The Relationship Between Soil and Water

How Soil Amendments and Compost Can Aid in Salmon Recovery

Fall 1999

Abstract: Soil degradation and water pollution are widely recognized as major environmental problems. Less widely recognized is that soil and water are interconnected. Soils for Salmon is a project promoting the conservation of native soils and improvement of disturbed soils. Soils for Salmon supports salmon and other species recovery and is consistent with many other efforts to minimize the human impact on the natural environment.

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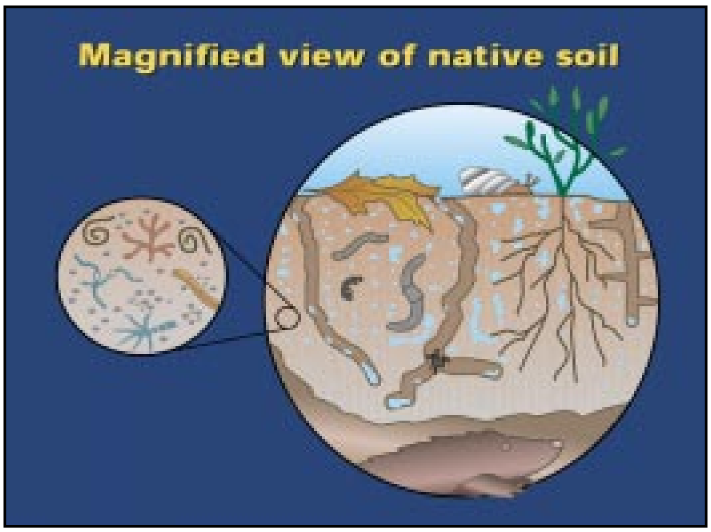
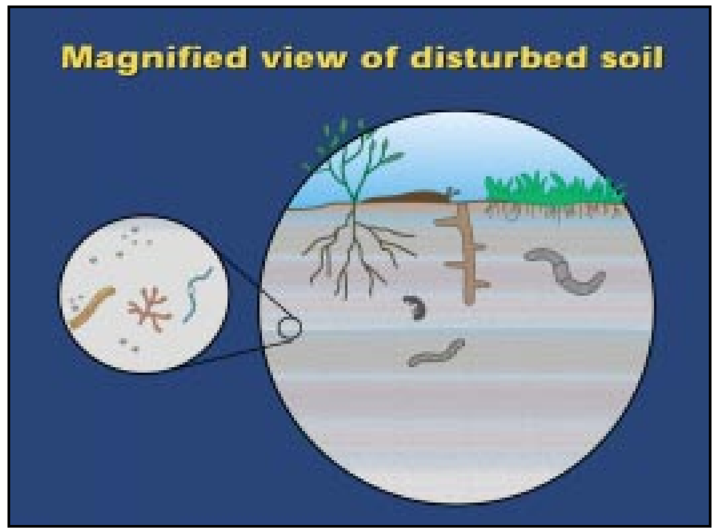
Executive Summary

Soils for Salmon is a project of the Washington Organic Recycling Council (WORC) designed to increase awareness of soil improvement as a means to support salmon and other species recovery. A goal of ***Soils for Salmon*** is for local governments to develop Best Management Practices that conserve native soils and improve disturbed soils.

- Soil degradation and water pollution are widely recognized as major environmental problems;
- Healthy soils directly contribute to healthier water resources and thus indirectly support salmon;
- Steps taken to improve soils lead to improved water quality and quantity that will result in healthier fish habitat;
- Increased use for compost helps close the recycling loop through beneficial use of organic materials.





A healthy soil provides a number of vital functions including the ability to store water and nutrients, regulate the flow of water, and immobilize and degrade pollutants.

Compost is the product resulting from the controlled biological decomposition of organic waste (such as yard debris, food waste, soiled paper, wood waste, biosolids and manures). Compost has the ability to bring back many critical functions to urban soils, which have lost their ability to hold and retain water, and bind pollutants.

Just as the retention of forest cover has been recognized as a land use tool for managing water quality and water volume, it is critical that soil structure retention be considered as a tool in the regulatory and land use tool box. Because salmon and other fish species rely on clean, fresh water to survive, they equally need healthy soil in the watershed above them.

The ***Soils for Salmon*** challenge is to implement a strategy designed to improve soil health. The goal is to improve the characteristics of urban soil to perform more like a native soil so that a more vibrant diversity of organisms will thrive, healthier plant growth will be sustained, and air and water will be held and retained longer.

Implementation of ***Soils for Salmon*** supports salmon and other species recovery efforts at the same time helping support agricultural viability and recycling organic waste into beneficial uses. Each of these helps to move the Pacific Northwest in the direction of a more sustainable future through healthier soil and water.

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Definitions

1. **Compost** – The product resulting from the controlled biological decomposition of organic waste.

2. **Disturbed soil** – Soils that have been impacted through urbanization and human activity.

3. **Organic Materials (waste)** – Materials that are not typically wanted by their producer. Examples include food waste, yard debris, soiled paper, wood waste, biosolids and manures.

4. **Native soil** – Soil that has been undisturbed by humans.

5. **Nematodes** – Microscopic worm-like organisms primarily soil borne and not related to earthworms.

6. **Protozoa** – Microscopic single celled animals.

7. **Soil aggregates** – A group of soil particles adhering to each other that form the soil structure.

8. **Soil amendment** – Any material such as compost, lime, animal manures, crop residues etc. that is worked into the soil. Generally pertains to materials other than fertilizers.

9. **Soil Foodweb** – The soil foodweb is a complex system made up of microscopic and macroscopic organisms such as bacteria, fungi, nematodes and protozoa. These organisms provide vital functions by keeping disease-causing organisms in check, helping to cycle soil nutrients, allowing healthy root growth and providing a highway for air and water to pass through.

10. **Soil organic matter** – That portion of soil that contains carbon in the form of decayed plant and animal residues (undecayed plant and animal residues are not soil organic matter).

11. **Soil structure** – The combination of soil particles into secondary aggregates. Examples are platy, prismatic, blocky or spherical. Compost helps bind primary soil particles to improve soil structure.

12. **Soil texture** – The combination of the different soil particles of sand, silt and clay. Example: silt loam contains > 50% silt and 12-27 % clay and <28% sand.

13. **WORC** – The Washington Organic Recycling Council is a nonprofit corporation formed to support the growing industry engaged in recycling of organic materials.

