

**APPENDIX 7.2**  
**SIMCAT MODELLING REPORT**

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<b><u>1</u></b>	<b><u>INTRODUCTION</u></b>	<b><u>1</u></b>
<b><u>2</u></b>	<b><u>OBJECTIVES:</u></b>	<b><u>2</u></b>
<b><u>3</u></b>	<b><u>RIVER STANDARDS, DATA REQUIREMENTS AND MODEL SETUP</u></b>	<b><u>1</u></b>
<b>3.1</b>	<b>STANDARDS</b>	<b>1</b>
<b>3.2</b>	<b>DATA COLLECTION AND ANALYSIS</b>	<b>2</b>
<b>3.3</b>	<b>MODEL SETUP</b>	<b>2</b>
<b><u>4</u></b>	<b><u>MODEL CALIBRATION</u></b>	<b><u>5</u></b>
<b><u>5</u></b>	<b><u>MODEL SIMULATION AND RESULTS</u></b>	<b><u>6</u></b>
<b>5.1</b>	<b>MODEL SIMULATION</b>	<b>6</b>
<b>5.2</b>	<b>MODEL RESULTS</b>	<b>7</b>
<b><u>6</u></b>	<b><u>DISCUSSION</u></b>	<b><u>12</u></b>
<b><u>7</u></b>	<b><u>CONCLUSIONS</u></b>	<b><u>14</u></b>

# 1 Introduction

In investigating proposed new developments in the Ashford area the issue of water quality is crucial in determining the degree of impact from the development and the extent of investment required in meeting water quality standards.

In order to understand the variation in river water quality in the River Stour, the Environment Agency has developed a SIMCAT model. SIMCAT is a mass balance water quality model based on Monte Carlo simulations. This model combines the distribution of water quality and flow with distributions of water quality and flow from Sewerage Treatment Works (STW) and other river inputs. Amongst other features this model provides the capability to amend discharge consents to ensure that water quality standards are met.

SIMCAT is however very much dependent on the quality of data used to run the model. A comprehensive data set at the upstream reaches of the model, of STWs and other river inputs will help provide more reliable predictions at various locations simulated by the model.

The following report describes the setup and running of the SIMCAT model and the results describing the existing situation. Additionally a range of wastewater discharge options have been developed to support proposed development in the Ashford area, and these options assessed using SIMCAT.

## 2 Objectives:

The main objective of this study is to understand the impact on water quality standards from discharge options proposed as part of new developments in the Ashford area. The SIMCAT model provides the best mode for assessing a range of options on a broad scale to evaluate the changes to water quality within the River Stour.

The EA has set targets based on a policy of “no deterioration” which is defined through<sup>1</sup>:

1. That based on ‘Present’ quality as per Agency sample data representing the last 4 years, and so incorporating the effect of present consented STW discharges in the Stour catchment.
2. That based on anticipated river quality incorporating post AMP3 period permitted STW effluent flows and loads.

Using these targets the main objective of this study is to derive potential consents at treatment works which are likely to receive increased wastewater flows.

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<sup>1</sup> (Memo R Kenway to S Fury, pers. comm., August 2004)

