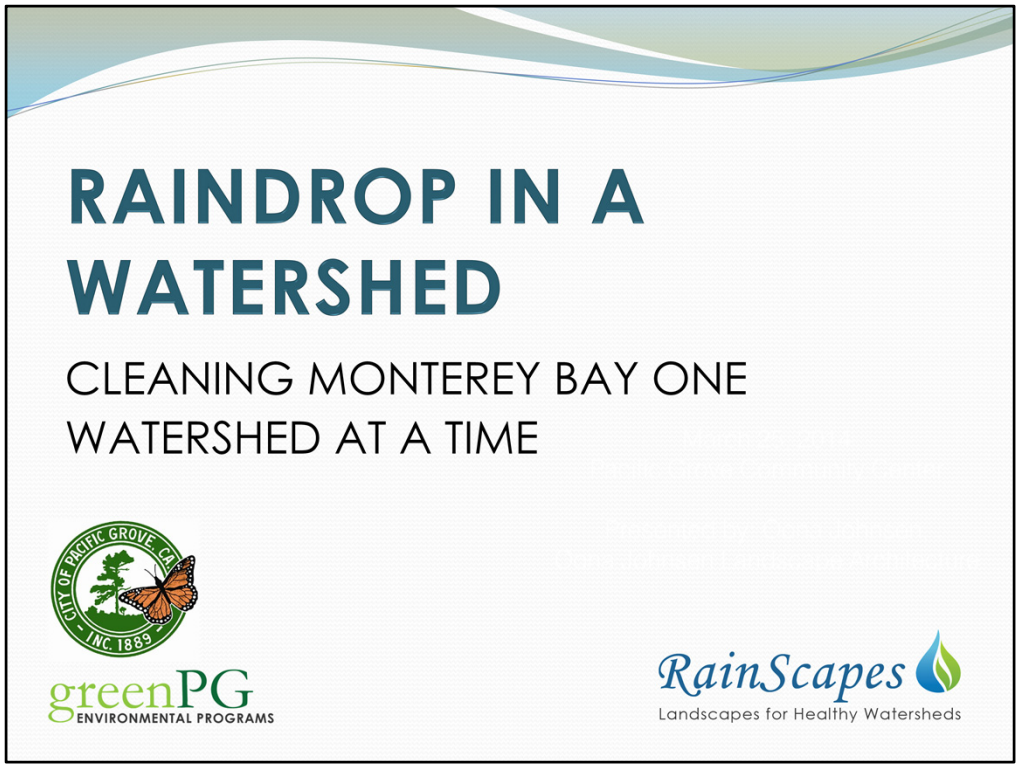
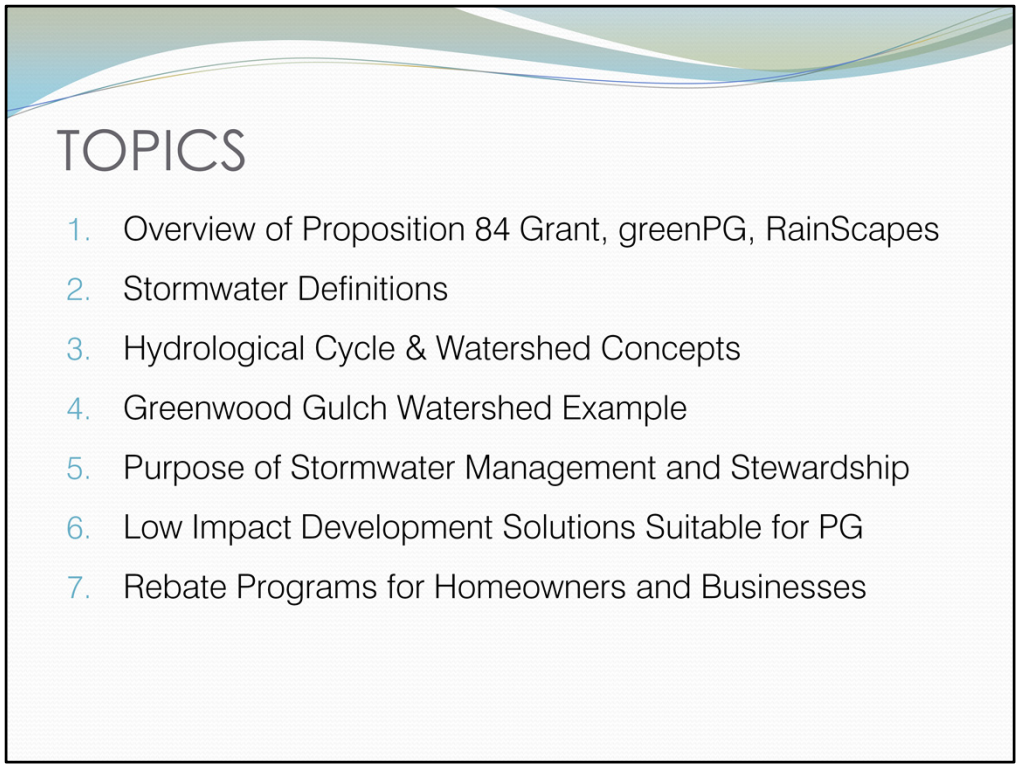


- Welcome and thank you for coming to the Raindrop in a Watershed community lecture!
- The purpose of this lecture is to help people understand why we should help manage stormwater through Low Impact Development as well as provide examples of how it can be achieved. Low Impact Development is a term (abbreviated as L – I – D) thrown around a lot as new stormwater issues and regulations arise in our community. It is easily misunderstood as Low Impact Development is full of concepts and principals as well as design practices. It is a lot to define in those three words! I hope to be able to explain it to you in a way that makes you appreciate its purpose.
- We have a lot to cover and would appreciate your questions at the end of the lecture.



1. Pilar Chaves, RainScapes Program Administrator, will present the Proposition 84 grant which funded this lecture and the development of the RainScapes program.
2. Basic terminology to help you understand the rest of the lecture.
3. The hydrologic cycle describes how water moves on, above, and below the surface of the earth. We will look at diagrams which illustrate how development has impacted the hydrologic cycle as well as understand the concept of what a watershed is.
4. To help you understand the concept of LID, we will look at a specific watershed in PG more closely and understand its opportunities and constraints in terms of cleaning stormwater.
5. Explain why we should care about managing stormwater correctly.
6. Will describe various Low Impact solutions suitable for PG. We live in a special place hydrologically speaking and I will tell you why. Also in this presentation, I have made an effort to only include local images (PG to Santa Cruz) where I could.
7. Review the upcoming RainScapes Rebate Program as well as other local programs which provide money incentives for homeowners and businesses who install specific LID practices.

