

<><> Time Stamp <><>

Code started: 05/10/2022 - 15:00:45

Total Run Time: 18.119 s

<><> Bore Information <><>

Bore ID: GW036872.1.1

Region: Coastal

Bore Coordinates: (-30.923963, 153.044423)

Agency: WaterNSW

Drilled Date: 01/08/1990

Bore Depth: 30.5 m

Drilled Depth: 30.5 m

Reference Elevation: nan m

Time Series Reference Elevation: nan m

Land Surface Elevation: nan m

Silo Grid Point Coordinates: (-30.9, 153.05)

<><> Model Output <><>

Averaged Period: 30 day(s)

Output: Average Standing Water Level (m) in 1 period(s) time

<><> Model Inputs <><>

Data Range: 01/05/2010 - 31/08/2021

Train Set Size: 80.0%

Test Set Size: 20.0%

Input Timesteps: Current period + 2 preceeding period(s)

Input Variables:

Average Standing Water Level (m)

Average Rainfall (mm)

<><> Data Quality <><>

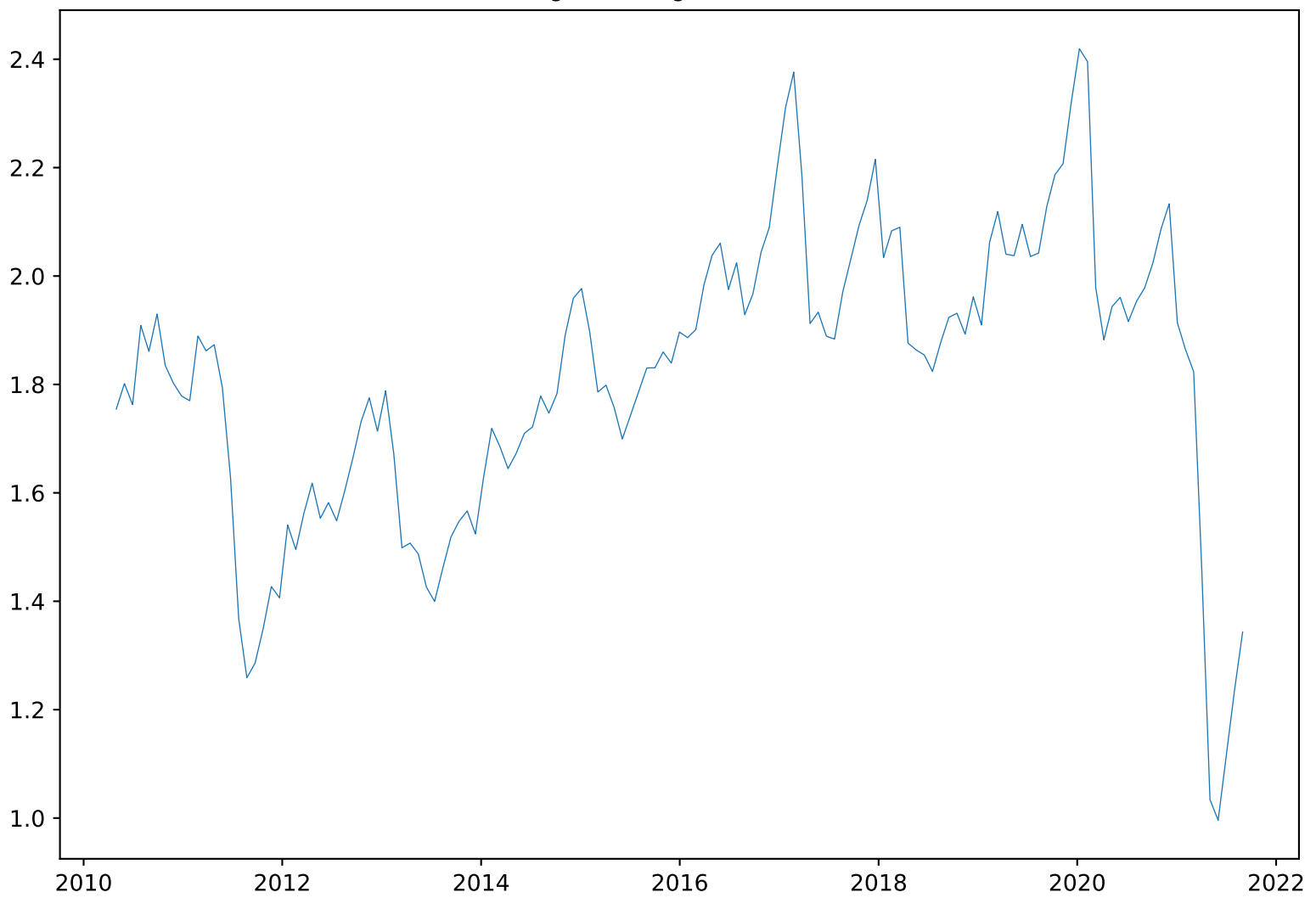
Interpolation Method: Spline

Quality Code: A, Number: 3434, Percentage: 82.33%

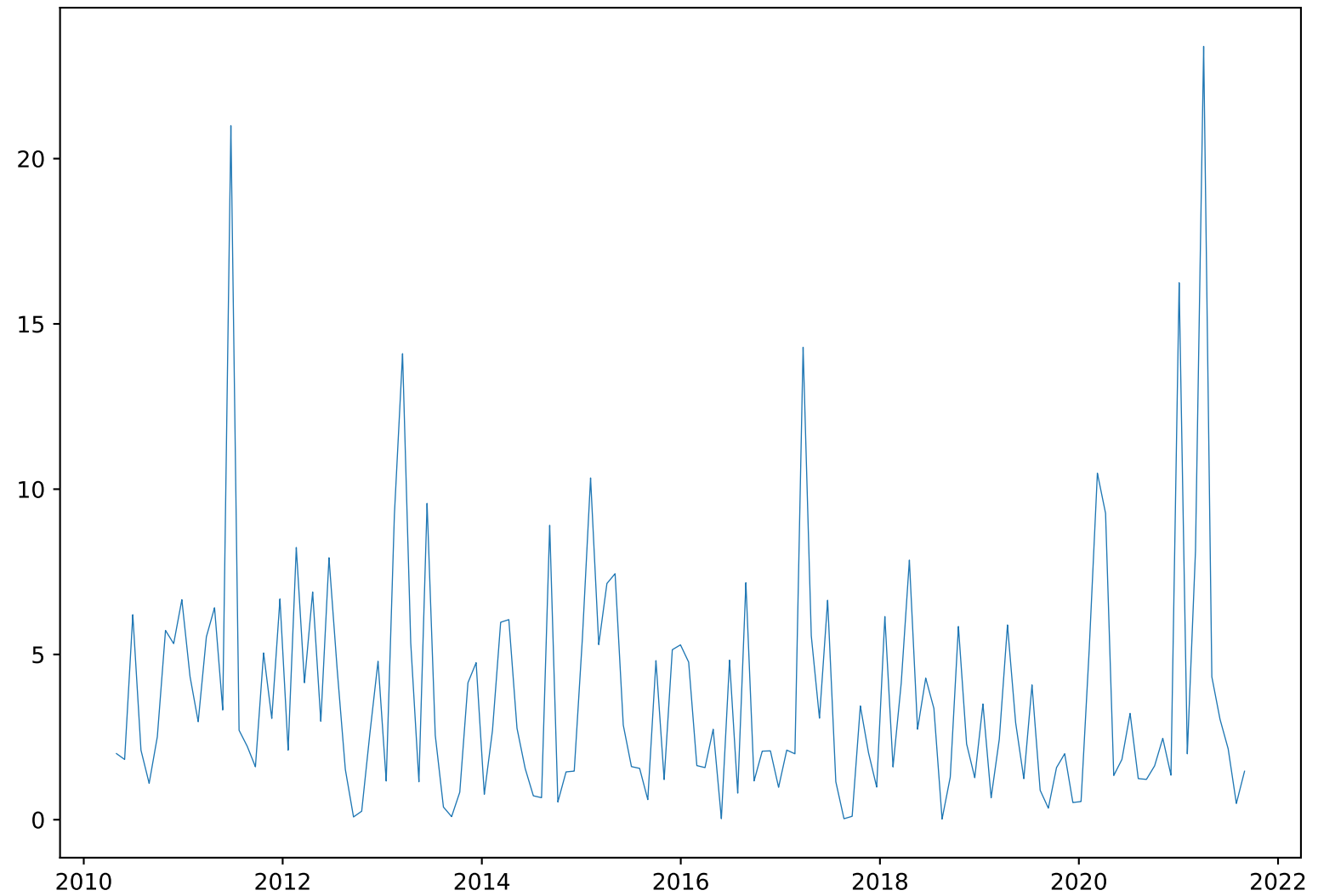
Quality Code: B, Number: 645, Percentage: 15.46%

