

CONSENT NO. BJ0087401

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Environment
Agency Wales

WATER RESOURCES ACT 1991

SECTION 88 – SCHEDULE 10

(AS AMENDED BY THE ENVIRONMENT ACT 1995)

VARIATION OF CONSENT TO DISCHARGE

TO: Environment Quality Scientist
Dŵr Cymru Cyfyngedig
Pentwyn Road
Nelson
Treharris
CF46 6LY

In pursuance of an application by the consent holder for variation of consent, the **ENVIRONMENT AGENCY** ("The Agency") in pursuance of its powers under the Water Resources Act 1991 **HEREBY VARIES ITS CONSENT** to the making of a discharge **OF SEWAGE EFFLUENT**, as follows:

Tertiary Treated Sewage Effluent incorporating the requirements of the Urban Waste Water Treatment Regulations 1994 (UWWTR)

with respect to Variation of Consent No. BJ0087401 issued on the 31st day of March 2005

FROM: MERLINS BRIDGE SEWAGE TREATMENT WORKS

AT: HAVERFORDWEST

TO: WESTERN CLEDDAU

HEREAFTER SUBJECT TO the conditions set out in the following schedule(s):

Tertiary Treated Sewage Effluent
UWWT Regulations 1994

Schedule No. BJ0087401 01
Schedule No. BJ0087401 01 / U

Subject to the provisions of Paragraphs 7 and 8 of Schedule 10 of the Water Resources Act 1991, no notice shall be served by the Agency, which affects the effect of variations made to this consent, without the agreement in writing of the Consent Holder, during a period of 4 years from the date this variation is issued.

This variation of consent is issued and takes effect on the 12 day of November 2007

Signed

Stuart Thomas
Team Leader – Regulatory Water Quality



CONSENT NUMBER	BJ0087401
SCHEDULE NUMBER	BJ0087401 01
DATE ISSUED	12th November 2007

CONDITIONS OF CONSENT TO DISCHARGE

Tertiary Treated Sewage Effluent ("the Discharge")

**FROM: MERLINS BRIDGE SEWAGE TREATMENT WORKS,
HAVERFORDWEST**

NATURE

1.

- (a) The Discharge shall consist solely of secondary treated sewage effluent which has been disinfected by means of ultra violet (UV) irradiation. For the purpose of this consent, "disinfection" is defined as the use of a process designed specifically to reduce the number of viable, potentially infectious micro-organisms in the effluent.
- (b) The discharge shall be disinfected by means of UV irradiation from an artificial source with at least 85% of the available radiation emitted in the wavelength range 250 to 260nm. A measured applied UV dose of 29.93 mJ/cm² must be exceeded subject to conditions (c) and (d).
- (c) The measured applied UV dose must exceed the limit set out in condition (b) for at least 99% of the measurements as required by condition 18.2 (i) b in any period of 12 consecutive months.
- (d) No more than 10% of measurements taken consecutively during any 24 hour period from midnight to midnight should fall below 15 mJ/cm²
- (e) The period(s) when the measured applied UV dose limit is less than the limit set out in condition (a) shall not be used by the Consent Holder for the maintenance of the UV plant. Maintenance is defined in the UV Code of Practice attached to this Consent.

FAILURE OF UV MEASUREMENT SYSTEMS

- 2.** In the event of failure of the flow monitor or UV transmittance meter in the control of the UV dosing system:
 - (a) the maximum available number of duty banks of UV lamps shall be automatically activated;
 - (b) the minimum applied UV dose at maximum effluent flow rates at a calculated UV transmittance (at 254nm) of 45 %, shall not be less than 29.93 mJ/cm²

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LOCATION

3. The Discharge shall be made in the manner and at the place specified as:
 - (a) discharging via a 530 millimetre diameter pipe;
 - (b) discharging to the Western Cleddau;
 - (c) at National Grid Reference SM 96330 14740 ;
 - (d) shown marked 'Consent Point' on Plan BJ0087401 attached as Annex 3.

