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April 3rd, 2018

Kevin Campbell
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Proposed Change of Language for Hillside Ordinance to allow larger homes on lots.

As requested at our meeting I am providing you a proposal for an ordinance change that will allow for larger homes in the hillside areas. This proposal will consider the increase of runoff due to the additional impervious surface area when this area exceed 5,000 sq. ft. There are two items that need to be considered in the design, first the size of the required retention basin and second the allowable size of the orifice plate or discharge pipe. These are considered as follows:

Retention Basin Sizing

I propose that his size be considered using the following rational method equation:

$$V = [CiA-0.2A]T$$

V = Required Basin Volume (cubic feet)
C = Difference in Runoff Coefficient (0.90 – 0.15) = 0.75
i = Rainfall Intensity (in/hour)
A = Additional Impervious Surface Area (acres)
0.2 = Allowable outflow (cfs)
T = Peak time of retention (sec.)

As you can see from this equation the two variables are the Rainfall Intensity and the Peak Time. If you would be willing to standardize these two variables it would certainly simplify this equation for all development. I have attached a copy of the NOAA Rainfall Calculation for The Rigby Court Property. As you can see the Rainfall intensity for a 25 year/ one hour storm is 1.31 in/hr. I checked this same number at the intersection of Main and Parrish Lane and it was 1.25 in/hr. I don't think you will find a significant change is this number across the city and I think you would be safe to assume an average value of 1.30 in/hr. for the city.

The peak time of the storm would be affected by several variables such as slope, configuration, size and vegetation. I have attached a spreadsheet which shows the calculation for Mr. Hales plan. This shows that the peak time would be at 60 mins. It is my opinion that you will not see a significant change in this peak time for most of the designs you receive for larger lots and you could safely assume that 60 mins is the peak time for all basins.

Based on these assumptions the above equation can be simplified and converted to more usable terms as follows:

V = [(0.75)(1.30)(A) – (0.2)(A)](3600) = 2790A With A in Acres

It would probably be easier if A was converted to Square Feet. Therefore the equation would be

V = 2790A/43560 = 0.064A

This is the Equation I would recommend using for all area above the 5,000 square feet.

Orifice Plate Sizing

I recommend using the following equation for the sizing of the orifice plate.

Q= (K)(D)*2(H)*1/2 HEC-22 Equation 8-18

Q = Flow Rate 0.2(A) (cfs)
K = Orifice Coefficient (3.78)
D = Orifice Diameter (ft.)
H = Head at Orifice Plate (ft.)

In terms of the Diameter this is as follows:

D= [(Q)/(K)(H)*1/2]*1/2

Inserting the know values and converting to more friendly terms this equation can be reduced as follows:

D = {[(0.2A/43560)/3.78H*1/2]*1/2}12 =

D = 0.0132(A/H*1/2)*1/2

D = Plate Diameter (inches)
A = Area (square feet)
H = Head at orifice Plat (ft.)

Based on this information I propose the following be added to the ordinance:

"In the event the impervious surface exceeds 5,000 square feet the applicant shall provide on site retention for the additional area according to the following equation

V = 0.064 A
V = Retention Volume (cubic feet)
A = Additional impervious area over 5,000 square feet (square feet)

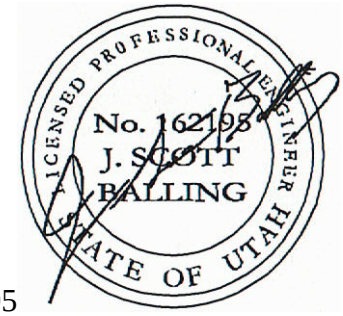
The allowable outflow orifice plate should be sized according to the following equation

D = 0.0132(A/H*1/2)*1/2

D = Plate Diameter (inches)
A = Area (square feet)
H = Head at orifice Plat (ft.)
In no event shall the impervious surface exceed 40% of the total lot area."

Please review the above information and we can discuss this at our meeting next Monday.