Quality Code: C, Number: 92, Percentage: 2.21%

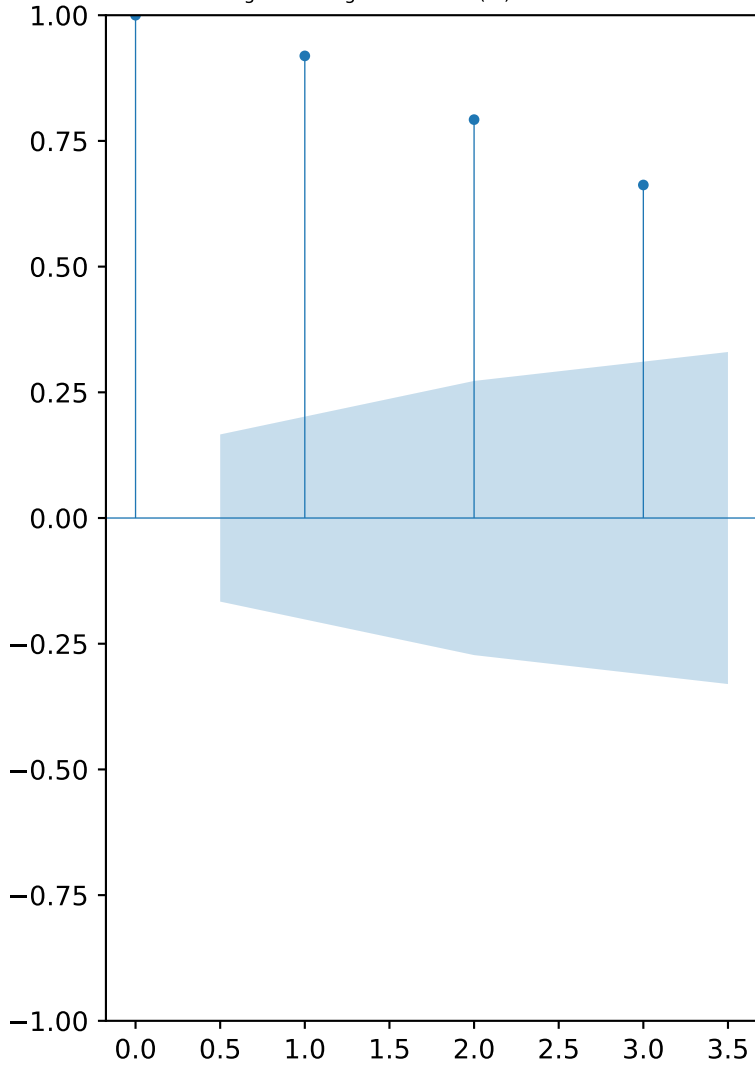
Average Standing Water Level (m)



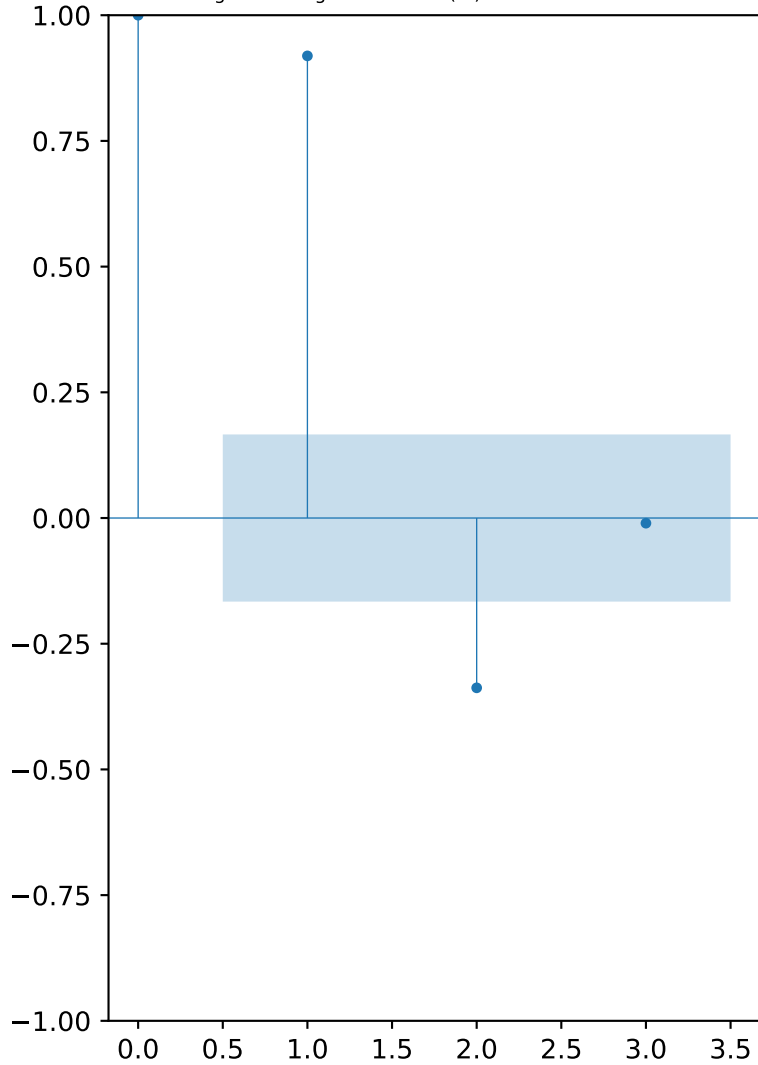
Average Rainfall (mm)



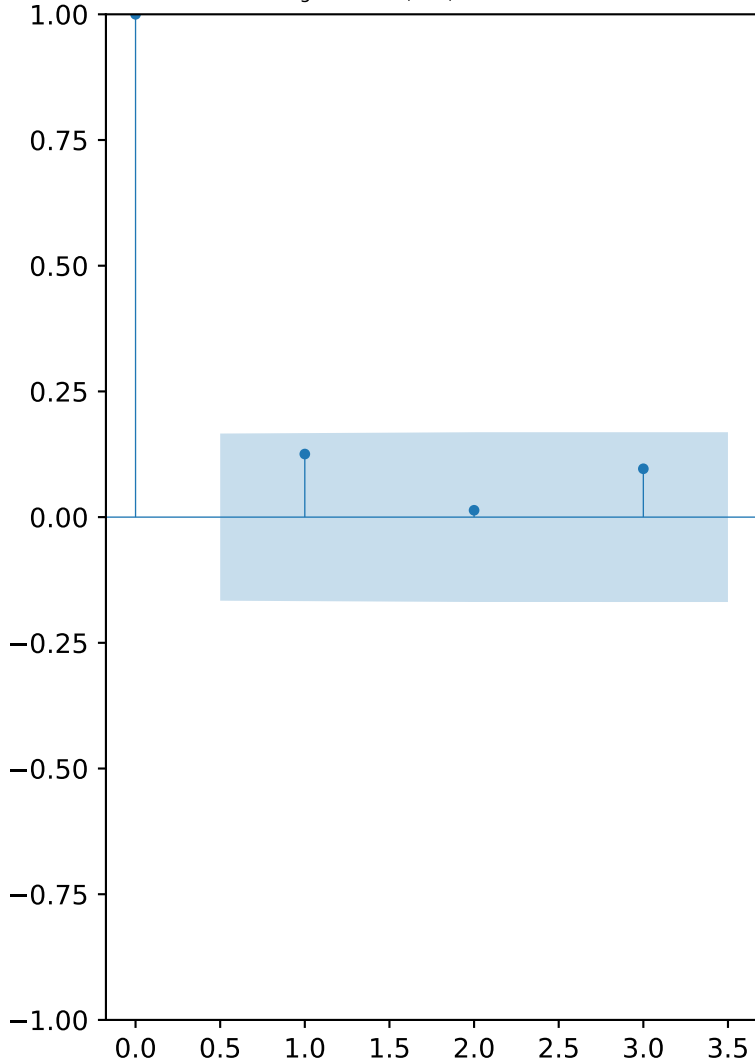
Average Standing Water Level (m) - Autocorrelation