SAMPLE POINT

4. An appropriately labelled sample point shall be provided and maintained at National Grid Reference SM 95708 14673, as shown marked 'Sampling Point' on Plan BJ0087401, or some other point as agreed in writing with the Agency, so that a representative spot sample of the Discharge may be obtained. The consent holder shall ensure that all constituents of the Discharge pass through the said sampling point at all times and in any legal proceedings it shall, for the purposes of Section 10 of the Rivers (Prevention of Pollution) Act 1961, be presumed, until the contrary is shown that any sample of the Discharge taken at the said sampling point is a sample of what was being discharged into controlled waters.

VOLUME

5. The volume of the Discharge shall not exceed 20,451 cubic metres per day.
6. The Dry Weather Flow of the Discharge shall not exceed 7221 cubic metres per day.

For the purpose of this condition Dry Weather Flow shall mean the average daily flow to the treatment works during seven consecutive days without rain (excluding a period which includes public holidays) following seven days during which the rainfall did not exceed 0.25 millimetres on any one day.

7. The rate of discharge shall not exceed 239 litres per second.

FLOW MEASUREMENT

8. A continuous flow measurement and recording system, to a specification provided by the Agency, shall be provided and operated to record the total daily volume, and the instantaneous or 15-minute integrated flow every 15 minutes of sewage through the treatment works. An on-site visual display from which instantaneous or 15-minute integrated flow readings can be readily obtained by the Agency shall be provided and operated. The Consent Holder shall hold records of the flow readings.

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9. As soon as practicable after completion of the flow system installation and subsequently on the expiry of any certificate issued, the Consent Holder shall employ an independent expert to certify that the installation and its quality management system complies with the Agency's specification. The independent expert shall be accredited to a competency scheme approved by the Agency. A copy of the certificate shall be sent to the Agency and the certifier's report shall be provided to the Agency on request. If a certificate issued for a flow system has no expiry date included then the certificate shall be deemed to expire five years after the issue date of the certificate.
10. The Consent Holder shall produce and maintain a documented quality management system, approved by the independent expert and to the satisfaction of the Agency, specifying procedures for the calibration, operation and maintenance of the flow measurement equipment. The flow measurement equipment shall be calibrated, operated and maintained by the Consent Holder in accordance with the provisions of the QMS. The Consent Holder shall keep a record of these procedures available for inspection by the Agency and provide a copy to the Agency on request.
11. The Consent Holder shall record all failures of the continuous flow measurement system and any other breaks in the flow record. The reasons for all significant failures and breaks, which lead to missing or suspect data, and all steps taken to prevent a re-occurrence shall be recorded and details shall be provided to the Agency on request. A failure or break is significant for the purposes of this condition if it prevents the calculation of the total daily volume to the required level of uncertainty. The Consent Holder shall ensure that as far as possible the recorder remains fully operational at all times. Any failures shall be remedied as soon as possible.
12. Records of the flow readings or the reasons for any breaks in the record, as described in condition 11 above, shall be provided to the Agency when requested, in a format specified by the Agency.
13. Flows of sewage through the treatment works shall be measured on the final effluent as part of the UV system at National Grid Reference SM 95708 14673, or such other point(s) as agreed by the Agency.

COMPOSITION

14. (a) Subject to paragraph (b) below, the Discharge shall not contain more than:
 - (i) 40 milligrammes per litre of biochemical oxygen demand (measured after 5 days at 20°C with nitrification suppressed by the addition of allyl-thiourea);
 - (ii) 60 milligrammes per litre of suspended solids (measured after drying at 105°C).

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- (b) The limit for any of the relevant parameters set out in paragraph (a) above may be exceeded where, in any series of samples of the Discharge taken at regular but randomised intervals in any period of twelve consecutive months as listed in Column 1 of the table at Annex 1 to this consent, no more than the relevant number of samples, as listed in Column 2 of the said table, exceed the applicable limit for that relevant parameter.

