

# Flood Prediction Using Artificial Neural Networks: A case study of Lower Tallapoosa, Alabama

- Rajesh Sawant

PhD Student,

School of Forestry and Wildlife Sciences

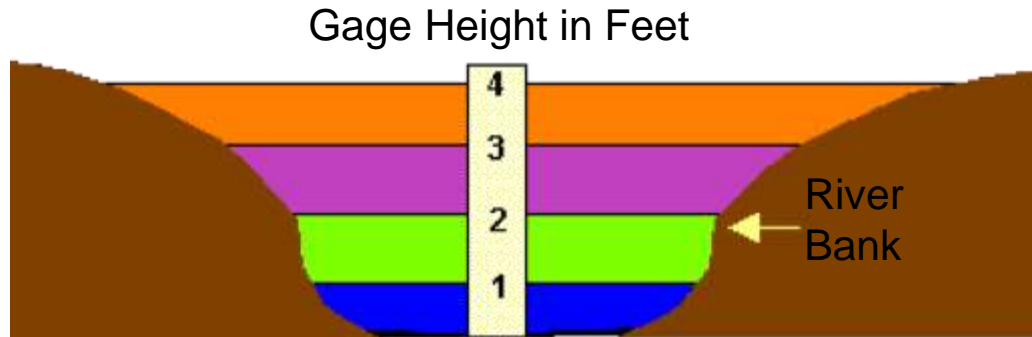
Auburn University, Auburn

# Introduction

- Background
- Hypothesis and Objective
- ANN Model introduction
- Model concept
- Site
- Methodology
- Model Output
- Decision Making

# Background

- How does the height of water in a stream relate to the amount of water flowing?



- Upstream and Downstream relationship.
- Use of ANN in streamflow prediction.

# Hypothesis and Objective

## Hypothesis:

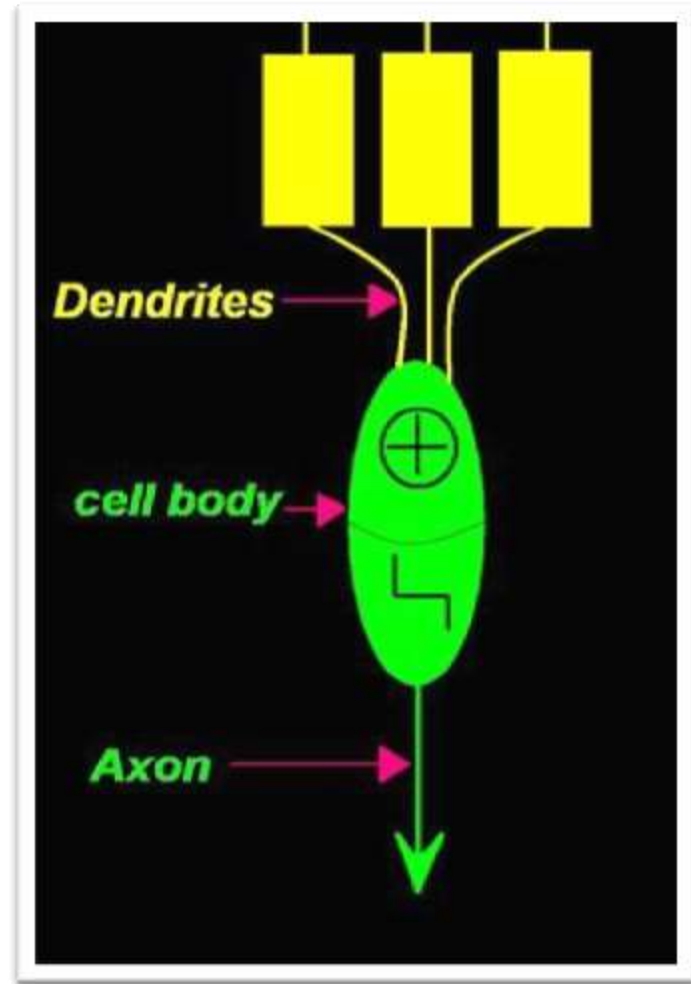
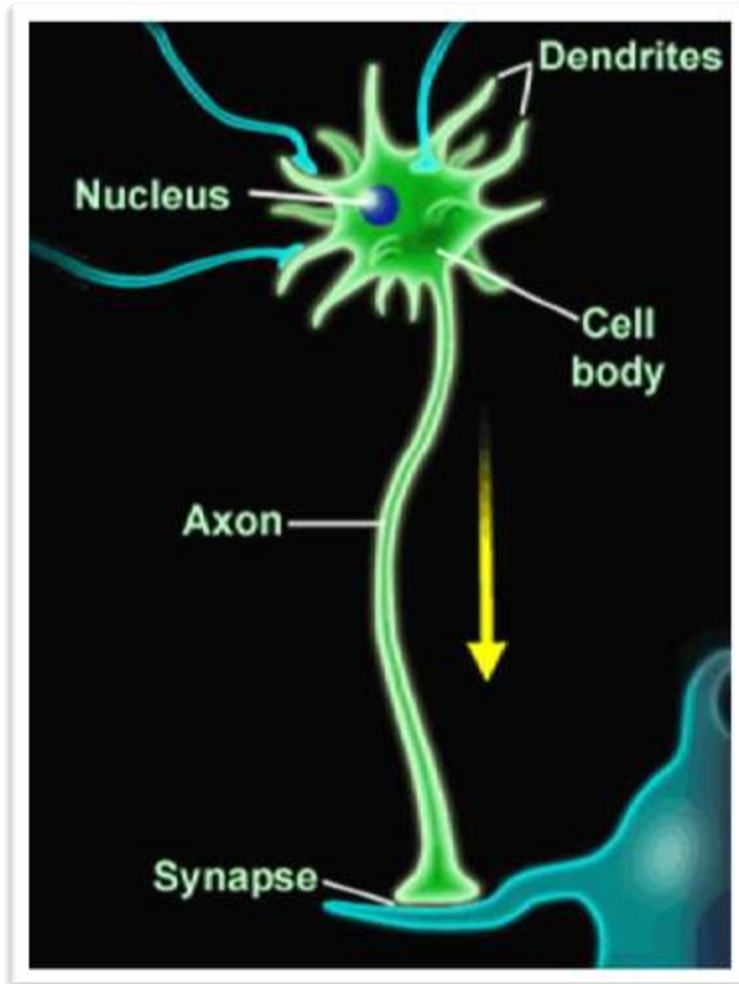
- Using hydro-climatic data from upstream in an ANN model for predicting streamflow at downstream gages.

