**WIMBORNE MODEL TOWN**

**DEVELOPMENT**

**RIVER SYSTEM REQUIREMENTS**

**Issue 0.1**

**8th April 2016**



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# INTRODUCTION

This document details the requirements for a number of enhancements to the Wimborne Model Town River feature.

## BACKGROUND TO THE REQUIREMENTS

WMT has embarked on an ambitious multi-phase programme to reduce the dependence of the Model Town and Gardens on mains water. Previously mains water was exclusively used to supply the model river system and for plant irrigation.

The programme is intended to have environmental benefits through its approach to sustainable water use and also to provide an educational platform, on a number of levels, to inform our visitors on topics like: the eco-system created; the technology utilised; the sustainability benefits; cost savings; and so forth.

It has been decided to undertake the programme in phases so as to cause minimal disruption to WMT as a visitor attraction and to align the affordability of our overall goal to the budgetary constraints of the charitable trust that runs it

### How Things Were

Mains water was used exclusively to fill the river system as the start of each season and to top it up when its water level dropped below that necessary to maintain a minimum water flow.

The river system itself suffered from a number of problems:

1. Water flow was low.
2. There was no water filtration
3. There was excessive algae growth
4. Water quality was poor
5. Water was lost due to numerous leaks
6. Maintaining correct water levels needed excessive manual intervention
7. Any excess water, from rainfall, was lost when the rivers capacity was exceeded.

While some attempt was made to harvest some rainwater from building roofs, which was fed into the river system in an uncontrolled way, any rainwater beyond the rivers capacity to hold it was lost as overflow into soak-aways.

A water butt was utilised in the plant potting area, but for general irrigation there was no alternative but to use hoses connected to mains water. The number and location of mains water taps was also an issue for the gardeners.

## Related Documents

The following documents have been used as the source materials for these Requirements.

Table 1: Related Documents

|  |  |  |
| --- | --- | --- |
| No | Requirement | Issue / Date |
| 1 | Water Sustainability at WMT - (reducing dependance on Mains Water) | 6th April 2017 |
| 2 | WMT River System (System Diagram) | 1.0 |
| 3 | WMT River System (Visitor Information) | 1.0 |
| 4 | River Layout | - |

# TOP-LEVEL REQUIREMENTS

The following Top-level requirements have been identified.

## Primary

1. Maintain a water flow in the river system at all times; sufficient to ensure water clarity and inhibit algae growth.

Note 1: The link between slow moving / stagnant water and algae growth has been made in literature but it is conjecture that it is the cause of WMT’s river system’s problem.

1. Reduce the dependence of the river system on mains water.
2. Enhance WMT as a visitor attraction.

## Secondary

1. Provide a source of harvested rain water that can be used to irrigate the gardens.

Note 2: In the past irrigation was by spraying with hosepipes, it is now planned to also introduce soaker hoses into some of the planting areas.

1. Expand rain water harvesting, storage and irrigation feeds to suit needs of river / gardens.
2. Stored water “balancing” between storage sites.

# DERIVED REQUIREMENTS

The following requirements have been derived from the Top-Level requirements. These are split into the proposed phased approach to the work. In the Tables below the following Notes apply:

Notes:

1. Requirement Numbers have been derived from various source documents detailed in Section 1.2 above, which for traceability have been included in the column headed ‘Source’.

1a. Reference Numbers in bold are taken from the Top-Level Requirements in Section 2 above.

1b. Other Reference Numbers are taken from Related Document 1 in Section 1.2.

2. Some of the Requirements have already been fulfilled under previous agreements and these are marked ‘Completed’ in the Tables below. They are included so that this document may provide a full picture of the Project.

## Functional

The Tables below details the functionality required of each element of the system during each Phase, it's priority, its type and its status. Top-level Requirements are highlighted, so that the origin of the Derived Requirements may be identified.

### Phase 1

Table 2: Phase 1 Functional Requirements

| Requirement Nos | | Requirement | Priority | Type | Status |
| --- | --- | --- | --- | --- | --- |
| Source | Derived |
| **2.1.1** |  | **Maintain a water flow in the river system at all times; sufficient to ensure water clarity and inhibit algae growth.** | **1** | **Essential** | **In progress** |
| 1.2 | 3.1.1.1 | The Project shall remove obstructions to water flow in the river. | 1 | Essential | Complete |
| 1.3 | 3.1.1.2 | The Project shall remove obstructions to water flow in the plumbing system. | 1 | Essential | Complete |
| 1.3 | 3.1.1.3 | The Project shall provide a more powerful, more efficient, variable speed pump. | 1 | Essential | Complete |
| **2.1.2** |  | **Reduce the dependence of the river system on mains water.** | **1** | **Essential** | **In progress** |
| 1.1 | 3.1.1.3 | The system shall maintain the integrity of the river bed by stopping all identifiable leaks. | 1 | Essential | Complete |

