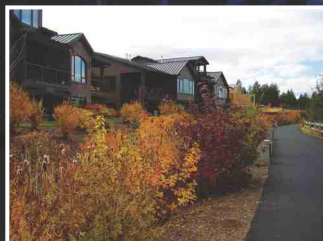




UTILITY DEPARTMENT

# Bend's Better Site Design Walking Tour

*Ideas for Keeping Water Quality in Mind When Developing Sites*



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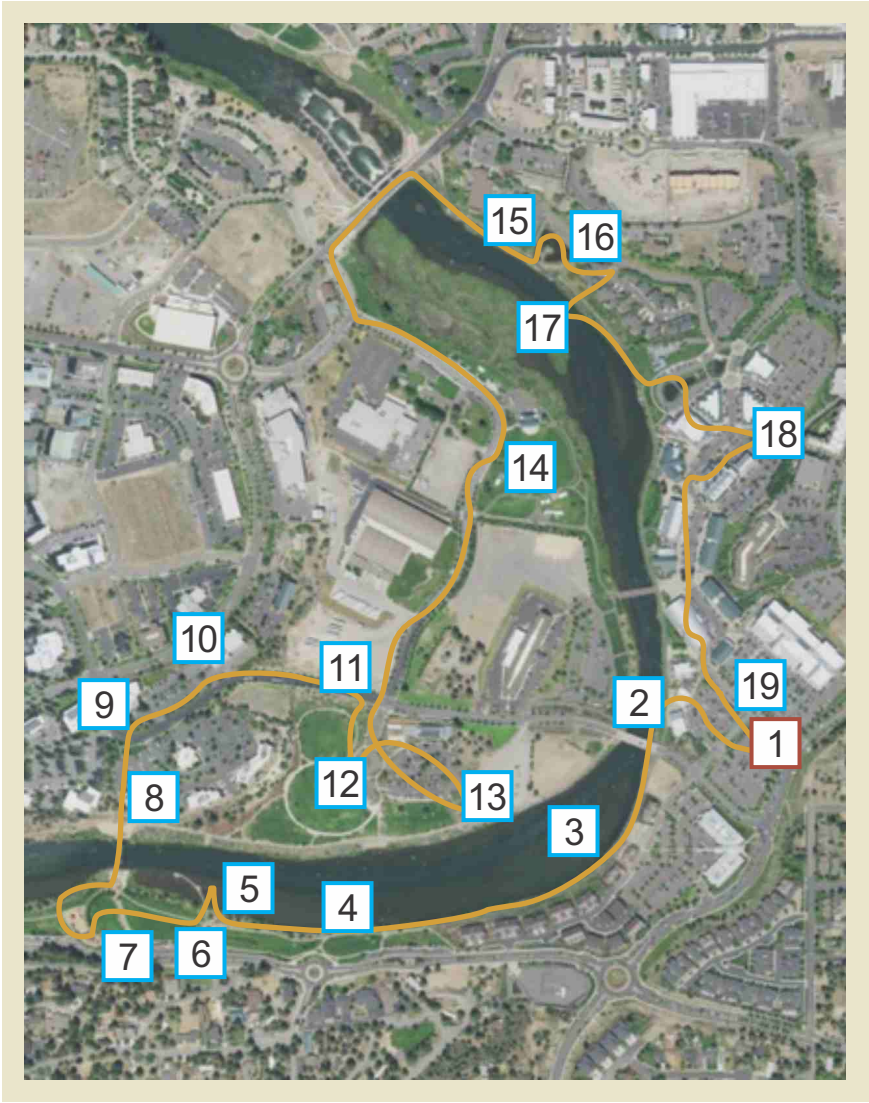
## Purpose

The purpose of this guide is to provide examples of better site designs within the City of Bend that help improve water quality. This can come in the form of reducing runoff, encouraging water to infiltrate near the surface, or preventing contact with pollutants. These methods help to reduce the amount of pollution in the Deschutes River, and reduce the possibility of contaminating underground drinking water resources.

## Introduction

This guide provides an approximately three mile long walking tour of site designs in Bend that exist in harmony with nature.

