

CE-QUAL-W2 WATER QUANTITY AND QUALITY MODEL
FOR EL CAJON RESERVOIR

by

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ABSTRACT

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Considering the recent completion of the El Cajon dam and the plans to build several more dams along the Santiago River, there is a tremendous need to understand the impact of these dams on the surrounding environment. High concentrations of biomass and sediment are two serious issues that are affecting dams currently in use along the Santiago River. The CE-QUAL-W2 reservoir program was used to help study the El Cajon Reservoir in an attempt to better understand these issues. CE-QUAL-W2 is a two-dimensional, laterally-averaged hydrodynamic model and is well-suited for long, narrow reservoirs like the one at El Cajon. Since a comprehensive model of the reservoir was not feasible in a period of just four months, the objective was to complete the initial setup of a model composed partly of true data and partly of fabricated data. Data such as digital elevation models (DEMs) and daily inflows were provided by students at ITESO

University in Guadalajara. Other data such as meteorological data was gathered from websites. Data that was unavailable was fabricated using data from CE-QUAL-W2 studies done on other reservoirs. Once the data was obtained, a geometric file, or bathymetry file, representing the general shape of the reservoir was constructed. A properly constructed bathymetry file is essential to an accurate CE-QUAL-W2 model. Although errors present in other input files prevented a successful model run, the collection of input files created represents a good foundation that will allow others to create a successful CE-QUAL-W2 model in the future.

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1 Introduction

Located on the Santiago River in the state of Nayarit, the El Cajon dam faces many issues common to most dams along the Santiago River. High concentrations of biomass, sediment, and waste together with large amounts of precipitation present many water quality and quantity concerns. Understanding the issues surrounding the El Cajon dam can help address issues at other dams along the Santiago River and better inform decision makers of the issues regarding the construction of future dams.

1.1 Background

El Cajon reservoir was developed as part of the El Cajon hydroelectric Project in order to meet the demand for electric energy. The reservoir is part of the Santiago Hydrologic system, a system capable of a hydroelectric potential of 4,300 MW, more than 60% of that available on the entire Colorado River. El Cajon is second only to Aguamilpa-Solidaridad Station in power and generation. The El Cajon dam and reservoir are located in the state of Nayarit (21°25'41" N, 104°27'14" W), 47 km from the capital Tepic. Construction on the dam was completed in June 2006 and the reservoir was filled that November.

1.2 Issues

There are several issues surrounding the Santiago River system and the El Cajon reservoir in particular. The watershed encompassing the El Cajon reservoir is a deciduous rainforest that creates beautiful green canyons during the rainy season. As a result, there are enormous amounts of vegetation and precipitation which can make dam planning and dam construction very difficult. In 2006, the closest gaging station to the dam recorded almost 70 inches of rain in July and August alone. Although such large amounts of rainfall are what made the idea of building a dam so attractive, it makes it difficult to predict how large the dams should be built and how quickly they will fill up, as in the case of El Cajon. Another issue is the volume of vegetation. Built inside deep, narrow canyons stretching almost 54 km (34 mi) long, the El Cajon dam site exhibits an enormous volume of vegetation. Rather than spend years removing the vegetation, however, the Mexican government decided to skip the typical routine of vegetation removal altogether and began filling the dam without modifying the land use. This has created huge concerns with respect to biomass concentrations and algal blooms in the reservoir.

Additional issues include sediment volumes and urban and human waste inflows to the river. The Santa Rosa dam, which sits immediately upstream from the El Cajon dam and immediately downstream from the city of Guadalajara, was constructed in 1964 (Gobierno, 2007). The inflows to the Santa Rosa reservoir, however, are so filled with sediment that as of 2006, the capacity of the dam has been reduced from 420 Mm³ to 213 Mm³, a capacity reduction of almost 50%. It is expected that the dam will be completely full of sediment within the next ten years. The quality of the water has also been

impacted by the high volumes of urban and human waste discharged into the reservoir. The city of Guadalajara, the third largest city in Mexico, currently discharges nearly all of its wastewater directly into the Santiago River, just upstream from the Santa Rosa dam. The polluted water emits a powerful stench and is unsuitable for recreation, irrigation, and does not support any aquatic life. With a second dam at Santa Rosa in the planning stages and another dam under construction at La Yesca, understanding the impact of sediment and waste volumes in the river has become extremely important.

1.3 Objective

The objective of the project is as stated in a summary document provided by ITESO University: “The Federal Commission of Electricity in its concern for predicting the quality of the water and the hydrological behavior of the dam requires both hydrological and water quality models which will be developed by ITESO and BYU students generating and using all hydrogeological, meteorological, and water quality information available. All information generated by the model will be useful for predicting hydrological behavior for similar projects in the future and to protect water quality standards in order to ensure the health of downstream users and reduce negative impacts to the environment.”

2 Materials and Methods

The methodology used for the project can be divided into four steps: understand the reservoir model, understand the project site, gather necessary data, and create model input files. An international collaborative project, however, rarely follows such an organized structure. Though the steps are presented in sequence, most of the tasks were performed simultaneously.

2.1 Understand the Model

The first step of the project was to gain an understanding of the CE-QUAL-W2 model. The Watershed Modeling System (WMS) provides a tutorial chapter which lists steps used in setting up two of the model's main files, the bathymetry and the control file. This tutorial was completed several times to familiarize ourselves with the CE-QUAL-W2 capabilities of WMS. It was also used for reference when the time came to set up our own bathymetry and control files for El Cajon reservoir.

Another useful resource was the CE-QUAL-W2 v.3.5 user's manual (Portland, 2007). This manual provided explanations of the model background and model assumptions, and offered clarification for each card contained in the input files.

Probably the best resources for understanding the model were Ana Paz, Ahmad Salah, Dr. Chris Smemoe, and Dr. Jim Nelson. Having worked with CE-QUAL-W2

previously, these people were able to answer questions and clarify issues regarding the purpose of the model and how to make it work. With their help, we were able to gain a much better understanding of CE-QUAL-W2 and find resources that helped tremendously in setting up our own model.

2.2 Understand the Site

One of the most difficult parts of the project was trying to figure out the characteristics of a site we had never visited. When the project began, we had no idea where the reservoir was even located. We soon found the coordinates of the dam on the Comisión Federal de Electricidad website and also received an email with the dam coordinates from Leon Mayoral Alonso on 24 March 2007. The next step was figuring out the reservoir extent. Receiving no direction regarding the reservoir extent prior to our trip to Mexico, we made our best guess based on the maximum annual ordinary water level (NAMO) and minimum annual ordinary water level (NAMINO) which we found on the CFE website. As it turned out, the reservoir was actually twice as long as we assumed it to be.

