Decision Support Tool for Land Use Planning

Prospectus for Tool Development

Charlene Andrade

PROGRAM MANAGER &
PROJECT DEVELOPMENT

Tara Newman

ASSISTANT PROJECT
MANAGER & ANALYSIS

JUNE 2020

Washington State Department of Commerce

DEPARTMENT OF ECOLOGY State of Washington

"This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement PC01J18101 to the Washington Department of Ecology. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use."

Project Overview

- Local governments have significant challenges planning for growth and development **while protecting critical areas**.
  - Limited land resources
  - Development pressures
  - Complex planning processes
- Existing mapping and modeling **tools have not been integrated** for efficient and balanced comprehensive planning.
- Planners often **unaware of tools or unable to put them together**
- Funding through Puget Sound Partnership's NTA process to research/scope development of an integrated decision support tool.

Developing a Prospectus

- Year 1 Funding
  - Developed a **prospectus** that:
    - Conceptualizes the project
    - Presents a plan for implementation
    - Addresses risks and barriers
- **Tool development** is yet to be funded
  - 3 years to **develop and test** the tool
  - Implement training & technical assistance programs in Year 4

Prospectus Outcomes

1) **Strong support and demand** for the tool from local governments and resource agencies
2) **Solutions to identified barriers** and risks
3) **Conceptual design** that meets priority needs, addresses barriers, and can be built using existing technology
4) **> 4 existing platforms** can be used to build the tool
5) **> 15 experienced contractors** interested in developing the tool
6) Project management structure for tool development

Conclusion: **Tool development is both worthwhile and achievable.**

Needs & Priorities for the Tool

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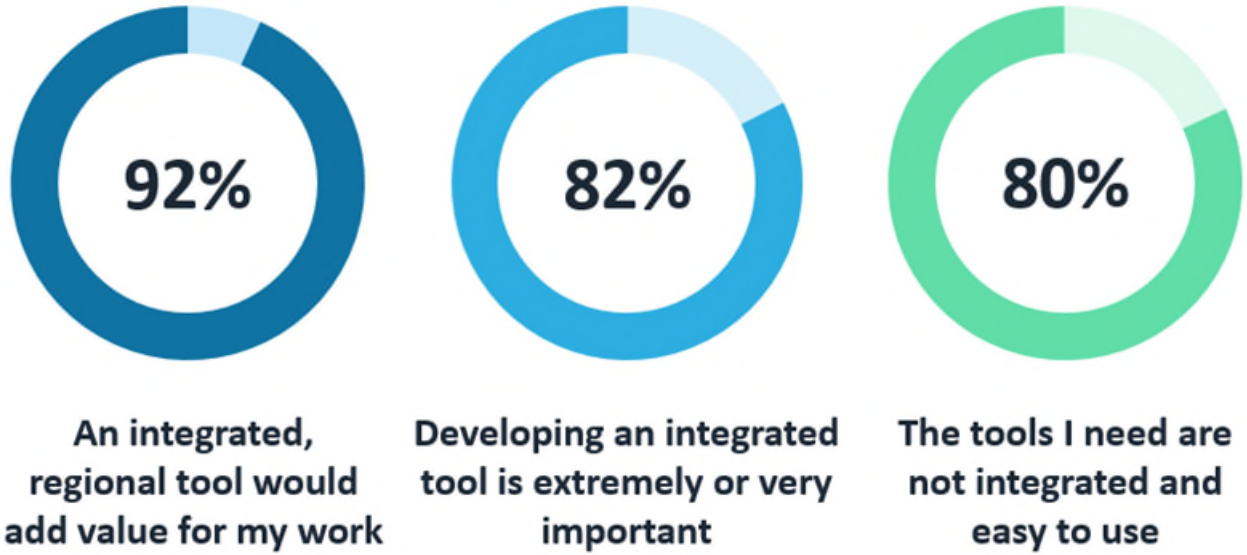
- Input from **135** planners & scientists from **64** organizations

- Very strong support and need for the tool:



Need for Integrated Tools

- Meet **multiple goals and requirements** with limited land resources
- Solve problems at the **watershed scale**
- **Integrate city and county** planning
- Implement restoration actions where they will have the **most benefit**
- **Assess and monitor** how well regulations are working

Planners need a tool that..

- Provides **access to Best Available Science** and agency recommendations
- Provides ability to **analyze and show relationships between datasets**

General Priorities for the Tool

1) **Identify & Protect Critical Areas**
2) **Inform Development Density Decisions**
3) **Inform Decisions about Areas to Restore**
4) **Compliance & Effectiveness Monitoring**

Tool functionality will help users:

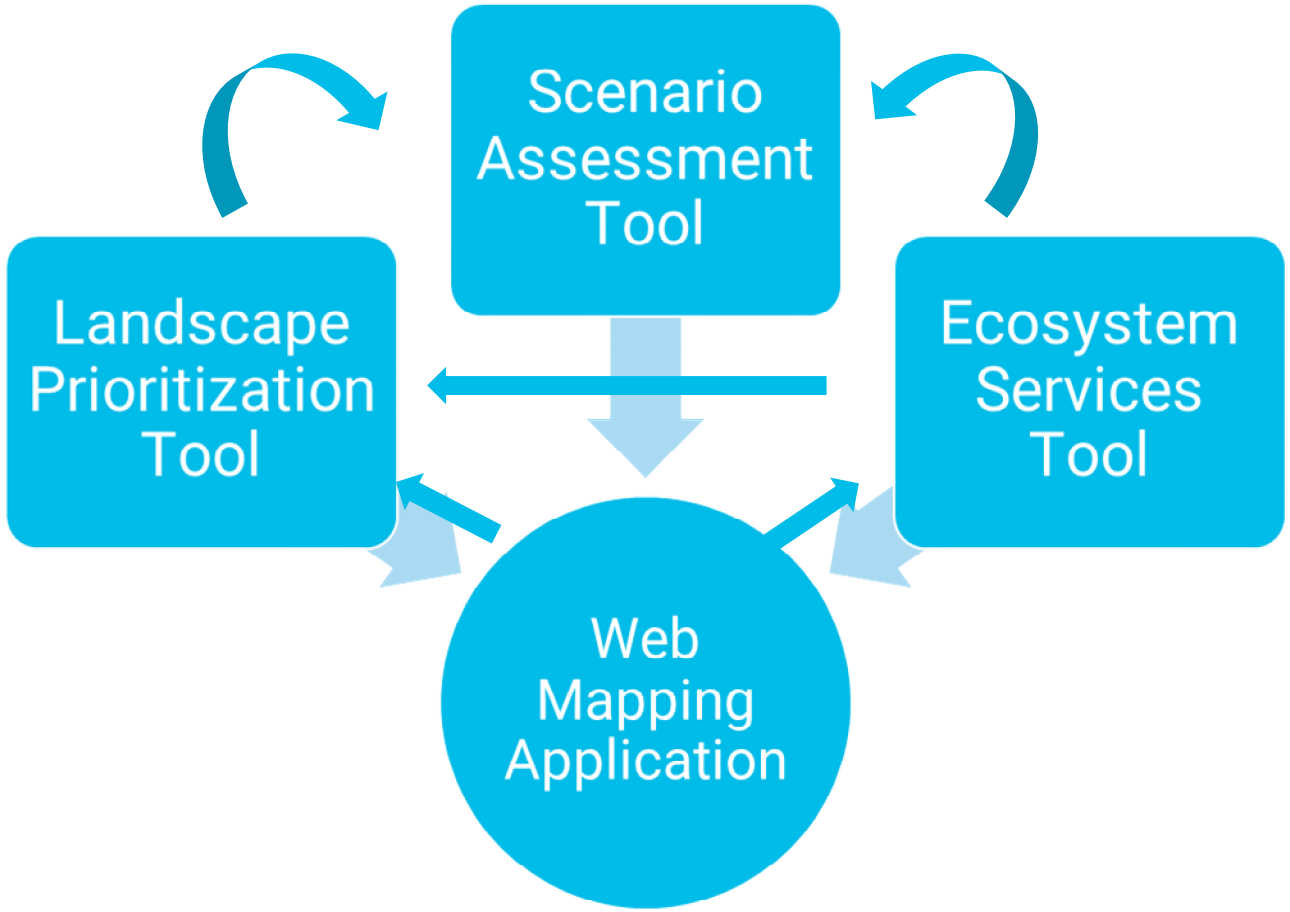
- **Find areas of compatibility** for competing goals and interests
- **Calculate cumulative effects** of land use decisions over time
- **More effectively communicate** with decision makers and stakeholders

Conceptual Design

Conceptual Design

- The tool will:
  - **Integrate and link** existing maps, models, and datasets
    - Allow users to **view/analyze relationships** between multiple points of interest across the region
  - Include a **web interface** that allows planners to:
    - Use datasets in a **decision support framework**
    - Assess alternative land **planning scenarios**.

