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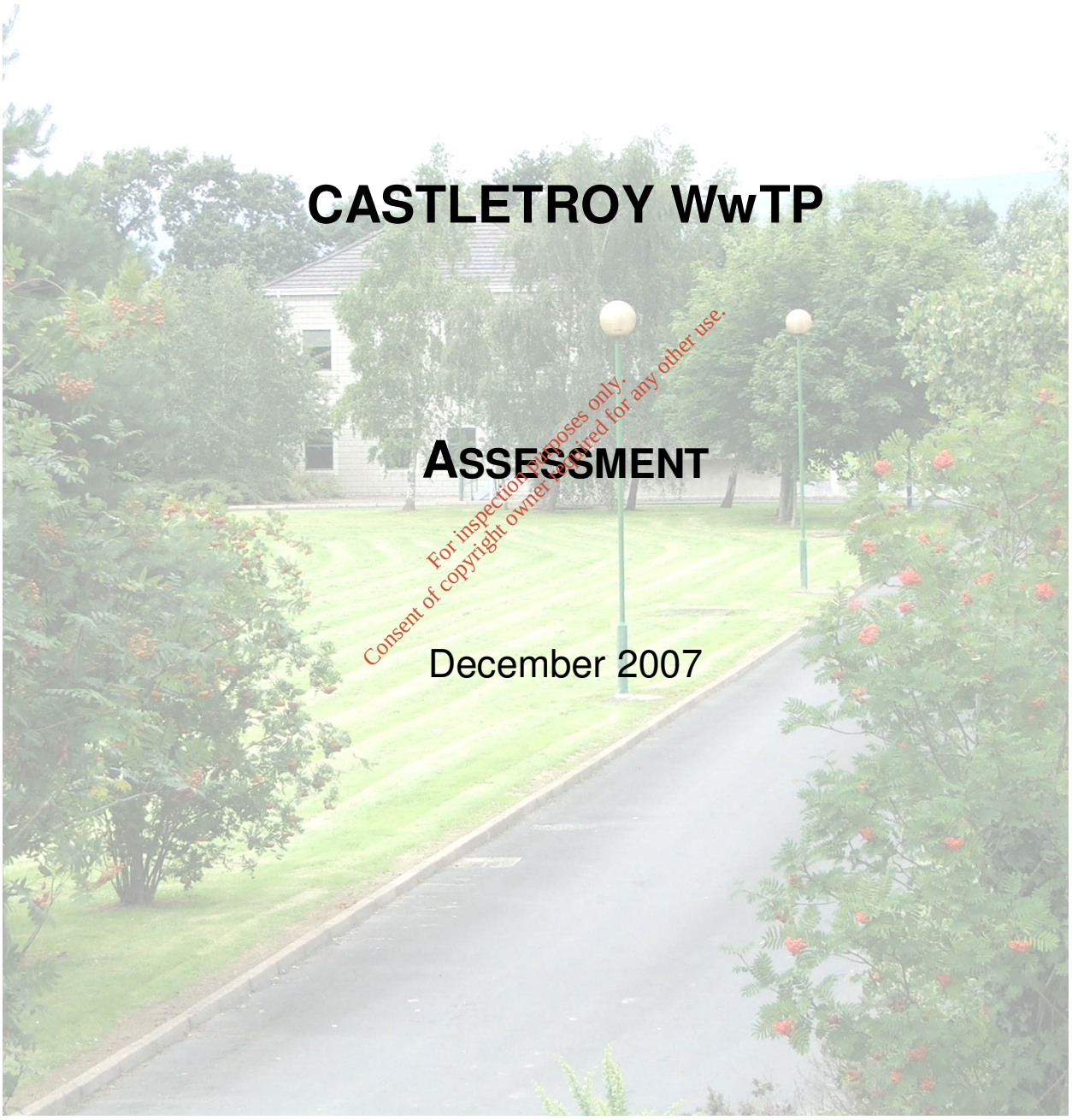

CASTLETROY WwTP

ASSESSMENT

December 2007

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CELEBRATING 40 YEARS IN BUSINESS

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PROJECT TITLE: **Castletroy Wastewater Treatment Plant**

DOCUMENT TITLE: **Castletroy Wastewater Treatment Plant Assessment**

DOCUMENT No.: **12127_6001**

CLIENT: **Limerick County Council**

PROJECT LOCATION: **Castletroy, Co. Limerick**

Rev	Date	Issue Description	By	Checked	Approved
A	01/10/2007	Draft Issue	MJO'S	PS	MJO'S
B	10/10/2007	Issue For Information	PS	MJO'S	MJO'S
C	22/11/2007	Issue For Approval	PS	MJO'S	MJO'S
D	28/11/2007	Re-Issue For Approval	PS	MJO'S	MJO'S
E	07/12/2007	Final Issue	PS	MJO'S	MJO'S

This Document Comprises of:	DCS	TOC	Text	Tables	Figures	Appendices
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DOCUMENT ISSUED FOR:

☒	Entire Document Issued this Revision	☐	In-House Review	☐	Tender
☐	Revised Pages Only Issued this Revision	☐	Information Only	☐	Construction
		☐	Client Approval	☒	Final Issue

Project Manager Authorisation: _____ Date: _____

Client Authorisation: _____ Date: _____

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1.0 INTRODUCTION

1.1 CLIENT'S BRIEF

Carry out an assessment of the existing Wastewater Treatment Plant at Castletroy in respect of its current load, problems in dealing with the existing load, capacity to accept additional load, potential sources of additional load and options for the future management of that load whether by expansion of the WwTP or transfer of the load to Limerick City WwTP.

This, by its very nature would be broad bush. However, the intent would be to try to identify the options available for consideration when determining the best strategy for any future upgrade to Castletroy WwTP. In doing so it would also be prudent to identify items of work necessary to improve current shortcomings within the Plant itself and to propose short-term upgrades that would allow for the acceptance of an increasing load over the next few years.

1.2 SUMMARY OF REPORT

The following bullet points can be read as a brief summary of the Assessment on Castletroy WwTP:-

Existing & Projected Loads

- The existing Plant is designed for 19,500 p.e. (Stage 1) and 58,500 p.e. (Stage 2).
- The Plant is currently overloaded biologically and hydraulically by 55% and 33% respectively.
- The present loading on Castletroy WwTP is in the order of 30,000 p.e.
- Short-term loading on the Plant will increase to 39,000 p.e.
- Medium-term development within the catchment could reach 53,000 p.e.

Plant Capacity & Condition

- The penstock on the Inlet Pumphouse is seized and needs to be refurbished / replaced and the greasing nipples extended to the surface.
- The build-up of grit and stones in the Inlet Pumphouse sump must be removed on a regular basis to avoid damage to the pumps. An isolating valve / penstock is vital to this removal.
- There is a suspicion that there is some infiltration of groundwater into the Collection system via some low-lying manholes and pipelines. This should be investigated.
- The Screezers need some maintenance and one in particular has a gap in the screen.
- The Screezer greasing nipples should be extended to a more accessible location.
- A different screen configuration should be chosen when the Screezers come up for replacement.
- An alternative flow measurement device (e.g. a Water Rat in the pipe downstream of the existing Measurement Flume) is required to measure "Flow to Treatment" (FTT).
- The overflow penstock setting could be increased to the level of the preceding Overflow Weirs in order to allow more "Flow to Treatment".
- Maintain new overflow setting until additional Biological Reactor is in place.
- Provision should be made for Storm Water Balancing with a minimum of 2 hours Retention for 3 DWF of the Stage 2 Design Load, i.e. 3,375 m^3.

- An auxiliary fine bubble diffused air system, capable of delivering 3,160 kg O_2 /day, needs to be retrofitted to the Aeration Basins to run in conjunction with the existing aerators.
- It will become much more important to control the type of bacteria in the process system (i.e. prevent the growth of filamentous bacteria). Control of scum may also become a problem.
- The pump capacity on the Sludge Return / Waste lines should be increased.
- It is suggested that a simple Pressure Nozzle System, fixed to the scraper bridge and using settled water, be used to replace the defunct Brush System for cleaning the outlet channels of the clarifiers.
- A new flow measurement chamber and device is required upstream of the Final Effluent Inspection Chamber to enable accurate flow measurement of the Final Effluent discharging to the river in times of flood. This should be in the form of a combined velocity / level meter installed in the 1,050 mm Φ Final Effluent Pipe.
- A second PFT is required.
- Provide a second Sludge Dewatering Machine. (A Centrifuge is recommended)
- An automatic loading conveyor should be installed with the new Sludge Dewatering Machine.
- Provide a temporary Dewatered Sludge Storage Silo or additional trailers for an eventuality where the normal sludge disposal route is temporarily unavailable.
- An air scrubbing system should be installed for the Sludge Handling Facility.
- It is recommended that a formal Imported Sludge Reception Facility be provided.
- Consideration should be given to reconfiguring the outlet chamber to utilise all the diffusers, to prevent any build-up of solids and to ensure accurate flow measurement and effluent sampling.
- The Alarm Call-Out System needs to be up-dated to a text message GSM system.
- Remote access to the SCADA via a laptop computer should be provided to the Curator to optimise management of alarm events.

Health & Safety

- Concern about the safety of the Operators if an emergency arises while they are unaccompanied.
- The entrance should be secured using an automated gate complete with recorded CCTV monitoring and a swipe card system for operatives.
- A communication system between the gate / Administration Building and the curator is required.

Mountshannon Pumping Station

- A maceration system is recommended ahead of the pumps.
- Some form of grit capture system is required.
- The flap valve on the storm overflow pipe needs to be fixed / replaced.
- An analysis of the contributing collection system is required to establish the correct approach to the upgrading of the Pump Station.
- The Castletroy WwTP SCADA system should be extended to connect Mountshannon and Castleconnell Pumping Stations.

Expansion Options

- Option 1 Pump the collected wastewater from the Castletroy site to the City WwTP on the Dock Road.
- Option 2 Upgrade and expand the existing WwTP at Castletroy.

Expansion Costs

- Option 1 € 12,400,000
- Option 2 € 4,770,000

2.0 EXISTING AND PROJECTED LOADS

2.1 EXISTING LOADS

The existing pollution and hydraulic loads arriving at Castletroy WwTP have increased substantially since 2006. These loads are made up of a number of factors including the addition of the pumped flows from both Annacotty (Mountshannon) and Castleconnell.

The current loads arise from: -

- Residential Population
- University of Limerick
- Commercial
- Industrial
- Imported Sludges
- Imported Leachates
- Pumped loads from Annacotty (Mountshannon Pumping Station)
- Pumped loads from Castleconnell (Castleconnell Pumping Station)

Analysis of the influent arriving at Castletroy WwTP also shows a distinct change in strength (in terms of BOD_5) between 2006 and April 2007. In 2006 the average BOD_5 concentration was approximately 150 mg/l compared to April 2007 when it increased to approximately 300 mg/l.

In March 2007 the average recorded daily B.O.D. level was 1820 kg BOD_5, a population equivalent of approximately 30,300 p.e., and the associated average daily flow was 5,990 m^3/d. These figures are 55% and 33% above their respective design loads for Castletroy WwTP. These design loads are discussed in Section 3.

Despite this significant increase in both the pollution and hydraulic loads the Plant is continuing to produce a very good effluent. However certain elements of the Plant, e.g. the aeration system and the sludge handling system, are under severe pressure.

2.2 SLUDGE PRODUCTION

Another method of establishing the order of contributing pollution load arriving at the Plant is to assess the quantities of sludge produced. Luckily the Curator (Operator) at Castletroy WwTP has kept a good log of the quantities of sludge produced at the Plant over the years.

In general the Plant is exporting up to 9 Tonnes of Dry Solids per week, i.e. 1.285 Tonnes per day. The records for the months of May and June 2007 show that a total of 63 Tonnes of Dry Solids were produced at the Plant, i.e. an average of 1.07 Tonnes per day (assuming that the last quantity of sludge measured during this period was on June 29th).

Sludge production at an Extended Aeration Activated Sludge Plant such as Castletroy WwTP may be expected to vary between 0.8 kg and 0.6 kg of Dry Solids per kg of BOD_5 removed. Using this relationship the amount of BOD_5 removed during treatment on a daily basis would generally be in the range of between 1,606 kg and 2,141 kg of BOD_5. In May and June of this year this range was between 1,338 kg and 1,783 kg of BOD_5.

