth in both Aeration and Membrane Tank to see whether it is below the required levels. If the depth is too great, have the tanks pumped out and, if necessary, cleaned. |
| **Unpleasant odour from the MBR system** | Blower and air piping are not operating correctly | Check the maximum flow and BOD loading rate to the MBR unit to see whether it is within the normal limits |
| | System is overloaded | Check the quality and contents of the flow into the MBR unit for any abnormal or prohibited substances |
| **Blower/pump not working** | Motor overload | Electrician to check |
| | Fuse blown | Electrician to check |
| | Power failure | Electrician to check |
| **System not in run mode** | Kill switches are mistakenly pushed in/power failure | Ensure kill switches (on control panel/wall) are not pressed. Electrician to check. |

## 6.0 System Maintenance


ATTENTION: MAINTENANCE SHOULD BE PERFORMED ONLY BY TRAINED PERSONNEL!

When providing maintenance or cleaning the plant, avoid direct contact with wastewater, organic materials, etc.

Always wear protective clothing, e.g. waterproof, protective gear, boots, and gloves to keep these materials from body. Wear face and eye protection as required by health & safety protocols and standards, especially when handling chemicals.

**CAUTION: Shut off all electrical power before working on the mechanical or electrical equipment.**

The system should be routinely checked for any signs of operational problems. Such problems could include, but are not necessarily limited to, abnormally high peak flows, unpleasant odour, and diffuser clogging, and so on.

### Plant Visual Checks

| | |
|---|---|
| **Noise** | During normal operation, there is a uniform humming sound at the plant. In case of an unusual noise, it could be an indication that the blower needs maintenance or repairs. |
| **Smell** | The MicroClearTM MBR is an aerobic system. During normal operation, the system has an earthy smell similar to that of a well-maintained compost pile. If other odours are noticed, the aeration process may not be operating or the system has been overloaded. Check the DO manually and the blower to verify proper operation. |
| **Sight** | Normally, the effluent is reasonably clear, colourless, and odourless. If the effluent becomes turbid, there is a pin hole in the membrane or a leakage in the piping. Take the unit out of operation and investigate. |

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

## Schedule for Routine Operation and Maintenance Checkups (if Applicable)

| Location | Item | Day | Week | Month | Quarter | Year | Comments |
|---|---|---|---|---|---|---|---|
| HEADWORKS | **Inspect and maintain grease trap in the kitchen of the work/mining camp** | | X | X* | | | *Kitchen grease trap(s) should be checked weekly and cleaned monthly to ensure proper performance. |
| | **Inspect lift station with sump pumps** | | X | | | | |
| | **Remove grease from lift stations and top of PC tank** | | X | | | | |
| PROCESS | **Perform visual check** | X | | | | | Refer to Plant Visual Checks |
| | **Check for proper wasting to sludge system** | | X | | | | |
| | **Record permeate flow rate** | X | | | | | |
| | **Record DO in the aeration tank** | X | | | | | |
| | **Record pH in the aeration tank** | X | | | | | |
| | **Record vacuum pressure at the membranes** | X | | | | | Normal range: 0.07 – 0.15 bar (28" -61" WC) |
| ***Note: When the vacuum at the membranes reaches 0.2 bar/2.9 psig/80" WC), stop the permeation and perform recovery cleaning (please see procedure separately)*** | | | | | | | |
| *MECHANICAL & PROCESS* | **Inspect membranes and permeate withdrawal system** | | X | | | | 1 hour |
| | **Clean and calibrate the DO sensor** | | | X | | | 1 hour |
| | **Inspect and maintain valves & fittings for leaks** | | X | | | | |
| | **Clean manually Fine Screen and direct solids to primary settling/sludge holding tank** | | X | | | | may require daily cleaning during start-up (subject to PI502 reading) |
| | **Membrane in-situ cleaning** | | | | X | | 2-4 hours |
| | **Remove membrane module for mechanical cleaning and inspection** | | | | | X | Drain membrane tank. Roll out membrane cassette. Remove membranes and inspect. (1 -2 days) |
| | **Visual inspection of air bubbles in the equalization, aeration and membrane tanks** | | X | | | | Replace diffusers if big uneven bubbles/high turbulence is found. |

