APPENDIX A. SUB-BASIN CUT SHEETS

CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 01

Basin Treatment Characteristics

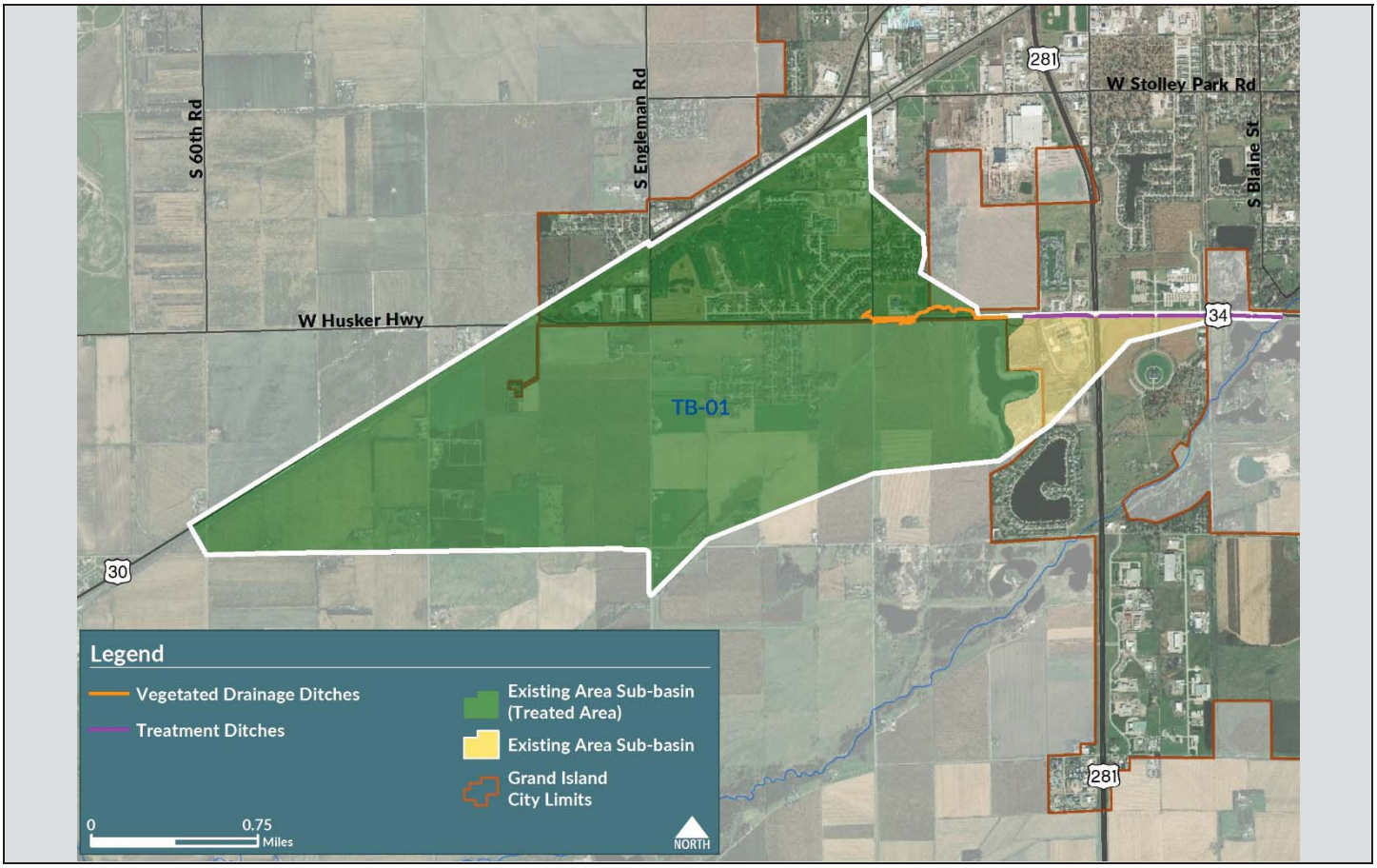
Sub-Basin Acres:	**2,526**
Max Impervious (%):	**40.5**
WQCV (Ac-Ft):	**62.8**
Q_{WQ} (cfs):	**61.6**

Treatment Type:	**Vegetated Ditch**
Flow Depth: (ft)	**2.19**
Flow Velocity (ft/sec):	**1.25**
Required Treatment Length (ft):	**4,907**
Treated Sub-Basin Area (ac):	**2,379**
Basin Treated (%):	**94%**

Improvements and Maintenance

Existing vegetated ditch provides sufficient water quality treatment for existing and future growth. No improvements recommended.

Maintain minimum vegetated depth of 4" throughout vegetated ditch treatment.



CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 02

Basin Treatment Characteristics

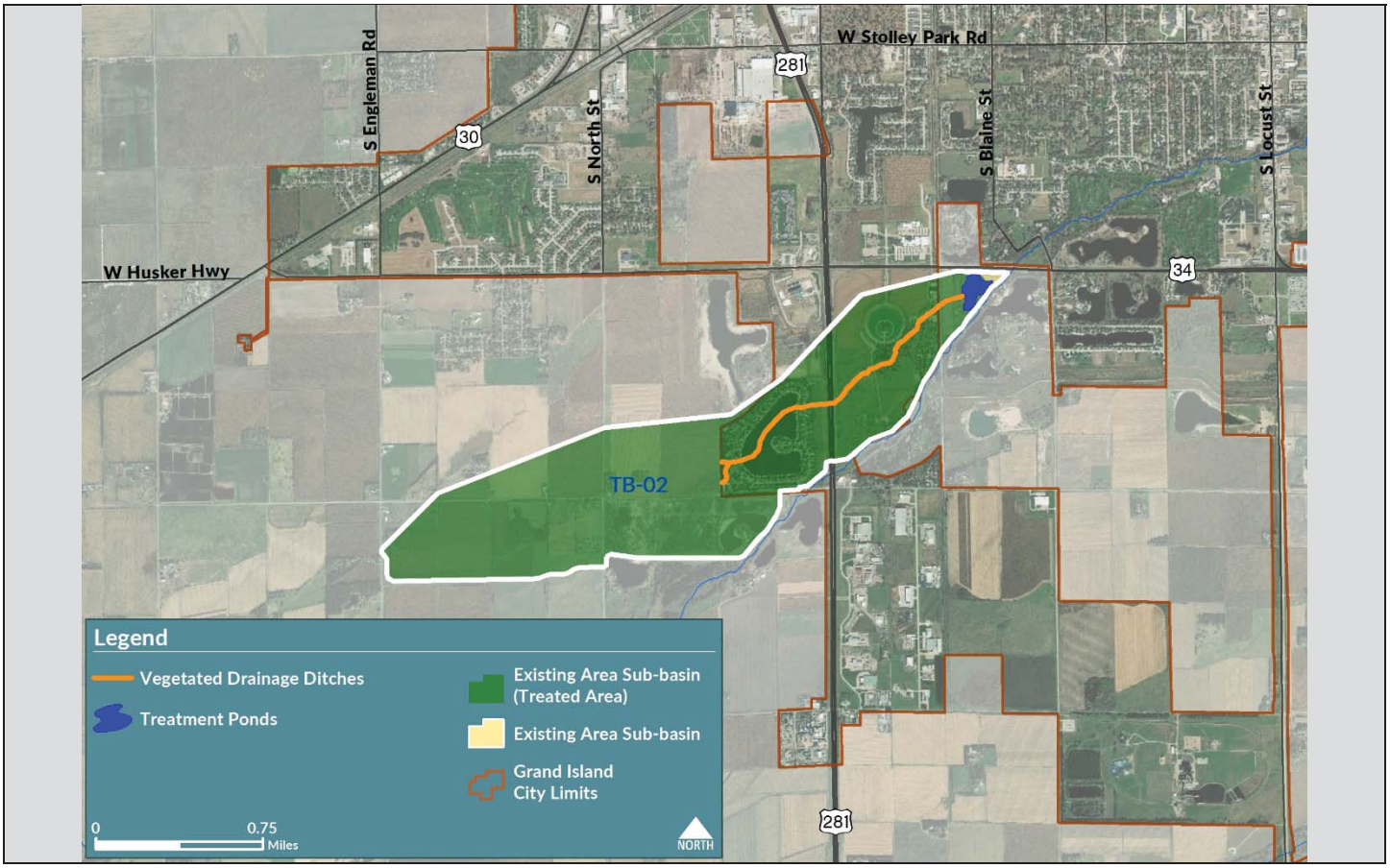
Sub-Basin Acres:	**913**
Max Impervious (%):	**38.3**
WQCV (Ac-Ft):	**21.6**
Q_{WQ} (cfs):	**34.0**

Treatment Type: Wet Extended Detention Pond

Top Area of Perm. Pool: (ac)	**7.7**
Required Depth of Perm. Pool (ft):	**3.0**
Required Depth above Perm. Pool (ft):	**2.7**
Available Depth above Perm. Pool (ft):	**7.4**
Treated Sub-Basin Area (ac):	**910**
Basin Treated (%):	**100**

Improvements and Maintenance
Existing wet extended detention pond provides sufficient water quality treatment for existing and future growth. No improvements recommended.

Preserve depth of permanent pool and storage depth for treatment. Maintain elevation and structural integrity of culvert pipe outlet.



CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 03

Basin Treatment Characteristics

Sub-Basin Acres:	**349**
Max Impervious (%):	**51.6**
WQCV (Ac-Ft):	**10.8**
Q_{WQ} (cfs):	**15.5**

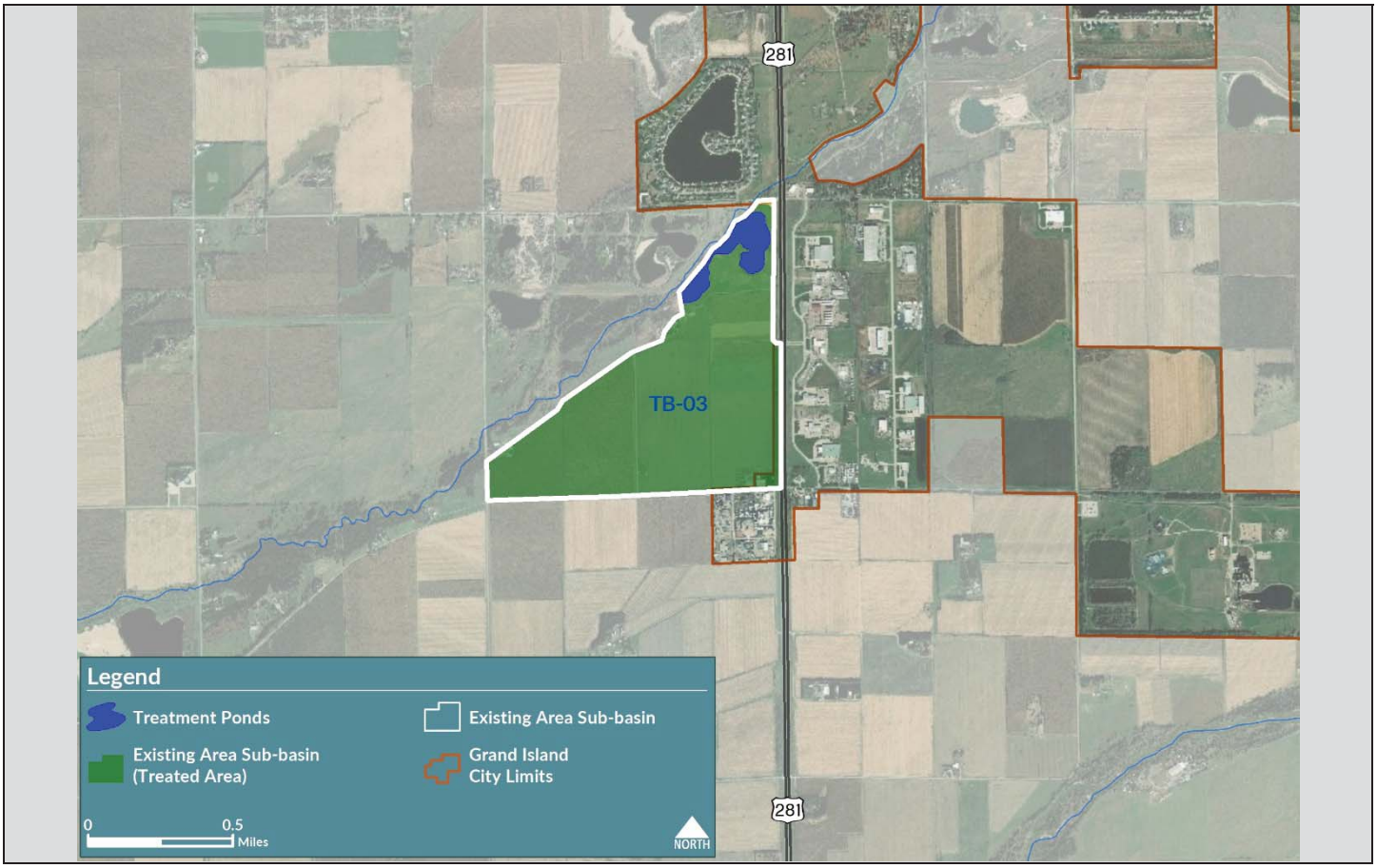
Treatment Type: Wet Extended Detention Pond

Top Area of Perm. Pool: (ac)	**18.0**
Required Depth of Perm. Pool (ft):	**0.6**
Required Depth above Perm. Pool (ft):	**0.6**
Available Depth above Perm. Pool (ft):	**8.4**
Treated Sub-Basin Area (ac):	**348**
Basin Treated (%):	**100**

Improvements and Maintenance

Existing wet extended detention pond provides sufficient water quality treatment for existing and future growth. No improvements recommended.

Preserve depth of permanent pool and storage depth for treatment. Maintain elevation and structural integrity of culvert pipe outlet.



CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 04

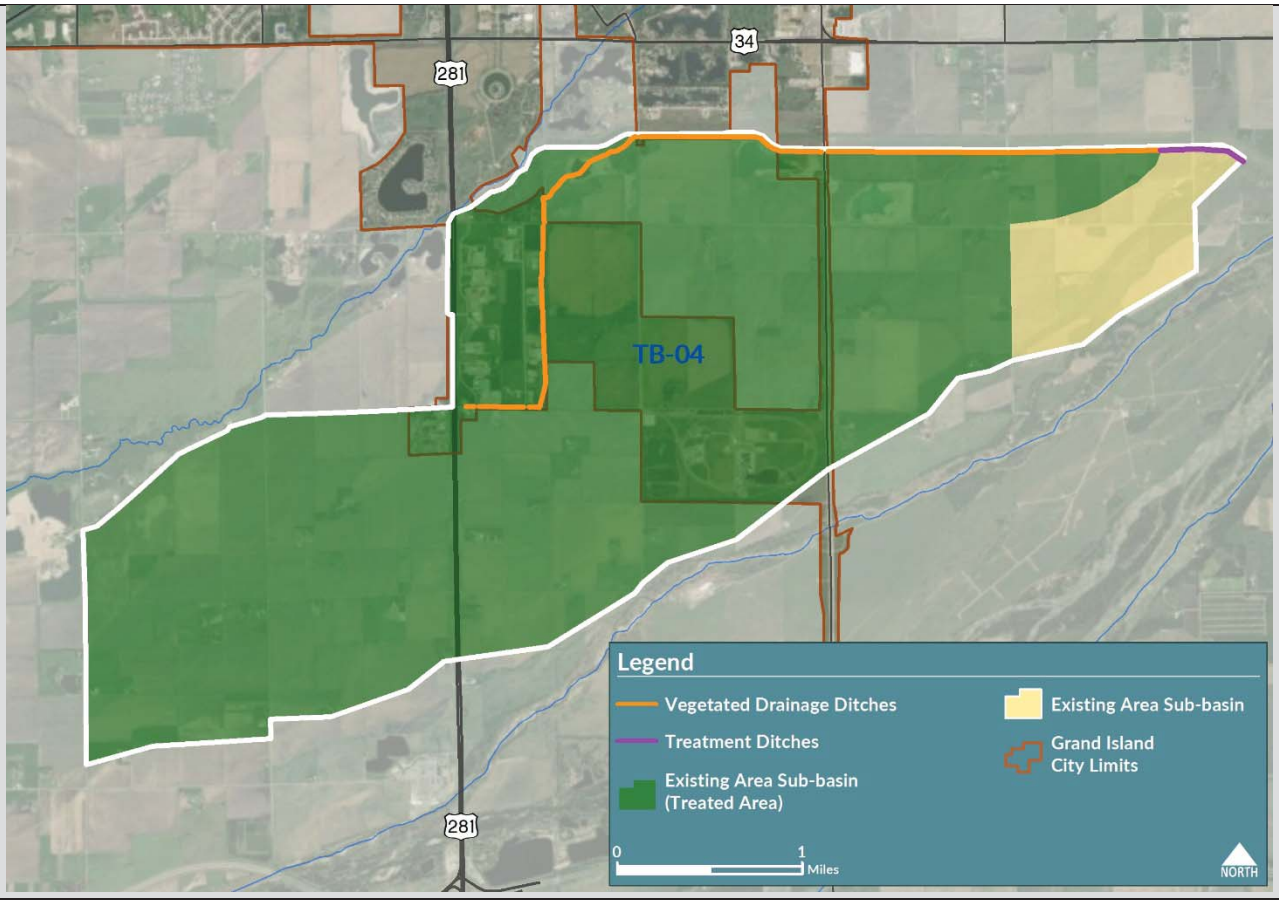
Basin Treatment Characteristics

Sub-Basin Acres:	**6,563**
Max Impervious (%):	**46.8**
WQCV (Ac-Ft):	**186**
Q_{WQ} (cfs):	**103**

Treatment Type:	**Vegetated Ditch**
Flow Depth: (ft)	**2.31**
Flow Velocity (ft/sec):	**1.01**
Required Treatment Length (ft):	**4,190**
Treated Sub-Basin Area (ac):	**6,078**
Basin Treated (%):	**93**

Improvements and Maintenance
Existing vegetated ditch provides sufficient water quality treatment for existing and future growth. No improvements recommended.

Maintain minimum vegetated depth of 4" throughout vegetated ditch treatment.



CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 05

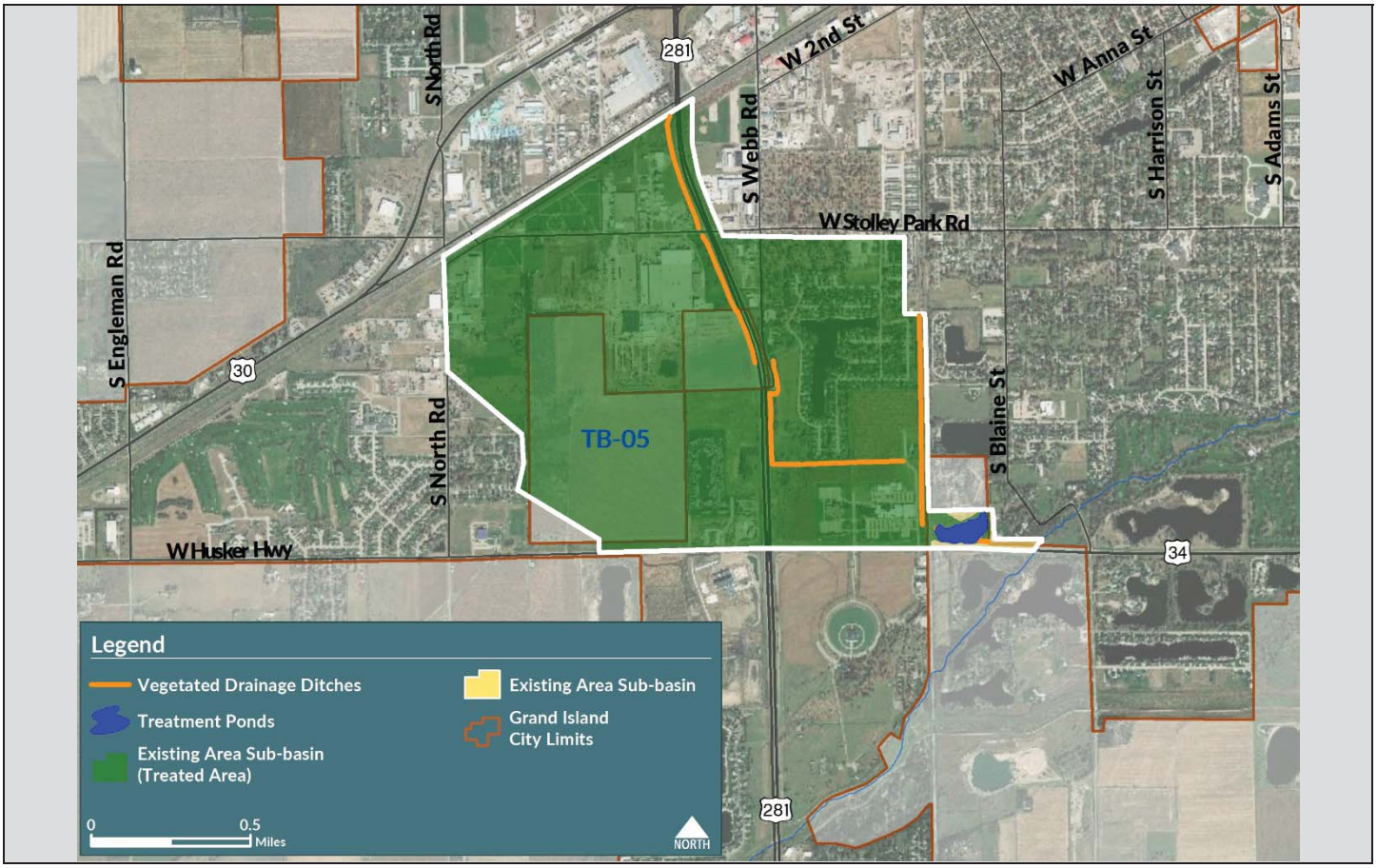
Basin Treatment Characteristics

Sub-Basin Acres:	**976**
Max Impervious (%):	**79.8**
WQCV (Ac-Ft):	**45.0**
Q_{WQ} (cfs):	**78.3**
Treatment Type:	**Wet Pond**
Top Area of Perm. Pool: (ac)	**5.8**
Required Depth of Perm. Pool (ft):	**11.8**
Required Depth above Perm. Pool (ft):	**6.6**
Available Depth above Perm. Pool (ft):	**1.3**
Treated Sub-Basin Area (ac):	**968**
Basin Treated (%):	**99**

Improvements and Maintenance

Existing wet pond provides sufficient water quality treatment for existing and future growth. No improvements recommended.

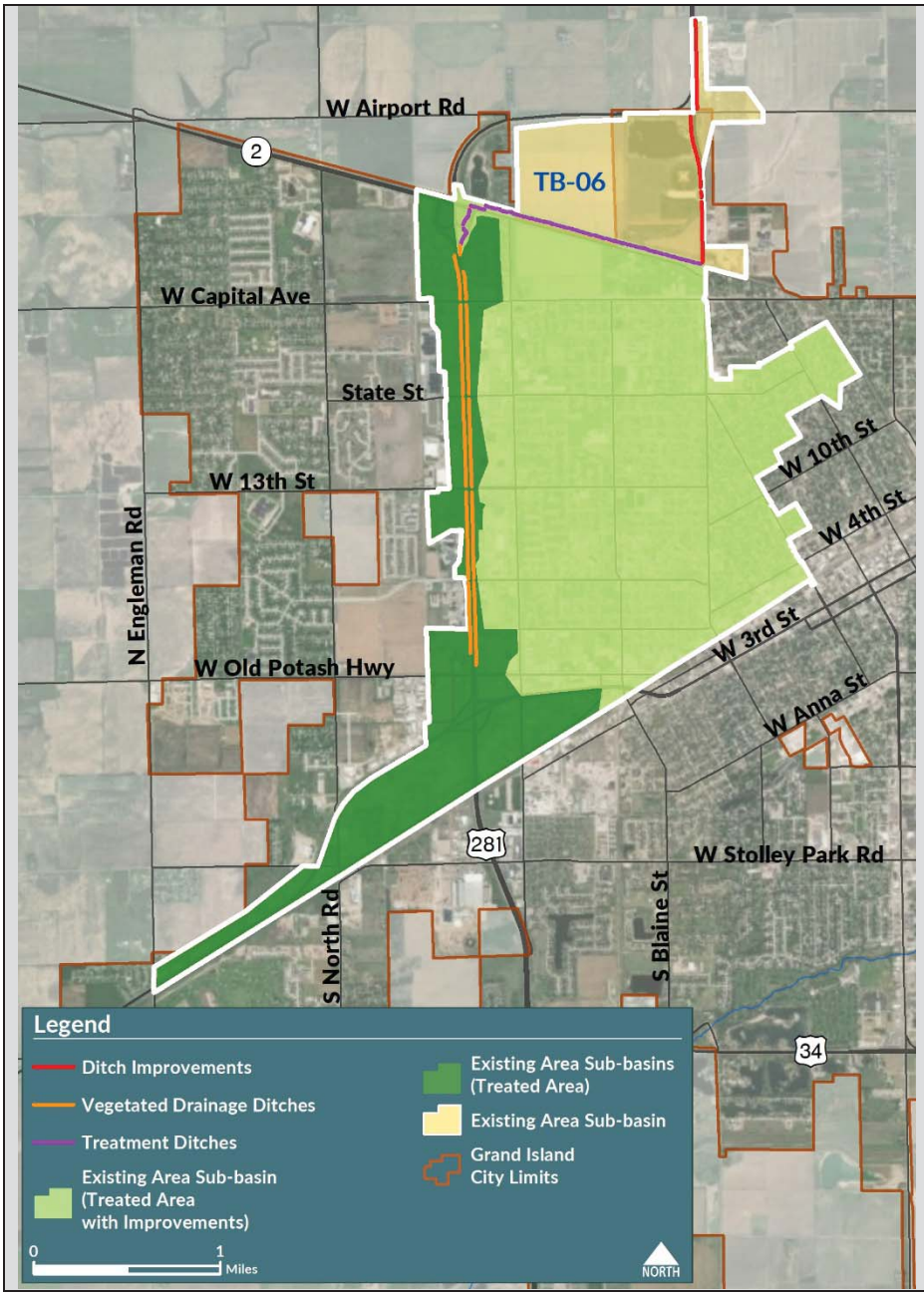
Preserve depth of permanent pool and storage depth for treatment. Maintain elevation and structural integrity of culvert pipe outlet.



CITY OF GRAND ISLAND

Watershed BMP Master Plan

Treatment Basin: 06



Basin Treatment Characteristics

Sub-Basin Acres:	**3,670**
Max Impervious (%):	**75.4**
WQCV (Ac-Ft):	**161**
Q_{WQ} (cfs):	**192**

Treatment Type: **Vegetated Ditch**

Flow Depth: (ft)	**4.65**
Flow Velocity (ft/sec):	**1.75**
Required Treatment Length (ft):	**14,642**
Treated Sub-Basin Area (ac):	**891**
Basin Treated (%):	**24**

Improvements and Maintenance

Subbasin is mostly developed and more than 20 detention cells provide extended storage not included in this treatment assessment. For additional treatment, widening existing ditch to 35' wide from railroad to MS4 outfall into Moore's Creek would increase percent basin treatment from 24% (891 ac.) to 87% (3,190 ac.). Additional treatment would include undeveloped area within the subbasin.

Maintain minimum vegetated depth of 4" in existing treatment ditch and proposed ditch improvement.

CITY OF GRAND ISLAND

Watershed BMP Master Plan

Treatment Basin: 07

Basin Treatment Characteristics

Sub-Basin Acres:	**922**
Max Impervious (%):	**65.0**
WQCV (Ac-Ft):	**35.1**
Q_{WQ} (cfs):	**53.2**

Treatment Type:	**No Current Treatment**
Top Area of Perm. Pool: (ac)	**0.0**
Required Depth of Perm. Pool (ft):	**0.0**
Required Depth above Perm. Pool (ft):	**0.0**
Available Depth above Perm. Pool (ft):	**0.0**
Treated Sub-Basin Area (ac):	**0**
Basin Treated (%):	**0**

Improvements and Maintenance

Subbasin is mostly developed and includes four detention cells for extended storage not included in this treatment assessment. For additional treatment, construct wet pond upstream of outfall to the Wood River (35.1 ac-ft of storage required but only 7.8 ac-ft is likely available on privately owned property). Improvement could increase known percent basin treatment from 0% (0 ac.) to 22% (205 ac.).

CITY OF GRAND ISLAND

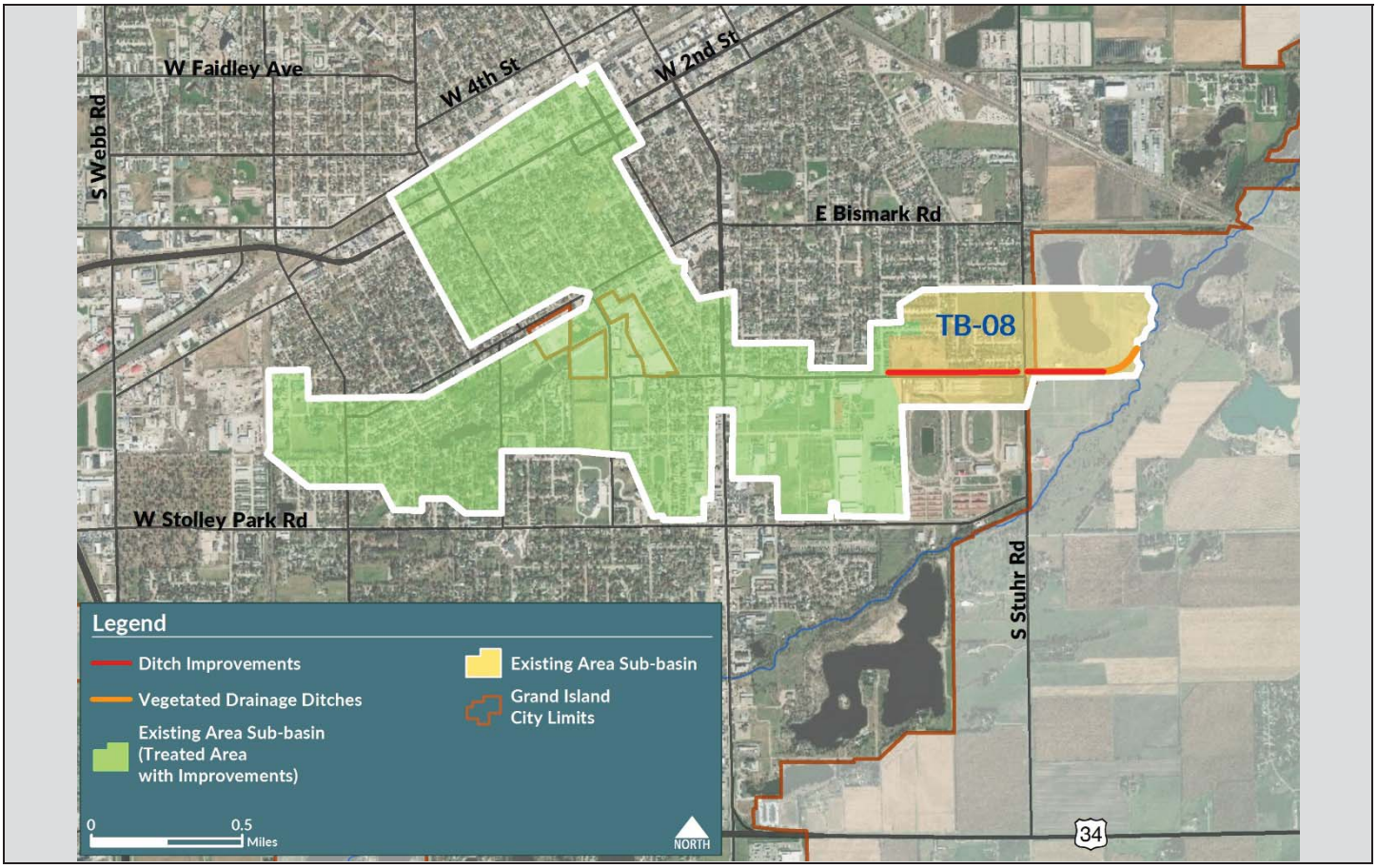
Watershed BMP Master Plan
Treatment Basin: 08

Basin Treatment Characteristics

Sub-Basin Acres:	**1,125**
Max Impervious (%):	**58.9**
WQCV (Ac-Ft):	**39.2**
Q_{WQ} (cfs):	**88.6**

Treatment Type:	**No Current Treatment**
Flow Depth: (ft)	**0.0**
Flow Velocity (ft/sec):	**0.0**
Required Treatment Length (ft):	**0**
Treated Sub-Basin Area (ac):	**0**
Basin Treated (%):	**0%**

Improvements and Maintenance
Subbasin is mostly developed and includes three detention cells for extended storage not included in this treatment assessment. For additional treatment, widen ditch to 35' from Pleasant View to curve upstream of MS4 outfall to Wood River. Improvement could increase known percent basin treatment from 0% (0 ac.) to 84% (944 ac.).



CITY OF GRAND ISLAND

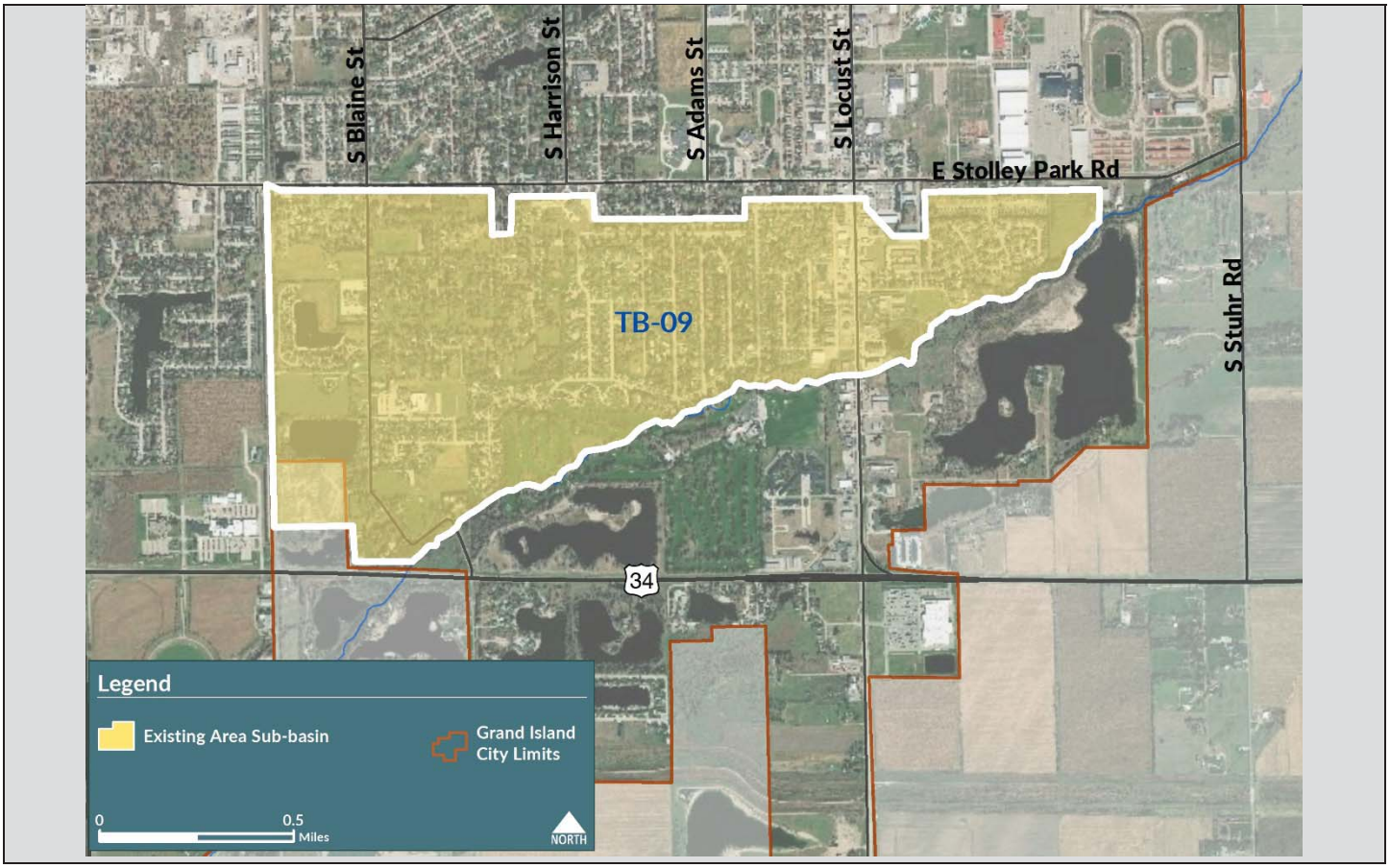
Watershed BMP Master Plan
Treatment Basin: 09

Basin Treatment Characteristics

Sub-Basin Acres:	**773**
Max Impervious (%):	**56.5**
WQCV (Ac-Ft):	**25.9**
Q_{WQ} (cfs):	**44.5**

Treatment Type:	**No Current Treatment**
Flow Depth: (ft)	**0.0**
Flow Velocity (ft/sec):	**0.0**
Required Treatment Length (ft):	**0**
Treated Sub-Basin Area (ac):	**0**
Basin Treated (%):	**0**

Improvements and Maintenance
Subbasin is mostly developed and includes four detention cells for extended storage not included in this treatment assessment. No improvements have been recommended as multiple drains carry stormwater to different MS4 outfalls along the Wood River.



CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 10

Basin Treatment Characteristics

Sub-Basin Acres:	**279**
Max Impervious (%):	**54.4**
WQCV (Ac-Ft):	**9.0**
Q_{WQ} (cfs):	**21.9**

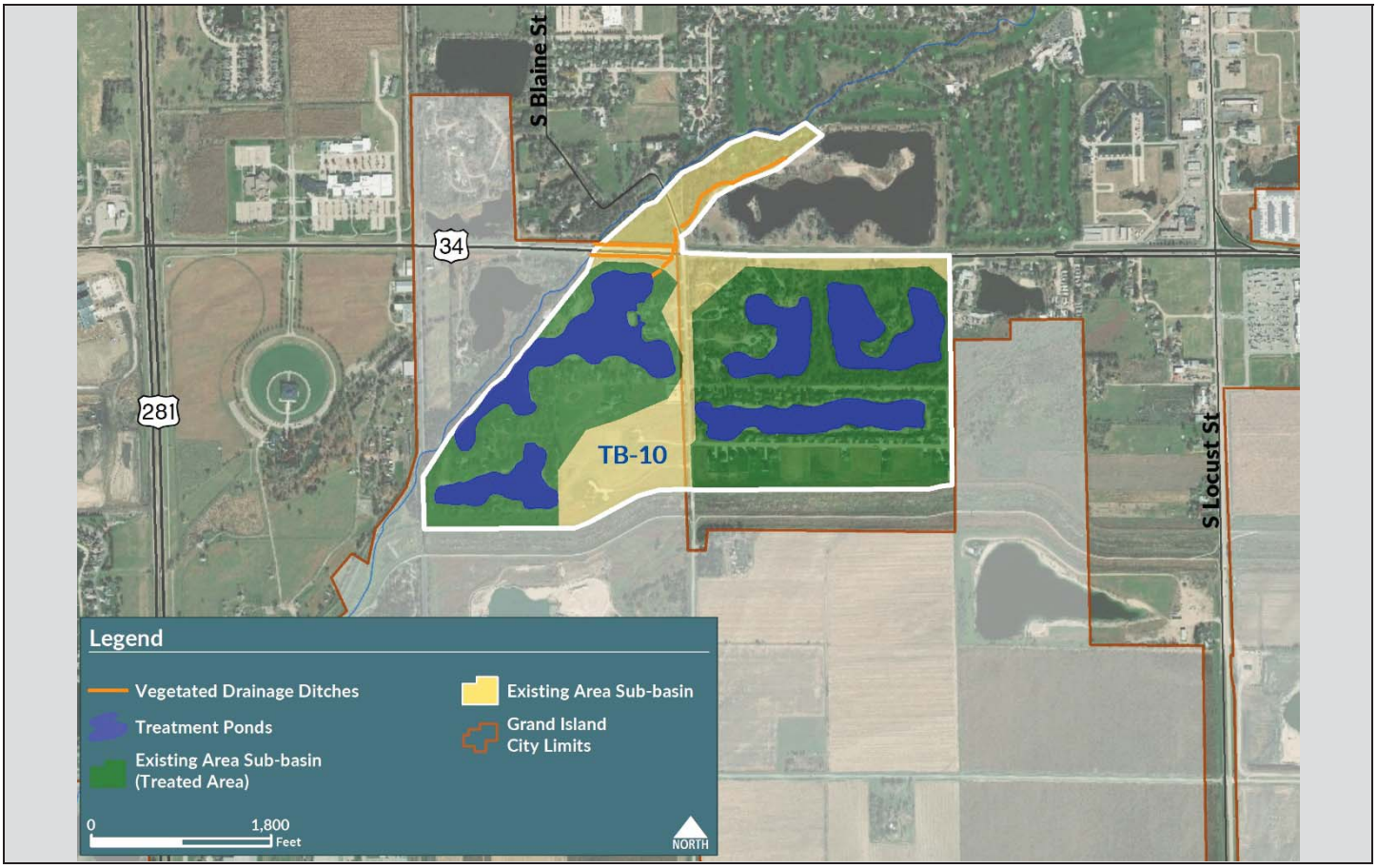
Treatment Type: Wet Extended Detention Pond

Top Area of Perm. Pool: (ac)	**67.9**
Required Depth of Perm. Pool (ft):	**0.1**
Required Depth above Perm. Pool (ft):	**0.1**
Available Depth above Perm. Pool (ft):	**3.7**
Treated Sub-Basin Area (ac):	**212**
Basin Treated (%):	**76**

Improvements and Maintenance

Subbasin is mostly developed and undeveloped area is within floodpain unlikely to be developed. No improvements recommended.

Preserve depth of permanent pool and storage depth for treatment. Maintain elevation and structural integrity of culvert pipe outlets.



CITY OF GRAND ISLAND

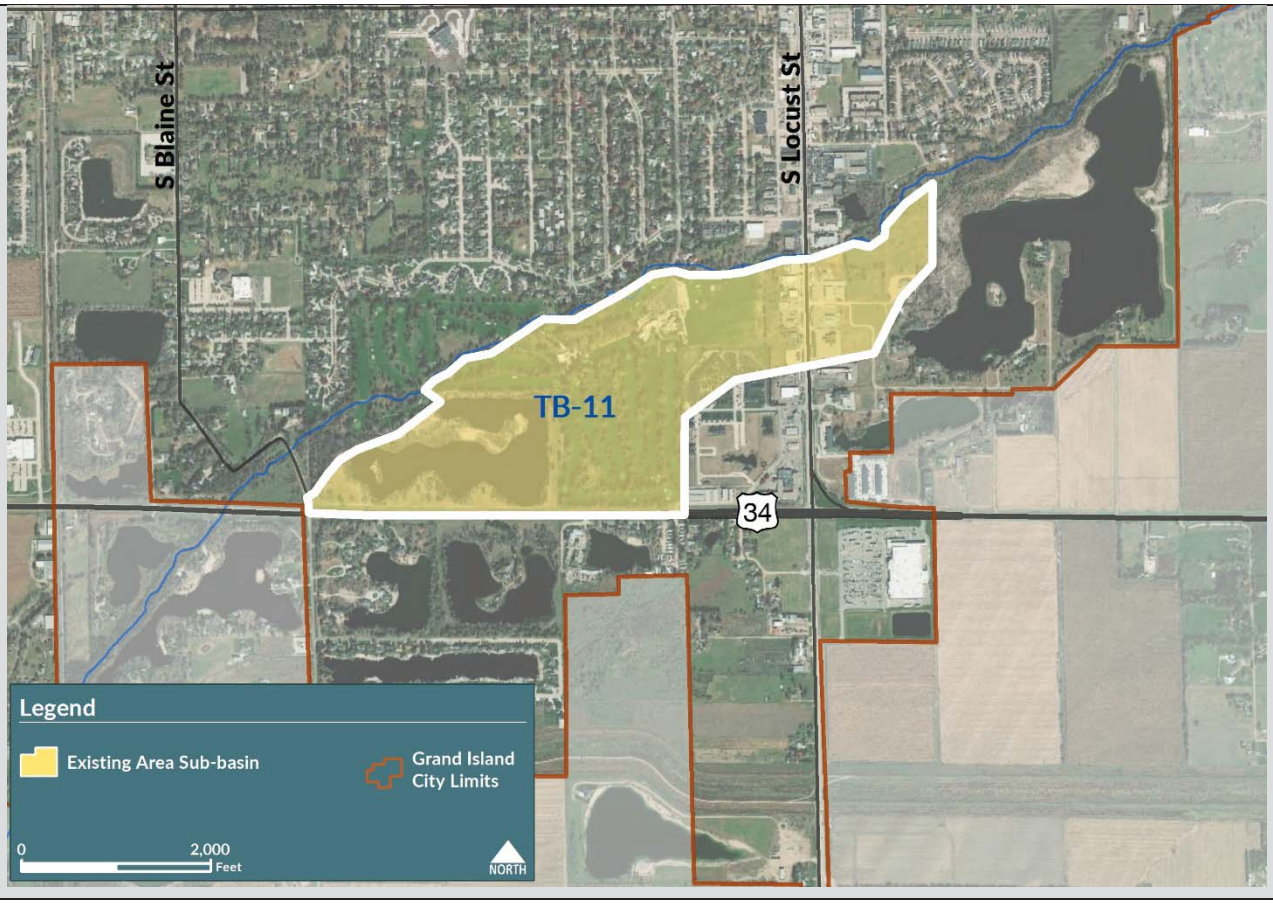
Watershed BMP Master Plan
Treatment Basin: 11

Basin Treatment Characteristics

Sub-Basin Acres:	**217**
Max Impervious (%):	**37.8**
WQCV (Ac-Ft):	**5.1**
Q_{WQ} (cfs):	**14.9**

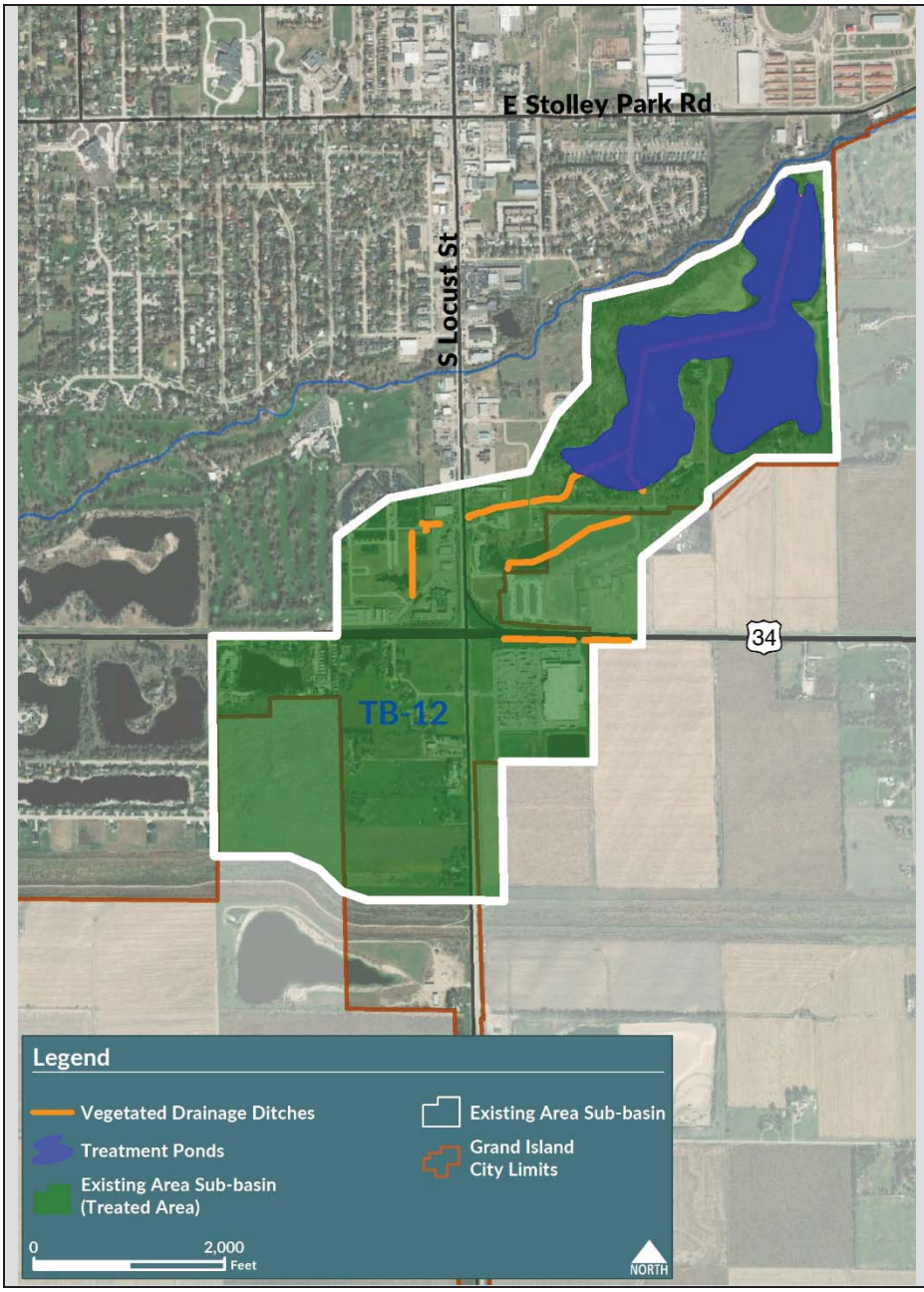
Treatment Type:	**No Current Treatment**
Flow Depth: (ft)	**0.0**
Flow Velocity (ft/sec):	**0.0**
Required Treatment Length (ft):	**0**
Treated Sub-Basin Area (ac):	**0**
Basin Treated (%):	**0**

Improvements and Maintenance
Subbasin is mostly golf course developed and includes one park lake with extended storage not included in this treatment assessment. No improvements have been recommended as the subbasin mostly drains golf course sheet flow runoff without MS4 outfalls along the Wood River.



CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 12



Basin Treatment Characteristics

Sub-Basin Acres:	**482**
Max Impervious (%):	**77.1**
WQCV (Ac-Ft):	**21.5**
Q_{WQ} (cfs):	**57.3**

Treatment Type:
Wet Extended Detention Pond

Top Area of Perm. Pool: (ac) **81.6**

Required Depth of Perm. Pool (ft): **0.3**

Required Depth above Perm. Pool (ft): **0.3**

Available Depth above Perm. Pool (ft): **City to Verify**

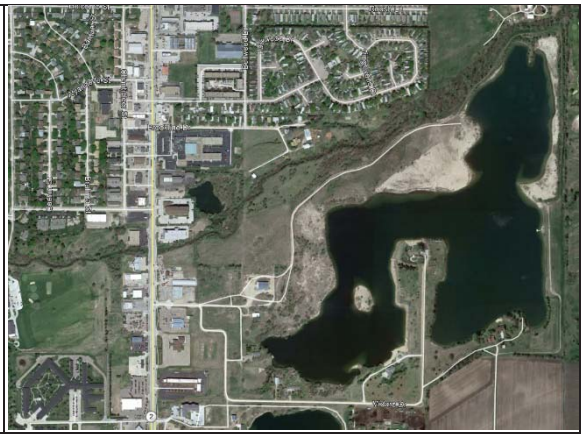
Treated Sub-Basin Area (ac): **482**

Basin Treated (%): **100**

Improvements and Maintenance

Existing wet extended detention pond provides sufficient water quality treatment for existing and future growth. No improvements recommended.

Preserve depth of permanent pool and storage depth for treatment. Maintain elevation and structural integrity of culvert pipe outlet.



CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 13

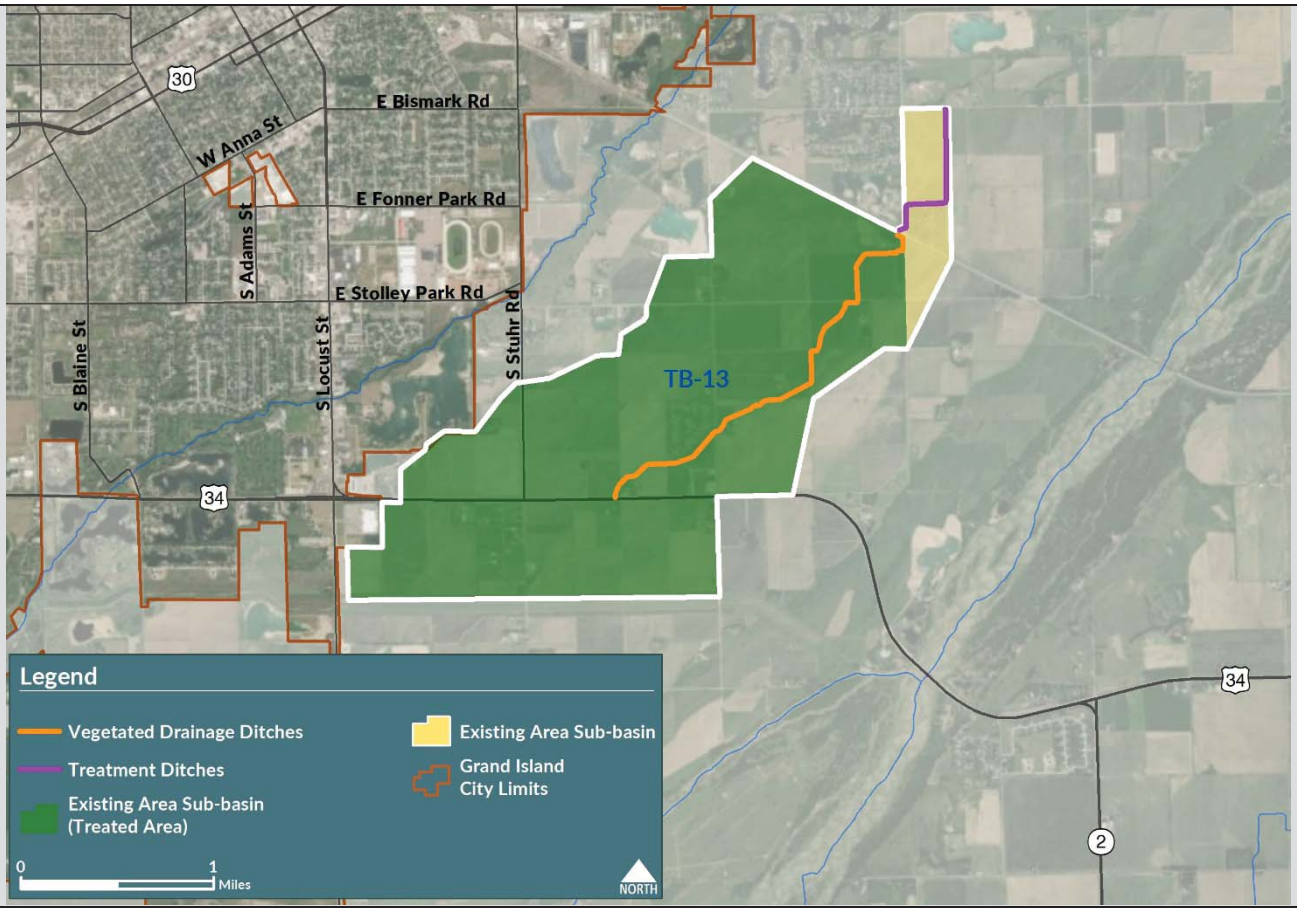
Basin Treatment Characteristics

Sub-Basin Acres:	**2,281**
Max Impervious (%):	**34.0**
WQCV (Ac-Ft):	**48.7**
Q_{WQ} (cfs):	**65.8**

Treatment Type:	**Vegetated Ditch**
Flow Depth: (ft)	**3.11**
Flow Velocity (ft/sec):	**0.77**
Required Treatment Length (ft):	**4,331**
Treated Sub-Basin Area (ac):	**2,123**
Basin Treated (%):	**93**

Improvements and Maintenance
Existing vegetated ditch provides sufficient water quality treatment for existing and future growth. No improvements recommended.

Maintain minimum vegetated depth of 4" throughout vegetated ditch treatment.



CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 14

Basin Treatment Characteristics

Sub-Basin Acres:	**679**
Max Impervious (%):	**46.7**
WQCV (Ac-Ft):	**19.1**
Q_{WQ} (cfs):	**30.0**

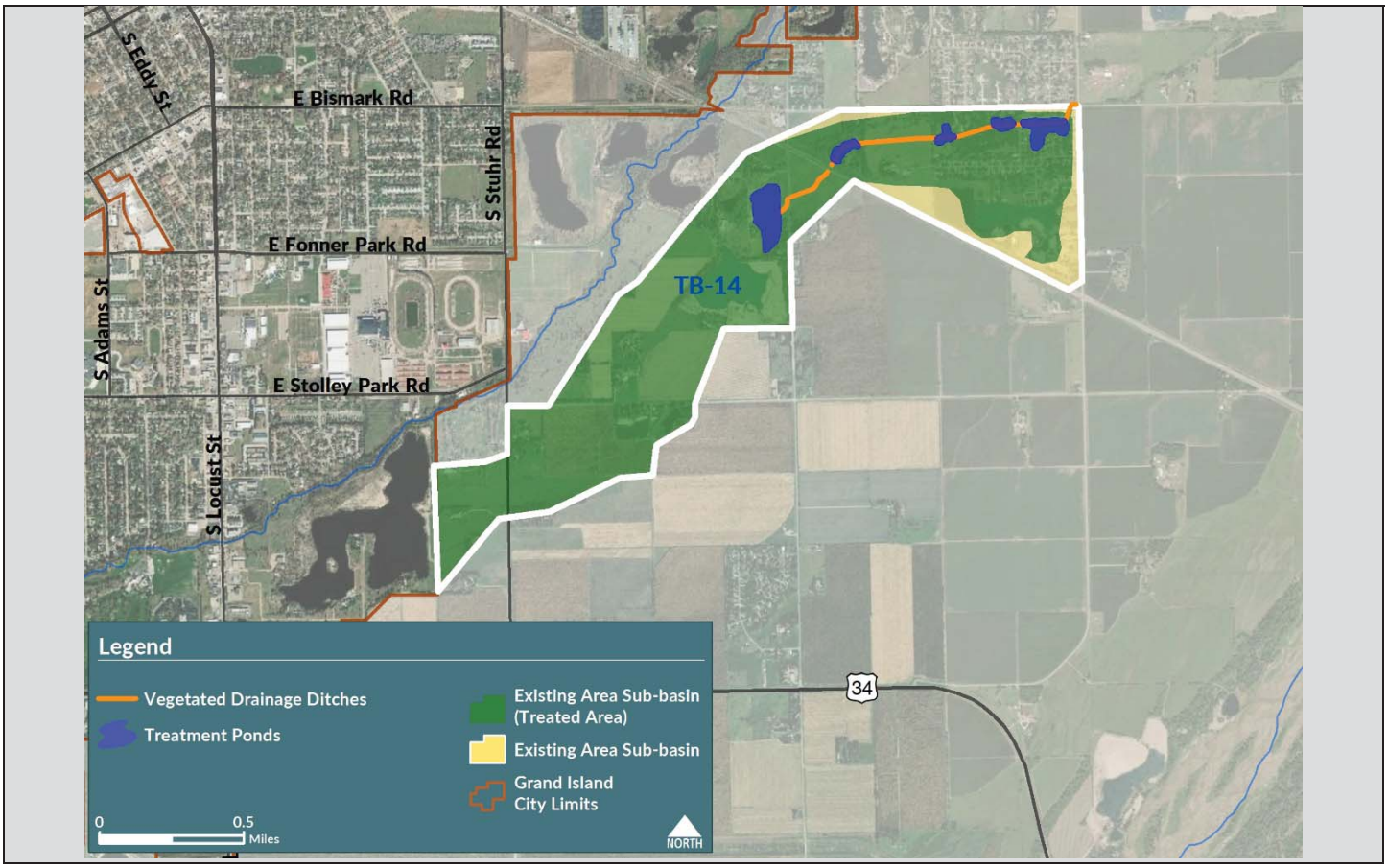
Treatment Type: Wet Extended Detention Pond

Top Area of Perm. Pool: (ac)	**24.0**
Required Depth of Perm. Pool (ft):	**0.8**
Required Depth above Perm. Pool (ft):	**0.8**
Available Depth above Perm. Pool (ft):	**City to Verify**
Treated Sub-Basin Area (ac):	**616**
Basin Treated (%):	**91**

Improvements and Maintenance

Existing wet extended detention pond provides sufficient water quality treatment for existing and future growth. No improvements recommended.

