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CITY OF DURHAM WATER QUALITY WEB PORTAL

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June 2014

Abstract

The City of Durham's Stormwater & GIS Services continually collects water quality monitoring data in accordance with the City's Stormwater National Pollution Discharge Elimination System (NPDES) permit. UNCW was originally contracted in October 2011 to create an online database to house this data, which was named the City of Durham Water Quality Web Portal. Following the successful launch of the water quality web portal, and the end of the original contract, a contract addendum was awarded in February 2013. This addendum requested that UNCW provide the following tasks:

- Maintain the City of Durham Water Quality Web Portal
- Make web portal updates/changes as directed by the City of Durham Stormwater Services staff.
- Respond to Cardno Entrix' information request related to the City of Durham's Web Portal

All of the above tasks, as outlined in the 2013 original and amended proposal, were completed by the contract end date of May 31, 2014. The web portal was maintained with full functionality, updates and changes were made as requested, and UNCW's project manager worked with City staff migrate the portal from UNCW servers to an on-line hosting site and Cloud computing server. The project manager also provided information regarding the web portal to Cardno Entrix for development of a separate web portal based on the same platform.

Acknowledgements

City of Durham Stormwater & GIS Services Staff, specifically Maverick Raber, have been instrumental in the design and maintenance of the City of Durham's water quality monitoring web portal.

UNC GA was instrumental in keeping this project on track since they allowed Ms. Qi to continue working on the project.

Introduction

The City of Durham's Stormwater & GIS Services continually collects water quality monitoring data in accordance with the City's Stormwater National Pollution Discharge Elimination System (NPDES) permit. Traditionally the information collected from this monitoring has been stored and maintained in multiple Microsoft Access databases created by Stormwater Services which required manual entry of field and laboratory data by Stormwater Services staff. Data retrieval, data calculations (i.e. Water Quality Index Calculations), and graphical data representations have relied on the development of queries by Stormwater Services staff. Data requests from entities outside of Stormwater Services required Stormwater Services staff to compile and provide requested data.

In 2011, the City of Durham contracted UNCW to design and build a web portal for Stormwater & GIS Services that fulfills the following functions: data storage; file upload; quality control; data access; data query and visualization; and, annual reports and exception reports generation. The final report for the initial portal development and launch (WRRRI project number 11-13-F (2012-0694)) is found in Appendix 1.

In Year 2, for which supplemental funds in 2013 were provided, UNCW focused on the following tasks:

- Maintenance of the City of Durham Water Quality Web Portal
- Web portal updates/changes
- Respond to Cardno Entrix' information request related to the City of Durham's Web Portal

Methods

Task 1. Maintain the City of Durham Water Quality Web Portal

The web portal supports several functions for Stormwater & GIS Services staff, including:

- Data storage and retrieval in a consistent format;
- Quality assurance checks by Stormwater & GIS Services personnel; and,
- Standard reports and graphs, including an exceptions report and summary statistics.

In order to maintain the web portal and associated functionality during the project period, UNCW provided the following services:

- Maintenance for the:
 - postgresql database
 - Apache webserve
 - Linux server
- Assurance that the web portal is fully operational. It should be noted that the site remained on-line throughout the reporting period so the Project Manager did not have to work with UNCW ITSD to correct any issues.

During the course of this project, UNCW maintained the web portal on existing UNCW servers through May 2014. Beginning in January 2014 the Project Manager and City of Durham staff started investigating other web hosting and server options so that the City of Durham's portal would no longer be housed on UNCW Coastal Ocean Research and Monitoring (CORMP) servers, accessible only by UNCW personnel.

The City of Durham did not have the server capacity to host the Portal and its associated databases; therefore, the chosen solution was to use Cloud computing services by Hostmonster for the required server functions. Once the City of Durham acquired a new domain name, <http://durhamwaterquality.org>, the Project Manager completed the following tasks:

- installed and configured the Postgres database server
- reconfigured the apache web server to include the modules needed for this project
- set up different levels of database, linux users and email accounts
- configured the firewalls and IP tables

After the platform was set up, all the codes and data were copied over to the new server from the UNCW server. Extensive testing was conducted to ensure the data portal functions were all operational and that the user interface was not altered by the migration from one server to another. A PHP page was created to redirect the traffic from UNCW domain to the new domain. The Portal's web address changed from <http://cormp2.das.uncw.edu/durhamwq/> to <http://durhamwaterquality.org>.