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

| Location | Item | Day | Week | Month | Quarter | Year | Comments |
|---|---|---|---|---|---|---|---|
| *MECHANICAL & PROCESS* | **Remove, inspect and maintain diffusers in equalization, aeration and membrane tanks** | | | | | X | This involves a complete draining of tanks (1-2 days) |
| | **Pump out solids collected in the primary settling/sludge holding tank for offsite disposal** | | | | X | | |
| | **Check and record UV instrumentation: % Transmissivity vs required minimum; Remaining Lamp Life; Total Days of Operation** | | X | | | | |
| | **Inspect and maintain pump bearings** | | | X | | | |
| | **Check blower operation (if vibrating)** | | X | | | | |
| | **Check time clock setting** | | X | | | | |
| | **De-ragger (foam suppression unit)** | | | | | | may require daily cleaning during start-up |
| | **Inspect functionality of baseboard heater** | | | | X | | |
| | **Check ventilation systems for container** | | | | | X | |
| ELECTRICAL | **Check electrical leads** | | | | X | | |
| | **Inspect and maintain breakers, fuses, resets and anodes** | | | X | | | |
| | **Check motor mounting bolts** | | | X | | | |
| | **Clean dust away from electric motor** | | | X | | | |
| | **Check PLC and control panel functionality** | | X | | | | |

**De-ragger operation and maintenance cleaning**

Please refer to the drawing presented in Appendix A of this O&M Manual.

De-ragger is part of the anti-foaming system which is provided in the system for foam suppression in the aeration tanks . The main purpose of a de-ragger in this system is to avoid the spray nozzles clogging by catching fibres and other impurities found in the recirculation water pumped through the system.

De-ragger is simple equipment consisting of a PVC clear pipe, a nylon bristle brush installed in the pipe, and a fernco coupling for quick disconnection. During the water spraying process the brush (with a sliding fit in the pipe) catches fibres and other impurities.
When the de-ragger is filled with impurities, perform maintenance as follows:

- Turn off P-502 / P-503 operation.
- Open drain valve and drain the content to a 20-L pail.
- Disconnect fernco coupling.
- Remove brush and rinse with clean water.
- Close the drain valve and reassemble the fernco coupling
- Make sure all connections are tight
- Turn on P-502/P-503.

**Submersible pumps installation and operation**

- All piping is adequately supported, so as not to impart any piping strain into the pump.
- Pump discharge piping is equipped with quick disconnect fittings (camlocks) to allow quick pump removal.
- Before pump removal press the OFF switch to disconnect the power.
- After, secure the lifting device (chain or rope), disconnect the camlock, and start lifting the pump

### 6.1 Membrane Cleaning

#### 6.1.1 Maintenance Cleaning – Chemically Enhanced Backwash (CEB).

A maintenance cleaning is the backwashing of the MicroClear® membrane filter with chemical solution from the backwash tank at a maximum pressure of 0.1 bar (1m of water).
It is advisable to conduct a CEB operation once every quarter to minimize the membrane pore blocking. The CEB operations need to be conducted if permeability drops quickly below 100 LMH/bar.

|  | **Chemical cleaning is only to be carried out by qualified and trained personnel! Chemicals can lead to serious injuries. Always wear protective glasses, clothing and gloves. Obey the safety data sheet of the chemical manufacturer!** |
|---|---|

For better cleaning performance, it is recommended:

- Potable water (permeate is acceptable if potable water is unavailable)
- Water temperature is above 20 $^0$C (better cleaning efficiency if water temperature ranges from 20 to 30 $^0$C)

## Procedure

**Note: Only clean / backwash one membrane tank at time.**

***Step 1: Cleaning with (sodium hypochlorite***
Typically - 3L/ MCXL cassette; MB3-1 contains 15 MCXL cassettes → 3L x 15 = 45L

1) Hit the disable membrane button on the screen (you need to hold it for over 3s to disable the membrane filter). Make sure scouring air is OFF.

