

## TABLE OF CONTENTS

**Preface** (not included for draft review)

**Purpose of This Manual** (not included for draft review)

**How This Manual is Organized** (not included for draft review)

**Low Impact Development Applications** (not included for draft review)

**Acknowledgements** (not included for draft review)

**Glossary of Terms and Acronyms** (not included for draft review)

<b>Chapter 1: Introduction</b> .....	1
1.1 Puget Sound Hydrology	
1.2 Impacts of Urbanization	
1.3 Current Stormwater Management	
1.4 Low Impact Development	
1.4.1 Definition	
1.4.2 Goal of LID	
1.4.3 Flow Control Objective	
1.4.4 Flow Control Objective Discussion	
1.4.3.1 Rural setting	
1.4.3.2 Medium to high density settings	
1.4.5 Flow Control Objective and the Department of Ecology Stormwater Management Manual for Western Washington	
1.4.6 Site Design and Management Objectives	
1.4.7 Low Impact Development in the Watershed Context	
1.4.8 Low Impact Development and Comprehensive Stormwater Management	
<b>Chapter 2: Site Assessment</b> .....	15
2.1 Stormwater Site Plans	
2.1.1 Site plans for Minimum Requirements 1-5	
2.1.2 Site plans for Minimum Requirements 1-9	
2.2 Soil and Subsurface Characterization	
2.3 Hydrologic Patterns and Features	
2.4 Native Soil and Forest Protection Areas	
2.5 Wetlands	
2.6 Riparian Management Areas	
2.7 Streams	
2.8 Floodplains	
2.9 Sub-basin Delineation	
2.10 Site Planning Process	
<b>Chapter 3: Site Planning and Layout</b> .....	35
3.1 Urban Redevelopment and Infill	
3.1.1 Roads, Driveways and Parking	
3.2.2 Lot and Building Design	
Project Case Study: Danielson Grove	

- 3.2 New Suburban Development
  - 3.2.1 Roads, Driveways and Parking
    - Road layout
    - Road width
    - Turnarounds
    - Parking
    - Traffic calming strategies
    - Driveways
    - Sidewalks
  - 3.2.2 Lot Layout
    - Medium to High Density Cluster
    - Project Case Study: Fairhaven Heights
    - Rural Cluster and Large Lot Development
  - 3.2.3 Building Design
- 3.3 Commercial
  - 3.3.1 Parking
    - Project Case Study: Wilson Motors
- 3.4 Road Crossings

**Chapter 4: Vegetation and Soil Protection and Reforestation and Maintenance ..... 68**

- 4.1 Native Soil and Vegetation Protection
  - 4.1.1 Protection During Construction Phase
- 4.2 Re-establishing Native Vegetation
  - 4.2.1 Evaluating Existing Vegetation
  - 4.2.2 Plant Selection
  - 4.2.3 Plant Size
  - 4.2.4 Planting
- 4.3 Maintenance

**Chapter 5: Precision Site Preparation and Construction ..... 80**

- 5.1 Precision Site Preparation
- 5.2 Techniques to minimize site disturbance
  - 5.2.1 Efficient Site Design
  - 5.2.2 Coordinated Planning and Activity
  - 5.2.3 Training Personnel
  - 5.2.4 Proper Equipment
- 5.3 Inspection of LID Facilities
  - 5.3.1 Amended Construction Site Soils
  - 5.3.2 Bioretention
  - 5.3.3 Permeable Pavement
- 5.4 Construction Sequencing of LID Facilities
  - 5.4.1 Bioretention
  - 5.4.2 Permeable Pavement

**Chapter 6: Integrated Management Practices ..... 98**

- 6.1 Bioretention Areas
  - 6.1.1 Applications
  - 6.1.2 Design
    - 6.1.2.1 Determining Subgrade and Bioretention Soil Media Infiltration rates
    - 6.1.2.2 Bioretention Components
    - 6.1.2.3 Installation

	6.1.2.4	Maintenance	
	6.1.2.5	Performance	
6.2		Amending Construction Site Soils.....	145
	6.2.1	Applications	
	6.2.2	Design and Implementation	
	6.2.2.1	Developing a Soil Management Plan	
	6.2.2.2	Verifying Soil Quality and Depth	
	6.2.2.3	Compost	
	6.2.2.4	Steep Slopes	
	6.2.3	Construction Sequencing for Protecting Construction Site Soils	
	6.2.4	Maintenance	
	6.2.5	Performance	
6.3		Permeable Paving.....	162
	6.3.1	Applications	
	6.3.2	Design and Construction	
	6.3.2.1	Common Components, Design and Construction of Permeable Paving	
	6.3.2.1	Types of Permeable Pavement	
		Porous Hot or Warm Mix Asphalt	
		Portland Cement Pervious Concrete	
		Permeable Interlocking Concrete Pavement	
		Plastic or Concrete Grid Systems	
	6.3.3	Maintenance	
	6.3.4	Performance	
6.4		Urban Trees.....	213
	6.4.1	Application	
	6.4.2	Assessment and Design	
	6.4.2.1	Site Assessment and Planning	
	6.4.2.2	Drainage	
	6.4.2.3	Soil Strategies	
	6.4.2.4	Protecting Existing Trees	
	6.4.3	Tree Selection	
	6.4.4	Planting Size	
	6.4.5	Spacing	
	6.4.6	Performance	
6.5		Vegetated Roofs.....	229
	6.5.1	Applications	
	6.5.2.1	Planning	
	6.5.2.2	Types of Vegetated Roofs	
	6.5.3	Components	
	6.5.3.1	Roof Deck	
	6.5.3.2	Waterproof Membrane	
	6.5.3.3	Drainage Layer	
	6.5.3.4	Growth Media	
	6.5.3.5	Vegetation	
	6.5.4	Maintenance	
6.6		Minimal excavation foundations.....	242
	6.6.1	Applications	
	6.6.2	Design	
	6.6.2.1	Pier Applications	
	6.6.2.2	Wall Applications	
	6.6.2.3	Dispersing Roof Stormwater	

6.6.3	Construction	
6.6.4	Performance	
6.7	Roof water Harvesting Systems.....	249
6.7.1	Applications	
	6.7.1.1 Rainwater Harvesting in the Stormwater Management Context	
6.7.2	Design	
	6.7.2.1 Components of a Rainwater Collection System	
6.7.3	Maintenance	
6.7.4	Performance	

## **Chapter 7: Washington State Department of Ecology Low Impact Development Design and Flow Modeling Guidance**

To be completed later. This is in Appendix III-C of the SWMMWW Volume 3. Once comments are received and Ecology updates that section we will include it in the LID Manual.

### **Appendix 1: Bioretention Plant List**

### **Appendix 2: Bioretention Performance**

### **Appendix 3: Recommended Bioretention Soil Mix Ksat Procedures**

### **Appendix 4: Maintenance of LID Facilities**

### **Appendix 5: Street Tree List**

### **Appendix 6: Compost Specifications**

### **Appendix 7: Permeable Pavement Performance**