Land Use Decision Support Tool Framework



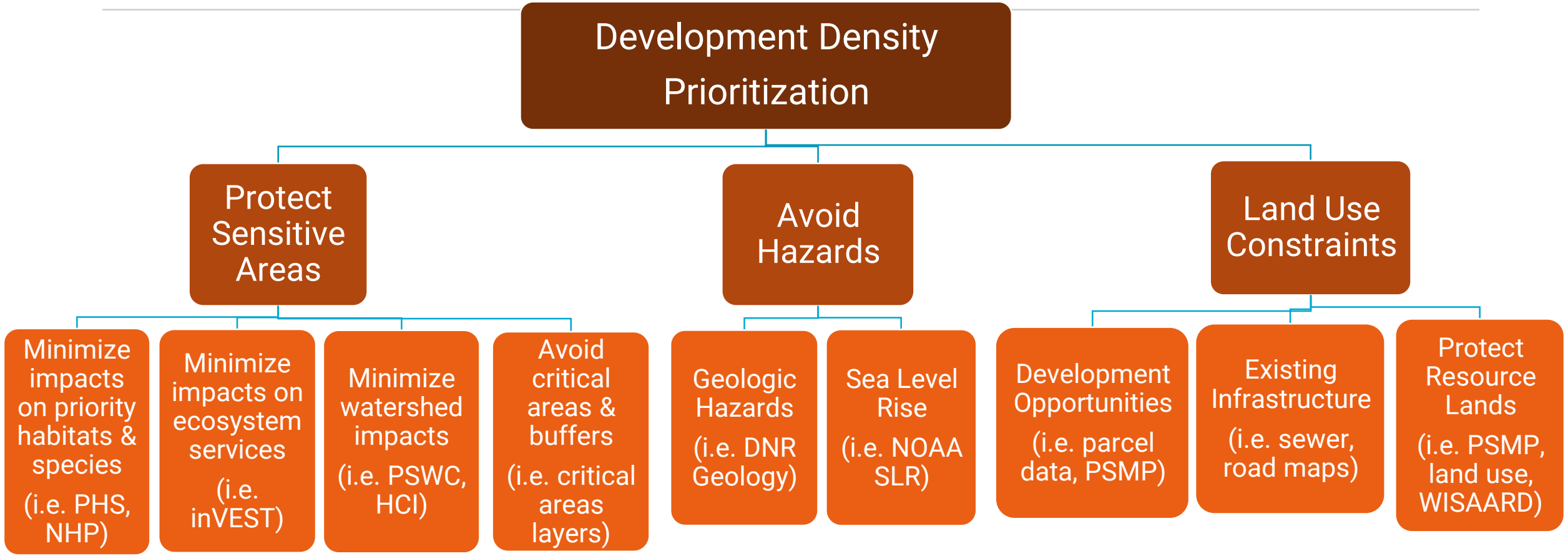
Web Mapping Application

- **Display, overlay, add layers**
- **Query & filter data**
  - **By attribute** and **by relationship** to other layers
    - Example: Show where and how much land cover change has occurred in sensitive areas for monitoring
    - Example: Show which areas on the landscape have overlap between habitat, working land, and open space goals
- **Interface for decision analysis tools**
  - Landscape prioritization
  - Scenario assessment
  - Ecosystem services modeling
- **Display analysis results**
- **Create & export maps and data**

Landscape Prioritization Component

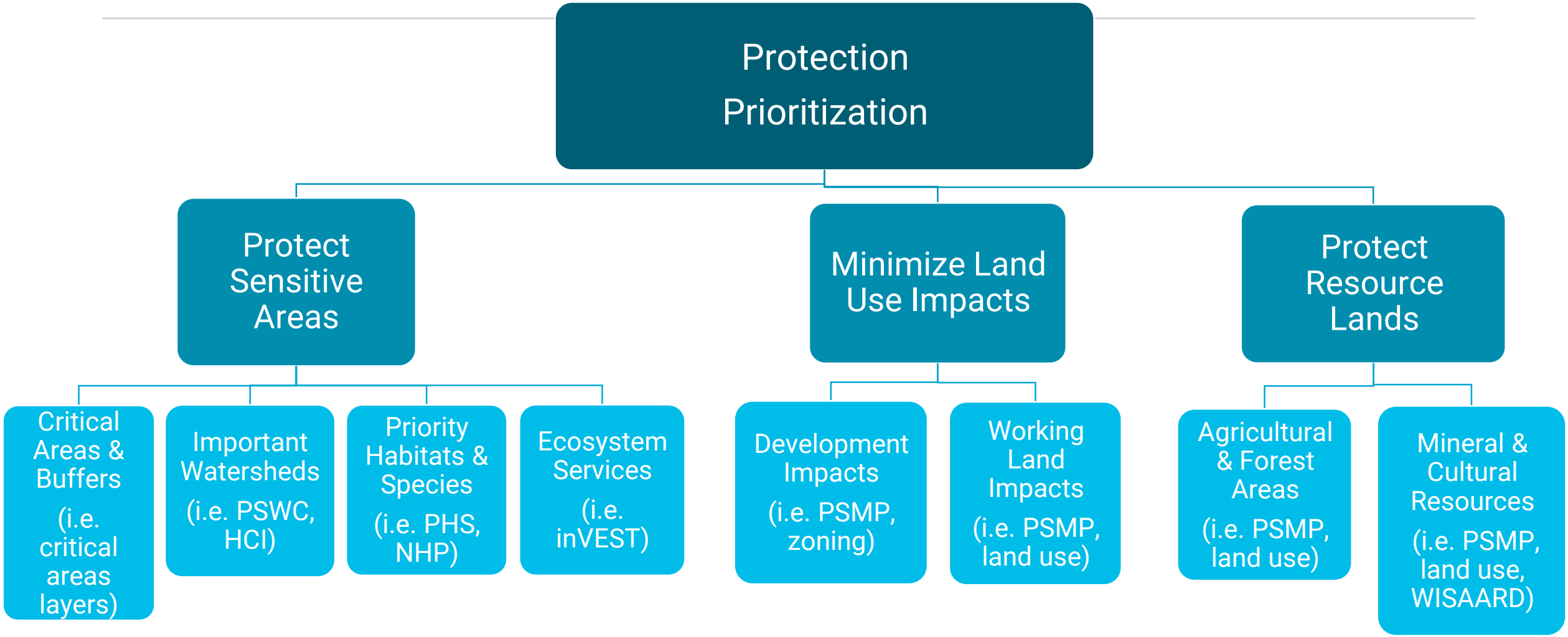
- **Prioritize landscape areas for development, protection, restoration**
  - Based on **spatial data** and weighted **user criteria**
- Produce **map layers and tables** of prioritization scores

Landscape Prioritization Component



Calculate Buildable Land in most suitable areas for development

Landscape Prioritization Component



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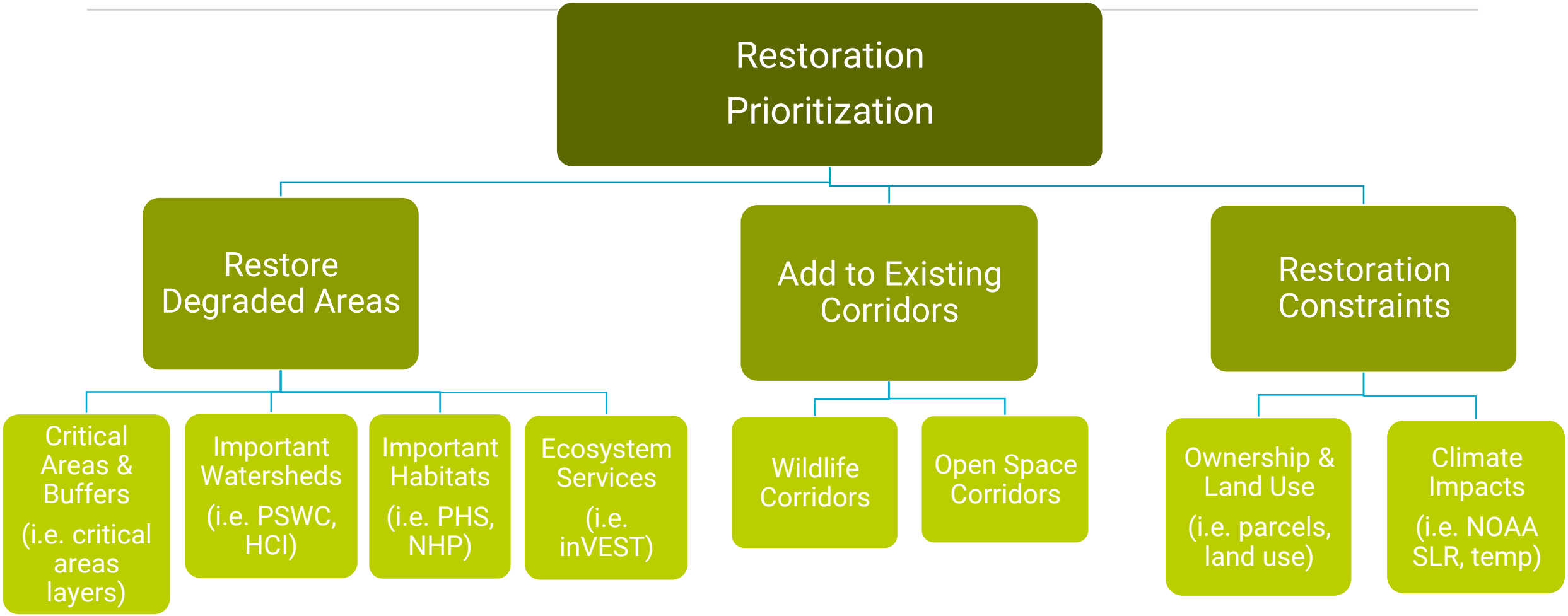