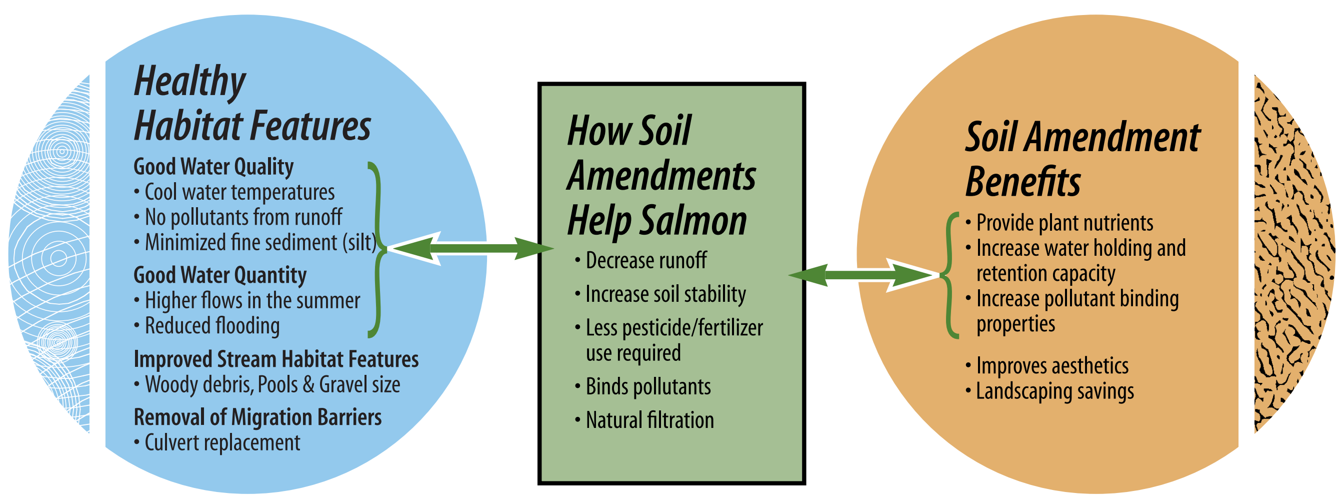
Introduction

In the wake of the National Marine Fisheries Endangered Species Act listing of Chinook salmon, more than 200 professionals gathered at the Center for Urban Horticulture at the University of Washington for the first ***Soils for Salmon, The Urban Environment*** seminar. Led by the Washington Organic Recycling Council (WORC)[i], the seminar addressed the relationship between urban soils, hydrology and salmon habitat. The March 31st event was well attended and widely acclaimed as providing a needed recognition for the soil/water interconnection concept. This concept includes several ideas that combine to form a unifying theme:

- Soil degradation and water pollution are widely recognized as major environmental problems;
- Healthy soils directly contribute to healthier water resources and thus indirectly support salmon;
- Steps taken to improve soils will improve water quality and quantity that will result in healthier fish habitat;
- Increased use for compost helps close the recycling loop through beneficial use of organic materials.

These ideas have also provided a central theme or umbrella for a coalition of agencies, individuals and private enterprise to organize. Simply stated, there is interconnection between soil quality and water quality and healthy water resources. But healthy soils do far more than help fisheries.

Figure 1. Healthy Habitat Features and Soil Ammendments



Healthy habitat is one critical component to salmon recovery. Soil amendments provide many benefits as depicted above. Several of these benefits directly coincide with characteristics of a healthy habitat. The arrows point to those soil amendment benefits that can help salmon by improving water quality and quantity. From this it is clear why proper soil management should be considered as another tool in the regulatory and land use tool-box to support Salmon efforts.

This paper discusses the function of soils, their relationship to water, the human impact on soils, and how disturbed soils can be improved. It takes a preliminary look into actions local and state governments can begin to make to protect soil health and salmon habitat. Now is the opportunity to focus on improved soil as an additional management tool, given the current attention to endangered species in the Pacific Northwest.

Purpose of Soils for Salmon

Soils for Salmon crosses a wide variety of disciplines including hydrology, soil science, waste management, agriculture, development, and landscaping, and thus it is difficult to define one goal.

Fundamentally *Soils for Salmon* is about:

- Improving soil quality
- Improving the health of water quality and quantity
- Recycling organic materials into beneficial resources and closing the recycling loop by using compost to amend disturbed soils.

In addition to supporting healthier fish populations, *Soils for Salmon* promotes these activities:

- Water conservation
- Agricultural viability
- Diverting materials from disposal landfills
- Strengthening the market for composted materials.

The Importance of Soil and its Effect on Water Resources

Soil serves a vital function in nature, providing a medium for plant growth as well as nutrients for plants, and habitat for millions of micro and macro organisms. Healthy soil allows them to flourish, release oxygen, hold water and diminish destructive storm runoff, break down waste materials, bind and breakdown pollutants and serve as the first course in the larger food chain.

The disturbance, compaction and degradation of soils impacts the soil structure and reduces its ability to provide these functions. Preserving native soils as much as possible and adding organic amendments such as compost to disturbed soils (prevalent in the urban environment), offer a strategy that allow soils to do their job.

Figure 2. Healthy Soil Functions

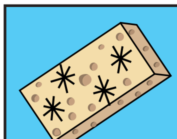
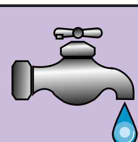
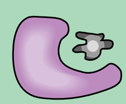
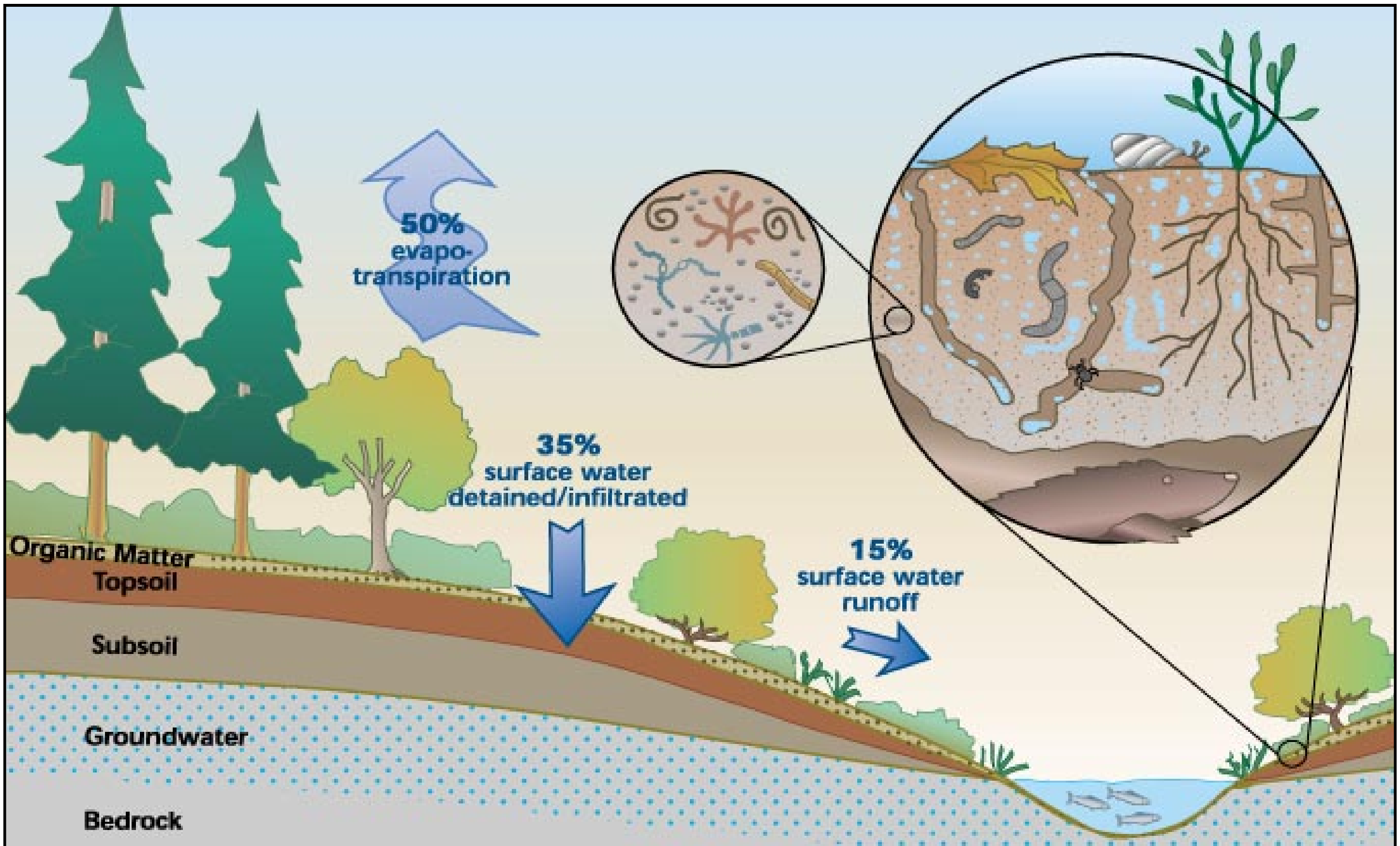
 **Store water and nutrients**	 **Water flow regulation**	 **Neutralization of pollutants**
Much like a giant sponge, healthy soil acts as a storehouse for water and nutrients. The slow release helps plants absorb the correct amount. As a storage reservoir for both water and nutrients, healthy soil has a greater holding capacity than soils that lack sufficient organisms, organic matter and pore spaces.	Like the on/off function of a faucet, healthy soil regulates and partitions water flow, naturally maintaining the water cycle by slowly discharging to streams, lakes and recharging aquifers.	Healthy soil is the site of intensive physical, chemical and biological activity, thus it can prevent water and air pollution. Soil rich in organic matter contains microorganisms that can immobilize or degrade pollutants.