All of the required elements to move the Portal from the UNCW server and domain to independent services were complete by May 2014. The Water Quality Portal remained on-line and available to the City of Durham staff and the public through the CORMP server during the migration process.

Task 2. Web Portal Updates/Changes

As authorized by the City of Durham, and agreed to by UNCW, the Database Manager had the ability to make minor adjustments to the web portal such as code changes, changes to site functionality, changes to the portal layout/design, etc.

Task 3. Respond to Cardno Entrix' information request related to the City of Durham's Web Portal

The Upper Neuse River Basin Association (UNRBA), whose membership includes the City of Durham and other local government entities, contracted the consulting firm Cardno ENTRIX to develop an online database to house water quality data. Cardno ENTRIX decided to model the new UNRBA online database to the City of Durham's Web Portal as developed by UNCW. To develop the UNRBA database, Cardno ENTRIX has requested information related to the City of Durham's web portal development. This addendum added an additional task (Task 3) to the previous contract to support the information and database sharing request from Cardno ENTRIX.

Cardno ENTRIX requested all information related to the Web Portal be uploaded to an ftp site provided by Cardno Entrix. Files uploaded to the ftp site included the following:

- Source file;
- Database schema file; and
- Readme text file.

Prior to uploading the files, the Project Manager performed the following functions as requested by the City of Durham:

- Deleted existing user login information;
- Deleted existing City of Durham monitoring data;
- Created three logins for the three different user privileges for testing purposes; and,
- Provided QC of user account removal

The Project Manager provided the Web Portal design, database schema, coding, and file structure to Cardno ENTRIX project staff and was available for conference calls to answer any questions they had related to the City of Durham Web Portal development.

Conclusions

UNCW and the City of Durham worked cooperatively to create a web portal tailored for the City of Durham (Appendix 1). Beta testing was conducted prior to full site launch to ensure that the portal met all of the City's identified needs and changes were made based on feedback from City staff. The iterative nature of the collaboration between UNCW and the City of Durham allowed for the successful launch of the City of Durham Water Quality Web Portal. On-going collaboration and tasks associated with this supplemental award have provided the City of Durham with a stable, secure on-line Water Quality Web Portal which meets the needs of City of Durham staff and their stakeholders. Moving the site from a University based system to Cloud computing provides greater control of the site to City of Durham staff and their contractors who will continue to maintain the site into the future.

Overall, a major success of the project is that other City's/municipalities would like to build similar portals for their use, as highlighted by the Cardno Entrix' project. The UNRBA requested that Cardno Entrix evaluate different database platforms to determine the best option for their water quality monitoring needs. Based upon Cardno Entrix' evaluations, the best option was the City of Durham's Water Quality Web Portal and associated online database schema and structure, as developed by UNCW. The UNRBA is contracting Cardno Entrix to coordinate monitoring efforts amongst different agencies as well as perform additional monitoring. All data will be housed in a single online database which was designed based on the City of Durham's Water Quality Web Portal.

Appendix A

Appendix A

Final Report – City of Durham Water Quality Web Portal
WRRI project number: 11-13-F (2012-0694)
December 18, 2012

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Abstract

The City of Durham's Stormwater Services continually collects water quality monitoring data in accordance with the City's Stormwater National Pollution Discharge Elimination System (NPDES) permit. The City of Durham requested that UNCW design and build a web portal for the uploading and access of data collected by Stormwater Services. The objectives of this project were to:

- Create a database for data storage of the City of Durham's monitoring data
- Provide data retrieval in a consistent format
- Provide online availability of the City's monitoring data to Stormwater Services staff and entities outside of Stormwater Services
- Increase data integrity by performing digital data entry versus manual data entry; this also relieves Stormwater Services staff time by eliminating the need for manual data entry
- Provide data calculations and graphical data representations for QA/QC, reference, and various reporting purposes.

