Case Study: Water Efficiency on construction sites

Water management is a challenge at unmeasured site

A high number of unmetered standpipes and a faulty water meter made managing water consumption at the site a challenge. A water audit, where metered standpipes were deployed, indicated that savings could have been achieved through using more efficient wheel wash techniques and dust suppression technology, regular leak detection and repair, and reviewing domestic and canteen facilities.

Background
A construction site water audit was conducted to identify areas for water efficiency action during April 2012. The construction site was new build and refurbishment of a railway station, tunnel portal and associated works.

Key Facts

- **Location:** London
- **Activities on site:**
  - Construction of a tunnel portal and railway station
  - Demolition of an existing railway station and connection of new station to existing infrastructure.
  - Other associated works
- **Project duration:** Mid 2011 – Early 2015
- **Staff level:** Typically 220 on site at any one time
- **Water use captured during one month monitoring:** 118m³ (excluding welfare use).

Opportunity for savings

Monitoring water consumption on site would have allowed a clearer picture of areas for water efficiency focus to be identified by the site team. Following a short period of monitoring significant opportunities for saving were identified as:

- 43% reduction in water use achievable at the drive on wheel wash by reducing pressure, as well as resolving permanently flowing overflows from the system.
- Fixing leaks on site could have resulted in significant water reduction.
- Improved technology for vehicular dust suppression using misting rather than splash plates could have saved an estimated 70-90% of water use for this activity.
- 20% reduction from improvement to welfare facilities through reduced operating times of percussion taps and installation of pressure reduction valves.

Significant water saving potential through fixing leaks on hoses and standpipes. Regular leak detection should be undertaken alongside health and safety walk arounds.

The following water consuming areas/activities were noted:

- Hydro-demolition
- Bentonite mixing and piling
- Welfare (toilets, food preparation canteen and offices)
- Road sweeper and high pressure washing
- Wheel wash

The largest barrier to improving water efficiency on site was the lack of quantitative information, due to the use of unmetered standpipes and a faulty water meter. Installation of metered standpipes and a submeter allowed the site to better manage their consumption.
Managing water consumption at the site was a challenge, due to the use of a high number of unmetered standpipes as well as a faulty water meter, and quantification of the total site water consumption could not be undertaken. However, 4 metered standpipes were installed in preferred locations to allow quantification of a number of the higher priority water using areas, as well as a dedicated sub-meter on the wheel wash. The following table summarises the data which was captured during a period of around a month in March - April 2012:

<table>
<thead>
<tr>
<th>Standpipe/Sub-meter</th>
<th>Supply Size</th>
<th>Monthly Consumption</th>
<th>Main Water Using Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standpipe A1</td>
<td>2.5”</td>
<td>60 m³</td>
<td>Hydro-demolition, bentonite mixing, piling, road sweeper, high pressure washer.</td>
</tr>
<tr>
<td>Standpipe A2</td>
<td>2.5”</td>
<td>9 m³</td>
<td>Wheel wash (secondary supply), piling</td>
</tr>
<tr>
<td>Standpipe B1</td>
<td>1”</td>
<td>Minimal</td>
<td>Negligible throughout audit duration</td>
</tr>
<tr>
<td>Standpipe B2</td>
<td>1”</td>
<td>Minimal</td>
<td>Negligible throughout audit duration</td>
</tr>
<tr>
<td>Sub-meter</td>
<td>25mm</td>
<td>49 m³</td>
<td>Wheel wash only</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>118 m³</strong></td>
<td></td>
</tr>
</tbody>
</table>

The wheel wash sub-meter consumption was higher than typical levels, as the monitoring period includes instances of leaks/overflows. A typical consumption, if these had not occurred, was estimated as 24 m³/month.

Most major water consuming areas/activities are quantified in the table above. The most notable exception is site welfare, which was likely to account for a significant percentage of the site’s water consumption. Also, the road sweeper sometimes filled it’s tank off-site.

