WELCOME

Culpepper Landing
Elmwood Landing
Stormwater Update

Agenda

- Why are we here? (Purpose of Meeting)
- Anatomy of a Storm (5 minutes)
- USFWS Dismal Swamp Refuge Update (25 minutes)
- US Army Corps of Engineers Update (10 minutes)
- City of Chesapeake Update (15 minutes)
- Resources to prepare
- Breakout for Questions and Answers @ various stations (separate stations for Refuge, Corps and City)

Hurricane Matthew Anatomy of a Flood

Excerpts from National Weather Service Presentations

City of Chesapeake

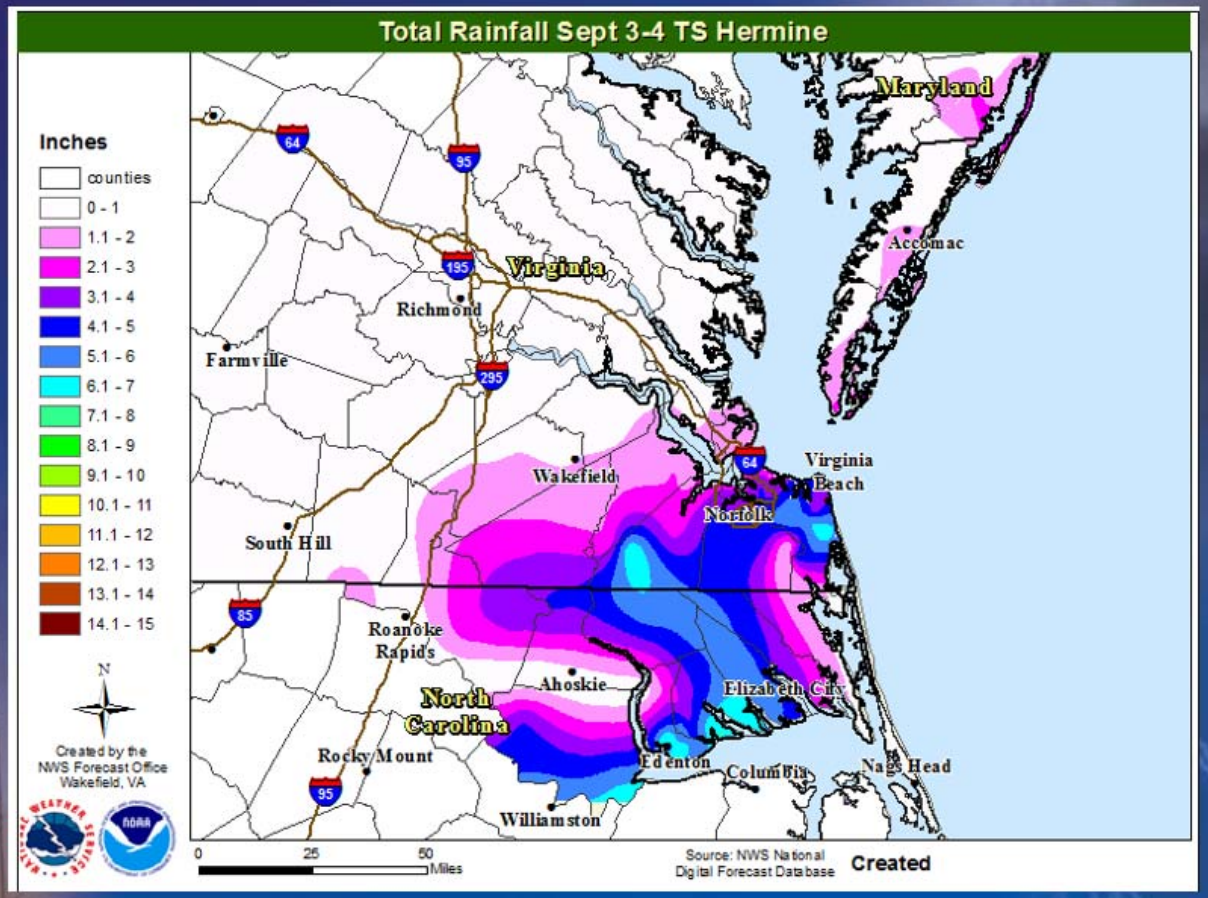
Citizen Information Meeting

July 27,2017

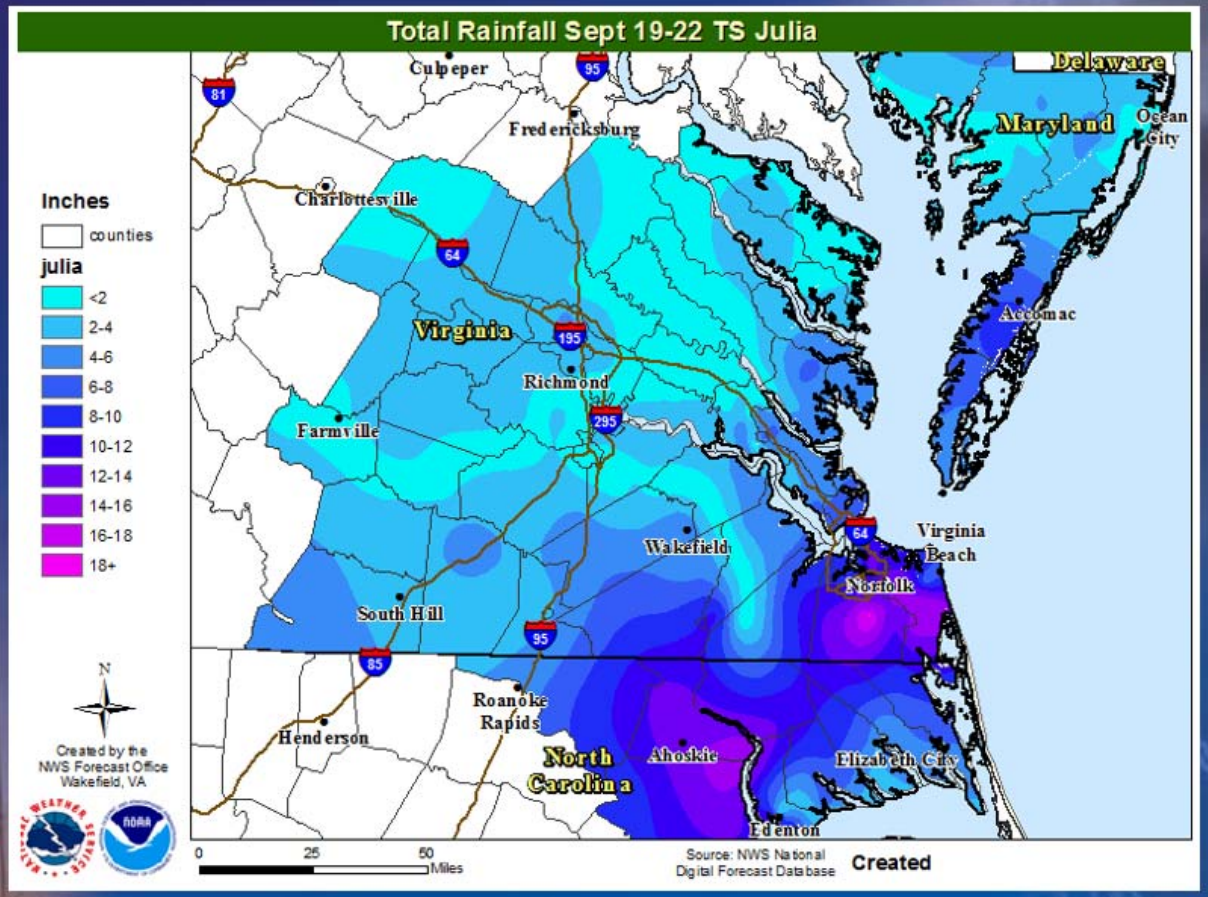
Salient Points

- Widespread Major Floods Rarely Result from a Single Heavy Rain Event
- Antecedent Moisture Conditions Play a Critical Role
- Heavy Rainfall in September Made Matthew's Flooding Possible
- Rainfall Pattern Resulted in Unusual Impacts
- *Looking at rainfall climatology (Average Recurrance Intervals) can help us understand the potential severity beforehand*

