CITY OF CARSON

April 25, 2017

Mr. Samuel Unger, P.E.
Executive Officer
California Regional Water Quality Control Board
Los Angeles Region
320 West 4th Street, Suite 200
Los Angeles, CA 90013

Attention Iva Ridgeway

Dear Mr. Unger:

RE: SUBMITTAL OF FILTERA BIOFILTRATION BEST MANAGEMENT PRACTICE FOR REVIEW AND APPROVAL AT 17706 MAIN ST. CARSON, CA 90745

The 2012 Municipal Separate Storm Sewer System Permit requires biofiltration Best Management Practices (BMPs) to be designed in accordance with the design specifications provided in *Attachment H* of the permit. However, if a biofiltration BMP does not meet these specification, then an alternative design criteria must be submitted to the Regional Board's Executive Officer for approval.

A developer for a project site located at 17706 Main St. Carson, CA 90745 of Los Angeles County is proposing to use a biofiltration BMP that does not meet the design specifications of *Attachment H* of the permit, but provides alternative design criteria. Accordingly, the County of Los Angeles hereby submits the developer-proposed biofiltration BMP for your review and approval along with out initial review findings for your consideration.

We look forward to your timely review of this biofiltration BMP.

If you have any questions regarding this letter, please contact Julio Gonzalez at (310) 952-1700 X1822 or JGonzale@Carson.ca.us . If you have any questions regarding any design aspects of the project please contact Brynn Everhart at (949)339-5330 or Brynn@Mfkessler.com .

Regards,

Julio Gonzalez
Senior Engineering Technician

CITY HALL • 701 E. CARSON STREET • P.O. BOX 6234 • CARSON, CA 90749 • (310) 830-7600
WEBSITE: ci.carson.ca.us

PRECISE GRADING IMPROVEMENT PLANS
FOR
17706 S MAIN STREET
CITY OF CARSON

GENERAL INFORMATION:

- GRADING PERMIT APPLICATION NUMBER NO. GR 17
- GRADING PERMIT APPLICATION NO. GR1708220001 *
- EARTHWORK VOLUMES CUT 4249(CY), FILL 4499 (CY) *

OVER EXCAVATION/ ALLUVIAL REMOVAL & COMPACTION 28,000 (CY)
EXPORT LOCATION: TBD *

- TOTAL DISTURBED AREA 4.66 (ACRES) *
- TOTAL PROPOSED LANDSCAPE AREA 1.00TOTAL
- TURF AREA 10% (PERCENT OF TOTAL PROPOSED LANDSCAPING) *
- TOTAL DROUGHT TOLERANT LANDSCAPING AREA 90 % (PERCENT OF TOTAL PROPOSED LANDSCAPING) *
- PRE-DEVELOPMENT IMPERVIOUS AREA 4.46 (ACRES) *
- POST-DEVELOPMENT IMPERVIOUS AREA 3.66 (ACRES) *
- WASTE DISCHARGE IDENTIFICATION NUMBER (WDID #) TBD
- CONSTRUCTION & DEMOLITION DEBRIS RECYCLING AND REUSE PLAN (RPP ID) TBD *
- POST-CONSTRUCTION BMP FEATURE(S) GPS COORDINATES X 33°52'18.25" , Y 118°16'29.50"

(PROPERTY INFORMATION)

- PROPERTY ADDRESS 17706 S MAIN STREET (IF EXIST *)
- TRACT / PARCEL MAP NO. SEE FULL LEGAL DESCRIPTION HEREON
- PROPERTY OWNER XEBEC BUILDING COMPANY – AGENT *
- ASSESSORS ID NUMBER(S) 7339-002-003 *

(ZONING, REGIONAL PLANNING, AND OTHER AGENCY INFORMATION)

- PROPERTY ZONING: C1 *
- INTENDED LAND USE: COMMERCIAL

AQWM NOTES:

1. ALL ACTIVE PORTIONS O THE CONSTRUCTION SITE SHALL BE WATERED EVERY THREE HOURS DURING DAILY CONSTRUCTION ACTIVITIES AND WHEN DUST IS OBSERVED MIGRATING FROM THE PROJECT SITE TO PREVENT EXCESSIVE AMOUNTS OF DUST.

2. PAVE OR APPLY WATER EVERY THREE HOURS DURING DAILY CONSTRUCTION ACTIVITIES OR APPLY NON-TONIX SOIL STABILIZERS ON ALL UN PAVED ACCESS ROADS, PARKING AREAS, AND STAGING AREAS. MORE FREQUENT WATERING SHALL OCCUR IF DUST IS OBSERVED MIGRATING FROM THE SITE DURING SITE DISTURBANCES.

3. ANY ON SITE STOCK PILES OF DEBRIS, DIRT OR OTHER DUSTY MATERIAL SHALL BE ENCLOSED, COVERED, OR WATERED TWICE DAILY, OR NON TOXIC SOIL BINDER SHALL BE APPLIED.

4. ALL GRADING AND EXCAVATION OPERATIONS SHALL BE SUSPENDED WHEN WIND EXCEEDS 25 MILES PER HOUR.

5. DISTURBED AREAS SHALL BE REPLACED WITH GROUND COVER OR PAVED IMMEDIATELY AFTER CONSTRUCTION IS COMPLETED IN THE AFFECTED AREA.

6. GRAVEL BAG TRACK OUT APRONS (3 INCHES DEEP, 25 FEET LONE, 12 FEET WIDE PER LANE AND EDGED BY ROCK-BERM OR ROW OF STAKES) SHALL BE INSTALLED TO REDUCE MUD/DIRT TRACKOUT FROM UNPAVED TRUCK EXIT ROUTES.

7. ON-SITE VEHICLE SPEED SHALL BE LIMITED TO 15 MILES PER HOUR.

8. ALL ON SITE ROADS SHALL BE PAVED AS SOON AS FEASIBLE, WATERED TWICE DAILY, OR CHEMICALLY STABILIZED.

9. VISIBLE DUST BEYOND THE PROPERTY LINE WHICH EMANATED FROM THE PROJECT SHALL BE PREVENTED TO THE MAXIMUM EXTEND FEASIBLE.

10. ALL MATERIAL TRANSPORTED OFF SITE SHALL BE EITHER SUFFICIENTLY WATERED OR SECURELY COVERED TO PREVENT EXCESSIVE AMOUNTS OF DUST PRIOR TO DEPARTING THE JOB SITE.

11. REROUTE CONSTRUCTION TRUCKS AWAY FROM CONGESTED STREETS OR SENSITIVE RECEPTOR AREAS.

12. TRACK OUT DEVICES SHALL BE USED AT ALL CONSTRUCTION SITE ACCESS POINTS.

13. ALL DELIVERY TRUCK TRIES SHALL BE WATERED DOWN AND/OR SCRAPED DOWN PRIOR TO DEPARTING THE JOB SITE.

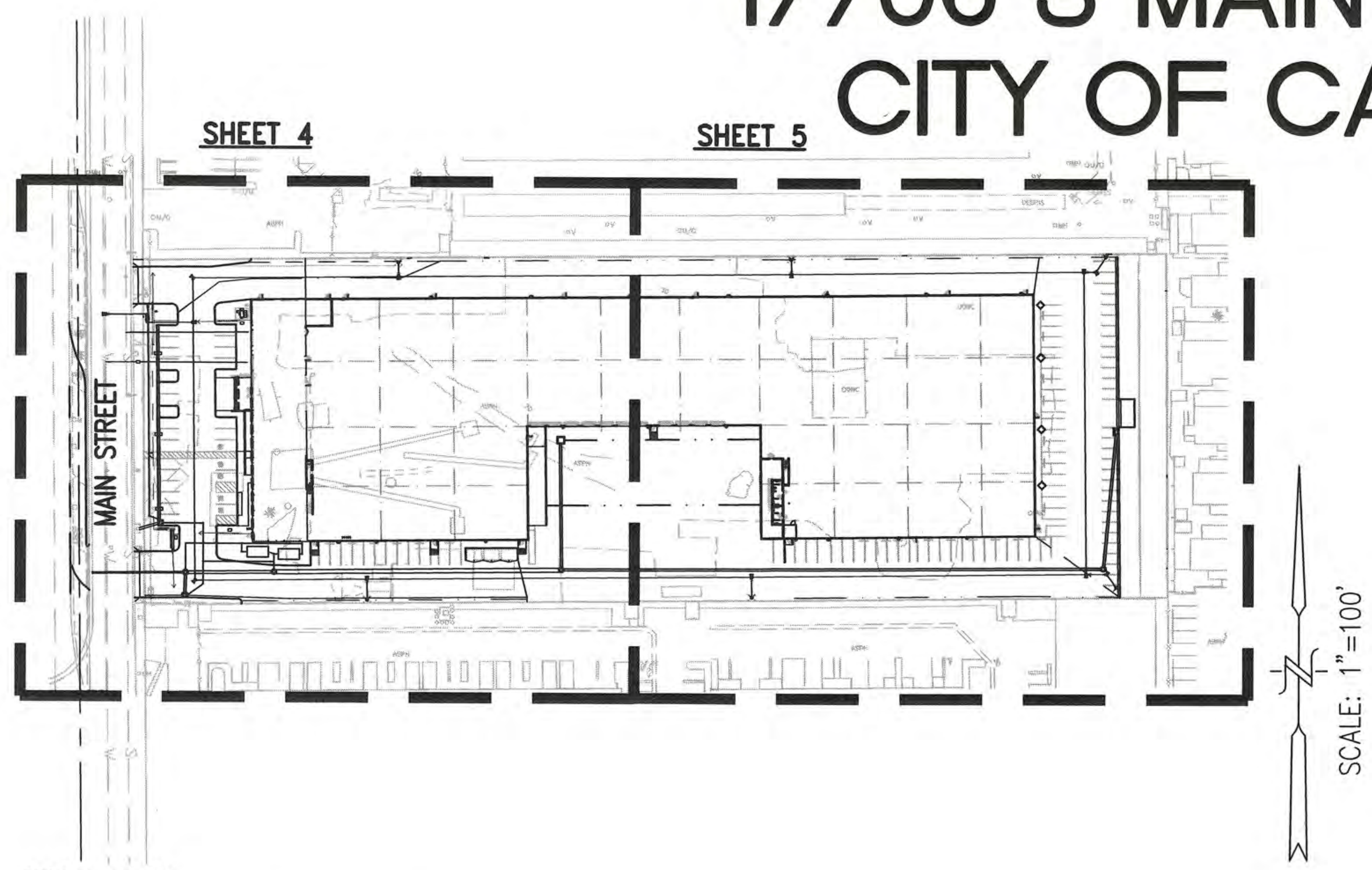
CIVIL ENGINEER'S NOTICE TO CONTRACTOR:

1. THE EXISTENCE AND LOCATION OF ANY UNDERGROUND UTILITY PIPES OR STRUCTURES SHOWN ON THEIR PLANS ARE OBTAINED BY A SEARCH OF THE AVAILABLE RECORDS. THE CONTRACTOR IS REQUIRED TO TAKE DUE PRECAUTION – ANY MEASURES TO PROTECT THE UTILITIES AND STRUCTURES SHOWN AND ANY OTHER LINES OR STRUCTURES NOT OF RECORD OR NOT SHOWN ON THESE PLANS, AND IS RESPONSIBLE FOR THE PROTECTION OF, AND ANY DAMAGE TO, THESE LINES OR STRUCTURES.

2. THE CONTRACTOR AGREES THAT HE WILL ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THIS PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY; THAT THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS, AND THAT THE CONTRACTOR SHALL DEFEND, INDEMNIFY, AND HOLD THE OWNER AND ENGINEER HARMLESS FROM ANY AND ALL LIABILITY REAL OR ALLEGED IN CONNECTION WITH THE PERFORMANCE OR WORK ON THIS PROJECT, EXCEPTING FOR LIABILITY ARISING FROM THE SOLE NEGLIGENCE OF THE OWNER OR THE ENGINEER, OR ANY PUBLIC AGENCY.