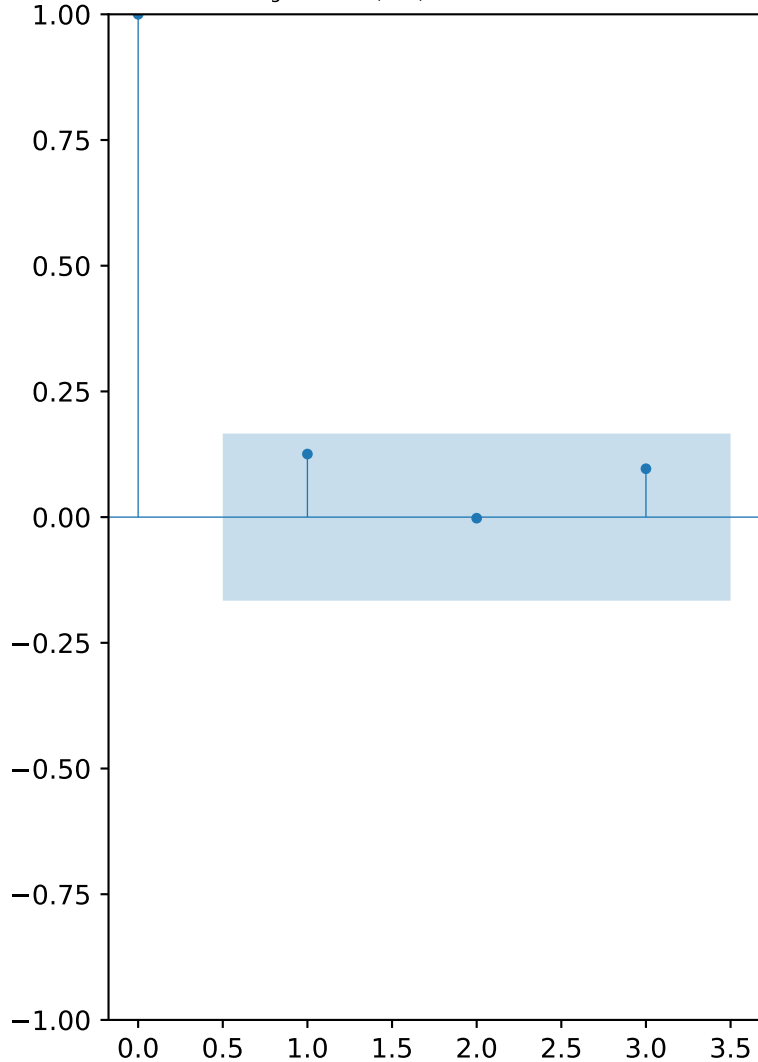
Average Standing Water Level (m) - Partial Autocorrelation



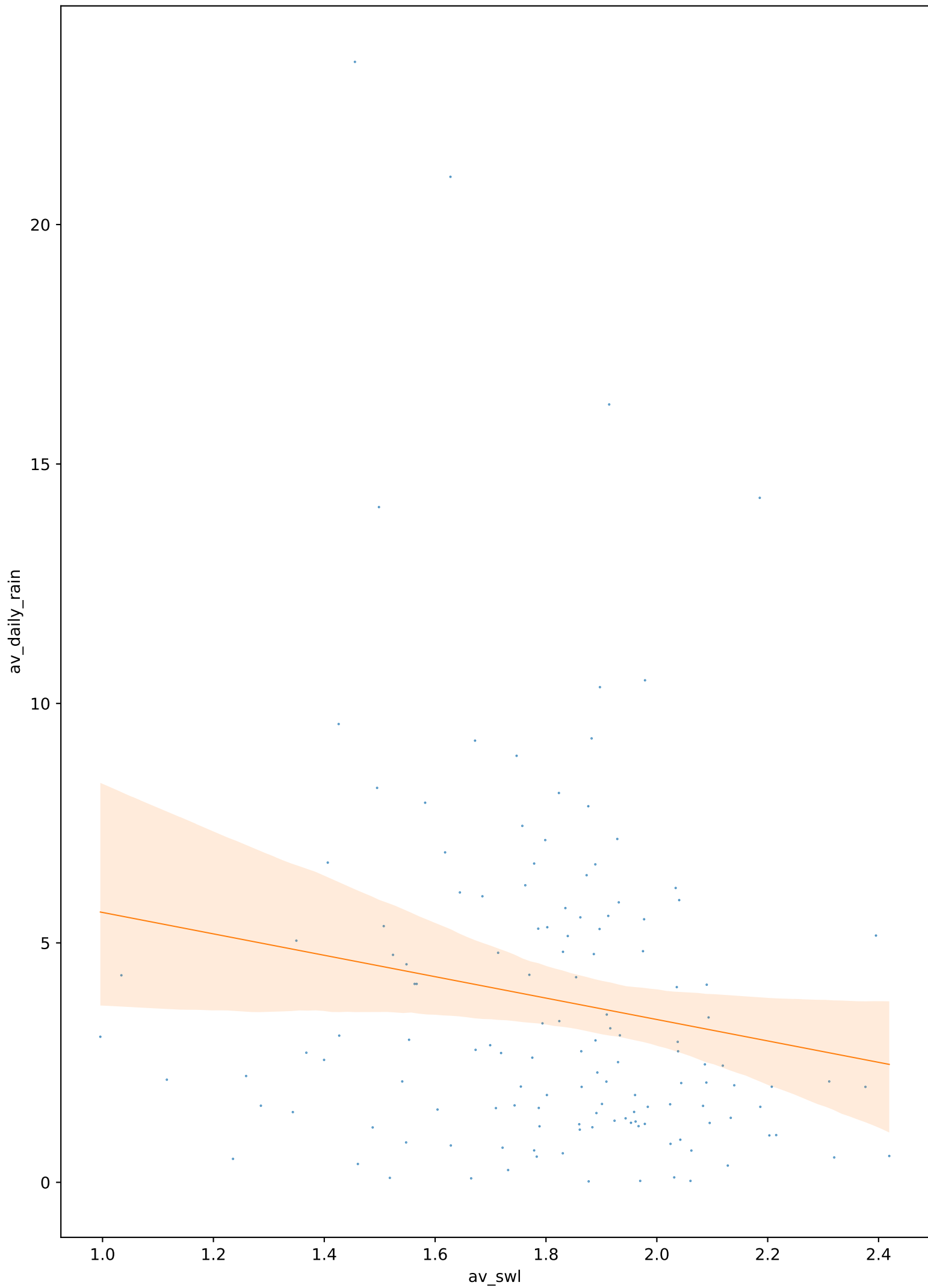
Average Rainfall (mm) - Autocorrelation



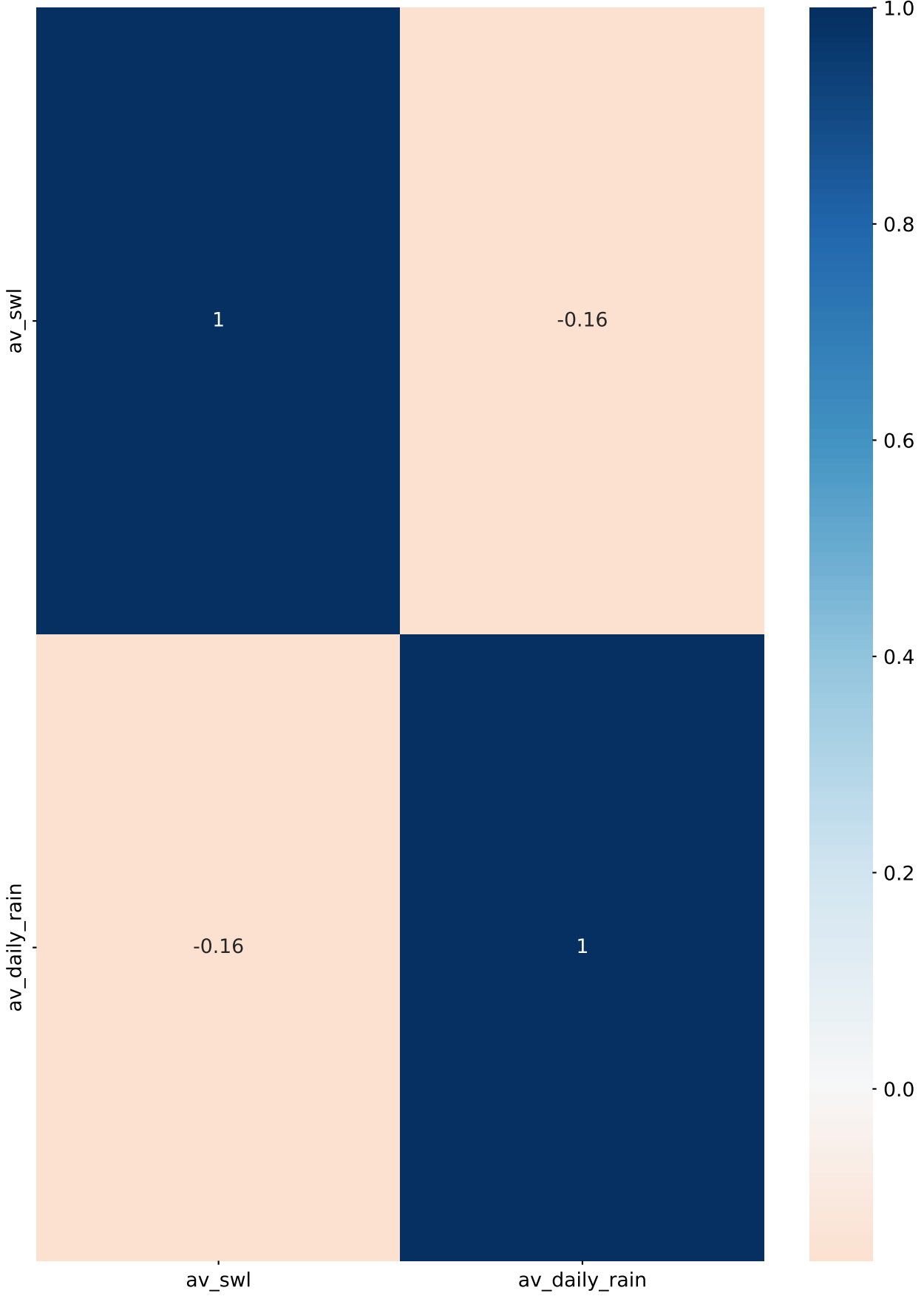
Average Rainfall (mm) - Partial Autocorrelation