15. The Discharge shall not contain more than

- (i) 80 milligrammes per litre of biochemical oxygen demand (measured after 5 days at 20°C with nitrification suppressed by the addition of allyl-thiourea);
- (ii) 120 microgrammes per litre of total copper;
- (iii) 120 microgrammes per litre of total zinc;
- (iv) 120 microgrammes per litre of total lead;
- (v) 120 microgrammes per litre of total chromium;
- (vi) 120 microgrammes per litre of total nickel.

WORKS OPERATION

- 16.** The works shall be operated and the effluent shall be treated in a manner which, so far as reasonable practicable, minimises the polluting effects of the discharge made from the works on controlled waters.

This condition does not require -

- (a) any higher standard to be achieved in relation to any characteristic of the discharge which is specifically regulated by conditions 14 and 15, than is required by those conditions;
- (b) any alteration of the works or a change in the type of treatment used.

UNUSUAL WEATHER CONDITIONS

- 17.** (a) No sample of the discharge, taken at a time when unusual weather conditions are adversely affecting the operation of the sewage treatment works, shall be taken into account in deciding whether or not the conditions 14, 15 and 16 of this consent have been complied with.
- (b) For the purpose of this condition "unusual weather conditions" shall include:

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- (i) low ambient temperatures as evidenced by effluent temperatures of 5°C or less, or by the freezing of mechanical equipment in the works;
 - (ii) significant snow deposits;
 - (iii) tidal or fluvial flooding;
 - (iv) weather conditions causing unforeseen loss of power supply to the sewage treatment which could not be ameliorated by the reasonable provision and operation of standby generation facilities.
- (c) On any occasion where unusual weather conditions adversely affect the operation of the sewage treatment works, the Consent Holder shall use its best endeavours to mitigate that adverse effect.
- (d) For a sample of the discharge to be considered for the purposes of (a) above, the Consent Holder shall notify the Agency by telefax or telephone as soon as unusual weather conditions are known to have adversely affected operations and shall confirm the circumstances in writing as soon as possible thereafter (and in any event within 14 days of the occurrence of such conditions). That notification shall include a full description of the unusual weather conditions and their impact on the operation of the works.

RECORDING AND REPORTING

18.1 Maintenance programme

- (i) The Consent Holder shall establish and operate a documented maintenance programme including the method and frequency of cleaning and replacement of UV lamps, transmittance meters and flow meters, and record all non-routine actions undertaken that may have adversely affected effluent quality. Details of the maintenance programme shall be provided to the Agency for agreement. Copies of the programme shall be made available for inspection by the Agency's officers at all reasonable times.
- (ii) The Consent Holder shall keep records of the maintenance undertaken (both routine and non-routine). Copies of these records shall be maintained by the Consent Holder and kept available for inspection by the Agency's officers at all reasonable times.
- (iii) On request, the Consent Holder shall supply the Agency with a written report on the maintenance, and all non-routine actions that may have adversely affected effluent quality.

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18.2 UV Process Monitoring and Reporting

- (i) Continuous recorders, with on-site visual display from which readings may be readily obtained, shall be provided and maintained by the Consent Holder enabling the following to be measured and recorded at 15 minute intervals:
 - a. the instantaneous flow rate through each UV irradiation channel;
 - b. the instantaneous measured applied UV dose for each UV irradiation channel;
 - c. the number of operational UV lamps for each UV irradiation channel;
 - d. the instantaneous measured UV transmittance at the inlet to or the outlet from the UV irradiation plant;
 - e. any other parameters used in calculating the UV dose.
- (ii) Copies of the records shall be maintained by the Consent Holder for a minimum of 2 years or such longer time as the Agency may from time to time specify and be kept at a nominated place available for inspection by the Agency's officers at all reasonable times.
- (iii) The Consent Holder shall supply to the Agency, 2 month in arrears, in a format specified by the Agency, on a three monthly basis, the records of the readings specified in condition 18.2 (i).

