

EXHIBIT B

Section 151.08.008 Surface Drainage and Storm Sewer Systems

A. General Provisions

1. Purpose

The primary purpose of this section is to outline and define the drainage planning and management practices necessary to mitigate potential flooding and to provide for an orderly, controlled means of collecting, controlling, and allowing drainage runoff to flow safely through the community.

A secondary purpose is to allow a means to replenish groundwater supplies by enhancing absorption of surface water. To accomplish these purposes, the City has adopted the Surface Water Plan for the City of Sierra Vista, prepared by [\(1\) Simons, Li & Associates, Inc., January 1988](#), [\(2\) Cochise County Flood Control / Urban Runoff Recharge Plan- Appendix A - Hydrology and Flood Control – Stantec Consulting Inc. April 2006](#); [\(3\) the Surface water Plan for the City of Sierra Vista, prepared by CMG Drainage Engineering, inc., dated may 2023](#). It is recommended that all of these documents be reviewed as each update to the SWP may address different floodplain management issues. The 1988 Simons, Li & Associates SWP focuses on regional detention basins, the 2006 Stantec Consulting, Inc. study on groundwater recharge, the 2023 CMG Drainage Engineering, Inc. SWP on Hydrology, identification and evaluation of flood vulnerable communities and erosion control.

The requirements stated herein shall be adhered to and are required of all new developments. These requirements will also be used as guidelines for the improvement of existing developments.

2. Administration and Enforcement

The administration and enforcement of this section shall be the responsibility of the City Engineer, unless otherwise specifically assigned herein or described in the Development Code.

3. Interpretation and Application

In the interpretation and application of this section, all provisions shall be considered as minimum requirements and are subject to approval by the City Engineer as they apply to the Development Code requirements.

Unless otherwise specifically provided herein, the provisions of this section shall apply to any subdivision or commercial development or the improvement of any lot or parcel, developed or undeveloped, within the City of Sierra Vista.

Interpretations and the implementation of the drainage concepts described by this section are not intended to violate the regulations of the Federal Emergency Management Agency or the National Flood Insurance Program with regard to [placement of new structures within the floodplain and/or floodway encroachments](#), or the requirements of Section 151.22.029.

4. Circumvention Unlawful

It shall be unlawful for any person to change the location or character of any watercourse, change the flow of any surface water; construct any structure that may retard or impede the historical flow of a drainage course; or modify the ground surface permeability in a manner that will result in an increase in the amount of storm water flow without the written permission of the City Engineer as allowed by this section.

It shall be unlawful to direct and discharge storm water into a wastewater sewerage system. A storm water drainage system shall be separate and required whenever the storm water flow exceeds the street drainage carrying capacity, as defined herein.

[It shall be unlawful to discharge any substance into a storm water facility other than storm water.](#)

B. Responsibility for Improvement

It is the responsibility of the developer to finance the planning, design, and construction of all drainage improvements on site or off site, as may be required by the City.

1. Dedication of Right-of-Way

The developer shall be required to dedicate to the public sufficient right-of-way and easements for the maintenance of the public drainage improvements associated with the development [unless otherwise directed by the City.](#) Adequate right-of-way or an ingress/egress easement, no less than 20 feet wide, shall be provided by the developer to access all public drainage improvements [for maintenance and repairs.](#) Dedicated drainageways and access easements must be traversable by a vehicle.

2. Design and Construction

Design and construction of the required public drainage improvements shall be made in accordance with Section 151.08.002.D and the applicable requirements of this section. Inspection and acceptance by the City for maintenance shall comply with the procedures outlined in Section 151.08.002.G.

C. Drainage Reports

A drainage report shall be required for all new development, for new development on existing sites, and subdivisions. The drainage report shall contain all necessary calculations and information necessary to justify all recommendations made by the study, or as directed by the City. All drainage reports shall be prepared and stamped by a professional civil engineer, registered in the state of Arizona and shall address all the requirements of this section and any other requirements deemed necessary by the City Engineer.

1. Preliminary Drainage Reports: Preliminary drainage reports are required to be submitted with preliminary plats. The purpose of the preliminary drainage report is to accurately establish hydrologic conditions associated with both the existing site conditions and the conditions upon completion of the proposed development. Hydrologic calculations presented in the preliminary drainage report should be considered complete. Hydraulic

design components associated with the proposed development shall be presented in conceptual terms. Hydraulic calculations associated with collection, conveyance, and detention/retention of stormwater are to be included in the preliminary drainage report to the extent necessary to demonstrate the feasibility of the proposed improvements. If the development is adjacent to a wash, the preliminary report will address the wash hydrology, identify floodplains currently defined by FEMA and show floodplain boundaries (as determined by FEMA or the developer's engineer), identify any existing or proposed erosion setback limits, discuss the wash designation identified in the Surface Water Plan for the City of Sierra Vista, and discuss proposed improvements in the wash at a conceptual level. At a minimum, the preliminary drainage report shall include:

- a. A table in the text portion of the report showing the size of the watershed or subbasin areas.
- b. A table in the text portion of the report showing runoff coefficients or soil parameters.
- c. A table in the text portion of the report showing pre-development peak flows (10-year and 100-year, 1-hour design storms).
- d. A table in the text portion of the report showing post-development peak flows (including effects of storm water basins).
- e. A map in the text portion of the report showing the locations where storm water discharges from the site in pre-development conditions and post development conditions.
- f. A table in the text portion of the report showing the peak flow and high water elevations expected in all components of collection and conveyance systems, including storm water basins. This information may be omitted from the preliminary drainage report but must be included in the final drainage report.
- g. The required tables may be combined as long as the information presented is clear and complete.