Sincerely,



J. Scott Balling, P.L.S. No. 162195

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NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: UT

Data description

Data type: Precipitation depth **Units:** English **Time series type:** Partial duration

Select location

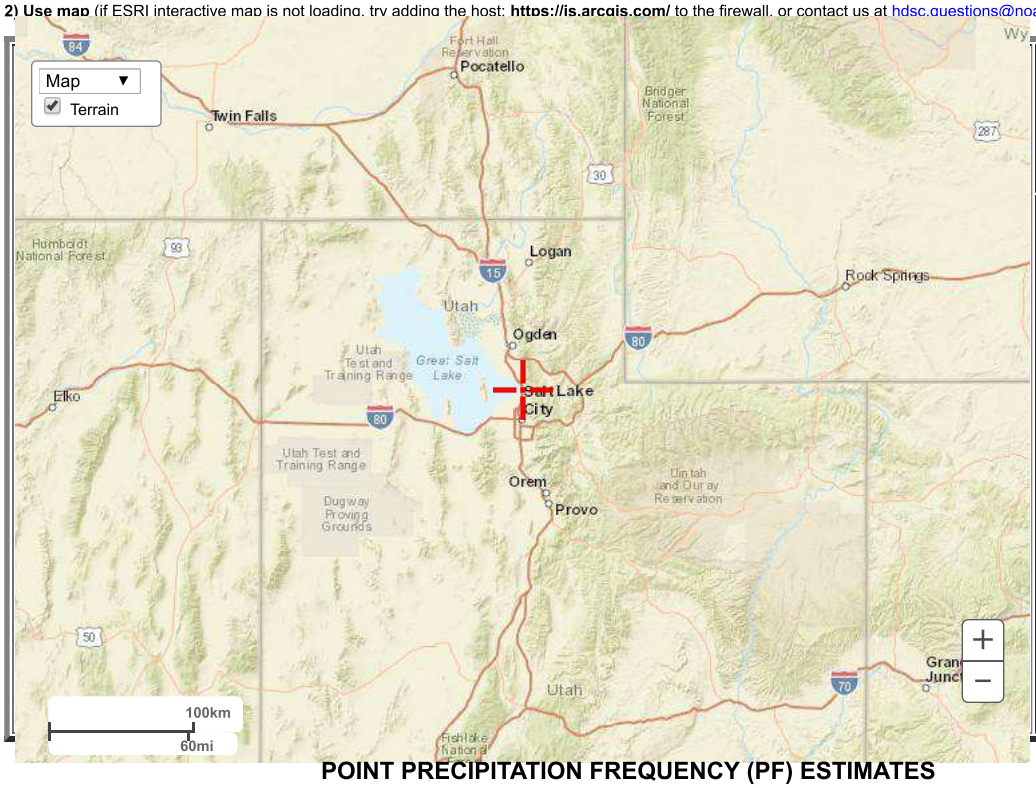
1) Manually:

a) By location (decimal degrees, use "-" for S and W): Latitude: 40.942950 Longitude: -111.87873 Submit

b) By station (list of UT stations): Select station

c) By address Search

2) Use map (if ESRI interactive map is not loading, try adding the host: **https://is.arcgis.com/** to the firewall, or contact us at hdsc.questions@noaa.gov):



a) Select location
Move crosshair or double click

b) Click on station icon
Show stations on map

Location information:
Name: Centerville, Utah, USA*
Latitude: 40.9430°
Longitude: -111.8787°
Elevation: 4351.19 ft **

