



Newport Avenue **STORMWATER QUEST**

Name ANSWER KEY Teacher _____

Welcome to the Newport Avenue Stormwater Walking Tour! Follow the directions on each page to find out what types of stormwater tools the City of Bend has developed along the Newport Avenue corridor. Not sure where to go? Use the QR code below to find the exact location of each stop. As you're on your tour, don't forget to answer each trivia question and figure out the secret phrase! Each starred letter from the stormwater term question at each stop will be used at the end of your stormwater quest to make a secret phrase.

Stormwater Walking Tour on Google Maps





STOP #1: Start the Stormwater Walking Tour!

Directions: Head to Pageant Park and look for the stormwater map on the left side of the park as you're looking towards the river.

Student Challenge:

See if you can pick up the most pieces of trash from Harmon Park to Pageant Park! Once you get to the start of the tour, discuss why trash on the ground could have an impact on stormwater and dispose of your trash in the can near the sign.

Trivia Term:

What is the term on the walking tour map that means any rainwater or melting snow or ice that flows over the surface of the land to nearby sewers, rivers, lakes, or streams? Write it down below!



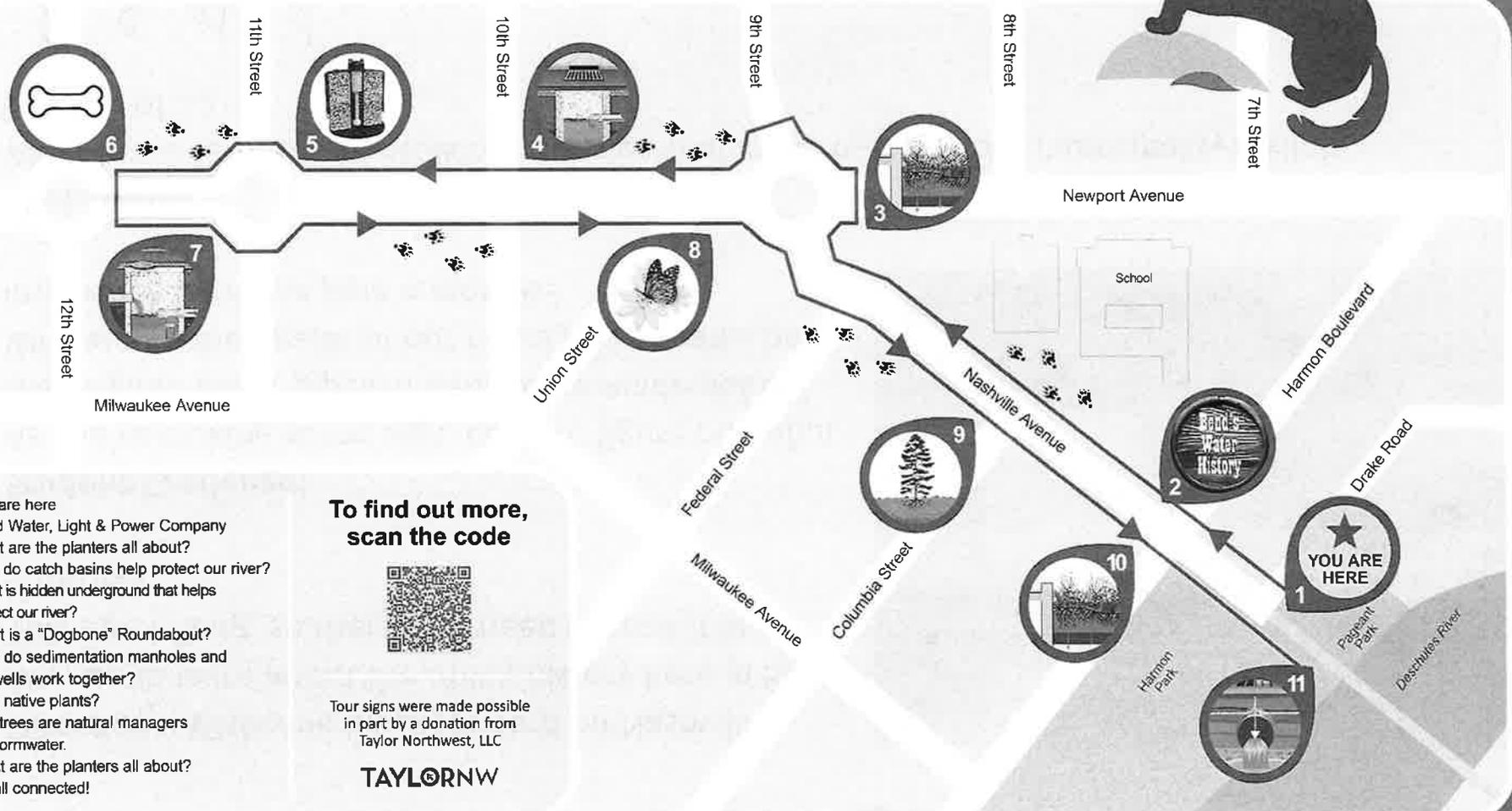
s t o r m w a t e r .
*

Take the Stormwater Walking Tour!

Are you curious about how portions of Newport Avenue help keep the Deschutes River clean?
Take the stormwater walking tour and follow the otter footprints to find out!



CITY OF BEND
STORMWATER



- 1 You are here
- 2 Bend Water, Light & Power Company
- 3 What are the planters all about?
- 4 How do catch basins help protect our river?
- 5 What is hidden underground that helps protect our river?
- 6 What is a "Dogbone" Roundabout?
- 7 How do sedimentation manholes and drywells work together?
- 8 Why native plants?
- 9 Our trees are natural managers of stormwater.
- 10 What are the planters all about?
- 11 It's all connected!