The State Water Resources Control Board (SWRCB) awarded the City a Proposition 84 ASBS grant in the amount of $2,400,000 for the following:

1) Installation of dry weather diversions on two storm drain outfalls at the ASBS, directing flows to the Monterey Regional Wastewater Treatment Facility

2) Construction of an urban runoff lift station adjacent to the Monterey Bay Aquarium, in conjunction with the City's Sewer Pump Station #11 replacement project

3) Stormwater system improvements in the Greenwood Park watershed, with city-funded sewer improvements (14th St. & Sinex Ave. to Junipero Ave.)

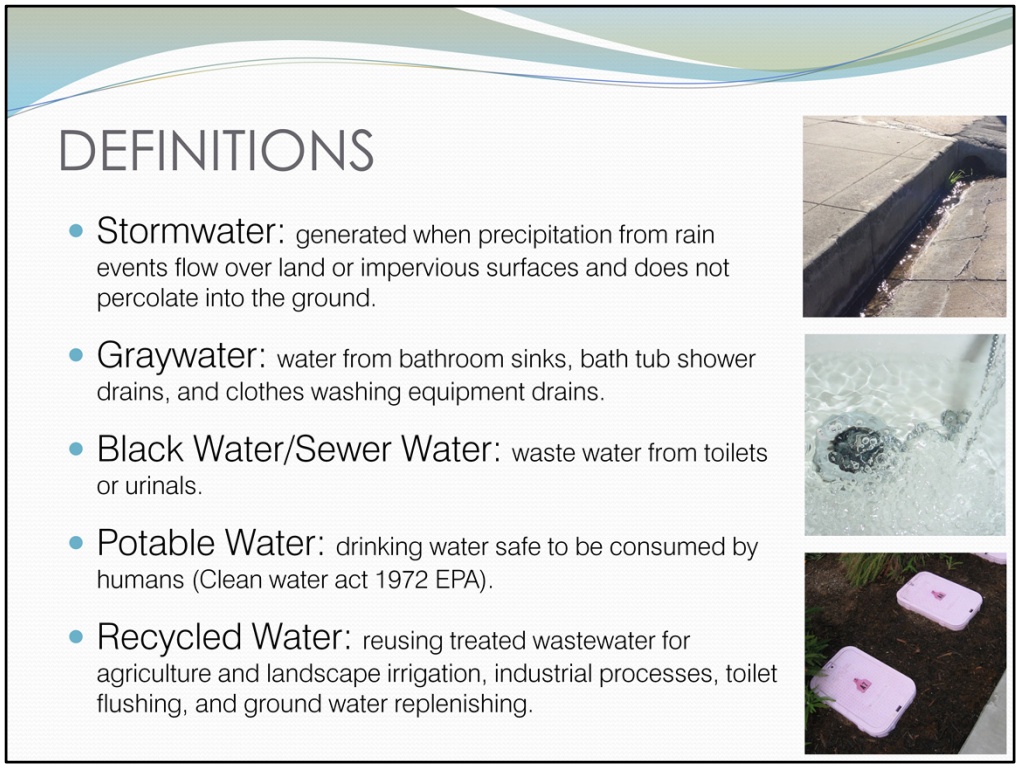
4) Implementation of an outreach and incentive program in the project area to encourage residents and businesses to install building and landscaping retrofits to retain storm water on site.

RainScapes
The purpose of the outreach and education strategy is to improve community engagement and stewardship for watershed management and water quality improvement projects.

The purpose of the program is to offer technical and financial assistance (in the form of rebates) to encourage and support property owners to implement eligible Low Impact Development techniques in their property. The *RainScapes* Rebate Program will promote

and implement projects which help to retain stormwater runoff on site and improve water quality within Pacific Grove's ASBS watershed.

5) Effectiveness monitoring to document any improvements to water quality resulting from the above projects



There are certain definitions that you will see used in describing stormwater concepts. I want to make sure you understand them before we move forward.

There are different types of water, in general, the differences are based on where the water comes from and its water quality.

Graywater – not including kitchen sink water and water from dishwashers since this water may contain high chemical and nutrient levels (food contaminants, bacteria and other contaminants). Great for landscape irrigation, but there are guidelines and requirements on how to do this safely. For instance, graywater for irrigation must be underground.
Blackwater – depending on the municipality, the blackwater can be combined with graywater and/or stormwater. For example, San Francisco has a combined sewer system, combining blackwater and stormwater in the same network of pipes. Creates overflow problems into the SF bay.
Recycled water – Marina Coast Water District is working on a network of recycled water piping (not yet available)

DEFINITIONS

- Roof Area: area of roof of a structure
- Gutter: a shallow trough at the perimeter of a structure that collects rainwater
- Downspout: a pipe that carries rainwater from a roof to a drain or to the ground
- Storm Drain/Storm Sewer: collects excess water from the surface and drains it to underground collection pipes
- Storm Drain Outfall: discharge point of the storm drain system

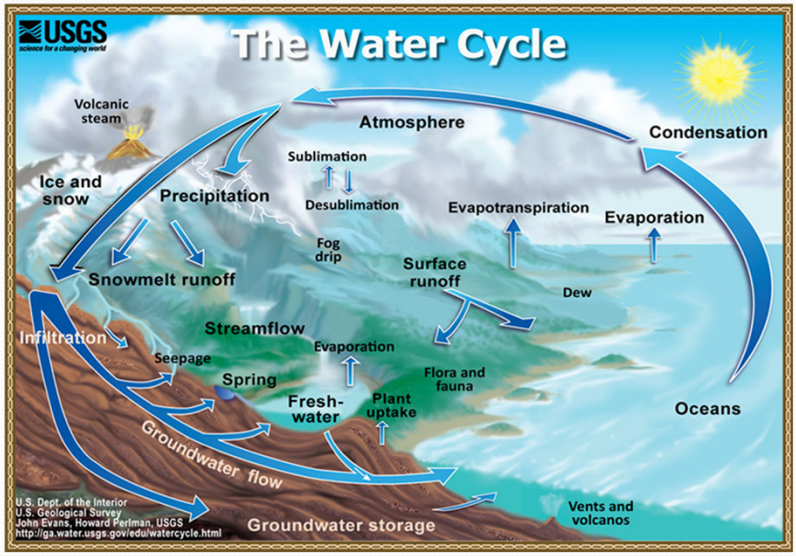
Note: A Storm Sewer does NOT mean that it contains Sewer Water. It contains stormwater.