Another challenge was understanding the issues surrounding El Cajon. ITESO University provided a helpful document entitled “Información General sobre el proyecto: Presa Hidroeléctrica El Cajon” which explained the issues at the dam in great detail. They also provided a summary of the document in English that was also quite useful. The issues contained in this document came to life once we visited the Santiago River and Santa Rosa dam. Once we were there in person, it was easy to see the serious environmental issues affecting the inflows to El Cajon reservoir. Upon returning from

Mexico, even though we never visited the El Cajon dam specifically, we had a much better understanding of our objective and the type of problems we were trying to address.

2.3 Gather Data

As we learned more about the input required for the CE-QUAL-W2 model and the issues related to the El Cajon dam, we began gathering data to be used in setting up the model input files. We first obtained a digital elevation model (DEM) from the INEGI website. A more detailed DEM showing changes in topography caused by the construction of the dam was later provided by Jaime Severino, which he obtained from CFE. These terrain models proved very helpful in setting up the geometric files needed for the reservoir model.

Next we obtained meteorological information. This data includes air temperature, dew point temperature, wind speed, wind direction and cloud cover. This was found at the Weather Underground website, which was referred to us by the ITESO students. All the meteorological data was obtained for the capital Tepic, it being the closest gaging station to El Cajon. Downloading the data presented quite a challenge. Although hourly data was available, the Weather Underground website only allows hourly data to be downloaded one day at a time. With the help of Joshua Draper, we developed a Unix script that automated the daily download routine so that we were able to acquire 18 months of hourly data in 30 minutes.

Inflow data was obtained by the ITESO students. This data represents the daily inflows to the El Cajon reservoir from the La Yesca site. Outflow data for the El Cajon dam is not yet available. Though rainfall data is available for the Tepic gaging station, it

was not collected. Monitoring data was provided by the ITESO students, but was not used due to lack of time and technical problems with the control file.

2.4 Create Model Input Files

Although dozens of input files can be used for CE-QUAL-W2, four were created for this project. The bathymetry and control files were created using WMS and the meteorological file and inflow file were created by hand.

WMS was used to create the bathymetry and control files. The bathymetry file contains the geometric information for the reservoir and the control file contains constituent information for the reservoir, including kinetic coefficients for pollutant parameters. Using the DEM provided by the ITESO students, we created a TIN from which we delineated the reservoir boundary. This was done by displaying a single contour at the top elevation of the reservoir and selecting the “convert TIN Contour to Feature Object” option. Once the reservoir boundary was defined, a branch coverage was created. With the first DEM we created three branches, but since each branch requires inflow and outflow information which we did not have, we used a single branch for the second DEM. Once the reservoir polygon was converted to a branch polygon, the branch coverage was duplicated and changed to a segment coverage. Seventeen segments were created and numbered 2 through 18 with the dummy segments at each end assigned as segments 1 and 19 (Figure 2-1).

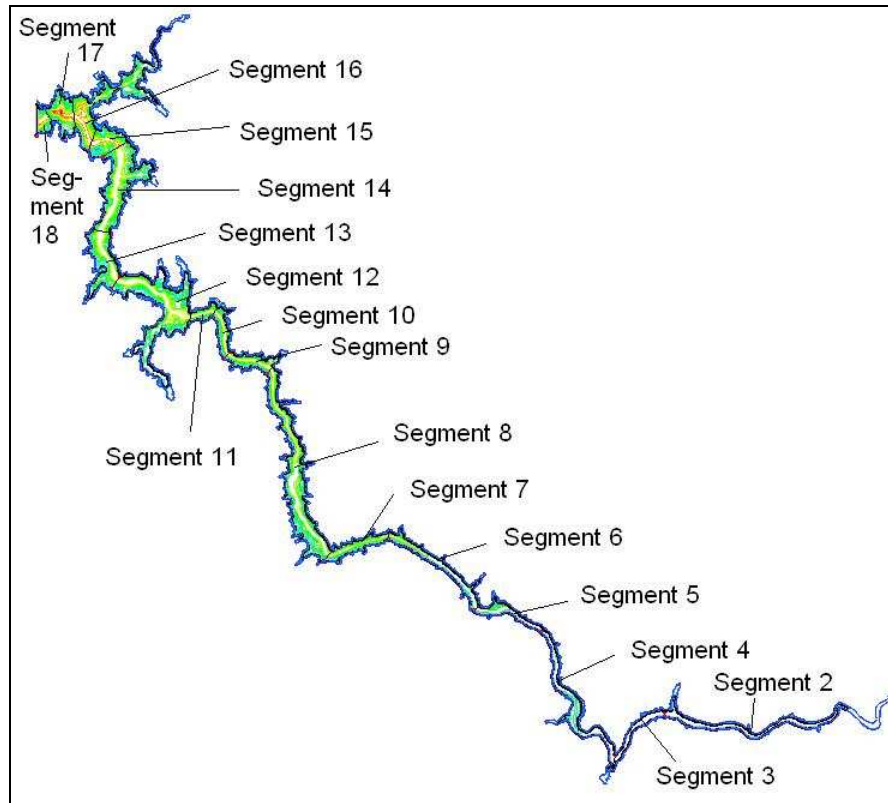


Figure 2-1 Reservoir TIN showing segment partitions

Once the segments polygons were built and renumbered, the lengths of each segment were determined using the “measure lengths” tool in WMS. The storage capacity curve was then computed for all the segments (Figure 2-2).

The layer height was set to 15 meters, the widths for each layer were computed for each segment, and the segment orientations were defined. The simulation time was patterned after the meteorological data; 1 November 2005 to 6 March 2007, a simulation time of almost 18 months. For simplicity, the control parameters were left alone and the files were saved using WMS.

