

A Cost Comparison of Traditional Drainage and SUDS in Scotland

11 Diff Pol, Belo Horizonte, Brasil, 2007

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Content of Presentation

- The DEX site
- Rationale for undertaking the cost comparison
- Construction Costs
- Maintenance Activities and Costs
- Whole Life Costs
- Results
- Conclusions

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The DEX Site

- DEX is an international showcase development site for Sustainable Drainage Systems (SUDS)
- DEX commenced construction in 1996. By 2012 the development will comprise
 - around 3,500 residential units
 - a retail centre
 - schools and community facilities
 - an 18 hectare leisure park
 - 59 hectares of parkland
 - 30 hectares of industrial/commercial land

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Why undertake comparison cost analysis?

- Practitioners (developers / unitary & water authorities) believe SUDS to be an additional financial burden to existing budgets
- No reliable actual cost data available for the implementation, operation & maintenance of SUDS
- There is no such study to our knowledge

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Water Quality & SUDS

- SUDS (particularly ponds) provide treatment of runoff
- + attenuation
- (+ amenity & biodiversity benefits)



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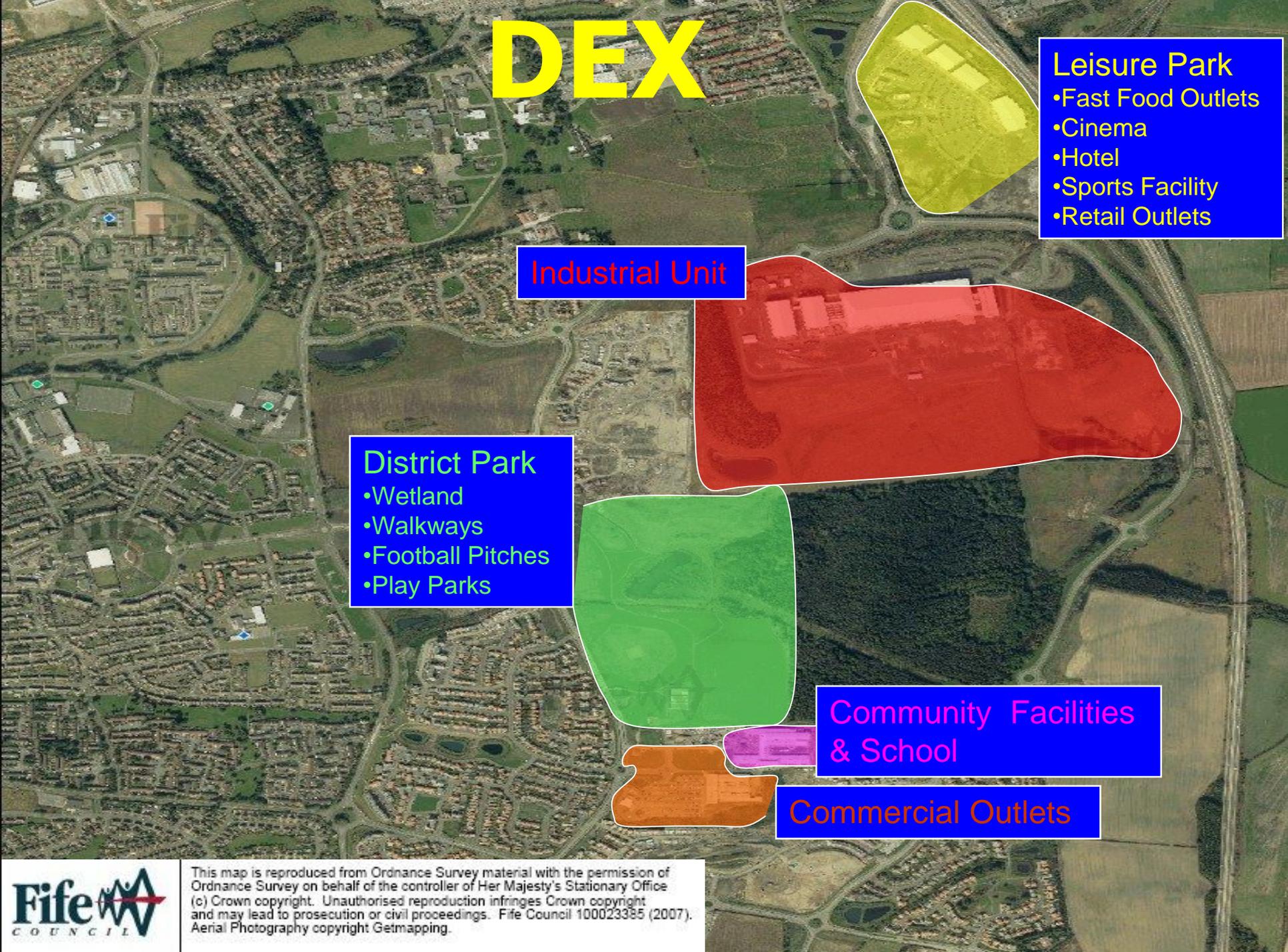
Water Quality & Traditional Drainage