Figure 3. Native Soil



A healthy vibrant soil structure teeming with micro and macro organisms. The presence of abundant organic material allow the soil to hold and retain water, and bind and degrade pollutants.

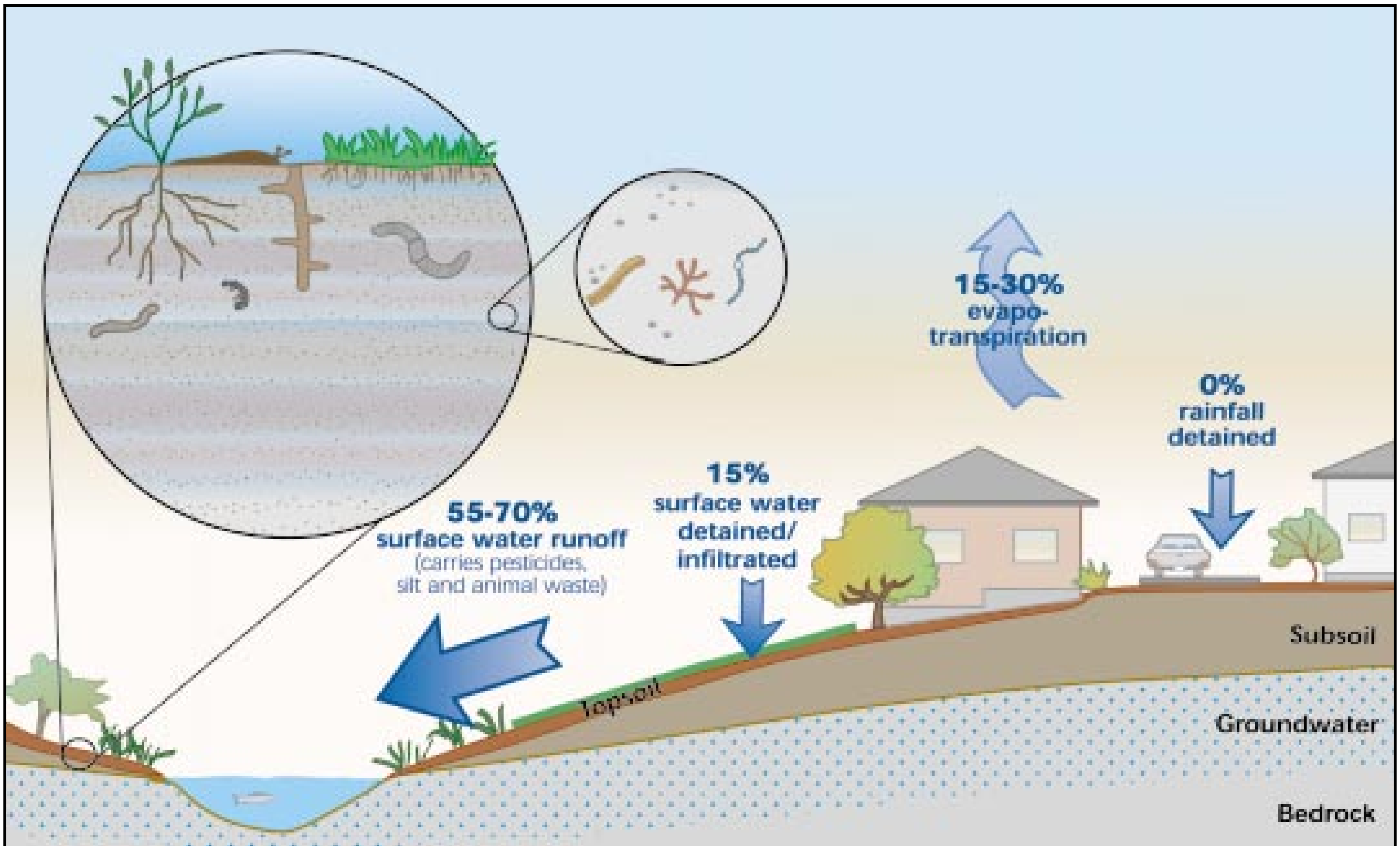
The Soil Foodweb

The soil foodweb is an incredibly complex system made up of microscopic and macroscopic organisms (Figure 3). For example, a spoonful of healthy soil contains many millions of different organisms including beneficial species of bacteria, fungi, nematodes and protozoa. These organisms perform vital functions such as keeping disease-causing organisms in check, recycling and storing nutrients and making them available to plants, allowing healthy root growth, and providing a highway for air and water to pass through. The more diverse the soil foodweb, the healthier the soil ecosystem.

Soil structure is a complex system of aggregates, pores and channels, all created by the activities of soil organisms. Dr. Elaine Ingham of *Soil Foodweb Incorporated* likens it to building a house out of bricks. To build bricks, straw and sand have to stick together. Then the bricks are held together with mortar to form walls. The house has structure when the walls are arranged in certain patterns. Different organism groups in the soil foodweb do the same for soil structure. Bacteria glue the clays, silts and sands together into what are called microaggregates.

Microaggregates are bound together by fungal hyphae (underground fungal vegetative growth), root hairs and roots. Larger creatures called arthropods, insects and earthworms make the structure of the rooms. Only when all the organisms are present and active can roots and water move into (and through) the soil with ease." [ii]

Figure 4. Disturbed Soil-Urbanization



A soil structure impacted by human activity with limited organic life. Erosion and surface water run-off are high.

The soil foodweb is fueled by plant primary production, which provides organic matter (both living and dead) to support the other organisms. Plants also actively release large amounts of carbohydrates, produced by photosynthesis, into the soil around their roots. This process provides support for both bacteria and the essential symbiotic fungi that form a net around plant root hairs, protecting them from disease-causing fungi and greatly extending their ability to absorb nutrients.

Bacteria and fungi, along with the organic matter they produce, function as a storehouse for most of the nutrients in the soil. These in turn are eaten by protozoa, nematodes, and micro-arthropods. It is the by-products of these organisms that provide the soluble nutrients that plants need in small but steady amounts for optimal plant health. Many species of larger creatures, such as earthworms, also eat these smaller soil organisms and they create the larger aggregates and pore spaces in soil. Similarly their waste become nutrients that get recycled into the storehouse by bacteria and fungi and made available to plants.

