Update to the Technical Drainage Study

for

ANN ROAD & HUALAPAI WAY

Date Prepared:
August 2021

Prepared for:
Richmond American Homes of Nevada, Inc.
7770 Dean Martin Drive, Suite 308
Las Vegas, NV 89193
702.240.5605

Prepared by:
Kimley-Horn and Associates, Inc.
6671 Las Vegas Boulevard South, Suite 320
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Kimley»Horn

Kimley»Horn

August 30, 2021

Mr. Albert Sung, P.E.
City of Las Vegas Flood Control
333 Rancho Drive
Las Vegas, NV 89106

RE: ***Update to the Technical Drainage Study for Ann Road and Hualapai Way***

Dear Mr. Sung,

This letter certifies that all items provided on the Update to the Technical Drainage Study for Ann Road and Hualapai Way electronic submittal matches the paper version bound into the study.

With Kimley-Horn, you should expect more and will experience better. Please contact me at (702) 790-0206 or michael.schwab@kimley-horn.com should you have any questions or concerns.

Sincerely,

Michael E. Schwab, P.E.

David Harvey, E.I.T

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: Ann Road & Hualapai Way Date: August 2021

Location of Development: a) Descriptive (Cross Streets) North/South: Hualapai Way

East/West: Ann Road

b) Section: 31 Township: 19S Range: 60E

c) APN : 125-31-101-001

Name of Owner: Richmond American Homes of Nevada, Inc.

Telephone No.: 702.240.5605 Fax No.: E-Mail Address: angela.pinley@mdch.com

Address: 7770 Dean Martin Drive, Suite 308 Las Vegas, NV 89139

Contact Person-Name: Michael Schwab, P.E. **Telephone No.:** 702.790.0206

* **E-Mail Address:** michael.schwab@kimley-horn.com **Fax No.:**

Firm: KIMLEY-HORN

Address: 6671 Las Vegas Boulevard South, Suite 320 Las Vegas, NV 89119

Type of Land Development/Land Disturbance Process:

☐	Rezoning	☐	Subdivision Map	☐	Clearing and Grading Only
☐	Parcel Map	☒	Planned Unit Development	☒	Other (Please specify below)
☐	Large Parcel Map	☐	Building Permit	GRADING PERMIT	

1. Total Owned Land Area: At Site: +/- 25.9 acres Being Developed/Disturbed: +/- 25.9 acres
2. Is a portion or all of the subject property located in a designated FEMA Flood Hazard Area? ☐ **Yes**** ☒ **No**
3. Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? ☐ **Yes**** ☒ **No**
4. Proposed type of development (Residential, Commercial, Etc.): Residential
5. Approximate upstream land area which drains to the subject site: N/A
6. Has the site drainage been evaluated in the past? ☒ **YES** ☐ **NO** If yes, please identify documentation: TDS for Ann & Grand Canyon
7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: Two drainage easements to the north; undeveloped parcel to the south
8. Briefly describe your proposed schedule for the subject project: ASAP

Engineer's Seal

Submit this form as part of the required drainage study to the local entity which has jurisdiction over the subject property. This form may provide sufficient information to serve as the Conceptual Drainage Study.

***New Required Field**

****Review and concurrence of the Clark County Regional Flood Control District is required.**

Local Entity File No.

Revision	Date

REFERENCE:

STANDARD FORM 1

Updated 05/01/2008

Kimley»Horn

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August 2021
KH Project #291400024

Kimley»Horn

August 30, 2021

Albert Sung, P.E.
Flood Control Project Engineer
Department of Public Works

RE: ***Update to the Technical Drainage Study for Ann Road & Hualapai Way (DS5439C)***

Dear Mr., Sung,

The purpose of this letter is to serve as the **Update** to the subject project. The *Technical Drainage Study for* **Ann Road and Hualapai Way** *(*hereinafter referred to as **TDS**) was approved by City of Las Vegas (CLV) on July 22, 2021. The **Update** included herein, is intended to supersede data contained in previous studies.