## Objective:

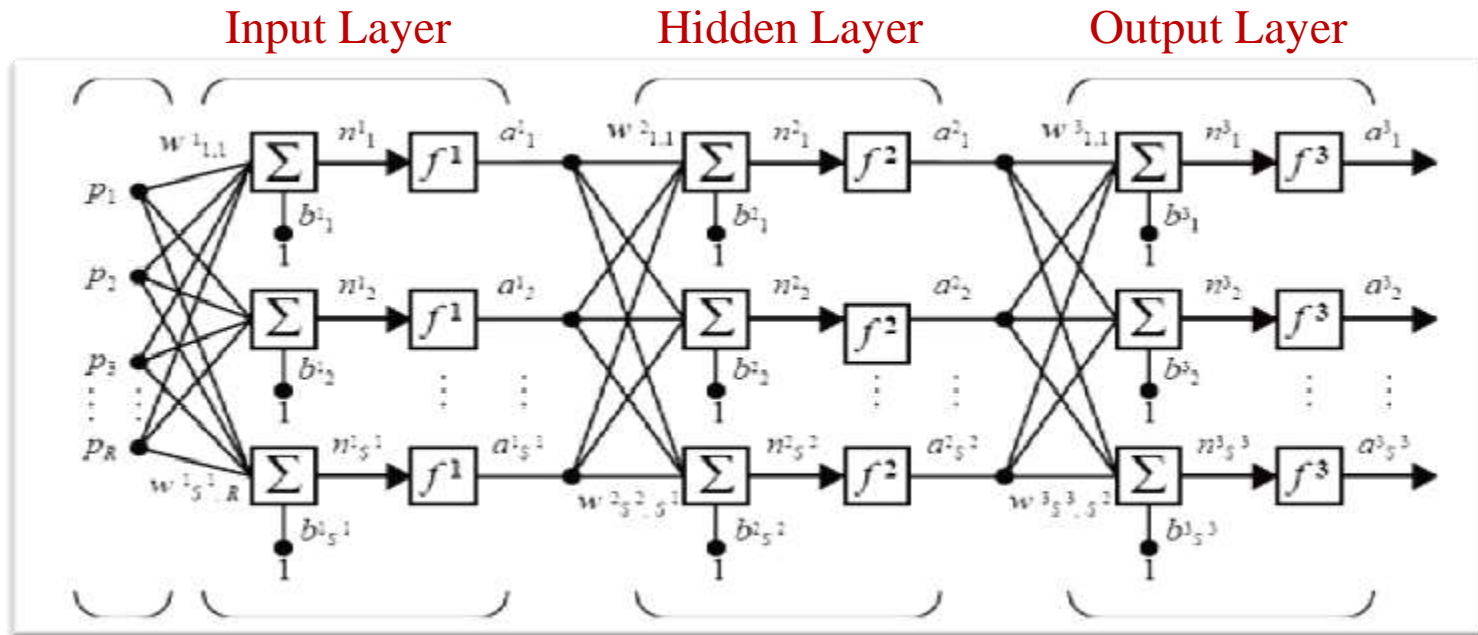
- Develop an ANN Model for downstream streamflow prediction using upstream streamflow, stream level and weather parameters such as precipitation and temperature.

