DRAINAGE REPORT
FOR
VENTANA TOWNHOMES AT VENTANA RANCH

SEPTEMBER 17, 2004

Prepared for:

LAS VENTANAS LIMITED PARTNERSHIP
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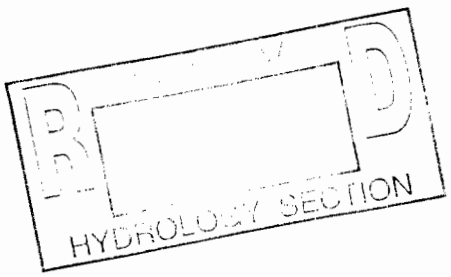

PREPARED BY:

Rudolph P. Archuleta 7/17/2004

Rudolph P. Archuleta, E.I. **Date**

UNDER THE SUPERVISION OF:

Yolanda Padilla

Yolanda Padilla, P.E. **Date**

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APPENDICES

EXHIBITS

I. PURPOSE

The purpose of this report is to present the drainage management plan for Ventana Mesa Subdivision at Ventana Ranch (Tracts 1A, 1B and 3) and to obtain approval of the preliminary/final plat and grading plan by the Development Review Board (DRB). The proposed development of the Ventana Mesa Subdivision consists of 188 single family detached residential lots on approximately 31.83 acres.

II. METHODOLOGIES

Drainage conditions were analyzed utilizing 10-year and 100-year, 6-hour storm event in accordance with the City of Albuquerque Drainage Ordinance and the Development Process Manual (DPM) Volume 2, Design Criteria, Section 22.2, Hydrology, for the City of Albuquerque, January 1993.

This site, as described in the 'Site Location and Characteristics' section below, is approximately 31.83 acres. Therefore, Part A of the DPM, Section 22.2 was used, which provides a simplified procedure for projects with sub-basins smaller than 40 acres.

This report will reference the following City of Albuquerque and the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) approved studies prepared for the Ventana Ranch Subdivision development.

1) *Las Ventanas Subdivision Drainage Master Plan*, dated April 1995
2) *Ventana Ranch West Subdivision Drainage Management Plane*, dated October, 2003

The *Las Ventanas Subdivision Drainage Master Plan*, (LVSDMP) prepared by Bohannan Huston (originally dated April 1995 and updated October 1995)dated April 1995 (hereafter referred to as the LVSDMP), was prepared to summarize the findings of a hydrologic analysis of existing and developed drainage conditions for the proposed Las Ventanas Subdivision and formulates a drainage master plan for the development of the property. The report evaluated drainage in Las Ventanas Subdivision based on the Piedras Marcadas Hydrologic model prepared by Molzen-

Corbin & Associates in 1993, and provided a conceptual plan for drainage in order to determine drainage facilities sizes and total costs. In addition, it provided drainage outfall alternatives for the Las Ventanas Subdivision. Additional information was provided in "The Final Addendum No. 4 for The Design Analysis Report for Ventana Ranch Subdivision Drainage Facilities" prepared by Bohannan Huston dated December 1997. This report identifies downstream drainage improvements and confirms that the storm drain hydraulics for the North Outfall or the West Branch Calabacillas Storm Drain Diversion presented in Addendum 3, have not been changed. The developed flows from this tract will ultimately drain into the West Branch Calabacillas Storm Drain.

The *Ventana Ranch West Subdivision Drainage Management Plan*, (VRWSDMP) was prepared by Bohannan Huston dated October 2003 (hereafter referred to as the VRWSDMP). This report addresses the drainage patterns, peak flow rates and drainage infrastructure requirements for the Ventana Ranch West development. The report references previous drainage studies related to the site, including the Las Ventanas Management Plan, the Design Analysis Report for Ventana Ranch Subdivision Drainage Facilities (including its four addendums) and the Piedras Marcadas DMP (Molzen-Corbin, May 1993).

III. SITE LOCATION AND CHARACTERISTICS

Ventana Ranch West is a 290-acre development directly west of the Ventana Ranch Subdivision. It is bound by Irving Blvd and the Calabacillas Arroyo to the north, Paseo del Norte to the south and Del Oeste Boulevard to the west. Ventana Mesa Subdivision is bound by Ventana Ranch to the east, Paseo del Norte to the south and Ventana West Parkway to the west. The site will be accessible from Ventana West Parkway.

IV. EXISTING HYDRAULIC AND HYDROLOGIC CONDITIONS

For additional assistance throughout this portion of the report, please refer to the Existing Drainage Basin Map enclosed in the Exhibit section of this report.

Ventana Mesa Subdivision has been mass graded to match existing drainage patterns, with slopes ranging from 5% to less than 1%. There are three existing onsite basins, Basin A, Basin B and Basin C. The soils onsite consist primarily of fine to medium grained silty sands with traces of clayey sands, silts and slightly silty to poorly graded sands. Existing drainage patterns direct the runoff east toward the existing Ventana Ranch Subdivision, see Existing Conditions Basin Map: Exhibit 3. There are no recognized FEMA Floodplains within the proposed development.

V. DEVELOPED HYDRAULIC AND HYDROLOGIC CONDITIONS

For additional assistance throughout this portion of the report, please refer to the Proposed Drainage Basin Map and the Grading and Drainage Plan enclosed in the Exhibit section of this report.

The majority of discharge generated by Ventana Mesa Subdivision will be directed to Mesa del Oro and ultimately to two low points within Carson Mesa. Discharge generated from northern Ventana Mesa is conveyed south to Mesa del Oro via Cerro Largo or Sunshine Mesa. High points located within both Cerro Largo, south of Mesa del Oro, and Chaco Mesa direct flow either north to Mesa del Oro or east to Carson Mesa. The flow within Mesa del Oro travels south to Carson Mesa and is captured by inlets at the north low point, which will discharge runoff via proposed 84" storm drain into the existing Piedras Marcadas North Channel. The flow within Latir Mesa (an extension of Cerro Largo) is directed east and will be captured by inlets at the south low point within Carson Mesa just south of Latir Mesa. This flow will discharge to Vista Casitas within Vista Casitas Subdivision via proposed storm drain. Inlets within Mesa del Oro and Sunshine Mesa provide additional assistance in reducing discharge generated by Ventana Mesa Subdivision.

A. On-Site Basins

The proposed site is composed of eleven (11) basins (Basins A-K). Five of the eleven basins have been divided into sub-basins for hydraulic analysis reasons. The major basins are discussed below.

