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Title: Stormwater Management Solutions for Whittaker Inn

Executive Summary:

The owners of The Whittaker Inn have experienced issues with their existing stormwater system. The issues pose a threat to the safety of the guests and the natural beauty of the property. The proposed solution uses various stormwater control measures to eliminate the issue while providing an environmental benefit.

Background:

Construction and land development for The Whittaker Inn was completed in 2018. The contemporary farmhouse-inspired inn, provides visitors with a unique and luxurious experience. Land development plans specify a single grassed channel to drain the property. Two retention ponds along the channel were designed to fill during storms and slowly release the water to prevent excessive runoff to the municipal drainage ditch.

Project Scope:

The owners have identified two problems with the existing stormwater system:

1. The retention pond located next to the inn never drains fully. Being located so close to the building and parking lot, this is a source of concern for the owners. The standing water poses a safety concern for guests and is a source of insect infestations.
2. During periods of heavy precipitation, runoff from the front lawn is directed over the driveway. This creates a safety hazard due to skidding over water or ice.



Figure 1. Whittaker Inn stormwater issues

Criteria and Constraints:

Criteria	Constraints
1. Safety for guests	1. Limited time
2. Aesthetic consistency	2. Compliance with local codes
3. Price	
4. Ease of implementation	
5. Ease of maintenance	

Alternate Solutions:

Solutions: Criteria:	Solutions Rated From 1 (less good) to 5 (best)					Criteria Weight Multiplier
	Retention Pond	Rain Garden	Amend Soil	Vegetation Change	Subsurface Drainage	
Ease of Implementation	5	2	3	4	3	5
Ease of Maintenance	2	3	5	4	5	4
Price of Implementation	5	1	4	4	4	3
Aesthetic Quality	1	4	4	4	4	5
Safety for Guests	1	5	5	5	5	8
Solution Efficacy	3	2	2	3	5	8
Solution Weighted Total:	85	101	123	132	147	

Table 1. Design matrix for solutions to the ponding issue

Solutions: Criteria:	Solutions Rated From 1 (less good) to 5 (best)			Criteria Weight Multiplier
	Culvert	Redirect Flow	Permeable Paver	
Ease of Implementation	1	2	1	5
Ease of Maintenance	5	3	5	4
Price of Implementation	3	3	2	3
Aesthetic Quality	4	3	3	5
Safety for Guests	5	4	5	8
Solution Efficacy	5	2	4	8
Solution Weighted Total:	134	94	118	

Table 2. Design matrix for solutions to the overflow issue

Final Design

The final design consists of 4 parts:

- A 2.3-inch diameter pipe will allow controlled flow out of the retention pond to ensure full drainage within 2 days of a 24-hour, 25-year storm.
- A small grassed channel, 1-foot bankfull depth, will guide the runoff along the driveway, preventing flow from the front lawn from moving across the driveway
- The channel will lead to an 18-foot-long culvert (10.8-inch drop, 1-foot diameter) that will direct the flow of water under the front driveway and into the main drainage channel. The installation of this culvert will require resurfacing of the asphalt.
- Vegetation along the channel will naturally slow and filter the water, increase infiltration, and prevent erosion. Riverbank Tussock Sedge is recommended for planting in the channel. Morton Chokeberry and Tardiva Hydrangea are shrubs that can be planted around the channel to create a barrier.

Models and Testing

Elevation data was collected using a real-time kinematic survey system. A surface was built from these data points and construction plans were created in Autodesk Civil 3D. The final design was tested by simulating precipitation events over the surface in HEC-RAS.