Landscape Prioritization Component

- **Outputs:**
  - **Map layers showing areas best suited** for development, protection, or restoration
  - **Broad scale ⇒ Finer scale**, as data are available
- **Using the Outputs:**
  - **Overlay results with other layers** (i.e. current zoning)
    - How well does prioritization **align with current regulations**?
    - Where are there **conflicts or areas where multiple goals intersect**?
  - **Change criteria weights** to see how prioritization changes
    - How does **emphasizing one goal over another** change results?
  - **Develop scenarios** for putting prioritization results into action

Scenario Assessment Component

- Assess **impacts and benefits of user-defined scenarios** based on prioritization:
  - **Zoning & buildout scenarios** *(i.e. upzoning & downzoning, rural cluster development)*
  - **Regulatory scenarios** *(i.e. expanding critical area buffer, protection of sensitive watershed)*
  - **Restoration scenarios** *(i.e. restoring critical areas, wildlife corridors, tree cover in riparian areas)*
- **Compare current conditions to future conditions** if actions are implemented
  - Based on **actions translated into spatial changes in land cover** that can be fed into models

Scenario Assessment Component

- **Outputs:**
  - **Quantified benefits & impacts** of scenarios
    - Economic values where appropriate
  - Ability to **adjust each variable** to see how it affects the scenario and each other variable
  - **Map layers** of scenarios
- **Using the Outputs:**
  - **Overlay** scenario layers with other data layers
  - **Show benefits** of changing zoning, protecting critical areas or doing restoration work (i.e. ecosystem service values)
  - **Calculate cumulative effects** of land use decisions

What are the impacts of expanding a critical area buffer?

Select County/Area – or select/draw on map

Select Critical Area Type

Select buffer width:

0 ft — BAS Low — BAS High — 500 ft

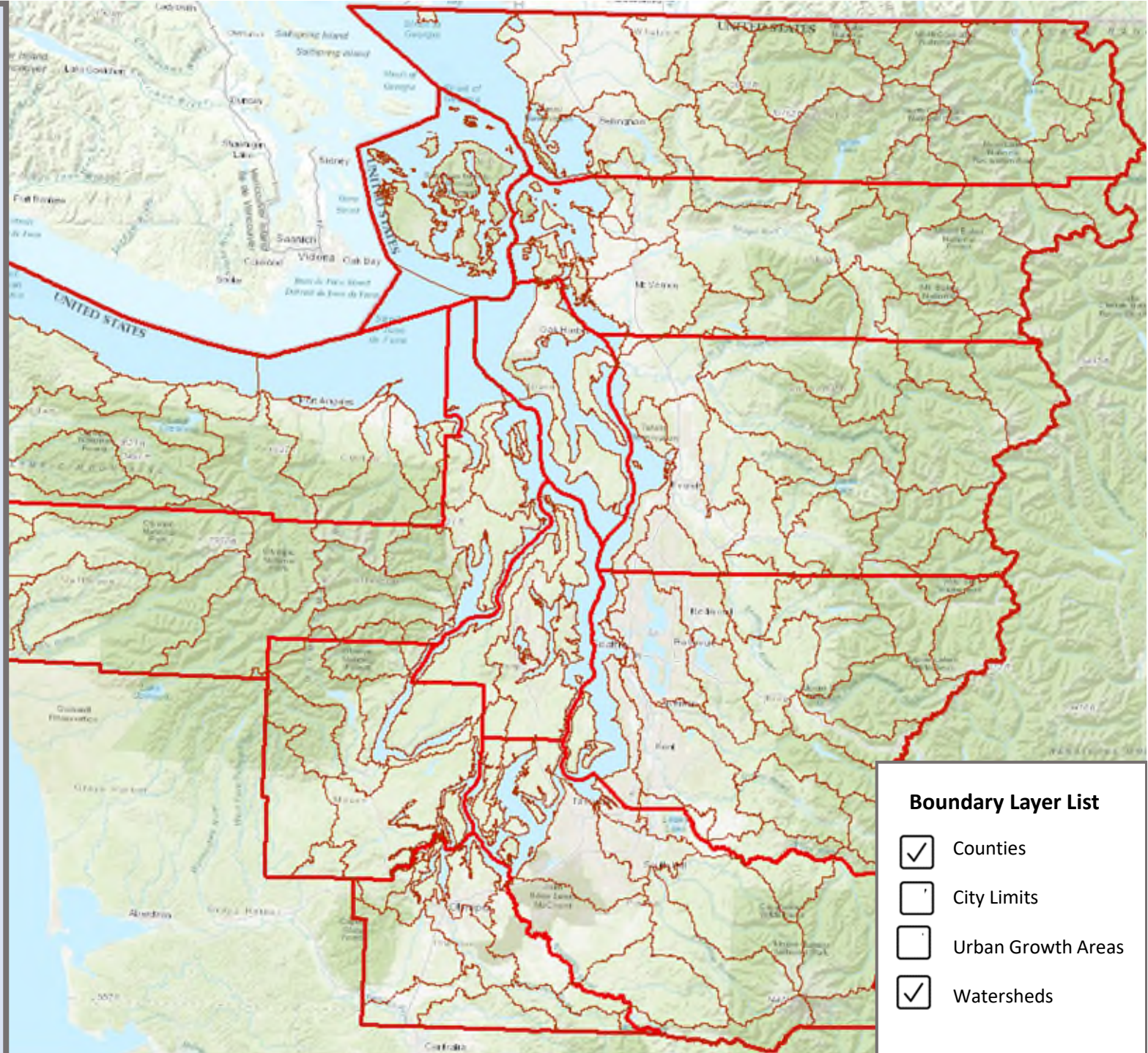
Output Information:

Acreage affected ☑	Landowners affected ☑	Land Use affected ☑	Current Land Cover ☑
Climate Benefits ☑	Water Quality Benefits ☑	Priority Species ☑	Restoration Potential ☑

Select data source:

Select Data Sources

ⓘ **Upload Data Source**



What are the impacts of expanding a critical area buffer?

Thurston County – Budd Inlet Watershed

Wetland

Select buffer width:

0 ft | BAS Low | BAS High | 500 ft

300 ft

Output Information:

Acreage
30,204

Parcels
12,090

Land Cover (acres)
Trees: 15,135
Shrubs: 3,355
Grass: 4,959
Dirt: 474
Built: 1,415
Impervious:1,415
Pervious: 23,923

Priority Species
16
(click for list)

Land Use

Land Use Categories Affected: 24

Lost Housing Capacity: 26,538 - 69,380 units

Lost Working Lands: 6,139 acres

Lost Agricultural Land Value: $4.53 Million

Lost Forest Land Value: $2.29 Million

Water Quality
Temperature: -2.4 C
Stormwater:
2.4 Billion gal/year
Stormwater Value:
$50.5 Million/year

Restoration Potential
Acres: 10,203
Trees Planted: 540,759
Carbon: 6,387 tons/year
Stormwater: 1.6 Billion gal/year
Value: $35 Million/year

