<><> Time Stamp <><>

Code started: 05/10/2022 - 14:59:13
Total Run Time: 17.91 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 <><>

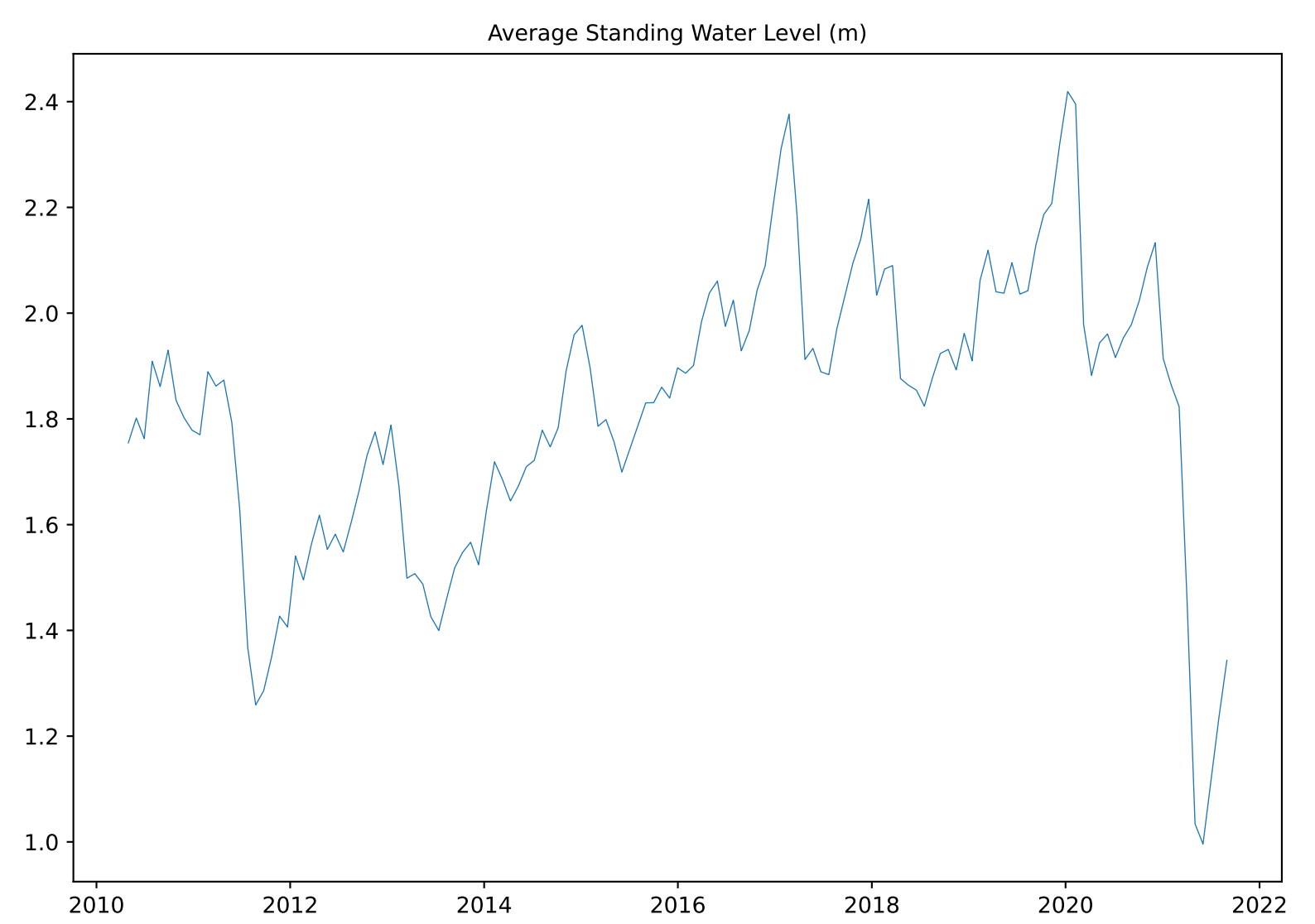
Averaged Period: 30 day(s)
Output: Average Standing Water Level (m) in 1 period(s) time

