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OXFORD CITY COUNCIL

**To: City Executive Board**

**Date: 20 May 2009** **Item No:**

**Report of: Head of Environmental Development**

**Title of Report: Flood Mitigation by Rainwater Harvesting**


**Summary and Recommendations**

**Purpose of report**: To seek the endorsement of Council's motion with regard to seeking measures to reduce flooding caused by rainwater runoff from the City.

**Key decision? No**

**Executive lead member: Councillor Cook**

**Report approved by:**
**Finance: Chris Kaye**
**Legal: Emma Griffiths**

**Policy Framework: Tackle climate change and promote environmental resource management.**

**Recommendation(s):**

- In light of the calculations and limited benefit rainwater harvesting is likely to bring in providing a buffer against flooding, it is recommended that the Council takes no further direct action.
- Note the benefit that Rainwater harvesting could bring to the City for conservation and future security of water supply and to encourage developers to incorporate harvesting wherever feasible into their current best practices.
- Encourage the uptake of sustainable urban drainage where ever possible in all future development.


**Council Motion**

1. Full Council passed the following motion on 6th October 2009:

   *Councillor Morton seconded by Councillor Dhall moved the following Motion on Notice: -*

   *"The Council is eager to implement a series of measures to alleviate flooding in the Thames valley. The Council recognises that a small but significant proportion of the floodwaters originate from run-off*

*inside the City area. The Council would like to set an example by taking responsibility for as much of the rainwater as is feasible by seeking measures to reduce our contribution to the flood through the storm water system. With a mind to discover the potential for rainwater harvesting and hence flood mitigation the Council invites the Executive to find funds to investigate the following:-*

*In a pilot area, St Mary's Ward for example,*

- *To calculate the domestic and commercial roof area of all properties combined in metres squared and as a proportion of the total area.*
- *To calculate the per annum water which falls on all roofs in that area.*
- *To calculate the peak flow for heavy downpours in cubic metres per second.*
- *To estimate the storage capacity necessary to mitigate peak flow.*
- *To make suggestions as to the most cost effective water storage facilities and make recommendations regarding implementation and funding."*

2. Following a debate Council voted upon the Motion and this was carried, 22 members voting in favour and 21 members voting against.

**Current Situation with Rainwater Disposal**

3. This City is fortunate in having separate public foul and surface water sewer systems. The majority of dwellings in Oxford, particularly in the older parts like the St Mary's Ward, have roofs and back yards that drain into the surface water system which empty directly into local watercourses and from there into the Thames. Every dwelling and business that is connected to surface water sewer is contributing in a small way to peak flows that continue to cause surface flooding in a number of locations in the City and river flooding across the Thames Valley floodplain down stream of Oxford.

4. Residents regularly call upon Thames Water to invest in new and larger surface water sewers to address the problem in the City. However, this can have the potential to merely increase flooding down stream, leading to calls for more investment at an unsustainable level.

**Rainwater Harvesting**

5. Rainwater harvesting aims to collect rainfall from the roofs of individual properties for later use on gardens and in grey water systems. This would be advantageous in conserving water, which is becoming a scarce resource in the southeast of England and enhance future resilience of water supply. Rainwater harvesting could also potentially reduce $CO_2$ emissions by 0.4kg for every 1,000 litres of mains water not used.

6. For most effective operation, rainwater storage capacity would be sized to save enough water from rainy days for later use – especially in dry spells. The emphasis would be on retaining sufficient water to meet estimated needs.

7. Storage tanks could be provided above or below ground level. It could be difficult to find space to accommodate tanks above ground, especially in areas of terraced housing. Tanks could be raised but this would incur structural costs. Installing below ground level, soil excavation and disposal would raise costs, and access for machinery would be a problem. In most cases, the water could only be usable if pumps were provided.
8. Household plumbing would also need to be carefully adapted to enable the use of grey water without risk of cross-contamination.
9. The UK Rainwater Harvesting Association estimate that it costs between £2,000 and £3,000 to install a system - excluding excavation and disposal costs. Each year, about 400 systems are installed in the UK. In Europe the figure is nearer to 100,000. So equipping St Mary's Ward as a pilot scheme could cost around £6 million.
10. Appendix 1 includes an analysis of storage capacity required to meet potential demand. This would be equivalent to about 12 water butts per dwelling.

**Sustainable Urban Drainage Systems (SUDS)**

11. The City's current policies seek the introduction of Sustainable Urban Drainage Systems [SUDS], where feasible, in order to mitigate flood risk. Planning approvals for new developments now commonly include a condition requiring the use of SUDS, and there are a number of examples now operating in the City.
12. SUDS reduce peak flows by using temporary storage to detain rainwater or by discharging rainwater into porous rock and gravel sub-soils. However, the principle purpose of SUDS is to control the downstream release of storm-water in order to prevent flooding, not to store it for future use. Unless retaining water for amenity reasons, the systems tend to be kept empty.
13. Operation of SUDS depends on controlled gravity flow, so the systems are normally installed below ground level. This normally makes such systems costly to install unless constructed in the course of new development. So SUDS are useful in preventing new development from increasing storm-water run-off, but the cost of correcting an existing problem can be high.

**Operational criteria**

14. In order to provide storm capacity, storage tanks would need two sections. One would provide for expected water needs and the other would need permanently open trickle drainage to ensure that maximum capacity remained available when needed.
15. Providing capacity to store the volume of rain that fell on Oxford in July 2007 in St Mary's Ward would need the equivalent of about 17 water butts per dwelling. This additional capacity would take up significant space at each property and at significant cost to householders.