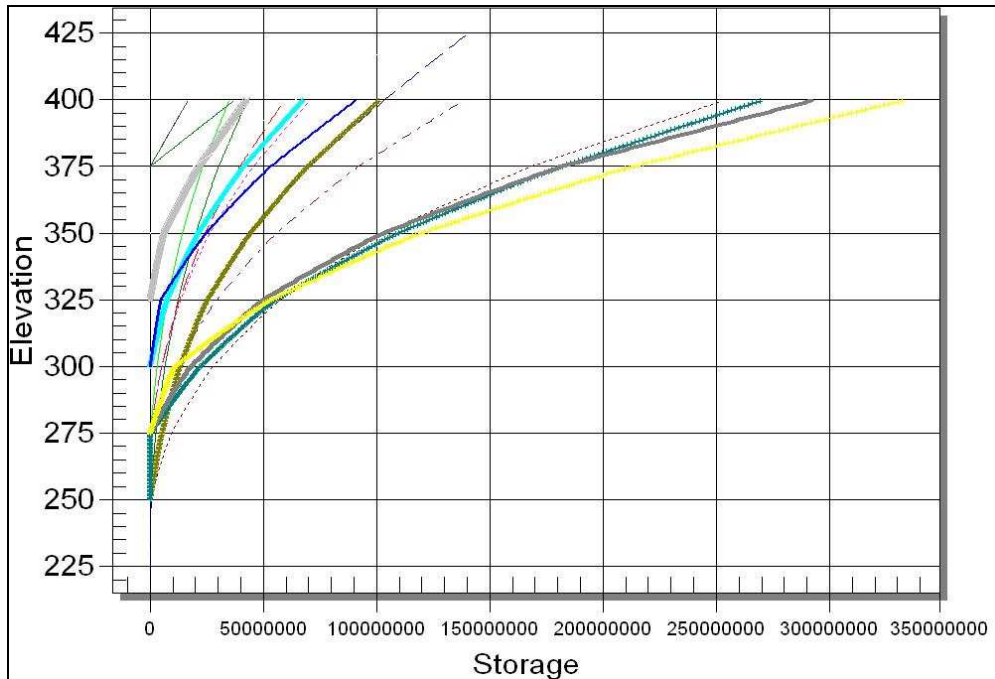


Figure 2-2 Storage Capacity Curve for reservoir segments

A program called AGPM was used to verify our bathymetry file. After loading the control file into AGPM, the program displays the geometry contained in the bathymetry file or if there are errors in the bathymetry file, it displays nothing. Our first several attempts to verify the bathymetry file were unsuccessful. We made several adjustments to the bathymetry file and still were unsuccessful. Finally, once we deleted the first line in the file, a line generated by WMS describing that the file was created using WMS, the bathymetry file was able to be read properly by the AGPM viewer. Whether this line was the only problem or the last of a series of problems is uncertain. Once the bathymetry file was properly constructed, we shifted our attention to the control file. Though we added no constituents and kept all values at their default values, the CEQUAL-W2 preprocessor consistently reported errors in the control file. After several

unsuccessful attempts to locate and correct the errors, the hopes of obtaining a properly constructed control file, and in turn a running model, were abandoned.

The meteorological data was constructed by hand. Since the meteorological data was separated into daily reports, the 491 files of hourly meteorological data needed to be formatted and combined into a single file to be used by CE-QUAL-W2. First, we constructed a Visual Basic subroutine that would format the meteorological data of a single file. This meant changing degrees Celsius to degrees Fahrenheit, wind speed from m/s to mph, wind direction into degrees from north, and cloud cover from Spanish descriptions to integer values. Once this was accomplished for a single file, the subroutine was modified so that it could be executed for all the files in a directory and combined into a single file. Though this process was a challenge to figure out, it saved weeks of what would have otherwise been very tedious work. The formatted data was then entered into a CE-QUAL-W2 input file creator program created by former BYU Master's student Nick Williams and saved in a file with proper naming and spacing. This program was also used by students at ITESO University to format the inflow data into the correct format for the CE-QUAL-W2 inflow file.

In addition to these four files, several other files were needed to obtain a running CE-QUAL-W2 model. These files include a graph file, an outflow file, a shade file, an inflow temperature file, a wind sheltering file, and a tributary temperature file. Since the data needed to construct these files was either unavailable or not collected, sample files containing erroneous data were borrowed from a running CE-QUAL-W2 model created for Lake Zapotlan and used for El Cajon.

3 Results and Discussion

Without a running model, there is no model output to present as results. Our project results, then, include the files created using the data we collected. Some files, such as the bathymetry file were created successfully while other files, such as the control file, still need work.

3.1 Bathymetry File

The bathymetry file contains the geometric information for the reservoir (Figure 3-1). Images showing the geometry of the reservoir based on the bathymetry input file are displayed below. Figure 3-2 shows the geometry of segment 2, Figure 3-3 shows the geometry of segment 8, and Figure 3-4 shows the geometry of segment 18. These images were created using the AGPM viewer. Since the bathymetry file is vital to obtaining accurate model results, a correct bathymetry file represents a crucial step towards obtaining a successful CE-QUAL-W2 model.

```

bth_wb1.npt - Notepad
File Edit Format View Help
for the water body named:      Main water body

segment lengths [DLX]
7908.9 7908.9 2907.9 6361.0 2989.3 4911.9 2740.7 8367.7 1964.5 1933.9
1100.6 3502.3 2245.8 3692.1 1077.3 1435.2 1112.8 549.5 549.5

water surface elevation [WSEL]
391.0 391.0 391.0 391.0 391.0 391.0 391.0 391.0 391.0 391.0
391.0 391.0 391.0 391.0 391.0 391.0 391.0 391.0 391.0

segment orientations [PHIO]
4.7 4.7 3.9 5.7 5.3 5.5 4.3 5.9 5.1 5.9
4.3 5.1 5.9 0.2 5.1 5.5 4.3 4.1 4.1

bottom friction [FRICTC]
0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04
0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04

layer heights [H]
15.09 15.09 15.09 15.09 15.09 15.09 15.09 15.09 15.09 15.09
15.09 15.09 15.09 15.09

segment 1 - branch 1
0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0

segment 2 - branch 1
0.0 188.8 188.3 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0

segment 3 - branch 1
. . . . .
. . . . .
. . . . .
. . . . .

segment 8 - branch 1
0.0 575.3 470.5 407.1 314.6 251.1 193.9 63.3 46.5 0.0
0.0 0.0 0.0 0.0
. . . . .
. . . . .

segment 18 - branch 1
0.0 926.9 765.3 682.1 567.8 488.1 410.5 305.8 254.6 182.8
168.8 0.0 0.0 0.0

segment 19 - branch 1
0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0