Figure 2. Final design drawing

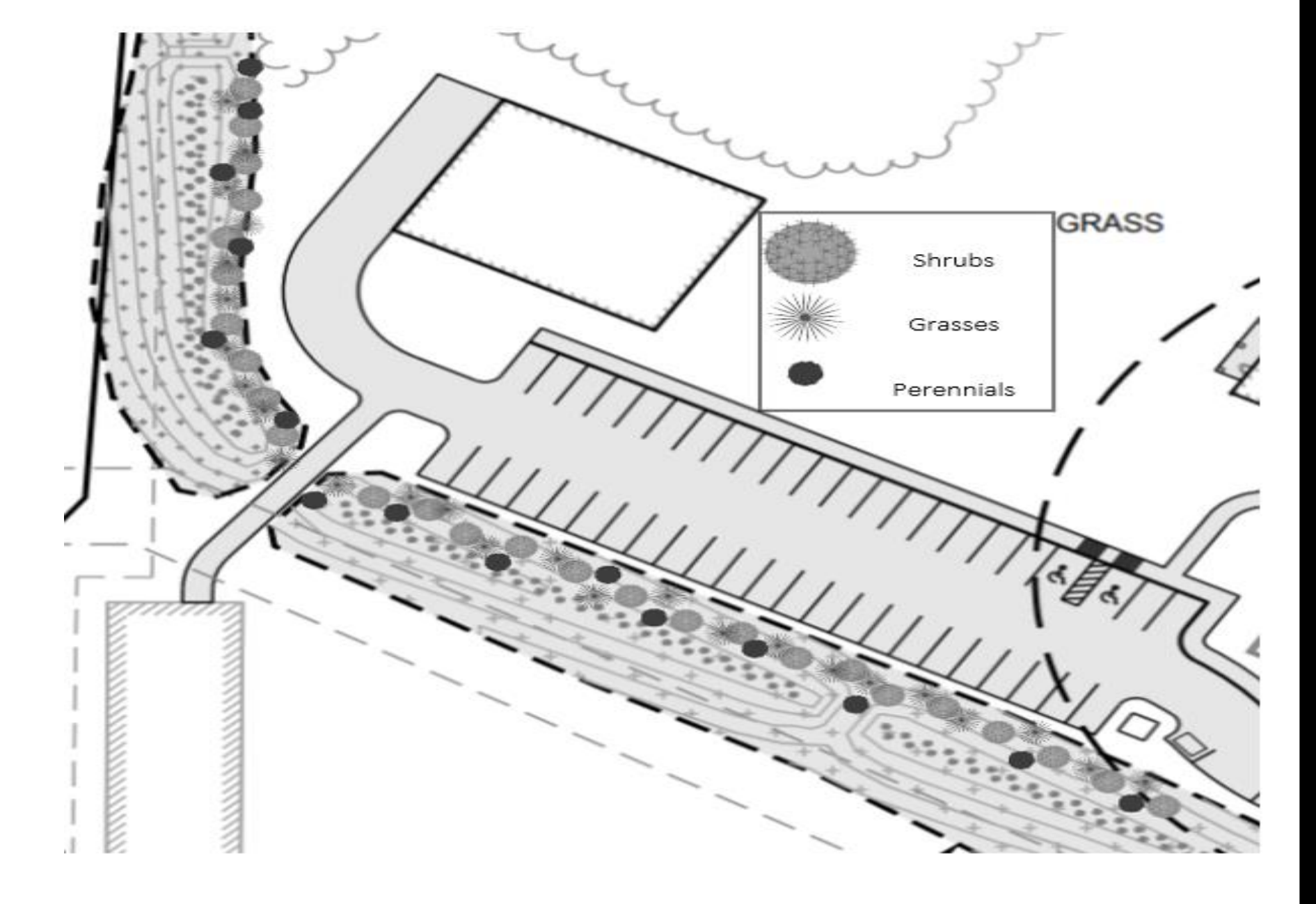


Figure 3. Final vegetation layout

Codes, standards, and tools:

The *Tippecanoe County Stormwater Technical Standards Manual* is the main source of the utilized stormwater design methods. The tools used for digital modeling and analysis are ArcMap, Autodesk Civil 3D, and HEC-RAS.



Impact and sustainability:

This project will improve the aesthetics, safety, and environmental value of the land. The drainage system will prevent water stagnation, proliferation of bacteria, and animal infestations. The recommended vegetation will add ecological benefit and beauty to the landscape. Removing the liability and improving the land will bolster the inn's reputation, providing long-term financial benefits to the owners.

Results and recommendations:

The simulation shows that the design will successfully drain the property as required by the owners and by county regulations. Regular checks are recommended to ensure the design is working properly. Checking for clogs at the pipe and culvert inlet may be necessary after periods of heavy precipitation. Planting recommendations as shown will improve the aesthetic property and environmental benefit of the design.

Overall implementation cost is estimated to be \$ 8,000–15,000 depending on contractor choice. Return on investment for the owner is derived from the reduction of liability and increased beauty of the land.

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