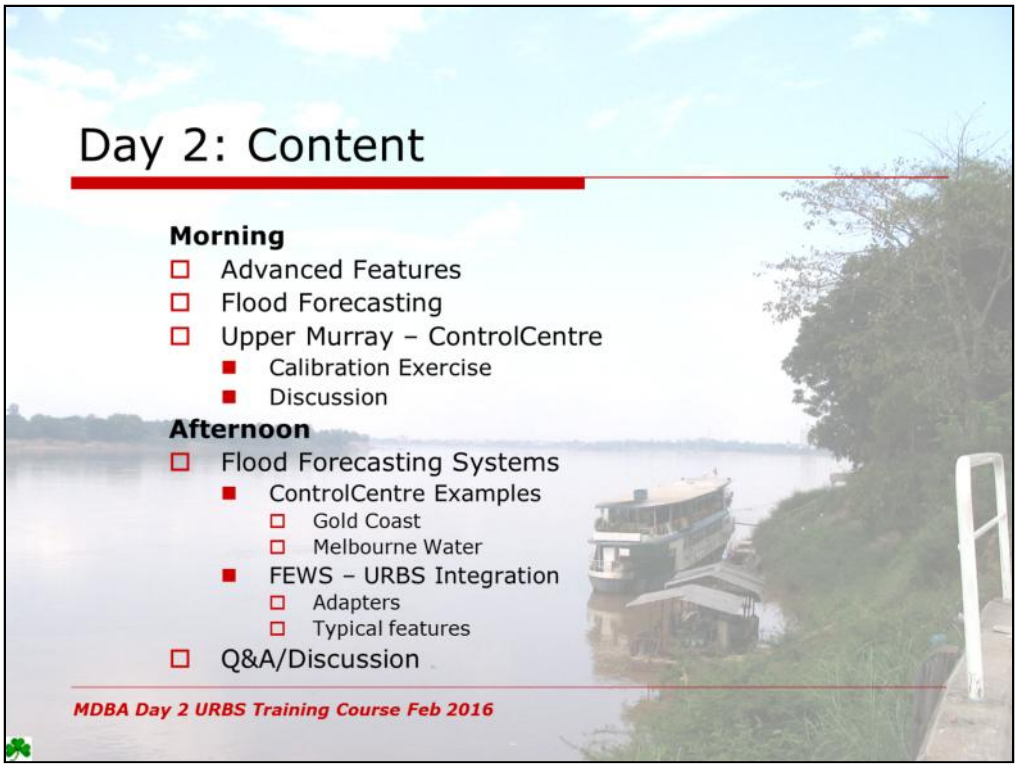
Day 2: Content
Morning
Advanced Features
Flood Forecasting
Upper Murray – ControlCentre
Calibration Exercise
Discussion
Afternoon
Flood Forecasting Systems
ControlCentre Examples
Gold Coast
Melbourne Water
FEWS – URBS Integration
Adapters
Typical features
Q&A/Discussion
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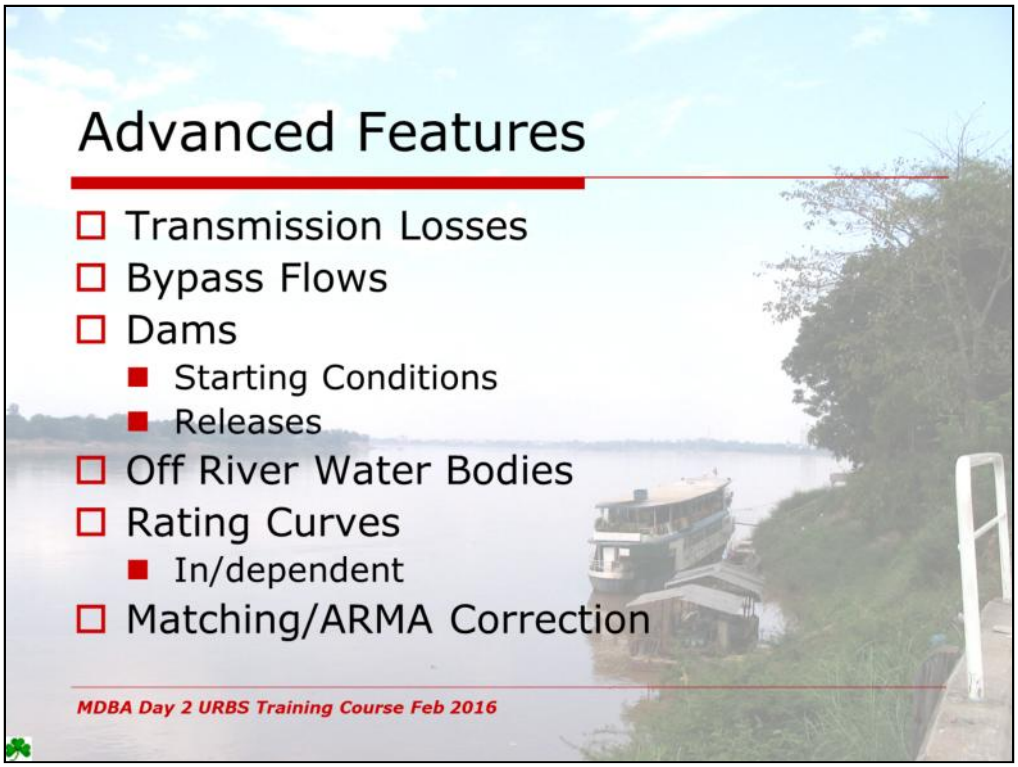
Advanced Features
Transmission Losses
Bypass Flows
Dams
Starting Conditions
Releases
Off River Water Bodies
Rating Curves
In/dependent
Matching/ARMA Correction
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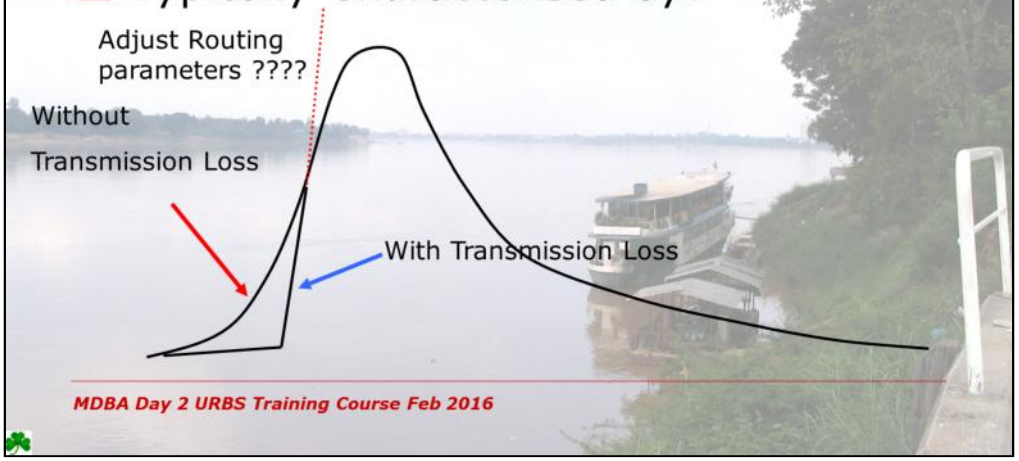
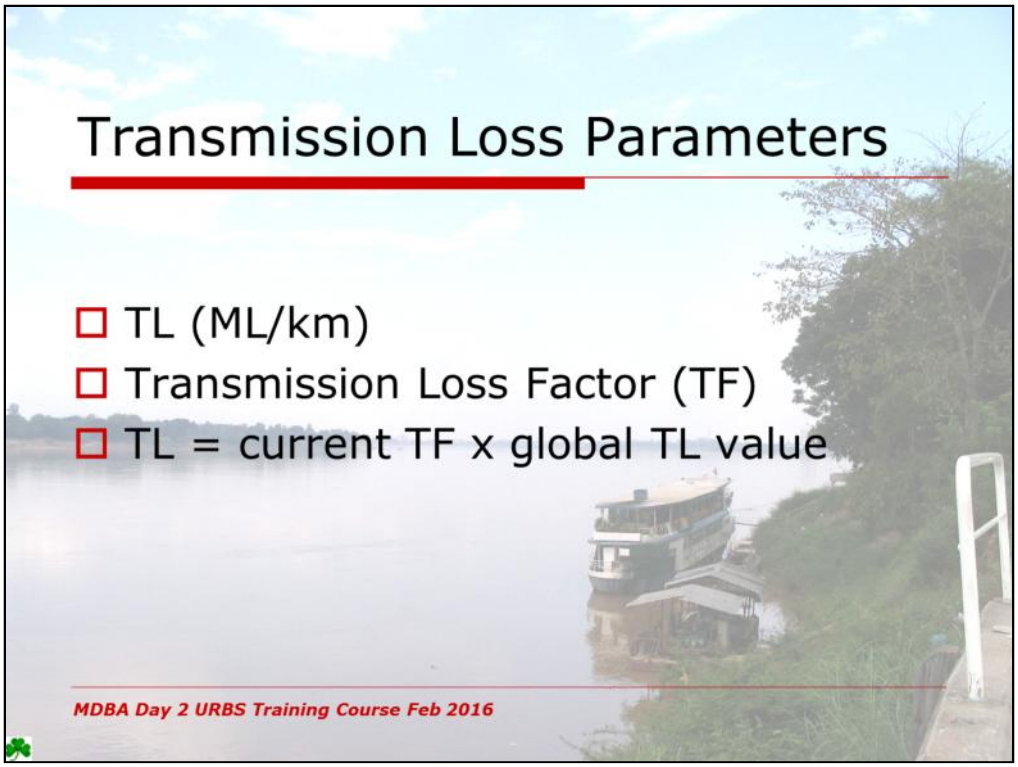
Transmission Losses (TL)

- Loss occurs through in-river storages
- Typically Characterised by:




Transmission Loss Parameters
TL (ML/km)
Transmission Loss Factor (TF)
TL = current TF x global TL value
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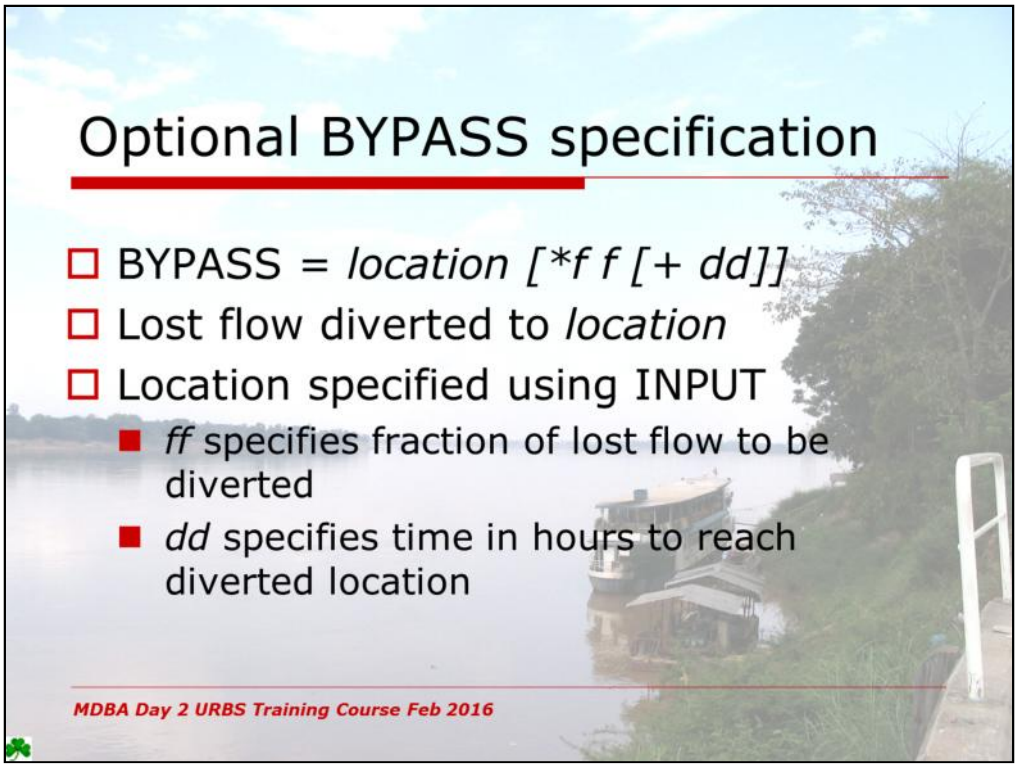
Optional BYPASS specification
BYPASS = location [*f f [+ dd]]
Lost flow diverted to location
Location specified using INPUT
ff specifies fraction of lost flow to be diverted
dd specifies time in hours to reach diverted location
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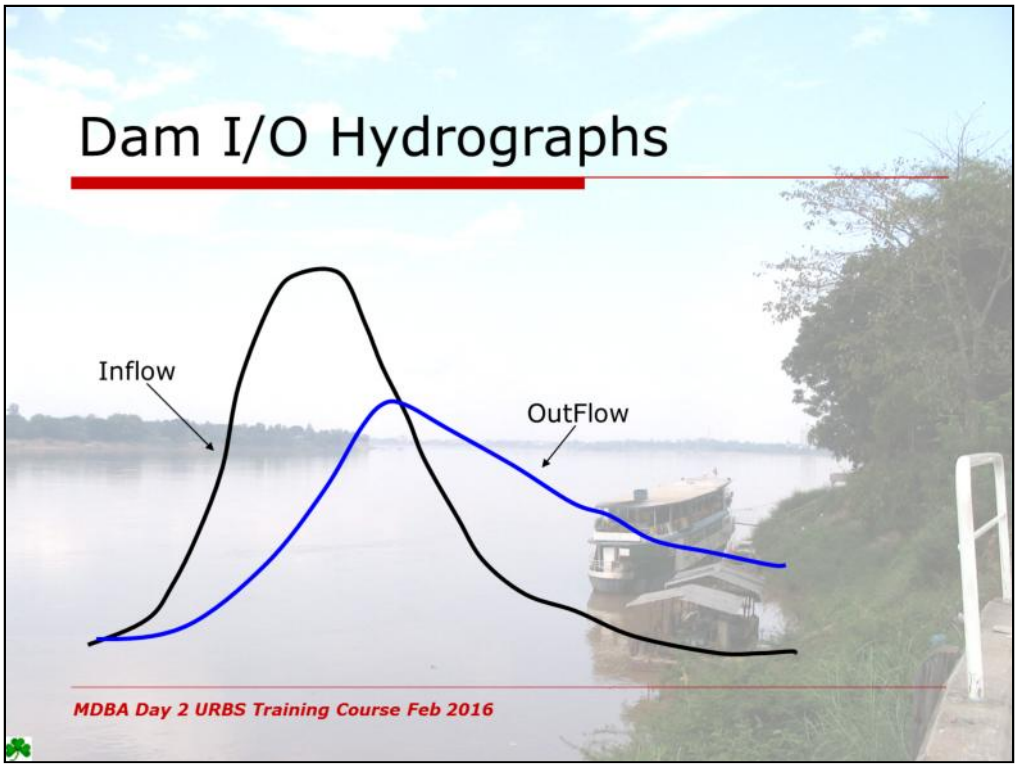
Dam I/O Hydrographs
Inflow
OutFlow
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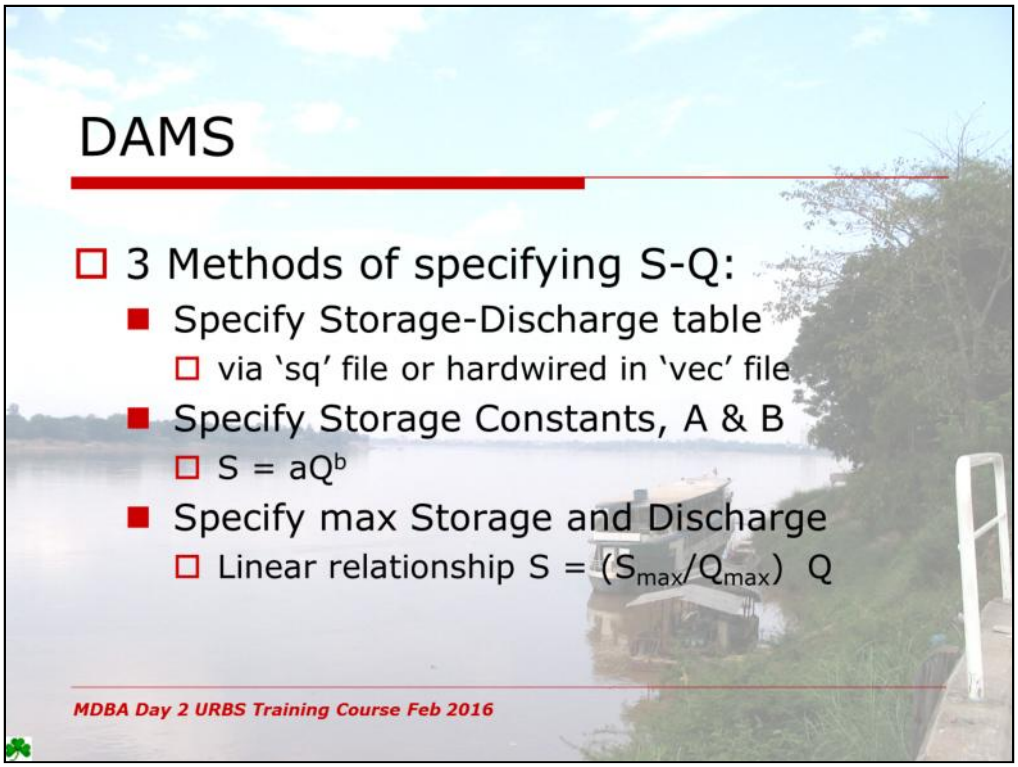
DAMS
3 Methods of specifying S-Q:
Specify Storage-Discharge table
via 'sq' file or hardwired in 'vec' file
Specify Storage Constants, A & B
$S = aQ^b$
Specify max Storage and Discharge
Linear relationship $S = (S_{max}/Q_{max})\ Q$
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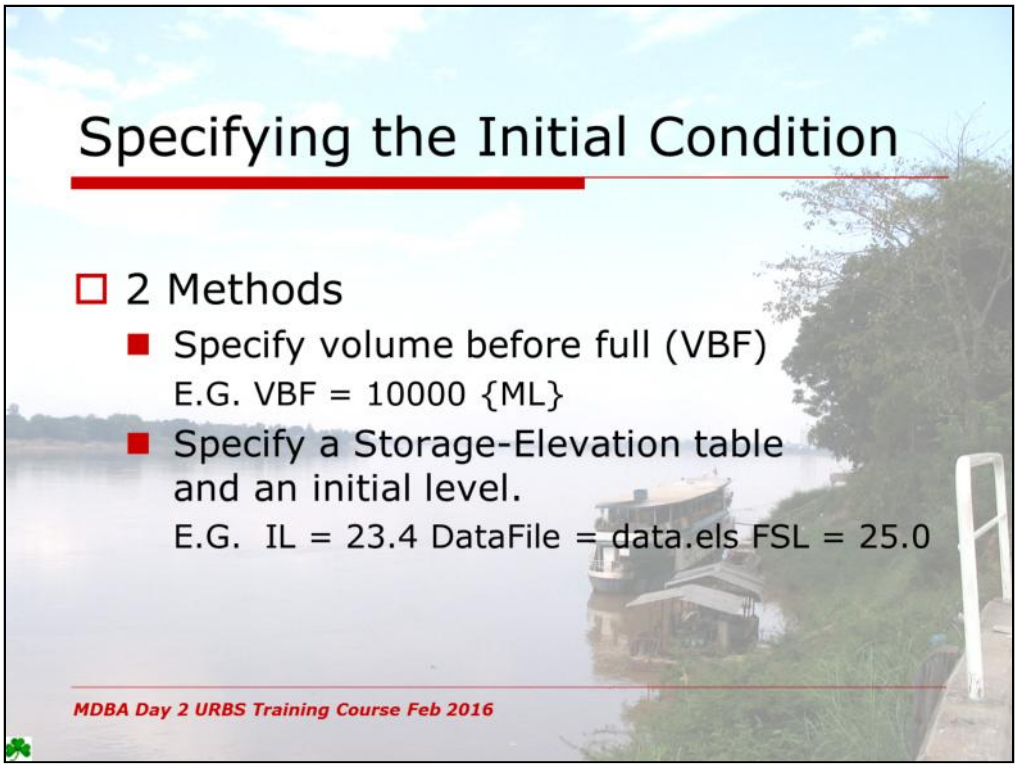
Specifying the Initial Condition
2 Methods
Specify volume before full (VBF)
E.G. VBF = 10000 {ML}
Specify a Storage-Elevation table and an initial level.
E.G. IL = 23.4 DataFile = data.els FSL = 25.0
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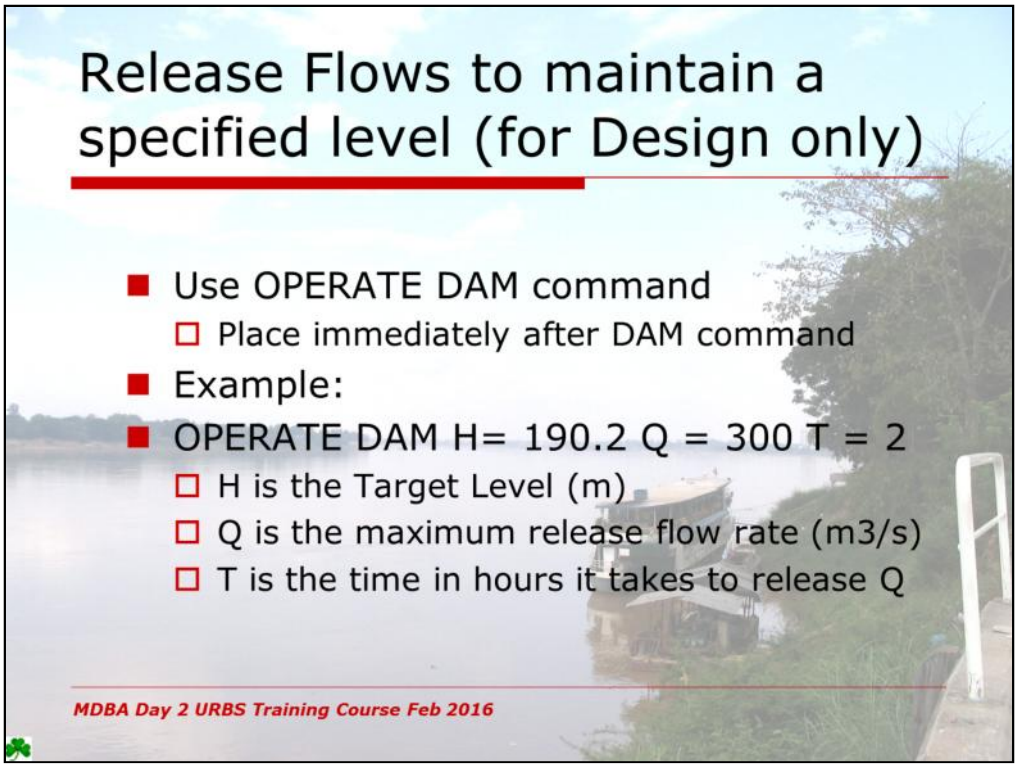
Specified Release Flows