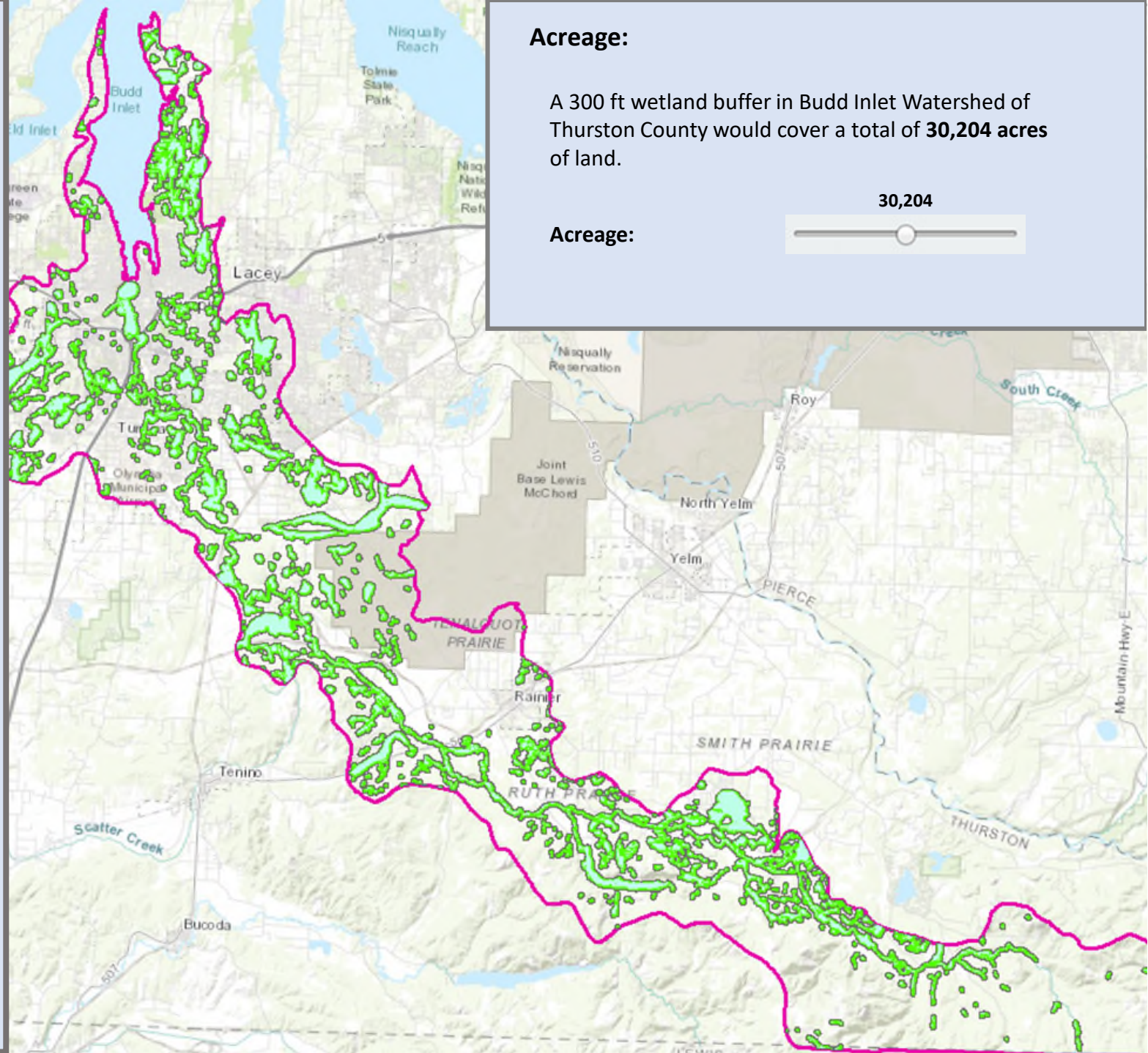
Climate Change
Carbon stored: 1.6 Million tons
Storage Value: $206.2 Million
Carbon sequestered: 9,475 tons/year
Sequestration Value: $1.2 Million/year

Generate a Report

Acreage:

A 300 ft wetland buffer in Budd Inlet Watershed of Thurston County would cover a total of **30,204 acres** of land.

Acreage: 30,204



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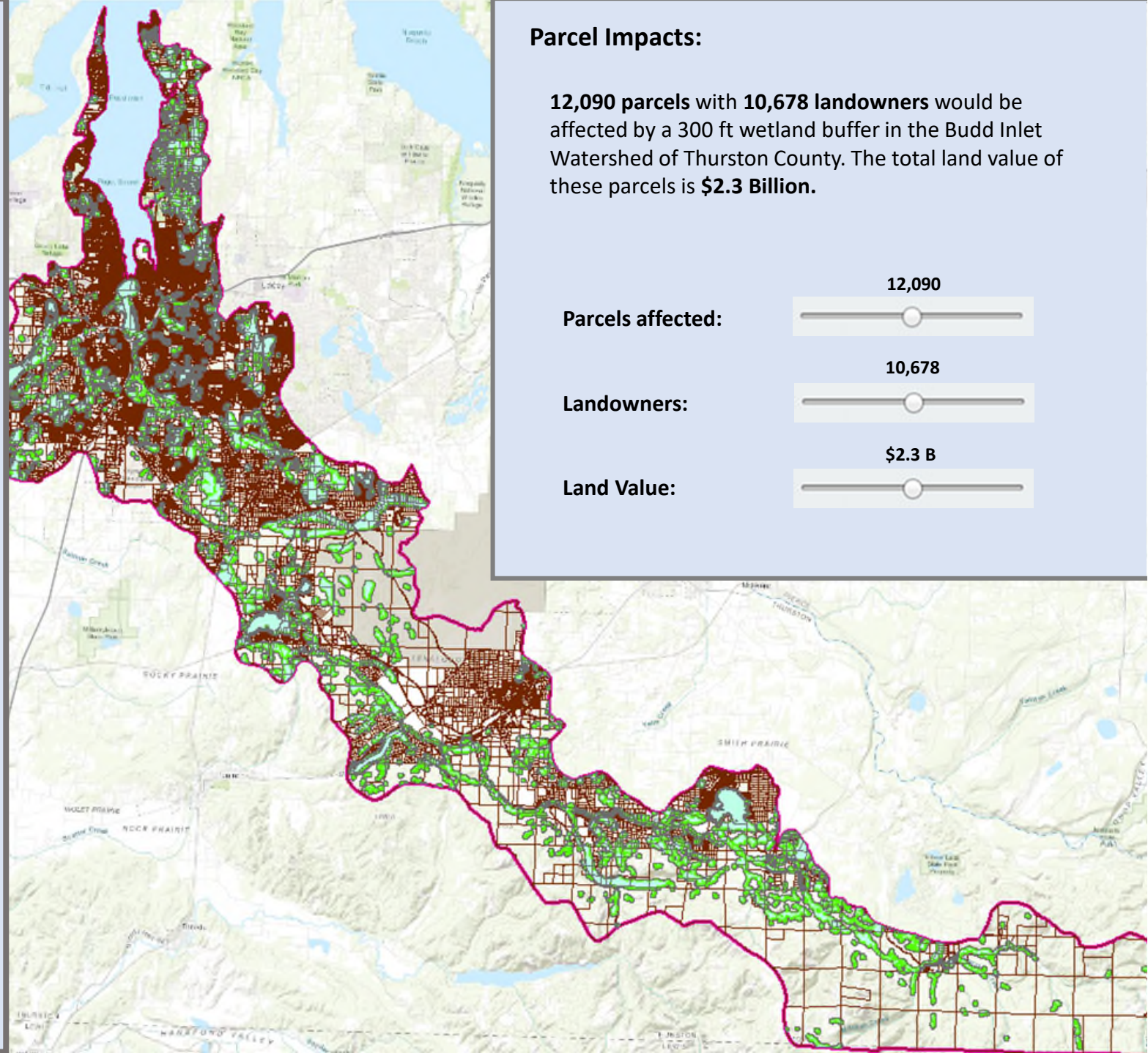
Generate a Report

Parcel Impacts:

12,090 parcels with **10,678 landowners** would be affected by a 300 ft wetland buffer in the Budd Inlet Watershed of Thurston County. The total land value of these parcels is **$2.3 Billion.**

Parcels affected:	12,090
Landowners:	10,678
Land Value:	$2.3 B



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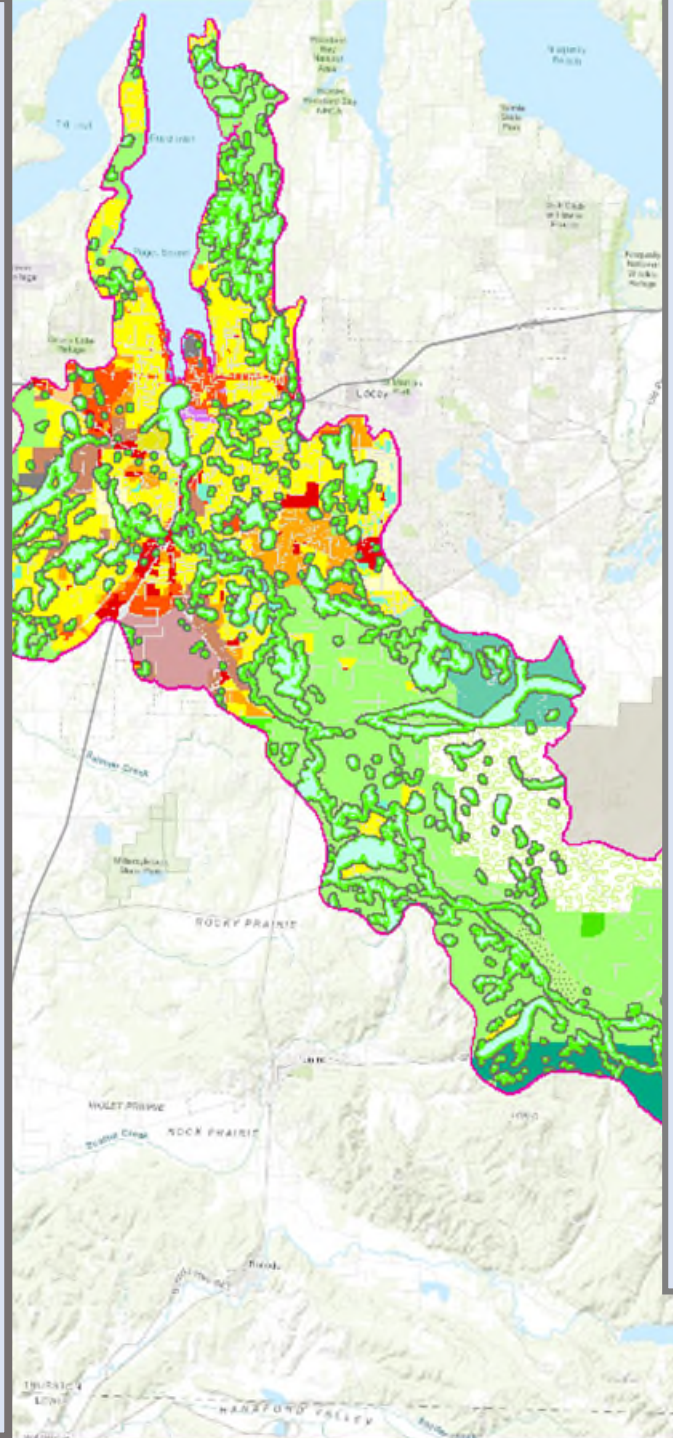