```

Figure 3-1 Bathymetry file

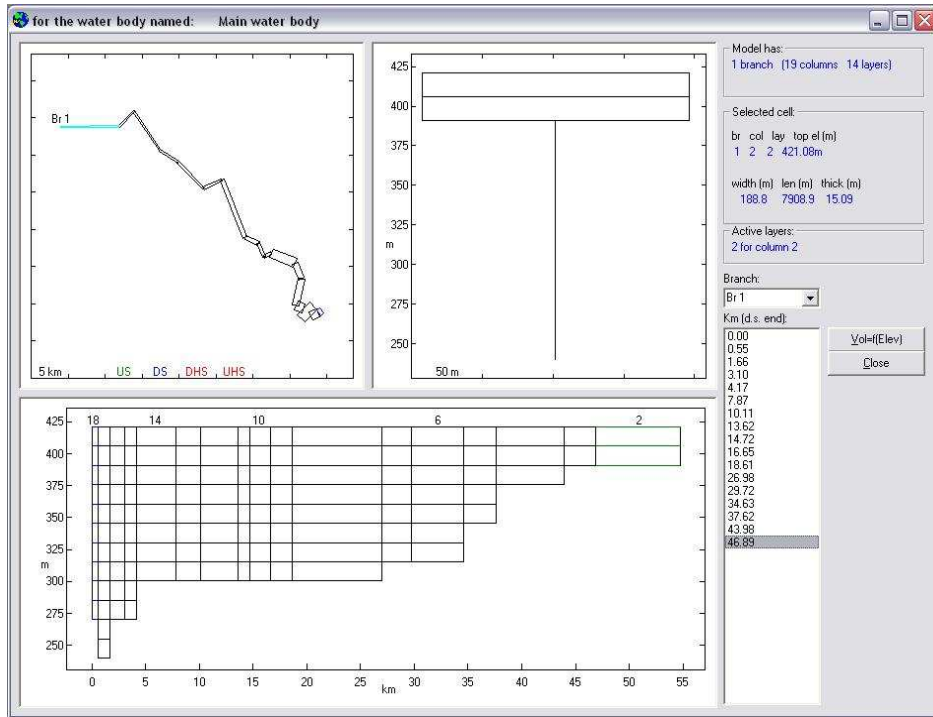


Figure 3-2 Bathymetry profile for segment 2

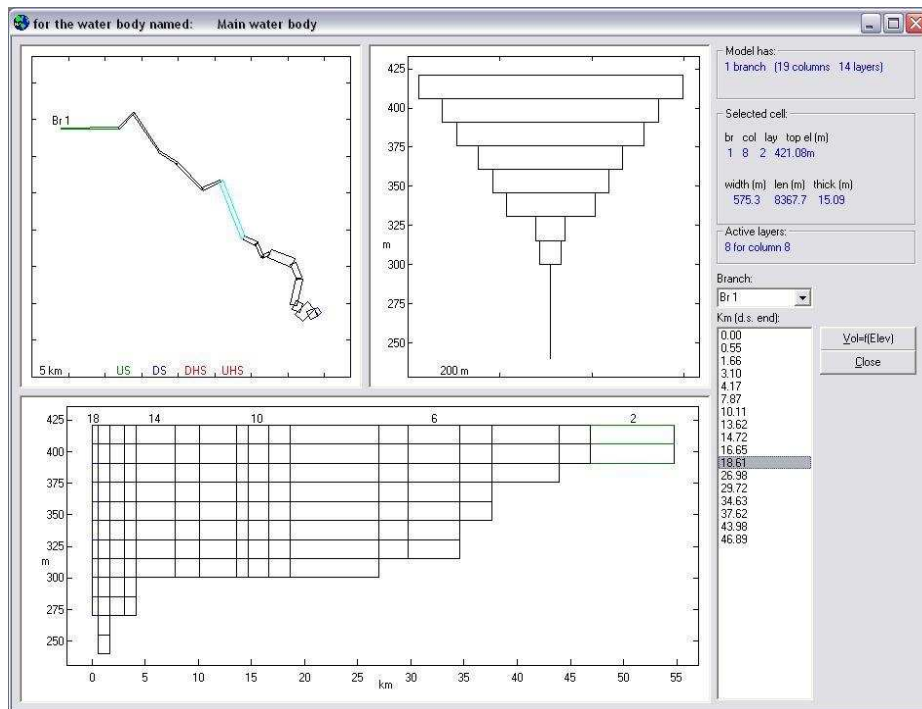


Figure 3-3 Bathymetry profile for segment 8

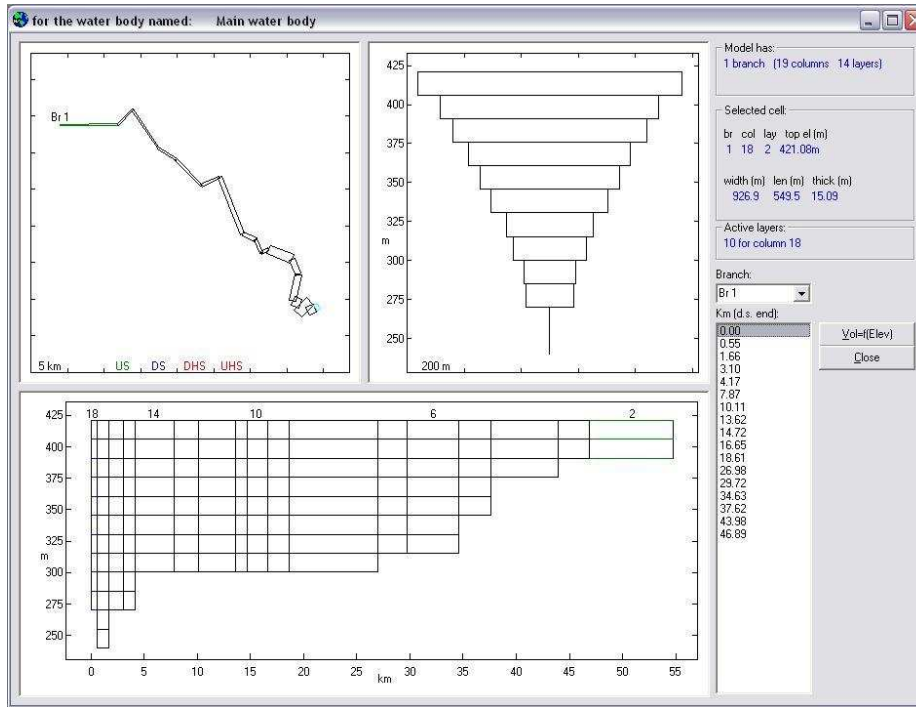


Figure 3-4 Bathymetry profile for segment 18

3.2 Control File

Of the four input files created with actual data, the control file is the file needing the most work. Besides the fact that no constituent parameters are listed, all the values that do appear are the default values specified in the user's manual. In fact, the only portion of the file that appears to be accurate is the grid card, the simulation time information, the branch geometry, and the water body location. While the file should be able to run without any constituents defined, the CE-QUAL-W2 preprocessor consistently reports an "inflow/ouflow" error in the control file. Once this and the rest of the errors are located and corrected, constituent parameters must still be defined to make the model meaningful. For students attempting to build on this project, this is a good starting point.