18.3 Exception Reports

The Consent Holder shall supply to the Agency at three monthly intervals, or upon request, a written report, detailing all occurrences where:

- (i) there were any failures of any measurement system used to control the UV dosing system;
- (ii) the external power supply to the UV disinfection system was interrupted;
- (iii) a Discharge of sewage effluent was made which had not been subjected to the required UV dose as specified in conditions 1(d) and 2 of this consent.
- (iv) The report shall detail the reasons why the situation occurred, and the actions taken by the Consent Holder. The report shall include an assessment of what measures can be adopted in the future to minimise such occurrences.
- (v) The Agency, if satisfied that the cause is an emergency and outside the control of the Consent Holder, and that all possible measures were taken to minimise the impact of the discharge on controlled waters, shall

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exclude the measurements for the period for compliance purposes with condition 1(d)

18.4 Disinfection Efficacy Monitoring

The Consent Holder shall carry out the monitoring programme as detailed below, unless otherwise notified in writing by the Agency. The results of the monitoring programme are to be supplied to the Agency in a format specified by the Agency, on a three monthly basis, 2 months in arrears.

- (i) Sample points as shown on attached plan:
 - A Crude influent to sewage treatment works at NGR SM 95630 14617.
 - B Secondary treated sewage effluent before UV disinfection at NGR SM 95720 14688
 - C Secondary treated sewage effluent after UV disinfection at NGR SM 95705 14679
- (ii) Microbiological determinands and frequencies (Agency Standard Analytical Methods to be employed, including AQC)
 - 1) **Faecal Coliforms** - fortnightly at sample points A, B and C;
 - 2) **F-specific bacteriophage** - fortnightly at sample points A, B and C.

Following two consecutive years of full consent compliance, the Agency will review the data annually and notify in writing the Consent Holder of any resulting change to the monitoring regime.

- (iii) Other determinands and frequencies

The measurement of all determinands below shall coincide with the measurement of microbial determinands. At each sample point, samples for analysis should be sub-sampled from a single bulk sample. Where this cannot be achieved, the sampling regime shall be clearly recorded.

- a) The flow through each UV irradiation channel shall be measured.
- b) The measured applied dose shall be recorded in each UV irradiation channel.
- c) The measured UV transmittance at 254nm in the channel shall be measured by both in-situ meter and by laboratory analysis of samples collected from sample point B or C.
- d) Suspended solids shall be measured at sample point B or C
- e) BOD (ATU) shall be measured at sample point B or C.

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18.5 Telemetry

A telemetry alarm system connected to a 24-hour manned station shall be provided and maintained by the Consent Holder to provide a warning in the event that:

- a) the external power supply to the UV disinfection system has been interrupted;
- b) failure of any measurement system used to control the UV dosing system has occurred;
- c) a Discharge of sewage effluent has occurred which has not been subjected to the required UV dose as specified in conditions 1d and 2 of this consent.

18.6 Emergency notification

The Consent Holder shall notify the Agency and Local Food Authority in the event of a Discharge of sewage effluent which has not been subjected to the required UV dose as specified in conditions 1(d) and 2 of this consent, or of power failure causing loss of secondary treatment. Such notification must be made as soon as practicable and no later than 24 hours after the event, and shall detail the reasons why the situation occurred, and the actions taken by the Consent Holder.

18.7 Power

Full stand-by power generation facilities shall be provided and maintained by the Consent Holder in good working order to enable automatic resumption of power to the UV disinfection system in the event of external power supply failure to the UV disinfection plant.

LISTED SUBSTANCES

- 19. The Consent Holder shall notify the Agency in writing if any known or planned introduction or material change in respect of discharges from trade premises to the sewerage system occurs, that may increase or introduce into the effluent any "dangerous substance" (set out in Annex 2 attached to this notice as updated from time to time and notified to the Consent Holder in writing), and any other substance considered by the Consent Holder as having or likely to have a significant effect on the receiving waters.