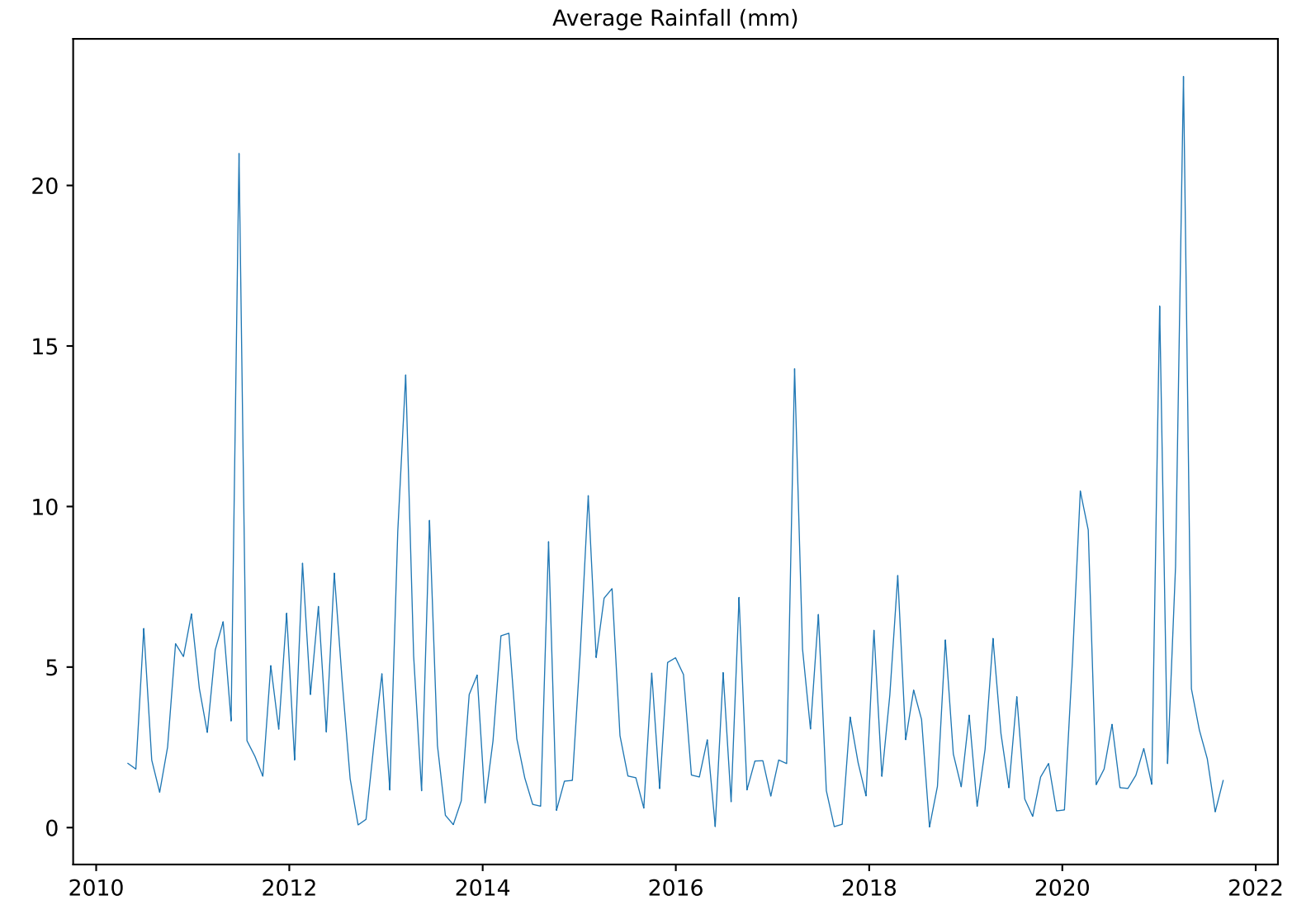
<><> Model Inputs <><>

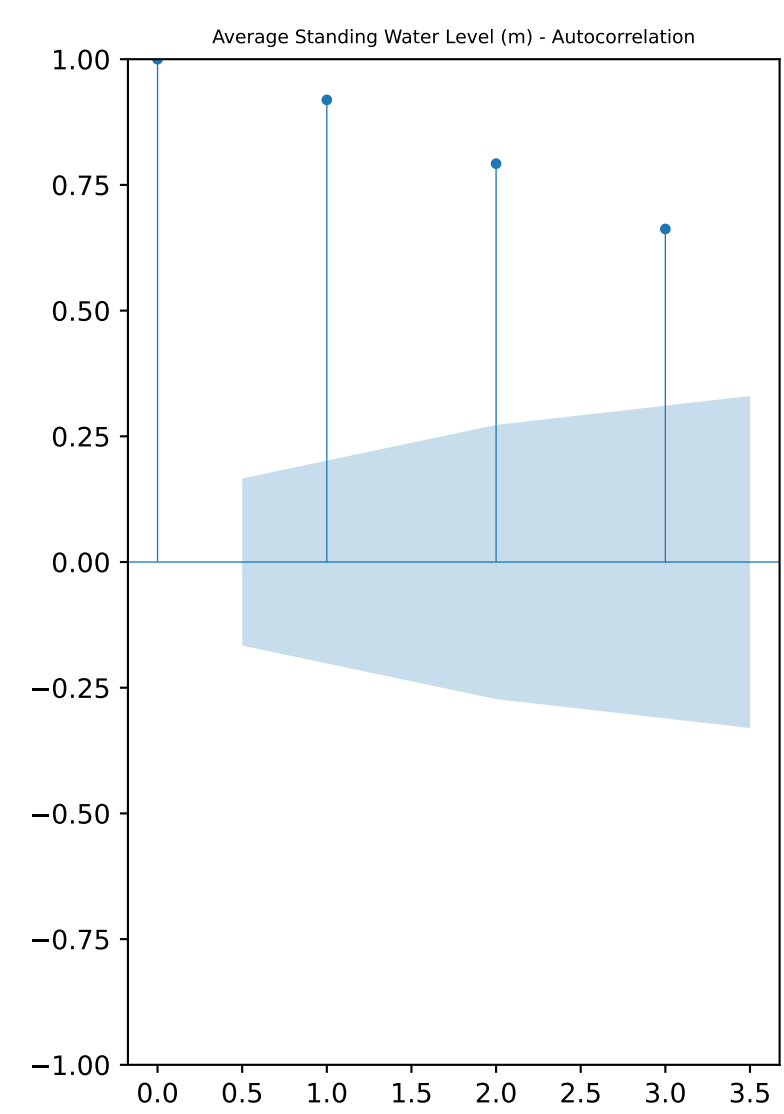
Data Range: 01/05/2010 - 31/08/2021
Train Set Size: 80.0%
Test Set Size: 20.0%
Input Timesteps: Current period + 2 preceeding period(s)
Input Variables:
    Average Standing Water Level (m)
    Average Rainfall (mm)