2. Final Drainage Reports: Final drainage reports are required to be submitted with final plats and site plans. The purpose of the final drainage report is to document all hydrologic and hydraulic design associated with the development. All information presented in the preliminary drainage report shall be revised and finalized as required and included in the final drainage report. The final drainage report shall present complete hydrologic calculations and complete hydraulic calculations in one bound volume. The final report may not refer to the preliminary report for calculations or other information. The conditions documented in the final drainage report shall match the proposed improvements shown on the final plans.

D. Hydrologic Methods and Design Requirements

Hydrologic methods that may be used when determining on-site and off-site drainage runoff shall be as follows, or as approved by the City Engineer:

1. Rational Method for watersheds that have a calculated time of concentration of less than 30 minutes in the pre-development condition. Rational Method calculations shall be based on the following parameters:

a. Design storms shall be the 10-year, 1-hour storm (precipitation depth 1.65 inches) and the 100-year, 1-hour storm precipitation depth 2.48 inches. As an alternative, site specific precipitation depths from National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 1, Version 5, 90% confidence intervals may be used.

b. Small area watersheds such as those modeled using the Rational Method are assumed to experience high intensity storms (design storms) as a result of summer thunderstorms.

c. Intensity-Duration-Frequency Curves from NOAA Atlas 14, Volume 1, Version 5, 90% confidence intervals.

d. Time of concentration (TC) as determined by either the Highway Drainage Design Manual, ADOT, current edition or the Drainage Design Manual for Maricopa County Arizona, Volume I, Hydrology, current edition. Minimum time of concentration to be 10 minutes, regardless of calculation methodology.

e. Runoff coefficient (C value) for pre-development conditions to be C=0.35. This C value shall apply to both the 10-year and 100-year design storm. Landscaped areas on the developed site are to have a C value of 0.35 or greater. Pre-development condition calculations are to assume that the entire site is undeveloped for the purposes of storm water basin design.

f. Post-development C values are to be based on the values in Table 151.08.006-1. Site specific C values may calculated and included in the drainage report along with supporting documentation.

Table 151.08.006-1

Post-Development C Values

Land Use	C Values
Commercial Sites	
Asphalt	0.90 ⁽¹⁾
Concrete	0.90 ⁽¹⁾
Roof	0.95
Landscape Areas	0.35
Residential Subdivisions⁽²⁾	
4,500 sf lots	0.74
5,000 sf lots	0.71
5,500 sf lots	0.69
6,000 sf lots	0.67
6,500 sf lots	0.66
7,000 sf lots	0.64

7,500 sf lots	0.63
8,000 sf lots	0.62
9,000 sf lots	0.60

(1) C Values for pervious pavements shall be evaluated on a case by case basis. Pervious pavements shall not be permitted for street construction.

(2) C Values for residential subdivisions shall include estimated area occupied by the required storm water basin.

g. Hydrographs are to be used to analyze the performance of proposed storm water basins. Hydrographs for these small watersheds are to be created using the methodology described in the Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona, [Section 4.5](#), 1998 Revision. Hydrograph duration is to be a minimum of 60 minutes (to match the design storm).

h. Hydrographs may be routed through storm water basins using spreadsheets, HEC-HMS or a commercial software developed for this purpose.

2. HEC-HMS-analysis [shall be used](#) for watersheds that have a calculated time of concentration of greater than 30 minutes in the pre-developed conditions. HEC-HMS calculations shall be [in accordance with the Surface Water Plan \(SWP\) For City of Sierra Vista, 2023](#).

The City of Sierra Vista will provide preliminary HEC-HMS models for all watersheds within the City Limits. The models may be modified as needed to create site specific models for proposed development. Modifications shall follow the procedures in the Surface Water Plan (SWP) For City of Sierra Vista, 2023.

3. Washes Designated as FEMA Floodplains - Project specific revisions to the hydrology calculations will not be accepted for washes currently designated as FEMA Floodplains. The peak flows used to determine the current 100-year FEMA floodplains shall be considered accurate for the purpose of development review. Developers wishing to revise FEMA wash hydrology must do so by obtaining a Letter of Map Revision (LOMR) from FEMA.