SUBSTANTIAL CHANGE

- 20.1 A discharge shall not be made from the works if it would cause a significant increase in the polluting effects of the discharge on controlled waters as a result of a new or altered discharge of trade effluent into the works.

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20.2 A discharge of trade effluent into the works is new if -

- (a) it is made by the sewerage undertaker and is of a kind not made into the works by the undertaker immediately before the date of effect of this consent; or
- (b) it is made by a third party and the discharge is authorised on or after that date.

20.3 A discharge of trade effluent into the works is altered if -

- (a) it is made by the sewerage undertaker and its composition or quantity changes significantly on or after the date of effect of this consent; or
- (b) it is made by a third party and the alteration of the discharge is authorised on or after that date.

20.4 An increase in the polluting effects of the Discharge on controlled waters is not significant for the purposes of this condition if it relates to any characteristic of the Discharge which is specifically regulated by conditions 14 and 15 of this consent but it may be significant if it is caused by a change in some other characteristic of the Discharge.

20.5 For the purposes of this condition "trade effluent" means -

- (a) any discharge by the sewerage undertaker other than
 - (i) domestic sewage from premises connected directly or indirectly to the works; or
 - (ii) surface water run-off;
- (b) any discharge by a third party which is authorised under Chapter III of Part IV of the Water Industry Act 1991 or which is only accepted as a result of a contract with the sewerage undertaker.

UNAUTHORISED DISCHARGES

21. A discharge made from the works shall not contain any poisonous, noxious or polluting matter or solid waste matter which is attributable to any unauthorised discharge into the works.

- (a) A discharge into the works is unauthorised if it is made by a third party and either there is no obligation to receive it or conditions subject to which there is an obligation to receive it are not observed.
- (b) Nothing in this, or any other, condition of this consent prevents anyone from relying on any defence available to them under section 87 of the Water Resources Act 1991.

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DATE ISSUED	12th November 2007

CONDITIONS OF CONSENT TO DISCHARGE

Tertiary Treated Sewage Effluent ("the Discharge")

**FROM: MERLINS BRIDGE SEWAGE TREATMENT WORKS,
HAVERFORDWEST**

URBAN WASTE WATER TREATMENT REGULATIONS

- U0** (a) The Consent Holder shall comply with the Urban Waste Water Treatment (England and Wales) Regulations 1994 ("the Regulations").
- (b) For the purpose of conditions U1 and U2 below, interpretations and references to a numbered regulation or Schedule shall have the meaning as in the Regulations, unless otherwise indicated.
- U1** (a) The Discharge derives from an agglomeration with a population equivalent of more than 15,000, discharging to an estuary.
- (b) The Consent Holder shall inform the Agency in writing of any change, or proposed change, to the population equivalent such as would make a material change to the application of the Regulations and shall, on request, inform the Agency in writing of the actual population equivalent.
- (c) The Discharge shall be subject to Regulation 5(1) and shall satisfy the relevant requirements of Part I of Schedule 3.
- U2** (a) The Consent Holder shall provide apparatus for the purpose of:
- (i) measuring or recording the volume, rate of flow, nature, composition or temperature,
 - (ii) collecting samples of any waste water,
- as is necessary to ensure compliance with paragraph (b) below.
- (b) The Consent Holder shall monitor the Discharge to verify compliance with the requirements of condition U1(c) above in accordance with control procedures as set out in Part II of Schedule 3.
- (c) The Consent Holder shall provide to the Agency any information collected in complying with paragraph (b) above in a manner agreed with the Agency.
- U3** Condition U2 above shall apply for the purpose of verifying compliance with the Directive from the date as specified in the relevant paragraph of Regulation 5 as incorporated into this consent under condition U1(c) above.

