

The content of this document is draft and relates to material [or data] which is still in the course of completion in travel to Gate 2 and should not be relied upon at this early stage of development. We continue to develop our thinking and our approach to the issues raised in the document in preparation for Gate 2.

Gate 2 Carbon Calculator

Introduction

- This tool calculates the carbon emissions in the construction of an asset (embodied carbon emissions) and the emissions associated with annual operation.
- The input data required is based on information available at Gate 2 such as capacity, e.g. 10MI/d Activated Sludge plant.
- Carbon emissions are calculated from carbon-curves, derived from a best fit line through an existing data set of emissions and capacity.
- The Net Present Costs (NPCs) are derived from emissions embodied in the construction of the asset and operational emissions over a 40 year period, with a 3.5% discount rate.
- The NPCs are calculated according to the latest Defra guidelines with the Shadow Price of Carbon based on 2009 prices (£27.60 rising by 2% each year).

User Guide

- The user should enter quantities in the light blue cells in columns D~J.
- Compulsory input requirements are specific to individual Design Manual Categories (DMCs) and may include:
 - Capacity (m³ or p.e.);
 - Number of items;
 - Dosed flow (l/hr);
 - Pumping station power (kW) or flow (MI/d);
 - Pipe diameter (mm), length (m), depth to invert (m) and location (field or highway); and
 - Tonnes of treated dry solids (TTDS).
- Annual Electricity Consumption is an optional input for some DMCs. When the major input has been entered, if a value for electricity appears in the Annual Electricity Consumption input cell, a default electricity usage has been calculated by the tool. This electricity usage is used in the calculation of operational emissions. If the user knows the electricity usage for the item, the default electricity can be overwritten and the tool will use this new electricity usage for operational emissions. Those items with no default electricity input require compulsory input of electricity usage for calculation of operational emissions.
- The 'Ancillary Works' category is a generic additional item to allow the user to make an allowance for construction of items that are not included in the principal DMC.
- Holding the mouse over column C will reveal a comment containing a description of the items included within each DMC. More detailed descriptions of the items included or excluded in a DMC are provided in the individual tabs for each DMC.
- Carbon has been used throughout this tool to represent carbon dioxide equivalent.
- The carbon curves are presented for information only and do not allow user input. They will be updated by the administrator when additional data is available.
- If more than one instance of a DMC is required (e.g. for multiple diameters of water mains) the model should be run with the different capacities and the results recorded in the Record Sheet by clicking the "copy" button in the Design Manual Input Sheet.
- A new copy of the Carbon Tool should be used for each project.

Process Emissions

- The operational emissions calculated by this tool are typically in addition to the operational emissions reported annually in the June returns.
- The operational emissions for a number of additional treatment processes are taken from the UKWIR 08/WW/20/3 report and include direct emissions from operation of the process, indirect emissions from electricity use and chemical dosing and emissions associated with sludge disposal. These additional processes are:
 - activated carbon;
 - biofilters;
 - phosphorous removal;
 - activated sludge;
 - sludge digestion; and
 - tertiary treatment
- In all other treatment processes, direct emissions, emissions embodied in the production of chemicals and emissions as a result of additional sludge are excluded.
- The reduction in NO₂ emissions downstream of an effluent discharge point that may result from improved levels of treatment are not included.

Related Documents:

Severn Trent Water Design Manual
 UKWIR report 08/WW/20/3 'Water Framework Directive: Sustainable Treatment Solutions for Achieving Good Ecological Status'
 Carbon Accounting PR09 Phase 1 report

Version Control

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GATE 2 CARBON CALCULATOR											
USER INSTRUCTIONS:											
Enter quantities for required Design Manual Categories in the pale blue cells in this sheet in columns D to J. Some contain drop-down lists. Annual Electricity Consumption must be entered if a default (<i>ITALICS</i>) is not available. The default electricity consumption can be overwritten if there is more information. The Carbon Emissions and Net Present Cost are displayed in columns L to N. The Design Manual Category must be copied to the Record Sheet by clicking the button in column O to record the calculations.											
	Design Manual Category		User Input					Proposed Year of Construction	Embodied CO _{2eq} (kgCO _{2eq})	Operational CO _{2eq} (kgCO _{2eq} /yr)	Net Present Cost of Carbon
Water Resources and Treatment	Boreholes		No. of boreholes		Annual Electricity Consumption (kWh)			2012	0	0	£0
	Service Reservoirs & Water Retaining Structures		Capacity (m³)					2009	0		£0
	Arsenic Removal		Dosed Flow (l/hr)		Annual Electricity Consumption (kWh)			2012	0	0	£0
	Fluoridation		Dosed Flow (l/hr)		Annual Electricity Consumption (kWh)			2012	0	0	£0
	pH Correction		Dosed Flow (l/hr)		Annual Electricity Consumption (kWh)			2012	0	0	£0
	Clarification		Capacity (ML/d)		Annual Electricity Consumption (kWh)			2012	0	0	£0
	Filtration		Flow (ML/d)		Annual Electricity Consumption (kWh)			2009	0	0	£0
	Activated Carbon Removal of Endocrine Disruptors (Full flow)		Flow (ML/d)		Annual Electricity Consumption (kWh)			2012	0	0	£0
	Activated Carbon - Removal of Pesticides (Full flow)		Flow (ML/d)		Annual Electricity Consumption (kWh)			2012	0	0	£0
	Activated Carbon Removal of Zinc (Full flow)		Flow (ML/d)		Annual Electricity Consumption (kWh)			2012	0	0	£0
	Iron & Manganese Treatment		Dosed Flow (l/hr)		Annual Electricity Consumption (kWh)			2012	0	0	£0
	Nitrate Treatment		Flow to Treatment (m³/hr)		Annual Electricity Consumption (kWh)			2012	0	0	£0
	Disinfection		Dosed Flow (l/hr)		Annual Electricity Consumption (kWh)			2012	0	0	£0
Stabilisation & Conditioning		Dosed Flow (l/hr)		Annual Electricity Consumption (kWh)			2012	0	0	£0	
Water Transfer and Distribution	Distribution Mains & Service Pipes		Length (m)		Diameter (mm)			2012	0	-	£0
	...contd		Pipe Location		Depth to invert (m)						
	Pumping Stations		Flow (ML/d)		Annual Electricity Consumption (kWh)			2014	0	0	£0
	Trunk Mains		Length (m)		Diameter (mm)			2009	0		£0
	...contd		Pipe Location		Depth to invert (m)						
Sewerage	Sewage Pumping Stations		Pump Power (kW)		Pipe Length (m)		Depth to invert (m)	2012	0	0	£0
	...contd		Pipe Diameter (mm)		Pipe Location		Annual Electricity Consumption (kWh)				
	Sewer Rehabilitation		Sewer Length (m)		Diameter (mm)			2012	0	-	£0
	...contd		Pipe Location		Depth to invert (m)						
	Manholes		No.					2012	0		£0
Sewage Treatment	Inlet Works		m³/d		Annual Electricity Consumption (kWh)			2012	0	0	£0
	Primary Sedimentation		Capacity (m³)		Annual Electricity Consumption (kWh)			2012	0	0	£0
	Bio Filters (Trickling Filters)		Capacity (p.e.)		Annual Electricity Consumption (kWh)			2012	0	0	£0
	Chemical Phosphorous Removal		Dosed Flow (l/hr)		Annual Electricity Consumption (kWh)			2012	176,323	282,258	£222,817
	Activated Sludge Process		Capacity (p.e.)		Annual Electricity Consumption (kWh)			2012	0	0	£0
	Enhanced Biological Phosphorous Removal		Capacity (p.e.)		Annual Electricity Consumption (kWh)			2012	0	0	£0
	Sludge Digestion (new plant)		TTDS per annum		Annual Electricity Consumption (kWh)			2012	0	0	£0
	Sludge Thickening - Centrifuge Dewatering		TTDS per annum		Annual Electricity Consumption (kWh)			2012	0	0	£0
	Sludge Thickening Sludge Press		No. of works		Annual Electricity Consumption (kWh)			2012	0	0	£0
	Sludge Drying		TTDS per annum		Annual Natural Gas Consumption (kWh)			2012	0	0	£0
	Sludge Mixing		Dosed Flow (l/hr)		Annual Electricity Consumption (kWh)			2012	0	0	£0
	Tertiary Treatment		Capacity (ML/d)		Annual Electricity Consumption (kWh)			2012	176,323	282,258	£219,338
	Small Sewage Treatment Works		Capacity (p.e.)		Annual Electricity Consumption (kWh)			2012	0	0	£0
Access to Assets	Flooring		Floor area (m²)					2012	91,977	-	£2,430
	Guarding of Equipment		No. of works					2012	0	-	£0
	Lifting Equipment		No. of plants		Annual Electricity Consumption (kWh)			2012	0	0	£0
Civil Engineering	Access Road		Road Length (m)					2012	77,922		£5,041
	Outfall Structures		No. of structures					2012	1,223	-	£32
	Tunnelling & Low Dig Techniques		Tunnel length (m)					2012	0	-	£0
Other	Environmental and Landscape		No. of sites					2012	1,663		£108
	Remote Asset Monitoring (Telemetry) Systems		No. of works		Annual Electricity Consumption (kWh)			2012	1,751	282,258	£214,760
	Security and Fencing		No. of installations		Annual Electricity Consumption (kWh)			2012	0	0	£0
	Site Investigation		No. of sites					2012	0	-	£0
	Ancillary Works		No. of works					2012	0	-	£0
Renewable Energy	CHP		TTDS per annum		Power generated per annum (kWh)			2012	0	0	£0