To find out more,
scan the code



Tour signs were made possible
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Taylor Northwest, LLC

TAYLORNW



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UPPER DESCHUTES
WATERSHED COUNCIL

STOP #2: Historical Sign

Directions: Walk one block forward on Nashville Avenue to learn about the utility history here in Bend. This sign is long, so there's no need to read it in its entirety!

Student Challenge:

As you're looking at the sign, can you figure out what the original water pipes in Bend were made out of? Why would the health of our rivers and streams be important for these pipe materials?



Trivia Term:

What is the term on the walking tour sign that is the name of our municipality? (Hint: The city of....)

B e n d .
*

Bend Water, Light and Power Company Machine-Banded Wood Stave Pipe



B.W.L.P. Co. power dam constructed in 1910, view southeast towards downtown Bend. Photo credit: Deschutes County Historical Museum

The Bend Water, Light and Power Company (B.W.L.P. Co.) played a central role in the development of the City of Bend from 1905 to 1926, providing the necessary utility infra-

structure for residential and industrial growth. The company was awarded a franchise following the incorporation of the city in 1904, enabling it to install a water system constructed from machine-banded wood stave pipe beginning in 1905. The construction of a dam and the creation of Mirror Pond in 1910 was a landmark development in the city's history. B.W.L.P. Co. provided electricity and street lighting to the community of Bend from the first power plant in operation on the Deschutes River.

The B.W.L.P. Co. changed ownership in 1911 and 1912, resulting in substantial improvements to water and power systems in the years of 1913-1914.



B.W.L.P. Co. brick powerhouse erected 1912-1913 at the outlet of Mirror Pond.

The water system was expanded to the west side of the river, a brick power plant was constructed immediately north of the power dam, and street lighting was tripled. Construction of The Brooks-Scanlon and Shevlin-Hixon Companies sawmills from 1915-1916 required B.W.L.P. Co. to increase the size of its turbine and generator and add a switchboard at the power plant. The city grew considerably in 1917, and by 1918 Bend's population swelled to 5,000. B.W.L.P. Co. growth continued into the 1920s with the construction of a new power plant on Tumalo Creek and westward extensions of its water mains.

In 1926, the B.W.L.P. Co was acquired by the Pacific Power and Light Company, and its water facilities transferred to municipal ownership. The transferred water system included 34.15 miles of pipe in the

distribution system, 55.9% made of wood and 44.1% metal, 67 fire hydrants, and 2,139 service connections. Water was sourced from both the Deschutes River and Tumalo Creek and located within lands ceded by the Confederated Tribes of Warm Springs during the Treaty of 1855. The waterways within the Deschutes River Basin have been inhabited since time immemorial and continue to be important to the Tribes for subsistence and cultural traditions.



Turned-down end of eight-inch machine-banded wood stave pipe

The historical wood stave pipes laid by B.W.L.P. Co. continue to serve as a physical reminder of Bend's original development. Wooden stave pipes have been used for centuries across forested regions of Europe and were introduced to America by colonists. The first wood pipes on the East Coast were bored-out whole pine logs. As demand for water distribution systems increased, the structure of wooden pipes evolved to larger interior diameter pipes formed from milled wood staves. Cast iron pipes were also used, but the cost-effectiveness and availability of wood on the Pacific Coast made wood pipe the local choice. Wood stave pipe was two to three times less expensive and found superior in acidic mining applications that would quickly deteriorate cast iron.

Machine-banded wood stave pipes were composed of accurately milled wood staves, typically from redwood, pine, or Douglas fir, assembled by specialized machinery, banded with wire, and the exterior coated with high-grade asphaltum for preservation. Although no longer in service, the wood stave pipes installed by



Detail of wood stave used to form machine-banded wood stave pipe.



Machine-banded wood stave pipe inserted joint.



Machine-banded wood stave pipe wood coupling

B.W.L.P. Co. retain remarkable integrity and are a part of Bend's rich historic past that is preserved beneath the city streets.

Machine-banded wood stave pipe dating ca. 1912-1920 was identified at this location and westward along Newport Ave. and its

cross streets. The pipes varied from two-inch, six-inch, and eight inches in interior diameter and were constructed from three, seven, and nine staves respectively. Wood pipes are connected with either a mortise and tenon style inserted joint or an abutting joint held in place with an exterior machine-banded wood coupling. Cast iron and brass fittings were also used in the wood stave pipe distribution system for service connections, pipe connections, and valves. The observations made during modern utilities improvements provide a glimpse into the centuries-old technology of wood stave pipe infrastructure installed by The Bend Water, Light and Power Company that greatly contributed to the city's growth and development during the early 20th century.



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Segment of six-inch machine-banded wood stave pipe and wood coupling removed from this location.



STOP #3: What are the planters all about?

Directions: Keep walking forward to head to the corner of Newport Avenue and Nashville Avenue to explore some planters.

Student Challenge:

As you are walking to your next stop, count how many planters near the road or garden boxes you see around you. Once you get to your next stop, find out why these are so important to protecting our rivers from stormwater!

Trivia Term:

Stormwater _____ can pick up pollutants like vehicle waste and trash.



r u n o f f .

