Technical Design Note

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Design note title	Sewage Treatment Plant Capacity Assessment		
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HMP Prescoed : Sewage Treatment Plant Capacity Assessment

1. Introduction

To facilitate the proposed rapid deployment cell programme (RCDP) development at HMP Prescoed and the retrospective inclusion of the COVID units, it is necessary to assess the capacity of the sewage treatment plant to determine its current capability and its potential ability to serve the current development and the additional wastewater flows that will occur as a result of the increased prison and staff population at the site.

A further assessment will consider the requirements of future development at HMP Prescoed in relation to wastewater treatment.

2. Purpose of report

The purpose of this report is to present the existing and proposed cases for wastewater flows, waste water treatment, the facilities that are required, the compliance criteria and permit requirements.

The overall objective is to confirm the wastewater treatment facility requirements for the existing, existing development + RCDP + future development scenario. This will enable decisions to be made on the provision of the appropriate wastewater treatment infrastructure, at the appropriate time and to ensure that the correct maintenance contracts are in place to ensure ongoing compliance with the discharge consent and for infrastructure longevity.

3. Existing Drainage and Treatment Plant

3.1 Drainage

The existing drainage system at HMP Prescoed is a separate foul and surface water gravity drainage system.

Since its construction in the 1950s the site has utilised a privately owned sewage treatment plant system to treat and clean wastewater to a quality that can be discharged to the local watercourse to the south of the site.

The existing foul drainage system is like many typical older estates, with manholes, gullies and pipes needing ongoing cleaning and maintenance.

It is the responsibility of the estate managers and facilities management company to ensure the existing drainage system is inspected at appropriate intervals, operating correctly and any identified defects, mis-connections, ground water infiltration and blockages are rectified. This approach will ensure that the correct type and volume of water is reaching the sewage treatment plant.

A schematic existing site drainage plan is attached to this report.

3.2 Treatment Plant

The current sewage treatment plant was installed in 2009 and it comprised of the following elements:

- 22500L primary settlement tank
- 2 x GL007T High Capacity Titan BioTec treatment plant tanks at 51760L each
- 22500L final settlement tank
- Equivalent to "300PE" - 300 population equivalent, which must also consider all other flows from staff, visitors and kitchen activities

The sewage treatment plant is maintained through the year in accordance with the manufacturer's specification to maintain good working order and discharge consent compliance.

The existing treatment plant benefits from a discharge permit with the following discharge criteria:

7. The quality of the effluent discharged at all flows up to the maximum specified in Condition 4 shall not be inferior to the following numerical limits:-

i) The 5 day Biochemical Oxygen Demand (BOD ATU) determined at 20 degrees Celsius after the suppression of nitrification using allyl thiourea, shall not exceed 30 milligrammes of oxygen per litre.

ii) The Suspended Solids concentration (dried at 105 degrees Celsius) shall not exceed 60 milligrams per litre.

iii) The Ammoniacal Nitrogen concentration expressed at Nitrogen shall not exceed 25 milligrammes per litre.

Photo of existing treatment plant installation showing two visible treatment tanks and 2 below ground tanks

Refer to Hydrock report ref. HMP Prescoed - STP Management Plan (ref. 504560-4793-HYD-066-XX-RP-C-0001-S4-01-D0100) for details on the proposed treatment works, operation and maintenance strategy.

4. Existing Capacity Assessment

A capacity assessment of the existing sewage treatment plant is attached to this report.

The approach is based on British Water Flows and Loads 4

4.1 Base data considered:

- **Existing staff data provided by the prison:**
  - simplified max total number - 120 existing staff, 90% normal work hours
  - simplified likely total number - 90 existing staff, 90% normal work hours
- **Existing visits data provided by the prison:**
  - simplified max total number - 120 existing visitors, sat/sun/wed, 2-4pm
  - simplified likely total number - 80 existing visitors, sat/sun/wed, 2-4pm
- **Existing prisoner data provided by the prison:**
  - simplified max total number - 250 existing prisoners, 20% are out of the site 11:30-20:00
  - simplified likely total number - 200 existing prisoners, 20% are out of the site 11:30-20:00
- **Further existing data provided by the prison**:
  - simplified total number - 3 existing commercial washing machines running 6:00-21:00

Both maximum and likely figures have been used within the assessment to avoid considering an unrealistic total that is very unlikely to happen.

The existing treatment plant capacity of 60,000L per day is considered to have been reached by the existing uses on site.

5. Proposed Capacity Assessment

The existing and predicted waste water flows from the current development and the proposed RCDP project have been calculated to determine the treatment capacity that is required to serve that scenario.