Input Variable Correlation



Input Variable Correlation Heatmap



<><> TensorFlow Keras LSTM Model <><>

Optimiser: adam  
Loss: mse  
Number of Epochs: 100  
Percentage of Training Data for Validation: 20.0%  
Time Series Order: Chronological  
Verbose: Off

<><> Model Architecture <><>

Input Shape (Samples, Timesteps, Features): (108, 3, 2)  
LSTM Layers: 1  
LSTM Cells per Layer: 64  
Fully Connected Hidden Layers: 2  
Fully Connected Hidden Neurons per Layer: 32  
Fully Connected Output Neurons: 1  
LSTM Dropout Rate: 20.0%  
LSTM Recurrent Dropout Rate: 20.0%

Model: "sequential\_239"

Layer (type)	Output Shape	Param #
=====		
lstm_259 (LSTM)	(None, 64)	17152
dense_552 (Dense)	(None, 32)	2080
dense_553 (Dense)	(None, 32)	1056
dense_554 (Dense)	(None, 1)	33
=====		
Total params: 20,321		
Trainable params: 20,321		
Non-trainable params: 0		

<><> Training Loss <><>

Epoch: 10,    Loss: 0.017698276787996292  
Epoch: 20,    Loss: 0.013590880669653416  
Epoch: 30,    Loss: 0.014785894192755222  
Epoch: 40,    Loss: 0.015285593457520008  
Epoch: 50,    Loss: 0.01235910039395094  
Epoch: 60,    Loss: 0.010068386793136597  
Epoch: 70,    Loss: 0.013645523227751255  
Epoch: 80,    Loss: 0.01687304861843586  
Epoch: 90,    Loss: 0.01337177213281393  
Epoch: 100,   Loss: 0.012844766490161419

<><> Validation Loss <><>

Epoch: 10, Loss: 0.006326393689960241  
Epoch: 20, Loss: 0.01621788553893566  
Epoch: 30, Loss: 0.012213725596666336  
Epoch: 40, Loss: 0.009228267706930637  
Epoch: 50, Loss: 0.009287013672292233  
Epoch: 60, Loss: 0.007730226032435894  
Epoch: 70, Loss: 0.0061829062178730965  
Epoch: 80, Loss: 0.006867599207907915  
Epoch: 90, Loss: 0.0071543678641319275  
Epoch: 100, Loss: 0.007010442204773426

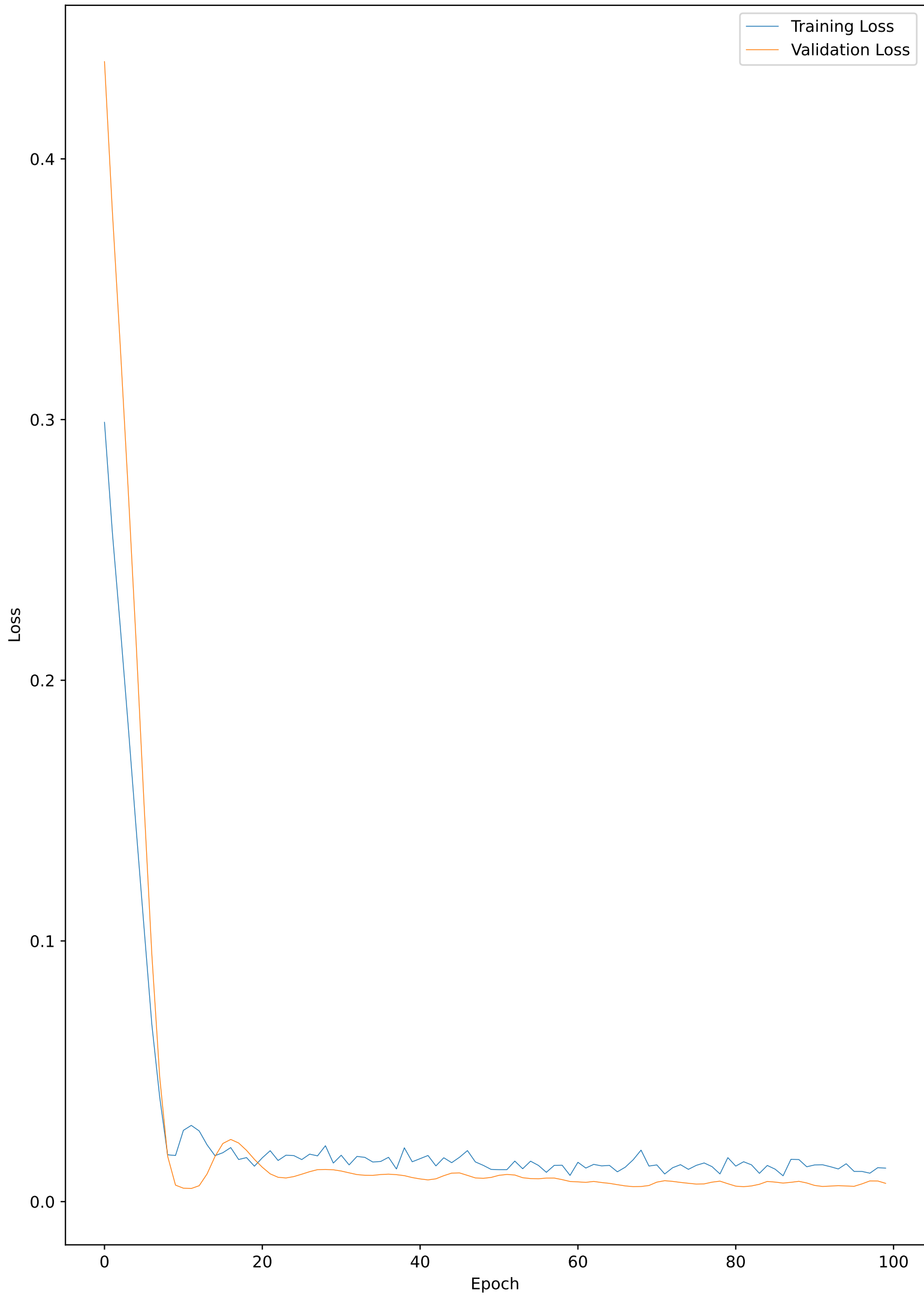
<><> Training Set Scores <><>

Train Root Mean Squared Error: 0.08755  
Train Mean Squared Error: 0.00767  
Train Normalised Root Mean Squared Error: 0.11153  
Train Coefficient of Determination: 0.69273  
Train Normalised Nash Sutcliffe Efficiency: 0.76495  
Train Mean Absolute Error: 0.069  
Train Pearson's Correlation Coefficient: 0.92473  
Train Index of Agreement: 0.86466  
Train Kling-Gupta Efficiency: 0.52041  
Train Mean Bias Error: -0.00992  
Train Mean Absolute Percentage Error: 0.05584