Basin A-1 (4.09 ac, Q_{100} = 14.41 cfs) encompasses lots 11-36, the south half of Latir Mesa and west half of Cerro Largo from Carson Mesa to Basin A-2. Basin A-2 (1.51 ac, Q_{100} = 5.31 cfs) encompasses lots 1-10 and the west half of Cerro Largo from Basin A-1 to Mesa del Oro. Basin A-3 (2.74 ac, Q_{100} = 9.64 cfs) encompasses lots 37-54, the north half of Latir Mesa and east half of Cerro Largo from Carson Mesa to Basin A-2. Basin A-4 (1.24 ac, Q_{100} = 4.36 cfs) contains lots 55-63 and the east half of Cerro Largo from Basin A-3 to Mesa del Oro. The combined flow (Q_{100} = 24.05 cfs) from Basin A-1 and Basin A-3 is conveyed via curb and gutter south to Latir Mesa and east on Latir Mesa to Carson Mesa. The flow enters inlets 8 and 9 at the southern low point within Carson Mesa, ultimately discharging into Vista Casitas via storm drain and sidewalk culvert. The combined flow from Basin A-2 and Basin A-4 (Q_{100} = 9.67 cfs) travels north on Cerro Largo to Mesa del Oro and combines with flow from Basin H, to be discussed at the end of this section.

Basin B-1 (2.21 ac, Q_{100} = 7.80 cfs) contains lots 70-84 and the south half of Chaco Mesa from Carson Mesa to Basin B-2. Basin B-3 (1.24 ac, Q_{100} = 4.37 cfs) consists of lots 85-91 and the north half of Chaco Mesa from Carson Mesa to Basin B-4. The combined flow from Basin B-1 and B-3 (Q_{100} = 12.17 cfs) travels east along Chaco Mesa to inlets 6 and 7 located at the northern low point within Carson Mesa. Basin B-2 (0.78 ac, Q_{100} = 2.75 cfs) contains lots 64-69 and the west half of Chaco Mesa from Basin B-1 to Mesa del Oro. Basin B-4 (0.64 ac, Q_{100} = 2.24 cfs) contains lots 92-95 and the east half of Chaco Mesa from Basin B-3 to Mesa del Oro. The combined flow (Q_{100} = 4.99 cfs) travels north on Chaco Mesa to Mesa del Oro and combines with flow from Basin-H.

Basin C-1 (2.13 ac, Q_{100} = 7.51 cfs) encompasses lots 153-163 and the west half of Cerro Largo from Sunshine Mesa to Mesa del Oro. Basin C-3 (2.11 ac, Q_{100} = 7.43 cfs) encompasses lots 164 to 177 and the east half of Cerro Largo from Sunshine Mesa to Mesa del Oro. The discharge from Basin C-1 and C-3 (Q_{100} = 14.94 cfs) combines in Cerro Largo and is conveyed via curb and gutter to Mesa del Oro, where it combines with Basin-H. A five foot ribbon channel located along the back property line of Lot 164 directs a portion of flow from this lot directly to Mesa del Oro, bypassing Cerro Largo. Basin C-2 (2.18 ac, 7.68 cfs) consists of lots 143-152 and

Cerro Largo from the north cul-de-sac to Sunshine Mesa. The flow from Basin C-2 merges with Basin K, to be discussed below. An additional five foot ribbon channel is located along the back property line of Lot 143 and along the east property line of Tract L (See Preliminary Plat). A portion of flow from these lots is conveyed directly to Sunshine Mesa.

Basin D-1 (1.22 ac, Q_{100} = 4.32 cfs) contains lots 178-189 while Basin D-2 (2.47 ac, Q_{100} = 8.69 cfs) contains lots 123-142. Basins D-1 and D-2 discharge into Sunshine Mesa and combine with basin K. Basin K (1.20 ac, Q_{100} = 5.00 cfs) consists of Sunshine Mesa from Ventana West Parkway to Mesa del Oro. The combined flow from Basin C-2, D-1, D-2 and Basin K (Q_{100} = 25.69 cfs) travels south along Sunshine Mesa to Mesa del Oro and will be collected by inlets 4 (6.30cfs collected, 6.54cfs bypassed) and 5(6.30cfs collected, 6.54cfs bypassed). The residual flows (Q_{100} = 13.08cfs) will discharge into Mesa del Oro. Select lots within Basin D-2 discharge a portion of flow directly east to the existing gas line easement (See Preliminary Plat). A five foot ribbon channel along the back property line of Lots 123-124 directs a portion of flow from these lots to Tract B (See Preliminary Plat).

Basin F (0.79 ac, Q_{100} = 2.80 cfs) contains lots 96-99 and discharges flow to Carson Mesa. Basin G (0.68, Q_{100} = 2.41 cfs) encompasses lots 117-122 and discharges flow into Mesa del Oro. Basin E-2 (0.92 ac, Q_{100} = 3.25cfs) consists of lots 109-116 and Basin J (0.41ac, Q_{100} = 1.77cfs) both discharge flow into Carson Mesa. The aforementioned flows all combine with Basin H.

As mentioned earlier, the majority of discharge generated by Ventana Mesa enters Mesa del Oro and travels to the northern low point (inlets 6 and 7) within Carson Mesa. Basin H (1.61 ac, Q_{100} = 6.74 cfs) contains Mesa del Oro and Carson Mesa from Ventana West Parkway to Basin I. Basin H facilitates the combined discharge from Basins A-2, A-4, B-1, B-2, B-3, B-4, E-2, J, F, G and all flow from the basins north of Mesa del Oro. Inlets 1, 2 and 3 located just west of Chaco Mesa gather a combined flow of 18.47 cfs. The residual flow of 9.34 cfs travels east on Mesa del Oro to Carson Mesa and combines with flows from Basins G, F, J, E-2, B-1, B-2, B-3, B-4 and the residual flow from Sunshine Mesa. The remaining flow (Q_{100} = 53.34 cfs) is captured by Double Wing, Double Grate Type "A" inlets 6 and 7at the northern low point within Carson Mesa and conveyed via storm drain to the existing Piedras Marcadas North Channel. These inlets are designed to accommodate the 2 x 100 year combined flow of 106.68 cfs (53.34 cfs each) since there is no emergency spillway.

Too much

Basin E-1 (1.26 ac, 4.44 cfs) consists of lots 100-108 and discharges flow into Carson Mesa, to combine with flow in Basin I. Basin I (0.39 ac, Q_{100} = 1.62 cfs) contains Carson Mesa from the south property line to Basin H. The combined flow from Basin A-1, A-3, E-1 and Basin I (Q_{100} = 30.11cfs) is captured by Double Wing, Double Grate Type "A" inlets 8 and 9 at the southern low point just south of Latir Mesa within Carson Mesa. This flow is conveyed via storm drain and sidewalk culvert to Vista Casitas within Vista Casitas Subdivision. These inlets will accommodate the 2 x 100 year storm event with a combined flow of 60.22 cfs (30.11 cfs each) since there is no emergency spillway.

VI. CONCLUSION

The VRWSDMP governs the development of Ventana Mesa at the Ventana Ranch West Subdivision. Increases in runoff, depth and velocity due to proposed development are within parameters anticipated within the previously approved Master Drainage Plan for this area. These flows can be safely conveyed by the improvements proposed in this drainage plan to existing drainage facilities, which have adequate capacity to accept such runoff. Erosion and dust control, consisting of erosion control berms, silt fencing and sedimentation basins, are proposed to prevent soil washing or blowing into paved streets, storm drains, and existing development areas. This report supports the preliminary/final plat and grading plan and should be approved as requested.