This intricate food web not only provides nutrients, but also serves as an "environmental protection agent." The multitude of pathways used by this diverse soil life allows it to break down pesticide and hydrocarbon pollutants, bind heavy metals into immobile forms, and convert soluble fertilizers into complex stored organic forms. Breaking down, binding and converting these contaminants in the soil is known as "biofiltration" or "bioremediation" and is what keeps these pollutants from entering ground and surface waters. All of this happens naturally in soils with adequate organic matter. [iii]

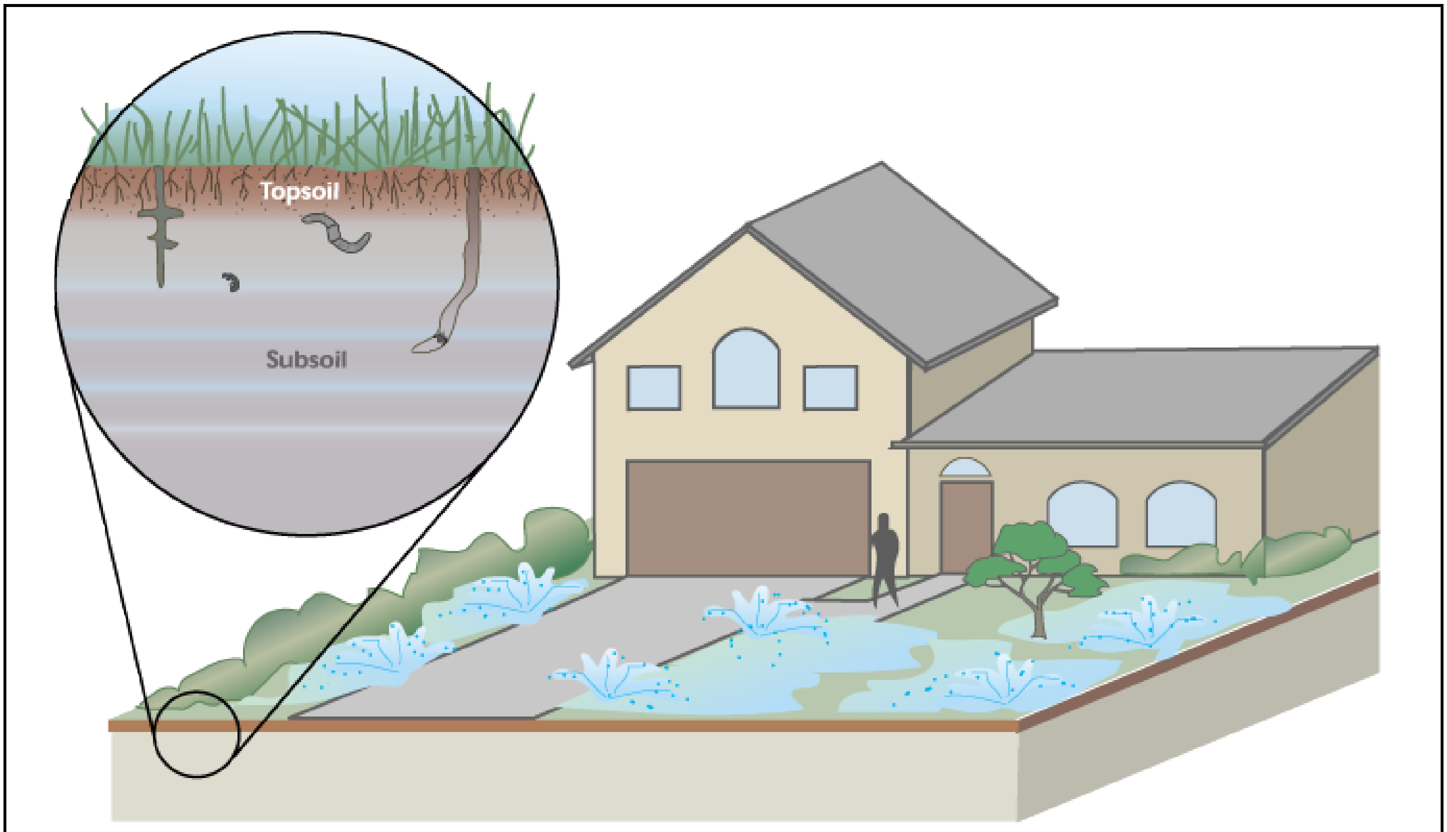
The Human Impact on Soils and its Effect on Habitat

Human Impact on Soils

Soil disturbance from human activity cause dramatic changes to soils from compaction, erosion and development and can lead to the degradation of soil quality. When native soils are removed or eroded, soil organic matter content is reduced, soil structure declines and diversity of soil organisms is lost. (See figure 4) Likewise as heavy machinery moves across soil, the pores and channels within a soil profile collapse. As these spaces are reduced, the organisms that thrive there are killed. The heavy use of certain pesticides reduces the numbers of beneficial organisms. With the loss of these organisms, many of the soil's vital functions are lost:

- Decline in organic matter inhibits the soil's ability to hold water, depletes nutrients, suppress' plant growth and inhibits the breakdown of toxins
- Decreased biological activity in soil limits nutrient availability to plants
- Soil compaction inhibits water infiltration and contributes to water runoff
- Soil erosion clogs and contaminates waterways

Figure 5. Typical Landscaping Practices



A typical urban landscape where soils contain little organic matter, shallow root growth, and water usage and run-off are high.

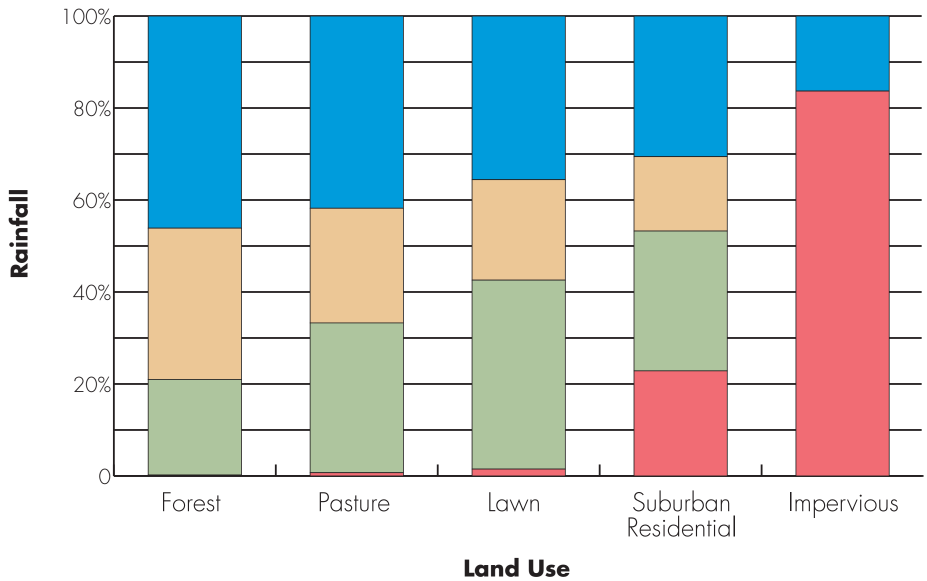
The impact of human activities on water can be viewed using information collected from an extensive modeling effort completed by Beyerlein and Brascher[iv] that simulated potential runoff in the Puget Sound Region. The results of their analysis are shown in Figure 6 and in Table 1 on the following page.[1]

Table 1: Where average annual rainfall of 40.70 inches goes[v] (measured in inches)

Land Use	Surface Run-off	Interflow*	Groundwater	Evapo-transpiration
Forest	0.09	8.46	13.40	18.79
Pasture	0.29	13.26	10.15	17.02
Lawn	0.61	16.72	8.89	14.48
Suburban Residential	9.30	12.37	6.58	12.44
Impervious	34.05	0.00	0.00	6.64

*Water that travels just below the surface

Figure 6. Where the Rain Goes



Clearly as land uses are intensified, surface water runoff increases and evapotranspiration is diminished. This pattern is common in the urban environment and highlights the need for creative alternatives that can help reduce water runoff and increase groundwater infiltration in the face of continued urban growth.