The Urban Waste Water Directive (91/271/EEC) has now defined a 'Population Equivalent' (or 1 p.e.) as being 60 grams of BOD_5 per head of population per day. By equating the quantity of Dry Solids produced with the amount of BOD_5 removed during treatment it is possible to express the treated pollution load as a 'Population Equivalent'. In general the range is between 26,767 and 35,683 p.e. During the period of May – June this range varied from 22,300 and 29,717 p.e.

Therefore the sludge production documented at Castletroy WwTP would indicate that the pollution load arriving at the Plant is typically in the following ranges:

Period	Sludge Production Rate	Equivalent Quantity of BOD_5 Removed	Population Equivalent
		kg BOD_5 / d	p.e.
Generally (1.285T)	0.6 kg D.S. / kg. BOD_5	2,141	35,683
	0.8 kg D.S. / kg. BOD_5	1,606	26,767
May/June (1.070T)	0.6 kg D.S. / kg. BOD_5	1,783	29,717
	0.8 kg D.S. / kg. BOD_5	1,338	22,300

It is noted that the sludge production figures discussed are for May and June when one would expect the local University population to be significantly reduced given that they have a month of study leave prior to the exams which take place mainly in May.

From the foregoing it is felt safe to state that the existing loading on Castletroy WwTP is in the order of 30,000 p.e.

2.3 ADDITIONAL ANTICIPATED LOADING

It is certain that, while the pressure for building development may moderate in the short term, there will continue to be a need for both normal residential housing and for student accommodation. This latter requirement is being directly addressed by UL as well as the private sector.

There is a significant area of land still available for development in the Castletroy to Annacotty area for both residential and industrial growth. The existing housing density in the area is quite low and the Local Area Development Plan (see Appendix F) indicates future housing densities of 25 units per hectare. There are approximately 173 hectares currently zoned for residential use and at the maximum planning density this could yield a further 4,000 housing units. At an average of 2.5 persons per housing unit this could potentially increase the pollution load on Castletroy WwTP by an additional 10,000 p.e.

Added to this would be an allowance for growth in local industry. An existing company, Vistakon, has already applied to discharge a new waste stream to the Plant at Castletroy and has carried out successful compatibility trials. This waste stream was predicted to add a highly concentrated pollution load to the Plant, roughly equivalent to 2,800 p.e. However initial records indicate that the effluent discharged to the Plant may be more than three times that prediction, i.e. 8,500 p.e. This highly concentrated load is estimated to be contained in approximately 31 m^3 of liquid and should have a negligible impact on the Hydraulic Retention Time (HRT) associated with the existing treatment process.

In fact, subject to sufficient aeration and sludge handling capacity, this load would be an aid to the operation of the Plant, provided it is bled in at a constant rate or alternatively overnight, since it would give a good source of food matter to the biological population of the Plant in times of dilute flow.

Apart from providing for the load from the Vistakon plant there must also be an allowance made for other industrial loads resulting from the future development of the industrial parks in the Castletroy catchment. These are expected to be "dry" industries and an allowance of a further 2,000 p.e. should cater for their needs.

Finally, the 2007-2013 Draft Local Area Plan for Castleconnell (see Appendix F) projects an increase of 2,600 p.e. for the catchment.

The result of all of the foregoing is that a further load of 23,100 p.e. may be expected to contribute to the load arriving at Castletroy Wastewater Treatment Plant in the medium to long term bringing the total projected future load to some 53,000 p.e. (This would be slightly below the Stage 2 'Biological' Design Load for Castletroy WwTP discussed in Section 3).

As discussed in Section 3, the standard hydraulic load used is 230 litres per head of population per day. Based on this figure, a 'Biological' Design Load of 53,000 p.e. would be expected to equate to a 'Hydraulic' Design Load of 12,190 m^3/d.

However, it must be remembered that the anticipated loading from Vistakon is a 'Biological' Load of 8,500 p.e. in 31 m^3/d. Therefore it is more accurate to adjust the 'Hydraulic' Load and base it on a figure excluding the Vistakon 'Biological' Load. This adjusted 'Hydraulic' Load would be in the order of 10,235 m^3/d, when based on a 'Biological' Load of 44,500 p.e. plus the hydraulic load from Vistakon.

In conclusion, the medium to long term total Projected Future Loads for the Castletroy WwTP would be;

'Biological' Load	3,180 kg BOD_5/d	(equivalent to 53,000 p.e. @ 60g BOD_5/hd/d)
'Hydraulic' Load	10,235 m^3/d	(equivalent to 44,500 p.e. @ 230 litres/hd/d)

3.0 THE WASTEWATER TREATMENT PLANT

The published design data for Castletroy WwTP (see Appendix A) describes a 2 – Stage design. Stage 1 was designed to cater for a Design Load (Population Equivalent) of 18,000 p.e. Stage 2 was intended to meet the future needs of a fully developed catchment with a maximum Design Load (Population Equivalent) of 54,000 p.e. It was also intended that both the 'Biological' and 'Hydraulic' Design Loads would be based on the same Population Equivalent figures. This can be summarised as follows: -

Parameter	**Stage 1 (Original)**	**Stage 2 (Original)**
Design Load	18,000 p.e.	54,000 p.e.
DWF	4,500 m^3/d	13,500 m^3/d
BOD_5 Load	1,170 kg/d	3,510 kg/d

The above design data was based on previous historical definitions of Population Equivalent and Dry Weather Flow. It was accepted that 1 Population Equivalent was defined as being 65 grams of BOD_5 per head of population per day. Also Dry Weather Flow was defined as being equivalent to 250 litres per head of population per day.

The above design parameters are somewhat in excess of those used today and as discussed briefly in Section 2.2 a "Population Equivalent" (1 p.e.) is now defined by the Urban Waste Water Directive (91/271/EEC) as being 60 grams of BOD_5 per head of population per day (60 g BOD_5 /hd/d).

In relation to the Hydraulic Load, while the above data defined Dry Weather Flow as being equivalent to 250 litres per head of population per day the design itself, in terms of pump capacity etc, appears to be based on a figure in the order of 230 litres per head of population per day. This latter figure for the Hydraulic Load (230 l/hd/d) is more usual and is used hereafter.

Therefore by adjusting the original design figures to reflect current standards the Adjusted Design Loads for Castletroy WwTP can be compared to the Projected Future Loads and summarised as follows:

Parameter	**Stage 1 (Adjusted)**	**Stage 2 (Adjusted)**	**Projected Future Loads (See Section 2.3)**
Design Load	19,500 p.e.	58,500 p.e.	53,000 p.e. / 44,500 p.e.
DWF	4,500 m^3/d	13,500 m^3/d	10,235 m^3/d (44,500 p.e.)
BOD_5 Load	1,170 kg/d	3,510 kg/d	3,180 kg/d (53,000 p.e.)

4.0 PROCESS DESCRIPTION

The existing Plant operates as a Secondary Extended Aeration Activated Sludge Plant and consists of the following elements: -

- Inlet Pumphouse (with Foul and Storm pumps)
- Emergency Gravity Overflow to Outfall
- Fine (5mm) Inlet Screening complete with Screenings Removal, Washing and Compaction
- Jeta Grit Trap complete with Classifier
- Inlet Flow Measurement (Electromagnetic Meters on Rising Mains and Measuring Flume after screening and grit removal)
- Twin Stream Tapered Aeration
- Twin Secondary Clarifiers
- Final Effluent Inspection Chamber
- Outfall to the River Shannon
- Picket Fence Thickener
- Sludge Dewatering Building complete with Double Belt Press Dewatering Machine
- Administration / Control House

Appendix E contains two drawings, a Process Schematic and a process Flow Diagram. These can be read in conjunction with the following description of the existing works.

4.1 INLET PUMPHOUSE

Flows arrive at the Castletroy WwTP via 1,050 mm Φ gravity sewers from the east and west. These combine into a single 1,050 mm Φ gravity sewer at foul manhole F63 just inside the WwTP boundary. This sewer then combines with the return supernatant liquors from the sludge dewatering process at foul manhole F63A before entering the Inlet Pump Sump through a 1,100 mm Φ pipe.

The Inlet Pump Sump consists of a two level tank internally with the incoming flows discharging to the deeper section of the Tank (2.3 mOD Malin Head).

This section of the sump, measuring 4 m wide by 8.5 m long (34 m^2) houses the suctions for 2 No. Duty / Assist and 1 No. Stand-By Foul Pumps, each with a reputed capacity of 138 l/s (3 DWF for 17,280 persons at 230 litres/head/day). There is provision for a fourth pump to give a total foul pump capacity of 51,840 persons at 3 DWF. This figure is based on a Duty / Assist / Assist pumping arrangement with the fourth pump on Stand-By. These pumps discharge to the Preliminary Treatment (Inlet) Works at an Invert Level of 11.75 mOD.

During low flows one Foul Pump is in operation. As the flow entering the Inlet Pump Sump exceeds the capacity of the Foul Pump the liquid level in the Inlet Pump Sump rises to the upper level in the sump at 3.9 mOD. This effectively adds a further 5 m to the length of the sump creating a storm water

sump with a plan area of 54 m^2. This section of the Inlet Pumphouse contains 2 No. Storm Pumps (Duty, Assist) each with a reputed capacity of 350 l/s. (2.5 DWF for 52,590 persons at 230 litres/head/day). The rising main from these Storm Pumps also discharges to the Preliminary Treatment (Inlet) Works at an Invert Level of 11.75 mOD.

If the combined capacity of the Foul and Storm Pumps is exceeded, then the liquid level within the Inlet Pump Sump rises to an Emergency Gravity Overflow at a level of 8.1 mOD. It should be noted that the current capacity of the Foul and Storm Pumps is 626 l/s, i.e. 2 x 138 l/s (Foul Pumps) and 1 x 350 l/s (Storm Pump). At full Plant capacity, i.e. when the fourth Foul Pump is installed, this figure will increase to 764 l/s. The overflow is protected by a baffle plate and medium mesh screen (covering the invert of the baffle).

The overflow discharges to a 1,050 mm Φ Final Effluent Pipe which runs the length of the WwTP site and collects the secondary overflows (from the Preliminary Works) as well as the final effluent from the Secondary Clarifiers. It is understood that overflows entering this pipe, from the Inlet Pumphouse, are virtually unknown.

It is worth noting that there are no formal storm water balancing facilities at the Plant. However, the Curator manages the foul pump cut-in levels to mobilise the lower sections of the Sewage Collection System to balance flows. The volume mobilised is calculated at 2,611 m^3. This volume may be sufficient for the Projected Future Loads arriving at the WwTP but one cannot be certain without a detailed study of the Collection System. It is recommended that a full hydraulic model of the Foul and Storm Systems associated with Castletroy WwTP be carried out to confirm the available capacity and, should this be insufficient, the additional capacity required.

4.2 PRELIMINARY TREATMENT (INLET WORKS)

Flows from the Foul and Storm Pumps discharge to the Inlet Works at an invert level of 11.75 mOD. These Works consist of Duty and Stand-By Screezers (each with a 1000 l/s capacity and capable of passing the full ultimate pumped flow of 764 l/s). These machines have a horizontal screen of 5 mm spacing. The screenings are lifted into an integrated compactor where they are washed and compacted prior to discharge to a skip.

Having passed through the Screezers the flow passes through a Jeta 900 Grit Trap (880 l/s capacity), which removes the grit and discharges it to a classifier.

The flow then passes through an Overflow Channel followed by a Measurement Flume. The flume has a semi-circular invert and a throat of 508 mm. This flume is rated at 250 l/s and, it appears, the design intent was to replace it with a larger (wider) flume during the future construction of Stage 2.

Just upstream of the Measurement Flume it was intended that an Actuated Penstock, linked to the ultrasonic flow measurement device situated at the Measurement Flume, would adjust its level to limit the Flow to Treatment (FTT). This, together with the height of the Overflow Weirs, would then control the flow left through to the Secondary Treatment Plant. According to the construction drawings made available by Limerick County Council, if the penstock were not in place the Overflow Weirs would be engaged at 200 l/s (with a depth of flow of 400 mm). This is equivalent to 3 DWF for 25,045 persons at 230 l/hd/d. In fact, the Curator at Castletroy WwTP has manually fixed the level of the Actuated Penstock in order to limit the "Flow to Treatment" to approximately 150 l/s (13,000 m^3/d) roughly equivalent to 3 DWF for 18,780 persons at 230 l/hd/d.

These Overflow Weirs also discharge to the Final Effluent Pipe and mix with the treated Final Effluent prior to discharging to the Final Effluent Inspection Chamber.