BASIN SUMMARY FOR VENTANA MESA SUBDIVISION AT VENTANA RANCH WEST

HYDROLOGICAL VOLUMETRIC & DISCHARGE DATA

BASIN I.D.	AREA (AC)	UNITS #	% LAND TREATMENT A	B	C	D	DISCHARGE (CFS) 10 YR	100YR
HYRDOLOGICAL VOLUMETRIC & DISCHARGE DATA (EXISTING CALCULATED)								
Basin A	10.00		97.0%	0.0%	0.0%	3.0%	3.3	13.6
Basin B	16.97		97.0%	0.0%	0.0%	3.0%	5.6	23.1
Basin C	4.87		97.0%	0.0%	0.0%	3.0%	1.6	6.6
TOTAL	31.83						10.5	43.4
HYRDOLOGICAL VOLUMETRIC & DISCHARGE DATA (DEVELOPED)								
ONSITE								
BASINS								
A	9.57	63	0.0%	22.0%	22.0%	56.0%	20.18	33.72
B	4.87	32	0.0%	22.0%	22.0%	56.0%	10.26	17.15
C	6.42	35	0.0%	22.0%	22.0%	56.0%	13.54	22.62
D	3.69	31	0.0%	22.0%	22.0%	56.0%	7.78	13.01
E	2.18	17	0.0%	22.0%	22.0%	56.0%	4.60	7.69
F	0.79	4	0.0%	22.0%	22.0%	56.0%	1.67	2.80
G	0.68	6	0.0%	22.0%	22.0%	56.0%	1.44	2.41
H	1.61	0	0.0%	5.0%	5.0%	90.0%	4.37	6.74
I	0.39	0	0.0%	5.0%	5.0%	90.0%	1.05	1.62
J	0.42	0	0.0%	5.0%	5.0%	90.0%	1.15	1.77
K	1.20	0	0.0%	5.0%	5.0%	90.0%	3.24	5.00
SUBTOTAL	**31.83**	**188**					**69.3**	**114.5**
SUB-BASINS								
A-1	4.09		0.0%	22.0%	22.0%	56.0%	8.62	14.41
A-2	1.51		0.0%	22.0%	22.0%	56.0%	3.18	5.31
A-3	2.74		0.0%	22.0%	22.0%	56.0%	5.77	9.64
A-4	1.24		0.0%	22.0%	22.0%	56.0%	2.61	4.36
B-1	2.21		0.0%	22.0%	22.0%	56.0%	4.67	7.80
B-2	0.78		0.0%	22.0%	22.0%	56.0%	1.64	2.75
B-3	1.24		0.0%	22.0%	22.0%	56.0%	2.61	4.37
B-4	0.64		0.0%	22.0%	22.0%	56.0%	1.34	2.24
C-1	2.13		0.0%	22.0%	22.0%	56.0%	4.50	7.51
C-2	2.18		0.0%	22.0%	22.0%	56.0%	4.60	7.68
C-3	2.11		0.0%	22.0%	22.0%	56.0%	4.44	7.43
D-1	1.22		0.0%	22.0%	22.0%	56.0%	2.58	4.32
D-2	2.47		0.0%	22.0%	22.0%	56.0%	5.20	8.69
E-1	1.26		0.0%	22.0%	22.0%	56.0%	2.66	4.44
E-2	0.92		0.0%	22.0%	22.0%	56.0%	1.94	3.25
SUBTOTAL	**26.73**						**56.4**	**94.2**

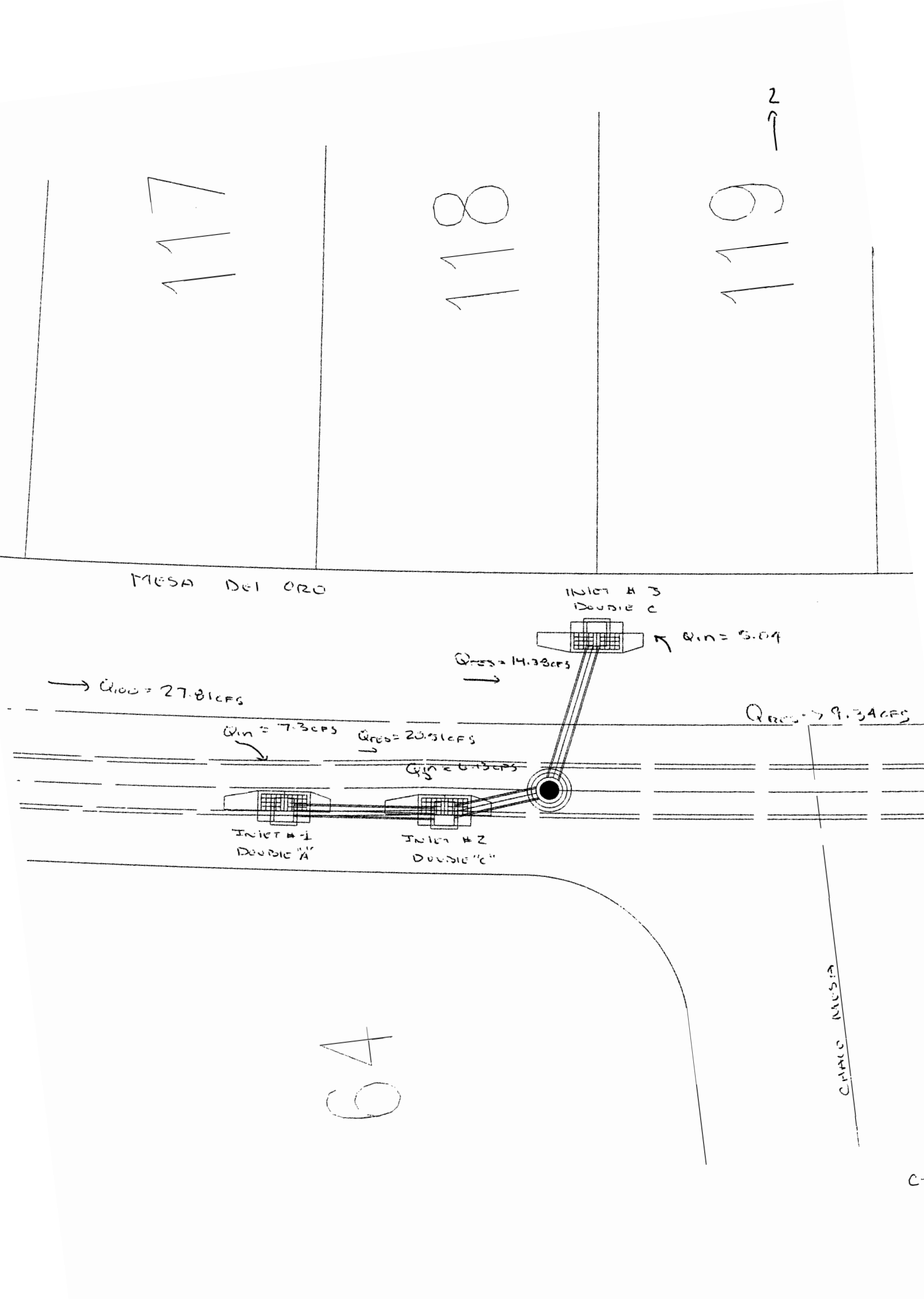
NOTES: Impervious percentages were calculated from the DPM equation A-4, with the remaining percentages distributed to land treatment type B, due to the relatively flat terrain

