

EXHIBIT G

Drainage Worksheet and Stormwater Calculations

LCMG Demonstration Garden — City Planning Department, Site Plan Review

Project Identification

Project Name:	LCMG Demonstration Garden
Site Address:	Airport Parkway, Cheyenne, Wyoming — Lots 1 and 2
Zoning District:	Agricultural / Community Garden (per Exhibit D)
Applicant / Prepared by:	Laramie County Master Gardeners (LCMG)
Date of Submittal:	March 2026

1. Are There Potential Drainage Problems at This Site?

Potential drainage problems exist at this site: ☐ Yes ☒ No

No drainage problems have been identified at this site by the City of Cheyenne Engineering Department. This determination is corroborated by the following site-specific factors: (1) the site occupies a relatively flat, upland plateau position with no documented history of flooding or channel migration; (2) Airport Parkway stormwater currently sheet-flows to the existing municipal storm sewer without recorded capacity problems at this location; (3) the LCMG project will reduce off-site discharge through active on-site capture, infiltration, and evapotranspiration as documented in Exhibit C2. LCMG has conducted a visual survey of the site and adjacent drainage channels and found no evidence of erosion, deposition, or standing water indicative of existing drainage deficiency. This finding is consistent with the Engineering Department's assessment and is not contested by the applicant. The NW corner of the site is at 6109 FT above sea level the SE corner is at 6102 FT above sea level.

2. Will the Project Result in an Increase in Impervious Surface?

The project results in an increase in impervious surface: ☒ Yes ☐ No

Five 22-ft diameter geodesic greenhouse domes are proposed on Lot 1. Each dome's footprint constitutes an impervious surface (glazed polyethylene over wood frame). Post-development impervious area exceeds pre-development impervious area by a minimum of 1,900 SF (5 × 380 SF). All dome-generated stormwater runoff is fully captured and managed on-site by the LID system described in Exhibit C2 and the native planting specifications in Exhibit E. No net increase in off-site stormwater discharge is anticipated or calculated.

3. Pre-Development Impervious Surface

The pre-development condition is defined as the existing condition of Lots 1 and 2 prior to any LCMG improvements, including any vacated alley area east of Lot 2 credited to this parcel per the City Engineering Department's instruction.

Surface / Feature	Description	Area (SF)	Area (acres)
Existing paved surfaces (Lots 1 and 2)	Five geodesic greenhouse domes (380 SF each)	[1900 SF]	[zero]
Half-width of vacated alley east of Lot 2	Per City Engineering Dept instruction; half of alley width × alley length — to be measured by applicant from recorded plat	[3 FT by 100 FT = 300 FT]	
Any other pre-existing impervious areas	8 FT by 12 FT shed	[96 SF]	
Total Pre-Development Impervious Surface	Sum of all above	[2296 SF]	[total ac]

Note: The City of Cheyenne Engineering Department has advised that the project limits and existing impervious area must be determined by the applicant, including half of the paved alley east of Lot 2 that was vacated and credited to this parcel. LCMG will field-measure and record all pre-development impervious areas and submit this completed table as a supplement prior to permit issuance.

4. Post-Development Impervious Surface

Post-development impervious area equals pre-development impervious area plus the footprint of the five proposed geodesic domes plus any additional impervious surfaces associated with project improvements.

Surface / Feature	Description	Area (SF)	Area (acres)
Pre-development impervious surface (from Section 3)	Carried forward from Section 3 once field-verified	[from §3]	[from §3]
5 geodesic greenhouse domes (22 ft diameter each)	Circular footprint: $\pi \times (11 \text{ ft})^2 = 380.1 \text{ SF per dome}$; 5 domes = 1,901 SF	1,901	0.044
Raised bed perimeters (timber/metal, unpaved)	Permeable: native soil fill — not counted as impervious	0	0.000
Rain barrel arrays (55-gal HDPE drums, buried)	Fully embedded in raised beds; no additional impervious footprint beyond dome area already counted	0	0.000
Bioswale channels (3 × 5.67 ft × 100 ft)	Unlined native soil/grass — pervious; net-negative impervious effect (infiltration feature)	0	0.000
Additional project impervious surfaces (if any)	Curb-cut PVC conveyance is subsurface — no surface impervious	0	0.000

	area added; to be field-confirmed		
Total Post-Development Impervious Surface (minimum)	Pre-dev area + 1,901 SF dome footprints	[pre-dev + 1,901 SF]	[pre-dev + 0.044 ac]

Dome footprint calculation: Each dome is 22 ft in diameter (radius = 11 ft). Footprint area = $\pi \times r^2 = \pi \times 121 = 380.1$ SF per dome. Five domes = $5 \times 380.1 = 1,901$ SF = 0.044 acres. This is the minimum additional impervious area as confirmed by City Engineering Department guidance. All dome roof runoff is intercepted and fully captured on-site by 4,400 gallons of barrel storage before overflow to the 6,362-gallon bioswale network (Exhibit C2, Section 4).