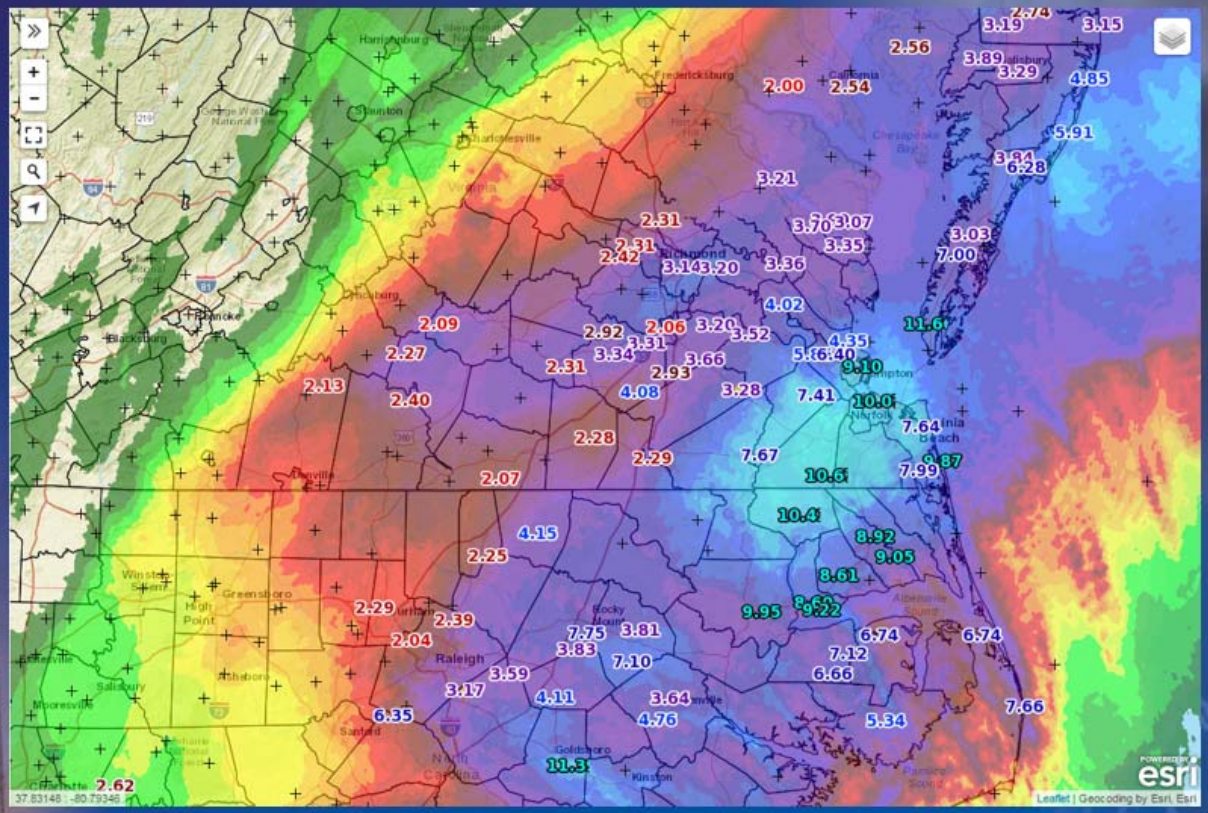
Rainfall from TS Hermine



Rainfall from remnants of TS Julia



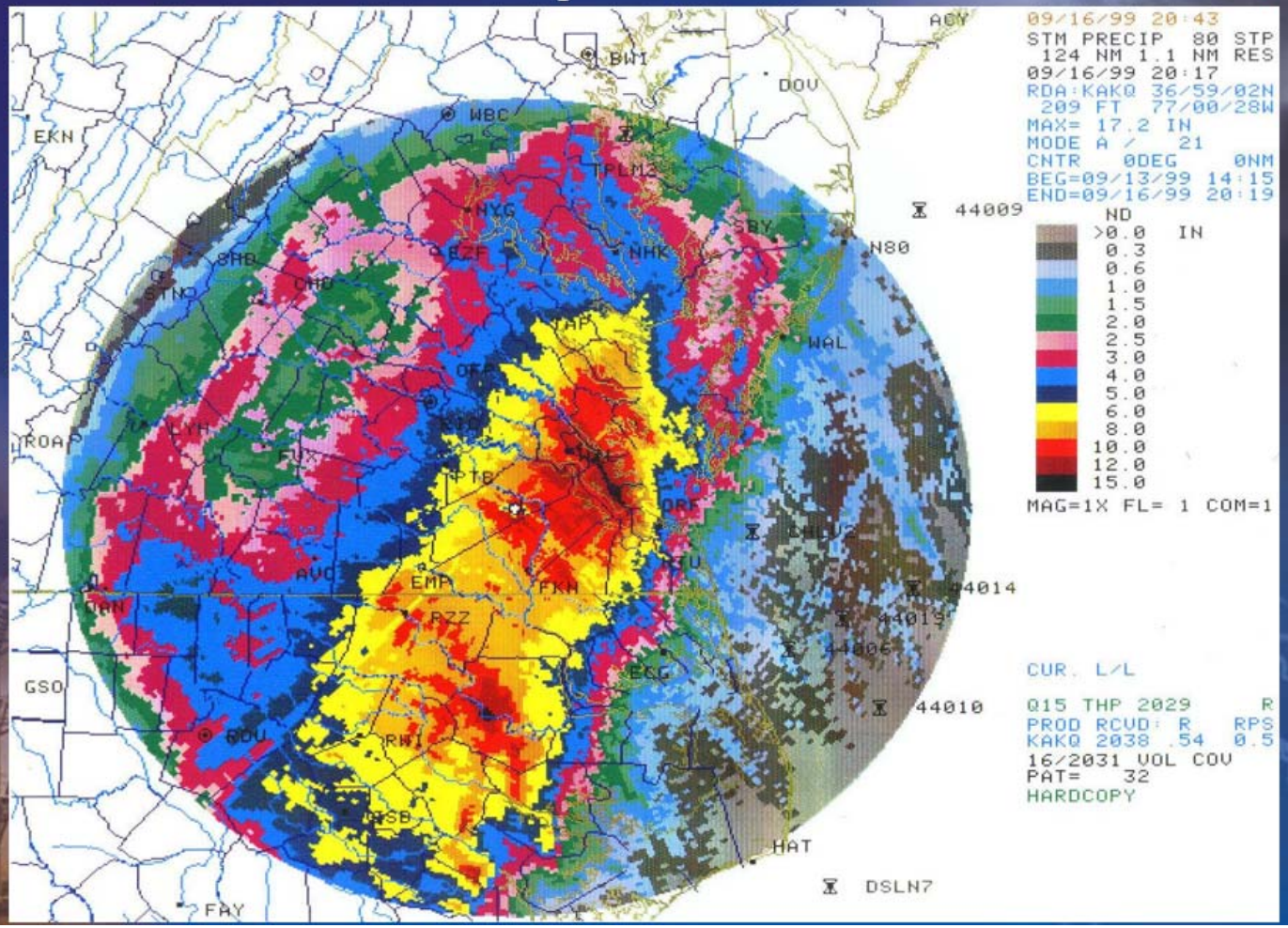
Rainfall from Hurricane Matthew



Selected Rainfall Totals from Sept. 2 – Oct. 10

Location	Amount	Rank	Period of Record
Edenton, NC	30.72”	1st	1896
Elizabeth City, NC	20.97”	1st	1948
Norfolk, VA	22.63”	2nd	1946
Suffolk, VA	24.09”	2nd	1945
Lewiston, NC	25.11”	2nd	1954