# Tour Overview Map



## Tour Legend



Start/ Finish Location



Location

680 SW Powerhouse Dr.  
Bend, OR 97702



# Location #1

## Old Mill Parking Lot Near Theater/Bus Shelter



### Features

- ◆ Bus shelter to promote alternative transportation
- ◆ Drains to detention pond (see also Location #2)



## Points to Ponder

### ***Notice the bus shelter on Bond Street.***

- Where do pollutants from roadways come from?
- How might using alternative transportation like buses, bikes, walking, etc. help protect stormwater quality?

### ***Notice the parking lot itself.***

- Where does rainwater or snowmelt go?
- Can it go through the pavement?
- Can it collect in the grass or landscaping beds? Why or why not?

## DID YOU KNOW?

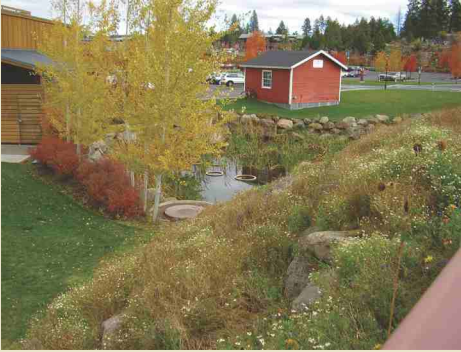
*Lead is the pollutant we see most often in stormwater. It comes from many sources including car batteries and wheel balances.*

### **Direction to next location:**

From the Bus stop walk south on Bond St. to Columbia Dr. turn right on Columbia Dr. and proceed one block west to Theater Dr. The next point of interest will be located off to your right.

## Location #2

### Old Mill Wet Pond Near the Deschutes River



#### Features

- ◆ Wet Detention Pond
  - Drains roadways and parking lots
  - Settles pollutants
  - Mixed use as recreational activity (fly casting course)



#### Points to Ponder

- From where does this pond receive its water?
- How has this pond also been designed to be an amenity to the development?

#### Direction to next location:

Walk north to the retail shops, cut between the first two buildings. Locate the paved path along the River and proceed west along the east bank 1 mile.

## Location #3

### Walkway Swale Along Riverside Homes



#### Features

- ◆ Vegetated Swale and Detention Basin
  - Slows water
  - Allows infiltration
  - Natural pollutant treatment
- ◆ Multi-story homes
  - Reduces building footprint
    - Less hardscape
    - Less runoff

#### Points to Ponder

- How can concave landscaping like this swale act as both a storm-water filter and a privacy screen?
- What benefits might the vegetated swale provide prior to runoff from the home sites reaching the river?
- How can soil (especially during construction), pesticides, and fertilizers from developed sites get into our waterways? What are ways to prevent that?
- Look across the river at the dog park. What pet care steps can be taken to help prevent water pollution?

**Direction to next location:**  
Proceed south along the  
Deschutes River .75 miles until  
you reach Farewell Bend Park.

## Location #4

### Farewell Bend Park–Detention Basins



#### Features

- ◆ Several detention basins treating Reed Market and Farewell Bend Park parking lot water
- ◆ Overflows to river
- ◆ Vegetation helps hold soil, settle and break-down pollutants, and provides aesthetic value

#### Points to Ponder

- Where does the water in the detention basins come from?
- Where does it go?
- How do the plants help?

#### DID YOU KNOW?

*This area once served as a log lay-down area during timber operations, which resulted in compacted soils. These detention basins were constructed within these compacted soils so drainage became an issue. In this area, clay soil was also a drainage issue. **Lessons***

**Learned:** *Know what type of soils you are working with and make sure to take steps to minimize compaction in soils meant to drain runoff.*

**Direction to next location:**  
Proceed south through the park along the river.



## Location #5

# Farewell Bend Park–Habitat Protection and Restoration



## Features

- ◆ Protected buffer zones within riparian area
  - Re-vegetation with Native Plants slows the runoff; provides natural treatment
- ◆ Wetland treatment
- ◆ Provides wildlife habitat
- ◆ Allowing deeper channels and shade from streamside trees/vegetation can help cool waters
- ◆ Bend Park and Recreation District and the City employ integrated pest management techniques

## Points to Ponder

- Consider the vegetation behind the Habitat Restoration Area fences. Can this serve to filter water before it reaches the river? What other benefits does the vegetation provide to the river?
- The higher temperatures of the river are a "pollutant of concern"? What might cause the temperatures in the river to be higher? How might the vegetation help?
- Can you see any trash from the bridge? How do you think it got there? What are steps that you can take to keep trash where it belongs?
- Read the "Founding of Bend" sign. How was this stretch of river used during the logging days? How would the water quality of the river be different then and now?



