Integrating sustainable drainage systems - Henry Box affordable housing scheme, Witney: Case experience from Oxfordshire UK

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From standards & guidance to legislation...

Consultation on the Implementation of the Sustainable Drainage Systems provisions in Schedule 3
Flood and Water Management Act 2010
December 2011
Interpretation of forthcoming National Standards

Amenity and biodiversity

Volume and or rate control to greenfield runoff or 2l/s/ha

Greater focus on ‘functionality’: loading, soil erosion, maintenance, flood risk and using public space

Prescribed number of treatment train stages.
No quantification of limits / targets
Treatment train SuDS for QUALITY

1. Filter drain
2. Swale
3. Trench
4. Detention basin
5. Wetland
6. Retention pond
7. Green roof
8. Soakaway
9. Rainwater harvesting
10. Permeable pavement
11. Attenuation systems
12. Channels and rills
13. Bio-retention
14. Infiltration trench
15. Filter strip
16. Rain garden

Water quality benefit

Source: Ciria C687 pp 27-29
Implementing SuDS on commercial developments

- Many commercial sites 2 – 10 ha – in dense urban environment
- Large volumes - 1:100 year event managed on-site
- Commercial goal: zero car park space loss
- Infiltration not always possible
- Costs – maintenance
Applying lessons learnt from housing

- Role of “on-site conveyance “ through linear channel systems
- Integrating SuDS components
- Managing quantity and quality separately
- Land owned by Oxfordshire County Council
- Identified for affordable housing
- 92 houses on 1.1 hectares
- Sovereign Housing Association
- Atkins as consultants
- 2002 completion
A site with some engineering challenges...

- 1m deep peat layer
- Max gradient 1:1000
- Water table 400-700mm below site level
- Average water level
Drainage overview – high invert conveyance via linear combined kerb drainage

ACO KerbDrain

Geo-cell storage System i.e. ACO StormBrixx

Perforated pipe

Over edge drain to swale

Type B filter material

Pipe

Swale

Watercourse
Resilient details

- Overland flood flow accommodation in structures
Roof drainage connection to conveyance system
Site design theme – conveyance at high invert

- Swales
- Ditches
- Combined kerb drains
- Tight radius
- On-line storage
## Channel design methodology

<table>
<thead>
<tr>
<th>Gradient</th>
<th>Uniform flow</th>
<th>Steady Non-uniform flow</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Velocity m/s</td>
<td>Capacity l/s</td>
</tr>
<tr>
<td>1/1000</td>
<td>0.491</td>
<td>23.57</td>
</tr>
<tr>
<td>1/100</td>
<td>1.55</td>
<td>74.53</td>
</tr>
</tbody>
</table>

Table 1. Adapted from Naqvi, M. 2003 – Design of Linear Drainage systems
Water level and flow velocity in channel

- Lateral inflow (50mm/hr intensity) 182.5 l/hr
- Overall length 230m before surcharge
- Velocity ≈ 0.3m/s for 160m
Measurements

Water level measurement

Max water level in 18 months 237mm of 325mm available

Water Level ‘proxy’ taken at manhole chamber prior to geocellular attenuation

Flow rate

126mm
Measurements on 6th April 2004

13.30-14.30 6th April 04

Sump Level
Kerb Drain Level

22 minutes
10 years on

Observations on performance
Roof drainage connection to conveyance system – effect on debris build up?
Sediment in channel run?
At drop kerb constraint
At cross carriageway junction
At swale treatment stage
At outfall to watercourse
Integrated sustainable drainage

As employed on Henry Box - Witney

- Conveyance – at or near surface using linear channel drains
- High invert outlet to subsurface geocellular attenuation
- Discharge to swale (treatment)
- Discharge to watercourse
Implementing SuDS on commercial developments

- Many commercial sites 2 – 10 ha – in dense urban environment
- Large volumes - 1:100 year event managed on-site
- Commercial goal: zero car park space loss
- Infiltration not always possible
- Costs – maintenance
On commercial / urban projects

- Conveyance – at or near surface using linear channel drains (high capacity QMax for example)
- **high invert outlet to surface vegetated swale (treatment)**
- discharge to high invert outlet to subsurface geocellular attenuation
- discharge to watercourse
Thank you for listening

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