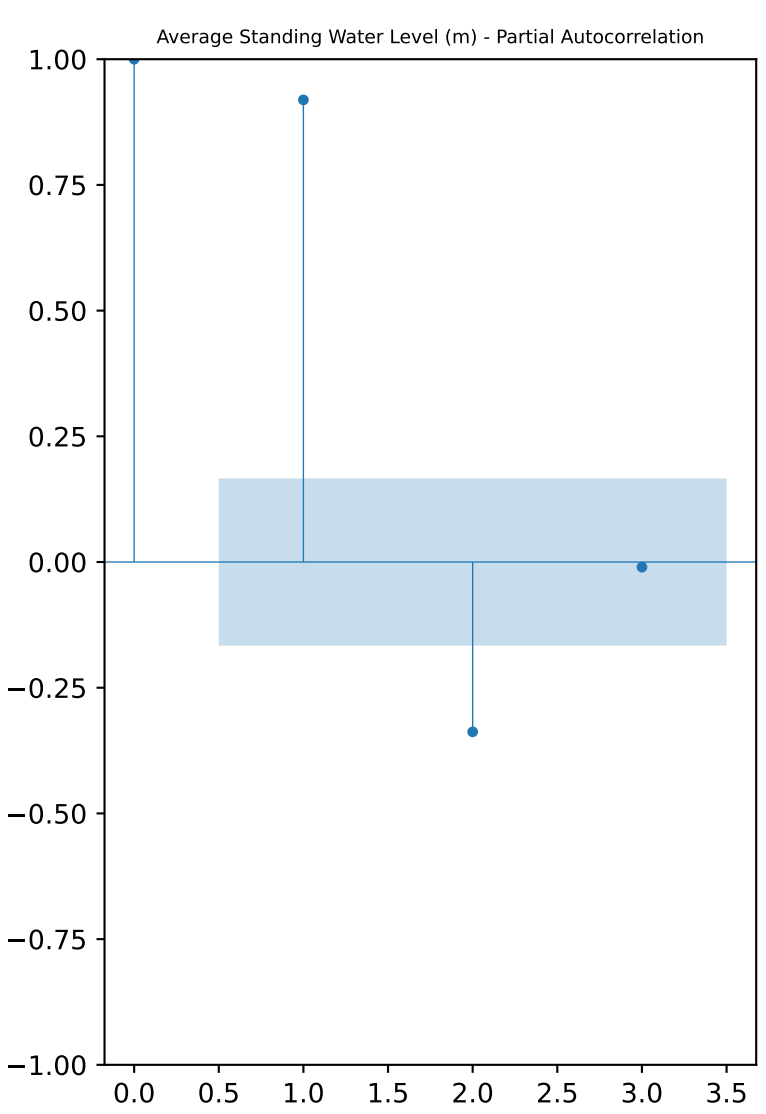
<><> Data Quality <><>

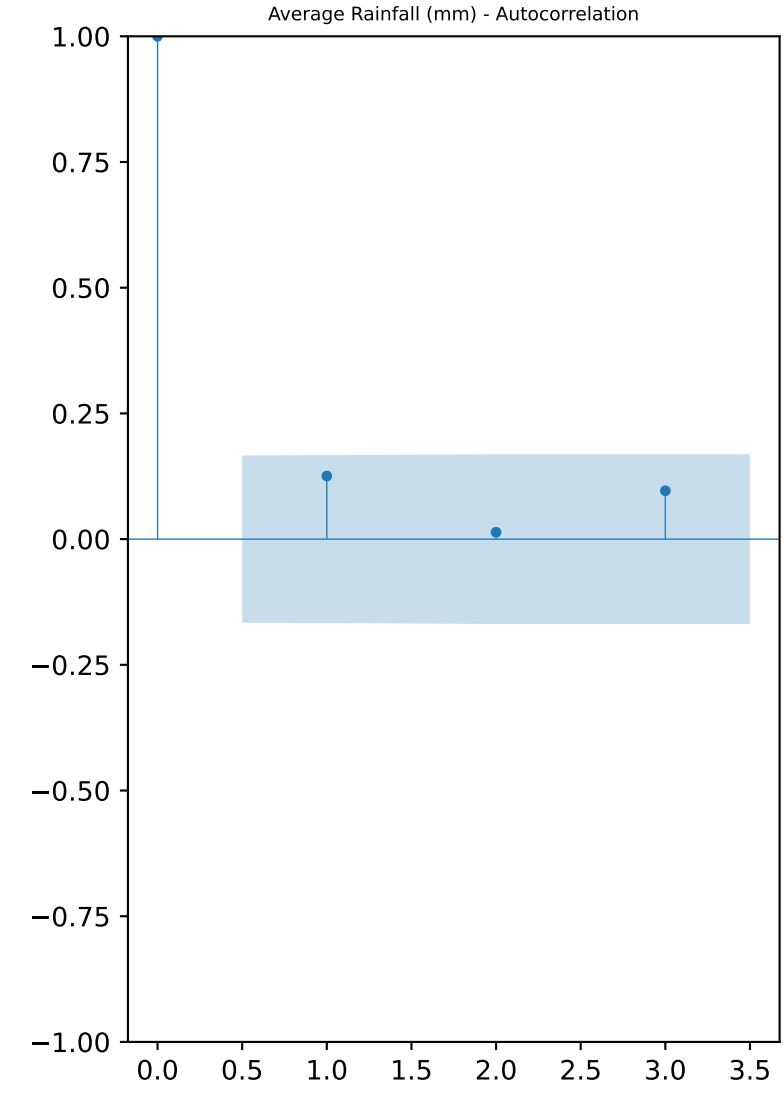
Interpolation Method: Spline
Quality Code: A,   Number: 3434,   Percentage: 82.33%
Quality Code: B,   Number: 645,   Percentage: 15.46%
Quality Code: C,   Number: 92,   Percentage: 2.21%

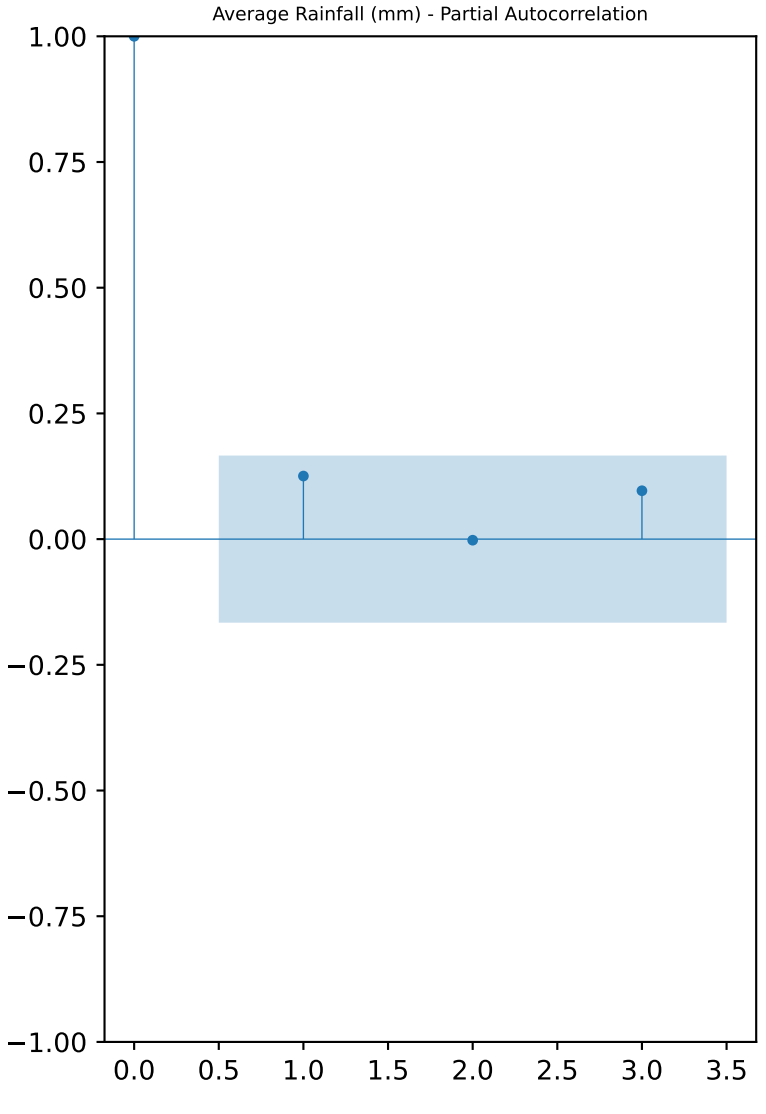

Average Standing Water Level (m)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
2010
2012
2014
2016
2018
2020
2022