DEFINITIONS

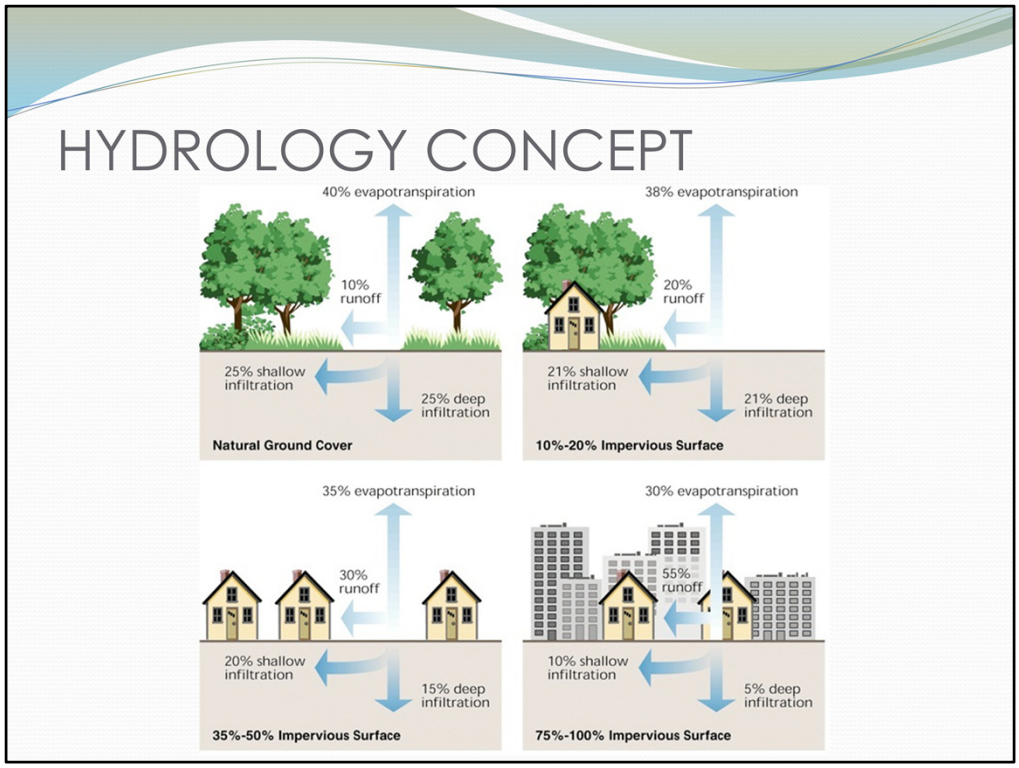
- Impervious Surface: a surface that does not allow water to percolate through; eliminating rainwater infiltration and natural groundwater recharge.
- Pervious Surface/Porous Surface: a surface that allows water to percolate through
- Hardscape: a built structures or surfaces made with hard materials covering the natural surface (concrete, pavers, asphalt, brick, walls, wood decks,)
- Runoff: water that flows over the surface of the lands when rainfall is not able to infiltrate into the soil

Impervious surfaces - roads, sidewalks, driveways, patios
Pervious surfaces - natural and landscape areas, certain paving types

HYDROLOGIC CYCLE

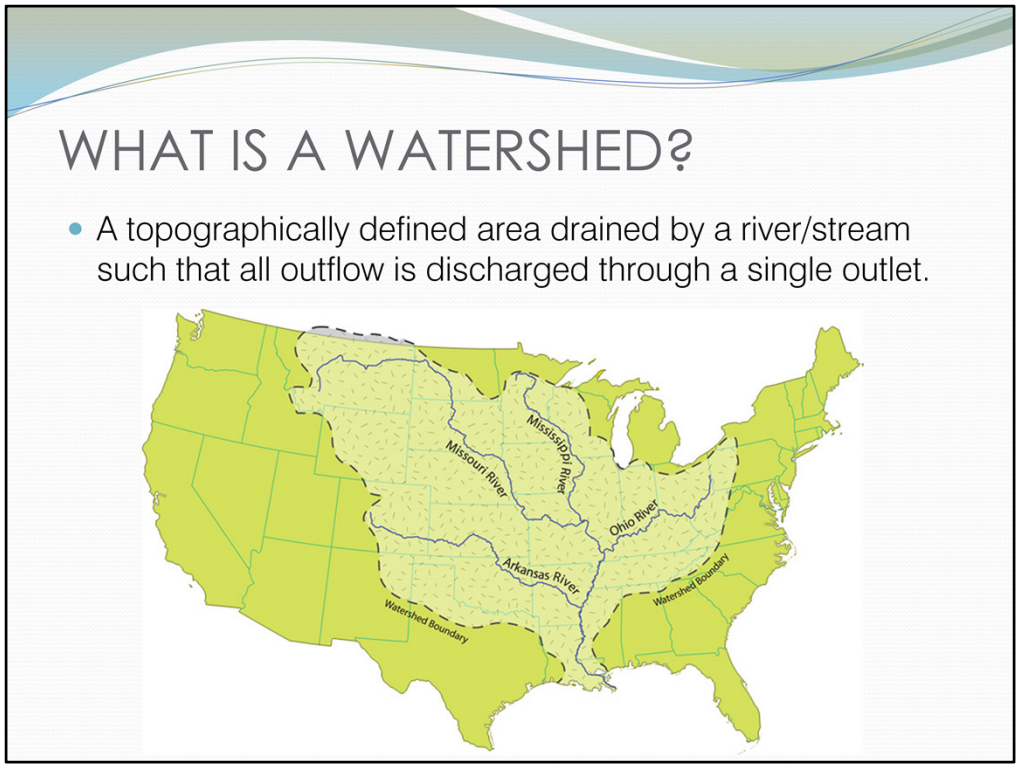


- How many of you remember this diagram in your middle school/high school text books?
- The hydrologic cycle describes how water moves on, above, and below the surface of the earth. The water cycle is also essential for the maintenance of most life and ecosystems on the planet. This cycle is the basis of defining Low Impact Development.