- Traditional Drainage such as underground chambers as used in this study provide attenuation only
- No water quality improvement, or amenity or biodiversity benefits...



Land above storage chamber

DEX

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- The map shows a development site with several colored overlays and callout boxes. A yellow area in the top right is labeled 'Leisure Park'. A large red area in the center is labeled 'Industrial Unit'. A green area in the center-left is labeled 'District Park'. A purple area in the bottom center is labeled 'Community Facilities & School'. An orange area in the bottom center is labeled 'Commercial Outlets'. The background is an aerial photograph of a residential and industrial area.
- Fast Food Outlets
 - Cinema
 - Hotel
 - Sports Facility
 - Retail Outlets

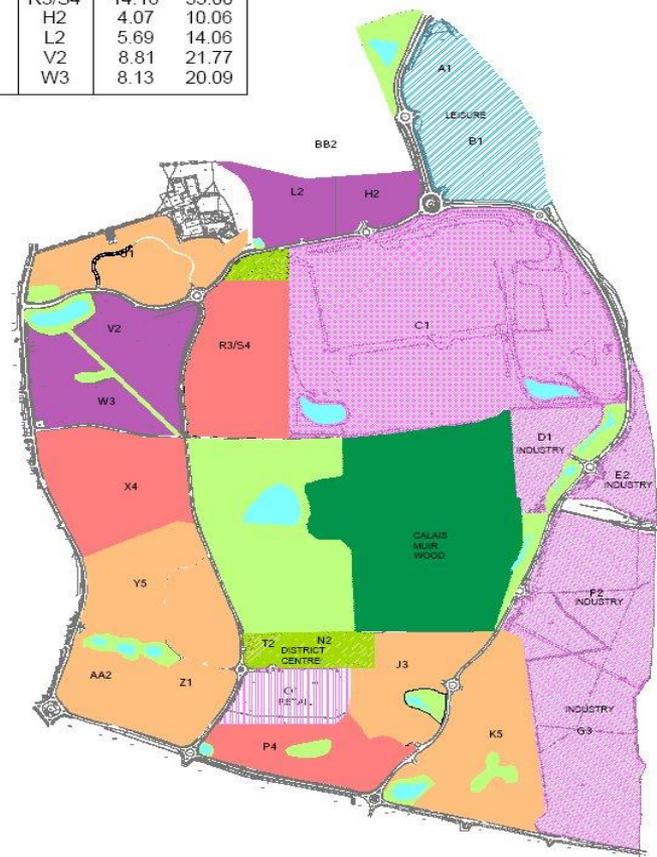
Industrial Unit

- District Park
- Wetland
 - Walkways
 - Football Pitches
 - Play Parks

Community Facilities
& School

Commercial Outlets

Proposed Area for Re-phasing			
Year	Plot	Area	
		Ha	Acres
2005 - 2006	P4	3.68	9.10
	2006 - on	P4	6.59
	X4	14.82	36.64
	R3/S4	14.16	35.00
	H2	4.07	10.06
	L2	5.69	14.06
	V2	8.81	21.77
	W3	8.13	20.09



Residential Development Phasing Schedule

- Existing Developed Areas
- Current Development Proposals Commencing 2005
- Remaining Land for Residential Development