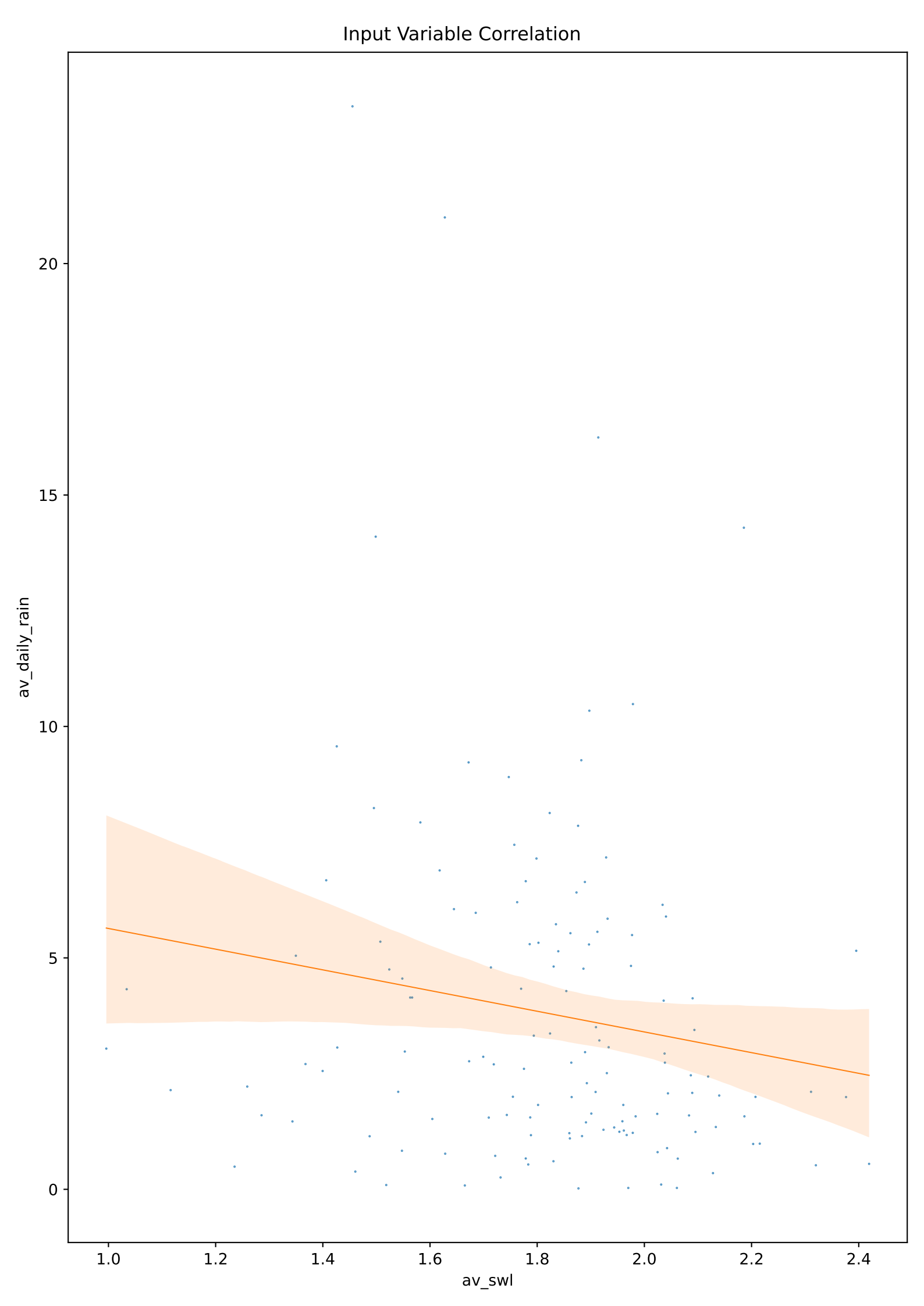

Average Rainfall (mm)
20
15
10
5
0
2010
2012
2014
2016
2018
2020
2022

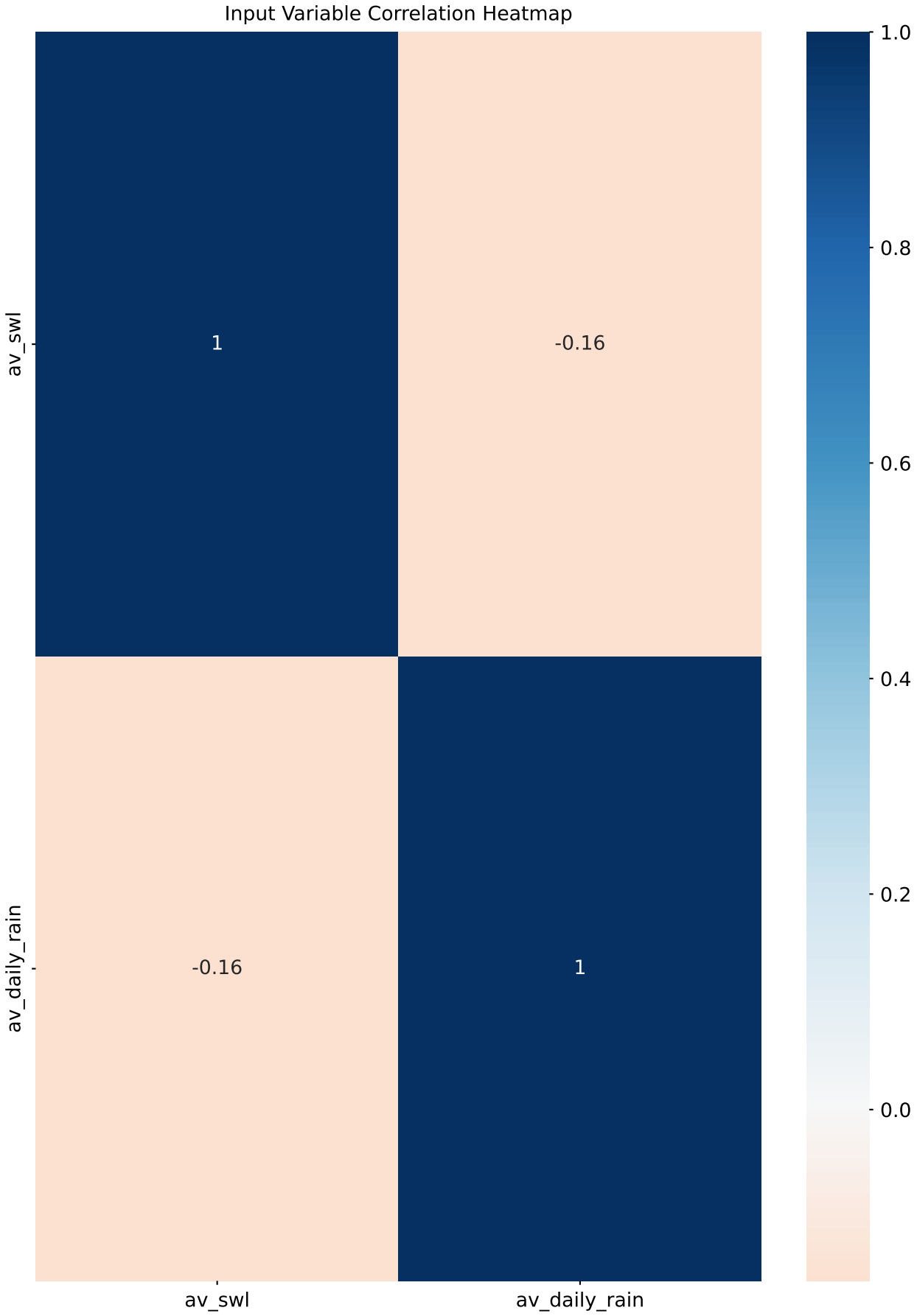

Average Standing Water Level (m) - Autocorrelation
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5


Average Standing Water Level (m) - Partial Autocorrelation
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5


Average Rainfall (mm) - Autocorrelation
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5


Average Rainfall (mm) - Partial Autocorrelation
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5


Input Variable Correlation
av_daily_rain
av_swl
0
5
10
15
20
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4


Input Variable Correlation Heatmap
av_swl
av_daily_rain
1
-0.16
-0.16
1
av_swl
av_daily_rain
1.0
0.8
0.6
0.4
0.2
0.0

<><> 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_237"

Layer (type)	Output Shape	Param #
lstm_257 (LSTM)	(None, 64)	17152
dense_546 (Dense)	(None, 32)	2080
dense_547 (Dense)	(None, 32)	1056
dense_548 (Dense)	(None, 1)	33

Total params: 20,321
Trainable params: 20,321
Non-trainable params: 0

<><> Training Loss <><>

Epoch: 10,   Loss: 0.02569032460451126
Epoch: 20,   Loss: 0.023263227194547653
Epoch: 30,   Loss: 0.014996726997196674
Epoch: 40,   Loss: 0.01500666793435812
Epoch: 50,   Loss: 0.016650177538394928
Epoch: 60,   Loss: 0.01140747219324112
Epoch: 70,   Loss: 0.013076319359242916
Epoch: 80,   Loss: 0.014942419715225697
Epoch: 90,   Loss: 0.013616717420518398
Epoch: 100,   Loss: 0.011128737591207027