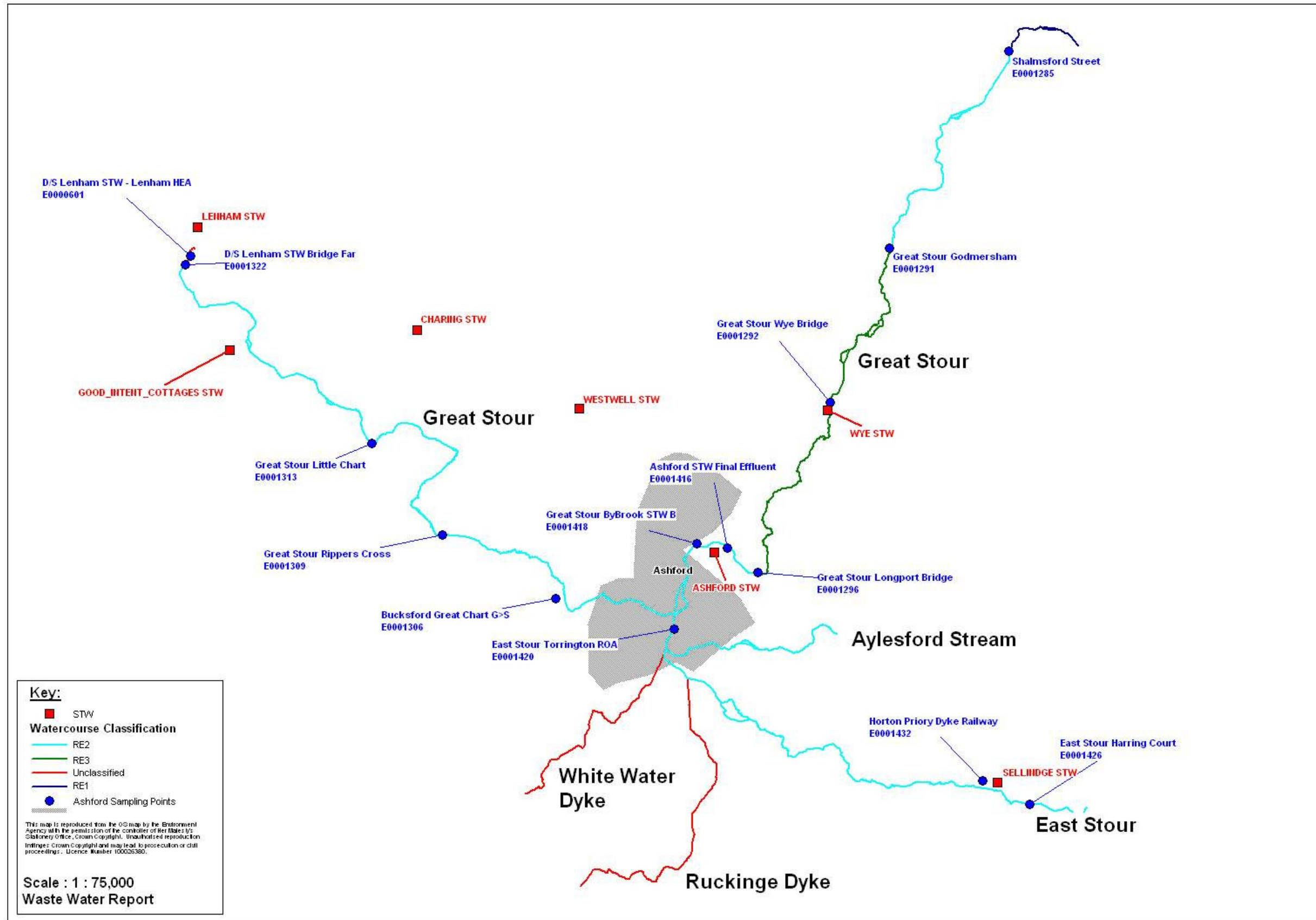


Figure 1-1: Geographical Overview - River Stour -Kent

### 3 River Standards, Data Requirements and Model Setup

#### 3.1 Standards

Water quality standards set within watercourses are set through the River Ecosystem Classification scheme which takes into account European Directives, such as the Freshwater Fish Directive and the Urban Waste Water Treatment Directive.

Watercourses in the UK are assessed as part of the General Quality Assessment (GQA) Scheme which specifies the chemical, biological, nutrient and aesthetic quality objectives of a river. These water quality objectives for the River Stour and its main tributaries are set by the Environment Agency through River Quality Objectives (RQOs) based on the River Ecosystem (RE) classification system to protect current water quality and future uses. The classification within the River Stour varies and this variation is graphically presented in Figure 1-1.

Water Quality is sampled on monthly basis and compliance is assessed for a stretch based on 36 months (3 years) of data. The Biological Oxygen Demand (BOD) and Ammonia standard for the river is set through the River Quality Objectives for Chemistry. The standards to meet these objectives are specified through the RE Classification Scheme and are provided in Table 3-1.

The sampling results for the parameters described in Table 3-1 are analysed to assess if the reach has passed or failed its RE classification.

**Table 3-1: River Ecosystem (RE) Classification Standards <sup>2</sup>**

River Ecosystem Classification					
Class	Dissolved Oxygen	BOD (ATU)	Total Ammonia	Un-ionised Ammonia	pH
	% saturation	mg/l	mg N/l	mg N/l	
	10 percentile	90 percentile	90 percentile	95 percentile	lower limit as 5 percentile upper limit as 95 percentile
RE1	80	2.5	0.25	0.021	6.0-9.0
RE2	70	4	0.6	0.021	6.0-9.0
RE3	60	6	1.3	0.021	6.0-9.0
RE4	50	8	2.5	-	6.0-9.0
RE5	20	15	9	-	-

The drivers behind river quality criteria for nutrients such as phosphorus and nitrates are less clear. These parameters are stipulated through various directives but a clear strategy is yet to be developed by the UK government for the aforementioned parameters. For the time being the River Stour between Ashford STW and Canterbury STW is a designated Sensitive Area (Eutrophic) with DEFRA's approval under the requirements of the Urban Waste Water Treatment Directive (91/271/EEC). Through this designation the limit for Phosphorus is 200µg/l.

In the case of nitrates the picture is less clear. No clear policy has been developed for nitrates in the UK and the EA have indicated that for the time being that the "no deterioration" policy be implemented.

<sup>2</sup> "Economic Instruments for Water Pollution", DEFRA, 1998

### **3.2 Data Collection and Analysis**

The main components necessary to setup a SIMCAT model include:

- Upstream river flow
- Upstream river quality
- Discharge flow from all STW
- Discharge quality for all STWs
- River quality at any monitoring stations within the model extent

This information is made available through the EAs River monitoring programme. The data collected between the period of 2001 to 2004 has been used to model the River Stour using the SIMCAT model. In setting up the SIMCAT model the parameters used to define the flow and quality in the River Stour is provided in the form of mean and standard deviation of flow and quality. Therefore before input into SIMCAT this EA data has to be analysed to eliminate outliers which may skew the distribution of the data. The commercial software AARDVARK (Analyse Any Real Data Visually Acquire Real Knowledge) has been used to analyse the data for outliers and to ensure a more statistically robust analyses. Based on data collected it can produce summary statistics for feature types as listed below.