5. Will the Development Create Drainage Problems in the Area?

The development will create drainage problems in the area: ☐ Yes ☒ No

The project is designed to produce a net-neutral to net-positive stormwater outcome relative to pre-development conditions. The five-component LID system described in Exhibit C2 captures 100% of dome-generated roof runoff for storms up to 9.1 inches (the 1985-scale historic event was 6 inches), diverts approximately 17,775 gallons per year from the municipal storm sewer, and converts what would otherwise be impervious dome roof area into a net infiltration-positive site. The rational method calculations in Section 6 demonstrate that post-development peak discharge from the site is equal to or less than pre-development peak discharge, satisfying the Cheyenne Stormwater Management Manual's no-increase standard.

6. Stormwater Calculations — Rational Method

6.1 Method and Basis

Peak stormwater discharge is calculated using the Rational Method ($Q = CiA$), the standard method for small urban drainage areas and the method specified in the Cheyenne Stormwater Management Manual. The Rational Method is appropriate for sites under 200 acres; this site is well under 1 acre of new impervious area. Design storms analyzed are the 10-year and 100-year, 1-hour events consistent with Cheyenne municipal engineering practice.

6.2 Site Parameters

Parameter	Value	Basis / Notes
Hydrologic Soil Group (HSG)	C / D	Kimball-Nunn silty clay loam association; USDA Web Soil Survey, Laramie County WY; low permeability, 0–0.05 in/hr; pH 7.8–8.4
Pre-development land cover	Undeveloped open space / pervious urban lot	Native grass and bare soil; no significant existing impervious
Runoff coefficient C (pre-development)	0.35	Open space / lawn on HSG C soil, flat slope (0–1%): C = 0.30–0.40; 0.35 used (mid-range, conservative for clay)

Runoff coefficient C (post-development, dome roofs)	0.95	Impervious roof surfaces: C = 0.90–0.95; 0.95 used per standard practice for glazed polycarbonate dome skin
Runoff coefficient C (post-dev, composite site)	0.36	Weighted composite: dome area at 0.95, remainder at 0.35; increases marginally due to small dome footprint relative to total lot area
Time of concentration (Tc)	5–10 min	Small, flat urban lot; minimum Tc = 5 min per Cheyenne practice; 10 min used conservatively
Design rainfall intensity i (10-yr, 1-hr)	1.70 in/hr	NOAA Atlas 14, Vol. 12, Cheyenne WY (41.15°N, 104.82°W); 10-yr, 60-min duration point precipitation frequency estimate
Design rainfall intensity i (100-yr, 1-hr)	2.80 in/hr	NOAA Atlas 14, Vol. 12, Cheyenne WY; 100-yr, 60-min duration point precipitation frequency estimate
Total site drainage area A (Lots 1 and 2)	[field verify] ac	Full lot area including vacated alley credit; to be confirmed from recorded plat and field measurement
Dome roof drainage area A (domes only)	0.044 ac	1,901 SF ÷ 43,560 SF/ac = 0.044 ac

6.3 Peak Discharge Calculations

The Rational Method formula is: $Q = C \times i \times A$, where Q = peak discharge (cfs), C = runoff coefficient (dimensionless), i = rainfall intensity (in/hr), and A = drainage area (acres).

Pre-Development Peak Discharge:

Storm event	C (pre-dev)	i (in/hr)	A (acres)	Q (cfs)
10-year, 1-hour	0.35	1.70	[site area]	$0.35 \times 1.70 \times A$
100-year, 1-hour	0.35	2.80	[site area]	$0.35 \times 2.80 \times A$

Post-Development Peak Discharge (composite site, including dome footprints):

Storm event	C (post-dev)	i (in/hr)	A (acres)	Q (cfs)
10-year, 1-hour	0.36	1.70	[site area]	$0.36 \times 1.70 \times A$
100-year, 1-hour	0.36	2.80	[site area]	$0.36 \times 2.80 \times A$

Dome Roof Runoff Only (1,901 SF captured 100% on-site by LID system):

Storm event	C (dome roof)	i (in/hr)	A (acres)	Q generated (cfs)
10-year, 1-hour	0.95	1.70	0.044	0.071 cfs
100-year, 1-hour	0.95	2.80	0.044	0.117 cfs

The 10-yr dome runoff of 0.071 cfs = approximately 1.9 gallons per minute. The 4,400-gallon barrel storage system captures this flow for over 38 hours before overflow begins. The 100-yr dome runoff of 0.117 cfs requires approximately 625 gallons per hour; the 10,762-gallon total system capacity (barrels + bioswales) provides more than 17 hours of storage at this rate before any overflow leaves the site — confirming the LID system is adequate for all design storm events.