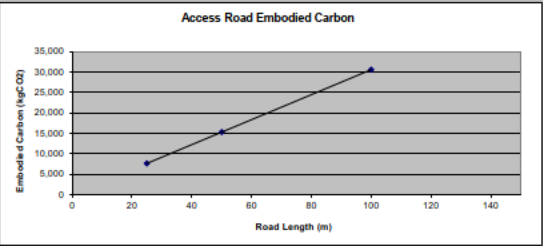
Access Road

Embodied Carbon Emissions

Design Manual Work Package	Road Length (m)	Design Life (yrs)	Carbon Cost (kg CO2)
Access Road	255	15	77,922

Operational Carbon Emissions

Design Manual Work Package	Carbon Cost (kg CO2/yr)
No operational carbon associated with this item	

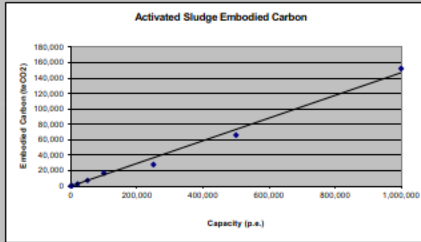


	Included	Excluded
Embodied Carbon	4m wide access road - 750mm sub-base and 75mm wearing	Kerbs and drainage
	-	-
	-	-

ACTIVATED SLUDGE (NITRIFICATION)

Embodied Carbon Emissions

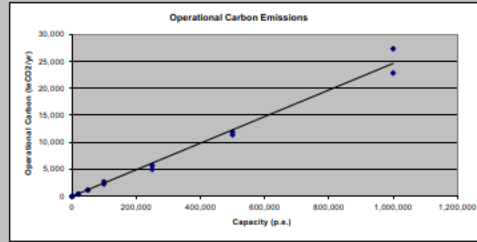
Design Manual Work Package	Capacity (p.e.)	Design Life (yrs)	Design Life for calcs (yrs)	Carbon Cost (kg CO2)
Enhanced Biological Phosphorus Removal Activated Sludge Process	0	60	40	0
	0	60	40	0



	Included	Excluded
Embodied Carbon	Rectangular concrete selector zone with mechanical mixers	Pumping to selector
	Rectangular concrete aerobic aeration lanes with fine bubble diffusers	Short cycle CO2 released during sewage treatment
	Concrete radial hopper bottom final settlement tanks, scraper bridges, SAS pumps and RAS	-

Operational Carbon Emissions

Design Manual Work Package	Capacity (p.e.)	Default Annual Electricity (kWh)	Carbon Cost (kg CO2)
Enhanced Biological Phosphorus Removal Activated Sludge Process	0	0	0
	0	0	0



	Included	Excluded
Operational Carbon	Mechanical mixer power	Process control and building services
	Blower power for air delivery to the aeration lanes	Trace heating of rails
	RAS pumping	Short cycle CO2 released during biological treatment
	SAS pumping	Any emissions from sludge produced
	Scraper bridge	

CARBON RELATIONSHIP		
p.e.	teCO2	
500	128	
2,500	422	
20,000	2,546	
50,000	7,209	
100,000	16,367	
250,000	27,868	
500,000	66,040	
1,000,000	152,384	

Click here to calculate carbon for PCO2

User input following Update to Carbon Calculations

Scaling factor relationship validity limits (p.e.)	500	1,000,000
Scaling Factor (slope)	0.15	
Scaling Factor (intercept)	0	

CARBON RELATIONSHIP		
p.e.	teCO2/yr	teCO2/yr (excl elec)
500	41	
2,500	58	
20,000	407	
50,000	1,209	
100,000	2,738	
250,000	5,017	
500,000	11,913	
1,000,000	27,392	

Click here to calculate carbon for PCO2

User input following Update to Carbon Calculations

Scaling factor relationship validity limits (p.e.)	500	27392
Scaling Factor (slope)	0.02	0.01
Scaling Factor (intercept)	0.00	-0.22

ELECTRICITY RELATIONSHIP		
p.e.	kWh/yr	
500	10,273	
2,500	51,375	
20,000	410,998	
50,000	1,027,494	
100,000	2,064,988	
250,000	5,137,469	
500,000	10,274,938	
1,000,000	20,549,876	

Click here to calculate electricity from assumed CO2

Scaling factor relationship validity limits (p.e.)	500	1000000
Scaling Factor (slope)	20.55	
Scaling Factor (intercept)	0.05	

Activated sludge to meet 1 mg/l NH4-N

Activated sludge to meet 3 mg/l NH4-N

11 11

1054 1105

10543 11053

21086 22107

Ancillary Works

Embodied Carbon Emissions

Design Manual Work Package	No. of works	Design Life (yrs)	Total Embodied Carbon (kg CO2)
Ancillary Works	0	40	0

Operational Carbon Emissions

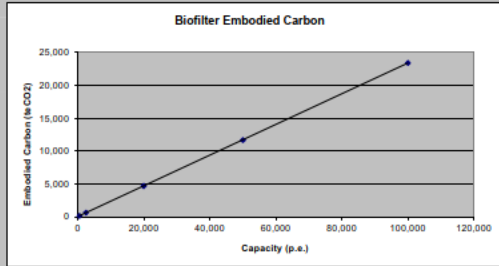
Design Manual Work Package	Carbon Cost (kg CO2/yr)
No operational carbon associated with this item	

Embodied Carbon	Included	Excluded
	Connecting pipework; 50m 150mm DI	-
	Fencing; 50m chain link 2.4m high, post and gate	-
	Valves and Splitter Chamber; 2no. Gate valves and 5no. Bends (700kg cast iron) and a 2m by 2m by 2m concrete chamber with 300mm thick walls	-

BIOFILTERS

Embodied Carbon Emissions

Design Manual Work Package	Capacity (p.e.)	Design Life (yrs)	Carbon Cost (kg CO2)
Bio Filters	0	40	



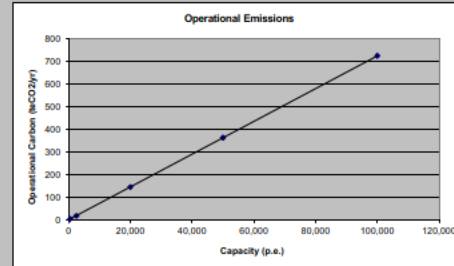
	Included	Excluded
Embodied Carbon	Circular trickling filters: concrete construction, distribution arms, rock media, recirculation pump.	Flow distribution
	Conical base humus tanks: concrete construction, desludge	Process control
	Connecting pipework	-

[illegible]

Scaling factor relationship validity limits (p.e.)	500	100000
Scaling Factor (slope)	0.23	
Scaling Factor (intercept)	55	

Operational Carbon Emissions

	Capacity (p.e.)	Default Annual Electricity (kWh)	Carbon Cost (kg CO2)
Design Manual Work Package			
Bio Filters	0	0	



	Included	Excluded
Operational Carbon	Distribution arms	Any emissions from sludge produced
	Recirculation pump	-
	Desludge pump	-

