MURRAY CITY

LOW IMPACT DEVELOPMENT

STANDARDS MANUAL

PREPARED BY:

M U R R A Y C I T Y C O R P O R A T I O N

PUBLIC WORKS

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TABLE OF CONTENTS

APPENDIX

1 INTRODUCTION

Murray City has prepared the Low Impact Development (LID) Standards Manual to comply with the requirements of the Utah Pollutant Discharge Elimination System (UPDES) Permit No. UTS000001. The LID Standards Manual provides guidance for the implementation of stormwater quality control or Best Management Practices (BMPs), to be incorporated into new developments and redevelopment projects within Murray City. The intent of BMP's are to improve water quality and mitigate water quality impacts by reducing the likelihood of contaminants from getting introduced into stormwater systems and consequently carried into streams, rivers, lakes, etc.

Under the current UPDES permit section 4.25, starting July 1, 2020 new development and redevelopment projects within Murray City that disturb one acre or more, including projects less than one acre that are part of a larger common plan of development or sale which collectively disturbs land greater than or equal to one acre, must incorporate long-term water quality BMPs, that allow stormwater to infiltrate, evapotranspire, or be harvested and used on-site to reduce stormwater runoff and protect water quality.

LID requirements address long-term post-construction stormwater management and should be incorporated into new developments and redevelopments design in addition to the Stormwater Pollution Prevention Plans (SWPPP), which only addresses stormwater management during construction activities.

Guidance for incorporating BMP features into new developments and redevelopment appropriate for use in the State of Utah can be found in A Guide to Low Impact Development within Utah (The Guide), available on the Utah Department of Environmental Quality website.

The Murray City LID Standards Manual is an update and compilation of the following documents:

- State of Utah Department of Environmental Quality, Division of Water Quality, UPDES permit No. UTS000001
- Utah Department of Environmental Quality, Division of Water Quality "A Quality to Low Impact Development within Utah", December 2018, Revised August 2020.
- Murray City Corporation Public Works "Stormwater Guidance Manual", Revised August 2020.
- Murray City, "2020 Stormwater Management Program".

2 MURRAY CITY LID REQUIREMENTS

LID permit requirements for post-construction stormwater runoff can be found in Section 4.25 of the UPDES permit. LID requirements apply to new development and redevelopments identified as meeting the following criteria:

- **New Development Projects** that disturb land greater than or equal to one acre, including projects that are part of a larger common plan of development or sale which collectively disturbs land greater than or equal to one acre must manage rainfall on-site, and prevent the off-site discharge of the precipitation from all rainfall events less than or equal to the 80th percentile rainfall event or a predevelopment hydrologic condition, whichever is less. This objective must be accomplished by the use of practices that are designed, constructed, and maintained to infiltrate, evapotranspire and/or harvest and reuse rainwater. The 80th percentile rainfall event is the event whose precipitation total is greater than or equal to 80 percent of all storm events over a given period of record.

- **Redevelopment Projects** that disturb greater than or equal to one acre, including projects less than an acre that are part of a larger common plan of development or sale which collectively disturbs land greater than or equal to one acre must provide a site-specific and project-specific plan aimed at net gain to onsite retention or a reduction to impervious surface to provide similar water quality benefits. If a redevelopment project increases the impervious surface by greater than 10%, the project shall manage rainfall on-site, and prevent the off-site discharge of the net increase in the volume associated with the precipitation from all rainfall events less than or equal to the 80th percentile rainfall event. This objective must be accomplished by the use of practices that are designed, constructed, and maintained to infiltrate, evapotranspire and/or harvest and reuse rainwater.

New developments and redevelopment meeting these criteria must incorporate long-term BMP principles in their design to ensure project sites meet predevelopment hydrology and reduce the number of pollutants into Murray City storm drain systems.

As a co-permitee, it is Murray City's responsibility to revise, implement, and enforce the UPDES permit requirements, such as programs that address post-construction storm water runoff from private and public new developments and redevelopment construction sites as described above. In general, project sites meeting the criteria identified above, must provide site plans which include the following requirements:

- New development/redevelopment must incorporate BMP practices in their design to meet predevelopment hydrologic conditions and minimize impacts to water quality. BMPs are site specific and must be selected to address pollutants expected to be discharged from site. Guidance for BMP selection is provided in Chapter 3.

- New development/redevelopment must incorporate detailed BMP drawings into the plans and define hydrologic methods for calculating runoff volumes and flow rates, to ensure consistent sizing of structural BMPs and to facilitate plan review. As a minimum BMPs shall be sized to retain the 80th percentile storm rainfall runoff volume. Guidance for calculating the 80th percentile runoff

volume is provided in Chapter 5.

- New development/redevelopment are required to develop a Long-term Storm Water Management Plan that includes an inventory of long-term BMPs including location, description, maintenance requirements, owner contact information, and inspection information. BMPs must be accessible to City personnel to ensure structures are constructed and maintained properly. In addition, all BMPs control measures must be inspected at least once during installation and prior to construction permit close-out to ensure the BMP's were constructed as designed and at least every 5 years by the Permittee. Condition of the structure, maintenance and violations and re-inspection dates are to be documented. A Long-Term Storm Water Management Plan checklist is provided in in Appendix B.