## Points to Ponder

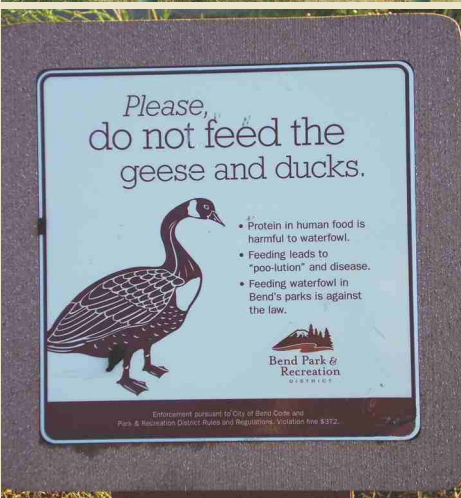
- Examine the beach areas. Sediment and turbidity are “pollutants of concern” for the Deschutes River.
- Consider the green grass compared to the buffer areas. What can you do to help prevent nitrogen from reaching the river?



## DID YOU KNOW?

*Fertilizers contain nitrogen. The Deschutes River is nitrogen-limited. This means adding nitrogen to the Deschutes River can increase primary productivity, which can increase how great the swings of dissolved oxygen and pH are in the river. “Pollutants of concern” for the Deschutes River include chlorophyll a (primary production), dissolved oxygen, pH, and sediments. Nitrogen is one pollutant that has been found in Central Oregon stormwater at higher than regulatory screening levels.*

## Location #6 Park Signs



### Features

- ◆ Public Education
- ◆ Pollutant Prevention
  - Bacteria
  - Nutrients
- ◆ Public Health Protection

### Points to Ponder

- In addition to the buffer area signage, have you noticed the “Please do not feed the geese and ducks” and Dog E Rest Stop stations? What benefits do taking these steps have to protecting the river water quality? How would the animal poop reach the river?

**Direction to next location:**  
Head toward the picnic pagoda and bathrooms adjacent to Reed Market Road and the children's play structure.

## Location #7

### Reed Market Stormwater Median



#### Features

- ◆ Road median swale
  - Detains runoff
- ◆ Street trees reduce volume and velocity of runoff
  - Prevents erosion
- ◆ Allows for infiltration and treatment of pollutants

#### Points to Ponder

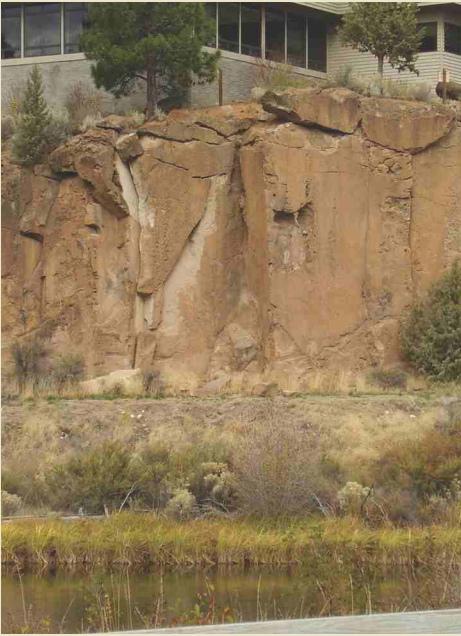
- From the Farewell Bend pagoda near the bathrooms, look out across Reed Market Road. Notice the shape of the landscaping between the two roads. Are most medians that you see like this one?
- How is it different? How might its concave shape benefit stormwater?
- Check out the trees in the median—do you think they take up much rainwater? Would a raindrop that hits a tree or vegetation first come down with as much force as if it just hit bare soil directly? How might this affect erosion of the soil?

