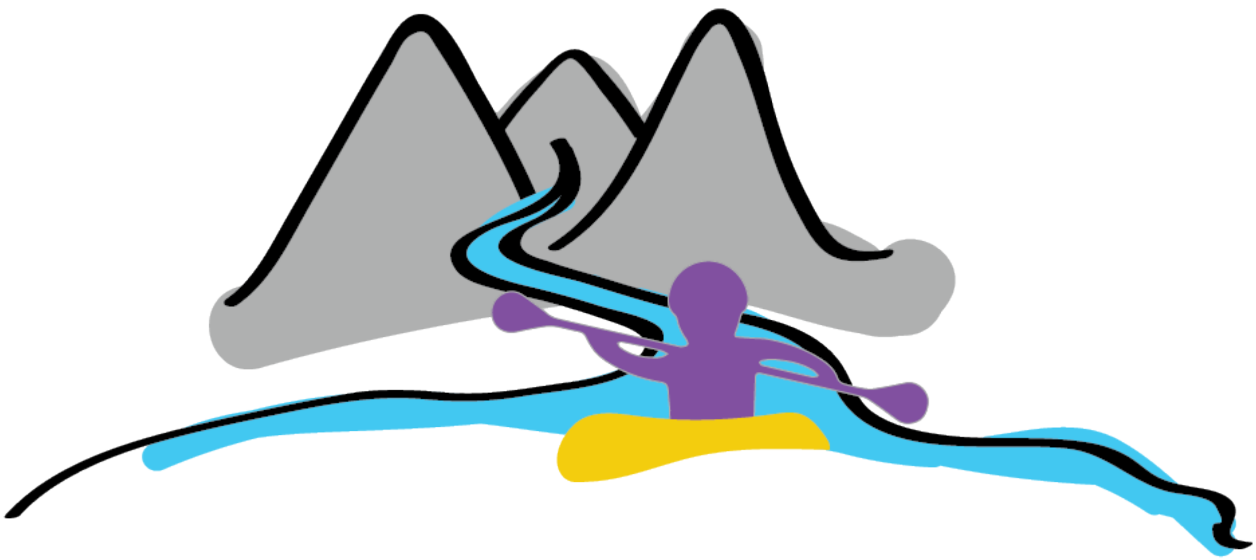
RAFTER

Software for the Geological Analysis of River Stream Data



Software Requirements Specifications

6 May 2018

Revision Signatures

By signing the following, each team member acknowledges that they have read the entire document and, to the best of their knowledge, found the both relevant and accurate to the continued development of RAFTER.

Name	Signature	Date
Connor Cox		
Kaitlin Hendrick		
Kiet Nguyen		
Jim Pfluger		

Revision History

This table is a history of document revisions.

Version	Changes	Date
1.0	Initial Document	27 September 2017
2.0	Moved Information to Design Document	20 October 2017
3.0	Minor Revisions	17 November 2017
4.0	Filled in Missing Info	15 December 2017
5.0	Final Document	6 May 2018

A. System Overview:

The target audience for this product is geologists who work out in the field or examine ancient geological records; however, the usage of the product can vary from academic purposes to uses in industry. The project features a web-based application that lets a user choose either the Fulcrum Theory Calculations, the Stream Specific t_{bd} Calculations, or Searching for an Analogue Stream to get results from calculations performed using a combination of user input and additional geological data stored within the database. We have the opportunity to work with Nicole Wilson, a Geology graduate student, who has the role of both client and business analyst for our team. Nicole has researched the subject matter and the Fulcrum Theory Approach methodology as well as gathered the stream data which will populate the database from a variety of different sources including the United States Geological Survey, USGS. The main functionalities of the application include calculating the year averaged bankfull flow duration (t_{bd}) based on a specific river's attributes, taking user input and returning values calculated using the Fulcrum Theory Approach, and using the two processes described above in combination to calculate a more accurate sediment discharge estimate based on the Fulcrum Theory and the calculated variable of year averaged bankfull flow duration for a specific river. In addition, a user should be able to access supporting documentation regarding the Fulcrum Approach, know the reference source of the stream data used in the calculations, and be able to identify analogue streams in order to extend research on different streams or to quantify potential reservoir rock for oil deposits.

B. Technical Requirements:

i. Functional Requirements:

Our functional requirements are laid out in the detailed user stories below.

a. A user should be able to input data so that sediment volume discharges, slope, mean flow velocity, bankfull discharge, bedload discharge and bedload sediment volume discharge can be calculated using a variety to equations from the Fulcrum Theory.
b. A user should be able to determine year averaged bankfull flow duration (t_{bd}) binned on a combination of attributes including climate, river size and drainage basin to get a more accurate value for days at bankfull flow based on a specific river's attributes.
c. A user should be able to determine year averaged bankfull flow duration (t_{bd}) binned on a combination of attributes and use this specified variable

with data they input to calculate sediment volume discharge using the Fulcrum Theory Approach.

d. A user should be able to see what specific streams' data contributed to the value of t_{bd} so that they can feel confident in the calculation and look for a specific analogue stream.
e. A user should be able to search for analogue rivers based on a combination of attributes including climate, river size and drainage basin.
f. A user should be able to look at stream specific data and an aerial map of that stream in order to see what type of river this is (i.e. braided, meandering etc.) and further confirm it as a possible analogue.
g. A user should be made aware of the reference source of the estimated bankfull discharge volume for each specific stream so that they can look at the original data source if desired.
h. A user should be able to access to supporting documentation regarding the Fulcrum Theory Approach for a more detailed understanding of the methodology.
i. A user should be able to choose a level of precision by being able to select whether the stream specific t_{bd} value is calculated based on being within 10% or 20% of the literature bankfull discharge value.

