Woodville Wastewater Treatment Plant

Nutrient Removal Options Report

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Date: 8 June 2018
Reference: 5-P0531.06
Status: Final

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1. Introduction

As part of Woodville consent application an optioneering study has been undertaken to summarise nutrient removal options that could be implemented at the Woodville Wastewater Treatment Plant (WWTP). This report should be read in conjunction with the assessment of flows and loads in relation to the Woodville WWTP.

This report considers possible technologies scale of cost and expected performance, primarily around nitrogen and phosphorus treatment.

2. Technologies for nutrient removal

There are a number of different options for nutrient removal on the existing WWTP, these can be considered as follows:

- Upgrading the plant before ponds and use the ponds just for effluent polishing
- Upgrade the ponds using tertiary treatment

There are a number of technologies available in the market for phosphorus and nitrogen removal. Depending on the technology and the location of the equipment installation, different components of the system should be considered. The most common **technologies** used in New Zealand for the nutrient removal from pond systems includes:

- **Biological nutrient removal (BNR) raw inlet, upgrade before the ponds**
    - Mechanical treatment or inlet works
    - Bioreactor with anoxic and aerobic zones
    - Aerators
    - Clarifier (existing lamella possibly could be used)
    - Disinfection (existing UV can be used)
    - Recycle of sludge for N removal
    - Sludge disposal off site. This will require sludge disposal consent as the nature of sludge is different from the sludge in the ponds. The storage in the ponds can be considered if the ponds are not used any more.
- **Submerged Aerated Filter (SAF) tertiary treatment**
    - Bioreactor with submerged attached growth filter
    - Recycle to Pond 2
    - Aeration system
    - Disinfection (existing UV can be used)
    - Sludge disposal in the pond 1. Additional amount of sludge will be generated during nitrogen removal process, but it won't be significant compare to sludge production in the ponds.
- **Moving bed bioreactor (MBBR) tertiary treatment**

  - Bioreactor with attached growth plastic media and anoxic zone
  - Aeration system
  - Clarifier (existing lamella possibly could be used)
  - Disinfection (existing UV can be used)
  - Recycle of sludge for N removal
  - Sludge disposal in the pond 1. Additional amount of sludge will be generated during nitrogen removal process, but it won't be significant compare to sludge production in the ponds.
- **Tertiary Membrane (TM)**
  - New inlet screening 1mm for pond effluent (or use effluent after commissioning work)
  - Reactor with membranes
  - Aeration system
  - Chemical dosing for P removal
  - Sludge disposal to Pond 1. Additional amount of sludge will be generated during nitrogen removal process, but it won't be significant compare to sludge production in the ponds.
  - Chemical dosing for membrane wash
- **Trickling filter (TF) tertiary**
  - Trickling filter
  - Recycle to pond 2
  - Disinfection (existing UV can be used)
  - Sludge disposal to Pond 1. Additional amount of sludge will be generated during nitrogen removal process, but it won't be significant compare to sludge production in the ponds.
- **Dissolved air flotation.** Stand alone tertiary treatment unit for phosphorus removal.
- **Irrigation.** Land disposal as per Water balance Report (WSP Opus February 2018).

3. Nitrogen and Phosphorus removal

Any of the technologies presented in the section above can be used to upgrade the existing system. Further investigation needs to be undertaken to identify which technology suits the site the most. Most of the technologies on their own can remove nitrogen **or** phosphorus and only some can do both. Therefore:

For total nitrogen (TN) removal ammonia and nitrates should be removed, this can be done by:

- **SAF**
- **MBBR**
- **BNR**

- **TF**

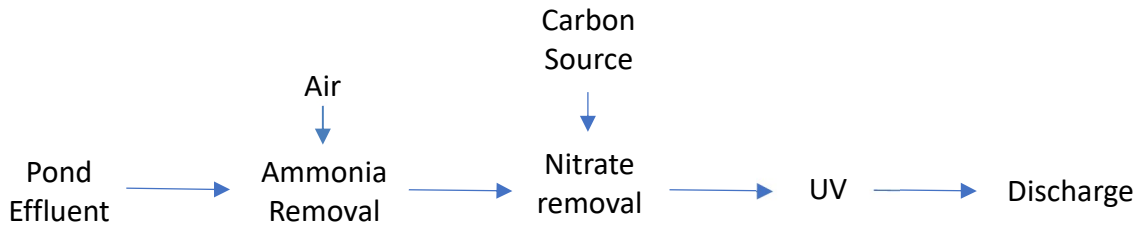
For total phosphorus (TP) removal biological or chemical removal can be applied, which can be achieved by these technologies:

- **BNR** for biological removal
  - Add 20% bigger reactor
  - So plant is anoxic
  - Anaerobic
  - Then aerobic
- **MBR**
- **DAF**

For nitrogen removal a carbon source is required, which won't be sufficient in the existing influent, except for the BNR option as it would receive a raw influent. The following is assumed for tertiary treatment:

- Remove Ammonia
- Provide air for ammonia removal
- Then remove Nitrate
- Provide carbon for nitrate removal

Figure 1 Nitrogen removal diagram for tertiary treatment



All the above technologies will require skilled operator.

4. Technology comparison

The target for the ponds upgrade is to reduce nitrogen and phosphorus as discussed in the flow and load assessment report:

- DRP 0.4 mg/l
- TSS <30 mg/l
- TN <10 mg/l

As discussed previously, to achieve the target removal the combination of technologies should be considered. Therefore, a layout of a different technology on side can considered as in the examples below:


ASSESSMENT
COUNCIL PARCELS
LEGAL PARCELS
DN
SAF
D
CAL


ASSESSMENT
COUNCIL PARCELS
LEGAL PARCELS
Sludge
BNR

+High level technology comparison is presented in the Table 1 below.

Table 1 High level technologies comparison

	DRP	NO_3	E.Coli	TSS	CAPEX $ indicative	Comment	Confidence
BNR	✓	✓	UV	✓	$ 1.6 M	Replace Ponds	10
SAF	✗	✓	UV	✗	$ 2.3 M		
MBBR	✗	✓	UV	✗	$ 2.4 M		
SAF + Chem dose + solids remove	✓	✓	UV	✓	$ 4 M		7
TM + Chem dose	✓		✓	✓	$ 4.5 M		
TF	✗	✓	UV	✗	$ 2 M		
TF + Chem dose + solids remove	✓	✓	UV	✓	$ 3.8 M		6
DAF + Chem dose	✓	✗	UV	✓	$ 4 M		
Existing equipment	✓	✗	E. Coli	✓	$ 1 M		

The layout of new tertiary treatment could be expected similar to the ones in pictures above.