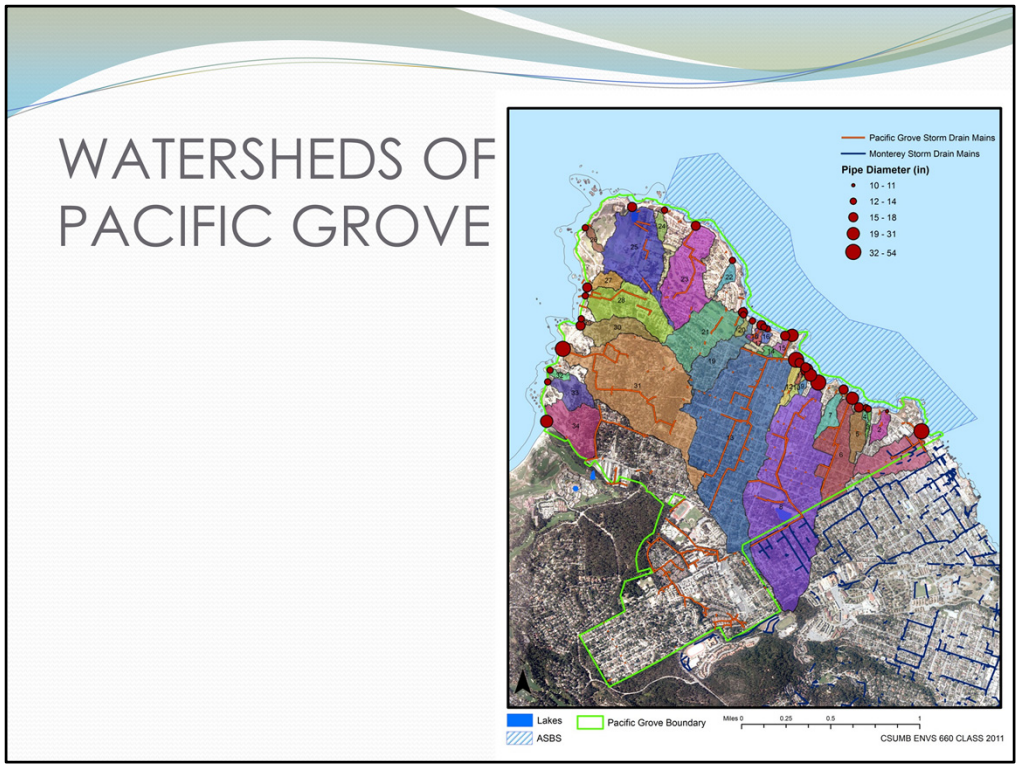
Low Impact Development is an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treat stormwater as a resource rather than a waste product. There are many practices that have been used to adhere to these principles such as bioretention facilities, rain gardens, vegetated rooftops, rain barrels, and permeable pavements. By implementing LID principles and practices, water can be managed in a way that reduces the impact of built areas and promotes the natural movement of water within an ecosystem or watershed. Applied on a broad scale, LID can maintain or restore a watershed's hydrologic and ecological functions. EPA definition

(This graphic is from the Slow it! Spread it! Sink it! Manual from the Resource Conservation District of Santa Cruz County)

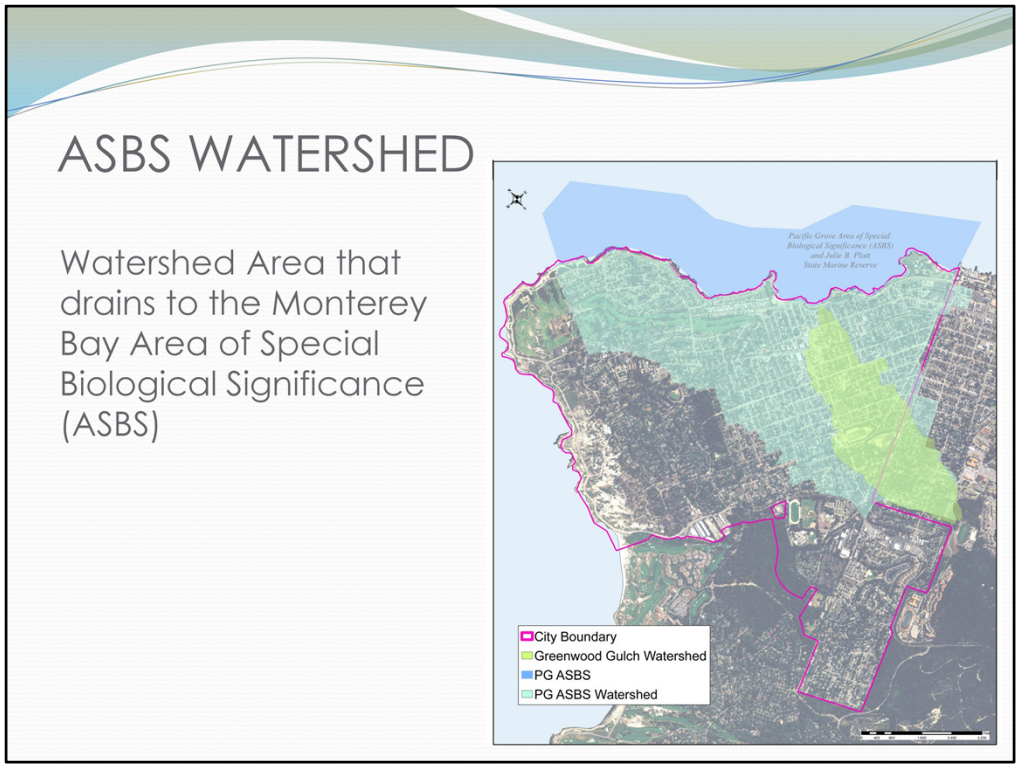


- Now with your understanding on the hydrologic cycle, I want you to think about it but within a specific area - called a watershed. Watersheds are important to the concept of LID.
- A raindrop that falls anywhere inside the dashed line will flow into a tributary river, then join up in the Mississippi River. The end point of the raindrop is in the Gulf of Mexico. Quite a travel.

- Here is another playful graphic which helps describe a watershed.
- A raindrop that falls inside the dashed line will flow into a tributary river, then joining up in a larger river. The end point of the raindrop is in an Ocean.
- Here you can imagine what the stromwater might pick up as it travels. It is cleanest at the high points but then picks up all sort of debris, contaminants as it passes through urban developments, pastures with animals, crop land, suburban housing development, etc.
- As more development occurs, the natural state of how the stormwater flow is altered. This has implications down stream and ultimately in the outfall, which is the ocean our case.
- You can also see how we as a society use the stormwater: wildlife, water recreation activities, fishing, water for irrigation, water for drinking, washing, and other uses including residential, commercial, manufacturing, and agricultural uses.

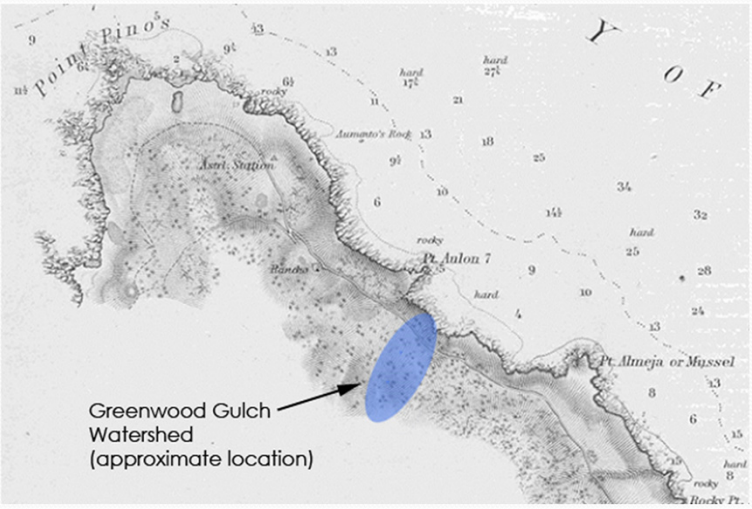


- This map shows the watersheds in Pacific Grove. Each color represents a watershed and the red dot indicates where the outfall is located.
- In our case, we don't have any major streams or rivers in which the stormwater flows. Rather the stormwater flows in underground pipes; delineated as red lines. The outfall is the Pacific Ocean, Monterey Bay.
- Now you can start to think about how the stormwater has been affected in our situation.
- I would like to call your attention to the Greenwood Gulch Watershed (the large purple watershed). We will use this as an example watershed area in this presentation.