2) Ensure that the Backwash Tank (T-801) is filled with tap water/ permeate (until LSH is ON).

3) Add NaOCl into the Backwash Tank (T-801) to a concentration of 200 mg/L (0.02% as free chlorine). Volume of NaOCl required can be calculated with the following formula:

$$V_x = \frac{V_m \times 0.02}{C_s}$$

$V_m$: Volume of backwash tank (Gallon, or Litre)
$C_s$: NaOCl concentration (%)
$V_x$: Volume of NaOCl required (Gallon, or Litre)

4) For backwashing, pump (P-801) is activated. The pump will transfer chemical solution through the valve (PV-701,PMV-702) and redirects the flow back into the suction line of the permeate withdrawal and purges the membranes (inside – out principle).

5) Soak the membranes in NaOCl solution for 2 -3 h.

6) Enable MBR operation to its normal operation mode by holding the enable MBR button for longer than 3s.

7) Check permeability. Normal permeability after cleaning: 150 to 300 LMH/bar.

8) Repeat the CEB operation with chlorine concentration of 500 mg/L (0.05% as free chlorine) if normal permeability is not achieved.

**Note: Membranes have a maximum active chlorine tolerance of 100,000 ppm.h over the entire life time.**

***Step 2: Cleaning with Citric Acid – only required in case of inorganic fouling caused by the high hardness.***

1) Repeat the above steps with 0.2% citric acid solution instead of bleach.

### 6.1.2 Membrane Recovery Cleaning

The membrane recovery cleaning is compulsory to be done once a year. On certain occasions, membrane cassette may need to be inspected for membrane integrity (suspect of membrane deterioration, membrane permeability performance does not recover after the cleaning, etc.).

**Operation of MBR system will need to be stopped during membrane recovery cleaning.**

For better cleaning performance, it is recommended:

- Potable water is used
- Water temperature is above 20 $^{0}$C (better cleaning efficiency if water temperature ranges from 20 to 30 $^{0}$C)

**Procedure**

**Note: Disable operation of the dedicated membrane tank that needs to be cleaned by pressing the disable membrane button the screen)**

***Step 1: Cleaning with Sodium Hypochlorite*** Hit the disable membrane button on the screen (you need to hold it for over 3s to disable the membrane filter). Make sure scouring air is OFF.

1. Drain/pump out all the mixed liquor from the membrane tank using pumps (P-601/P-602).

2. Fill the membrane tank with potable water, and add NaOCl to a concentration of 500 mg/L as free chlorine (max. 1,000 mg/L). Turn on air scour to mix the solution and turn it off during membrane soak. Volume of NaOCl required can be calculated with the following formula:

$$V_x = \frac{V_m \times 0.05}{C_s}$$

$V_m$: Volume of backwash tank (Gallon, or Litre)
$C_s$: NaOCl concentration (%)
$V_x$: Volume of NaOCl required (Gallon, or Litre)

3. Keep the membranes soaked in the NaOCl solution for about 12hours.

4. Initiate membrane scouring blower every hour to provide scour air for 5 min

5. Drain / pump-out spent NaOCl solution

6. Rinse membrane filter thoroughly with potable water and drain / pump-out entire bleach rinse waters.

***Step 2: Cleaning with Citric Acid – only required in case of inorganic fouling caused by the high hardness***

1. Repeat the above steps with 0.2% citric acid solution instead of NaOCl.

***Step 3: Checking Permeability on Clean Water***

Repeat the CEB operation with NaOCl concentration of 1,000 mg/L (0.1% as free chlorine) If normal permeability is not achieved.

**Step 4:** ***Resume normal operation***

### *6.1.3 Membrane Replacement*

*If membranes require changing v*erify membrane modules are secure within the membrane tanks after re-installing the modules – i.e. verify wheel chocks are in the correct location and that there is no lateral movement (less than an inch) of the membrane modules on the wheel tracks in the tanks.

Membrane maintenance and recovery cleaning has to be recorded according to Membrane Cleaning Log Sheet presented on the next page.