*

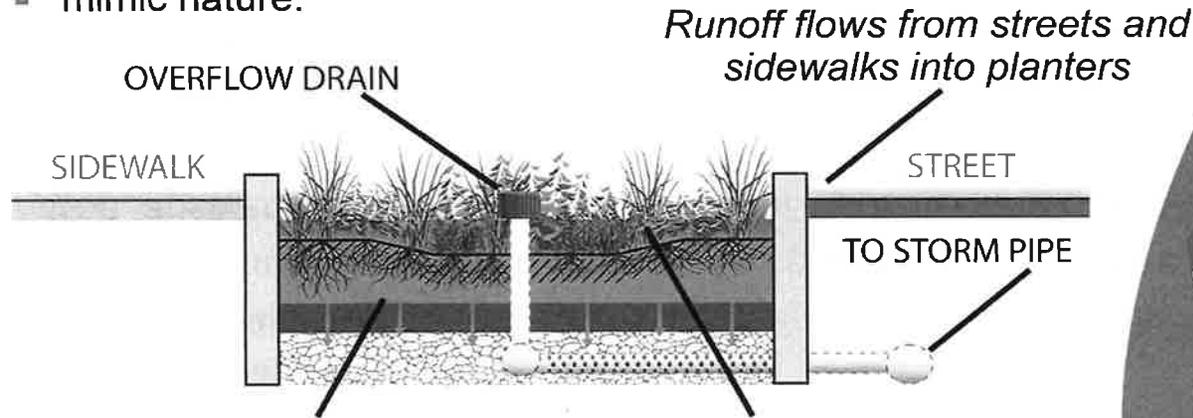
What are the Planters All About?

We're Protecting the River and Its Critters!

Stormwater runoff picks up pollutants like vehicle waste, landscape materials and trash that can harm the river.

THREE WAYS STORMWATER PLANTERS HELP

- 1 Planters catch water and help slow down flows to the river to mimic nature.



- 2 Layered soils and natural bacteria help catch and break down pollutants.

- 3 Native plants help reduce and clean the stormwater.

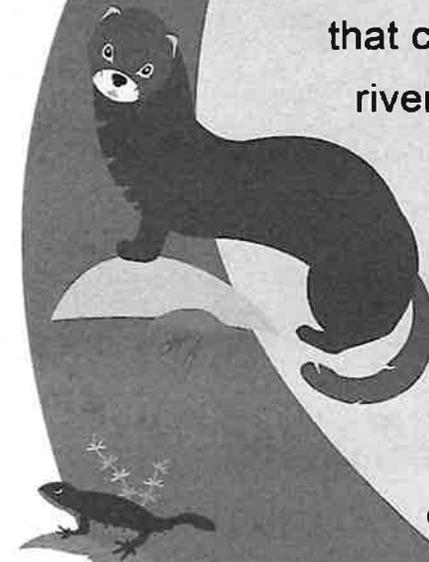


Scan to learn more about stormwater features and simple ways you can also help protect our river.
bendoregon.gov/greeninfrastructure



Why?

Hard surfaces like streets, sidewalks and rooftops cause stormwater runoff that can harm our river and critters living there.



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STOP #4: How do catch basins help protect our river?

Directions: Cross Newport Avenue and 9th Street and continue onwards towards the corner of 10th Street to find some catch basins to explore.

Student Challenge:

As you are walking to your next stop, count how many catch basins you see near the sides of the roads. Once you get to your next stop, answer why these are so important to protecting our rivers from stormwater!

Trivia Term:

_____ “catch” excess water from hard surfaces like streets, sidewalks and rooftops.

c a t c h / b a s i n s .

*



How do Catch Basins Help Protect Our River?

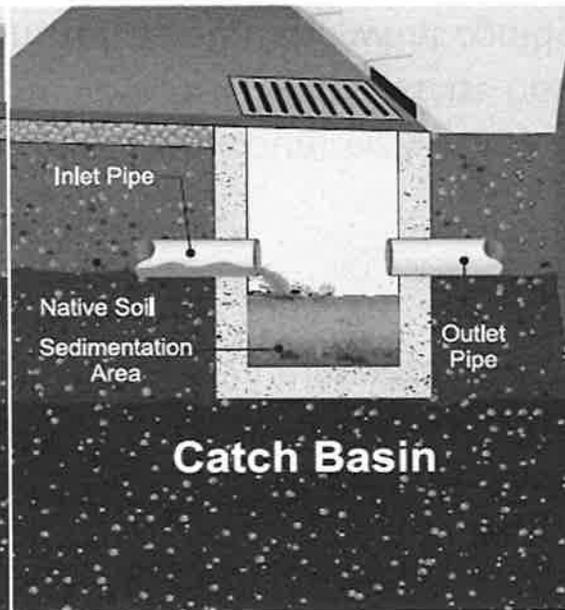
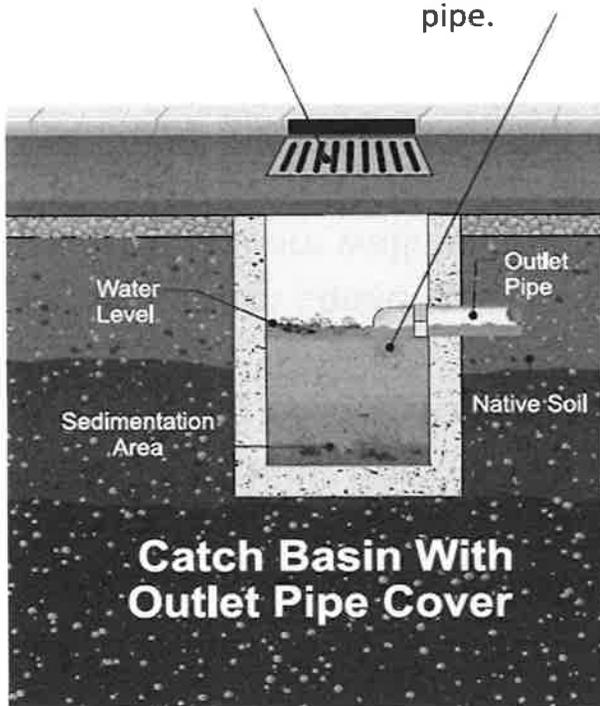
Catch basins “catch” excess water from hard surfaces like streets, sidewalks and rooftops during rain storms and when snow melts. They direct the stormwater to treatment facilities like sedimentation manholes, drywells, stormwater planters and stormwater filter vaults that help clean the water before it reaches the Deschutes River or groundwater.