 A1	Clach Park, Duffryn, Taylor Woodrow Developments Ltd Residential Development Summary Plan	IronsideFarrar Environmental Consultants 5970142
	<small> Date: 12/01/05 Scale: 1:1000 Author: J.F. Checked: J.F. Approved: J.F. </small>	<small> Date: 12/01/05 Scale: 1:1000 Author: J.F. Checked: J.F. Approved: J.F. </small>

Detention Basins

Halbeath Pond

DEX

Regional Structures in the study



Linburn Pond



The Wetland



The Cascades

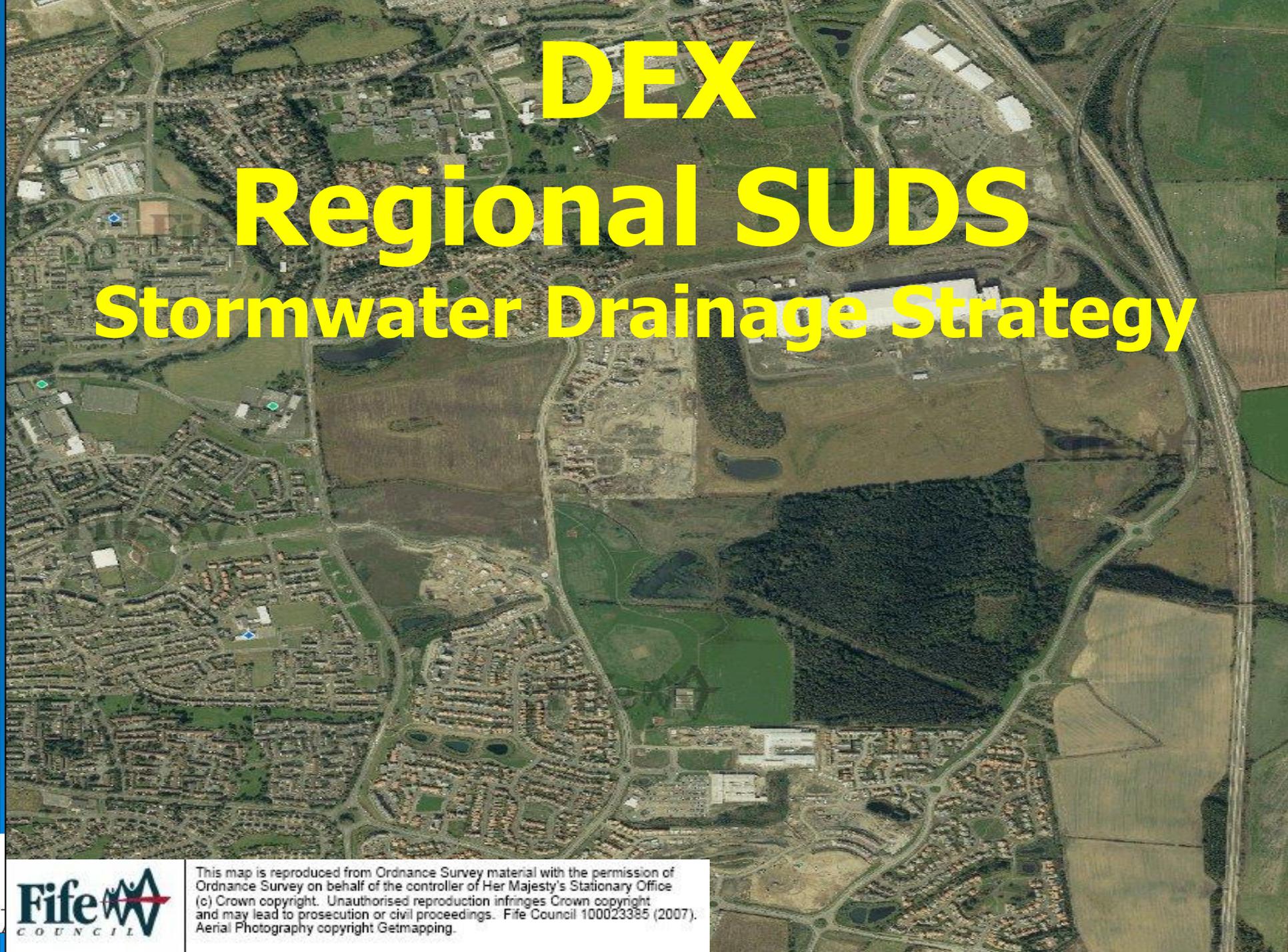
Swales



Pond 7



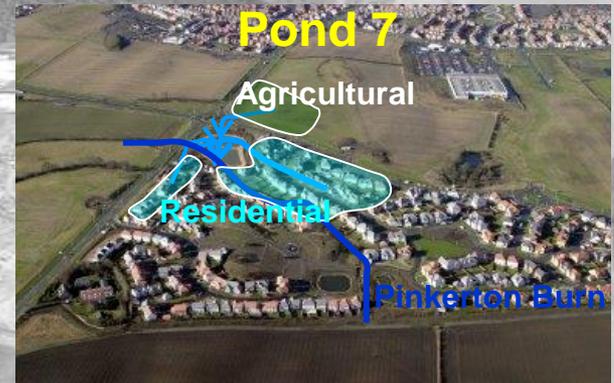
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DEX

Regional SUDS

Stormwater Drainage Strategy

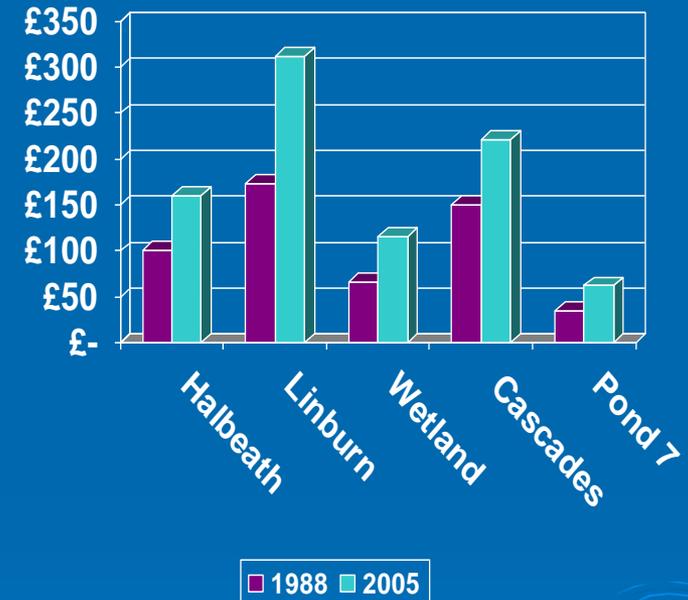




Pond under construction on the DEX site today
This pond shows the stage where a liner is being installed
One of the DEX ponds has a liner (Halbeath)
Even with a liner, the ponds were cheaper to construct than traditional drainage!

Determining Construction Costs

- Ponds constructed in 1998, but the cost comparison undertaken in 2005
- Linear projection of costs was not representative for changes in inflation in UK construction industry



Construction Costs of Ponds

1998

2005



	1998	2005	Difference
Linburn Pond	£174.000	£312.000	44% more
Halbeath Pond	£101.000	£160.000	37% more
Wetland	£66.000	£115.000	43% more
Cascade	£150.000	£221.000	32% more
Pond 7	£35.000	£62.000	44% more

Example

- Rock excavation at Cascade was £70.466 in 1998. By 2005 these costs had almost doubled to £130.000. This was mainly due to the introduction of landfill & aggregate taxes & disposal of unsuitable material

Other Examples

- Increase in fuel taxes above inflation
- New health & safety regs
- Labour, plant & material costs

Maintenance Activities & Costs

- UAD has catalogued maintenance activities and subsequent cost data received from the maintenance contractor and consultants since 1999 (Irregular maintenance activities are still being added to this list i.e. access clearance, various structural remediation works..)
- Data used from 1999 to 2005 (data collection continuing)
- Regular visual inspections undertaken to check that routine, irregular & remediation maintenance activities were carried out to the required standards

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Routine – Seasonal Activity



Weed Killer Application

Routine – Monthly Activity



Litter Picking

Irregular



Clearing vegetation for access to pond inlet



Inspection

Maintenance Activities & Costs

A photograph of a residential area. In the foreground, a grassy path is flanked by dense, red-tinted bushes and trees. In the background, there are several houses with grey roofs and bare trees, suggesting a winter or late autumn setting. The sky is overcast.