E. Hydraulic Methods and Design Requirements

Hydraulic calculations shall be included in the drainage report to demonstrate the hydraulic adequacy of all proposed drainage structures. Calculations shall be based on the information contained in Current version of the current version of the Drainage Design Manual, for Maricopa County, Arizona, Hydraulics, Flood Control District of Maricopa County or the Urban Drainage Design Manual, Hydraulic Engineering Circular No. 22, Federal Highway Administration latest edition. Other published manuals may be used with pre-approval of by the City Engineer. Hydraulic design shall be subject to the following requirements:

1. Drainage Structure Design Criteria. Hydraulic structures shall be designed to collect and convey the calculated peak flow for the 100-year, 1-hour design storm. In no case may the drainage leave the public right-of-way for any new flows up to and including the 100-year storm event.

2. Freeboard. A minimum of 1 foot of free board shall be provided in all conveyance structures except streets. This includes storm drains, ditches, washes, channels, and storm water basins.

3. Grading of Commercial and Residential Lots. Lots shall be graded so that:

a. All lots shall be graded toward the roadway from where the property takes access so that positive drainage to an improved public street right-of-way is assured during and after development. As an alternative, runoff may be discharged to an adjacent, improved drainage easement, a dedicated drainageway, or an alternative street, provided the drainage alternative is approved by the City Engineer.

b. Cross-lot drainage will not be allowed in residential subdivisions.

c. Cross-lot drainage may be allowed for commercial development as long as cross-lot drainage easements are recorded and CC&R's are in place assigning maintenance responsibilities.

d. All finish floor elevations shall be constructed a minimum of one foot above the base flood elevation of any abutting street, drainage easement, drainageway, detention basin, or other storm water conveyance facility.

e. If existing conditions make it difficult to comply with the finish floor elevation requirements, the City may approve the construction of an acceptable drainage control structure, designed by a professional civil engineer, which will afford at least the same margin of safety that had the finish floor been constructed one foot above the base flood elevation. Alternative drainage designs are subject to review and approval of the City Engineer.

f. Certification of finish floor elevations: The developer shall submit final as-built plans in electronic format showing all lot drainage, lot grading, building pad elevations, finish floor elevations (if available) and the highest 100 year base flood adjacent to each lot. Final as-built plans shall show the approved design conditions and reflect any field changes approved by the City and the developer's engineer. The developer's engineer shall certify that the final plans represent as nearly as possible the actual field conditions of all improvements as constructed.

g. As-built drawings may serve as certification for lots whose pad elevations are at least one foot above the 100-year base flood elevation. However, when pad elevations are less than one foot above the 100-year base flood elevation, the proposed finish floor elevation shall be certified to be a minimum of one foot above the 100 year base flood elevation by a registered land surveyor (RLS). The RLS shall use the City's elevation certificate for certification.

h. If the City determines that actual pad elevations are different than the as-built drawings, an elevation certificate shall be required.

4. Streets. Storm runoff conveyance in streets shall be designed so that:

a. Flow depth shall not exceed 0.6 feet at any location during the 100-year storm.

b. Flow volume shall not exceed 60 cubic feet per second (cfs) at any location during the 100-year design storm.

c. Runoff from local streets shall not cross an arterial or collector street. Runoff from local streets may be diverted to the gutters of arterial and collector streets if it does not violate the drainage criteria for the arterial or collector street.

d. Flow depth in major intersections (where both streets are collector or above) is to be limited to 0.6 feet during the 10-year design storm. Valley gutters may be used to convey flow across either street.

e. Storm drains or collection systems shall be provided in locations where estimated flows exceed the allowable flow volume or flow depth. Nuisance flows (very small amounts of water that wouldn't leave the gutter pan) shall always be conveyed on concrete surfaces (curb and gutters or valley gutters). Nuisance flows will not be permitted on any asphalt surfaces.

f. A four-foot wide concrete valley gutter with no more than a 1/2" depression shall be required at all intersections within a subdivision where drainage is required to cross a local street. Valley gutters may be constructed at local streets intersecting arterials or collectors as needed to properly preserve the historical flow direction.

g. A four-foot concrete valley gutter shall be required along the centerline of all new alleys that receive direct runoff discharge from private property. The design and construction of alley improvements shall be in accordance with Section 151.08.003.K of the Sierra Vista City Code, and be capable of conveying the expected 100-year peak discharge entirely within the alley cross-section. The depth of flow at the flow line shall not exceed 0.6 feet.

h. The existing and proposed street drainage capacity shall be evaluated for all streets as impacted by all new developments. Lack of street drainage capacity, as specified above, shall require the construction of storm drains, additional detention improvements, or a combination of the two requirements as a means of controlling street drainage.

i. Collection of storm water in a sump or sag condition will only be permitted if a non-clogging, emergency overflow is provided. Storm flows must be able to leave the sump area in an open channel such as a ditch or a street without endangering a structure. The highest inert elevation of the emergency overflow must be at least 1 foot below the finish floor elevation of structures that might be affected by flow in the emergency channel.