CARBON RELATIONSHIP			
p.e.	teCO ₂ /yr	teCO ₂ /yr (excl elec)	
500	9	n/a	STW Carbon
2,500	9	n/a	
20,000	22	n/a	
50,000	48	n/a	
100,000	92	n/a	
500	4	3	UKWV Carbon calculations
2,500	18	13	
20,000	145	109	
50,000	363	272	
100,000	726	544	
			User input following Update to

Note - due to the discrepancy here, only Sustain tool values have been used

Scaling factor relationship validity limits (p.e.)	500	100000
Scaling Factor (slope)	0.0073	0.0054
Scaling Factor (intercept)	0.03	-0.02

p.e.	kWh/yr
500	1,741
2,500	8,706
20,000	69,648
50,000	174,119
100,000	348,238

Scaling factor relationship
validity limits (o.e.)
Scaling Factor (slope)
Scaling Factor (intercept)

UKWIR
assumptions
from Sustain
Tool

Boreholes

Embodied Carbon Emissions

Design Manual Work Package	No. of Boreholes	Design Life (yrs)	Total Embodied Carbon (kg CO2)
Boreholes	0	20	0

Embodied Carbon	Included	Excluded
	Borehole with grouted in place casing for top section of borehole	Trial boreholes
	Pumps valves, motors and MCC	Test pumping
	Concrete headworks	-

Operational Carbon Emissions

Design Manual Work Package	Annual Electricity Consumption (kWh)	Carbon Cost (kg CO2/yr)
Boreholes	0	0

Operational Carbon	Included	Excluded
	All-inclusive power to run the process: building services, pumps.	Fuel in travel for maintenance

CHP

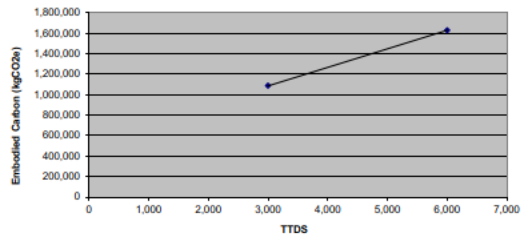
Embodied Carbon Emissions

Design Manual Work Package	TTDS/yr	Design Life (yrs)	Carbon Cost (kg CO2)
CHP	0	40	0

Operational Carbon Emissions

Design Manual Work Package	Annual Electricity Generation (kWh)	Carbon Cost (kg CO2)
CHP	0	0

CHP Embodied Carbon



	Included	Excluded
Embodied Carbon	Stainless steel sludge import and storage tanks and	
	Sludge press, pumps, valves, and MCC's	
	Package digester plant (glass coated steel) and double skinned ballon type gas storage vessel	

	Included	Excluded
Operational Carbon	User input of net electricity generated	Emission associated with the sale of ROCs
		Short cycle CO2 released during sewage treatment-
		Sludge disposal, on-site methane losses

CHEMICAL DOSING

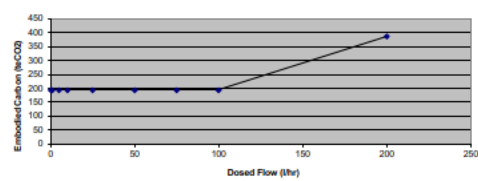
Embodied Carbon Emissions

Design Manual Work Package	Dosed Flow (l/hr)	Design Life (yrs)	Carbon Cost (kg CO2)
Arsenic Removal	0	20	0
Fluoridation	0	20	0
pH Correction	0	20	0
Iron & Manganese Treatment	0	20	0
Disinfection	0	20	0
Stabilisation & Conditioning	0	20	0
Chemical Phosphorous Removal	0	20	0
Sludge Mixing	0	20	0

Operational Carbon Emissions

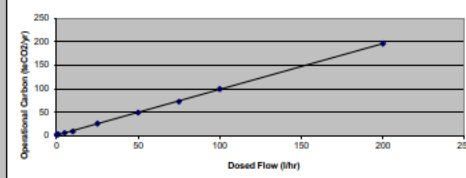
Design Manual Work Package	Dosed Flow (l/hr)	Default Annual Electricity (kWh)	Carbon Cost (kg CO2/yr)
Arsenic Removal	0	0	0
Fluoridation	0	0	0
pH Correction	0	0	0
Iron & Manganese Treatment	0	0	0
Disinfection	0	0	0
Stabilisation & Conditioning	0	0	0
Sludge Mixing	0	0	0

Chemical Dosing Embodied Carbon



	Included	Excluded
Embodied Carbon	Bundled dosing area: concrete construction	Emergency shower / eyewash, control panel.
	Bulk storage tank: plastic construction	Access
	Pumped pipework	Control hardware
	Delivery of tank and pipework to site	-

Operational Emissions



	Included	Excluded
Operational Carbon	Chemical delivery to site	Specific chemical manufacture
	Dose pump power	Carrier flow if applicable
	-	Emissions from any sludge generated

CARBON RELATIONSHIP

teCO2	Dosed Flow (l/hr)
193	0.2
193	1.0
193	5.0
193	10
193	25
193	50
193	75
193	100
387	200

STW Carbon Calculations for PR09

User Input to Existing Update to Carbon Calculations

Scaling factor relationship validity limits (l/hr)	0.2	200
Scaling Factor (slope)	1.93441	
Scaling Factor (intercept)	0	

CARBON RELATIONSHIP

teCO2/yr	Dosed Flow (l/hr)
3.3	0.2
3.3	1.0
6.6	5.0
19	10
27	25
50	50
73	75
100	100
196	200

STW Carbon Calculations for PR09

User Input to Existing Update to Carbon Calculations

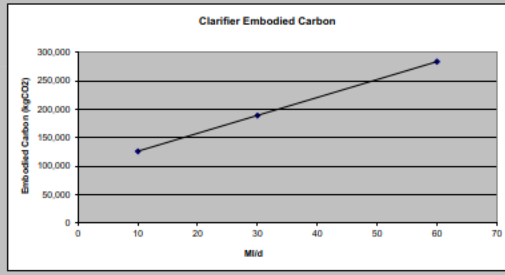
Scaling factor relationship validity limits (l/hr)	0.2	200
Scaling Factor (slope)	0.97	
Scaling Factor (intercept)	1.81	

Note UKWIR sustain tool not used for comparison as cannot be compared directly given inclusion of chemicals.

DAF CLARIFIER

Embodied Carbon Emissions

Design Manual Work Package		Mild	Design Life (yrs)	Carbon Cost (kg CO2)
Clarification		0	40	0



	Included	Excluded
Embodied Carbon	DAF units	
	Sludge separators, blowers, pumps, diffusers and pipes	
	MCC	

Operational Carbon Emissions

Design Manual Work Package		Annual Electricity Consumption (kWh)	Carbon Cost (kg CO2)
Clarification		0	0

	Included	Excluded
Operational Carbon	All-inclusive power to run the process: building services, pumps.	Fuel in travel for maintenance

Environmental and Landscape

Embodied Carbon Emissions

Design Manual Work Package	No. of sites	Design Life (yrs)	Carbon Cost (kg CO2)
Environmental and Landscape	1	15	1,663

Operational Carbon Emissions

Design Manual Work Package	Carbon Cost (kg CO2/yr)
No operational carbon associated with this item	

	Included	Excluded
Embodied Carbon	Allowance for 20 m3 of excavation	-

Equipment Guarding**Embodied Carbon Emissions**

Design Manual Work Package	No. of sites	Design Life (yrs)	Carbon Cost (kg CO2)
Guarding of Equipment	0	20	0

Operational Carbon Emissions

Design Manual Work Package	Carbon Cost (kg CO2/yr)
No operational carbon associated with this item	

	Included	Excluded
Embodied Carbon	Installation of new gate and fencing	-

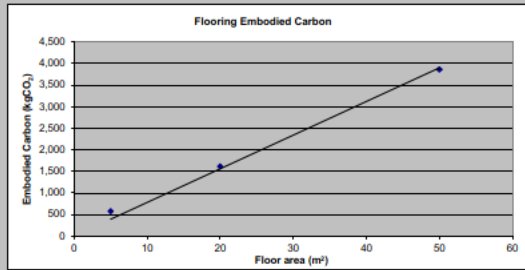
Flooring

Embodied Carbon Emissions

Design Manual Work Package	Floor Area (m ²)	Design Life (yrs)	Carbon Cost (kg CO ₂)
Flooring	1250	40	91,977

Operational Carbon Emissions

Design Manual Work Package	Carbon Cost (kg CO ₂ /yr)
No operational carbon associated with this item	