- DEX benefits from a well structured & intensive maintenance regime when compared to other regimes in existence
- Visual Aesthetics, amenity & biodiversity potential are all high on the agenda

Results – Construction Costs

Wide variation in results due to catchment sizes & site specific construction details

In all cases there is a significant difference between traditional drainage & SUDS capital costs (~ 70% less on average)

Pond Name	Catchment Area	Storage Volume	Capital Cost	
		100 Yr	Storage Chamber	SUDS
Halbeath Pond	13.5 Ha	2.145 m ³	£281.875	£159.950
Linburn Pond	67.5 Ha	10.723 m ³	£1.350.676	£312.470
Wetland	58.1 Ha	9.230 m ³	£1.164.653	£115.037
Pond 7	16.5 Ha	2.621 m ³	£341.186	£106.524
Cascades	16.8 Ha	2.661 m ³	£346.170	£251.174
Total	172 Ha	27.380 m³	£3.484.560	£945.155
Average	34 Ha	Aliso 5.480 m ³ WTC, UAD	£696.900	£189.000

Results – Maintenance Activities

Pond Maintenance Activities

Activity	Frequency
Inspection	Monthly (from year 3)
Litter Picking	Monthly
Grass Cutting	3 per year
Weeding	1 per year
Prune / Trim	1 every 3 years
Algae Removal	Seasonal in first 3-5 years
Silt Removal	Regularly during construction. Intermittently once construction complete. Frequency depends on catchment conditions (soil type etc)
Aquatic Plant Aftercare	Seasonal in first 2 years
Fence/ Sign Maintenance	Seasonal – winter danger signs. Reactionary – usually related to vandalism
In/ Outlet Maintenance	Reactionary – clearing blockages
Filter Drain Maintenance	Reactionary – if structure becomes overwhelmed from overland runoff

Storage Chamber Maintenance Activities

Item Description	Frequency
Routine	
Grass cutting (rate allows for 8 cuts per year)	8 per year
Litter removal (rate allows for 8 visits per year)	8 per year
Engineers inspection of structures	2 per year
Desilt inlet / outlet structures	1 per year
Controlled disposal / haulage of silt	1 per year
Irregular	
Blockages	Every 10 years
Jetting	Every 10 years
Repair Broken Components	Every 10 years

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Results – Maintenance Costs

- Comparison is based on a 5 yr period using recorded data for the SUDS & estimated maintenance costs for traditional drainage
- Note: Halbeath Pond has greater costs. This pond has extensive amenity & barrier vegetation planted which is an additional cost burden to the owner
- On average – maintenance cost is less (~50%) for SUDS than the traditional drainage solution

Pond Name	Catchment Area	Maintenance Cost (Average Annual)		% Difference SUDS - Storage
		Storage Chamber (100 yr)	SUDS	
Halbeath Pond	13.5 Ha	£3.584	£4.981	-28
Linburn Pond	67.5 Ha	£6.801	£3.383	50
Wetland	58.1 Ha	£6.241	£2.321	37
Pond 7	16.5 Ha	£3.763	£2.700	72
Cascades	16.8 Ha	£3.778	£2.000	53
Total	172 Ha	£24.167	£15.385	
Average	34 Ha	£4.045	£2.564	48