### Phase 2

Table 3: Phase 2 Functional Requirements

| Requirement Nos | | Requirement | Priority | Type | Status |
| --- | --- | --- | --- | --- | --- |
| Source | Derived |
| **2.1.1** |  | **Maintain a water flow in the river system at all times; sufficient to ensure water clarity and inhibit algae growth.** | **1** | **Essential** | **In progress** |
| 2.1 | 3.1.2.1 | The system shall provide a filter cage at the inlet of the pump to prevent large debris from being drawn into the pump impeller. | 1 | Essential | Complete |
| 2.2 | 3.1.2.2 | The system shall provide a natural water filtration system in the form of a bog garden to mechanically and biologically condition the water passing through it. | 1 | Essential | Complete |
| 2.3 | 3.1.2.3 | The system shall provide a pre-sump filter to prevent large debris from reaching the pump impeller inlet filter. | 1 | Essential | In progress |
| **2.1.3** |  | **Enhance WMT as a Visitor Attraction.** | **1** | **Essential** | **In progress** |
| 2.2 | 3.1.2.3 | A variety of suitable plants shall be planted in the bog garden to create a new eco-system. | 1 | Essential | In progress |

### Phase 3

Table 4: Phase 3 Functional Requirements

| Requirement Nos | | Requirement | Priority | Type | Status |
| --- | --- | --- | --- | --- | --- |
| Source | Derived |
| **2.1.2** |  | **Reduce the dependence of the river system on mains water.** | **1** | **Essential** | **In progress** |
| 3.2 | 3.1.3.1 | Water butts shall be provided to store excess water from the river, so that the level may be replenished as necessary. | 1 | Essential | In progress |
| 3.1 | 3.1.3.1.1 | The necessary piping shall be provided between the water butts and the river. | 1 | Essential | In progress |
| 3.3 | 3.1.3.1.2 | The system shall utilise the original sump pump to transfer the water to the butts. | 1 | Essential | In progress |
| 3.3 | 3.1.3.1.3 | A stop-tap shall be provided to control the flow of water from the butts to the river. | 1 | Essential | In progress |

### Phase 4

Table 5: Phase 4 Functional Requirements

| Requirement Nos | | Requirement | Priority | Type | Status |
| --- | --- | --- | --- | --- | --- |
| Source | Derived |
| **2.1.1** |  | **Maintain a water flow in the river system at all times; sufficient to ensure water clarity and inhibit algae growth.** | **1** | **Essential** | **In progress** |
| 4.1 | 3.1.4.1 | Capture Requirement for the Phase. | 2 | Desirable | This document |
| 4.2 | 3.1.4.2 | Develop high level design for the system. | 2 | Desirable | Not started |
| 4.3 | 3.1.4.2.1 | The system shall provide a fully automated control for all aspects of the river system. | 2 | Desirable | Not started |
| 4.3 | 3.1.4.2.1.1 | Automated control of the system shall utilise embedded computer techniques. | 2 | Desirable | Not started |
| 4.3 | 3.1.4.2.1.2 | The system shall allow for manual override of the controlling functions. | 2 | Desirable | Not started |
| 4.3 | 3.1.4.3 | A Graphical User Interface (GUI) shall be provided. | 2 | Desirable | Not started |
| **2.1.3** |  | **Enhance WMT as a Visitor Attraction.** | **2** | **Essential** | **Not started** |
|  | 3.1.4.4 | Educational displays shall be provided to inform visitors. | 2 | Desirable | Not started |
|  | 3.1.4.5 | A TV display shall be provided.???????????????? | 2 | Desirable | Not started |

### Phase 5

Table 6: Phase 5 Functional Requirements

| Requirement Nos | | Requirement | Priority | Type | Status |
| --- | --- | --- | --- | --- | --- |
| Source | Derived |
| **2.2.2** |  | **Expand rain water harvesting, storage and irrigation feeds to suit needs of river / gardens.** | **2** | **Desirable** | **Not started** |
| - | 3.1.5.1 | Flexible hoses and ‘soaker’ hoses shall be provided to allow gardeners to irrigate plants. | 2 | Desirable | In progress |
| - | 3.1.5.1.1 | A means of controlling the flow of water to the soaker hoses shall be provided. | 2 | Desirable | Not started |

### Phase 6

Table 7: Phase 6 Functional Requirements

| Requirement Nos | | Requirement | Priority | Type | Status |
| --- | --- | --- | --- | --- | --- |
| Source | Derived |
| **2.2.3** |  | **Stored water “balancing” between storage sites.** | **2** | **Desirable** | **Not started** |
| - | 3.1.6.1 | Additional rainwater butts shall be located in suitable places to harvest water from the roofs of the WMT buildings. | 2 | Desirable | Not started |
| - | 3.1.6.1.1 | A means of balancing the water levels in the rainwater butts shall be provided. | 2 | Desirable | Not started |

## Operational

The Table below details the operational capabilities required of the system, it's priority and type.