3. THE ESTIMATES OF IMPROVEMENT QUANTITIES AS SHOWN HEREON ARE PROVIDED ONLY FOR THE PURPOSE OF SATISFYING DISTRICT PLAN INFORMATION REQUIREMENTS. THE CONTRACTOR SHALL PERFORM AN INDEPENDENT ESTIMATE OF ALL IMPROVEMENT QUANTITIES AND SHALL USE SAME AS A BASIS FOR HIS BID(S) AND CONTRACT(S).

4. CONTRACTOR TO VERIFY CLEARANCE AT ALL UTILITY CROSSINGS. IF INTERFERENCE OCCURS, OTHER THAN NOTED ON PLAN, CONTRACTOR SHALL CONTACT DESIGN ENGINEER FOR POSSIBLE REDESIGN. IF REDESIGN IS UNFEASIBLE, CONTRACTOR SHALL RELOCATE UTILITY AT NO EXPENSE TO ENGINEER.



SPECIAL NOTES:

IN THE EVENT THAT HUMAN REMAINS ARE FOUND DURING CONSTRUCTION, NO FURTHER EXCAVATION OR DISTURBANCE OF THE SITE OR ANY NEARBY AREA REASONABLY SUSPECTED TO OVERLIE ADJACENT REMAINS SHALL OCCUR UNTIL THE COUNTY CORONER HAS MADE A DETERMINATION OF ORIGIN AND DISPOSITION PURSUANT TO PUBLIC RESOURCES CODE SECTION 5097.98 AND CALIFORNIA HEALTH AND SAFETY CODE SECTION 7050.5 DETERMINED: WITHIN TWO WORKING DAYS NOTIFICATION OF THE DISCOVERY. IF THE CORONER DETERMINES THAT THE REMAND ARE OR BELIEVED TO BE NATIVE AMERICAN, THE COUNTY CORONER SHALL NOTIFY THE NATIVE AMERICAN HERITAGE COMMISSION IN SACRAMENTO WITHIN 48 HOURS. IN ACCORDANCE WITH SECTION 5097.98 OF THE CALIFORNIA PUBLIC RESOURCES CODE, THE NAHC MUST IMMEDIATELY NOTIFY THOSE PERSONS IT BELIEVES TO BE THE MOST LIKELY DESCENDED FROM THE DECEASED NATIVE AMERICAN. THE DESCENDANTS SHALL COMPLETE THEIR INSPECTION WITHIN 48 HOURS OF BEING GRANTED ACCESS TO THE SITE. THE DESIGNATED NATIVE AMERICAN REPRESENTATIVE WOULD THEN DETERMINE, IN CONSULTATION WITH THE PROPERTY OWN, THE DISPOSITION OF THE HUMAN REMAINS.

STATEMENT OF UNDERSTANDING

AS THE CIVIL ENGINEER OF THE PROJECT, I HAVE REVIEWED THE DEVELOPMENT PLANNING FOR STORM WATER MANAGEMENT –A MANUAL FOR THE STANDARD URBAN STORMWATER MITIGATION PLAN (LID), AND HAVE PROPOSED THE IMPLEMENTATION OF THE PERMANENT BEST MANAGEMENT PRACTICES (BMP'S) APPLICABLE TO EFFECTIVELY MINIMIZE THE NEGATIVE IMPACTS OF THE PROJECTS STORMWATER RUNOFF. THE SELECTED BMP'S WILL BE INSTALLED PER THE APPROVED PLANS AND AS RECOMMENDED BY THE PRODUCT MANUFACTURER AS APPLICABLE.

SIGNATURE ______ DATE: 5/2/18

ENGINEER'S SURVEYORS STATEMENT REGARDING THE PRESENCE OF MONUMNTS WITHIN PROJECT LIMITS

I HEREBY ATTEST THAT I HAVE LOCATED AND REFERENCED ON THESE PLANS THE MONUMENTS EXISTING PRIOR TO CONSTRUCTION TO ENSURE PERPETUATION OF THEIR LOCATION IN ACCORDANCE WITH SECTION 8771 O THE BUSINESS AND PROFESSIONS CODE. I FURTHER ATTEST THAT I HAVE PERFORMED A RECORD SEARCH AND FIELD INSPECTION TO IDENTIFY EXISTING MONUMENTS AND SHALL FILE THE REQUISITE CORNER RECORD OR RECORD OF SURVEY OF THE PREFERENCES WITH THE COUNTY SURVEYOR.

SIGNATURE ______ DATE:

GEOTECHNICAL REVIEW

THESE PLANS HAVE BEEN REVIEWED FROM A GEOTECHNICAL STANDPOINT ONLY. BASED ON THAT REVIEW, IT APPEARS THE PLANS ARE IN GENERAL CONFORMANCE WITH RECOMMENDATIONS CONTAINED IN THE GEOTECHNICAL INVESTIGATION REPORT PREPARED FOR THE PROJECT (TGR GEOTECHNICAL INC., DATED MAY 23, 2016, JOB NO. 16-5868).

SIGNATURE AND DATE:______

TGR GEOTECH
3037 S HARBOR BLVD.
SANTA ANA, CA 92704
P: 714-641-7189
F: 714-641-7190
CONTACT: EDWARD BURROWS

ABBREVIATIONS

AB	AGGREGATE BASE	MH	MANHOLE
AC	ASPHALTIC CONCRETE	N'LY	NORTHERLY
BC	BEGIN CURVE	N	NORTH
BO	BLOW OFF	NTS	NOT TO SCALE
BLDG.	BUILDING	OC	ON CENTER
℄	CENTER LINE	OD	OUTSIDE DIAMETER
CB	CATCH BASIN	PCC	PORTLAND CEMENT CONCRETE
CF	CURB FACE	ℙ	PROPERTY LINE
CFS	CUBIC FEET PER SECOND	Q_{25}	25-YR FLOW
CSP	CORRUGATED STEEL PIPE	R	RADIUS
CY	CUBIC YARDS	RCP	REINFORCED CONCRETE PIPE
DW	DOMESTIC WATER	RT	RIGHT
EA	EACH	RW	RECLAIMED WATER
EC	END CURVE	R/W	RIGHT OF WAY
ECR	END CURB RETURN	S	SOUTH
EG	EXISTING GRADE	SD	STORM DRAIN
E'LY	EASTERLY	SF	SQUARE FEET
ES	EXISTING SURFACE	S'LY	SOUTHERLY
EX	EXISTING	SS	SANITARY SEWER
FG	FINISHED GRADE	STA	STATION
FL	FLOW LINE	STD	STANDARD
FNC	TOP OF FENCE	TC	TOP OF CURB
FPS	FEET PER SECOND	TF	TOP OF FOOTING
FS	FINISHED SURFACE	TG	TOP OF GRATE
FG	FINISH GRADE	TRW	TOP OF RET. WALL
HDPE	HIGH DENSITY POLYETHYLENE	TYP	TYPICAL
HGL	HYDRAULIC GRADE LINE	V	VELOCITY
HP	HIGH POINT	W/	WEST/WITH
ID	INSIDE DIAMETER	W	WITH
INV	INVERT	W'LY	WESTERLY
JS	JUNCTION STRUCTURE		
LT	LEFT		
MIN	MINIMUM		
MISC	MISCELLANEOUS		

SPECIAL NOTES:

IN THE EVENT THAT PALEONTOLOGY RESOURCES ARE UNEARTHED DURING SUBSURFACE CONSTRUCTION ACTIVITIES, A LOS ANGLES COUNTY CERTIFIED PALEONTOLOGIST SHALL BE RETAINED TO EVALUATE THE DISCOVERY PRIOR TO RESUMING GRADING IN THE IMMEDIATE VICINITY OF THE FIND. IF THE PALEONTOLOGIST RESOURCES ARE FOUND TO BE SIGNIFICANT, THE PALEONTOLOGIST SHALL DETERMINE APPROPRIATE ACTIONS, IN COOPERATION WITH THE CITY OF COMMERCE AND PROPERTY OWNER, WHICH ENSURE PROPER EXPLORATION AND/OR SALVAGE. A TECHNICAL REPORT SHALL BE PREPARED AND INCLUDE THE PERIOD OF INSPECTION, A CATALOGUE AND ANALYSIS OF THE FOSSILS FOUND, AND THE PRESENT REPOSITORY OF THE FOSSILS. THE PROJECT APPLICANT SHALL PREPARE EXCAVATED MATERIAL TO THE POINT OF IDENTIFICATION AND SHALL OFFER EXCAVATED FINDS FOR CURATORIAL PURPOSES TO THE COUNTY OF LOS ANGLES, OR ITS DESIGNEE, ON THE FIRST REFUSAL BASIS.

APPLICANT:

XEBEC BUILDING COMPANY
3010 OLD RANCH PARKWAY STE 480
SEAL BEACH, CA 90740
PHONE: 562-546-0260
CONTACT: SYLVIA TRAN

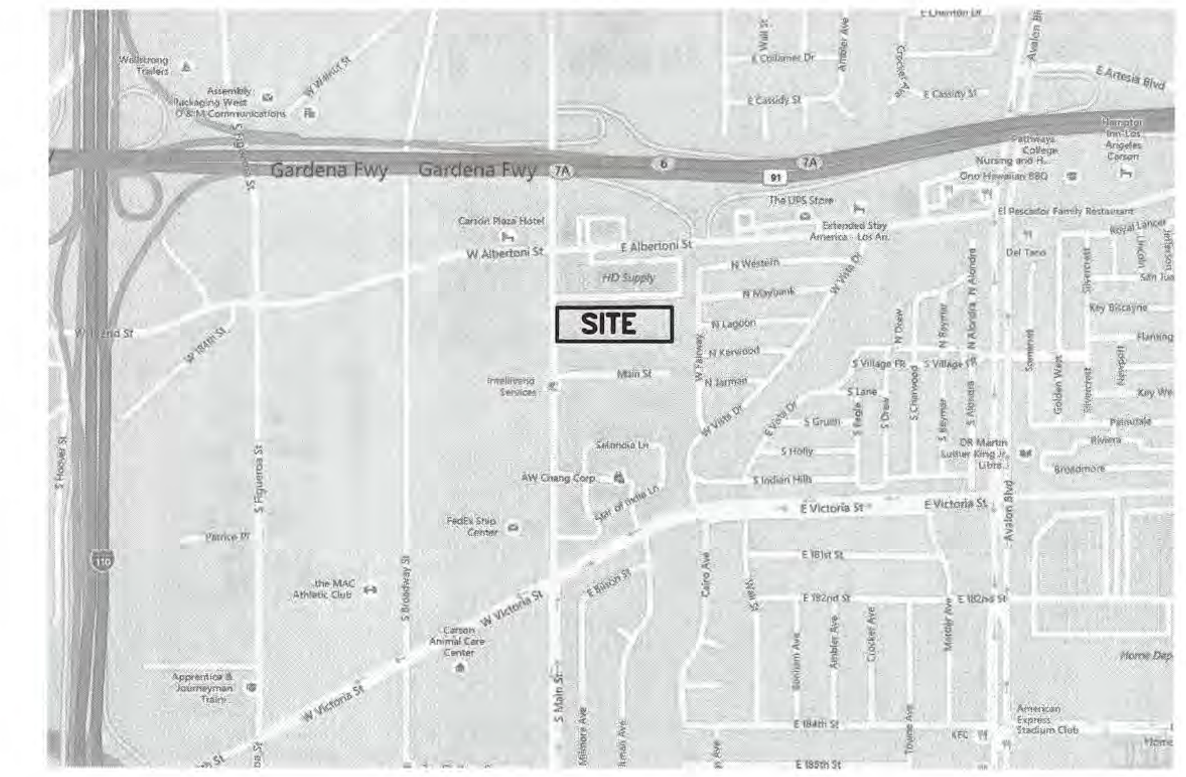
ENGINEER INFORMATION

KES TECHNOLOGIES INC
1 VENTURE STE 130
IRVINE, CA 92618
PHONE NO. 949-339-5331

SHEET INDEX:

LEGEND

- WALL OR RETAINING WALL
- BOUNDARY LINE
- LOT LINE
- 96.50 TC SPOT ELEVATION
- FLOW ARROW
- PROPOSED SLOPE
- EX. SLOPE
- SWALE FLOWLINE
- SD



VICINITY MAP
NTS

TITLE REPORT
FIRST AMERICAN TITLE COMPANY
18500 VON KARMAN AVE STE 600
IRVINE, CA 92621
ORDER NO. NVS-789925-SA1
DATED: APRIL 27, 2016

LEGAL DESCRIPTION

THE LAND REFERRED TO IN THIS COMMITMENT IS SITUATED IN THE CITY OF CARSON, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

THE SOUTH HALF OF LOT 7 OF SOUTH GARDENA TRACT, IN THE CITY OF CARSON, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 43 PAGE 39 OF MISCELLANEOUS RECORDS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY. EXCEPT THEREFROM THAT PORTION THEREOF LYING WESTERLY OF THE FOLLOWING DESCRIBED LINE: BEGINNING AT A POINT ON THE EASTERLY LINE OF MAIN STREET, 60 FEET WIDE, SHOWN AS BURLINGAME AVENUE ON SAID MAP, DISTANT ALONG SAID EASTERLY LINE, SOUTH 0° 29' 02" EAST, 810.48 FEET FROM THE MOST SOUTHERLY CORNER OF LAND DESCRIBED IN DEED TO THE STATE OF CALIFORNIA RECORDED IN BOOK 42804 PAGE 266 OFFICIAL RECORDS IN SAID OFFICE; THENCE NORTH 10° 49' 32" EAST 101.99 FEET TO A LINE PARALLEL WITH AND DISTANT EASTERLY 20.00 FEET, MEASURED AT RIGHT ANGLES FROM SAID EASTERLY LINE; THENCE NORTH 0° 29' 02" WEST, ALONG SAD PARALLEL LINE, 206.20 FEET; THENCE NORTH 40° 58' 04" EAST, 35.99 FEET, THENCE NORTH 87° 01' 14" EAST, 91.45 FEET TO THE NORTHERLY LINE OF SAID LOT.

ALSO EXCEPT THEREFROM THAT PORTION OF THE EASTERLY 20 FEET OF THE WESTERLY 50 FEET OF LOT 7, SOUTH GARDENA TRACT, AS SHOWN ON MAP RECORDED IN BOOK 43 PAGE 39 OF MISCELLANEOUS RECORDS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, WHICH LIES WITHIN THAT CERTAIN PARCEL OF PARCEL OF LAND DESCRIBED IN DEED TO SULLY-MILLER CONTRACTING COMPANY, RECORDED AS DOCUMENT NO. 2228 ON JANUARY 03, 1975 IN BOOK D6519, PAGE 459 OF OFFICIAL RECORDS, IN THE OFFICE OF THE COUNTY RECORDER; AREAS AND DISTANCE BEING MEASURED FROM THE CENTER LINE OF ADJOINING STREET, AS SAID STREET IS SHOWN ON SAID MAP. ALSO EXCEPT THEREFROM ALL OIL, GAS AND OTHER MINERALS LYING AT A DEPTH OF 500 FEET OR MORE BENEATH THE SURFACE OF SAID LAND WITHOUT RIGHT OF ENTRY UPON THE SURFACE OR THE FIRST 500 FEET BENEATH THE SURFACE THEREON AS RESERVED BY BELL PETROLEUM COMPANY, IN THE DEED RECORDED JANUARY 14, 1955 IN BOOK 46637 PAGE 151 OFFICIAL RECORDS.

EASEMENTS

4. EASEMENT(S) FOR THE PURPOSE(S) SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS GRANTED IN A DOCUMENT.

GRANTED TO: BLUE DIAMOND, A CORPORATION
PURPOSE: POLES
RECORDED: BOOK 47436, PAGE 185, OF OFFICIAL RECORDS

FLOOD ZONE:

PER FEMA'S WEBSITE ZONE X (AREA'S DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN) PER MAP NO. 06037C1935F DATED SEPT. 26, 2008.

PROJECT ADDRESS:
17706 MAIN STREET, CARSON, CQ

ENGINEER'S NOTES

AREA (GROSS)

PARCEL 1	203,023 SQ. FT. = 4.661 ACRES
TOTAL	203,023 SQ. FT. = 4.661 ACRES

BASIS OF BEARINGS THE BEARING N 00°28'80" W FOR THE CENTERLINE OF MAIN STREET. AS SHOWN ON RECORD OF SURVEY FILED IN BOOK 127, PAGE 47 OF MISCELLANEOUS MAPS, INCLUSIVE, IN THE OFFICE OF THE COUNTY RECORDER, CALIFORNIA.

ASSESSOR'S PARCEL MAP NO.

APN: 7339-002-003

SOILS NOTE:
THE UPPER 5 FEET OF SITE SOILD WITHIN THE PROPOSED BUILDING AND 5 FEET OUTSIDE THE FOOTPRINT SHALL BE REMOVED AND PLACED AS ENGINEERED FILL.

WDID: 4 19C382365

DIGALERT
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TWO WORKING DAYS BEFORE YOU DIG
TOLL FREE 1-800-227-2600
A PUBLIC SERVICE BY UNDERGROUND SERVICE ALERT

REVISIONS

NO	DATE	INITIAL	DESCRIPTION	APP	DATE

OWNER/DEVELOPER:
XEBEC BUILDING COMPANY
3010 OLD RANCH PARKWAY STE 480
SEAL BEACH, CA 90740
(562) 546-0260

PREPARED BY :
KES TECHNOLOGIES INC
CIVIL ENGINEERING
LAND PLANNING AND SURVEYING
1 VENTURE STE 130
IRVINE, CALIFORNIA 92618
PHONE (949) 339-5331
FAX (866) 426-2201

REGISTERED PROFESSIONAL ENGINEER
ALI MONSHIZADEH
C67674
EXP. 06/30/2019
CIVIL
STATE OF CALIFORNIA

I hereby certify that:
1. These plans have been prepared under my supervision:
2. The grading shown hereon will not divert drainage from its natural downstream course or obstruct the drainage of adjacent properties:
3. All specimen trees located on this properly are shown:
4. Existing ground contours and elevations were obtained by field survey on/aerial topography flown on MAY, 2016

ENGINEER ______ RCE 33520 DATE 5/2/2018 EXP. DATE 6-31-18

CALPAK
GRADING PLAN
TITLE SHEET

SHEET 1 OF 11

SCALE: AS SHOWN | DRAWN BY: DSK | CHECKED BY: AM

CITY OF CARSON

GENERAL NOTES:

1. ALL GRADING AND CONSTRUCTION SHALL CONFORM TO THE 2017 COUNTY OF LOS ANGELES BUILDING CODES AND THE STATE MODEL WATER EFFICIENCY LANDSCAPE ORDINANCE UNLESS SPECIFICALLY NOTED ON THESE PLANS.
2. ANY MODIFICATIONS OF OR CHANGES TO APPROVED GRADING PLANS MUST BE APPROVED BY THE BUILDING OFFICIAL.
3. NO GRADING SHALL BE STARTED WITHOUT FIRST NOTIFYING THE BUILDING OFFICIAL. A PRE-GRADING MEETING AT THE SITE IS REQUIRED BEFORE THE START OF THE GRADING WITH THE FOLLOWING PEOPLE PRESENT: OWNER, GRADING CONTRACTOR, DESIGN CIVIL ENGINEER, SOILS ENGINEER, GEOLOGIST, COUNTY GRADING INSPECTOR(S) OR THEIR REPRESENTATIVES, AND WHEN REQUIRED THE ARCHEOLOGIST OR OTHER JURISDICTIONAL AGENCIES. PERMITTEE OR HIS AGENT ARE RESPONSIBLE FOR ARRANGING PRE-GRADE MEETING AND MUST NOTIFY THE BUILDING OFFICIAL AT LEAST TWO BUSINESS DAYS PRIOR TO PROPOSED PRE-GRADE MEETING.
4. APPROVAL OF THESE PLANS REFLECT SOLELY THE REVIEW OF PLANS IN ACCORDANCE WITH THE COUNTY OF LOS ANGELES BUILDING CODES AND DOES NOT REFLECT ANY POSITION BY THE COUNTY OF LOS ANGELES OR THE DEPARTMENT OF PUBLIC WORKS REGARDING THE STATUS OF ANY TITLE ISSUES RELATING TO THE LAND ON WHICH THE IMPROVEMENTS MAY BE CONSTRUCTED. ANY DISPUTES RELATING TO TITLE ARE SOLELY A PRIVATE MATTER NOT INVOLVING THE COUNTY OF LOS ANGELES OR THE DEPARTMENT OF PUBLIC WORKS.
5. ALL GRADING AND CONSTRUCTION ACTIVITIES SHALL COMPLY WITH COUNTY OF LOS ANGELES CODE, TITLE 12, SECTION 12.12.030 THAT CONTROLS AND RESTRICTS NOISE FROM THE USE OF CONSTRUCTION AND GRADING EQUIPMENT FROM THE HOURS OF 8:00 PM TO 6:30 AM, AND ON SUNDAYS AND HOLIDAYS. (MORE RESTRICTIVE CONSTRUCTION ACTIVITY TIMES MAY GOVERN, AS REQUIRED BY THE DEPARTMENT OF REGIONAL PLANNING AND SHOULD BE SHOWN ON THE GRADING PLANS WHEN APPLICABLE.)
6. CALIFORNIA PUBLIC RESOURCES CODE (SECTION 5097.98) AND HEALTH AND SAFETY CODE (SECTION 7050.5) ADDRESS THE DISCOVERY AND DISPOSITION OF HUMAN REMAINS. IN THE EVENT OF DISCOVERY OR RECOGNITION OF ANY HUMAN REMAINS IN ANY LOCATION OTHER THAN A DEDICATED CEMETERY, THE LAW REQUIRES THAT GRADING IMMEDIATELY STOPS AND NO FURTHER EXCAVATION OR DISTURBANCE OF THE SITE, OR ANY NEARBY AREA WHERE HUMAN REMAINS MAY BE LOCATED, OCCUR UNTIL THE FOLLOWING HAS BEEN MEASURES HAVE BEEN TAKEN: A. THE COUNTY CORONER HAS BEEN INFORMED AND HAS DETERMINED THAT NO INVESTIGATION OF THE CAUSE OF DEATH IS REQUIRED, AND B. IF THE REMAINS ARE OF NATIVE AMERICAN ORIGIN, THE DESCENDANTS FROM THE DECEASED NATIVE AMERICANS HAVE MADE A RECOMMENDATION FOR THE MEANS OF TREATING OR DISPOSING, WITH APPROPRIATE DIGNITY, OF THE HUMAN REMAINS AND ANY ASSOCIATED GRAVE GOODS.
7. THE LOCATION AND PROTECTION OF ALL UTILITIES IS THE RESPONSIBILITY OF THE PERMITTEE.
8. ALL EXPORT OF MATERIAL FROM THE SITE MUST GO TO A PERMITTED SITE APPROVED BY THE BUILDING OFFICIAL OR A LEGAL DUMPSITE. RECEIPTS FOR ACCEPTANCE OF EXCESS MATERIAL BY A DUMPSITE ARE REQUIRED AND MUST BE PROVIDED TO THE BUILDING OFFICIAL UPON REQUEST.
9. A COPY OF THE GRADING PERMIT AND APPROVED GRADING PLANS MUST BE IN THE POSSESSION OF A RESPONSIBLE PERSON AND AVAILABLE AT THE SITE AT ALL TIMES.
10. SITE BOUNDARIES, EASEMENTS, DRAINAGE DEVICES, RESTRICTED USE AREAS SHALL BE LOCATED PER CONSTRUCTION STAKING BY FIELD ENGINEER OR LICENSED SURVEYOR. PRIOR TO GRADING, AS REQUESTED BY THE BUILDING OFFICIAL, ALL PROPERTY LINES, EASEMENTS, AND RESTRICTED USE AREAS SHALL BE STAKED.
11. NO GRADING OR CONSTRUCTION SHALL OCCUR WITHIN THE PROTECTED ZONE OF ANY OAK TREE AS REQUIRED PER TITLE CHAPTER 22.56 OF THE COUNTY OF LOS ANGELES ZONING CODE. THE PROTECTED ZONE SHALL MEAN THAT AREA WITHIN THE DRIP LINE OF AN OAK TREE EXTENDING THERE FROM A POINT AT LEAST FIVE FEET OUTSIDE THE DRIP LINE, OR 15 FEET FROM THE TRUNK(S) OF A TREE, WHICHEVER IS GREATER. IF AN OAK TREE PERMIT IS OBTAINED: (ADD THE FOLLOWING NOTE :) ALL GRADING AND CONSTRUCTION WITHIN THE PROTECTED ZONE OF ALL OAK TREES SHALL BE PER OAK TREE PERMIT NO.______________. ALL RECOMMENDATIONS IN THE PERMIT AND ASSOCIATED OAK TREE REPORT MUST BE COMPLIED WITH AND ARE A PART OF THE GRADING PLAN. A COPY OF THE OAK TREE PERMIT AND ASSOCIATED REPORTS SHALL BE MAINTAINED IN THE POSSESSION OF A RESPONSIBLE PERSON AND AVAILABLE AT THE SITE AT ALL TIMES.
12. THE STANDARD RETAINING WALL DETAILS SHOWN ON THE GRADING PLANS ARE FOR REFERENCE ONLY. STANDARD RETAINING WALLS ARE NOT CHECKED, PERMITTED, OR INSPECTED PER THE GRADING PERMIT. A SEPARATE RETAINING WALL PERMIT IS REQUIRED FOR ALL STANDARD RETAINING WALLS. NOTE: THIS NOTE ONLY APPLIES TO STANDARD RETAINING WALLS. GEOGRID FABRIC AND SEGMENTAL RETAINING WALLS DO NOT REQUIRE A SEPARATE RETAINING WALL PERMIT. DETAILS AND CONSTRUCTION NOTES FOR ALL GEOGRID WALLS MUST BE ON THE GRADING PLAN.
13. A PREVENTIVE PROGRAM TO PROTECT THE SLOPES FROM POTENTIAL DAMAGE FROM BURROWING RODENTS IS REQUIRED PER SECTION J101.8 OF THE COUNTY OF LOS ANGELES BUILDING CODE. OWNER IS TO INSPECT SLOPES PERIODICALLY FOR EVIDENCE OF BURROWING RODENTS AND A FIRST EVIDENCE OF THEIR EXISTENCE SHALL EMPLOY AN EXTERMINATOR FOR THEIR REMOVAL.
14. WHERE A GRADING PERMIT IS ISSUED AND THE BUILDING OFFICIAL DETERMINES THAT THE GRADING WILL NOT BE COMPLETED PRIOR TO NOVEMBER 1, THE OWNER OF THE SITE ON WHICH THE GRADING IS BEING PERFORMED SHALL, ON OR BEFORE OCTOBER 1, FILE OR CAUSE TO BE FILED WITH THE BUILDING OFFICIAL AN ESCP PER SECTION J110.8.3 OF THE COUNTY OF LOS ANGELES BUILDING CODE.
15. TRANSFER OF RESPONSIBILITY: IF THE FIELD ENGINEER, THE SOILS ENGINEER, OR THE ENGINEERING GEOLOGIST OF RECORD IS CHANGED DURING GRADING, THE WORK SHALL BE STOPPED UNTIL THE REPLACEMENT HAS AGREED IN WRITING TO ACCEPT THEIR RESPONSIBILITY WITHIN THE AREA OF TECHNICAL COMPETENCE FOR APPROVAL UPON COMPLETION OF THE WORK. IT SHALL BE THE DUTY OF THE PERMITTEE TO NOTIFY THE BUILDING OFFICIAL IN WRITING OF SUCH CHANGE PRIOR TO THE RECOMMENCEMENT OF SUCH GRADING.