Since approval of **TDS**, the client has wished to apply for a stockpile permit. Furthermore, since approval of the TDS, the TDS and addenda were sent to Clark County Public Works (CCPW) for concurrence. CCPW provided comments August 19, 2021. The CCPW comment letter can be found in **Appendix A**. The proposed revisions include:

- Creation of soil stockpile on northwestern portion of the site
    - Revised flow paths affected by placement of stockpile.
    - Added hydraulic sections to check depth and velocity against the toe-of-slope of the stockpile.
    - Revised the analysis for referenced onsite subbasins *EXOF2 and *EXOF4 for Interim conditions due to the land use change resulting from the placement of the stockpile.
    - Correct Existing condition flow rates at CP2
- Address CCPW comments
    - Revise Proposed and Ultimate Conditions to address CCPW Comment #1
    - Provide Finished Floor check for APN 125-31-101-006 to address Comment #2
    - Provide pre- and post-conditions water surface elevations in Hammer Lane to ensure house and structures are not negatively impacted by the proposed changes to address Comment #3
    - Provide sections of revised channel to address Comment #4 and #5
    - Revise plans to address Comments #6 through #9

This is an effort to acquire a stockpile permit for **APN 125-31-101-001** to place the excess aggregate from the adjacent property, and to include update calculations and plans that will be submitted to CCPW in response to comments for concurrence. This will keep both entities up to speed.

The proposed project generally maintains existing drainage patterns. The methodologies and calculations presented in this report are in compliance with CLV criteria and the CCRFCD Hydrologic Criteria and Drainage Design Manual (Manual).

HYDROLOGY

Previous submittals of the approved TDS analyzed the Existing conditions, Proposed conditions, and Ultimate conditions. Existing conditions hydrology was referenced from the Grand Canyon Study and the 215 Study. In preparation of this Update, the existing conditions hydrology was reviewed, and it was found that not all of the flows were accounted for; the Existing conditions will be corrected with this Update. This Update analyzed an Interim condition hydrology to analyze the impacts of the proposed stockpile. Proposed and Ultimate conditions were revised to address CCPW concurrence comments. Existing, Interim, Proposed, and Ultimate condition subbasins have been included on **Figures EX, INT, PRO,** and **ULT**, respectively, and depict the drainage patterns used in the hydrologic analysis for the project. Copies of the figures are included in **Appendix A**. HEC-1 Models for Existing, Interim, Proposed, and Ultimate conditions have been included in **Appendix B**. Tables summarizing the results of the HEC-1 Models have been included on **Figures EX, INT, PRO,** and **ULT** in **Appendix A**.

EXISTING CONDITIONS

Existing conditions assume the site undeveloped and the development to the west is in its proposed condition such that Phase 1 of the *215 Study* is complete and Phase 2 is mass graded. Additionally, existing conditions assume the west half street improvement in Hualapai is built out with Phase 1 of the adjacent Ann & 215 project, and that the Ann CIP improvements by Clark County Public Works, from 215 to Hualapai, are complete. Offsite flows from the property to the west are conveyed east to Hualapai Way. There is an existing berm/swale on the east side of the Hualapai Way alignment that directs flow generated by **HUAL-1 south. This flow as well as other offsite and onsite flows are conveyed through natural washes through the project site and discharged to two drainage easements at the development to the east, and to a natural channel on the eastern property boundary that conveys flows east to a concrete channel. See **Figure EX** in **Appendix A**.

The project-specific existing conditions hydrology consists of three (3) onsite subbasins that were referenced from the *Grand Canyon Study* (***EXOF2, *EXOF3, *EXOF4**). Referenced basins ***EXOF2** and ***EXOF4** were prorated to identify the onsite flow rates for basin **EON3** and **EON2**, respectively. **Table 2** summarizes the prorated existing condition flow rates, and **Table 1** summarizes the onsite flow rates. Offsite flows are referenced from the *215 Study* and are assumed to be the same in the Interim condition. The referenced hydrologic calculations have been included in **Appendix D**. Previous submittals added the flow of ****CP3** (**17/75 cfs**) and prorate basin **EON3**; however, the wrong flow rate of (**2/8 cfs**) was used. This has been corrected with this submittal and the correct prorate flow rate of **4/14 cfs** for prorate basin **EON3** has been added to ****CP3** to come up with the flow rate at CP2 (**22/92 cfs**). In the Existing and Interim conditions, subbasin ANN1 is slightly smaller than in the Proposed condition due to Hualapai Way not being fully improved. This is reflected in the hydrologic analyses.