# Artificial Neural Network (ANN)

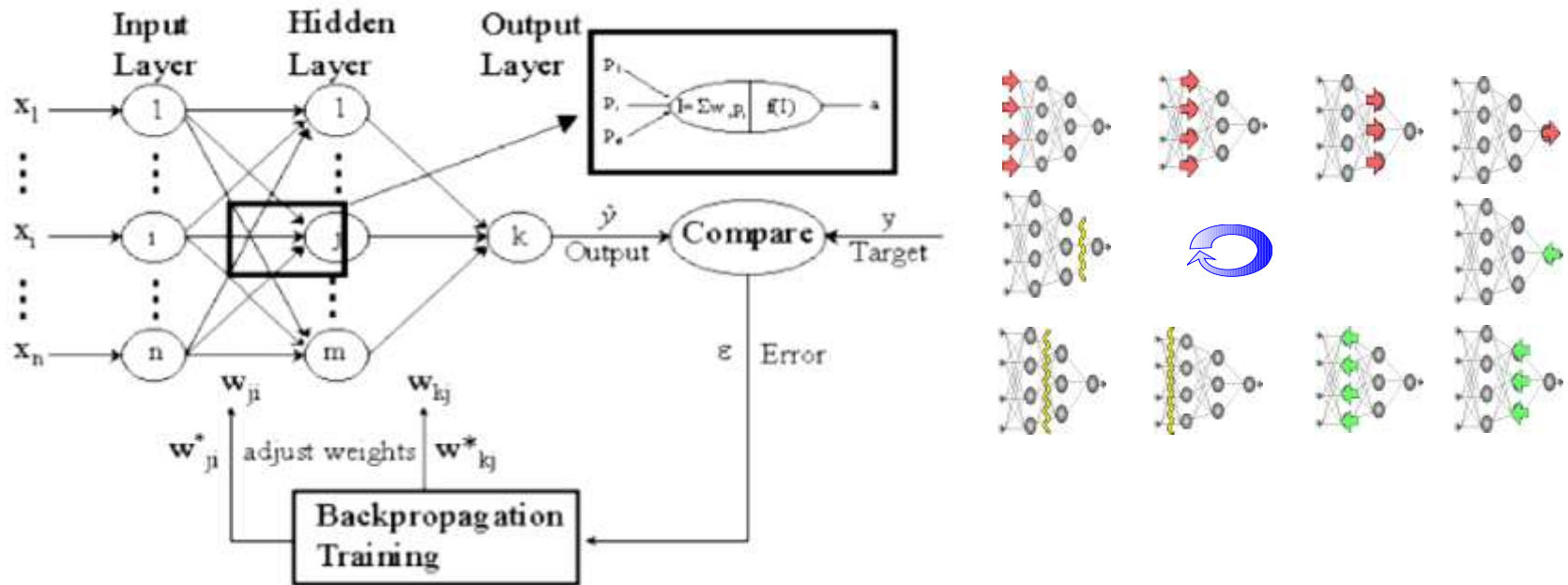
- Neurons



