BeST Case Study

Reducing Combined Sewer Overflow Spills in Roundhay

Background

Yorkshire Water investigated the potential of different options to reduce combined sewer overflow (CSO) spills in Roundhay Park in Leeds, as part of its plans for the 2014 Periodic Review. The aim was to compare the costs, immediate and wider benefits of a SuDS and conventional drainage approach. An initial assessment of the benefits of the options using an ecosystem services approach was completed in 2013. This case study sets out an update to this work using BeST.

Approach

The study considered four options.

- **Option 1**: A **conventional** solution to store water in concrete tanks at CSOs to limit the volume spilling to the watercourse and return it to the combined sewer after the storm.
- **Option 2**: A **conventional (+)** option that limited the volume spilling from the CSOs but also reduced predicted flooding in the catchment (giving similar hydraulic performance in the combined sewer network to options 3 and 4). This option included a combination of storage tanks and pipe upsizing to manage the flow in the combined sewer.
- **Option 3**: A **SuDS** approach in **public areas** to disconnect surface water from the combined system and pass it through the conveyance and storage SuDS. This used a combination of swales, detention basins, geocellular storage and connecting pipes.
- **Option 4**: A **SuDS** approach as in option 3 with measures added in residential **private** locations. These included water butts and residential rain gardens on properties of sufficient size.

Based on the screening questions, Table 1 shows the benefit categories assessed.

Most of the benefit categories were assessed using information within the tool and guidance. The exceptions to this were 'flood

Table 1: Summary of the options assessed and the expected benefits

Option summary	Ecosystem service type							
	Cultural		Regulating				Provisioning	Supporting
	Recreation	Amenity	Flooding and climate resilience	Carbon reduction	Water quality	Flooding	Treating wastewater	Biodiversity and ecology
Option 1: Conventional	-	-	×	×	✓	-	×	-
Option 2: Conventional+	-	-	×	×	✓	✓	×	-
Option 3: Public SuDS	✓	✓	✓	✓	✓	✓	✓	✓
Option 4: Public-Private SuDS	✓	✓	✓	✓	✓	✓	✓	✓

× indicates a negative impact, ✓ indicates a positive impact, - indicates no impact.

risk', assessed using damage cost estimates from the Multi-Coloured Manual, and 'climate resilience', a user defined benefit also following estimates from the Multi-Coloured Manual.

Results

Table 2 shows an example of the results for option 3 exported from BeST. Here, the estimated benefits are higher than the costs for pre-confidence and sensitivity high, and slightly greater than the costs post confidence. The central estimate after confidence is applied gives a benefit cost ratio if 1.0 (i.e. benefits equal to costs). The distribution of benefits (before and after confidence applied) is shown in Figures 1, 2 and 3. The main benefits are associated with amenity, flood risk and water quality. Amenity benefits related to creating a park with a detention basin and general street greening, replacing grass verges with bio-infiltration swales. Figure 4 shows total present value benefits and net present values.

A comparison (Figure 5) of the costs and benefits shows how the different options are associated with a large range in net present value. Option 1 reduced the CSO spills, was lowest cost but offered limited other benefits. Option 2 provided similar levels of drainage performance in the sewer network as option 3 and 4, but created fewer benefits having underground infrastructure only, and was also less resilient to climate change. Options 3 and 4 included distributed SuDS features across the catchment, creating a second drainage network to manage surface water, in turn creating wider benefits to the community and environment. These options had similar costs and benefits. Overall, only the 'SuDS public' option 3 generated a positive NPV (benefits greater than costs).

Table 2: Summary of the results for option 3

Present Value Assessment Stage	Total PV Benefits	Total PV Costs	Net Present Value	Benefit Cost Ratio
Present Value before confidence applied	£28,983,678	£9,258,860	£19,724,818	3.1
Present Value after confidence applied	£9,510,907	£9,258,860	£252,047	1.0
Present Value sensitivity - low	£3,035,051	£9,258,860	-£6,223,809	0.3
Present Value sensitivity - high	£20,449,844	£9,258,860	£11,190,984	2.2