- DAM ROUTE FDL=220 datafile=hume.els IL=HUME REL=hd_outflow.g file=hume.sq
- Notes
  - IL=HUME, HUME value set in ini file
  - REL= Hd_outflow.g is the flow release file
  - FDL – Full Dam Level above which hume.sq applies
  - Hume.els is the elevation/area/storage file


Release Flows to maintain a specified level (for Design only)
Use OPERATE DAM command
Place immediately after DAM command
Example:
OPERATE DAM H= 190.2 Q = 300 T = 2
H is the Target Level (m)
Q is the maximum release flow rate (m3/s)
T is the time in hours it takes to release Q
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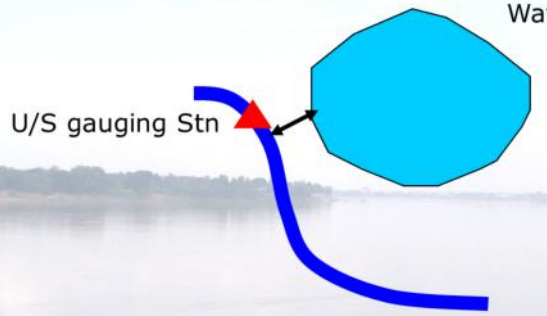
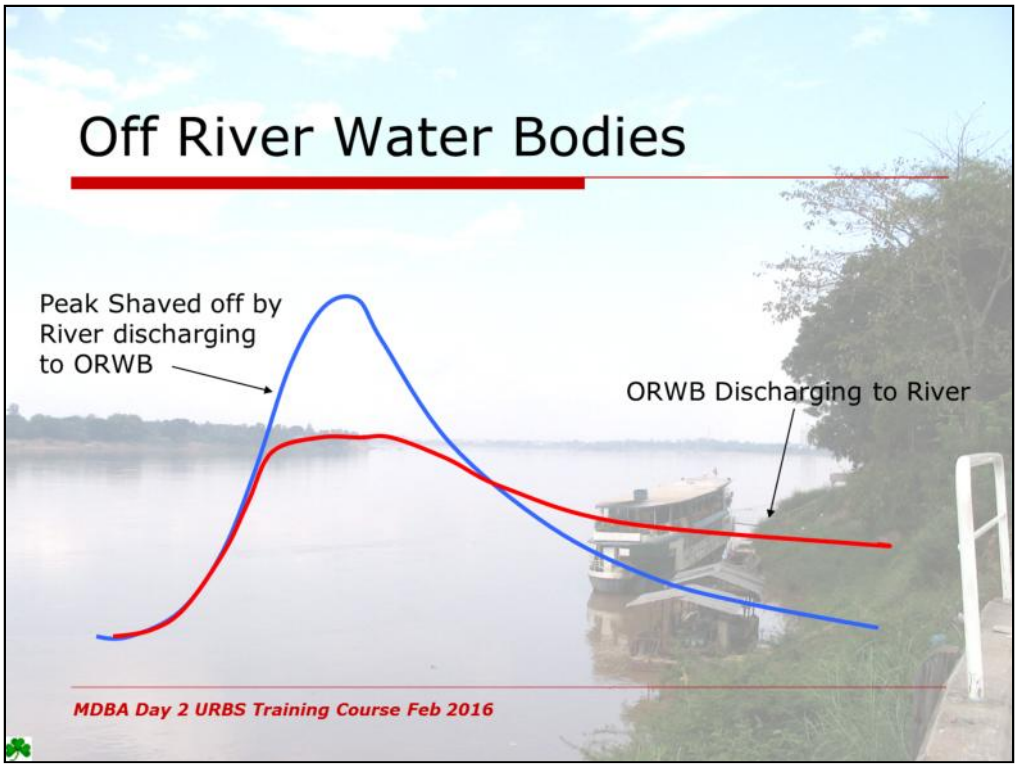
Off River Water Bodies (OWRBs)