INSPECTION NOTES:

1. THE PERMITTEE OR HIS AGENT SHALL NOTIFY THE BUILDING OFFICIAL AT LEAST ONE WORKING DAY IN ADVANCE OF REQUIRED INSPECTIONS AT FOLLOWING STAGES OF THE WORK. (SECTION J105.7 OF THE BUILDING CODE.)

   (A) PRE-GRADE – BEFORE THE START OF ANY EARTH DISTURBING ACTIVITY OR CONSTRUCTION.

   (B) INITIAL – WHEN THE SITE HAS BEEN CLEARED OF VEGETATION AND UNAPPROVED FILL HAS BEEN SCARIFIED, BENCHED OR OTHERWISE PREPARED FOR FILL. FILL SHALL NOT BE PLACED PRIOR TO THIS INSPECTION. NOTE: PRIOR TO ANY CONSTRUCTION ACTIVITIES, INCLUDING GRADING, ALL STORM WATER POLLUTION PREVENTION MEASURES INCLUDING EROSION CONTROL DEVICES WHICH CONTAIN SEDIMENTS MUST BE INSTALLED.

   (C) ROUGH – WHEN APPROXIMATE FINAL ELEVATIONS HAVE BEEN ESTABLISHED; DRAINAGE TERRACES, SWALES AND BERMS INSTALLED AT THE TOP OF THE SLOPE; AND THE STATEMENTS REQUIRED IN THIS SECTION HAVE BEEN RECEIVED.

   (D) FINAL – WHEN GRADING HAS BEEN COMPLETED; ALL DRAINAGE DEVICES INSTALLED; SLOPE PLANTING ESTABLISHED, IRRIGATION SYSTEMS INSTALLED AND THE AS-BUILT PLANS, REQUIRED STATEMENTS, AND REPORTS HAVE BEEN SUBMITTED AND APPROVED.
2. IN ADDITION TO THE INSPECTION REQUIRED BY THE BUILDING OFFICIAL FOR GRADING, REPORTS AND STATEMENTS SHALL BE SUBMITTED TO THE BUILDING OFFICIAL IN ACCORDANCE WITH SECTION J105 OF THE COUNTY OF LOS ANGELES BUILDING CODE.
3. UNLESS OTHERWISE DIRECTED BY THE BUILDING OFFICIAL, THE FIELD ENGINEER FOR ALL ENGINEERED GRADING PROJECTS SHALL PREPARE ROUTINE INSPECTION REPORTS AS REQUIRED UNDER SECTION J105.11 OF THE COUNTY OF LOS ANGELES BUILDING CODE. THESE REPORTS, KNOWN AS "REPORT OF GRADING ACTIVITIES", SHALL BE SUBMITTED TO THE BUILDING OFFICIAL AS FOLLOWS: 1. BI-WEEKLY DURING ALL TIMES WHEN GRADING OF 400 CUBIC YARDS OR MORE PER WEEK IS OCCURRING ON THE SITE; 2. MONTHLY, AT ALL OTHER TIMES; AND 3. AT ANY TIME WHEN REQUESTED IN WRITING BY THE BUILDING OFFICIAL. SUCH "REPORT OF GRADING ACTIVITIES" SHALL CERTIFY TO THE BUILDING OFFICIAL THAT THE FIELD ENGINEER HAS INSPECTED THE GRADING SITE AND RELATED ACTIVITIES AND HAS FOUND THEM IN COMPLIANCE WITH THE APPROVED GRADING PLANS AND SPECIFICATIONS, THE BUILDING CODE, ALL GRADING PERMIT CONDITIONS, AND ALL OTHER APPLICABLE ORDINANCES AND REQUIREMENTS. THIS FORM IS AVAILABLE AT THE FOLLOWING WEBSITE HTTP://DPW.LACOUNTY.GOV/BSD/DG/DEFAULT.ASPX. "REPORT OF GRADING ACTIVITIES" MAY BE SCANNED AND UPLOADED AT THE WEBSITE OR FAXED TO (310) 530-5482. FAILURE TO PROVIDE REQUIRED INSPECTION REPORTS WILL RESULT IN A "STOP WORK ORDER."
4. ALL GRADED SITES MUST HAVE DRAINAGE SWALES, BERMS, AND OTHER DRAINAGE DEVICES INSTALLED PRIOR TO ROUGH GRADING APPROVAL PER SECTION J105.7 OF THE COUNTY OF LOS ANGELES BUILDING CODE.
5. THE GRADING CONTRACTOR SHALL SUBMIT THE STATEMENT TO THE GRADING INSPECTOR AS REQUIRED BY SECTION J105.12 OF THE COUNTY OF LOS ANGELES BUILDING CODE AT THE COMPLETION OF ROUGH GRADING.
6. FINAL GRADING MUST BE APPROVED BEFORE OCCUPANCY OF BUILDINGS WILL BE ALLOWED PER SECTION J105 OF THE COUNTY OF LOS ANGELES BUILDING CODE.

DRAINAGE NOTES:

1. ROOF DRAINAGE MUST BE DIVERTED FROM GRADED SLOPES.
2. PROVISIONS SHALL BE MADE FOR CONTRIBUTORY DRAINAGE AT ALL TIMES.
3. ALL CONSTRUCTION AND GRADING WITHIN A STORM DRAIN EASEMENT ARE TO BE DONE PER PRIVATE DRAIN PD NO.______________ OR MISCELLANEOUS TRANSFER DRAIN MTD NO. ______________.
4. ALL STORM DRAIN WORK IS TO BE DONE UNDER CONTINUOUS INSPECTION BY THE FIELD ENGINEER. STATUS REPORTS REQUIRED UNDER NOTE 18 AND SECTION J105.11 OF THE COUNTY OF LOS ANGELES BUILDING CODE SHALL INCLUDE INSPECTION INFORMATION AND REPORTS ON THE STORM DRAIN INSTALLATION.

AGENCY NOTES:

26. AN ENCROACHMENT PERMIT FROM (COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS) (CALTRANS) (CITY OF ______________) IS REQUIRED FOR ALL WORK WITHIN OR AFFECTING ROAD RIGHT OF WAY. ALL WORK WITHIN ROAD RIGHT OF WAY SHALL CONFORM TO (COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS) (CALTRANS) (CITY OF ______________) ENCROACHMENT PERMIT.

27. AN ENCROACHMENT PERMIT/ CONNECTION PERMIT IS REQUIRED FROM THE COUNTY OF LOS ANGELES FLOOD CONTROL DISTRICT FOR ALL WORK WITHIN COUNTY OF LOS ANGELES FLOOD CONTROL RIGHT OF WAY. ALL WORK SHALL CONFORM TO CONDITIONS SET BY THE PERMIT.

STATEMENT OF UNDERSTANDING

AS THE CIVIL ENGINEER/LAND SURVEYOR OF THIS PROJECT, I HAVE IDENTIFIED THE LOCATION OF ALL EASEMENTS WHICH ARE DEPICTED ON THESE PLANS. PRIOR I HAVE REVIEWED THE PROPOSED EASEMENT DOCUMENTS AND HAVE VERIFIED THE PROPOSED CONSTRUCTION CONSTRUCTION DOES NOT CONFLICT OR INTERFERE THE INTENDED EASEMENT USE.