course of a single month. Although this file represents the only inflow information currently available, better inflow data may become available in the future. As with the meteorological file, the inflow file appears to be constructed properly, though until the control file is corrected, there really is no way of knowing for sure

JDAY	QIN
1.0	2.58
2.0	2.58
3.0	2.58
4.0	2.58
5.0	2.58
6.0	2.58
7.0	2.58
8.0	2.58
9.0	2.58
10.0	2.58
11.0	2.58
12.0	2.58
13.0	2.58
.	.
.	.
75.0	1.76
76.0	1.76
.	.
.	.
132.0	2.34
133.0	2.34
.	.
.	.
282.0	2.56
283.0	2.56
.	.
.	.
581.0	32.32
582.0	32.32
.	.
.	.
728.0	2.00
729.0	2.00
730.0	2.00

Figure 3-6 Inflow file

4 Conclusion

Although we never obtained a running model, much progress was made toward being able to create the model. A bathymetry file, control file, meteorological file, and branch inflow file were created using the best data available. Though we did verify the bathymetry file with the AGPM program, the same cannot be said of the control file. The control file still contains errors which are identified in the pre.err file created by the CE-QUAL-W2 preprocessor. Unfortunately, the error messages are vague and it is unclear how much time would be needed to resolve them.

Though the model is incomplete, this project has accomplished much more than creating a partially completed set of input files. Through the efforts of this project we and the students in Mexico were able to learn more about how the CE-QUAL-W2 model works and what it can do. We were also able to identify what needs to be done in order to obtain a working model. Probably the most important lesson learned from this project is how to work as a team and collaborate with engineers on an international scale. If the teamwork lessons learned and relationships formed were the only outcomes of the project they would be results enough to make the project worthwhile.

5 References

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Attachments


Communication

ITESO e-mails

Date: Wed, 28 Mar 2007 11:08:36 -0600

From: ab50638@iteso.mx

To: "oliver obregon" <oliverobregon@yahoo.com.mx>

Subject:  branch inflow data

Ajuntamos los datos de entrada por día del 2001 y 2002 en un archive listo para usarse en CE QUAL, los datos obtenidos son a partir de promedios de datos mensuales y se los enviamos para que puedan ir corriendo el modelo. En este momento estamos trabajando sobre datos reales por día para enviárselos a la brevedad posible.

Date: Thu, 29 Mar 2007 07:12:39 +0800

From: "adan espejo" <adanes@mexico.com>

To: "oliver obregon" <oliverobregon@yahoo.com.mx>, shaiderol@hotmail.com, ab50638@iteso.mx, ab64336@iteso.mx, "jaime severino" <jaimeseverino@gmail.com>

CC: "clark barlow" <clark.barlow@gmail.com>


Subject: Re: Reporte semanal 3

Hola! qué tal? Sólo queríamos preguntarles dos cosas: 1.- si les fue de ayuda lo que les enviamos? 2.- qué otras cosas necesitan? Bueno, que estén bien. Estamos a sus órdenes. Gracias. Adán

Date: Mon, 5 Mar 2007 20:08:10 -0600

From: "Leon Mayoral Alonso" <leon27@gmail.com>

To: oliverobregon@yahoo.com.mx, severino@iteso.mx, "Karla Barajas" <karlabarajas@gmail.com>, hugo.dealba@gmail.com, adanes@mexico.com, shaiderol@hotmail.com, leon27@gmail.com

Subject:  Parameters of pollutants and temperatures

Hi

Here I send you the parameters of pollutants and temperatures you might need.

Farewell León.

Date: Tue, 27 Feb 2007 19:39:36 -0600

From: ab64336@iteso.mx

To: "oliver obregon" <oliverobregon@yahoo.com.mx>

CC: hdealba@iteso.mx, severino@iteso.mx

Subject: Re: WMS informacion

Hola Oliver:

Estamos buscando los datos que nos pidieron.

Por lo pronto te mando la liga a una página donde puedes encontrar

precipitación, dirección y velocidad del viento por hora para la ciudad

de Tepic (muy cerca del Cajón). Solo tienes que especificar el día en la sección de historia y almanaque.

La página es:

<http://espanol.wunderground.com/global/stations/76556.html?bannertypeclick=big2>

En cuanto a los datos de temperatura y parámetros de contaminación. Esperamos tenerlos a más tardar este viernes. Y de los flujos de entrada y salida parece que no hay datos por hora ni por día pero estamos haciendo lo posible por conseguirlos y se los mandaremos a la brevedad posible. Cualquier cosa estamos en contacto. Adán

Date: Mon, 26 Feb 2007 10:17:28 -0600

From: "Leon Mayoral Alonso" <leon27@gmail.com>

To: hugo.dealba@gmail.com, "Karla Barajas" <karlabarajas@gmail.com>, oliverobregon@yahoo.com.mx,

clark.barlow@gmail.com,  tlloyd24@yahoo.com,  adam_birdsall@yahoo.com, kyle_sanford@byu.net,

emmelate@hotmail.com, benjaminriggs@gmail.com, adanes@mexico.com,

patito_amarillo@hotmail.com, severino@iteso.mx

Subject: Geographic coordinates of the dam

Greetings!

I give you the coordinates of the dam "El Cajon" wich are 21° 25' 41" of north latitude and 104° 27' 14" of west longitude. Leon.

Date: Mon, 12 Feb 2007 12:56:22 -0600

From: "Jaime Severino" <jaimeseverino@gmail.com>

To: "oliver obregon" <oliverobregon@yahoo.com.mx>, clark.barlow@gmail.com

CC: "Hugo de Alba" <hugo.dealba@gmail.com>

Subject: Re: Pregunta

Hola Oliver y Clark

No es posible descargar información más detallada que la que se encuentra en el INEGI. Nosotros tenemos la carta 1:250,000 que contiene los tipos y usos de suelo y que abarca aproximadamente el 90% de la cuenca de El Cajón. Los estudiantes comenzarán hoy a hacer el cambio en los códigos de tipos y usos de suelo para que se puedan usar directamente en el WMS. ¿Quieres que te los envíe así como están con los nombres y códigos usados en México o en un par de días que terminen ese trabajo los estudiantes y ya esté en los códigos usados en Estados Unidos?