ii. Nonfunctional Requirement:

Since the application will be used by geologists from around the world, it must be able to be accessed from foreign domains, perform fast database queries and calculations, and be able to hold up to hundreds of simultaneous requests as well as take security into consideration. We must also ensure the application is intuitive and simple enough so that the nontechnical user will be able to leverage the application. We set up many security measures to ensure the data is protected, especially since the UI will be querying the database.

iii. UI Requirement:

We know we want the UI to be as intuitive as possible which will include providing a brief explanation of the Fulcrum Theory Approach and the Stream Specific t_{bd} approach, as well as links to supporting documents in case users need further clarification or want to learn more about the concepts. The user should be able to select which approach they want to utilize in the calculations and enter all the data needed to perform the calculations. The result data and a table with data about streams used to derive the results should be displayed to the user after the calculations are performed.

C. Acceptance Criteria/ Interaction Scenarios:
The user has the option to utilize the Fulcrum approach, the stream specific t_{bd} approach, or both to get results from calculations performed using a combination of user input and additional data stored within the database as well as should be able to search for analogue streams independent of the calculation pieces. The user will first specify which method(s) they would like to use, which will determine what is displayed on the user input and results pages. A user can choose to use default value for t_{bd} or a stream specific t_{bd} value in the Fulcrum Theory calculations. If the user opts to utilize the stream specific t_{bd} section, they can select values for the climate and the drainage size and/or river size to get a more specific, and accurate, t_{bd} value to use in the other calculations. In this situation, the climate is the only required input but the user can choose a major climate or the Köeppen climate classification. Another important piece of information to note here is a record for a stream is only valid and eligible to be used as a part of the calculations if there is five full year’s worth of data on the stream. The identifying analogue streams functionality needs to be independent of the calculations because the rivers without five years of data are still eligible to be analogue streams.

D. Validation/Verification:
Both validation and verification will involve talking with Nicole, since she is the subject matter expert. Validation will specifically be done by Nicole and her advisor, as they are the primary contacts who will be executing the code and have a better idea of the way the application will be used. We will have regular discussions that will determine whether the software is meeting the needs of Nicole and the needs of her advisor. Additionally, Nicole and the team will perform testing to ensure the product works correctly, such as what is required as input and what is valid output. Verification will also be done occasionally with Nicole, but more often than not, it will fall on all members of the team. She will be there to help guide us along the documentation side of things, but ultimately we will be the ones who decide the design specifications and code so we must perform the necessary tests to ensure the project works as designed. Ideally, we will do code reviews on each commit to Git in addition to participating in pair programming. This will prevent errors from coming up that are costly to fix in the future. We also created unit tests for each calculation or new functionality we included to help identify if any new code changes break old functionality. As the project continues, we will perform the necessary checks with Nicole and the

necessary checks within the team. To summarize, validation will occur with Nicole during weekly Scrum meetings. Verification will mostly involve intra-team testing, analysis, and discussion throughout development of the product.

E. Requirements Considerations:

i. Assumption made about the software:

a. The team assumes that the users (the geologists) will be able to access TCU's database through the UI from foreign domains.
b. The team assumes someone will continue the maintenance of the project since the goal is for this application to be used long-term and internationally and new data may need to be periodically uploaded to the database.

ii. End users:

a. The primary users will be geologists, with little computer knowledge or experience, but each may have a different use for the application, primarily academic and industry usages.

iii. Existing system:

a. There is no current existing system or software for this project concept.

iv. Environment:

a. The front end is developed in ReactJS, Javascript and CSS.
b. The backend/middleware will be developed in C# in Visual Studio.
c. The database uses Microsoft SQL Server Management Studio 17.
d. Everything will be hosted by Amazon Web Services.

v. Limitation:

a. The system does not support modification of any data in the database; however new data can be loaded into the database by someone with access to the server.

vi. Rationale:

a. Our requirements will at least meet the needs of our users since there is no other solution that exists at this time. However, we are not simply providing a platform that will perform complex calculations. With Nicole's help and expertise in the area, we have designed an application that will be useful in many aspects of geology and allow for users to get more out of their research by being provided much more data and details than just results from the calculations. For example, as we have mentioned, one major use of this application will be to help geologists identify analogue streams that reflect properties of other streams. Our application will not only display stream names as the results but will allow a user to click on hyperlinks that will pull up a Google image of the stream and the reference source in case the user is interested in completing additional research on their own. We tried to create the most useful tool utilizing all of the data and providing many options for the user.

F. Glossary:

- Analogue stream - analogue refers to something parallel or comparable to something else so in this case a stream that shares similar properties to another existing stream or maybe an ancient stream. Some of the factors that help determine if it is an analogue stream is the climate classification, the river size, and the sediment volume discharged as well as what type of river it is (i.e. braided, meandering etc.)
- Bankfull Flow - bankfull refers to the water level stage that just begins to spill out of the channel into the floodplain; then bankfull flow is the rate at which water flows through a stream at this maximum height (year averaged bankfull flow is simply the average number of days in a year at which the river or stream flows at this rate and height)
- Fulcrum Theory approach - method and equations for calculating bankfull flow; the driving concept behind our project and Nicole's research
- t_{bd} Value - the t_{bd} value is also known as the year averaged bankfull flow duration and is simply the average number of days in a year at which the river or stream flows at bankfull flow rate and height which is calculated using the climate classification, drainage size, and the river size