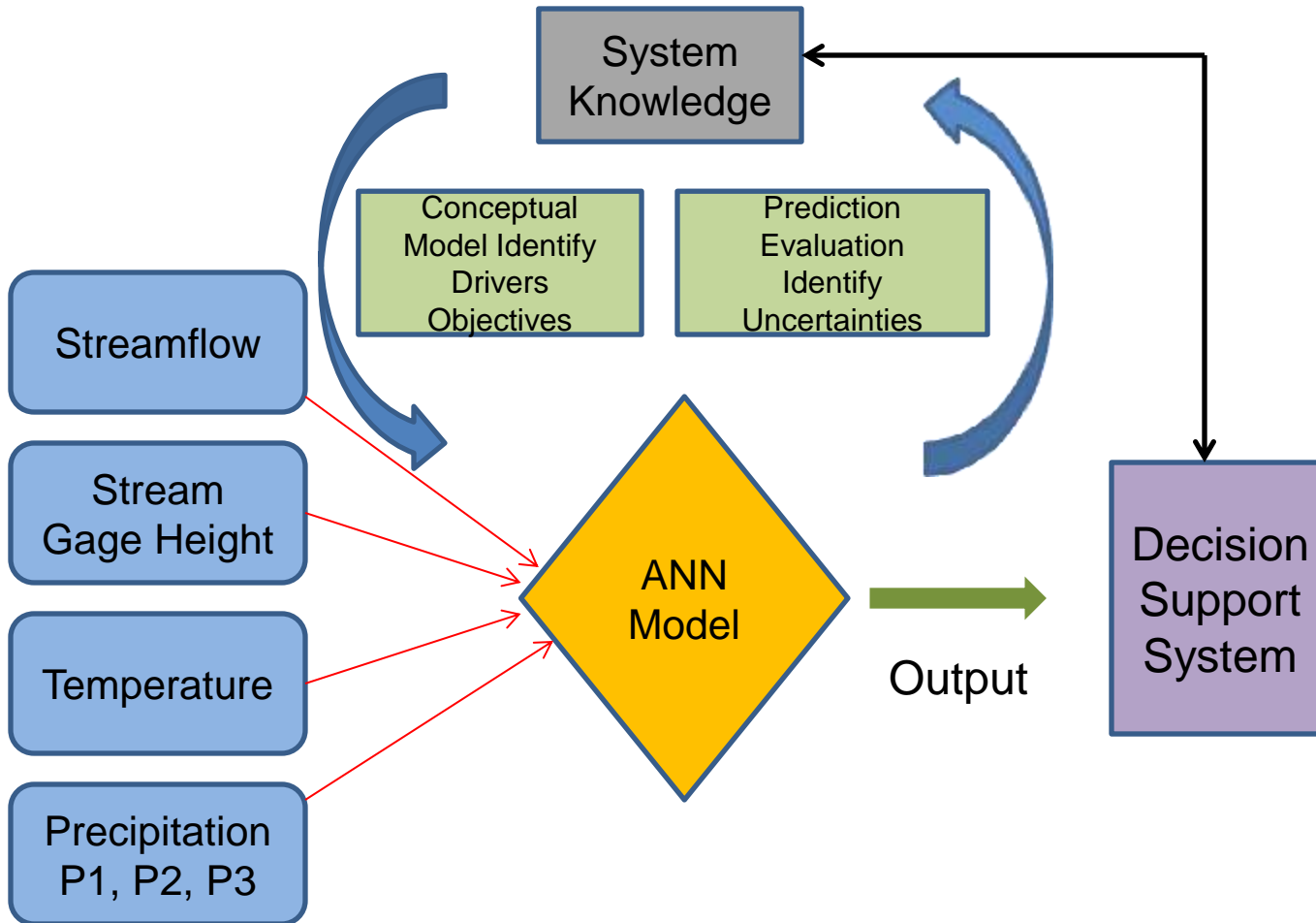
# General Structure of Multi Layer Perceptron (MPL) for Stream Gage Modeling