También están comenzando a delimitar el embalse y los segmentos para el modelado. Se los enviamos en cuanto estén listos, o ¿prefieren que recibir la delimitación del embalse desde sin los segmentos?

Una aclaración/duda técnica: nosotros estamos considerando la cuenca de aportación a el embalse El Cajón desde la cortina de la presa, hasta (aguas arriba) el futuro embalse de La Yesca cuya construcción está comenzando (21°11' 51.9"N, 104°06'19.37"W), pues la dinámica de El Cajón se verá influenciada directamente por el funcionamiento de La Yesca. Con esta consideración la superficie de la cuenca se reduce notablemente y se considera la salida de La Yesca como la entrada a El Cajón. ¿cómo les parece esta consideración? Saludos Jaime

Date: Sun, 11 Feb 2007 21:40:44 -0600

From: "Leon Mayoral Alonso" <leon27@gmail.com>

To: hugo.dealba@gmail.com, "Karla Barajas" <karlabarajas@gmail.com>,oliverobregon@yahoo.com.mx, clark.barlow@gmail.com, 📧 tloyd24@yahoo.com, 📧 adam_birdsall@yahoo.com, kyle_sanford@byu.net, emmelate@hotmail.com, benjamingriggs@gmail.com, adanes@mexico.com, patito_amarillo@hotmail.com

Subject: 📧 Greetings! MDE files!

Greetings!

I am Leon Mayoral, one of the students of environmental engineering in Guadalajara, Mexico at University ITESO. I have attached a copy (as an image file) of the zone that corresponds to the dam "El Cajon". We might need the use of DME files (Digital Model of Elevation) that correspond to the zone we are studying. You can Download them at <http://www.inegi.gob.mx/> You will have to create an account so you can download the files. To do this, click "Secciones de Consulta" in the "Informacion Geografica" Seccion, then find and select the "Sistema de Descarga del Continuo de Elevaciones Mexicano". Then you will be asked your Log In and password, you can create one just below. When you have entered the new page, click the "Area de descarga del CEM" seccion. Then, on the blank below, on the Option 1 seccion, write the code related to the image in the picture I just sent you and click "enviar" Then on the following page, just click "Extraer MDE" to download the files.


I could send the files to you but we were asked to tell you how to do it. If you have any problem you can just send me an e-mail to this direction and I will gladly solve any problems.

Thaks for your attention!

Leon.

Date: Wed, 07 Feb 2007 17:50:36 -0600

From: ab50638@iteso.mx

To: oliverobregon@yahoo.com.mx, clark.barlow@gmail.com,  tlloyd24@yahoo.com, adam_birdsall@yahoo.com, kyle_sanford@byu.net

Subject:  Introducción presa "El Cajón"

 **Presentaci_n_del_Proyecto_Hidroel_ctrico_El_Caj_n.doc** (2.5MB)

 **SUMMARY.doc** (232k)

Date: Wed, 7 Feb 2007 17:32:04 -0600

From: "Jaime Severino" <jaimeseverino@gmail.com>

To: "oliver obregon" <oliverobregon@yahoo.com.mx>

Subject: Re: CE-QUAL-W2 model BYU

Hola Oliver

Ok, que bueno que me dices cómo andan en el CE-QUAL-W2. Nosotros también estamos aprendiendo a usarlo, así que nos apoyaremos entre todos.

Los estudiantes que estarán involucrados directamente son Jorge Abraham del Valle y Adan Espejo.

Estamos en contacto y saludos

Date: Fri, 2 Feb 2007 15:47:58 -0600

From: "Jaime Severino" <jaimeseverino@gmail.com>

To: "oliver obregon" <oliverobregon@yahoo.com.mx>, clark.barlow@gmail.com

CC: "Hugo de Alba" <hugo.dealba@gmail.com>, "Karla Barajas" <karlabarajas@gmail.com>, "Montserrat Miramontes" <monchester@gmail.com>

Subject: Re: BYU lago el cajon

Hola Oliver

Muy bien, por acá los alumnos están preparando un documento que explica toda la situación de El Cajón y el río Santiago, para enviárselos. Estará listo lunes o martes.

Sobre el modelo ¿ustedes tiene práctica en el uso del software? En cuanto esté el documento listo se los enviamos para ponernos de acuerdo con las actividades.

Estamos en contacto.

Saludos

Jaime

Date: Sat, 27 Jan 2007 11:30:35 -0600

From: "Montserrat Miramontes" <monchester@gmail.com>

To: jimn@byu.edu, oliverobregon@yahoo.com.mx, clark.barlow@gmail.com, 🌐 tlloyd24@yahoo.com, kyle_sanford@byu.net, 🌐 adam_birdsall@yahoo.com, emmelate@hotmail.com, benjamingriggs@gmail.com

CC: "Karla Barajas" <karlabarajas@gmail.com>, "Jose de Anda Sanchez" <janda@cencar.udg.mx>

Subject: 📧 Greetings from Mexico!

Hola,

Les escribo para decirles quiénes estarán participando en cada uno de los proyectos (estudiantes y graduados):

En el Cajón:

Responsable: Javier Clausen (jclausen@iteso.mx)

Participan:

Hugo de Alba (hugo.dealba@gmail.com) ,

Jaime Severino (jaimeseverino@gmail.com) ,

Montserrat Miranmontes (monchester@gmail.com) y

Karla Barajas (karlabarajas@gmail.com)

Estudiantes:

José Adán Espejo Preciado

ab64336@iteso.mx

adanes@mexico.com

León Mayoral Alonso

ab52645@iteso.mx

leon27@gmail.com

Jorge Abraham del Valle Márquez

ab50638@iteso.mx

shaiderol@hotmail.com

Roberto Sánchez Oropeza

ab48720@iteso.mx

robert.oropeza@gmail.com

Todavía no está definido quiénes de los estudiantes estarán en el modelado de calidad del agua y quiénes en el modelado hidrológico, sin embargo, esto se definirá la próxima semana.