- This map shows the group of watersheds that drain into the Monterey Bay which is designated as an Area of Special Biological Significance.
    - This is one of 34 ASBS areas.
    - 3 miles long
    - These areas support an unusual variety of aquatic life, and often host unique individual species and are protected from pollution discharges. We know this! We play in the tidepools and know how special our coastline and waters are!
    - More information about the Pacific Grove ASBS area in a handout at the check in table.
- The bright green is the Greenwood Gulch Watershed. We will use this as an example watershed and piece out its history and significant characteristics.

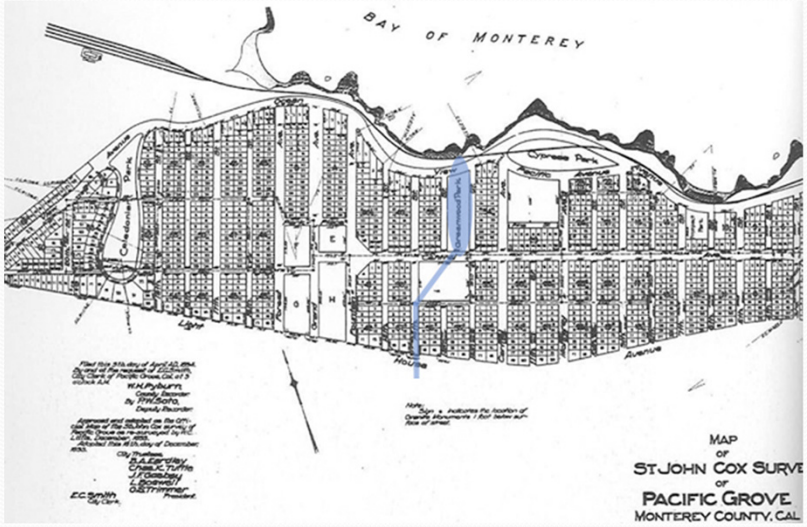
HISTORY OF GREENWOOD GULCH



Excerpt from the 1852 U.S. Coast Survey map of Monterey Harbor and vicinity

- I have given you some vocabulary as well as the concept of hydrology and an understanding of what a watershed is, now I would like to explain the history of the Greenwood Gulch Watershed and how it has changed over time. Again, this is all part of understanding Low Impact Development.
- This map from 1852 shows the Greenwood Gulch watershed as vegetated (road to the lighthouse perhaps?). This is what we know as the natural state of the watershed. Trees and vegetation, as well as the soil filtered the water all over the peninsula before it went into the ocean.

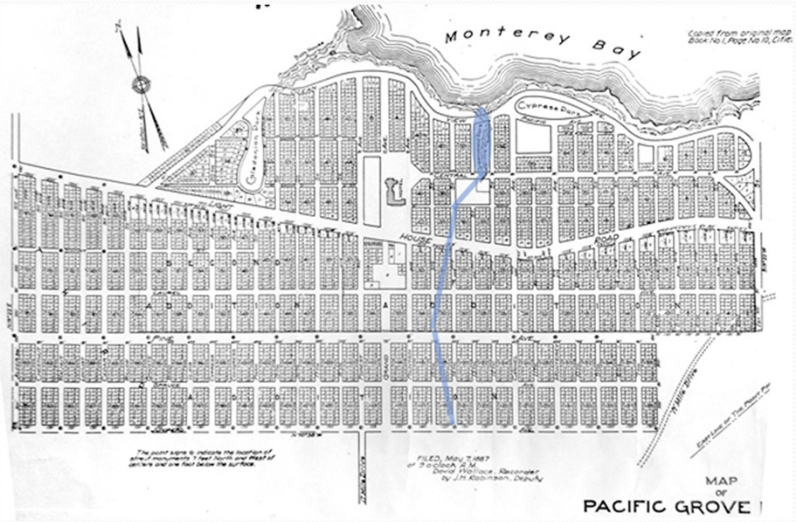
HISTORY OF GREENWOOD GULCH



1894 map of the entire St. John Cox Survey

- Development up to Light House Avenue
- Partially piped - Undeveloped area due to steep slopes from the gulch

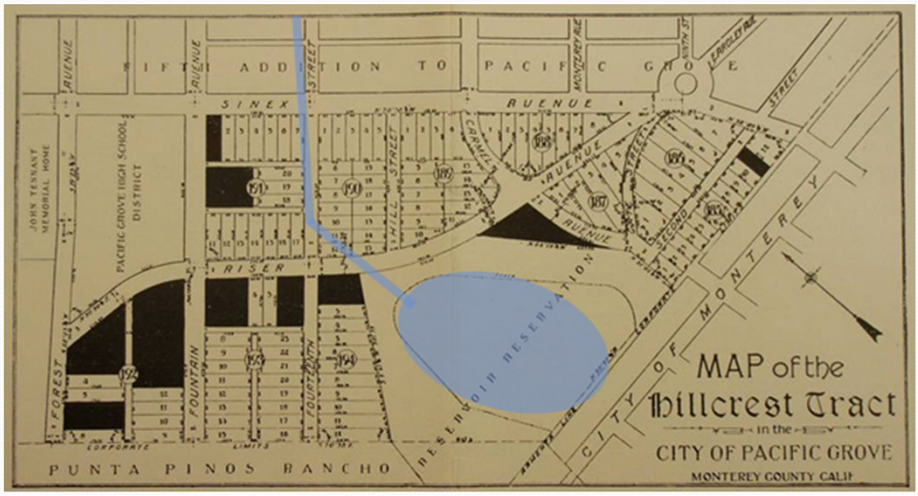
HISTORY OF GREENWOOD GULCH



1887 showing the First, Second, and Third editions to the Pacific Grove Retreat. The additions are located south of Light House Road, while the original retreat boundaries are to the north.