5. Street Drainage Crossings. Storm water may be conveyed across streets using culverts or dip crossings. The following design criteria shall apply:

a. Storm water crossings of arterial streets shall pass the 100-year peak discharge under the roadway.

b. Design of storm water crossings of all collector and local streets shall provide all weather access. All weather access requires, that the flow depth in the street be limited to one foot or less during the 100-year storm.

c. Where the storm water discharge is less than 500 cfs at a collector and local streets, a portion of the storm water may be allowed to cross over the roadway. If a portion of the flow crosses over the roadway, flow depth in the roadway may not exceed 0.6 feet in depth and the 100-year peak flow must be fully contained within the right-of-way (channel right-of-way and street right-of-way).

d. Drainageways or open channels may cross a local street carrying no more than 1,000 vehicles per day, as determined by the Trip Generation manual of the Institute of Transportation Engineers, if there exists at least one all-weather access route available to all properties in the area to be developed. A concrete pavement crossing is required at all dip crossings. Painted bollards are required at the sides of the concrete pavement to show depth of flow. Advance warning signs shall advise motorists not to cross when flooded. The 100-year discharge must be contained within the drainage/street right-of-way.

e. The bottom is earthen with grade control structures and the banks are armored when the conditions above are exceeded.

f. Bank armor that has a natural appearance when established. Rip rap, gabions, rail bank, and pre-approved geotechnical reinforcing mats are encouraged. Concrete and grouted rip rap are discouraged for use as bank armor.

g. Bed erosion is to be controlled by grade control structures. See requirements for grade control structures below.

6. Ditches and Channels. Shall be designed so that:

a. Anticipated velocities in unarmored ditches and channels shall not exceed 3 feet per second (fps). Peak flow in unarmored ditches and channels shall not exceed 50 cfs.

b. The bottom is earthen with grade control structures and the banks are armored when the conditions above are exceeded.

c. Bank armor that has a natural appearance when established. Rip rap, gabions, rail bank, and pre-approved geotechnical reinforcing mats are encouraged. Concrete and grouted rip rap will not be permitted for use as bank armor.

d. Bed erosion is to be controlled by grade control structures. See requirements for grade control structures below.

7. Grade Control Structures. Grade control structures are to be designed using the following criteria:

a. Channel bottom is to be left as natural earth or armored in such a way as to encourage vegetation growth. Longitudinal concrete or grouted rip rap armor in channel bottoms will not be permitted. Localized armor is required to control erosion at grade control structures.

b. Equilibrium slope of all channel bottoms is assumed to be zero (level).

c. Depth of grade control structures shall be at least 1 foot below the calculated scour depth.

d. Maximum depth of grade control structures to be 6 feet unless the structure is designed structurally support the upstream channel bed. Design of deeper grade control structures require structural calculations stamped by a civil engineer registered in the state of Arizona.

8. Bank Armor. Bank armor is to be designed using the following criteria:

a. Channel bottom is to be left as natural earth or armored in such a way as to encourage vegetation growth.

b. Channel armor shall extend at least one foot below anticipated scour depths longitudinally and at grade control structures.

c. Channel armor shall extend at least one foot below anticipated equilibrium bed of channel. Bed elevations to be determined from downstream hard points such as grade control structures or culvert crossings.

d. Channel armor shall extend one foot above calculated water surface elevations. Water surface elevation calculations shall include the anticipated superelevation in bends.

9. Storm Drains. All storm drain systems are to be designed using the following criteria:

a. Design of all storm drain system shall include hydraulic grade line (HGL) calculations. HGL to be below all inlets and manholes.

b. HGL calculations to account for all friction losses including entrance and exit losses, bend losses, and pipe friction losses.

c. HGL calculations are to assume water surface elevation at outlet at the top of pipe. Alternate outlet water surface elevations may be used if supported by hydraulic calculations.

d. Storm drain inlet capacity shall be calculated using the following clogging factors:

- Grated openings in sag - 50% clogged
- Grated openings on a continuous grade - 40% clogged
- Curb openings in a sag - 20% clogged
- Slotted drains on grade - 20% clogged
- Slotted drains in sag - 50% clogged
- Combination inlets - use appropriate clogging factors shown above for each component of the inlet

(1) Design Criteria for Small Diameter Storm Drains - Storm drains having pipes 48 inches in diameter or smaller shall be designed to the following criteria:

(a) Manholes or catch basins are to be located at all changes in direction of pipes, slope of pipes, or pipe junctions.

(b) Maximum manhole spacing to be 500 feet.

(c) Pipes must have at least three feet of cover above the top of the pipe. If less than three feet of cover is provided, pipe material shall be concrete. A minimum of 2 feet of cover is permitted at catch basins if the depth of cover increases to three feet within 10 feet of the catch basin.

(d) These design criteria shall apply to small diameter lateral pipes that discharge to a large diameter trunk line.

(e) Pipes to be installed in accordance with City of Sierra Vista Trench Detail.

(2) Design Criteria for Large Diameter Storm Drains - Storm drains having pipes larger than 48 inches in diameter shall be designed to the following criteria:

(a) Maximum manhole spacing to be 800 feet.