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

## Membrane Cleaning Log Sheet

| **Date** | **Type of Cleaning ( In-Situ / Recovery)** | Start time | Finish time | Sodium Hydroxide Solution (Volume / Concentration) | Sodium Hypochlorite Solution (Volume / Concentration) | Citric Acid (Volume / Concentration) | TMP / Permeability |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

## *7.0* Shut Down

### 7.1 Temporary Shut Down

A temporary shutdown for a few days requires continuous aeration of the biomass to keep the DO level at least 2 mg/L and continues biomass recycle between the bioreactors.

### 7.2 Permanent Shut Down / Winterizing

Permanent shut-down is required if system operation stops at least for 2 weeks without inflow. Permanent Shut Down includes the following procedure:

- Perform membrane cleaning before permanent shut down / winterizing.
- Drain all tanks.
- Remove membranes and winterize
    - For short term storage (up to 6 months): soak membranes in 10 ppm NaOCl solution, and membranes are not allowed to dry out), never expose the membrane unit to frost, dust, rain, or direct sunlight.
    - For long term storage: soak membranes in preservation solution - 20 % glycerin solution (by weight).The glycerin will pass through the membrane via diffusion and provides pore protection from freezing and from drying out.
- Disassemble all PVC ball valves and drain any water inside (open and close to ensure trapped water escapes).
    - Leave all valves ½ open during reinstallation
- Open all drain valves and leave open.
- Clean and reinstall all sprayer nozzles.
- Find all check valves and make sure water is not being held by valve (Wet/Dry Vac works well here).
- Drain / remove all pumps from tanks, ensure no water is left inside the pump.
- Use RV biodegradable Antifreeze to
    - Refill any check valve
    - Dump in 2 (qty) 4-L bottles in each tank
- Remove pH and DO probes (if unit is equipped) and store with membranes in a heated area ensure probes are kept wet.
- Remove power from system**.**

Double check and ensure that there is no water left in any pipes, fittings etc. If it is not possible to remove the water fill with antifreeze.

**Glycerine Solution Solution Components and Solution Make-Up**

**1. Chemicals:**
Technical Glycerin (86.5%)
Distilled water

**2. Solution make-up procedure:**

Dissolve technical glycerin (86.5%) in water and homogenize according the following table.

| Preservation Solution 20 % Glycerin | Technical Glycerin [86,5%] | Distilled Water |
|---|---|---|
| [kg] | [kg] | [kg] |
| 1 | 0.23 | 0.75 |
| 10 | 2.3 | 7.5 |
| 100 | 23 | 75 |
| 1000 | 230 | 750 |

The preservation solution has a density of 1,045 g/cm$^3$. The concentration of preservation solution can be tested and corrected with a density meter.

**Membrane preservation procedure**

- Allow the membrane unit to soak in preservation solution for a few hours.
- Remove the membrane unit and allow excess glycerin to drain.
- Shrink wrap the unit with a thick (1.5 mm) plastic bag and seal membrane unit using a hand sealer or tape.

For long term storage preserved unit should be stored in a cool (4$^0$C - 20$^0$C), dry area, away from direct sunlight and protected from accidental damage.

Re-commissioning the unit is straight forward. Once unit is lowered into MBR Tank, first start the aeration, then the permeate pump. In order to let all the traces of glycerin in the permeate to dissipate, make the arrangement for the permeate to recycle back to the aeration tank for the first half hour.

## 8.0 SERVICE & SUPPORT

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

## Commissioning and Start-up

**newterra** MicroClear™ MBR System's **commissioning & start-up** is the last step of the **newterra** project execution process. Experienced engineers and technicians are available to assist clients in these procedures including system initial set up and primary start-up and providing all performance tests according to the pre-commissioning checklist.

**Initial on-site training program** is an important part of the commissioning service as well. During on-site training, **newterra** technical representative will cover process monitoring, system operation, maintenance, and troubleshooting activities related to the **newterra** ™MBR System. Customized training packages are available. Contact **newterra** for more information.