<><> Validation Loss <><>

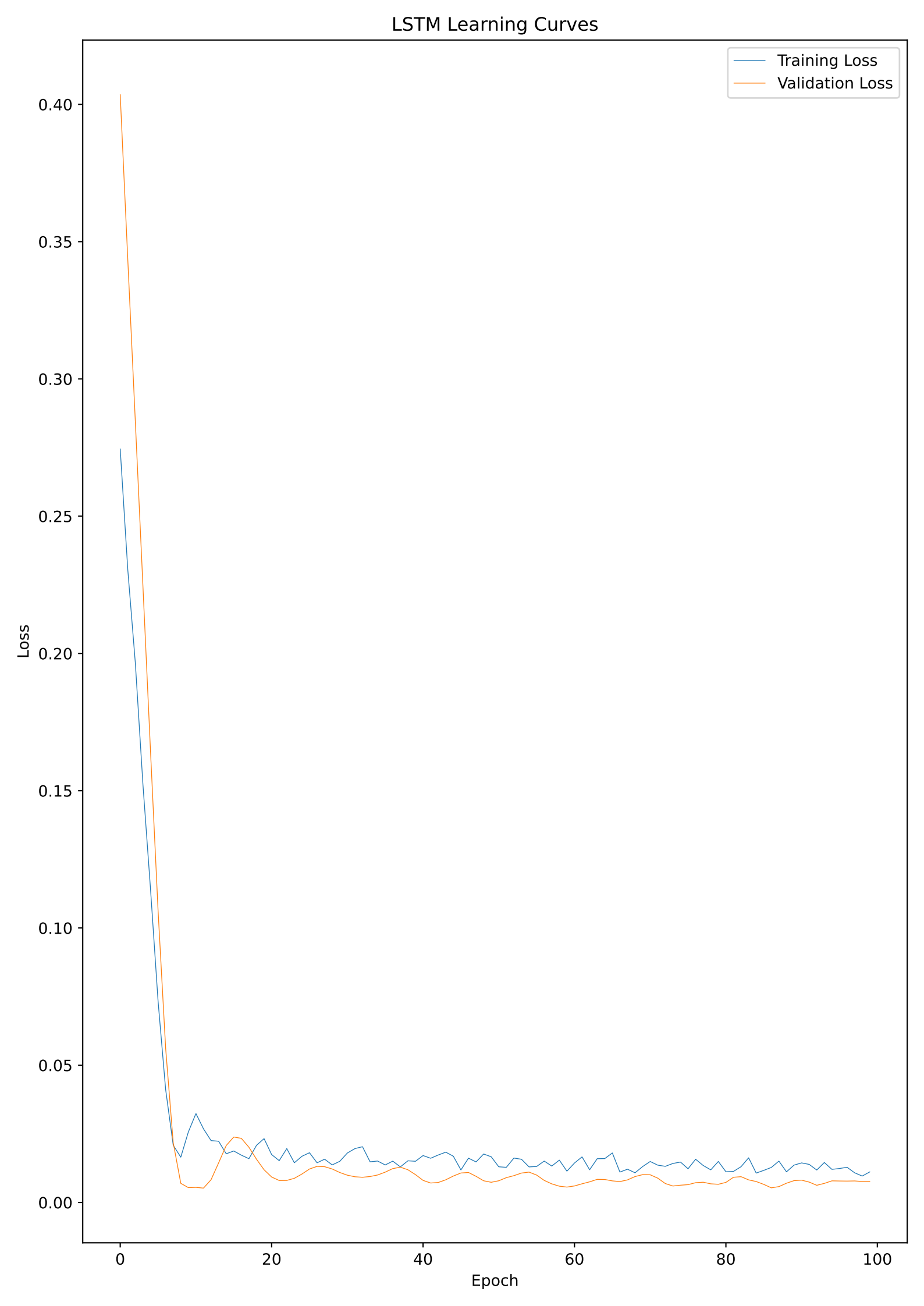
Epoch: 10,   Loss: 0.00541045144200325
Epoch: 20,   Loss: 0.011921466328203678
Epoch: 30,   Loss: 0.010918756015598774
Epoch: 40,   Loss: 0.01014319434762001
Epoch: 50,   Loss: 0.007357765920460224
Epoch: 60,   Loss: 0.005608136299997568
Epoch: 70,   Loss: 0.01013648696243763
Epoch: 80,   Loss: 0.0066274781711399555
Epoch: 90,   Loss: 0.007960439659655094
Epoch: 100,   Loss: 0.007711237762123346