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- U4**
- (a) An appropriately labelled sample point shall be provided and maintained at National Grid Reference SM 95630 14617, as shown marked 'UWWTR Influent Sample point' on the attached Plan BJ0087401, or some other point as agreed in writing with the Agency, so that a representative sample of the Influent may be obtained.
 - (b) An appropriately labelled sample point shall be provided and maintained at National Grid Reference SM 95708 14673, as shown marked 'UWWTR Discharge Sample point' on the attached Plan BJ0087401, or some other point as agreed in writing with the Agency, so that a representative sample of the Discharge may be obtained.

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ANNEX 1

TABLE

Column 1

Column 2

Number of samples
taken in any period
of 12 months

Maximum number of samples
permitted to exceed limit
for given determinand

4-7	1
8-16	2
17-28	3
29-40	4
41-53	5
54-67	6
68-81	7
82-95	8
96-110	9
111-125	10
126-140	11
141-155	12
156-171	13
172-187	14
188-203	15
204-219	16
220-235	17
236-251	18
252-268	19
269-284	20
285-300	21
301-317	22
318-334	23
335-350	24
351-365	25

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ANNEX 2

- | | |
|--|------------------------------|
| 1. Mercury and its compounds | 2. Cadmium and its compounds |
| 3. Hexachlorocyclohexane
(lindane and related compounds) | 4. Carbon tetrachloride |
| 5. DDT (the isomers of 1,1,1-trichloro-2,2 bis(p-chlorophenyl) ethane) | |
| 6. Pentachlorophenol (PCP) | 7. Aldrin |
| 8. Dieldrin | 9. Endrin |
| 10. Isodrin | 11. Hexachlorobenzene (HCB) |
| 12. Hexachlorobutadiene (HCBd) | 13. Chloroform |
| 14. Polychlorinated biphenyls | 15. Dichlorvos |
| 16. 1,2-Dichloroethane | 17. Trichlorobenzene |
| 18. Atrazine | 19. Simazine |
| 20. Tributyltin compounds | 21. Triphenyltin compounds |
| 22. Trifluralin | 23. Fenitrothion |
| 24. Azinphos-methyl | 25. Malathion |
| 26. Endosulfan | 27. Lead |
| 28. Chromium | 29. Zinc |
| 30. Copper | 31. Nickel |
| 32. Arsenic | 33. *Iron |
| 34. *pH outside range 5.5 to 9.0 | 35. *Boron |
| 36. Vanadium | 37. PCSD'S |
| 38. Cyfluthrin | 39. Sulcofuron |
| 40. Flucifuron | 41. Permethrin |
| 42. 4-Chloro-3-methyl-phenol | 43. 2-Chlorophenol |
| 44. 2,4-Dichlorophenol | 45. 2,4-D (ester) |
| 46. 2,4-D (non ester) | 47. 1,1,1-Trichloroethane |
| 48. 1,1,2-Trichloroethane | 49. Bentazone |
| 50. Benzene | 51. Biphenyl |
| 52. Chloronitrotoluenes | 53. Demeton |
| 54. Dimethoate | 55. Linuron |
| 56. MCPA | 57. Mecoprop |
| 58. Mevinphos | 59. Napthalene |
| 60. Omethoate | 61. Toluene |
| 62. Triazophos | 63. Xylene |
| 64. Cyanide | 65. Azinphos-ethyl |
| 66. Fenthion | 67. Parathion |
| 68. Parathion-methyl | 69. Trichloroethylene |
| 70. Tetrachloroethylene | 71. Dioxins |
| 72. PAHs | 73. Nonyl phenol |
| 74. Nonyl phenyl ethoxylate | 75. Di-ethylhexyl phthalate |
| 76. Bisphenol-A | 77. Diazinon |
| 78. Chlorfenvinphos | 79. Chlorotoluron |
| 80. Isoproturon | 81. Diuron |
| 82. Propetamphos | 83. Flumethrin |
| 84. Amitraz | 85. High-Cis Cypermethrin |
| 86. Cyromazine | 87. Deltamethrin |
| 88. Cypermethrin | |

This list is applicable as at 1 December 1998 and will be updated as and when changes to the relevant legislative requirements occur.