Land Use Impacts:

Acreage Affected by Land Use Type:

Active Open Space and Recreation	912
Airport/Seaport	104
Commercial/Office	174
Heavy Industrial	19
Institutional Uses	12
Large Lot Residential	14
Light Industrial	308
Low Density Urban Residential	445
Mixed Use	354
Mixed Use/Planned Neighborhood	102
National Forest	1,165
Natural Preservation and Conservation	1,566
Primary Agricultural Area	4,573
Primary Forest Area	38
PROW	12
Public	890
Residential	883
ROW	11,182
Rural Transition	4,132
Traditional Single Family Residential	60
Undesignated	904
Undeveloped Military Lands	67
Urban Edge	99
Very Large Lot Residential	2,185

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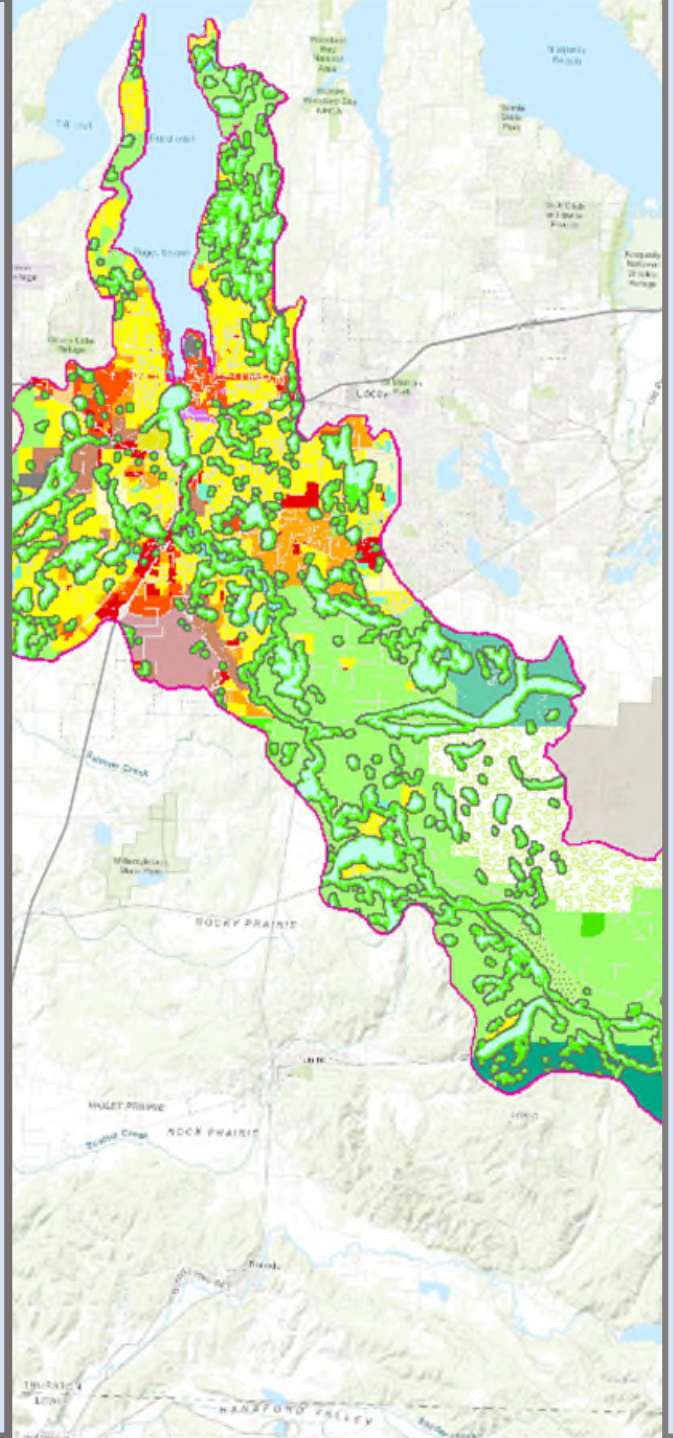


Housing Capacity Impacts:

Evaluate Alternatives

Large Lot Residential: 14 acres
1 unit/ 10 acres to 1 unit/ 19.9 acres
Number of units lost: 0 - 1

Low Density Urban Residential: 445 acres
1.1 - 3 units/acre
Number of units lost: 489 – 1,335

Mixed Use: 354 acres
3.1 - 12 units/acre
Number of units lost: 1,097 – 4,248

Mixed Use/Planned Neighborhood: 102 acres
3.1 - 12 units/acre
Number of units lost: 316 – 1,224

Residential: 890 acres
12 + units/acre
Number of units lost: 10,680 +

Rural Transition: 11,182 acres
1 unit/ 5 acres to 1 unit/ 9.9 acres
Number of units lost: 1,129 - 2,236

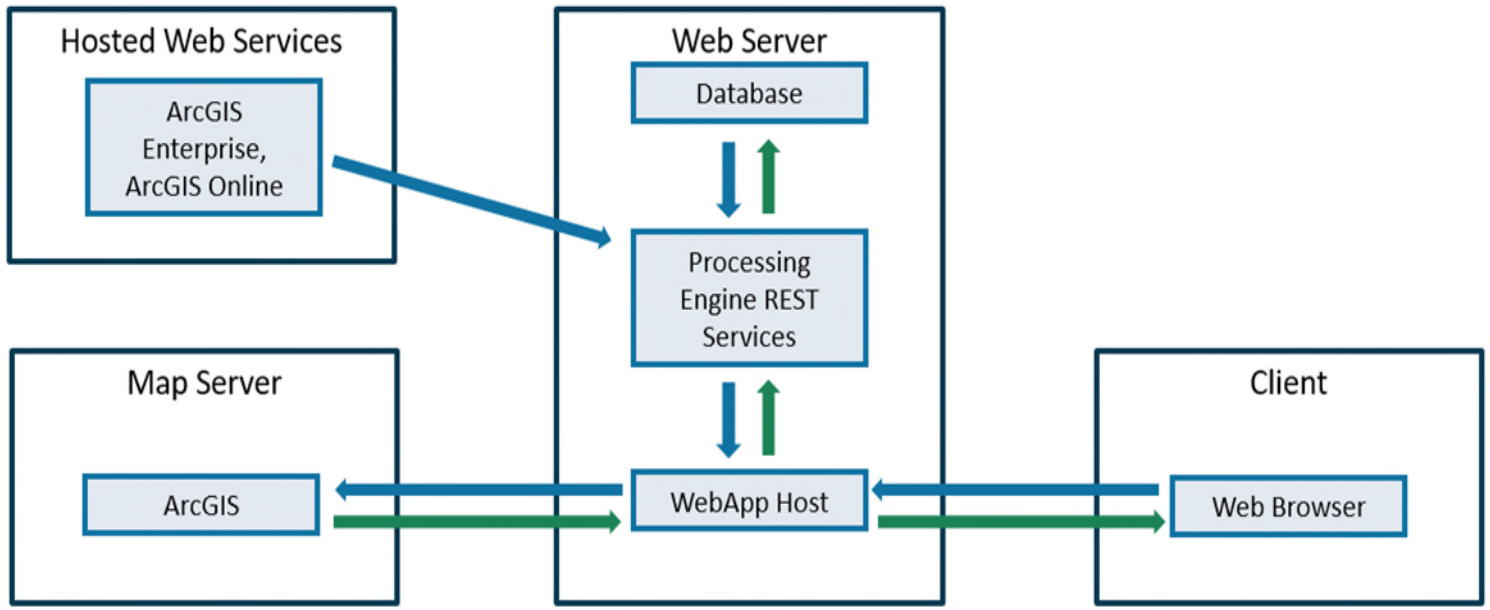
Traditional Single Family Residential: 4,132 acres
3.1 - 12 units/acre
Number of units lost: 12,809 – 49,584

Urban Edge: 67 acres
1 unit/ 1 acres to 1 unit/ 4.9 acres
Number of units lost: 13 - 67

Very Large Lot Residential: 99 acres
1 unit/ 20 acres or more
Number of units lost: less than 5

Tool Architecture & Key Data

Tool Architecture & Components



Web Client (web page): Presents user interface for using tools.

Web Server: Houses database, web application, and decision analysis and scenario processing engine services.

Map Server: Provides services for more complex maps.

Hosted Web Services: Data shared with this tool will be hosted on the servers of other agencies.