If meeting the 80th percentile rainfall runoff volume retention standards is not feasible, the site is not required to retain the full retention goal. However, new development or redevelopment are required to identify technical infeasibilities and provide a justification to use an alternative design criteria. In addition, new development and redevelopments must document that BMP designs have been used to the maximum extent feasible, and full employment of these measures cannot be achieved due to site constraints. BMPs technical infeasibilities are generally related to shallow groundwater, soil conditions, project boundaries, economic factors, or other reasons.

3 LID TYPES AND SELECTION

3.1 LID Types

BMPs should be incorporated into design of new development and redevelopment during the planning stage to ensure Murray City requirements are met, the design is compatible with the site's hydrology, and to reduce costs associated with redesign of site layouts, or additional feasibility studies.

BMPs are long-term structures, graded features, or practices that are designed to retain and/or treat runoff close to its origin after construction is complete. A complete list of LID BMPs appropriate for use in the state of Utah, and guidance for selection and design can be found in Appendix C of The Guide. Any BMPs presented Appendix C of the Guide that meets the 80th percentile runoff volume retention requirements and is feasible for construction may be used.

Strategies to manage stormwater runoff, generally fall under two categories: Planning Practices, and BMPs. By applying Planning Practices developers may be able to reduce stormwater impacts, reduce capital and maintenance cost of infrastructure, and increase quality of life and property value. Common Planning Practices include the following methods:

- Reduction of Impervious Surfaces – Minimizing impervious ground cover can help meet on-site retention requirements and possibly decrease the cost of installing other BMP measures.
- Disconnected Impervious Areas – Direct storm water runoff from impervious surface toward pervious surfaces or vegetated areas.
- Curb Cuts— Used to divert runoff from a traditional storm drain network to a pervious area or a BMP.

Along with Planning Practices, structural BMPs may be implemented to manage stormwater on-site in more effective and sustainable ways. The Department of Water Quality developed fact sheets for 12 common BMPs. Relevant information for design of all these BMPs has been outlined in Appendix C of The Guide.

Generally, in Murray City it has been difficult for residential developer to design BMPs that meet the 80th percentile retention requirement due to site constraints, and project layouts. Murray City has documented two alternatives BMP examples that have been implemented in new residential developments throughout the city, along with standard designed engineering details (Appendix C). The following BMPs are not intended to be all inclusive, may not be appropriate for every site, and should be adapted to type and size of project, and site conditions.

The following sections introduce two BMPs that can have been used in existing and planned Murray City developments to treat runoff near the source.

- Dry Well and Infiltration Trench Combination
- Rock Infiltration Swale / Dry well combination

3.1.1 Dry Well and Infiltration Trench Combination

This BMP consist of a catch basin cleanout box serving as a dry well, placed at a low point of a typical curb and gutter. The box is connected to a perforated pipe, placed in an infiltration trench excavated along park strips or below sidewalk areas. The trench is backfilled with a minimum of 12 inches of washed gravel such as No. 57 aggregate. Pipe diameter will vary depending on the project retention requirements. The volume of the perforated pipe and the voids in the aggregate may be used to size the runoff volume of the 80th percentile.

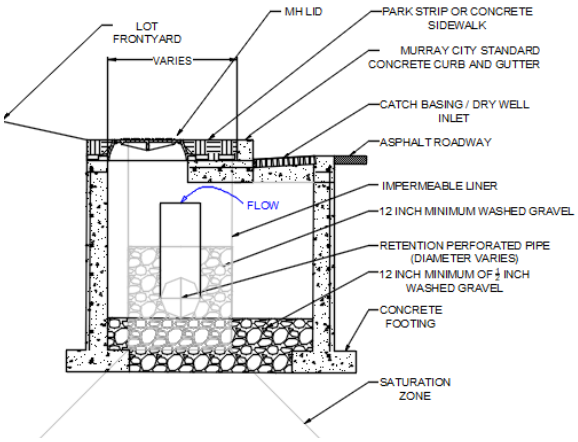


Figure 1. This diagram shows the major design components of this BMP. The Dry Well box captures the runoff, and the connected perforated pipes distributes it below park strips or sidewalks to be infiltrated into the underlying soils.
The roadway and dry well box are maintained by the City and the property owner maintains the park strip as typical.

This BMP has been found to be ideal for narrow park strips or below sidewalks. The perforated pipe should be placed at a **minimum of 6 feet below grade**, and an impermeable liner must be placed along the walls of the trench to maintain the saturation zone below utilities zones or adjacent building foundations.

Stormwater from impervious areas such as rooftops, or driveways may be routed into the infiltration trench. However, this type of BMP should be carefully engineered to the site's conditions, are not allowed within drinking water Well Protection Zones, and are not recommended for sites where the infiltration rate is less than 0.25 inch/hour.