5/2/18

CIVIL ENGINEER/LAND SURVEYOR DATE:

GENERAL GEOTECHNICAL NOTES:

1. ALL WORK MUST BE IN COMPLIANCE WITH THE RECOMMENDATIONS INCLUDED IN THE GEOTECHNICAL CONSULTANT'S REPORT(S) AND THE APPROVED GRADING PLANS AND SPECIFICATIONS.
2. GRADING OPERATIONS MUST BE CONDUCTED UNDER PERIODIC INSPECTIONS BY THE GEOTECHNICAL CONSULTANTS WITH MONTHLY INSPECTION REPORTS TO BE SUBMITTED TO THE GEOLOGY AND SOILS SECTION. (900 S. FREMONT, ALHAMBRA CA 91803 – 3RD FLOOR)
3. THE SOIL ENGINEER SHALL PROVIDE SUFFICIENT INSPECTIONS DURING THE PREPARATION OF THE NATURAL GROUND AND THE PLACEMENT AND COMPACTION OF THE FILL TO BE SATISFIED THAT THE WORK IS BEING PERFORMED IN ACCORDANCE WITH THE PLAN AND APPLICABLE CODE REQUIREMENTS.
4. ROUGH GRADING MUST BE APPROVED BY A FINAL ENGINEERING GEOLOGY AND SOILS ENGINEERING REPORT. AN AS-BUILT GEOLOGIC MAP MUST BE INCLUDED IN THE FINAL GEOLOGY REPORT. PROVIDE A FINAL REPORT STATEMENT THAT VERIFIES WORK WAS DONE IN ACCORDANCE WITH REPORT RECOMMENDATIONS AND CODE PROVISIONS (SECTION J105.12 OF THE COUNTY OF LOS ANGELES BUILDING CODE). THE FINAL REPORT(S) MUST BE SUBMITTED TO THE GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION FOR REVIEW AND APPROVAL.
5. FOUNDATION, WALL AND POOL EXCAVATIONS MUST BE INSPECTED AND APPROVED BY THE CONSULTING GEOLOGIST AND SOIL ENGINEER, PRIOR TO THE PLACING OF STEEL OR CONCRETE.
6. BUILDING PADS LOCATED IN CUT/FILL TRANSITION AREAS SHALL BE OVER-EXCAVATED A MINIMUM OF THREE (3) FEET BELOW THE PROPOSED BOTTOM OF FOOTING.

FILL NOTES:

1. ALL FILL SHALL BE COMPACTED TO THE FOLLOWING MINIMUM RELATIVE COMPACTION CRITERIA:
   a. 90 PERCENT OF MAXIMUM DRY DENSITY WITHIN 40 FEET BELOW FINISH GRADE.
   b. 93 PERCENT OF MAXIMUM DRY DENSITY DEEPER THAN 40 FEET BELOW FINISH GRADE, UNLESS A LOWER RELATIVE COMPACTION (NOT LESS THAN 90 PERCENT OF MAXIMUM DRY DENSITY) IS JUSTIFIED BY THE GEOTECHNICAL ENGINEER. THE RELATIVE COMPACTION SHALL BE DETERMINED BY A.S.T.M. SOIL COMPACTION TEST D1557-91 WHERE APPLICABLE: WHERE NOT APPLICABLE, A TEST ACCEPTABLE TO THE BUILDING OFFICIAL SHALL BE USED. (SECTION J107.5 OF THE COUNTY OF LOS ANGELES BUILDING CODE.)
   c. 95 PERCENT OF MAXIMUM DRY DENSITY IS REQUIRED FOR ALL FIRE LANES UNLESS OTHERWISE APPROVED BY THE FIRE DEPARTMENT.
2. FIELD DENSITY SHALL BE DETERMINED BY A METHOD ACCEPTABLE TO THE BUILDING OFFICIAL. (SECTION J107.5 OF THE COUNTY OF LOS ANGELES BUILDING CODE.) HOWEVER, NOT LESS THAN 10% OF THE REQUIRED DENSITY TEST, UNIFORMLY DISTRIBUTED, AND SHALL BE OBTAINED BY THE SAND CONE METHOD.
3. SUFFICIENT TESTS OF THE FILL SOILS SHALL BE MADE TO DETERMINE THE RELATIVE COMPACTION OF THE FILL IN ACCORDANCE WITH THE FOLLOWING MINIMUM GUIDELINES:
   a. ONE TEST FOR EACH TWO-FOOT VERTICAL LIFT.
   b. ONE TEST FOR EACH 1,000 CUBIC YARDS OF MATERIAL PLACED.
   c. ONE TEST AT THE LOCATION OF THE FINAL FILL SLOPE FOR EACH BUILDING SITE (LOT) IN EACH FOUR-FOOT VERTICAL LIFT OR PORTION THEREOF.
   d. ONE TEST IN THE VICINITY OF EACH BUILDING PAD FOR EACH FOUR-FOOT VERTICAL LIFT OR PORTION THEREOF.
4. SUFFICIENT TESTS OF FILL SOILS SHALL BE MADE TO VERIFY THAT THE SOIL PROPERTIES COMPLY WITH THE DESIGN REQUIREMENTS, AS DETERMINED BY THE SOIL ENGINEER INCLUDING SOIL TYPES, SHEAR STRENGTHS PARAMETERS AND CORRESPONDING UNIT WEIGHTS IN ACCORDANCE WITH THE FOLLOWING GUIDELINES:
   a. PRIOR AND SUBSEQUENT TO PLACEMENT OF THE FILL, SHEAR TESTS SHALL BE TAKEN ON EACH TYPE OF SOIL OR SOIL MIXTURE TO BE USED FOR ALL FILL SLOPES STEEPER THAN THREE (3) HORIZONTAL TO ONE VERTICAL.
   b. SHEAR TEST RESULTS FOR THE PROPOSED FILL MATERIAL MUST MEET OR EXCEED THE DESIGN VALUES USED IN THE GEOTECHNICAL REPORT TO DETERMINE SLOPE STABILITY REQUIREMENTS. OTHERWISE, THE SLOPE MUST BE REEVALUATED USING THE ACTUAL SHEAR TEST VALUE OF THE FILL MATERIAL THAT IS IN PLACE.
   c. FILL SOILS SHALL BE FREE OF DELETERIOUS MATERIALS.
5. FILL SHALL NOT BE PLACED UNTIL STRIPPING OF VEGETATION, REMOVAL OF UNSUITABLE SOILS, AND INSTALLATION OF SUBDRAIN (IF ANY) HAVE BEEN INSPECTED AND APPROVED BY THE SOIL ENGINEER. THE BUILDING OFFICIAL MAY REQUIRE A "STANDARD TEST METHOD FOR MOISTURE, ASH, ORGANIC MATTER, PEAT OR OTHER ORGANIC SOILS" ASTM D-2974-87 ON ANY SUSPECT MATERIAL. DETRIMENTAL AMOUNTS OF ORGANIC MATERIAL SHALL NOT BE PERMITTED IN FILLS. SOIL CONTAINING SMALL AMOUNTS OF ROOTS MAY BE ALLOWED PROVIDED THAT THE ROOTS ARE IN A QUANTITY AND DISTRIBUTED IN A MANNER THAT WILL NOT BE DETRIMENTAL TO THE FUTURE USE OF THE SITE AND THE SOILS ENGINEER APPROVES THE USE OF SUCH MATERIAL.
6. ROCK OR SIMILAR MATERIAL GREATER THAN 12 INCHES IN DIAMETER SHALL NOT BE PLACED IN THE FILL UNLESS RECOMMENDATIONS FOR SUCH PLACEMENT HAVE BEEN SUBMITTED BY THE SOIL ENGINEER AND APPROVED IN ADVANCE BY THE BUILDING OFFICIAL. LOCATION, EXTENT, AND ELEVATION OF ROCK DISPOSAL AREAS MUST BE SHOWN ON AN "AS BUILT" GRADING PLAN.
7. CONTINUOUS INSPECTION BY THE SOIL ENGINEER, OR A RESPONSIBLE REPRESENTATIVE, SHALL BE PROVIDED DURING ALL FILL PLACEMENT AND COMPACTION OPERATIONS WHERE FILLS HAVE A DEPTH GREATER THAN 30 FEET OR SLOPE SURFACE STEEPER THAN 2:1. (SECTION J107.8 OF THE COUNTY OF LOS ANGELES BUILDING CODE)
8. CONTINUOUS INSPECTION BY THE SOIL ENGINEER, OR A RESPONSIBLE REPRESENTATIVE, SHALL BE PROVIDED DURING ALL SUBDRAIN INSTALLATION. (SECTION J107.2 OF THE COUNTY OF LOS ANGELES BUILDING CODE)
9. ALL SUBDRAIN OUTLETS ARE TO BE SURVEYED FOR LINE AND ELEVATION. SUBDRAIN INFORMATION MUST BE SHOWN ON AN "AS BUILT" GRADING PLAN.
10. FILL SLOPES IN EXCESS OF 2:1 STEEPNESS RATIO ARE TO BE CONSTRUCTED BY THE PLACEMENT OF SOIL AT SUFFICIENT DISTANCE BEYOND THE PROPOSED FINISH SLOPE TO ALLOW COMPACTION EQUIPMENT TO BE OPERATED AT THE OUTER LIMITS OF THE FINAL SLOPE SURFACE. THE EXCESS FILL IS TO BE REMOVED PRIOR TO COMPLETION OF ROUGH GRADING. OTHER CONSTRUCTION PROCEDURES MAY BE USED WHEN IT IS DEMONSTRATED TO THE SATISFACTION OF THE BUILDING OFFICIAL THAT THE ANGLE OF SLOPE, CONSTRUCTION METHOD AND OTHER FACTORS WILL HAVE EQUIVALENT EFFECT. (SECTION J107.5 OF THE COUNTY OF LOS ANGELES BUILDING CODE.)

PLANTING AND IRRIGATION NOTES:

1. PLANTING AND IRRIGATION ON GRADED SLOPES MUST COMPLY WITH THE FOLLOWING MINIMUM GUIDELINES:
   a. THE SURFACE OF ALL CUT SLOPES MORE THAN 5 FEET IN HEIGHT AND FILL SLOPES MORE THAN 3 FEET IN HEIGHT SHALL BE PROTECTED AGAINST DAMAGE BY EROSION BY PLANTING WITH GRASS OR GROUNDCOVER PLANTS. SLOPES EXCEEDING 15 FEET IN VERTICAL HEIGHT SHALL ALSO BE PLANTED WITH SHRUBS, SPACED AT NOT TO EXCEED 10 FEET ON CENTERS; OR TREES, SPACED AT NOT TO EXCEED 20 FEET ON CENTERS, OR A COMBINATION OF SHRUBS AND TREES AT EQUIVALENT SPACING, IN ADDITION TO THE GRASS OR GROUNDCOVER PLANTS. THE PLANTS SELECTED AND PLANTING METHODS USED SHALL BE SUITABLE FOR THE SOIL AND CLIMATIC CONDITIONS OF THE SITE. PLANT MATERIAL SHALL BE SELECTED WHICH WILL PRODUCE A COVERAGE OF PERMANENT PLANTING EFFECTIVELY CONTROLLING EROSION. CONSIDERATION SHALL BE GIVEN TO DEEP-ROOTED PLANTING MATERIAL NEEDING LIMITED WATERING, MAINTENANCE, HIGH ROOT TO SHOOT RATIO, WIND SUSCEPTIBILITY AND FIRE-RETARDANT CHARACTERISTICS. ALL PLANT MATERIALS MUST BE APPROVED BY THE BUILDING OFFICIAL. (SECTION J110.3 OF THE COUNTY OF LOS ANGELES BUILDING CODE) NOTE: PLANTING MAY BE MODIFIED FOR THE SITE IF SPECIFIC RECOMMENDATIONS ARE PROVIDED BY BOTH THE SOILS ENGINEER AND A LANDSCAPE ARCHITECT. SPECIFIC RECOMMENDATIONS MUST CONSIDER SOILS AND CLIMATIC CONDITIONS, IRRIGATION REQUIREMENTS, PLANTING METHODS, FIRE RETARDANT CHARACTERISTICS, WATER EFFICIENCY, MAINTENANCE NEEDS, AND OTHER REGULATORY REQUIREMENTS. RECOMMENDATIONS MUST INCLUDE A FINDING THAT THE ALTERNATIVE PLANTING WILL PROVIDE A PERMANENT AND EFFECTIVE METHOD OF EROSION CONTROL. MODIFICATIONS TO PLANTING MUST BE APPROVED BY THE BUILDING OFFICIAL PRIOR TO INSTALLATION.
   b. SLOPES REQUIRED TO BE PLANTED BY SECTION J110.3 SHALL BE PROVIDED WITH AN APPROVED SYSTEM OF IRRIGATION THAT IS DESIGNED TO COVER ALL PORTIONS OF THE SLOPE. IRRIGATION SYSTEM PLANS SHALL BE SUBMITTED AND APPROVED PRIOR TO INSTALLATION. A FUNCTIONAL TEST OF THE SYSTEM MAY BE REQUIRED. FOR SLOPES LESS THAN 20 FEET IN VERTICAL HEIGHT, HOSE BIBS TO PERMIT HAND WATERING WILL BE ACCEPTABLE IF SUCH HOSE BIBS ARE INSTALLED AT CONVENIENTLY ACCESSIBLE LOCATIONS WHERE A HOSE NO LONGER THAN 50 FEET IS NECESSARY FOR IRRIGATION. THE REQUIREMENTS FOR PERMANENT IRRIGATION SYSTEMS MAY BE MODIFIED UPON SPECIFIC RECOMMENDATION OF A LANDSCAPE ARCHITECT OR EQUIVALENT AUTHORITY THAT, BECAUSE OF THE TYPE OF PLANTS SELECTED, THE PLANTING METHODS USED AND THE SOIL AND CLIMATIC CONDITIONS AT THE SITE, IRRIGATION WILL NOT BE NECESSARY FOR THE MAINTENANCE OF THE SLOPE PLANTING. (SECTION J110.4 OF THE COUNTY OF LOS ANGELES BUILDING CODE)
   c. OTHER GOVERNMENTAL AGENCIES MAY HAVE ADDITIONAL REQUIREMENTS FOR LANDSCAPING AND IRRIGATION. IT IS THE RESPONSIBILITY OF THE APPLICANT TO COORDINATE WITH OTHER AGENCIES TO MEET THEIR REQUIREMENTS WHILE MAINTAINING COMPLIANCE WITH THE COUNTY OF LOS ANGELES BUILDING CODE.
2. THE PLANTING AND IRRIGATION SYSTEMS SHALL BE INSTALLED AS SOON AS PRACTICAL AFTER ROUGH GRADING. PRIOR TO FINAL GRADING APPROVAL ALL REQUIRED SLOPE PLANTING MUST BE WELL ESTABLISHED. (SECTION J110.7 OF THE COUNTY OF LOS ANGELES BUILDING CODE)
3. LANDSCAPE IRRIGATION SYSTEM SHALL BE DESIGNED AND MAINTAINED TO PREVENT SPRAY ON STRUCTURES. (TITLE 31, SECTION 5.407.2.1)
4. PRIOR TO ROUGH GRADE APPROVAL THIS PROJECT REQUIRES A LANDSCAPE PERMIT. LANDSCAPE PLANS IN COMPLIANCE WITH THE "MODEL WATER EFFICIENT LANDSCAPE ORDINANCE" TITLE 23, CHAPTER 2.7 OF CALIFORNIA CODE OF REGULATIONS (AB 1881) MUST BE SUBMITTED TO THE DEPARTMENT OF PUBLIC WORKS, LAND DEVELOPMENT DIVISION. (900 S. FREMONT AVE, ALHAMBRA – 3RD FLOOR, CA 91803 (626) 458-4921). TO OBTAIN LANDSCAPE PERMIT APPROVED PLANS AND WATER PURVEYOR ACKNOWLEDGMENT FORM MUST BE SUBMITTED TO THE LOCAL BUILDING AND SAFETY OFFICE.