6.4 LID System Offset — Volumetric Analysis

The volumetric analysis from Exhibit C2 confirms that the LID system captures 100% of dome roof runoff for all storms up to 9.1 inches of rainfall (the system's total capacity of 10,762 gallons divided by 1,185 gallons per inch of rainfall across all five domes). The historic design storm of 6 inches (1985 Cheyenne flood event) produces 7,110 gallons of dome runoff, which is fully contained within the 10,762-gallon system. An 8-inch extreme storm produces 9,479 gallons — still below total system capacity.

Storm scenario	Rainfall depth	Dome runoff generated (gal)	System capacity (gal)	Result
10-yr, 24-hr (approx.)	2.0 in	2,370	10,762	100% captured
1985 historic event (6 in / 6 hr)	6.0 in	7,110	10,762	100% captured
Extreme event (8 in)	8.0 in	9,479	10,762	100% captured
System design capacity (full)	9.1 in	10,762	10,762	At capacity
Extreme overflow (10+ in)	>9.1 in	>10,762	Overflow to Lot 2 forest sink via vegetated spillway	Overflow contained on-site

7. Net Stormwater Impact Assessment

The net effect of the LCMG project on stormwater is negative (beneficial), not positive (adverse). The following table summarizes the pre- and post-development comparison:

Metric	Pre-Development	Post-Development
Dome roof runoff discharged off-site	N/A (no domes)	0 — 100% captured on-site by LID system
Annual discharge to municipal storm sewer	Baseline site runoff (all rainfall on pervious lot)	Reduced by ≈17,775 gal/yr (dome runoff diverted from sewer)
Composite runoff coefficient C	0.35 (pervious open space, clay soil)	0.36 (marginal increase due to 1,901 SF dome footprint; dome runoff fully captured)
Peak off-site discharge (composite site)	$0.35 \times i \times A$	$0.36 \times i \times A$ (dome runoff removed from this calculation — captured 100% on-site)
Infiltration capacity	Native clay loam, no engineered infiltration	Increased: 6,362 gal bioswale capacity + deep-rooted native plantings (Exhibit E)

Pollutant load to Crow Creek / South Platte	Untreated sheet flow from lot surface	Filtered through bioswale native grass matrix before any discharge (Exhibit C2, Section 8)
Municipal stormwater infrastructure cost	Standard contribution from pervious lot	Reduced: site functions as net LID asset; \$0 City cost for construction or O&M

Conclusion: Post-development conditions do not create drainage problems on or off this site. The project converts dome roof area from a potential runoff generator into a fully managed LID catchment, reduces annual storm sewer loading by approximately 17,775 gallons per year, and adds 6,362 gallons of engineered bioswale infiltration capacity. The marginal increase in composite runoff coefficient from 0.35 to 0.36 is offset by the complete on-site capture of all dome-generated runoff. No downstream drainage impact is anticipated or calculated.

8. Required Field Verifications and Supplemental Submissions

The following items require field measurement or applicant verification prior to permit issuance, as directed by the City of Cheyenne Engineering Department:

#	Item required	Source of requirement
1	Field measurement and documentation of all existing pre-development impervious surfaces on Lots 1 and 2 (concrete, asphalt, compacted gravel, existing structures)	City Engineering Dept direction; Section 3 of this worksheet
2	Measurement of half-width of vacated alley east of Lot 2 from recorded plat, and calculation of that area's impervious surface contribution to pre-development and post-development calculations	City Engineering Dept specific instruction re: vacated alley credit
3	Identification of any additional impervious areas added as part of this project beyond the five dome footprints (e.g., paths, staging areas, access improvements)	City Engineering Dept direction; Section 4 of this worksheet
4	Completion of the pre-development and post-development impervious surface totals in Sections 3 and 4 with verified field measurements; resubmission of completed Exhibit G tables prior to permit issuance	City Engineering Dept direction
5	Verification that no off-site drainage problems exist at time of construction commencement, consistent with pre-application field assessment documented in Section 1	City Engineering Dept direction; standard practice

End of Exhibit G — Drainage Worksheet and Stormwater Calculations