**Pilot Area**

16. We have undertaken sample calculations as requested in the Council's motion. Roof areas have been estimated from Ordnance Survey digital maps, and rainfall statistics have been obtained from the Oxford Observatory. The results are shown in Appendix 1.

17. Flooding is the outcome of peak flows and not total annual flows. So fully understanding the costs and benefits that rainwater harvesting might bring to flood mitigation and water conservation would require a detailed study that would need to be commissioned from an external provider.

18. However, it has been calculated that in July 2007 about 9.6 million litres of rain fell on St Mary's Ward. In order to estimate how effective rainwater harvesting might be at mitigating flood risk these figures have been compared with flood flow rates in the Thames.

19. The River Thames in full spate in July was conveying in the order of 250 cubic meters per second of water through Oxford. The 9.6 million litres from the St. Mary's Ward would pass along the Thames in 40 seconds.

20. So a pilot scheme in St Mary's ward alone would be insufficient to mitigate the current risks in the floodplain. The cost of such a scheme for the whole of Oxford would be of the order of £140 million, which is comparable to the £100 million estimate for the Environment Agency's proposed strategy.

**Risk Assessment**

21. This report proposes no wholly new initiatives so has insignificant bearing on the Council's current risk rating. The risk register is attached at Appendix 2.

**Climate Change / Environmental Impact**

22. The body of the report addresses these issues.

**Financial Implications**

23. This report includes no financial implications.

**Legal Implications**

24. This report includes no legal implications.

**Equalities Impact**

25. This report has no impact upon the equality objective.

**Recommendations**

26. City Executive Board is recommended to:

    1. In light of the calculations and limited benefit rainwater harvesting is likely to bring in providing a buffer against flooding, it is recommended that the Council takes no further direct action.

    2. Note the benefit that Rainwater harvesting could bring to the City for conservation and future security of water supply and to encourage developers to incorporate harvesting wherever feasible into their current best practices.

3. Encourage the uptake of sustainable urban drainage where ever possible in all future development.

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**List of background papers:**
**Version number: 1.0**

**Appendix 1**

**TABLE ONE – Demand for grey water**

| | | |
|---|---|---|
| *1.* | *Average daily water consumption per person* | *160 litres / p /d* |
| *2.* | *Assuming grey water use potentially 25%* | *40 litres / p /d* |
| *3.* | *Assume average household 2.5 people* | *100 litres /hhld /d* |
| *4.* | *Assume minimum 30 days storage* | *3,000 litres /hhld* |
| *5.* | *Equivalent number of domestic water butts per property. (250 litre water butt)* | *12* |

**TABLE TWO - Statistics for St Mary's Ward:**

| | | |
|---|---|---|
| *1.* | *Total area of St Mary's Ward* | *674,353 sq m* |
| *2.* | *Total area of all rooftops in the ward* *(Percentage of total area 22%)* | *148,342 sq m* |
| *3.* | *Total area of road in the ward* *(Percentage of total area 12%)* | *80,225 sq m* |
| *4.* | *Average Annual rainfall over the past 240 years* | *644mm* |
| *5.* | *Mean annual rainfall falling on rooftops in St Mary's Ward* | *95,467 cu m* |
| *6.* | *Highest daily rainfall 2002 to 2006* | *50mm* |
| *7.* | *Rainfall 19th & 20th July 2007* | *65mm* |
| *8.* | *The water that the roof area of St Mary's Ward might have collected in July 2007* | *9,640 cu m = 9.6 million litres* |
| *9.* | *Number of roofs in St Mary's Ward* | *2,257* |
| *10.* | *Rainfall collected per roof (on average) (65mm storm)* | *4.25 cu.m = 4,250 litres* |
| *11.* | *Equivalent number of domestic water butts per property. . (250 litre water butt)* | *17* |

## Appendix 2

## CEB Report Risk Register – Rainwater Harvesting Pilot Study in St Mary's Ward.

Risk Score **Impact Score**: 1 =Insignificant; 2 = Minor; 3 = Moderate; 4 = Major; 5 = Catastrophic **Probability Score:** 1 = Rare; 2 = Unlikely; 3 = Possible; 4 = Likely; 5 = Almost Certain

| No. | Risk Description Link to Corporate Obj | Gross Risk | | Cause of Risk | Mitigation | Net Risk | | Further Management of Risk: Transfer/Accept/Reduce/Avoid | | Monitoring Effectiveness | | | | Current Risk | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | P | | | I | P | | | Q1 ☹ 😐 ☺ | Q2 ☹ 😐 ☺ | Q3 ☹ 😐 ☺ | Q4 ☹ 😐 ☺ | I | P |
| 1 | Lost of a potential buffer in times of flood (40 seconds) Corporate objective is to tackle climate change and promote environmental resource management. | 1 | 1 | Not undertaking the pilot study in St Mary's Ward. | Mitigating Control: None Level of Effectiveness: (HML) | 1 | 1 | Action: Accept Action Owner: Mitigating Control: Control Owner: | Outcome required: None proposed Milestone Date: | | | | | | |
| 2 | Loss of stored water capacity in extended periods of drought. Corporate objective is to tackle climate change and promote environmental resource management. | 2 | 1 | Not undertaking the pilot study in St Mary's Ward. | Mitigating Control: None Level of Effectiveness: (HML) | 2 | 1 | Action: Accept Action Owner: Mitigating Control: Control Owner: | Outcome required: None proposed Milestone Date: | | | | | | |