Figure 3 demonstrates how native soils are able to perform with a healthy layer of organic debris and topsoil. In a typical disturbed area (Figure 4), topsoil is very thin and therefore runoff is much greater. In native forests in the Puget Sound region, more than 46% of the rain that falls is able to return to the sky through evapotranspiration, compared to only 30% returned from suburban residential areas and less than 15% from impervious surfaces like roads, roofs and driveways. Native forest soils also detain and infiltrate into the groundwater up to 33% of annual rainfall, reducing damage from peak storm flows in streams and providing more flow during the dry summer months. Suburban residential areas, where soils have been stripped and compacted and most of the forest has been removed, detain and infiltrate less than 16% of rainfall into the groundwater, and of course impervious surfaces detain none at all.[vi]

Figure 5 shows a typical urban landscape, where topsoil is thin and excess water, fertilizer and pesticides may be required to maintain turf because of a shallow root system in poor soil. In the typical urban soil, we do not see the abundance of life and activity characteristic of healthy native soil.

1 The analysis was performed using the HSPF computer program, SeaTac Airport hourly precipitation (Oct 1948 through Sep 1996), Puyallup daily pan evaporation (same time period), and USGS regional HSPF parameter values for Puget Sound lowland watersheds in King and Snohomish counties. See endnote iv and v for additional information.

Impact on Salmon

Soils in poor condition from improper management have a reduced ability to function like a healthy native soil. Instead of absorbing water, supplying nutrients and breaking down toxins, surface water runoff increases which can contribute to negative impacts in the watershed hydrology and the salmon habitat including:

Changes in water volumes and flows from surface water runoff

Adequate water volume is critical to healthy salmon habitat. Altered volumes and flow result in:

- reduced flows in drier months;
- increased flows from flooding in wet months.

Increased flow velocities also accelerate natural stream bank erosion, contributing to sedimentation.

Increased sediment to spawning grounds from runoff and erosion

Alterations of sites by development expose bare soils to rainfall which increases erosion. When sediment enters streams and deposits itself in spawning beds, it inhibits oxygen from getting to salmon eggs, suffocating them and causing them to die.

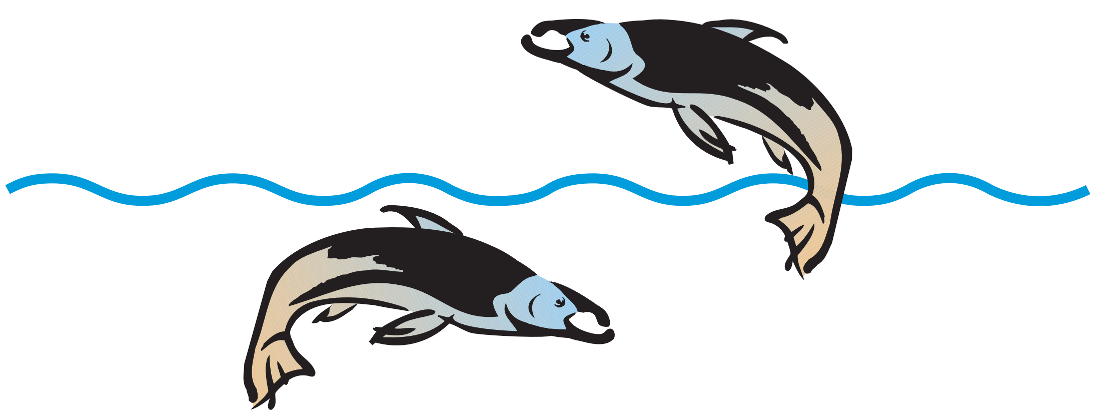
Increased chemicals and pollutant levels from runoff and erosion

Landscapes on poor soils may require more fertilizer and pesticides. Poor soils are also less effective at binding and breaking down pesticides, fertilizers, hydrocarbons, and other urban pollutants. These toxins significantly degrade water quality and damage fish health in the short and long term, as well as reducing populations of the organisms that they eat.

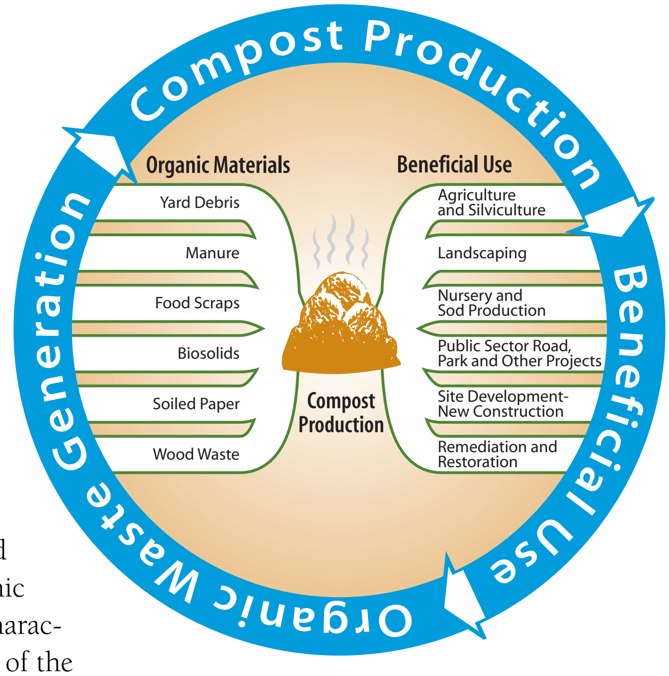
Increases in water temperature from surface water runoff

Fish need cool water temperatures to thrive and reproduce. Warmer temperature variations occur when groundwater infiltration is diminished resulting from increased runoff and damaged water quality.

Habitat degradation is one of many factors linked to diminishing salmon populations that can lead to a decline in the species.



The Story of Compost



The creation of waste, or materials, that are no longer desired by their source is a function of life. Recycling organic materials (such as food scraps, yard debris, wood waste, biosolids and manures) into compost, creates an abundant resource that can be beneficially reused in the environment. Finished compost bears little resemblance to the raw materials from which it came. Moreover using compost to improve soil and water quality closes the recycling loop and creates a product that makes the highest and best use of these materials.

Compost is a natural organic material produced when microorganisms break down organic residue. This process occurs continually in nature, resulting in a sweet, earthy smelling humus teeming with life. Compost adds both food for many organisms and an enormous diversity of organisms. It is also a rich source of organic matter. Although compost contains plant nutrients, it is typically characterized as a soil amendment rather than as a fertilizer because most of the nutrients are not readily available and only become available very slowly over many years.

The quality of the compost used for soil restoration is important. Commercial compost should have passed through a hot process and have a sweet, earthy smell. Compost should meet the Washington Department of Ecology's guidelines for "Grade A" compost. [vii]

Compost Amendments Improve Soil and Water Resources: [viii]

Improves Soil Structure

Improved soil structure creates passageways in the soil for air and water. In heavy clay soils, the addition of compost enhances the physical make-up of soil, improving soil structure, porosity and bulk density, and creating a better environment for plant growth.

Supplies Slow-Release Nutrients to Plants

Compost is a good source of nitrogen, phosphorus, potassium, sulfur, other nutrients and the variety of microorganisms essential for plant growth. Since compost is made of relatively stable organic matter, these nutrients are slowly made available for root uptake. In this way, nutrients are less likely to be lost through leaching.

Holds Moisture and Reduces Erosion

Compost has a large capacity to hold water - many times its own weight. This reduces water loss and leaching in soil. The soil-binding properties of compost result from its humus content which acts like a glue, holding soil particles together, making soil resistant to erosion and improving moisture retention.