If > than Weir Crest level

River Water Level (via rating) > ORWB level then flow into ORWB

River Water Level (via rating) < ORWB level then flow into River


Off River Water Bodies
Peak Shaved off by River discharging to ORWB
ORWB Discharging to River
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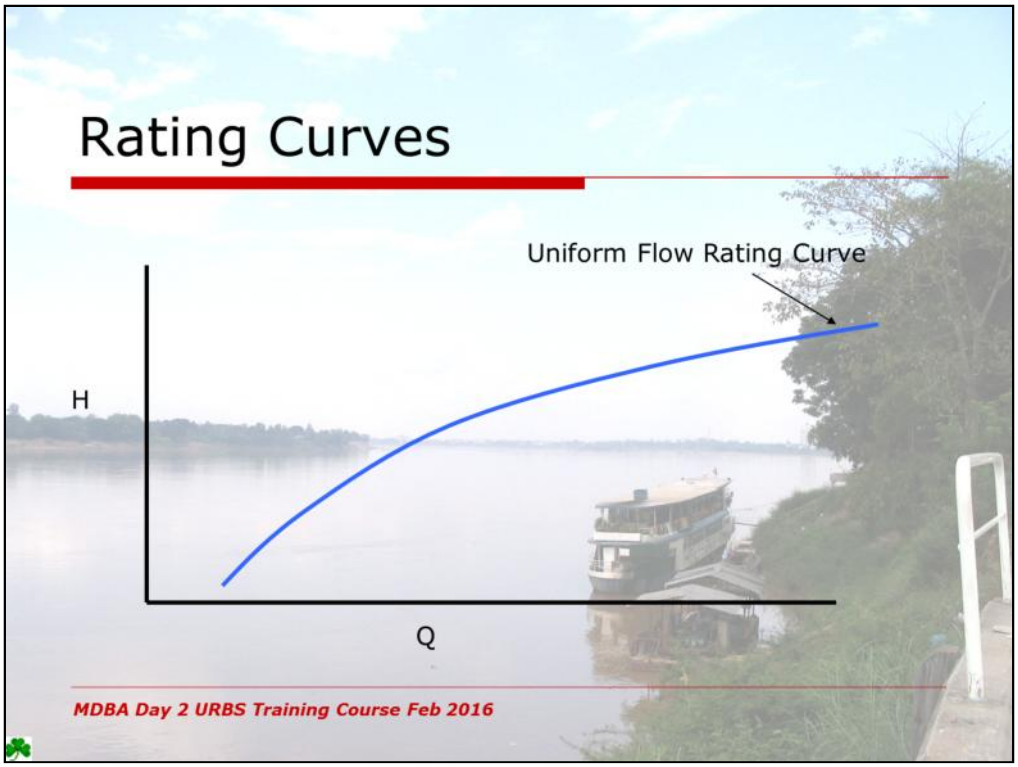
Rating Curves
Uniform Flow Rating Curve
H
Q
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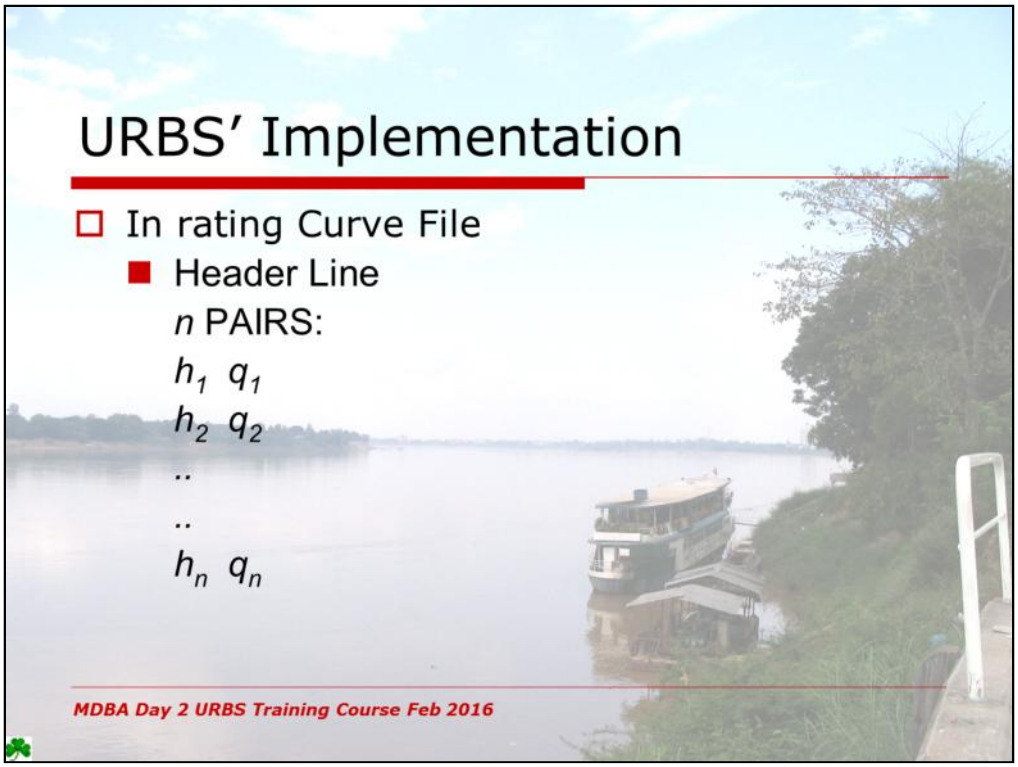
URBS' Implementation
In rating Curve File
Header Line
n PAIRS:
h_1 q_1
h_2 q_2
..
..
h_n q_n
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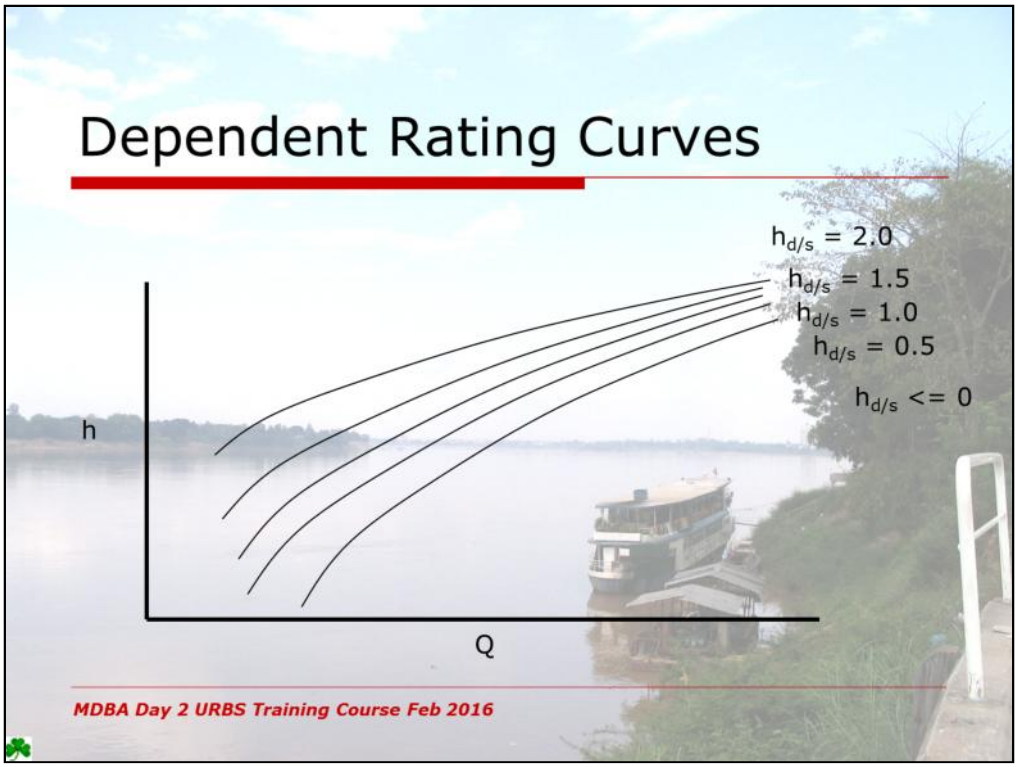
Dependent Rating Curves
$h_{d/s}$ = 2.0
$h_{d/s}$ = 1.5
$h_{d/s}$ = 1.0
$h_{d/s}$ = 0.5
$h_{d/s}$ <= 0
h
Q
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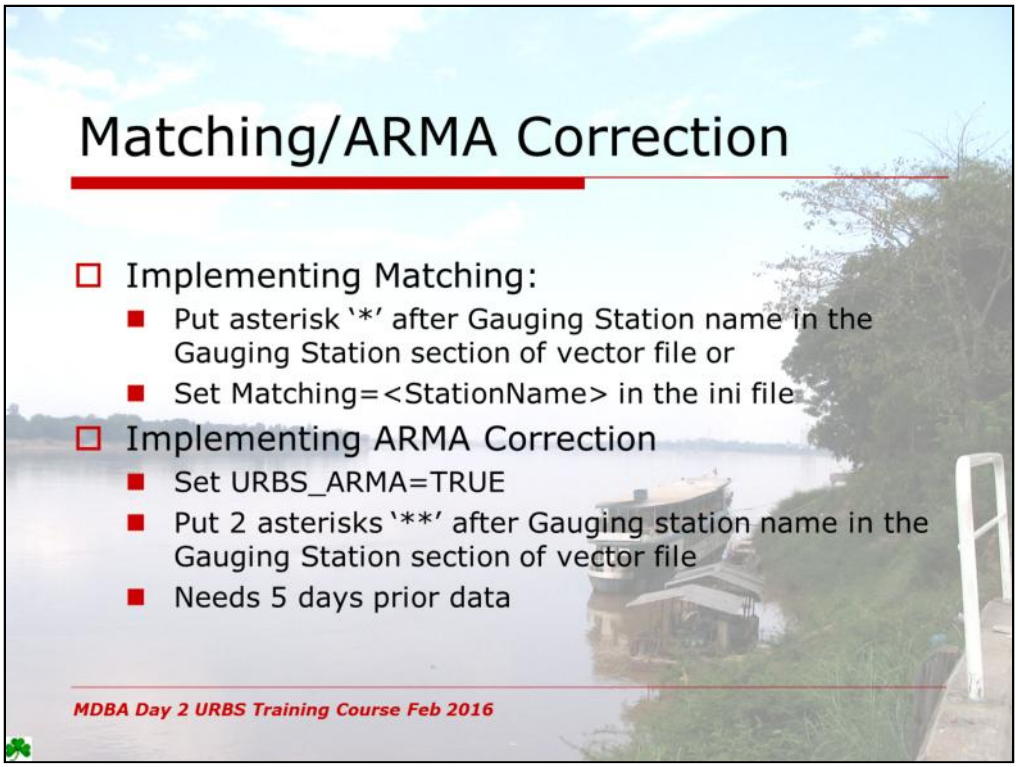
URBS' Implementation

- Insert downstream h after header ie

Header Line
/ *dslocation* = h_1
N_1 PAIRS:
h_1 q_1
h_2 q_2
..
h_{n1} q_{n1}
/ *dslocation* = h_2
N_2 PAIRS:
h_1 q_1
h_2 q_2
..
h_{n2} q_{n2}