As with any stormwater control system, the design of this type of BMP must include provisions to manage precipitations events that will exceed their capacity, such as connections to emergency overflow structures that drain to public storm water. Drainage path should always be well maintained and stabilized.

Maintenance Considerations

Task	Frequency	Maintenance Notes
Dry Well Inspection	Annually, as needed, and after every major storm event	• Remove litter and debris to prevent clogging • Inspect water depth • Remove and dispose of built-up sediments when it causes a reduction in detention capacity
Inlets and Trench Inspection	Annually, as needed, and after every major storm event	• Remove trash and debris at inlets and outlets • Remove trees in the vicinity • Inspect for standing water above trench

3.1.2 Rock Infiltration Swale

This type of BMP typically consists of linear shallow depressions that capture and temporarily store stormwater. Rock infiltration swales are appropriate for small subdivisions where limited narrow space along roads, sidewalks, trails, park strips or along property boundaries is available. Rock infiltration swales are generally backfilled up to the bottom of the swale with a 2-to-4-foot layer of native or engineered soils, consisting of sandy soils or open graded gravel. The backfill soils should have a minimum infiltration rate of 5 inches per hour. The Infiltration swale may be designed to retain the 80th percentile storm volume within voids in the gravel and sand layers, and/or depth controls features such as control dams. The swale may also be graded to distribute stormwater across the site and if necessary to convey runoff into a detention BMP or to flow into the storm drain network.

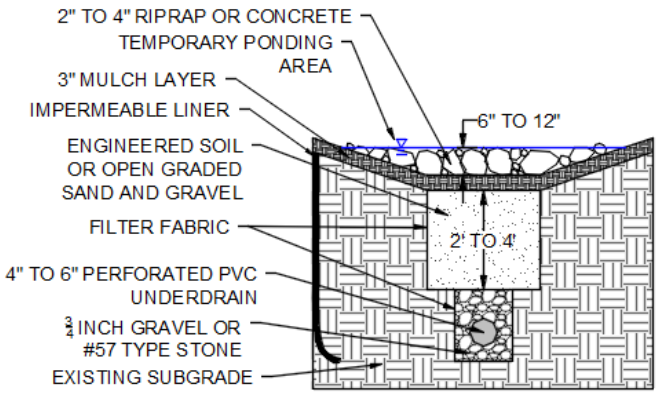


Figure 2. This diagram shows the major design components of a Rock Infiltration Swale. The capture runoff percolates through the bottom of the swale and a soil layer capable of draining the swale within a specified design drawdown time.

These swales typically require elevation change between the inlet and outlet to maintain a slope between 0.5 and 2.0 percent. Rock infiltration swales can be used in any type of soil, however, if the infiltration rate is less than 0.25 in/hour or if site conditions do not allow infiltration, an underdrain pipe should be installed to transport excess stormwater into a detention BMP or the city storm drain. In addition, impermeable liners may be needed to maintain saturation zones below utilities and adjacent building foundations.

In Murray City where paved roads and gutter systems with high curb are usually required, curb cuts may be incorporated to route stormwater from impervious areas into the infiltration swells.

Maintenance Considerations

Task	Frequency	Maintenance Notes
Catchment Inspection	Semiannual and as needed	• Remove litter and debris • Remove and dispose of built-up sediments when it causes a reduction in detention capacity
Side Slopes and Channel	Semiannual and as needed	• Inspect for erosion and sloughing, regrade if needed. • Inspect for standing water above trench • Inspect for standing water.

3.2 BMPs Considerations and Selection

BMPs are site specific, and their selection is based on many factors. Receiving waters, 303(d) impairments, TMDLs, land use, and watershed management plans should be considered at the planning level when determining which BMPs are most appropriate. In addition, project boundaries, groundwater, contaminated soils and groundwater, site topography, low permeability soils, and available connections to existing storm drains will guide the project site BMP selection.

In Murray City, Retention/Infiltration type of BMPs are not allowed within Well Protection Zone 3 (See Well Protection Zones in Figure 3). For project sites located within these zones, BMPs should consist of Flow-through BMPs or Retention BMPs, provided impermeable liners and underdrains are installed. In addition, landscape areas should by lined with impermeable liners to protect drinking water zones. Open detention ponds that remain full of standing water for periods longer than 72 hours due to poor draining soils will also not be allowed.