* Source: ESRI Maps
** Source: USGS

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 1, Version 5

PF tabular PF graphical Supplementary information Print page

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	**0.148** (0.128-0.176)	**0.188** (0.162-0.223)	**0.255** (0.219-0.302)	**0.316** (0.269-0.376)	**0.415** (0.344-0.497)	**0.508** (0.409-0.614)	**0.616** (0.480-0.752)	**0.746** (0.559-0.928)	**0.956** (0.678-1.22)	**1.15** (0.779-1.51)
10-min	**0.226** (0.195-0.268)	**0.286** (0.247-0.339)	**0.389** (0.333-0.460)	**0.482** (0.409-0.572)	**0.632** (0.524-0.757)	**0.773** (0.622-0.934)	**0.938** (0.731-1.14)	**1.13** (0.850-1.41)	**1.45** (1.03-1.86)	**1.76** (1.19-2.31)
15-min	**0.280** (0.241-0.332)	**0.354** (0.306-0.421)	**0.482** (0.413-0.570)	**0.596** (0.507-0.709)	**0.783** (0.649-0.938)	**0.958** (0.771-1.16)	**1.16** (0.906-1.42)	**1.41** (1.05-1.75)	**1.80** (1.28-2.31)	**2.18** (1.47-2.86)
30-min	**0.377** (0.325-0.447)	**0.477** (0.412-0.566)	**0.648** (0.557-0.768)	**0.803** (0.682-0.954)	**1.06** (0.874-1.26)	**1.29** (1.04-1.56)	**1.57** (1.22-1.91)	**1.89** (1.42-2.36)	**2.43** (1.72-3.11)	**2.93** (1.98-3.85)
60-min	**0.467** (0.402-0.553)	**0.590** (0.510-0.701)	**0.802** (0.689-0.950)	**0.994** (0.844-1.18)	**1.31** (1.08-1.56)	**1.60** (1.29-1.93)	**1.94** (1.51-2.36)	**2.34** (1.76-2.92)	**3.00** (2.13-3.85)	**3.63** (2.45-4.76)
2-hr	**0.617** (0.543-0.711)	**0.770** (0.679-0.892)	**0.993** (0.869-1.15)	**1.21** (1.04-1.40)	**1.55** (1.31-1.82)	**1.87** (1.54-2.21)	**2.25** (1.80-2.69)	**2.70** (2.07-3.30)	**3.43** (2.49-4.30)	**4.11** (2.85-5.29)
3-hr	**0.717** (0.641-0.815)	**0.885** (0.792-1.01)	**1.10** (0.978-1.26)	**1.31** (1.15-1.49)	**1.65** (1.42-1.90)	**1.96** (1.65-2.27)	**2.33** (1.92-2.75)	**2.78** (2.21-3.33)	**3.51** (2.66-4.32)	**4.18** (3.05-5.34)
6-hr	**0.945** (0.864-1.04)	**1.16** (1.06-1.28)	**1.39** (1.26-1.54)	**1.60** (1.45-1.78)	**1.93** (1.72-2.15)	**2.20** (1.93-2.47)	**2.53** (2.19-2.88)	**2.93** (2.47-3.38)	**3.66** (2.98-4.35)	**4.31** (3.42-5.39)
12-hr	**1.21**	**1.48**	**1.78**	**2.05**	**2.45**	**2.77**	**3.13**	**3.51**	**4.16**	**4.71**

