

2.3. STORM WATER DESIGN

2.3.1. GENERAL

All subdivisions and site developments shall be designed to accommodate rainfall in systems separate and independent from the sanitary sewer system. A flood control system shall be designed and approved as part of the construction plans. Flood water may be conveyed in approved drainage facilities which is defined to mean storm drain pipes, major washes, designated floodway easements, or dedicated city streets. Minor washes may also be considered approved drainage facilities if the discharge of storm water from a developed area does not exceed what the natural flow of the wash was prior to any development or if a dedicated drainage easement or its equivalent for the wash is provided.

2.3.2. STORM SYSTEM SIZING CRITERIA

The following criteria are used in determining and designing flood conveyance:

- A. Storm water runoff from the 10-year storm will be conveyed by approved drainage facilities such that all collectors and arterials shall maintain at least two 12-foot drivable lanes. All residential streets shall maintain at least one 12-foot drivable lane. When underground systems are provided, all waters from the 10-year flood shall be contained within the system and not include over-ground flows as a portion of the capacity.
- B. The 100-year storm will be conveyed within the limits of the street right-of-way or easements. All arterial streets must have a minimum 12-foot lane of travel.
- C. Culverts and bridges should be sized as follows:
 - 1. Arterial Streets – convey the 100-year flood.
 - 2. Collectors – convey the 25-year flood.
 - 3. All other streets – convey the 10-year flood.
- D. Any exceptions must be approved by the City Engineer.

2.3.3. PRECIPITATION

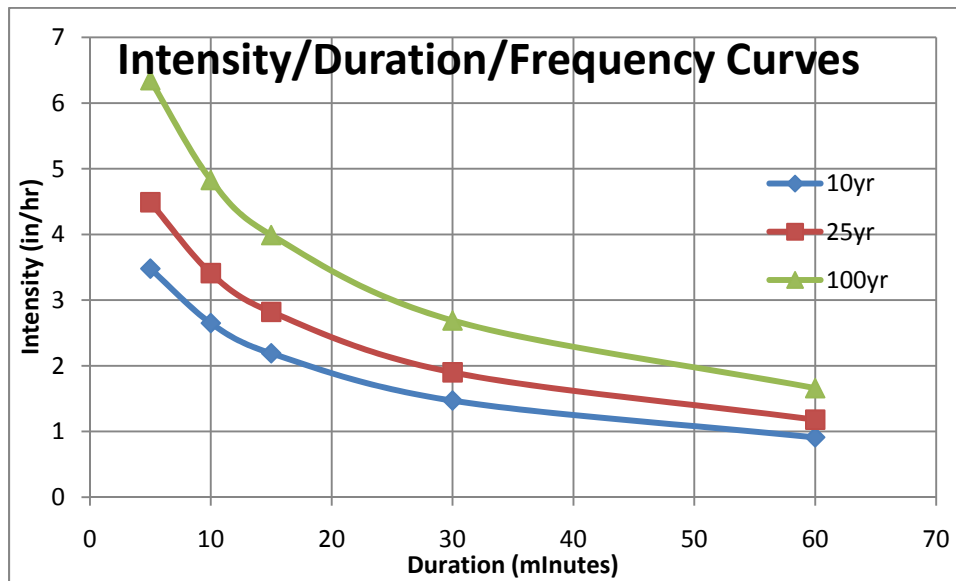
- A. All drainage studies shall use rainfall data published by the National Oceanic and Atmospheric Administration (NOAA) in the *NOAA Atlas 14, Precipitation – Frequency Atlas of the Western United States, Volume 1, Version 4.0* or any modifications of such data by NOAA.
- B. The Ivins City Storm Drain Capital Facilities Plan uses this data as listed for latitude 27.17 North, longitude 113.68 West, elevation 3162 feet, extracted from the NOAA Precipitation Frequency Data Server located at the following Internet web site:

http://hdsc.nws.noaa.gov/hdsc/pfds/sa/ut_pfds.html

Table 2.3.3 Point Precipitation Estimates from NOAA Atlas 14
for Ivins City
Utah 37.17N 113.68W 3162 feet

Precipitation Intensity Estimates (in/hr)										
ARI (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr
10	3.48	2.65	2.19	1.47	0.91	0.52	0.37	0.22	0.13	0.08
25	4.49	3.41	2.82	1.9	1.18	0.65	0.46	0.27	0.16	0.09
100	6.35	4.83	3.99	2.69	1.66	0.9	0.61	0.36	0.2	0.11

