APPENDIX A

NATURAL RESOURCE INVENTORY UPDATE

RIPARIAN CORRIDORS AND WILDLIFE HABITAT | CITY OF PORTLAND, OREGON

PROJECT REPORT
RECOMMENDED DRAFT, JUNE 2012

Bureau of Planning and Sustainability
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7. APPENDICES

MAPS

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1. INTRODUCTION

The City of Portland Bureau of Planning has recently produced extensive updated inventory information for riparian areas and wildlife habitat resources in the city.

The Natural Resource Inventory Update supports Portland's long-standing investment in conserving natural resources to enhance neighborhood livability, protect public health and safety, and sustain fish and wildlife habitat. This inventory update also helps implement the City's River Renaissance Strategy and the Portland Watershed Management Plan by informing the following activities:

- Development of citywide and area- or topic-specific plans (e.g., the River Plan, Terrestrial Ecology Enhancement Strategy)
- Updates to existing regulatory programs (e.g., Willamette Greenway Program and environmental overlay zones)
- Preparation of strategies to comply with regional, state and federal regulatory requirements (e.g., riparian area and wildlife habitat protections required by Title 13 of Metro's Urban Growth Management Functional Plan)
- Prioritization of restoration and willing-seller land acquisition actions
- Public education and outreach

INVENTORY PRODUCTS INCLUDE

1. Updated natural resource feature information, GIS data and maps
2. Updated special-status animal and plant species
3. Lists and maps of Special Habitat Areas (SHAs)
4. Criteria and models to evaluate the relative function and quality of the resources using Geographic Information Systems (GIS) technology
5. Relative ranking maps for riparian areas, wildlife habitat, and combined resources
6. Documentation of the project approach

Metro's 2005 inventory of regionally significant riparian corridors and wildlife habitat provided the technical basis and starting point for Portland's inventory update project. By starting with Metro's inventory, the Bureau of Planning has been able to incorporate and build on the extensive research, technical analysis, and public review that shaped the regional inventory.

Working with the Bureau of Environmental Services, the Bureau of Parks and Recreation, and Metro, the Bureau of Planning has also refined the regional inventory to increase the level of detail and accuracy, incorporate new information, and better reflect Portland-specific conditions. The refinements were also reviewed by a group of technical experts to ensure that any changes would be scientifically acceptable and generally consistent with the regional approach.

This report documents the approach and methodologies used to develop the new riparian corridor and wildlife habitat inventory for Portland. It provides the context for the inventory update, followed by a detailed description of the project methodology. Summary statistics and maps are presented for the city as a whole, and by watershed and inventory planning area.

The following points are important to remember:

- The inventory is designed to support many activities identified in the City's adopted River Renaissance Strategy and Portland Watershed Management Plan.
- The inventory is "information only" and does not propose programs or regulations.
- The City inventory was not produced "from scratch." It incorporates and builds on the well-vetted science and approach Metro developed to produce a comprehensive riparian corridor and wildlife habitat inventory for the region.
- The City inventory reflects the realities of the urban landscape, and includes:
    - Both "natural" and "constructed" features
    - Resources that range in condition from relatively good to highly degraded.
- The inventory information does not automatically update existing inventories. Although the new information is already being put to good use, implementation of the City's environmental and Willamette Greenway overlay zoning programs will continue to use 6 to 20 year old inventories until they are updated via a legislative project such as the River Plan.
- The inventory must evolve to reflect new information, changing conditions, and emerging technologies. New mapping tools provide not only higher quality products, but the ability to update over time.

2. PROJECT CONTEXT

2A. PORTLAND'S NATURAL RESOURCES

"… The happy citizen of this place will be the one with access to the wild in the city — in the marshes, the stream margins, the forests, and the self …." Kim Stafford (Cody, M.J., 2002)

Portland would not be here today were it not for an historic abundance of natural resources. Long before Portland was established in 1851, native peoples lived for thousands of years on salmon and game that were abundant in the Willamette Valley and lower Columbia River basin. When immigrants came to the United States from Europe and Asia, many traveled westward via the Oregon Trail and settled in the Willamette Valley. Surrounded by waterways, forests, woodlands and prairies, fish and fur-bearing animals, and fertile soils, these settlers could build their homes, feed their children, and establish businesses and transport their wares.

Today, approximately 562,700 people reside within the 130 square mile area that is the City of Portland. The Portland metropolitan region is home to roughly 2.12 million people (Population Research Center, PSU, 2007). Portland metropolitan regional population is expected to grow by another estimated 832,200 people by the year 2025 (Metro 2000-2030 Regional Forecast, Metro 2002). This growth can be attributed in part to Portland's reputation as a beautiful, livable, and "green city," with easy access to nature and many outdoor recreational opportunities. Although many parts of the city are developed, a wealth of streams, wetlands, forests and other types of natural open spaces remain and support a wide variety of fish and wildlife species. Important natural resources are interwoven throughout major parts of the city, including public parks and natural areas, many residential neighborhoods, golf courses, cemeteries and college campuses, and industrial areas along the Willamette River and in the Columbia Corridor.

These resources provide important ecosystem services that can protect public health, safety and property, and reduce local infrastructure costs. For example, although the city has developed an elaborate stormwater pipe system, local rivers, streams, wetlands and floodplains still provide critical water storage and conveyance capacity throughout Portland's watersheds. Trees, shrubs and groundcover help reduce the impacts of stormwater runoff by intercepting precipitation and filtering out pollutants. Vegetation also helps prevent erosion and landslides by stabilizing streambanks and steep slopes. Trees and vegetation help maintain healthful air quality and reduce energy demand and discharge of greenhouse gases, particularly carbon dioxide which contributes to global warming.

Tree canopy over impervious surfaces reduces ground level air temperatures and associated ozone formation that exacerbates respiratory problems such as asthma. Trees can keep buildings cooler in summer and warmer in winter which reduces demand for heating and air conditioning. Tree shading helps keep the water in local streams cool enough to support native fish.

Portland's watersheds support numerous native fish and wildlife species. The city is part of the regional ecologies of the Lower Willamette River Basin and Columbia River Estuary. Portland's river and streams are used by native salmonids such as steelhead trout, fall and spring Chinook and Lower Columbia River Coho, which are listed as "threatened" under the federal Endangered Species Act (ESA). Resident cutthroat trout, lamprey and other native fish species also live in many Portland streams.

Portland is also home to many native amphibian, reptile, mammal and bird species, some of which have been deemed at risk status by state and federal agencies, and/or other organizations such as the Oregon Natural Heritage Information Center or Partners in Flight. Portland is also located along the Pacific Flyway, and is one of seven U.S. cities that are part of a collaborative treaty with the U.S. Fish and Wildlife Service under the Urban Migratory Bird Conservation Act. Thirty-one additional community partners have signed on since Portland entered into the treaty in 2003.

The City watersheds also contain many non-native plant and animal species. Portland residents and business owners landscape their yards and business sites with various native and non-native ornamental plant species. While not all non-native plants are problematic, some exotic plants are invasive and crowd out native plants. This results in loss of biodiversity and habitat quality. Plants such as Himalayan blackberry, English ivy and clematis are already out of control in many of Portland's most valuable remaining natural areas. Other plant species such as purple loosestrife and Japanese knotweed are not yet as wide-spread but pose significant risks. Non-native animal species can also have negative impacts on watershed conditions in the city. Domestic (outdoor) and feral cats are responsible for 40% of the wildlife intakes at Audubon Society of Portland's Wildlife Care Center, the number one cause of injury by a wide margin. Dogs can harass wildlife if allowed to run free in natural areas. Dog waste left on the ground contributes to pollution of local waterways via runoff from rain or landscape watering. Non-native wildlife species such as nutria and European starlings compete with native species for food, habitat, and nesting areas.

2B. MANAGING PORTLAND'S NATURAL RESOURCES: A HISTORICAL PERSPECTIVE

The City of Portland has a long history of protecting, conserving and restoring natural resources through land acquisition, proactive stewardship activities, and land use regulations.

2B1. Land Acquisition

In the early 1900s the city began acquiring land to create a diverse system of parks and natural areas. The city's natural areas total more than 7,000 acres. Forest Park is the jewel of the system. This 5,000-acre Douglas fir forest creates a habitat corridor spanning five miles along the west hills from the north-western edge of the city southward. Forest Park is also part of a major regional east-west habitat corridor extending from Willamette River to forests of the Coast Range. Portland's southwest hills contain Marquam Park, Tryon Creek State Park, and a number of smaller publicly-owned natural areas. Major public natural areas located east of the Willamette River include Smith and Bybee Wetlands Wildlife Refuge and Kelley Point Park to the north, Oaks Bottom Wildlife Refuge to the south, and the Powell Butte natural area park in outer southeast Portland.

In October 2006, the City Council endorsed a new long-term natural area land acquisition strategy for Portland. The Bureau of Parks and Recreation designed the acquisition strategy to enhance existing natural areas, acquire new high-value natural areas, and create and improve linkages and corridors between natural areas. The land will be purchased using capital dollars and Portland's "local share" of funds from a regional greenspaces bond measure that was approved by voters in November 2006.

In addition to purchasing natural area parks and recreation areas, the City has established a program to improve floodplain and watershed function. For example, in 1997 the City established the Johnson Creek Willing Seller Land Acquisition Program to purchase flood-prone properties in four target areas. The primary goals of the program are to reduce risk to public health, safety and property while improving natural conditions on the land to increase flood storage and improve water quality and habitat. Since the program began, the City has used both local and federal funds to purchase more than 160 acres of property and has completed several large projects to reconfigure and restore stream channels, floodplains and riparian areas.

2B2. Stewardship Activities

The City actively partners with local organizations such as Friends of Trees and the Columbia Slough, Johnson Creek, and Tryon Creek watershed councils, and private property owners, to help improve the condition of Portland's watersheds. For example, the Bureau of Environmental Service's Watershed Revegetation Program partners with local agencies and private property owners to remove invasive plants and install native trees and plants on public and privately owned land. The city also sponsors public education and grant programs to encourage citizen participation in "naturescaping," stormwater retrofit projects, and other stewardship efforts.

2B3. Land Use Planning and Zoning

The City land use and zoning program is an important tool in Portland's natural resource management "toolbox." In 1982 the City adopted new stream setback provisions in the Portland Zoning Code and a map of local streams. The new regulations were intended to preserve a buffer between development and local waterways. In 1990 the City adopted its first regulations to protect upland forests, Chapter 33.221 "Temporary prohibition on the disturbance of forests."

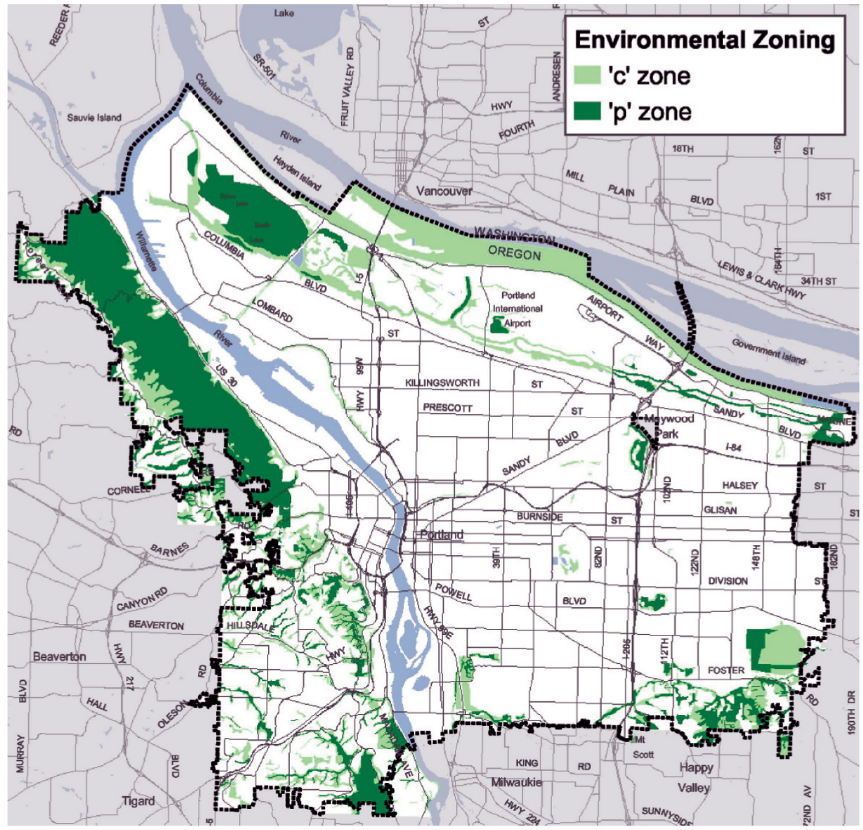
During the mid- to late-1980s the Bureau of Planning began producing a series of reports and maps that describe Portland's important natural resources and their functions. Since then, the City has adopted natural nine separate natural resource inventories and protection plans for different parts of the city. The first inventory was developed for the Willamette River Greenway in 1986. The most recent inventory was produced for urbanizing pockets of Multnomah County in 2001.

1. Columbia Corridor (1989)
2. Balch Creek (1991)
3. Northwest Hills (1991)
4. Johnson Creek Basin (1991); Boring Lava Domes Supplement (1997)
5. Southwest Hills (1992)
6. Fanno Creek and Tributaries (1993)
7. East Buttes, Terraces and Wetlands (1993)
8. Skyline West (1994)

* Willamette River and Multnomah County inventories not shown.

NATURAL RESOURCE INVENTORY AREAS*

In adopting the inventories and associated protection plans, the City established overlay zones to protect and conserve significant natural resource identified in the inventories. The environmental and greenway overlay zones are Portland's primary tools to comply with State Land Use Planning Goals 5 and 15. Land Use Planning Goal 5 requires cities and counties to take steps to inventory and establish programs to protect significant natural resources. Goal 15 provides general local planning guidelines for the Willamette River Greenway. Environmental and greenway overlay zones also help the City comply with Goal 6 Air, Water and Land Resources, and Goal 7 Areas Subject to Natural Hazards, and are listed Best Management Practices (BMPs) in the City Stormwater Management Plan and Municipal Stormwater (NPDES) Permit as required by the Clean Water Act.



