Interdepartmental Correspondence

November 1, 1999

To : Dr. Marsha Landolt, Dean and Vice Provost , the Graduate School

From: Dr. Jeffrey Richey, Professor, School of Oceanography

Concurrence: Dr. Arthur Nowell, Dean, College of Ocean and Fisheries Sciences

Please find attached the PRISM Progress Report for Academic Year 1998-99, as per the letter of October 12. In the spirit of the short report requested, we have attempted to provide more of a project overview, rather than details on each activity (we would be happy, of course, to subsequently go into whatever detail you would like on any specific activity).

We believe that PRISM is going well. We would like to use this Report as the means to open discussions with the Administration about:

- How future funding requirements be met;
- How to work with the Administration to leverage PRISM regionally.

PRISM PROGRESS REPORT
Academic Year 98-99

Our promise to the UIF Process was to assemble the best available tools that the University has to offer for a synthesis of resources available within the UW that can be used to help address major issues facing Puget Sound. Our project strategy was, and still is, to approach this mission by sharing a "coupled and integrated" model of the Puget Sound (the Virtual Puget Sound, or VPS) for education, outreach, and research.

PRISM faces two major challenges. The first is essentially technical - how to work out and execute the specific details of each of the component models, within the context of the integrating and technological vision of the Virtual Puget Sound as a whole. The second challenge is essentially cultural and motivational – how to mobilize a community of individuals of vastly different disciplines, backgrounds, and interests into a coherent and communicating process. Without a clear understanding of a benefit to PRISM participants and/or to their academic unit, PRISM puts at risk participants' investment in time and intellectual property to share and educate their fellow investigators, students from different fields of study, and interest groups from our community. At risk to the University is both the investment in funds that support this program, and the opportunity to achieve a true interdisciplinary educational resource by the turn of the century. By overcoming these challenges, PRISM will be able to produce a highly meaningful product (in the broad sense of the word), work out how to conduct such interdisciplinary work within the structure of a major university, and do it in a regionally-significant way.

Now entering our third year, we face a critical point of self-evaluation and institutional commitment to the project. We believe that our accomplishments to date are significant and we anticipate this success will continue. We highlight below specific accomplishments, issues, and future opportunities central to the PRISM project (and see www.prism.washington.edu for more details).

Specific Accomplishments

In Year 2 we structured the PRISM organization as three interactive modules: *Science* (the knowledge base), *Partners* (as the team building and educational activities to build and to work with the VPS), and the VPS itself (the computer-based technologies.

Physiography (David Montgomery, Harvey Greenberg, David Finlayson, Geological Sciences; Miles Logsdon, Oceanography; Ralph Haugerud, USGS). The goal of this project area is to produce a **"**seamless physiography" to reconcile differences in how elevation (land) and bathymetry (ocean floor) data were originally recorded. In Year 2 we completed a digital representation of the landscape (a "DEM"), and used this DEM to create computer drainage basins and their river networks. Similar to land elevation, bathymetry is a data model, which represents the surface of the ocean floor. An interpolated bathymetry dataset was produced from all historical NOAA bathymetry data points, and three modeled shorelines were suggested. This "shoreline" was finalized and integrated the datum and tide corrected shoreline for an integrated hypsometric and bathymetry dataset. These data models are integral to all PRISM modeling.

Contemporary Landcover (Frank Westerlund, Urban Design and Planning; Robin Weeks, Geological Sciences; Miles Logsdon, Mary Jane Perry, Oceanography). The goal of this project is to design and implement a repeatable method for processing remotely sensed imagery of the landcover of Puget Sound for use in the various PRISM modeling and research activities. An August 1998 satellite image set (Landsat TM) was acquired, georegistered, and processed. As a prototype of how to incorporate the educational process in PRISM, the actual classification of this data set was as part of the Winter Quarter URBDP467 course. Two graduate thesis works completed: "Rapid Classification for Urban Watershed Hydrology", and "Landcover Change Detection Along the Urban Growth Boundary", and a Summer Ground-truth/accuracy assessment task was completed.

A classified landcover image is of significant regional importance. It is key in addressing important questions such as, what are the effects of forestry, agriculture, urban development and other land uses in the Puget Sound basin. PRISM partnerships on this project include the King County Department of Natural Resources (DNR), Snohomish County, Skagit Watershed Council and Northwest Indian Fisheries Commission. PRISM is working with these organizations to provide these landcover data and assess their further needs for information. In additional to technical details, such collaborations must work out how to deal with such issues as intellectual property and copyrights; this will be a major challenge for Year 3.