Precipitation Frequency Estimates (inches)										
ARI (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr
10	0.29	0.44	0.55	0.74	0.91	1.04	1.11	1.32	1.56	1.92
25	0.37	0.57	0.71	0.95	1.18	1.30	1.38	1.62	1.92	2.16
100	0.53	0.81	1.00	1.35	1.66	1.80	1.83	2.16	2.40	2.64



C. Drainage studies should use these rainfall data unless there is sufficient justification otherwise.

2.3.4. STORM RUNOFF CALCULATIONS

A. The following storm distributions/methods are recommended for use:

1. Rational Method - recommended for small sites (less than 5 acres) and sizing individual inlets. Engineer may apply the 0.5 factor to the rational equation as recommended by the Clark County Hydrologic Criteria and Drainage Design Manual (1999, p611).
2. Farmer-Fletcher 3-hour Storm Distribution
3. SCS Type II compressed to a 6-hour Distribution

4. SCS Type II 24-hour Storm Distribution

- B. The rational method may be used with hand calculations, however, if the Farmer Fletcher or SCS Type II distribution is used then a computer application must be used applying either the SCS TR-55, SCS Unit Hydrograph or Kinematic Wave method. All computer input and output data should be provided in the drainage report. If a detention basin is being recommended, a storm distribution modeled through a computer application must be applied and a 3-hour, 6-hour and 24-hour storm shall be considered.
- C. Time of Concentration (t_c) may be calculated as per methods recommended by the Clark County Hydrologic Criteria and Drainage Design Manual or any method approved by St. George City. The value should be comparative to the t_c values calculated in the Storm Drain Capital Facilities Plan.
- D. When using SCS curve numbers, if the proposed conditions have a curve number that is lower or nearly equal to the existing conditions then it may be necessary to calculate the runoff solely from the estimated proposed impervious areas.
- E. In a development where a fence or wall that would interrupt surface drainage is allowed but not installed with the development improvements, drainage must be designed as if such fencing were existing.

2.3.5. HYDRAULIC ANALYSIS

- A. Any system with two or more inlets must be designed using hydraulic analysis software.
- B. The EGL and HGL must be determined throughout the reaches of the pipe and must be shown on the construction drawings.

2.3.6. STREETS

- A. Streets may be used as the primary storm drainage system in many subdivisions and site developments. Streets must be shown to adequately handle the variety of storms per the storm system sizing criteria given above.
- B. All subdivisions and site development should indicate the carrying capacity of the street using the Manning's equation.
- C. Highback curbs (versus modified curbs) may be required in locations where streets are on a grade 2% or steeper with a curvilinear shape.

2.3.7. MANHOLES

- A. Manholes shall be provided for maintenance purposes at a maximum horizontal distance of 500 feet.
- B. Cleanouts are not allowed in lieu of manholes.
- C. Required at all changes in pipe size, horizontal alignment, or vertical alignment.

2.3.8. DROP INLETS

- A. Combination curb opening/grate inlet type shall generally be used in any urban street unless otherwise approved.
- B. A drop inlet shall be used to collect storm water in lieu of a cross gutter whenever located within 300 feet of an underground storm drainage system.
- C. Inlets must be considered with 50% blockage.
- D. Engineer shall verify inlet capacity following methodology in the Clark County Hydrologic Criteria and Drainage Design Manual (1999, p818)

2.3.9. STORM DRAIN PIPELINES

- A. Located within a dedicated right-of-way, drainage easement or equivalent.
- B. Pipelines shall be designed to convey entire flood as per sizing criteria given above with no surface flooding following any inlets.
- C. Minimum pipe diameter is 12 inches when slopes are 1.5% or greater, 15 inches when slopes are less than 1.5%.
- D. Minimum pipe cover is 12-inches. If less than 24-inches must use reinforced concrete pipe with Class I backfill only. Less than 12-inches cover may be allowed with concrete encasement.
- E. Pipelines must be installed straight between manholes/inlets. Curvilinear pipes may be considered if pipe is running parallel to a curvilinear road.
- F. Approved pipe materials:

Table 2.3.8 Approved Storm Drain Pipe Materials

Type	Ref Std.	Common Brand Name*	Design Manning's n	Pipe Stiffness (psi)	Min Burial Depth (ft)	Max Burial Depth (ft)	Backfill Material Class	Allowed Pipe Diameters (in)	Notes
Reinforced Concrete	ASTM C76		0.013	Rigid	1	30**	I, II, III, IV	12" to 96"	
Non Reinforced Concrete	ASTM C14		0.013	Rigid	2	17**	I, II, III, IV	12" to 30"	
Corrugated HDPE	ASTM F2648	ADS N-12	0.013	50 to 42	2	10**	I,II	12" & 15"	Larger diameters may be allowable with flowable fill in the pipe zone.
Corrugated Polypropylene	ASTM F2736 & F2764	ADS N-12 HP	0.013	75 to 46	2	17**	I,II	12" to 30"	Larger diameters may be allowable with flowable fill in the pipe zone.
Corrugated PVC	ASTM F949 & F794	Contech A-2000	0.013	46	2	17**	I,II	12" to 30"	Larger diameters may be allowable with flowable fill in the pipe zone.

*provided for reference only, other equal brands may be used upon approval.

** Greater depths may be allowed with prior written approval by City Engineer.

2.3.10. CULVERTS

- A. The minimum culvert size is 18 inches in diameter.
- B. The engineer shall consider a blockage factor of 50 percent for all culverts conveying storm drainage from undeveloped areas as determined by the City.
- C. Trash racks shall be used where the City determines that there is a high risk of severe blockages.

2.3.11. HEADWALLS

- A. For any culvert entrance or exit a head wall and concrete apron shall be required to control erosion
- B. Headwall shall be reinforced concrete if culvert material is any type of plastic.
- C. Stacked rock with a concrete apron may be used for concrete pipe culverts.
- D. A railing may be required if the City determines there is a risk to pedestrians or bicyclists.

2.3.12. BRIDGES

- A. A minimum of 2 feet of freeboard shall be provided.

- B. Local and regional scour analysis are required on the structure, upstream and downstream and embankments. All potential scour will be mitigated.

2.3.13. OPEN CHANNELS

- A. Located within a dedicated right-of-way, drainage easement or equivalent.
- B. Convey the 100-year flood event with a minimum freeboard of 1 foot.
- C. Line with rock or other similar erosion control if velocities are expected to exceed 2 feet per second.
- D. No side-slopes steeper than 2H:1V.

2.3.14. DETENTION/RETENTION

- A. Required when:
 - 1. Downstream conveyance facilities are considered to be at full capacity.
 - 2. Discharging to private property without a drainage easement unless discharge does not exceed that which existed prior to development, nor does it concentrate.
- B. Minimum of 1 foot freeboard.
- C. Maximum of 4H:1V side-slope.
- D. Provide monitoring and maintenance plan.
- E. Provide vehicular access.
- F. Provide emergency spillway sized with the assumption that outlet is closed in 10-year event or 50% clogged in 100-year event.
- G. All detention facilities shall be landscaped.
- H. No reduction of size shall be made for evaporation or infiltration.
- I. Maximum depth of 3 feet unless otherwise approved.
- J. Outlet shall have a minimum discharge area of 6 square inches.
- K. Retention basins:
 - 1. Only allowed in extreme situations with written approval by City.
 - 2. Percolation test must show that the capability of draining within 48 hours of storm event.

3. When located within 25 feet of adjacent property or structure, must be certified by geotechnical engineer to have no impact on the foundation stability strength of the soil underlying the adjacent property or structure.
4. Provide detailed maintenance plan.

2.3.15. FLOOD PLAINS

Any development occurring within a flood plan shall comply with the City's Flood Damage Prevention ordinance located in Ivins City Code, Title 7, Chapter 11.

2.3.16. POST-CONSTRUCTION POLLUTION PREVENTION

- A. Storm water treatment for oil and grease are required on all sites with more than 6 parking spaces.
- B. Provide a maintenance plan for the storm water treatment facility.
- C. Erosion/sediment basins are required on developed sites that have the potential to produce more erosion than the natural desert environment as determined by the City.

2.3.17. DRAINAGE REPORTS

- A. A preliminary drainage report shall be provided at preliminary plan for subdivisions.
- B. A final drainage report shall be provided prior to any review of construction drawings for a subdivision or site development.
- C. The drainage report shall contain all the information as provided in the drainage report checklist attached to these specifications in Appendix H. All reports shall be submitted with this checklist attached.

2.3.18. PRIVATE DRAINAGE SYSTEMS

- A. Private systems not maintained by Ivins City must meet these above requirements except as follows:
 1. Approved pipe and inlet materials do not apply.
 2. Smaller pipe sizes may be used for systems draining roofs, landscape areas, or any area that is not considered common area nor used for public access and parking.
 3. Cleanouts may be used in lieu of manholes.

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