	Included	Excluded
Embodied Carbon	Concrete flooring	-

INLET WORKS

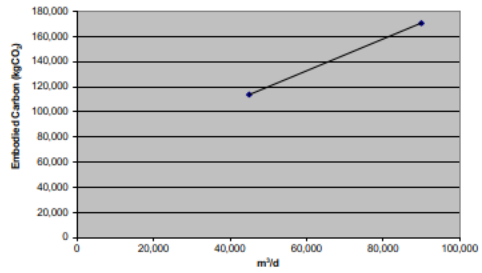
Embodied Carbon Emissions

Design Manual Work Package	m ³ /d	Design Life (yrs)	Carbon Cost (kg CO2)
Inlet Works	0	40	0

Operational Carbon Emissions

Design Manual Work Package	Annual Electricity Consumption (kWh)	Carbon Cost (kg CO2/yr)
Inlet Works	0	0

Inlet Works Embodied Carbon



	Included	Excluded
Embodied Carbon	Inlet channel, splay channel, bypass channel	
	CSO	
	MESH flooring and handrails	
	Inlet Screens	
	M&E	

	Included	Excluded
Operational Carbon	All-inclusive power to run the process: building services, pumps.	Fuel in travel for maintenance

LIFTING EQUIPMENT**Embodied Carbon Emissions**

Design Manual Work Package	No. of plants	Design Life (yrs)	Carbon Cost (kg CO2)
Lifting Equipment	0	20	0

	Included	Excluded
Embodied Carbon	Steel frame and winch	

Operational Carbon Emissions

Design Manual Work Package	Annual Electricity Consumption (kWh)	Carbon Cost (kg CO2/yr)
Lifting Equipment	0	0

	Included	Excluded
Operational Carbon	All-inclusive power to run the process: building services, pumps.	Fuel in travel for maintenance

MANHOLES**Embodied Carbon Emissions**

Design Manual Work Package	No. of Manholes	Design Life (yrs)	Carbon Cost (kg CO2)
Manholes	0	40	0

Operational Carbon Emissions

Design Manual Work Package	Carbon Cost (kg CO2/yr)
No operational carbon associated with this item	

	Included	Excluded
Embodied Carbon	One manhole	Trench/pipework associated with the manhole

Embodied Carbon Emissions

100

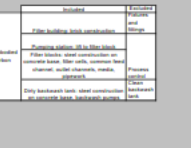
Estimated Carbon	Flow (MGD)
~400	~10
~450	~15
~500	~20
~550	~25
~600	~30
~650	~35
~700	~40
~750	~45
~800	~50
~850	~55
~900	~60
~950	~65
~1000	~70

Media Filters Estimated Carbon

Flow (MGD)

Estimated Carbon (lb)

$y = 10.1x + 290.5$



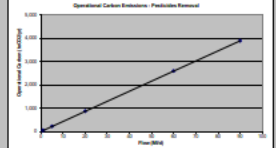
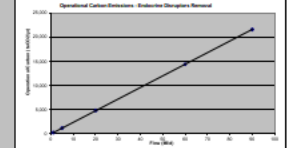
Scaling factor relationship validity limits (MHA)	γ
Quadratic coefficient	-0.0629
α coefficient	11.891
α intercept	721.49

Operational Carbon Emissions - Utilization

Time (Days)	Operational Carbon Emissions (tons of CO ₂ e)
0	0
5	4
10	8
15	12
20	16
25	20
30	24

Operational Carbon Emissions - Inductive Storage

Time (Days)	Operational Carbon Emissions (kWh)
0	0
5	4000
10	8000
15	12000
20	16000
25	20000
30	24000

[illegible][illegible][illegible]

Monitoring and Telemetry**Embodied Carbon Emissions**

Design Manual Work Package	No. of works	Design Life (yrs)	Carbon Cost (kg CO2)
Remote Asset Monitoring (Telemetry) Systems	1	20	1,751

	Included	Excluded
Embodied Carbon	MCC, Cabinet and cabling	

Operational Carbon Emissions

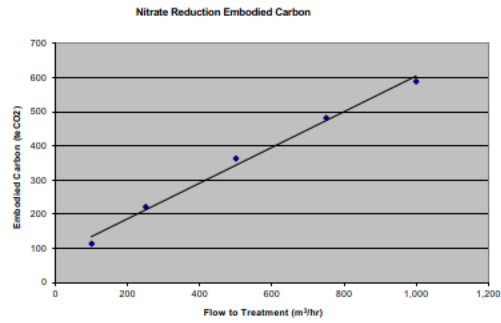
Design Manual Work Package	Annual Electricity Consumption (kWh)	Carbon Cost (kg CO2/yr)
Remote Asset Monitoring (Telemetry) Systems	525600	282,258

	Included	Excluded
Operational Carbon	All-inclusive power to run the process: building services, pumps.	Fuel in travel for maintenance

NITRATE REDUCTION (ION EXCHANGE)

Embodied Carbon Emissions

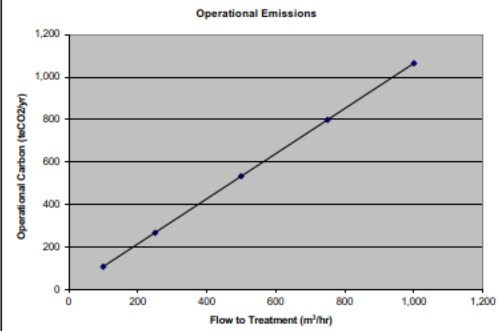
Design Manual Work Package	Flow to Treatment (m ³ /hr)	Design Life (yrs)	Design Life for calcs (yrs)	Carbon Cost (kg CO ₂)
Nitrate Treatment	0	15	15	0



	Included	Excluded
Embodied Carbon	Treatment building: concrete base slab, steel wall and roof construction, steel pipework, pumps, strainers.	Internal walls, fixtures and fittings.
	IX Vessels: concrete slab, steel pressure vessels.	Pipework other than main process.
	Salt / Waste bund: high-sided concrete bund containing duty / assist salt bulk storage and duty waste tanks.	Media manufacture.
	New length of water main to form bypass.	-

Operational Carbon Emissions

Design Manual Work Package	Flow to Treatment (m ³ /hr)	Default Annual Electricity (kWh)	Carbon Cost (kg CO ₂)
Nitrate Treatment	0	0	0



	Included	Excluded
Operational Carbon	All inclusive power to run the process: building services, booster pumps, regeneration, waste transfer.	Any emissions from salt residue
	Salt transport to bulk storage.	Salt manufacture

OUTFALL STRUCTURES

Embodied Carbon Emissions

Design Manual Work Package	No. of structures	Design Life (yrs)	Carbon Cost (kg CO2)
Outfall Structures	1	40	1,223

	Included	Excluded
Embodied Carbon	Head wall	Scour protection
	Flap valve	

Operational Carbon Emissions

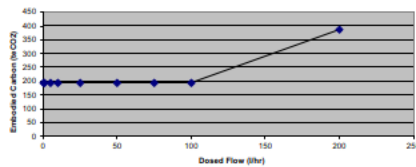
Design Manual Work Package	Carbon Cost (kg CO2/yr)
No operational carbon associated with this item	

PHOSPHOROUS REMOVAL

Embodied Carbon Emissions

Design Manual Work Package	Dosed Flow (l/hr)	Design Life (yrs)	Carbon Cost (kg CO2)
Chemical Phosphorous Removal	0	20	0

Phosphorous Removal Embodied Carbon



	Included	Excluded
Embodied Carbon	Bunded dosing area: concrete construction	Emergency shower / eyewash, control panel
	Bulk storage tank: plastic construction	Access
	Pumped pipework	Control hardware
	Delivery of tank and pipework to site	-

CARBON RELATIONSHIP

teCO2	Dosed Flow (l/hr)
193	0.2
193	1.0
193	5.0
193	10
193	25
193	50
193	75
193	100
387	200

STW Carbon Calculations for PHOS

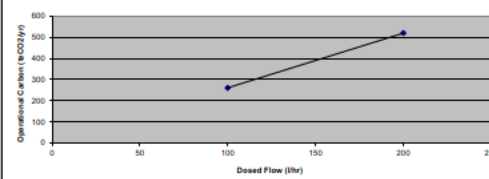
User Input following Update to Carbon Calculations

Scaling factor relationship validity limits (l/hr)	0.2	200
Scaling Factor (slope)	1.93441	
Scaling Factor (intercept)	0	