CITY OF PORTLAND ENVIRONMENTAL ZONING

Today, environmental and greenway overlay zones apply to more than 18,200 acres of land, local streams and wetlands in Portland and urbanizing Multnomah County. The overlay zones also apply to portions of the Willamette and Columbia rivers. Environmental overlay zone regulations are contained in Chapter 33.430 of the Portland Zoning Code, and in several plan districts and Natural Resource Management Plans (Bureau of Planning, 2007). The regulations are triggered when new development and redevelopment is proposed to be located within the environmental overlay zone. The City has established two types of environmental overlay zones. In the environmental protection zone ("p" zone), most types of development are generally prohibited. In the environmental conservation zone ("c" zone), development is allowed if it meets specific standards or approval criteria. The environmental zone regulations also require mitigation of unavoidable adverse impacts on natural resources.

The Willamette Greenway overlay zoning regulations were established as part of the Willamette Greenway Plan (1987) and are found in Chapter 33.440 of the Portland Zoning Code. These regulations address a broad range of issues including industrial and river dependent development, recreation, trails and public access, and natural resources. Natural resources in the greenway are addressed through design guidelines that all development in the greenway must meet. These guidelines include requirements for planting the banks of the Willamette to help restore natural resource function. The guidelines also require development to avoid adversely impacting high value resources that are identified in the 1986 inventory. Two of the five existing greenway overlay zones (Greenway Natural, or n-zone; Water Quality or q-zone) address natural resources and water quality.

In 1998 NOAA Fisheries/National Marine Fisheries Service listed steelhead trout as a threatened species under the federal Endangered Species Act (ESA). Steelhead trout inhabit Portland rivers and streams, as do spring and fall Chinook salmon. These species are currently listed as “threatened” under the ESA. To better understand the implications of the listings, the City evaluated existing activities that could harm the listed species and their habitats. One of the recommendations was to update the existing environmental zoning program to better protect aquatic and riparian ecosystems.

In 1999, the Bureau of Planning initiated the “E-zone Update” project. The project, later renamed “Healthy Portland Streams,” was intended to update the city’s environmental policies, environmental codes and environmental zone boundaries. The initial Healthy Portland Streams proposal was released in late 2001. It included expanding the environmental zones by about 20 percent to improve protections for aquatic ecosystems and riparian areas. The proposal generated significant public comment and controversy. Many people expressed concerns about the complexity of the proposal and the potential for additional regulation of private property. Some questioned the methods used to produce the riparian resource inventory and draft zoning maps.

Several other related planning efforts were also underway during the same time period:

- The Bureau of Planning was leading a multi-bureau effort to develop a strategy to realize the River Renaissance Vision which was adopted by the City Council in 2001.
- Portland’s Bureau of Environmental Services had begun an effort to produce an integrated scientific framework for restoring watersheds and the first citywide watershed management plan.
- Metro had started developing a new program to protect and restore fish and wildlife habitat throughout the tri-county region.
- The Oregon Department of Environmental Quality had initiated new Clean Water Act requirements for managing pollutant loads to streams that do not meet existing water quality standards (i.e., Total Maximum Daily Loads, or TMDLs).

Taking into consideration: 1) that both the City and Metro were in the middle of two major watershed/natural resource planning projects; and, 2) public concern over the Healthy Portland Streams proposal, the Bureau of Planning decided to suspend the Healthy Portland Streams proposal and propose a new workplan.

The first phase of the workplan would focus on two elements: updating City natural resource inventories and improving existing environmental regulations. The Bureau would also continue working closely with Metro and BES during development of the regional habitat protection program and citywide watershed plan.

The new phased workplan was designed so that future program updates would be guided by the goals, policies and requirements of the City’s first watershed plan and Metro’s regional habitat protection program. Future work would also benefit from improved City regulations and natural resource information. In November 2002, the Planning Commission endorsed the workplan and directed Planning staff to proceed.

As of today:

Metro Title 13: Nature in Neighborhoods

- The Metro Council adopted the "Nature in Neighborhoods" program in September of 2005. The program establishes new requirements to protect, conserve and restore riparian corridors and wildlife habitat in the tri-county region. The adopted program includes an inventory of regionally significant riparian corridors and wildlife habitat, a new Title 13 of Metro's regional Urban Growth Management Functional Plan, and a series of maps. The program establishes regulatory requirements, incentives and technical assistance to protect, conserve and restore regionally significant riparian corridors and wildlife habitat.

  The Oregon Department of Land Conservation and Development adopted an order in January 2007 finding the Nature in Neighborhoods program in compliance with state land use planning goals. The Nature in Neighborhoods program now implements the state Goal 5 rule pertaining to riparian areas and wildlife habitat within Metro's jurisdiction. The Nature in Neighborhoods program also supplements the region's program to protect water quality under statewide Land Use Planning Goal 6, and is intended to assist local jurisdictions in meeting applicable requirements of the Clean Water Act (e.g., TMDLs).

  The provisions of Metro's Title 13 apply to high-value riparian corridors called Habitat Conservation Areas. The provisions generally require that impact on Habitat Conservation Areas be avoided or mitigated. Portland and other Metro area cities and counties have until January 2009 to demonstrate that their local programs comply with Title 13 requirements. Local jurisdictions may adopt Metro's model ordinance, or ask Metro Council to approve existing or proposed programs under a substantial compliance option. Compliance programs may include both regulatory and non-regulatory components.

Portland Watershed Management Plan

- The Portland City Council adopted the *Portland Watershed Management Plan (Watershed Plan)* in March 2006 (Bureau of Environmental Services, 2005). The *Watershed Plan* characterizes the conditions of Portland's watersheds, establishes citywide goals and objectives relating to hydrology, water quality, physical habitat, and biological communities. The plan recommends strategies and actions to protect and restore watershed health. Included in the Council adoption action were the *Framework for Integrated Management of Watershed Health* and the *2005-2006 Annual Watershed Action Plan*. The *Framework* synthesizes a wealth of scientific information and establishes ecological principles and guidelines for watershed planning and restoration in Portland. The *Framework* and the *Watershed Plan* emphasize the importance of protecting high-value natural resources to sustain and restore watershed health. The *2005 – 2006 Annual Watershed Action Plan* calls for completion of the Natural Resource Inventory Update project.

Environmental Code Improvement

- The Bureau of Planning's Environmental Code Improvement (ECI) project was adopted by the City Council in August 2005 (new codes went into effect in September 2005). A general purpose of the project was to clarify and simplify existing City environmental regulations while continuing to protect and conserve significant natural resources. The project addressed problems that had been identified by people who have used or are affected by the regulations, such as the process for resolving violations of the environmental zoning code. The environmental regulations are now clearer, simpler, and more equitable, efficient, and enforceable. Modified review procedures are quicker and cost less. New standards encourage enhancement of natural resources and site conditions as well. The Environmental

Code Improvement project was completed using a collaborative problem-solving process that engendered strong support from community stakeholders and other City bureaus.

Natural Resource Inventory Update

- The Bureau of Planning has produced new inventory information for riparian corridors and wildlife habitat in Portland. Project staff briefed the Portland Planning Commission on the inventory update in October of 2006. Staff plans to return to the Planning Commission in 2008/2009 for endorsement of the draft citywide inventory methodology and a recommended workplan for the Bureau's Environmental Planning program. The workplan will lay out the steps in which the updated inventory information will be adopted in conjunction with citywide or area-specific legislative projects (e.g., River Plan). The updated inventory is the subject of the remainder of this report.

3. PROJECT APPROACH

This chapter describes the approach used to develop the City's new inventory of riparian corridors and wildlife habitat. The information is presented in the following sections:

3A. Project Success Criteria
3B. Scientific Foundation
3C. Inventory Methodology

The Inventory Methodology section includes a summary of Metro's approach to developing the regional inventory of riparian corridors and wildlife habitat. Following is a step-by-step description of the City's project approach and methodology, including efforts to refine the regional inventory.

3A. PROJECT SUCCESS CRITERIA

Developing new natural resource inventory information for Portland is an ambitious undertaking, involving large, diverse landscapes, complex data and model development, and collaboration with technical experts and key stakeholders. In order for the project to be successful, it would need to meet the following criteria:

- The project methodology would need to reflect current, generally-accepted scientific principles and information.
- The project should build on existing information and avoid duplication of effort.
- The project approach and products must be clear, consistent, and understandable.
- The inventory products must be designed to inform a broad array of resource management and watershed activities citywide.
- Inventory tools and products must be readily accessible to potential users of the information.
- The inventory must be easy to maintain and update over time.
- The inventory must help the City achieve compliance with existing and emerging regional, state and federal requirements to protect public health and safety, water quality, and fish and wildlife habitat.

To meet the above criteria most efficiently, the Bureau of Planning elected to build on work already done. The Bureau chose to use Metro's regional inventory of riparian corridors and wildlife habitat as the methodological basis for the citywide inventory update project.

Metro developed the regional inventory over a period of years, by completing the following steps:

1. Established a committee of local experts and agency staff to work with project staff during development of the inventory.

2. Conducted an extensive review of scientific literature relating to riparian corridors and wildlife habitat. From this literature Metro identified a set of key riparian functions and wildlife habitat attributes that would form the basis of the inventory.

3. Generated GIS data and maps of rivers and streams, wetlands, flood areas, vegetation and other landcover types – features that contribute significantly to specific functions and overall health of riparian areas and wildlife habitat.

4. Developed GIS models comprised of criteria to evaluate, rank and map the relative functional value of natural resources. Criteria addressed key riparian functions and wildlife habitat attributes.

5. Produced regional fish and wildlife species lists and identified habitats of concern.

6. Generated preliminary inventory reports and maps.

7. Conducted field work to assess the habitat model's performance and adjusted the model based on the results.

8. Provided the draft inventory methodology and preliminary products to the Independent Multidisciplinary Science Team (comprised of leading experts in the Pacific Northwest) and other local experts and stakeholders for review and comment.

9. Submitted the draft inventory to the Metro technical and policy advisory committees for endorsement.

10. Notified stakeholders, including affected property owners, about opportunities to comment.

11. Held public workshops in different parts of the region and a public hearing before the Metro Council.

12. Endorsed the inventory and directed the development of a regional program to protect, conserve, and restore regionally significant riparian corridors and wildlife habitat (2001). Adopted the inventory as part of the Nature in Neighborhoods program (2005).

By using Metro's inventory as the starting point for Portland's inventory update, Bureau of Planning has addressed the success criteria listed above in an efficient, cost-effective manner. The approach builds on work already done and avoids duplicating efforts. The approach relies on generally-accepted, current scientific information, applies consistent policies and methods, and produces high quality, understandable, accessible products. The updated inventory maps and reports will inform a broad array of resource management activities, and help the City achieve compliance with existing and emerging regional, state and federal requirements. New mapping tools will allow the City's inventory information to be kept current over time.

3B. SCIENTIFIC FOUNDATION

Before presenting the methodology used to produce the updated natural resource inventory, it is important to become familiar with the underlying science. The scientific basis for the inventory is found in two key documents:

- *Portland Framework for Integrated Management of Watershed Health (2005*); and
- *Metro's Technical Report for Fish and Wildlife Habitat (2005)*

3B1. FRAMEWORK FOR INTEGRATED MANAGEMENT OF WATERSHED HEALTH

The *Framework for Integrated Management of Watershed Health (Framework)* presents a science-based approach to restore urban watershed systems. The *Framework* establishes the technical basis and process used to develop the *Portland Watershed Management Plan* (adopted by City Council in March 2006). The Bureau of Environmental Services developed the *Framework* in consultation with a team of independent scientists, the City's Watershed Science Advisory Group (WSAG), and staff from other City bureaus.

The *Framework* provides a comprehensive reference document for City bureaus to use in implementing their respective programs. The *Framework* emphasizes the need for a "scientific foundation" as a basis for making decisions. The term "scientific foundation" is described as a "set of scientific principles and assumptions that can give direction to management activities…," noting that, "reestablishing healthy watersheds will require restoration of *ecological functions and conditions."* (Italics added). The *Framework* points out that, "… scientific information is rarely static …," and that "… this scientific foundation will be refined over time…"

The ecological principles and guidelines presented in the *Framework* provide valuable context and support for the natural resource inventory update work. The principles focus on watersheds as complex, dynamic systems of interdependent spatial and temporal factors. The principles emphasize that rivers are not separate from the wetland and upland areas they drain, and that watershed health should be assessed in terms of physical, chemical and biological integrity.

The guidelines call for the characterization of existing conditions to inform restoration planning. This emphasizes the importance of protecting and restoring fish and wildlife functions, populations and habitats, and building outward from existing populations, functions and rare and high quality habitats.

In addition, the *Framework* provides a wealth of information about Portland's natural environment, including existing watershed conditions, biological communities and habitats in the city, priority habitats and wildlife species. This information will be supplemented by current projects such as the Natural Resource Inventory update and the development of a Terrestrial Ecology Enhancement Strategy.

The inventory update project is consistent with the principles and guidelines set forth in the *Framework*. The inventory reflects the best available information pertaining to Portland's streams, wetlands, vegetation and other natural features. It helps to characterize Portland's natural resources and their respective functions and attributes, and identifies key species and habitats. The inventory evaluates the relative quality of Portland's natural resources based on physical, chemical and biological criteria. The inventory will allow resource managers to examine connections and gaps in resource and habitat systems, and set priorities to protect, conserve and restore natural resources to improve watershed conditions over time.

3B2. METRO'S TECHNICAL REPORT FOR FISH AND WILDLIFE HABITAT

The *Framework* described above has provided a sound foundation and guidance for the City's inventory update effort. The specific scientific basis is found in Metro's *Technical Report for Fish and Wildlife Habitat (Technical Report)* (April 2005).

The first step Metro took toward developing a regional inventory of riparian corridors and wildlife habitat was to conduct a comprehensive review of the relevant scientific literature. Metro's *Technical Report* summarizes the literature review, highlighting the interconnectedness of watershed systems and functions, and interrelationships between streams, riparian corridors and upland areas. Watershed ecosystems are characterized by a network of natural resources including tributaries, streams and rivers, floodplains, groundwater, and upland and riparian vegetation. Urban features are also part of the watershed ecosystem, including buildings and streets and other paved areas, and landscaped areas. Watershed ecosystems also consist of the plants and animals that live there, including people. Combined, these features drive a complex mix of physical, chemical and biological processes that together represent the overall health of a watershed.

Metro found that although many of the scientific studies had been conducted in rural forested areas, the information from these works is applicable and relevant to urban and urbanizing watersheds. Whether in an urban or rural area, a watershed is an area of land from which water, sediment and organic and dissolved materials drain to a common point such as a stream, river, pond, lake or ocean. The ecological health of a watershed and its value for fish and wildlife depends on preserving the connectivity of natural resource components over time and space (Naiman et al. 1992).