Preserve depth of permanent pool and storage depth for treatment. Maintain elevation and structural integrity of culvert pipe outlet.



CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 15

Basin Treatment Characteristics

Sub-Basin Acres:	**146**
Max Impervious (%):	**47.4**
WQCV (Ac-Ft):	**4.2**
Q_{WQ} (cfs):	**12.9**

Treatment Type:	**No Current Treatment**
Flow Depth: (ft)	**0.0**
Flow Velocity (ft/sec):	**0.0**
Required Treatment Length (ft):	**0**
Treated Sub-Basin Area (ac):	**0**
Basin Treated (%):	**0**

Improvements and Maintenance
Subbasin is mostly floodplain and include one pond with extended storage not included in this treatment assessment. No improvements have been recommended as the subbasin mostly drains sheet flow runoff without MS4 outfalls along the Wood River.

CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 16

Basin Treatment Characteristics

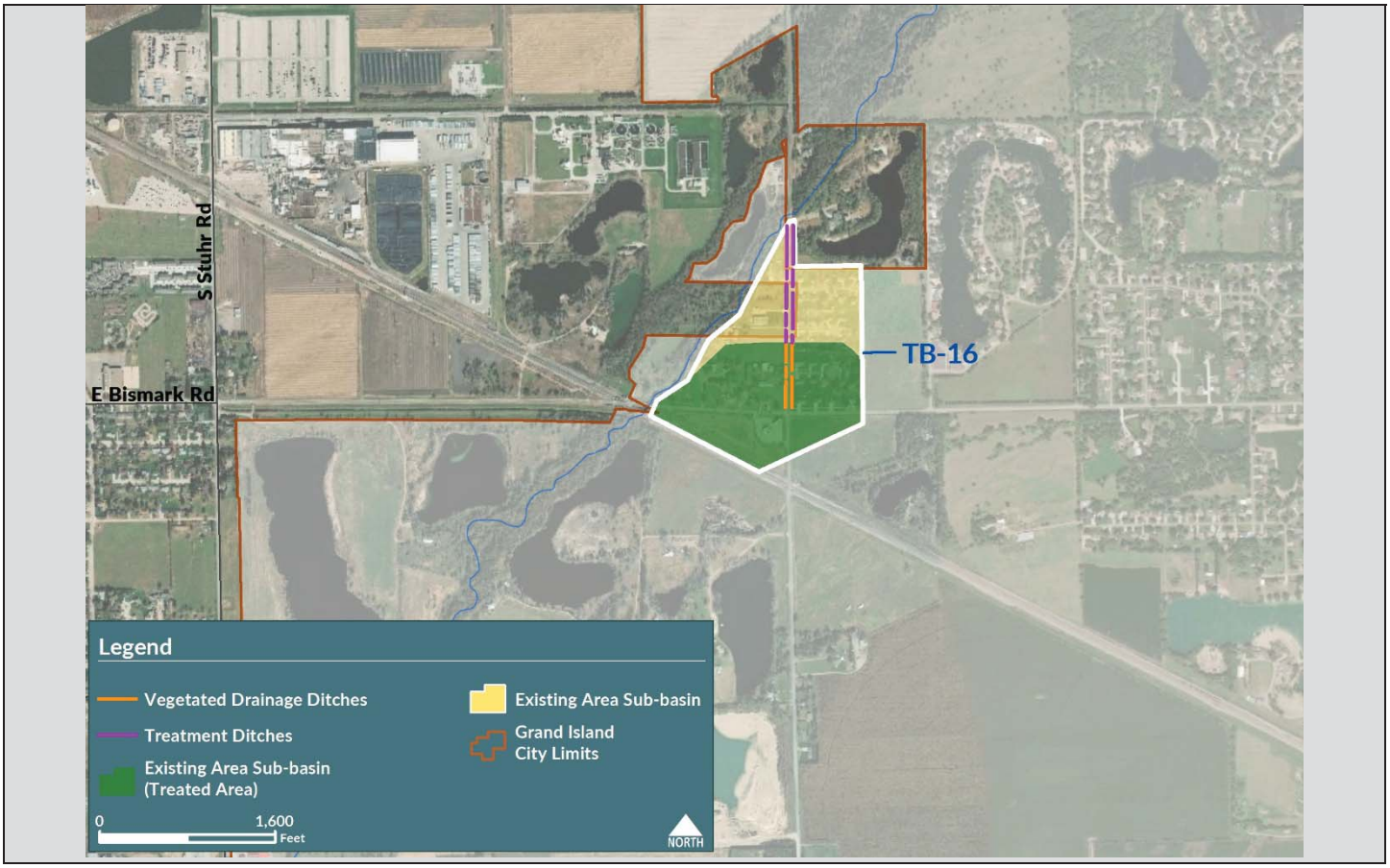
Sub-Basin Acres:	**57**
Max Impervious (%):	**55.0**
WQCV (Ac-Ft):	**1.8**
Q_{WQ} (cfs):	**10.7**

Treatment Type:	**Vegetated Ditch**
Flow Depth: (ft)	**2.11**
Flow Velocity (ft/sec):	**0.28**
Required Treatment Length (ft):	**1,067**
Treated Sub-Basin Area (ac):	**37**
Basin Treated (%):	**65**

Improvements and Maintenance

No improvements recommended.

Maintain minimum vegetated depth of 4".



CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 17

Basin Treatment Characteristics

Sub-Basin Acres:	**385**
Max Impervious (%):	**55.0**
WQCV (Ac-Ft):	**12.6**
Q_{WQ} (cfs):	**30.7**

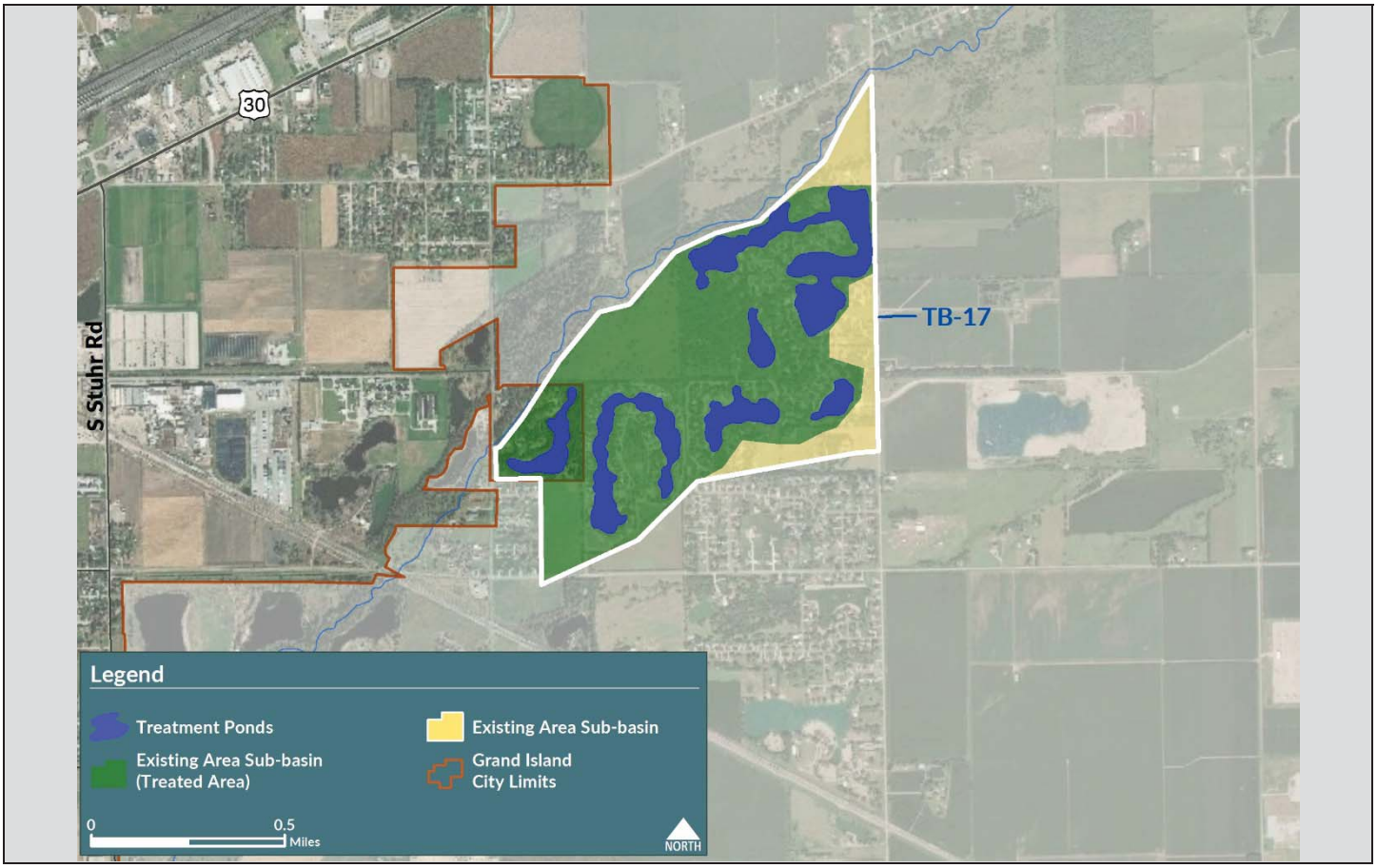
Treatment Type: Wet Extended Detention Pond

Top Area of Perm. Pool: (ac)	**76.2**
Required Depth of Perm. Pool (ft):	**0.2**
Required Depth above Perm. Pool (ft):	**0.2**
Available Depth above Perm. Pool (ft):	**City to Verify**
Treated Sub-Basin Area (ac):	**332**
Basin Treated (%):	**86**

Improvements and Maintenance

Existing wet extended detention ponds provide sufficient water quality treatment for existing and future growth. No improvements recommended.

Preserve depth of permanent pool and storage depth for treatment. Maintain elevation and structural integrity of culvert pipe outlets.



CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 18

Basin Treatment Characteristics

Sub-Basin Acres:	**106**
Max Impervious (%):	**55**
WQCV (Ac-Ft):	**3.5**
Q_{WQ} (cfs):	**11.3**

Treatment Type:	**No Current Treatment**
Flow Depth: (ft)	**0.0**
Flow Velocity (ft/sec):	**0.0**
Required Treatment Length (ft):	**0**
Treated Sub-Basin Area (ac):	**0**
Basin Treated (%):	**0**

Improvements and Maintenance

Subbasin is mostly developed. For additional treatment, widening existing ditch to 15' would increase percent basin treatment from 0% (0 ac.) to 100% (106 ac.). Development in the subbasin is primarily residential and uses curbless streets to flow stormwater into vegetated swales. Maintain neighborhood street cross sections.

CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 19

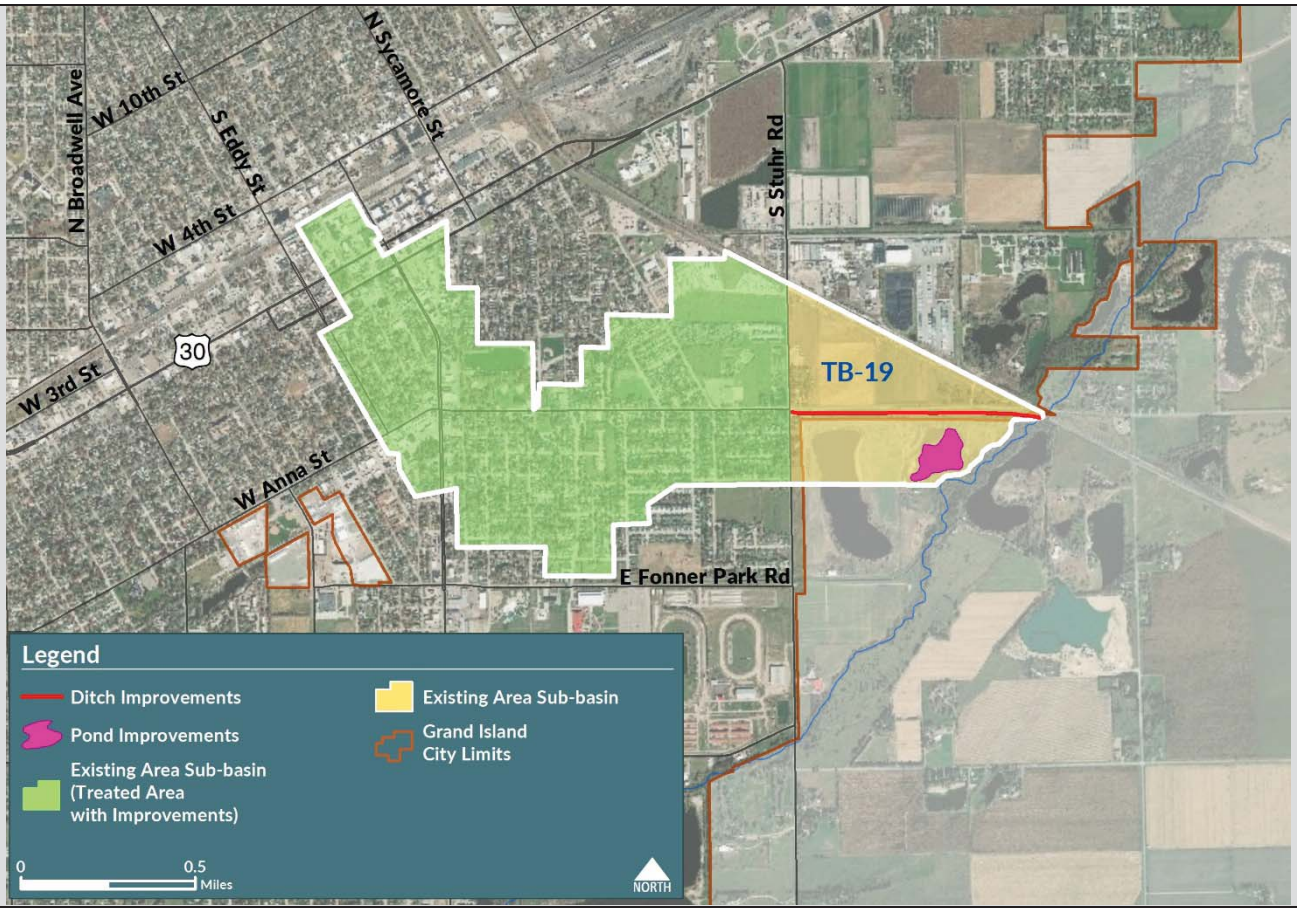
Basin Treatment Characteristics

Sub-Basin Acres:	**684**
Max Impervious (%):	**64.3**
WQCV (Ac-Ft):	**25.8**
Q_{WQ} (cfs):	**119**

Treatment Type: Wet Extended Detention Pond

Top Area of Perm. Pool: (ac)	**0.0**
Required Depth of Perm. Pool (ft):	**0.0**
Required Depth above Perm. Pool (ft):	**0.0**
Available Depth above Perm. Pool (ft):	**0.0**
Treated Sub-Basin Area (ac):	**0**
Basin Treated (%):	**0**

Improvements and Maintenance
Subbasins is mostly developed. For additional treatment, widen channel to 15' or redirect flow into existing wet extended detention pond upstream of outfall to the Wood River (25.8 ac-ft of storage available on privately owned property). Improvement could increase known percent basin treatment from 0% (0 ac.) to 76% (521 ac.).



CITY OF GRAND ISLAND

Watershed BMP Master Plan

Treatment Basin: 20

Basin Treatment Characteristics

Sub-Basin Acres:	**710**
Max Impervious (%):	**80.9**
WQCV (Ac-Ft):	**33.2**
Q_{WQ} (cfs):	**75.9**

Treatment Type:	**Vegetated Ditch**
Flow Depth: (ft)	**2.65**
Flow Velocity (ft/sec):	**0.94**
Required Treatment Length (ft):	**4,474**
Treated Sub-Basin Area (ac):	**425**
Basin Treated (%):	**60**

Improvements and Maintenance

Subbasin is mostly developed and includes two detention cells for extended storage not included in this treatment assessment. For additional treatment, maintain flap gates and route ditch flow into wet detention pond between wastewater treatment plant the Wood River (33.2 ac-ft of storage required on publicly owned property). Improvement could increase known percent basin treatment from 60% (425 ac.) to 83% (592 ac.). Maintain minimum vegetated depth of 4" throughout existing vegetated ditch treatment.

CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 21

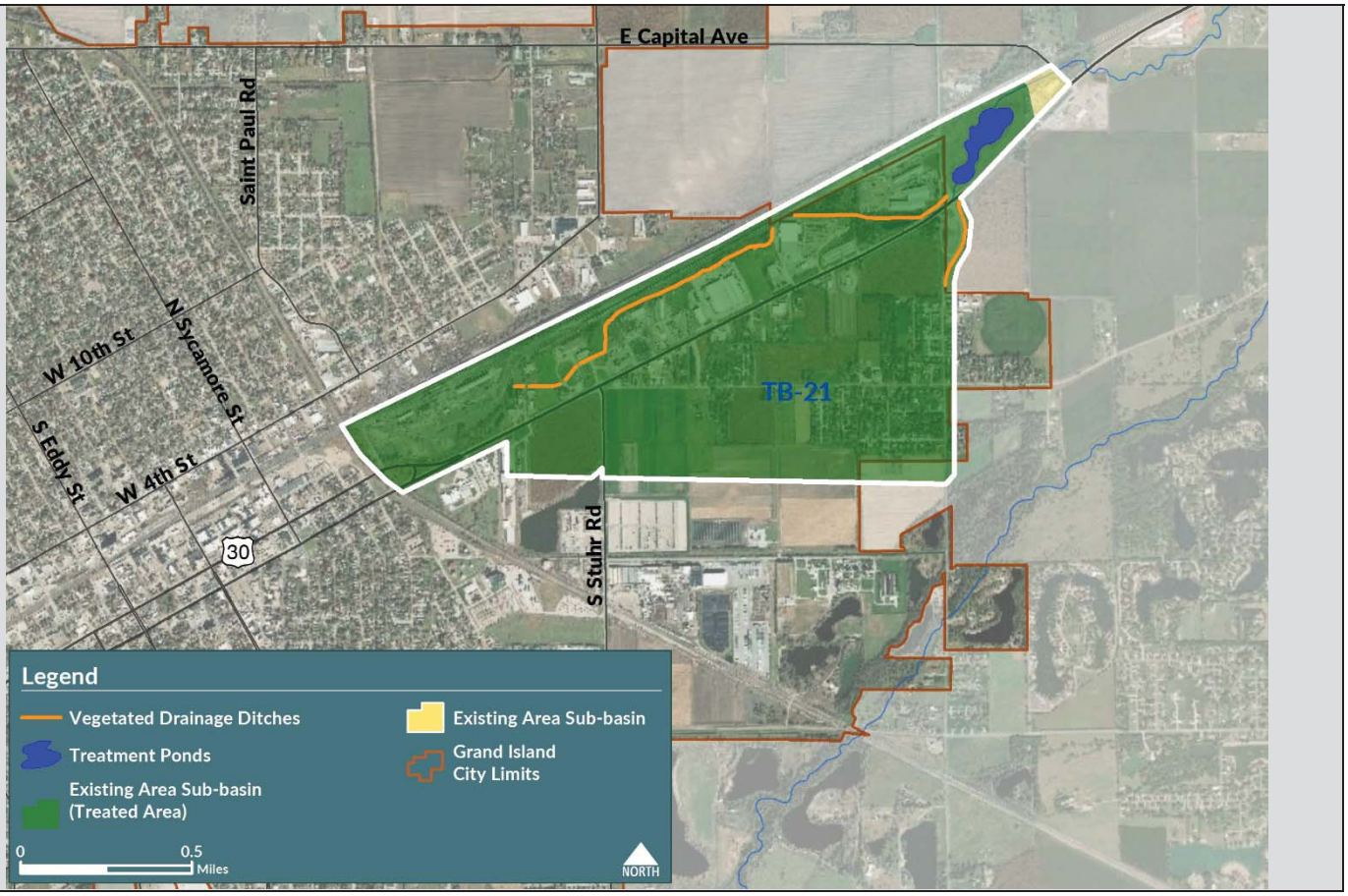
Basin Treatment Characteristics

Sub-Basin Acres:	**721**
Max Impervious (%):	**82.0**
WQCV (Ac-Ft):	**34.1**
Q_{WQ} (cfs):	**104**
Treatment Type:	**Wet Pond**
Top Area of Perm. Pool: (ac)	**8.9**
Required Depth of Perm. Pool (ft):	**4.9**
Required Depth above Perm. Pool (ft):	**3.3**
Available Depth above Perm. Pool (ft):	**City to Verify**
Treated Sub-Basin Area (ac):	**714**
Basin Treated (%):	**99**

Improvements and Maintenance

Existing wet extended detention pond provides sufficient water quality treatment for existing and future growth. No improvements recommended.

Preserve depth of permanent pool and storage depth for treatment. Maintain elevation and structural integrity of culvert pipe outlet.



CITY OF GRAND ISLAND

Watershed BMP Master Plan

Treatment Basin: 22

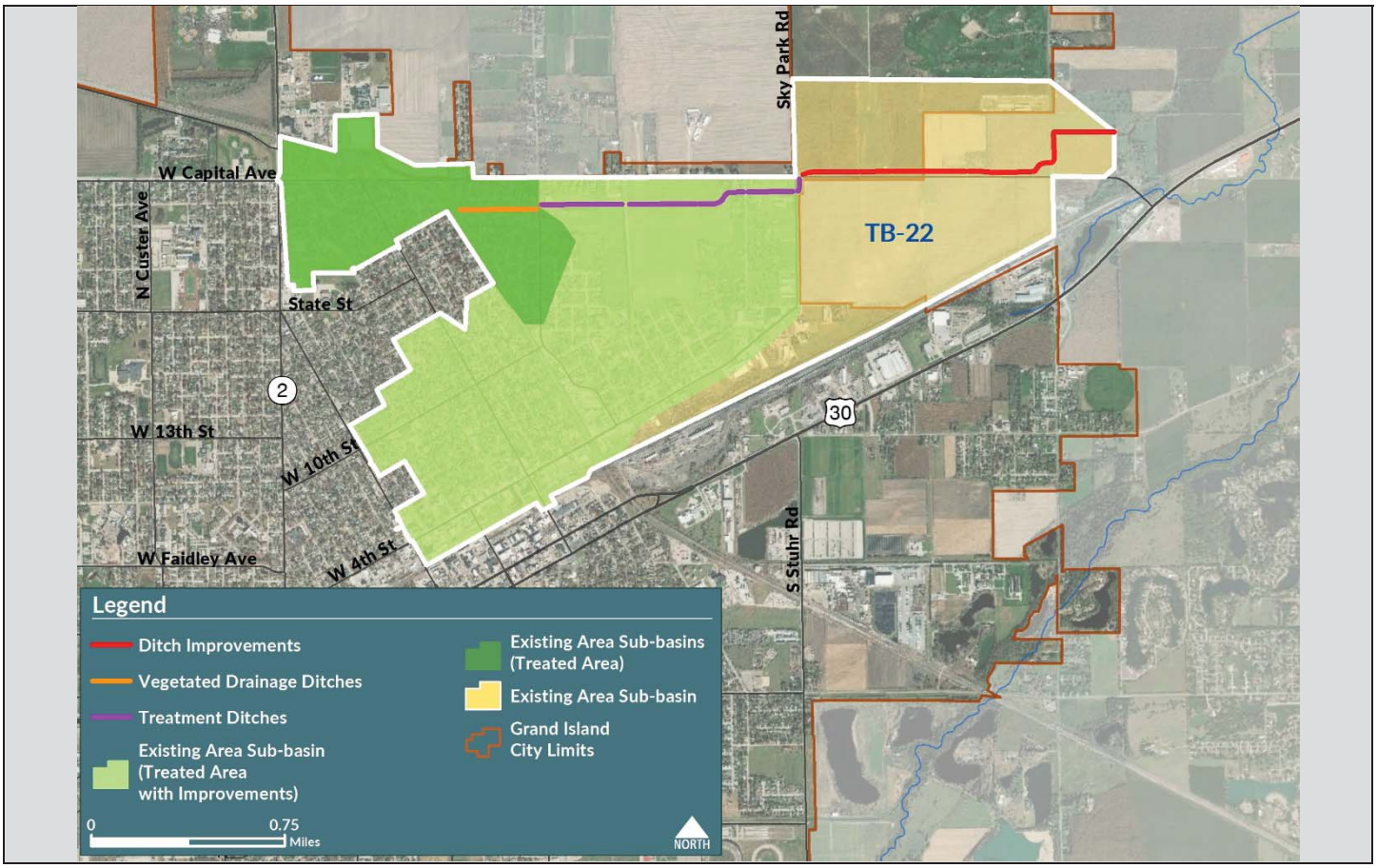
Basin Treatment Characteristics

Sub-Basin Acres:	**1,827**
Max Impervious (%):	**69.9**
WQCV (Ac-Ft):	**74.5**
Q_{WQ} (cfs):	**161**

Treatment Type:	**Vegetated Ditch**
Flow Depth: (ft)	**4.43**
Flow Velocity (ft/sec):	**1.53**
Required Treatment Length (ft):	**12,211**
Treated Sub-Basin Area (ac):	**296**
Basin Treated (%):	**16**

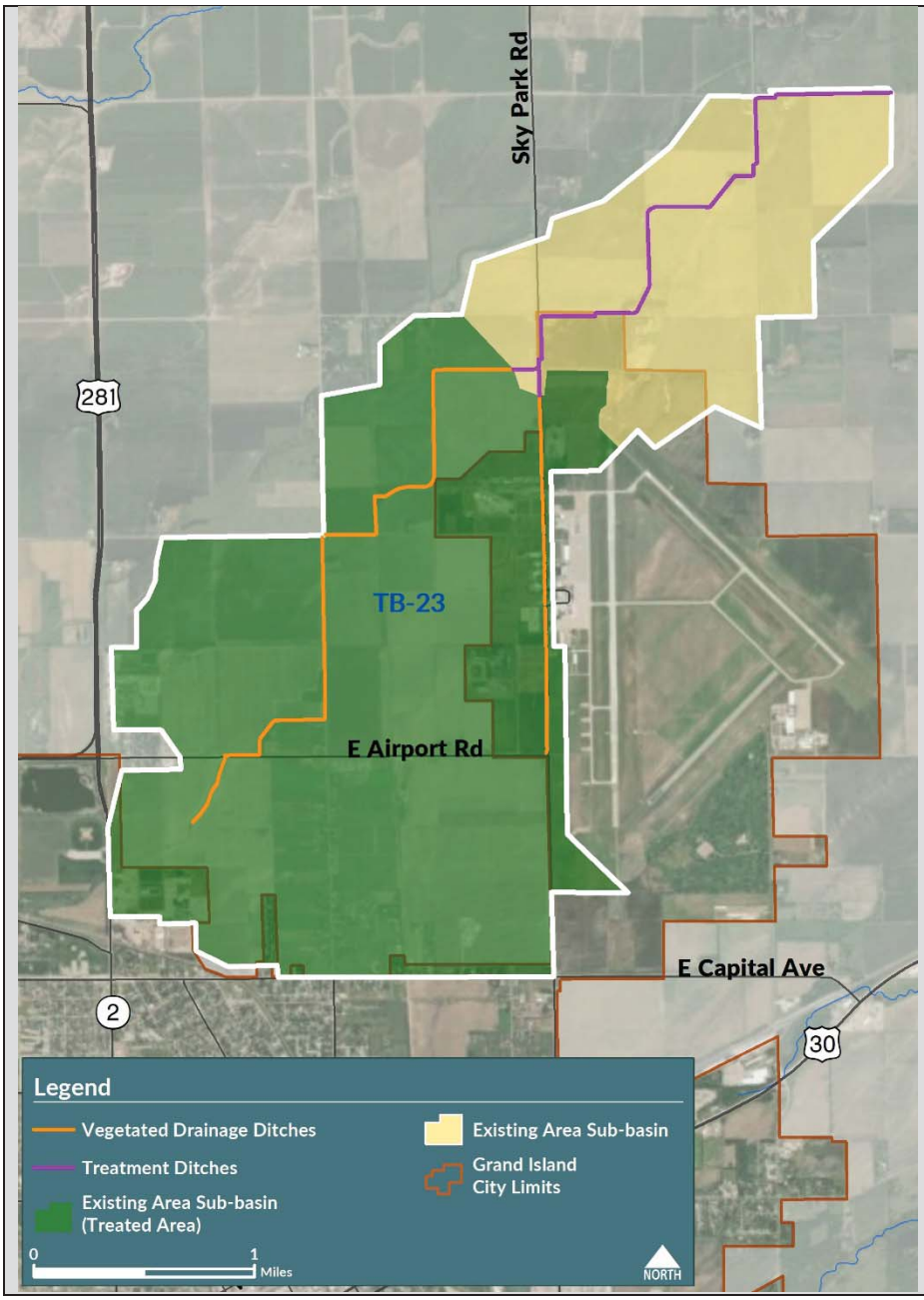
Improvements and Maintenance

Lower portion of subbasin is undeveloped. Provide treatment by widening existing ditch to 30' from Sky Park to 3060 Capital Ave and 35' to the mouth of the subbasin. Basin treatment would increase from 16% (296 ac.) to 65% (1,186 ac.). Property north of Capital Avenue could remain undeveloped or require treatment on site to meet 80% subbasin treatment. Maintain minimum vegetated depth of 4" in existing treatment ditch and proposed ditch improvement.



CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 23



Basin Treatment Characteristics

Sub-Basin Acres:	**4,173**
Max Impervious (%):	**66.9**
WQCV (Ac-Ft):	**163**
Q_{WQ} (cfs):	**270**

Treatment Type: **Vegetated Ditch**

Flow Depth: (ft)	**5.36**
Flow Velocity (ft/sec):	**1.51**
Required Treatment Length (ft):	**14,534**
Treated Sub-Basin Area (ac):	**3,065**
Basin Treated (%):	**73**

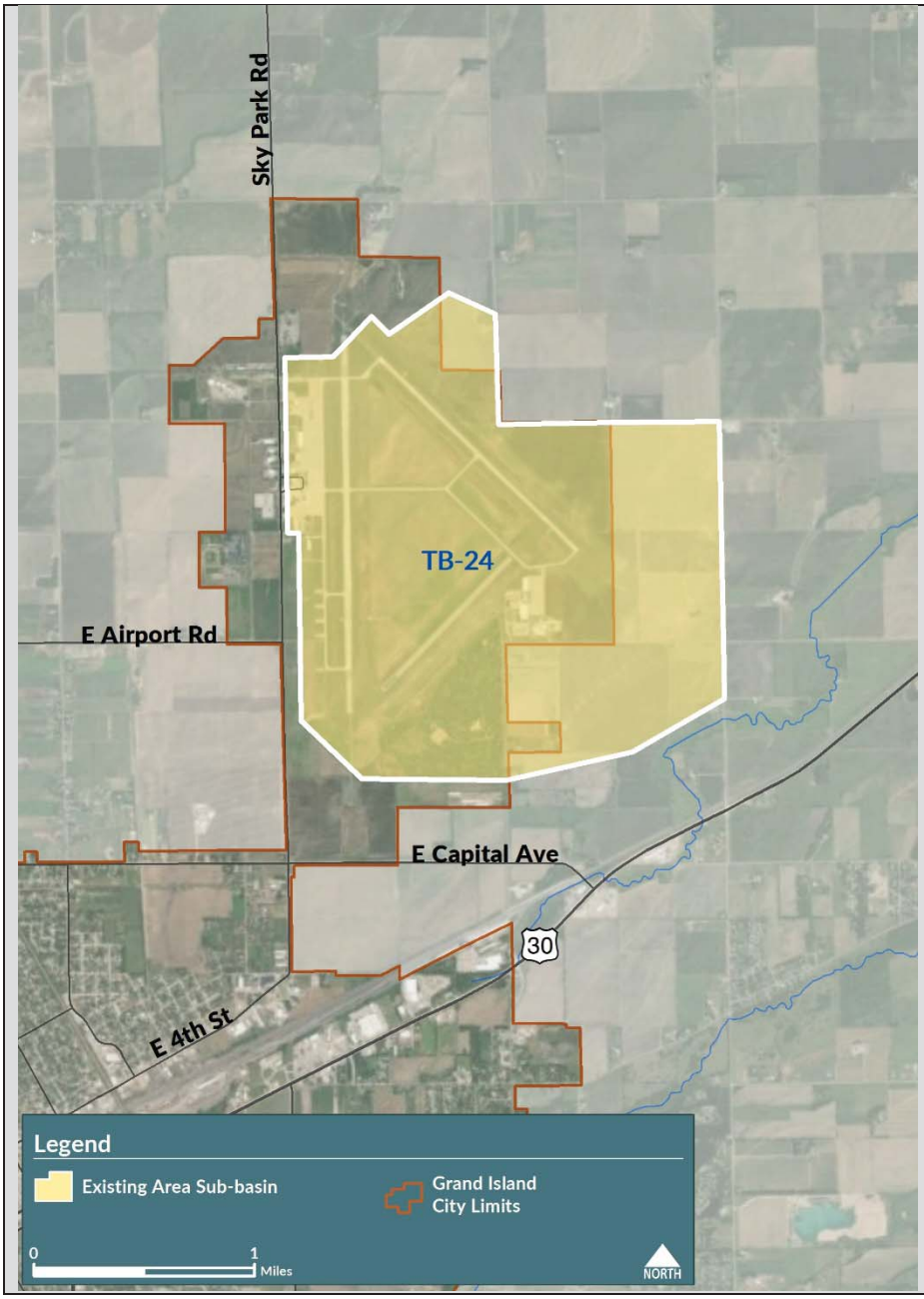
Improvements and Maintenance

Existing vegetated ditch provides sufficient water quality treatment for existing and future growth. No improvements recommended. Property in the lower portion of the subbasin could require treatment on site to meet 80% subbasin treatment target.

Maintain minimum vegetated depth of 4" throughout vegetated ditch treatment.

CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 24



Basin Treatment Characteristics

Sub-Basin Acres:	**2,147**
Max Impervious (%):	**52.6**
WQCV (Ac-Ft):	**67.4**
Q_{WQ} (cfs):	**159**

Treatment Type:
No Current Treatment

Flow Depth: (ft)	**0.0**
Flow Velocity (ft/sec):	**0.0**
Required Treatment Length (ft):	**0**
Treated Sub-Basin Area (ac):	**0**
Basin Treated (%):	**0**

Improvements and Maintenance

Subbasin is mostly airport developed and conveys stormwater as sheetflow or through vegetated swales.

CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 25

Basin Treatment Characteristics

Sub-Basin Acres:	**44**
Max Impervious (%):	**79.6**
WQCV (Ac-Ft):	**2.0**
Q_{WQ} (cfs):	**7.0**

Treatment Type:	**Vegetated Ditch**
Flow Depth: (ft)	**1.03**
Flow Velocity (ft/sec):	**0.83**
Required Treatment Length (ft):	**1,549**
Treated Sub-Basin Area (ac):	**10**
Basin Treated (%):	**23**

Improvements and Maintenance

Small subbasin cannot provide sufficient treatment with vegetated ditch alone. Either mitigate 31.5 acres of development in another subbasin or require new development to provide onsite treatment.

Maintain minimum vegetated depth of 4" throughout vegetated ditch treatment.

CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 26

Basin Treatment Characteristics

Sub-Basin Acres:	**226**
Max Impervious (%):	**87.7**
WQCV (Ac-Ft):	**11.4**
Q_{WQ} (cfs):	**28.6**

Treatment Type:
No Current Treatment

Flow Depth: (ft)	**0.0**
Flow Velocity (ft/sec):	**0.0**
Required Treatment Length (ft):	**0**
Treated Sub-Basin Area (ac):	**0**
Basin Treated (%):	**0**

Improvements and Maintenance

Subbasin is mostly undeveloped and will require treatment to be designed and constructed unless mitigation is provided in another subbasin. For treatment, construct 12' wide trapezoidal ditch along north side of sub-basin with 0.1% maximum slope from North Shady Bend Road to East Capital Avenue along a preferred alignment. Treatment may be provided up to 82% (185 ac.) of the subbasin.

Maintain minimum vegetated depth of 4" throughout vegetated ditch treatment once constructed.

CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 27

Basin Treatment Characteristics

Sub-Basin Acres:	**139**
Max Impervious (%):	**55.0**
WQCV (Ac-Ft):	**4.6**
Q_{WQ} (cfs):	**9.7**

Treatment Type:	**No Current Treatment**
Flow Depth: (ft)	**0.0**
Flow Velocity (ft/sec):	**0.0**
Required Treatment Length (ft):	**0**
Treated Sub-Basin Area (ac):	**0**
Basin Treated (%):	**0**

Improvements and Maintenance

Subbasin is mostly undeveloped and will require treatment to be designed and constructed unless mitigation is provided in another subbasin. For treatment, construct 5' wide trapezoidal ditch along south side of East Seedling Mile Rd with 0.1% maximum slope from South Shady Bend Road to North Gunbarrel Rd along a preferred alignment. Treatment may be provided up to 87% (121 ac.) of the subbasin.

Maintain minimum vegetated depth of 4" throughout vegetated ditch treatment once constructed.

CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: 28

Basin Treatment Characteristics

Sub-Basin Acres:	**223**
Max Impervious (%):	**73.3**
WQCV (Ac-Ft):	**9.5**
Q_{WQ} (cfs):	**23.7**

Treatment Type:
No Current Treatment

Flow Depth: (ft)	**0.0**
Flow Velocity (ft/sec):	**0.0**
Required Treatment Length (ft):	**0**
Treated Sub-Basin Area (ac):	**0**
Basin Treated (%):	**0**

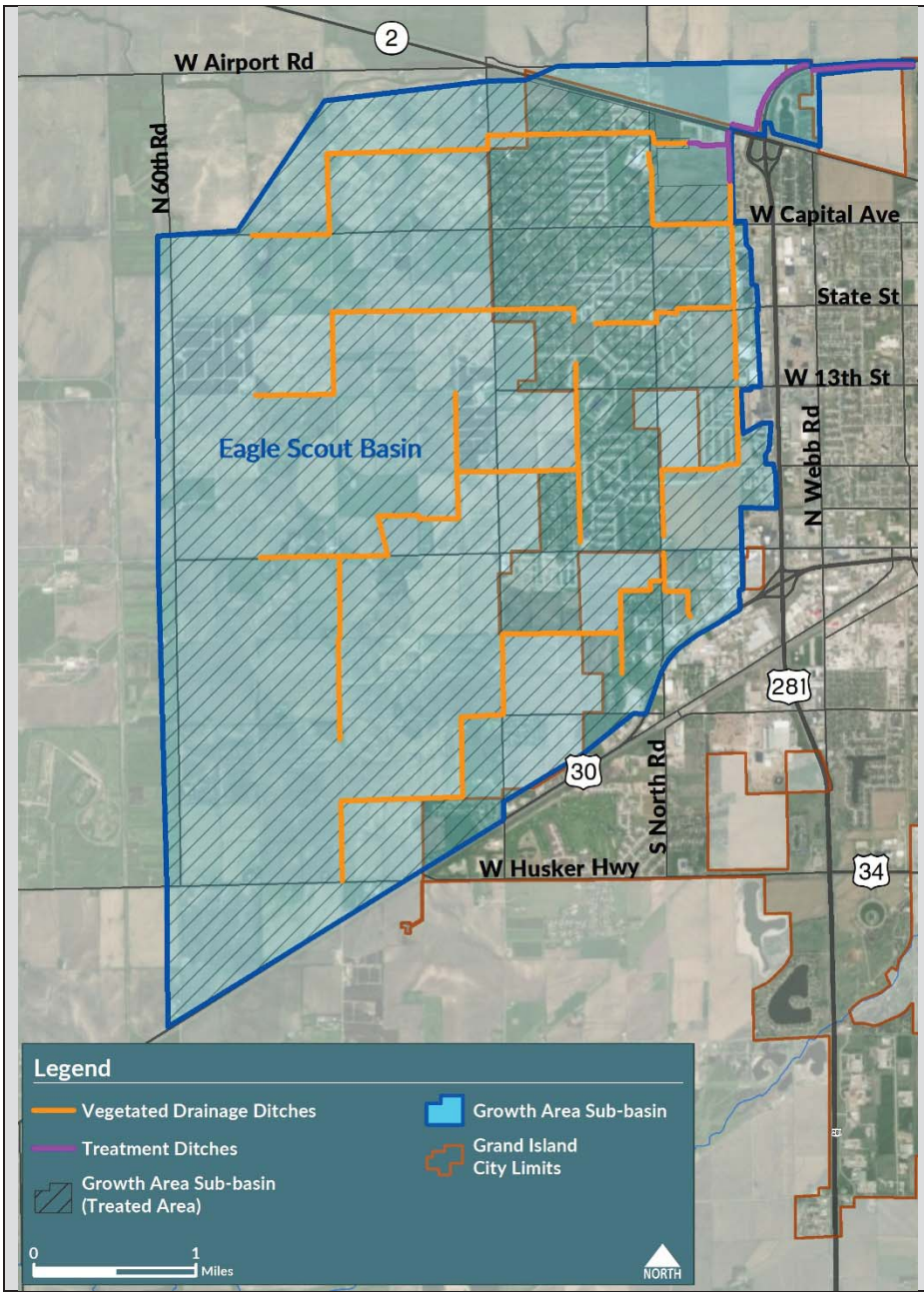
Improvements and Maintenance

Subbasin is mostly undeveloped and will require treatment to be designed and constructed unless mitigation is provided in another subbasin. For treatment, construct 12' wide trapezoidal ditch along west side of North Gunbarrel Road with 0.1% maximum slope from Baker Avenue to East Capital Avenue along a preferred alignment. Treatment may be provided up to 85% (189 ac.) of the subbasin.

Maintain minimum vegetated depth of 4" throughout vegetated ditch treatment once constructed.

CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: Eagle Scout Composite



Basin Treatment Characteristics

Sub-Basin Acres:	**10,508**
Max Impervious (%):	**34**
WQCV (Ac-Ft):	**225**
Q_{WQ} (cfs):	**211**

Treatment Type: **Vegetated Ditch**

Flow Depth: (ft)	**5.02**
Flow Velocity (ft/sec):	**0.95**
Required Treatment Length (ft):	**8,606**
Treated Sub-Basin Area (ac):	**10,032**
Basin Treated (%):	**95**

Improvements and Maintenance

Existing vegetated ditch provides sufficient water quality treatment for existing and future growth. No improvements recommended.

Maintain minimum vegetated depth of 4" throughout vegetated ditch treatment.

CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: Capital Heights

Basin Treatment Characteristics

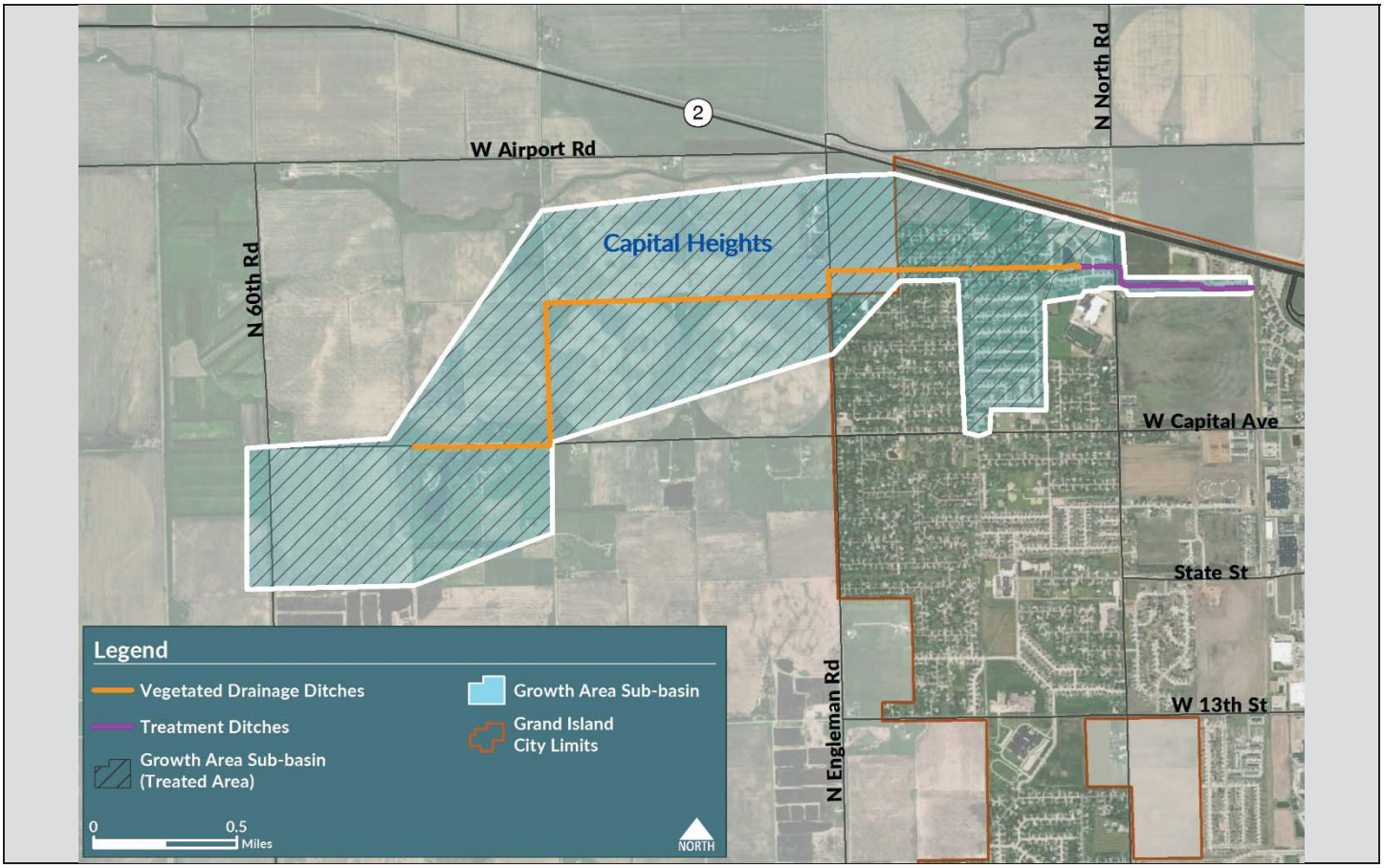
Sub-Basin Acres:	**1,252**
Max Impervious (%):	**24.0**
WQCV (Ac-Ft):	**20.0**
Q_{WQ} (cfs):	**24.0**

Treatment Type:	**Vegetated Ditch**
Flow Depth: (ft)	**1.74**
Flow Velocity (ft/sec):	**1.06**
Required Treatment Length (ft):	**3,329**
Treated Sub-Basin Area (ac):	**1,219**
Basin Treated (%):	**97**

Improvements and Maintenance

Existing vegetated ditch provides sufficient water quality treatment for existing and future growth. No improvements recommended.

Maintain minimum vegetated depth of 4" throughout vegetated ditch treatment.



CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: Capital Avenue

Basin Treatment Characteristics

Sub-Basin Acres:	**480**
Max Impervious (%):	**63.6**
WQCV (Ac-Ft):	**17.9**
Q_{WQ} (cfs):	**67.8**

Treatment Type: **Vegetated Ditch***

Flow Depth: (ft)	**3.07**
Flow Velocity (ft/sec):	**1.36**
Required Treatment Length (ft):	**7,495**
Treated Sub-Basin Area (ac):	**0**
Basin Treated (%):	**0**

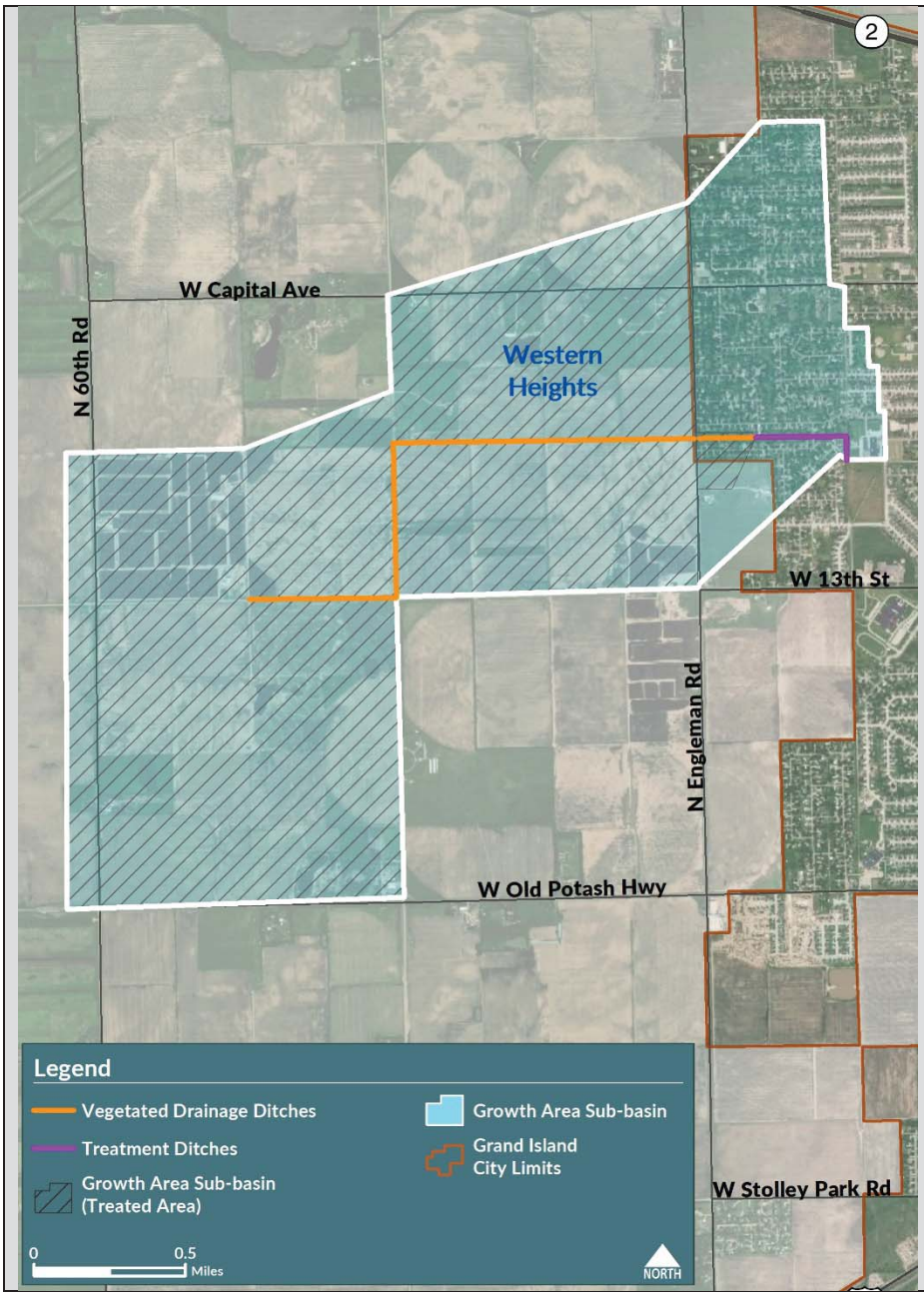
Improvements and Maintenance

***Treatment provided within the composite of all Eagle Scout subbasins exceeds 80%.**

Subbasin is mostly developed or platted for development. No improvements are recommended, but vegetated roadside swales will support stormwater treatment within the subbasin.

CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: Western Heights



Basin Treatment Characteristics

Sub-Basin Acres:	**2,207**
Max Impervious (%):	**19.1**
WQCV (Ac-Ft):	**29.4**
Q_{WQ} (cfs):	**49.1**

Treatment Type: **Vegetated Ditch**

Flow Depth: (ft)	**3.54**
Flow Velocity (ft/sec):	**1.13**
Required Treatment Length (ft):	**7,215**
Treated Sub-Basin Area (ac):	**1,814**
Basin Treated (%):	**82%**

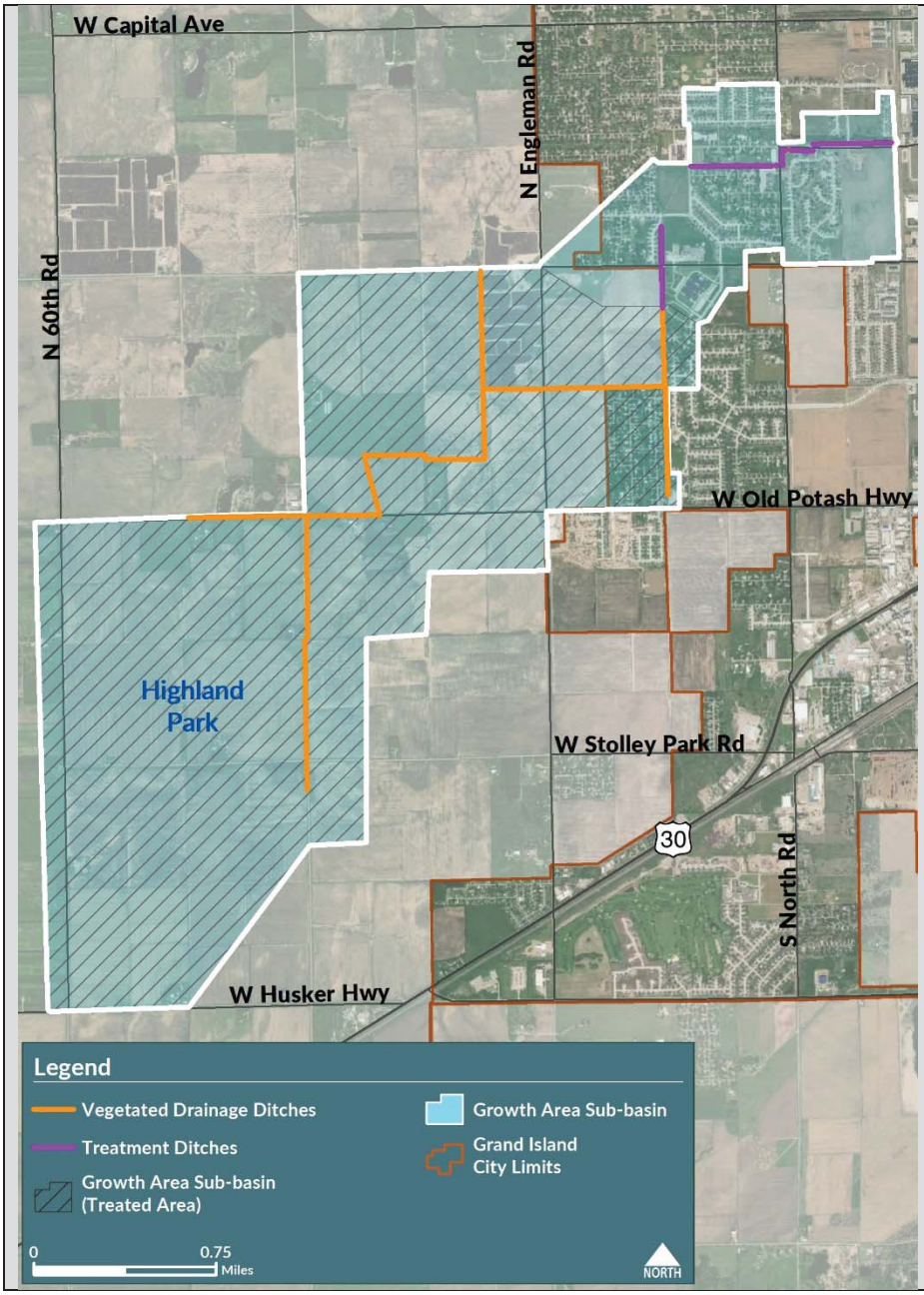
Improvements and Maintenance

Existing vegetated ditch provides sufficient water quality treatment for existing and future growth. No improvements recommended.

Maintain minimum vegetated depth of 4" throughout vegetated ditch treatment.

CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: Highland Park



Basin Treatment Characteristics

Sub-Basin Acres:	**3,175**
Max Impervious (%):	**22.8**
WQCV (Ac-Ft):	**48.6**
Q_{WQ} (cfs):	**52.4**

Treatment Type: **Vegetated Ditch**

Flow Depth: (ft)	**3.54**
Flow Velocity (ft/sec):	**1.13**
Required Treatment Length (ft):	**7,215**
Treated Sub-Basin Area (ac):	**2,635**
Basin Treated (%):	**83**

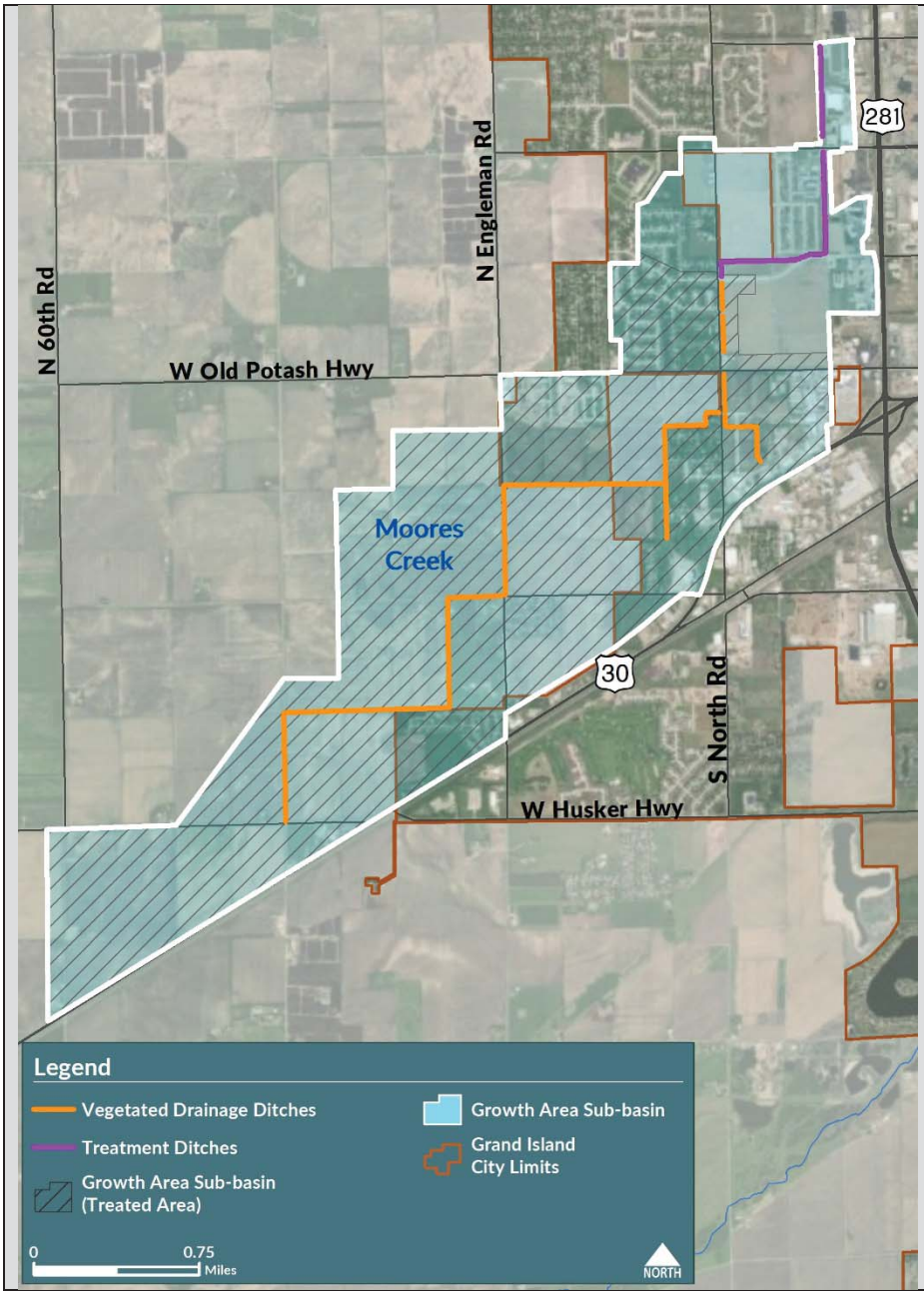
Improvements and Maintenance

Existing vegetated ditch provides sufficient water quality treatment for existing and future growth. No improvements recommended.

Maintain minimum vegetated depth of 4" throughout vegetated ditch treatment.

CITY OF GRAND ISLAND

Watershed BMP Master Plan
Treatment Basin: Moores Creek



Basin Treatment Characteristics

Sub-Basin Acres:	**2,978**
Max Impervious (%):	**50.6**
WQCV (Ac-Ft):	**90.2**
Q_{WQ} (cfs):	**101**

Treatment Type: **Vegetated Ditch**

Flow Depth: (ft)	**4.27**
Flow Velocity (ft/sec):	**0.94**
Required Treatment Length (ft):	**7,245**
Treated Sub-Basin Area (ac):	**2,485**
Basin Treated (%):	**83**

Improvements and Maintenance

Existing vegetated ditch provides sufficient water quality treatment for existing and future growth. No improvements recommended.

Maintain minimum vegetated depth of 4" throughout vegetated ditch treatment.

APPENDIX B. NEBRASKA H_2O POST CONSTRUCTION STORMWATER PROGRAM DESIGN STANDARDS AND PROCEDURES – APPLIED TO NON-STEP PROJECTS

FINAL Nebraska H_2O Post-Construction Stormwater Program Design Standards and Procedures Memorandum

To: Participating Nebraska H_2O Members

Project: NE H_2O Post Construction Stormwater Management Program Development – Phase 2 (FHU No. 12-221-XX)

From: Felsburg Holt & Ullevig

Date: August 26, 2015

1.0 Objective and Purpose

The Clean Water Act requires select communities in Nebraska to implement treatment practices to manage urban stormwater runoff in a manner that protects receiving water quality. These requirements are enforced through the National Pollutant Discharge Elimination System (NPDES) permit for each Municipal Separate Storm Sewer System (MS4). This programmatic permit is issued by the Nebraska Department of Environmental Quality (NDEQ).

Nebraska H_2O is a working group of Phase II communities in Nebraska that collaborate to develop solutions for common challenges in meeting MS4 permit requirements. Post-Construction Stormwater Management is one of six minimum control measures that each Nebraska H_2O community must satisfy. Each community is required to establish a Post-Construction Stormwater Management Program that meets Phase II MS4 permit general conditions as required by NDEQ.

The purpose of this memorandum is to provide the framework and guidance that each Nebraska H_2O community can use to satisfy part of their post-construction stormwater management program. Establishing this framework helps a community meet MS4 permit requirements and promotes sustainable watershed management policies. Whereas traditional storm sewer design and stormwater management focused on addressing water quantity and potential flood issues, the post-construction program also addresses water quality in each community. The framework includes establishment of minimum treatment and design standards, submittal and review process procedures, as well as maintenance, inspection and enforcement protocol.

2.0 Applicability

Post-construction stormwater program requirements shall be applicable to all construction activity and land developments requiring; including, but not limited to site plan applications, subdivision applications, building applications, and right-of-way applications from the City, unless exempt below. These provisions apply to all portions of any common plan of development or sale which would cause the disturbance of at least one acre of soil even though multiple, separate and distinct land development activities may take place at different times on different schedules.

The following activities are exempt from these requirements:

(1) Any emergency activity that is necessary for the immediate protection of life, property, or natural resources; and

(2) Construction activity that provides maintenance and repairs performed to maintain the original line and grade, hydraulic capacity, or original purpose of a facility.

3.0 Definitions

Definitions applicable to this memorandum are as follows:

70th Percentile Rain Event: A rainfall storm event equivalent to a depth of rainfall which is not exceeded in 70 percent of the historic runoff producing rainfall events. The depth of rainfall to be used shall be that which is identified in this memorandum or by a specific community using local precipitation data. The depth of rainfall is used in hydrologic calculations to determine the water quality volume or rate of discharge to be controlled for.

80th Percentile Rain Event: A rainfall storm event equivalent to a depth of rainfall which is not exceeded in 80 percent of the historic runoff producing rainfall events. The depth of rainfall to be used shall be that which is identified in this memorandum or by a specific community using local precipitation data. The depth of rainfall is used in hydrologic calculations to determine the water quality volume or rate of discharge to be controlled for.

Best Management Practices (BMPs): Schedules of activities, prohibitions of practices, general good housekeeping practices, pollution prevention and educational practices, maintenance procedures, and other management practices to prevent or reduce the discharge of pollutants directly or indirectly to storm water, receiving waters, or storm water conveyance systems.

To avoid confusion with temporary and permanent BMPs used during construction; best management practices associated with the post-construction stormwater management program shall be referred to as stormwater treatment facilities (STFs).

Builder: shall mean the general contractor responsible for permitting and constructing a structure and associated construction activity.

Common Plan of Development or Sale: A contiguous area where multiple separate and distinct land disturbing activities may be taking place at different times, on different schedules, but under one proposed plan which may include, but is not limited to, any announcement or piece of documentation (including a sign, public notice or hearing, sales pitch, advertisement, drawing, permit application, zoning request, computer design, etc.) or physical demarcation (including boundary signs, lot stakes, surveyor markings, etc.) indicating construction activities may occur on a specific plot.

Construction Activity: Such activities include but are not limited to clearing and grubbing, grading, excavating, demolition and other land disturbing actions.

Construction Site: Any location where construction activity occurs.

Contractor: Any person performing or managing construction work at a construction site, including, but not limited to, any construction manager, general contractor or subcontractor, and any person engaged in any one or more of the following: earthwork, pipe work, paving, building, plumbing, mechanical, electrical, landscaping or material supply.

Clearing: Any activity that removes the vegetative surface cover.

Drainage Design Guidance or Manual: Documentation that references design criteria and guidance by a community for stormwater management.

Disturbed Area: Area of the lands surface disturbed by any work or activity upon the property by means including, but not limited to, grading; excavating; stockpiling soil, fill, or other materials; clearing; vegetation removal; removal or deposit of any rock, soil, or other materials; or other activities which expose soil. Disturbed area does not include the tillage of land that is zoned for agricultural use.

Earthwork: The disturbance of soil on a site associated with construction activities.

Final Drainage Plan: A plan that indicates the characteristics of the complete project. The plan will also indicate the future conditions post-construction STFs will be maintained under.

Grading: Excavation or fill of material, including the resulting conditions thereof.

Municipal Separate Storm Sewer System (MS4): Publicly-owned facilities by which storm water is collected and/or conveyed, including, but not limited to, any roads with drainage systems, municipal streets, gutters, curbs, catch basins, inlets, piped storm drains, pumping facilities, retention and detention basins, natural and human-made or altered drainage ditches/channels, reservoirs, and other drainage structures.

Land Development: Any land change, including, but not limited to, clearing, digging, grubbing, stripping, removal of vegetation, dredging, grading, excavating, transporting and filling of land, construction, paving, and any other installation of impervious cover.

Maintenance Agreement: A binding document between an owner or developer and the community that outlines responsibilities of maintenance and inspection for STFs associated with land development along with recourse by the community upon default of said responsibilities.

MS4 Boundary: The boundary defined by each individual community that is subject to the requirements of their MS4 program. In no instance shall the MS4 boundary be less inclusive than the Urbanized Area map boundary prepared by the U.S. Census Bureau, the minimum boundary adopted by the EPA for Phase II communities as part of the MS4 program.

National Pollutant Discharge Elimination System (NPDES) Storm Water Discharge Permit: A permit issued by the EPA (or by a State under authority delegated pursuant to 33 USC § 1342(b) i.e. Nebraska Department of Environmental Quality) that authorizes the discharge of pollutants to waters of the State.

Owner: The person who owns a facility, development, part of a facility, or land.

Person: Means any individual, association, organization, partnership, firm, corporation, cooperative, limited liability company or other entity recognized by law.

Pollutant: Anything which causes or contributes to pollution. Pollutants may include, but are not limited to: paints, varnishes, and solvents; oil and other automotive fluids; non-hazardous liquid and solid wastes and yard wastes; refuse, rubbish, garbage, litter, or other discarded or abandoned objects, ordinances, and accumulations, so that same may cause or contribute to pollution; floatables; pesticides, herbicides, and fertilizers; hazardous substances and wastes; sewage, fecal coli form and pathogens; dissolved and particulate metals; animal wastes; wastes and residues that result from constructing a building or structure; wastes and residues that result from mobile washing operations; and noxious or offensive matter of any kind.

Pollution: The presence in waters of the State of any substances, contaminants, pollutants, or manmade or man-induced impairment of waters or alteration of the chemical, physical, biological, or radiological integrity of water in quantities or at levels which are or may be potentially harmful or injurious to human health or welfare, animal or plant life, or property or which unreasonably interfere with the enjoyment of life or property, including outdoor recreation unless authorized by applicable law.

Post-Construction Stormwater Management: The management of stormwater for a period of time in perpetuity from approval for final acceptance of the construction phase of any construction activity. The management of stormwater includes the use of STFs that meet minimum site performance standards in accordance with a community's MS4 permit. STFs are intended to provide stormwater treatment during this time period and are considered functional after vegetation has been established.

Post-Construction Stormwater Management Plan: Documentation supporting analysis, design, maintenance and inspection of STFs installed on a site in order to meet minimum site performance standards in accordance with a community's MS4 permit.

Receiving Water: Any water of the State of Nebraska, including any and all surface waters that are contained in or flow in or through the State of Nebraska, all watercourses, even if they are usually dry, irrigation ditches that receive municipal storm water, and storm sewer systems owned by other entities.

Sediment: Soil (or mud) that has been disturbed or eroded and transported naturally by water, wind or gravity, or mechanically by any person.

Site: The land or water area where any facility or activity is physically located or conducted, including adjacent land used in connection with the facility or activity.

Stormwater: Any surface flow, runoff, and drainage consisting entirely of water from any form of natural precipitation, and resulting from such precipitation.

Stormwater Treatment Facilities (STFs): Permanent best management practices put in place to provide control and treatment of stormwater runoff after construction activity for land development is complete. These facilities are physical in nature and sometimes referred to as "structural" BMPs.

Subdivision: Includes activities associated with the platting of any parcel of land into two or more lots and all construction activity taking place thereon.

Utilities: Infrastructure constructed to provide services that support land development such as water, sanitary sewer, storm sewer, electric, gas, telephone, television and communication services.

Waters of the State: Any and all surface and subsurface waters that are contained in or flow in or through the State of Nebraska. The definition includes all watercourses, even if they are usually dry.

4.0 Requirements

Each MS4 will implement a set of minimum programmatic requirements for new and redevelopment projects that disturb one acre of soil or more within their jurisdiction. This collection of requirements is generally referred to as the Permanent Stormwater Treatment for Post-Construction program. NDEQ has not dictated what minimum program requirements must be implemented, but five content areas must be satisfied according to Part IV.D.4 of the MS4 Permit. The five content areas include:

1. Minimum Site Performance Standards
2. Site Plan Review
3. Maintenance of Controls
4. Tracking Controls
5. Inspection and Enforcement

4.1 Minimum Site Peformance Standards

Each MS4 will require new and redevelopment projects to satisfy minimum site performance standards that address water quality. Minimum site performance standards vary in each of these instances however the methodology for calculating the minimum water quality control volume (WQCV) and water quality volume discharge rate (Q_{WQ}) remain the same. The methodology is based on average daily rainfall data gathered regionally and applied to three specific zones across the state. From that data, the runoff amount is calculated and applied to the treatment drainage area to get the WQCV or Q_{WQ}.

New Development

New development requirements apply to those areas which are being platted for development or have been platted but not built and are within the community's "MS4 boundary". The percentile rainfall event used as a minimum standard for new development is the 80th percentile rainfall event.

> *Example 1) A parcel that had not been platted or zoned for development (i.e. agricultural land) is being platted as a subdivision for single family residential and is greater than 1 acre. The subdivision would be required to meet the minimum standard set forth herein for new development.*
>
> *Example 2) Several parcels are being replatted for development and the total area being replatted is greater than 1 acre. The replatted parcels would be required to follow new development standards.*
>
> *Example 3) An undeveloped parcel is being rezoned for another use and is greater than 1 acre. The rezoned parcel would be required to follow new development standards.*
>
> *Example 4) A warehouse has been proposed on an undeveloped parcel in an industrial area. Site disturbance is greater than 1 acre. The proposed development would be required to follow new development standards.*

Redevelopment

Redevelopment requirements apply to those areas which have been platted and built on within the community's "MS4 boundary". The percentile rainfall event used as a minimum standard for new development is the 70th percentile rainfall event.

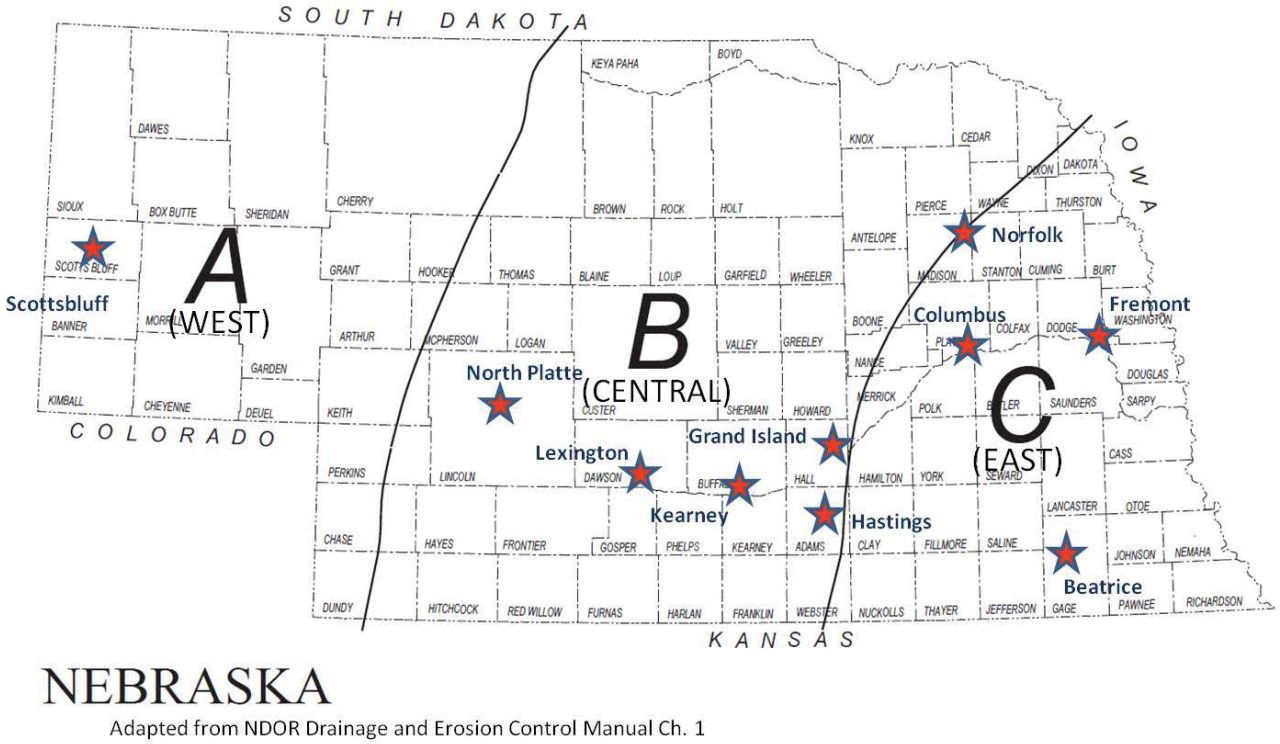
> *Example 1) A parcel that included a structure that was purchased and demolished by the City or other entity, and was sold or deeded over to a new property owner for constructing his or her own building. Site disturbance is greater than 1 acre. This site would be required to meet the minimum standard set forth herein for redevelopment.*
>
> *Example 2) A parcel with a building has been sold and is being converted into a new use with expanded parking. Site disturbance is greater than 1 acre. This parcel would be subject to requirements for redevelopment.*

Rainfall Zones

The percentile rainfall event varies across the state. Three regional rainfall zones have been established to support the calculation of WQCV or Q_{WQ} by any MS4 in Nebraska. These zones are displayed in Figure 1 and are the same as the zones portrayed in the Nebraska Department of Roads (NDOR), *"Drainage and Erosion Control Manual"*, Chapter One.

Rainfall values were interpolated between the depth of rainfall identified in Urban Drainage and Flood Control District's (UDFCD) *"Urban Storm Drainage Criteria Manual"* for the Denver, Colorado area for Region A (West Region) and the City of Lincoln's *"Drainage Criteria Manual"* for Region C (East Region).

Figure 1. Nebraska Regional Rainfall Zones



Adapted from NDOR Drainage and Erosion Control Manual Ch. 1

Rainfall amounts by region for new and redevelopment are provided in Table 1. These values will be used to calculate runoff and water quality control volume (WQCV).

Table 1. Rainfall Depth (P) By Region for Defined Percentile Rainfall Events

Applicable Region	Rainfall, P	
	80th Percentile Event (New Development)	70th Percentile Event (Redevelopment)
A (West)	0.61”	0.44”
B (Central)	0.72”	0.53”
C (East)	0.83”	0.62”

Minimum Design Criteria

STFs must be sized to handle the appropriate WQCV or equivalent water quality discharge rate to properly treat stormwater. Best Management Practices include retention-based stormwater treatment facilities that typically require or encourage using infiltration, evapotranspiration, or harvest practices to control a specified volume of stormwater within each development site.

The regulatory logic of controlling volume is that the stormwater pollutants contained in the volume of runoff captured are prevented from reaching the receiving water, and the remaining volume that does reach the receiving water is less polluted and erosive to the receiving waterbody.

The regulatory logic of controlling discharge rate is that the stormwater pollutants contained in stormwater runoff can be reasonably treated and that volume that does reach the receiving water is less polluted and erosive to the receiving waterbody.