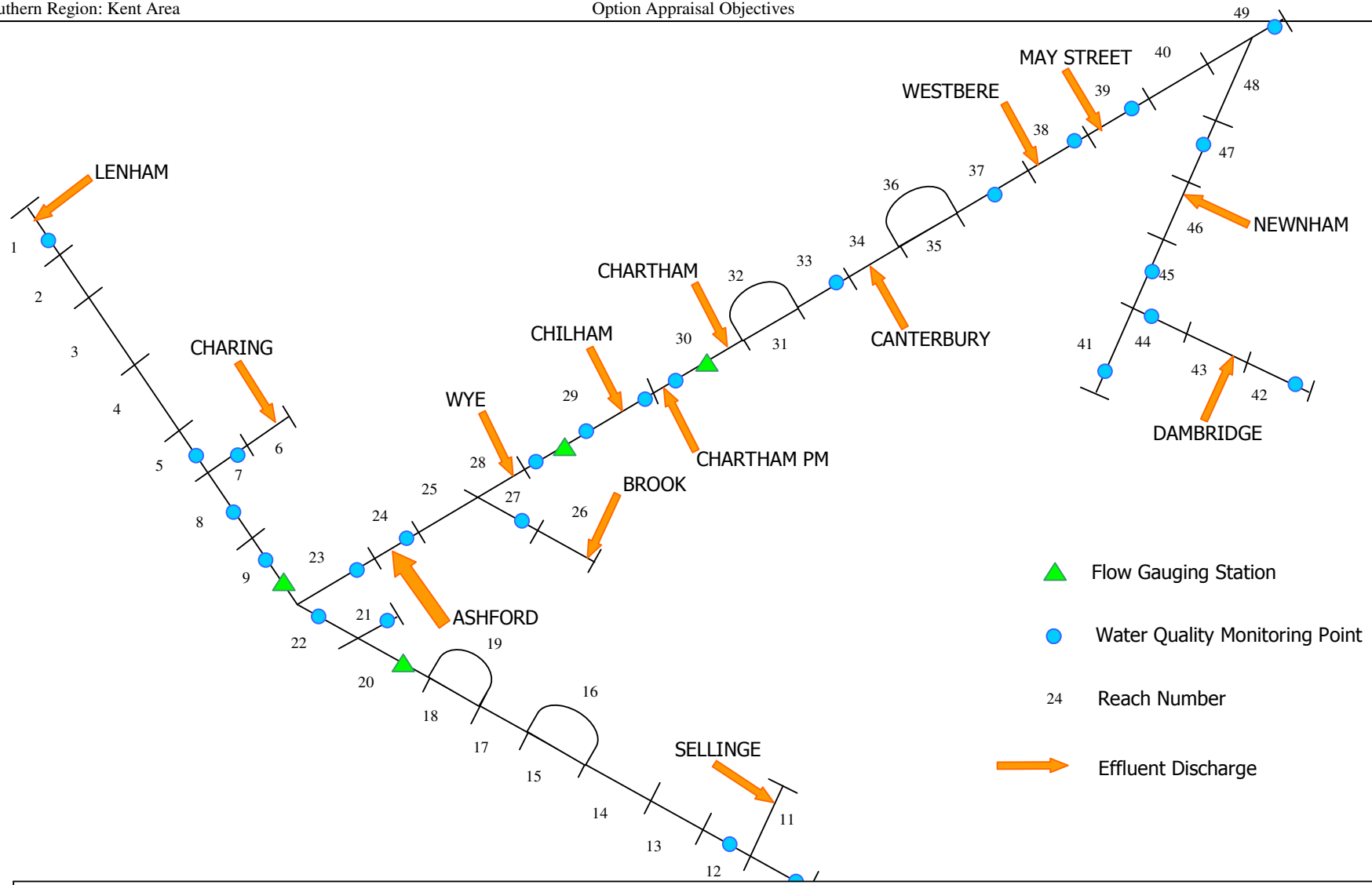
1. monitoring station;
2. stream or tributary;
3. sewage works or sewage discharge;
4. river flow gauge;
5. industrial effluent discharge;
6. plotting point;
7. abstraction (of flow);
8. weir;
9. river flow regulation point;
10. upstream river boundary;
11. bifurcation;
12. start point for diffuse pollution;
13. end point for diffuse pollution;

### **3.3 Model Setup**

As described above the model is setup using summary statistics for the headwaters and various inputs into the River. A schematic of the SIMCAT model is shown in Figure 3-1.

The features within the River Stour SIMCAT model is summarised in Table 3-2.

Two main models have been set up; one for BOD and Ammonia and the second for Total Reactive Phosphorus (TRP) and Total Organic Nitrogen (TON).



**Figure 3-1: Kentish Stour SIMCAT model for 2001 - 2004**

Feature Name	Feature Type
'Head of Great Stour'	Upstream River Boundary
'Head of Charing Stream'	Upstream River Boundary
'Harringe Bridge E0001426'	Upstream River Boundary
'Head of Horton Priory Dyke'	Upstream River Boundary
'Newtown Road E0001427'	Upstream River Boundary
'Head of Spiders Castle Dyke'	Upstream River Boundary
'Littlebourne E0001373'	Upstream River Boundary
'Durlock E0001382'	Upstream River Boundary
'Chartham PM ETP'	Industrial Effluent Discharge
'Chart Leaon GS'	River Flow Gauge
'South Willesborough GS'	River Flow Gauge
'Wye GS'	River Flow Gauge
'Horton GS'	River Flow Gauge
'West Stourmouth PS'	River Flow Gauge
'Lenham STW'	Sewage Treatment Works
'Charing STW'	Sewage Treatment Works
'Sellindge STW'	Sewage Treatment Works
'Ashford STW'	Sewage Treatment Works
'Brook STW'	Sewage Treatment Works
'Wye STW'	Sewage Treatment Works
'Chilham STW'	Sewage Treatment Works
'Chartham STW'	Sewage Treatment Works
'Canterbury STW'	Sewage Treatment Works
'Westbere STW'	Sewage Treatment Works
'Maystreet STW'	Sewage Treatment Works
'Dambridge STW'	Sewage Treatment Works
'Newnham STW'	Sewage Treatment Works
'Sandway Stream'	Stream or Tributary
'Barnfield Stream'	Stream or Tributary
'Hunger Hatch stream'	Stream or Tributary
'streams adj Ram Lane'	Stream or Tributary
'Westwell Stream'	Stream or Tributary
'Brabourne Stream'	Stream or Tributary
'Park Farm Stream'	Stream or Tributary
'Ruckinge & Whitewater Dykes'	Stream or Tributary
'Bockhanger stream'	Stream or Tributary
'Kennington stream'	Stream or Tributary
'Bourne Dyke'	Stream or Tributary
'Bridge Farm E0001322'	Monitoring Point
'Little Chart E0001313'	Monitoring Point
'Westwell Rd E0001311'	Monitoring Point
'Rippers Cross E0001309'	Monitoring Point
'Bucksford E0001306'	Monitoring Point
'Aldington Road E0001425'	Monitoring Point
'Torrington Road E0001420'	Monitoring Point
'Bybrook Bridge E0001418'	Monitoring Point
'Longport Bridge E0001296'	Monitoring Point
'u/s Gt Stour confl E0001410'	Monitoring Point
'Wye Bridge E0001292'	Monitoring Point
'Godmersham E0001291'	Monitoring Point
'Shalmsford Street E0001285'	Monitoring Point
'Horton E0001273'	Monitoring Point
'Vauxhall Bridge E0001262'	Monitoring Point
'Bretts Bridge E0001255'	Monitoring Point
'Grove Ferry E0001250'	Monitoring Point
'A257 Wingham E0001379'	Monitoring Point
'Blue Bridge E0001366'	Monitoring Point
'Plucks Gutter'	Monitoring Point