A weekend baseload check was undertaken which showed that there was no unwarranted water consumption through any of the metered standpipes or the wheel wash sub-meter.
## Water Efficiency Assessment

The following table provides an assessment of the main water using activities on site:

<table>
<thead>
<tr>
<th>Activity/Area</th>
<th>Typical Water Consumption</th>
<th>Potential Savings</th>
<th>Comments/Actions</th>
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| Drive-on Wheel Wash | 94 litres/wash 24 m³/month | 40 litres/wash 10 m³/month | - The supply pressure was found to be excessive, and the water consumption per wash was reduced by 43% by throttling the valve on the water supply by around 50% (see photograph). The level of throttling may require alteration depending on site conditions (and thus savings may vary).  
- A faulty ball float valve was leading to a constant overflow of 900 litres/hour from the rear of the system, which corresponds to around 650 m³/month (if constantly active). Reducing the supply pressure and replacing the float valve eliminated this loss.  
- A blocked filter within the recirculation tank was leading to an overflow at the front of the system - regular cleaning of the filter unit was implemented to prevent this re-occurring.  
- Including the elimination of these overflows, the actual reduction of the wheel wash water consumption was well in excess of the 43% (10 m³/month) stated.  
- The typical water consumption is likely to vary significantly depending on site conditions, weather, etc. |

| Leak Detection & Repair | N/A | Significant | - Several leaks were noted around the site, some of which were significant. In terms of the potential for water savings, improved leak detection and repair may be the action which provided the greatest opportunity.  
- The priority area for the site was the maintenance of standpipes and associated fittings. On one occasion the below-ground connection point to the mains network on Standpipe A1 was loose, and on another occasion the hose connection to the same standpipe had a significant leak (see photograph), and on both occasions significant leaks were witnessed. Manually tightening the connection point, and installation of a jubilee clip, resolved these issues and led to significant water savings.  
- In order to reduce water losses from leaks on site, regular leak detection was to be undertaken in conjunction with the existing health and safety walk-rounds. |

