**SPEECH LAYOUT**

**Introduction Us and Problem**

* Introduce team – we are CORE and international company that focuses on projects by consulting, optimising, revolutionising and executing solutions for our clients.
* Four months ago GHD advertised the issue of waterway contamination from an historic landfill site located in Mackay. This landfill site
* Environmental protection act
* Why do we need to model it: landwater model is vital because of

**Model (2mins)**

* Richards equation
  + Coupling with..
* Outline evotranspiration
* Rainfall input
* Cjrea

I’d now like to introduce Zander to discuss how we implemented these conditions into our chosen software.

**Computational Model (3-4 min)**

* Thank you Laura, using matlab we …
* Why is the model efficient? <- focus question!!
* No for loops
* Adaptive time step

I’ll pass you to Olivia to introduce how we incorporated rainfall data specific to Mackay

**Climate Model**

Thank you, Zander,

As the computational model was being created our team was able to work simultaneously on the rainfall model. Ten years of rainfall data was gathered from the Bureau of Meteorology (BOM) using a weather station nearby to our landfill in Mackay. The rainfall model used data ranging from 2011 to 2020 this was to encapsulate a wide range of years to gain an accurate dataset. When reading this data into our software it was found that there were some days in which the weather station did not record the daily rainfall. For these blank entries we decided to take an average of the rainfall on this date for all other years which recorded data and use that average as the value of the missing day. This way any missing values were not simply set to zero or based on the day before instead they were filled in with an average which is a more accurate representation of the missing data. Now that the data was checked for completeness and any inconsistencies filled in we used this data to create the rainfall models.

The first step in developing the rainfall model was to determine a daily average, to do this the nine years of data was averaged excluding the data from 2011 this is because in 2011 Australia, particularly Queensland, experienced intense flooding this skewed the overall average, so our team decided to take the average from 2012-2020 **(show figure)** and analyse the effect of extreme weather events on the model separately. The overall daily average calculated was 4.2 mm/day, this will be used as a baseline for the implementation of the next model. The next model developed to convey a more accurate depiction of the overall rainfall pattern was the cosine model. As seen in this plot here Mackay sees a spike in rainfall for the first few months of the year this then reduces significantly for \_\_\_ months before increasing again by the end of the year. The cosine model begins at the maximum oscillates to the minimum then increases again to the maximum which as you can see better displays the general pattern of rainfall. The limitation of this model is that it fails to capture these significant peaks as it has instead averaged the data. The cosine model also does not depict the number of days ***(how many days was it?)*** which Mackay had zero rainfall. This led to the implementation of a more accurate model the Fourier series approximation. The Fourier series approximation takes a dataset and \_\_\_ to produce a plot which follows closely to the given rainfall data. The benefits to utilising the Fourier model is that it can accept any dataset and a function in terms of time can be produced for the yearly rainfall of that data. ***(Talk about setting the oscillation of the Fourier series to zero)***

Due to the incomparable accuracy of the Fourier series approximation when compared to the cosine model and constant rainfall model it was decided that this approximation would be used for all further analysis. We decided to develop a Fourier series approximation for the average function as well as for significant weather events for example droughts and floods. The average Fourier model approximated this data to this function. **Show slide.** For drought periods the model was simply given zero rainfall, the results of this will be further detailed in the following analysis. Finally, the flood year data from 2011 was approximated to this model. **Show slide.** All analysis will consider these differing rainfall conditions to determine how the groundwater will move based on each condition.

**Markov chains**

Now that you’ve seen the code developed and the rainfall implementation to the current model, I will pass you to Laura to explain how we validated our model.

**Bucket Problem and Model Validation (1-2 min)**

Thank you, Olivia

* We modelled the implementation of our solution based on the analytic or expected solution
* The bucket problem disregards the more complex conditions and assumes no outflow at the boundaries and that the bucket is homogeneous meaning its made up of only one material. – also show drought year for hetero mesh
* The only condition introduced is the rainfall coming in from the top of the bucket.
* As seen in the graphs the model is valid ….
* Now that the model has been validated we can reintroduce this to the heterogenous problem with multiple different materials and boundary conditions

**Analysis**

* Constant, cosine , Fourier – Fourier reaches steady state the fastest (steady state is when the landfill can no longer accept more water – 95%) – evident that there are oscillation within the data – Baseline model
* Location of water table – evident that it remains roughly 2-4m below the landfill surface. Hence Fourier climate model was considered for the rest of the analysis (in the interest of time) .
* Benzene creek outflow based on range of Kc values
* Increasing evaporation rates in different sections (showing what an evaporate cap would do) – research plants that can result in greater evapotranspiration
* How changing the evaporation rate changes the water table 🡪 increasing evapotranspiration will lower the water table
* Provide recommendations on monitoring stations/evaporative measures if necessary
* Limitations of model (it is important to be transparent that there are limitations to the model) – there are tradeoffs

**Project Management (3-4 min)**

* Overview of approach to project – include animation thing that liv mentioned on the PPT
* Include PBS,WBS &OBS – established stakeholders
* Maintained good group dynamic – constant communication (met at least twice a week)
* Lessons learnt
  + Computational model took longer than expcted to implement – analysis when quite smoothly subsequent to its implementation
  + Previous experiences together, we knew where to allocate peoples roles as we knew peoples strengths/weaknesses. – we were also able to redelegate tasks along the way
* Quality assurance – drive home bucket problem validation/heterengous model also validated by project sponsor
* Risk impact – covid (one week of isolation)
* Not afraid to ask for help (very inclusive/positive environment)
* Iterative approach
* Time management – met up twice a week – progress was made every week as a group, we used github as a filesharing mechanism to be able to see edits that had been – we were constantly in contact with each

**Conclusion and Recommendations (1 min)**

* Recommendations (limitation doesn’t properly account for flood year – this can be further investigated if you are hired)
* Evaoprtaive cap (provide summary

Thank you listening to our presentation, are there any questions regarding our model or anything we can clarify further?