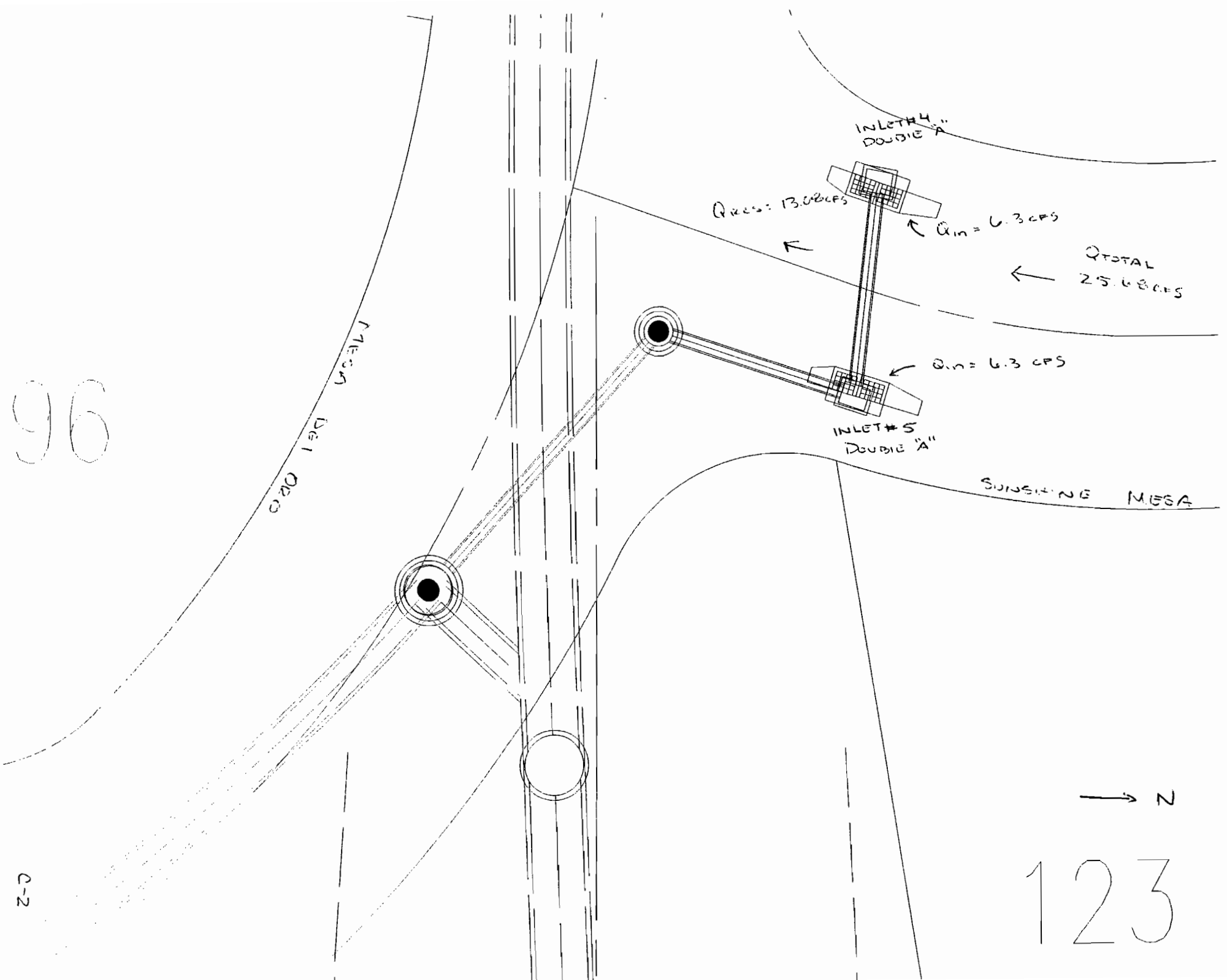
N=UNITS/ACRES = 5.9

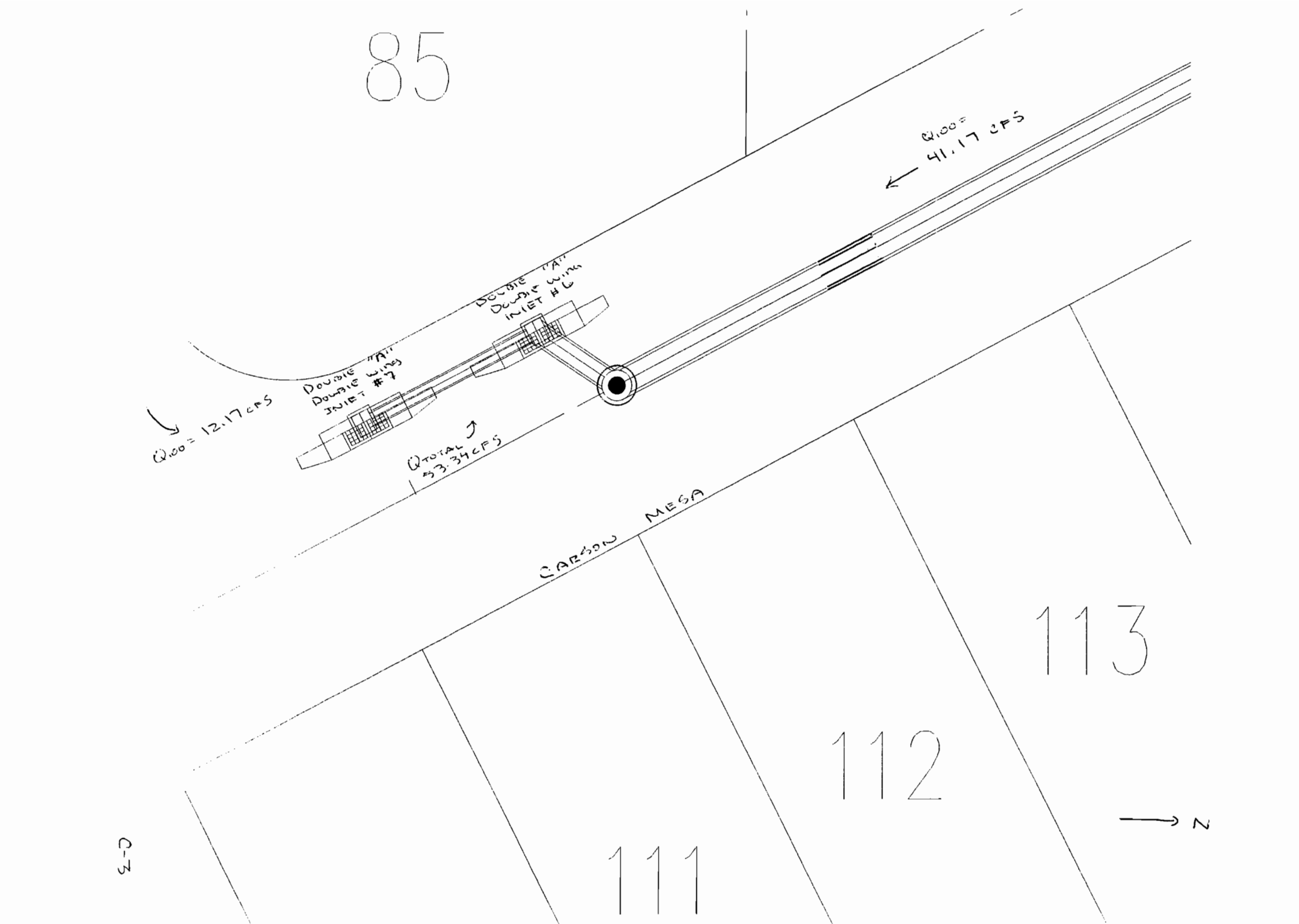
%D= 7*SQRT((N*N)+(5*N)) = 56.2 %

*Table A-4

**Table A-11


117
118
119
MESA DEL ORO
INLET # 3
DOUBLE C
Q100 = 27.81CFS
Q100 = 14.38CFS
Q100 = 9.34CFS
Q100 = 7.3CFS
Q100 = 20.51CFS
INLET #1
DOUBLE "A"
INLET #2
DOUBLE "C"
CHACO MESA


INLET#4
DOUBIE "A"
Q RES = 13.08 CFS
Q in = 6.3 CFS
Q TOTAL
25.68 CFS
Q in = 6.3 CFS
INLET#5
DOUBIE "A"
SUNSITE NEGA
VALLEY VIEW DRIVE
96
123
N
C-2


85
Q100 = 41.17 CFS
DOUBLE "A" DOUBLE WING INLET #6
DOUBLE "A" DOUBLE WING INLET #7
Q100 = 12.17 CFS
Q TOTAL 53.34 CFS
CARSON MESA
113
112
111
N
C-3

ANALYSIS OF AN INLET IN A SUMP CONDITION - **Northern Low Point Carson Mesa**

INLET TYPE: Double Grate Type "A" with curb opening wings on both sides on inlet.

WEIR: Q=C*L*H^1.5		ORIFICE: Q=C*A*(2*G*H)**0.5	
Wing opening	Grate opeining	Grate opening	Wing opening
C= 3.0	C=3.0	C=0.6	C=0.6