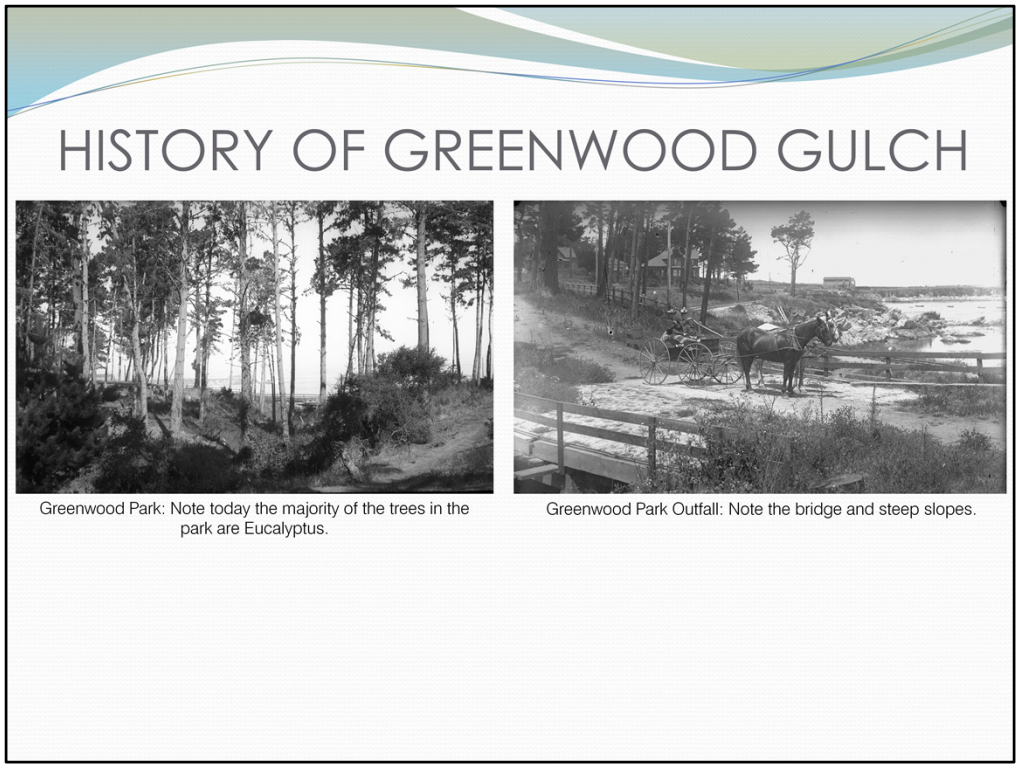
- Development past Lighthouse Avenue
- More piping
- Small lots
- Reference the location of Robert Down Elementary School as the Greenwood Gulch pipe goes underneath the main building.
- At RHD, you can see the Greenwood Gulch flowing in a deep pipe. Look down the grate near the blue ball wall and US map painted on the asphalt.

HISTORY OF GREENWOOD GULCH

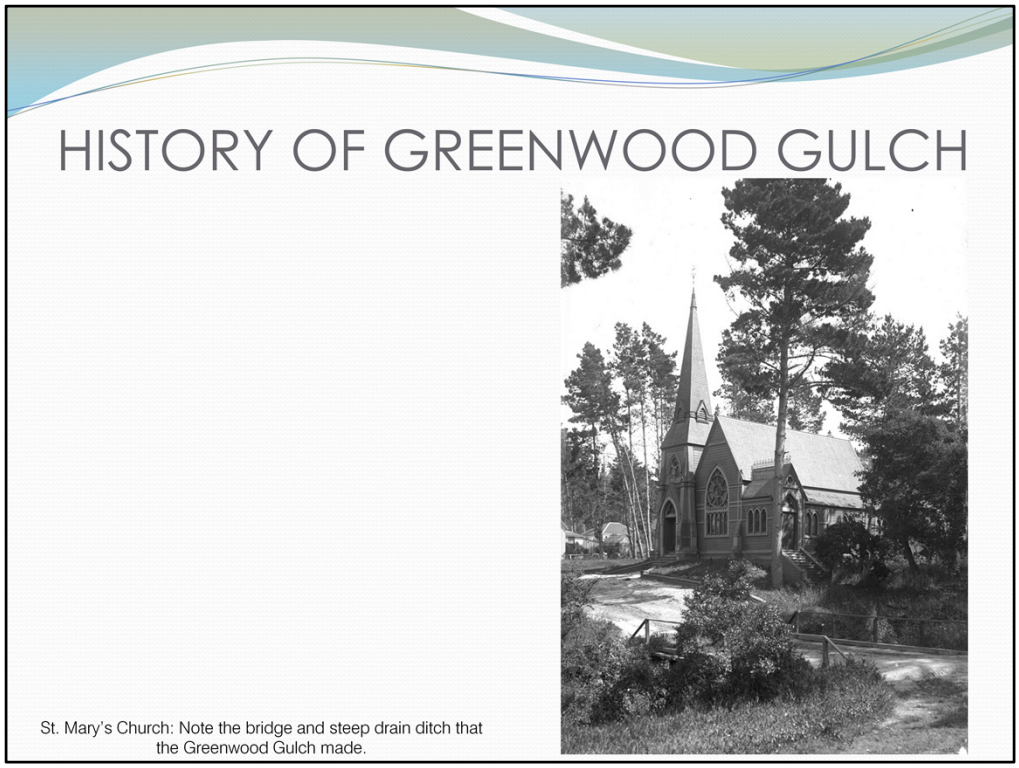


Map of Hillcrest Tract, circa 1915

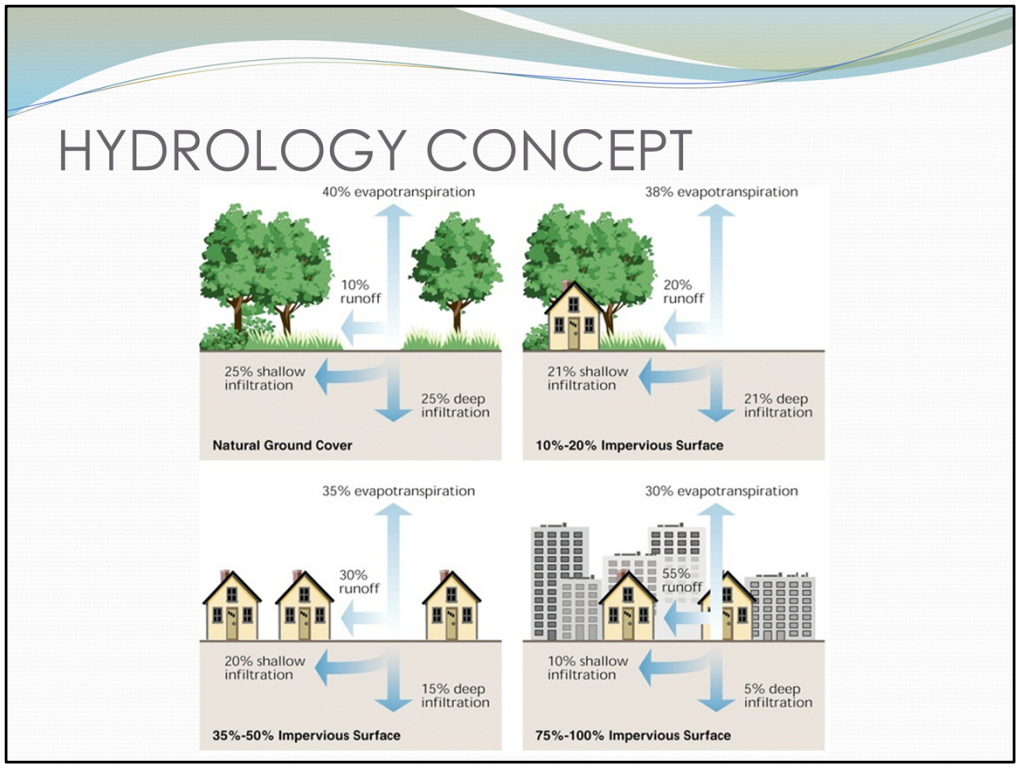
- Start of the Greenwood Gulch is at David Avenue Reservoir – put in by the Pebble Beach Company
- Now is abandoned but reuse strategies are underway