4.3 SECONDARY TREATMENT (AERATION BASINS)

The Secondary Treatment consists of a Two – Stream Tapered Aeration Biological Reactor followed by a Secondary Clarifier. Clearly this was designed for the Stage 1 loading of 18,000 p.e. (19,500 p.e. using the current UWWD definition).

Each Aeration Basin measures 32.5 m long by 16.25 m wide with an operating maximum water depth of 5 m. This gives a reactor volume for each stream of 2,640 m^3, i.e. a combined total reactor volume of 5,280 m^3.

Each stream has a Primary and Secondary Surface Aerator (1 No. 45 kW, on inverter, and 1 No. 22 kW respectively) with a combined design aeration capacity of 75 kg O_2 /hour. (This figure is accepted although no calibration data from installation was available.)

Based on the Stage 1 Design DWF of 4,500 m^3/d, the combined total reactor volume of 5,280 m^3 gives a Retention Time of 28 hours with a minimum HRT of 9.5 hours at 3 DWF. This puts the design squarely in the Extended Aeration Activated Sludge category, which will give full Nitrification in addition to full Carbonation.

The Tapered Aeration given by the smaller Secondary Aerator in the second half of each stream would not depress the dissolved oxygen levels sufficiently for denitrification to occur.

Extended Aeration treatment has the advantage that it minimises Waste Sludge production in the absence of digestion. It is noted that this level of treatment is not specifically required to meet the discharge standards.

4.4 SECONDARY TREATMENT (CLARIFIERS)

There are two Secondary Clarifiers, one for each treatment stream. Each clarifier measures 20m in diameter giving a combined total surface area of 628.3 m^2. Based on the Stage 1 Design DWF of 4,500 m^3/d, this combined total surface area is sufficient for 3 DWF. At 3 DWF the flow rate through the Secondary Clarifiers would be 21.5 m^3/m^2/d, which is a safe loading rate for a clarifier.

Due to the lack of a selector tank or anoxic zone in the biological treatment section of the Plant there would be a susceptibility to denitrification occurring in the clarifiers giving rise to excessive scum.

From the Secondary Clarifiers settled Return Activated Sludge (RAS) is pumped back to the inlet of the Aeration Basins while Waste Activated Sludge (WAS) is pumped forward to the Picket Fence Thickener (PFT).

The clarified liquor is discharged to the Final Effluent Inspection Chamber and thence to the River Shannon.

4.5 SLUDGE MANAGEMENT

As mentioned previously, Waste Activated Sludge (WAS) from the Secondary Clarifiers is pumped forward to a Picket Fence Thickener (PFT) for thickening, storage and dewatering. The PFT has an internal diameter of 7.1 m and a sidewall depth of 2.95 m, giving a total volume of 116.8 m^3.

Ideally one needs at least three days storage of WAS to take account of weekends, breakdowns and the working day. As discussed in Section 2.2, sludge production at an Extended Aeration Activated Sludge Plant such as Castletroy WwTP may be expected to vary between 0.6 kg and 0.8 kg of Dry Solids per kg of BOD_5 removed. This means that based on the Stage 1 Design Loading of 1,170 kg BOD_5 /d, an average of 819 kg WAS would be produced at 1% Dry Solids. This would equate to a volume of 82 m^3 WAS /d. Assuming the need for three days of storage the PFT would require a capacity of 246 m^3 in order to cope with the quantities of WAS produced at 1% Dry Solids.

Given that the total volumetric capacity of the PFT is only 116.8 m^3 it is clear that the WAS thickens to between 2% and 3% Dry Solids within the PFT so that the Stage 1 Design Load can be catered for with some spare capacity.

The thickened WAS is pumped from the PFT to the Dewatering Building. Here it is passed through a 'Series 2/2000 Double Belt Press', designed for the original Stage 2 Design Load of 54,000 p.e. The Dry Solids content of the dewatered sludge is in the order of 18%. It is loaded into an articulated lorry with sealed sludge trailers by the Operators of the Plant and made ready for disposal off-site.

5.0 RECEIVING WATERS

Castletroy WwTP discharges to the adjacent River Shannon, just above the tidal divide. No part of the River Shannon nor any part of its estuary downstream is designated as "Sensitive" under the Urban Waste Water Treatment Regulations, 2001 (S.I. 254 of 2001).

The Environmental Protection Agency (EPA) website currently designates the River Shannon (Lower) as Q3 – Q4. From data produced on river Dry Weather Flows (DWF) and Ninety Five Percentile (95%) Flows, the **DWF of the Shannon at the Castletroy WwTP Outfall is 11 cumec**. (This comprises of the River Shannon DWF at Parteen Weir plus the River Mulkear DWF at Annacotty). This data is published on their website (origin is ESB). The **95% flow** is just 1 cumec more than this at **12 cumec**.

This gives an existing initial dilution of 1/150 at DWF.

The Castletroy WwTP Outfall is downstream of all existing Water Supply Intakes with the main Limerick City Waterworks located at Castleconnell, some 4.5 km upstream and Burlington Industries Waterworks (defunct at present) located approximately 300 m upstream. Therefore the only beneficial uses of the River Shannon downstream of the Castletroy WwTP Outfall are fishing and water sports (rowing).

Based on these uses and the large dilution available it is considered that the discharge standards given in Schedule 2 of the Urban Waste Water Treatment Regulations, 2001 (S.I. 254 of 2001) are adequate to safeguard the existing beneficial uses of the waters downstream.

Even at the ultimate stated design capacity of 13,500 m^3/d, the dilution would be 1/50 and a UWWTD effluent would still be acceptable.

6.0 PLANT CAPACITY AND CONDITION

The overall presentation of the Plant is very good and the general cleanliness of the Site is laudable. The Plant is being very actively and effectively managed by its Operators and is producing a very good standard of effluent. However there are a number of issues throughout the Plant, which it would be desirable to address. There are also areas where it is felt that change would be advantageous to the operations and safety within the Plant.

6.1 INLET PUMPHOUSE

As detailed in Section 4.1 the Inlet Pumphouse has 3 No. 138 l/s capacity Foul Pumps (Duty, Assist & Stand-By) installed as well as provision for a fourth similar sized Foul Pump (suction pipework already installed). These are sufficient for the full Projected Design Flow (3 DWF for 10,235 m^3/d), which is less than the envisaged full Stage 2 Design Flow of 13,500 m^3/d.

There are also 2 No. 350 l/s capacity Storm Pumps (Duty, Assist), each capable of pumping greater than 2.5 DWF based on the full Projected Design Flow. It should be noted that these pumps would be incapable of pumping 2.5 DWF based on the full Stage 2 Design Flow of 13,500 m^3/d. There is no provision for more Storm Pumps.

There are a number of problems with the Inlet Pumphouse as follows: -

- The inlet penstock is seized due to the difficulty in maintaining the greasing points. This should be refurbished / replaced and the greasing nipples extended up to the surface for ease of maintenance.
- Even when the inlet penstock was working it proved to be almost impossible to operate when the Collection System was surcharged in times of flood. This effectively meant that maintenance work within the Inlet Pump Sump could only be carried out during dry weather. A By-Pass System should be installed so that the pressure build-up can be relieved more easily. It is recommended that a 300mm Φ By-Pass Pipe be installed between foul manhole F63A and the Inlet Pump Sump at a similar invert level to the existing 1050mm Φ Inlet Pipe. This should be fitted with a penstock and used to equalise pressures either side of the penstock on the Inlet Pipe. Rough estimates suggest that the time required to 'equalise' pressures on the inlet penstock would be in the order of 10 – 30 minutes, depending on the pipework arrangement.
- There is a significant problem with grit and stones arriving at the Inlet Pumphouse and subsequently building up in the sump. This is a common problem in a catchment where construction of housing is in progress. This build-up must be removed on a regular basis to avoid damage to the pumps. An isolating valve / penstock is vital to this removal.
- There is a suspicion that there is some infiltration of groundwater into the Collection system via some low-lying manholes and pipelines. This should be investigated.

6.2 PRELIMINARY TREATMENT (INLET WORKS)

As already stated in Section 4.2, flows from the Foul and Storm Pumps discharge to the Inlet Works at an invert level of 11.75 mOD. These Works consists of Duty and Stand-By Screezers (each with a 1000 l/s capacity and capable of passing the full ultimate pumped flow of 764 l/s). Therefore there is adequate capacity in the inlet screens for future loading.

These Screezers are being damaged by construction waste finding its way through the inlet pumps and, consequently, need some maintenance. One in particular has a gap in the screen, increasing the screening gap to approximately 15mm, i.e. changing it from fine to medium screening. This machine should be overhauled as soon as possible. The difficulty with this is the long overhaul period quoted which would leave the Plant vulnerable.

As with the Inlet Pumphouse penstock there is difficulty in greasing these machines and the greasing nipples should be extended to a more accessible location.

In addition, the screen bars are horizontal rather than vertical so that narrow floating material, such as tampons and small plastics can readily stream through causing problems further downstream within the WwTP. A different screen configuration should be chosen when these screens come up for replacement.

Following on from the Screezers the flow passes through a Jeta 900 Grit Trap (880 l/s capacity), which removes the grit and discharges it to a classifier. This has adequate capacity for future loading and is operating well.

The flow then passes through an Overflow Channel followed by a Measurement Flume. This flume is rated at 250 l/s and may need to be replaced with a larger (wider) flume. Because of the configuration and levels just downstream of the Measurement Flume it cannot accurately measure the flows. An alternative flow measurement device (e.g. a Water Rat in the pipe downstream) is required to accurately measure “Flow to Treatment”.

The height setting of the Actuated Penstock, which controls the volume to be left through to the Secondary Treatment processes within the Plant, means that an overflow occurs each time the second Foul Pump cuts in. This height setting could be raised to the same level as the Overflow Weirs to allow more flow through. This would limit the flow to Secondary Treatment to a maximum 17,280 m^3/d, thereby ensuring a minimum HRT of 7.33 hours (just OK for Extended Aeration).

It must be noted that the above figure equates to a Plant Hydraulic Capacity of 25,045 p.e. (at 230 l/hd/d) and any subsequent mention of higher population equivalents relate to pollution load only and are dependent on those loads being more concentrated than normal domestic wastewaters.

This setting should be retained until an additional Biological Reactor is in place.

6.3 STORM WATER BALANCING

There is currently no formal provision for Storm Water Flow Balancing or Return at Castletroy WwTP.

In theory, this means that any flow in excess of 3 DWF for 18,000 p.e. is discharged directly to the River Shannon. In practice however, the curator manages the foul pump cut-in levels to mobilise the lower sections of the Sewage Collection System to balance flows. The volume mobilised is calculated at 2,611 m^3.

In the absence of a detailed hydraulic model of the Collection System provision should be made for a minimum of 2 hours retention of 3 DWF of the Stage 2 Design Load, i.e. 3,375 m^3 which would be returned for treatment after the storm incident passes. This would also cater for the current situation whereby any pumped flows from the second foul pump or the storm pumps are overflowed directly to

the River Shannon via the Outlet Chamber. The volume currently utilised by the curator is 77% of this figure so that the shortfall may be insignificant.

The current configuration of the foul pump cut-in probes ensures that the available storage in the Sewage Collection System is automatically mobilised when required and also automatically emptied as capacity in the Inlet Pumphouse Sump becomes available. However, it would be far more desirable to have a formal properly configured Storm Water Balancing Tank through which all overflows would pass. Such a tank would give an added physical (sedimentation) treatment, albeit small, to the storm water.

The present situation whereby any pumped flows from the second foul pump or the storm pumps are overflowed directly to the Final Effluent Inspection Chamber results in a build-up of solids in that chamber which can cause nuisance.

Storm Water Balancing will be required whether the Castletroy Site continues as a WwTP or changes to a Transfer Pumping Station. In the latter scenario the existing Aeration Basins could be readily converted to Storm Water Balancing Tanks.

6.4 SECONDARY TREATMENT (AERATION BASINS)

The Secondary Treatment consists of a Two – Stream Tapered Aeration Biological Reactor followed by a Secondary Clarifier designed for the Stage 1 loading of 18,000 p.e. (19,500 p.e. using the current UWWD definition). The combined total reactor volume is 5,280 m^3 and the installed aeration capacity is 3,840 kg.O_2/day.

The reactors do suffer from depressed Dissolved Oxygen levels during the day but generally the treatment standard is above requirements. Theoretically, since the system operates as Extended Aeration and there is no Denitrification, the installed aeration capacity should now be 5,900 kg O_2/day, i.e. the installed aeration capacity is inadequate.