## Post commissioning Services

A comprehensive range of post commissioning services is available from within **newterra** beyond system design and installation. Specific services are included:

- Technical support (including after-hours emergency telephone support).
- Spare parts order and delivery.
- Training program.
- Plant optimization and upgrades.
- Telemetry control and monitoring.
- Assistance in preparing system performance reports (process data monitoring & analysis).
- Preventive maintenance cleaning (including membrane cleaning).
- System audits for reviewing the performance of all MBR subsystems and the efficiency.

1. **Technical support** is available to assist in troubleshooting of **newterra** MBR system during normal working hours 8:30 am to 5:00 pm (Eastern Time Zone for **newterra** ltd.). Telephone service is available via **1.800.420.4056**.

   **Emergency 24/7 telephone technical support –** This will be activated upon subscribing to **newterra's** 24/7 technical support service.
   If problem cannot be resolved through telephone or e-mail supports, **newterra** engineers are available for site visit.

## 2. Spare parts:

**newterra** has spare parts to provide quick response to any system critical breakdown. Critical (commissioning) spare parts for the **newterra** MBR Systems are provided during start-up period**.** Contact **newterra** part department at **1.800.420.4056.**

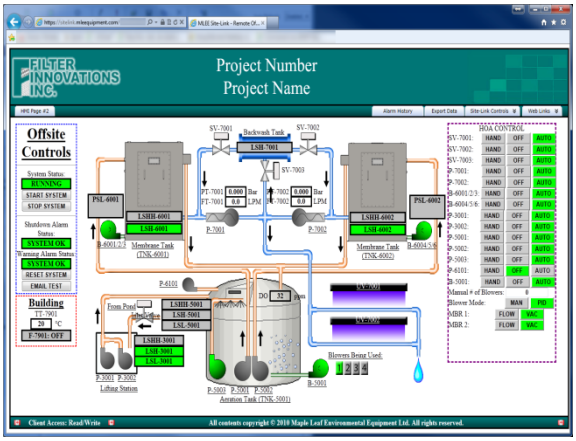
All parts and components associated with **newterra** MBR Systems are available from within service departments and manufacturing facilities of **newterra** ltd across Canada and abroad.

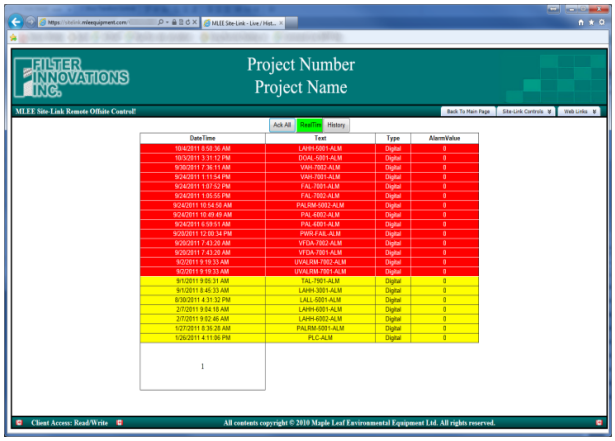
**Potentially required spare parts are:**

- membrane modules/membrane cassettes;
- parts for repair/replacement (valves, transmitters, switches, gauges, pH & DO, pump motors, analyzers, PLC components, fuses, etc.);
- maintenance spare parts (air blowers, air filters, pumps, immersion heaters, chemical metering pumps, etc.).

## 3. Assistance in telemetry control and monitoring

**newterra** SITE-LINK is a customized software program and hardware configuration which provides a real-time link to a treatment system via cellular modem or customer supplied internet connection using our secure Site-Link Server.




**newterra** Site-Link comes with the following customizable features:

- Customized P&ID layout with system status
- Start/Stop/Reset of system
- Manual control of all system components†
- Data logging exports in .csv format
- Daily system status reports (E-Monitor) – quick summarize of daily system performance
- Alarm history including current alarm status
- Hour meters for equipment††

- Customization of all system set points†
- Live and historical trending†††
- Immediate text & email on alarm (E-Alarm)

†certain restrictions apply †† only applies when hour meters are quoted with system ††† must be requested at quote stage

The basic system requires that the customer provide a standard computer network cable to the control panel. If the customer's computer network is accessible to the internet, this system can also be monitored from any internet enabled computer.
This system is not available if customer supplied internet connection or cellular service is not available at the site. During internet outages, reports cannot be sent and system status cannot be monitored remotely.