Table 1: Existing Condition Flow Summary

BASIN ID/ COMB. PT.	BASIN AREA (ac)	10-YR FLOW (cfs)	100-YR FLOW (cfs)
**CP1	-	13	28
ANN1	1.2	3	5
CP1	-	16	32
**HUAL-2	3.0	2	7
**CP3	-	17	75
**HUAL-1	1.3	1	4
CP2	-	22 (18)	92 (78)
*EXOF4	18.4	6	25
*EXOF3	2.6	1	4
*EXOF2	99.8	40	139

*Referenced/Revised from the Grand Canyon Study (PW# 10-18993)

**Referenced from the 215 Study (PW# 20-11651)

(X) - HEC-1 flow

Table 2: Existing Condition Prorate Flow Summary

Existing Onsites					
Subbasin	**Q_{10} (cfs)**	**Q_{100} (cfs)**	**Area (ac)**	**cfs/acre$_{10yr}$**	**cfs/acre$_{100yr}$**
*EXOF2	40	139	99.80	0.40	1.39
*EXOF4	6	25	18.37	0.33	1.36
Existing Onsite Prorated Basins					
Subbasin	**Q_{10} (cfs)**	**Q_{100} (cfs)**	**Area (ac)**	**cfs/acre$_{10yr}$**	**cfs/acre$_{100yr}$**
EON3	4	14	10.40	0.40	1.39
REMAINDER *EXOF2	36	125	89.40	0.40	1.39
TOTAL	**40**	**139**	**99.80**	**NA**	**NA**
EON2	4	16	11.43	0.33	1.36
REMAINDER *EXOF4	2	9	6.94	0.33	1.36
TOTAL	**6**	**25**	**18.37**	**NA**	**NA**

INTERIM CONDITIONS

The Interim condition drainage patterns assume the offsite area described as in Existing conditions with the propose stockpile in place. Referenced subbasins ***EXOF2** and ***EXOF4** have been revised to incorporate the land use of Newly Graded associated with the stockpile. **Figure INT** in **Appendix A** depicts the revised subbasins and drainage patterns**.** Hydrologic calculations for **Interim** conditions

has been included in **Appendix B**. The Interim condition HEC-1 results have been summarized in **Table 3**, and **Table 4** summarizes the prorated Interim condition flow rates.

Table 3: Interim Condition Flow Summary

BASIN ID/ COMB. PT.	BASIN AREA (ac)	10-YR FLOW (cfs)	100-YR FLOW (cfs)
**CP1	-	13	28
ANN1	1.2	3	5
CP1	-	16	32
**HUAL-2	3.0	2	7
**CP3	-	17	75
**HUAL-1	1.3	1	4
CP2	-	22 (18)	93 (78)
*EXOF4	18.4	7	27
*EXOF3	2.6	1	4
*EXOF2	99.8	42	143

*Referenced/Revised from the Grand Canyon Study (PW# 10-18993)

**Referenced from the 215 Study (PW# 20-11651)

(X) - HEC-1 flow

Table 4: Interim Condition Prorate Flow Summary

Interim Onsites					
Subbasin	**Q_{10} (cfs)**	**Q_{100} (cfs)**	**Area (ac)**	**cfs/acre$_{10yr}$**	**cfs/acre$_{100yr}$**
*EXOF2	42	143	99.80	0.42	1.43
*EXOF4	7	25	18.37	0.38	1.36
Interim Onsite Prorated Basins					
Subbasin	**Q_{10} (cfs)**	**Q_{100} (cfs)**	**Area (ac)**	**cfs/acre$_{10yr}$**	**cfs/acre$_{10yr}$**
EON3	4	15	10.40	0.42	1.43
REMAINDER *EXOF2	38	128	89.40	0.42	1.43
TOTAL	**42**	**143**	**99.80**	**NA**	**NA**
DON1	0	1	0.37	0.38	1.36
DON2	4	15	10.69	0.38	1.36
DON3	0	1	0.37	0.38	1.36
REMAINDER *EXOF4	3	9	6.94	0.38	1.36
TOTAL	**7**	**25**	**18.37**	**NA**	**NA**