The approach is based on British Water Flows and Loads 4

5.1 Base data considered:

- Existing staff data provided by the prison:
  - simplified max total number - 120 existing staff, 90% normal work hours
  - simplified likely total number - 90 existing staff, 90% normal work hours
- Existing visits data provided by the prison:
  - simplified max total number - 120 existing visitors, sat/sun/wed, 2-4pm
  - simplified likely total number - 80 existing visitors, sat/sun/wed, 2-4pm
- Existing prisoner data provided by the prison:
  - simplified max total number - 250 existing prisoners, 20% are out of the site 11:30-20:00
  - simplified likely total number - 200 existing prisoners, 20% are out of the site 11:30-20:00
- Further existing data provided by the prison:
  - simplified total number - 3 existing commercial washing machines running 6:00-21:00 + 2 further machines for the RCDP expansion
- Proposed RCDP flows
  - simplified total number - 80 proposed prisoners + 5 staff
  - simplified likely number - 80 proposed prisoners + 5 staff
- Allowance for future expansion
  - Add 20% treatment capacity for future expansion

Both maximum and likely figures have been used within the assessment to avoid considering an unrealistic total that is very unlikely to happen.

5.2 Assessment summary:

Predicted volume per day (L)	76100
Volume capacity per day (L) (2 x BioDisc BN units)	90000
Spare volume capacity (L)	13900
Percentage spare volume capacity	15.4%

This is all based on the maximum occupancy numbers, which is considered to be a less likely scenario, so the actual volume per day is more likely around 70000 Litres per day, which offers a 20% spare capacity value.

The results show that a replacement treatment plant is required to prove this level of treatment capacity. Refer the constraints section 6 and the proposed treatment plant section 7 for recommendations.

6. Constraints

The key constraints that must be considered when selecting the appropriate course of action to achieve the required treatment capacity are set out below:

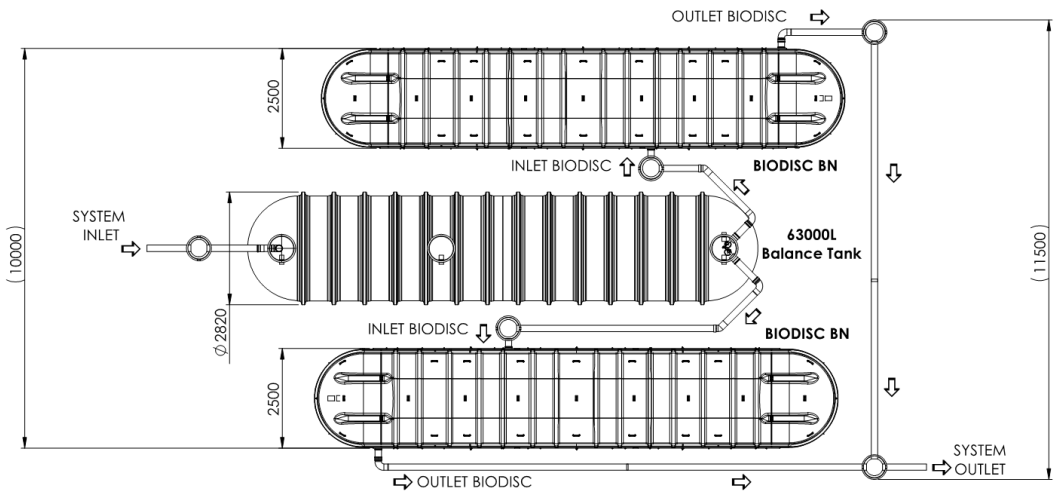
- The existing Biotec treatment plant will be over capacity in terms of its treatment volume per day,
- It is not possible to add tanks or treatment stages to the existing system within the confines of the existing treatment plant compound area due limited space.
- It is not possible to keep the existing Biotec treatment system in place while the new BioDisc plant is constructed, which will require the temporary tankering away of waste water during the construction period of the new treatment plant
- There are existing foul drainage lines that enter the treatment plant compound area that need diverting into the upstream end of the replacement BioDisc treatment plant
- The existing discharge consent needs to be updated for the proposed increase in flows and for the new discharge water quality limits.
- The replacement treatment plant needs to comply with modern discharge limits, including the nitrates/phosphates reduction due to the River Usk Catchment Special Area of Conservation.

7. Proposed Drainage & Treatment Plant

7.1 Treatment Plant

A suitable replacement sewage treatment plant system has been considered and designed to serve the existing + RCDP + future expansion case.