Key information from Metro's technical report is summarized below under the topic headings:

- Riparian Corridors
- Terrestrial and Upland Wildlife Habitat

Literature citations in the next section include sources identified by Metro and additional sources by the City as part of Portland's inventory update effort.

3B2.1 Riparian Corridors

Riparian corridors are generally thought of as areas bordering rivers, streams, lakes and wetlands. Riparian corridors include the transition between the aquatic and upland areas, where vegetation continues to provide streams with structure, shade, microclimate, nutrients, and other organic materials, and habitat for fish and wildlife. For the purpose of the regional and city inventories, "riparian corridor" includes river and stream channels, adjacent riparian vegetation, and off-channel areas including wetlands, side channels, and the floodplain. Riparian corridors also encompass subsurface areas beneath stream channels where streamflow and groundwater interact physically, chemically and biologically (hyporheic zones).

Intact riparian corridors in the region are generally characterized by multi-story vegetation assemblages consisting of trees or woody vegetation (live and downed wood), shrubs and herbaceous plants. The character of a riparian corridor reflects the influence of multiple factors such as climate, light and water availability, topography, soil properties, surface and groundwater flows, and natural disturbances (flood, fire, etc.). Riparian plant communities vary from headwaters to the mouth of a stream, reflecting differences in watershed hydrology, hydraulic gradient, geomorphology, and disturbance regimes (Harr 1976; Kauffman et al. 2001).

The spatial extent or width of a riparian area is not fixed. The scientific literature suggests that riparian corridor widths should be viewed in the context of specific functions and relationships between terrestrial and aquatic features and systems (Naiman and Decamps, 1997; Gregory et al. 1991).

Riparian Functions

Riparian corridors provide important ecological functions including:

- ***Microclimate and shade***
- ***Bank function and control of sediments, nutrients and pollutants***
- ***Streamflow moderation and flood storage***
- ***Organic inputs and food web***
- ***Large wood and channel dynamics***
- ***Wildlife habitat/corridors***

- ***Microclimate and shade***

  The presence of vegetation and water affects air temperature, humidity, and soil moisture in riparian corridors. The shade provided by riparian vegetation also affects the temperature of water in streams and wetlands (Thomas et al. 1979; Swanson et al. 1982; Naiman et al. 1992; Pollock and Kennard 1998; Kauffman et al. 2001; Pollock and Kennard 1998). Riparian microclimate effects directly influence ecological processes and metabolic activity (Chen et al. 1999; Swanson et al. 1982). Water temperature is a critical factor for aquatic ecosystems. In general, salmon require cold water ranging between 4 and 17 degrees C (39 to 63 degrees F). The effectiveness of riparian corridors in producing shade depends on vegetation composition, height, and density; channel width, and channel orientation relative to solar angle. Riparian tree canopy has the greatest shade impact on narrower streams channels. Riparian canopy cannot fully shade larger rivers, but can create cool microhabitats for fish and aquatic organisms.

- ***Bank function, and control of sediments, nutrients and pollution***

  Although some erosion and sedimentation is natural in a stream system, increased erosion and sedimentation from urbanization and disturbance can negatively impact stream functions and aquatic ecosystems (Beauchamp et al. 1983). Streams of all sizes, and especially headwater streams, benefit from the regulating influence that riparian vegetation has on the amount of sediment entering aquatic habitats (Knutson and Naef 1997). The dense root networks of species such as willow, alder and dogwood are effective in protecting streambanks from erosion (Bureau of Land Management, 1999). The physical structure of standing riparian vegetation and large wood in the stream channel slows water, mechanically filters and stores fine silt and sediment, holds materials in place, and reduces stream channel scouring which is especially important during periods of high streamflow (Swanson et al. 1982; Gregory et al. 1991; Knutson and Naef 1997; Naiman and Decamps 1997). Riparian vegetation can trap excess nutrients, such as nitrogen and phosphorus found in fertilizers, and pollutants such as herbicides and industrial chemicals carried in surface water. Riparian microbial processes can also help immobilize nutrients and degrade organic pollutants found in overland flows (Palone and Todd 1997). In urban areas such as Portland, engineered alternatives have been used to stabilize river and stream banks (e.g. pilings). These structures generally prevent erosion and slumping but also immobilize the banks and isolate the river bank or stream bank from the water and natural fluvial processes. Non-vegetated hardened banks are also limited in their ability to filter or capture sediments, nutrients and pollutants.

- ***Streamflow moderation and flood storage***
  Variability in streamflow volume, rate, and velocity influences the structure, dynamics, and habitats of rivers and streams. In urbanized landscapes, increases in impervious surfaces prevent infiltration, resulting in more runoff, increased storm flows and flood flows, and decreased dry season flows (Booth 1991; Schueler 1994; Booth and Jackson 1997; May et al. 1997; Morgan and Burton 1998; Karr et al. 2000; Booth et al. 2001). Riparian and upland vegetation helps moderate streamflows by intercepting, absorbing and storing rainfall. Plant roots increase soil porosity and help promote infiltration. These areas can also help provide cool groundwater to streams during the dry season. Floodplains and riparian wetlands provide important storage capacity for flood flows. In urban areas such as Portland, floodplains have often been developed with structures and impervious surfaces. Although highly degraded, these areas still contribute on a cummulative basis to the storage of flood water, which can delay or reduce flood damage downstream.

- ***Organic inputs and food web***
  Forest ecosystems adjacent to stream corridors provide over 99 percent of the energy and carbon sources in aquatic food webs (Budd et al. 1987). Riparian plant communities affect the quantity, quality, and timing of nutrients delivered to the stream channel that are then used by aquatic species (Swanson et al. 1982; Gregory et al. 1991; Naiman and Decamps 1997). Deciduous and coniferous forests contribute important organic matter to Pacific Northwest stream systems. Leaves, wood, fruit, cones, insects and other types of organic matter can fall directly into the stream channel from the riparian area. Organic matter can also be deposited into streams via wind or erosion (Gregory et al. 1991; Naiman et al. 1992). Organic matter may enter the stream as dissolved materials in water, flowing subsurface from the hyporheic zone. Organic matter is also produced within the streams themselves. Many fish, amphibians, reptiles, birds and mammals rely on freshwater macroinvertebrates and fish eggs, fry, live adults and carcasses for food. Although the aquatic food web in large rivers is primarily driven by phytoplankton production, riparian vegetation provides localized sources of organic matter and nutrients, especially in shallow-water areas.

- ***Large wood and channel dynamics***
  Stream channels move and change naturally over time. However, in urban environments, channel migration is often constrained by channel straightening, streambank armoring and land development. These factors, combined with increases in impervious surfaces throughout urban drainages, generate higher rates of runoff, resulting in stream channel down-cutting and scouring.

  Riparian areas can contribute branches, logs, uprooted trees, and rootwads that help to form channel features and provide instream cover for fish. Large in-channel wood also controls the routing of water and sediment, dissipates stream energy, protects stream banks, stabilizes streambeds, helps retain organic matter, and acts as a surface for biological activity (Swanson et al. 1982; Harman et al. 1986; Bisson et al. 1997; Sidell et al. 1988; Bilby and Ward 1989; Gregory et al. 1991). In headwater streams large wood typically stays where it falls and spans the stream. Large wood helps form the channel in headwater streams and mid-section stream reaches. Channel formation in larger river is influenced by regional events (e.g., floods and geomorphic preprocesses. Large wood can also provide important localized functions, such as sediment capture and cover for fish, in large, low-gradient rivers.

Active floodplains and riparian wetlands also contribute to stream channel formation by providing areas for high streamflows to spread out and form new channels. These areas allow high flows to slow down and deposit sediment, which affects channel form over time. In urban watersheds, channel movement is often constrained, and floodplains and riparian wetlands are often developed or disconnected from river and stream channels. Still, even degraded channels, floodplains and wetlands contribute to the overall dynamics of river and stream systems.

- ***Riparian wildlife habitat/corridors***
  In the Metro region, 93 percent of terrestrial vertebrate wildlife species regularly use water-associated habitats. The three main water-associated habitat types in the Metro region are open water (rivers, lakes, and streams), herbaceous wetlands (also known as emergent wetlands), and riparian wetlands (includes conifer/hardwood corridors and forested and shrub-scrub wetlands). Each of these habitat types supports a broad array of plant and wildlife species, including a number of species at risk. Riparian vegetation surrounding these features creates a unique microclimate and provides abundant food, cover, and a link to drinking water. In addition, riparian areas provide important movement corridors for wildlife. Water bodies and associated riparian corridors allow wildlife to move along and between habitat areas (Thomas et al. 1979). Riparian corridors provide edge habitat which can promote species diversity, while also having a negative effect on species that rely on interior habitat characteristics or species vulnerable to predators moving along edge habitat.

The key riparian features and functions described above are summarized in the following table.

TABLE 1: RIPARIAN CORRIDOR RESOURCE FEATURES AND FUNCTIONS

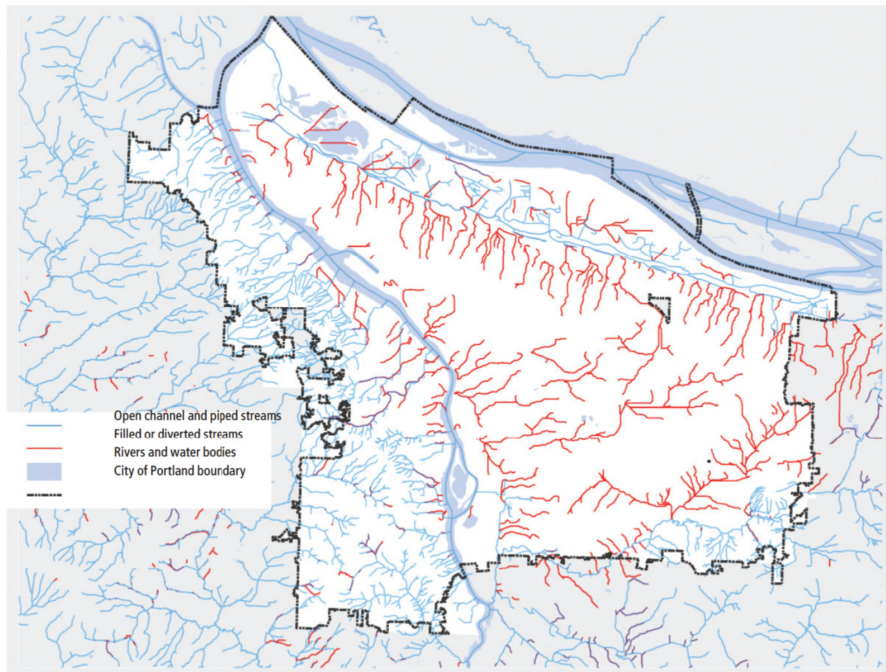
	Streamflow Moderation and Flood Storage	Bank Function, Control of Sediments, Nutrients, Pollutants	Large wood and Channel Dynamics	Organic Inputs and Food Web	Microclimate and Shade	Wildlife Movement Corridor
Open water (rivers, streams, drainages, sloughs, ponds, lakes)	Open water features store and convey water and interact with groundwater. Headwater streams are particularly important to the hydrology and chemistry of watersheds.	Water volumes, levels and flows correlate directly with water temperature, dissolved oxygen and pollutant levels in rivers, streams, lakes and ponds. Interaction between the water body and bank influence ground water, microclimate and microbial activity.	Channel dynamics cannot occur without the presence of waterway channels and flows; wood is carried from upstream and is deposited along banks and in shallow-water areas.	Distinct food web functions occur within open water bodies. Processing of organic matter reflects portion of the drainage, flow rates, nutrients, plants, insects, and light availability.	Where open water and vegetation coexist, they produce humidity and moderate soil and air temperatures.	Open water features are essential to the life cycles and survival of most fish and wildlife species. Rivers, streams, lakes and ponds provide water, food, cover and movement corridors.
Wetlands	Riparian and upland wetlands intercept and store surface runoff and groundwater throughout watersheds, and can contain floodwaters in riparian areas.	By moderating stream flows, wetlands can reduce bank erosion. Wetlands also store and filter sediments, cycle nutrients, decompose organic waste and prevent heavy metals from entering streams	Wetlands can reduce channel degradation by moderating streamflows. Forested wetlands contribute large wood to nearby streams. Floodplain and riparian wetlands contribute to overall complexity and resilience.	Wetland productivity contributes to the food chain. In floodplains, wetlands nutrient cycling is enhanced by flooding and fluctuating groundwater levels.	Evaporation from wetlands contributes to localized humidity levels and air and soil temperature moderation.	Wetlands provide food, water, refuge from summer heat, shelter from winter cold, and cover for a broad variety of wildlife species. Wetlands are a type of off-channel habitat and provide key habitat for young salmon.
Floodplain	Floodplains reduce or delay peak streamflows during storms by providing storage and/or infiltration capacity. These functions occur even if the floodplain is developed. Intact floodplains connect streams to groundwater (hyporheic zone), helping maintain year-round stream flow.	Floodplains slow flows down, allowing sediments to drop out before entering the stream. Vegetated floodplains also reduce nutrient loads, help process chemical and organic wastes, and help create fertile soils and riparian areas	Vegetated floodplains reduce flow velocities, redirect flows, settle sediment, and promote side channel formation. They also contribute large wood to nearby streams.	Flooding interchanges organic material, nutrients, and organisms between aquatic and terrestrial environments. Flooding can establish vegetation and control biotic communities. Floodplain vegetation contributes organic material to streams and wetlands.	Floodplains contribute to microclimate by influencing vegetation, increasing humidity and moderating soil moisture and water temperatures. Floodplains connect to hyporheic zones which help maintain year-round streamflow.	Floodplains provide periodic habitat for fish, macroinvertebrates, amphibians, and many bird species. They can also provide refugia and cover during flood events. Floodplain plants are valuable food sources for fish and wildlife.