dsLocation is name of downstream location with attached rating curve


Matching/ARMA Correction
Implementing Matching:
Put asterisk '*' after Gauging Station name in the Gauging Station section of vector file or
Set Matching=<StationName> in the ini file
Implementing ARMA Correction
Set URBS_ARMA=TRUE
Put 2 asterisks '**' after Gauging station name in the Gauging Station section of vector file
Needs 5 days prior data
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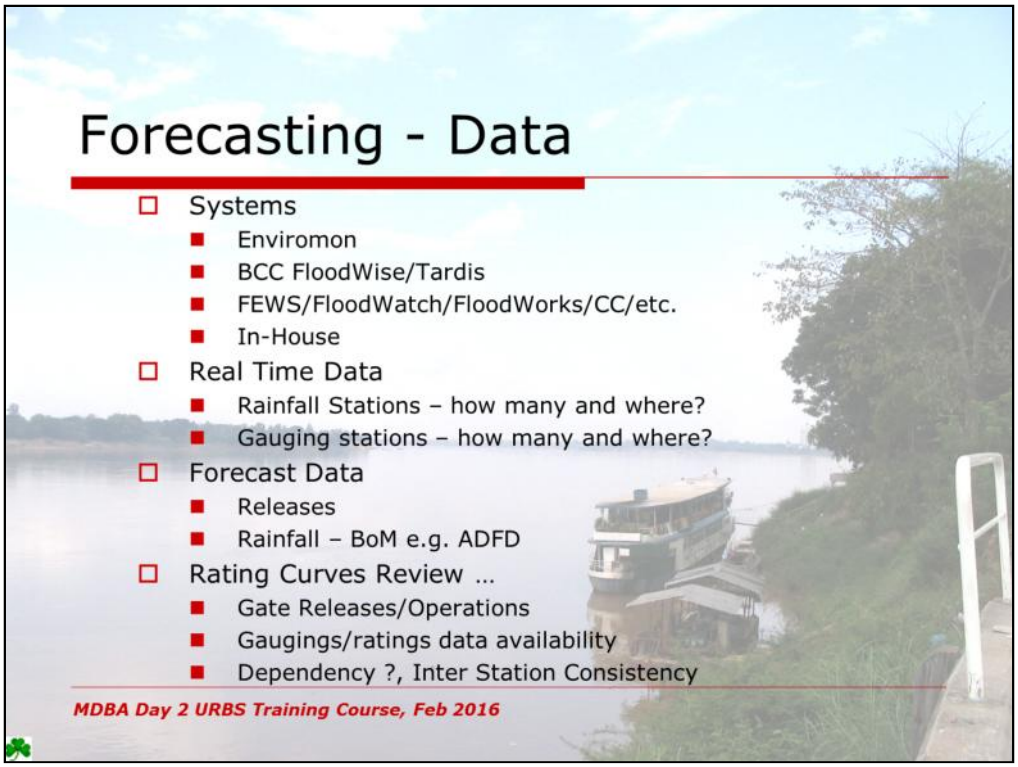
Forecasting - Data
Systems
Enviromon
BCC FloodWise/Tardis
FEWS/FloodWatch/FloodWorks/CC/etc.
In-House
Real Time Data
Rainfall Stations – how many and where?
Gauging stations – how many and where?
Forecast Data
Releases
Rainfall – BoM e.g. ADFD
Rating Curves Review …
Gate Releases/Operations
Gaugings/ratings data availability
Dependency ?, Inter Station Consistency
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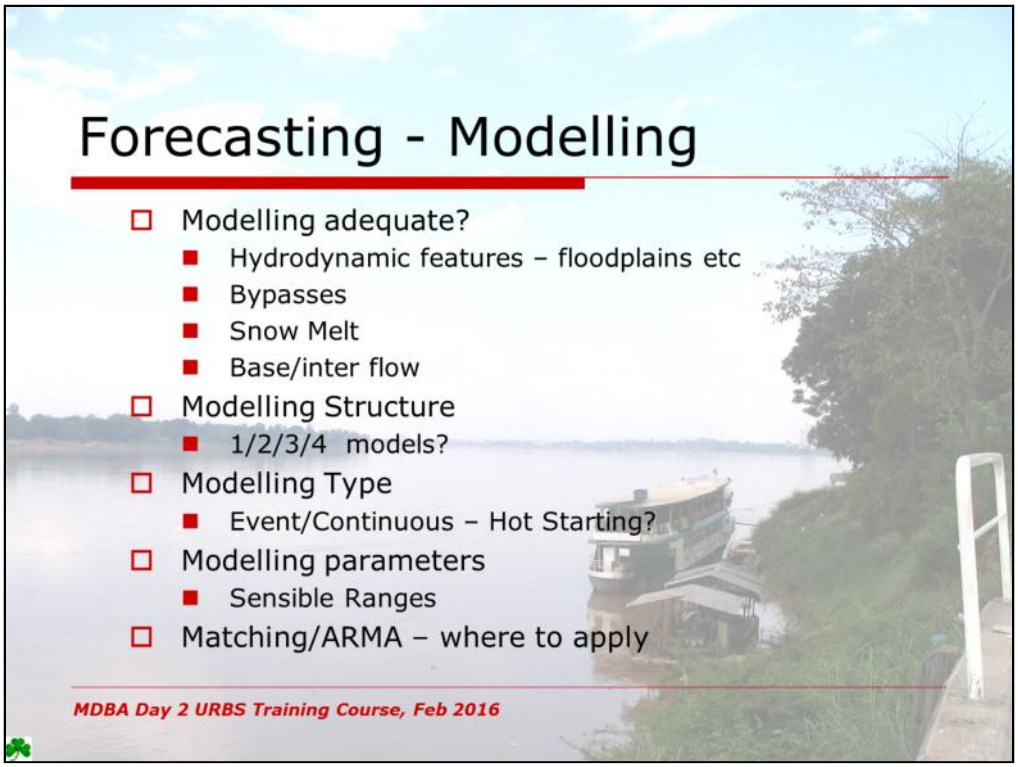
Forecasting - Modelling
Modelling adequate?
Hydrodynamic features – floodplains etc
Bypasses
Snow Melt
Base/inter flow
Modelling Structure
1/2/3/4 models?
Modelling Type
Event/Continuous – Hot Starting?
Modelling parameters
Sensible Ranges
Matching/ARMA – where to apply
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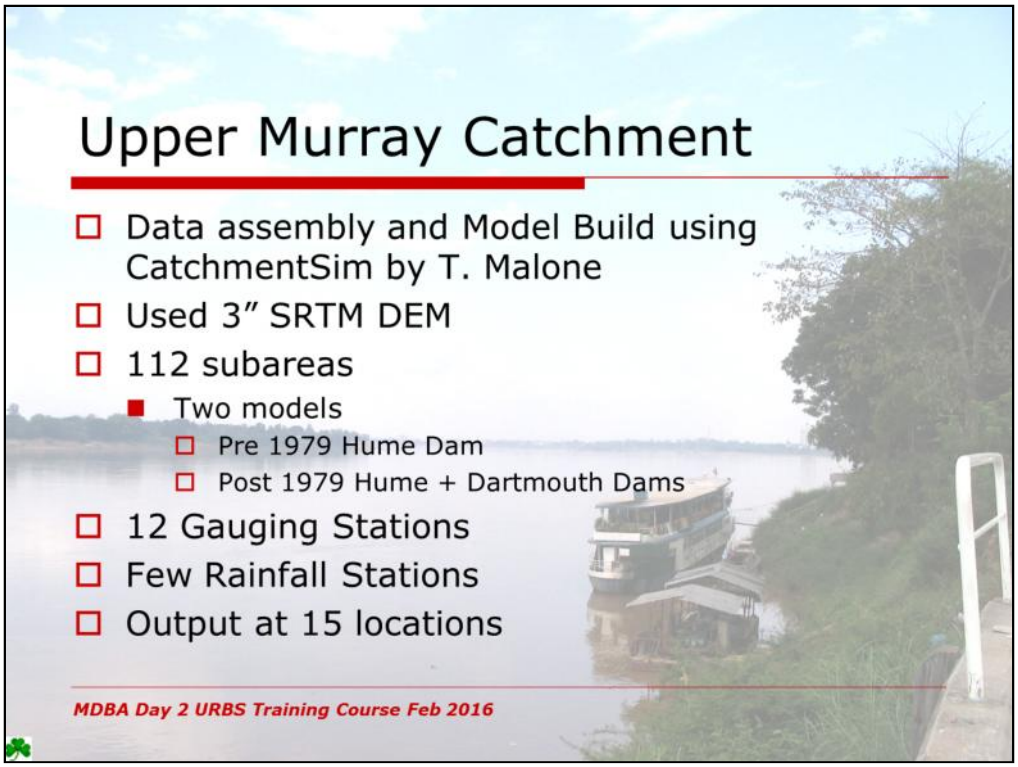
Upper Murray Catchment
Data assembly and Model Build using CatchmentSim by T. Malone
Used 3" SRTM DEM
112 subareas
Two models
Pre 1979 Hume Dam
Post 1979 Hume + Dartmouth Dams
12 Gauging Stations
Few Rainfall Stations
Output at 15 locations
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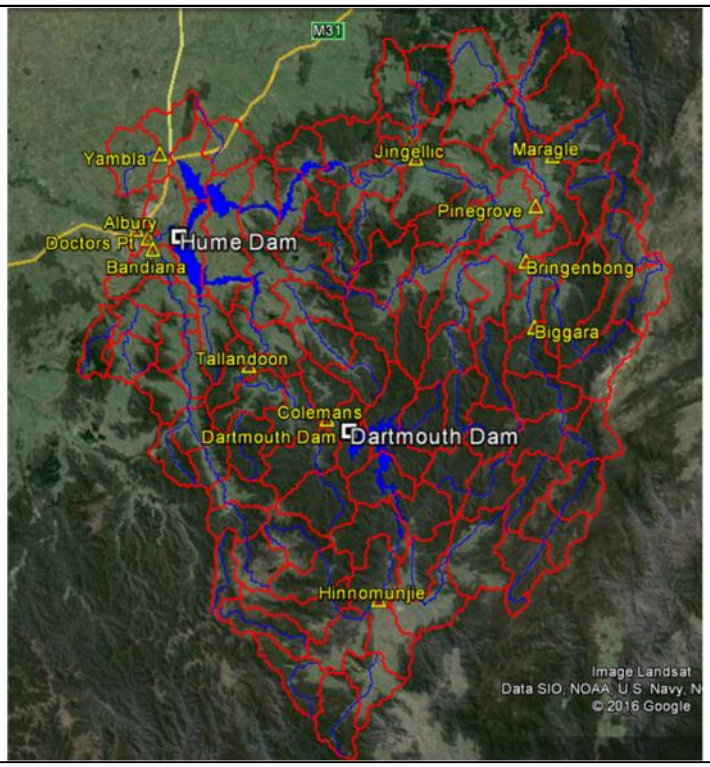

M31
Yambla
Jingellic
Maragle
Pinegrove
Albury
Doctors Pt
Hume Dam
Bandiana
Bringenbong
Biggara
Tallandoon
Colemans
Dartmouth Dam
Dartmouth Dam
Hinnomunjie
Image Landsat
Data SIO, NOAA, U.S. Navy, N
© 2016 Google