(b) Manholes are to be located within approximately 20 feet from bends having an angle greater than 60 degrees from the tangent alignment. Maximum spacing criteria shall be applied to bends less than 60 degrees.

(c) Bends in trunk lines may be prefabricated pipe sections or made in the field by cutting the pipe and installing a pipe collar per MAG Standard Detail 505. If pipe collars are used the pipes to be joined shall be trimmed so that no gaps larger than 12 inches remain between the pipe sections when they are fitted together.

(d) Manholes shall be in accordance with MAG Standard Detail 521. The 4-foot diameter riser shall be a prefabricated TEE section. The trunk line may not be field cut to install manhole risers.

(e) Lateral pipes that intersect the trunk line may be field fit if the inside diameter of the smaller pipe is less than one-half the outside diameter of the trunk line. If the inside diameter of the smaller pipe is more than one-half the outside diameter of the trunk line, the connection shall be made with a prefabricated TEE. Field connections shall be trimmed smooth and sealed neatly from the inside of the trunk line. Connection shall be made watertight by using a concrete encasement, field welding, or a factory made attachment collar.

(f) Lateral pipes intersection trunk lines shall be connected so that the smaller pipe is radial to the trunk line.

(g) Pipes to be installed in accordance with City of Sierra Vista Trench Detail.

(h) Pipes must have at least three feet of cover above the top of the pipe. If less than three feet of cover is provided, pipe material shall be concrete.

10. Erosion Protection and Energy Dissipation. Design of open channels, storm water basins, and improvements in washes shall incorporate adequate erosion protection and energy dissipation. Design of erosion protection shall address potential scour depths, bed and bank erosion, bend erosion, and long-term effects of proposed improvements. Improvements in washes shall not have an adverse impact on other property owners, including the City of Sierra Vista. Improvements are to be designed using the following considerations:

a. Peak flow to be 100-year, 1-hour design storm. However, design of erosion protection incorporating hydraulic jumps or spillways shall consider effects of 10-year and 25-year design storms as well.

b. Proposed improvements in washes designated as FEMA floodplains shall be approval through FEMA by obtaining a Conditional Letter of Map Revision (CLOMR) before construction and a Letter of Map Revision (LOMR) after completion of construction.

c. Design of erosion protection and energy dissipation structures shall incorporate whatever materials are necessary to withstand design conditions. However, concrete and grouted rip rap are to be avoided whenever possible.

d. Design criteria of other portions of the Development Code shall be followed when designing these structures.

e. Erosion setbacks from washes may be used in lieu of armoring with the approval of the City Engineer.

f. Setbacks from existing or future drainage ways shall be as allowed per Section 151.22.029.D, erosion setback distances shall be as calculated using the procedure described Section 7.6 of the Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona, 1998 Revision. Use of erosion setbacks shall be guided by the requirements of the Surface Water Plan. Preservation of the riparian vegetation zone is encouraged wherever possible. Substitution of setbacks for the preservation of the riparian vegetation zone, in lieu of channel improvements, may be allowed in Flood Erosion Control Corridors, if approved by the City Engineer.

g. Requirements of this section do not apply to components of Storm Water Pollution Prevention Plans (SWPPP) required by the Arizona Department of Environmental Quality.

11. Design of Improvements in Regional Washes. Regional washes are defined as those washes addressed in the Surface Water Plan (SWP). The SWP has determined the hydrology information to be used to design and construct the drainage improvements necessary to capture, control, and convey storm water runoff through the City. Developers should consult the SWP to identify the recommended locations and sizes of regional drainage facilities, and recommended improvements as they affect new development. Specifically, the Surface Water Plan identifies potential locations for regional detention basins; defines Natural Drainage Maintenance Corridors (NDMC); defines Flood and Erosion Control Corridors (FECC); and designates regional washes as NDMCs and FECCs. The SWP makes the following recommendations regarding NDMCs and FECCs:

a. Natural Drainage Maintenance Corridors (NDMC). Natural Drainage Maintenance Corridors (NDMCs) have been established at the locations recommended by the Surface Water Plan. Said locations have been established in undeveloped areas, within open space/ recreation areas, or where channel velocities in developed areas have been determined to be low. The purpose for the NDMC is to maintain a continuous flood hazard and erosion hazard buffer along established channels. Preservation of the mature riparian environment along the channel should provide a natural stabilizing influence and reduce erosion. The most restrictive of the following setbacks shall be established and maintained.

(1) The [FEMA](#)-floodway.

(2) The limits of the riparian vegetation zone, as determined by recent aerial photographs.

(3) A 50 foot setback from each bank of the low flow channel for watersheds less than or equal to 1.5 square miles; or a 100-foot setback from each bank of the low flow channel for watercourses draining watersheds greater than 1.5 square miles.

b. Flood and Erosion Control Corridors (FECC).-The purpose of establishing a FECC is to determine and designate the location, direction of flow, and required setbacks for future drainage improvements. A detailed determination of the FECC limits shall require floodplain mapping. The limits of the Flood and Erosion Control Corridor (FECC) shall be determined as follows:

(1) Up to a 100-foot wide drainage way centered within the FECC, that would allow for any drainage improvements necessary to control and convey the flows determined to be contributed by the upstream watershed upon ultimate development upstream.