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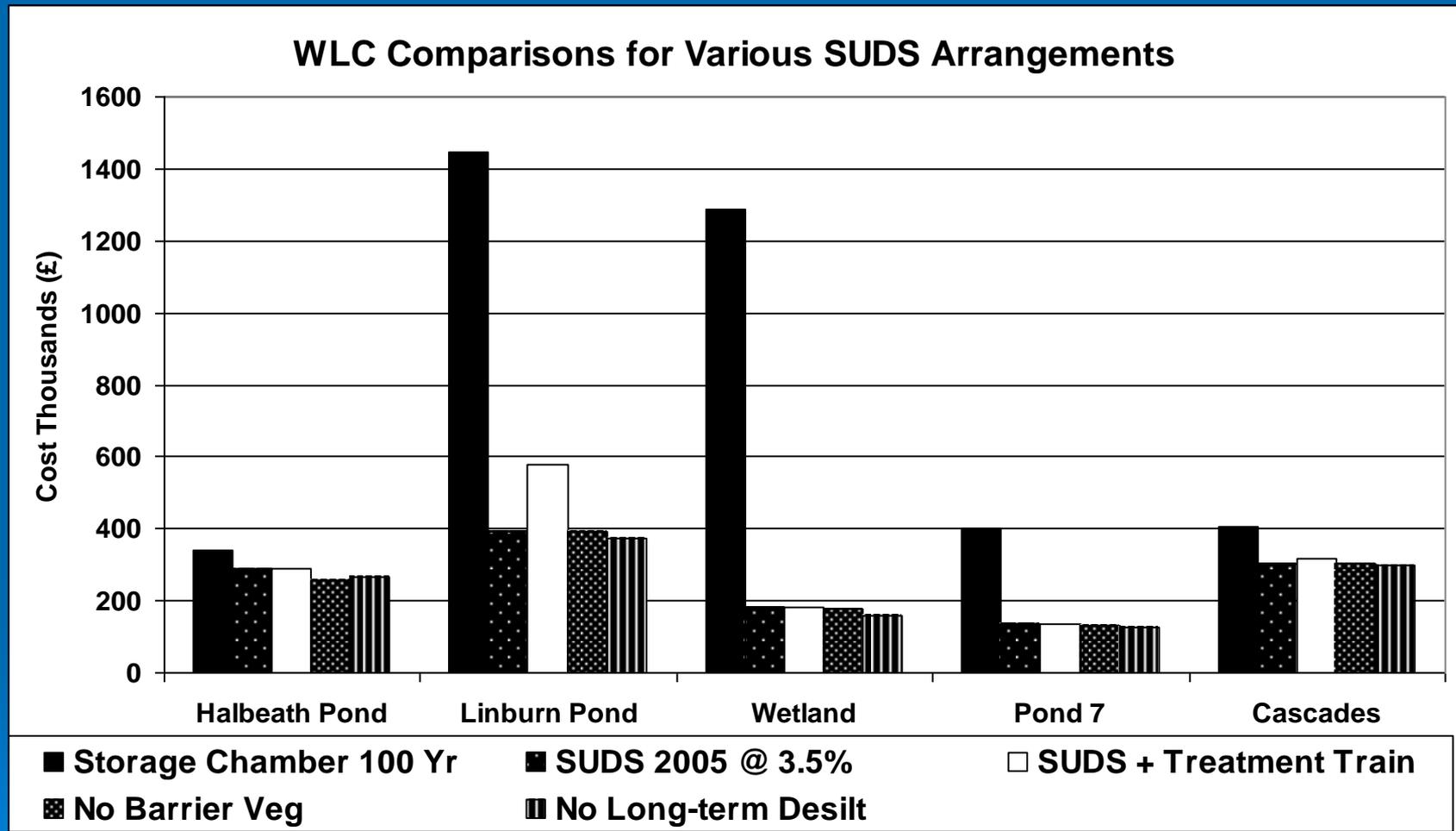
Results – Whole Life Costs

- Land take costs are excluded due to variable increase over time & the assumption that SUDS will be implemented in public open space
- Results show that ponds are significantly more cost effective when compared with traditional drainage storage chambers

Pond Name	Catchment Area	Storage Volume	WLC 3.5%		% Difference	
			Chamber 100yr	Chamber	SUDS	SUDS - Storage
Halbeath Pond	13.5 Ha	2.145 m ³		£339.185	£290.092	14
Linburn Pond	67.5 Ha	10.723 m ³		£1.488.227	£394.291	74
Wetland Pond 7	58.1 Ha	9.230 m ³		£1.288.238	£181.065	86
Cascades	16.5 Ha	2.621 m ³		£402.948	£137.147	66
	16.8 Ha	2.661 m ³		£408.307	£275.449	25
Total	172 Ha	27.380 m³		£3.927.006	£1.280.049	
Average	34 Ha	5.480 m³		£785.400	£256.010	67