- Historic photos of Greenwood Park – steep slopes, bridges
- Notice the trees are Monterey pine with native understory shrubs – not eucalyptus as are growing today



- St Mary's by-the-Sea Episcopal Church
- Steep slope next to it and bridges
- The Greenwood Gulch flows underneath the Mayflower Presbyterian Church

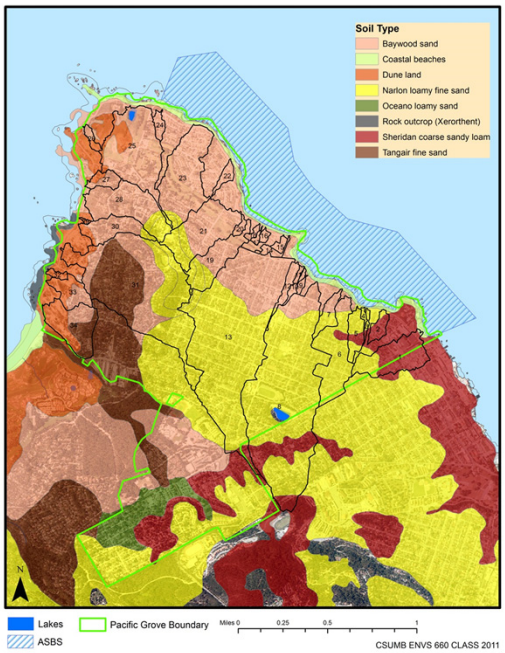


- Think about the natural state of Pacific Grove and how water moved and now think about the state of Pacific Grove now. Development significantly alters the natural hydrological cycle.
- Now we will get into some of the significant characteristics of the Greenwood Gulch Watershed.
- I will be presenting some maps which were complied from a 2011 study conducted by the CSUMB's Watershed Institute Advance Watershed Science and Policy class, which delineated the City's stormwater outfalls watersheds and identified land cover characteristics.
- The City of Pacific Grove is still working with students at CSUMB in developing new watershed models as new data is being collected.

GREENWOOD GULCH WATERSHED

Characteristics

- Soils & Geology
  - Soil Type

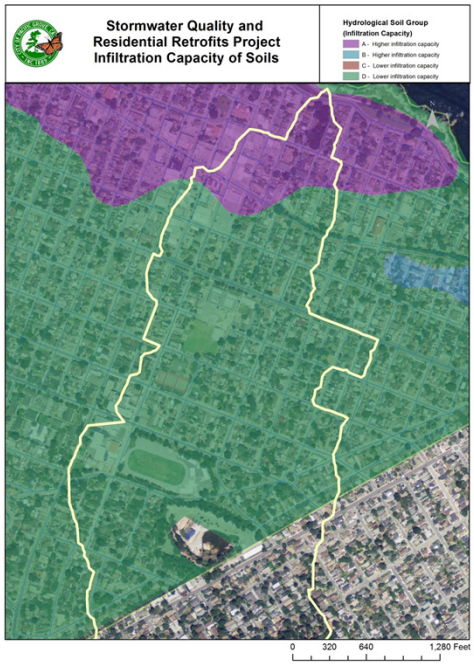


- Orient audience to Greenwood Gulch Watershed, David Avenue Reservoir, PG Middle School, PG Community Center, RHD, Greenwood Park
- Yellow = Narion loamy fine sand (Loamy fine sand = 50% or more of fine sand OR less than 25% very coarse, coarse, and medium sand plus less than 50% very fine sand.)
- Pink = Baywood Sand
- Geology – granite bedrock below the soil layer. The soils sit on mainly Marine Terrace Deposits and granodiorite (igneous similar to granite).

GREENWOOD GULCH WATERSHED

Characteristics

- Soils & Geology
  - Infiltration Capacity

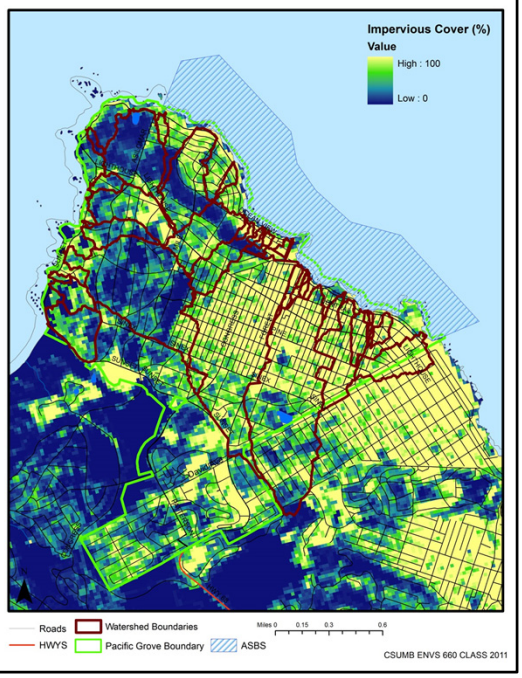


- Orient audience to Greenwood Gulch Watershed, David Avenue Reservoir, PG Middle School, PG Community Center, RHD, Greenwood Park
- Infiltration links the information in geology and soils. Very complicated process to measure.
- Purple = A soils – high infiltration (like sand)
- Green = D soils – very low infiltration

GREENWOOD GULCH WATERSHED

Characteristics

- Soils & Geology
- Impervious Surface

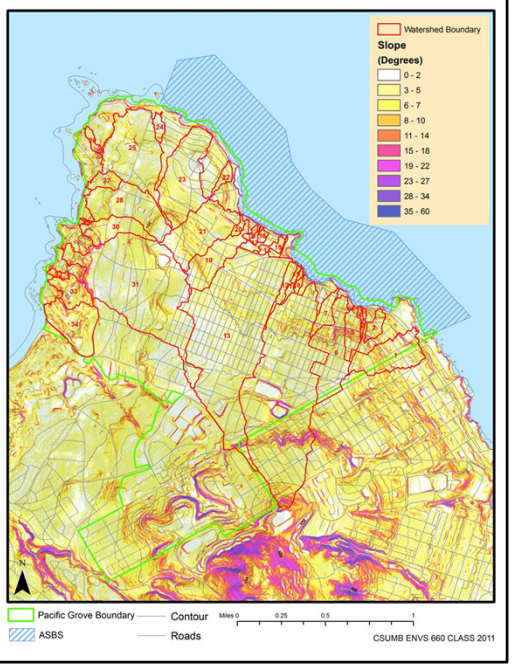


- Orient audience to Greenwood Gulch Watershed, Greenwood Park
- Yellow = more paved surfaces
- Blue = vegetated cover (RHD field, PG Middle School field, Golf Course, Asilomar)