Rainfall from Hurricane Floyd 1999



How Historic Was This 30-45 day period?

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.415 (0.378-0.457)	0.481 (0.435-0.533)	0.534 (0.483-0.592)	0.623 (0.560-0.690)	0.701 (0.629-0.774)	0.776 (0.695-0.859)	0.842 (0.750-0.930)	0.905 (0.802-1.00)	0.977 (0.859-1.08)	1.05 (0.918-1.17)
10-min	0.662 (0.603-0.731)	0.769 (0.695-0.853)	0.855 (0.774-0.948)	0.996 (0.896-1.10)	1.12 (1.00-1.23)	1.24 (1.11-1.37)	1.34 (1.19-1.48)	1.43 (1.27-1.59)	1.55 (1.36-1.71)	1.66 (1.45-1.84)
15-min	0.828 (0.754-0.913)	0.966 (0.874-1.07)	1.08 (0.979-1.20)	1.26 (1.13-1.40)	1.42 (1.27-1.56)	1.57 (1.40-1.73)	1.69 (1.51-1.87)	1.81 (1.60-2.00)	1.94 (1.71-2.15)	2.08 (1.82-2.31)
30-min	1.14 (1.03-1.25)	1.34 (1.21-1.48)	1.54 (1.39-1.70)	1.83 (1.64-2.02)	2.10 (1.88-2.32)	2.36 (2.11-2.61)	2.59 (2.31-2.86)	2.82 (2.50-3.11)	3.09 (2.72-3.43)	3.37 (2.94-3.74)
60-min	1.42 (1.29-1.56)	1.68 (1.52-1.86)	1.97 (1.78-2.18)	2.38 (2.14-2.63)	2.79 (2.50-3.08)	3.20 (2.86-3.53)	3.57 (3.18-3.94)	3.95 (3.50-4.37)	4.44 (3.90-4.92)	4.92 (4.29-5.46)
2-hr	1.68 (1.52-1.86)	1.99 (1.79-2.21)	2.38 (2.14-2.64)	2.92 (2.62-3.23)	3.49 (3.12-3.86)	4.07 (3.61-4.50)	4.61 (4.07-5.10)	5.19 (4.56-5.74)	5.94 (5.17-6.58)	6.69 (5.78-7.41)
3-hr	1.81 (1.63-2.02)	2.14 (1.92-2.40)	2.56 (2.30-2.87)	3.16 (2.83-3.53)	3.82 (3.40-4.26)	4.50 (3.98-5.00)	5.15 (4.53-5.72)	5.86 (5.11-6.50)	6.80 (5.87-7.54)	7.76 (6.64-8.61)
6-hr	2.19 (1.97-2.45)	2.60 (2.32-2.92)	3.11 (2.78-3.50)	3.84 (3.42-4.31)	4.66 (4.13-5.21)	5.51 (4.85-6.14)	6.34 (5.54-7.06)	7.25 (6.28-8.06)	8.46 (7.25-9.41)	9.72 (8.24-10.8)
12-hr	2.59 (2.32-2.92)	3.06 (2.73-3.47)	3.69 (3.28-4.16)	4.57 (4.05-5.16)	5.60 (4.92-6.29)	6.67 (5.83-7.48)	7.73 (6.70-8.66)	8.91 (7.64-9.97)	10.5 (8.90-11.8)	12.2 (10.2-13.6)