UNCW completed all of the tasks and their associated objectives as outlined in the original proposal. The completed City of Durham web portal can be found at the following address: <http://cormp2.das.uncw.edu/durhamwq/>

Introduction

The City of Durham's Stormwater Services continually collects water quality monitoring data in accordance with the City's Stormwater National Pollution Discharge Elimination System (NPDES) permit. Traditionally the information collected from this monitoring has been stored and maintained in multiple Microsoft Access databases created by Stormwater Services which required manual entry of field and laboratory data by Stormwater Services staff. Data retrieval, data calculations (i.e. Water Quality Index Calculations), and graphical data representations have relied on the development of queries by Stormwater Services staff. Data requests from entities outside of Stormwater Services required Stormwater Services staff to compile and provide requested data.

The City of Durham contracted UNCW to design and build a web portal for Stormwater Services that fulfills the following functions: data storage; file upload; quality control; data access; data query and visualization; and, annual reports and exception reports generation. The resulting portal, as developed by UNCW, provides the following tools that fulfill those functions for the City of Durham:

- Data access and download in a standard format.
- Database query page that allows retrieval of user-defined data sets. Data can be viewed in table format, graphical format, or can be downloaded as a csv file.
- File upload functions that allow City staff to upload data files from field measurements and different laboratories. Error messages are displayed if there are problems during a data upload and these messages provide details on the type of error encountered.
- Google Earth base map that displays sampling station locations. Station data is downloadable as kml files.
- Google Earth Base map that displays the monthly water quality index calculated at each sampling location.
- Quality control page that allows City of Durham staff to verify and add quality control flags to data before it is pushed to the web for view and download by general users.
- Database management page that allows City staff to add, update, or remove the data records. With this tool, staff can define new stations, new parameters, new flags, etc.
- Database log that records changes made to the database. For example, a comment is automatically generated whenever a parameter is updated.

Project Tasks

The following tasks were completed during the course of the project:

Task 1. Design and build a City of Durham Water Quality Web Portal

UNCW designed and built the web portal mainly using PHP and JavaScripts with the PostgreSQL as the backend. The web portal supports several functions for Stormwater staff, including:

- Data storage and retrieval in a consistent format
- Quality assurance checks by Stormwater Services staff
- Standard reports and graphs, including an exceptions report and summary statistics

Appendix A

Xiaoyan Qi presented the initial design and development work to City of Durham staff in early May 2012. UNCW worked with the City of Durham and finished most of the development work in early June. This web portal has similar functionality to the portal the City supports through the Upper Cape Fear Basin Association. Beta testing for the developed portal was conducted by City of Durham staff from June 2012 through September 2012. City staff provided UNCW will feedback as well as requested changes to the portal. Once these modifications were made the portal was fully launched on September 14, 2012. The completed City of Durham web portal can be found at the following address: <http://comp2.das.uncw.edu/durhamwq/>. Figure 1 provides an overview of the homepage.