BEST MANAGEMENT PRACTICE NOTES:

1. EVERY EFFORT SHOULD BE MADE TO ELIMINATE THE DISCHARGE OF NON-STORMWATER FROM THE PROJECT SITE AT ALL TIMES.

2. ERODED SEDIMENTS AND OTHER POLLUTANTS MUST BE RETAINED ON-SITE AND MAY NOT BE TRANSPORTED FROM THE SITE VIA SHEET FLOW, SWALES, AREA DRAINS, NATURAL DRAINAGE COURSES OR WIND.

3. STOCKPILES OF EARTH AND OTHER CONSTRUCTION RELATED MATERIALS MUST BE PROTECTED FROM BEING TRANSPORTED FROM THE SITE BY THE FORCES OF WIND OR WATER.

4. FUELS, OILS, SOLVENTS, AND OTHER TOXIC MATERIALS MUST BE STORED IN ACCORDANCE WITH THEIR LISTING AND ARE NOT TO CONTAMINATE THE SOIL AND SURFACE WATERS. ALL APPROVED STORAGE CONTAINERS ARE TO BE PROTECTED FROM THE WEATHER. SPILLS MUST BE CLEANED UP IMMEDIATELY AND DISPOSED OF IN A PROPER MANNER. SPILLS MAY NOT BE WASHED INTO THE DRAINAGE SYSTEM.

5. EXCESS OR WASTE CONCRETE MAY NOT BE WASHED INTO THE PUBLIC WAY OR ANY OTHER DRAINAGE SYSTEM. PROVISIONS SHALL BE MADE TO RETAIN CONCRETE WASTES ON-SITE UNTIL THEY CAN BE DISPOSED OF AS SOLID WASTE.

6. TRASH AND CONSTRUCTION RELATED SOLID WASTES MUST BE DEPOSITED INTO A COVERED RECEPTACLE TO PREVENT CONTAMINATION OF RAINWATER AND DISPERSAL BY WIND.

7. SEDIMENTS AND OTHER MATERIALS MAY NOT BE TRACKED FORM THE SITE BY VEHICLE TRAFFIC. THE CONSTRUCTION ENTRANCE ROADWAYS MUST BE STABILIZED SO AS TO INHIBIT SEDIMENTS FROM BEING DEPOSITED INTO THE PUBLIC WAY. ACCIDENTAL DEPOSITIONS MUST BE SWEPT UP IMMEDIATELY AND MAY NOT BE WASHED DOWN BY RAIN OR OTHER MEANS.

8. ANY SLOPES WITH DISTURBED SOILS OR DENUDED OR VEGETATION MUST BE STABILIZED SO AS TO INHIBIT EROSION BY WIND AND WATER.

9. AS THE PROJECT OWNER OR AUTHORIZED AGENT OF THE OWNER, I HAVE READ AND UNDERSTAND THE REQUIREMENTS LISTED ABOVE, NECESSARY TO CONTROL STORM WATER POLLUTION FROM SEDIMENTS, EROSION, AND CONSTRUCTION MATERIALS, AND I CERTIFY THAT I WILL COMPLY WITH THESE REQUIREMENTS.

PRINT NAME ______________________________
(OWNER OF AUTHORIZED AGENT OF THE OWNER)

SIGNATURE ______________________________ DATE __________
(OWNER OR AUTHORIZED AGENT OF THE OWNER)

THE FOLLOWING BMP'S AS OUTLINED IN, BUT NOT LIMITED TO, THE CALIFORNIA STORMWATER BEST MANAGEMENT PRACTICES HANDBOOK, JANUARY 2003, OR THE LATEST REVISED EDITION, MAY APPLY DURING THE CONSTRUCTION OF THIS PROJECT (ADDITIONAL MEASURES MAY BE REQUIRED IF DEEMED APPROPRIATE BY THE PROJECT ENGINEER OR THE BUILDING OFFICIAL)

EROSION CONTROL

- EC1 – SCHEDULING
- EC2 – PRESERVATION OF EXISTING VEGETATION
- EC3 – HYDRAULIC MULCH
- EC4 – HYDROSEEDING
- EC5 – SOIL BINDERS
- EC6 – STRAW MULCH
- EC7 – GEOTEXTILES & MATS
- EC8 – WOOD MULCHING
- EC9 – EARTH DIKES AND DRAINAGE SWALES
- EC10 – VELOCITY DISSIPATION DEVICES
- EC11 – SLOPE DRAINS
- EC12 – STEAMBANK STABILIZATION
- EC13 – POLYACRYLAMIDE

TEMPORARY SEDIMENT CONTROL

- SE1 – SILT FENCE
- SE2 – SEDIMENT BASIN
- SE3 – SEDIMENT TRAP
- SE4 – CHECK DAM
- SE5 – FIBER ROLLS
- SE6 – GRAVEL BAG BERM
- SE7 – STREET SWEEPING AND VACUUMING
- SE8 – SANDBAG BARRIER
- SE9 – STRAW BALE BARRIER
- SE10 – STORM DRAIN INLET PROTECTION

WIND EROSION CONTROL

- WE1 – WIND EROSION CONTROL

EQUIPMENT TRACKING CONTROL

- TC-1 – STABILIZED CONSTRUCTION ENTRANCE EXIT
- TC-2 – STABILIZED CONSTRUCTION ROADWAY
- TC-3 – ENTRANCE/OUTLET TIRE WASH

NON-STORMWATER MANAGEMENT

- NS1 – WATER CONSERVATION PRACTICES
- NS2 – DEWATERING OPERATIONS
- NS3 – PAVING AND GRINDING OPERATIONS
- NS4 – TEMPORARY STREAM CROSSING
- NS5 – CLEAR WATER DIVERSION
- NS6 – ILLICIT CONNECTION/DISCHARGE
- NS7 – POTABLE WATER/IRRIGATION
- NS8 – VEHICLE AND EQUIPMENT CLEANING
- NS9 – VEHICLE AND EQUIPMENT FUELING
- NS10 – VEHICLE AND EQUIPMENT MAINTENANCE
- NS11 – PILE DRIVING OPERATIONS
- NS12 – CONCRETE CURING
- NS13 – CONCRETE FINISHING
- NS14 – MATERIAL AND EQUIPMENT USE
- NS15 – DEMOLITION ADJACENT TO WATER
- NS16 – TEMPORARY BATCH PLANTS

WASTE MANAGEMENT & MATERIAL POLLUTION CONTROL

- WM1 – MATERIAL DELIVERY AND STORAGE
- WM2 – MATERIAL USE
- WM3 – STOCKPILE MANAGEMENT
- WM4 – SPILL PREVENTION AND CONTROL
- WM5 – SOLID WASTE MANAGEMENT
- WM6 – HAZARDOUS WASTE MANAGEMENT
- WM7 – CONTAMINATION SOIL MANAGEMENT
- WM8 – CONCRETE WASTE MANAGEMENT
- WM9 – SANITARY/SEPTIC WASTE MANAGEMENT
- WM10 – LIQUID WASTE MANAGEMENT

LID NOTES

1. DTERMINE AND PROVIDE THE PRE- AND POST- DEVELOPMENT PERVIOUS AND IMPERVIOUS AREAS CREATED BY THE PROPOSED DVELOPMENT. SHOW THE FOLLOWING TABLE ON THE PLANS.

2. ALL STRUCTURAL BMP'S SHALL BE ACCESSIBLE FOR INSPECTION AND MAINTANANCE AND SHALL BEAR A "NO DUMPING – DRAINS TO OCEAN" SYMBOL IN TRAFFIC RATED PAINT PER DETAIL HEREIN. STENCILS ARE AVAILABLE AT THE LOCAL BUILDING AND SAFETY DISTRICT OFFICE.

3. PRIOR TO COMMENCEMENT OF ANY WORK WITHIN THE ROAD RIGHT OF WAY AND OR CONNECTION TO A COUNTY MAINTAINED STORM DRAIN, AN ENCROACHMENT PERMIT FROM CONSTRUCTION DIVISION IS REQUIRED. FOR MORE INFORMATION CALL (626)458-3129.

4. PRIOR TO COMMENCEMENT OF ANY WORK AND/OR DISCHARGE OF DRAINAGE TO A WATERCOURSE, A PERMIT FROM BOTH THE CALIFORNIA DEPARMENT OF FISH AND GAME AND U.S. ARMY CORPS OF ENGINEERS MAY BE REQUIRED.

5. STATEMENTS OF UNDERSTANDING

AS THE ENGINEER OF THE PROJECT, I HAVE REVIEWED TEH DEVELOPMENT PLANNING FOR STORM WATER MANAGEMENT – A MANUAL FOR THE STANDARD URBAN STORMWATER MITIGATION PLAN (LID), AND HAVE PROPOSED THE IMPLEMENTATION OF THE PERMANENT BEST MANAGEMENT PRACTICES (BMPs) APPLICABLE TO EFFECTIVELY MINIMIZE THE NEGATIVE IMPACTS F THE PROJECT'S STORMWATER RUNOFF. THE SELECTED BMPs WILL BE INSTALLED PER THE APPROVED PLANS AND AS RECOMMENDED BY THE PRODUCT MANUFACTURER AS APPLICABLE.