TABLE 1: (CONTINUED) RIPARIAN CORRIDOR RESOURCE FEATURES AND FUNCTIONS

	Streamflow Moderation and Flood Storage	Bank Function, Control of Sediments, Nutrients, Pollutants	Large wood and Channel Dynamics	Organic Inputs and Food Web	Microclimate and Shade	Wildlife Movement Corridor
Vegetation and soil	Vegetation affects watershed hydrology by intercepting and storing precipitation, and returning water to the atmosphere through transpiration. These functions vary depending on the extent, age, density and composition of vegetation. Soil porosity affects the rate of water infiltration and runoff. Vegetation reduces runoff by contributing organic matter, which soaks up water, and protecting soils from compaction.	Plants, roots, wood and soils reduce erosive power of stream flows and hold soil in place. Riparian vegetation is especially important to reduce cumulative sedimentation impacts. Vegetation absorbs nutrients and other dissolved materials as they are transported through uplands and riparian zones, thereby reducing or preventing water pollution. Riparian vegetation filters and traps soil particles and organic matter, and can intercept undesirable dissolved compounds (pesticides, herbicides, heavy metals)	Riparian vegetation provides large wood, stabilizes banks and side channels, and retains and filters sediment. Large wood promotes formation of channels, side channels, islands and bars. Vegetation can also promote stream bank development. In large, low gradient rivers, wood deposits from upstream and adjacent riparian areas have a localized effect on channel structure. Relationships between soil, landforms, geomorphic processes and vegetation substantially influence how channels are formed and change over time.	Forested riparian areas provide more than 99% of the energy and carbon in aquatic food webs. Riparian trees, shrubs and herbaceous vegetation (leaves, needles, cones and wood) provide nutrition to stream channels. Fluctuating water levels and periodic flushing can affect soil characteristics in riparian corridors, resulting in increased plant (and therefore animal) diversity. Wetter soils can also promote decomposition of organic matter.	Vegetation influences microclimate in riparian areas by altering soil moisture, wind speed, relative humidity and the temperature of soil, air and water. Vegetation affects soil, and soil affects vegetation. Riparian vegetation provides shading critical to keep water cool in open water bodies and wetlands. By affecting vegetation characteristics, riparian soils can have a profound effect on microclimate and shade.	Riparian vegetation provides wildlife movement corridors and migration routes, food and forage, nesting and breeding sites, resting areas, and cover. Large wood and organic matter in streams provides substrate and food for invertebrates and cover for fish. Large wood provides critical habitat for amphibians and small mammals. Riparian soils support many bacteria, fungi, and insect species. Soil animals (for example, macroinvertebrates) are generally more abundant and diverse in riparian than upland soils.
Steep slopes	Steep slopes reduce infiltration while increasing overland flow of stormwater runoff. Steep slopes with little or no vegetation can increase streamflow rates, fluctuation ("flashiness") and flooding.	Non-vegetated steep slopes can increase erosion and landslides, causing stream sedimentation and turbidity and altering hydrology. Altered hydrology can reduce streambank stability and riparian vegetation cover. Steep slopes can also increase nutrient and pollutant loads to streams.	Steep slopes with vegetation contribute large wood to streams. Vegetation on these slopes protects hydrology, thereby increasing streambank stability.	Steep slopes can influence the organic inputs to streams by affecting the types and position of overhanging vegetation relative to channel, wind and runoff rates. Gravity carries more organic material down steep slopes than across flatter areas.	Steep ravines and stream canyons can contribute to riparian microclimate effects by limiting solar radiation and creating local inversions (cold air trapped at the canyon floor).	Wildlife species can take refuge on undeveloped hillsides if their preferred habitat is degraded by development. Certain plant and wildlife species utilize steeply sloped landscapes (e.g. Oregon white oak, winter wrens). Riparian vegetation can often be found on steep slopes because groundwater emerges from such areas.

Effects of Urbanization on Riparian Corridors

Riparian corridors in Portland and the Metro region have been significantly altered by the cumulative impacts of urbanization. Hundreds of miles of streams have been channeled or placed underground in pipes. Many streams do not meet current water quality standards for temperature, bacteria, nutrients, toxics and other pollutants.



PORTLAND'S CURRENT AND HISTORIC STREAMS

Riparian corridors in Portland are fragmented by streamside development, loss of native vegetation, and proliferation of invasive plant species. This fragmentation reduces the supply of large wood and organic inputs to aquatic and terrestrial ecosystems, and interrupts riparian wildlife movement corridors. In many places, riparian areas now consist of riverfront development, levees, hardened banks, and other man-made structures. Development has often severed the connections between streams and their floodplains.

Science-based Planning Guidelines for Riparian Corridors

Metro noted the following points when preparing to map and assess the functions of riparian corridors in the region.

- Continuous riparian vegetated corridors protect functions more effectively than fragmented corridors (Fisher et al. 2000).
- The functionality of upstream riparian corridors has an effect downstream, e.g., contribution and accumulation of large wood (Pollack and Kennard 1998).
- Protecting riparian corridors is especially important along small headwater streams (Osborne and Kovacic 1993; Hubbard and Lowrance 1994; Lowrance et. al. 1997; May et al. 1997a; Fisher et al. 2000).
- Key factors that should be taken into consideration when determining size of riparian buffers are the presence of floodplains, steep slopes, riparian wetlands, site potential tree height, and aquatic and terrestrial habitat.
- Large buffers are even more important in areas of high intensity use than low intensity use (Johnson and Ryba 1992).

Metro used information from the following table to develop riparian corridor mapping criteria described later in the report.

TABLE 2: RANGE OF FUNCTIONAL RIPARIAN AREA WIDTHS FOR FISH AND WILDLIFE HABITAT

Aquatic Habitat			
	Function	**Reference**	**Functional width (each side of stream)**
Temperature regulation and shade	Shade	FEMAT 1993	100 ft
	Shade	Castelle et al. 1994	50-100 ft
	Shade	Spence et al. 1996	98 ft
	Shade	May 2000	98 ft
	Shade	Osborne and Kovacic 1993	33-98 ft
	Shade/reduce solar radiation	Brosofske et al. 1997	250 ft
	Control temperature by shading	Johnson and Ryba 1992	39-141 ft
Bank stabilization and sediment control	Bank stabilization	Spence et al. 1996	170 ft
	Sediment removal/erosion control	May 2000	98 ft
	Ephemeral streams	Clinnick et al. 1985	66 ft
	Bank stabilization	FEMAT 1993	½ SPTH
	Sediment control	Erman et al. 1977	100 ft
	Sediment control	Moring 1982	98 ft
	Sediment removal	Johnson and Ryba 1992	10 ft (sand) – 400 ft (clay)
	High mass wasting area	Cederholm 1994	125 ft
Pollutant removal	Nitrogen	Wenger 1999	50-100 ft
	General pollutant removal	May 2000	98 ft
	Filter metals and nutrients	Castelle et al. 1994	100 ft
	Pesticides	Wenger 1999	>49 ft
	Nutrient removal	Johnson and Ryba 1992	33 – 141 ft
Large woody debris and organic litter	Large woody debris	Spence et al. 1996	1 SPTH
	Large woody debris	Wenger 1999	1 SPTH
	Large woody debris	May 2000	262 ft
	Large woody debris	McDade et al. 1990	150 ft
	Small woody debris	Pollock and Kennard 1998	100 ft
	Organic litterfall	FEMAT 1993	½ SPTH
	Organic litterfall	Erman et al. 1977	100 ft
	Organic litterfall	Spence et al. 1996	170 ft
Aquatic wildlife	Cutthroat trout	Hickman and Raleigh 1982	98 ft
	Brook trout	Raleigh 1982	98 ft
	Chinook salmon	Raleigh et al. 1986	98 ft
	Rainbow trout	Raleigh et al. 1984	98 ft
	Cutthroat trout, rainbow trout and steelhead	Knutson and Naef 1997	50 – 200 ft
	Maintenance of benthic communities (aquatic insects)	Erman et al. 1977	100 ft
	Shannon index of macroinvertebrate diversity.	Gregory et al. 1987	100 ft
	Trout and salmon influence zone (Western Washington)	Castelle et al. 1992	200 ft
	Willow flycatcher nesting	Knutson and Naef 1997	123 ft
	Frogs and salamanders	NRCS 1995	100 ft
	Full complement of herpetofauna	Rudolph and Dickson 1990	>100 ft
	Belted Kingfisher roosts	USFWS HEP Model	100 – 200 ft
	Deer	NRCS 1995	200 ft
	Smaller mammals	Allen 1983	214 – 297 ft
	Birds	Jones et al. 1988	246 – 656 ft
	Beaver	NRCS 1995	300 ft
	Minimum distance needed to support area-sensitive Neotropical migratory birds	Hodges and Krementz 1996	328 ft
	Western pond turtle nests	Knutson and Naef 1997	330 ft
	Pileated woodpecker	Castelle et al. 1992	450 ft

TABLE 2: (CONTINUED) RANGE OF FUNCTIONAL RIPARIAN AREA WIDTHS FOR FISH AND WILDLIFE HABITAT

Terrestrial Habitat			
	Function	**Reference**	**Functional width (each side of stream)**
Aquatic wildlife (continued	Bald eagle nest, roost, perch	Castelle et al. 1992	600 ft
	Nesting ducks, heron rookery and sandhill cranes		
	Pileated woodpecker nesting	Small 1982	328 ft
	Mule deer fawning	Knutson and Naef 1997	600 ft
	Rufous-sided towhee breeding populations	Knutson and Naef 1997	656 ft
	General wildlife habitat	FEMAT 1993	100-600 ft
	General wildlife habitat	Todd 2000	100-325 ft
	General wildlife habitat	May 2000	328 ft
Edge effect	Interior bird species	Tassone 1981	164 ft
	Neotropical migrants	Keller et al. 1993	328 ft
	Effect of increased predation	Wilcove et al. 1986	2,000 ft
	Noise reduction of a mature evergreen buffer	Harris 1985	20 ft
	Reduce commercial noise	Groffman et al. 1990	100 ft
LWD and structural complexity	Snags and downed wood	FEMAT 1993	1 SPTH outside the buffer
Species movement	Travel corridor for red fox and marten	Small 1982	328 ft
	Minimum to allow for interior habitat	Environment Canada 1998	328 ft
Microclimate	Maintain microclimate	May 2000	328 ft
	Prevent wind damage	Pollock and Kennard 1998	75 ft
	Approximate natural conditions	Brosofske et al. 1997	250 ft
	Maintain microclimate	Knutson and Naef 1997	200-525 ft
	Maintain humidity and soil temperature	Chen et al. 1995	98 – 787 ft

Acronyms:
SPTH: site potential tree height NMFS: National Marine Fisheries Service NRCS: National Resource Conservation Service USFWS: U.S. Fish and Wildlife Service FEMAT: Forest Ecosystem Management Assessment Team
Source: *Attachment 2 to Exhibit F of Ordinance No. 05-1077C; Metro's Technical Report for Fish and Wildlife Habitat, April 2005 Table 7, Page 82*

3B2.2 Terrestrial and Upland Wildlife Habitat

As noted, most wildlife species in Portland and the metropolitan region rely on riparian areas, wetlands, and open water bodies to survive. Many species also depend on upland areas for breeding, food and shelter. Upland habitat types include grassland or meadow, mixed conifer and deciduous forest, woodland and shrubland vegetation, rocky slopes and other topographic features. Some wildlife species may reside in the area year round, while others migrate through or use an area for breeding (e.g., Neotropical songbirds) or as a wintering ground, (e.g., waterfowl and wintering raptors).

To inform the regional wildlife habitat inventory, Metro reviewed correlated landcover data for the region with a widely accepted terrestrial habitat classification system (Johnson and O'Neil 1995). Metro reviewed the basic upland habitat types and species that use them, and found that 89 percent of the 292 native amphibians, reptiles, birds and mammal species in the Metro region use upland habitats types.

To identify and map wildlife habitat patches in the region, Metro focused on forest vegetation and wetlands. This was due in part to limitations on available vegetation data. However that said, forested areas and tree canopy provide critical functions for native wildlife in the Willamette Valley, including breeding, foraging, dispersal, and wintering habitat for wildlife species. Recent benthic macroinvertebrate studies in the region show positive correlations between forested land in watersheds and along stream corridors, and healthy stream communities (Frady et al. 2003). Wetlands also provide important habitat for birds, mammals, amphibians and reptiles. Many breeding bird populations feed, nest, and raise their young in wetlands. For some animals and plants, such as wood ducks and cattails, inland wetlands are the only place they can live. Metro also acknowledged the importance of upland meadows and grasslands as wildlife habitat, and addressed these areas through the designation of regional Habitats of Concern.

Wildlife Attributes

From the scientific literature, Metro identified key wildlife habitat attributes to serve as indicators of habitat function and the impacts of habitat fragmentation due to urbanization. These attributes are:

- ***Habitat patch size***
- ***Edge effect***
- ***Connectivity (including distance and age effect)***

- ***Habitat patch size***

  Studies indicate that larger habitat patches are better for the survival of native species than smaller patches (Wilcove 1985; Bolger et al. 1997a; Burke and Nol 1998). Some species need a certain amount of territory for foraging and breeding. Larger animals typically require more land areas to support their body mass (Soule 1991a). Smaller patches generally contain more edge habitat than larger patches. Edge effect can benefit some species, but can also foster proliferation of invasive species, next parasitism, and predation (see next section for more detail on edge effect).

  Small patches that are well-connected to other patches can provide important functions for species that are not dependent on interior habitat. Small patches provide "habitat islands" in developed urban areas. Some species may compose a home range made up of multiple habitat fragments. Proximity of small patches to rivers, streams and wetlands elevates their importance for wildlife.

- ***Edge effect***

  Edge habitat occurs where one habitat type, such as a forest, meets a stream, grassland, road, yard or landscaped area, or other natural or artificial habitat type (Forman and Godron 1986; Lidicker and Koenig 1996). Urbanization typically increases habitat fragmentation, resulting in more edge habitat and less interior habitat (Lidicker and Koenig 1996).

  Both the size and shape of a patch influence the amount of edge habitat in a patch. For instance, a large square or round patch has less edge habitat and more interior habitat than a long narrow patch. Circular or square patches often contain more species diversity, allow for increased foraging efficiency, and contain fewer barriers than rectangular or oblong patches (Forman and Godron 1986).

  Increased fragmentation favors species that thrive on habitat edges, while the reproduction and survival of interior species declines (Soule, 1991a; Nilon et al. 1994). Predators such as foxes and coyotes are better able to hunt along edge habitats where prey such as birds and small mammals are easier to find. Species such as the House Finch, Anna's Hummingbird, deer and raccoons are also able to use resources in human-altered landscapes (Bolger et al. 1997b).