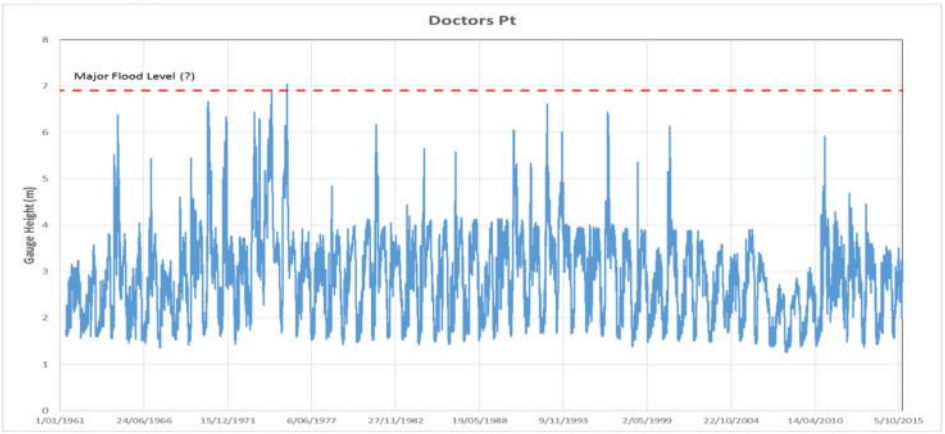
Hume Dam

- Type: Concrete gravity dam with four earth embankments
- Commissioned: 1936
- Purpose: Flood mitigation, hydro-power, irrigation and water supply
- Catchment Area: 15,300 km^2
- FSL: 192.0 m AHD
- Full Supply Volume: 3,036,500 ML
- Outlet Structures: 29 vertical undershot gated concrete overflow spillways

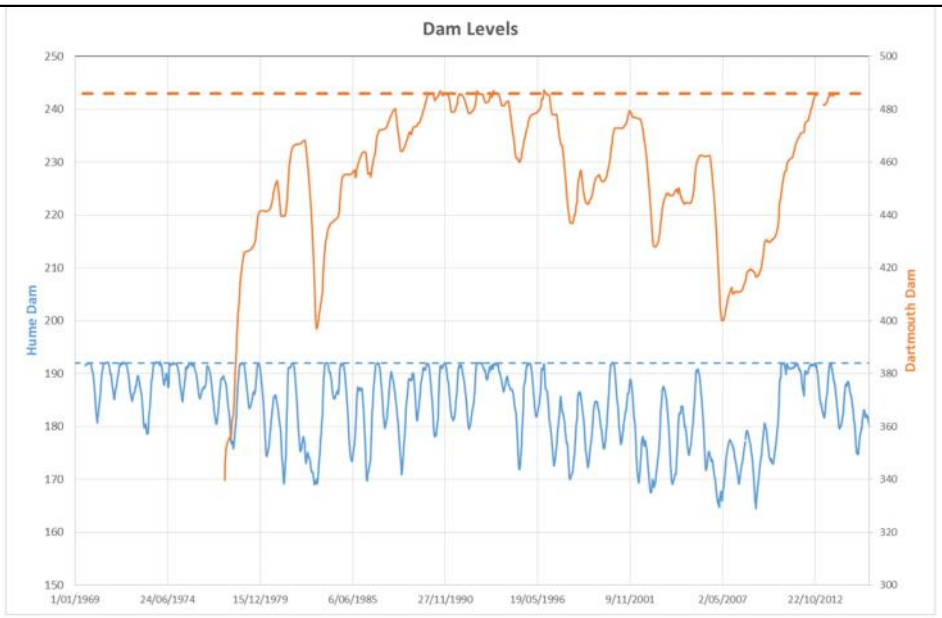
Dartmouth Dam

- Type: Rock-fill embankment dam
- Commissioned: 1979
- Purpose: Irrigation, hydro-electric power and water supply
- Catchment Area: 3,600 km^2
- FSL: 486.0 m AHD
- Full Supply Volume: 3,856 ,000 ML
- Outlet Structures: Uncontrolled chute spillway

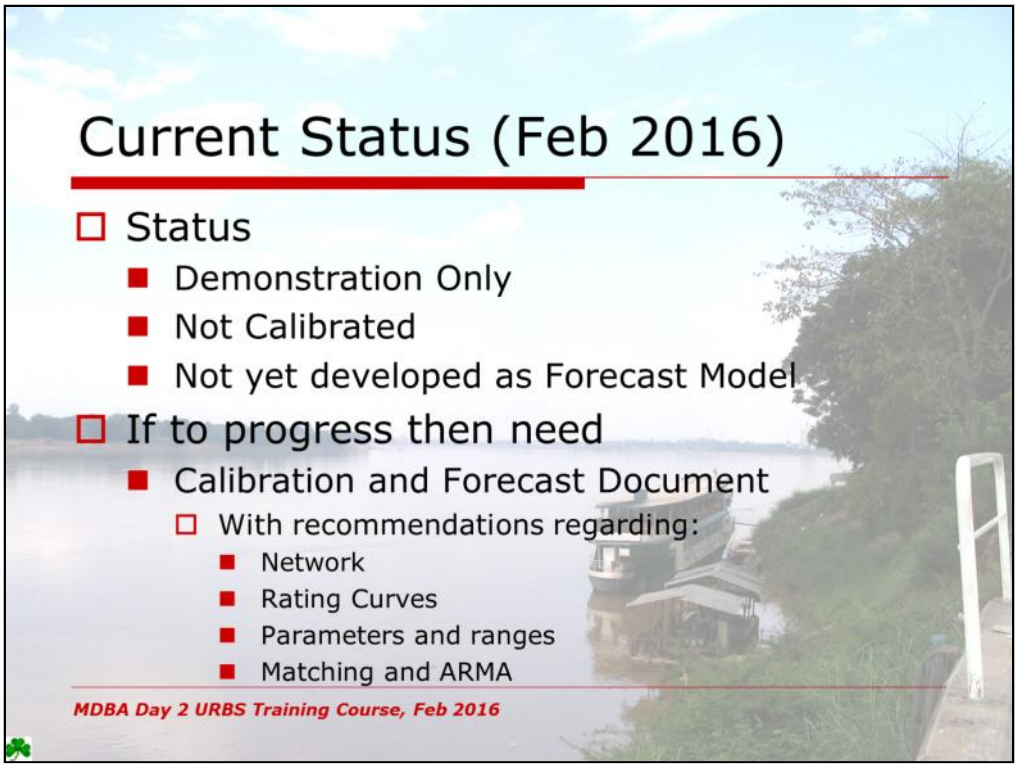
Frequency of Floods



(?) Based on major flood level at Albury



Inflows typically fall to less than one-third capacity by March each year, but in normal years refills to at least two-thirds capacity before November