Operational Carbon Emissions

Design Manual Work Package	Dosed Flow (l/hr)	Default Annual Electricity (kWh)	Carbon Cost (kg CO2/yr)
Chemical Phosphorous Removal	0	0	0

Operational Emissions



	Included	Excluded
Operational Carbon	Electricity/Power use	-
	Chemical Delivery	-
	Sludge Disposal	-
	FeCl3 emissions	-

CARBON RELATIONSHIP

p.e	teCO2/yr	Dosed flow (l/hr)	teCO2/yr (excl elec)
50,000	261	100	191
100,000	521	200	380

UKWIR Sustain Tool

User Input following Update to Carbon Calculations

Scaling factor relationship validity limits (l/hr)	100.0	200
Scaling Factor (slope)	2.60	1.89
Scaling Factor (intercept)	1.00	2.00

ELECTRICITY RELATIONSHIP

Dosed flow (l/hr)	kWh/yr
100	134,569
200	269,138

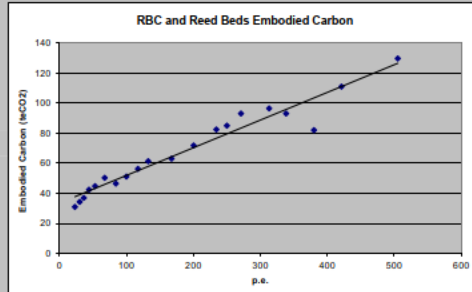
UKWIR assumptions from Sustain Tool

Scaling factor relationship validity limits (l/hr)	100	200
Scaling Factor (slope)	1345.69	
Scaling Factor (intercept)	0.00	

RBC & Reed Beds

Embodied Carbon Emissions

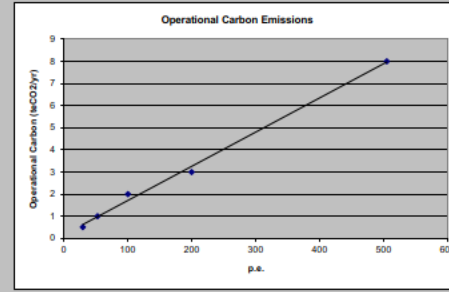
Design Manual Work Package	Capacity (p.e.)	Design Life (yrs)	Carbon Cost (kg CO ₂)
Small Sewage Treatment Works	0	20	0



	Included	Excluded
Embodied Carbon	RBC: concrete base, size-dependent GRP or concrete tank, GRP cover, steel shaft and media holders, polypropylene	Pumping to treatment. Gravity flow is assumed.
	Reed bed: sand base, bed lining, lining protection, gravel fill, outlet chamber and ductile iron decant arm, transport of materials	-
	Pipes: inlet, outlet and distribution	-

Operational Carbon Emissions

Design Manual Work Package	Capacity (p.e.)	Default Annual Electricity (kWh)	Carbon Cost (kg CO ₂)
Small Sewage Treatment Works	0	0	0



	Included	Excluded
Operational Carbon	RBC shaft motor	Process control and panel services
	-	Any emissions from reed bed process and sludge produced by RBC

Security and Fencing

Embodied Carbon Emissions

Design Manual Work Package	No. of works	Design Life (yrs)	Carbon Cost (kg CO2)
Security and Fencing	0	20	0

	Included	Excluded
Embodied Carbon	Security doors, padlocks, intruder detection system, and access control system	-
	Gate and Fencing	

Operational Carbon Emissions

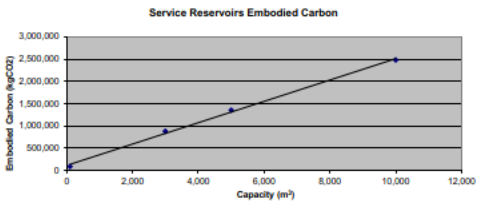
Design Manual Work Package	Annual Electricity Consumption (kWh)	Carbon Cost (kg CO2/yr)
Security and Fencing	0	0

	Included	Excluded
Operational Carbon	All-inclusive power to run the process: building services, pumps.	Fuel in travel for maintenance

Service Reservoirs

Embodied Carbon Emissions		Capacity	Design	Carbon Cost
Design Manual Work Package		(m ³)	Life (yrs)	(kg CO ₂)
Service Reservoirs & Water Retaining Structures		0	40	0

Operational Carbon Emissions		Carbon Cost
Design Manual Work Package		(kg CO ₂ /yr)
No operational emissions associated with this item		



Embodied Carbon	Included	Excluded
	Reinforced Concrete Tank	Pumps, MCC etc
	Granular Fill and valves	
	Transport of materials to site	-

PRIMARY SETTLEMENT TANKS

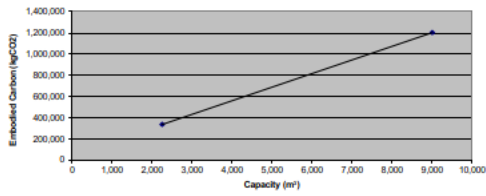
Embodied Carbon Emissions

Design Manual Work Package	Capacity (m ³)	Design Life (yrs)	Carbon Cost (kg CO2)
Primary Sedimentation	0	40	0

Operational Carbon Emissions

Design Manual Work Package	Annual Electricity Consumption (kWh)	Carbon Cost (kg CO2/yr)
Primary Sedimentation	0	0

Settlement Tanks Embodied Carbon



	Included	Excluded
Embodied Carbon	IBC Distribution Chamber	Connecting pipework etc
	PST	
	Desludging Chambers	
	Hopper	

	Included	Excluded
Operational Carbon	All-inclusive power to run the process: building services, output	Fuel in travel for maintenance

SEWERAGE PIPELINES

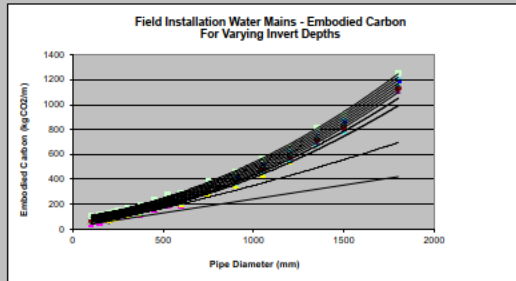
Embodied Carbon Emissions

Design Manual Work Package	Length (m)	Diameter (mm)	Depth (m)	Field/Hig hway												Design Life (yrs)	Design Life for calcs (yrs)	Carbon Cost (kg CO2)
Sewer Rehabilitation	0	0	0	0	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	100	40	
Sewage Pumping Stations	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	40	

Operational Carbon Emissions

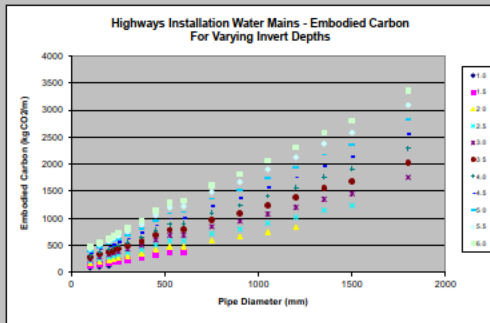
Design Manual Work Package	Carbon Cost (kg CO2)
No operational carbon associated with this item	
No operational carbon associated with this item	

Field Installation



	Included	Excluded
Embodied Carbon	Pipes: materials, transport to site, bed, surround and trench reinstatement	Materials other than VC or Ductile Iron
	Trench reinstatement	CSOs
	Manholes, covers and frames	Pumping stations

Highways Installation



Sewage Pumping Station

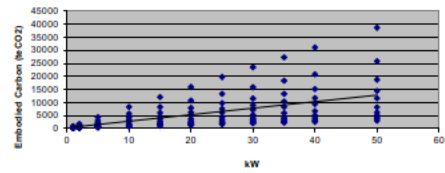
Embodied Carbon Emissions

Design Manual Work Package	Power kW	Design Life (yrs)	Design Life for calcs (yrs)	Carbon Cost (kg CO2)
Sewage Pumping Station	0	60	40	0

Operational Carbon Emissions

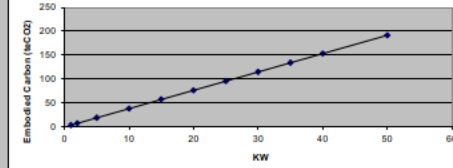
Design Manual Work Package	Power kW	Default Annual Electricity usage (kWh)	Carbon Cost (kg CO2)
Sewage Pumping Station	0	0	0