Immobilizes and Degrades Pollutants

Compost has the ability to bind heavy metals, pesticides, herbicides and other contaminants, reducing both their leachability and absorption by plants. The soil microorganisms that compost supports also help break down pesticides, fertilizers and hydrocarbons. This same binding and bio-remediation effect allows compost to be used as a filter for storm water and other runoff.

Provides Organic Matter

Compost supplies organic matter to the soil stimulating the increase of organisms. The activity of these microorganisms promotes root development and assists in the extraction of nutrients from the soil. It also encourages the growth of earthworms and other macro-organisms, whose tunneling increases water infiltration and aeration.

Suppresses Soil-Borne Diseases and Plant Pathogens

Plant disease is influenced by the level and type of organic matter and microorganisms present in the soil. Detrimental organisms like root-eating nematodes and specific plant diseases such as pythium, fusarium, as well as a number of lawn diseases, are suppressed by certain microorganisms found in compost.

Developing a Soil Health Strategy

Recognizing that soil health has a role in water quality and quantity, an implementation strategy should be developed that aims to preserve native soil and improve disturbed soils. Efforts aimed at protecting soils through increases in the use of organic amendments such as compost will be steps that support many ongoing resource conservation efforts such as:

Water Conservation

Release of water for salmon from City water reservoirs is being proposed to assist local salmon recovery efforts. As more water is allocated to fish, it is imperative that we conserve water in numerous ways. Lawn and garden watering is estimated to account for 30% of total water use from mid-May to mid-September in this region, and can increase water use by over 100% on the hottest days of summer, when water supplies are lowest.[ix] Compost retains and slowly releases moisture, and encourages deeper rooting, thus reducing the need for watering.

Water Quality Improvement

Healthy soils mean healthier plants and root systems that in turn may require less fertilizers and pesticide use. Many programs are underway in Seattle and King County such as *Natural Lawn Care* and *Green Gardening* to reduce the amount of non-point pollution entering waterways. Also healthy soils bind and degrade toxins and restrict them from entering waterbodies.

Stormwater Detention and Infiltration

It is widely recognized that urbanization brings increased peak storm flows and decreased summer flows to streams, both of which significantly degrade salmon habitat. This results from the increase in impervious surface and decrease in groundwater infiltration. It has been clearly demonstrated that minimizing development impact on native soils and forests, and restoring impacted soils with compost, can reduce peak storm flows and increase infiltration.

Illegal Dumping of Yard Debris

Yard debris illegally dumped on stream banks and in wetlands also impacts water quality. Besides releasing excess nitrogen into the waterway, grass-clipping piles suppress native vegetation. Increasing the demand for compostable materials and compost facilities helps get the material to the correct location for processing into needed soil amendments.

More Sustainable Handling of Organic Materials

There is a tremendous amount of organic material still being burned, landfilled or illegally dumped, including land clearing debris, yard debris, agricultural wastes, clean wood waste, and food waste. Widespread amendment of disturbed soils could create a high demand for these materials. Such demand will help divert these materials to composting facilities.

Agricultural Viability

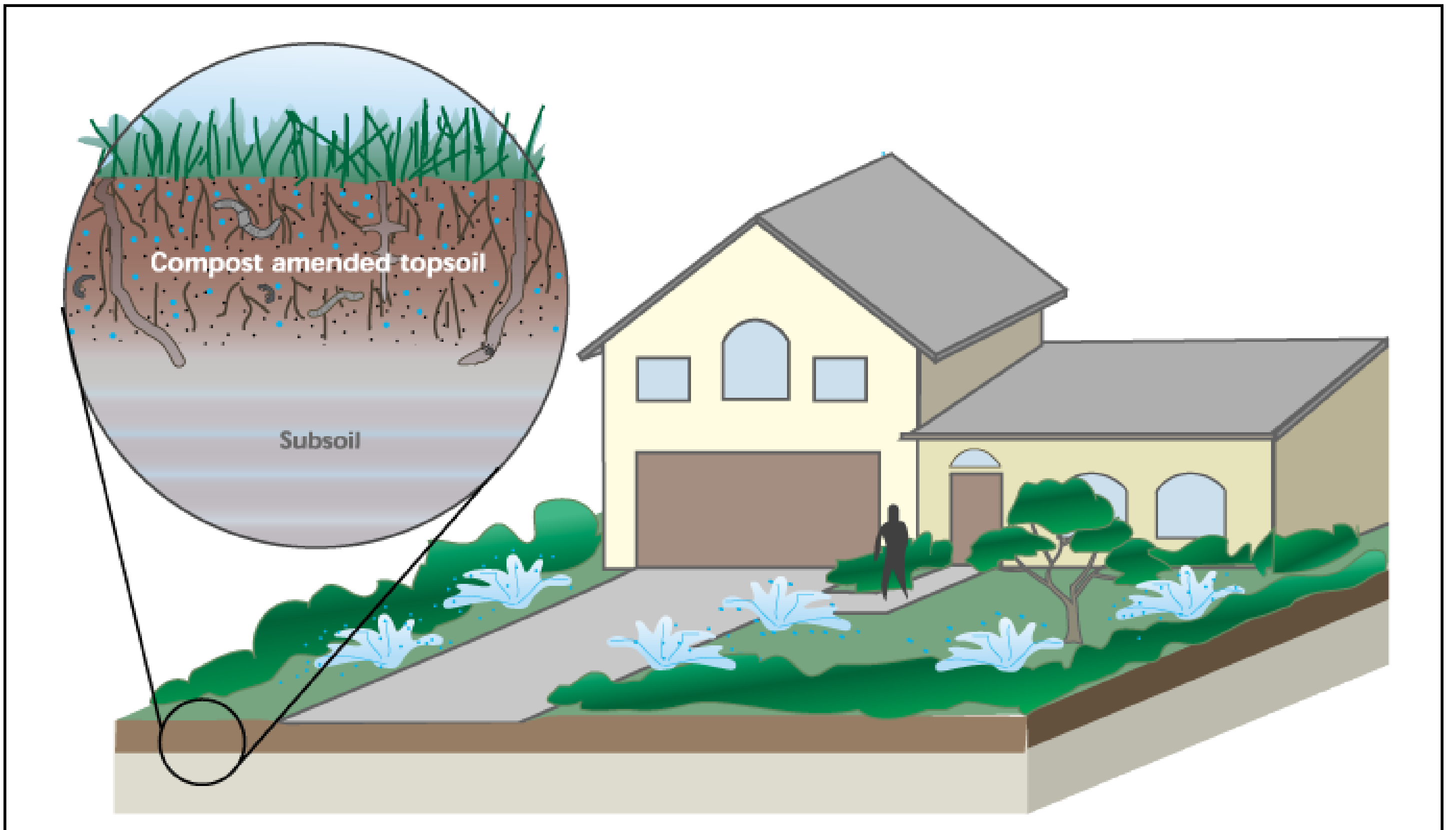
Supporting agricultural lifestyles is vital to the Northwest quality of life. Agriculture benefits from heightened attention in several ways. Increased demand for compost opens market opportunities for on farm composted products and provides more flexibility in managing farm by-products. Additionally increased awareness and demand for compost offers farmers a much needed revenue potential opportunity. Finally the use of compost in their practices also assists farmers to better attain water quality standards and reduce negative impacts to adjacent waterbodies.

Using Organic Amendments to Improve Soils

While retaining native vegetation and minimizing impervious surfaces must be a priority, some soil disturbance in a rapidly developing region is unavoidable. Disturbed soils can be amended so that they function more like a native vegetated soil and less like an impervious surface. By amending soil with compost, the overall soil structure, fertility, bio-filtration, plant vigor and health improve.