SIGNATURE – ENGINEER OF RECORD DATE

DIGALERT
DIAL BEFORE YOU DIG — TWO WORKING DAYS BEFORE YOU DIG
TOLL FREE 1-800-227-2600
A PUBLIC SERVICE BY UNDERGROUND SERVICE ALERT

REVISIONS

NO	DATE	INITIAL	DESCRIPTION	APP	DATE

OWNER/DEVELOPER:
XEBEC BUILDING COMPANY
3010 OLD RANCH PARKWAY STE 480
SEAL BEACH, CA 90740
(562) 546-0260

PREPARED BY :
KES TECHNOLOGIES INC
CIVIL ENGINEERING
LAND PLANNING AND SURVEYING
1 VENTURE STE 130
IRVINE, CALIFORNIA 92618
PHONE (949) 339-5331
FAX (866) 426-2201

REGISTERED PROFESSIONAL ENGINEER — ALI MONSHIZADEH — C67874 — EXP. 06/30/2018 — CIVIL — STATE OF CALIFORNIA

I hereby certify that:
1. These plans have been prepared under my supervision:
2. The grading shown hereon will not divert drainage from its natural downstream course or obstruct the drainage of adjacent properties:
3. All specimen trees located on this property are shown:
4. Existing ground contours and elevations were obtained by field survey on/aerial topography flown on MAY, 2016

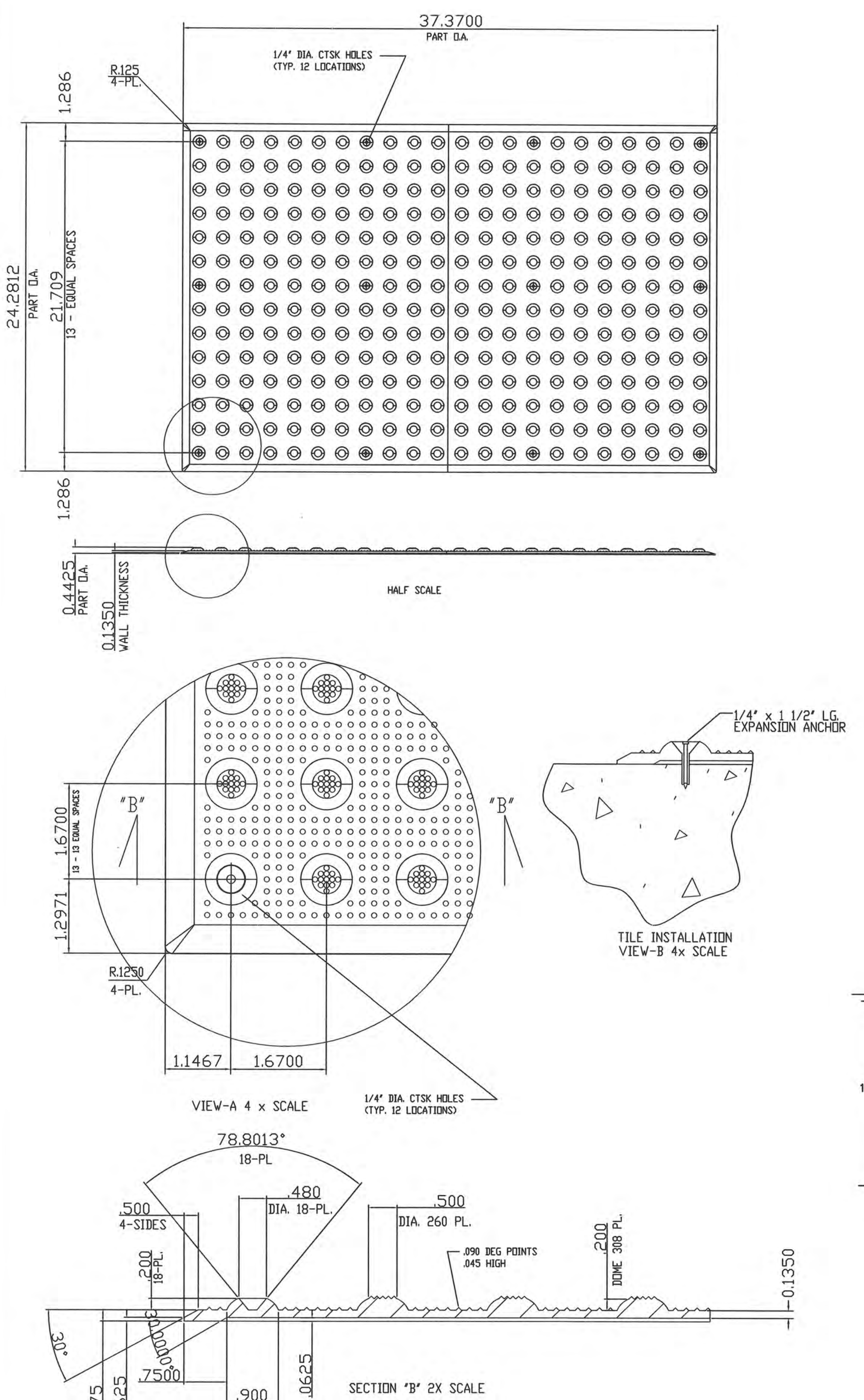
ENGINEER ______ DATE 5/2/2018
RCE 33520 EXP. DATE 6-31-18

CALPAK
GRADING PLAN
NOTES

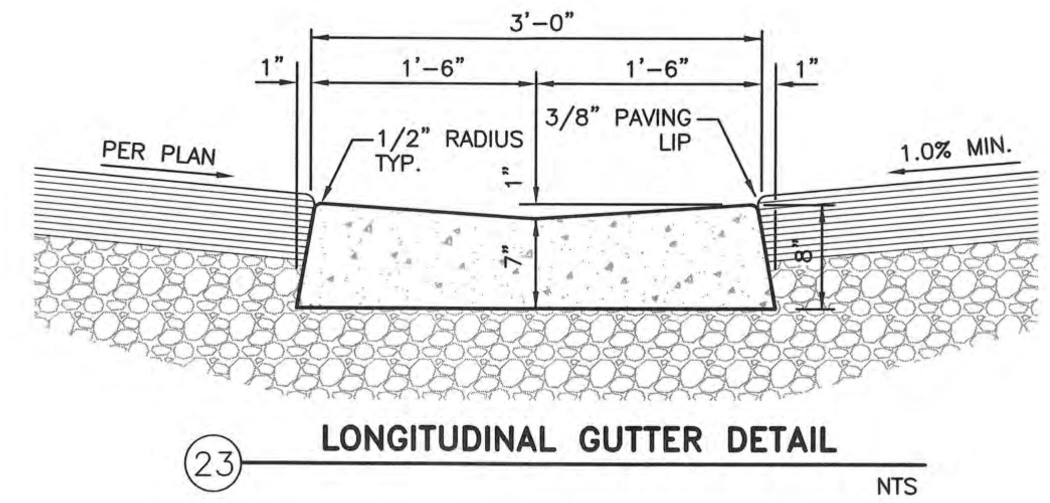
SHEET 2 OF 11

SCALE: AS SHOWN | DRAWN BY: DSK | CHECKED BY: AM

CITY OF CARSON

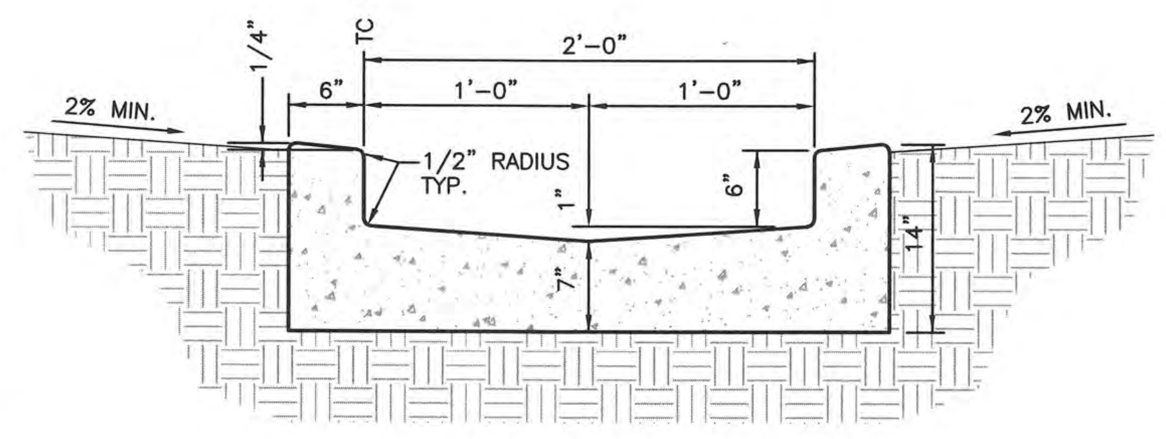


TRUNCATED DOME DETAIL

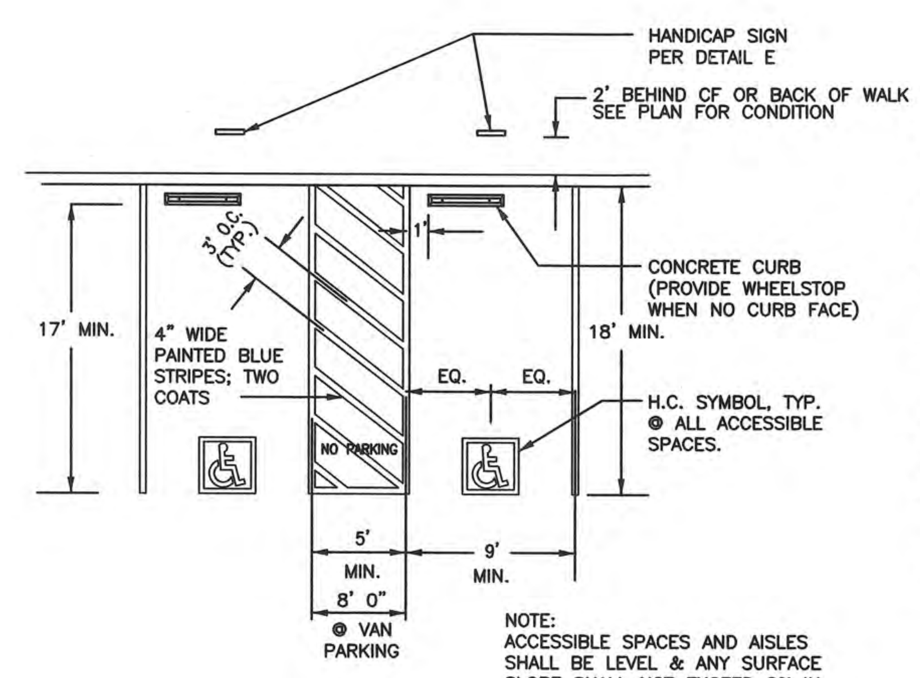


(23) LONGITUDINAL GUTTER DETAIL

NTS



(18) CONCRETE U-CHANNEL DETAIL



NOTES:

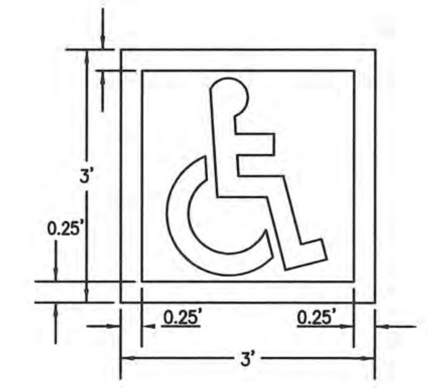
1. ALL STROKES TO BE 3" WIDE.
2. PROVIDE TWO COATS OF PAINT.
3. BLUE BACKGROUND WITH WHITE SYMBOL.
4. LOCATE SYMBOL AT CENTER OF STALL WHERE SHOWN ON SITE PLAN.
5. ONE SYMBOL FOR EACH HANDICAP PARKING SPACE.
6. SEE RAMP DETAILS ABOVE FOR TRUNCATED DOME LOCATION.
7. "NO PARKING" SHALL BE PAINTED ON THE GROUND WITHIN THE LOCADING ZONE IN WHITE LETTERING.