Grates help screen out debris like sticks, leaves and other items.

Some catch basin outlets have pipe covers to prevent small floating debris from entering the pipe.

You can help!

- *Never wash a car near a storm drain.*
- *Keep yard debris and litter out of the street.*



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STOP #5: What is hidden underground that helps protect our river?

Directions: Continue up Newport Avenue towards the corner of 11th Street.

Student Challenge:

As you are walking to your next stop, count how many cars pass by you. Once you get to your next stop, discuss how cars can have an impact on stormwater and what could help improve this stormwater quality before it gets to the river.

Trivia Term:

Stormwater _____ vaults use cartridges that absorb and retain the most challenging pollutants from stormwater.

f i l t e r.

*



What is Hidden Underground that Helps Protect Our River?

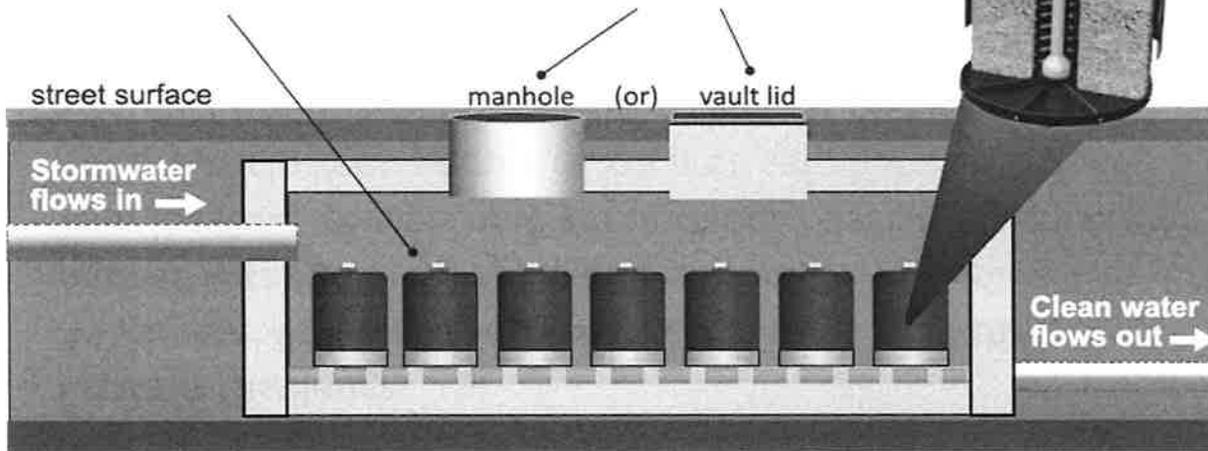


Stormwater filter vaults use cartridges that absorb and retain the most challenging pollutants (like motor oil and sediment) from stormwater and greatly improve the stormwater quality before it gets to the river.

Several rows of filters are needed to clean the large quantities of water that flow from hard surfaces.

Crews have access to the filter units for required maintenance and repairs.

Rechargeable filter cartridges absorb and retain pollutants.



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STOP #6: What is a “dogbone” roundabout?

Directions: Continue up Newport Avenue towards the corner of 12th Street.

Student Challenge:

As you are walking to your next stop, count all of the pedestrians and bicycles that pass by you. Once you get to your location, discuss how a roundabout design like this can not only help keep people in the area safe but also reduce stormwater impacts by walking, rolling, or biking.



Trivia Term:

What is the street on the walking tour sign that we are currently on? (Hint: Newport is the first part!)

A v e n u e .

*

What is a “Dogbone” Roundabout?

The "dogbone" is a connected series of two small roundabouts that provide many benefits to this busy location.

- **SAFETY:** The roundabouts slow traffic speeds and eliminate dangerous left turns in this busy location, reducing the risk and severity of crashes.
- **ACCESS TO BUSINESSES:** Newport Avenue is a critical arterial for moving goods and services through the City and the "dogbone" layout was important for the continued operations of the businesses to maintain access for delivery vehicles and customers from Newport Avenue to the driveways on 11th Street and 12th Street.
- **ACCESSIBILITY FOR ALL:** Crossing three multiple busy lanes of traffic can be dangerous and stressful for people walking, biking and rolling and is a barrier for people accessing this corridor. The protected islands in the "dogbone" median provide a safe location for people walking, biking or rolling to rest and allow crossing of only one-direction of traffic at a time.
- **JUST RIGHT FIT:** Two full-sized "standard" roundabouts would have a larger footprint. Connecting the two roundabouts together with the median allowed for a smaller roadway footprint, reducing the need to purchase more property from the neighbors while maintaining the neighborhood connections.

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STOP #7: How do sedimentation manholes and drywells work together?

Directions: Cross the roundabout at Newport Avenue and 12th Street. Continue down Newport Avenue until you reach the corner of 11th Street.

Student Challenge:

As you are walking to your next stop, count how many manholes you see. Once you get to your next stop, find out what's under these manholes and how they filter out pollutants and surface water!

Trivia Term:

_____ allow the stormwater to soak into the ground.

D r y w e l l s.
*



How do Sedimentation Manholes and Drywells Work Together to Help Our River and Groundwater?



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These stormwater structures are designed to work together to protect our river and the critters who live there. Together they filter pollutants and minimize surface water discharge directly to the river.