Retention/Infiltration BMPs are also not allowed in areas with the following site conditions:

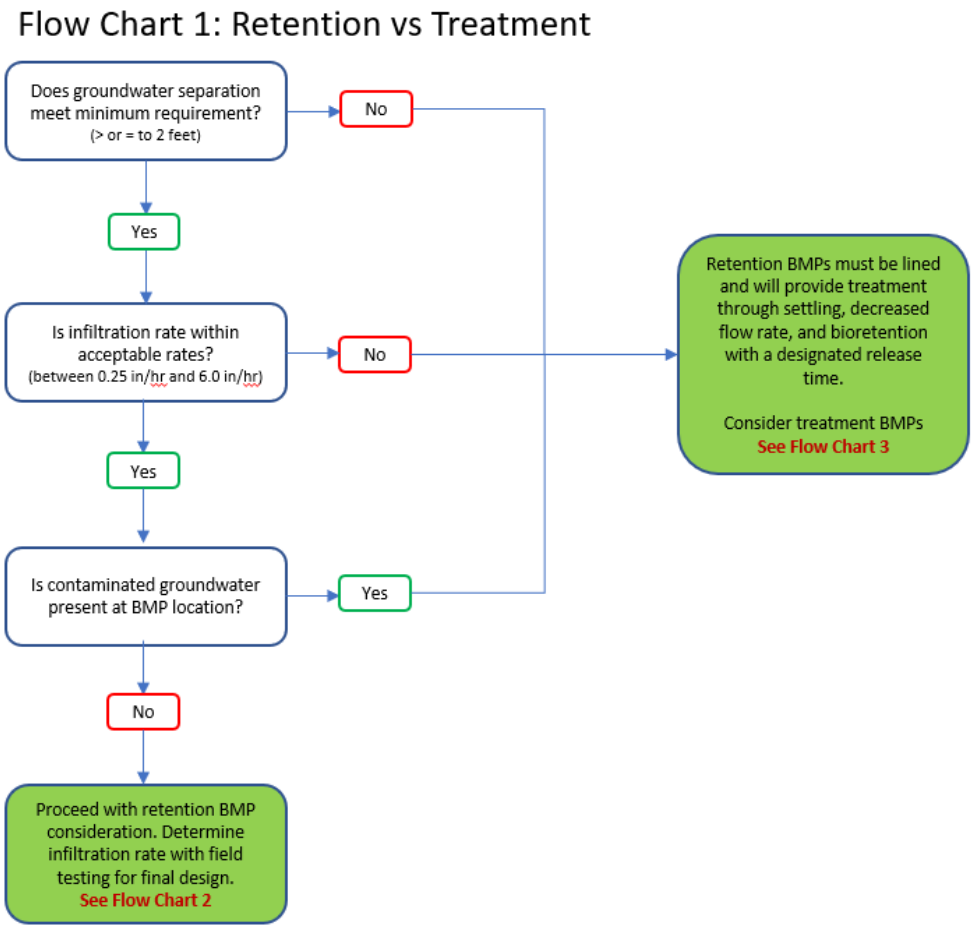
- Locations where seasonal groundwater level is located at less than 2 feet from the bottom of the BMP.
- Locations within drinking water Well Protection Zone 3 (See figure 1).
- Brownfield development sites where infiltration poses a risk of pollutants mobilization.
- Locations at or near properties that are contaminated or store hazardous substances.
- Locations where the infiltration rate is less than 0.25 inch/hour, and it is not feasible to amend in-situ soils to attain an infiltration rate necessary for storm water quality control measure.

Guidance for LID BMP selection can be found in pages 33 through 38 of The Guide. In addition, the following three charts were copied from The Guide and modified to Murray City standards to guide developers through general BMP evaluation and selection process.

Murray City LID Standards Manual

Flow Chart 1: Retention vs Treatment

Based on site conditions, determine if retention or treatment will be used.



Flow Chart 2

Retention BMPs 1

Rain Garden
Bioretention Cell
Green Roof
Pervious Surface
Infiltration Basin
Infiltration Trench
Underground Infiltration Galleries
Dry Well
Proprietary Devices
Harvest and Reuse 3
Other

Flow Chart 3

Treatment BMPs 2

Bioswale
Vegetated Strip
Tree Box Filter
Proprietary Devices
Harvest and Reuse 3
Other

1 When retention BMPs are infeasible, they may still provide treatment by using impermeable liners and underdrains.
2 Bioswales may function as retention devices if soils permit and if a raised outlet is provided.
3 Harvest and Reuse may be considered a retention BMP or a treatment BMP depending on the application.