Current Status (Feb 2016)
Status
Demonstration Only
Not Calibrated
Not yet developed as Forecast Model
If to progress then need
Calibration and Forecast Document
With recommendations regarding:
Network
Rating Curves
Parameters and ranges
Matching and ARMA
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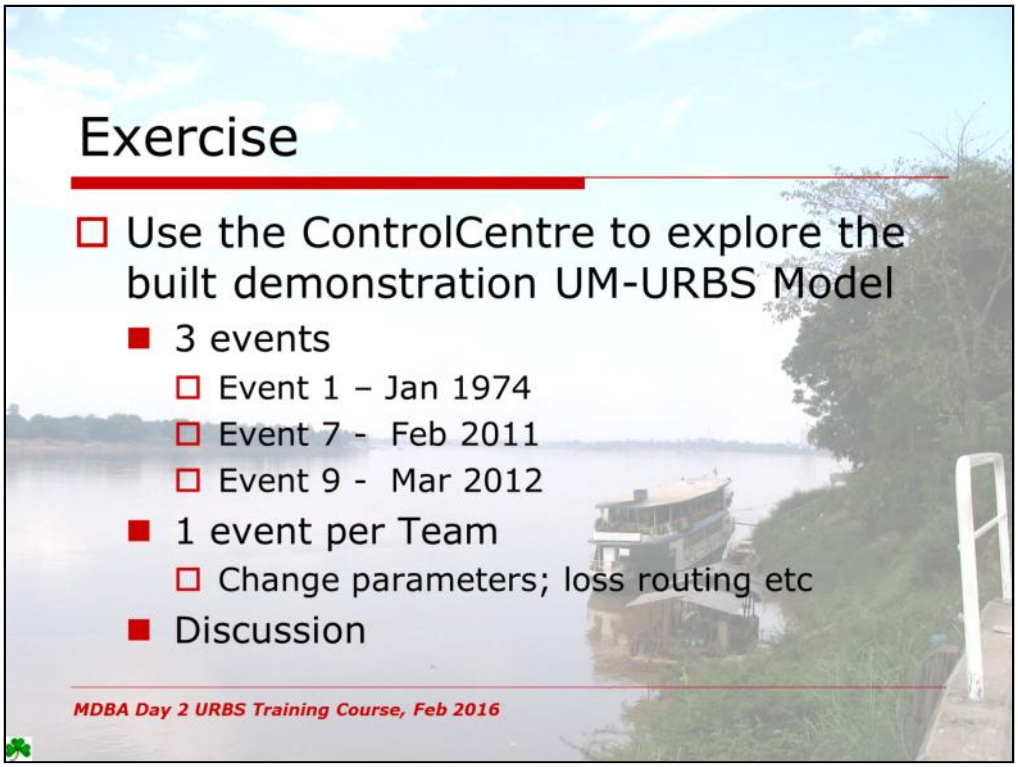
Exercise
Use the ControlCentre to explore the built demonstration UM-URBS Model
3 events
Event 1 – Jan 1974
Event 7 - Feb 2011
Event 9 - Mar 2012
1 event per Team
Change parameters; loss routing etc
Discussion
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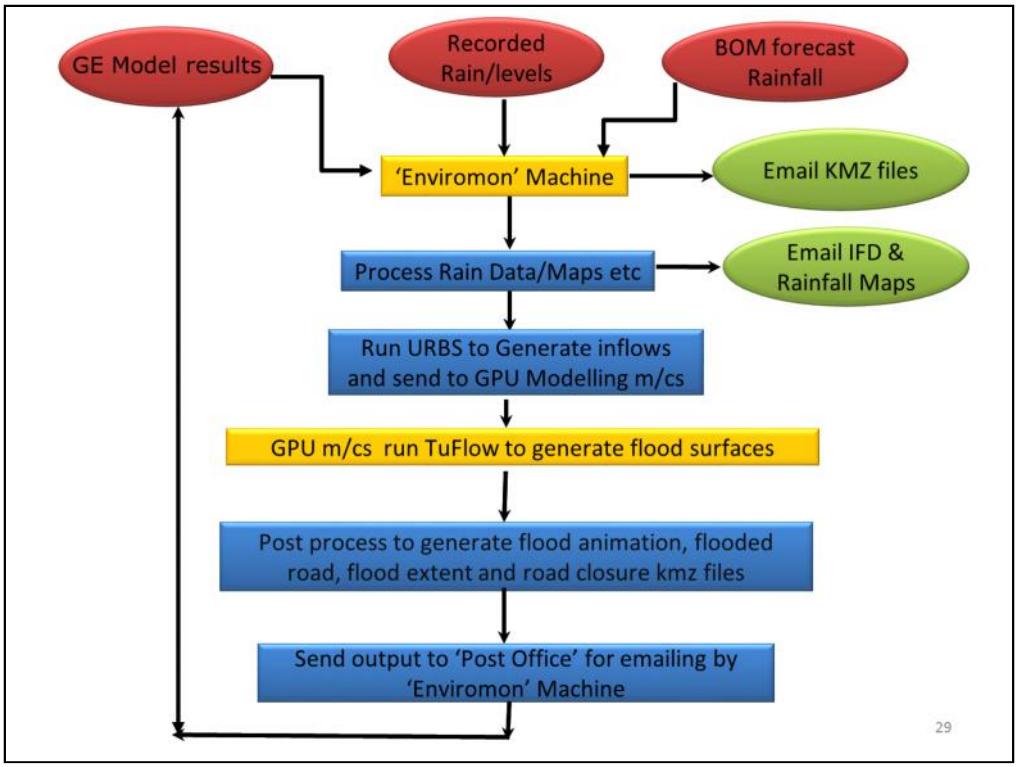
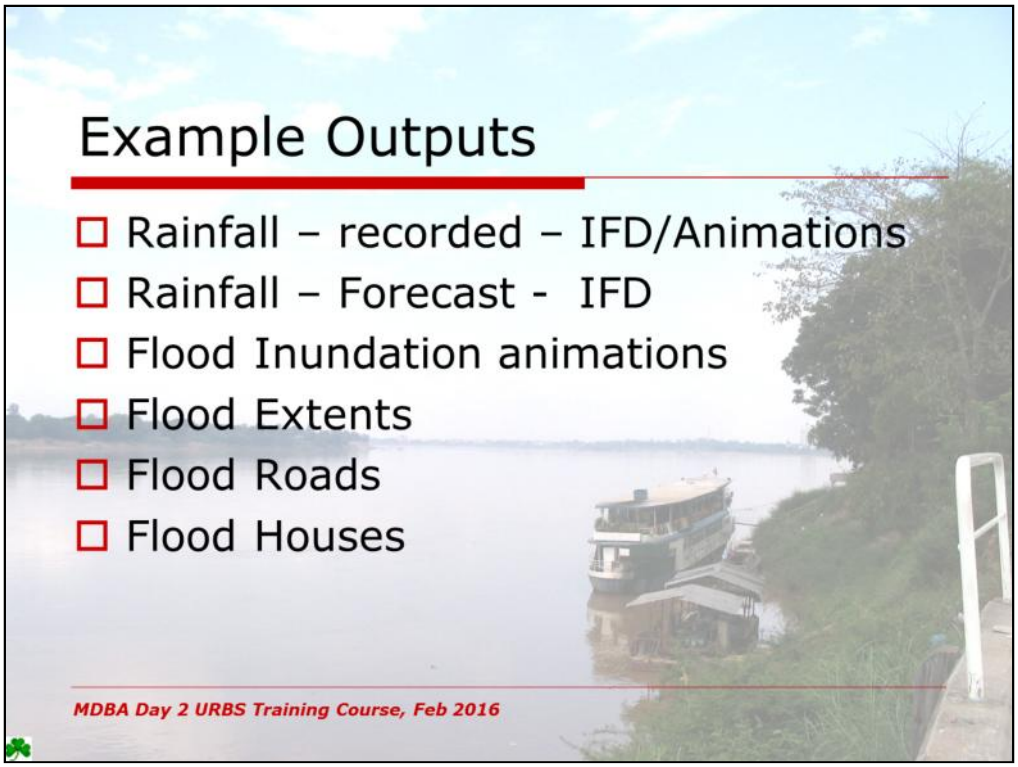
Flood Forecasting systems – Examples - Gold Coast

- Used for small catchments – Nerang largest - about 500 sq kms with uncontrolled dam
- Initially ControlCentre/WaterRide/MapInfo – manual operation
- Automated using In-House developed DSS
  - Refer paper by Mirfenderesk et al found at: http://www.floodplainconference.com/papers2015/Hamid%20Mirfenderesk%20Full%20paper%20for%20FMA%202015.pdf
  - Incorporates Real time GPU 2D Modelling
  - Uses open source software tools e.g. Python
  - Outputs: flood surfaces, extent and animations, flooded roads, Real time and forecast rainfall analysis – all in Google Earth format
  - National Winner 2015 Banksia Smart Technology Award


GE Model results
Recorded Rain/levels
BOM forecast Rainfall
'Enviromon' Machine
Email KMZ files
Process Rain Data/Maps etc
Email IFD & Rainfall Maps
Run URBS to Generate inflows and send to GPU Modelling m/cs
GPU m/cs run TuFlow to generate flood surfaces
Post process to generate flood animation, flooded road, flood extent and road closure kmz files
Send output to 'Post Office' for emailing by 'Enviromon' Machine
29