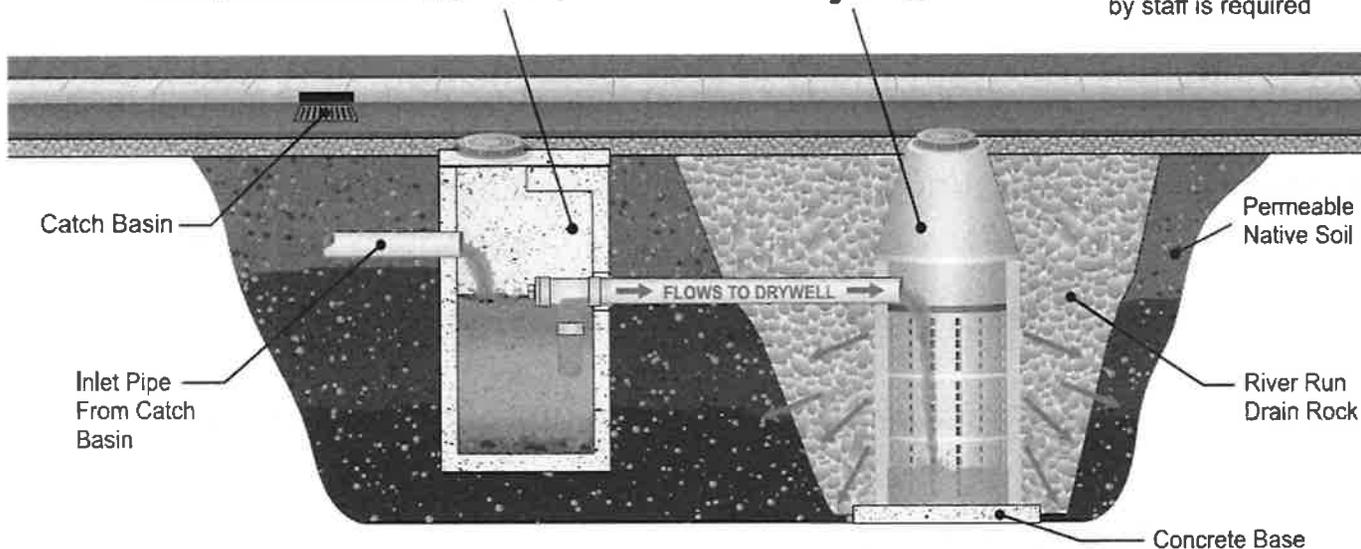
1 Sedimentation manholes trap oils and settle out debris and sediment from stormwater runoff. The pre-treated runoff then flows through pipes to the drywells.

2 Drywells allow the stormwater to soak into the ground in a way that better resembles the natural pre-development drainage path, filtering stormwater through the ground and recharging groundwater.

Sedimentation Manhole*

Drywell*

*Regular maintenance by staff is required



Scan to learn more about stormwater features and ways you can help protect our river and its critters.
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STOP #8: Why Native Plants?

Directions: Continue down Newport Avenue until you meet the far corner of Union Street.

Student Challenge:

As you are walking to your next stop, count how many plants you see right next to the road in the planters. Once you get to your next stop, find out what type of plants these are and how they play a role in filtering pollutants and capturing rainwater!

Trivia Term:

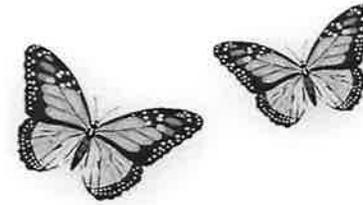
Native plants can have long root systems that help us by capturing rainwater, reducing local flooding, and preventing

_____.

e r o s i o n .
*



Why Native Plants?



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Native plants are adapted to the local climate and soil conditions where they naturally occur. This means they require less water and can naturally withstand Bend's hot summers and cold winters. Native plants can have long root systems that help us by capturing rainwater, reducing local flooding and preventing erosion by holding soils together.

Native plants also have the ability to filter pollutants from entering our rivers and groundwater, improving water quality and preserving natural habitats. Native plants provide food and habitat for a variety of insects, birds and mammals, including pollinators like bees and butterflies.



NATIVE BLANKETFLOWER
(Gaillardia pulchella)



TUFTED HAIR GRASS
(Deschampsia caespitosa)



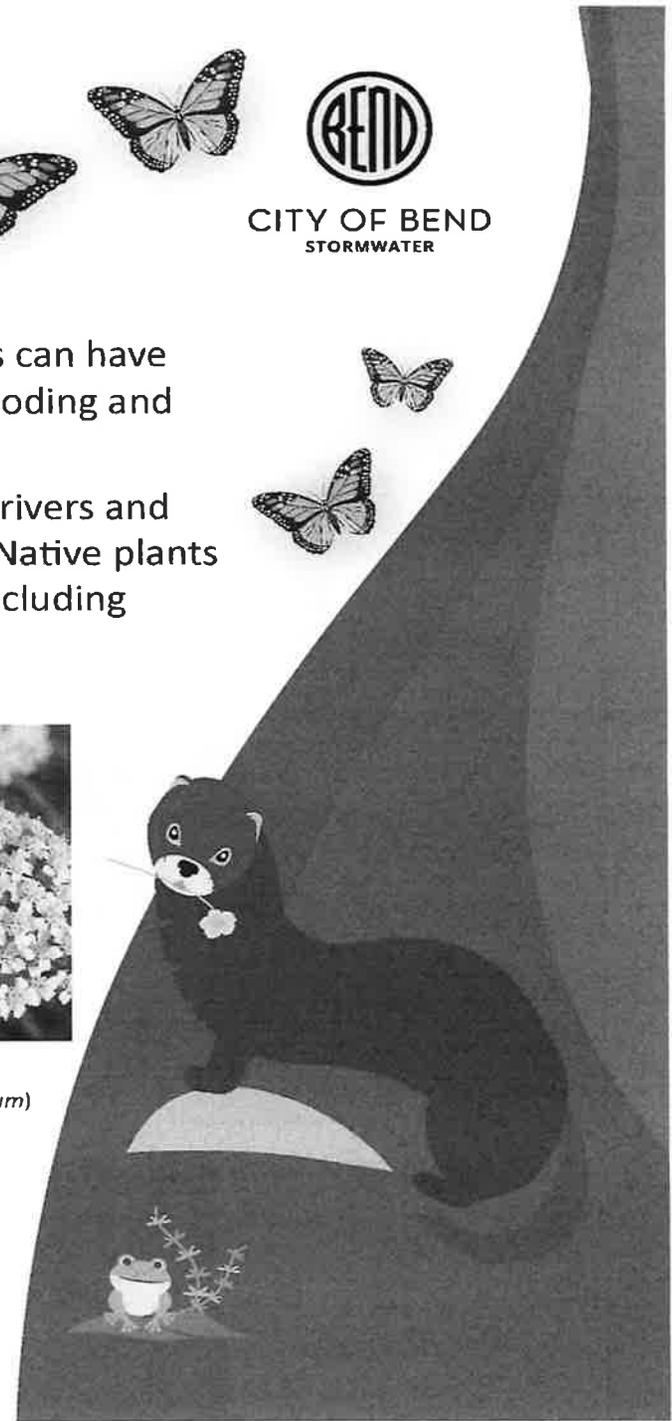
GREEN RABBITBRUSH
(Chrysothamnus viscidiflorus)