One way to restore soil functions in urbanized areas is to till compost into landscapes to improve soil structure (2 to 4 inches of compost per 8 inches of soil, depending on soil type). This practice can significantly improve detention/infiltration and reduce storm runoff from lawn and landscaped areas, especially on the sand, clay, or compacted glacial till soils common to this region.[x]

Figure 8. Utilization of Best Management Practices for Soils



A suburban lawn and landscape where topsoil removal may have been minimized, or an organic amendment such as compost has been added. Life in the soil is abundant, and water usage and stormwater runoff are both significantly reduced.

The City of Redmond has been a pioneer in this area and produced the *"Guidelines for Landscaping with Compost-Amended Soils".*[xi] They found that for the best hydrologic response in urban soil, the ideal ratio of compost to soil is best obtained when the final organic matter is somewhere between 8 and 14% by weight.

Best Management Practices

A goal of ***Soils for Salmon*** is for local government to develop a comprehensive list of Best Management Practices (BMP's) that improve soil structure and increase the use of compost. These guidelines could be used in many different public and private sector construction and landscaping projects such as roads, parks, stormwater etc.

For agencies, project managers, developers, private landscapers, homeowners and others to begin to use more compost and other organic amendments to improve the quality of their soils, a list of Best Management Practices needs to be developed. The list below offers preliminary recommendations and will be refined as further study, funding and pilot projects are initiated.

This initial set of BMP's is grouped into the following 4 general categories.

Retaining Native Topsoil

- Minimize disturbance of native soils
- Reduce the removal of native topsoil
- Restore retained soils to original or higher level of porosity and water retention capacity by amending retained topsoil with 30% compost by volume to a depth of 8 inches

Construction Practices

- Minimize compaction of soil by heavy equipment, especially by limiting the construction activity "footprint" on sites and leaving as much area as possible undisturbed
- Store topsoil on-site for replacing after construction
- Process vegetative land clearing debris and use on-site for mulching, where practical to do so, or transport to a composting facility for composting

Organic Amendments

- Incorporate 2-4 inches of compost into disturbed soils after construction during landscape development
- Amend soils with compost prior to landscape development
- Improve soil quality of disturbed/damaged soils by amending with 30% compost by volume to a depth 8 inches
- Restore surrounding native soils impacted by construction with 30% compost and mulching with wood debris

Vegetation

- Retain native vegetation as much as possible
- Cover soil during re-vegetation efforts using mulch materials from on-site materials or imported materials

Projects to Implement

Implementing the ***Soils for Salmon*** concept includes a variety of activities from using more compost to educating the public on how to improve soil health. The following list provides just a few of many possibilities.

Turf Research

Local research has shown that compost additions will increase organic matter levels and productivity of agricultural soil, and will reduce runoff from urban fill soils planted to turf. Questions remain about how much compost to apply to urban soils in different situations to make the best use of this resource. Research objectives for Soils for Salmon include determining appropriate compost application rates, and compost application effects on turf quality and longevity, water use, runoff, and off-site loss of nutrients and pesticides. The research will need to be interdisciplinary - involving soil scientists, turf scientists, horticulturists, and hydrologists, and will need to have a long term component to determine if compost amendments have a lasting effect. A demonstration and education program will be set up as part of the research project so that agencies and citizens can keep abreast of research findings and recommendations.

Master Composter Demonstration Sites

The Seattle Tilth Association developed the first Master Composter program for the city of Seattle in 1985. The program is nationally recognized and has spawned numerous spin-offs in cities and towns throughout the U.S. and Canada. The program supports public education of backyard composting through a network of volunteers. Incorporating the Soils For Salmon message into existing Master Composter demonstration sites and education materials has great potential.

"Street of Dreams"

Each year, local Master Builder organizations sponsor "Street of Dreams"(registered trademark) - a weeklong open house designed to showcase new residences in a designated neighborhood. Thousands of people tour the Street of Dreams to view latest construction and decorating trends. With enough advanced planning, Soils for Salmon concepts could be incorporated into the project and then showcased during the open house. "Street of Dreams" exposure for Soils for Salmon could reach a wide audience in the context of urban development.

Watershed Planning Units

In 1998, the Washington State legislature passed the Comprehensive Watershed Planning bill. The bill provides a framework for developing local solutions to water issues on a watershed basis. Framed around watersheds or sub-watersheds known as water resources inventory areas (WRIAs), the watershed planning process allows local citizens and local governments to join with tribes to form watershed-management planning units. To date, 19 planning units are addressing 27 of the 62 WRIAs in the state. The planning units are charged with developing management plans for their watersheds. They may also choose to develop strategies for improving water quality, for protecting or enhancing fish habitat. The Soils for Salmon message can be included in these strategies.

Local County Projects

Many local projects and practices in Counties lend themselves to incorporation to a ***Soils for Salmon*** theme:

- Incorporation into planning and regulatory documents:
  Comprehensive Growth Plan, Stormwater Manual, Development Regulations, etc.
- Endangered Species Act/National Marine Fisheries Service response
- Streambank restoration
- Native plant gardens
- Local Drainage Services
- Incorporation into County published educational materials, brochures and handouts
- County Department landscaping projects: Transportation, Parks, Construction and Facility Management, Natural Resources, etc.
- Educating suburban/incorporated Cities and the general public

Potential Funding Sources

Funding to support Soils for Salmon projects is available through several sources. Possibilities include the following grant programs.

EPA Sustainable Development Challenge Grant Program

The Environmental Protection Agency (EPA) is soliciting proposals for the combined FY 1999/2000 Sustainable Development Challenge Grant (SDCG) program. Grants range from $30,000-$100,000 or $100,001-$250,000. These grants are intended to catalyze community-based projects to promote environmentally and economically sustainable development and build partnerships. Deadline for applications is September 29, 1999. For more information, visit http://www.epa.gov/ecocommunity/sdcg/ or contact Anne Dalrymple at 206/553-0199.

Puget Sound Water Quality Action Team - PIE Grants

The Puget Sound Water Quality Action Team is looking for projects that energize people with new information and tools and involves them in protecting Puget Sound. Any Washington State resident, business, organization, tribal or local government, state college, university or community college may apply for a PIE Grant to fund projects that relate directly to Puget Sound. The project must also relate to the priorities identified in the 1999-2000 Puget Sound Water Quality Work Plan. Maximum funding per project is $45,000. An RFP for Round 12 will be out in August, and the application deadline is October 5, 1999. Proposal assistance workshops will be held in September. More information is available on line at http://www.wa.gov/puget_sound

Department of Ecology - Public Participation Grants

The Department of Ecology administers the Public Participation Grant (PPG) program, which helps citizen groups and not-for-profit organizations with cleanup oversight and waste management education projects. Ecology wants to fund projects that enable people to influence the decisions made about waste sites and projects that show how to prevent pollution by reducing or eliminating waste at the source. The PPG application for the current grant cycle (‘99 - ‘00) is due August 31, 1999. Copies of the grant guidelines (Publication #99-506) may be obtained by calling 1-800-RECYCLE.

Department of Ecology - Coordinated Prevention Grant (CPG) Program

Washington law requires local governments to plan how they will manage both hazardous and solid waste. The Coordinated Prevention Grant Program is designed to help local governments pay for local plans, and to put into action the projects identified in those plans. The program encourages consolidating hazardous and solid waste efforts at the county or regional level. Most grant dollars will flow to counties, and to countywide and inter-county implementation agencies such as health districts/departments. Several composting projects have been funded under the CPG program. For more information, look on the web at http://www.wa.gov/ecology/swfa/cpg.