Historical Landuse (David Montgomery, Geological Sciences). As part of the VPS as a "time machine," it is important to look at what has happened in the past. Starting in the Summer of '98, this project is digitizing historic maps and photos that show the historic riverine and estuarine features of Puget Sound, as well as the maps and photos which document the history of change to and loss of these features and their habitats.

Nearshore (Charles Simenstad, School of Fisheries). The goal of this newly formed working group is to develop information on estuarine and nearshore processes and environments that can be integrated into the emerging PRISM synthesis of the Puget Sound Basin. This working group exemplifies the across-region Partnership aspect of PRISM, as it includes members from WaDNR, Battelle, DOE, and King County.

Atmosphere Dynamics (Cliff Mass, Ken Westrick, Atmospheric Sciences) and *Land Surface Dynamics (Dennis Lettenmaier, Pascal Storck, Civil Engineering).* An atmospheric model referred to as the MM5 simulates the meteorological processes that occur within our atmosphere. In 1998, the means to write out MM5 surface meteorological data for PRISM users was implemented. Acquisition of historic meteorological data for observational sites in the PRISM region from 1987 to current was completed. Quality control, interpolation and testing with this data are presently near completion. Acquisitions of remotely sensed snow cover extent for entire PRISM modeling domain for validation of retrospective simulation and real-time system was completed. And a real-time visualization system for calibration and validation of the coupled MM5/DHSVM model was completed.

The output meteorological fields produced by the MM5 are then the input to a model of how water moves across drainage basins (the Distributed Hydrology-Soil-Vegetation Model, or DHSVM). In 1998-99, the DHSVM was calibrated to ~70% of Puget Sound Basins. A real-time coupled model system was developed and applied for 17 forecast points over the Snohomish River basin, with the output made available to the hydrologic forecasters at the Seattle National Weather Service Office and archived for future use by PRISM. The forecasting capability of the coupled system is currently being expanded to the entire PRISM modeling area. Major issues include incorporating data from county agencies into the DHSVM modeling framework, calibration and validation of results against historic streamflow and wetland records. Successful migration of DHSVM from rural to suburban watersheds will require significant code enhancements. This cutting-edge, multi-institution work represents a significant resource for the Region. It is critically important to develop the means to take full advantage of it.

Marine and Freshwater Dynamics **(**Mitsuhiro Kawase, Allan Devol, John Dunne, Steve Emerson, Mark Warner, Miles Logsdon, Oceanography; Jan Newton, Oceanography, WA Dept Ecology; Randy Shuman, King County DNR; Michael Brett, C.E.; Daniel Schindler, Zoology). Over the last year, significant progress has been made on determining the properties of the circulation, chemistry, and biology of Puget Sound itself (remembering that detailed studies have been lacking for decades). The work focuses on coupling computer models with field observation programs.

The modeling focused on the use of computer models of ocean circulation (primarily the Princeton Ocean Model, or POM, and the EFDC at DOE). Following earlier adaptation to Puget Sound, the POM completed trial model runs to simulate Sound water circulation on hourly time step and stratification for an average year. Model simulation for simulated effects of tidal forcing and impacts of river flows into the basin were completed. With circulation in place, the next challenge is to couple a biological/chemical model to the circulation. The current status of such models was evaluated with OCEAN506b, a Spring Quarter seminar involving faculty, students, and staff from the UW, DOE, and King County. In a complementary class set up with Civil and Environmental Engineering and Zoology, freshwater quality issues were evaluated. The

decision was reached that current applications are inadequate, and that a “new generation” system is necessary. To launch that effort, faculty from Computer Sciences and Engineering are being engaged.

Field observations are essential to provide the “truth” for models. Over the last year we have implemented a program designed to identify and monitor potential anthropogenic effects by remotely sampling a time series of critical chemical, biological, and physical parameters with a profiling mooring system along with ship board samples and coupling these results with satellite remote sensing. The profiling mooring (with primary support from EPA and NASA) is now under construction and work continues on the deployment and data management plans. To extend point field measurements, the means to use satellite data must be developed. Over 250 daily images from the SeaWiFS satellite remote-sensing platform have were acquired and processed (using specific software acquired for this purpose).