YARROW
(Achillea millefolium)



Scan to learn more about native plants you can use and other ways you can help protect our river and groundwater.
bendoregon.gov/greeninfrastructure





STOP #9: Our trees are natural managers.

Directions: Turn right down Nashville Avenue and continue onwards until you meet the corner of Columbia Street.

Student Challenge:

As you are walking to your next stop, observe the different types of trees in this area and how many there are. Once you get to your next stop, answer why trees have such an important influence on our stormwater management!

Trivia Term:

The tree canopy captures and slows down the _____.

r a i n.
*

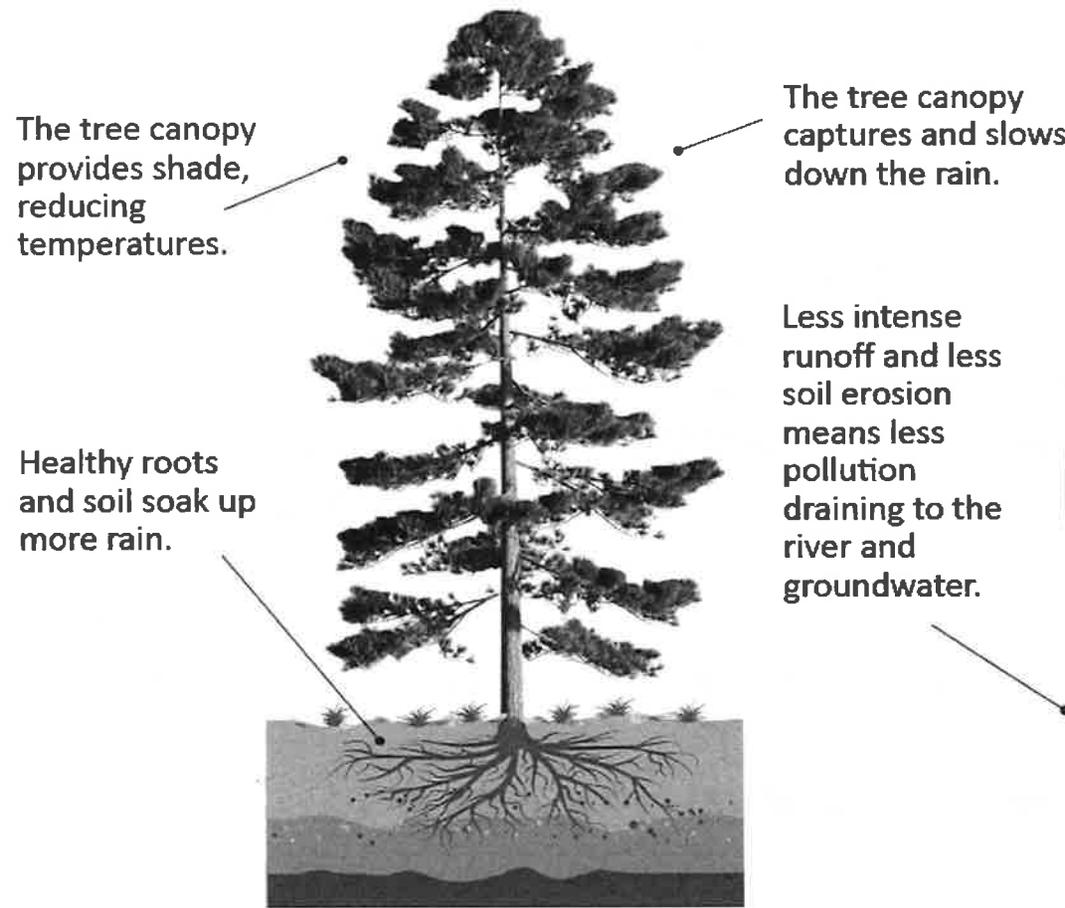


Our Trees are Natural Managers of Stormwater



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In Bend, we love our beautiful trees. They help to improve our air quality, keep soils from eroding and provide shade to help cool our environment and the river. But did you know that trees also reduce stormwater runoff and improve water quality by absorbing and filtering rainwater? Trees can transform pollutants into less harmful substances, helping to protect our river and the critters who live there.