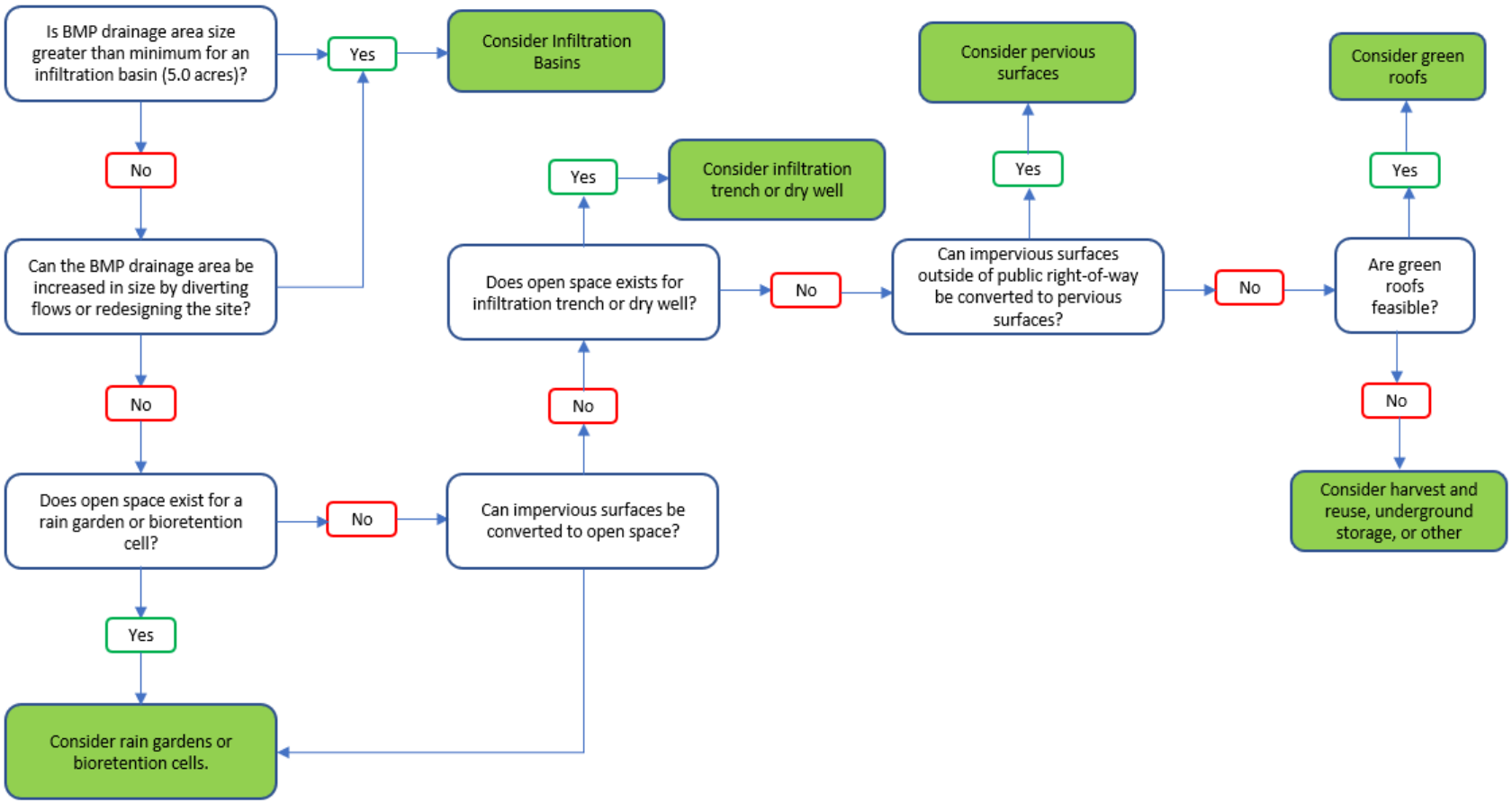
Adapted from "A Guide to Low Impact Development within Utah", UDEQ

Murray City LID Standards Manual

Flow Chart 2: Retention BMP Selection

Determine which BMPs will provide retention based on the design criteria and technical criteria of each BMP.