**Table 3-2: Feature Name and Type within River Stour SIMCAT**

## 4 Model Calibration

Calibration within the SIMCAT model is done by trying to fit summary statistics as calculated by the model with summary statistics for sampled data at monitoring locations. The main monitoring stations provide the source to compare model data with real data. In ensuring that a good fit is provided between model output and real data, the main parameter for manipulation is diffuse flows into the River Stour.

The quantity and quality of diffuse sources are manipulated to achieve a better agreement between modelled and observed results. While some judgement is made taking into account areas likely to result in larger diffuse flows, this exercise is relatively arbitrary and aims to account for uncertainties about the reasons behind changes in river water quality. Figure 4-1 shows the calibration achieved between sampled and modelled data for the River Stour SIMCAT model for BOD and Ammonia.

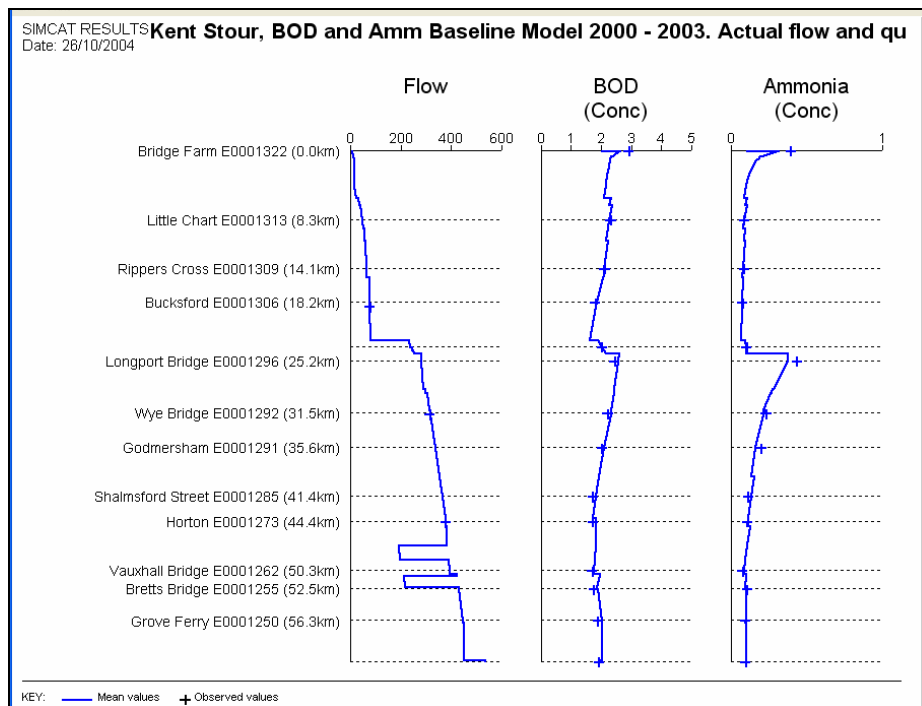


Figure 4-1: Calibration of River Stour SIMCAT model for BOD and Ammonia

## 5 Model Simulation and Results

### 5.1 Model Simulation

As described above the model has been run using flow and quality data analysed for the period 2001 to 2004. While a longer period is likely to provide more reliable statistics, it is assumed that restricting the period will help eliminate large fluctuations in the behaviour of treatment works which are known have been subject to modifications.

This SIMCAT model has been simulated to represent the existing situation and the quality has been attained at a range of locations. Subsequently a range of scenarios have been developed to help solve the problem of additional wastewater flows from the proposed Ashford development. These additional scenarios have been tested within the SIMCAT model and the results compared with the existing situation. It is anticipated that the additional wastewater flows from the proposed Ashford Development will amount to an extra 7.15 ML/D from the northern Ashford area and an extra 12.5 ML/D from the southern Ashford area. A description of each scenario is described below.

**Scenario 1:** This scenario relates to the treatment and discharge of only an extra 7.15 ML/D from the northern Ashford area at Bybrook Sewage Treatment Works (STW) on top of the flows already being treated at Bybrook, amounting to 37.15 ML/D.

**Scenario 2:** This scenario relates to the treatment and discharge of all flows, amounting to a total of 49.63 ML/D from the proposed development both within the northern and southern Ash at Bybrook STW.

**Scenario 3:** This scenario relates to the discharge of flows as specified in Scenario 1 to all be discharged at a location downstream of Wye STW. In this scenario Bybrook discharge is completely removed to be replaced by new discharge location.

**Scenario 4:** This scenario relates to the discharge of all flows as specified in Scenario 2 to be discharged at a location downstream of Wye STW. In this scenario Bybrook discharge is completely removed to be replaced by new discharge location.

**Scenario 5:** This scenario combines scenario 1 with the flows from the southern Ashford area to be treated and discharged at a location just upstream of Ashford on the Great Stour.