L= 4.0 ft	L(double grate)=[2(2.67')+2(1.8')]=8.94	A(double grate)=8.19 sf	A=2.0 sf
Q=3.0(4.0')H**1.5= 12.0H**1.5	Q=3.0(8.94)H^1.5=26.82*H^1.5	Q=4.194*(64.4*H)^0.5	Q=1.2*(64.4*H)^0.5

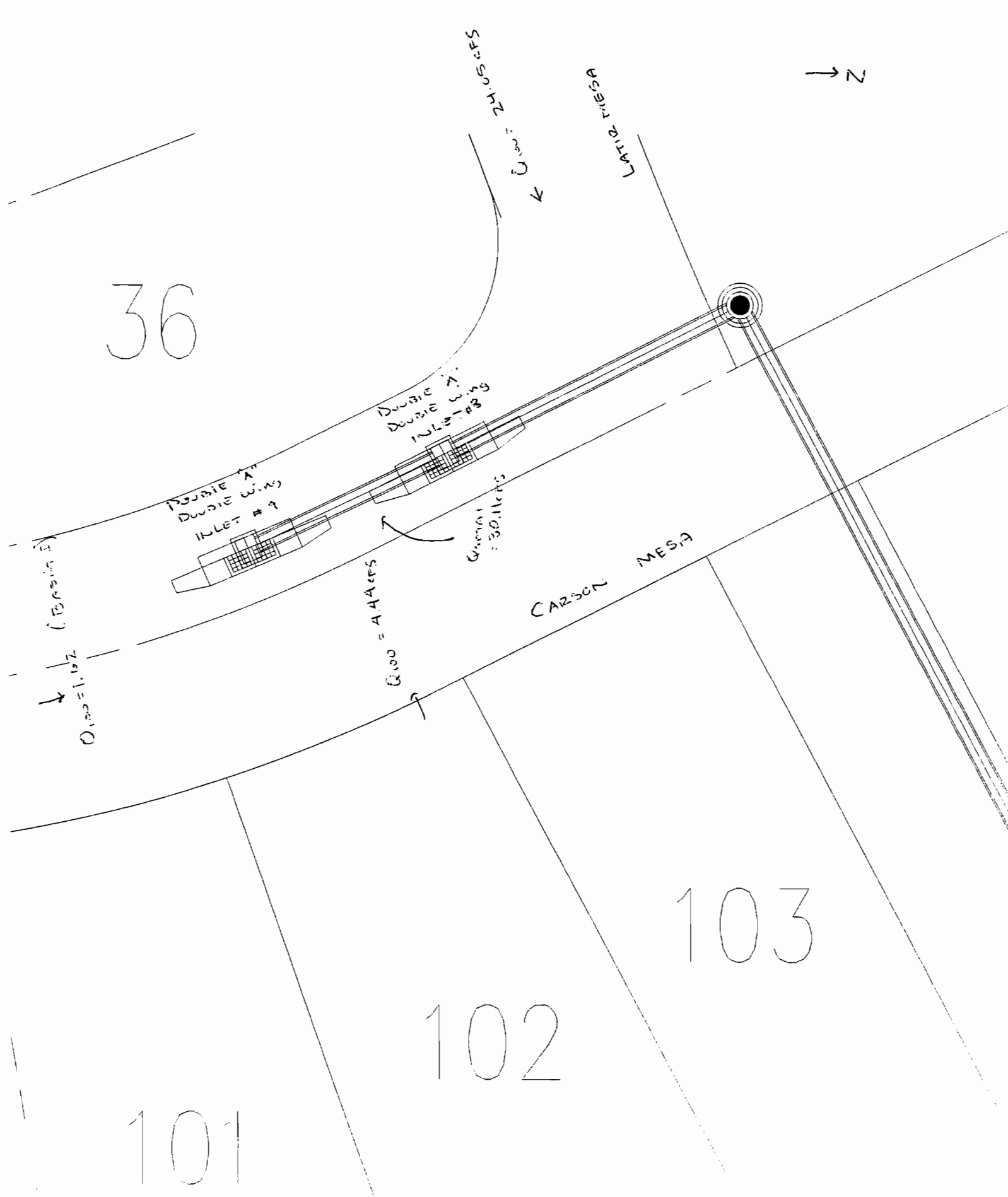
	WS ELEVATION	HEIGHT ABOVE INLET	Q (CFS) WEIR "A" OPENING	Q (CFS) WEIR DOUBLE GRATE	Q (CFS) ORIFICE DOUBLE GRATE	TOTAL Q (CFS)	COMMENTS:
~FL @ INLET	0.00	0.00	0.00	0.00	0.00	0.00	Flow at double "A" inlet w/ two wing openings
	0.10	0.10	0.38	0.85	12.47	1.61	Weir controls on grate analysis
	0.20	0.20	1.07	2.40	17.64	4.55	
	0.30	0.30	1.97	4.41	21.60	8.35	
	0.40	0.40	3.04	6.78	24.94	12.86	
	0.50	0.50	4.24	9.48	27.88	17.97	
	0.60	0.60	5.58	12.46	30.55	23.62	
TOP OF CURB	0.70	0.70	7.03	15.71	32.99	29.76	Q(100 yr) =26.67 cfs is provided at this depth
	0.80	0.80	8.59	19.19	35.27	36.36	
	0.90	0.90	10.25	22.90	37.41	43.39	
ROW LIMIT	1.00	1.00	12.00	26.82	39.43	50.82	Q(2 x 100 yr) = 53.34 cfs is provided at this depth