# Weight and Bias Optimization

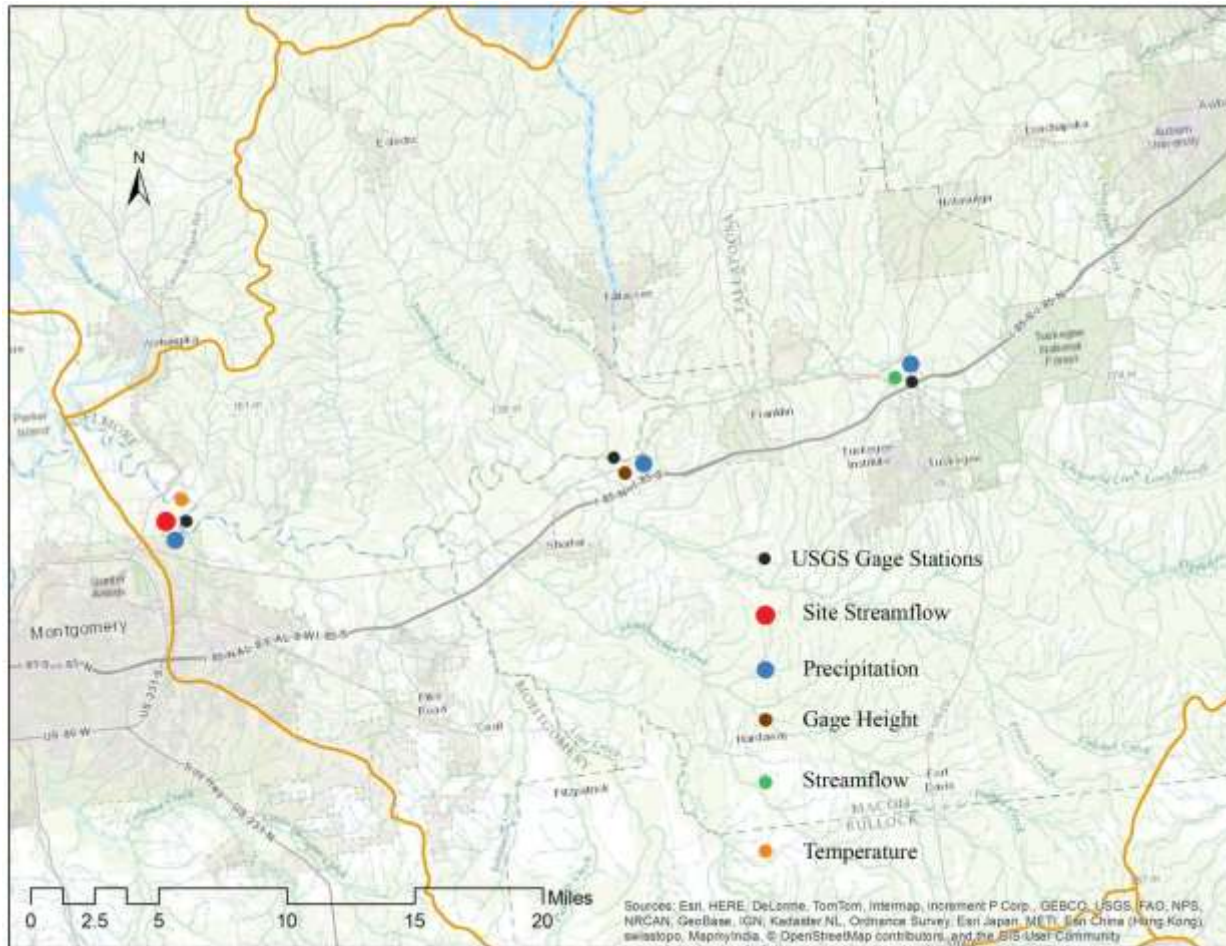


# Conceptual Model





# Site: Tallapoosa River at Montgomery Water Works



# ANN Model Workflow

- Clean the dataset
- Read dataset
- Normalize dataset
- Randomize dataset
- Splitting the dataset
- Train network and Test network
- Denormalize dataset
- Read output

# ANN Model Code

The image displays the MATLAB 7.11.0 (R2010b) environment with the following components:

- Editor:** Contains the MATLAB script for the ANN model. The code includes data loading, normalization, and a loop for calculating normalized output values.
- Variable Editor:** Shows the variable `te` as a 39x2 double matrix. The first column contains values from 1.6010 to 2.0000, and the second column contains values from 1.0 to 2.0.
- Workspace:** Lists various variables including `min2`, `n1`, `net`, `nn1`, `nn2`, `ns_test`, `ns_train`, `ou`, `p`, `ptest`, `ptrain`, `r`, `str`, `t`, `tr`, `test`, and `train`.
- Command Window:** Displays a message about customizable keyboard shortcuts and a link to the help documentation.
- Command History:** Shows the execution of `xlabel`, `title`, `subplot`, `plot`, and `hold` commands, along with the resulting plot data.

```
2 - clear all;
3 - A = xlsread('GSFTP_Final.xlsx'); %Reads file from excel
4 -
5 -
6 - [n1,n2]=size(A);
7 -
8 - ou = A(1:1461,1); %output *****n1=1074, wrong 1072
9 - in = A(1:1461,2:end); %input length(A(:,2))
10 -
11 - min1=min(ou);
12 - max1=max(ou);
13 -
14 - min2=min(in);
15 - max2=max(in);
16 - %[o] = noc(r,min1,max1);
17 - %n=0.05+(0.95*(2-min)/(max-min)); *****
18 - for i=1:length(ou)
19 -     nml(i)=noc(ou(i),min1,max1);
20 - end
21 - nml=nml'; %Normalize values for output
22 -
23 - for j=1:6
24 -     for i=1:length(in)
```

Command Window:

New to MATLAB? Watch this [Video](#), see [Demos](#), or read [Getting Started](#).

MATLAB desktop keyboard shortcuts, such as Ctrl+S, are now customizable. In addition, many keyboard shortcuts have changed for improved consistency across the desktop.

