

Dynamic Generation of Online, Interactive Environmental Report Cards

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INTRODUCTION

The Health-e-Waterways Project is a three-way collaboration between the University of Queensland, Microsoft Research and the Healthy Waterways Partnership (over 60 local government, state agency, universities, community and environmental organizations). The project is developing a highly innovative framework and set of services to enable streamlined access to an integrated collection of real-time, near-real-time and static datasets acquired through ecosystem monitoring programs in South East Queensland. Using a novel combination of semantic web technologies, scientific data servers, web services, GIS visualization interfaces and scientific workflows, we are enabling the sharing and integration of high quality data and models, through a combined integrated water information management system and Web portal.

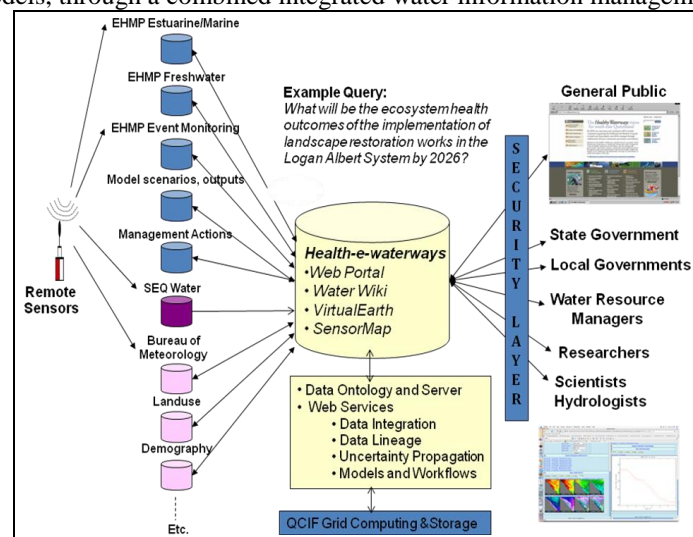


Figure 1: Overview of the Health-e-Waterways System

The primary aim of the project is to improve the speed, reliability and adaptability of the water management decisions being made within SE Qld by the partners in HWP - by providing scientists and planners with fast, Web-based access to the disparate and heterogeneous datasets and models describing: climate (rainfall, temperature, evaporation), water flow, water quality, land use, vegetation coverage, species distributions, population growth, urban development, water consumption and water management rules. Figure 1 provides an overview of the components and architecture of the system.

DYNAMICALLY GENERATED, INTERACTIVE ECOSYSTEM HEALTH REPORT CARDS

The SEQ HWP is responsible for the Ecosystem Health Monitoring Program (EHMP)¹ in South East Queensland. They currently sample 30 freshwater indicators at 100 sites twice a year and 250 estuarine/marine sites every month. With the impending installation of sensors, the number of sampling sites and monitoring data will rapidly expand. These data sets are statistically aggregated and standardized to produce ecosystem health grades that are published annually in regional report cards. Politicians and planners within 20 different agencies (including the EPA), 4 universities, 18 local councils, CSIRO and the SEQ Catchments regional body, use the report cards to make decisions with respect to land use, effluents, water allocations and investments in water recycling plants etc. The report cards provide a standardized method for understanding and comparing environmental assets (e.g., catchments) between regions and over time. To date, these report cards have been largely produced manually, via a five-step process described below:

1. Values for each of the 5 indicators (physical, chemical, nutrients, ecosystem processes, aquatic macroinvertebrates and fish) which encompass 16 indices (e.g. pH, conductivity) are calculated for each site, for two seasons (spring and autumn);
2. Index values are compared against Ecosystem Health Guideline values to derive standardised scores accounting for major (natural) spatial differences in stream types and differences in the scale of measurement across

¹ <http://www.ehmp.org/>

indices. Resulting scores range from zero to one, with zero indicative of ‘unhealthy’ or heavily disturbed conditions, and a score of one indicative of ‘healthy’ or minimally disturbed conditions;

3. Standardised scores are averaged across several combinations of indices, sites and seasons to provide intelligible summaries;
4. Visual summaries of results are produced to simplify the comparison of results for indices and indicators within individual reporting areas, including seasonal changes, and spatial variation within and amongst reporting areas. These graphical summaries comprise: box and whisker plots, horizontal bar charts, and Ecosystem Health (EcoH) plots.
5. Summarisation of the EHMP results culminate in an annual report card grade from A to F

This process takes about 5 months. Currently the most tedious process is the generation of the graphs and EcoH plots which are generated manually using Photoshop Illustrator. The results are published in November in the Annual EHMP Report Card using data from the previous July-June year. For the past 6 months, we have been working with the SEQ-HWP staff who are responsible for generating the annual ecosystem report cards. We have been developing software services that will enable the report cards to be generated dynamically via a Web-based (GoogleEarth or VirtualEarth) interface to an underlying database that contains the spatio-temporal monitoring data. Figure 2 shows the results of our collaboration – the Web-based user interface on the left hand side and the architectural components of the system on the right hand side.

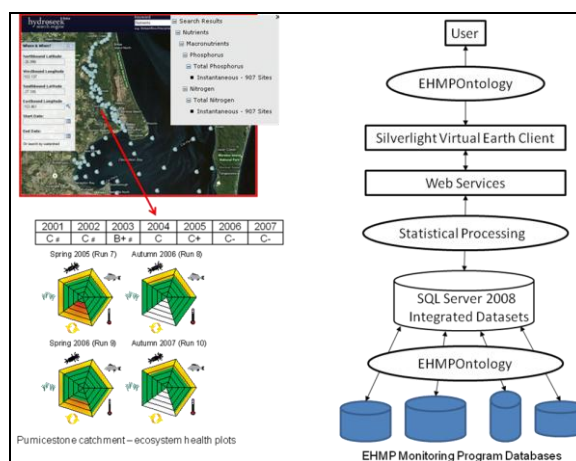


Figure 2: User Interface and Software Architecture

Users are able to spatially identify regions of interest (e.g., particular catchments or sites) through the Google Earth or Microsoft Virtual Earth interface. They are able to use the EHMPontology (a localized and extended version of the ODM ontology developed by CUAHSI HIS) to specify concepts or indicators of interest. A timeline enables them to specify seasons or years of interest. They can click on a catchment to see the Report Card Grade for that catchment and specified period. Clicking on a grade, displays the corresponding EcoH plots, dynamically generated from the 5 indicators in the underlying SQL Server database. Clicking on an EcoH plot, displays the actual raw data (16 indices) used to generate the indicators and EcoH plots. Users can also drill down to see the data for a specific site location.

CONCLUSIONS

Numerous state, national and international agencies are advocating the need for standardized frameworks and procedures for environmental accounting. The Health-e-Waterways project provides an ideal model for delivering a standardized approach to the aggregation of ecosystem health monitoring data and the generation of dynamic, interactive reports (that link back to the raw data sets). The system we have described here will not only save agencies significant time and money, but it can be used to guide regional, state and national environmental policy development. Future work includes linking management action strategies to specific spatio-temporal indicators to identify the extent of impact of management actions and investments – enabling adaptive management strategies based on environmental outcomes.

REFERENCES

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3. A. Alabri, J. Hunter, C. Van Ingen, E. Abal, The Health-e-Waterways Project: Data Integration for Smarter Collaborative Whole-of-Water-Cycle Management, *8th International Conference on Hydroinformatics 2009*. Conception, Chile, January 11 - 16, 2009.