**Scenario 6:** This scenario combines scenario 1 with the flows from the southern Ashford area to be treated and discharged at a location just upstream of Ashford on the East Stour.

The SIMCAT model has been used to model the baseline situation and a range of discharge scenarios. In modelling these discharge scenarios the quality of the effluent has been assumed to be the same as the current quality of effluent from Bybrook STW (refer to Table 5-3 and Table 5-4 for existing quality). This is a starting point and where a discharge scenario is found to result in a failure of the river water quality targets the quality of the wastewater discharge has been increased to the point where compliance with the standard is achieved. This is the process by which potential consents for proposed treatment works has been developed.

## **5.2 Model Results**

Each of the above scenarios has been run to look at the fate of BOD, Ammonia, TRP and TON. In the case of BOD and Ammonia, where the above scenarios have been found to breach the River Ecosystem classification at a monitoring point, an iterative exercise has been undertaken involving the tightening of consents at the treatment works receiving the additional flows. In the case of TRP and TON the "no deterioration" policy has been used to tighten consents to ensure that the additional flows do not cause the river to deteriorate any further. Table 5-1 presents the results of changes in BOD and Ammonia while Table 5-2 present results for TRP and TON at monitoring locations for each of the above scenarios. Accordingly the changes to consents which ensure that river quality targets are met for these additional wastewater flows are presented in Table 5-3 and Table 5-4 for BOD & Ammonia and TRP & TON respectively.

Table 5-1: SIMCAT modelling results for BOD and Ammonia

SIMCAT Modelling Summary										SIMCAT Results for Designated Sampling Points																	
Discharge Location 1				Discharge Location 2				Discharge Location 3				Discharge Location 4				Torrington Road		Bybrook Bridge		Longport Bridge		Wye Bridge		Godmersham		Shalmsford Street	
Mean Flow (ML/D)	Standard Deviation (ML/D)	Mean Flow (ML/D)	Standard Deviation (ML/D)	Mean Flow (ML/D)	Standard Deviation (ML/D)	Mean Flow (ML/D)	Standard Deviation (ML/D)	Mean Flow (ML/D)	Standard Deviation (ML/D)	Scenario	Scenario Description	RE 2	RE 2	RE 3	RE 3	RE 2	RE 2	RE 3	RE 3	RE 2	RE 2	RE 3	RE 3	RE 2	RE 2	RE 1	RE 1
30	9.99									Base	System as it is	4	0.6	4	0.6	4	0.6	6	1.3	6	1.3	4	0.6	4	0.6	2.5	0.25
37.15	12.38									Scenario1	System as it is including the additional flows from developments draining into Bybrook	2.73	0.17	2.79	0.15	3.41	0.62	3.1	0.43	2.8	0.34	2.8	0.34	2.8	0.34	2.48	0.24
49.63	16.54									Scenario2	System as it is including all additional flows from new developments to be treated at Bybrook	2.73	0.17	2.79	0.15	3.62	0.99	3.25	0.53	2.96	0.41	2.96	0.41	2.96	0.41	2.62	0.3
		37.15	12.38							Scenario3	New treatment works at Wye to treat existing and proposed flows draining to Bybrook	2.73	0.17	2.79	0.15	2.99	0.14	3.16	0.72	2.85	0.51	2.85	0.51	2.85	0.51	2.5	0.34
		49.63	16.54							Scenario4	New treatment works at Wye to treat existing and all proposed flows from all new Ashford Developments	2.73	0.17	2.79	0.15	2.99	0.14	3.32	0.88	3.03	0.62	3.03	0.62	3.03	0.62	2.88	0.42
37.15	12.38			12.48	4.16					Scenario5	Upstream of Bybrook in the Great Stour before confluence with East Stour	2.73	0.17	2.95	0.39	3.48	0.95	3.19	0.52	2.93	0.39	2.93	0.39	2.93	0.39	2.6	0.29
37.15	12.38					12.48	4.16			Scenario6	Upstream of Bybrook in the upper parts of the East Stour	3.05	0.63	2.96	0.42	3.52	0.97	3.21	0.53	2.93	0.4	2.93	0.4	2.93	0.4	2.62	0.29

Table 5-2: SIMCAT modelling results for TRP and TON

SIMCAT Modelling Summary								Designated River Ecosystem (RE) Class		SIMCAT Results for Designated Sampling Points											
Discharge Location 1		Discharge Location 2		Discharge Location 3		Discharge Location 4		Target Quality		RE 2		RE 2		RE 3		RE 3		RE 2		RE 1	
Mean Flow (ML/D)	Standard Deviation (ML/D)	Mean Flow (ML/D)	Standard Deviation (ML/D)	Mean Flow (ML/D)	Standard Deviation (ML/D)	Mean Flow (ML/D)	Standard Deviation (ML/D)	Scenario	Scenario Description	mean TRP	mean TON	mean TRP	mean TON	mean TRP	mean TON	mean TRP	mean TON	mean TRP	mean TON	mean TRP	mean TON
30	9.99							Base	System as it is	315.5	6.8	243.1	6.2	273.0	8.1	244.6	7.8	205.4	7.6	170.0	7.3
37.15	12.38							Scenario1	System as it is including the additional flows from developments draining into Bybrook	315.5	6.7	243.1	6.2	283.4	8.4	253.3	8.1	213.0	7.8	175.6	7.6
49.63	16.54							Scenario2	System as it is including all additional flows from new developments to be treated at Bybrook	315.5	6.7	243.1	6.2	299.7	9.0	267.0	8.6	225.3	8.4	185.6	8.1
		37.15	12.38					Scenario3	New treatment works at Wye to treat existing and proposed flows draining to Bybrook	315.5	6.7	243.1	6.2	216.3	5.9	267.7	8.1	224.5	7.9	184.0	7.6
		49.63	16.54					Scenario4	New treatment works at Wye to treat existing and all proposed flows from all new Ashford Developments	315.5	6.7	243.1	6.2	216.3	5.9	284.6	8.7	239.4	8.4	196.0	8.1
37.15	12.38			12.48	4.16			Scenario5	Upstream of Bybrook in the Great Stour before confluence with East Stour	315.5	6.7	262.4	7.0	292.9	8.8	261.6	8.5	221.0	8.2	182.5	8.0
37.15	12.38					12.48	4.16	Scenario6	Upstream of Bybrook in the upper parts of the East Stour	347.8	8.2	268.6	7.1	296.8	8.9	264.7	8.5	223.5	8.3	184.3	8.0