The full Vistakon load discussed in Section 2.3 is estimated as being in the order of 510 kg BOD_5. If this full load were discharged to the Plant the aeration capacity would need to increase to 7,000 kg O_2/day, i.e. 3,160 kg O_2/day more than currently in place.

The hydraulic loading arising from the addition of the Vistakon load is expected to be approximately 31 m^3/d, which is negligible when compared to the scale of the potential incoming flows. This additional flow would not reduce the HRT, which would be just less than 24 hours at DWF.

Therefore, in order to safeguard the existing treatment and to make provision for the additional high strength load arising from the Vistakon site, additional aeration capacity of 3,160 kg.O_2/day should be installed in the existing Aeration Basins.

Since these basins cannot be taken out of service and the volumes required are substantial, it is recommended that an auxiliary fine bubble diffused air system be retrofitted to the Aeration Basins to run in conjunction with the existing aerators. This should be linked to a remote Dissolved Oxygen control system. Any refurbishment of the Aeration Tanks should be designed so as to achieve full 'stepped aeration', including, if possible, a defined anoxic zone within the stream.

The increase in Pollution Load being treated together with the improved aeration capability will lead to a fully nitrified MLSS being discharged to the Secondary Clarifiers leading to increased potential for denitrification to occur in these tanks. In order to reduce the chance of this the pump capacity of the Sludge Return / Waste lines should be increased.

6.5 SECONDARY TREATMENT (CLARIFIERS)

The two existing Secondary Clarifiers, measuring a combined total surface area of 628.3 m^2, are currently designed for a loading of 21.5 $m^3/m^2/d$ at 3 DWF. This is a safe clarifier loading rate.

If the Hydraulic Load is increased to 17,280 m^3/d the loading rate would increase to 27.5 $m^3/m^2/d$. This is still an acceptable loading rate and should not compromise the effluent standard, although it will become much more important to control the type of bacteria in the process system (i.e. prevent the growth of filamentous bacteria). Control of scum may also become a problem.

Phased maintenance of these tanks should be planned for the summer period when low flows can be predicted with confidence allowing the use of a single clarifier for a short period.

It is noted that the Brush System for cleaning the outlet channels of the clarifiers is defunct and a replacement is desirable. It is suggested that a simple Pressure Nozzle System, fixed to the scraper bridge and using settled water, be used to replace the defunct system.

6.6 FINAL EFFLUENT INSPECTION CHAMBER

The Final Effluent Inspection Chamber, located close to the river bank, was originally designed to act as a standard splitter chamber following the Stage 2 Upgrade of the WwTP. Its purpose is to distribute the final effluent between the three 630mm Φ Outfall Pipes once they are all in use.

The chamber itself comprises of three sections. The first two sections are divided by a baffle wall. The 1,050 mm Φ Final Effluent Pipe discharges to the first section of the chamber and the baffle wall kills any turbulence. Normal flow then passes under the baffle wall into the second section of the chamber. The third section of the chamber is further divided into three smaller 'Outlet Chambers', each servicing one of the three 630mm Φ Outfall Pipes. All three Outfall Pipes are in place and each ends in a Diffuser located at the approximate midpoint of the river. Following the full Stage 2 Upgrade of the WwTP a V-notch Weir will be installed at the inlet to each of the Outlet Chambers for flow measurement.

At present the WwTP is operating to the original Stage 1 design and only the centre Outfall Pipe is in operation. The final effluent flows from the second section of the Final Effluent Inspection Chamber over the V-notch Weir into the Outlet Chamber and through the Outfall Pipe to the Diffuser. The remaining two Outlet Chambers are currently isolated by steel plates.

Problems are periodically experienced during high river flows when the inspection chamber is flooded. This prevents accurate flow measurement of the final effluent. In order to ensure continued flow measurement under all river level conditions a combined velocity / level meter would need to be

installed at a point along the 1,050 mm Φ Final Effluent Pipe upstream of its discharge point to the Final Effluent Inspection Chamber. A new manhole / chamber should be constructed to facilitate the operation and maintenance of such a meter.

During low river flows, especially in dry weather, 'boil' is often visible at the river surface above the location of the diffuser ports. It can be difficult to reassure the public that this is not a specific cause for concern. Using all three Outfall Pipes and Diffusers could help reduce the incidence of 'boil' and thus positively affect the public's perception of the Plant's overall performance.

In addition to the above there can be also be a build-up of sludge (from the WwTP overflows) in the Final Effluent Inspection Chamber and this could be flushed to the river if not cleaned out in time. In fact, the current operating regime dictates that any cleaning carried out on this chamber is allowed to discharge to the river directly through the central Outfall Pipe. This practise should be stopped immediately and any 'washings' should either be taken away by suction tanker or pumped back to the head of the Inlet Works.

Consideration should be given to reconfiguring the Final Effluent Inspection Chamber to utilise all the diffusers, to prevent any build-up of solids and to ensure accurate flow measurement and effluent sampling. It would be possible to refurbish the existing chamber in such a manner as to construct a formal splitter chamber, allowing the use of all (or a selection) of the existing Outfall Pipes. The new chamber should also be benched appropriately so that cleaning and maintenance is made easier. The manual penstocks on the three 630mm Φ Outfall Pipes should be replaced with actuated penstocks.

6.7 SLUDGE MANAGEMENT

The existing Sludge Management System consists of a single stream. This poses a significant problem in that if an issue arises in any one section of the system it has the potential to shut down the entire dewatering system and, by extension, the entire Plant. This is undesirable in a Plant of this size and strategic importance.

A reasonable projection regarding the load that may pass through the existing Treatment Plant in the short term is 2,340 kg BOD_5 /d, i.e. twice the Stage 1 Design Load. This load would be contained in a maximum DWF volume of approximately 5,760 m^3/d (max. flow 17,280 m^3/d). This would be expected to generate a waste sludge volume of up to 1,870kg of Dry Solids per day. At 1% Dry Solids this would equate to 187 m^3/d, which is well in excess of the existing PFT capacity of 116.8 m^3.

As previously discussed, it is preferable that there is the facility for at least three days storage of Waste Activated Sludge (WAS) to take account of weekends, breakdowns and the working day. Therefore a second PFT is required. This would have the added advantage of providing a two-stream Sludge Management System.

The design of this second PFT and the operation of the existing PFT might be reviewed in light of simplifying the sludge wastage system to a continuous one whereby Sludge Age in the process is directly controlled by wasting from the Aeration Basins rather than the Secondary Clarifiers.

The 'Series 2/2000 Double Belt Press' installed in the Dewatering Building is under severe pressure to cope with the existing sludge production and any breakdown or other hic-cup in the sludge handling creates enormous problems for the Operators and requires a back-up. A second sludge dewatering machine is required to provide Duty / Assist capability.

It is recommended that a Centrifuge be installed instead of a second Belt Press. This would have a number of advantages, such as;

- Less 'Water For Operations' (WFO) is used. At present Castletroy WwTP uses the mains water supply to run the existing 'Series 2/2000 Double Belt Press' and therefore there is a cost implication with installing a similar type dewatering machine. A Centrifuge would be more cost efficient to run.
- The existing 'Series 2/2000 Double Belt Press' can produce Dry Solids of up to 18% and these are exported to Bunlickey. However, should Bunlickey be unable to accept dewatered sludge there is no alternative in place. A Centrifuge would be capable of producing Dry Solids of 22% to 25%, giving the option of exporting to the Cortadroma Landfill.
- By treating the dewatered sludge from a Centrifuge with lime it may be possible to export to a number of landfills.

Regardless of the type of dewatering machine chosen as a back-up for the existing Belt Press, it is worth considering the provision of a temporary Dewatered Sludge Storage Silo or additional trailers to provide for an eventuality where the normal sludge disposal route is temporarily unavailable.

The matter of loading the sludge trailers should also be addressed. At present the Curator has to manoeuvre an articulated trailer back and forth to ensure the trailer is filled evenly before being removed from site. An automatic loading conveyor with a sensor reading the level of sludge in the trailers and capable of controlling the position of the conveyor should be installed with the new sludge dewatering machine.

There is no air scrubbing system in place for the Sludge Handling Facility. It is understood that some complaints about arising odours have been received from members of the public using the adjacent riverside walk, although this is a rare occurrence. If a second PFT is installed the Sludge Age would most likely increase leading to greater levels of odour nuisance. An air handling unit should be installed within the Dewatering Building to address this.

6.8 IMPORTED SLUDGES & LEACHATES

The Plant presently caters for sludges and leachates imported from the surrounding area. There are no formal reception facilities or control of this import. Tankers arriving at the Plant discharge to Foul Manhole F63 just upstream of the Inlet Pumphouse to be pumped forward to treatment with little or no attenuation or dilution. This leads to shock loading on the biological part of the WwTP.

If the Council intends to continue this practice of importing sludges and leachates, it is recommended that a formal Reception Facility for both imported sludges and leachates be constructed on Site. This Reception Facility should include screening, a reception / balancing tank and bleed pumps so that the imports can be bled into the Plant load over a reasonable period.

6.9 MOUNTSHANNON PUMPING STATION

Bearing in mind that Mountshannon Pumping Station is outside the strict interpretation of the Brief, it is felt appropriate to comment on it in relation to its impact on the operation of the WwTP. This installation collects the wastewater from the Annacotty area and pumps it into one of the catchment perimeter trunk sewers feeding the WwTP. It is a small submersible installation with a control kiosk located on a reasonably large site so there is room for expansion or the addition of a balancing tank in the future.

There are regular maintenance problems with this pumphouse due to blockages of the pumps by ragging. This is an increasingly common phenomenon around the country in recent times and may be due to the advent of the more fibrous kitchen and toilet papers. A maceration system, such as the Mono Muncher type, is recommended ahead of remote pumping stations to address this problem.

In addition there is the problem of an accumulation of grit in the sump and resulting in the abrasion of the pump impellers, and ultimately leading to the need to replace the pumps. Some form of grit capture system is desirable to address this.

There is a storm overflow pipe at a high level within the pump chamber allowing for discharge to the nearby river during extended periods of wet weather. However, in times of flood the river backs up along the storm overflow pipe and floods the chamber forcing the pumps to operate continually until the flooding abates. The existing flap valve does not operate properly and should be fixed / replaced to prevent this.

Finally, the pumps operate between 20 and 23 hours per day, at a rate of approximately 5 – 6 l/s, which indicates that the pumping station has reached its capacity and needs to be upgraded. It is possible that increasing the size of the pumps, to achieve a pump rate of 15 l/s, would have a significant effect on the operation of the pumping station. The overall daily operation time for the pumps would be in the order of 7 – 8 hours per day. However, it is understood that there may be surface water infiltration to the system. An analysis of the contributing collection system is required to establish the correct approach to the upgrading of the pump station.

In terms of operation there is no alarm system in place for this pumping station so that the site must be visited each day to ensure that it is operating properly. If a problem arises following this visit it would not be discovered until the next visit unless reported. A telemetry connection between Mountshannon Pumping Station and Castletroy WwTP is essential. Such a connection is necessary for proper management of the system. By extension a similar connection should be made to the Castleconnell Pumping Station. It is understood that the Castletroy WwTP SCADA system has recently been upgraded and the contract for this upgrade should be extended to include this connection.

7.0 HEALTH AND SAFETY

While the purpose of this report is not to discuss Health & Safety it would be remiss not to refer to it at some level. In general no physical problems were evident during Site visits. However one issue did become apparent during the later stages of those visits. That issue being the fact that there are times during the day when the Plant Operators are unaccompanied while working at the Site.

There are two Plant Operators and they work different albeit overlapping shifts. One Plant Operator tends to work from 8am to 2 or 3pm, Monday to Friday, and works the remainder of his 'weekly' hours over the weekend. The second, the Curator, works a standard five day week with normal working hours of 9am to 5pm. While there is some degree of overlap between the hours worked by the Plant Operators there are times when they must operate the Plant on their own.

This raises a concern about the safety of the Plant Operators if an emergency arises while they are unaccompanied.

It must be noted however that this issue is not particular to Castletroy WwTP and it is a concern on a national level. The majority of Wastewater Treatment Plants have this staffing problem due to budget restraints. This aside, it is recommended that the issue be addressed and mitigating measures put in place to reduce on-site risks.

7.1 SITE SECURITY / MANAGEMENT

As mentioned above the Curator is often unaccompanied when working in the site. During this time the entrance gates are open and un-authorised access is possible. In addition control of imported wastes is more difficult as the curator may be away from the Administrative Building. This is unsafe and undesirable.