## 4. Site visits and system audits

Site visits and system audits can be arranged at an additional cost. Contact **newterra** for all financial aspects of **newterra** initial and post-commissioning services.

During a system audit, technical reviews the performance of all **newterra** MBR subsystems and the efficiency of the biological process can be performed. Based on the site visit and agenda discussed with client, we can assist in:

- Maintenance coordination and scheduling, including membrane maintenance and cleaning.
- Validation of chemical dosing settings.
- MBR System inspection for the proper operation of the membrane system in accordance with the O&M manual; equipment calibration, process optimization and upgrades.
- Continued on-site operator training and coaching.

## 9.0 WARRANTY and Performance Guarantee

**newterra** ltd. will abide by the warranties and guarantees as provided the bid documents.

### General Warranty Statement

1. **newterra** warrants and guarantees products of its manufacture against defective workmanship or material for a period of one year from the date of notice of readiness to ship.

2. This warranty is expressly and strictly limited to replacing, without charge, any part or parts which prove to **newterra** satisfaction upon examination, to have been defective in design, material, and workmanship, and which have not been neglected, abused or misapplied, and provided that the buyer gives **newterra** immediate written notice upon discovery of any claimed defect.

3. During the warranty period, parts will be shipped with the instructions to replace, which can be further elaborated over the telephone; visit of our technician can be covered under the service agreement; otherwise, actual charges will be quoted to the owner at that time, if required.

4. All components are designed in accordance with the local/national governing building code(s).

5. All wastewater components meet the specified guideline and standards.

### Warranty Exclusions

1. Warranty coverage does not include:
    - Freight, labour, travel, and living expenses associated with parts replacement
    - Normal wear & tear for items such as lubrication, fan belts, and cleaning of the equipment

2. In the event that the customer, or any contractor employed by the customer, contracts an outside company other than **newterra** for modification of plant equipment, without knowledge of **newterra**, the warranty in that case my become null & void.

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

## Conditions of Warranty

Newterra highly recommends that the system be started up by newterra factory trained technician to ensure the correct installation and trouble-free start up. The start-up checklist provided in the manual must be completed and returned to the Product Support Department at **newterra** to validate the equipment warranty which begins on the date of notice of readiness to ship from the factory.

## CONDITIONS FOR THE MEMBRANE WARRANTY

1. The process design of the complete plant as well as the component design of all parts in relation to the filtration technology has to be approved by **newterra** in writing. This applies to the design and regulation of the filtrate removal system.

2. No firbrous substances or particles larger than 2 mm can accumulate in the membrane tank or underneath the filter plates as these can block the flow of air and water through the filter plates. A suitable screen on the inlet to the WWTP must be installed and maintained to ensure the membranes are protected.

3. The maintenance manual has to be followed in all aspects.

4. No substances may be used, that can harm or block membranes (see list in the maintenance manual). No antifoaming may be used unless approved by **newterra**.

5. A full maintenance clean according to the maintenance manual must be carried out at a minimum, once every 6 months. In the case of industrial wastewater, a shorter cleaning frequency may be required.

6. A **newterra** Technician or engineer must be on site during the start-up of the system (membrane clean water test with potable water).

7. **newterra** must receive complete documentation of all relevant operation parameters and data from the first day of operation. An hourly report of the parameters is sufficient. The documentation should be sent to **newterra** regularly every month after the start-up of the system. Any malfunction must be reported to **newterra** immediately, so that actions can be taken to prevent further damage. Relevant process and operation parameters are: filtrate flows and trans-membrane pressures, pressure and air flow rate of the membrane air scouring, the maintenance procedures that have been carried out, analysis of the mixed liquor inventory(amount of fibers, concentration of dried solid matter, etc), solid mass loading

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

in the system, system operating SRT, F:M ration, DO, pH, influent and effluent wastewater characteristics.

8. No abrasive substances may be contained in the feed-water to the membrane tank.

9. Chemical substances (e.g. hypochlorite) must be used within the specified limits.

10. No untreated water may come into contact with the membranes.

11. The water temperature must be within the temperature tolerance limit for the process and membrane operating condition as specified in the operation and maintenance manual.