24-hr	3.02 (2.77-3.31)	3.67 (3.37-4.03)	4.74 (4.34-5.21)	5.64 (5.15-6.18)	6.98 (6.33-7.63)	8.14 (7.32-8.89)	9.41 (8.38-10.3)	10.8 (9.54-11.8)	12.9 (11.2-14.1)	14.7 (12.6-16.2)
2-day	3.48 (3.19-3.83)	4.22 (3.87-4.64)	5.42 (4.97-5.96)	6.45 (5.89-7.08)	8.00 (7.24-8.76)	9.35 (8.40-10.2)	10.8 (9.64-11.9)	12.5 (11.0-13.7)	15.0 (13.0-16.5)	17.2 (14.6-19.0)
3-day	3.68 (3.38-4.03)	4.46 (4.10-4.89)	5.70 (5.24-6.25)	6.76 (6.18-7.39)	8.32 (7.55-9.09)	9.66 (8.70-10.5)	11.1 (9.93-12.1)	12.8 (11.2-13.9)	15.2 (13.2-16.7)	17.4 (14.8-19.1)
4-day	3.88 (3.58-4.24)	4.70 (4.33-5.14)	5.99 (5.51-6.54)	7.07 (6.48-7.70)	8.64 (7.86-9.41)	9.97 (9.01-10.9)	11.4 (10.2-12.4)	13.0 (11.5-14.2)	15.3 (13.4-16.8)	17.5 (15.1-19.3)
7-day	4.54 (4.20-4.94)	5.48 (5.07-5.96)	6.89 (6.36-7.48)	8.06 (7.42-8.74)	9.75 (8.93-10.6)	11.2 (10.2-12.1)	12.7 (11.4-13.8)	14.4 (12.8-15.6)	16.7 (14.7-18.3)	18.7 (16.3-20.5)
10-day	5.11 (4.76-5.51)	6.13 (5.71-6.61)	7.60 (7.06-8.19)	8.81 (8.17-9.49)	10.6 (9.74-11.4)	12.0 (11.0-12.9)	[illegible]			
20-day	6.93 (6.48-7.43)	8.25 (7.71-8.86)	10.0 (9.36-10.7)	11.5 (10.7-12.3)	13.5 (12.5-14.5)	15.2 (14.0-16.3)	[illegible]			
30-day	8.55 [illegible]	10.2 [illegible]	12.2 [illegible]	13.8 [illegible]	16.1 [illegible]	17.9 [illegible]	[illegible]			
45-day	[illegible] (9.91-11.3)	[illegible] (11.7-13.3)	[illegible] (14.0-15.9)	[illegible] (15.7-17.9)	[illegible] (18.2-20.8)	[illegible] (20.2-23.2)	[illegible]			
60-day	12.6 (11.9-13.4)	14.9 (14.0-15.8)	17.5 (16.5-18.6)	19.6 (18.4-20.8)	22.4 (21.0-23.8)	24.6 (23.0-26.2)	26.9 (25.0-28.6)	29.1 (26.9-31.1)	32.1 (29.5-34.4)	34.4 (31.4-37.1)