  However, many species rely on relatively undisturbed interior habitat, such as Swainson's thrush and winter wren. Friesen et al (1995) found that the edge effect of residential development affected the diversity and abundance of songbirds in forest habitat patches regardless of patch size. In addition, edge habitats are associated with higher frequency and increased severity of fire, increased intensity of predation and invasion of exotic plants.

- ***Connectivity***

  Connection between habitat patches and between terrestrial habitat and water (rivers, streams and wetlands) is important to the survival of many wildlife species. Wildlife populations that are connected to each other are more likely to survive catastrophic events by moving from one patch to another to escape or to repopulate or revive an area (Hess 1994). Dispersal of animals between patches helps to preserve populations by protecting against catastrophes and preventing genetic decline due to inbreeding (Soule 1991a; Lidicker and Koenig 1996). Connections between habitats allow seasonal migrations (Lidicker and Koenig 1996; Duerkson et al. 1997) and interbreeding between populations. This increases the vigor and survival of overall populations (Duerkson et al. 1997).

  Animal movement decreases in direct relation to distance between habitat patches. However, if the landscape contains barriers, animal movement can be inhibited even where the distance between habitat fragments is not great (Bolger et al. 1997a). The impact of distance (distance effect) between patches is influenced by the amount of time that has passed since fragmentation took place (age effect). Several studies show that the species diversity is negatively correlated with the length of time a habitat patch has been fragmented from a large habitat area (Bolger et al. 1997a; Sole et al. 1988).

  Well-designed corridors can have a key role in maintaining ecosystem vitality (Adams and Dove 1989; Soule 1991 a, b; Beier and Noss 1998). However, the potential benefits and disadvantages of habitat corridors have been debated though not quantified in our region. Potential risks include invasion by exotic plant and animal species, transmission of disease, and predation (Simberloff and Cox 1987; Simberloff et al. 1992; Adams and Dove 1989; Duerdson et al. 1997). However, the literature indicates that the benefits of a connected landscape typically outweigh the potential negative effects of corridors, especially in urban environments (Soule at al. 1988; Beier and Noss 1998).

Effects of Urbanization on Wildlife Habitat

Urbanization has adverse impacts on each of the key attributes listed above, including:

- ***Loss of total wildlife habitat area***
- ***Loss of larger habitat patches and interior area***
- ***Fragmentation and loss of habitat connectivity and corridors***
- ***Reduction in habitat quality (e.g., through loss of canopy or understory, habitat disturbance, contamination and wildlife harassment), and***
- ***Alteration or conversion of one habitat type to another.***

Metro identified several main impacts of urbanization on wildlife habitat:

- ***Influx of non-native species***
  In natural ecosystems there are a number of biological, physical and environmental barriers that help prevent influx of non-native species such as land barriers and the presence of food that is unsuitable for introduced species (Parendes and Jones 2000; University of Washington, 1998). However, human disturbance can create conditions that allow non-native species to overcome such barriers (Witmer and Lewis 2001). Invasive species tend to respond positively to disturbance and often lack natural predators. The Portland metropolitan area already experiences significant impacts from non-native plant and animal species that are crowding, overtaking, and out-competing native species for food and habitat availability. Impacts from non-native insects are suspected but are relatively unstudied.

- ***Increased predation and competition***
  E.g., increases in small mammals that eat bird eggs and cat predation of birds and amphibians. Increases in edge habitat associated with urban development and habitat fragmentation provide additional opportunities for nest predation and parasitism by crows, jays, Brown-headed cowbirds, and European Starlings.

- ***Road impacts***
  E.g., loss of trees and vegetation, dispersal of exotic species, sediment and pollutants to streams, fragmentation of habitat, direct mortality impacts, and barriers to fish and wildlife movement. Wildlife species most at risk are those that avoid edge environments, occur in low densities, are unwilling or unable to successfully cross roads (e.g., amphibians), or that seek roads for heat (snakes) or food (owls) (Fleury and Brown 1997). Local data suggests that long-distance migratory bird species such as Black-headed Grosbeak and Common Yellowthroat are especially susceptible to road or other urban impacts (Hennings 2001).

- ***Recreational impacts***
  Protected open spaces can provide important opportunities for people to recreate and to connect with nature. However, recreation can also have negative impacts on wildlife and habitat such as vegetation trampling and disturbance from trails and roads, and harassment by domestic dogs. Some species are more or less sensitive to human disturbance. A number of bird species are particularly vulnerable during breeding season (Hennings 2001). Bats are sensitive to human disturbance during breeding and hibernation (Montana Chapter, The Wildlife Society 1999).

Science-based planning guidelines for wildlife habitat

Based on information from the literature, Metro produced the planning guidelines for upland wildlife habitat provided in the table below.

TABLE 3: METRO PLANNING GUIDELINES FOR UPLAND WILDLIFE HABITAT

Aquatic Habitat		
Guideline	**Explanation**	**Supporting literature**
Large patches are better than small patches, *and they should be round or square to reduce the amount of edge effect*	• Research shows that the edge effect ranges from 200-500 meters • Larger patches provide more interior habitat • Can support a larger number of individuals and a greater diversity of species • Can support a wildlife population for a longer time period • Provides greater opportunity for foraging and dispersal	Wilcove 1985; Forman and Godron 1986; Soulé 1991a; Bolger et al. 1997a; Duerkson et al. 1997; Fleury and Brown 1997; Germaine et al. 1998; Burke and Nol 1998; Environment Canada 1998
Small patches of unique habitat are worth saving	• Can retain unique vegetation communities • May provide "stepping stones" of habitat if in relatively close proximity, or in combination with habitat corridors • Can provide habitat for generalist and edge species • Especially important if near water resources	Soulé 1991a Dunning et al. 1992; Noss and Csuti 1997; Bolger et al. 1997a; Environment Canada 1998; Hennings 2001
Connectivity to other patches is important, *corridors should be as wide as possible, and it is cheaper to retain corridors than to create them after the fact*	• Can play a key role in maintaining ecosystem vitality and the survival of may species • Connected populations are more likely to survive over the long term • Allows populations to interbreed, maintaining genetic variability • Provides movement corridors for seasonal migration, finding better habitat, finding a mate, dispersal of post-breeding young, and escape routes	Adams and Dove 1989; Soulé 1991a Linehan et al. 1995; Lidicker and Koenig 1996; Bolger et al. 1997a; Clergeau and Burel 1997; Fleury and Brown 1997; Environment Canada 1998
Connectivity and/or proximity to water resources is valuable	• Habitat patches near water resources have increased diversity of wildlife • Most wildlife species use riparian areas for some aspect of their life history • Over 60 percent of mammals in the Northwest use riparian areas for breeding or feeding • Riparian corridors frequently serve as travel routes, especially in urban areas	Forman and Godron 1986; Environment Canada 1998; Hennings 2001; Kauffman et al. 2001
Buffers can help protect wildlife from human disturbance	• Surrounding land uses have an impact on the effectiveness of a habitat patch in providing functions and values to wildlife • People like to use natural areas and open space for recreation • A buffer zone allows for human use of a selected part of a habitat patch, while protecting wildlife from excessive disturbance	Adams and Dove 1989; Adams 1994; Nilon et al. 1994; Friesen et al. 1995; Linehan et al. 1995; Lidicker and Koenig 1996

3C. INVENTORY METHODOLOGY

The previous section summarizes the scientific literature review from which Metro's and the City's inventory methodologies are derived. The following section describes the actual inventory methodology, models and other tools that were developed to produce the inventories.

3C1. METRO'S INVENTORY METHODOLOGY

Based on the scientific literature, Metro developed GIS natural resource data and maps, and created GIS models to rank the relative value of the natural resource features as riparian corridors and wildlife habitat. Metro conducted fieldwork, and consulted with local, state and federal agencies, academic institutions and other organizations to identify key fish and wildlife species and habitats of concern.

3C1.1 Mapping and Ranking Riparian Corridors

Metro began mapping riparian corridors and wildlife habitat in early 2001. The first step was to collect and produce GIS data and maps of natural resource features such flood areas, lakes, wetlands, streams, forest canopy, steep slopes, woody vegetation, culverts, etc.

Metro found that neither the science nor the regulatory agencies provide guidelines for how to map and evaluate the value of riparian corridors. For example, the state's rule for compliance with Goal 5 defines a riparian corridor generally as a "…resource that includes the water areas, fish habitat, adjacent riparian areas, and wetlands within the riparian area boundary." The rule defines the riparian area boundary as an "imaginary line that is a certain distance upland from the top of bank" (OAR 660-23-090(1)).

Given this flexibility, Metro developed an innovative scoring system to map and evaluate the significance of riparian corridors based on the functions they provide. Specific GIS mapping and scoring criteria were developed for the following functions:

- Microclimate and shade
- Streamflow moderation and water storage
- Bank Stabilization, and control of sediment, nutrients and pollutants
- Large wood and channel dynamics
- Organic inputs

Metro developed a GIS model that assigned relative scores for riparian function based on specific criteria. Relative scores were based on the types of natural resource features present; the proximity to and/or distance from a river, stream, or wetland. "Primary" scores were applied to landscape features that provide the most direct and substantial contribution to a particular riparian function. Generally, the features that received primary scores included vegetated flood areas, wetlands located within ¼ mile of a stream, and forest or woody vegetation located adjacent to or near a stream (typically within 100 to 200 feet, although floodplains are often more extensive). Metro also assigned primary scores to low-structure vegetation for the water quality functions it provides within 100 from a stream (or 200 feet if in a steeply sloped area).

"Secondary" scores were assigned to features that provide lesser, but still important riparian functions based on Metro's review of the scientific literature. Secondary functional scores were typically assigned to vegetation that is contiguous to the primary functional area and extends to distances ranging from 170 feet to 780 feet from a river or stream. Maximum functional distances reflect factors such as vegetation type, presence of steep slopes and the particular function being evaluated. Once the primary and secondary scores had been assigned, Metro ranked the region's riparian corridors by summing the individual functional scores. The highest possible score was 30 points (6 points for each of the five riparian functions).

In spring 2001, Metro tested this methodology in three parts of the region to ensure that the model results correlated with actual conditions. Satisfied with the results, Metro Council directed staff to produce riparian corridor maps for the entire region. After Metro's technical and policy committees reviewed the mapping approach and draft maps, Metro Council held a public hearing and approved the riparian corridor mapping criteria with proposed amendments. The most notable amendment was the Council's decision to downgrade the functional score assigned to developed floodplains from primary to secondary. Metro Council also deemed that all the riparian corridors receiving primary and/or secondary scores are regionally significant according to the provisions of the Goal 5 rule (described further below). (Metro Resolution No. 01-3141C).

After this initial endorsement, Metro revised the riparian corridor inventory several times before it was adopted as part of the Nature in Neighborhoods program in 2006. Revisions included correcting the maps and extending the inventory to include areas within one mile of Metro's jurisdictional boundary and potential urban growth boundary expansion areas.

3C1.2 Mapping and Ranking Wildlife Habitat

Metro designed a separate inventory methodology to map and rank the relative quality of wildlife habitat areas in the region. The regional wildlife habitat inventory design is based on the following assumptions:

- Large habitat patches are more valuable than small patches
- Interior habitat is more important to at-risk wildlife species than edge habitat
- Connectivity and proximity to other habitat patches is important
- Connectivity and proximity to water is important
- Unique or at-risk habitats deserve special consideration

Metro's produced a second GIS model to assess the relative value of wildlife habitat "patches" in the region. Habitat patches were not based on documented use by wildlife, but rather, were based on vegetation features that would be expected to support wildlife on a non-incidental basis. Metro defined two types of patches for the modeling exercise. "Type 1" habitat patches had to be at least two acres in size, and comprised of contiguous forest vegetation, wetlands, or a combination of forested area and wetlands. "Type 2" patches included shrubs and other low structure vegetation within 300 feet of streams and wetlands. Type 2 patches were meant to account for habitat connectivity riparian corridors, but were not valued as highly as the mapped forest or wetland areas.

Consistent with the science, Metro decided to evaluate relative habitat quality based on each of the following attributes:

- Habitat patch size
- Interior habitat area
- Connectivity between patches
- Connectivity of patches to water

Metro developed scoring criteria for each of these attributes, and combined the individual attribute scores to generate a 1 to 10-point overall wildlife habitat rank for each patch. In fall 2001, Metro tested the wildlife habitat model by conducting field assessments at randomly selected sites throughout the region. The model results were compared with the field results, confirming that the model provided a reasonable means to evaluate relative value of the patches.

Ultimately, Metro simplified the wildlife habitat rankings from the 10-point scoring system to an A, B, and C class ranking system. Metro also adjusted the model-generated inventory rankings as needed to incorporate Habitats of Concern (described in the next section).

3C1.3 Identifying Wildlife Species and Habitats of Concern

State of Oregon rules for compliance with Land Use Planning Goal 5 require local wildlife habitat inventories to contain information about threatened, endangered, and sensitive wildlife species and their habitats, sensitive bird sites, and any species or habitats of concern that are identified and mapped by the Oregon Department of Fish and Wildlife (ODFW) (OAR 660-023-0110 (3). Metro worked with local, state and federal wildlife habitat experts to develop vertebrate species lists and identify and map Habitats of Concern (HOCs) for the region. Metro created a comprehensive list of vertebrate species that typically occur in the region on a yearly basis. The species list reflected input from local wildlife experts, including the species-habitat associations developed by Johnson and O'Neil (2001). In addition, the list indicated the status of a species as threatened, endangered, or sensitive, and the relative importance of different habitat types for the different species.

The species list illustrated the region's biodiversity, identifying more than 290 known native vertebrate species occurring here. Ninety-three percent of the species listed use riparian areas, and eighty-nine percent of the terrestrial species in the region also use upland habitats.

Metro compiled species and habitat information, gathering data on sensitive species sighting locations, sensitive bird sites, and wildlife species and habitats of concern. Habitats of Concern, contain unique features or are of critical importance for particular wildlife species or functions. The HOCs include some important habitat areas that were not captured by the GIS Wildlife Model (e.g., open grassland areas on butte tops; key wildlife connectors).