NOTE: The total runoff intercepted by the inlet at the low point in the road is:

Qr(100) = 2*[(runoff of the wing opening) + (the lesser of the weir or orifice amount taken by the double grate)].

THE 100 YR STORM EVENT = 26.67 CFS at the sump condition

THE 2 x 100 YR STORM EVENT = 53.34 CFS at the sump condition


N
36
Double A
Double Wing
Inlet #3
Double A
Double Wing
Inlet #4
CARBON MESA
103
102
101

ANALYSIS OF AN INLET IN A SUMP CONDITION - **Southern Low Point Carson Mesa**

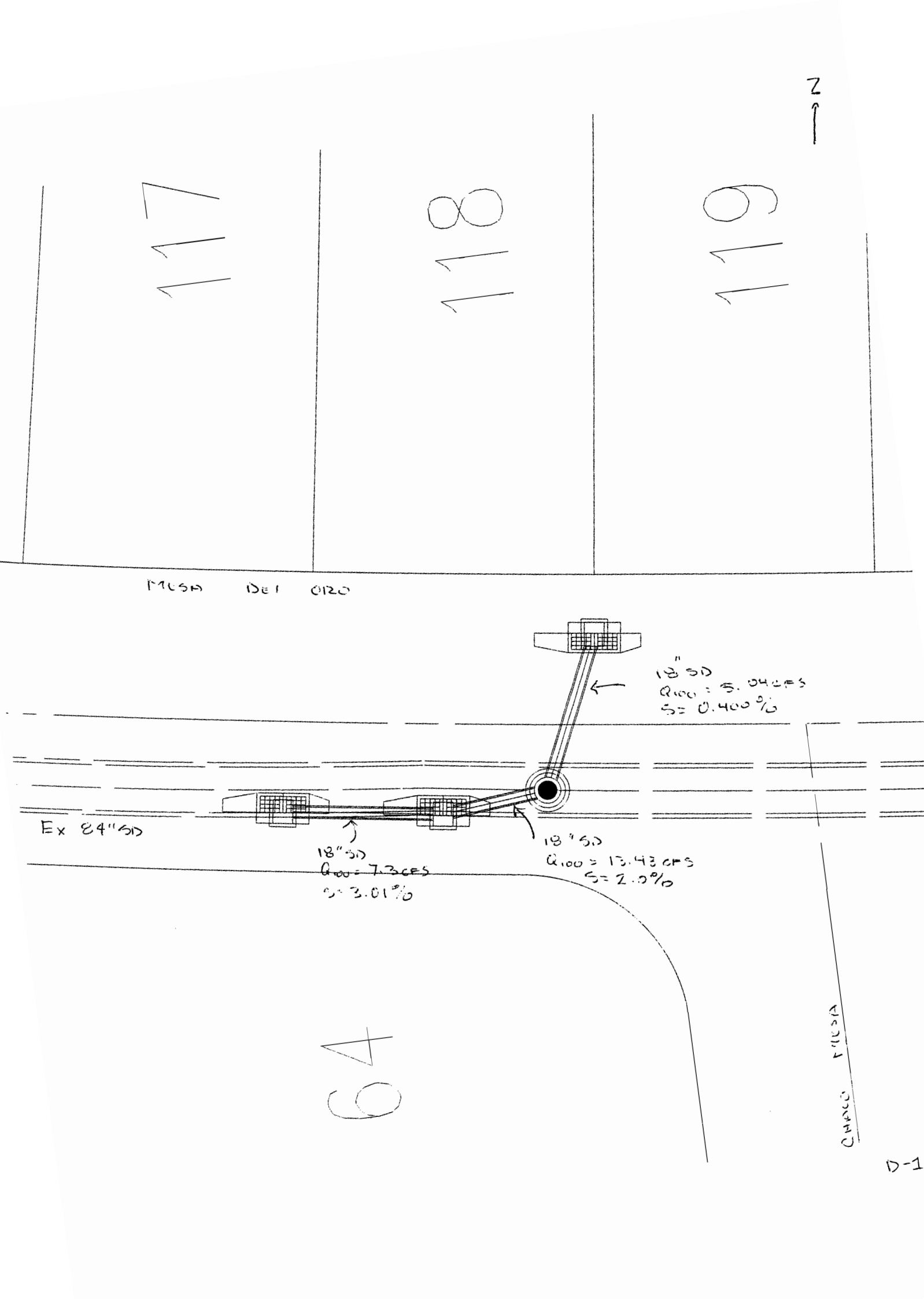
INLET TYPE: Double Grate Type "A" with curb opening wings on both sides on inlet.