Department of Ecology - Centennial Clean Water Fund

The Centennial fund provides grants and low-interest loans to local governments and Indian tribes for water pollution control facilities and water pollution control activities designed to prevent and control water pollution to our state’s surface and ground water. Centennial funds may be available for certain composting activities. Please contact Kim Mckee at 360/4-7-6566 for more information.

Local Public Utility Funding

- Waste Management Utility
- Wastewater Treatment/Biosolids

Conclusion

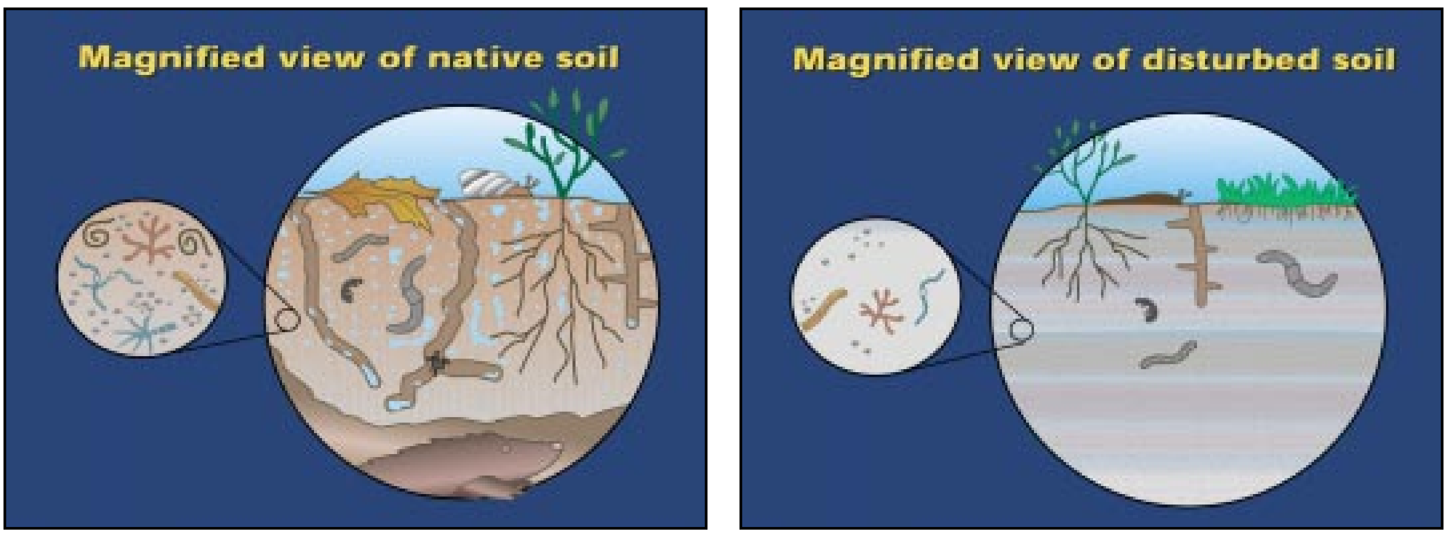
Soil Amendments as a Water Quality Tool

Just as the retention of forest cover has been recognized as a land use tool for managing water quality and water volume, it is critical that a healthy soil be considered as a tool in the regulatory and land use tool box. Because salmon and other fish species rely on clean, fresh water to survive, they equally need healthy soil in the watershed.

There are numerous opportunities in both the public and private sectors to improve soil quality and hence water resources through the use of organic amendments. Recognition of the interconnectedness of soils and water is the first step. Policy and programs designed to conserve native soils and improve soil quality will help minimize the negative impacts on the environment from continuing urbanization. In particular, wide-scale recognition of and support for ***Soils for Salmon*** boosts efforts to recycle organic materials into beneficial resources and improve the health of water resources.

The need to focus on salmon habitat protection given the requirements of the Endangered Species Act in this region strengthens opportunities to focus on the health and maintenance of soils. Implementation of ***Soils for Salmon*** provides a win/win solution to many societal goals including healthier salmon runs, agricultural viability and diversion of compostable materials from solid waste landfills.

Figure 9. Magnified View of Disturbed and Native Soil



The ***Soils for Salmon*** challenge is to implement a strategy designed to improve soil health. With the goal to improve the characteristics of urban soil to perform more like a native soil, a more vibrant diversity of organisms will thrive, healthier plant growth will be sustained, and air and water will be held and retained longer. Implementation of ***Soils for Salmon*** will support other efforts to move the Pacific Northwest Region in the direction of a more sustainable future through healthier soil and water.

Endnotes:

i Information on the Washington Organic Recycling Council can be obtained by contacting WORC at PO Box 7514, Olympia, WA 98507-7514, phone (360) 754-5162 or e-mail to alacarte@olywa.net

ii Ingham, Elaine R. "The Soil Foodweb". 1998, p. 2. on her web site at http://www.soilfoodweb.com/thesfw.html This web site provides a number of resources for understanding soil ecology in lay terms.

iii Parts of this section are excerpted from "Soils for Salmon: Restoring Living Soils with Compost" by David McDonald, Seattle Public Utilities, which can be downloaded off the SPU web site at http://www.ci.seattle.wa.us/util/rescons.

iv The analysis was performed using the HSPF computer program, SeaTac Airport hourly precipitation (Oct 1948 through Sep 1996), Puyallup daily pan evaporation (same time period), and USGS regional HSPF parameter values for Puget Sound lowland watersheds in King and Snohomish counties. Standard EIA (effective impervious area) values for rural residential (4%), suburban residential (26%), multifamily (48%), and commercial (86%) development were used. The impervious land category is 100% EIA. DOE pond sizing was computed using the SBUH procedure described in the DOE publication "Stormwater Management Manual for the Puget Sound Basin", Vol. III - Runoff Control, Feb 1992. Flood frequency analysis was computed using Log Pearson Type III procedure described in the U.S. Water Resources Council publication "Guidelines for Determining Flood Flow Frequency", Bulletin #17B of the Hydrology Committee, revised Sep 1981. Flow duration analysis was conducted using the HSPF utility DURANL and 420768 hours (48 years) of simulated flows for each land use category. See next citation for source.

v Beyerlein, Douglas, and Joseph Brascher. "Traditional Alternatives: Will More Detention Work?" in Salmon in the City, proceedings of conference in Mt. Vernon, WA, 1998, p. 45. Copies available by calling WA State Univ. (253) 445-4575, or can be downloaded from the web site http://weber.u.washington.edu/~cuwrm/

vi Beyerlein, Douglas, and Joseph Brascher, see above.

vii There are two useful publications from Department of Ecology, "Interim Guidelines for Compost Quality" publication #94-38, April 1994, and "Compost Facility Resource Handbook" publication #97-502, November 1998.

viii U.S. Composting Council, "A Watershed Manager's Guide to Organics; The Soil and Water Connection", March 1997, p. 8. Copies can be obtained from the Composting Council at http://compostingcouncil.org/index.html

ix Seattle Water Dept. (now Seattle Public Utilities). *1996 Long Range Regional Water Conservation Plan*. 1996, pp. 25, etc. Available from Seattle Public Utilities, 710 2nd Ave, Suite 505, Seattle WA 98104.

x Kolsti, Kyle F., Burges, Stephen J., and Bruce W. Jensen. *Hydrologic Response of Residential-Scale Lawns on Till Containing Various Amounts of Compost Amendment.* Univ. of WA Center for Urban Water Resources, for WA Dept. of Ecology, 1995. Copies available from UW Engineering Professional Programs at (206) 543-5539.

xi Chollak, Tracy, and Paul Rosenfeld. *Guidelines for Landscaping with Compost-Amended Soils.* City of Redmond Public Works, 1998. Copies available by calling project manager Phil Cohen at (425) 556-2815.