Sewerage PS Embodied Carbon



Embodied Carbon	Included	Excluded
	Concrete blinding, base and	Step irons
	Pre-cast concrete rings and roof slab	
	Pipework incoming and	Pump

Sewerage PS Embodied Carbon



Operational Carbon	Included	Excluded
	Pump power electricity	Maintenance and inspection

Site Investigation**Embodied Carbon Emissions**

Design Manual Work Package	No. of sites	Design Life (yrs)	Carbon Cost (kg CO2)
Site Investigation	0	20	0

Operational Carbon Emissions

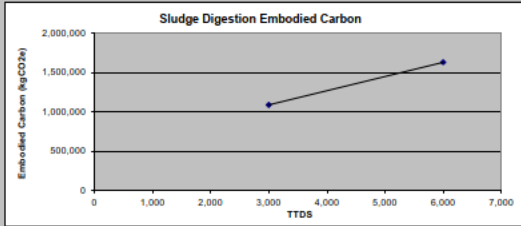
Design Manual Work Package	Carbon Cost (kg CO2/yr)
No operational carbon associated with this item	

Embodied Carbon	Included	Excluded
	Site Investigation boreholes Trial Pits	Sampling equipment

SLUDGE DIGESTION

Embodied Carbon Emissions

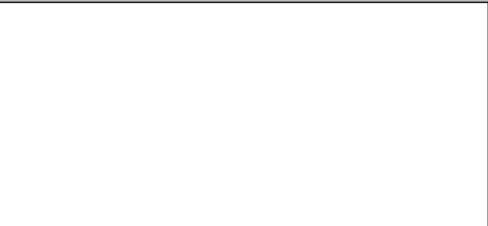
Design Manual Work Package	TTDS/yr	Design Life (yrs)	Carbon Cost (kg CO2)
Sludge Digestion (new plant)	0	20	0



	Included	Excluded
Embodied Carbon	Stainless steel sludge	
	Sludge press, pumps, valves and MCC's	
	Package digester plant (glass coated steel) and	

Operational Carbon Emissions

Design Manual Work Package	Annual Electricity Consumption (kWh)	TTDS/yr	Carbon Cost (kg CO2)
Sludge Digestion (new plant)	0	0	0

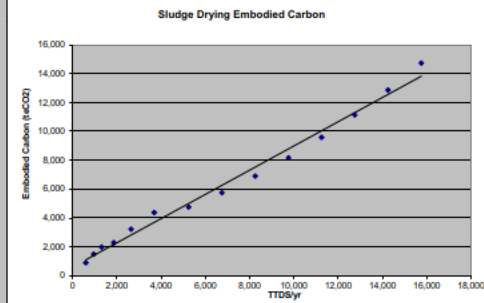


	Included	Excluded
Operational Carbon	All-inclusive power to run the process	Fuel in travel for maintenance
	Emissions from disposal of sludge	-

SLUDGE DRYING

Embodied Carbon Emissions

Design Manual Work Package	TTDS/yr	Design Life (yrs)	Design Life for calc's (yrs)	Carbon Cost (kg CO2)
Sludge Drying	0	60	40	0



	Included	Excluded
Embodied Carbon	Sludge treatment building; concrete base, steel structure; Sludge treatment dryer; mild steel machinery and plastic paneling.	Fixtures and fittings; Process control

TTDS/yr	teCO2
600	894
960	1,495
1,320	1,974
1,860	2,285
2,640	3,224
3,690	4,372
5,250	4,749
6,750	5,738
8,250	6,895
9,750	8,166
11,250	9,579
12,750	11,139
14,250	12,858
15,750	14,734

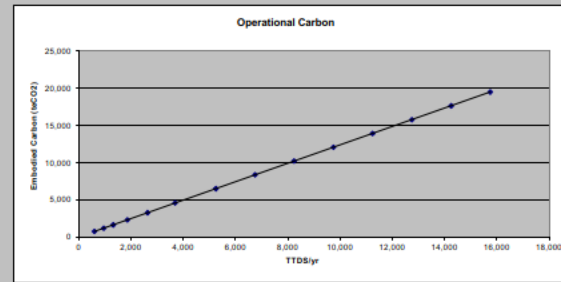
STW Carbon Calculations for P809

User Input following Update to Carbon Calculations

Scaling factor relationship validity limits (TTDS/yr)	0	0
Scaling Factor (slope)	0.94	
Scaling Factor (intercept)	595.48	

Operational Carbon Emissions

Design Manual Work Package	TTDS/yr	Annual Natural Gas Consumption (kWh)	Carbon Cost (kg CO2/yr)
Sludge Drying	0	0	0



	Included	Excluded
Operational Carbon	Power from gas; Power from electricity; Transport of sludge to agriculture; Delivery of polymer	Short-cycle CO2 emissions and other direct emissions of GHGs from drying; Building services; Any emissions from decomposition of sludge products; Polymer manufacture

TTDS/yr	teCO2/yr
600	744
960	1,191
1,320	1,637
1,860	2,308
2,640	3,274
3,690	4,577
5,250	6,511
6,750	8,371
8,250	10,921
9,750	12,092
11,250	13,952
12,750	15,812
14,250	17,672
15,750	19,532

STW Carbon Calculations for P809

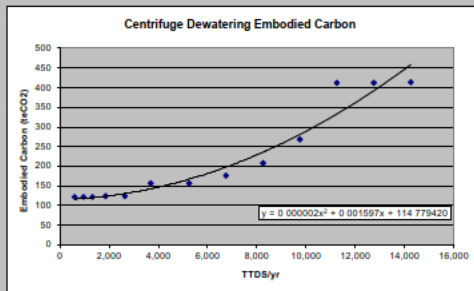
User Input following Update to Carbon Calculations

Scaling factor relationship validity limits (M/d)	600	15750
Scaling Factor (slope)	1.24	
Scaling Factor (intercept)	0.53	

Embedded Carbon Emissions

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Design Manual Work Package	TTDS/yr	Design Life (yrs)	Design Life for Calcs (yrs)	Carbon Loss (kg CO2)
Sludge Thickening - Centrifuge dewatering	0	60	40	



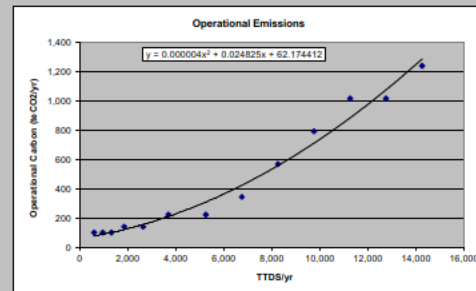
	Included	Excluded
Embodied Carbon	Sludge treatment building: steel construction on concrete slab	Fixtures and fittings
	Centrifuge machines: steel construction	Odour control. Process control Conveyors.

[illegible]

Scaling factor relationship validity limits (TTDS/yr)	600	14250
Quadratic coefficient	0.000002	
x coefficient	0.001597	
y intercept	114.77942	

To update the carbon equation after user input, select cell D63 and click button

Design Manual Work Package	TTDS/yr	Electricity (kWh)	Carbon Cost (kg CO2)
Sludge Thickening - Centrifuge dewatering	0	0	



	Included	Excluded
Operational Carbon	Electrical power to run centrifuge	Building services process control, labour
	-	Any emissions from decomposition of sludge products

CARBON RELATIONSHIP		
TDS/yr	teCO₂/yr	
600	102	STW Carbon Calculations for P709
860	102	
1,320	102	
1,860	142	
2,640	142	
3,690	224	
5,250	224	
6,750	346	
8,250	570	
9,750	784	User input following Update to Carbon Calculations
11,250	1,017	
12,750	1,017	
14,250	1,241	

Scaling factor relationship validity limits (TDS/yr)	600	14250
Quadratic coefficient	0.000004	
x coefficient	0.024825	
y intercept	62.174412	

To update the carbon equation after user input, select cell Q60 and click button

SLUDGE THICKENING - SLUDGE PRESS

Embodied Carbon Emissions

Design Manual Work Package	No. of works	Design Life (yrs)	Carbon Cost (kg CO2)
Sludge Thickening - Sludge Press	0	20	0

Operational Carbon Emissions

Design Manual Work Package	Annual Electricity Consumption (kWh)	Carbon Cost (kg CO2)
Sludge Thickening - Sludge Press	0	0