The marine observation program has provided the opportunity for hands-on, experiential learning for both undergraduate and graduate students. PRISM partnered with the School of Oceanography on four cruises on the *R/V Thompson* with the joint purpose of gathering oceanographic data from Puget Sound for the VPS database and teaching students collection and analyses skills. State and King County agencies have also participated in these cruises to obtain data on water quality. Participation by Seattle Times reporter Ross Anderson resulted in excellent coverage of one of these research cruises in Anderson’s "Voyage of Discovery" series (Summer ‘98).

The regional applications of this work are considerable. Through PRISM, King County is evaluating the effects of combined sewer overflows and exploring sites for a new sewage treatment plant. By tying the hydrology of the Lake Washington and Lake Sammamish watersheds to the hydrologic framework of PRISM, county planners can determine how rapid urbanization in the Seattle area will affect water quality.

Water Resources & Allocation (Richard Palmer, Amy Groome, Civil and Environmental Engineering). The primary goals of the water resource management modeling team since September of 1998 has been on a) the development of the Cascade Regional Yield Simulation Analysis Model (CRYSTAL) and b) in gaining the endorsement of regional water managers in using that tool to evaluate regional water resources options. With PRISM support, this group has translated and enhanced models of the Seattle and Tacoma water supply systems, integrated the Everett water supply system and the Snohomish Hydropower system, and designed the current model to operate on a weekly time-step while simulating water supply operations. PRISM’s water resource group has convened regional water interests (managers for Seattle, Tacoma, Everett, King County, Pierce County, Snohomish County and the Snohomish County PUD#1, and the Department of Ecology) to address water supply issues.

Urban Growth and Population Impacts (Paul Waddell, School of Public Affairs; Marina Alberti, Urban Design and Planning; Alan Borning, Computer Science & Engineering). One of the most unique attributes of PRISM is the integration of the physical world with human dynamics, through the “UrbanSim” model. The main focus of this working group has been on the redesign and implementations of the architecture of the UrbanSim to support micro-simulation of the behavior of households, businesses, and developers and their spatially explicit interactions with biophysical ecosystem process models. The group completed the development of a conceptual framework and structure for the redesign of UrbanSim, implemented the revision to the model and begun testing, began the acquisition and quality control of spatial data required in the model, and developed partnerships with regional agencies. The PRISM resources in this arena catalyzed three major NSF grants.

*An Example of a Partners Initiative: The Endangered Species Acts (Linda Maxson, Sea-Grant)***.** One of the defining environmental issues of the Puget Sound Region is the listing of local salmon populations under the Endangered Species Act. The University of Washington was looked to early on for scientific expertise and leadership on addressing the listing. Jeff Richey, PRISM PI, represents the UW on the Tri-County ESA Response Effort Executive Committee. PRISM researchers have participated in a number of regional salmon-related efforts, from Department of the Interior’s salmon information management discussions, to providing information to Governor Lock’s Salmon Recovery Funding Board, and exploring the potential for collaboration with Battelle Pacific Northwest Laboratory in their work with Washington Department of Transportation. Additionally, there are on-going discussions between PRISM and NOAA’s National

Marine Fisheries Service, the Northwest Indian Fisheries Commission, and Long Live the Kings on ways in which PRISM's modeling efforts could further scientific understanding of salmon in Puget Sound.

PRISM has brought the ESA issues to the classroom for both UW and non-UW students. During Winter Quarter '99, PRISM sponsored FISH 497, "The Puget Sound Basin and Salmon". The class enrollment reached 100, over half of whom were non-matriculated students enrolled through UW Extension. Additionally, with support from UW's Office of Educational Partnerships, PRISM was able to provide video-tape of class lectures, web access to course materials, and some TA time to a small group in Port Townsend, thus improving access to higher education for state residents.

Problems Encountered and Issues to be Resolved

Interdisciplinary research and education always creates technical problems when bringing the structured departmental-based disciplines together to address common research questions. Differences in terminology, methodology, and technical issues as basic as operating systems and data formats, constantly arise as different research groups learn to work together. Overcoming these obstacles required PRISM to make a dedicated effort to maintain communication between groups. We developed a scheme of using: a) focused working groups that met regularly to address common technical problems, b) an informational web site with several collaboration utilities to assist groups working together, c) an annual Orientation meeting for all PRISM participants in the fall quarter.

Through these mechanisms, and a commitment to collaboration at all levels, PRISM has been very successful at breaking down barriers between disciplines involved with research in the program. In the educational context, PRISM has also been able to cross-over the UW's departmental compartmentalization of course offerings by ensuring that courses that utilize PRISM content are cross-listed and marketed to students in all relevant departments. Finally, by integrating partnerships within all the projects PRISM undertakes, the barriers to communication with colleagues and partners outside the University have begun to be broken as well. As a result the PRISM community is really becoming "without walls" and has engaged faculty, staff, students and partners from all disciplines and a wide range of organizations within and outside of the University.