| High pressure washing | 13.2 litres/minute Monthly consumption dependent on highly variable operating times. | Savings are dependent on particular application | - System used on site was a Brendan Powerwashers Bowserwasher Diesel, a system-type which is common on construction sites.  
- Maximum flow rate was 13.2 litres/minute, and the system allowed users to control this flow through throttling a valve on the supply pipework.  
- In general terms, to achieve water savings, the user should reduce the flow rate to the minimum required for the particular application. The potential savings will vary from application to application (and site to site) but could be significant in some instances.  
- In order to achieve these savings on site, users of high pressure washing systems on site are to be provided with training to ensure they operate the equipment as efficiently as possible.  
- Reducing the water consumption of the system will also reduce the frequency of top-up required - this could prove a greater benefit than the actual water savings in difficult to access areas. |
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| Vehicular Dust Suppression | Unknown (currently no mains water consumption) | 70% - 90% | - System used on site utilised a 2,200 litre storage tank mounted on a small trailer which was driven around the site when dust suppression was required. The system utilised a traditional (and water inefficient) splash plate technique. As the system used abstracted groundwater there was no opportunity for mains water savings.  
- Modification of the existing system to reduce water consumption was unlikely to prove practical, or even possible (as the unit is hired). As such, in order to improve the efficiency of vehicular dust suppression on site, consideration was given to hiring water efficient alternatives to the current system at the next available opportunity. These alternative systems create a mist pattern (see photograph), which provides similar or even improved dust suppression for significantly less water (up to 90% less in some instances).  
- Reducing the water consumption of the system would also reduce the frequency of top-up required, reducing operator dead-time, which can sometimes prove a greater benefit than the actual water savings. |
| Welfare Blocks | 158 m$^3$/month | 32 m$^3$/month (20% reduction) | - The actual water consumption of the welfare blocks was not quantified, and the figure shown is an approximation based on 220 FTE staff and a consumption of 40 litres per person per day, minus a 25% allowance due to the use of waterless urinals (i.e. 10 l/p/d)  
- The flow rate of Wash Hand Basins (WHBs) fed directly from mains will vary with the mains pressure, and thus the site currently had little control over their water consumption. Consideration was given to installing variable Pressure Reduction Valves (PRVs) at strategic locations around the distribution network to improve control. A good practice flow rate is < 5 litres/minute.  
- In general, percussion (push) taps were in use, which can be considered good practice. However, the operating times varied from WHB to WHB, and in some instances were excessive (i.e. > 10 seconds). The site is to undertake a review of each WHB to limit the operating time to a maximum of 5 seconds. |
| Road Sweeper | 35 litres/minute (typical flow capacity of Johnston Sweeper 650 spray systems) 62 m$^3$/month | 19 m$^3$/month (30% reduction from spray systems) | - A single Johnston Sweeper 650 (containing a 1,300 litre water tank) was used on site, which utilised a front-loaded spray bar and single spray nozzle adjacent to the side channel brush. The operator had on/off control of each of these spray systems, and could also vary the flow rate from within the cab, and as such the road sweeper could be considered relatively water efficient. The system also had a high pressure washer.  
- The monthly consumption has been estimated based on an average top-up frequency of 2 per day - this figure could vary significantly depending on a number of different factors (e.g. weather, site conditions, etc.).  
- Some road sweepers (including this model) have an optional water recirculation system (though it was not fitted in this instance), whereby a portion of the recovered wastewater is filtered and then transferred to the clean water tank. This can provide water savings of up to 50%, though a figure of 30% may be more realistic.  
- Reducing the water consumption of the system would also reduce the frequency of top-up required, reducing operator dead-time, which can sometimes prove a greater benefit than the actual water savings. |
| Hydromechanical Excavation | 50 lpm  717 m$^3$/month (maximum) | None identified. | - The instantaneous flow shown relates to the operation of a single hydromechanical excavation system, and based on the limited number of systems which have been assessed at other sites, this would appear to be typical for concrete removal.  
- The monthly volume shown is the maximum a single system could use in a month, assuming 10 hours operation per day and 5.5 days operation per week. The actual consumption will vary significantly as hydromechanical excavation only occurs during some phases of the works, and even then, not always every working day.  
- The pressure and flow rate of the system is set to a level which achieves efficient concrete removal, and it is unlikely this could be reduced to achieve water savings. Therefore, the only potential for water savings may be via staff training (to ensure that concrete is demolished as efficiently as possible). However, as hydromechanical excavation is a relatively high-risk activity, the focus during operation is quite rightly on health and safety, and training is not expected to represent a practical opportunity for water savings. |
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| Dust Suppression (Stockpile)     | Unknown                   | Up to 90%        | • This activity was not witnessed on site and so could not be fully assessed or quantified. However, manual hosing was reportedly used - this is water inefficient and represents significant opportunity for improvement.  
  • For future instances of dust suppression, the site was to consider using fan misting systems - these create a fine mist which offers improved dust suppression for significantly less water (see photograph). |
| Bentonite Mixing                 | 53 m³/month               | None identified  | • Water used as ingredient for bentonite mixing accounts for a relatively large water consumption. However, the water content of the mix is strictly controlled for quality purposes and offers little opportunity for improvement.  
  • The cleaning activities associated with the bentonite plant are potentially variable, and could offer opportunity for improvement. However, no specific opportunities were identified during the audit. |

**Summary**

The largest barrier to improving water efficiency on site was the lack of quantitative information, due to the use of unmetered standpipes and a faulty water meter. With the installation of 4 metered standpipes and a sub-meter on the feed to the wheel wash system, in conjunction with regular meter readings, the site was better able to manage and improve their consumption. For example, analysis of the data provided by the wheel wash sub-meter helped:

1. Identify and eliminate the presence of a significant overflow  
2. Quantify the typical water consumption per vehicle wash  
3. Quantify the water savings achieved by reducing the water supply pressure

This one example highlights well the potential benefits from utilising a robust metering and monitoring system on site.

As the total site water consumption was not identified, the percentage savings cannot be estimated. However, there are a number of areas where significant savings can be (or have been) achieved on site, and reducing total site water consumption by 20% (as per the SFFC Water Sub-group’s sector target) should not only be achievable, but could be exceeded by some margin.
Further information on water use in construction and how to reduce use on your site can be found at:

http://www.strategicforum.org.uk/water.shtml

and


Information includes a ‘how to’ guide that can be displayed as a poster, along with a toolbox talk on water efficiency.

The full water audit report is available at:

http://www.wrap.org.uk/content/water-efficiency-construction