	Included	Excluded
Embodied Carbon	Sludge press	Pumps and valves
	Associated MCC	-

	Included	Excluded
Operational Carbon	All-inclusive power to run the process: building services, pumps.	Fuel in travel for maintenance

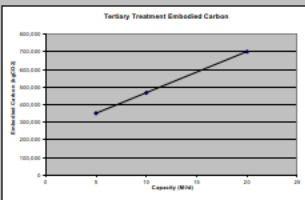
From Atkins Carbon Calculator Tool:

Sludge Press										
Item: Equipment/ Plant/ Vehicle		unit	waste allowance	Comments	Component grade	Temp works			Design Life (yrs)	Carbon Cost (kg CO2)
Materials:										
Rotomat SP4 Strainpress RC slab 20 m2 x 300 deep.	6	m3	6.36	Reinforced concrete	0	0.01			60	3,427
Duty and Standby or Duty and Assist: Rotomat SP4 Strainpress has capacity of 60 m3/h at 6% DS each.	1000	kg	1000	Stainless steel	0.65				20	10,148
Steel for RC MCC	48	kg	51,072	Steel					20	969
	500	kg	500						29	
Construction:										
Construction Duration	10.0	days								
No of site staff	4	no.								
Typical excavator hours during installation	80.0	hours	80.0							1,705
Typical dumper truck hours during installation	80.0	hours	80.0							2,588
On-site power use and welfare facilities	200	kWh	200.00							537
Design and Site Management:										
Survey, design and contract docs	5	days	5.00							35
Site supervision	2.50	days	2.50	full-time supervision						17
Component to be transported	Notes	Quantity	Unit	Transportation distance	unit	Journey	Max load	unit	no of loads	kg CO2
Materials										
Steel, MCC	Articulated Lorry (>33t)	551	kg	100	km	out	20000	kg	1	111
					back					67
Concrete	Rigid Lorry (>17t)	6	m3	100	km	out	8.3	m3	1	112
					back					78
Strainpress	Articulated Lorry (>33t)	80	kg	800	km	out	20000	kg	1	889
					back					534
										1,422
Labour										
Labour	Assume 2 workers per vehicle per day	20.0	vehicles	50	km	out			20.0	214
					back					214
										428
Waste Removal										
Excavated material	Rigid Lorry (>17t)	0.36	m3	50	km	out	8.3	m3	1	39
					back					56
										95
Embodied Carbon Cost (kg CO2)										7,195

Assumptions:
1x 60m3/h press

TERTIARY TREATMENT

Embedded Carbon Emissions			
Design Material Work Package	Capacity	Design Life	Carbon Cost
Tertiary Treatment	0	40	kg CO2e



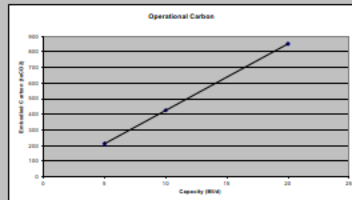
	Included	Excluded
Embedded Carbon	Sand Filter, Pump station, tanks, media, electrical, installation, storage, equipment and transport	-

Carbon Delay Factor			
Capacity (Mld)	kg CO2e	kg CO2e	kg CO2e
0	0	0	0
10	350,000	350,000	350,000
20	700,000	700,000	700,000
30	1,050,000	1,050,000	1,050,000
40	1,400,000	1,400,000	1,400,000
50	1,750,000	1,750,000	1,750,000
60	2,100,000	2,100,000	2,100,000
70	2,450,000	2,450,000	2,450,000
80	2,800,000	2,800,000	2,800,000
90	3,150,000	3,150,000	3,150,000
100	3,500,000	3,500,000	3,500,000
110	3,850,000	3,850,000	3,850,000
120	4,200,000	4,200,000	4,200,000
130	4,550,000	4,550,000	4,550,000
140	4,900,000	4,900,000	4,900,000
150	5,250,000	5,250,000	5,250,000
160	5,600,000	5,600,000	5,600,000
170	5,950,000	5,950,000	5,950,000
180	6,300,000	6,300,000	6,300,000
190	6,650,000	6,650,000	6,650,000
200	7,000,000	7,000,000	7,000,000
210	7,350,000	7,350,000	7,350,000
220	7,700,000	7,700,000	7,700,000
230	8,050,000	8,050,000	8,050,000
240	8,400,000	8,400,000	8,400,000
250	8,750,000	8,750,000	8,750,000
260	9,100,000	9,100,000	9,100,000
270	9,450,000	9,450,000	9,450,000
280	9,800,000	9,800,000	9,800,000
290	10,150,000	10,150,000	10,150,000
300	10,500,000	10,500,000	10,500,000
310	10,850,000	10,850,000	10,850,000
320	11,200,000	11,200,000	11,200,000
330	11,550,000	11,550,000	11,550,000
340	11,900,000	11,900,000	11,900,000
350	12,250,000	12,250,000	12,250,000
360	12,600,000	12,600,000	12,600,000
370	12,950,000	12,950,000	12,950,000
380	13,300,000	13,300,000	13,300,000
390	13,650,000	13,650,000	13,650,000
400	14,000,000	14,000,000	14,000,000
410	14,350,000	14,350,000	14,350,000
420	14,700,000	14,700,000	14,700,000
430	15,050,000	15,050,000	15,050,000
440	15,400,000	15,400,000	15,400,000
450	15,750,000	15,750,000	15,750,000
460	16,100,000	16,100,000	16,100,000
470	16,450,000	16,450,000	16,450,000
480	16,800,000	16,800,000	16,800,000
490	17,150,000	17,150,000	17,150,000
500	17,500,000	17,500,000	17,500,000
510	17,850,000	17,850,000	17,850,000
520	18,200,000	18,200,000	18,200,000
530	18,550,000	18,550,000	18,550,000
540	18,900,000	18,900,000	18,900,000
550	19,250,000	19,250,000	19,250,000
560	19,600,000	19,600,000	19,600,000
570	19,950,000	19,950,000	19,950,000
580	20,300,000	20,300,000	20,300,000
590	20,650,000	20,650,000	20,650,000
600	21,000,000	21,000,000	21,000,000
610	21,350,000	21,350,000	21,350,000
620	21,700,000	21,700,000	21,700,000
630	22,050,000	22,050,000	22,050,000
640	22,400,000	22,400,000	22,400,000
650	22,750,000	22,750,000	22,750,000
660	23,100,000	23,100,000	23,100,000
670	23,450,000	23,450,000	23,450,000
680	23,800,000	23,800,000	23,800,000
690	24,150,000	24,150,000	24,150,000
700	24,500,000	24,500,000	24,500,000
710	24,850,000	24,850,000	24,850,000
720	25,200,000	25,200,000	25,200,000
730	25,550,000	25,550,000	25,550,000
740	25,900,000	25,900,000	25,900,000
750	26,250,000	26,250,000	26,250,000
760	26,600,000	26,600,000	26,600,000
770	26,950,000	26,950,000	26,950,000
780	27,300,000	27,300,000	27,300,000
790	27,650,000	27,650,000	27,650,000
800	28,000,000	28,000,000	28,000,000
810	28,350,000	28,350,000	28,350,000
820	28,700,000	28,700,000	28,700,000
830	29,050,000	29,050,000	29,050,000
840	29,400,000	29,400,000	29,400,000
850	29,750,000	29,750,000	29,750,000
860	30,100,000	30,100,000	30,100,000
870	30,450,000	30,450,000	30,450,000
880	30,800,000	30,800,000	30,800,000
890	31,150,000	31,150,000	31,150,000
900	31,500,000	31,500,000	31,500,000
910	31,850,000	31,850,000	31,850,000
920	32,200,000	32,200,000	32,200,000
930	32,550,000	32,550,000	32,550,000
940	32,900,000	32,900,000	32,900,000
950	33,250,000	33,250,000	33,250,000
960	33,600,000	33,600,000	33,600,000
970	33,950,000	33,950,000	33,950,000
980	34,300,000	34,300,000	34,300,000
990	34,650,000	34,650,000	34,650,000
1000	35,000,000	35,000,000	35,000,000