Scan to learn more about stormwater and more ways you can help protect our river.
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STOP #10: What are the planters about?

Directions: Continue down Nashville Avenue until you meet the corner of Harmon Boulevard.

Student Challenge:

As you are walking to your next stop, think about how native plants help return water to the water cycle. Once we get to our next stop, discuss why planters not only help keep our stormwater clean but also help to keep water cycling throughout our watershed!

Trivia Term:

Hard surfaces like _____, sidewalks, and rooftops cause stormwater runoff.

s t r e e t s .
*



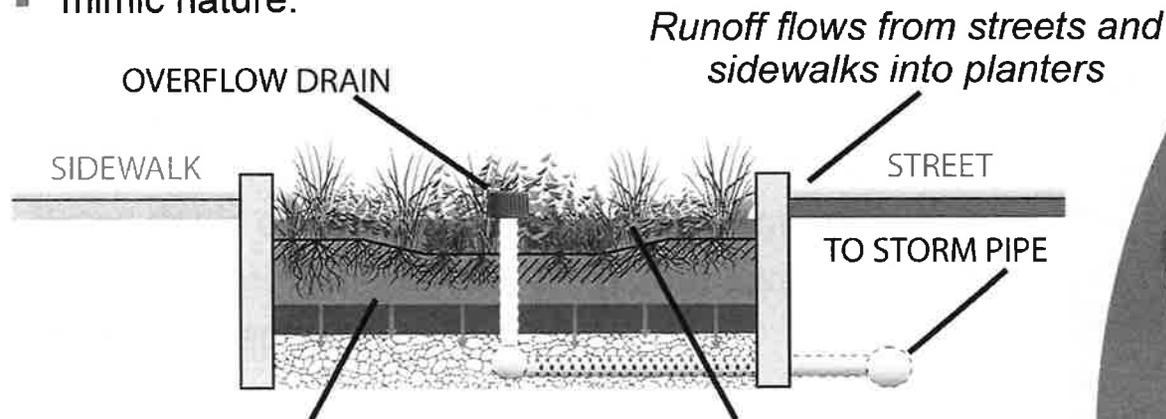
What are the Planters All About?

We're Protecting the River and Its Critters!

Stormwater runoff picks up pollutants like vehicle waste, landscape materials and trash that can harm the river.

THREE WAYS STORMWATER PLANTERS HELP

- 1 Planters catch water and help slow down flows to the river to mimic nature.



- 2 Layered soils and natural bacteria help catch and break down pollutants.

- 3 Native plants help reduce and clean the stormwater.

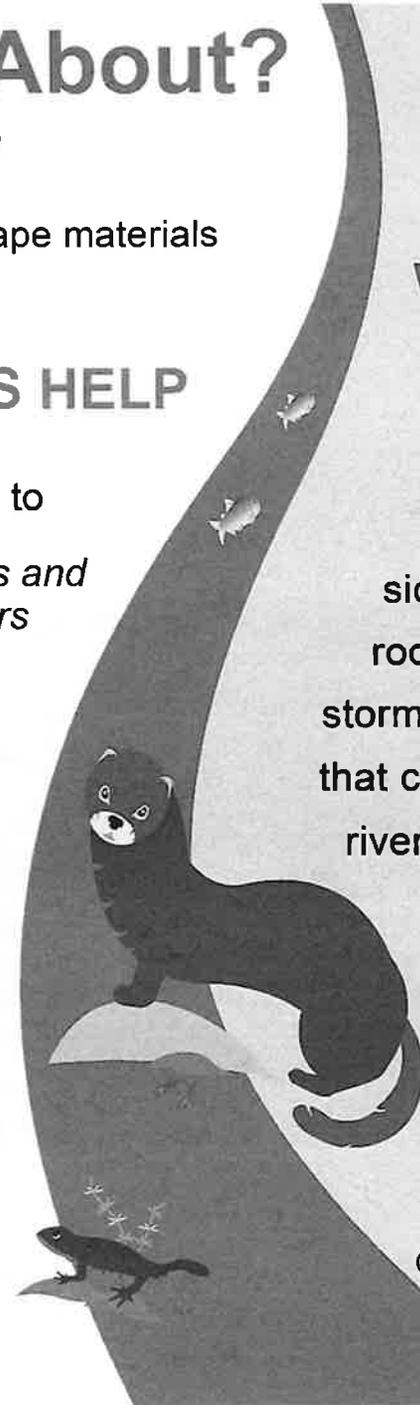


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Why?

Hard surfaces like streets, sidewalks and rooftops cause stormwater runoff that can harm our river and critters living there.



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STOP #11: It's all connected!

Directions: Head down Nashville Avenue until you're once again in Pageant Park. Look for the outfall where some of our stormwater drains into the Deschutes River!

Student Challenge:

As you are walking to your next stop, take a look out for oil spots or other chemicals that could be on the ground. Once you get to your stop, talk about how these non-point source pollutants could have an impact on the health of our rivers and streams.