Metro worked with agencies and wildlife experts to identify and map areas meeting one or more of the following criteria:

1. Vegetation patches identified as Priority Conservation Habitats by ODFW, USFWS, or other agencies or local wildlife experts. Priority Conservation Habitats include Oregon white oak savannas and woodlands, native prairie grasslands, wetlands and bottomland hardwood forests. Less than one percent of historic Willamette Valley native oak and grassland habitats still exists (World Wildlife Fund, 2001). Over 70 percent of the bottomland hardwood forests have been lost. In the Willamette Valley, between 40 and 70 percent of documented wetlands have been lost, with continuing losses of more than 500 wetland acres per year. *(Metro Habitat Inventory Report* Appendix 5: Riparian corridors and wildlife habitat GIS model criteria matrices, 2005)

2. Land cover identified by ODFW, USFWS or other agencies or local wildlife experts as a riverine island or delta important to wildlife. Riverine islands and deltas provide unique habitat for shorebirds, waterfowl, nesting terns and gulls, and other wildlife through enriched food resources,

sand and mudflats, and protection from predators and disturbance. Bald Eagles winter, breed and forage on islands in the Willamette and Columbia rivers. Channel complexity and large wood, which are linked to island formation, have been substantially reduced from historic levels.

3. Habitat areas that meet life-history requirements of sensitive, threatened or endangered wildlife species; habitat that supports at-risk plants; or habitats that support important wildlife functions, such as Great Blue Heron rookeries, elk migratory corridors and migratory bird stopover areas.

4. Grassy hilltops, inter-patch connectors, biologically or geologically unique areas (rocky outcrops or talus slopes) provide vital habitat for sensitive wildlife species and support at-risk plant species.

Metro mapped HOCs using existing GIS data, aerial photos and other information submitted by local agencies and wildlife experts. Preliminary HOC designations and maps were reviewed by Metro's Goal 5 Technical Advisory Committee and during public hearings process for the regional inventory. The Habitats of Concern were integrated with the wildlife habitat model results to produce a regional Wildlife Habitat map. Integrating the HOCs with the model results caused a minor expansion in inventoried wildlife habitat area and some changes in the wildlife habitat rankings. HOCs were assigned a Class A wildlife habitat or Class I riparian corridor/wildlife habitat designation which superseded lower rankings assigned by the model.

3C1.4 Resource Site Analysis

To comply with the state's rules for compliance with Goal 5, local jurisdictions must produce natural resource inventory information for individual resource sites. A "resource site" or "site" is defined as "…a particular area where resources are located. A site may consist of a parcel or lot or portion thereof or may include an area consisting of two or more contiguous lots or parcels." (OAR 666-23-010 (10)

Metro identified 27 resource sites based on groupings of watersheds and subwatersheds located wholly or partially within Metro's jurisdictional boundary. For each site, Metro identified:

- Named streams
- Communities (jurisdictions) within the site
- Total acreage within Metro's boundary
- Total acreage within riparian corridors (and by jurisdiction)
- Riparian resources (descriptions and relative value/ecological scores)
- Wildlife habitat resources (descriptions and patch scores; patch breakdowns by landcover type and known wetlands; habitat availability based on habitat types and species habitat associations per Johnson and O'Neil (2001))
- Species of concern
- Habitats of concern

Eleven of the regional resource sites are located at least partially within Portland, including:

Rock Creek/Tualatin River area
Site #7: Middle Rock Creek – Tualatin River subwatershed
Site #8: Beaverton Creek subwatershed

Lower Tualatin River
Site #12 Upper and Middle Fanno Creek subwatershed
Site #14 Lower Fanno Creek subwatershed

Johnson Creek
Site #18 Johnson Creek – Sunshine Creek subwatershed
Site #19 Kelley Creek subwatershed
Site #20 Middle Johnson Creek subwatershed
Site #22 Lake Oswego subwatershed
Site: #23 Tryon Creek subwatershed
Site #24 Johnson Creek – Crystal Springs Creek subwatershed
Site: #25 Mt. Scott Creek subwatershed

Scappoose Creek
Site #26 Lower Willamette River subwatershed
Site #27 Columbia Slough subwatershed

Although the scale of Metro's resource sites is considerably larger than the scale of Portland's existing resource sites, the regional information provides a useful reference for the City inventory update.

3C1.5 Determining Regional Significance

Metro concluded the regional inventory process by:

- Confirming that the regional inventory process meets state Goal 5 requirements for adequacy of the information; and
- Determining which of the inventoried resources are regionally significant.

Adequacy of the Information

According to the Goal 5 rules, the information contained in local natural resource inventories must address location, quantity and quality in order to be deemed "adequate." (OAR 660-023-0030) Metro addressed these factors as follows:

- **Location**
  To meet the location requirement, a local inventory must include a description or map for each resource site, sufficient to determine whether a resource exists. Precise locations need not be determined at this stage of the inventory process. Metro's regional inventory provides resource information at the tax lot level. Maps were reviewed and corrected based on input from property owners and other stakeholders.

- **Quantity**
  To address the quantity requirement, an inventory must estimate the relative abundance or scarcity of the resource for each resource site. Metro's regional inventory quantified natural resource features by site, including streams (miles), riparian corridors (acres) and wildlife habitats (acres).

- **Quality**
  To meet the quality requirement, an inventory must indicate resource value, by resource site, relative to other known examples of the same resource. Relative value may or may not reflect the actual condition of a natural resource feature. In other words, a resource could somewhat degraded but still receive a high relative value rating if it is in better condition than other local examples of the same resource. Metro's inventory mapping and ranking methodology (described in the previous section) produced a meaningful assessment of the relative ecological function and quality of the region's riparian corridors and wildlife habitat.

Resource Significance

If a local inventory meets the "adequacy" requirements, the Goal 5 rule requires local jurisdictions to determine if a resource site is "significant" based on location, quantity and quality of the resource (described above), and additional criteria pertaining to specific resource types (in this case riparian corridors and wildlife habitat). The city or county may consider any other criteria adopted by the local jurisdiction as long as they do not conflict with criteria in the rule. Resources that have been deemed significant must then be evaluated to determine if and how those resources should be protected by the local jurisdiction.

Metro first confirmed the ecological significance of inventoried riparian corridors and wildlife habitat based on the science. Metro then determined which of the ecologically significant riparian corridor and wildlife habitat areas are regionally significant.

Riparian corridors

For riparian corridors, Metro determined that all resources that received scores for riparian functional value should be considered ecologically significant. Metro points to the scientific literature in explaining this decision:

- To the maximum extent possible, all perennial, intermittent, and ephemeral streams should be protected from surrounding land use activities by a buffer (May 2000).

- Continuous buffers are more effective at moderating stream temperatures, reducing non-point source pollution, and providing better habitat and movement corridors for wildlife (Fischer et al. 2000).

- The temperature in streams is influenced by the condition of adjacent forest and also by upland conditions (Pollack and Kennard 1998).

- Riparian corridors are especially important along the small headwater streams that typically make up the majority of stream miles in any basin (Osborne and Kovacic 1993; Binford and Bucheneau 1993; Hubbard and Lowrance 1994; Lowrance et al. 1997; May et al. 1997A; Fischer et al. 2000).

Next, Metro staff and technical committees evaluated several approaches for determining which inventoried riparian corridors should be deemed significant. Ultimately, Metro determined that any ecologically significant riparian corridor is also regionally significant. Metro notes that this approach:

- Is consistent with the scientific literature
- Addresses resources at the watershed scale
- Fosters protection of hydrologic function
- Promotes connectivity between tributaries and larger rivers, groundwater and surface water, wetlands and floodplains, and fish and wildlife habitats and movement corridor
- Fosters protection of biological diversity
- Promotes restoration by recognizing riparian corridors that are currently degraded but are important to ecological functions
- Meets Goal 5 requirements and likely addresses Endangered Species Act requirements for listed salmonids

Wildlife habitat

Similarly, Metro deemed all wildlife habitat areas receiving a score greater than zero to be biologically significant based on the following rationale:

- The regional wildlife habitat mapping approach established minimum guidelines for inclusion in the inventory, including size and composition requirements (2-acre minimum and forest/wetland, respectively), and/or designation as a Habitat of Concern.
- An inclusive approach reflects the proven importance of connectivity across the landscape as a basic component of functioning wildlife habitat.
- The mix of factors used to construct the wildlife habitat inventory (patch size, interior area, and connectivity), provide a regional "backbone" of habitats that could potentially support healthy, productive and diverse wildlife populations.

Before deciding which of the inventoried wildlife habitat areas should be deemed significant, Metro staff and technical committees evaluated the options to ensure that the determination would:

- Meet Goal 5 requirements
- Meet the goals in the Metro's Vision Statement for the fish and wildlife habitat planning effort
- Support the goals in the Oregon Department of Fish and Wildlife, Wildlife Diversity Plan
- Be consistent with the scientific literature
- Apply an ecosystem approach
- Promote sensitive species/habitat conservation
- Promote maintenance of existing connectivity
- Maximize restoration potential

After evaluating several options, Metro Council determined that all but the lowest-ranked wildlife habitats are regionally significant. The lowest-ranked habitats consisted primarily of small, isolated and/or linear patches in developed areas (e.g., street trees in areas like Portland's Ladd's Addition and Eastmoreland neighborhoods). Metro Council noted that these types of areas could provide locally significant habitat, and recommended that cities and counties consider these areas when developing local protection programs.

3C1.6 Creating A Combined Regional Inventory Map

After determining the significance of riparian corridors and wildlife habitat, Metro produced a single inventory map by combining both inventories.

The final combined regional significance rank categories included:

Class I Riparian/Wildlife Habitat Resources
Class II Riparian/Wildlife Habitat Resources
Class III Riparian/Wildlife Habitat Resources
Class A Wildlife Habitat Resources
Class B Wildlife Habitat Resources
Class C Wildlife Habitat Resources

Where the Class I, II, and III ranked areas overlapped with the Class A, B, and C ranked areas, AND where the two ranks differed, Metro used the higher of the two for the combined rank.

Metro identified "impact areas" adjacent to significant riparian corridors and wildlife habitat. They are intended to represent areas where land uses and development could have an adverse impact on the significant resources. Metro did not assign the impact areas relative ranks or regional significance.

3C1.7 Adopting The Regional Inventory

Metro's inventory includes 89,682 acres of regionally significant riparian corridors and 56,979 acres of wildlife habitat in the region. Combined, the total acreage in the regional inventory is approximately 146,661. Of the total resource area included in the regional inventory, 23,899 acres are located within Portland. The inventory was used as a basis for identifying and evaluating potential programmatic approaches to protect, conserve and restore the riparian corridors and wildlife habitat identified in the regional inventory.

In September 2005, the Metro Council adopted the regional inventory as part of the new "Nature in the Neighborhoods" program. Program requirements were established through the adoption Title 13 of the Urban Growth Management Functional Plan (September 29, 2005, Metro Ordinance 05-1077C). Title 13 establishes a regional baseline level of protection for identified resource areas. Prior to adoption, Metro evaluated different program options using the Economic, Social, Environmental and Energy (ESEE) Analysis process required for compliance with State Land Use Planning Goal 5. After completing the ESEE Analysis, the Metro Council decided to apply the regional program requirements only to inventoried Class I and II riparian corridors/wildlife habitat areas. Metro also applied regional requirements to Class A and B wildlife habitats that will be brought into the Urban Growth Boundary after the program goes into effect. Metro calls the areas to which the Title 13 provisions apply "Habitat Conservation Areas."

In making these decisions, Metro established regional program requirements for Class III Riparian Areas or Class A, B, or C Wildlife Habitat resources within the UGB that existed at the time of program adoption. Metro also exempted four marine terminal sites along the Willamette River in Portland from the Title 13 requirements, determining that from a regional perspective the economic value of the terminals outweighs the benefits of protecting natural resources on these sites.

The Metro Council agreed to establish incentives to promote voluntary resource protections for natural resources not addressed by Title 13. For example, Metro promised to pursue a regional bond measure to purchase important natural resources. This commitment was realized with the passage of Ballot Measure 26-80 in November 2006. In addition, Metro established a grants program and is providing "habitat friendly development" technical assistance to residential, commercial and industrial developers.

In October 2006, the Oregon Land Conservation and Development Commission found that Metro's program meets the state requirements of Goal 5, and augments the region's existing requirements to meet Goal 6 Air, Water and Land Resource Quality (found in Title 3 of the Urban Growth Management Functional Plan). The program was officially acknowledged through a final order signed on January 5, 2007 (Oregon LCDC Order 06-ACK-001713)

Cities and counties within Metro's jurisdiction must, by January 2009, demonstrate that their local programs meet Title 13 requirements. Local programs to protect Habitat Conservation Areas may include regulatory and/or non-regulatory components, and may include more stringent provisions than required by Title 13. Title 13 recognizes that some localities, including the City of Portland, have already established programs to protect significant natural resources. Title 13 restricts local jurisdictions from taking actions that would weaken existing state-approved Goal 5 programs.

3C2. PORTLAND'S INVENTORY METHODOLOGY

The previous section outlines the approach Metro took to produce the regional inventory on which the new City inventory is based. The following section describes the methodology the Bureau of Planning has implemented to develop the new citywide inventory of riparian corridors and wildlife habitat.

Relying on the science and Metro's general methodology, the Bureau of Planning completed the following steps to produce the new inventory information for Portland:

1. Assembling GIS data for key natural resource features
2. Developing GIS models to rank and map the relative quality of Portland's riparian corridors and wildlife habitat areas
3. Updating regional species lists and designating Special Habitat Areas
4. Assigning "relative ranks" to riparian corridors and wildlife habitat areas
5. Technical Review Process
6. Quality Control – Quarter-Section Assessments
7. Determining Resource Significance

As these steps were completed the Bureau made a number of updates and refinements to the regional inventory, including:

- Upgrading the landscape feature data
- Honing the regional mapping criteria
- Localizing the regional species lists
- Updating regional Habitats of Concern and designating local special habitat areas (or SHAs)

The refinements are intended to:

- Increase the level of detail of the inventory maps;
- Improve clarity and transparency of the inventory process;
- Enhance mapping accuracy and consistency;
- Integrate new Portland-specific conditions and functions; and
- Enable the city to update the inventory regularly and cost-effectively over time.

3C2.1 Step 1: Assembling GIS Data For Key Natural Resource Features.

The City inventory methodology is integrally tied to the role of key natural resource features on the ground. Thus, the quality of the City inventory will be a direct reflection of the quality of the GIS data for streams, wetlands, floodplains, vegetation and topography in Portland. To improve the level of detail and accuracy of the regional data, the Bureau of Planning invested considerable effort to produce new data for streams, vegetation and flood areas in the city. See Appendix 6: Mapping Protocols for a description of updating feature data.