#### DID YOU KNOW?

*Did you know that temperature, dissolved oxygen, pH, chlorophyll a, sedimentation, and turbidity are pollutants of concern in the Deschutes River in parts of Bend?*

## Location #8

### Cliffs



#### Features

- ◆ Geotechnical Conditions
  - Pink tuff
  - Naturally impervious
  - Affects options

### Points to Ponder

- Check out the cliffs—what are they made of mostly? Can water easily drain through the rock?
- How might that affect where stormwater goes? How might that affect treatment and control options?

### DID YOU KNOW?

**Lessons Learned:** *Understanding soil and geologic conditions specific to your site is critical to successfully handling stormwater runoff. Working with natural site drainage and considering stormwater flows and treatment needs during the conceptual phase of a project will lead to better, more cost-effective design options.*

#### Direction to next location:

Cross the footbridge, after examining the cliffs, hike up the cliffs using the staircase, cross the parking lot to Columbia Street. An accessibility alternative is to continue down to Riverbend Park and do an out and back heading west (uphill) on Columbia Street.



## Location #9

### Trees



#### Features

- ◆ Street Trees
  - Reduce volume and velocity of runoff
  - Help prevent soil erosion



#### Points to Ponder

- Check out the trees along the road. Are their leaves out? How far out do they reach?
- How do trees help protect storm-water quality?
- If it is raining, notice if there is more or less rainwater hitting the ground under the tree canopy. What other benefits do they have?

#### Direction to next location:

Walk 500 feet northeast along Columbia Street if by stairs. The Mill Point Center Building will be on the north side of Columbia St. If you took the accessible alternative route, travel west on Columbia Street from Riverbend Park up the hill.

## Location #10 Millpoint Center



### Features

- ◆ Multi-Story Building and Tuck-Under Parking
  - Reduced building and parking footprints reduce impervious surface area and thus reduce runoff amounts.

### Points to Ponder

- Where are the cars parked?
- If each floor layer was taken off and set down on land so that the whole place was one story, including the parking, how much land would that take up?
- How does “reducing the building footprint” and the “parking footprint” help protect stormwater quality?

### DID YOU KNOW?

*Properties that reduce their impervious surface coverage may see a reduction in their stormwater utility service charge, to a minimum of one equivalent residential unit. Credits for additional quality and quantity control measures are also available.*

#### Direction to next location:

Continue east along Columbia Street .25 miles, until you reach Shevlin Hixon Drive. Make a right turn and head east into the Bend Metro Parks Administration Building and Riverbend Park.

## Location #11

### Bend Park and Recreation Administration Building–Green Roof and Roadside Drainage



#### Features

- ◆ Extensive Green Roof
  - Detains, stores water
  - Provides some treatment
- ◆ Bioretention swale
  - Detains, infiltrates water
  - Provides treatment



#### Points to Ponder

- As you walk down the hill, notice the rooftop on the Bend Park and Recreation Administration Building. What is on the front section?
- How might a green roof affect stormwater runoff and quality? What other spaces may be a good candidate for a green roof?
- Notice as you walk down the sidewalk, the concave landscape area bordering Columbia St. and Riverbend Park.  
Where does water come into this bioretention swale (or rain garden)?

## Location #12

### Bend Park and Recreation District Administration Building Parking Lot



#### Features

- ◆ Concave parking lot medians with curb cuts
- ◆ Bioretention swales
- ◆ Dry overland stream bed directing water around west side of building

#### Points to Ponder

- As you walk along the driveway of the Administration building towards the river, notice the median. How have they adjusted the curb and roadway to allow stormwater runoff into the median?
- How does water move from around the building, and from one drainage swale across a road or sidewalk to another? What would you need to consider as you design these? Would certain sizes of trenches help reduce maintenance? Is access for cleaning important?
- Could any of these features work at your home or business?

#### Direction to next location:

Continue through the parking lot towards the dog park, you'll notice a walkway (and maintenance vehicle access drive) heading towards the river on the north east portion of the site.



## Location #13

### Bend Park and Recreation Administration Building Pervious Asphalt Walkway



#### Features

- ◆ Permeable Pavement
  - Pervious asphalt

## Points to Ponder

- How does this asphalt look different from regular asphalt?
- If you have some water with you, pour some on. Where does it go? What benefits might this have for rainwater runoff or snow melt?