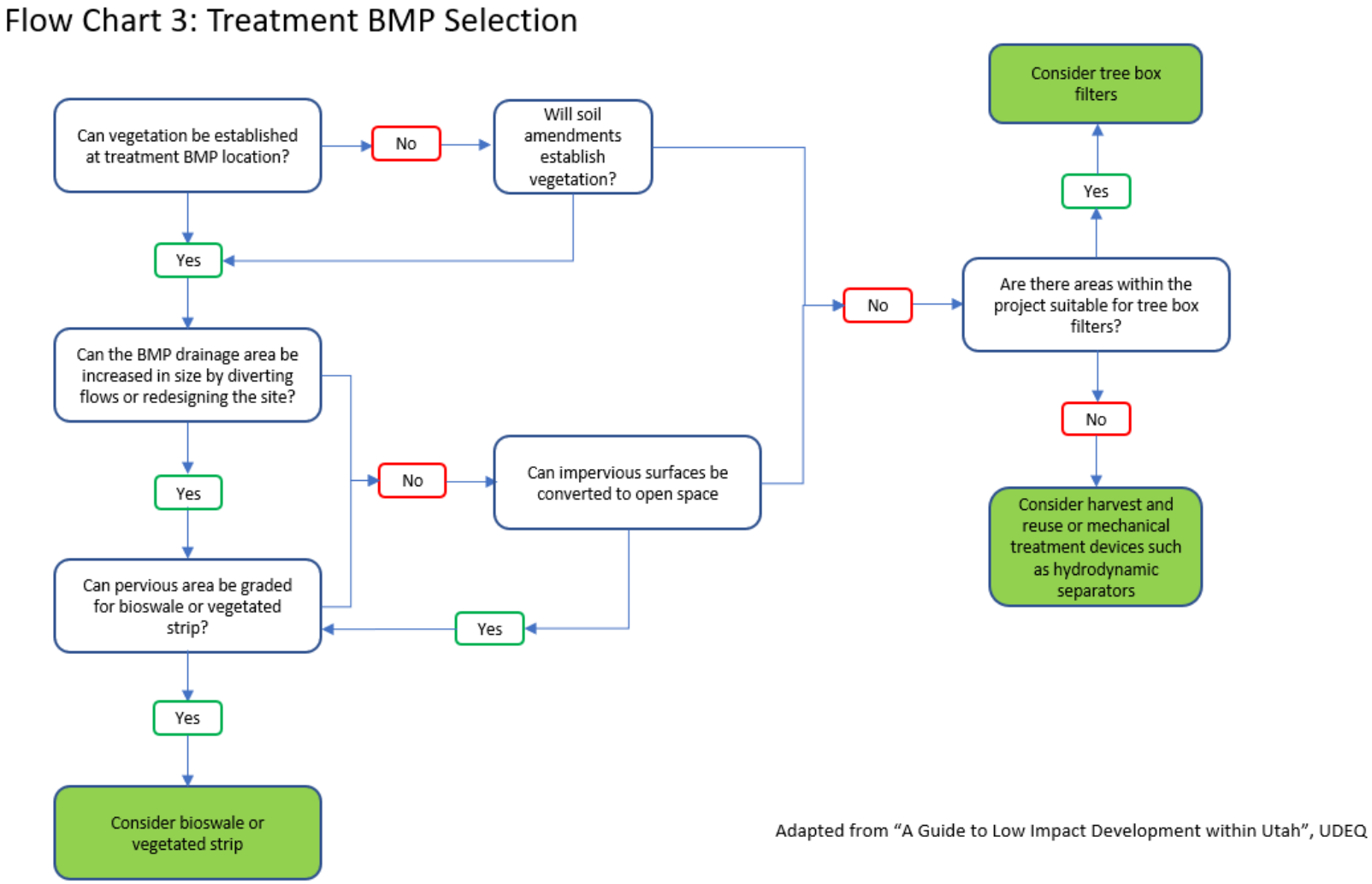
Flow Chart 2: Retention BMP Selection



Adapted from "A Guide to Low Impact Development within Utah", UDEQ

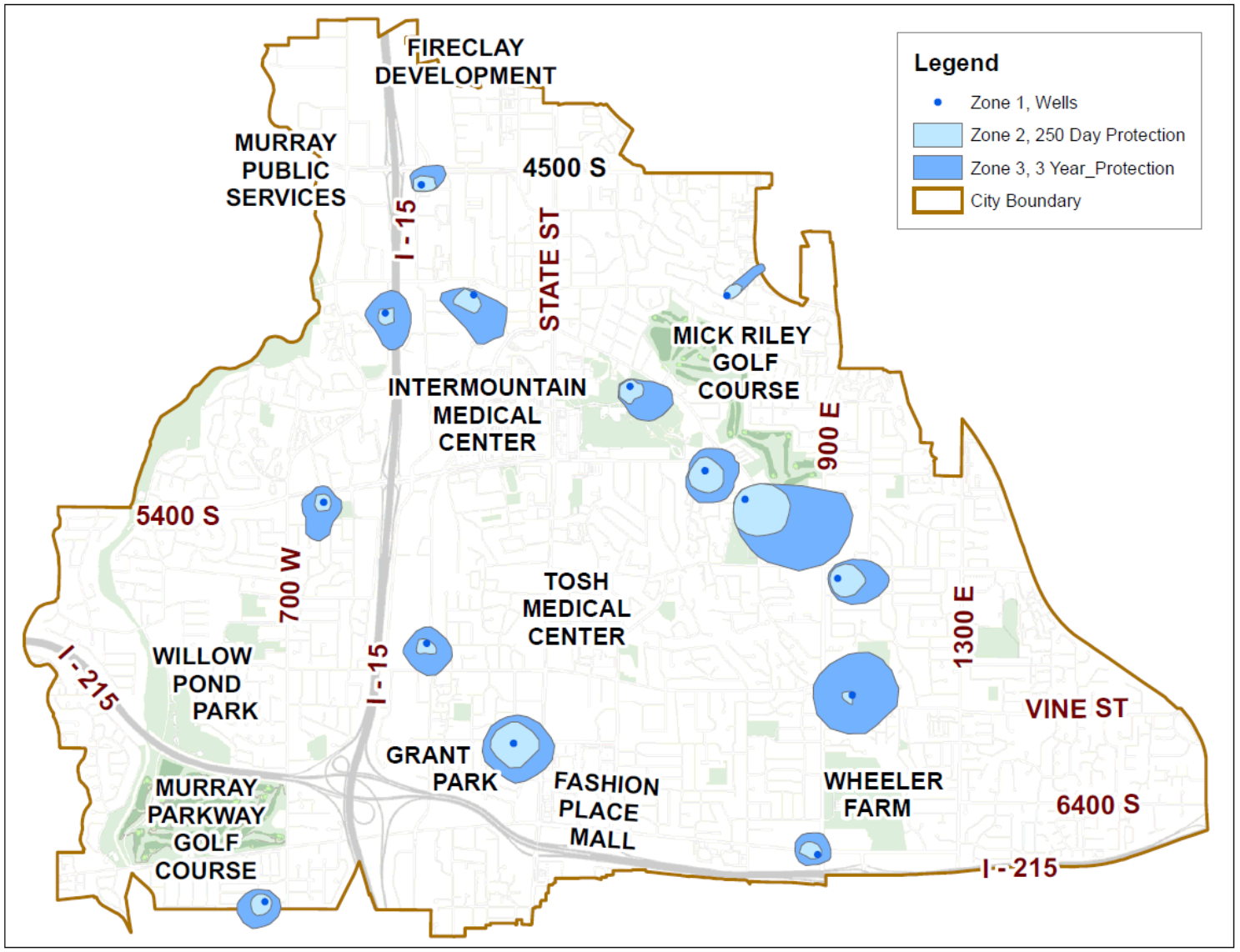
Flow Chart 3: Treatment BMP Selection

Determine which BMPs will provide treatment based on the design criteria and technical criteria of each BMP.



Adapted from "A Guide to Low Impact Development within Utah", UDEQ

Figure 3: Murray City Well Protection Zones



4 PROJECT PLANS AND SUBMITTALS

Once project site has been evaluated and BMPs are selected, applicants for new development and redevelopment must submit and LID Plan for review and approval to Murray City Public Works. The LID Plan should comply with the Murray City requirements and must include the following information:

- Total project area
- Construction site area to be disturbed
- Percentage impervious area before construction
- Feasibility of infiltration including a percolation rate as part of the geotechnical report for projects where Retention/Infiltration BMPs are planned for construction
- Topography and drainage patterns
- Groundwater information
- Runoff coefficient before construction
- List of pollutants expected to be discharge from development
- List of proposed post-construction BMPs
- Provide calculations for sizing of planned BMPs
- Show location and type of each post construction BMP features planned to be installed
- Plans must show construction details and/or manufacturers requirements needed to construct proposed BMPs
- Identify any applicable federal, state, or local requirements for design and installation
- Potential impacts of lateral migration of water across property lines
- Proposed BMPs long-term maintenance guidelines

Murray City recommends developers to use the LID Checklist (Appendix A) template during the project design phase and review process. This report should be submitted to Murray City to assist with project documentation, and for ease of review.