Streams – The Bureau conducted an extensive stream remapping effort between 2002 and 2004. The Bureau worked closely with other City bureaus to ensure that the new stream data could be used by the City as a whole. The remapping process involved reviewing the most recent aerial photos and other data sources, and conducting more than 160 site visits to confirm the existence and location of points along streams (using GPS units where feasible to locate points along the drainages).

The updated stream data include more than 180 miles of remapped stream centerlines and about 86 miles of newly mapped streams or stream segments in the city. Products also included improved mapping of stream/stormwater pipe connections. Many of the newly mapped streams are located in the headwater areas of Portland's watersheds. These headwater areas, including intermittent streams, provide critical watershed functions relating to system hydrology, water quality and temperature, and aquatic and terrestrial ecosystems (Meyer, J.L. et al 2003). The stream remapping project report can be accessed on-line at http://www.portlandonline.com/planning. The Bureau submitted the updated stream data to Metro in 2003 for inclusion in the regional inventory.

Vegetation – Vegetation mapping was carried out between 2004 and 2006. The Bureau of Planning produced new GIS vegetation data and maps for Portland using current aerial photographs and targeted site visits. The Bureau selected a minimum vegetation mapping unit of ½ acre to provide more detail than the vegetation data (which used a one acre minimum mapping unit). Like Metro, city-mapped vegetated areas may contain mixes of native, non-native and invasive plant species. In addition, because the region is so large, Metro was able to classify the different vegetation types (other than forest) only within 300 feet of streams. The Bureau of Planning updated the classification of different vegetation types (forest, woodland, shrubland and herbaceous) and extended the classification to a distance of ¼ mile from mapped streams, environmental zones and regionally significant resource areas. The Bureau used the National Vegetation Classification System (NVCS) which allowed this data to be merged with existing vegetation information produced by the Bureau of Parks and Recreation for the City-managed natural areas.

Flood Area – The Bureau of Planning has continued to update the City flood area data for use in the inventory. The Bureau has incorporated the 2004 FEMA 100-year floodplain and information from the Port of Portland and others regarding alterations to the floodplain.

The GIS layers used to develop the updated inventory information is presented in the following table.

TABLE 4: NATURAL RESEOURCE INVENTORY GIS IMODEL DATA INPUTS

Natural Resource Feature(s)	Description	Lineage	Online Reference
Rivers and major streams (Willamette River, Columbia River, Johnson Creek, Columbia Slough)	Regional streams, rivers, lakes, ponds and other surface water features. Only features large enough to be visible on aerial photographs were mapped (more detailed stream information is available as centerlines).	Updated from original Metro dataset by City of Portland, Bureau of Planning, to refine geometry, remove erroneously mapped water bodies, and add missing water bodies.	GIS data metadata: http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52070&Db_type=sde &City_Only=False
Streams and drainageways	Regional stream centerlines.	Updated from original Metro dataset by City of Portland, Bureau of Planning, to refine stream centerline geometry, remove erroneously mapped streams, add missing stream centerlines, and route the stream dataset through the City of Portland sewer and stormwater network.	Stream mapping project description: http://www.portlandonline.com/shared/cfm/image.cfm?id=106049 GIS data metadata: http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52071&Db_type=sde &City_Only=False
Wetland	National Wetland Inventory (NWI) with revisions made by local governments in the tri-county region.	Portland wetlands are updated from the original Metro dataset by City of Portland, Bureau of Planning to refine geometry, remove erroneously mapped wetlands, and add missing wetlands.	GIS data metadata: http://www.portlandonline.com/ cgis/metadata/viewer/display.cfm? Meta_layer_id=52608&Db_type=sde &City_Only=False
Flood area	The combination of the modified FEMA 100-year floodplain and the 1996 flood inundation area.	The 100-year floodplain was originally delineated by the Federal Emergency Management Association (FEMA).Digitized by the Portland Office of the Army Corps of Engineers using by registering the flood plain maps to USGS 7.5 minute quadrangle maps. The floodplain has been modified based on local input by the City of Portland and Metro to remove areas that meet FEMA standards for removal from the floodplain. The 1996 flood inundation area was digitized by the Army Corps of Engineers using aerial photos taken during the February 1996 flood. The flood area is not registered to taxlot base maps.	100-year floodplain GIS data metadata: http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52128&Db_type=sde &City_Only=False 1996 flood GIS data metadata: http://geode.metro-region.org/metadata/display.cfm?Meta_layer_id= 2056&Db_type=rlislite
Vegetation	Vegetation patches larger than 1/2 acre. Vegetation patches area classified as forest, woodland, shrubland, or herbaceous. The mapping area includes all land within the City of Portland and the unincorporated parts of Multnomah County that are administered by the City of Portland.	Created and maintained by the City of Portland, Bureau of Planning. Based on information from reference data sources including aerial photos, City of Portland Parks and Recreation "natural area assessments," and vegetation surveys along the banks of the Willamette and Columbia rivers.	Vegetation mapping project description: http://www.portlandonline.com/shared/cfm/image.cfm?id=106047 GIS data metadata: http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52135&Db_type=sde &City_Only=False
Steep slopes	Areas with a slope equal to or greater than 25 percent (12 degrees)	Slope was mathematically derived by Metro from USGS 10' contours using GIS software. The resulting dataset was "smoothed" to remove the "sawtooth" edges.	GIS data metadata: http://geode.metro-region.org/metadata/display.cfm?Meta_layer_id= 358&Db_type=rlislite

3C2.2 Step 2: Developing GIS Models To Rank And Map The Relative Quality Of Portland's Riparian Corridors And Wildlife Habitat Areas.

Like Metro, the City has developed GIS modeling tools to evaluate the relative quality of the riparian corridor and wildlife habitat in Portland. The City inventory models are comprised of the same general modeling approach that Metro developed for the regional inventory.

Riparian Corridor Model

The City riparian corridor model assigns scores to natural resources for each of the riparian functions:

- **Microclimate and shade –** Open water bodies, wetlands, and surrounding trees and woody vegetation are associated with localized air cooling and increased humidity.
- **Bank function and control of sediments, nutrients and pollutants –** Trees, vegetation, roots and leaf litter intercept precipitation, hold soils, banks and steep slopes in place, slow surface water runoff; take up nutrients, and filter sediments and pollutants found in surface water.
- **Stream flow moderation and flood storage –** Waterways and floodplains provide for conveyance and storage of streamflows and floodwaters, while trees and vegetation intercept precipitation and promote infiltration which tempers streamflow fluctuations or "flashiness" that often occurs in urban watersheds.
- **Large wood and channel dynamics –** Streams, riparian wetlands, floodplains and large trees and woody vegetation contribute to the natural changes in location and configuration of stream channels over time.
- **Organic inputs, food web and nutrient cycling –** Water bodies, wetlands and nearby vegetation provide food for aquatic species (e.g., plants, leaves, twigs, and insects) and are part of an ongoing chemical, physical and biological nutrient cycling system.
- **Wildlife habitat/corridors –** Vegetated corridors along waterways, and between waterways and uplands, allow wildlife to migrate and disperse among different habitat areas, and provide access to water.

As noted in the Scientific Foundation Section above, riparian functions occur within certain distances of streams and wetlands depending on the type and extent of the features present. The riparian corridor model assigns primary and secondary scores to landscape features depending on how close the feature is to a river, stream, drainageway or wetland. "Primary" scores are applied to features that provide the most direct and substantial contribution to a particular riparian function. "Secondary" scores are assigned to features that provide lesser, but still important, riparian functions. Consistent with Metro, the City assigns riparian functional scores to land within 50 feet of a river, stream or wetland regardless of land cover. The predominance of riparian functions occurs within 30 to 100 meters (approximately 100 to 300 feet) of a water body. However, some functions can occur up to several hundred feet from a water body. Locations where at least one primary-scoring feature exists receive a primary score for that function. Table 5 summarizes the criteria the City is using to score and map riparian corridor functions in Portland.

Within the City, natural resources generally reflect the impacts of urbanization; however, the resources still provide important riparian and wildlife habitat functions. For example, vegetated areas in riparian corridors are often comprised of a mix of native, non-native and invasive plants. Native plant species generally provide a broader suite of benefits, such as varied wildlife food source and effective slope stabilization. However, non-native plants still provide critical watershed functions such as water storage and nutrient cycling. Other examples of the affects of urbanization include rivers and streams with constrained or altered channels, wetlands with soil contamination, and developed floodplains. In each of these cases, the resource has experience some degradation but still provides provide important functions such as water conveyance and storage, and fish and wildlife habitat.

Refining Metro's Riparian Corridor Model

The criteria summarized in Table 5 reflect some refinements to the criteria Metro used to map riparian corridors across the region. The City riparian corridor model uses the same criteria framework Metro developed for the regional inventory. However, some of the regional criteria specifications have been revised to:

- **Recognize the riparian functions provided by rivers, streams, and wetlands.** The City assigns riparian functions directly to these features explicitly, while Metro incorporated the features by assigning function to the land, vegetation, and flood areas around them. To better reflect existing conditions in the North and Central reaches of the Willamette River, secondary scores are assigned for river bank function and control of sediments, nutrients, and pollutants.

- **Recognize beaches as part of the Willamette River channel.** Beaches are dynamic features in the Lower Willamette River, inundated daily and seasonally; and because of this direct relationship with the river, it is appropriate to consider beaches as part of the river channel itself.

- **Narrow the functional scoring and broaden the secondary scoring functions attributed to riparian wetlands and vegetation adjacent to or near wetlands.** The City inventory reduces the distance from a stream within which a wetland must be located in order to receive a primary score for certain functions. The City inventory broadens the array of secondary functions attributed to vegetation near wetlands.

Technical reviewer comments:

" Wetlands, even away from a stream channel, affect nutrient processing, microbial production, etc. The hydrologic connection between streams and wetlands is not always apparent from the surface topography." Nancy Munn, NOAA/National Marine Fisheries Service, June 21, 2006

" Adjacent riparian areas may even be more important to the adequate functioning of a wetland than they are for streams…I question whether 150' is adequate, but certainly I would think this is at least minimally needed for a wetland." Dr. Alan Yeakley, PSU, July 16, 2006

" I still have concerns specifically with wetlands that are not hydrologically connected to streams or rivers even during overbank flows in the stream…If the wetlands are not hydrologically connected to the stream, then there is no pathway for large wood to recruit to the stream." Paul Fishman, SWCA, June 12, 2006

- **Reflect more variability in the riparian functions provided by different types of vegetation.** The City refined the vegetation mapping to classify vegetation patches as natural/semi-natural or cultivated as part of the Willamette River Natural Resource Inventory update. Cultivated vegetation is narrowly defined as landscaped, highly manicured, intensely managed (e.g. mowed) vegetation and generally includes lawn and common areas, golf courses, parks and rights-of-way. This refinement recognizes that cultivated vegetation does not provide the same level of resource functions as more natural vegetation types. In some cases cultivated vegetation can have a negative impact on natural resource functions, such as when fertilizers and pesticides are applied and run off into local waterways. The City's inventory applies a lower score to cultivated woodland and shrubland vegetation for riparian functions associated with bank function, and sediment, pollution and nutrient control; and organic inputs, food web and nutrient cycling, Such refinements may be undertaken for parts of the City other than the Willamette Corridor if the data and science support additional differentiation. The City inventory distinguishes more closely between the functions provided by different vegetation types than was done for the regional inventory. In Portland, relatively little natural or unmanaged grassland areas remain. Much of the herbaceous vegetation consists of lawn, cultivated turf grass, or landscape groundcover in developed areas with compacted soils. (City of Tacoma, 2003) It is assumed that throughout the Metro region there are more areas comprised of meadow, grassland, and agricultural fields, as well as urban landcover types. While lawns can help slow and filter runoff, stabilize banks, and provide wildlife corridors, they function at a lower level than healthy stands of trees, woody/shrubby vegetation, and more natural or complex grasses or groundcovers. Further, lawns located near streams contribute more runoff than wooded areas and the runoff can be laden with pollutants such as fertilizer nutrients and pesticides. (USGS, 2003) The City inventory reflects these functional differences by assigning lower relative ranks to riparian herbaceous vegetation than the ranks assigned by the regional model. Depicting more variation in riparian corridor functions will better inform future management decisions relating resource protection, land acquisition, restoration and public education.

Technical reviewer comments:

" I support ascribing a lower functional value to lawns … given their potential negative contributions (e.g., pesticides, nutrients, bacteria)." Karen Font Williams, Oregon Dept. of Environmental Quality, June 13, 2006

" While … there may be concern over the proposal to assign a secondary score to herbaceous vegetation for bank stabilization, sediment, pollution, and nutrient control, I agree that it is appropriate for the City of Portland. Quality low structure vegetation outside of forest and shrub areas in the City is pretty rare and does mostly consist of lawn or graveled and weedy areas." Tom McGuire, Adolfson and Associates, June 12, 2006

" … I agree, particularly in relation to lawns, while also recognizing that non-lawn herbaceous veg (sic) can provide effective functions in some situations …" Paul Fishman, SWCA, June 12, 2006

" … concur that herbaceous vegetation provides lesser value than riparian forest for water quality and hydrologic function … these areas are important for restoration and enhancement, and should be recognized as such even though current conditions are degraded and highly modified …" Susan Barnes/ Patty Snow, Oregon Department of Fish and Wildlife, June 21, 2006

" My concern is whether by taking this approach the restoration potential of a site is lost." Mike Houck, Urban Greenspaces Institute, July 12, 2006

" … lawns and unmanaged herbaceous areas have very different hydrological and water quality signals. I believe they should be separated into distinct classes." Dr. Alan Yeakley, PSU, July 16, 2006

- **Recognize how the management activities of drainage districts affect riparian function.** The City inventory includes additional riparian corridor mapping criteria that apply only to areas managed by local drainage districts. The Multnomah County Drainage District (MCDD) manages an extensive system of pumps and levees to control the rates and the elevations of water in the upper and middle Columbia Slough and associated waterways. Without pumping, the area would be flooded causing extensive damage to local industries, businesses and residents. The drainage district also routinely removes large wood to maintain channel conveyance capacity. While riparian corridors within drainage districts continue to provide important water quality and fish and wildlife habitat functions, these management activities eliminate floodplain functions and restrict natural channel dynamics. The City inventory reflects these impacts by assigning lower relative ranks to riparian corridors within a drainage district for functions relating to flood storage and channel dynamics. The proposed mapping criteria refinements more accurately reflect MCDD's management of flow levels to prevent flooding and also of the channels themselves to maintain conveyance, including the regular removal of large wood to maintain adequate flow conveyance capacity. MCDD agrees with the City's proposal to modify criteria relating to hydrology and channel dynamics without modifying criteria relating to other riparian functions (e.g., pollution and sediment control, microclimate and shade, wildlife habitat). By reflecting these local differences, the City inventory can educate citizens and stakeholders about the important and unusual role of drainage districts, and to help tailor local planning and restoration efforts for the Columbia Corridor.