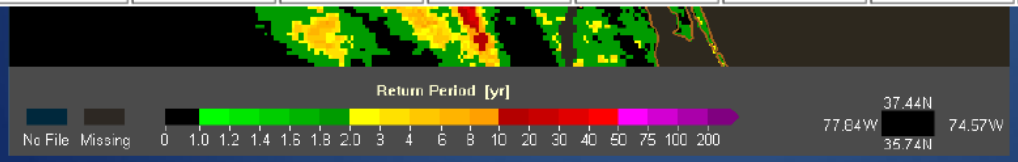
24.1 (21.9-26.0)	**26.1** (23.6-28.3)
29.5 (26.8-31.7)	**32.1** (28.9-34.6)

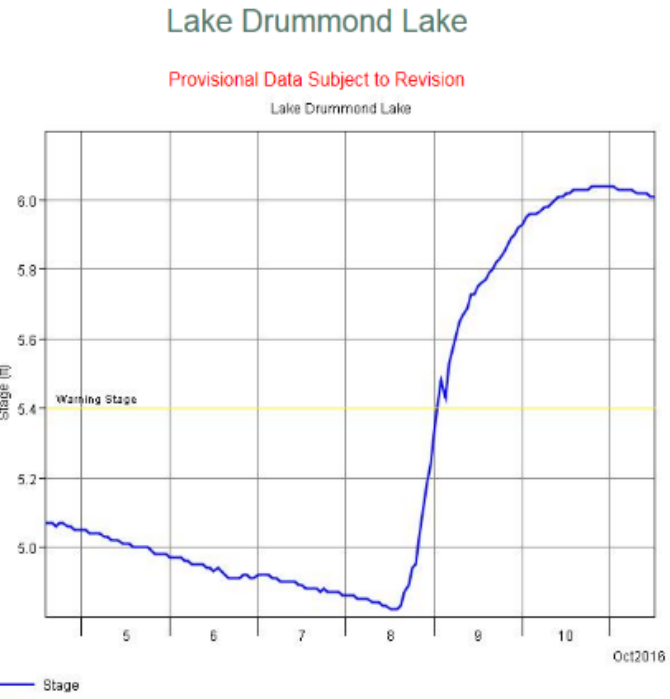
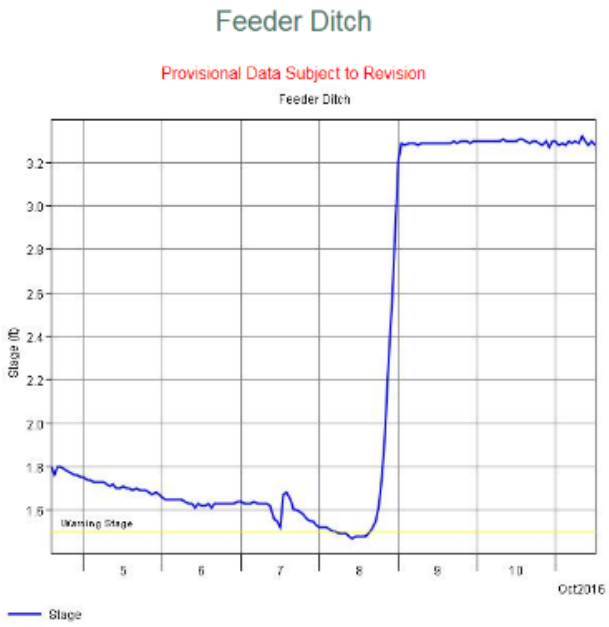
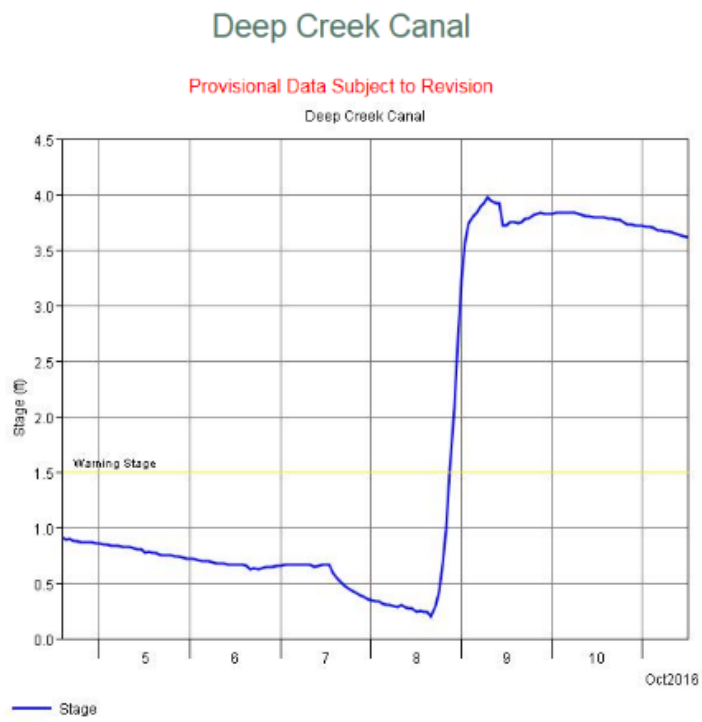
3 hour observed return period ending 11 PM