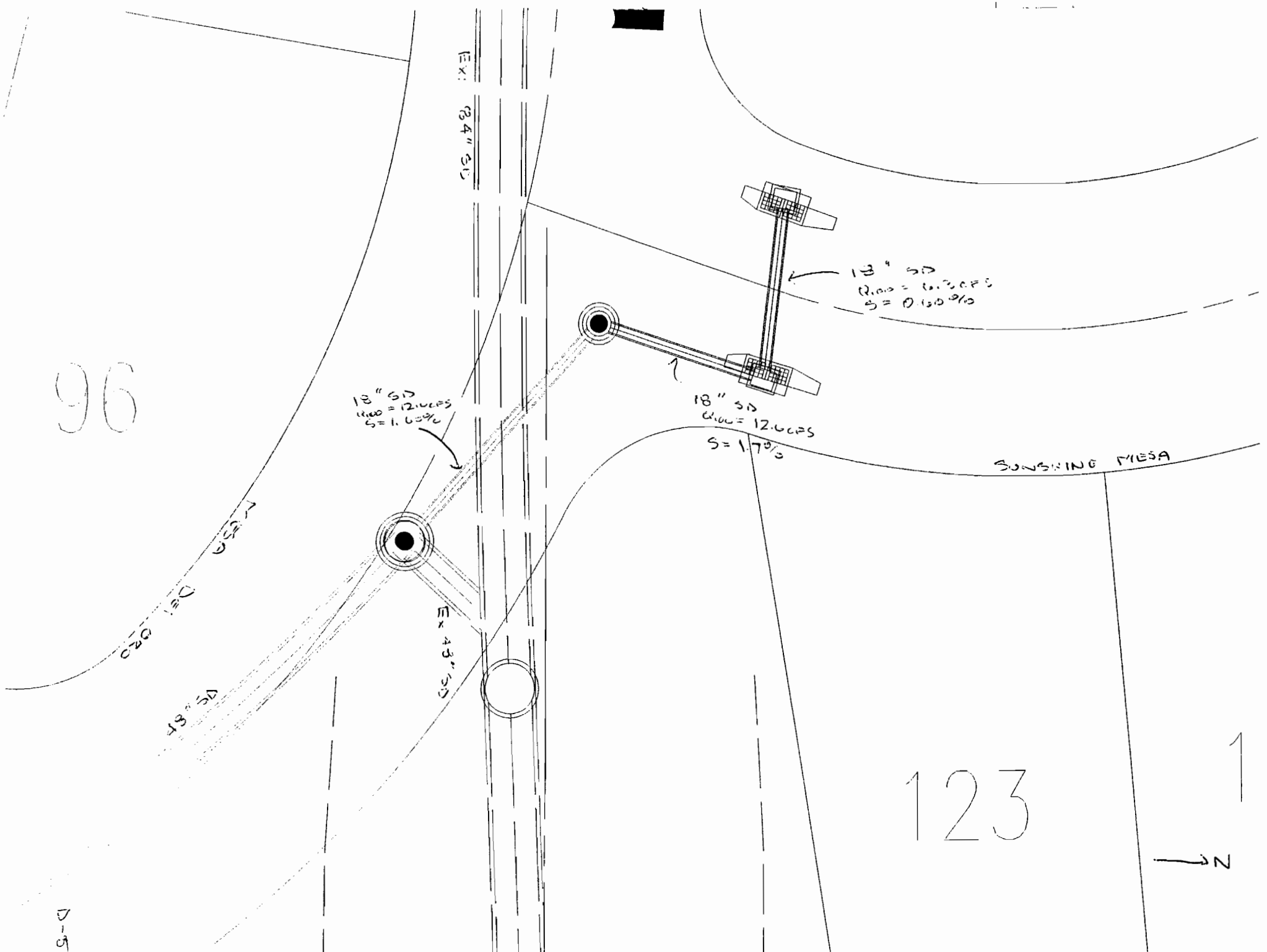
WEIR: Q=C*L*H^1.5		ORIFICE: Q=C*A*(2*G*H)**0.5	
Wing opening	Grate opeining	Grate opening	Wing opening
C= 3.0	C=3.0	C=0.6	C=0.6
L= 4.0 ft	L(double grate)=[2(2.67')+2(1.8')]=8.94	A(double grate)=8.19 sf	A=2.0 sf
Q=3.0(4.0')H**1.5= 12.0H**1.5	Q=3.0(8.94)H^1.5=26.82*H^1.5	Q=4.194*(64.4*H)^0.5	Q=1.2*(64.4*H)^0.5

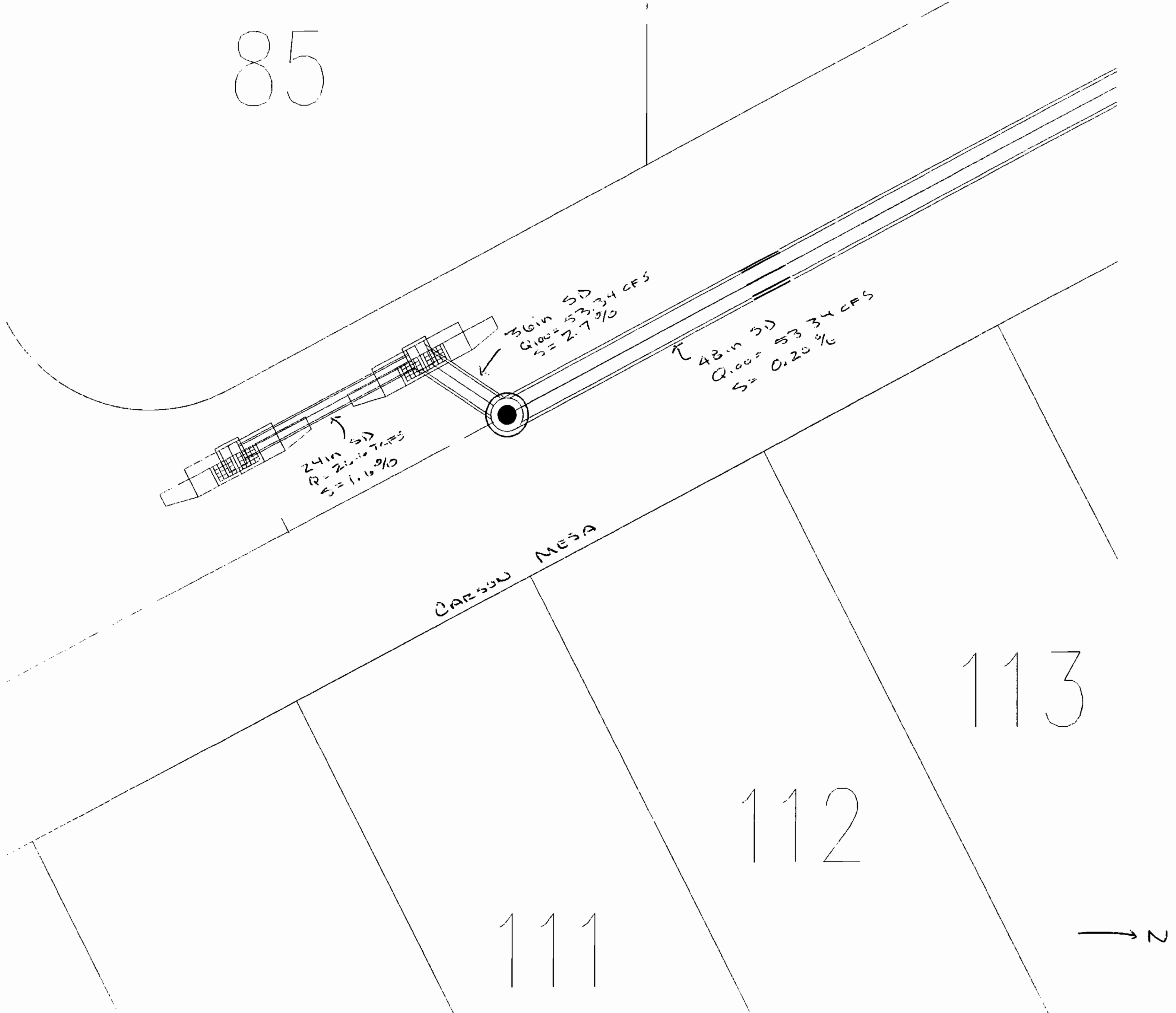
	WS ELEVATION	HEIGHT ABOVE INLET	Q (CFS) WEIR "A" OPENING	Q (CFS) WEIR DOUBLE GRATE	Q (CFS) ORIFICE DOUBLE GRATE	TOTAL Q (CFS)	COMMENTS:
~FL @ INLET	0.00	0.00	0.00	0.00	0.00	0.00	Flow at double "A" inlet w/ two wing openings
	0.10	0.10	0.38	0.85	12.47	1.61	Weir controls on grate analysis
	0.20	0.20	1.07	2.40	17.64	4.55	
	0.30	0.30	1.97	4.41	21.60	8.35	
	0.40	0.40	3.04	6.78	24.94	12.86	
	0.50	0.50	4.24	9.48	27.88	17.97	Q(100 yr) =15.06 cfs is provided at this depth
	0.60	0.60	5.58	12.46	30.55	23.62	
TOP OF CURB	0.70	0.70	7.03	15.71	32.99	29.76	
	0.80	0.80	8.59	19.19	35.27	36.36	Q(2 x 100 yr) = 30.11 cfs is provided at this depth
	0.90	0.90	10.25	22.90	37.41	43.39	
ROW LIMIT	1.00	1.00	12.00	26.82	39.43	50.82	