- 63,000L primary settlement tank
- 2 x Kingspan BioDisc BN treatment plant units
- Chemical dosing facility to reduce phosphates
- Equivalent to "500PE" - 500 population equivalent, which must also consider all other flows from staff, visitors and kitchen activities



7.2 Discharge Consent Permit

A replacement discharge consent is required to support both the existing site uses and proposed RCDP development, to meet the following limits:

Effluent quality (mean):

- BOD 20mg/l
- Suspended Solids 15mg/l
- Ammoniacal Nitrogen 10mg/l
- Phosphate 2mg/l (or lower)

This is currently being assessed by NRW, following an application made in October 2022. It is due for determination in June 2023.

8. Phosphates

NRW have confirmed that the sewage treatment works discharge is within a the River Usk catchment Special Area of Conservation, where strict limits and controls apply to the allowable phosphate discharge to contributing watercourses linked to that river catchment.

A comparative assessment between the existing treatment plant and the proposed plant has been completed, based on the general treatment performance of each system in terms of phosphate reduction.

In 2021 NRW published a report on 'Compliance Assessment of Welsh River SACs against Phosphorous targets' which shows that five (Dee, Cleddau, Teifi, Usk, Wye) of the nine Special Areas of Conservation (SAC) rivers in Wales are failing to meet the targets set out by the Joint Nature Conservation Committee (JNCC) in 2016 to protect the SAC's.

As a consequence, NRW updated their planning advice to Local Authorities in relation to developments in SAC catchment areas and also developed a permitting policy for new discharges within these SAC catchments that contain phosphates. NRW's permitting policy states that applications for these new discharges are to be refused on the basis that additional phosphorus loading to the catchment of a SAC river that is already failing its Conservation Objectives in relation to phosphorus, will further undermine those objectives and have an adverse effect on site integrity.

The strategy at HMP Prescoed is to offer an **overall reduction in phosphorous** discharged to the receiving watercourse, even with the predicted increased in discharge volume from the proposed expansion at the site. This is achieved through the proposed use of a chemical dosing unit (ferric sulphate-based) in each BioDisc treatment tank unit.

This comparative assessment between the existing treatment plant and the proposed plant has been completed on the general treatment performance of each system, in terms of phosphate reduction.

- **EXISTING PLANT – BioTec System**
  - Existing design volume per day = 60000L (based on capacity of the units)
  - The existing plant achieves a 35% reduction in phosphate = 17 x 0.65 = 11.05mg/L
  - Phosphate per day = 663,000mg per day

- **PROPOSED PLANT - BioDisc System**
  - Proposed design volume per day = 76,100L
  - Without chemical dosing = treatment plant reduces phosphate by 45%
  - With chemical dosing = treatment plant reduces Phosphate level to 2 mg/L, can be up to a 95% reduction on untreated, which is closer to 0.9mg/l
  - P (reduced with CD max) = 2mg/L
  - P (reduced with CD min) = 0.9mg/L
  - P (untreated) = 17mg/L (based on typical phosphate levels in raw sewage)
  - P (reduced without CD) = P (untreated) x 0.55 = 9.35mg/L
  - Treated with Chemical Dosing = 152,200mg per day max
  - Treated with Chemical Dosing = 68,490mg per day min
  - Treated without Chemical Dosing = 711,535mg per day
  - Untreated = 1,293,700mg per day

Even with the proposed increase in discharge volume, the phosphate reduction and water quality improvement results are significant and favourable.

The proposed treatment plant is predicted to discharge between 68,490 and 152,200mg per day of phosphates (69 to 152 grams per day)

This is between 10% and 23% of the existing plant's phosphate discharge when at capacity, which is a 90% to 77% reduction.

9. Conclusion

The existing sewage treatment plant that serves the current HMP Prescoed development is currently at capacity in terms of: water quality, discharge rate and discharge volume.

A replacement sewage treatment plant is required to adequately serve the existing development, the proposed RCDP development and allow for some future expansion at the site.

To support the proposed replacement treatment plant, an application has been submitted to NRW for the uplift of the existing treated effluent discharge consent, up to a peak flow of 9 litres per second, a total volume of 72 cubic metres (72,000 litres) per day and improved discharge quality limits, which represent a reasonable upper limit of predicted flows.

The replacement sewage treatment plant is a three tank "BioDisc" treatment system which achieves improved water quality limits and contains a 'chemical dosing plant' feature, which will result in a net reduction of nitrate/phosphate load to the Usk river catchment via the local watercourse from present, which is a strict planning requirement that applies to the RCDP project..

The replacement sewage treatment plant is the single mitigation factor to the nitrate/phosphate restriction that must be resolved as part of the proposed planning application for the RCDP units.