Precipitation Accumulation Return Period Valid: 10/09/2016 03:00:00 UTC

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.415** (0.378-0.457)	**0.483** (0.438-0.535)	**0.541** (0.490-0.599)	**0.627** (0.565-0.694)	**0.705** (0.634-0.779)	**0.780** (0.699-0.862)	**0.845** (0.754-0.934)	**0.908** (0.806-1.00)	**0.982** (0.864-1.09)	**1.06** (0.922-1.17)
10-min	**0.663** (0.603-0.730)	**0.773** (0.700-0.856)	**0.866** (0.785-0.959)	**1.00** (0.903-1.11)	**1.12** (1.01-1.24)	**1.24** (1.11-1.37)	**1.34** (1.20-1.48)	**1.44** (1.28-1.59)	**1.55** (1.37-1.72)	**1.67** (1.45-1.85)
15-min	**0.828** (0.754-0.913)	**0.972** (0.881-1.08)	**1.10** (0.993-1.21)	**1.27** (1.14-1.40)	**1.43** (1.28-1.57)	**1.57** (1.41-1.74)	**1.70** (1.51-1.88)	**1.82** (1.61-2.01)	**1.95** (1.72-2.17)	**2.09** (1.82-2.32)
30-min	**1.14** (1.03-1.25)	**1.34** (1.22-1.49)	**1.56** (1.41-1.72)	**1.84** (1.66-2.03)	**2.11** (1.90-2.33)	**2.37** (2.12-2.62)	**2.60** (2.32-2.87)	**2.83** (2.51-3.13)	**3.11** (2.74-3.45)	**3.38** (2.95-3.76)
60-min	**1.42** (1.29-1.56)	**1.68** (1.53-1.87)	**2.00** (1.81-2.21)	**2.39** (2.16-2.65)	**2.81** (2.53-3.10)	**3.21** (2.88-3.55)	**3.58** (3.19-3.96)	**3.96** (3.52-4.38)	**4.46** (3.93-4.95)	**4.94** (4.31-5.49)
2-hr	**1.68** (1.53-1.86)	**2.01** (1.81-2.23)	**2.42** (2.18-2.68)	**2.95** (2.65-3.26)	**3.53** (3.16-3.90)	**4.10** (3.65-4.53)	**4.65** (4.11-5.13)	**5.23** (4.60-5.78)	**6.00** (5.23-6.63)	**6.75** (5.83-7.47)
3-hr	**1.82** (1.64-2.03)	**2.17** (1.94-2.42)	**2.62** (2.35-2.93)	**3.21** (2.87-3.58)	**3.88** (3.45-4.32)	**4.55** (4.03-5.06)	**5.21** (4.58-5.78)	**5.93** (5.17-6.57)	**6.89** (5.95-7.64)	**7.85** (6.71-8.71)
6-hr	**2.22** (1.99-2.49)	**2.64** (2.36-2.97)	**3.20** (2.86-3.59)	**3.92** (3.48-4.40)	**4.76** (4.21-5.32)	**5.61** (4.93-6.26)	**6.45** (5.63-7.19)	**7.38** (6.38-8.21)	**8.64** (7.39-9.62)	**9.92** (8.38-11.0)



This information prompted the issuance of a Flash Flood Emergency

Dismal Swamp Water Levels