<><> Test Set Scores <><>

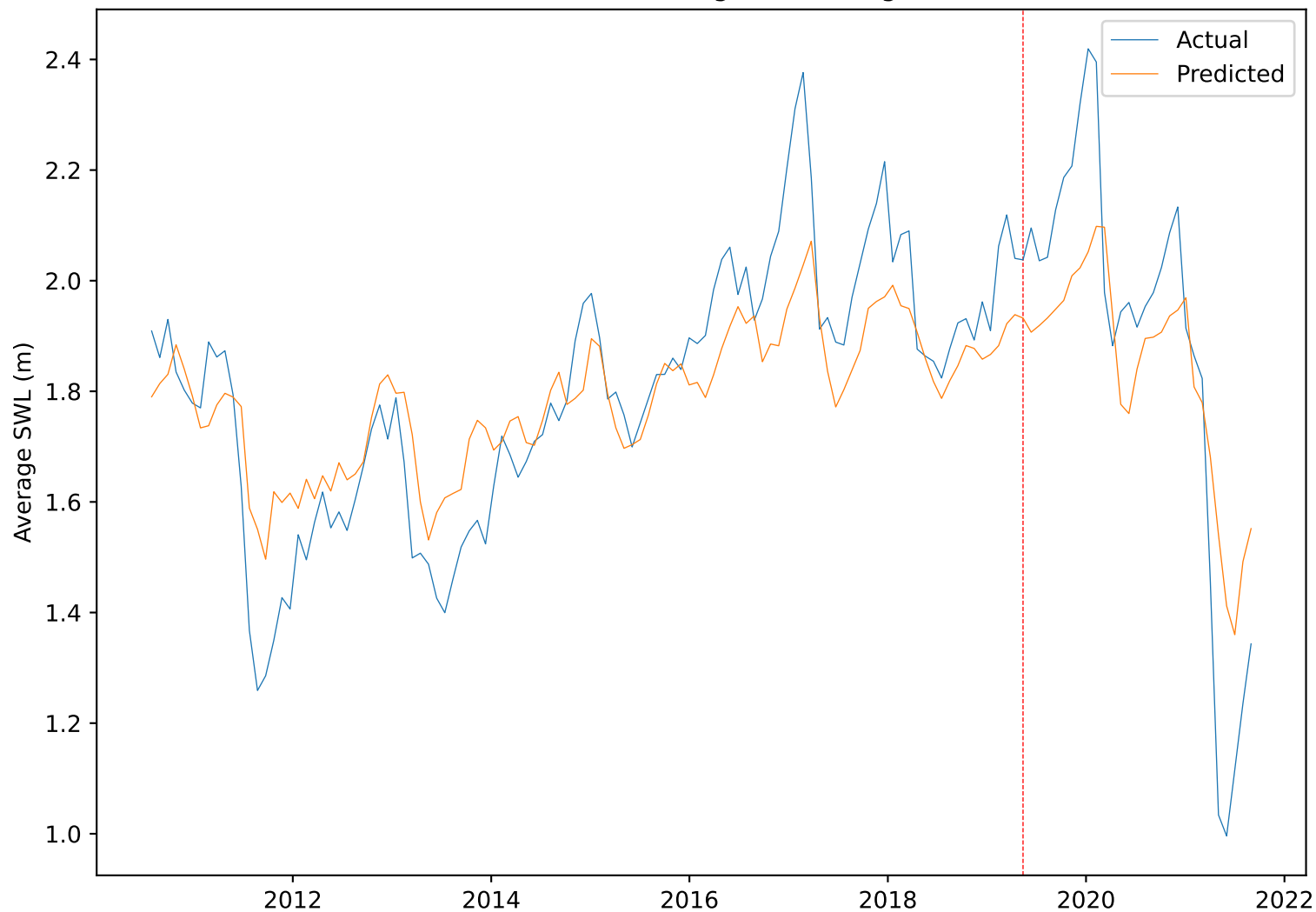
Test Root Mean Squared Error: 0.15271  
Test Mean Squared Error: 0.02332  
Test Normalised Root Mean Squared Error: 0.15271  
Test Coefficient of Determination: 0.6882  
Test Normalised Nash Sutcliffe Efficiency: 0.76231  
Test Mean Absolute Error: 0.13044  
Test Pearson's Correlation Coefficient: 0.94063  
Test Index of Agreement: 0.86067  
Test Kling-Gupta Efficiency: 0.50204  
Test Mean Bias Error: -0.02573  
Test Mean Absolute Percentage Error: 0.11474