Muchos saludos, Karla

BYU e-mails

Date: Wed, 4 Apr 2007 17:42:26 -0500 (CDT)

From: "oliver obregon" <oliverobregon@yahoo.com.mx>

To: "jaime severino" <jaimeseverino@gmail.com>, "Adan espejo" <adanes@mexico.com>, shaiderol@hotmail.com, ab50638@iteso.mx, ab64336@iteso.mx

CC: "Jose Clausen" <jclausen@iteso.mx>

Subject:  Bathymetry file

Saludos,

Les escribimos para comentarles que finalmente pudimos obtener el bathymetry file. Tuvimos algunos problemas para delinear el vaso de la presa, que nos tomo algo de tiempo pero ya esta listo.

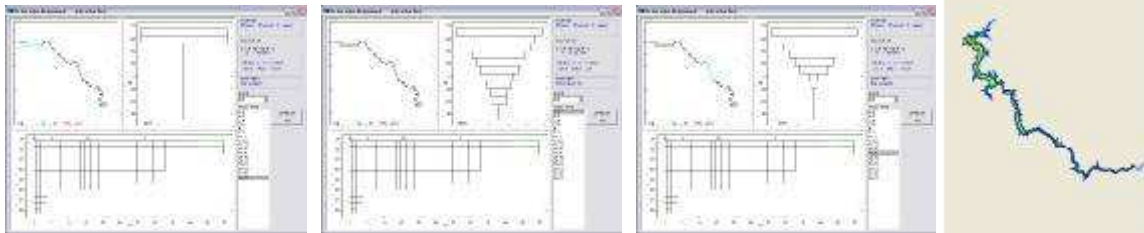
Les adjuntamos algunas imagenes del bathymetry file y de la delineacion del vaso de la presa. Esta delineacion se hizo utilizando el archivo que Jaime nos proporciono.

Saludos y seguimos en contacto

Clark Barlow

Oliver Obregon

Archivos adjuntos



Date: Fri, 9 Mar 2007 18:12:17 -0600 (CST)

From: "oliver obregon" <oliverobregon@yahoo.com.mx>  [Añadir a la Libreta de contactos](#)

To: "Adan espejo" <adanes@mexico.com>, shaiderol@hotmail.com, ab50638@iteso.mx,

ab64336@iteso.mx, "jaime severino" <jaimeseverino@gmail.com>, "Jim Nelson" <jimn@byu.edu>

CC: "clark barlow" <clark.barlow@gmail.com>

Subject: Reporte semanal 3

Les enviamos el link donde pueden revisar el reporte semanal 3 (Lago el Cajon):

<http://www.et.byu.edu/groups/cemexico/2007/LagoCajon/ProgressReport3.pdf>

Saludos,

Clark Barlow

Oliver Obregon

Date: Wed, 7 Mar 2007 17:20:49 -0600 (CST)

From: "oliver obregon" <oliverobregon@yahoo.com.mx>

To: "jaime severino" <jaimeseverino@gmail.com>

CC: "clark barlow" <clark.barlow@gmail.com>

Subject: Formato de presentacion

Jaime, Hola, como estan? Les escribimos para saludarlos y preguntarles si requieren algun formato para la presentacion (tiempo disponible) que haremos en 2 semanas. Ademas, si nos pueden enviar algunas preguntas que tengan y que les gustaria fueran contestadas el dia de la presentacion. Saludos,
Clark Barlow
Oliver Obregon

Date: Fri, 2 Mar 2007 17:51:03 -0600 (CST)

From: "oliver obregon" <oliverobregon@yahoo.com.mx>
To: "jaime severino" <jaimeseverino@gmail.com>, "Jim Nelson" <jimn@byu.edu>, "Adan espejo" <adanes@mexico.com>, shaiderol@hotmail.com, ab50638@iteso.mx, ab64336@iteso.mx
CC: "clark barlow" <clark.barlow@gmail.com>

Subject: Reporte semanal 2

Les enviamos el link donde pueden ver el segundo reporte semanal del proyecto "Lago el Cajon". Si tienen alguna pregunta no duden en contactarnos.

<http://www.et.byu.edu/groups/cemexico/2007/LagoCajon/ProgressReport2.pdf>

Saludos,
Clark Barlow
Oliver Obregon

Date: Mon, 26 Feb 2007 18:07:54 -0600 (CST)

From: "oliver obregon" <oliverobregon@yahoo.com.mx>
To: "jaime severino" <jaimeseverino@gmail.com>, "Adan espejo" <adanes@mexico.com>, shaiderol@hotmail.com, ab50638@iteso.mx, ab64336@iteso.mx
CC: "clark barlow" <clark.barlow@gmail.com>

Subject: Elevacion del vaso de almacenamiento

Jaime, Clark y yo encontramos las elevaciones maxima y minima del vaso de almacenamiento de la presa "El Cajon" en

<http://www.cfe.gob.mx/CAJON/es/InformacionTecnica/Datos/VasoAlmacenamiento/>

Nosotros utilizamos estos valores para desarrollar una prueba de los limites del vaso de almacenamiento de la presa. Ustedes pueden ver estos mapas en el siguiente link:

http://www.et.byu.edu/groups/cemexico/2007/LagoCajon/index_files/page0002.htm

Por favor chequenlos y digamos donde el vaso de almacenamiento comienza para que nosotros podamos definir correctamente el area del vaso de almacenamiento.

En el caso de que no tengas las coordenadas, les agradeceriamos que lo marcaran en el mapa que les estamos enviando. Gracias y estamos en contacto por si tienen alguna duda.

Saludos
Clark Barlow
Oliver Obregon

Date: Fri, 23 Feb 2007 18:20:04 -0600 (CST)

From: "oliver obregon" <oliverobregon@yahoo.com.mx>

To: "Adan espejo" <adanes@mexico.com>, shaiderol@hotmail.com, ab50638@iteso.mx, ab64336@iteso.mx, "jaime severino" <jaimeseverino@gmail.com>, "Jim Nelson" <jimn@byu.edu>

CC: "clark barlow" <clark.barlow@gmail.com>

Subject: Avance de Proyecto 1

Participantes del proyecto "Lago el Cajon": Les enviamos el link en donde pueden ver el primer reporte del proyecto. [Avance de proyecto1](#) Si tienen alguna pregunta, no duden en contactarnos. Gracias.