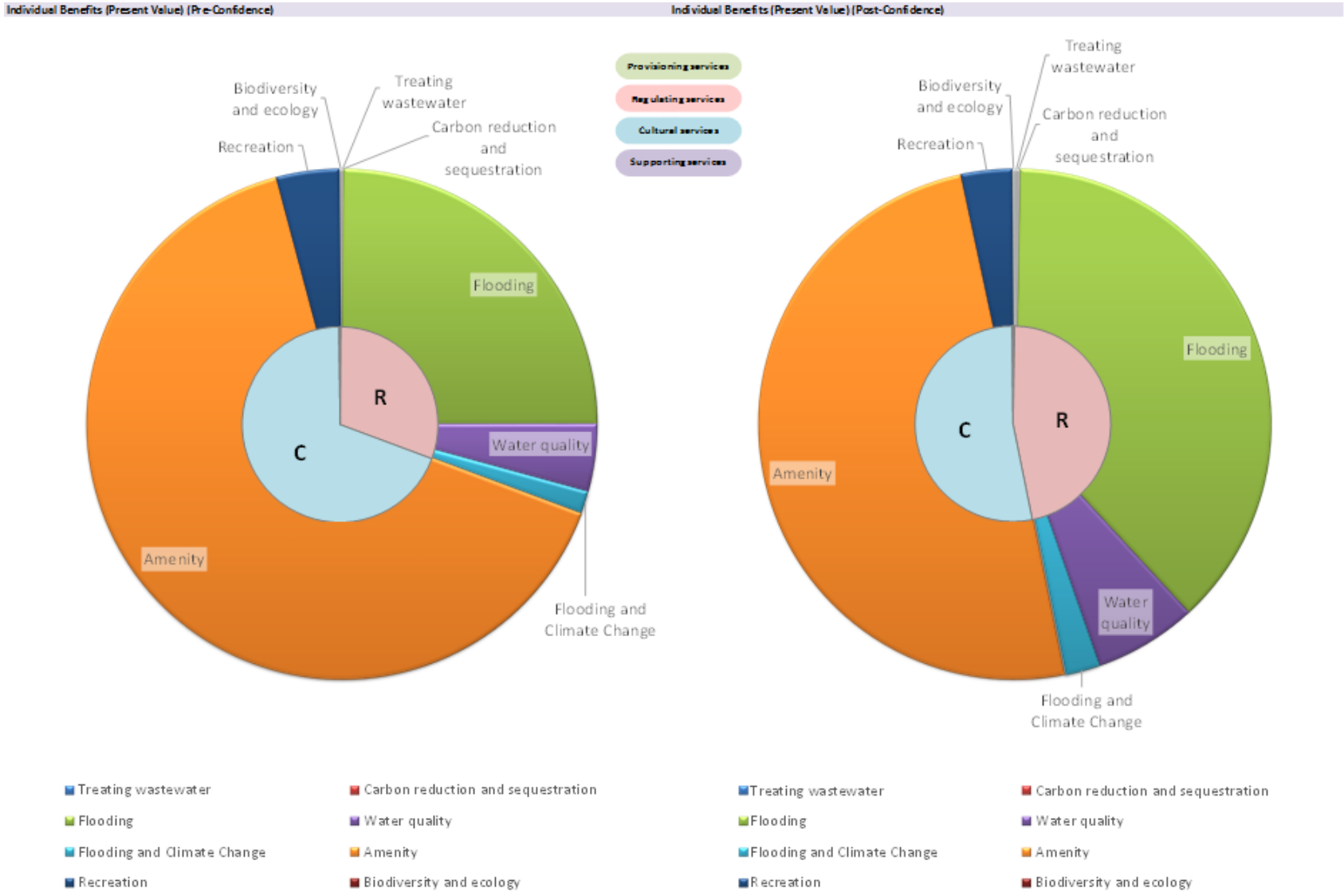

Figure 1: Breakdown of benefits per category pre (left) and post (right) confidence

Figure 2: Distribution of benefits pre (left) and post (right) confidence

Figure 3: Breakdown of benefits under triple bottom line categories pre (left) and post (right) confidence