### DID YOU KNOW?

*Even when 95% clogged, pervious asphalt can still handle 4" of rain per hour. Did you know that the 100-year storm in Bend is 3.1" of rain over a 24-hour period?*

#### Direction to next location:

From the Bend Parks & Recreation District Administration Building walk .25 miles north on Shevlin Hixon Dr. to the Less Schwab Amphitheater.

## Location #14

### Les Schwab Amphitheater



#### Features

- ◆ Reduced Impervious Surface
- ◆ Riparian Buffer

#### Points to Ponder

- As you walk north on Shevlin Hixon Road, notice the Les Schwab Amphitheater on your right. Some venues are designed to have permanent chairs set in concrete. What happens to rain and snow that falls on the Les Schwab Amphitheater? What if the amphitheater had been designed like a stadium with permanent seating—where would the rain and snow go then?
- When you get even with the stage, look to your left across the street. Do you see the alien-looking white/grey apparatus tucked between trees? That is the Agrimet Weather Station, a US Bureau of Reclamation automated agricultural weather station. It collects scientific data including temperature, precipitation, solar radiation, humidity, wind speed and direction, and dew point to help “regional crop water use modeling,...research, frost monitoring, and integrated pest and fertility management.”
- How can water conservation help protect water quality? If too much landscape irrigation water is applied, where does it go? Could excess irrigation runoff pick up pollutants such as oversprayed fertilizers on the way to the storm drain system?
- How can scientific data be used to help prevent runoff and misapplication of pesticides and fertilizers?
- As you continue along, notice the riparian buffer to your right? Notice any wildlife?

#### Direction to next location:

From Shevlin-Hixon, make a right onto SW Simpson Avenue and walk under SW Colorado Avenue. Cross the river on the footbridge. At the far end of the footbridge, take the foot trail under Colorado Avenue.

## Location #15

### Old Mill Quarter Wet Pond



#### Features

- ◆ Wet Pond (Retention)
  - Pollutant Settling/Treatment
  - Habitat

#### Points to Ponder

- How is a wet pond different from a detention basin?

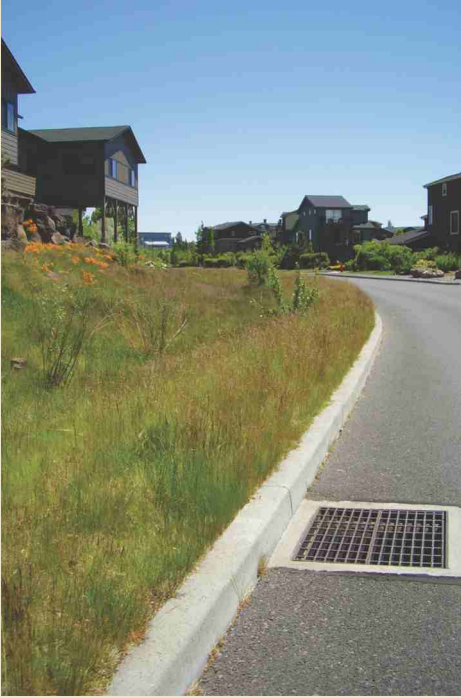
#### DID YOU KNOW?

*This pond allows for some retention and treatment of stormwater before it overflows to the river but is designed to retain water. It also serves as wildlife habitat for sensitive species and a recreational zone (fish casting; bird watching).*

**Direction to next location:**  
From the NE edge of the pond, continue about 300 feet SE down the road. Look to the NE side of the road.

## Location #16

### Old Mill Quarter Roadside Swale



#### Features

- ◆ Vegetated Swale
  - Infiltration
  - Slows, detains runoff
  - Natural treatment of pollutants

#### Points to Ponder

- Is it easier to see when maintenance is needed when a facility is underground or above ground?
- Does the swale provide an aesthetic buffer between the street and the uphill homes?