Water Quality Volume

Design criteria to meet minimum site performance standards for new and redevelopment are expressed as the runoff from a specified percentile rainfall event applied across the treatment drainage area. The minimum WQCV for new and redevelopment can be calculated as follows:

$$WQCV = P \times (0.05 + 0.009 \times \%Imp) \times A \times 1/12 \times 43{,}560$$

Where, P = rainfall depth, in (from Table 1)

A = treatment drainage area, ac

%Imp = maximum percent imperviousness (expressed as a whole number not as a decimal) for proposed zoning type (varies by community)

The following example illustrates use of the WQCV equation:

Example 1) A 4.2 acre parcel in Kearney was purchased to construct a storage facility. The parcel is one of 4 in a new development that was zoned limited industrial district (M-1) . Light industrial zoning in Kearney has a maximum impervious percentage of 90%. On that parcel, 2.4 acres will be disturbed to construct the facility. An additional 0.4 acres, also zoned M-1, drain directly onto the site from adjacent property. The WQCV for the site Is calculated as follows:

WQCV = 0.72" x (0.05 + 0.009 x 90) x (2.4 ac + 0.4 ac) x 1/12 x 43,560 = 6,294 cubic feet

If there are multiple land uses within the treatment drainage area, the effective maximum percent imperviousness should be pro-rated based on the area of each zone as a percentage of the total area.

Stormwater runoff from all disturbed areas shall be treated before leaving the site. The treatment drainage area shall include all disturbed areas on the site and upstream drainage or "runon" unless the runon is diverted or bypasses the disturbed site (i.e. by pipe or swale) so that STFs are not overwhelmed. STFs may be distributed across the site to provide the required treatment.

Additional storage in the STF may be allowed, depending on the type of STF selected, to address stormwater detention requirements to control runoff from larger storm events such as the 2-, 10-, or 100-year event.

Water Quality Volume Discharge Rate

STFs that are sized based on a flow rate (i.e. swales, filter strips, manufactured systems, etc.) shall use the water quality volume discharge rate (Q_{WQ}). The Q_{WQ} is the peak runoff from the design water quality volume rainfall event. This peak runoff equivalent shall be calculated using the Natural Resources Conservation Service (NRCS) Curve Number (CN) procedure. The calculation is based on the 80th percentile rainfall event depth by region, a 24 hour duration storm event, and a time of concentration of 5 minutes. The area used is the impervious surface only within the treatment drainage area.

Table 2 has been prepared to provide the Q_{WQ} in each Region for sites with up to 6 acres of impervious area. These values shall be used to size STFs for the area of impervious surface within a given treatment drainage area. For sites greater than 6 acres, the designer shall use the methods and criteria specified above in a suitable model to calculate the discharge rate.

Table 2. Water Quality Discharge Rate (Q_{WQ}) for Selected Impervious Areas By Region

Impervious Area (Acres)	Q_{WQ} (cfs) West | Central | East	Impervious Area (Acres)	Q_{WQ} (cfs) West | Central | East	Impervious Area (Acres)	Q_{WQ} (cfs) West | Central | East
0.2	0.1 | 0.2 | 0.2	2.2	1.5 | 1.9 | 2.2	4.2	2.9 | 3.6 | 4.2
0.4	0.3 | 0.3 | 0.4	2.4	1.6 | 2.0 | 2.4	4.4	3.0 | 3.7 | 4.4
0.6	0.4 | 0.5 | 0.6	2.6	1.8 | 2.2 | 2.6	4.6	3.2 | 3.9 | 4.6
0.8	0.5 | 0.7 | 0.8	2.8	1.9 | 2.4 | 2.8	4.8	3.3 | 4.1 | 4.8
1.0	0.7 | 0.8 | 1.0	3.0	2.1 | 2.5 | 3.0	5.0	3.4 | 4.2 | 5.0
1.2	0.8 | 1.0 | 1.2	3.2	2.2 | 2.7 | 3.2	5.2	3.6 | 4.4 | 5.2
1.4	1.0 | 1.2 | 1.4	3.4	2.3 | 2.9 | 3.4	5.4	3.7 | 4.6 | 5.4
1.6	1.1 | 1.4 | 1.6	3.6	2.5 | 3.0 | 3.6	5.6	3.8 | 4.7 | 5.6
1.8	1.2 | 1.5 | 1.8	3.8	2.6 | 3.2 | 3.8	5.8	4.0 | 4.9 | 5.8
2.0	1.4 | 1.7 | 2.0	4.0	2.7 | 3.4 | 4.0	6.0	4.1 | 5.1 | 6.0

4.2 Platting and Site Plan Review

Land development that meets the land disturbance criteria of this memorandum must address storm water runoff quality through the use of STFs. STFs shall be provided for in the drainage plan for any subdivision plat, annexation plat, development agreement, subdivision agreement or other local development plan.

Implementation Schedule

Each Nebraska H2O partner will adopt a post-construction stormwater management program based on the guidance in this memorandum. Each community must consider local conditions, criteria, and procedures that are compatible or conflict with these recommendations and advance the final post-construction stormwater management program for local adoption. Each community will implement their program independently and under their own schedule; however, the implementation schedule for the post-construction stormwater program for Nebraska H2O partners should not exceed the following:

January 1, 2016: Local MS4 shall begin or continue a public involvement process with local leaders, engineers, the development community and the general public that will lead to adoption of the post construction stormwater management program no later than January 1, 2017.

January 1, 2017: For all developments that have not had a preliminary plat approved, the post-construction stormwater management plan MAY BE required to be satisfied. The MS4 MAY elect to require minimum stormwater treatment practices for replats that significantly increase the amount of impervious area in a preliminarily platted subdivision previously approved by this date. During this period, the municipality shall make known to the owners of all preliminarily platted subdivision that implementation of stormwater treatment controls SHALL BE required if a replat is January 1, 2019 or later The method of notification will be left up to the individual communities and make take the form of a Public Notice.

January 1, 2019: For all developments that have not had a preliminary plat approved, the post-construction stormwater management plan SHALL BE required to be satisfied. The MS4 SHALL require minimum stormwater treatment practices for all replats and modifications of preliminary platted subdivisions.

Procedures

Platting

For major subdivision applications drainage and post-construction shall be discussed at the pre-application conference. This would be followed by an initial review of the general design at the preliminary platting stage and detailed design carrying over into final design review.

The plat applicant shall identify, through the Subdivision Agreement or other City-approved means, whether post-construction stormwater management facilities will be (1) constructed by each lot owner on their own lot (Lot Level STFs); (2) constructed for the subdivision by the developer with reimbursement sought from individual lot builders (Neighborhood STFs); (3) mitigated off-site at regional facilities (Regional STFs), or (4) addressed by other means approved by the City. Any other conditions agreed to between the two parties, including inspections, maintenance, and funding of maintenance shall be included in that agreement.

Building Permits

When seeking a building permit, the City will need to investigate how drainage and post-construction stormwater management is being handled. If Lot Level STFs are required per the Subdivision Agreement or

other agreement, then the lot builder will need to develop and have approved a drainage study, post-construction stormwater management plan, and maintenance agreement. A maintenance agreement for an individual lot shall include provisions for maintenance that shall be binding on all subsequent owners.

Submittals

Post Construction Stormwater Management Plan (PCSMP) Submittal

The PCSMP submittal will include the following components:

Plans

Plans showing topographic survey information along with proposed, grading, stormwater infrastructure (including STFs), pavement, and structures shall accompany any PCSMP submittal. Specifically, plans shall include the following information:

- Site topography including existing contours, property lines and easements, utilities, and site features such as existing water bodies, trees and shrubs, pavement and other structures
- Proposed contours
- Proposed inlets, storm sewer, culverts, and drainageways
- Proposed STFs and/or detention facilities
- Proposed roadways, parking, building footprints, and other structures

A table shall be provided in construction drawings that include, for each STF; (1) a location identifier, (2) the type of STF, (3) the location for each STF in latitude/longitude format, (4) the drainage area, and (5) the water quality volume/water quality volume discharge rate. The designer shall differentiate between the amount required by design and the amount that will be provided. Any discrepancies should be discussed with and approved by the City. The information shall be provided on drawings in a format that is consistent with the following:

STF Identification Number	STF Type	STF Location (Lat/Long)	Drainage Area (Acres)	Design WQCV (cf) or Q_{WQ} (cfs)	WQCV (cf) or Q_{WQ} (cfs) Provided

Preliminary submittals required by the City will include preliminary information. Final plans shall be representative of the intended construction bid package.

Calculations

All calculations for water quality volume and water quality volume discharge rate shall be submitted to the City as part of the site development drainage study. Calculations shall be completed as described herein for the appropriate STFs. Design criteria specific to the various STFs shall also be shown in the drainage study (i.e. calculations for drain down and infiltration).

When combining stormwater detention with STFs, the designer shall provide calculations that address both water quality volume and stormwater detention requirements using methodology approved by the community.

STFs shall be clearly shown on the drainage map along with other stormwater infrastructure and drainage basin boundaries.

Certification of Permanent STFs

Upon completion of a project the City shall be provided a written certification, by qualified personnel, stating that the completed project is in compliance with the approved Final Drainage Plan. Qualified personnel shall be a professional civil engineer licensed in the State of Nebraska or person(s) under the direct supervision of a professional engineer licensed in the State of Nebraska.

For commercial and industrial construction, certification will be required before a Certificate of Occupancy is granted (unless authorized by the community). All applicants shall submit "as built" plans certified by a professional engineer licensed in the State of Nebraska once final construction is completed. A final inspection by the City of all post-construction STFs shall be required before a Certificate of Occupancy will be issued or any public infrastructure is accepted.

Ongoing Inspection and Maintenance of STFs

A maintenance agreement will be required by the developer or builder for proposed STFs. The maintenance agreement shall include provisions that outline regular maintenance activity, and a schedule of periodic inspections by the Owner or Designees. Inspection frequency shall be consistent with the design criteria manual used and generally includes quarterly inspections during the first year of establishment following construction and annually thereafter.

The Owner or Designees providing routine inspections shall document all inspections and maintenance and repair needs to ensure compliance with the requirements of the agreement and the plan. The agreement shall allow access to City personnel for inspection and maintenance should the owner default in their responsibilities with the intent to invoice the owner for said work, if needed. Information about inspections and maintenance shall be provided by the owner to the City upon request.

<u>PCSMP Submittal Checklist</u>

A PCSMP checklist shall be submitted with design plans and be recorded by the City with the project record. The PCSMP checklist provided in Appendix A of this document may be used for reference by communities, developers, designers, and builders.

Off-Site Stormwater Mitigation

In some cases it may not be practicable to provide the required treatment within project limits due to various constraints such as site limitations, costs, or other obstacles. If shown by the owner that it is not practicable, off-site mitigation may be allowed at the discretion of the City.

Off site mitigation may be provided by a private land owner in a City-approved stormwater treatment facility or within a City-approved publicly owned stormwater treatment facility provided the proposed mitigation location meets the following minimum criteria;

- A drainage study confirms that the proposed mitigation location provides excess stormwater treatment that is not required to provide treatment for the drainage area.
- The excess treatment capacity in the proposed mitigation location is not already providing mitigation of required stormwater treatment for another development or redevelopment project.
- The owner of the proposed mitigation location maintains or enters into a maintenance agreement that shall be binding on all subsequent owners and includes all required inspection and maintenance requirements for stormwater treatment practices.

Off site mitigation should take place in accordance with the rules and conditions of each individual community. Each community will need to be able to provide the appropriate documentation for tracking all water quality debits and credits for such facilities in the event of an audit. Fees shall be established by the entity funding the stormwater treatment facility.

4.3 Maintenance of Controls

STFs located on private property shall be owned and operated by the owner(s) of the property on which the STF is located; unless the City agrees in writing that a person or entity other than the owner shall own or operate such STF. As a condition of approval of the STF, the owner shall also maintain the STF in perpetuity to its design capacity unless or until the City shall relieve the property owner of that responsibility in writing. The obligation to maintain the STF shall have been memorialized on a subdivision plat, annexation plat, development agreement, subdivision agreement or other form acceptable to the City and recorded by the City with the project records.

The City shall continue to maintain public storm sewer infrastructure including public STFs. Each homeowners association of a subdivision or individual lot owner shall maintain post-construction STFs. When public infrastructure improvements are constructed by the City, such as with the widening of a major arterial or other public improvement, the City shall take responsibility for maintenance of the STF unless otherwise specified in a maintenance agreement.

5.0 Design Guidance

STFs shall be designed using an approved design guidance manual that provides minimum design criteria and considerations. A selection of regional design guides are recommended for design within Nebraska H_2O communities. The most recent versions of the following design guides and manuals are approved for general use in the design of STFs:

- City of Omaha, *"Omaha Regional Stormwater Design Manual – Chapter 8: Stormwater Best Management Practices"*
- City of Lincoln, *"Drainage Criteria Manual - Chapter 8: Stormwater Best Management Practices"*
- NDOR, *"Drainage and Erosion Control Manual – Chapter 3: Stormwater Treatment within MS4 Communities"*
- Urban Drainage and Flood Control District (UDFCD), *"Urban Storm Drainage Criteria Manual, Volume 3: Best Management Practices"*

The designer is encouraged to adopt one design guide/manual for use on a project to the extent practicable. Other approved design guides and manuals may be used if design criteria for the desired STF are not provided in the primary design guide/manual. Any variances from these manuals will require approval of the City Engineer or their Designee. The community may evaluate the suitability of other types of STFs not referenced in the approved design guides and manuals on a case-by-case basis.

The designer shall discuss the use of the alternative design guidance manuals prior to starting design along with any variance in STF design. The designer shall also discuss other requirements for stormwater management within the community including the potential need for stormwater detention. Where one manual conflicts with another, the Engineer shall use sound, cost-effective design practices to resolve the issue. The following minimum design standards are provided to help resolve some conflicts identified.

Stormwater Treatment Facility Selection

Each design guidance manual includes a unique selection of STFs and what is included in one may not be included in another. Furthermore, two manuals may use different names for an STF with the same or similar function. The function, criteria and considerations of a specific STF is what shall be used to determine its use by a design engineer. Table 3 provides a general comparison of the types of STFs included in the approved design guidance manuals.

Table 3. STF Design Guidance for Various Regulatory Agencies

STF Type	Omaha	Lincoln	NDOR	UDFCD
Vegetated Filter Strip	X		X	X
Grass Swale	X		X	X
Infiltration Trench			X	
Infiltration Basin			X	
Bioretention Basin	X	X	X	X
Media Filter			X	
Sand Filter				X
Extended Dry Detention	X	X	X	X
Wet Detention Ponds	X	X	X	X
Stormwater Wetland	X	X	X	X
Underground Detention		X		X
Pervious Pavement	X	X	X	X
Proprietary Structural Treatment Controls	X		X	X
Green Roofs	X	X		X
Soil Conditioning	X			

All design guidance manuals include criteria and considerations for STF selection and should be used for this purpose. The design criteria within these guides shall be adhered to unless the design engineer demonstrates to the City why the criteria do not apply. Stormwater STF suitability will depend on number of factors including, but not limited to, the following:

- Available Space
- Property Access
- Site Topography
- Drainage Basin Size
- Infiltration Rates
- Depth to Groundwater/Bedrock
- Capital Costs/Maintenance

Community Preferences

Each community reserves the right to approve or reject certain STFs based on preferences and/or suitability for their community. Furthermore, certain communities may have regional STFs that they would prefer to use over on-site STFs. It is suggested that the designer discuss these preferences with the community during the pre-application phase of platting or at the beginning of design when considering building on an individual lot.

Collectively, Nebraska H_2O recommends the following preferences and exclusions from the approved manuals for consideration in your design:

Infiltration Rates

Minimum infiltration rate shall be 0.5 in/hr

Maximum infiltration rate shall be 12 in/hr

Infiltration Cells

Infiltration cells should incorporate conditioned soils to reduce the quantity of select material needed to provide treatment in a bioretention garden/basin. This method is described in the Omaha Regional Stormwater Design Manual and NDOR Drainage and Erosion Control Manual.

Drain Time and Control Valves

A design drain time of 24 hours will be used for all STFs that use a water quality control volume to provide treatment and control of runoff. Control valves shall be placed in underdrains to allow for adjustments to the drain time as needed.

Cleanouts

Cleanouts shall be provided on all underdrains to assist with providing needed maintenance.

Pretreatment

Measures shall be incorporated that prevent sediment from depositing in STFs during and after construction. Pretreatment of stormwater runoff through barriers, grass buffers or forebays is recommended on all STFs.

Landscaping

The following resources have been provided to assist in the design of landscaping for a project. It is strongly suggested that a landscape architect or designer assist with plant selection and landscape design.

- UNL Extension, "Stormwater Management: Plant Selection for Rain Gardens in Nebraska" http://www.ianrpubs.unl.edu/epublic/live/g1759/build/g1759.pdf
- UNL Extension, "Nebraska Bioretention and Rain Garden Plants Guide" http://marketplace.unl.edu/extension/ec1261.html
- NDOR, "Plan for the Roadside Environment" http://www.transportation.nebraska.gov/environment/docs/road-env-plan-total.pdf
- NDOR, "Roadside Flowers and Grasses" http://www.transportation.nebraska.gov/environment/flowers.html
- NDOR, "Roadside Vegetation Establishment and Maintenance" http://www.transportation.nebraska.gov/environment/docs/veg-manual_2014.pdf
- "The Seed", A Publication of the Nebraska Statewide Arboretum, Fall 2008 http://arboretum.unl.edu/documents/The%20Seed%20Water%20in%20Landscape.pdf

These links may contain other references to sources that may be helpful in plant selection and suitability for use with STFs. Keep in mind regional difference in your selection of plants along with differences in soil, light, and moisture within the stormwater STF itself.

APPENDIX A

POST-CONSTRUCTION STORMWATER MANAGEMENT PLAN (PCSMP)

SUBMITTAL CHECKLIST

Post-Construction Stormwater Management Plan (PCSMP)
Submittal Checklist

Preliminary submittals required by the City will include preliminary information. Final submittals shall be representative of the intended construction bid package.

PROJECT NAME: _____

PLANS

- ☐ Site topography including existing contours, property lines and easements, utilities, and site features such as existing water bodies, trees and shrubs, pavement and other structures
- ☐ Proposed contours
- ☐ Proposed inlets, storm sewer, culverts, and drainageways
- ☐ Proposed STFs and/or detention facilities
- ☐ Proposed roadways, parking, building footprints, and other structures
- ☐ A table shall be provided in construction drawings that includes, for each Stormwater Treatment Facility (STF) The information shall be provided on drawings in a format that is consistent with the following:

STF Identification Number	STF Type	STF Location (Lat/Long)	Drainage Area (Acres)	Design WQCV (cf) or Q_{WQ} (cfs)	WQCV (cf) or Q_{WQ} (cfs) Provided

CALCULATIONS

- ☐ Water Quality Volume (WQCV) or Water Quality Volume Discharge Rate (Q_{WQ}) for each STF (To be included with a site design or subdivision drainage study)
- ☐ Drainage Study

AGREEMENTS

A maintenance agreement is required for neighborhood level and lot level STFs. If an agreement is made for mitigation off site or other agreements are made, make note and describe below

- ☐ Inspection and Maintenance Agreement
- ☐ Other Agreement

_____

CERTIFICATION OF PERMANENT STFs

Unless otherwise indicated by the City, a Hold on the Certificate of Occupancy will be placed on the project until the STF has been certified. If applicable, check “Hold” until certification is received. If not applicable, check N/A.

- ☐ Hold on C.O.
- ☐ N/A

Submitted upon completion of a project; a statement by a professional engineer licensed in the State of Nebraska or person(s) under the direct supervision of a professional engineer licensed in the State of Nebraska attesting that the completed project is in compliance with the approved Final Plan.

- ☐ Certification of Permanent STFs
- ☐ Record Drawings (if required by City)

_____

☐ Hold on C.O. Released (if applicable) Released By: _____