In addition, all new developments and redevelopments are required to submit a long-term Storm Water Management Plan (SWMP) with the building permit application. The SWMP consist of a set of measures and practices to be maintained by the property owner or operator after construction activities are completed. SWMP practices include, regular maintenance, document inspections, as well as measures to prevent illicit discharges, pollutants, and other contaminants from entering the City storm water systems. The SWMP should be prepared by the property owners, as they will be required to implement the plan in perpetuity. A checklist for the long-term SWMP can be found in Appendix B.

5 80TH PERCENTILE VOLUME

As directed by the UPDES permit, projects meeting the criteria in Chapter 2 are required as a minimum to retain the 80th Percentile Storm Depth on site and are allowed to release the excess runoff into the City storm drains at a controlled rate of 0.2 cubic feet per second (cfs) per acre. Alternatively, developers may choose to completely retain all storm water. For developers choosing to fully retain stormwater, BMPs shall be sized to store 100 percent runoff volume from a 100-year 12-hour storm event, assuming no percolation occurs.

To retain the 80th Percentile, new developments are required to establish and meet a Project Volume Retention Goal (V_{goal}).

For New Developments, V_{goal}, consist of the product of the total area of the development, the 80th percentile storm rainfall depth and the volumetric runoff coefficient (R_v).

For Redevelopment that result in a net increase of impervious surface areas greater than 10%, V_{goal} is the net increase in volume between the existing condition and the proposed condition generated by the 80th percentile storm depth.

The following depth shall be used as the 80th Percentile Storm Rainfall Depth for project sites in Murray City:

0.46 inches

Sample and detailed calculations for 80th percentile volume for new developments and redevelopment, along with several methods for calculating R_v can be found in 80th Percentile Volume section of The Guide. In Murray City the preferred method to estimate R_v for the project retention goal is method 3 – Granato method.

$$R_v = 0.225i + 0.05; \quad \text{when } i < 0.55$$
$$R_v = 1.14i - 0.371 \quad \text{when } i \geq 0.55$$

$$\text{Where i} = \frac{Post\ Development\ Impervious\ Area}{Project\ Disturbance\ Area}$$

BMPs should be sized to retain or treat V_{goal}. Guidance and sample calculations to size all structural BMPs described in Chapter 3, can be found in Appendix C of The Guide.