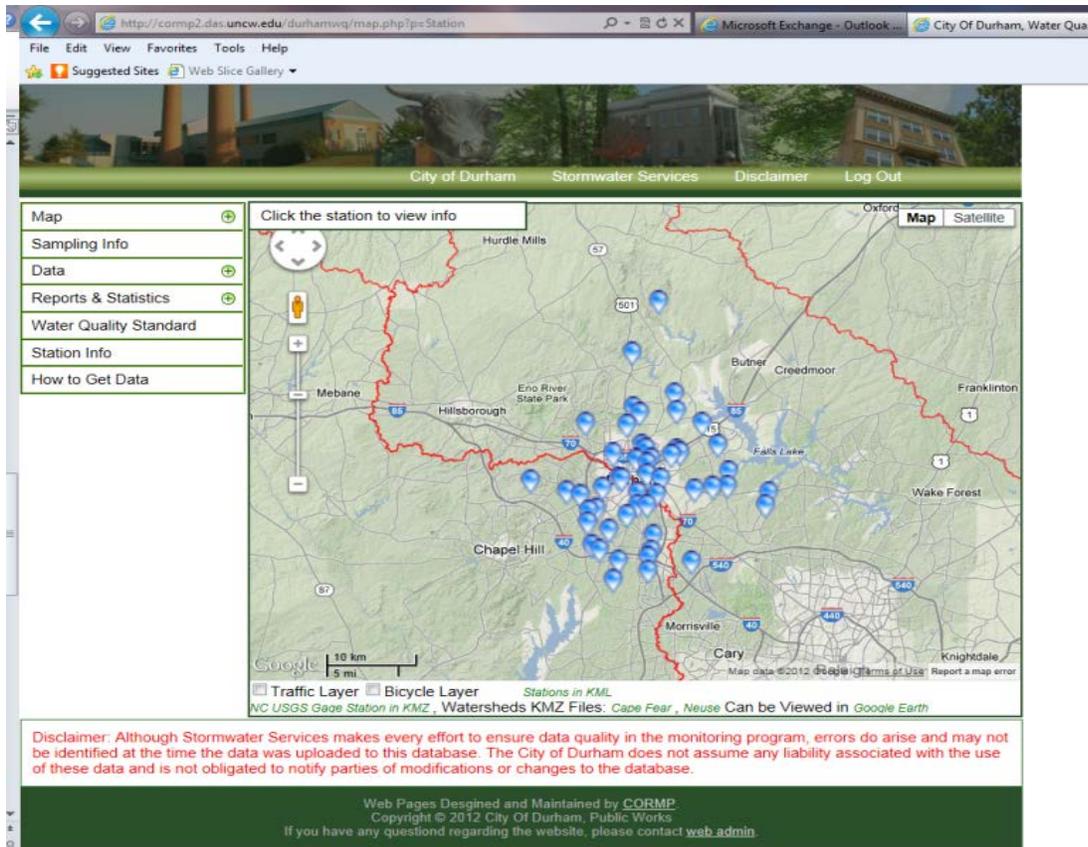


Figure 1. The City of Durham Stormwater Services web portal. The blue “bubbles” represent sampling stations. User map controls include the ability to zoom in/out and use map or satellite views.

The web portal is hosted on UNCW servers and surface water and sediment data were moved from the City’s Access database to a Postgresql database which is also maintained by UNCW. The Postgresql is a relational database which allows the Stormwater Services staff to easily access surface water and sediment data for multiple sampling stations and/or multiple sampling periods.

The portal was developed with 3 levels of user controls. All users (City staff or other interested parties) must sign up with a unique login name and password in order to access the portal. Level 1 users have general access to maps, data, statistics, and reporting capabilities. In

addition to Level 1 capabilities, Level 2 users can upload lab data files and can perform limited database management. Level 3 users, known as super users, have full database management capabilities, can upload data files, quality control data, and can set user level rights (anyone that signs up for the database is a default Level 1 user). The web portal was primarily developed for use by City of Durham staff. The web address is not publically available. If the City receives a data request, City staff can provide the web address to allow the requestor to sign up for the database and access the City's monitoring data.

The web portal houses the City's ambient water quality, special studies, and investigations data from 2004 to present. These data are from sampling stations monitored by the City of Durham within and in close proximity to Durham City limits. Data can be queried for data view/download, graph view/download, statistical analysis, and reporting according to the user's needs. There are up to five components used for queries in the web portal: Category, Medium, Parameter, Project, Date Range, and Visibility Flag. The *category* allows the user to define the site or list of sites to query. The four categories that may be defined during a query include Station Name, Stream Name, River Basin, and Watershed. For example, if the user selects the category 'Watershed' and chooses Ellerbe Creek, all stations located in Ellerbe Creek will be included with the query. *Medium* allows the user to select water or sediment data during a query. *Parameter* allows the user to select the parameter(s) they wish to query. A comprehensive list of surface water and sediment data parameters available on the portal are listed below:

Alkalinity, Aluminum, Ammonia Nitrogen, Antimony, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(g,h,i)perylene, Biochemical Oxygen Demand, Bulk Density, Cadmium, Calcium, Chloride, Chlorophyll a, Chromium, Chrysene, % Clay, Clay Weight, Conductivity, Copper, Dibenzo(a,h)anthrocene, Dissolved Organic Carbon, Dissolved Oxygen, Dissolved Oxygen Saturation, % Dry Weight, E Coli, Enterococcus, Fecal Coliform, Fluoranthene, Fluorene, Fluoride, % Gravel, Gravel Weight, Hardness, Indeno(1,2,3-c,d)pyrene, Iron, Lead, Magnesium, Manganese, Moisture % of Sample, Napthalene, Nickel, Nitrate + Nitrite as N, Orthophosphorus, pH, Phenanthrene, Pheophytin-a, Potassium, Pyrene, % Sand, Sand Weight, Secchi Depth, % Silt, Silt Weight, Sodium, Sulfate, Temperature, Total Kjeldahl Nitrogen, Total Organic Carbon, Total Organic Nitrogen, Total Phosphorus, Total Suspended Solids, Turbidity, Volume, Wet weight soil, Zinc

Project allows the user to query data from all projects or from individual projects. *Date range* allows the user to define the time period for the query. *Visibility* allows the user to include or not include QA data with the query. An example query for the water quality index is included in Figure 2.

http://cormp2.das.uncw.edu/durhamwq/queryAll.php?q=statistics&&tp=wqi

City of Durham Stormwater Services Disclaimer Log Out

Map

Sampling Info

Data

Reports & Statistics

- Water Quality Index
- Exception Report
- Statistics Report
- Annual Report

Water Quality Standard

Station Info

How to Get Data

Use the options to retrieve the **Water Quality Index**. Data are given in a tabular format to be viewed in the browser or csv format if downloaded.

Select Category: Station Name

Select Station Name: Choose no more than 5 for Graph and Download.

- All
- 1808 Milton Rd -
- Backwater 10WQ027 -
- Backwater 10WQ049 -
- CC2.5CC - Scott King Rd. @ 1st stream crossing near Fayetteville Rd.

Begin Date: 2004-01-20

End Date: 2012-12-12

Choose Time Period: Year

View and Download Graph and Download

Disclaimer: Although Stormwater Services makes every effort to ensure data quality in the monitoring program, errors do arise and may not be identified at the time the data was uploaded to this database. The City of Durham does not assume any liability associated with the use of these data and is not obligated to notify parties of modifications or changes to the database.

Web Pages Designed and Maintained by CORMP
 Copyright © 2012 City Of Durham, Public Works
 If you have any question regarding the website, please contact [web_admin](#).

Figure 2. The Water Quality Index report allows a user to define the beginning and end date for which they are interested and they can select all of the sampling stations to include in the report or they can select specific stations of interest. Once they have filled out the fields they have the option to “View and Download” the report or they can “Graph and Download” the results.

Additionally, there is a “how to” page available on the site so that a user can learn about the many different ways to access, view, and download all of the available data (Figure 3). This page provides users with information on the many different ways they can search the portal, such as by parameter name, parameter range, sampling stations, river basin, watershed, stream name, time period, project, medium and more.