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Results – WLC: Different Scenarios



Results – Unit Costs per Area

Capital Costs

- Capital costs of traditional drainage are more than double the capital costs for implementing SUDS

Pond Name	Catchment Area	Capital Cost		Capital Cost / Ha	
		Chamber 100 Year	SUDS	Chamber 100 Year	SUDS
Halbeath Pond	13.5 Ha	£281.875	£159.95	20.88 £/Ha	12 £/Ha
Linburn Pond	67.5 Ha	£1.350.67	£312.47	20.01 £/Ha	5 £/Ha
Wetland Pond 7	58.1 Ha	£1.164.65	£115.03	20.04 £/Ha	2 £/Ha
Cascades	16.5 Ha	£341.18	£106.52	20.67 £/Ha	7 £/Ha
	16.8 Ha	£346.17	£251.17	20.60 £/Ha	15 £/Ha
Total	172 Ha	£3.484.56	£946.31	102.21 £/Ha	40 £/Ha
Average	34 Ha	£696.91	£189.26	20.44 £/Ha	8 £/Ha

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Results – Unit Costs per Area

Maintenance Costs

- Annual average operation & maintenance costs are 20-25% greater for traditional drainage

Pond Name	Catchment Area	Maintenance Cost		Maintenance Cost / Ha	
		Chamber 100 Year	SUDS	Chamber 100 Year	SUDS
Halbeath Pond	13.5 Ha	£3.58	£4.98	266 £/Ha	369 £/Ha
Linburn Pond	67.5 Ha	£6.80	£3.38	101 £/Ha	50 £/Ha
Wetland	58.1 Ha	£6.24	£2.32	107 £/Ha	40 £/Ha
Pond 7	16.5 Ha	£3.76	£2.70	228 £/Ha	164 £/Ha
Cascades	16.8 Ha	£3.77	£2.00	225 £/Ha	119 £/Ha
Total	172 Ha	£24.16	£15.38	927 £/Ha	741 £/Ha
Average	34 Ha	£4.04	£2.56	185 £/Ha	148 £/Ha

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Results – Unit Costs per Area

WLC

- WLC for traditional drainage are around double the cost for SUDS

Pond Name	Catchment Area	WLC		WLC / Ha	
		Chamber 100 Year	SUDS	Chamber 100 Year	SUDS
Halbeath Pond	13.5 Ha	£318.62	£241.57	23.60 £/Ha	18 £/Ha
Linburn Pond	67.5 Ha	£1,439.41	£362.86	21.62 £/Ha	5 £/Ha
Wetland Pond 7	58.1 Ha	£1,244.34	£153.42	21.41 £/Ha	3 £/Ha
Cascades	16.5 Ha	£380.82	£107.68	23.08 £/Ha	7 £/Ha
	16.8 Ha	£408.30	£285.48	24.30 £/Ha	17 £/Ha
Total	172 Ha	£3,791.51	£1,151.03	113.72 £/Ha	49 £/Ha
Average	34 Ha	£758.30	£230.20	22.74 £/Ha	10 £/Ha

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Conclusions

- Developers think (wrongly) that SUDS will result in a significant increase in capital costs to implement surface water drainage infrastructure
- Drainage utilities think (wrongly) that costs to maintain & operate SUDS as per design function will be greater than statutory obligations associated with traditional drainage

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Conclusions (cont)

The data presented demonstrate positive cost benefits of SUDS when compared with Traditional Drainage

- Well designed, constructed & maintained SUDS are more cost effective than traditional drainage
- DEX SUDS also increase aesthetic appeal in addition to water quality protection & flood control
- Traditional systems would not deliver water quality targets required by current legislation. Downstream treatment would be necessary which would further accentuate cost differences highlighted in this study

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Acknowledgements

Taylor Wimpey Developments Ltd who commissioned the cost comparison study

Alison Duffy, UWTC, UAD



Thank You

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