Client Architecture (Front End)

- **Web browser** that oversees interaction with user
- **Web mapping application** with built in **interface for decision support** tools
  - Organize, display, add layers
  - Querying & filtering
  - Gather user inputs for scenario analysis
  - Display scenario results
  - Provide guidance
- **Application development tools** include Esri's WebApp Builder, ArcGIS Application Programming Interfaces (APIs), Leaflet, Data Basin.
  - **Start from existing tools** & templates and **customize**

Server Architecture (Back End)

- Back end components may be **hosted on Commerce's servers, vendor servers, or in the cloud**
  - Model & data **integration and processing engine**
  - Models
  - Database
  - Map Server
- Integrating & processing engine will **run decision support tools** and **organize data and models**
  - **Several existing platforms could be used**, including Envision, EMDS, Data Basin, among others
  - **Platform selection in the next phase** based on RFP responses

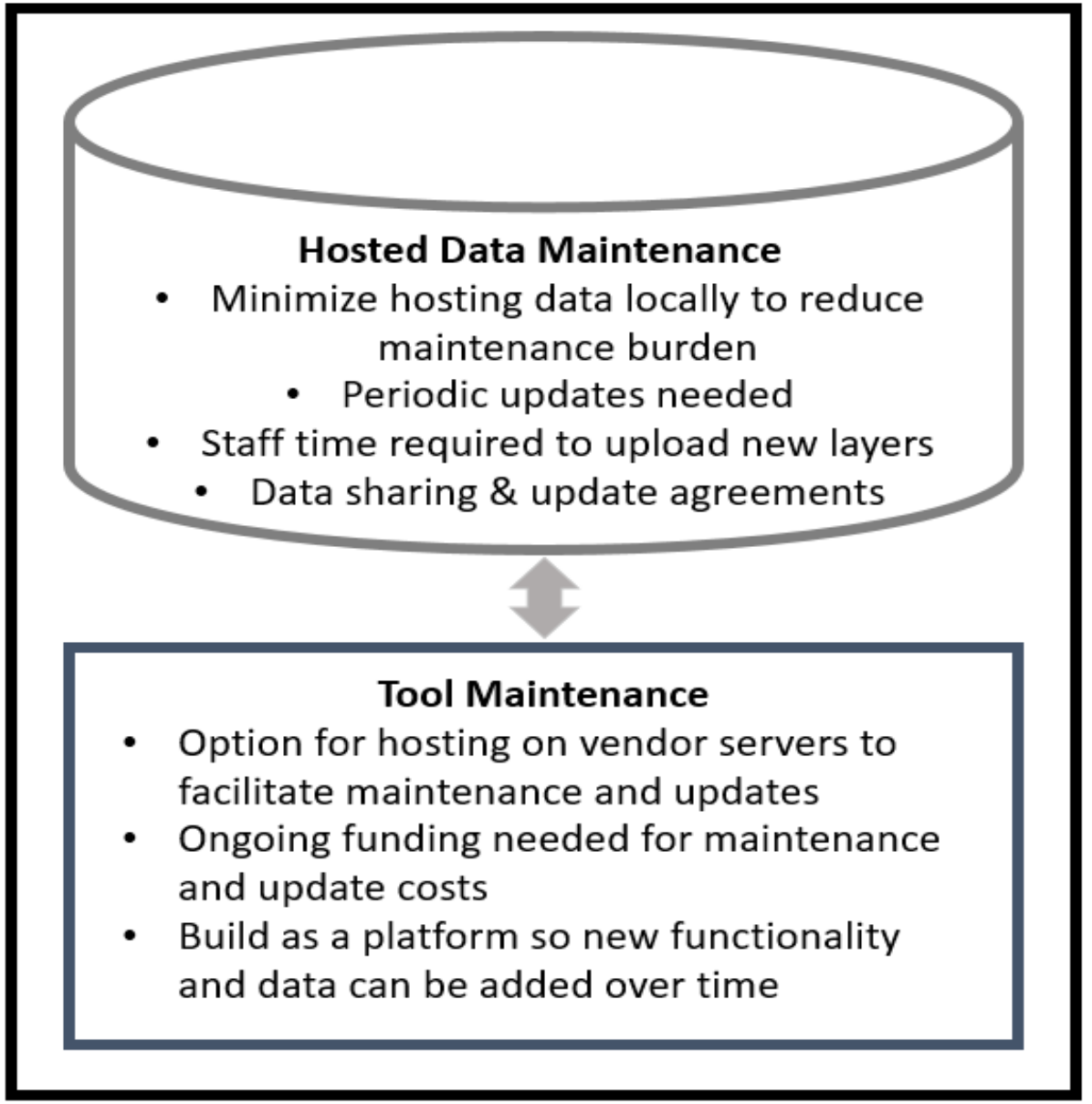
Back End Challenges

- Allowing use of **multiple data sources** and new/updated data
  - Models will be designed to **run using any dataset with same structure**
    - Challenges with **inconsistent data structure** between jurisdictions
    - User interface to facilitate **mapping of new dataset attributes** to the format recognized by the models
- Handling cases when data are unavailable
  - Run **analyses with missing or incomplete data** & notify users about implications for uncertainty
  - **Notify users** when data links are invalid and provide **mechanism for users to update links**

Tool Maintenance

Shared Data Maintenance (Web Services)

- Maximize use of shared data to reduce maintenance burden
- Tool automatically pulls in most up to date version
- Challenges: changes in links or attribute structure between updates
  - Solutions: Notification system and interface for users to address changes



Data Sharing & Governance

- Most data will be brought into tool as **web services**
- Existing data sharing tools:
  - i.e. Esri Portals and Hubs, Data Basin gateways, WA State Data Sharing Platform
  - **Organize and provide access** to data
  - Allow users to **share and find new data**
- Some data will need to be hosted with the tool
  - Implement **data sharing agreements**
- Most data will be public, but tool will **include sign in for secure data**
- All data in the tool will contain **metadata** that follows best practices
  - Develop a **data dictionary** to help users understand data

Key Data – Critical Areas Maps

- **Critical Areas Maps**
  - **Local government maps**
  - **State/federal resource agency maps:**

WDFW's Priority Habitats & Species	**DNR's** Geologic Hazards
DNR's Natural Heritage Program	**DOH's** Source Water Protection
FEMA's Flood Hazard maps	**National Hydrography Dataset**
National Wetlands Inventory	

  - Create a **regional, cross-jurisdictional map** of critical areas
  - Coordinate on data sharing and translate inconsistent data structures

Key Data – Land Use Maps

- Commerce's **Puget Sound Mapping Project**
  - Consolidated & **standardized map layer** of each jurisdiction's **land use**.
  - Use in the tool:
    - **Single base layer** for assessing land use impacts of scenarios
    - Integration of land use **analysis across jurisdictions** and at multiple scales
    - Designed to **integrate with tools developed at other agencies**
  - **Hosted online** as a web service.
  - **Update with current data** alongside tool development.

Key Data – Watershed Analysis Tools

- **Prioritize areas** for land use by **watershed impacts**
- Ecology's **Hydrologic Condition Index**
  - **Calculate watershed condition** for alternative land use scenarios.
  - Quantify **cumulative effects** of land use change.
  - Build **Python script** into web application.
- Ecology's **Puget Sound Watershed Characterization**
  - Coarse scale **watershed condition** indices for water flow, water quality, habitat.
  - Show most important places to protect or restore.
  - Available as **map layers.**

Key Data – Land Cover Analysis Tools

- WDFW's **High Resolution Change Detection**
  - Maps of **land cover change** from 2006 to 2017
  - **Integrate with critical areas maps** to assess change in critical areas
  - **Integrate with** models to quantify effects of land cover change.
  - Available as a **map layer.**
- WDFW's **High Resolution Land Cover**
  - High resolution maps of **canopy cover, surface water, impervious surfaces**
  - Important for **riparian and watershed condition** assessment
  - Can be linked with models for **more accurate, finer scale assessments**
  - Can be made available as a **raster layer**.

Key Data – Cultural Resources

- DAHP's **Washington Information System for Architectural & Archaeological Records Data (WISAARD)**
  - Information on where **cultural resources are required to be protected** from development alongside critical areas.
  - **Integrate into landscape prioritization** tools for comprehensive assessment.
  - Available as **web services**.

Key Data – Puget Sound Recovery

- PSP's **Vital Signs and Restoration Mapping**
- Assist with **Net Ecological Benefit efforts**
  - **Ecological assessment maps** for Vital Signs
  - **Integrate** with other planning information to facilitate communication & prioritize restoration projects
  - Link maps of **funded restoration projects** with models to **quantify benefits**
  - Available as **web services**.