(2) Setbacks for flood and erosion protection shall be established at a distance of 50 feet from each side of the drainage way for watercourses draining watersheds up to and including 1.5 square miles.

(3) Setbacks for flood and erosion protection shall be established at a distance of 100 feet from each side of the drainage way for watercourses draining watersheds greater than 1.5 square miles.

(4) The setbacks identified in items 2 and 3 may be reduced depending on drainage characteristics and the nature of the proposed improvements, as determined by the City Engineer. At a minimum, a 20-foot maintenance access easement shall be required on one side of the drainageway.

c. Information included in the Surface Water Plan is to be considered as preliminary planning information only. Design of regional facilities shall be based on the best information and data available. Regional storm water facilities are subject to the following considerations:

(1) Where development occurs downstream prior to the construction of upstream drainage improvements identified in the Surface Water Plan, the developer shall construct the necessary drainage improvements such that the improvements are capable of controlling and conveying the existing flows for the 100-year storm.

(2) Developers have the option of constructing upstream improvements to satisfy the intent of the Surface Water Plan, if approved by the City Engineer. The upstream improvements must be adequate to protect the developed parcel free of flood damage during the 100-year storm and the design criteria specified herein must be satisfied.

(3) Armoring on one bank of a regional wash will not be permitted.

12. Storm Water Basins, General. Storm water basins shall be used to detain/retain storm water from new development as follows:

a. Storm water runoff shall be detained/retained so that there is no increase in undeveloped peak flows from the site after development. The pre-development and post-development peak flows from the 10-year and 100-year, 1-hour storms shall be evaluated to determine compliance.

b. Where existing improvements such as parking lots exist, the requirements of this section apply and the new development will be treated as development on previously undisturbed ground in terms of stormwater detention/retention requirements.

c. Whenever feasible, storm water basins should detain flows rather than retain flows. Retention basins will not be permitted if it is feasible to discharge flows from the basin through a discharge pipe into a public street right-of-way, dedicated drainageway, or improved drainage easement that has the capacity to convey the flow.

d. Basins shall be designed to drain all runoff associated with the 100- year, 1-hour storm within 72 hours. Removal of runoff from the basin may be through percolation/infiltration or through a discharge pipe into a public street right-of-way, dedicated drainageway, or improved drainage easement that has the capacity to convey the flow. If the basin is to be drained by percolation/infiltration alone, percolation calculations stamped by geotechnical engineer registered in the state of Arizona are required.

e. Preliminary percolation tests shall be performed during the design stage of the basin at the ultimate finish grade of the bottom of the basin.

f. Basins that are designed to retain stormwater shall be scarified at the end of the construction period to maximize percolation capacity. At a minimum, basins shall be seeded with native grasses upon completion of construction.

g. Drainage runoff to be detained/retained on site. Storm water basins may not encroach City street right-of-way, dedicated washes or drainage easements (does not include area specifically platted as the storm water basin within a single family residential subdivision), FEMA floodplains, erosion setbacks, or Natural Drainage Maintenance Corridors.

h. Storm water basins shall be equipped with an emergency overflow weir. Water discharging from the weir shall flow directly into a public street right-of-way, dedicated drainageway, or improved drainage easement that has the capacity to convey the flow. The weir and the pathway to the discharge point shall be open and not prone to clogging under reasonable circumstances. Pipes shall not be used to meet the emergency overflow requirement. The weir shall be armored to resist erosion that could be caused by 20% of the 100-year peak flow.

i. Minimum diameter of discharge pipe shall be 18 inches. An orifice plate on a concrete headwall may be used to reduce the discharge from the pipe. This provision is recommended, but not mandatory for basins located in commercial, industrial, or multi-family developments.

j. Basin inlets and outlets shall be protected from erosion associated with the peak flow for the 100-year, 1-hour storm.

k. Where stormwater detention/retention cannot be located on site, off-site detention/retention may be permitted provided it is within the same watershed or subwatershed, as determined by the City Engineer.

13. Storm Water Basins, Single Family Residential. Storm water basins shall be used to detain/retain storm water from new single family residential developments as follows:

a. In single family residential subdivisions, whether public or private, the land occupied by the storm water basins shall be dedicated to the City for public use on the plat. The developer shall maintain the basin until the entire subdivision is developed and improvements are accepted by the City, at which time the City will assume maintenance responsibilities.

b. Wherever practical, all runoff from a subdivision shall be detained at a single basin.

c. Maximum water depth in basin shall be 3 feet. All basins shall be provided with one foot of freeboard above the maximum water surface elevation.

d. Maximum side slope shall be 4:1 (horizontal to vertical).

e. The City may accept storm water basins in single-family residential subdivisions as recreational facilities provided any appurtenances such as recreational equipment, ramadas, landscaping, etc., are approved by the City for future maintenance considerations. Improvements not acceptable to the City may not be installed.

f. Storm water basins on individual lots will not be permitted in subdivisions in lieu of a single basin.

g. At a minimum, basins shall be seeded with native grasses upon completion of construction.

h. Basin design and construction shall include provisions for adequate access to all improvements for maintenance.