Note that the interim condition flowrate for onsite Subbasins ***EXOF2** and ***EXOF4** increase slightly due to the revised land use/land cover for the basin consisting of "**Newly Graded**". In general, the drainage patterns and flow rates are generally consistent with the original **TDS**. At concentration point **CP2**, the 100-year flow increases approximately 1% between the Existing (**92 cfs**) and Interim condition (**93 cfs**), signifying the near negligible impact of the stockpile at this outfall. The concrete channel east of CP2 was designed for 137 cfs per the *Grand Canyon Study*. The drainage easements east of Eula Way will receive 1/4 cfs for the north easement and 7/27 cfs for the south easement. The *Grand Canyon Study* assumed a 100-year flow rate of 6 cfs and 34 cfs, respectively. Therefore, the proposed stockpile will not adversely impact downstream property or facilities.

An existing berm is located along the eastern side of Hualapai Way, creating a roadside swale that conveys flow from basin ****HUAL-1** south into a natural wash, eventually draining to concentration point **CP2**. With the addition of the stockpile, flow generated by prorate basin DON1 that drains to the drainage easements east of Eula Way is redirected to flow south to concentration point **CP2**. A Interim condition subbasin **DON1** has been prorated from ***EXOF4** to analyze the flow between the stockpile and roadside berm. An additional basin, **DON3** was prorated from ***EXOF4** to analyze the flow along the northern edge of the stockpile.

Note that prior analysis showed an existing 100-year discharge at concentration point, CP2 of 83 cfs. This value failed to account for the correct prorated flow from subbasin ***EXOF2**, represented by prorate basin **EON3 (4/15 cfs)**. This error has been corrected, and the existing 100-year discharge at **CP2** has been revised in the figures and calculations found in **Appendix A** and **Appendix B**, respectively.

PROPOSED CONDITIONS

The proposed conditions drainage patterns assume the offsite area as described in existing conditions with the proposed site and adjacent half streets as developed. The proposed onsite flow patterns are similar to existing conditions. See **Figure PRO-1** in **Appendix A**. Onsite basin DON1 has been revised to update the curve number to address CCPW comments. The original Proposed conditions used a curve number of 57 consistent with 14,000 square foot lots on Type A soil in HCDDM Table 602A; there is no lot smaller than 18,000 square feet in this proposed development. However, when accounting for impervious area of the house, garage, driveway, interior streets, and decks, the impervious area is closer to 38 percent, which is represented by 10,000 square foot lots which provides a curve number of 61. **Figure PRO** in **Appendix A** depicts the subbasins and drainage patterns**.** Hydrologic calculations for **Proposed** conditions has been included in **Appendix B**. The Proposed condition HEC-1 results have been summarized in **Table 5**, and **Table 6** summarizes the prorated Proposed condition flow rates.

Table 5: Proposed Condition Flow Summary

BASIN ID/ COMB. PT.	BASIN AREA (ac)	10-YR FLOW (cfs)	100-YR FLOW (cfs)
**ANN	4.5	8	15
**OFF1P	4.8	5	13
**CP1	-	13	28
ANN1	1.6	3	6
CP1	-	16	34
**ON2AP	27.6	11	43
**OFF3U	2.2	<1	<1
**OFF2P	9.1	4	16
**CP2A	-	15	59
**OFF4P	20.1	<1	6
**CP2B	-	15	64
**ON1A	4.9	<1	1
**CP2	-	15	66
**ON1B	18.1	<1	5
**HUAL-2	2.2	5	9
**CP3	-	18	75
**HUAL-1	1.3	3	5
DON1	22.5	1	11
DVDON1	-	<1	6
CP2	-	20	84

**Referenced/Revised from the 215 Study (PW# 20-11651)

Table 6: Proposed Condition Prorate Flow Summary

Subbasin	Q_{100} (cfs)	Area (ac)	$cfs/acre_{100yr}$
DON1	11	22.5	0.49
Subbasin	**Q_{100} (cfs)**	**Area (ac)**	**$cfs/acre_{10yr}$**
DON1-A	1.5	3.0	0.49
DON1-B	1.0	2.3	0.49
DON1-C	1.5	3.3	0.49
DON1-D	1.0	1.5	0.49
DON1-E	1.5	3.1	0.49
DON1-F	1.0	2.6	0.49
DON1-G	1.5	2.8	0.49
DON1-H	2.0	3.9	0.49
TOTAL	**11.0**	**22.5**	**NA**