Key Data - Climate Change Maps

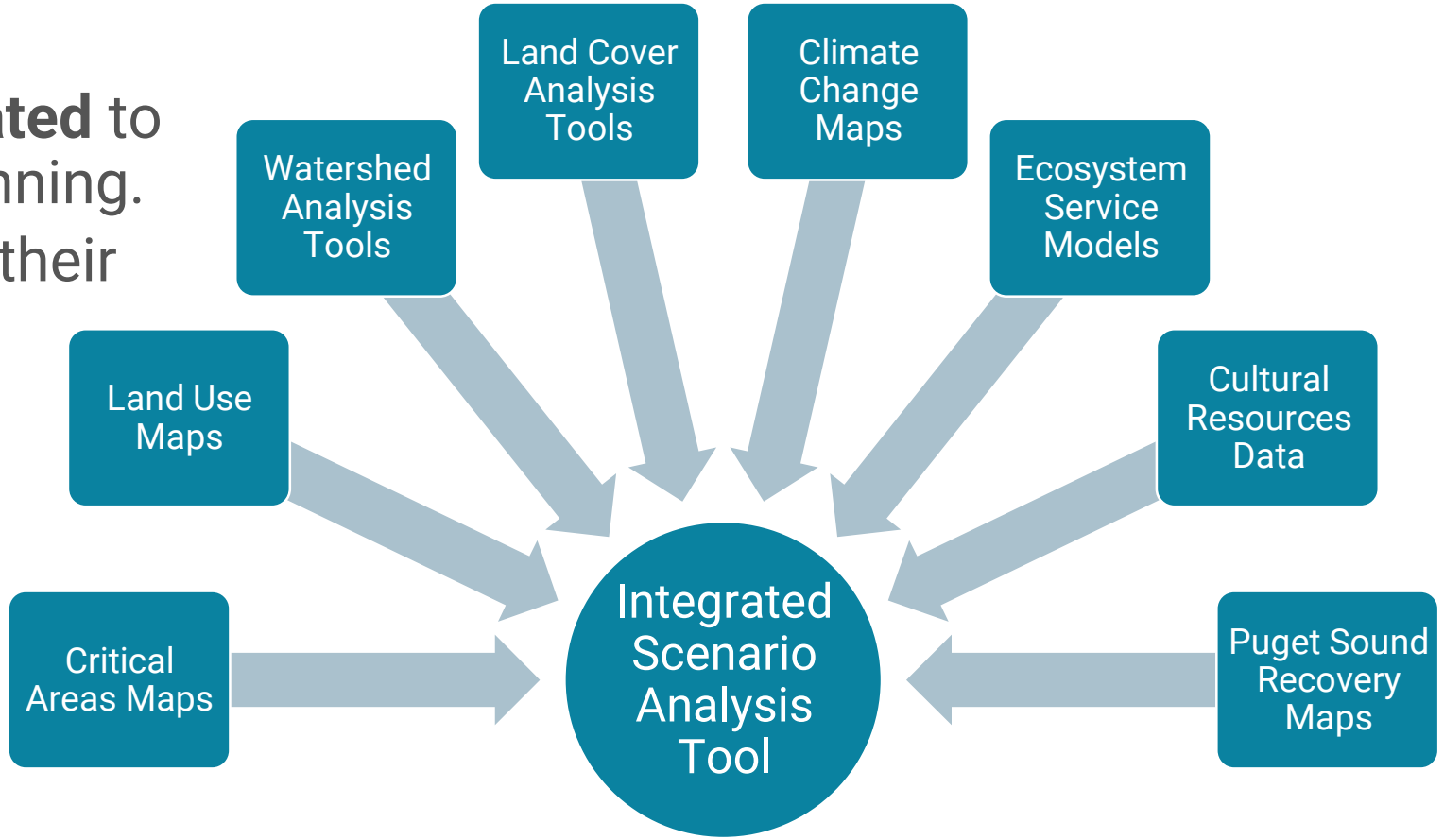
- Integrate climate effects to **plan for future threats.**
- **Sea Level Rise Maps**
  - NOAA & others have developed map layers for **sea level rise scenarios**
- **Temperature & Precipitation Change Maps**
  - Projected **stream temperature** maps are available
  - General **temperature and precipitation** change maps are available
- **Further assessment** in next phase

Key Data - Ecosystem Services Models

- Quantify the **benefits of protection and restoration** in terms of the value they provide for communities
  - i.e. carbon sequestration, air/water quality, habitat provision, etc.
- Some **options that may be integrated** include:
  - inVEST Natural Capital Project models
  - VELMA model
  - i-Tree models
- **Further assessment** in next phase.

Integrating Key Data

- **Many tools exist.**
  - Tools **need to be integrated** to **realize full value** for planning.
  - Jurisdictions can utilize their own data.



Use of the Tool

Use of the Tool

- **Tools that:**
  - Make **Best Available Science** more accessible
  - Provide increased **transparency, consistency, accountability** in decision analyses
- **Can help:**
  - Improve **efficiency** in planning processes
  - Ensure decisions are **science-based**
  - Facilitate planning at the **watershed scale**
  - Result in **better decisions** that benefit **Puget Sound Recovery** goals

Use of the Tool

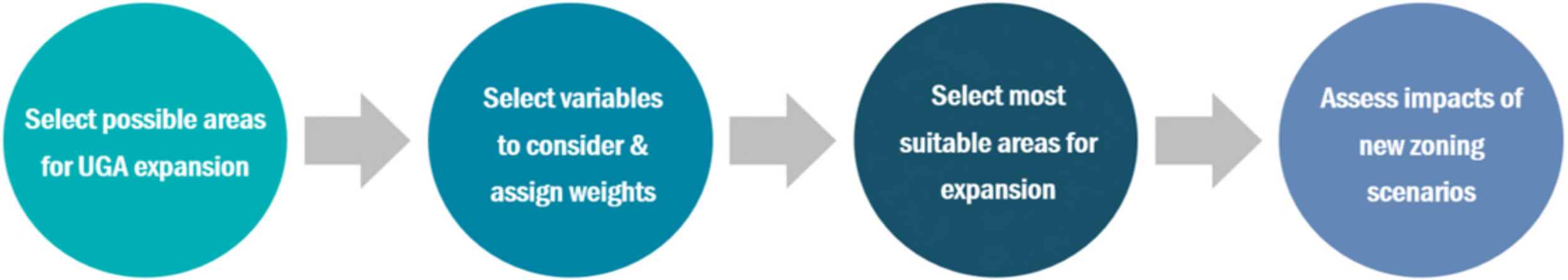
- **Commerce will provide:**
  - **Detailed guidance** on use of the tool to support specific decisions
  - **Disclaimers** about appropriate use
- **Tool design will:**
  - Allow scenarios and results to be viewed in **real time**
  - **Provide downloads** of data, results, reports, metadata
  - Include a decision support framework that ensures tool outputs can be consistently **applied to specific planning decisions.**

Using the Tool to Inform Planning Decisions

- **The tool will support decisions about:**
  - **Urban Growth Area** expansions
  - Urban **upzoning**
  - **Rural zoning** density
  - Selection of **mitigation/restoration** sites
  - **Critical Areas Ordinance** updates
- **Decision framework will take into account:**
  - Planning **processes**
  - **Information** needed
  - **Recommendations** of resource agencies

Informing UGA Expansions & Upzoning

- **UGA expansions** occur when more land is needed for **urban growth**
  - **Evaluate possible expansion areas** in the long range planning stage
  - Facilitate **communication between counties & cities**



- **Urban Upzoning** also increases density to **accommodate growth**
  - Very **similar to process for UGA expansion analysis**
  - Upzoning analysis is also **important for TDR programs**.

Informing Rural Zoning Density

- Rural development has **higher environmental costs**
  - Identify suitable **areas for rural clusters** (similar to UGA expansion process)
  - Identify **areas that should be downzoned** (opposite process to find areas to protect)
  - Show **housing capacity lost in downzoning scenarios** to guide amount of cluster development needed.
  - Priority areas for downzoning would also be good candidates for **protection under TDR programs**

Selecting Restoration Areas & Updating CAOs

- Select **best mitigation/restoration sites** for Puget Sound recovery.
  - **Prioritize restoration areas** and **calculate benefits** of restoration scenarios.
  - Justify site selection to decision makers, show **return on investment**.
  - Broader view to **restore corridors and connectivity.**
  - **Mapping priority restoration areas** will help planners **acquire the best lands** for mitigation/restoration projects
- Assess the **need for Critical Areas Ordinances updates**
  - **Assess land cover change** in or near critical areas and quantify impacts.
  - Evaluate scenarios for **expanding critical areas buffers**

Target End Users

- **Comprehensive planners** and other long range planners
  - Tailored to **support planning needs under GMA and SMA**, especially needs related to protecting critical areas at **broad to mid scale**.
  - Will also be useful for **regional planning**, **review of plans** by regulatory agencies, and some **permitting processes.**

- **Regional tools often too coarse** or not accurate enough
  - Use regional data for coverage, but **allow use of local data**
  - Provide **transparency about accuracy** and confidence in information

Citizen Use

- Tool can **facilitate pubic participation** in decision processes.
  - **Improve public understanding** of critical areas issues
  - **Show how hard it is** to make land use decisions that balance competing goals.
- **Concerns about explaining the tool** to the public will need to be addressed.
  - **Possibilities include:**
    - **Training** programs
    - Limiting public use to **controlled environment**
    - Building in bumpers to **limit analyses based on BAS, scale**, etc
    - Developing written **disclaimers**

Preventing Misuse

- **Ensure users understand** data and appropriate use
  - Keep analyses at **appropriate scales.**
    - i.e. watershed or subwatershed
  - Align analyses with **Best Available Science.**
    - i.e. buffer sizes and other measures based on BAS
  - **Bumpers and bounding ranges** can be used for both problems.