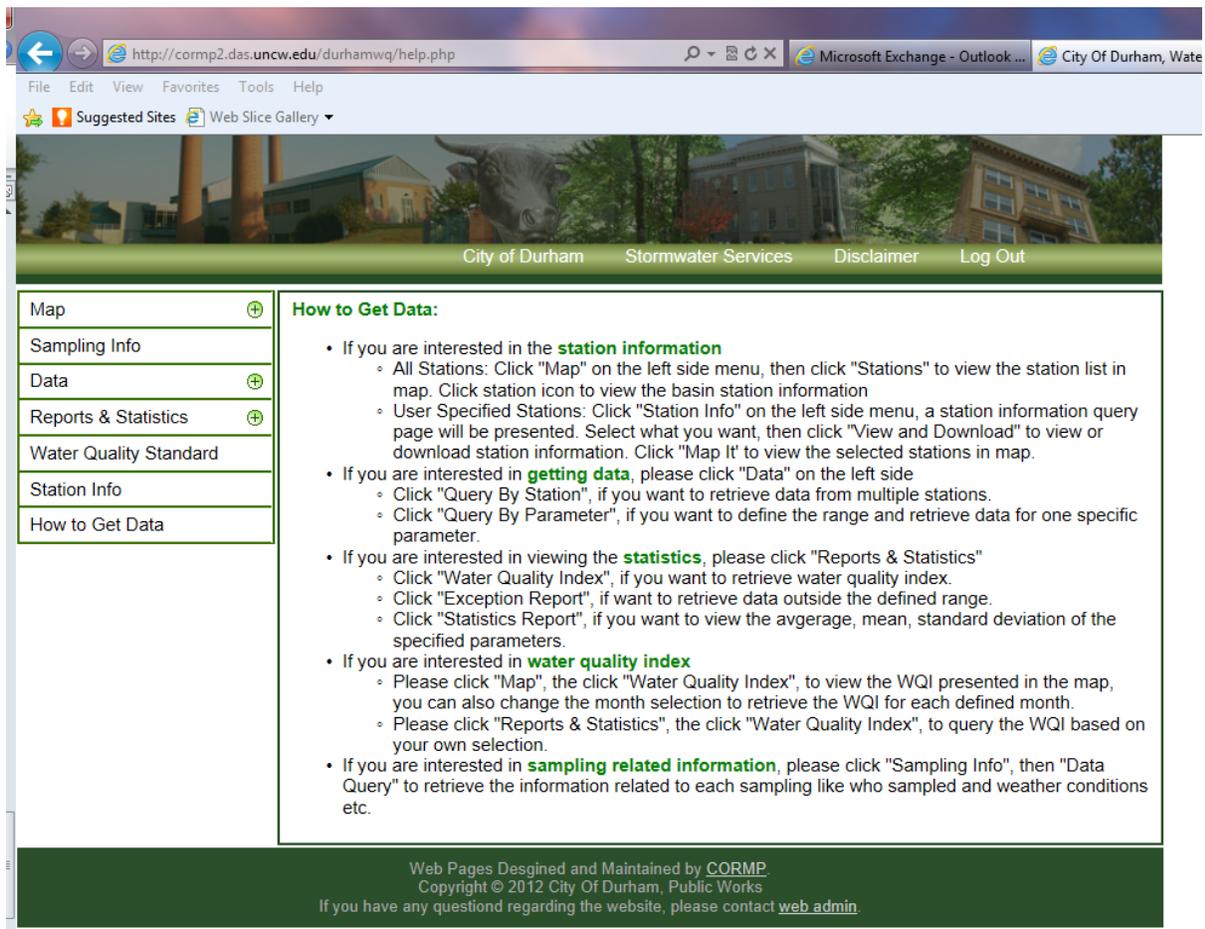


Figure 3. The “How to Get Data” page provides users with an overview of the many different approaches that are available for data access.

Task 2. Web Portal site and server maintenance

UNCW has maintained the web portal during the design and implementation phases of the project to ensure that a fully functional web portal is consistently available to Stormwater Services staff and the public.

UNCW continually tracked server usage and provided usage statistics to Stormwater Services staff. From September 12 to November 30, 2012, seventy one (71) unique visitors used the site for a total of 319 visits.

Task 3. Upload archived water quality data

Following the completion of Task 1, UNCW created a data upload tool so that Stormwater Services staff could upload surface water and sediment data, complete QA/QC analysis, and manage their data. Surface water and sediment data types identified in Task 1, dating back to 2004, were uploaded using this tool.

Conclusions

UNCW and the City of Durham worked cooperatively to create a web portal tailored for the City of Durham. Beta testing was conducted prior to full site launch to ensure that the portal met all of the City's identified needs and changes were made based on feedback from City staff. The iterative nature of the collaboration between UNCW and the City of Durham allowed for the successful launch of the site. In conjunction with this report, Michelle Woolfolk provided a live demonstration of the web portal's capabilities and functionality to the Urban Water Consortium on October 11, 2012.