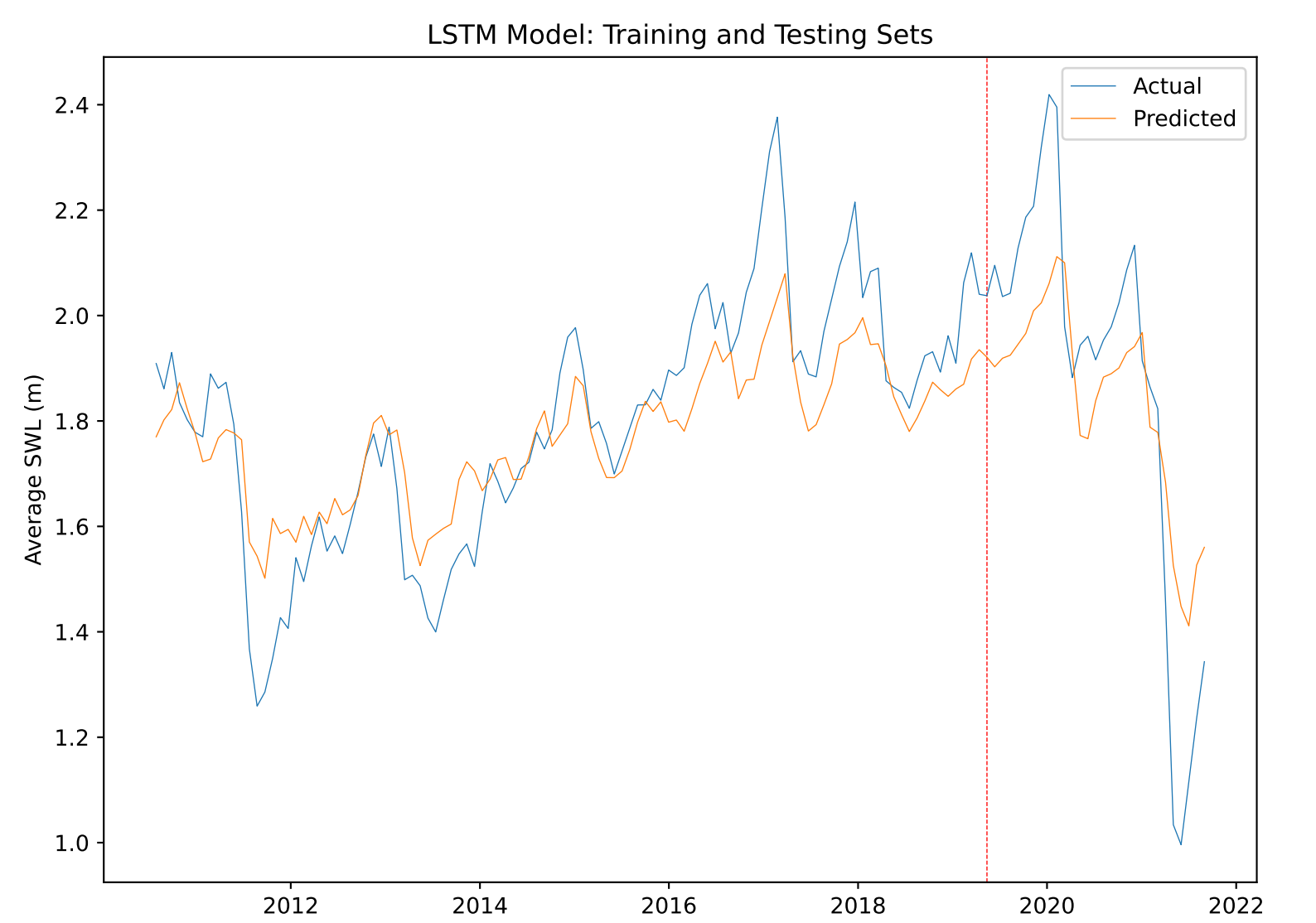
<><> Training Set Scores <><>

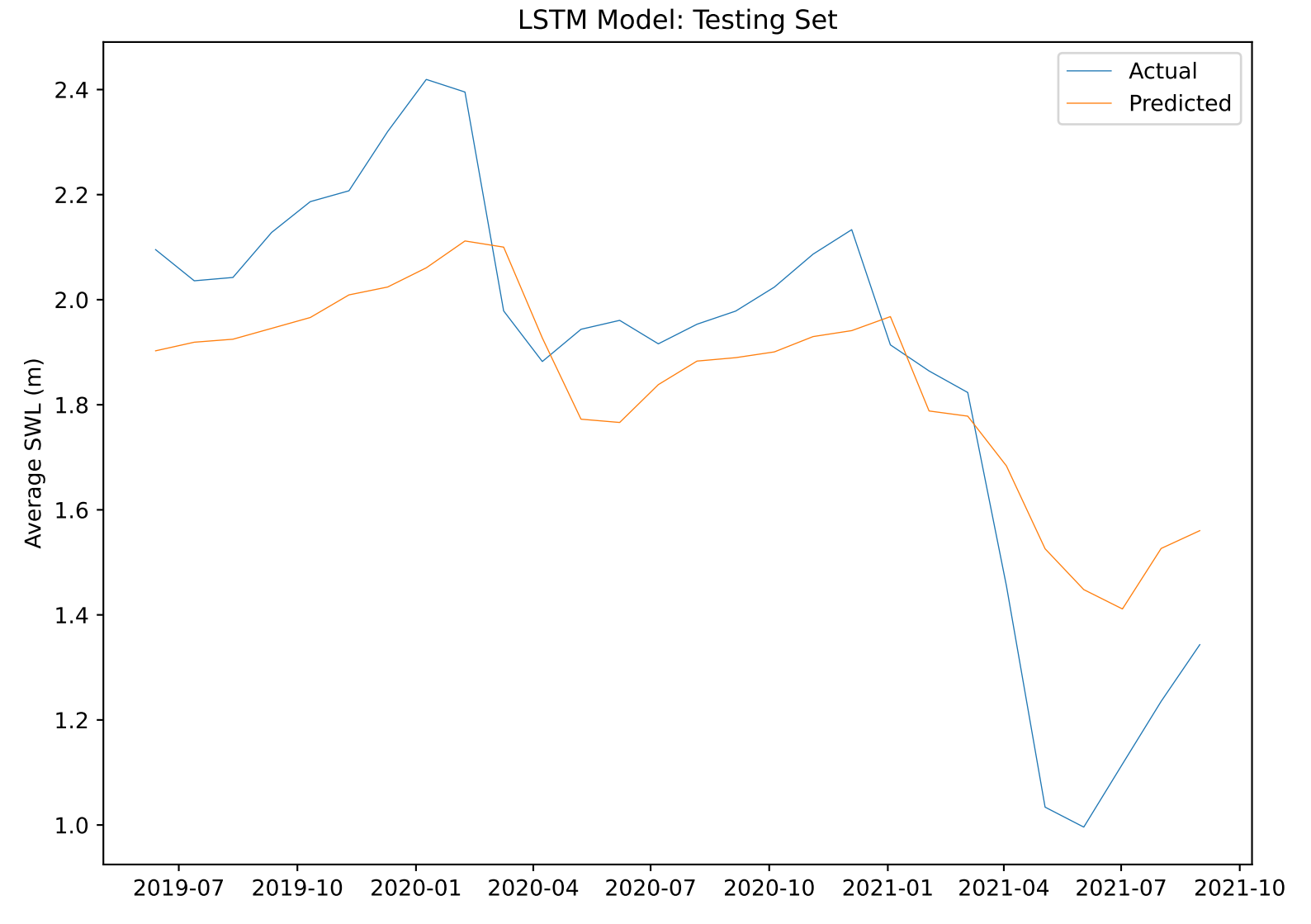
Train Root Mean Squared Error: 0.08624
Train Mean Squared Error: 0.00744
Train Normalised Root Mean Squared Error: 0.10986
Train Coefficient of Determination: 0.70186
Train Normalised Nash Sutcliffe Efficiency: 0.77033
Train Mean Absolute Error: 0.06782
Train Pearson's Correlation Coefficient: 0.93034
Train Index of Agreement: 0.87238
Train Kling-Gupta Efficiency: 0.53613
Train Mean Bias Error: -0.01819
Train Mean Absolute Percentage Error: 0.05432

<><> Test Set Scores <><>

Test Root Mean Squared Error: 0.15654
Test Mean Squared Error: 0.0245
Test Normalised Root Mean Squared Error: 0.15654
Test Coefficient of Determination: 0.67236
Test Normalised Nash Sutcliffe Efficiency: 0.75321
Test Mean Absolute Error: 0.13444
Test Pearson's Correlation Coefficient: 0.94308
Test Index of Agreement: 0.84949
Test Kling-Gupta Efficiency: 0.48109
Test Mean Bias Error: -0.02425
Test Mean Absolute Percentage Error: 0.11926


LSTM Learning Curves
Training Loss
Validation Loss
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Loss
0
20
40
60
80
100
Epoch


LSTM Model: Training and Testing Sets
Actual
Predicted
Average SWL (m)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
2012
2014
2016
2018
2020
2022


LSTM Model: Testing Set
Actual
Predicted
Average SWL (m)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
2019-07
2019-10
2020-01
2020-04
2020-07
2020-10
2021-01
2021-04
2021-07
2021-10


LSTM Model: Training and Testing Sets
Actual
Predicted
Inverted Average SWL (m)
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2012
2014
2016
2018
2020
2022
Actual
Predicted
Inverted Average SWL (m)
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2019-07
2019-10
2020-01
2020-04
2020-07
2020-10
2021-01
2021-04
2021-07
2021-10