14. Storm Water Basins, Commercial. Storm water basins shall be used to detain/retain storm water from new commercial, industrial, or multi-family developments as follows:

a. Individual storm water basins shall be installed at all new commercial, industrial, and multi-family developments.

b. Basins associated with commercial, industrial, and multi-family developments shall be owned and maintained by the property owner.

c. Parking areas may be used wholly or in part to detain storm water within commercial developments providing the following criteria are met:

(1) Detained water shall not be held on public pavement or encroach public improvements.

(2) Depth of detained water shall not exceed 9 inches within designated parking spaces.

(3) A non-clogging emergency overflow weir shall be provided to prevent water from exceeding a depth of 9 inches in designated parking spaces.

Predetermined Detention Basin Sizes						
Commercial Sites in Sierra Vista						
Basin Depth 3 Feet With 1 Foot of Freeboard						
Site Area (acres)	Pre-Development Peak Flow (cfs)	Post-Development Peak Flow (cfs)	Discharge Opening Diameter (in)	Basin Bottom Area (sf)	Basin Top Area (sf)	Volume (cf)
0.5	1.2	2.8	6	200	1,400	2,400
1.0	2.3	5.5	8	600	2,400	4,500
1.5	3.5	8.3	9	1,100	3,300	6,600
2.0	4.7	11.1	10	1,700	4,200	8,850
2.5	5.8	13.8	12	2,100	5,000	10,650
3.0	7.0	16.6	13	2,600	5,700	12,450
3.5	8.2	19.4	13	3,100	6,700	14,700
4.0	9.3	22.1	14	3,500	7,400	16,350
4.5	10.5	24.9	15	4,300	8,200	18,750
5.0	11.7	27.7	16	4,700	8,600	19,950
5.5	12.8	30.4	17	5,400	9,800	22,800
6.0	14.0	33.2	18	5,800	10,500	24,450

15. Harvested Storm Water Detention, Commercial

Rainwater harvesting as a means to address stormwater detention requirements is allowable. The City adheres to the Best Management Practices found on the University of Arizona Extension Office Water Wise website (waterwise.arizona.edu).

a. Storage of rooftop and/or parking lot runoff may be used to offset the required capacity of detention/retention basins. An analysis of the capacity of the storm water collection system shall be included in the hydrology report/statement. Depending on tank(s) capacity, portions, or all, of the roof area may be deductible from the site area for purposes of storm water calculations. The following criteria shall apply:

- (1) Harvested water shall be used for site landscape irrigation only, preferably instead of groundwater irrigation.
- (2) Multiple tanks may be used.
- (3) Above ground tanks may be used but must be sealed as per the BMP's to prevent mosquito breeding.
- (4) Underground tanks may be used but must be sealed as per the BMP's and a pumping system utilized.
- (5) Other design parameters shall meet the BMP's.

b. Parking lot runoff directed to landscaped water harvesting basins (“passive water harvesting”) may be used to offset the required capacity of detention/retention basins. An analysis of the capacity of storm water captured shall be included in the hydrology report/statement. The following criteria shall apply:

- (1) Basin depth must be a minimum of 6 inches.
- (2) Basin depth shall not exceed 18 inches.
- (3) Side slopes shall be no steeper than 3:1.
- (4) Storm water must percolate into the ground within 72 hours.

(5) Landscaping in the basins can count toward the 15 percent site landscaping requirement per Article 151.15.

(6) Discharge of storm water from basins, whether by design or by overflow, shall not allow outflow of groundcover materials into parking lot, public sidewalk or streets.

F. Drainage Runoff Discharge Planning

1. Storm water shall be conveyed through a development or subdivision in a manner that will not damage improvements within the development or subdivision nor create an undue nuisance to the inhabitants thereof. When improvements within a development or subdivision change the natural flow of storm drainage, they shall be designed in a manner that will not damage the land or change the flow characteristics of the natural drainage over the land upstream or downstream from the development or subdivision.

2. All new developments shall accept upstream drainage runoff from adjacent undeveloped land to preserve the historical flow direction and pattern, in accordance with Title 45 of the Arizona Revised Statutes. Upon development, the adjacent upstream public or private property shall comply with the requirements of this section.

3. Upon development of a private lot that receives offsite runoff, provisions shall be made to safely collect and convey the offsite runoff across the lot. If available, the runoff shall be discharged to a downstream public drainageway or into a drainage easement dedicated to the public. In the event the runoff must be discharged onto another private lot, the runoff shall be discharged in the location that historically received the runoff. The owner of the lot being developed shall grant an easement to the public to convey the offsite flows to the discharge point. If future upstream development is expected to eliminate the encroachment by offsite runoff, the drainage easement may be temporary. Temporary drainage easements shall be set to expire contingent upon the expected upstream development. Detention or retention of offsite water is not required.