SC1					
	Ashford STW	New Lower Wye STW			
<b>mean BOD</b>	3.70	0.00			
<b>95%ile BOD</b>	11.80	0.00			
<b>Mean Ammonia</b>	2.00	0.00			
<b>95%ile Ammonia</b>	4.10	0.00			
SC2			Consent Tightening for SC2		
	Ashford STW	New Lower Wye STW		Ashford STW	New Lower Wye STW
<b>mean BOD</b>	3.70	0.00	<b>mean BOD</b>	<b>3.20</b>	0.00
<b>95%ile BOD</b>	11.80	0.00	<b>95%ile BOD</b>	<b>7.81</b>	0.00
<b>Mean Ammonia</b>	2.00	0.00	<b>Mean Ammonia</b>	<b>1.60</b>	0.00
<b>95%ile Ammonia</b>	4.10	0.00	<b>95%ile Ammonia</b>	<b>3.57</b>	0.00
SC3			Consent Tightening for SC3		
	Ashford STW	New Lower Wye STW		Ashford STW	New Lower Wye STW
<b>mean BOD</b>	0.00	3.70	<b>mean BOD</b>	0.00	<b>3.70</b>
<b>95%ile BOD</b>	0.00	11.80	<b>95%ile BOD</b>	0.00	<b>11.80</b>
<b>Mean Ammonia</b>	0.00	2.00	<b>Mean Ammonia</b>	0.00	<b>1.40</b>
<b>95%ile Ammonia</b>	0.00	4.10	<b>95%ile Ammonia</b>	0.00	<b>3.37</b>
SC4			Consent Tightening for SC4		
	Ashford STW	New Lower Wye STW		Ashford STW	New Lower Wye STW
<b>mean BOD</b>	0.00	3.70	<b>mean BOD</b>	0.00	<b>3.10</b>
<b>95%ile BOD</b>	0.00	11.80	<b>95%ile BOD</b>	0.00	<b>7.54</b>
<b>Mean Ammonia</b>	0.00	2.00	<b>Mean Ammonia</b>	0.00	<b>1.10</b>
<b>95%ile Ammonia</b>	0.00	4.10	<b>95%ile Ammonia</b>	0.00	<b>2.74</b>
SC5			Consent Tightening for SC5		
	New STW on Great Stour	Ashford STW		New STW on Great Stour	Ashford STW
<b>mean BOD</b>	3.70	3.70	<b>mean BOD</b>	<b>3.30</b>	<b>3.20</b>
<b>95%ile BOD</b>	11.80	11.80	<b>95%ile BOD</b>	<b>8.23</b>	<b>7.97</b>
<b>Mean Ammonia</b>	2.00	2.00	<b>Mean Ammonia</b>	<b>1.70</b>	<b>1.60</b>
<b>95%ile Ammonia</b>	4.10	4.10	<b>95%ile Ammonia</b>	<b>4.00</b>	<b>3.90</b>
SC6			Consent Tightening for SC6		
	New STW on East Stour	Ashford STW		New STW on East Stour	Ashford STW
<b>mean BOD</b>	3.70	3.70	<b>mean BOD</b>	<b>3.10</b>	<b>3.20</b>
<b>95%ile BOD</b>	11.80	11.80	<b>95%ile BOD</b>	<b>7.87</b>	<b>8.31</b>
<b>Mean Ammonia</b>	2.00	2.00	<b>Mean Ammonia</b>	<b>1.70</b>	<b>1.60</b>
<b>95%ile Ammonia</b>	4.10	4.10	<b>95%ile Ammonia</b>	<b>4.00</b>	<b>3.90</b>

Table 5-3: Potential changes to consents for BOD and Ammonia for additional wastewater discharge