**Direction to next location:**  
Continue back along the SE  
edge of the Old Mill Pond to  
trail bordering the River and  
turn SE



## Location #17

### Residential Home Rain Garden/Pond



#### Features

- ◆ Residential Rain Garden (bioretention) / Wet Pond
  - Retains runoff
  - Provides natural treatment

#### Points to Ponder

- Are there areas of your yard that could use the extra water a rain garden would provide?
- In areas away from the river, how might a rain garden look different? (hint, see top picture on page 22)

#### DID YOU KNOW?

*The City has a list of plants suitable for Central Oregon rain gardens? See page 22 for a link to additional site design and low impact development information on our website, then click on "Central Oregon Plants for Stormwater Facilities."*

**Direction to next location:**  
From the Old Mill Quarter  
continue 0.1 Miles east on  
Otter Way until you reach  
the shopping center.

## Location #18

### Full Lot Coverage Storage



#### Features

- ◆ Reduced Building Footprint (Multi-story)
- ◆ Underground Storage to allow natural release rate
  - Hydrograph modification minimization



#### Points to Ponder

- This multistory property that abuts the downhill slope property line handles storm drainage with the use of underground storage.
- Is the underground storage used here similar to the use of rain barrels or cisterns on smaller properties?
- As you walk along the Old Mill District back to the tour start, how is street runoff handled?
- According to Oregon Drainage Law, adjoining landowners are entitled to have the normal course and amount of natural drainage maintained. How can you use the ideas seen today to meet that on your site?

**Direction to next location:**  
Walk south .5 miles on  
Powerhouse Drive along  
the retail shops, until you  
reach Bond Street.

## Location #19

### Cascade Range: Look up to the Mountains



#### Features

- ◆ The vast majority of the groundwater drains underground and flows down from the Cascades.
- ◆ Much of the City's stormwater is injected into the ground through dry wells or drill holes.
- ◆ Treatment helps make sure stormwater runoff does not pollute groundwater. Stormwater can get treatment through sinking in through the upper reaches of the soil, where pollutants get adsorbed or broken down biologically. Having good carbon content (mulch, leaves, etc.) in the soil helps this process.

#### Points to Ponder

- Most of the City gets its drinking water from groundwater aquifers (private purveyors within the City limits use 100% groundwater as their source; half of the City of Bend's water comes from surface water from Bridge Creek near Tumalo Falls). Where does the groundwater recharge come from?
- Can the steps taken to protect the river also be used to protect our groundwater drinking supplies?

## For Additional Information

*Interested in these designs? Here's how to get additional information.*

### Designs Within the Old Mill District:

Angle Consulting Engineering  
Terry Angle, P.E., 541-318-4822  
terry@anglece.com

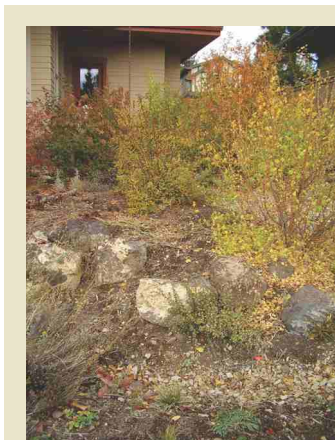
### Bend Park and Recreation District Stormwater Facilities:

District Office: 541-389-7275

Chelsea Schneider,  
Landscape Architect, 541-241-6134  
chelsea@loci.studio

### Designs Within Reed Market Road:

City of Bend, City Engineer, Ryan Oster,  
541-388-5580 ext 4, roster@bendoregon.gov



### Answers to Points to Ponder:

<https://www.bendoregon.gov/home/showdocument?id=13812>



### *Also of interest....*

### Additional Site Design and Low Impact Development Information:

<http://bendoregon.gov/index.aspx?page=298#Site>

### Agrimet Station:

U.S. Bureau of Reclamation: <http://www.usbr.gov/pn/agrimet/proginfo.html>

### Intensive Green Roof, 360 Bond (Requires Formal Tour):

Chelsea Schneider, Loci Studio, 541-241-6134, chelsea@loci.studio

### Oregon Rain Garden Guide:

<https://seagrant.oregonstate.edu/sgps/oregon-rain-garden-guide>

### Water-wise Gardening in Central Oregon:

Amy Jo Detweiler, Oregon State University Extension, <https://catalog.extension.oregonstate.edu/em9136>



### Accommodation Information for People with Disabilities.

To obtain this information in an alternate format such as Braille, large print, or electronic, please contact 541-317-3000 ext. 2 or email [utilities@bendoregon.gov](mailto:utilities@bendoregon.gov).