The entrance should be secured using an automated gate (at minimum, a barrier) complete with recorded CCTV monitoring and a swipe card system for both Plant Operators and other Council officials. A communication system between the gate / Administration Building and the Curator / Operator is also required since they cannot remain in the building.

Finally the Alarm Call-out System needs to be up-dated to a text message GSM system and remote access to the SCADA via a laptop computer should be provided to the Curator to optimise management of alarm events.

8.0 SHORT TERM WORKS REQUIREMENTS

8.1 IMMEDIATE WORKS REQUIREMENTS

In order to meet the short term requirements of the WwTP in addressing operational problems and existing and imminent loads, a number of items of work should be carried out. These items have been addressed in the sections above and may be summarised as follows (please note that a very rough "order-of-cost" estimate for each item is given in brackets in each item) : -

- The penstock on the Inlet Pumphouse is seized and needs to be refurbished / replaced and the greasing nipples extended to the surface. (€1,000)
- The build-up of grit and stones in the Inlet Pumphouse sump must be removed on a regular basis to avoid damage to the pumps. An isolating valve / penstock is vital to this removal. (€3,000)
- The Screezers need some maintenance and one in particular has a gap in the screen. (€20,000)
- The Screezer greasing nipples should be extended to a more accessible location. (€1,000)
- An alternative flow measurement device (e.g. a Water Rat in the pipe downstream of the existing Measurement Flume) is required to measure "Flow to Treatment" (FTT). (€3,000)
- The overflow penstock setting could be increased to the level of the preceding Overflow Weirs in order to allow more "Flow to Treatment". (€0)
- An auxiliary fine bubble diffused air system, capable of delivering 3,160 kg O_2 /day, needs to be retrofitted to the Aeration Basins to run in conjunction with the existing aerators. The new system should be a full 'stepped aeration' system, including, if possible, a defined anoxic zone. (€250,000)
- Dividing walls within the Aeration Basins, i.e. civil works associated with the proposed auxiliary fine bubble diffused air system. (extra €50,000)
- A new flow measurement chamber and system is required upstream of the Final Effluent Inspection Chamber to enable accurate flow measurement in times of river flooding. (€30,000)
- The Final Effluent Inspection Chamber should be refurbished to act as a formal splitter chamber. Refurbishment should include for maintenance requirements when cleaning out the chamber. (€100,000)
- Two new Automatic Samplers (24 Hour) are required for operations. (€10,000)
- The pump capacity on the Sludge Return / Waste lines should be increased. (€5,000)
- A second PFT is required. (€100,000)
- Provide a second Sludge Dewatering Machine (Centrifuge). (€150,000)
- An automatic loading conveyor should be installed with the new Sludge Dewatering Machine. (€30,000)
- The WwTP Site Entrance should be secured using an automated gate complete with security lighting, recorded CCTV monitoring and a swipe card system for Operatives. (€20,000)
- A communication system between the gate / Administration Building and the Curator is required. (€5,000)

- A telemetry connection between Mountshannon Pumping Station and Castletroy WwTP is essential. (€10,000)

Total Order of Cost is €788,000

8.2 OTHER DESIRABLE CHANGES

In addition to the foregoing works which are necessary to ensure continuing compliance with the effluent discharge standards, there are a number of other items which, while not absolutely vital, will in the medium term reduce the operating / maintenance costs of the WwTP and better ensure compliance with discharge standards. Please note that no "order-of-cost" estimate has been made for these items but some would be a relatively minor amount. The items are: -

- There is a suspicion that there is some infiltration of groundwater into the Collection System via some low-lying manholes and pipelines. This should be investigated.
- Provision should be made for formal Storm Water Balancing with a minimum of 2 hours Retention for 3 DWF of the design load, i.e. 3,375 m^3.
- The pump capacity on the Sludge Return / Waste lines should be increased.
- A simple Pressure Nozzle System, fixed to the scraper bridge and using settled water, should be used to replace the defunct Brush System for cleaning the outlet channels of the Clarifiers.
- Provide a temporary Dewatered Sludge Storage Silo or additional trailers for an eventuality where the normal sludge disposal route is temporarily unavailable.
- An air scrubbing system should be installed for the Sludge Handling Facility.
- It is recommended that a formal Imported Sludge Reception Facility be provided.
- The WwTP Access Road Entrance (off Plassey Park Road) should be secured using an automated gate complete with security lighting, recorded CCTV monitoring and a swipe card system for Operatives.
- The Alarm Call-Out System needs to be up-dated to a text message GSM system.
- Remote access to the SCADA via a laptop computer should be provided to the Curator to optimise management of alarm events.
- A maceration system is recommended ahead of the pumps at the Mountshannon Pumping Station.
- Some form of grit capture system is required at the Mountshannon Pumping Station.
- Increased Pump Capacity and Storm Water Balancing may be required at Mountshannon Pumping Station.
- An analysis of the contributing collection system is required to establish the correct approach to the upgrading of the Mountshannon Pumping Station.

9.0 MEDIUM TERM EXPANSION OPTIONS AND COSTS

The task facing Limerick County Council in the near future is deciding on the best strategy for the future treatment of wastewaters arising from Castletroy, Annacotty and Castleconnell catchments.

As can be seen from the foregoing the existing Wastewater Treatment Plant at Castletroy is currently overloaded by up to 55% biologically and 33% hydraulically. Some of this overloading is relieved by storm overflow to the River Shannon.

It should be noted that while the plant is overloaded at present, the standard of the effluent produced is within the limits set by the EPA. Indeed, the standard of the effluent leaving the Final Effluent Inspection Chamber, i.e. the combined effluent including storm overflows, is also within the limits set by the EPA.

However, going forward this is unlikely to be sustainable in the short-term and will almost certainly become an issue in the medium-term. In brief, the Council has two options: -

- Option 1 Pump the collected wastewater from the Castletroy site to the City WwTP on the Dock Road.
- Option 2 Upgrade and expand the existing WwTP at Castletroy.

9.1 OPTION 1

The first of these options (connection to the City Main Drainage Scheme) would entail the following: -

- Retention of the existing Inlet Pumphouse and Inlet Works at Castletroy WwTP to remove screenings and grit and improve longevity of the pumps.
- Conversion of the existing Aeration Basins to act as Storm Water Balancing Tanks.
- Construction of a new Pumphouse to pump screened raw sewage to the Limerick Main Drainage Outer Southern Interceptor Sewer.
- Construction of twin 500mm Φ Foul Rising Mains from Castletroy WwTP to the Limerick Main Drainage Outer Southern Interceptor Sewer.
- Possible septicity control of the pumped raw sewage within the proposed Foul Rising Mains.
- Decommissioning of the disused elements of the existing WwTP such as the Secondary Clarifiers, Sludge Handling System and Final Effluent Inspection Chamber.
- Provision of up to 53,000 p.e. capacity at the Limerick City Wastewater Treatment Plant.

Twin Foul Rising Mains have been chosen for security reasons and, while being more expensive than a single 700 mm Φ Foul Rising Main, would lend themselves to phasing and better management of the pumping. Obviously the laying of twin 500 Φ Foul Rising Mains along the inner Limerick Ring and Dublin Roads would be very difficult and the estimate must reflect this.

In making the following estimate it understood that the treatment capacity required is not presently available and, therefore, must be provided and paid for. There would be an economy of scale available in the capital and operating costs of the larger Plant but this may be off-set by the fact that while all of the Preliminary Treatment Capacity required at Castletroy WwTP exists, the Pumphouses, Inlet Works and Storm Water Balancing Tanks will still have to be managed and maintained.

9.2 OPTION 2

The second option is to upgrade the existing Castletroy WwTP to cater for the current and short-term load with provision to upgrade to the presently envisaged medium-term load of 53,000 p.e. There are many ways of doing this but the following is considered to be one of the most economical: -

- Provision of three No. Sequencing Batch Reactors (SBRs) to accommodate the short-term load.
- Conversion of the existing Aeration Basins to act as Storm Water and SBR Balancing Tanks (common with Option 1).
- Provision of pumping in the existing Secondary Clarifiers to act as Final Effluent Balancing Tanks.
- Addition of a Sludge Holding Tank.
- Provision of an additional Sludge Dewatering Machine.

When reviewing this option consideration should be taken of the immediate need to provide auxiliary aeration to the Aeration Basins to cater for the current loads experienced at the Plant. This aeration equipment can be reused in a new or upgraded Plant.

9.3 COSTS

In considering the options, and specifically in proposing conversion of the existing Aeration Basins to Storm Water Balancing Tanks, cognisance was taken of the fact that storm water balancing is required as soon as possible as is increased aeration capacity. Therefore the option of providing new SBRs allows for the construction of the new treatment units while maintaining operation of the existing system.

9.3.1 Costs Associated with Option 1

Item	Units	Quantity	Rate (€)	Amount (€)
Conversion of the existing Aeration Basins to Storm Water Balancing Tanks.		Sum		€ 400,000
Construction of a new Pumphouse.		Sum		€ 500,000
Construction of twin 500mm. Φ Foul Rising Mains.	m	3,000	€ 2,000	€ 6,000,000
Decommissioning of the disused elements of the existing WwTP.		Sum		€ 200,000
Provision of up to 53,000 p.e. capacity in the Limerick City WwTP.	p.e.	53,000	€ 100	€ 5,300,000
Total				**€ 12,400,000**

The allowance for the provision of treatment capacity at the Dock Road is based on the need to provide the full range of treatment from preliminary through to sludge management. In the case of Castletroy only the secondary treatment and some sludge treatment is needed. It is understood that Limerick County Council has already committed its share of the existing capacity and would have to pay for the additional required capacity.

9.3.2 Costs Associated with Option 2

Item	Units	Quantity	Rate (€)	Amount (€)
Inlet Band Screens.		Sum		€ 300,000
Pipework from Inlet to Balancing Tank.	m	70	€ 1,000	€ 70,000
Conversion of the existing Aeration Basins to Storm Water Balancing Tanks.		Sum		€ 400,000
Construction of a new Pumphouse.		Sum		€ 300,000
Provision of three No. SBRs.	No.	3	€ 900,000	€ 2,700,000
Provision of pumping in the existing Secondary Clarifiers.		Sum		€ 100,000
Sludge Holding Tank.		Sum		€ 200,000
Sludge Dewatering Machine.		Sum		€ 200,000
Siteworks.		Sum		€ 300,000
Electrical Works.		Sum		€ 200,000
Total				**€ 4,770,000**

10.0 SUMMARY & RECOMMENDATIONS

The existing Population Equivalent being treated at Castletroy WwTP is approximately 30,000 p.e. It is expected that, with the addition of a full Vistakon flow, this will rise to a pollution load of 39,000 p.e. in the short-term and 53,000 p.e in the medium-term.

There are a number of works immediately required, including addressing aeration capacity and sludge handling. **An "Order-of-Cost" for the immediate works, which must be done is €788,000.** Some of this cost (the Aeration and Sludge Dewatering items) are also included in the Option 2 estimate and these elements can be transferred to an upgraded WwTP.

It is most important to be aware that the proposed change will address the aeration capacity only (i.e. cater for the increase due to Vistakon) and that the existing Plant cannot cater for an increased hydraulic load.

The estimates for the Medium Term expansion are based on practical options for addressing these shortcomings. The option of upgrading the existing Plant appears to the most economical and is recommended.

APPENDIX A

TECHNICAL DATA

Design Population Stage 1	18,000 Persons
Design Population Stage 2	54,000 Persons
Dry Weather Flow Stage 1	4,500 m3/Day
Dry Weather Flow Stage 2	13,500 m3/Day
Design B.O.D. Load Stage 1	1,170 Kg/Day
Design B.O.D. Load Stage 2	3,510 Kg/Day
Sludge Loading Rate	0.5 to 0.9 kg/kg B.O.D. Removed
Final Effluent Standard	20 mg/l B.O.D. 30 mg/l Suspended Solids

Main Pumping Station (Stages 1 and 2)

Dry Weather Flow Pumps	3 no. dry well submersible pumps @138 l/s (30kw motors)
Stormwater Pumps	2 no. dry well submersible pumps @ 350l/s (75 kw motors)
Flowmeters	Magnetic flowmeters are fitted on the rising mains from the main pumping station

Preliminary Units (Stages 1 and 2)

Solids Removal Units	2 no. Jones & Attwood Screezers (1000HL @ 1,000 l/s)
Grit Removal	1 no. Jones & Attwood Jeta Grit Trap (@ 800l/s) Complete with Grit Classifier.