LSTM Learning Curves

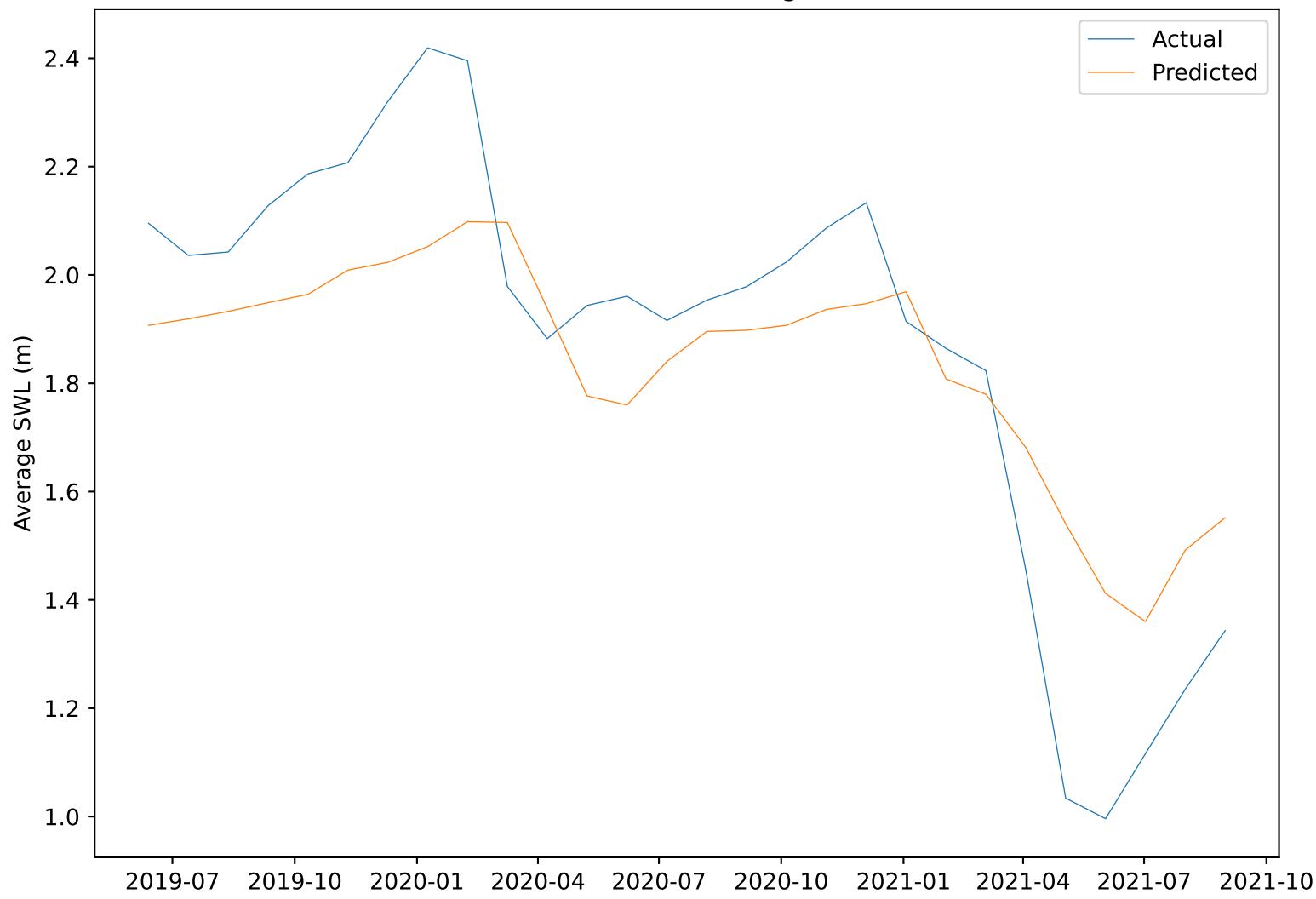




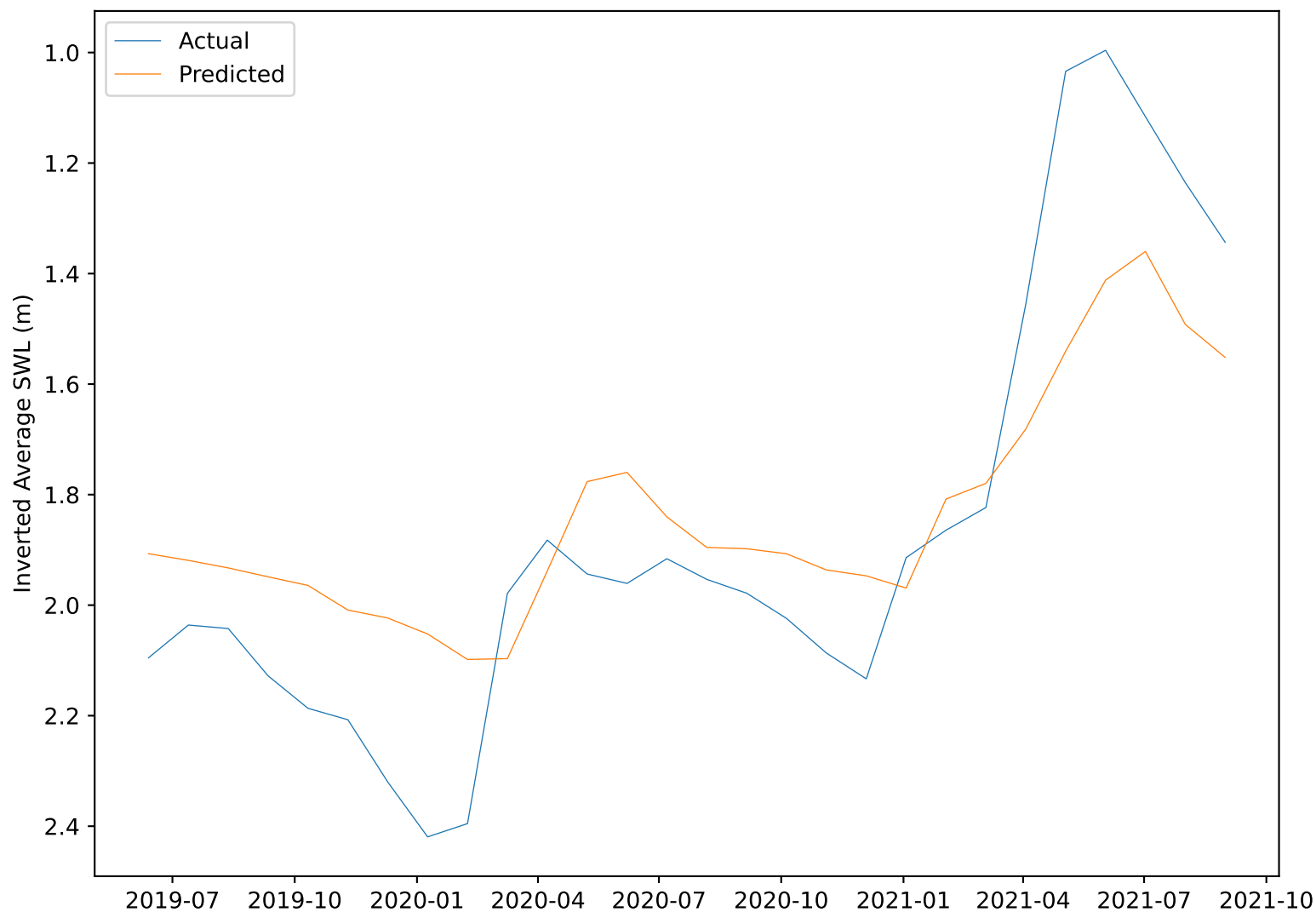
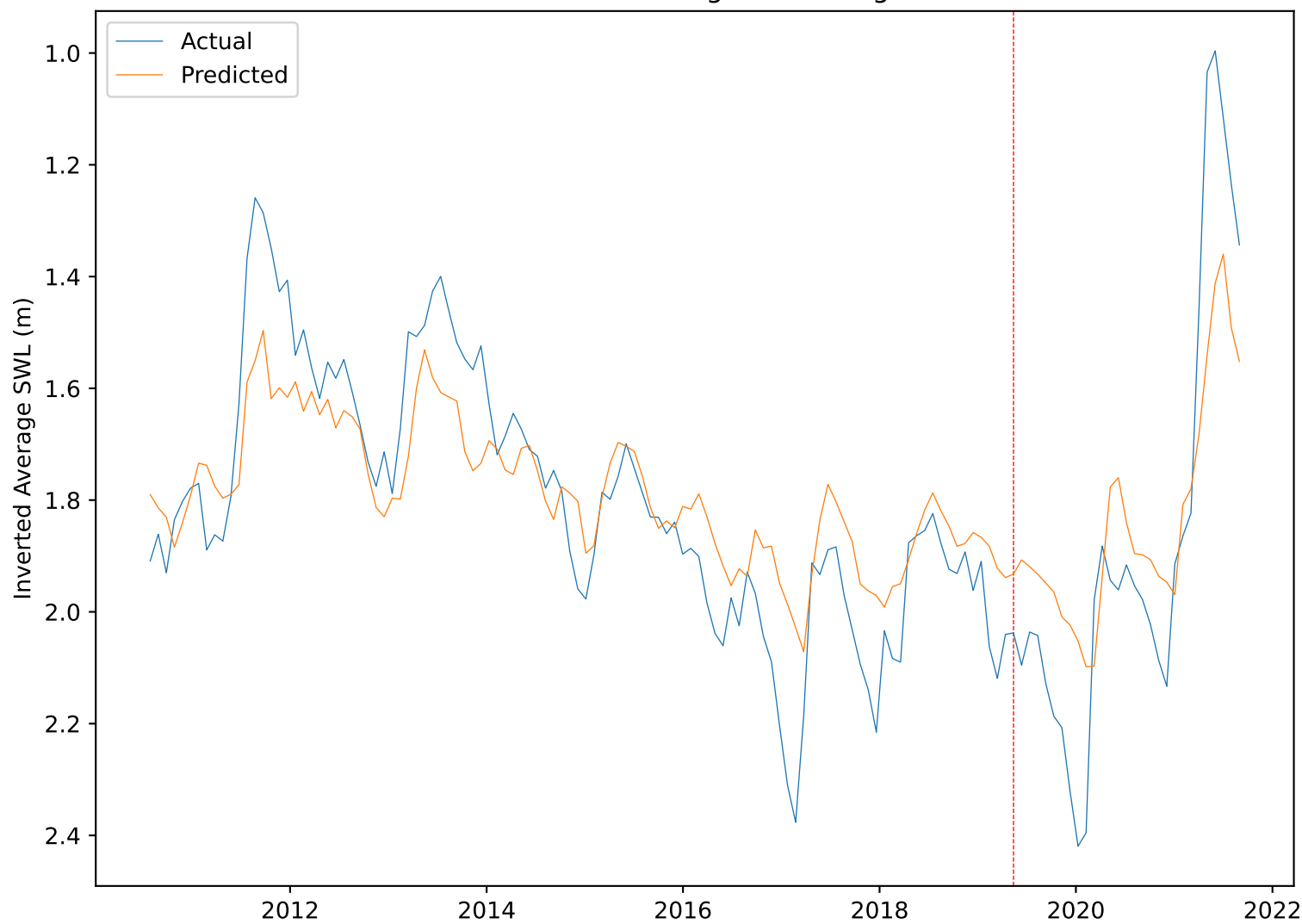
# LSTM Model: Training and Testing Sets



## LSTM Model: Testing Set



# LSTM Model: Training and Testing Sets



# <><> Scikit Learn SVR Model <><>

Kernel Function: rbf  
Kernel Coefficient: scale  
Epsilon: 0.1  
Stopping Criterion Tolerance: 1e-05  
Regularisation Parameter: 1.0  
Shrinking: True  
Time Series Order: Chronological  
Verbose: Off

## <><> Model Architecture <><>

Number of Support Vectors: 15  
Input/Support Vector Size: 6

## <><> 5-Fold Cross Validation Mean Training Loss <><>

Epoch: 8,	Loss: 0.0019374427545810011
Epoch: 16,	Loss: 0.00567416371292689
Epoch: 24,	Loss: 0.004521279978539594
Epoch: 32,	Loss: 0.003903370531878808
Epoch: 40,	Loss: 0.0036151893188993423
Epoch: 48,	Loss: 0.003431399024793989
Epoch: 56,	Loss: 0.003419250432910341
Epoch: 64,	Loss: 0.003429137211266223
Epoch: 72,	Loss: 0.0033985229589354182
Epoch: 80,	Loss: 0.003339700692594195