	(1.10-1.34)	(1.35-1.64)	(1.62-1.97)	(1.85-2.27)	(2.18-2.73)	(2.44-3.12)	(2.70-3.56)	(2.97-4.05)	(3.42-4.91)	(3.77-5.66)
24-hr	**1.57** (1.44-1.70)	**1.92** (1.77-2.09)	**2.29** (2.10-2.50)	**2.61** (2.39-2.84)	**3.04** (2.78-3.31)	**3.38** (3.07-3.68)	**3.72** (3.37-4.06)	**4.07** (3.67-4.45)	**4.55** (4.07-5.00)	**4.92** (4.36-5.72)
2-day	**1.85** (1.71-2.01)	**2.27** (2.09-2.47)	**2.72** (2.50-2.96)	**3.09** (2.84-3.37)	**3.60** (3.30-3.92)	**3.99** (3.64-4.35)	**4.39** (3.98-4.80)	**4.81** (4.33-5.26)	**5.35** (4.78-5.89)	**5.77** (5.12-6.38)
3-day	**2.06** (1.90-2.25)	**2.53** (2.33-2.77)	**3.05** (2.80-3.33)	**3.48** (3.19-3.80)	**4.07** (3.72-4.45)	**4.53** (4.12-4.96)	**5.01** (4.52-5.49)	**5.50** (4.93-6.04)	**6.16** (5.47-6.79)	**6.67** (5.88-7.39)
4-day	**2.28** (2.09-2.49)	**2.80** (2.57-3.06)	**3.38** (3.10-3.71)	**3.87** (3.54-4.24)	**4.54** (4.14-4.97)	**5.07** (4.60-5.56)	**5.62** (5.06-6.18)	**6.19** (5.53-6.81)	**6.96** (6.16-7.70)	**7.56** (6.64-8.40)
7-day	**2.82** (2.60-3.06)	**3.47** (3.21-3.78)	**4.19** (3.86-4.56)	**4.79** (4.40-5.21)	**5.61** (5.13-6.11)	**6.26** (5.69-6.83)	**6.93** (6.26-7.58)	**7.61** (6.83-8.35)	**8.54** (7.59-9.42)	**9.26** (8.16-10.3)
10-day	**3.23** (2.98-3.50)	**3.98** (3.67-4.31)	**4.76** (4.39-5.16)	**5.40** (4.97-5.85)	**6.25** (5.73-6.77)	**6.89** (6.28-7.47)	**7.53** (6.84-8.19)	**8.18** (7.38-8.91)	**9.02** (8.08-9.87)	**9.66** (8.60-10.6)
20-day	**4.34** (4.01-4.69)	**5.34** (4.94-5.78)	**6.35** (5.87-6.87)	**7.12** (6.58-7.71)	**8.12** (7.47-8.78)	**8.84** (8.12-9.57)	**9.56** (8.75-10.4)	**10.2** (9.34-11.1)	**11.1** (10.1-12.1)	**11.8** (10.6-12.9)
30-day	**5.38** (5.00-5.78)	**6.61** (6.14-7.11)	**7.80** (7.24-8.40)	**8.73** (8.09-9.40)	**9.93** (9.18-10.7)	**10.8** (9.97-11.7)	**11.7** (10.7-12.6)	**12.5** (11.4-13.5)	**13.5** (12.3-14.7)	**14.3** (12.9-15.6)
45-day	**6.76** (6.27-7.27)	**8.29** (7.69-8.94)	**9.77** (9.05-10.5)	**10.9** (10.1-11.8)	**12.5** (11.5-13.4)	**13.6** (12.5-14.7)	**14.7** (13.5-15.9)	**15.8** (14.4-17.1)	**17.2** (15.6-18.7)	**18.2** (16.4-19.9)
60-day	**8.01** (7.42-8.63)	**9.83** (9.11-10.6)	**11.6** (10.7-12.5)	**12.9** (12.0-13.9)	**14.7** (13.5-15.8)	**15.9** (14.7-17.2)	**17.1** (15.7-18.6)	**18.3** (16.7-19.9)	**19.8** (18.0-21.6)	**20.9** (18.9-22.9)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Estimates from the table in CSV format: Precipitation frequency estimates ▼ Submit

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Rigby Court Lot 4 by Scott Balling
Jennings Lane, Centerville 4/3/2018
25 year Storm Event

Area	0.30	acres
Coefficient of Runoff ©	0.75	
Outflow = 0.20cfs/ac	0.0593	cfs

Time (t) (Min)	Rainfall (inches)	Rainfall Intensity (in/hr)	Inflow Q=CiA (cfs)	Total Inflow (cu.ft.)	Outflow (cu.ft.)	Detention Volume (cu.ft.)
5	0.415	4.98	1.11	332	18	314
10	0.632	3.79	0.84	506	36	470
15	0.483	1.93	0.43	387	53	333
20	0.680	2.04	0.45	544	71	473
30	1.060	2.12	0.47	848	107	742
40	1.150	1.73	0.38	920	142	778
50	1.230	1.48	0.33	984	178	806
60	1.310	1.31	0.29	1,048	213	**835**
90	1.430	0.95	0.21	1,144	320	824
120	1.550	0.78	0.17	1,240	427	813

Required Volume = 9,200 cu. ft. (70 X44 X 3ft deep)

Required Volume = 142 cu.ft.