Aeration Basins (Stage 1 only)

Number of Cells	2 no.
Total Volume at Dry Weather Flow	28.3 hours
Aeration System	Tapered aeration
Mixed Liquor Suspended Solids	2000-5000 mg/l
Primary Aerators	45 kw variable speed transferring up to 50.8 kg/hr of oxygen
Secondary Aerators	22 kw fixed speed transferring up to 25.4 kg/hr of oxygen

Final Settlement Tanks (Stage 1 only)

Number of Tanks	2 no.
Total Surface Area	618.4 m^2
Diameter	20 m
Volume	763 m^3 per tank
Surface Loading Rate	28.66m^3./m^2./day

Sludge Handling Facilities (Stages 1 and 2)

Sludge Recirculation Pumps	2 no. dry well submersible pumps @ 52l/s
Sludge Recirculation Rate	1 x D.W.F
Sludge Wastage Pumps	2 no. dry well submersible pumps @ 52 l/s
Picket Fence Thickener	8.0 m diameter
Sludge Dewatering Machine	Series 2/2000 double belt press (designed for stage 2 population of 54,000 persons)
Dry Solids Content of Dewatered Sludge	18%
Method of Sludge Removal	Articulated lorry and sealed sludge trailers

Electrical Installation

Electrical Zoning	The main pumping station, the sludge return pumping station and the sludge dewatering plant house are electrically zoned to B.S. 5345. Gas leak detection systems are fitted in the main pumping station and the sludge return pump sump.
Control Panels	Control Panels are to IEC 439 form IV
Intruder Alarm System	To I.S. 199
Emergency Lighting System	To I.S. 3217

APPENDIX B

Castletroy Wastewater Treatment Plant

Introduction.

PMS Report Number: 4/07

PMS Report Period: April 2007.

Executive Summary.

Comments:
Excessive foaming in plant due to high sludge age.
Outstanding snags to be completed by E.P.S.
High Mixed liquor levels in Plant.
Low D.O. levels in Aeration tanks
Both sludge return pumps faulty
High recorded flows from 23 onwards due to sludge returned via transfer pumps to wet well.
Pilot study for IPA effluent discharges from Vistacon in operation.

Recommendations:
Provide storage for dried sludge at plant.
Design of final effluent chamber needs modification.
Increase Aeration in plant.
Purchase spare sludge return pump.

Other issues (complaints, equipment, health and safety, etc.);
Number of accidents during Month None
Number of complaints during Month None

Results

Influent

Date	BOD mg/l	COD mg/l	S.S. mg/l	PH	NH^4-N mg/l	NO3-N mg/l	T N mg/l	PO4-P mg/l	TP –P mg/l
11 Apr	290	905	328	7.24	75	0.2	90	6.5	9.4
19 Apr	318	687	356	7.91	49.2	0.6	72	6.2	9.1

Effluent

Date	BOD mg/l	COD mg/l	S.S. mg/l	PH	NH^4-N mg/l	NO3-N mg/l	T N mg/l	PO4-P mg/l	TP –P mg/l
11 Apr	4.19	51	6	6.78	4.60	3.0	8.5	2.7	3.2
19 Apr	5.14	38	10	7.73	2.63	5.2	10	3.3	3.5

BOD Loading

Date	BOD mg/l	Flow M3	Kg BOD	Pop. Eq.
11 Apr	290	5772	1673.88	27898
19 Apr	318	5919	1882.242	31370

Operating Data

Total flow for March	=	179537M^3
Average daily flow	=	5984M^3
Total BOD loading for March	=	54574 Kg
Average daily B.O.D. load	=	1819 Kg
Population equivalent for March	=	30316
Solids loading on plant	=	30015 Kg
Sludge loading rate	=	0.550kg/kg BOD
Sludge age	=	43 days
Food to microbes ratio	=	0.053 g/g/day
Design dry weather flow	=	4800 M^3
Design B.O.D. load	=	1,170 kg/ day
Plant operating as % of design capacity	=	155 %

Date	DWF Flow / M3	Sludge Return / M3	Flow Through Plant / M3	Sludge Build...g / M3	Storm Water / M3	Treatment Plant Out Flow / M3
01-Apr-07	6111	4025	6165	0	0	4656
02-Apr-07	6943	4034	8115	131	0	5251
03-Apr-07	6625	4052	6950	451	0	5291
04-Apr-07	6857	3820	7185	651	0	5238
05-Apr-07	5931	3667	5666	362	0	4843
06-Apr-07	5483	2714	5103	240	0	4517
07-Apr-07	5625	3990	5164	0	0	4138
08-Apr-07	5651	3965	5337	0	0	3989
09-Apr-07	5961	3925	5817	0	0	4233
10-Apr-07	6434	4013	6455	675	0	4956
11-Apr-07	5772	4074	5857	235	0	4874
12-Apr-07	6040	4031	7116	692	0	4916
13-Apr-07	6233	4064	9397	782	0	4332
14-Apr-07	5836	4019	6320	0	0	2657
15-Apr-07	5539	3962	5668	0	0	2571
16-Apr-07	6446	3930	6259	718	0	3108
17-Apr-07	5770	3966	5495	186	0	3092
18-Apr-07	5980	3951	6052	402	0	3155
19-Apr-07	5919	3892	5664	507	0	3791
20-Apr-07	5882	2006	5620	420	0	4832
21-Apr-07	5136	339	4852	0	0	4289
22-Apr-07	5505	582	5149	0	0	4407
23-Apr-07	8189	1503	8431	587	0	5186
24-Apr-07	11950	1484	13526	711	0	7069
25-Apr-07	10310	1702	10390	619	0	5679
26-Apr-07	9796	2323	9935	636	0	4840
27-Apr-07	11809	1047	12340	174	19	3949
28-Apr-07	12371	1215	14290	0	0	2742
29-Apr-07	11785	1360	14249	0	0	2729
30-Apr-07	11648	1513	12811	483	0	2945
Total	219537	89178	231376	9662	20	128272

Ignore Problems with Sludge return.

APPENDIX C

Castletroy Wastewater Treatment Plant

January Mixed Liquor results

Tank 1

Date	S. S. V. n	S.S. mg/l	S. V. I.
02-Jan	750	4440	169
03-Jan	650	4350	149
04-Jan	750	4610	163
05-Jan	750	4970	151
08-Jan	800	5060	158
09-Jan	800	4110	195
10-Jan	800	4320	185
11-Jan	800	4480	179
12-Jan	750	4540	165
15-Jan	760	4620	165
16-Jan	700	4520	155
18-Jan	750	4780	157
19-Jan	750	4930	152
22-Jan	500	2910	172
23-Jan	650	3860	168
24-Jan	600	3300	182
25-Jan	650	3520	185
29-Jan	700	3900	179
31-Jan	650	3650	178

Tank 2

Date	S. S. V. n	S.S. mg/l	S. V. I.
02-Jan	700	4740	148
03-Jan	650	4110	158
04-Jan	750	4260	176
05-Jan	750	5190	145
08-Jan	750	5080	148
09-Jan	800	4610	174
10-Jan	800	4750	168
11-Jan	800	4800	167
12-Jan	750	4540	165
15-Jan	760	4070	187
16-Jan	700	5030	139
18-Jan	700	5380	130
19-Jan	750	5020	149
22-Jan	450	3220	140
23-Jan	650	3650	178
24-Jan	600	3210	187
25-Jan	650	3200	203
29-Jan	700	4060	172
31-Jan	650	3720	175

Castletroy Wastewater Treatment Plant

February Mixed Liquor results

Tank 1

Date	S. S. V. n	S.S. mg/l	S. V. I.
01-Feb	640	4310	148
02-Feb	650	4440	146
05-Feb	600	4160	144
06-Feb	700	5560	126
09-Feb	700	5370	130
12-Feb	650	4500	144
13-Feb	600	4760	126
14-Feb	750	5130	146
15-Feb	740	5880	130
16-Feb	700	5420	129
19-Feb	750	5200	144
20-Feb	840	6610	127
21-Feb	700	5140	136
22-Feb	550	4150	133
23-Feb	750	5640	133
26-Feb	800	5590	143

Tank 2

Date	S. S. V. n	S.S. mg/l	S. V. I.
01-Feb	640	3960	162
02-Feb	570	4850	118
05-Feb	600	4040	149
06-Feb	700	5070	138
09-Feb	750	5440	138
12-Feb	650	4850	134
13-Feb	640	4770	134
14-Feb	780	6390	122
15-Feb	680	6030	113
16-Feb	700	5460	128
19-Feb	750	5450	138
20-Feb	840	7000	120
21-Feb	740	5920	125
22-Feb	600	4020	149
23-Feb	750	6160	122
26-Feb	800	5760	139

Castletroy Wastewater Treatment Plant

March Mixed Liquor results

Tank 1

Date	S. S. V. n	S.S. mg/l	S. V. I.
05-Mar	750	5280	142
06-Mar	700	5210	134
08-Mar	600	5000	120
09-Mar	450	3430	131
13-Mar	650	4400	148

Tank 2

Date	S. S. V. n	S.S. mg/l	S. V. I.
05-Mar	750	6050	124
06-Mar	700	4970	141
08-Mar	600	4250	141
09-Mar	450	3940	114
13-Mar	650	4320	150

22-Mar	630	5130	123
28-Mar	850	6240	136

22-Mar	670	5040	133
28-Mar	850	6430	132

Castletroy Wastewater Treatment Plant

April Mixed Liquor results

Tank 1

Date	S. S. V. n	S.S. mg/l	S. V. I.
05-Apr	800	7140	112
10-Apr	850	7140	119
11-Apr	650	6150	104
12-Apr	850	8160	104
13-Apr	850	7340	116
17-Apr	850	6500	131
19-Apr	850	7070	120
20-Apr	850	6650	128
24-Apr	800	6500	123
26-Apr	650	5730	145
27-Apr	800	6020	133

Tank 2

Date	S. S. V. n	S.S. mg/l	S. V. I.
05-Apr	800	6800	118
10-Apr	850	6810	125
11-Apr	850	7260	117
12-Apr	850	7260	117
13-Apr	850	6760	126
17-Apr	850	7070	120
19-Apr	900	7370	122
20-Apr	850	5950	143
24-Apr	800	6780	118
26-Apr	650	5530	147
27-Apr	800	6910	116

Castletroy Wastewater Treatment Plant

May Mixed Liquor results 2007

Tank 1

Date	S. S. V. n	S.S. mg/l	S. V. I.
02-May	850	5720	106
03-May	800	7530	144
04-May	820	5690	121
08-May	830	6850	121
09-May	870	6820	128
11-May	800	5240	153
14-May	800	7620	102
15-May	800	6560	122
16-May	800	6320	127
17-May	850	5800	147
18-May	800	5470	146
21-May	850	5940	143
22-May	840	6280	134
23-May	850	6480	131
24-May	845	6240	135
28-May	850	6210	137
29-May	860	6340	136
30-May	830	5550	150
31-May	840	6140	137

Tank 2

Date	S. S. V. n	S.S. mg/l	S. V. I.
02-May	850	5300	160
03-May	850	7400	115
04-May	820	6520	126
08-May	850	6860	124
09-May	870	6710	130
11-May	800	5290	151
14-May	800	7150	112
15-May	800	5960	134
16-May	800	6880	116
17-May	850	5400	157
18-May	800	5550	144
21-May	850	5920	144
22-May	860	6900	125
23-May	850	6350	134
24-May	855	6990	122
28-May	850	6540	130
29-May	860	6350	135
30-May	830	5550	150
31-May	840	6160	136

Castletroy Wastewater Treatment Plant

June Mixed Liquor results 2007

Tank 1

Date	S. S. V. n	S.S. mg/l	S. V. I.
01-Jun	840	6150	137
05-Jun	800	6350	126
06-Jun	800	5240	153
07-Jun	800	6440	124
08-Jun	800	5300	151
11-Jun	800	5710	140
12-Jun	800	5690	141
13-Jun	810	6790	119
14-Jun	800	6290	127
15-Jun	800	4580	175
18-Jun	800	6160	130
20-Jun	800	5450	147
21-Jun	720	5510	131
22-Jun	760	5690	134

Tank 2

Date	S. S. V. n	S.S. mg/l	S. V. I.
01-Jun	840	6230	135
05-Jun	800	5800	138
06-Jun	800	5600	136
07-Jun	850	6460	132
08-Jun	850	6140	138
11-Jun	800	5760	139
12-Jun	800	6310	127
13-Jun	810	5330	152
14-Jun	800	5960	135
15-Jun	800	5600	143
18-Jun	840	6120	137
20-Jun	800	5560	144
21-Jun	720	5170	139
22-Jun	760	5430	140