Trivia Term:

Urban runoff often carries with it eroded soil and pollutants like _____.

o i l .
*



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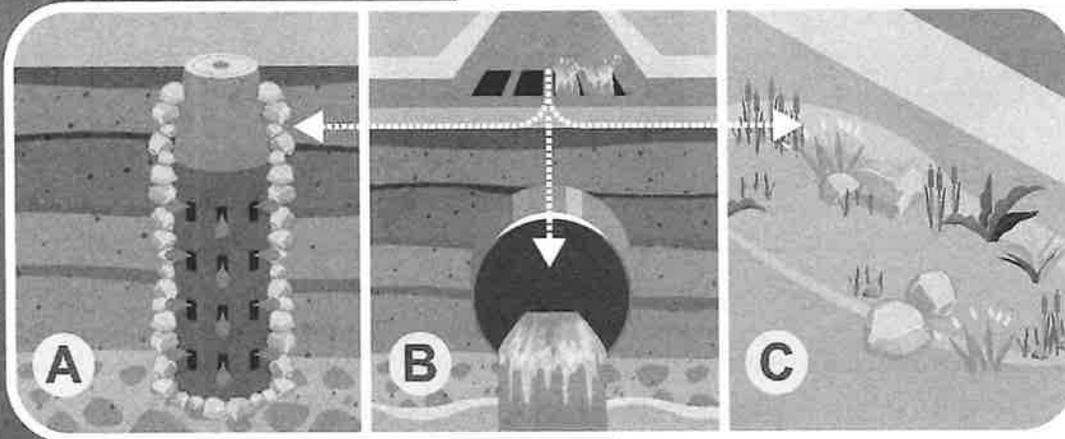
Protecting our waters... It's All Connected

When it rains or snow melts, the "runoff" along our streets drain to:

- A underground "injection" facilities,
- B the Deschutes River,
- C sometimes the runoff first drains into rain gardens or swales.



To find out more,
scan the code!



Reducing Floods, Removing Pollution

When it rains or snow melts, some enters the ground and the remainder is called "runoff." Streets, rooftops, driveways and other hard surfaces create more runoff than vegetated and natural areas.

Urban runoff often carries with it eroded soil and pollutants like oil, tire wear particulates, car brake metals, fertilizers, pesticides, pet waste and garbage.

The pipe outfall at the river's edge is the endpoint of the network of below- and above-ground drainage systems (Image B) that carries stormwater to the Deschutes River from this neighborhood, Newport Avenue, and even from Awbrey Butte!

Some stormwater also sinks down and recharges into the Deschutes Aquifer (Image A).

Since 2020, the City of Bend has improved the drainage system to reduce floods and remove pollution from stormwater flows before they enter the river or groundwater (Image C). Take the walking tour to learn more.



What is an illicit discharge?

An illicit discharge is any substance that enters a storm drain that is not clean rainwater runoff. Common types include motor oils, paint, household cleaners, grease, sediment, fertilizers, construction waste and septic/sewage waste.

Why are they bad?

Illicit discharges can harm water quality in the Deschutes River or groundwater aquifer, and they are illegal!

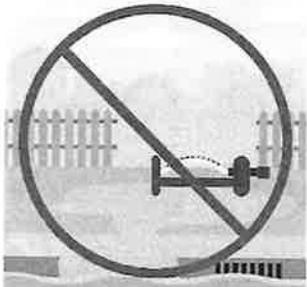
What if you see an illicit discharge?

Please report discharges to the City of Bend Utility Department at 541-317-3000 ext. 2

Remember, only rain in the storm drain! Keep reading for more helpful tips to protect our water.

Do your part to protect our waters!

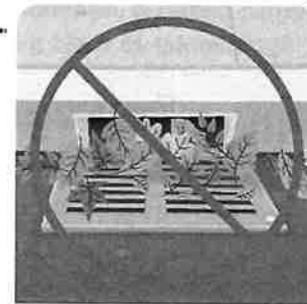
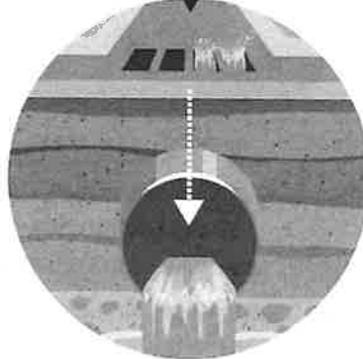
Everyone's actions or inactions can impact the clarity and health of the river and groundwater. Only clean rainwater runoff should enter catch basin drains.



Use the proper amount of fertilizer on the garden and lawn and don't overwater – irrigation water running into the street is wasted water and can carry chemicals to the river or groundwater.



Never dump or wash material into streets because it can travel to storm drain inlets.



Help prevent local flooding by keeping leaves, debris and soil out of streets, gutters and catch basins.



Pick up and properly dispose of your pet's poop.



Don't wash your car in the street – keep the water and grime on your property or go to a car wash.



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Now that you have finished up your tour, can you figure out the secret phrase below? HINT: it's the name of our program! Put the starred letter from each of the stops below to figure out the word and unscramble it!

E	N	R	T	T	A	W	S	I	E	O
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.

Answer: IT , S / ONE / WATER !



UPPER DESCHUTES

WATERSHED MONITORING

School: _____ Teacher: _____

Date: _____ Time: _____ Weather: _____

Stream/Site Name: _____

Any fish present? Yes No # of live fish: _____ # of carcasses: _____

TEST	Sample 1	Sample 2	Sample 3	Sample 4
Water Temperature <input type="checkbox"/> °C <input type="checkbox"/> °F Equipment used? Vernier <input type="checkbox"/> Manual <input type="checkbox"/>				
Air Temperature <input type="checkbox"/> °C <input type="checkbox"/> °F Equipment used? Vernier <input type="checkbox"/> Manual <input type="checkbox"/>				
Dissolved Oxygen (mg/L) Equipment used? Vernier <input type="checkbox"/> Manual <input type="checkbox"/>				
pH Equipment used? Vernier <input type="checkbox"/> Manual <input type="checkbox"/>				
Turbidity (NTU) Equipment used? Vernier <input type="checkbox"/> Manual <input type="checkbox"/>				

Adapted from: Environmental Services City of Portland



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Exit Ticket

What are **2** tools you saw today that can be used to clean our stormwater before it returns to the environment?

What is **1** new thing you learned about water quality in the Deschutes River?



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**Find more information about stormwater and the river:
bendoregon.gov/stormwater
www.upperdeschuteswatershedcouncil.org**