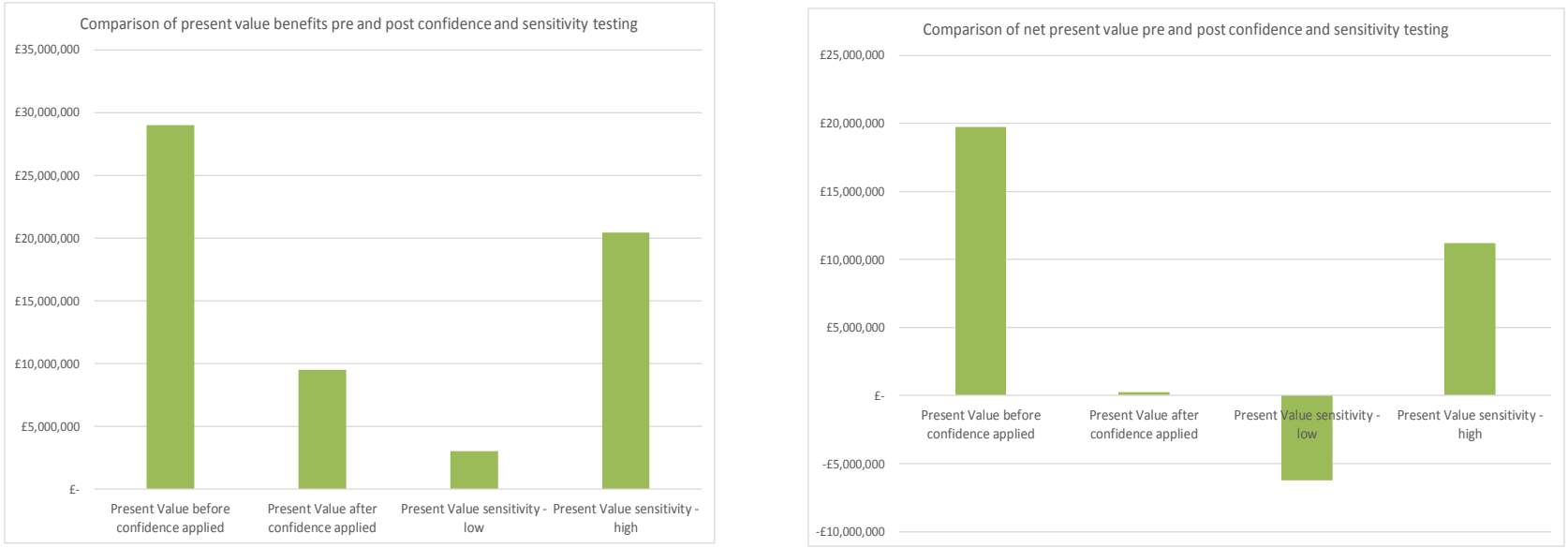

Figure 4: Comparison of benefits present value (left) and net present value (right) for pre and post confidence and sensitivity testing.

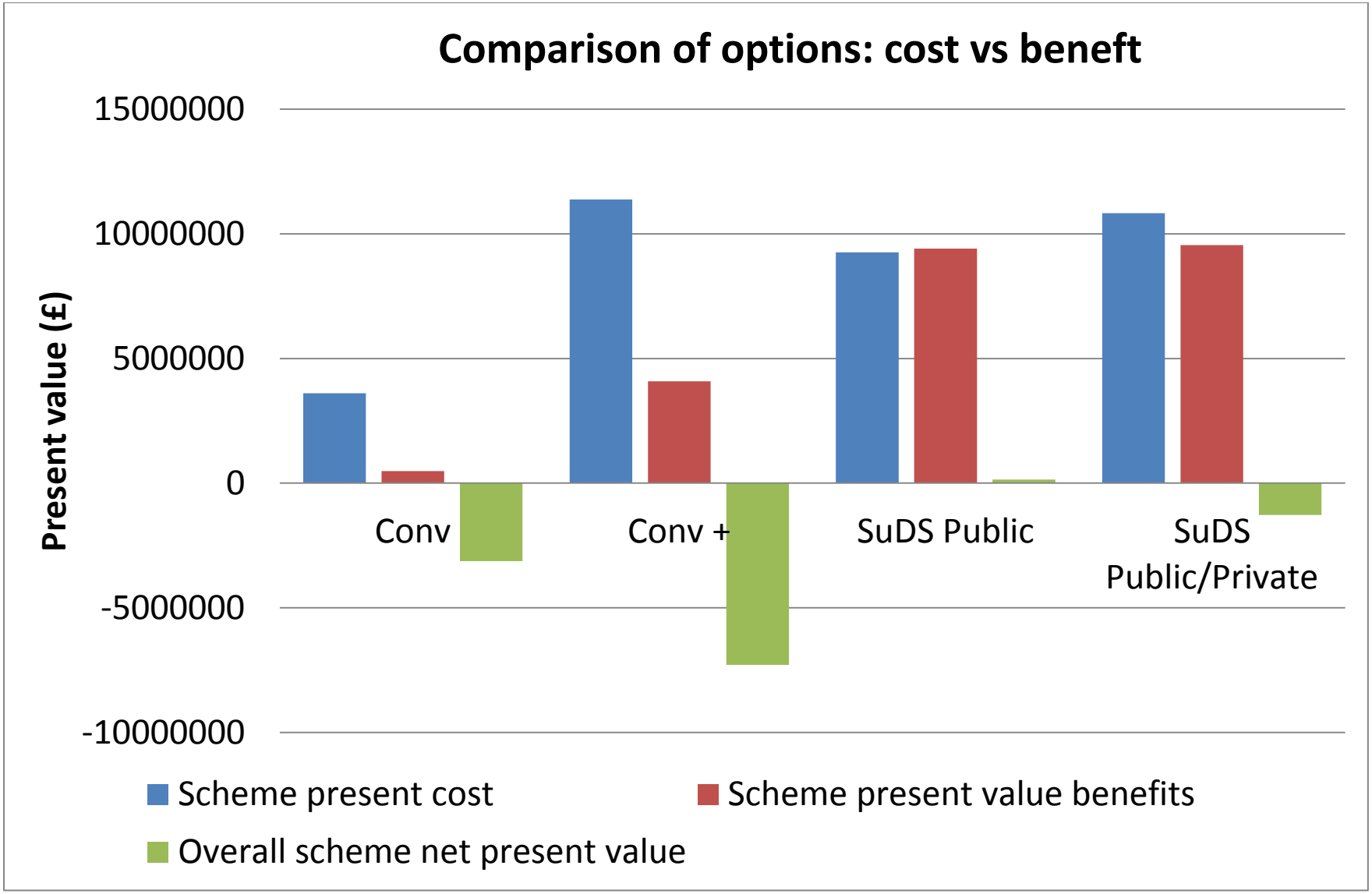

Figure 5: Comparison of the costs, benefits and net present value for each option