Castletroy Wastewater Treatment Plant

July Mixed Liquor results 2007

Tank 1

Date	S. S. V. n	S.S. mg/l	S. V. I.
10-Jul	600	5060	119
11-Jul	610	4860	126
13-Jul	550	4600	120
17-Jul	500	3100	161
19-Jul	600	4460	135
25-Jul	710	4970	143
30-Jul	750	4960	151

Tank 2

Date	S. S. V. n	S.S. mg/l	S. V. I.
10-Jul	600	4860	123
11-Jul	600	4360	137
13-Jul	550	4280	129
17-Jul	500	3360	149
19-Jul	650	4660	139
25-Jul	710	4870	146
30-Jul	750	4620	162

Castletroy Wastewater Treatment Plant

August Mixed Liquor results 2007

Tank 1

Date	S. S. V. n	S.S. mg/l	S. V. I.
01-Aug	700	5240	134
02-Aug	700	4670	150
17-Aug	400	3100	129
20-Aug	400	3120	128
21-Aug	400	3700	106
28-Aug	500	3780	132

Tank 2

Date	S. S. V. n	S.S. mg/l	S. V. I.
01-Aug	700	6200	113
02-Aug	700	5100	137
17-Aug	400	3740	107
20-Aug	500	3360	149
21-Aug	450	3070	147
28-Aug	550	3850	143

Castletroy Wastewater Treatment Plant

September Mixed Liquor results 2007

Tank 1

Date	S. S. V. n	S.S. mg/l	S. V. I.
03-Sep	500	4720	106
04-Sep	500	3970	126
07-Sep	510	4750	107
10-Sep	650	5610	116
13-Sep	700	4610	152
14-Sep	700	4170	168
17-Sep	740	4610	161
18-Sep	800	4290	186
21-Sep	700	4010	175
27-Sep	800	4430	181
28-Sep	780	4910	159

Tank 2

Date	S. S. V. n	S.S. mg/l	S. V. I.
03-Sep	500	4940	101
04-Sep	500	4010	125
07-Sep	520	4330	120
10-Sep	650	5040	129
13-Sep	700	4570	153
14-Sep	700	4290	163
17-Sep	740	4940	150
18-Sep	800	4240	189
21-Sep	700	4050	173
27-Sep	800	4530	177
28-Sep	780	5120	152

APPENDIX D

Castletroy Wastewater Treatment Plant Result Sheet 2013

Influent

Date	BOD	COD	SAS	PH	NH4-N	NO3-N	Total N	PO4-P	Total P
	mg/l	mg/l	mg/l		mg/l	mg/l	mg/l	mg/l	mg/l
04-Jan	1094	311	120	7.35	35.00	0.2	38.0	3.70	5.5
19-Jan	101	280	108	7.35	16.00	0.8	25.0	2.70	5.4
26-Jan	130	400	230	7.35	35.00	0.2		2.40	
16-Feb	126	448	240	7.90	17.00	0.4		2.60	
21-Feb	168	392	242	7.80	26.25	0.5	38.0	1.80	3.4
09-Mar	142	475	172	7.90	37.00	0.2	46.2	4.20	
11-Apr	290	905	328	7.21	75.00	0.2	90.0	6.50	9.4
19-Apr	318	687	358	7.91	49.25	0.6	72.0	6.20	9.1
03-May	302	736	370	7.94	40.75	0.4		5.70	
16-May	190	580	164	7.91	27.50	0.5		9.00	
23-May	192	874	318	7.95	56.00	0.5		7.30	
31-May	214	798	510	7.99	49.00	1.3		7.30	
07-Jun	230	803	278	7.43	27.25	1.3		5.90	
14-Jun	248	864	430	7.57	36.00	0.8		5.30	
21-Jun	1053	819	438	7.73	00.00	1.2		3.30	
21-Aug	138	1064	319	7.60	28.00	0.2	55.0	4.70	16.1
05-Sep	186	648	544	7.60	38.00	0.2	50.0	4.90	10.1
13-Sep	186	817	396	7.51	48.50			6.60	

Effluent

Date	ECD mg/l	COD mg/l	S.S. mg/l	PH	NH4-N mg/l	NO3-N mg/l	Total N mg/l	PO4-P mg/l	Total P mg/l
04-Jan	6.14	46	9	7.36	1.73	0.5	12.5	1.9	20
19-Jan	3.90	45	9	7.33	0.43	9.5	10.0	1.2	13
26-Jan	3.70	49	17	7.69	0.34	7.0		2.0	
16-Feb	4.87	14	12	7.63	2.75	7.6		3.3	
21-Feb	4.00	6	10	7.63	1.48	0.9	13.0	1.7	19
09-Mar	4.47	22	18	7.51	0.62	9.6	16.5	2.0	
11-Apr	4.19	51	6	6.73	4.60	3.0	8.5	2.7	32
19-Apr	5.14	38	10	7.73	2.63	5.2	10.0	3.3	35
03-May	6.39	37	10	7.56	6.64	5.4		3.4	
16-May	3.60	98	5	7.71	1.78	6.3		2.5	
23-May	2.63	95	5	6.93	3.18	0.0		3.0	
31-May	2.38	23	6	7.60	0.76	5.5		2.5	
07-Jun	7.09	124	37	7.47	6.00	9.1		2.0	
14-Jun	5.79	79	7	7.43	2.84	9.5		2.4	
21-Jun	3.36	31	14	7.50	0.23	0.0		2.3	
31-Aug	2.10	21	8	7.80	0.77	0.0	18.3	1.0	10
06-Sep	3.60	38	16	7.40	0.41	6.0	17.5	2.2	42
13-Sep	5.00	15	11	7.36	0.60			3.0	

Castletyoy Wastewater Treatment Plar Result Sheet 2006

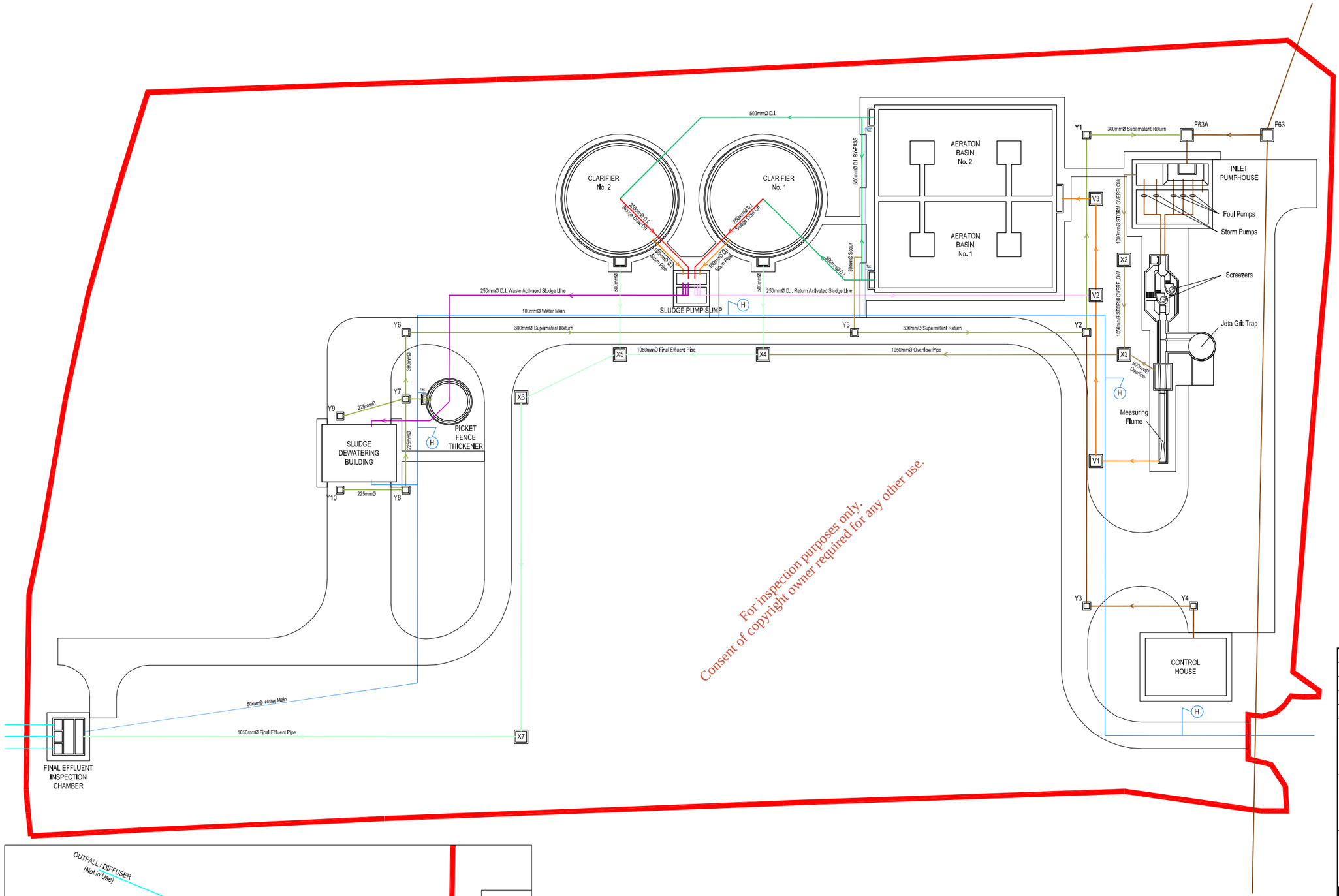
Influent

Date	BOD	COD	S,S.	PH	NH4-N	NO3-N	Total N	PO4-P	Total P
	mg/l	mg/l	mg/l		mg/l	mg/l	mg/l	mg/l	mg/l
05-Jan	163	798	392	7.52	31.25	0.2	44	5.5	13.3
12-Jan	156	527	192	7.80	26.00	0.1	48	4.6	7.5
25-Jan	130	778	460	7.78	43.00	0.2	56	3.4	10.8
09-Feb	180	701	366	7.76	45.00	0.2	58	4.1	8.4
15-Feb	87.3		72	7.71	5.00	0.9		4.6	
22-Feb	156	355	150	7.73	64.75	0.7		4.3	
01-Mar	185	504	320	7.77	24.00	0.1	38	10.3	
08-Mar	134	316	95	7.25	22.50	1.7	29	5.0	
15-Mar	92.4	215	180	7.53	63.75	3.8		10.3	
22-Mar	139	181	198	7.79	37.75	4.4		10.2	
25-Apr	181	438	220	7.72					
11-May	264	744	434						
24-May	168	868	608	7.88	2.50	0.1	62	4.3	7.7
16-Jun	156	974	348	7.77	48.00			10.0	
23-Jun	191	455	230	7.68	62.75				
29-Jun	202	613	194	7.53	30.00	0.1	42	5.3	9.5
19-Jul	258	617	228	7.45	40.00	0.2	50	7.3	12.9
23-Jul	230	1609	604	7.31	40.00	0.2	54	11.4	14.9
23-Aug	148	505	318	7.75	38.25			5.9	9.4
06-Sep	207	564	212	7.82	41.50	0.1	60	6.3	9.4
13-Sep	233	610	184	7.54	37.00	0.1	44	6.2	10.1
21-Sep	107	568	260	7.38	28.00	0.1	39	3.4	7.5
28-Sep	252	534	228	7.64	37.00	0.1	48	6.4	11.8
06-Oct	115	573	314	7.43	20.50	0.2	32	2.2	4.8
18-Oct	225	369	214	7.80	49.00	0.2	62	4.3	7.2
25-Oct	268	904	300	7.93	56.00	0.1	59	5.3	9.3
02-Nov	181	545	240	7.89	48.73	0.1	60	4.5	7.8
23-Nov	41.4	755	342	7.64	21.00	0.1		4.7	
08-Dec	104	204	88		10.05				