Saludos,

Clark Barlow

Oliver Obregon

Date: Thu, 22 Feb 2007 21:42:19 -0600 (CST)

From: "oliver obregon" <oliverobregon@yahoo.com.mx>

To: "jaime severino" <jaimeseverino@gmail.com>, "Adan espejo" <adanes@mexico.com>, shaiderol@hotmail.com, ab50638@iteso.mx, ab64336@iteso.mx

CC: "clark barlow" <clark.barlow@gmail.com>

Subject: Paginaweb presa el Cajon

Jaime, Aquí te enviamos la pagina web que creamos para que ustedes puedan ir viendo los avances del proyecto. Además, la pagina tiene un link el cual incluye el plan de trabajo (en ingles).

<http://www.et.byu.edu/groups/cemexico/2007/LagoCajon/>

Si crees que alguien del equipo necesita el plan de trabajo en español también podríamos agregarlo en español. Otra cosa, si tienen alguno avance de la información solicitada, se los agradeceremos mucho.

Gracias y estamos en contacto.

Saludos

Clark Barlow

Oliver Obregon

Date: Wed, 21 Feb 2007 18:09:48 -0600 (CST)

From: "oliver obregon" <oliverobregon@yahoo.com.mx>

To: "jaime severino" <jaimeseverino@gmail.com>, shaiderol@hotmail.com, ab50638@iteso.mx, adanes@mexico.com, ab64336@iteso.mx

CC: "clark barlow" <clark.barlow@gmail.com>

Subject: WMS informacion

Jaime, Hola como estan? El motivo de mi correo es saludarlos y solicitarles alguna informacion que necesitamos para correr el modelo.

1. El punto de elevacion mas alto y mas profundo del lago de la presa.
2. Flujos de entrada (desde inicio del embalse) y flujos de salida desde cortina de la presa El Cajon. De preferencia que los datos de los flujos seran de mediciones diarias, pero seria mucho mejor si tienen las mediciones por hora.
3. Temperatura diaria del embalse (lago de la presa), de puntos que usted consideren importantes.
4. Velocidad y direccion diaria del viento, pero si tienen esta informacion por hora seria mucho mejor.
5. Precipitacion diaria, pero si tienen esta informacion por hora seria de muchisima mas ayuda.
6. Parametros de contaminantes que ustedes quieran que nosotros corramos en el modelo. Por ejemplo nutrientes, DBO, etc.
7. Dimensiones de la presa: altura y ancho de la cortina, dimensiones del lago de la presa.

Gracias y cualquier pregunta no duden en contactarnos

Saludos Oliver Obregon

Date: Mon, 19 Feb 2007 16:08:05 -0600 (CST)

From: "oliver obregon" <oliverobregon@yahoo.com.mx>

To: "Jaime Severino" <jaimeseverino@gmail.com>

Subject: Gracias

Jaime,

Gracias por contestar nuestra pregunta y un disculpa por no haberte contestado antes.

Clark y yo pensamos que esta bien la delimitacion que estan haciendo, y seria mejor si nos envian esa delimitacion junto con los codigos (Mexico, como de Estados Unidos). Ademas vamos a solicitarles otra informacion que es necesaria para correr el el programa CE-QUAL-W2 (estamos definiendola). Ademas, el miercoles te enviaremos el plan de trabajo que hicimos y una pagina web que estamos haciendo para que ustedes puedan ver avances y resultados. Te comento que Clark y yo trabajaremos con el CE-QUAL-W2 en el embalse de la presa el Cajon y el equipo de Thomas esta trabajando con otro programa, usando informacion desde la Yesca hasta la cortina de el Cajon.

Gracias y estamos en contacto
Oliver

Date: Mon, 12 Feb 2007 12:25:18 -0600 (CST)

From: "oliver obregon" <oliverobregon@yahoo.com.mx>

To: "jaime severino" <jaimeseverino@gmail.com>

Subject: Pregunta

Jaime, Te escribo para saber de donde podemos bajar mapas (digitales) de uso y tipo de suelo del estado de Nayarit? Ya pudimos bajar el DEM pero necesitamos los de tipo y uso de suelo. Encontramos un link en la pagina del INEGI pero solo conseguimos bajar de todo el pais. Te agradeceriamos mucho nos pudieras ayudar con esa informacion.

Atte.

Clark Barlow

Oliver Obregon

Date: Wed, 7 Feb 2007 17:26:29 -0600 (CST)

From: "oliver obregon" <oliverobregon@yahoo.com.mx>

To: "Jaime Severino" <jaimeseverino@gmail.com>

CC: "clark barlow" <clark.barlow@gmail.com>

Subject: CE-QUAL-W2 model BYU

Hola Jaime

Antes que nada una disculpa por no haberte respondido antes. Te comento que somos nuevos utilizando CE-QUAL-W2, el cual es utilizado para analizar la calidad del agua. Clark tiene mas experiencia que yo pero el Dr. Nelson y algunos estudiantes de maestria nos estan apoyando (Ana Paz).

Por otro lado, nos gustaria saber quien especificamente estara trabajando con el CE-QUAL-W2 model para calidad del agua de el Cajon. Me imagino que tu estaras en el proyecto, pero te agraceriamos mucho que nos pudieras enviar los nombres para agragalos al plan de trabajo junto con los datos que nos enviarian.

Gracias y estamos en contacto.

Date: Fri, 2 Feb 2007 14:52:34 -0600 (CST)

From: "oliver obregon" <oliverobregon@yahoo.com.mx>

To: jclausen@iteso.mx, karlabarajas@gmail.com, monchester@gmail.com, jaimeseverino@gmail.com, hugo.dealba@gmail.com

CC: clark.barlow@gmail.com

Subject: BYU lago el cajon

Hola a todos,

Mi nombre es Oliver y voy estar trabajando, junto con mi compaño Clark desarrollando el WMS model para el lago del Cajon. El modelo que vamos a utilizar es CE-QUAL-W2. Mi equipo (Clark y yo) estamos diseñando un plan de trabajo. Tan pronto como este terminado se los enviaremos.

La verdad estamos muy contentos de poder trabajar con ustedes y estamos a sus ordenes para cualquier pregunta.

Saludos

Clark Barlow clark.barlow@gmail.com

Oliver Obregon oo24@et.byu.edu

Project Files

The files created and used for this project are located on the following file path:

J:\groups\cemexico\LagoCajon. They are also contained on CD-ROM. The files consist of the following folders: Control Files, Final Report, Input Files, NewWMSFiles, Presentation, RawData, and ReferenceDocs. The readme.txt file contained in the LagoCajon folder explains the contents of these folders in greater detail.