12. Excess sludge must be removed regularly, even if this does not seem to be necessary due to the sludge concentration. This is to prevent the build-up of fine particles in the system.

## MEMBRANE WARRANTY

1. The regular (or full) warranty for the membrane is two (2) years after the date of delivery.

2. Two (2) years after the date of delivery we offer an additional non-charged 3 year warranty that is prorated. On the basis of a projected lifetime of 5 years, the percentage of non-performance (quotient of time remaining until reaching the projected lifetime of 60 months) until the end of the projected lifetime of 5 years will be refunded. The remaining value of the membrane is the purchasing price multiplied by the percentage of non-performance. The remaining value will solely be refunded with the purchase of replacement membranes. The purchasing price is the actually paid price of the defect membrane.
   Example: 40 months after delivery, a filter (purchasing price was CAD 2 000) is defective. The projected lifetime is 60 months. The percentage of non-performance is 20 months/60 months = 33%. The remaining value is CAD 500 x 33% = CAD 165, that will be refunded, when purchasing a replacement membrane.

3. Warranty does not cover the onsite change out of other costs of the membrane replacement.

4. Consequential damages are excluded.

5. The pro-rated warranty shall nullify if the "**CONDITIONS FOR THE MEMBRANE WARRANTY" are not met.**

Membrane Module Warranty Exclusions:

1. **newterra** ltd. shall not be liable under this Warranty unless written notice thereof is received within the Warranty Period.
2. **newterra** ltd. shall not be liable for the membrane modules if any person other than an employee or representative of newterra has altered the membrane operating system without prior approval.
3. Without prejudice to the proceeding provisions of this clause, **newterra** shall not be liable for any damages caused by the Owner causing or permitting the membrane modules to dry out or to have moisture content below that specified in the operating instructions either during storage or operation. Shutdown, storage, and start-up of membranes must be as specified in the Operation and Maintenance Manual under Shutdown/Storage/Start-up. Failure to follow maintenance/warranty procedures will render this warranty null and void.
4. **newterra** shall not be liable if evidence of unusual plant upsets, and other potential transients or undefined operating conditions that can affect membrane performance or life: This includes excessive polymer “dumps”, any bypass of the pre-screen ahead of the biological system, rags or debris that fall into the biological or membrane tanks, toxic wastes entering the plant that upset the biological processes.
5. **newterra** shall not be liable for any damage/defect caused by chemical or physical conditions such as (but not limited to) pH, temperature, chemicals, or climatic factors outside the recommended operating parameters as outlined in the Operation and Maintenance Manual.
6. The membrane performance warranty requires that the membranes shall perform in-situ cleaning as specified in the Operation and Maintenance Manual. **newterra** shall not be liable if the cleaning protocols and chemicals other than that specified in the Operation and Maintenance Manual be used.
7. The membrane performance warranty requires that the influent, effluent, mixed liquor and sludge filterability parameters are monitored as per the Operating and Maintenance Manual. Sludge filterability for municipal sludge must be greater than 10 ml after the 10 min sludge filterability test. Capillary suction time for municipal sludge must be less than 100 sec before the membrane tank.
8. **newterra** shall not be liable if the sludge retention time (SRT) is less than 12 days or greater than 80 days over a 2 day rolling average for municipal/domestic wastewater. For industrial wastewater, operating SRT shall not be less than 20 days over a 2 day rolling average unless proven by the pilot study.
9. **newterra** shall not be liable for freight, labour travel and living expenses associated with membrane replacement.

**newterra** ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

## PERFORMANCE GUARANTEE

**newterra** guarantees the performance of the **newterra** MBR for one year for treated effluent quality from the date of issuance of Substantial Performance provided that:

- Influent wastewater flow rates and characteristics remain as specified in the RFP;
- There is no discharge of prohibited items into the drains;
- Waste activated sludge is wasted to maintain the MLSS in the aeration and membrane tanks between 8 and 12 g/L;
- Plant is run and maintained well.