Example Outputs
Rainfall – recorded – IFD/Animations
Rainfall – Forecast - IFD
Flood Inundation animations
Flood Extents
Flood Roads
Flood Houses
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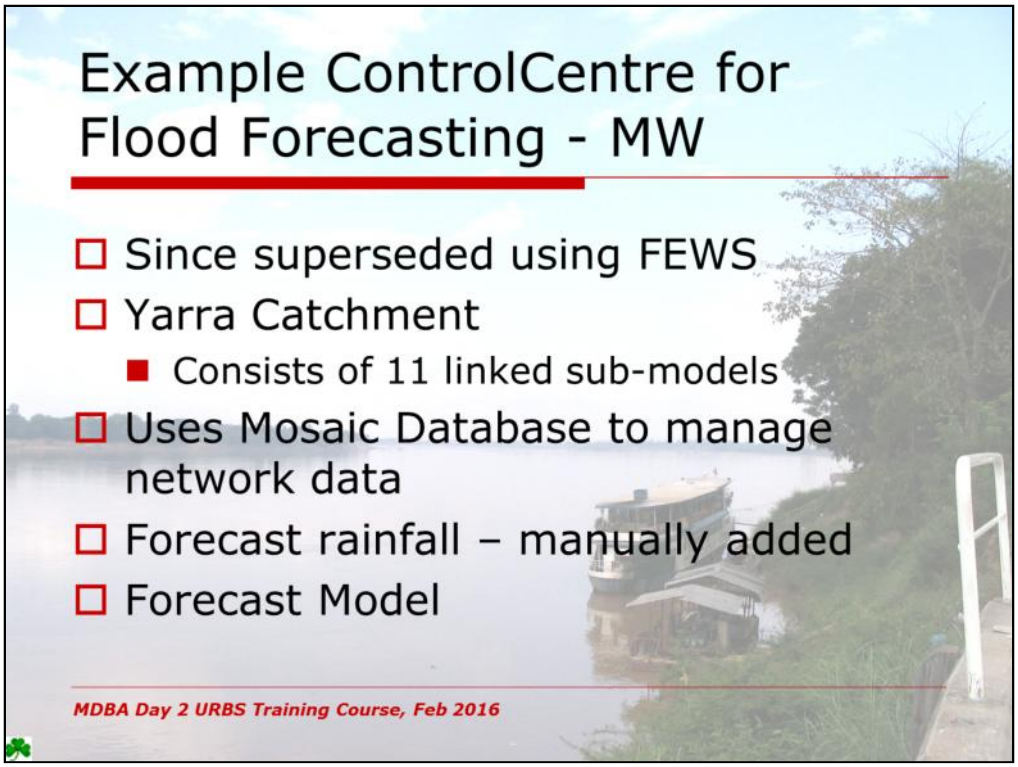
Example ControlCentre for Flood Forecasting - MW
Since superseded using FEWS
Yarra Catchment
Consists of 11 linked sub-models
Uses Mosaic Database to manage network data
Forecast rainfall – manually added
Forecast Model
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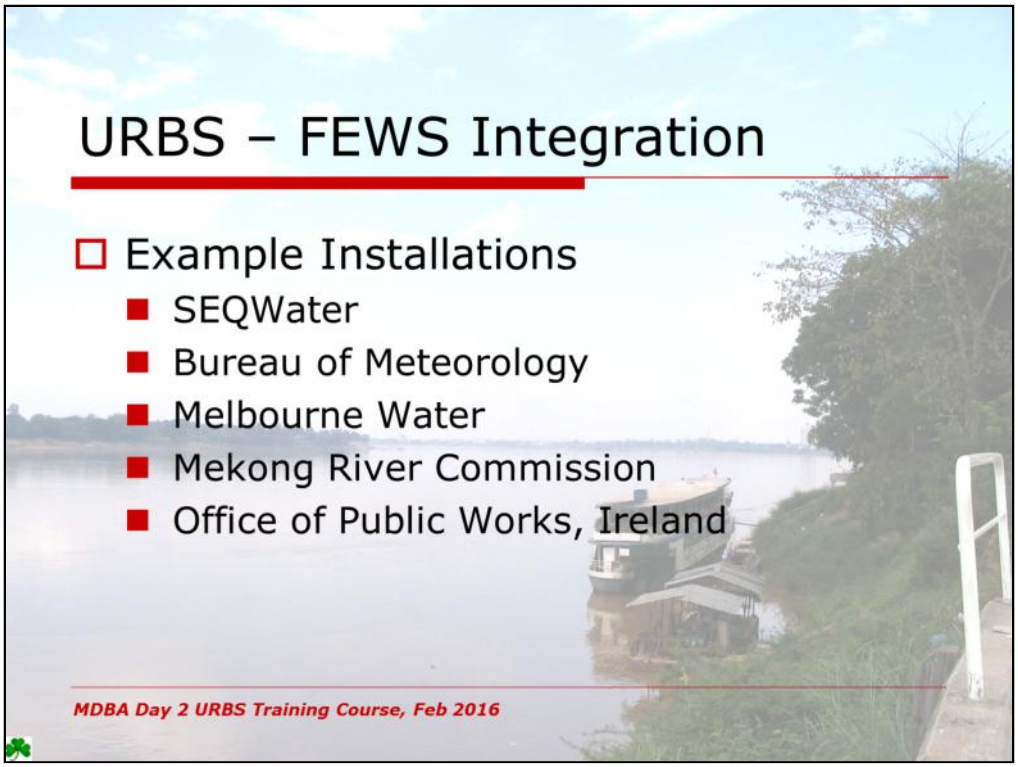
URBS – FEWS Integration
Example Installations
SEQWater
Bureau of Meteorology
Melbourne Water
Mekong River Commission
Office of Public Works, Ireland
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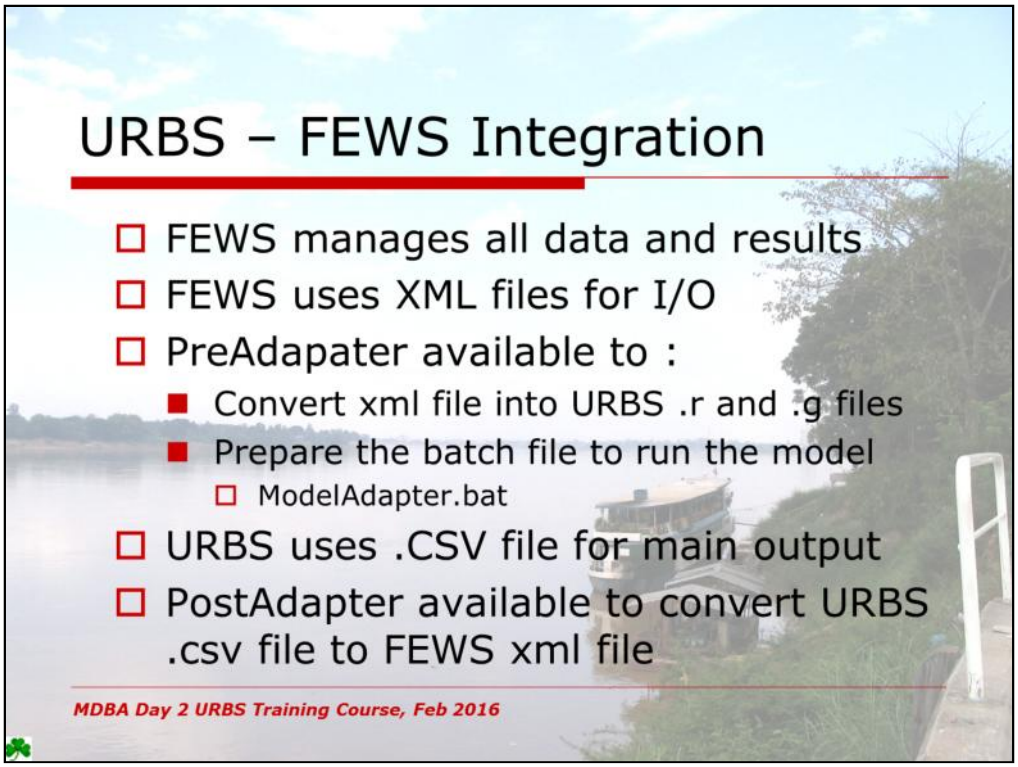
URBS – FEWS Integration
FEWS manages all data and results
FEWS uses XML files for I/O
PreAdapater available to :
Convert xml file into URBS .r and .g files
Prepare the batch file to run the model
ModelAdapter.bat
URBS uses .CSV file for main output
PostAdapter available to convert URBS .csv file to FEWS xml file
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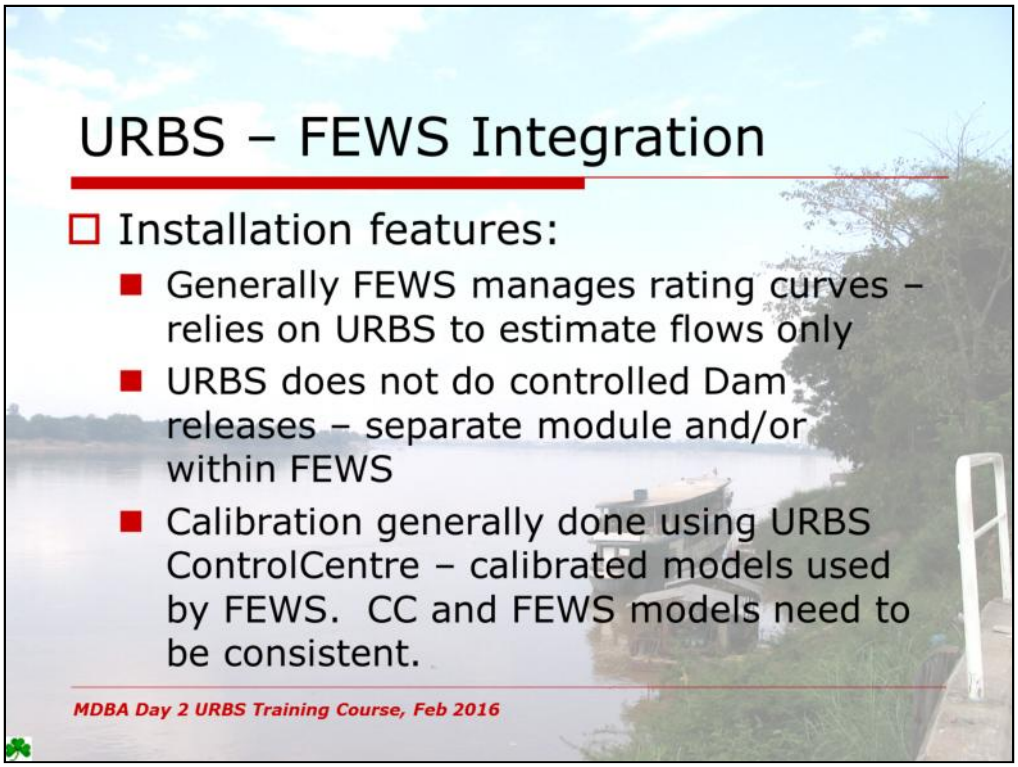
URBS – FEWS Integration
Installation features:
Generally FEWS manages rating curves – relies on URBS to estimate flows only
URBS does not do controlled Dam releases – separate module and/or within FEWS
Calibration generally done using URBS ControlCentre – calibrated models used by FEWS. CC and FEWS models need to be consistent.
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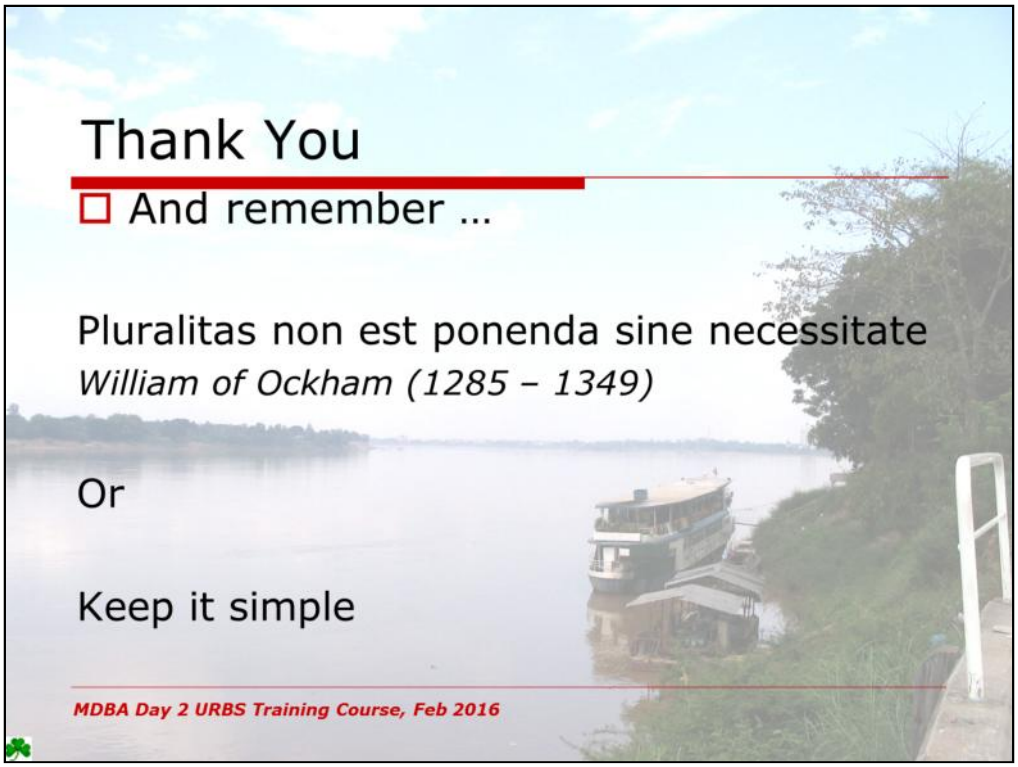
Thank You
And remember …
Pluralitas non est ponenda sine necessitate
William of Ockham (1285 – 1349)
Or
Keep it simple
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Contact Details
Email: doncarroll@optusnet.com.au
Phone: 0467 246109
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