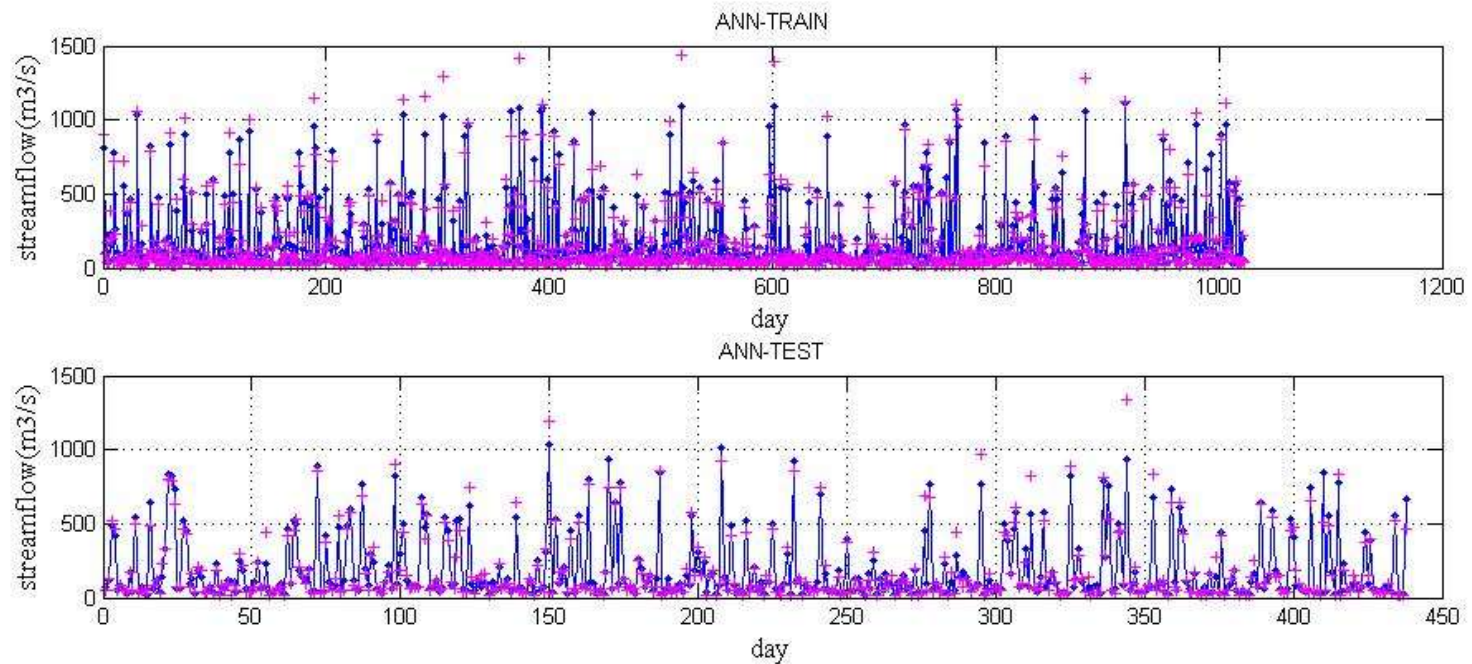
To customize keyboard shortcuts, use [Preferences](#). From there, you can also restore previous default settings by following the steps outlined in [Help](#).

[Click here](#) if you do not want to see this message again.

Command History:

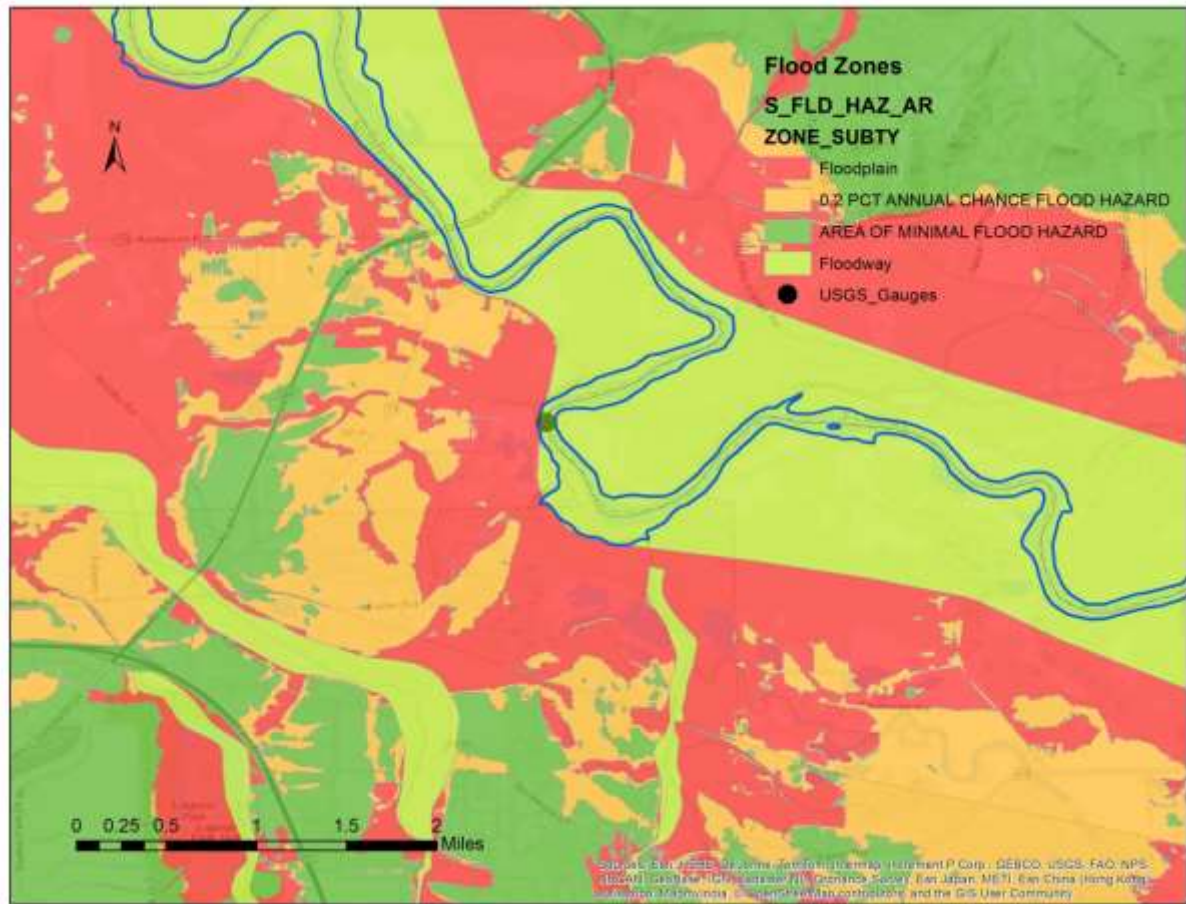
```
xlabel('day','FontName','times new r...
title('ANN-TRAIN')
subplot(2,2,2)
plot(S,'-o'), grid on
hold on
plot(te,'m','MarkerSize',5)
xlabel('day','FontName','times new r...
title('ANN-TEST')
4 - 4/28/2015 4:58 PM -->
|:
net
out11=noc(hh);
hh=hh';
out11=noc(hh);
4 - 4/29/2015 10:30 AM -->
4 - 4/29/2015 10:36 AM -->
```