## <><> 5-Fold Cross Validation Mean Validation Loss <><>

Epoch: 8,	Loss: 0.02183136536234781
Epoch: 16,	Loss: 0.02568272768919654
Epoch: 24,	Loss: 0.027524519166806392
Epoch: 32,	Loss: 0.026476606243362417
Epoch: 40,	Loss: 0.02449853479390369
Epoch: 48,	Loss: 0.024530166551195564
Epoch: 56,	Loss: 0.02066925464506738
Epoch: 64,	Loss: 0.021481066193390567
Epoch: 72,	Loss: 0.010073164262955065
Epoch: 80,	Loss: 0.007383241501958614

## <><> Training Set Scores <><>

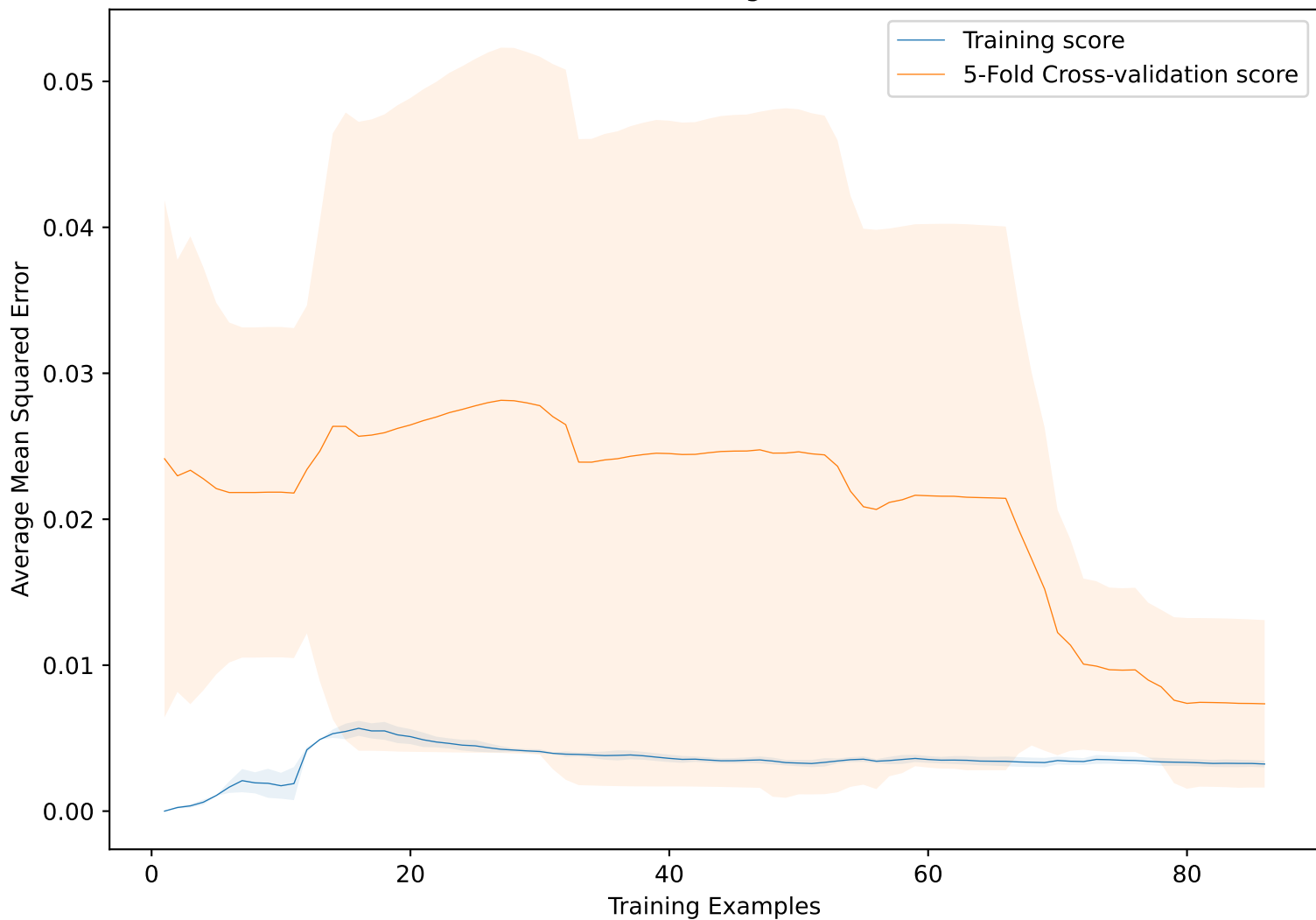
Train Root Mean Squared Error: 0.05559  
Train Mean Squared Error: 0.00309  
Train Normalised Root Mean Squared Error: 0.07081  
Train Coefficient of Determination: 0.87615  
Train Normalised Nash Sutcliffe Efficiency: 0.8898

Train Mean Absolute Error: 0.04567  
Train Pearson's Correlation Coefficient: 0.94196  
Train Index of Agreement: 0.96243  
Train Kling-Gupta Efficiency: 0.82777  
Train Mean Bias Error: -0.0028  
Train Mean Absolute Percentage Error: 0.03693

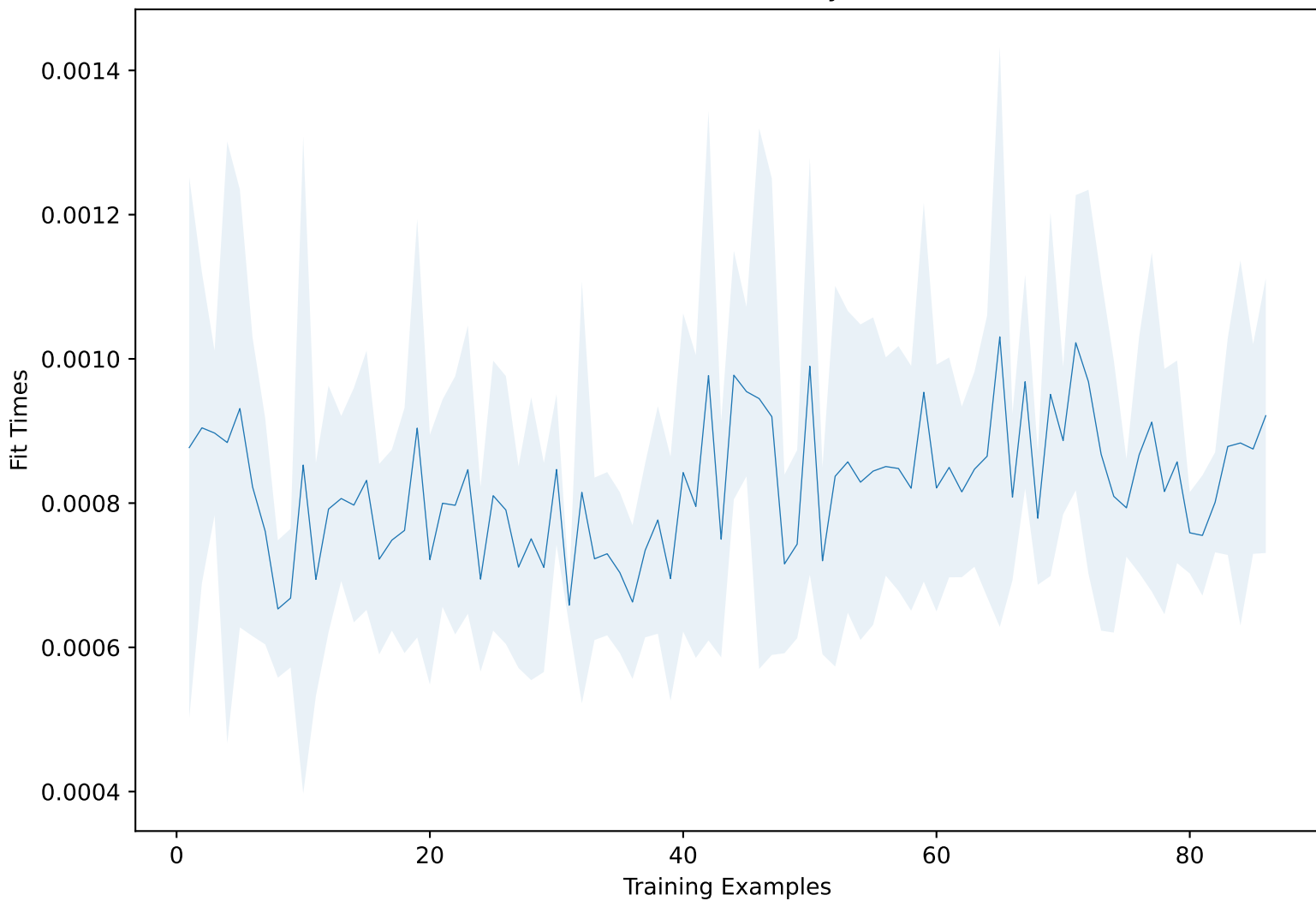
<><> Test Set Scores <><>

Test Root Mean Squared Error: 0.13422  
Test Mean Squared Error: 0.01801  
Test Normalised Root Mean Squared Error: 0.13422  
Test Coefficient of Determination: 0.75913  
Test Normalised Nash Sutcliffe Efficiency: 0.80589  
Test Mean Absolute Error: 0.09757  
Test Pearson's Correlation Coefficient: 0.91287  
Test Index of Agreement: 0.90876  
Test Kling-Gupta Efficiency: 0.63993  
Test Mean Bias Error: 0.02182  
Test Mean Absolute Percentage Error: 0.09586