6 REFERENCES

- "A Guide to Low Impact Development within Utah" (Utah LID Guide) https://deq.utah.gov/water-quality/low-impact-development
- "Murray City 2020 Storm Management Program", Murray City Corporation Public Works, September 2020, Murray-City-SWMP-Update-2020 (utah.gov)
- "Storm Water Guidance Manual", Murray City Corporation Public Works, August 2020, Stormwater-Guidance-Manual (utah.gov)
- "Sandy City Low Impact Development Toolbox" Sandy City Public Utilities, April 2021
- "UPDES Permit Number UTS000001", State of Utah Department of Environmental Quality, Division of Water Quality, Effective date February 26, 2020.
- "West Valley City 2020 Engineering Standards Volume I" West Valley City, August 2020.

Appendix A – LID Checklist

Site plans for new developments and redevelopment meeting the criteria described in section 2 of the Murray City LID Standards Manual must contain the following checklist information and be submitted to the City in electronic form for review and approval.

Project Information:

- Project name
- Project location
- Contact information for all parties involved (address, phone number, email)

Project Site Information:

New Development

Area of Land Disturbance (ac): _____

Project Impervious Area (ac): _____

Project Imperviousness (%): _____

Project Volumetric Runoff Coefficient, R_V: _____

80th Percentile Volume (cf): _____

Predevelopment Hydrologic Condition (cf): _____

Project Volume Retention Goal, V_{goal} (cf): _____

Redevelopment

Existing Project Impervious Area (ac): _____

Proposed Project Impervious Area (ac): _____

Change in Impervious Area (%): _____

If change in impervious area > 10%:

Existing Project Conditions

Imperviousness (%): _____

Volumetric Runoff Coefficient, R_V: _____

80th Percentile Volume, V_1 (cf): _____

Proposed Project Conditions

Imperviousness (%): _____

Volumetric Runoff Coefficient, R_V: _____

80th Percentile Volume, V_2 (cf): _____

$V_{goal} = V_2 – V_1$ = _____

Subsurface Information

- Depth to groundwater.
- Historical high depth to groundwater if known.
- Source of information.
- Groundwater contamination at site (if any), and a description of how it will be treated or managed.

Soil Information

- Infiltration rate
- Hydrologic soil group
- Source of information
- Soil contamination at site (if any), and a description of how it will be treated or managed.

Hydrologic Information

- Rainfall data (See Murray City, Storm Water Guidance Manual, Chapter 2 for requirements)

Drinking Water

- Is project site within a drinking water source area protection

Development Activities

- Description of potential site pollutants from new development
- Description of how pollutants from new development will be treated or managed.

Additional Relevant Site Information

- Description of any relevant site information

LID Drainage Areas

Contributing Drainage Area	Area (ac)	Impervious Area (ac)	Imperviousness (%)	Volumetric Runoff Coefficient, R_V	Water Quality Volume, WQV (cf)
CDA 1					
CDA 2					
CDA 3					
CDA 4					
				Total WQV (cf)	

LID BMP Design

Contributing Drainage Area	LID BMP Type	Water Quality Volume, WQV (cf)	Runoff Retained (cf)	Percent of Runoff Captured (%)
CDA1				
CDA 2				
CDA 3				
CDA 4				
Total Volume Retained (cf)				

- Percent of V_{goal} captured by LID BMPs: ____%
- If 100% of V_{goal} is not captured, document and provide narrative of technical infeasibilities and/or alternate compliance measures
- Describe additional storm water quality measures incorporated into the site:

Overall site plans

- Existing topography, proposed grading, and drainage patterns.
- Location and type of drainage features.
- Location and type of each post-construction LID BMPs planned to by installed.
- Plans must show construction details and/or manufacturers requirements needed to construct proposed LID BMPs.
- Provide calculations for sizing of planned BMPs

Appendix B – LID Long Term Stormwater Management Plan (SWMP) Checklist

As required by Murray City UPDES permit, new developments and redevelopments are required to build and maintain LID BMPs systems to minimize contaminants in stormwater runoff that pollute waters of the State.

To ensure that long-term, on-going inspections and maintenance are completed regularly, Murray City requires execution of a Stormwater Inspection and Maintenance Agreement, and submittal of a Maintenance Plan. The property owner or designated person is responsible for complying with the requirements of the Maintenance Agreement and Maintenance Plan.

The following items must be included with the Maintenance Agreement:

- Exhibit A – Legal Description of the Premises
- Exhibit B – Plans showing accurate locations of each LID BMP system proposed for construction, and maintenance easements that will ensure access to the site for purposes of inspections, maintenance, and repairs.
- Exhibit C – Maintenance and Repair Plans describing the activities that must be carried out to maintain compliance with the Maintenance Agreement.

Maintenance and Repair Plans Requirements

The Maintenance Plan must address the following:

- Operation plan and schedule, including a site map with locations for each permanent LID BMP.
- Provide a brief description of each LID BMP, and if appropriate manufacturer's maintenance recommendations, fact sheets, and any additional information.
- Maintenance and cleaning activities and schedule.
- A description of site inspection procedures and documentation.
- Measures to control spills and prevent illicit discharges.
- Equipment and resource requirements necessary to operate and maintain stormwater quality control measures.
- Responsible party for operation and maintenance