# ANN Model Graph Output

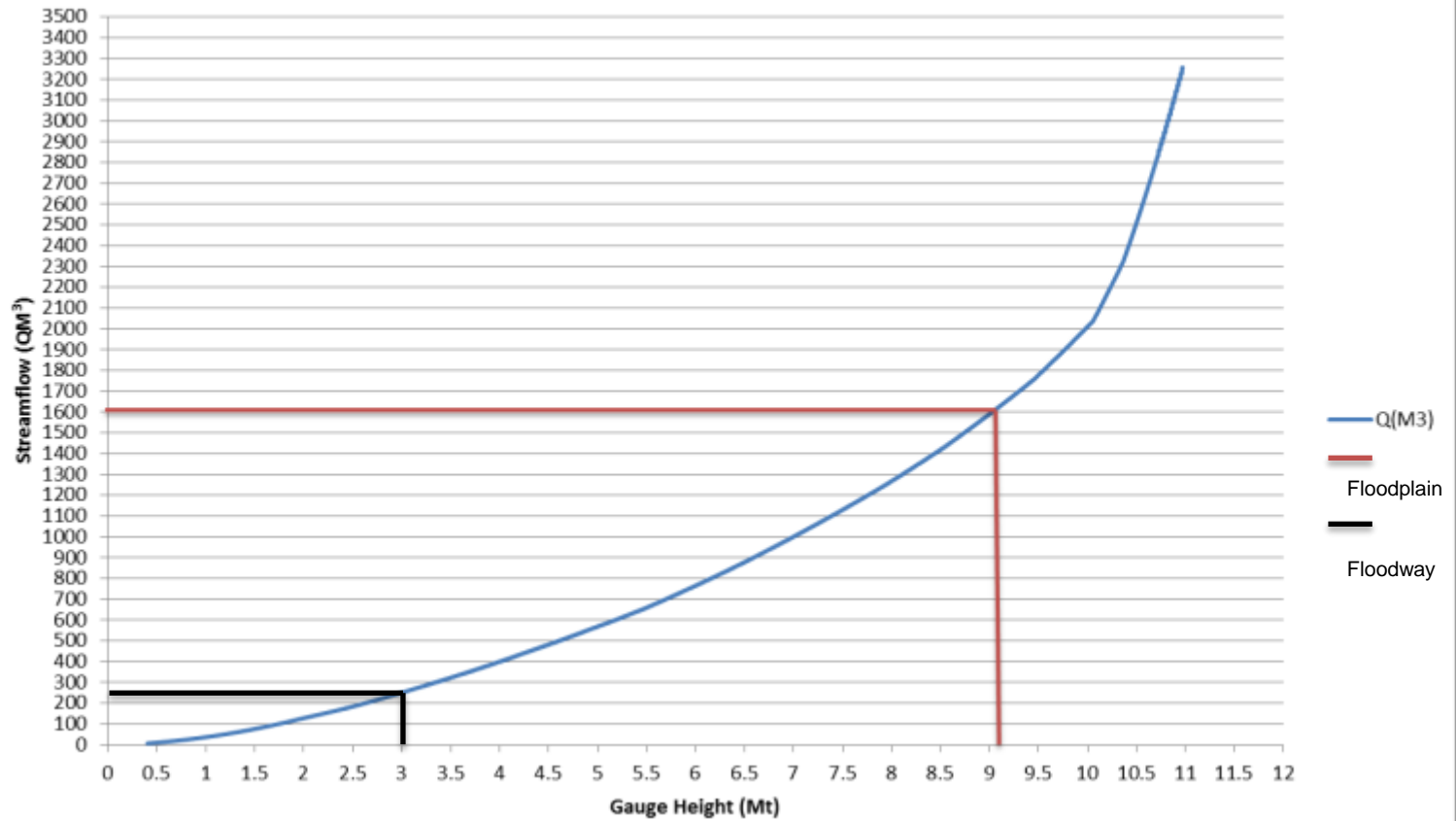


Combination (Train)	Nash	R2	RMSE M3/s
ANNCP4	0.9506	0.9506	49.1912
Combination (Test)	Nash	R2	RMSE M3/s
ANNCP4	0.9418	0.9425	52.6667

# Flood Map

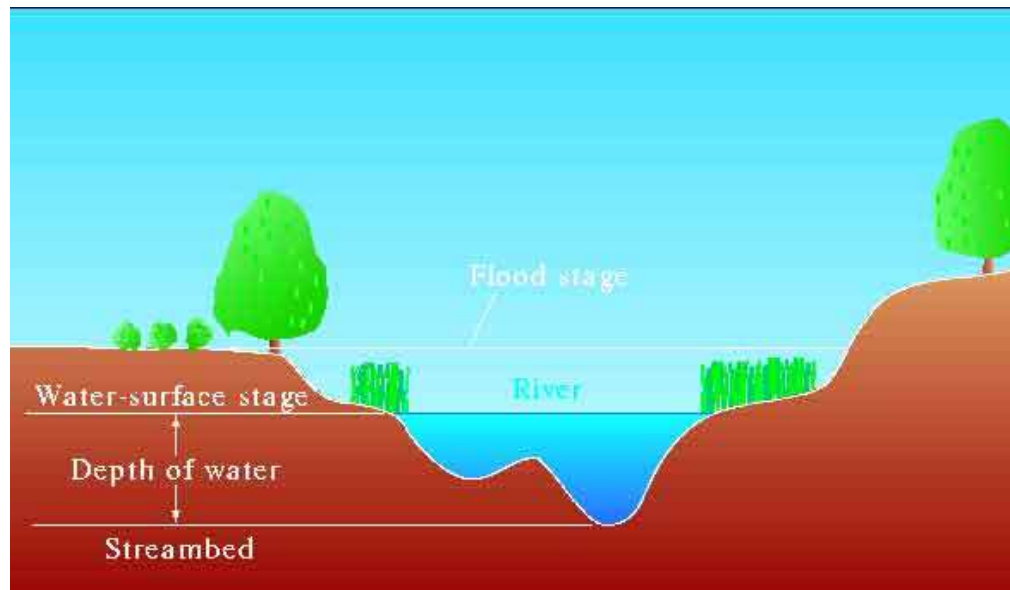


# Rating Curve



# Decision making

- This model can be used for future prediction
- If the stream water level exceeds the threshold level, a flood warning can be determined.



# Future Study

- Since this study was a point analysis of streamflow prediction, it can be further improved by :
  - Flood frequency analysis to estimate design flood based on various return periods (SMADA, HEC-SSP)
  - A HEC-RAS analysis to map the flood zone





**Thank you for your attention!**