GREENWOOD GULCH WATERSHED

Characteristics

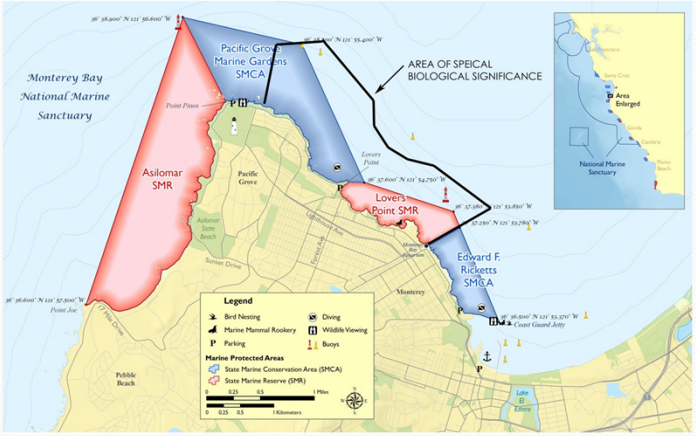
- Soils & Geology
- Impervious Surface
- Slope



- Orient audience to Greenwood Gulch Watershed, David Avenue Reservoir, PG Middle School Field, Greenwood Park
- Slope – rate of water flow, erosion potential
- Greenwood Gulch 2-10% slope range; New Monterey gets 19-22% slopes

PURPOSE OF STORMWATER MANAGEMENT & STEWARDSHIP

The Monterey Bay is a Protected Area:



- National Marine Sanctuary: US Federally protected marine area (the largest!)
- ASBS: State Water Resources Control Board
- Lovers Point State Marine Reserve
- Pacific Grove Marine Gardens State Marine Conservation Area

- Now that we understand the physical characteristics of the watersheds in Pacific Grove, lets understand why stormwater is important and what the effects of development are on Monterey Bay.
- Look at all the important designations the Monterey Bay has - four! I had no idea it was so special.

- The second point to the purpose of stormwater management and stewardship is that the Monterey Bay is polluted.
- Polluted runoff in areas with high impervious cover poses a danger to not only the flora and fauna that inhabit the receiving waterways, but also to humans that recreate in those waterways. Urban runoff carries contaminants, such as litter, food, human & animal waste, automobile fluids, industrial pollutants, fertilizers, and pesticides to waterways, the Ocean and beaches. Urban runoff can create health risks for people, harm marine life, and contribute to beach advisories and closures.

MAJOR POLLUTANTS

- Litter
- Dry Weather Flows
- Pollutants
- Pathogens/fecal coliform
- Motor Oil

- Remember this watershed map? Picture the Pacific Grove watersheds draining into the ASBS inside the dotted line. There may be different things happening inside the watershed, but how the water travels and where it ends up is the same. That is why each watershed is special and has to be evaluated individually.

REGULATIONS PG MUST FOLLOW

- Area of Special Biological Significance (ASBS):
  - There are 34 ocean areas monitored and maintained for water quality by the State Water Resources Control Board.
  - Pacific Grove must reduce pollution in stormwater flowing into the Pacific Grove ASBS waters.

- National Pollutant Discharge Elimination System (NPDES):
  - Pacific Grove must achieve a 90% reduction in pollution loading during storm events.
  - 85% runoff discharge elimination
  - Zero Trash

HOW CAN WE HELP?

- Eliminate/reduce as many source pollutants as possible from entering the storm drains
- Slow the rate of runoff during storm events
- Maximize area for infiltration of stormwater into the ground (not suitable for PG)

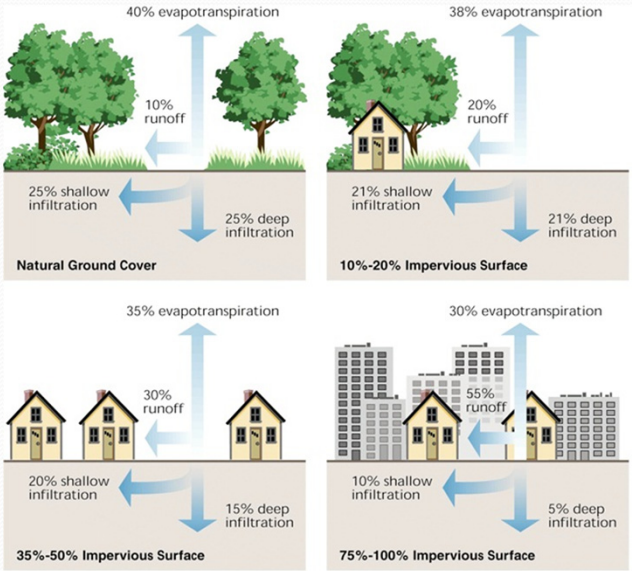
- In general there are three solutions to solving stormwater problems.
- Infiltration for groundwater replenishment is not be suitable for pacific grove because of the geology and soils. However, infiltration will help filter the stormwater of pollutants as it moves underground.

- Low Impact Development is a loaded term. It relates to everything that I have told you about the hydrological cycle and how stormwater rate, flow, infiltration, and water quality changes the watershed with development. It also takes into consideration the history of the watershed and how development has impacted its original natural state.
- In essence it would be great if we could break up all the concrete surfaces and replant with trees and vegetation, but we can't. However there are ways to help the cycle act like it is more natural. And that is the concept behind Low Impact Development.
- The bulleted points are some of those ways to help the stormwater get clean with slower flows. Not all the strategies listed may be appropriate for your situation in Pacific Grove, but it is important to know about them.
- I will present some photos of each Low Impact Development "technique" and describe their benefits and considerations.

EPA Definition: Low Impact Development is an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treat stormwater as a resource rather than a waste product. There are many practices that have been used to adhere to these principles such as bioretention facilities, rain gardens, vegetated rooftops, rain barrels, and permeable pavements. By implementing LID principles and practices, water can be managed in a way that reduces the impact of built areas and promotes the natural movement of water within an ecosystem or watershed. Applied on a broad scale, LID can maintain or restore a watershed's hydrologic

and ecological functions.

HYDROLOGY CONCEPT



- Who remembers what the definition of Pervious Surface is? - Obviously, this is NOT a pervious surface. Urban development has placed impervious surfaces all around us!
- Fort Ord – sea of hardscape
- Where does the rain drop go here. What would it pick up? Sediment, oil, other??

- I will present some pervious surfaces for driveways, patios, streetscapes, and parking.
- You may recognize some of these places in the images. I wanted to demonstrate that LID has been implemented in PG and the Central Coast already – we need more!

PERVIOUS SURFACES

- DRIVEWAYS