<><> 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

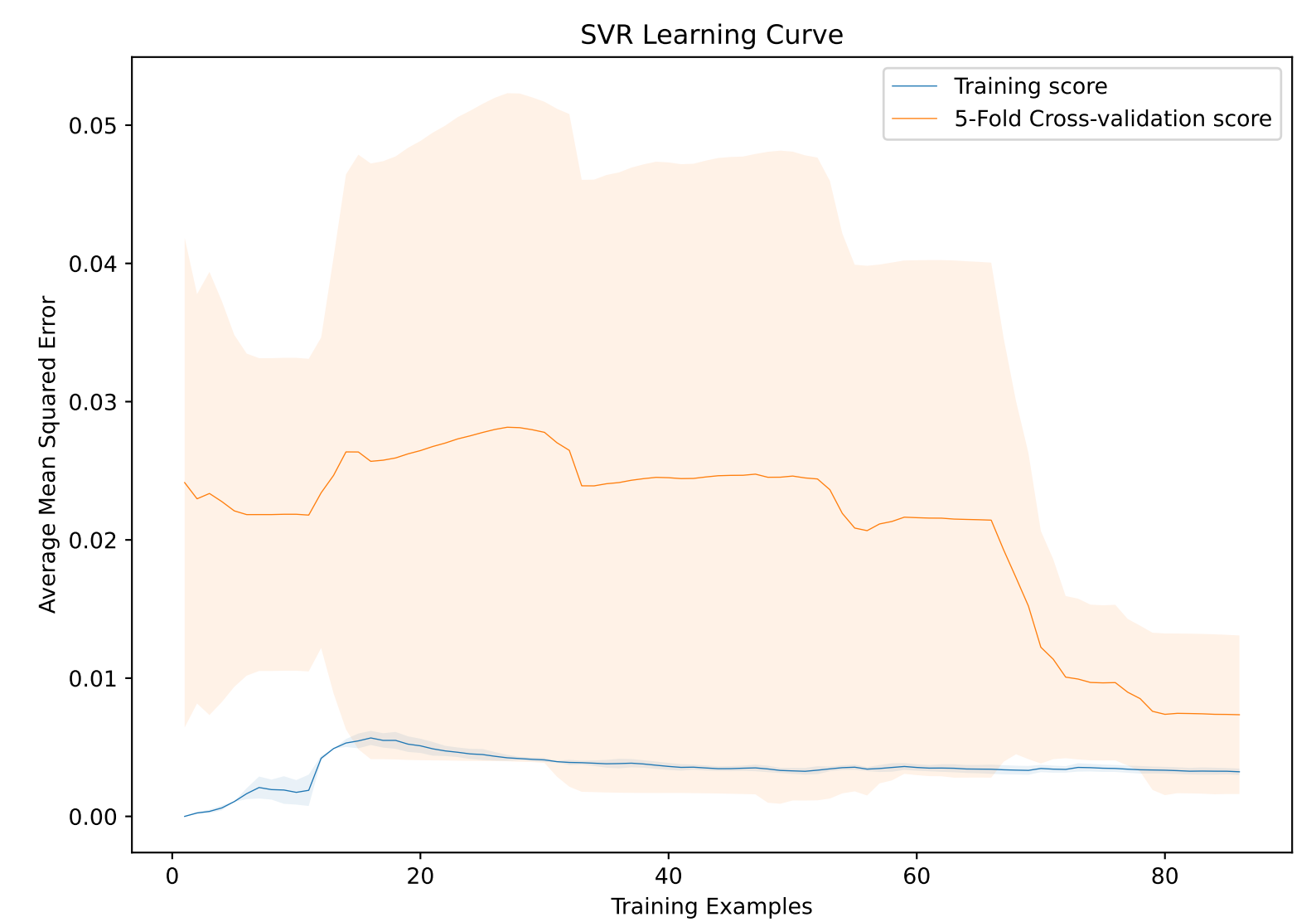
<><> Training Set Scores <><>

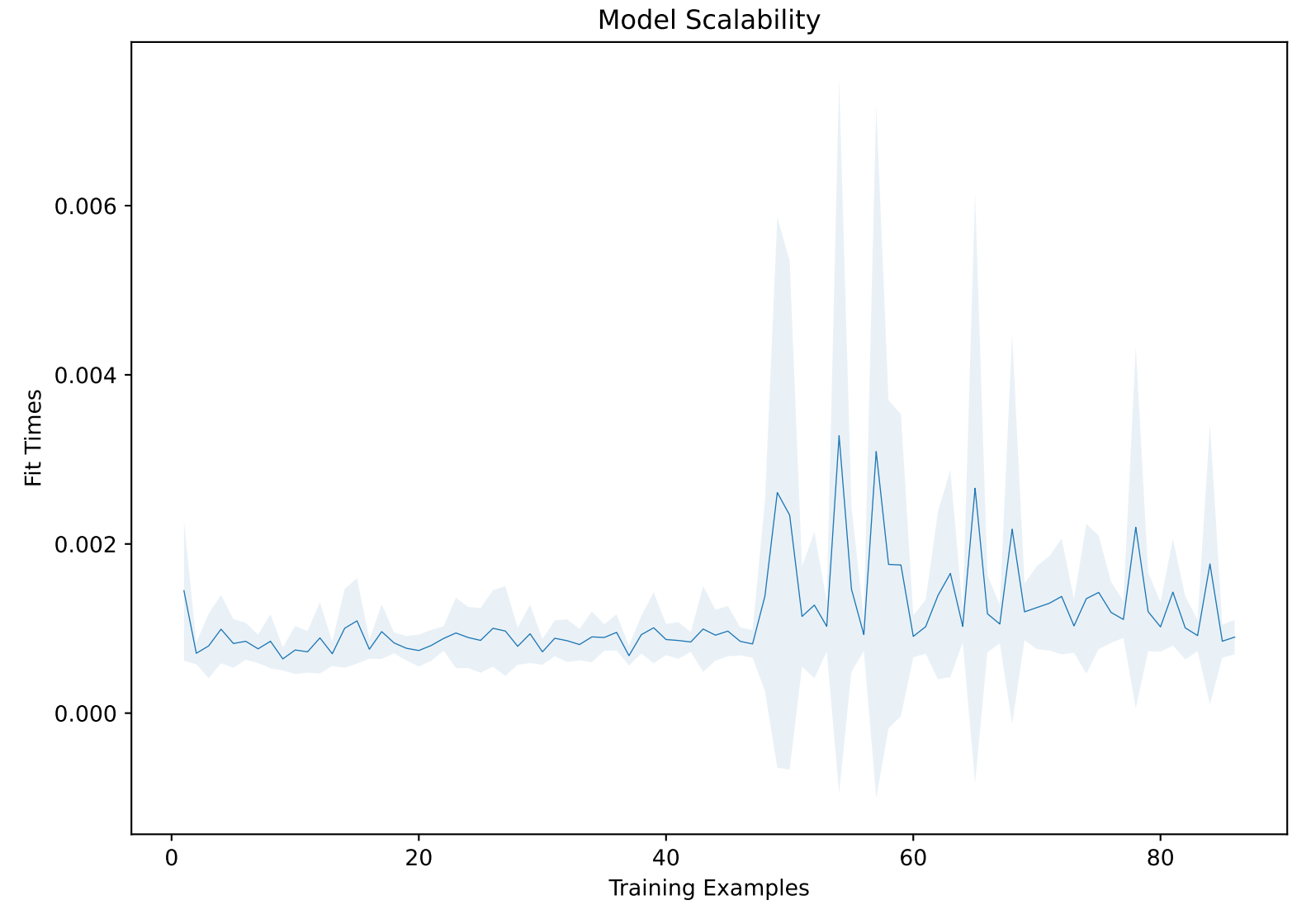
Train Root Mean Squared Error: 0.05559
Train Mean Squared Error: 0.00309
Train Normalised Root Mean Squared Error: 0.07081
Train Coefficient of Determination: 0.87615
Train Normalised Nash Sutcliffe Efficiency: 0.8898

