Appendix C

Preliminary calculations for sizing water & wastewater infrastructure components

Domestic Wastewater

a) Volume

Peak Workforce = 100 persons

Load = 100 x 0.2 EP/worker = 20 EP

Residents : 3 families = 10 EP

Load = 20EP + 10EP = 30 EP

Volume = 30 EP x 150 L/EP.d = 4,500 L/d

b) Treatment

Normally 70 gBOD/EP.d load for domestic sewage

Septic tank volume - allow 24hrs detention plus 80L/EP.year for sludge accumulation

septic tank volume = 4,500L + (30EP x 80L/EP.year)

= 7kL (say 1m deep x 2mW x 3.5mL)

BOD removal in septic tank 30% ie reduction to 50gBOD/EP.d

BOD load = 50 g /EP.d x 30 EP = 1,500 g BOD/d

Adopt aerobic sand filter to remove BOD and pathogens

Aerobic sand filter organic loading rate 25g/dBOD/m2 and hydraulic loading rate 50L/d/m2

Aerobic sand filter size $\Rightarrow 25gBOD/m^2 \Rightarrow 60\ m^2$
$\Rightarrow 50L/m^2 \Rightarrow 90\ m^2$ (say 8 m x 12 m)

Provide recirculation pump station to aerobic sand filter to enhance nutrient removal and pathogen destruction

c) Treated Effluent Storage

Wet Weather Storage : Allow storage Jan – March (90 days)

volume = 90d x 4.5kL/d = 405 kL

Adopt 4/100kL tanks say 2m deep x 8m dia

d) Treated Effluent Disposal

Allow 5 ML/ha.year for irrigation

Total annual volume = volume from daytime workforce + volume from residents

Assume peak workforce for 7 months of year

volume = (7/12 mths/yr x 365d x 100EP x 150L/EP.d) / 1,000,000L/ML

= 3.19 ML/year

Permanent residents

volume = (10EP x 365d x 150L/EP.d) / 1,000,000L/ML

= 0.55 ML/year

Total volume = 3.74 ML

Area required = 3.74 ML/a / 5.0 ML/ha.a

= 0.74 ha, i.e. 5m x 1500 m tree line

Depending on the topography and arrangement of the domestic wastewater system, raw sewage pumps, septic tank effluent pumps, aerobic sand filter recirculation / effluent pumps and irrigation pumps may be required.

Processing Wastewater

a) Waste Stream

Volume = 100 k/d Jan to Jun (6 months)

Assume treatment over 8 hrs/d; assume flow peaking factor of 3

treatment rate = 100kL/d x 1,000L/kL x 3 / (8 hrs/d x 3600 sec/hr)

= 10 L/s

Water Quality:

- salty
- particulates (legs, shells, etc.)
- organics ? (after boiling)
- colour ? (after boiling)

b) Treatment

Adopt screening, sand filtration, chlorination, dechlorination and release to the aquaculture pond treatment system.

Screening :

Adopt wedgewire screen to remove particles greater than say 1mm

Filtration : sand filter, say 5 m/hr filtration rate

Filter area = 10L/s x 3600sec/hr / (1000L/m3 x 5m/hr)

= 7m2

say 3 m square filter area

Adopt proprietary sand media filters modules

Backwash tank

Assume filtered water tank (for backwashing) say 20 minutes at 25 m/hr

volume = 3m x 3m x 25 m/hr x 20/60 mins/hr

= 75 kL (say 2m deep x 7m dia)

NaOCl Requirement:

Assume dose at say 10 mg/L with 10% Cl solution

Solution tank size, assume weekly or fortnightly deliveries from Bowen

volume = 1000L/kL x100kL/d x10mg/L x10d/(1,000,000mg/kg x10% sol)

= 100 L every 10 days

For 5 mg/L dose rate and 7 days storage, usage = 50 L

Chlorination requirement is pretty small and can be readily achieved with a poly storage tank and a dosing pump

Chlorine Contact Tank, assume 20 minutes

volume = 10L/s x 20mins x 60 secs / 1000L/kL

= 12kL say 2m deep x 2.5m dia

Dechlorination:

Allow 24 hours detention in an open storage lagoon to dissipate residual chlorine prior to release to treatment area no.1

Dechlorination lagoon = 100kL say 1m deep x 20m L x 5m W

Depending on the topography and arrangement of the processing water system, raw effluent pumps, screened effluent pumps, backwash pumps and final pumps may be required.

Potable Water

a) Demands:

Workforce	20 EP x 300 L/EP = 6 kL/d
Residents	10 EP x 300 L/EP = 3 kL/d
Process	30 – 50 kL/d
Total (say)	60 kL/d

b) Sources:

on-site dam – will require treatment by filtration and chlorination
rain water collection – will require treatment by chlorination
groundwater – will require treatment by chlorination
carted from Bowen – will require treatment by chlorination

c) Raw water storage

Assume 1 day storage at peak demand ie 60kL, say 2m deep x 6m dia

d) Treatment, adopt sand filtration and chlorine disinfection

Filtration: 1.5 (peaking factor) x daily flow rate filtered at 5 m/hr = 1 m^2 filter

Adopt simple proprietary sand media filter

Backwash recovery tank, assume 2 backwash volumes at 20 mins x 5 L/s ie 4kL

Chlorination (NaOCl) – say 2 mg/L Cl

NaOCl requirement = 60,000 L/d x 2 mgCl/L / (1,000,000mg/kg x 10% sol)

= 1.2 L/d

NaOCl requirement is pretty small and can be readily handled with a poly tank and dosing pump

e) Treated Water Storage, say 1day at peak demand ie 60kL, say 2mdeep x 6mdia

Depending on the topography and arrangement of the potable water system, source pumps, raw water pumps, backwash pumps, filtered water pumps and treated water pumps may be required.