Flows generated by onsite subbasin **DON1-A through DON1-D** will be discharged east to the adjacent development via one of two drainage easements that discharge to the adjacent drives. Flows generated by onsite subbasins **DON1-E through DON1-H** combine at **CP2** with the offsite flows from the *215 Study* and discharges to the existing natural wash to the east. A 100-year flowrate of **1 cfs** (**DON1-D**) will discharge to the drainage easement to the north, **4cfs** (**DON1-C**) will discharge out the drainage easement to the south, and **84 cfs** (**CP2**) will discharge to the existing natural wash and proposed channel north of Hammer Lane. Please note these flow rates are less than previously approved flow rates. See **Figure PRO-1** in **Appendix A**.

ULTIMATE CONDITIONS

The ultimate conditions drainage patterns assume the project site and offsite parcels as fully developed. The ultimate onsite flow patterns match the proposed condition flow patterns. The ultimate condition flow rates are less than the proposed condition flow rates. This is due to Phase 2 of the *215 Study* going from Newly Graded (CN of 78.2) to Residential – 20,000 sf lots (CN of 56.7). Therefore, all design of flood protection facilities and finished floor elevations used the worst-case proposed condition flow rates. **Table 7** summarizes the HEC-1 results for ultimate conditions. See **Figure ULT-1** in **Appendix A**.

Table 7: Ultimate Condition Flow Summary

BASIN ID/ COMB. PT.	BASIN AREA (ac)	10-YR FLOW (cfs)	100-YR FLOW (cfs)
**ANN	4.5	8	15
**OFF1P	4.7	4	11
**CP1	-	12	26
ANN1	1.6	3	6
CP1	-	15	31
**ON2AP	28.2	0	7
**OFF3U	2.2	<1	<1
**OFF2P	9.2	3	13
**CP2A	-	3	18
**OFF4P	20.1	<1	4
**CP2B	-	3	22
**ON1A	4.9	<1	1
**CP2	-	3	23
**ON1B	18.1	<1	5
**HUAL-2	2.2	6	12
**CP3	-	8	33

BASIN ID/ COMB. PT.	BASIN AREA (ac)	10-YR FLOW (cfs)	100-YR FLOW (cfs)
**HUAL-1	1.3	3	5
DON1	22.5	1	11
CP2	-	11	47

*Referenced/Revised from the 215 Study (PW# 20-11651)

HYDRAULICS

The onsite normal depth sections and flow rates have been calculated from their respective tributary subbasins. The resulting onsite flow data based on the flows generated during Proposed condition has been summarized in **Table 8**, and in tables on **Figure PRO** in **Appendix A**. The hydraulic calculations have been included in **Appendix C**.

Table 8: Proposed Condition Hydraulic Onsite Sections

SECTION	TRIBUTARY BASINS	SLOPE (%)	Q_{100} (cfs)	FLOW DEPTH (ft)	VELOCITY (ft/s)	D*V
ON1-A1	DON1-A	0.76	1.5	0.23	1.46	0.34
ON1-A2	DON1-A	0.63	1.5	0.24	1.35	0.32
ON1-B1	DON1-A+DON1-B	2.00	2.5	0.23	2.38	0.55
ON1-C1	DON1-A+DON1-B+DON1-C	4.34	4.0	0.12	2.92	0.35
ON1-C3	DON1-A+DON1-B+DON1-C	2.95	4.0	0.25	3.06	0.77
ON1-D	DON1-D	6.67	1.0	0.14	3.92	0.55
ON1-E1	**HUAL1+DON1-E	1.50	6.5	0.31	2.63	0.82
ON1-F1	**HUAL1+DON1-E+DON1-F	4.12	7.5	0.28	4.00	1.12
ON1-F2	**HUAL1+DON1-E+DON1-F	0.60	7.5	0.28	2.02	0.57
ON1-G	DON1-G	1.64	1.5	0.21	1.99	0.42
ON1-H2A	**CP3	3.87	75.0	0.55	7.71	4.24
ON1-H2B	**CP3+DON1-G+DON1-H	3.50	78.5	0.56	7.61	4.26
ON1-H4	CP2	0.50	84.0	0.76	4.54	3.45

The normal depth, flow rate, and velocity for five drainage easements throughout the project site have been calculated based on their respective tributary subbasins. The results for these sections can be found in **Table 9** as well as the table on **Figure PRO** in **Appendix A**.