Table 8: Operational Requirements

|  |  |  |  |
| --- | --- | --- | --- |
| No | Requirement | Priority | Type |
| 2.1 | The system shall be designed so that the Town staff can start the pumping and filtration system by turning on the power. | 1 | Essential |
| 2.2 | The system shall be designed so that the Town staff can stop the pumping and filtration system by turning off the power. | 1 | Essential |
| 2.3 | Manual control of the pumping and filtration system shall be provided. | 1 | Essential |
| 2.4 | Automatic control of the various functions shall be transparent to the Town staff, except when manual override is necessary. | 1 | Essential |
| 2.4.1 | Manual control of the automated functions shall be available to the Town staff via a standard computer in the WMT Office | 2 | Desirable |
| 2.5 | The educational display detailed in Requirement No 3.1.4.4 shall be provided in a form that allows the Visitors to monitor the following functions: | 2 | Desirable |
| 2.5.1 | Water flow through supply pipe. | 2 | Desirable |
| 2.5.2 | Water flow in the river. | 2 | Desirable |
| 2.5.2 | Height of water in the sump. |  |  |
|  | ???? |  |  |
|  | ???? |  |  |

## Environmental

The Table below details the environmental requirements of the system, their priority and type.

Table 9: Environmental Requirements

|  |  |  |  |
| --- | --- | --- | --- |
| No | Requirement | Priority | Type |
| 3.1 | The system must not pollute the river water or any other part of the environment. | 1 | Essential |
| 3.2 | All electronic components of the system that are installed as part of Phase 4 shall be protected from the ingress of moisture. | 1 | Essential |
| 3.3 | All electronic components shall be adequately cooled. | 1 | Essential |

## Reliability

The Table below details the reliability required of the system, it's priority and type.

Table 10: Reliability Requirements

| No | Requirement | Priority | Type |
| --- | --- | --- | --- |
| 4.1 | The system shall be designed to be fail-safe in the event of a power supply failure. | 1 | Essential |
| 4.2 | Components shall be de-rated where possible, especially circuits carrying powers in excess of 1 W. | 1 | Essential |

## Maintainability

The Table below details the maintainability required of the system, it's priority and type.

Table 11: Maintainability Requirements

|  |  |  |  |
| --- | --- | --- | --- |
| No | Requirement | Priority | Type |
| 5.1 | The system shall be designed to be maintainable by suitably qualified Town staff, using only the documentation provided by the developers. | 1 | Essential |
| 5.2 | Spares shall be provided for any components that are liable to end-of-life or frequent failure. | 1 | Essential |
| 5.3 | Backups of any software developed shall be made available for future maintainers. | 1 | Essential |

## Safety

The Table below details the safety requirements of the system, it's priority and type.

Table 12: Safety Requirements

|  |  |  |  |
| --- | --- | --- | --- |
| No | Requirement | Priority | Type |
| 6.1 | The system must be designed such that no mains or high voltage supplies are used within the functional parts of the system. | 1 | Essential |
| 6.2 | Power supplies derived from mains must be fully enclosed in a protective case. | 1 | Essential |

## Documentation

The Table below details the documentation requirements of the system, it's priority and type.

Table 13: Documentation Requirements

|  |  |  |  |
| --- | --- | --- | --- |
| No | Requirement | Priority | Type |
| 7.1 | A comprehensive design specification shall be produced. | 1 | Essential |
| 7.2 | The design specification shall include full descriptions of all functionality, parts lists and circuit diagrams. | 1 | Essential |
| 7.3 | All software shall be fully documented with comments. | 1 | Essential |
| 7.4 | An Installation Specification shall be provided that details how to deploy the software and hardware. | 1 | Essential |
| 7.5 | A User Manual shall be provided that details how to use and maintain the software and hardware. | 1 | Essential |

## Miscellaneous

The Table below details the miscellaneous requirements of the system, it's priority and type.

Table 14: Miscellaneous Requirements

|  |  |  |  |
| --- | --- | --- | --- |
| No | Requirement | Priority | Type |
| 8.1 | Where possible and without compromising the other requirements in this document, elements of the existing system shall be re-used. | 2 | Goal |
| 8.2. | The project team shall estimate the cost of each phase of the project, so that a budget may be agreed. | 2 | Goal |

# ASSUMPTIONS

The following assumptions are made.

* Developers will have the pre-requisite knowledge to design and implement the hardware and software required to realise this project and subsequently enhance it.
* Maintainers will have the pre-requisite knowledge, supported by the supplied documentation, to maintain the system.
* WMT staff will have the pre-requisite knowledge, supported by the supplied documentation, to operate and monitor the system.