SC1			Consent Tightening for SC1		
	Ashford STW	New Lower Wye STW		Ashford STW	New Lower Wye STW
<b>mean TRP</b>	600.00	0.00	<b>mean TRP</b>	<b>500.00</b>	0.00
<b>95%ile TRP</b>	1405.98	0.00	<b>95%ile TRP</b>	<b>1255.00</b>	0.00
<b>Mean TON</b>	19.20	0.00	<b>Mean TON</b>	<b>17.00</b>	0.00
<b>95%ile ATON</b>	26.95	0.00	<b>95%ile ATON</b>	<b>24.75</b>	0.00
SC2			Consent Tightening for SC2		
	Ashford STW	New Lower Wye STW		Ashford STW	New Lower Wye STW
<b>mean TRP</b>	600.00	0.00	<b>mean TRP</b>	<b>455.00</b>	0.00
<b>95%ile TRP</b>	1405.98	0.00	<b>95%ile TRP</b>	<b>1084.00</b>	0.00
<b>Mean TON</b>	19.20	0.00	<b>Mean TON</b>	<b>14.50</b>	0.00
<b>95%ile ATON</b>	26.95	0.00	<b>95%ile ATON</b>	<b>22.25</b>	0.00
SC3			Consent Tightening for SC3		
	Ashford STW	New Lower Wye STW		Ashford STW	New Lower Wye STW
<b>mean TRP</b>	0.00	600.00	<b>mean TRP</b>	0.00	<b>460.00</b>
<b>95%ile TRP</b>	0.00	1405.98	<b>95%ile TRP</b>	0.00	<b>1150.00</b>
<b>Mean TON</b>	0.00	19.20	<b>Mean TON</b>	0.00	<b>16.00</b>
<b>95%ile ATON</b>	0.00	26.95	<b>95%ile ATON</b>	0.00	<b>23.75</b>
SC4			Consent Tightening for SC4		
	Ashford STW	New Lower Wye STW		Ashford STW	New Lower Wye STW
<b>mean TRP</b>	0.00	600.00	<b>mean TRP</b>	0.00	<b>400.00</b>
<b>95%ile TRP</b>	0.00	1405.98	<b>95%ile TRP</b>	0.00	<b>909.00</b>
<b>Mean TON</b>	0.00	19.20	<b>Mean TON</b>	0.00	<b>13.50</b>
<b>95%ile ATON</b>	0.00	26.95	<b>95%ile ATON</b>	0.00	<b>21.25</b>
SC5			Consent Tightening for SC5		
	New STW on Great Stour	Ashford STW		New STW on Great Stour	Ashford STW
<b>mean TRP</b>	600.00	600.00	<b>mean TRP</b>	<b>290.00</b>	<b>500.00</b>
<b>95%ile TRP</b>	1405.98	1405.98	<b>95%ile TRP</b>	<b>701.00</b>	<b>1175.00</b>
<b>Mean TON</b>	19.20	19.20	<b>Mean TON</b>	<b>6.00</b>	<b>17.00</b>
<b>95%ile ATON</b>	26.95	26.95	<b>95%ile ATON</b>	<b>11.75</b>	<b>24.75</b>
SC6			Consent Tightening for SC6		
	New STW on East Stour	Ashford STW		New STW on East Stour	Ashford STW
<b>mean TRP</b>	600.00	600.00	<b>mean TRP</b>	<b>300.00</b>	<b>500.00</b>
<b>95%ile TRP</b>	1405.98	1405.98	<b>95%ile TRP</b>	<b>710.00</b>	<b>1175.00</b>
<b>Mean TON</b>	19.20	19.20	<b>Mean TON</b>	<b>6.00</b>	<b>17.00</b>
<b>95%ile ATON</b>	26.95	26.95	<b>95%ile ATON</b>	<b>11.75</b>	<b>24.75</b>

Table 5-4: Potential changes to consents for TRP and TON for additional wastewater discharges

## 6 Discussion

The SIMCAT model has enabled us to predict the changes in water quality as a result of implementing a variety of wastewater discharge options.

Before discussing the results of the simulation the capabilities of SIMCAT and should be discussed. SIMCAT is a useful tool which when plied with accurate data can be extremely useful in understanding the changes in water quality in a system. However like any statistical exercise this is limited by the quality and amount of data available. The greater the spatial gap of sampling the greater the uncertainty of water quality behaviour within these reaches. While SIMCAT may not be particularly useful in quantifying the small spatial scale changes in water quality it can be considered useful to understand catchment wide changes to water quality. It is this ability that makes SIMCAT useful for this exercise which effectively aims to understand the potential changes to water quality at designated monitoring stations for a broad range of options.

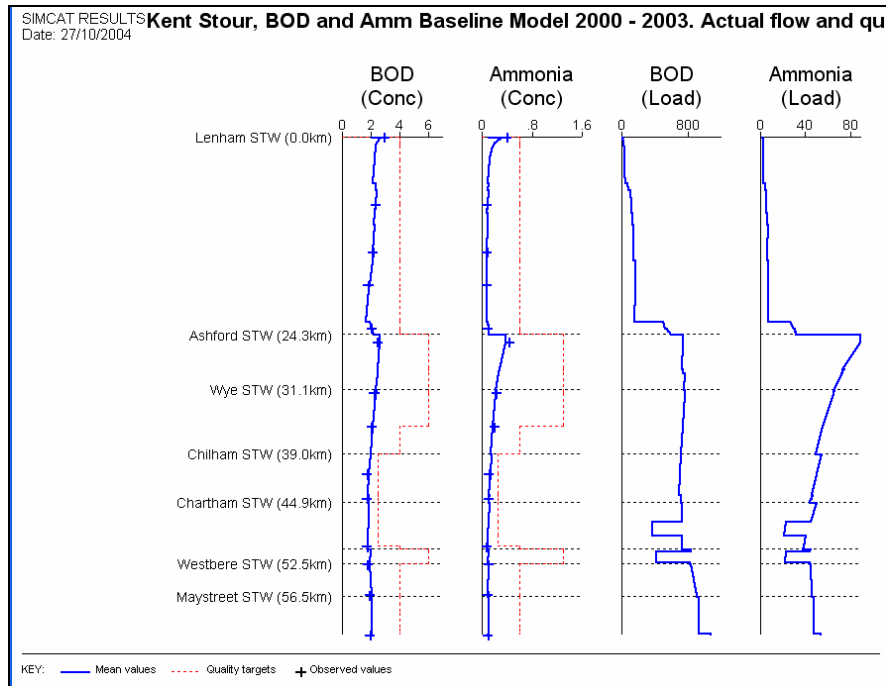
The baseline load for BOD & Ammonia (Figure 6-1) and TRP & TON (Figure 6-2) associated with all treatment works on the River Stour are presented below. These figures reveal that by far the largest loader is Bybrook STW (or called Ashford STW in figures).

As expected, given the increase in load into the River Stour the results show that for BOD and Ammonia all scenarios with the exception of Scenario 1 result in a breach of the RE standards.