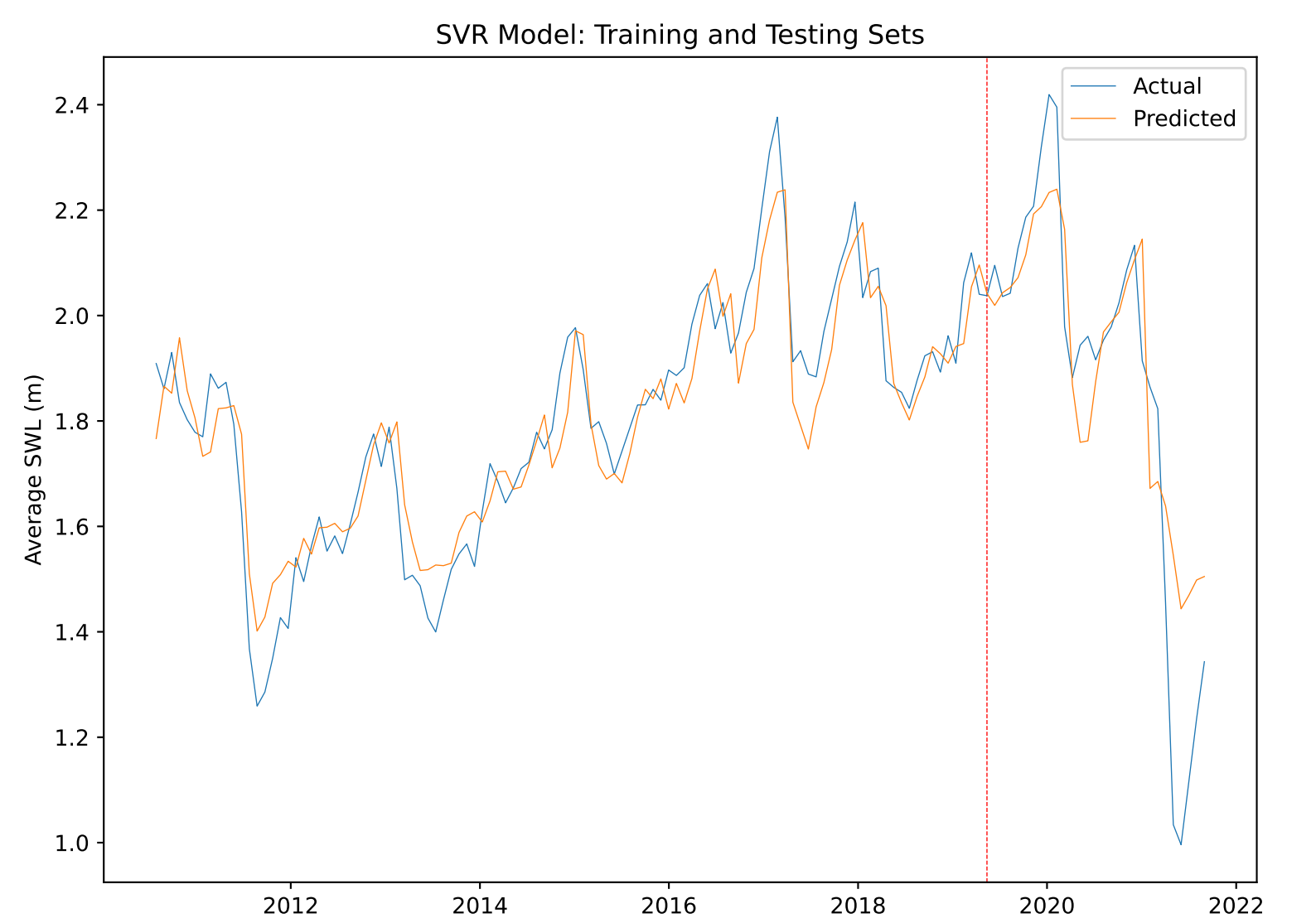
Train Mean Absolute Error: 0.04567
Train Pearson's Correlation Coefficient: 0.94196
Train Index of Agreement: 0.96243
Train Kling-Gupta Efficiency: 0.82777
Train Mean Bias Error: -0.0028
Train Mean Absolute Percentage Error: 0.03693

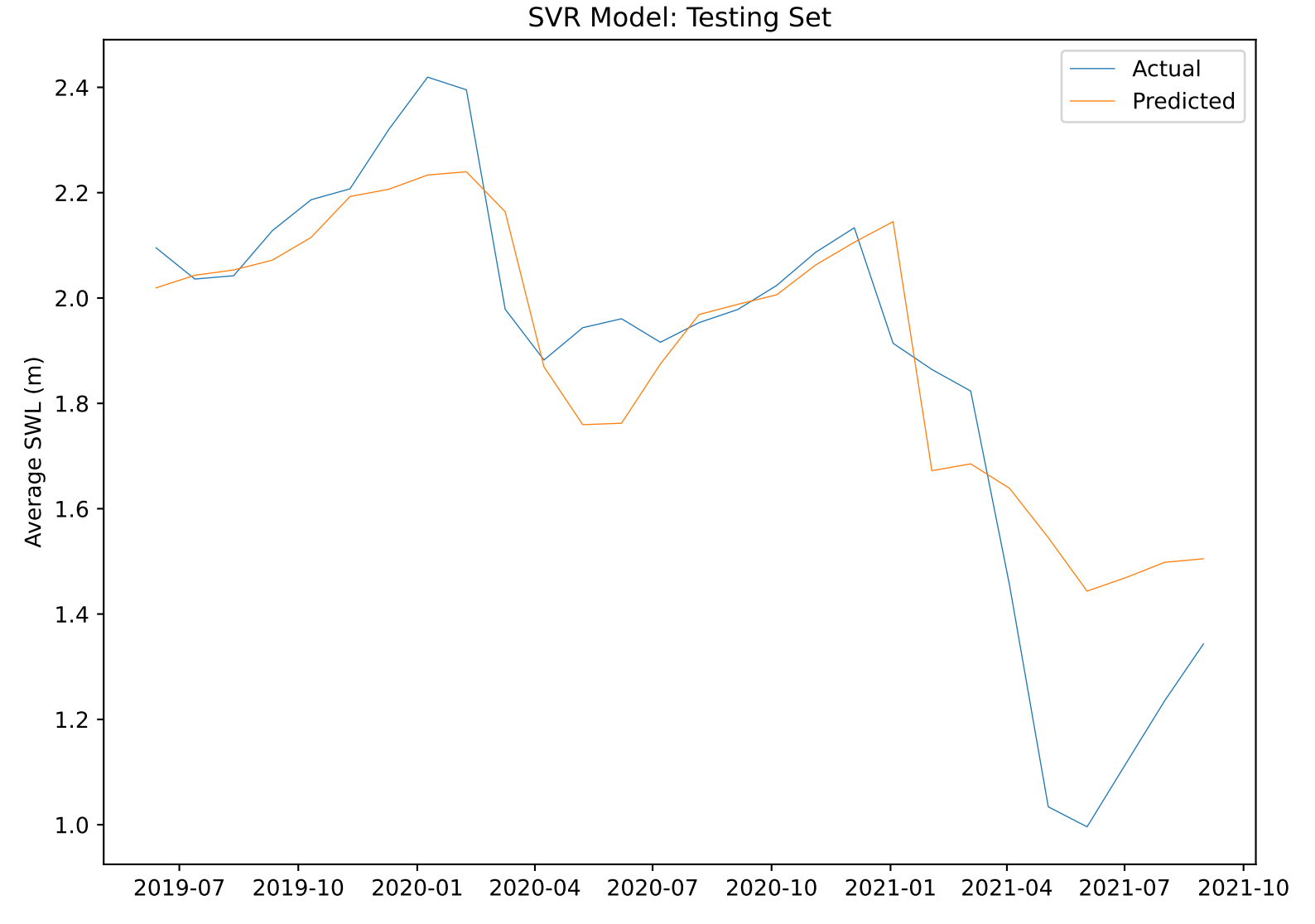
<><> Test Set Scores <><>

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
Training score
5-Fold Cross-validation score
Average Mean Squared Error
0.05
0.04
0.03
0.02
0.01
0.00
0
20
40
60
80
Training Examples


Model Scalability
Fit Times
0.006
0.004
0.002
0.000
0
20
40
60
80
Training Examples


SVR Model: Training and Testing Sets
Actual
Predicted
Average SWL (m)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
2012
2014
2016
2018
2020
2022


SVR Model: Testing Set
Actual
Predicted
Average SWL (m)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
2019-07
2019-10
2020-01
2020-04
2020-07
2020-10
2021-01
2021-04
2021-07
2021-10


SVR Model: Training and Testing Sets
Actual
Predicted
Inverted Average SWL (m)
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2012
2014
2016
2018
2020
2022
Actual
Predicted
Inverted Average SWL (m)
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2019-07
2019-10
2020-01
2020-04
2020-07
2020-10
2021-01
2021-04
2021-07
2021-10