Table 9: Proposed Condition Hydraulic Easement Sections

SECTION	SLOPE (%)	Q_{100} (cfs)	FLOW DEPTH (ft)	VELOCITY (ft/s)	D*V	TYPE	SIDE SLOPES	
ON1-B2	3.51	2.5	0.13	2.84	0.37	V	2%	2%
ON1-C2	1.89	4	0.18	2.54	0.46	V	2%	2%
ON1-E2	4.85	6.5	0.18	5.11	0.92	V	2%	2%
ON1-H1	4.22	75	0.45	8.43	3.79	V	2%	2%
ON1-H3	1.87	78.5	0.54	6.71	3.62	V	2%	2%

Additional hydraulic sections were analyzed along the swale adjacent to Hammer Lane to ensure containment within the swale based on the Proposed condition flows for the 100-year storm event. The results for these sections can be found in **Table 10** as well as the table on **Figure PRO** in **Appendix A**.

Table 10: Proposed Condition Hydraulic Hammer Lane Analysis Sections

SECTION	SLOPE (%)	Q_{100} (cfs)	FLOW DEPTH (ft)	VELOCITY (ft/s)	D*V
ES-1	2.10	84.0	0.42	3.47	1.46
HL-1	4.11	84.0	1.35	9.16	12.37
HL-2	5.01	84.0	1.30	9.87	12.83

The resulting onsite flow data based on the flows generated during Interim condition has been summarized in **Table 11**, and on **Figure INT** in **Appendix A**. Based on the calculated flow characteristics, the velocities are non-erosive during the 100-year storm event and are contained in their respective swales. Please note that section ON-1 incorporated the flow from **HUAL-1 to conservatively analyze the flow against the toe-of-slope of the stockpile if the existing berm/swale along the eastern edge of Hualapai Way is taken down.

Table 11: Interim Condition Swale Hydraulic Sections

SECTION	SLOPE (%)	Q_{100} (cfs)	FLOW DEPTH (ft)	TOTAL DEPTH (ft)	VELOCITY (ft/s)	TYPE	SIDE SLOPES		Req'd d_{50} (in)
ON1	1.60	5	0.5	1	2.84	V	12:1	2:1	N/A
ON3	3.30	1	0.4	1	2.62	V	14:1	2:1	N/A
HW1	1.20	4	0.6	1	2.96	V	3:1	4:1	N/A

With Kimley-Horn, you should expect more and will experience better. Please contact me at (702) 790-0206 or michael.schwab@kimley-horn.com should you have any questions.

Sincerely,

Michael E. Schwab, P.E.

David Harvey, E.I.T

Kimley»Horn

LIST OF APPENDICES

Appendix A – Documents & Figures

- EX Existing Condition Basin Map
- INT Interim Condition Basin Map
- PRO Proposed Condition Basin Map
- ULT Ultimate Condition Basin Map
- CCPW Comment Letter

Appendix B – Hydrologic Calculations

- Curve Number Calculations
- Existing Condition Standard Form 4
- Existing Condition HEC-1 Output
- Interim Condition Standard Form 4
- Interim Condition HEC-1 Output
- Proposed/Ultimate Condition Standard Form 4
- Proposed Condition HEC-1 Output
- Ultimate Condition HEC-1 Output

Appendix C – Hydraulic Calculations

- Normal Depth Calculations – Onsite
- Normal Depth Calculations – Easements
- Normal Depth Calculations – Hammer Lane Analysis
- Normal Depth Calculations – Stockpile Analysis

Appendix D – Reference Materials

- *Technical Drainage Study for Ann and Grand Canyon Residential Development. Approved October 4, 2010* (Grand Canyon Study, October 2010, PW No. 10-18993)

Appendix E – Improvement Plans

- Ann & Hualapai Stockpile Plans
- Ann & Hualapai Improvement Plans

Appendix F – Data CD