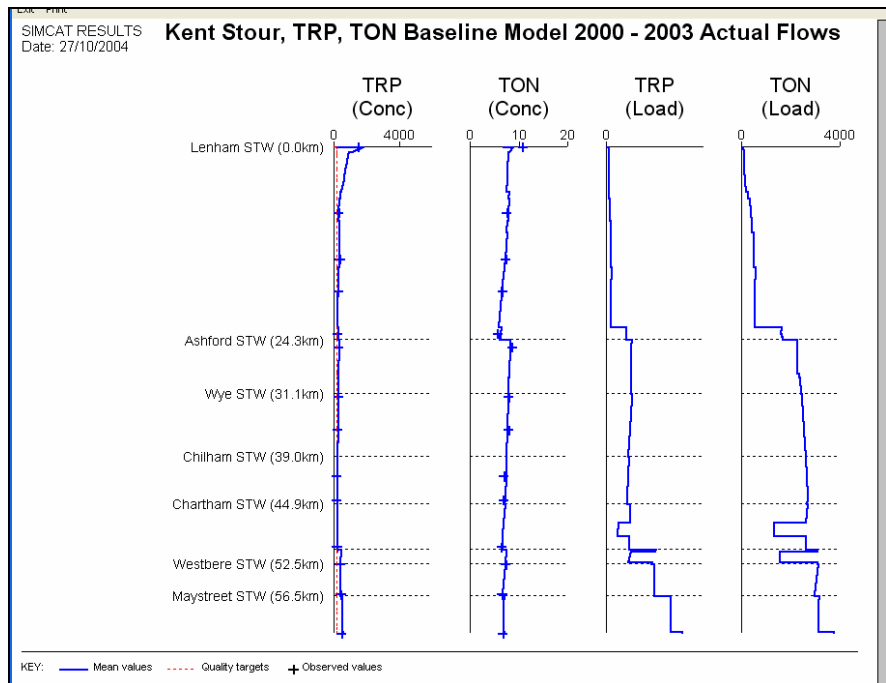
Scenario 1 which is the same as Scenario 3 with the only difference being the discharge location shows that discharging downstream of Wye results in a failure at downstream monitoring locations while this is not the case with Scenario 1. Relatively speaking the impact from either Scenario 1 or Scenario 3 should be similar given that SIMCAT is a statistical model and is not capable of modelling accurately the decay processes that occur within any reach. Apart from diffuse pollution, decay rates are relatively similar over much of the model. In this case the difference in results is more to do with the proximity of the discharge location to the next monitoring station and the targets set at this monitoring station. In Scenario 3 the discharge location is closer to the subsequent monitoring point. The targets are more stringent downstream and discharging closer to this area will result in a breach of the standards. This is the same for the difference seen between Scenario 2 and Scenario 4.

Scenario 5 and Scenario 6 are relatively similar with the main difference being that the former involves discharging in the Upper Great Stour just upstream of Ashford while the latter involves discharging the same flow into the East Stour also upstream of Ashford. Scenario 6 and Scenario 5 result in a failure downstream at Shalmsford Street while the former also causes a failure at the Torrington Road monitoring station. This is largely to do with the proximity of the discharge location in Scenario 6 to the monitoring station at Torrington Road. Presumably discharging further upstream should allow sufficient residence time for the pollutants to decay and thereby ensuring that Torrington Road does not fail.

For each of these scenarios where a failure of the RE classification is evident, consents have been tightened at the STW receiving increased flows.



**Figure 6-1: Stour \_Modelled Variation in BOD and Ammonia**



**Figure 6-2: Stour - Modelled Variation in TRP and TON**

## 7 Conclusions

A SIMCAT model for the Kentish Stour has been built, calibrated and verified. Black and Veatch have used this model to assess a range of wastewater discharge options for proposed new developments in the Ashford area.

The SIMCAT model has been used to model the baseline situation and a range of discharge scenarios. In modelling these discharge scenarios the quality of the effluent has been assumed to be the same as the current quality of effluent from Bybrook STW. This is a starting point and where a discharge scenario is found to result in a failure of the river water quality targets the quality of the wastewater discharge has been increased to the point where compliance with the standard is achieved. This is the process by which potential consents for proposed treatment works has been developed.

At this stage 6 main options have been tested to understand the general response of the River Stour. These include:

Scenario 1: Increased discharge at Bybrook STW from 30 ML/D to 37.15 ML/D

Scenario 2: Increased discharge at Bybrook STW from 30 ML/D to 49.63 ML/D

Scenario 3: Transfer discharge for Scenario 1 to a location downstream of Wye

Scenario 4: Transfer discharge for Scenario 2 to a location downstream of Wye

Scenario 5: Same as Scenario 1 with the inclusion of 12.38 ML/D to be discharged in the Great Stour just upstream of Ashford.

Scenario 6: Same as Scenario 1 with the inclusion of 12.38 ML/D to be discharged in the East Stour just upstream of Ashford.

Consents which may be required to allow for the additional flows are summarised in the following table.

	Name of STW	Mean BOD (mg/l)	95 %ile BOD (mg/l)	Mean Ammonia (mg/l)	95 %ile Ammonia (mg/l)	Mean TRP (µg/l)	Mean TON (mg/l)
Existing	Bybrook STW	3.7	11.8	2.0	4.1	600.0	19.2
Scenario 1	Bybrook STW	3.7	11.8	2.0	4.1	500.0	17.0
Scenario 2	Bybrook STW	3.2	7.8	1.6	3.6	455.0	14.5
Scenario 3	New Wye STW	3.7	11.8	1.4	3.4	460.0	16.0
Scenario 4	New Wye STW	3.1	7.5	1.1	2.7	400.0	13.5
Scenario 5	Bybrook STW	3.2	8.0	1.6	3.9	500.0	17.0
	New Great Stour STW	3.3	8.2	1.7	4.0	290.0	6.0
Scenario 6	Bybrook STW	3.2	8.3	1.6	3.9	500.0	17.0
	New East Stour STW	3.1	7.9	1.7	4.0	300.0	6.0