From Above Carbon Calculator Tool										
Item	Equipment	Plant	Vehicle	Unit	Waste	Comments	Compensate	Temp works	Carbon Cost (£/CO2e)	
Materials										
Fixed Pump Station	25.2	m3	26.71	Underground concrete structure - diameter 3m x 2m x 2m - Steel	0	0.01	80	14,362		
Submersible pumps and valves	3000	kg	3000.00	Submersible pump	0.5	0.01	20	27,952		
8 co Deep bed sand filters (6m x 4.6m x 5m depth)	426.568	m3	455.34	DC Tank type design and steel structure for suspended solids and sand removal	0	0.01	60	246,339		
Media material	426.568	m3	473.81	Sand	0	0	10	3,016		
Backwash water Station	25.2	m3	26.71	reinforced concrete	0	0.01	80	14,362		
Submersible pumps and valves	3000	kg	3000.00	One day pump standby 24 hours	0.5	0	20	27,675		
Backwash tank	88.48	m3	93.79	Allowance for 1 hour backwash volume (20% tanks, 12m x 10m x 4m)	0	0.01	80	50,533		
MCC	500	kg	500.00	Steel	0.5	0	20	1,454		
Material storage tank	800	kg	800.00	Riv steelwork steel	0.5	0	20	4,411		
Reinforce steel	45475.84	kg	45386.26	17t steel	0	0	80	3,254		
Construction										
Construction Duration	87.5	days								
No of site staff	8	no								
Typical excavator hours during construction	540.0	hours	540.0						11,512	
Typical dump truck hours during construction	1080.0	hours	1080.0						34,506	
On-site power use and waste	2700	kWh	2700.00						7,250	
Design and Site Management										
Survey, design and construct work	10	days	10.00						65	
Site supervision	16.88	days	16.88	on-site supervision					117	
Construction to be transported										
Material	Quantity	Unit	Transportation	Unit	Journey	Max load	Unit	No of loads	kg CO2e	
Concrete										
Rigid Lorry (x17)	803	m3	100	km	out	8.3	m3	73	8,189	
Back									5,679	
Back									13,868	
Bricks										
Rigid Lorry (x17)	8	m3	100	km	out	8.3	m3	2	224	
Back									158	
Back									379	
S Steel pumps										
Articulated Lorry	8000	kg	100	km	out	20000	kg	1	111	
Back									67	
Back									178	
Steel										
Articulated Lorry	48886	kg	100	km	out	20000	kg	3	333	
Back									230	
Back									633	
Sand for filters										
Rigid Lorry (x17)	474	m3	100	km	out	8.3	m3	58	6,490	
Back									4,512	
Back									11,003	
Labour										
Labour	Assume 2 vehicles per vehicle and day	270.0	vehicles	50	km	out		270.0	2,688	
Back									2,688	
Back									5,376	
Waste Removal										
Concrete/brick/sand waste removal	Rigid Lorry (x17)	78.94	m3	50	km	out	8.3	m3	10	369
Back									560	
Back									929	
Steel waste removal										
Articulated Lorry	2070.45	kg	50	km	out	20000	kg	1	56	
Back									35	
Back									90	

Assumption:
Assumed Sand Filter with Mechanical Cleaning

Operational Carbon Emissions			
Design Material Work Package	Capacity (Mld)	Default Annual Electricity (kWh)	Carbon Cost
Tertiary Treatment	0	0	kg CO2e



	Included	Excluded
Operational Carbon	Electricity power to run the process building equipment, pumps	Heat used in tank for maintenance

CARBON DELAY FACTOR			
Size	Capacity 200L	kgCO2eq	kgCO2eq based on 100L
25,000	1	233	381
50,000	10	436	381
100,000	20	852	723
	</		

TUNNELLING & LOW DIG TECHNIQUES

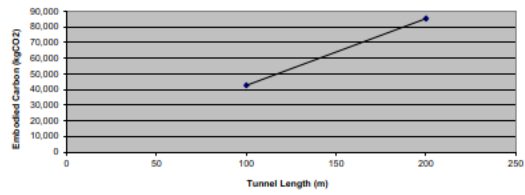
Embodied Carbon Emissions

Design Manual Work Package	Tunnel length (m)	Design Life (yrs)	Carbon Cost (kg CO2)
Tunnelling and low dig techniques	0	40	0

Operational Carbon Emissions

Design Manual Work Package	Carbon Cost (kg CO2/yr)
No operational carbon associated with this item	

Tunnelling Embodied Carbon



	Included	Excluded
Embodied Carbon	Tunnel excavation and associated manholes	-
	Concrete lining of tunnels	-

WATER MAINS

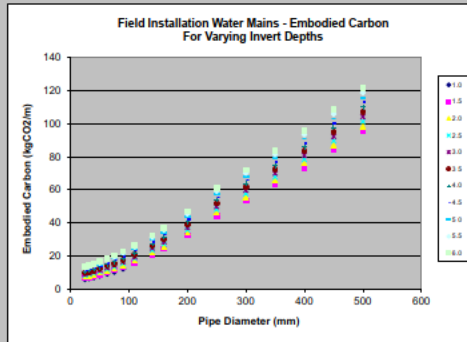
Embodied Carbon Emissions

Design Manual Work Package	Length (m)	Diameter (mm)	Depth (m)	Field/HI gwhwy												Design Life (yrs)	Design Life for calcs (yrs)	Carbon Cost (kg CO ₂)
Distribution Mains & Service Pipes	0	0	0	0	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	100	40	0
Trunk Mains	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	100	40	0

Operational Carbon Emissions

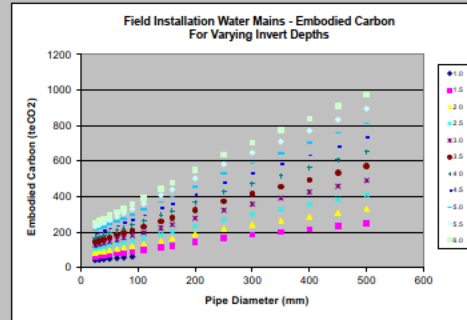
Design Manual Work Package	Carbon Cost (kg CO ₂)
No operational carbon associated with this item	

Field Installation



	Included	Excluded
Embodied Carbon	Pipes, materials, transport to site, bed, surround and trench reinstatement	Materials other than PE80 or ductile iron
	Trench reinstatement	-
	-	Pumping stations
	-	-

Highways Installation

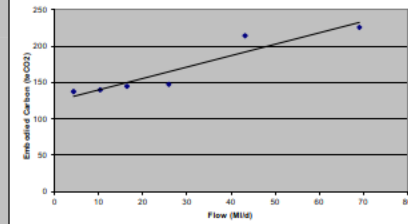


Water Mains Pumping Station

Embodied Carbon Emissions

Design Manual Work Package	Flow (Mld)	Design Life (yrs)	Design Life for calc (yrs)	Carbon Cost (kg CO2)
Pumping Stations	0	60	40	0

Water Mains PS Embodied Carbon



	Included	Excluded
Embodied Carbon	Building, brick construction on concrete base, sheet steel roof Pump, material for 2 duty and 1 standby units Pipework, inlet and outlet manifolds, individual pump sections	Fixtures and fittings Cabling and process control -

CARBON RELATIONSHIP

Flow (Mld)	kgCO2
4.9	137
10.4	140
16.4	145
23.9	147
43.2	214
69.1	226

STW Carbon Calculations for PR09

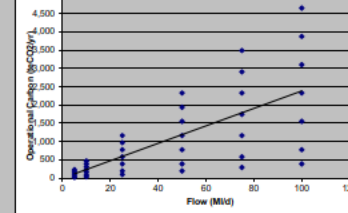
User Input (Drawing Update to Carbon Calculations)

Scaling factor relationship validity limits (Mld)	4	69
Scaling Factor (slope)	1.57	
Scaling Factor (intercept)	123.78	

Operational Carbon Emissions

Design Manual Work Package	Flow (Mld)	Annual Electricity usage (KWh)	Carbon Cost (kg CO2)
Pumping Stations	0	248,256	0

Operational Emissions



	Included	Excluded
Operational Carbon	Pump power electricity	Building services, process control, maintenance and inspection

CARBON RELATIONSHIP

Flow (Mld)	kgCO2/yr
5	39
10	78
15	117
20	156
25	195
30	234
35	273
40	312
45	351
50	390
55	429
60	468
65	507
70	546
75	585
80	624
85	663
90	702
95	741
100	780
105	819
110	858
115	897
120	936

STW Carbon Calculations for PR09

User Input (Drawing Update to Carbon Calculations)

Scaling factor relationship validity limits (Mld)	5	100
Scaling Factor (slope)	23.83	
Scaling Factor (intercept)	0.00	