*Notification to the Agency by the Consent holder is only required in respect of changes to trade effluents likely to cause significant changes to the pH value, and/or iron or boron concentrations, of the crude sewage.

FLOW MEASUREMENT

**A: CRUDE INFLUENT TO
SEWAGE WORKS & UWWTR
INFLUENT SAMPLE POINT**

UV code of practice

Consent No. BJ0087401 MERLINS BRIDGE WwTW FE

The UV disinfection system shall be provided and maintained to ensure that its hydraulic characteristics and the path length of UV irradiation are such that, during the required period of disinfection, the effluent is subjected to the UV dose rate specified in the consent.

The UV disinfection system and stand-by power facilities shall be operated so as to minimise the frequency and duration of an emergency discharge of sewage effluent which has not been subjected to the required UV dose (as specified in the consent).

The measured applied UV dose (as defined in the Calculation of UV dose) shall be determined from:

- 1) the flow rate of effluent through the UV disinfection system (l/s),
- 2) the reactor volume,
- 3) the measured UV transmittance for the effluent (at 254nm)
- 4) the number of operational UV lamps

Maintenance

- a) A maintenance programme, including the method and frequency of cleaning and replacement of the UV lamps/ UV transmittance monitors, shall be undertaken by the Consent Holder as agreed in writing with the Agency.
- b) Any failure to meet the requirements of the agreed maintenance programme shall be advised to the Agency as soon as practicable and a report providing an explanation of the circumstances provided to the Agency within 2 weeks.
- c) The Consent Holder shall keep records of the maintenance undertaken (both programmed and un-programmed). Copies of these records shall be maintained by the Consent Holder and kept available for inspection by the Agency's officers at all reasonable times.

Calculation of UV dose

Definitions

For each bank of UV lamps, UV dose is defined as the product of UV light intensity (impacting on wastewater passing through the bank) and the retention time (of wastewater passing through the bank).

For the purposes of consent, the following terms are defined for each UV irradiation bank:

“reactor volume”

is the volume of wastewater in the bank at any given time;

“adjusted retention time”

is the reactor volume divided by the measured rate of flow through the UV bank;

“UV intensity with measured UV Transmittance”

is the UV intensity across the reactor volumes, predicted from the rated output (mW) of the UV lamps at end of lamp life (cleaned) which are energised and the measured UV transmittance for the effluent (at 254nm), taking into account the lamp array configuration;

“theoretical UV intensity”

is the predicted average UV intensity across the reactor volumes, at the UV transmittance of 45% for the effluent (at 254nm - predicted from the rated output (mW) of the UV lamps at end of lamp life (cleaned) which are energised);

Calculations

- i.
$$\begin{array}{l} \text{Measured} \\ \text{Applied} \\ \text{UV Dose} \\ (\text{mJ}/\text{cm}^2) \end{array} = \begin{array}{l} \text{UV intensity} \\ \text{with} \\ \text{measured} \\ \text{UV} \\ \text{transmittance} \\ (\text{mW}/\text{cm}^2) \end{array} \times \begin{array}{l} \text{Adjusted} \\ \text{retention} \\ \text{time (s)} \end{array} \times \frac{\begin{array}{l} \text{Number of lamps in} \\ \text{bank confirmed as} \\ \text{operating} \end{array}}{\begin{array}{l} \text{Total number of} \\ \text{lamps in bank} \end{array}}$$
- ii.
$$\begin{array}{l} \text{Applied UV Dose} \\ (\text{mJ}/\text{cm}^2) \end{array} = \begin{array}{l} \text{Theoretical UV} \\ \text{Intensity (mW}/\text{cm}^2) \end{array} \times \begin{array}{l} \text{Adjusted Retention} \\ \text{Time (s)} \end{array}$$

The UV dose ((Measured Applied or Applied) for each channel is the sum of the UV doses for each operational bank in the channel.