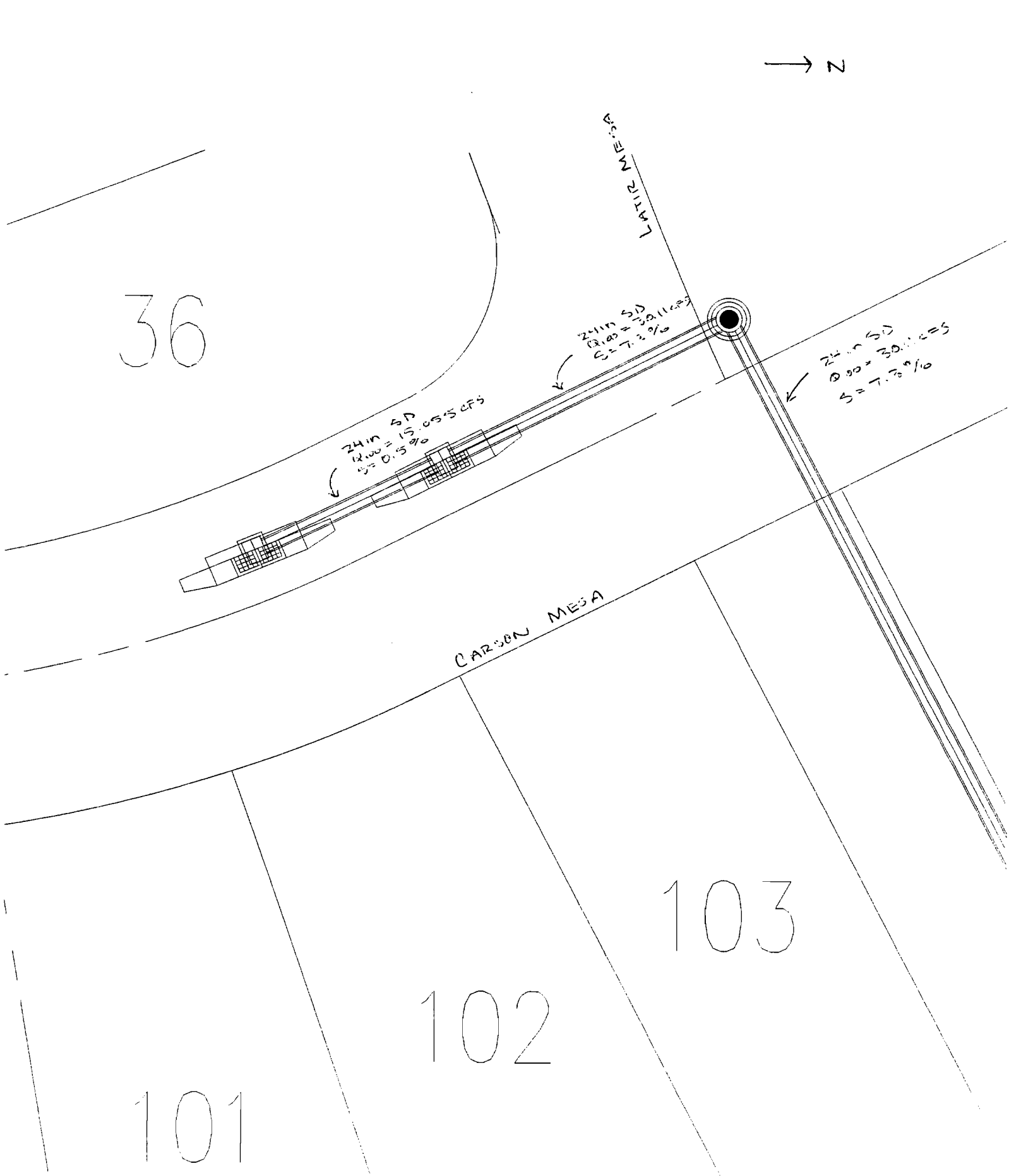
NOTE: The total runoff intercepted by the inlet at the low point in the road is:
Qr(100) = 2*[(runoff of the wing opening) + (the lesser of the weir or orifice amount taken by the double grate)].
THE 100 YR STORM EVENT = 15.06 CFS at the sump condition
THE 2 x 100 YR STORM EVENT = 30.11 CFS at the sump condition

C-6


N
117
118
119
MESA DEL OLIVO
18" SD
Q100 = 5.04 CFS
S= 0.400 %
Ex 84" SD
18" SD
Q100 = 7.3 CFS
S= 3.01 %
18" SD
Q100 = 13.43 CFS
S= 2.0 %
CHACO MESA
D-1


EX. 84" SD
18" SD
Q100 = 12.6 CFS
S = 1.7%
18" SD
Q100 = 12.6 CFS
S = 1.7%
18" SD
Q100 = 12.6 CFS
S = 1.7%
42" SD
EX 42" SD
SUNSHINE MESA
96
123
N


85
36in SD
Q100= 53.34 CFS
S= 2.7%
48in SD
Q100= 53.34 CFS
S= 0.20%
24in SD
S= 1.6%
CARSON MESA
111
112
113
N


N
LATIN MESA
36
24in SD
Q100 = 15.05 CFS
S = 0.5 %
24in SD
Q100 = 30.11 CFS
S = 7.3 %
24in SD
Q100 = 30.11 CFS
S = 7.3 %
CARBON MESA
103
102
101