- **Reflect the extent of bank hardening and vegetation removal in the North and Central Reaches of the Willamette River.** The land within 50 feet of the Willamette River in the North and Central Reach has been significantly altered by bank hardening and other development. The riparian model was refined to assign a secondary score to hardened, non-vegetated land within 50 feet of the Willamette River North and Central Reach for river bank functions, sediment, pollution and nutrient control; and large wood and channel dynamics.

- **Large wood recruitment from forest vegetation located on steep slopes.** Forest vegetation that is located further from a stream or river has the potential to contribute large wood to the waterway when it is located on steep slopes. The City refined the riparian model by limiting the assignment the secondary score for Large Wood and Channel Dynamics only to forest vegetation located on slopes greater than 25% (applies to vegetation 150 – 260 feet from a river or stream).

- **Use more comprehensive topography data to address the water quality benefits provided by vegetation on steep slopes** The City inventory uses local data for steep slopes instead of Metro's regional "break-in-slope" data to map the water quality functions of vegetation on steep slopes. This approach helps address significant gaps in the regional data for areas surrounding recently mapped streams.

TABLE 5: CITY OF PORTLAND RIPARIAN CORRIDOR MODEL CRITERIA

Microclimate and Shade

Primary Feature:	Footnotes	Secondary Feature:	Footnotes
River, stream/drainageway or wetland	2, 5	----	
Forest or dense trees within the flood area (except within a drainage district)	3, 4	Woodland vegetation within the flood area (except within a drainage district)	3, 4
Forest or dense trees contiguous to and within 100 feet of a river, stream or wetland	1, 2	Forest or dense trees contiguous to primary forest vegetation and within 780 feet of a river, stream or wetland	1, 2
----		Woodland vegetation contiguous to and within 100 feet of a river, stream or wetland	1, 2
----		Shrubland vegetation contiguous to and within 50 feet of a stream or wetland	1, 2

Stream Flow Moderation and Water Storage

Primary Feature:	Footnotes	Secondary Feature:	Footnotes
River, stream/drainageway or wetland	2, 5	----	
Vegetation within the flood area (except within a drainage district)	3, 4	Non-vegetated land within the flood area (except within a drainage district)	3, 4
----		Forest or dense trees, woodland or shrubland vegetation within 300 feet of a river, stream or wetland	1, 2
----		Forest or dense trees contiguous to flood area or starts within 300 feet of a river, stream or wetland, and extends up to 780 feet of a river, stream or wetland	1, 2
----		Herbaceous vegetation within 100 feet of a river, stream or wetland	1, 2

Bank Function, and Sediment, Pollution and Nutrient Control

Primary Feature:	Footnotes	Secondary Feature:	Footnotes
1 River, stream/drainageway or wetland (except Willamette River North and Central Reach)	2, 5	1 Willamette River North and Central Reach	5
2 Land within 50 feet of a river, stream/drainageway or wetland except land within 50 feet of a hardened, non-vegetated river bank in the Willamette River North and Central Reaches and the Columbia River within the Hayden Island NRI study area	1, 2, 7	2 Land within 50 feet of a hardened, non-vegetated river bank in the Willamette River North and Central Reaches and the Columbia River within the Hayden Island NRI study area	7
7 Forest, woodland or shrubland vegetation within the flood area (except within a drainage district)	3, 4	6 Herbaceous vegetation within the flood area (except within a drainage district)	3, 4
5 Forest and natural/semi-natural woodland or shrubland vegetation outside a flood area, between 50 feet and 100 feet of a river	1, 6, 8	Herbaceous or cultivated woodland or shrubland vegetation outside the flood area, and between 50 feet and 100 feet of a river	1, 6, 8
3 Forest, woodland or shrubland vegetation outside a flood area, between 50 feet and 100 feet of a stream/drainageway or wetland	1, 2	4 Herbaceous vegetation outside the flood area, and between 50 feet and 100 feet of a stream/drainageway or wetland	1, 2
6 Where the slope is at least 25%: Forest and natural/semi-natural woodland or shrubland vegetation that is outside the flood area, and is between 100 feet and 200 feet of a river	1, 6, 8	----	
4 Where the slope is at least 25%: Forest, woodland or shrubland vegetation that is outside the flood area, and is between 100 feet and 200 feet of a stream/drainageway or wetland	1, 2	3 Where the slope is at least 25%: Forest, woodland or shrubland vegetation that is outside the flood area, contiguous with primary vegetation, and more than 200 feet of a river, stream/drainageway or wetland, but does not extend beyond the area with at least 25% slope.	1, 2
----		5 Where the slope is at least 25%: Herbaceous vegetation that is outside the flood area, contiguous to vegetation within 100 feet, and between 100 feet and 200 feet of a river, stream/drainageway or wetland	1, 2

TABLE 5 (CONTINUED): CITY OF PORTLAND RIPARIAN CORRIDOR MODEL CRITERIA

Large Wood and Channel Dynamics

Primary Feature:	Footnotes	Secondary Feature:	Footnotes
1 River (including Willamette and Columbia River beaches) or stream/drainageway	2, 5	----	
2 Land within 50 feet of a river, stream or wetland except land within 50 feet of a river in the Willamette River North and Central Reaches and the Columbia River within the Hayden Island NRI study area	1, 4	----	
4 Forest vegetation within 50 feet of a river in the Willamette River North Reach and Columbia River surrounding Hayden Island		1 Woodland, shrubland, herbaceous or non-vegetated land within 50 feet of the river within the Willamette River North Reach and Columbia River surrounding Hayden Island	
7 Forest vegetation within the flood area (except within a drainage district)	3, 4	5 Woodland, shrubland or herbaceous vegetation within a flood area (except within a drainage district)	3, 4
5 Forest vegetation that is outside the flood area, contiguous to and within 150 feet of a river or stream/drainageway (except within a drainage district)	1, 3, 4	4 Where the slope is at least 25%: Forest vegetation that is outside the flood area, contiguous with primary forest vegetation, and between 150 feet and 260 feet of a river or stream/drainageway (except within a drainage district)	1, 3, 4
----		2 Within a drainage district, forest vegetation that is contiguous to and within 150 feet of stream/drainageway	1, 4
6 Forest that is contiguous to and within 150 feet of a wetland that is located completely or partially within the flood area or 150' of a river or stream (except within a drainage district)	1, 2, 3, 4	3 Where the slope is at least 25%: Forest vegetation that is contiguous with primary forest vegetation, and is between 150 feet and 260 feet of a wetland, where the wetland is located completely or partially in a flood area or within 150 feet of a river or stream/drainageway (except within a drainage district)	1, 2, 3, 4
3 Wetland located completely or partially within the flood area or within 150 feet of a river or stream/drainageway (except within a drainage district)	1, 2, 3, 4	----	

Organic Inputs, Food Web and Nutrient Cycling

Primary Feature:	Footnotes	Secondary Feature:	Footnotes
River, stream/drainageway or wetland	2, 5	----	
Flood area with forest or dense trees and natural/semi-natural woodland or shrubland vegetation (except within a drainage district)	3, 4, 8	Cultivated woodland and shrubland vegetation within a flood area (except within a drainage district)	3, 6, 8
Forest or dense trees and natural/semi-natural woodland or shrubland vegetation within 100 feet of a river	1, 2, 6	Forest or dense trees and natural/semi-natural woodland or shrubland vegetation that is contiguous to primary vegetation and is within 170 feet of a river	1, 2, 6
----		Cultivated woodland or shrubland vegetation within 100 feet of a river	1, 2, 6, 8
Forest or dense trees, woodland or shrubland vegetation within 100 feet of a stream or wetland	1, 2	Forest or dense trees, woodland or shrubland vegetation that is contiguous to primary vegetation and within 170 feet of a stream or wetland	1, 2

Riparian Wildlife Movement Corridor

Primary Feature:	Footnotes	Secondary Feature:	Footnotes
River, stream/drainageway or wetland	2, 5	----	
Vegetation that is contiguous to and within 100 feet of a river, stream or wetland	1, 2	Vegetation that is contiguous to primary vegetation and within 300 feet of a river, stream or wetland	1, 2

Footnotes:

1 All search distances are measured from either a) the edge of the mapped water body, or b) the stream/drainageway centerline.

2 "Wetland" refers to all mapped regional wetlands fully or partially within 1/4 mile of a river or stream/drainageway, unless otherwises specified.

3 "Flood area" is comprised of the combined FEMA 100-year floodplain (2004), the adjusted 1996 flood inundation area, and additional adjustments to reflect more recent permitted activities affecting site elevation.

4 Portland-area drainge districts: Peninsula Drainage District #1, Peninsula Drainage District #2, and Multnomah County Drainage District #1.

5 Rivers, streams/drainageways and wetlands are primary features for riparian functions under evaluation. The model produces functional rankings for such features if open water area has been mapped. Map notations will indicate relative riparian function levels associated with streams or drainageways where only centerline data are available.

6 Data classifications that differentiation between natural/semi-natural and cultivated vegetation has been assigned for the Willamette River Corridor only.

7 Hardened banks are defined as seawalls, pilings and non-vegetated riprap and adjacent land within 50 feet of the North or Central Reach of the Willamette River.

8 Criteria relating to natural, semi-natural and cultivated vegetation are currently applied only to the Willamette River corridor and to flood area. Criteria made be modified, if warranted, in the future during area-specific planning efforts.

Wildlife Habitat Model

The City wildlife habitat model assigns scores of high, medium, or low to mapped habitat patches. Patches are defined as areas of forest vegetation and/or wetlands, at least two acres in sizes, plus adjacent woodland vegetation. Scores area assigned for each of the following attributes:

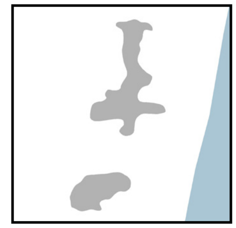
- **Habitat patch size –** Low: 2 to 30 acres in size; Medium: 30 to 585 acres; High: at least 585 acres in size.

- **Habitat interior area** (area net 200 ft. internal buffer) – Low: 2 to 15 acres; Medium: 15 to 500 acres; High: at least 500 acres.

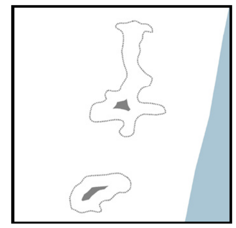
- **Connectivity between habitat patches –** Low: index value less than 30; Medium: index value between 30 and 100; High: index value at least 100 (based on Fragstats 3.3. "Proximity index" measures relative size and distance between patches).

- **Connectivity/proximity to water –** Habitat patches located close to water are valuable to wildlife survival. Scoring criteria: Low: less than 25% of patch is w/in 300 feet; Medium: between 25% and 75% of patch is w/in 300 feet; High: at least 75% of patch is w/in 300 feet of a river, stream, or wetland.

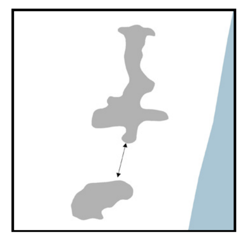
Scores for each of the four habitat patch attributes are combined to produce an overall relative rank of High, Medium or Low for each wildlife habitat patch. For example, a small patch could receive low ranks for size and interior area, but could receive higher rank if located close to other patches or water.



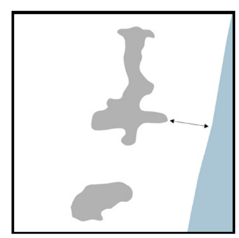
HABITAT PATCH SIZE



PATCH SHAPE/INTERIOR AREA



CONNECTIVITY BETWEEN PATCHES



PROXIMITY TO WATER

Like within the riparian corridors, habitat patches generally reflect the impacts of urbanization. For example, vegetated areas in upland habitats are often comprised of a mix of native, non-native and invasive plants. Native plant species generally provide a broader suite of benefits, such as varied wildlife food source. However, non-native plants still provide important watershed functions including cover and nesting opportunities. Other examples of the affects of urbanization include rivers and streams with constrained or altered channels, wetlands with soil contamination, and developed floodplains. In each of these cases, the resource has experience some degradation but still provides provide important functions such as fish and wildlife habitat.

Refining Metro's Wildlife Habitat Model

These wildlife habitat scoring criteria also reflect refinements to the Metro's regional habitat scoring criteria. The City's refinements to the wildlife habitat model include:

- Includes woodland vegetation in habitat patches. Wildlife habitat patches addressed by the regional inventory were comprised of forest vegetation and wetlands only. Given the availability of more detailed vegetation for Portland, the Bureau of Planning consulted with wildlife experts and determined it would be appropriate to also include woodland vegetation that is adjacent to the core forest/wetland patches.

- Correlates more directly to Portland habitat attributes and reflects recent local research. The thresholds that Metro used to assign scores for habitat patch size, interior habitat area, and connectivity were based on the characteristics of habitat patches throughout the region. Given the urbanized character of Portland's watersheds, the Bureau of Planning revised the scoring thresholds to correlate more closely with the characteristics of habitat patches in the City. The Bureau relied on additional scientific literature, including local research, to develop the scaled scoring thresholds (Murphy, M. T. (Principal Investigator), Bailey, D.C.; Lichti, N., and Roberts, L.A., 2005). Some habitat patch ranks will change as a result of changes in the criteria. For example, the Oaks Bottom Wildlife Refuge and Ross Island were assigned low ranks for habitat patch size in the regional inventory. Applying the City's criteria these sites received a medium rank for patch size. Similarly, the Bureau revised the regional connectivity criteria to correlate to the location and configuration of wildlife habitat patches located in the City.

Technical Reviewer comments:

"Good rationale. Great to see PSU's research being applied to real on-the-ground issues." Jennifer Thompson, US Fish and Wildlife Service, June 8, 2006

"Overall this change appears very sound … My one concern is with the 2-acre minimum at the low end… some species of native flora and fauna may yet thrive in smaller patches …" Dr. Alan Yeakley, PSU, July 16, 2006

The City's riparian corridor and wildlife habitat scoring criteria are presented verbatim in Tables 6 and 7. A comparison with the original Metro criteria is provided in Appendix 1.