By overcoming the problem of creating a truly open, interdisciplinary, and interdepartmental program, PRISM has quickly found that its opportunities for research projects, education programs and partner collaboration exceed its resources. In the arena of responding to the needs of the state, answering requests from local and tribal governments for prism data account for an unpaid "cost" of providing service. Managing the expectations of participants and partners within the resource base that PRISM can support is now the major management challenge. To address this issue, and to assist the PI with overall project development and strategic planning, a new and expanded Steering Committee has been constituted for the 1999-2000 period.

A problem that compounds the requirement for prioritizing and focusing limited resources is that the annual UIF funding available within PRISM is declining a net 3-4% per year due to salary increases for people funded on PRISM project (remembering that PRISM has not created any permanent positions).

Projected Near-term Activities

The Year 3 objectives for the PRISM community are to:

- Complete the model and data system plan integration and run and validate specific system models on all of Puget Sound;
- Implement an effective, scaleable PRISM education strategy;
- Refine and solidify PRISM role in the Region;
- Develop and implement a strategy for external funding sources;
- Create program documentation in all areas.

Prognosis for Transitioning to "Self-Sustaining"

PRISM is a broad-based effort to link academic units and the disciplines they represent into a program that addresses education at the UW as well as important issues across the Region. It has been envisioned from the beginning as an academic and regional partnership. To reach this goal PRISM was structured according to three complementary and necessary funding sources:

(1) Unit contributions in the form of faculty salary support allow faculty members to interact with PRISM as part of their normal academic duties. Contributions from several of the Units for significant computer equipment has allowed more rapid and efficient execution of PRISM modeling and visualization. The prognosis for the continuation of this support is excellent; it could be reversed only by faculty not being "allowed" to participate, or through loss of faculty interest. The latter would occur because an individual would judge that the return was not great enough for the effort involved). The former would occur due to lack of administrative or institutional support for PRISM.

(2) External funding as been very significant in the development of the specific modules. This support is in essentially three forms.

a) The first is grant money from an agency. To date PRISM has leveraged nearly $4 million in external support. This and future success is made possible by the existence of the core PRISM enterprise. A limitation is that such monies are P.I.-driven, and must be focused on specific research elements. They do not go into a general pool for PRISM support *per se* (nor were they ever intended to be). The greater the success in this sector, in fact, the greater the demand on the core resources.

b) A second source of External support is cooperation with Agency partners on specific common problems. It must be noted that financial realities of most such agencies mean that it is not realistic to expect significant money from them directly to the UW for PRISM. While the monetary exchange is generally small (*e.g.*, and R.A. or 2) or strictly in-kind (where no money is exchanged), the leverage of mutual expertise and data is enormous. This support will continue and be enhanced, if PRISM delivers on its promise for providing "better" solutions than what Agencies currently have. The resultant demand on (and opportunity for) PRISM is liable to be greater than the current PRISM structure can provide. We see the need for (and the external interest in) an operational facility.

c) We see private foundations as a significant source of funds for support of specific project elements. This point is critical, as what can, and should, be done exceeds the resources in hand to do them. PRISM is now maturing to the point where such funds can be sought. For example, we are in the process of a significant approach to he Hewlett Foundation. We would like to request Administration and Board of Regent support for such activities.

(3) UIF Monies have made this project possible. What is unique about this opportunity is that there are currently resources that can form the core backbone and engine that makes the whole project feasible. These monies make possible the materials that are used in the classroom and for student projects in developing specific modules. They form the basis of PRISM's ability to openly cooperate with agencies across the region. At a more fundamental level, the individual faculty and staff who comprise PRISM must have support if they are to do anything on developing the different project elements, then bring that product into their classroom.

In the original proposal, we requested only "temporary" funds from the UIF; we believed that the success of this program should be judged in an on-going manner, and that the flexibility and evaluation are more important than a rigid structure. We believe that PRISM is well on its way to meeting any criteria for success. It is mobilizing major collaborations across campus, it is attracting significant attention in the region (and is helping to break down some "anti-UW" barriers), and the degree of leverage of resources from externals sources is only beginning. But to continue in this trajectory, PRISM must have a continued core UW funding, be that the UIF or a comparable source. Otherwise, the various elements will revert to their "business-as-usual" model.