4. In the event that the developer is not able to discharge to a dedicated drainageway or a drainage easement, the developer shall attempt to obtain a drainage easement from the downstream owner. If the downstream owner landowner refuses to grant an easement, the developer shall provide a copy of a certified letter sent to the downstream landowner advising him of the developer’s rights under Title 45 of the Arizona Revised Statutes.

5. Once runoff has been collected in a conveyance (wash, street, channel, storm drain, ditch, etc.) owned by the City of Sierra Vista, it shall remain within a public easement. Discharge of storm runoff from a dedicated easement onto private property is prohibited. Storm water within a public easement must always be discharged into another public drainageway or into a drainage easement dedicated to the public.

6. All concentrated storm drainage that cannot be conveyed in a public street right-of-way shall be conveyed in a dedicated drainage way or in an improved (paved) drainage easement. Dedicated drainage ways shall be vested in the public for public use and to construct, operate, and maintain improvements for the control and conveyance of storm water and for recreational area purposes. Drainage ways shall not be included in any lot. Drainage easements are dedicated for public use, but the right to use them to construct and maintain drainage facilities shall be granted to the public and they may be included in a lot. The use thereof shall be restricted to uses that will not interfere with the maintenance of the natural flow of storm drainage over and/or under the easement. All drainage easements and dedicated drainageways shall be at least 20 feet in width. A drainage way shall be provided and so designated when the expected flow for the 100-year storm exceeds (100) cfs, or cannot be conveyed within the minimum drainage easement width. Both drainageways and drainage easements shall be provided to accommodate the flow expected to occur at least once every 100 years, plus one foot of freeboard, or as described herein.

G. Design Detail Documents Allowed

1. Design Documents

The following documents provide guidance for the design and construction of drainage facilities and shall be used to fulfill the standards in this Section.

a. The Surface Water Plan for the City of Sierra Vista, Volumes 1 through 3, written by Simons, Li & Associates, Inc. dated January 1988, if applicable and the Surface Water Plan for the City of Sierra Vista, Parts 1 and 2 written by CMG Drainage Engineering, Inc. dated May 2023.

b. The Development Code for the City of Sierra Vista.

c. Uniform Standard Specifications for Public Works Construction and the Uniform Standard Details for Public Works Construction as compiled by the Maricopa Association of Governments, hereinafter called MAG Specifications.

d. City of Sierra Vista Standard Construction Details, as compiled.

e. The Highway Drainage Design Manual, ADOT Current edition

f. Current version of the Drainage Design Manual, for Maricopa County, Arizona, Hydraulics, Flood Control District of Maricopa County. ~~The current Maricopa County Hydraulics Manual shall not be used.~~

[g. Site specific precipitation depths and rainfall intensities from National Oceanic and Atmospheric Administration \(NOAA\) Atlas 14, Volume 1, Version 5, 90% confidence intervals. See NOAA website.](#)

[h. Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona, 1998 Revision.](#)

[i. The City Engineer may allow the use of other documents for the design and construction of public drainage improvements or facilities, as necessary, should the information or details necessary to complete the design or construction not be covered by any of the above references.](#)

2. Document Conflict

In case of conflict between the referenced documents, the City Engineer shall determine the applicable design or construction requirements. In general, the more stringent or conservative requirement will be applied.

H. Variance Procedure for Alternative Drainage Designs

Should special conditions exist on the property that make meeting the detention basin requirements difficult, an alternative drainage design can be submitted to the City. Permission will not be granted until submittal of a written application demonstrates the following:

1. That special conditions and circumstances exist which are peculiar to the land or proposed structure(s) involved and which are not applicable to other lands or structures in the area.

2. That the alleged hardships caused by literal interpretation of the provisions of this code do not result from the actions of the applicant.

3. That granting permission to build an acceptable alternate drainage control structure will not confer upon the applicant any special privilege that is denied by this code to other lands or structures in the same area.

4. That granting permission to build an acceptable alternate drainage control structure will not interfere or injure the rights of other properties in the same area.

5. The application shall contain:

a. Written text fully describing the special conditions and circumstances prompting the request.

b. Drawings with enough detail and dimension to fully demonstrate how the proposed acceptable alternate drainage structure will meet the requirements of this code.

('76 Code, Art. 12-1) (Ord. 743, passed 4-10-86; Am. Ord. 834, passed 3-9-89; Am. Ord. 875, passed 1-10-91; Am. Ord. 925, passed 8-12-93; Am. Ord. 990, passed 10-26-95; Am. Ord. 1022, passed 12-12-96; Am. Ord. 1043, passed 9-11-97; Am. Ord. 1049, passed 11-13-97;

Am. Ord. 1149, passed 9-26-02; Am. Ord. 2003-005, passed 2-13-03; Am. Ord. 2012-004,
passed 6-28-12)