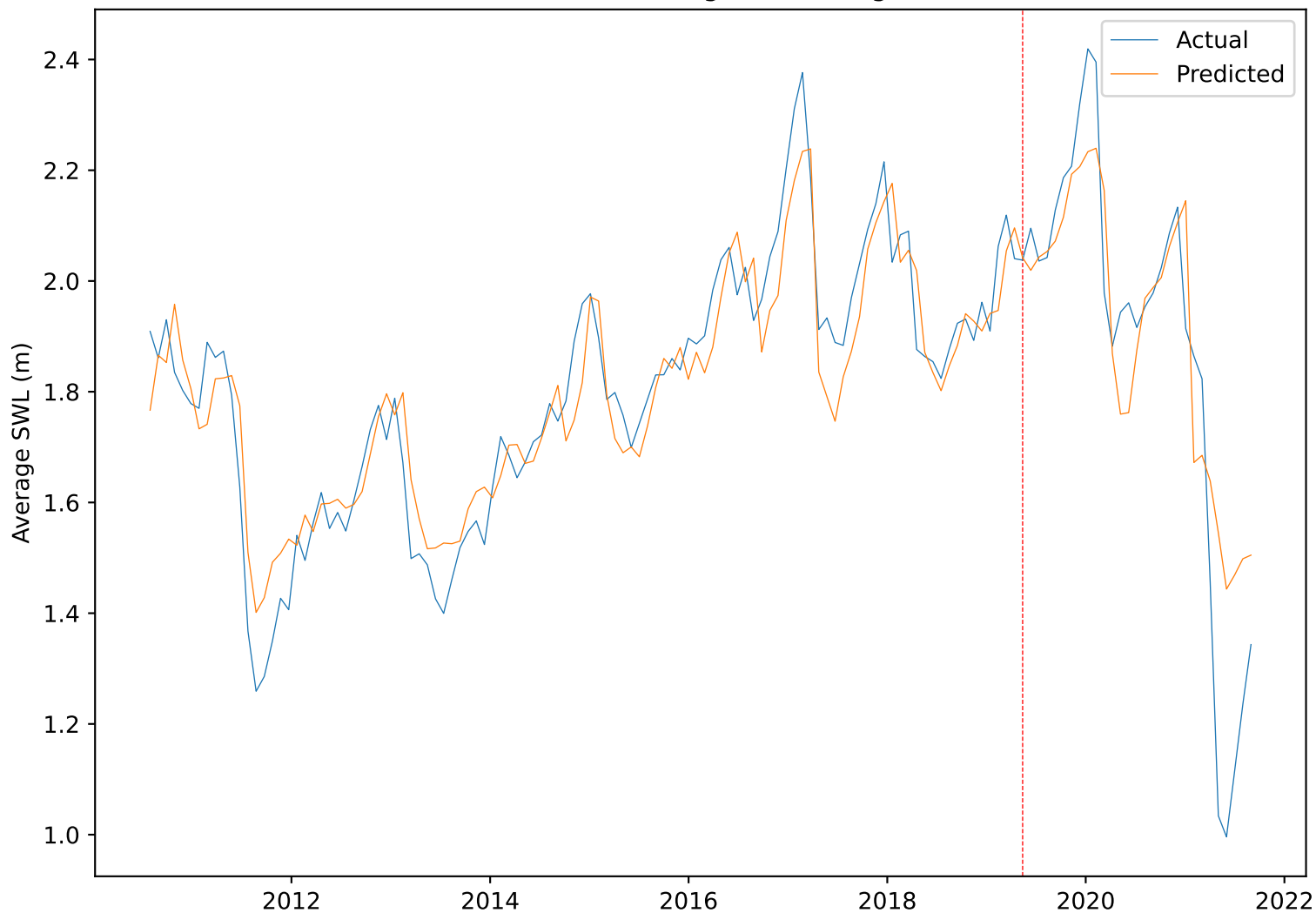
SVR Learning Curve



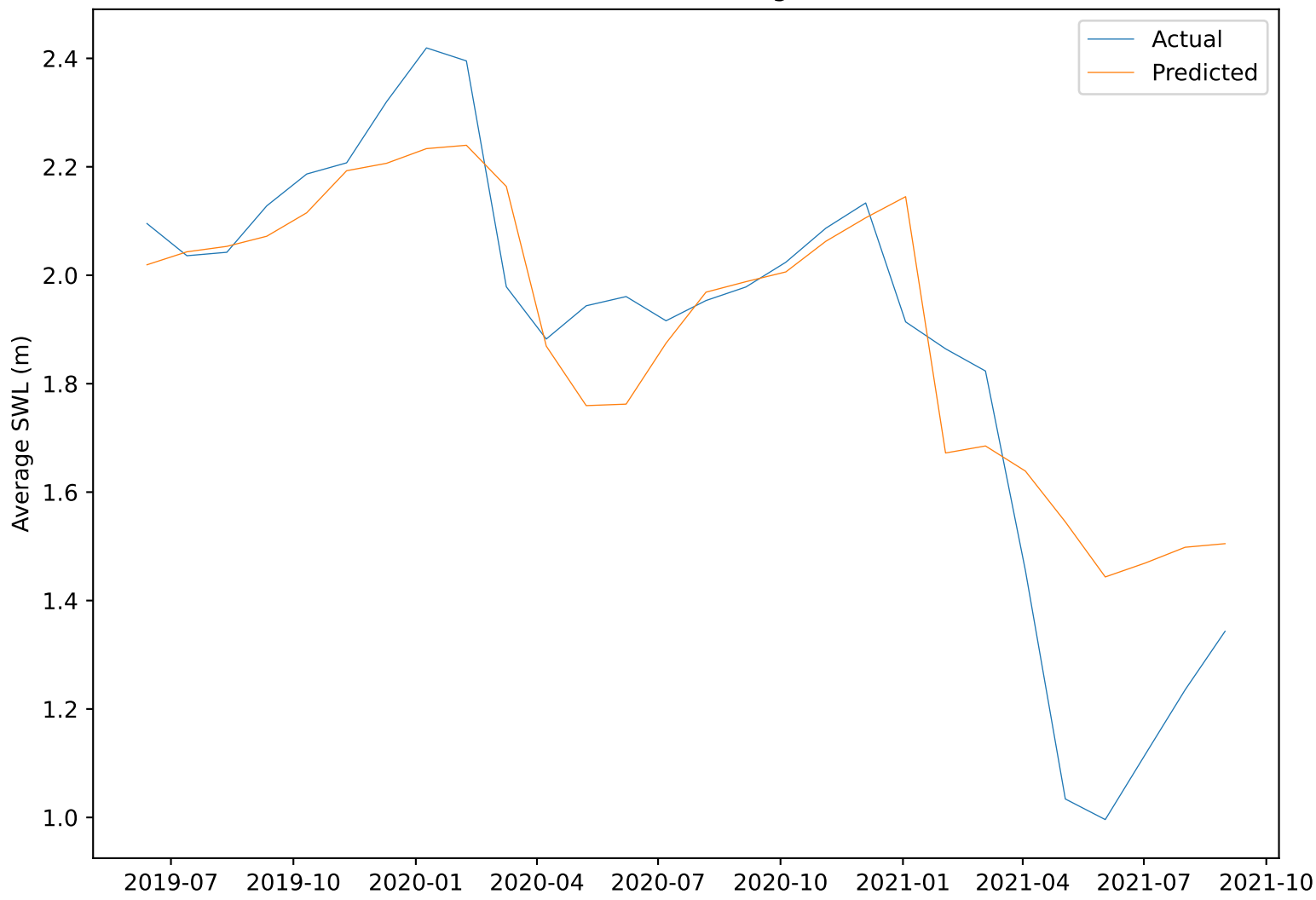
Model Scalability



SVR Model: Training and Testing Sets



SVR Model: Testing Set



SVR Model: Training and Testing Sets