Effluent

Date	BOD	COD	S.S.	PH	NH4-N	NO3-N	Total N	PO4-P	Total P
	mg/l	mg/l	mg/l		mg/l	mg/l	mg/l	mg/l	mg/l
05-Jan	6.33	14	20	7.40	0.14	12.8	20	3.0	3.3
12-Jan	3.13	33	2	7.61	0.10	4.8	17	1.9	2.1
25-Jan	3.32	43	5	7.71	0.49	10.9	20	1.7	2.2
09-Feb	3.13	29	5	7.64	0.63	12.2	23	2.3	2.4
15-Feb	6		23	7.58	0.28	4.8		2.7	
22-Feb	5.8	12	13	7.58	2.75	4.8	18	0.1	
01-Mar	6.16	84	17	7.52		5.1		3.5	
08-Mar	11.76	132	20	7.27	0.52	3.1	19	5.0	
15-Mar	3.3		5	7.21	0.17	10.8	16	3.3	
22-Mar	4.9	40	13	7.37		12.2	22	2.2	
25-Apr	2.73		8	7.49					
11-May	13.23	51	43						
24-May	2.52	4.9	8	7.74	0.10	12.2	19	1.0	1.0
16-Jun	2.32	11	14	7.75	0.21	16.6		2.7	
23-Jun	2.25	25	4	7.63	0.48				
29-Jun	1.98	26	3	7.78	0.17	15	24	2.3	2.9
19-Jul	2.46	16	8	7.72	0.72	5.3	9	2.4	2.6
23-Jul	1.56	30	7	7.64	1.13	4.6	8.2	1.7	1.6
23-Aug	2.42	25	11	7.61	0.24	14		2.7	2.9
06-Sep	3.42	15	5	7.64	0.42	18.5	21	3.7	3.8
13-Sep	5.09	9	9	7.36	1.20	16	20	3.4	3.5
21-Sep	15.83	42	15	7.45	2.50	6.4	7.2	3.8	3.9
28-Sep	3.42	22	8	7.23	0.62	6.2	7.3	3.2	3.4
06-Oct	7.89	34	12	7.66	1.78	6.2	7.5	1.9	2.0
18-Oct	7.26	51	21	7.70	0.18	7.1	12	2.3	2.5
25-Oct	4.62	57	18	7.64	0.99	4.6	15.3	2.7	3.0
02-Nov	4.84	28	9	7.72	0.88	12.4	14	2.1	2.3
23-Nov	13.8	44	29	7.69	2.02	6.7		1.2	
08-Dec	13.8	17	23		2.21				

APPENDIX E



LEGEND

- Raw Influent
- Screened Influent
- Post Aeration Basins
- Clarifier Sludge Draw Off
- Clarifier Scum Line
- Overflows
- Final Effluent
- Outfall Pipe
- Return Sludge
- Waste Sludge
- Scum Lines
- Supernatant Return
- Water Main

Rev.	Date	Description	by	ch'd	app
A	07/12/07	Final Issue	PS	PS	MJOS

Project: CASTLETROY WASTEWATER TREATMENT PLANT ASSESSMENT

Title: CASTLETROY WwTP PROCESS SCHEMATIC

Client: Limerick County Council, Comhairle Chontae Luimnigh

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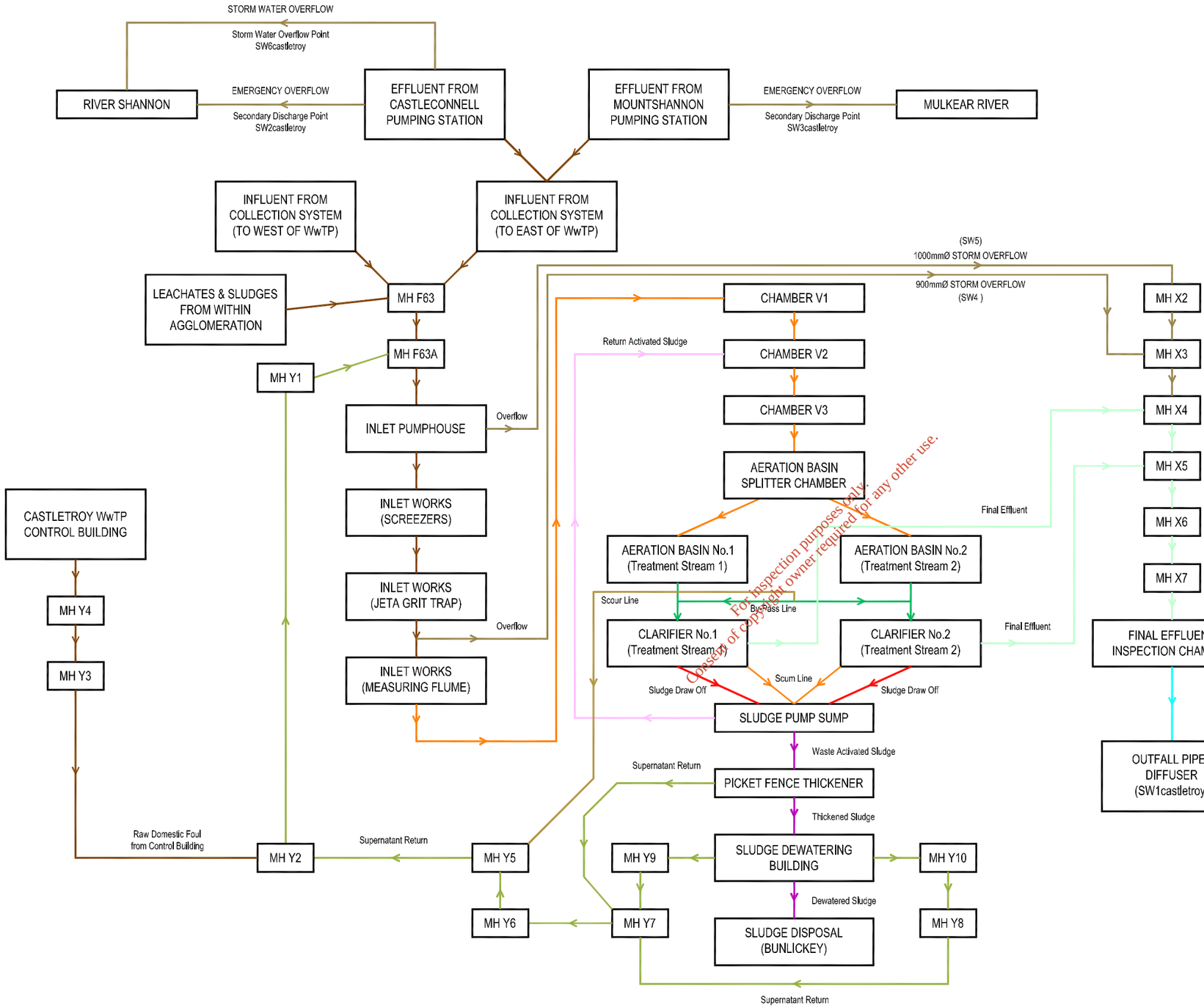
I.S. EN ISO 9001

Scales (A3)	1:750	
Drawn	PS	07/12/07
Ch'd(D.O.)	JD	07/12/07
Ch'd(Eng.)	PS	07/12/07
Approved	MJOS	07/12/07

Drg. No. E-01

Rev. A



Rev.	Date	Description	by	ch'd	app
A	07/12/07	Final Issue	PS	PS	MJOS

Project: CASTLETROY WASTEWATER TREATMENT PLANT ASSESSMENT

Title: CASTLETROY WwTP PROCESS FLOW DIAGRAM

Client: Limerick County Council, Comhairle Chontae Luimnigh

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Scales (A3)	NTS	
Drawn	PS	07/12/07
Ch'd(D.O.)	JD	07/12/07
Ch'd(Eng.)	PS	07/12/07
Approved	MJOS	07/12/07

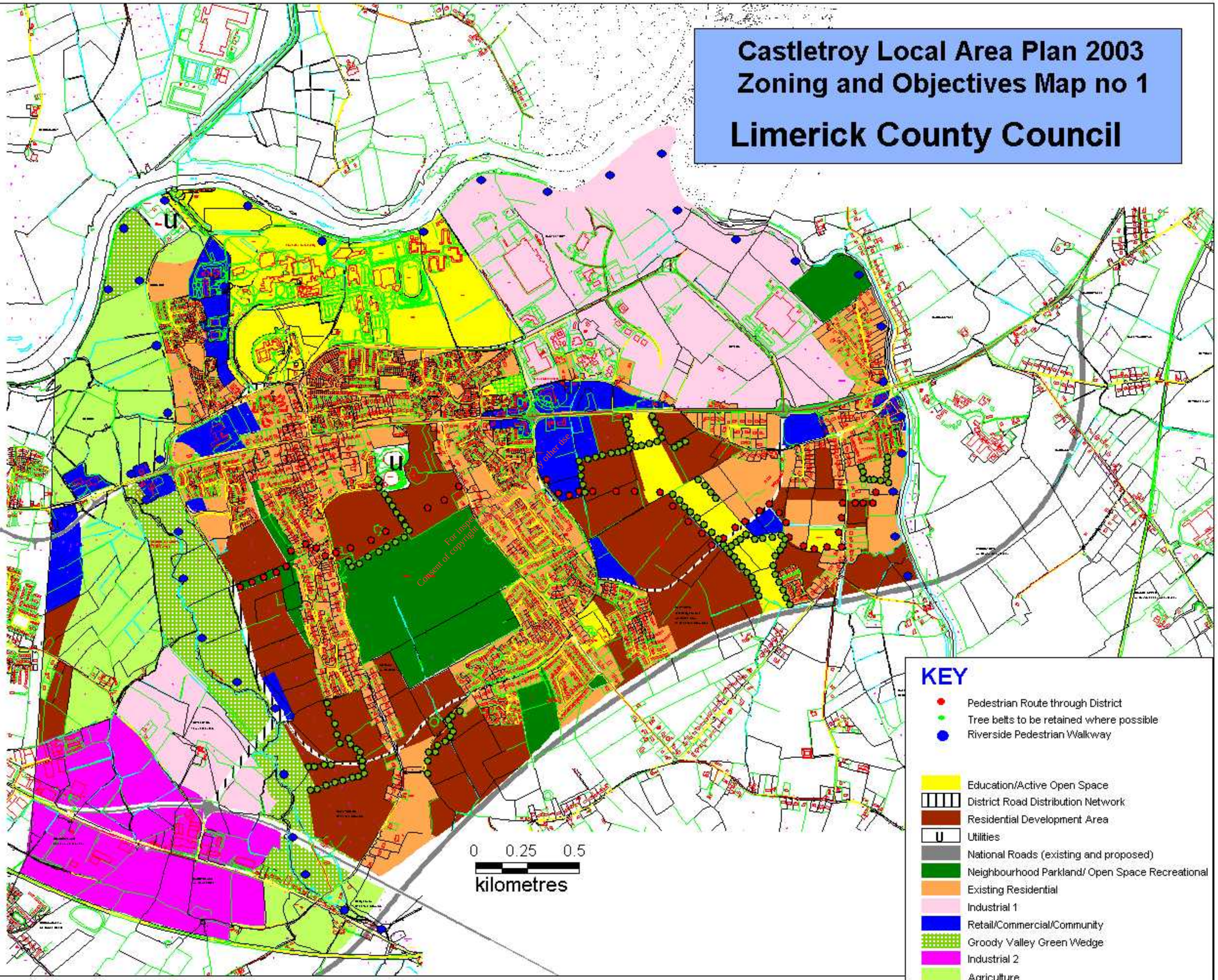
Drg. No. E-02

Rev. A

APPENDIX F

Castletroy Local Area Plan 2003
Zoning and Objectives Map no 1

Limerick County Council



Based on Ordnance Survey Ireland Permit no 7677 @ Ordnance Survey Ireland and Government of Ireland.

N
W E
S

KEY

- Pedestrian Route through District
- Tree belts to be retained where possible
- Riverside Pedestrian Walkway

- Education/Active Open Space
- District Road Distribution Network
- Residential Development Area
- U Utilities
- National Roads (existing and proposed)
- Neighbourhood Parkland/ Open Space Recreational
- Existing Residential
- Industrial 1
- Retail/Commercial/Community
- Groody Valley Green Wedge
- Industrial 2
- Agriculture

Date of adoption, November 2003.

ERRINA
Oireanach

LACKA
An Leaca

DERREEN
An Doirín

GOOIG
Guaig

CLOON and COMMONS
Cluain

SUMMERHILL

COOLBANE
An Chúil Bhán

COOLREIRY
Cúil Ruairí

STRADBALLY NORTH

STRADBALLY NORTH
An Sráidbhaile Thuaidh

WOODPARK

Key:

- Existing Residential Development
- Residential (Phase 1)
- Residential (Phase 2)
- Residential (Phase 3)
- Residential (Serviced Sites)
- Mix Use - Village Centre Uses
- Public Community Facilities / Education
- Open Space & Amenity
- Special Control Area
- Business & Industry
- Agricultural
- Town Boundary

Limerick County Council
Planning and Development Department

June 2007

N W E S

100 m

400 metres

Map 13: Zoning