Training & Technical Assistance Programs

- **Encourage local adoption** by implementing:
  - **Training programs** for planners, agencies, public
  - **Early adopter** program
  - **Outreach and marketing** campaign

Tool Development Process

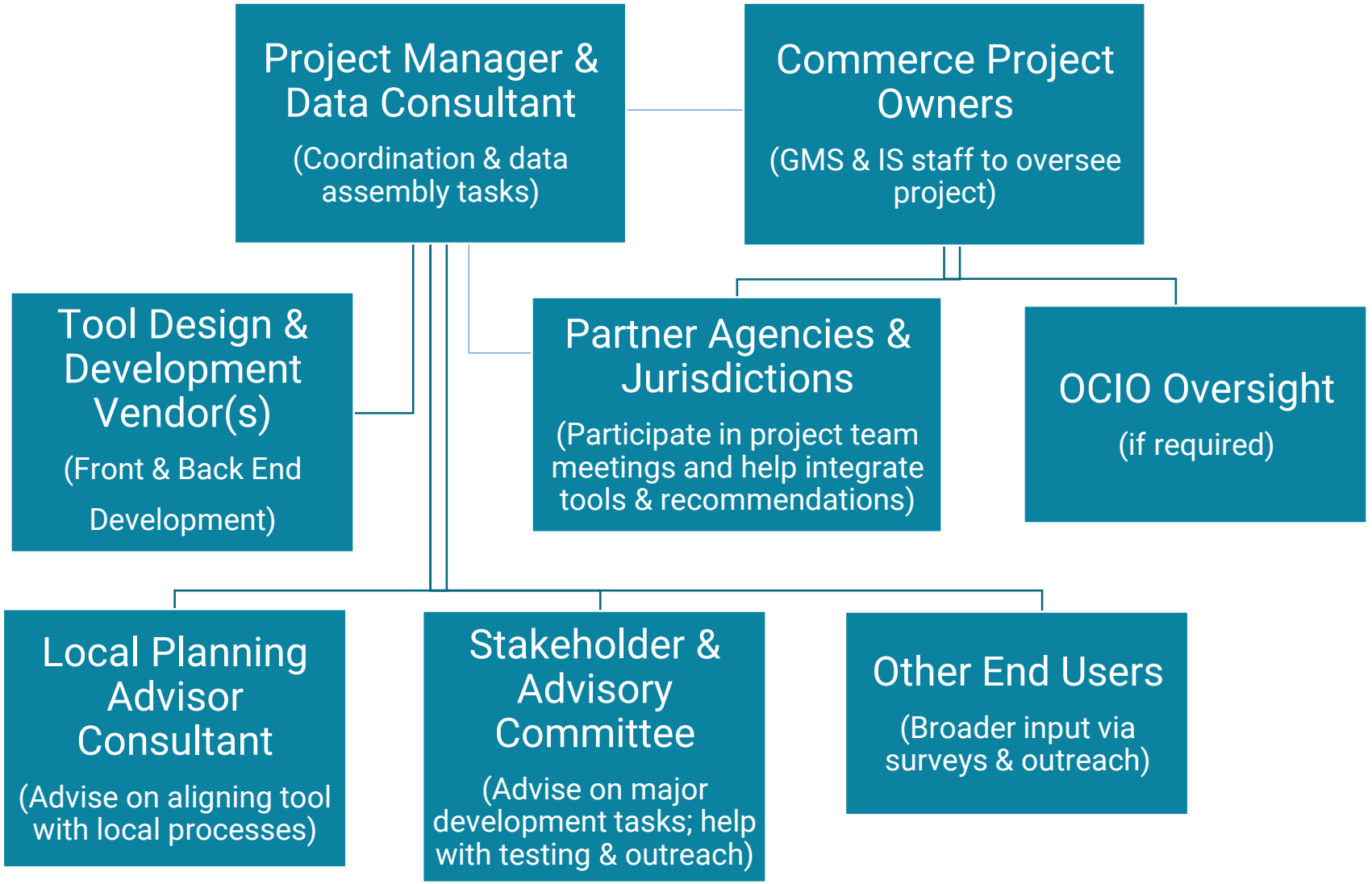
Tool Development Phase 1 (Years 1 & 2)

- In **Phase 1** we will:
  - Complete full scoping and framing.
    - **Develop full plans and workflows** for tool architecture.
    - **Assess data needs.**
    - **Contract with vendors**
  - **Compile, assess, standardize** critical areas planning data/models.
    - **Cross-jurisdictional map** of critical areas and other planning data.
    - **Prioritize data & models** for inclusion in scenario tool.
  - **Build out beta version** of scenario tools for a limited number of variables and at least two specific planning decisions.
  - **Develop web mapping application** and user interface.
  - **Test beta tool** with advisory committee.
  - **Update Puget Sound Mapping Project.**

Tool Development Phase 2 (Years 3 & 4)

- In **Phase 2** we will:
  - **Improve and expand** the beta tool
    - **Improvements** from testing recommendations
    - **Add additional maps and models** as variables to support initial use cases
    - **Build out the workflows** for the other use cases
  - Develop **plans for maintenance and communications**
  - Develop **training materials** and implement **training programs**

Management Team Structure



Addressing Risks & Barriers

Addressing Risks & Barriers

- **Unique challenges for:**
  - **Scoping** the tool
  - **Data & model** inclusion
  - **Use** of the tool
  - Tool **development**
  - **Maintenance**

Scoping Risks & Challenges

- Trying to **take on too much**
  - **Narrowed focus** to stakeholder priorities
  - **Phased implementation** approach
- **Missing important questions**
  - Platform to **add new data & functionality** later
- **Changing priorities**
  - Selected **priorities that will continue to be needed**
  - **Governance structure** to make decisions
- Project **team changes**
  - **Documentation** of vision & scoping decisions
  - **Rehiring** via contract amendment

Data & Model Inclusion Risks & Challenges

- **Accuracy, consistency, availability**
  - Preliminary review indicates needed **data & models are available.**
  - **Regional data for coverage**, more accurate **local data where available.**
  - **Build platform** where data & models can be swapped out
  - Provide **time & budget for data** assembly and standardization
- **Scale**
  - **Align analyses with data** at appropriate scale
- **Errors & limitations**
  - Show areas of **uncertainty and limitations**
- **Differences between models & reality**
  - Use existing **validated models** & document assumptions

Tool Use Risks & Challenges

- Difficulty **applying information to decisions**
  - Provide **decision framework & guidance** for applying tool
- Tool too **difficult to use**
  - **User-friendly interface**
- **User differences**
  - Make tool useful to **look up information and analyze scenarios**
- **Misuse & citizen use**
  - **Limit analyses** based on scale and BAS
  - Develop **guidance & disclaimers**
- **Local adoption**
  - Provide **training & technical assistance** programs
  - Allow use of **local data**

Tool Development Risks & Challenges

- Securing **sufficient funding**
  - **Phase implementation** & use **existing platforms** to reduce costs
- Finding **suitable contractors**
  - Research shows **>15 experienced contractors available**
- **Database & tool interoperability**
  - Interoperability **requirements**
  - Set up **standard data structure** and **translation tools**
- **Processing power**
  - Can be obtained through **cloud computing** services if needed
- **Data security**
  - **Log in** system

Maintenance Risks & Challenges

- Securing **long-term funding & stewardship** to keep tool & data up to date.
  - Identified **multiple options for hosting** tool
    - Could **host on vendor's servers to facilitate maintenance**
  - Link to **web services** hosted by originating organizations to reduce data maintenance burden
    - **Allow users to update data links** and match changed data attributes with needed structure.
  - **Gather analytics** for improvements and leave room to **add new features**

Solutions to Barriers & Risks

- **Prospectus describes solutions** for mitigating & addressing barriers and risks
- **All needed tool requirements** can be implemented by our contractors using existing platforms
- **Risks are acceptable** –

  No barriers likely to prevent us from developing a **useful and sustainable** tool, given sufficient funding.

Prospectus Outcomes

Prospectus Outcomes

- Developed **conceptual design** for tool that **meets needs** of local governments and resource agencies.
- We established that:
  1. There is **significant demand from >100 stakeholders.**
  2. **>4 existing platforms** can be used to build the tool
  3. **>15 skilled contractors** can build the tool
  4. **Technology & data** needed are readily available
  5. **Developed solutions** to mitigate & address risks & barriers.
     - Biggest remaining risks are **securing adequate funding**

Prospectus Outcomes

- Considered need for & benefits of tool alongside remaining risks and barriers
  - Concluded that tool development is **both worthwhile & achievable.**
- Providing this tool for local planners would:
  - **Improve decision making** by allowing better integration of critical areas planning with other comprehensive planning elements.
  - Improve access to and use of **Best Available Science**.
  - Allow planners to show their work & **justify decisions** to stakeholders and reviewers.
  - **Improve efficiency** in local planning processes.

Next Steps

- Seek funding to implement Phase 1
  - Looking for funding through PSP NTA process
  - Seeking assistance from SILs
  - Hoping to add project to Commerce's budget
  - Likely we can progress portions of Phase 1 with seed money through the PSP, but will need significant funding moving forward.
- Decide Commerce management structure
  - Who is going to be owner and manager?
  - How do we get it into our budget?

Charlene Andrade

PROGRAM MANAGER & PROJECT DEVELOPMENT

Charlene.Andrade@commerce.wa.gov

360.725.3063

Tara Newman

ASSISTANT PROJECT MANAGER & ANALYSIS

Tara.Newman@commerce.wa.gov

360.764.3414

Washington State Department of Commerce

www.commerce.wa.gov