NOTE:
ACCESSIBLE SPACES AND AISLES SHALL BE LEVEL & ANY SURFACE SLOPE SHALL NOT EXCEED 2% IN ALL DIRECTIONS.

NOTE:
IF A WALK CROSSES OR ADJOINS A VEHICULAR WAY, AND THE WALKING SURFACES ARE NOT SEPARATED BY CURBS, RAILINGS, OR OTHER ELEMENTS BETWEEN THE PEDESTRIAN AREAS AND THE VEHICULAR AREAS, THE BOUNDARY SHALL BE DEFINED BY A CONTINUOUS DETECTABLE WARNING WHICH IS 36" WIDE.

HANDICAP PARKING STRIPING DETAIL

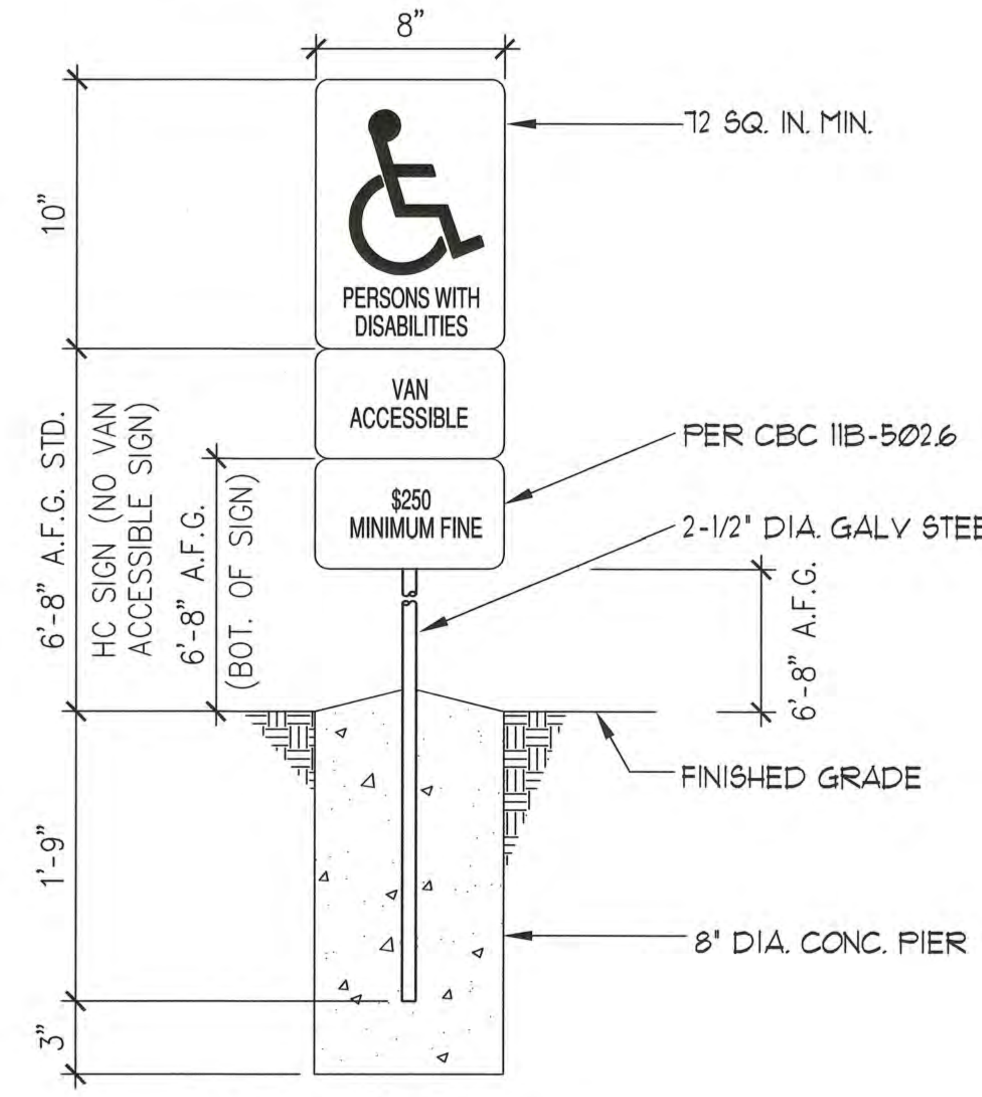
NTS



PATH OF ACCESSIBILITY SIGN D

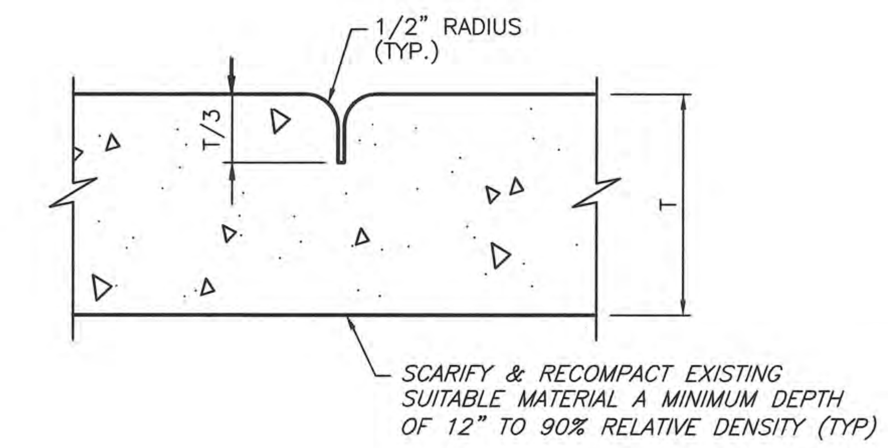
NTS

REFLECTORIZED PORCELAIN ON STEEL SIGN, BEADED TEXT OR EQUAL W/ INTERNATIONAL SYMBOL OF ACCESSIBILITY IN WHITE OR BLUE BACKGROUND

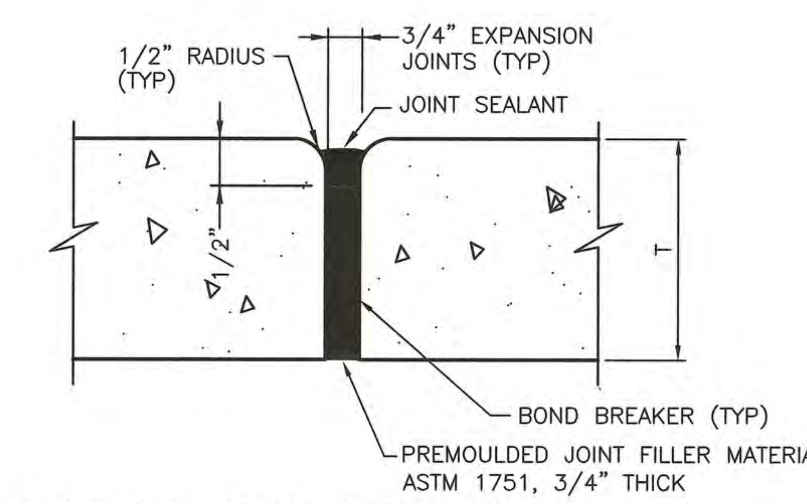


ADA PARKING SIGN

NTS



TOOLED JOINT (TJ)



NOTE: REINFORCING TO BE NON-CONTINUOUS AT EXPANSION JOINTS

EXPANSION JOINT (EJ)

TYPICAL CONCRETE JOINT DETAILS

N.T.S.

CATCH BASIN STENCILING DETAIL

NTS

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LAND PLANNING AND SURVEYING
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IRVINE, CALIFORNIA 92618
PHONE (949) 339-5331
FAX (866) 426-2201

REGISTERED PROFESSIONAL ENGINEER — ALI MONSHIZADEH — C67674 — EXP. 06/30/2019 — CIVIL — STATE OF CALIFORNIA

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4. Existing ground contours and elevations were obtained by field survey on/aerial topography flown on MAY, 2016

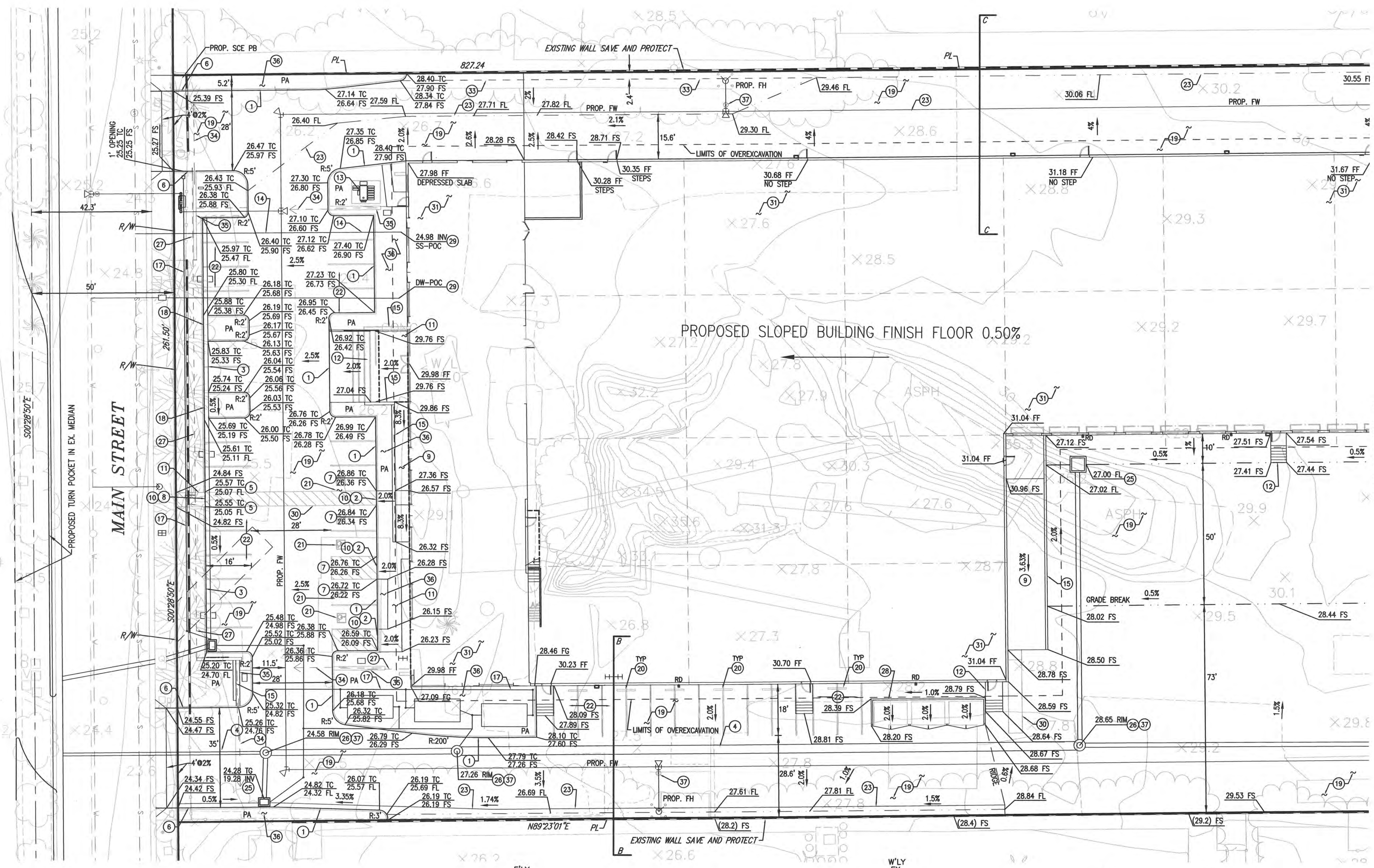
ENGINEER RCE 33520 DATE 5/2/2018 EXP. DATE 6-31-18

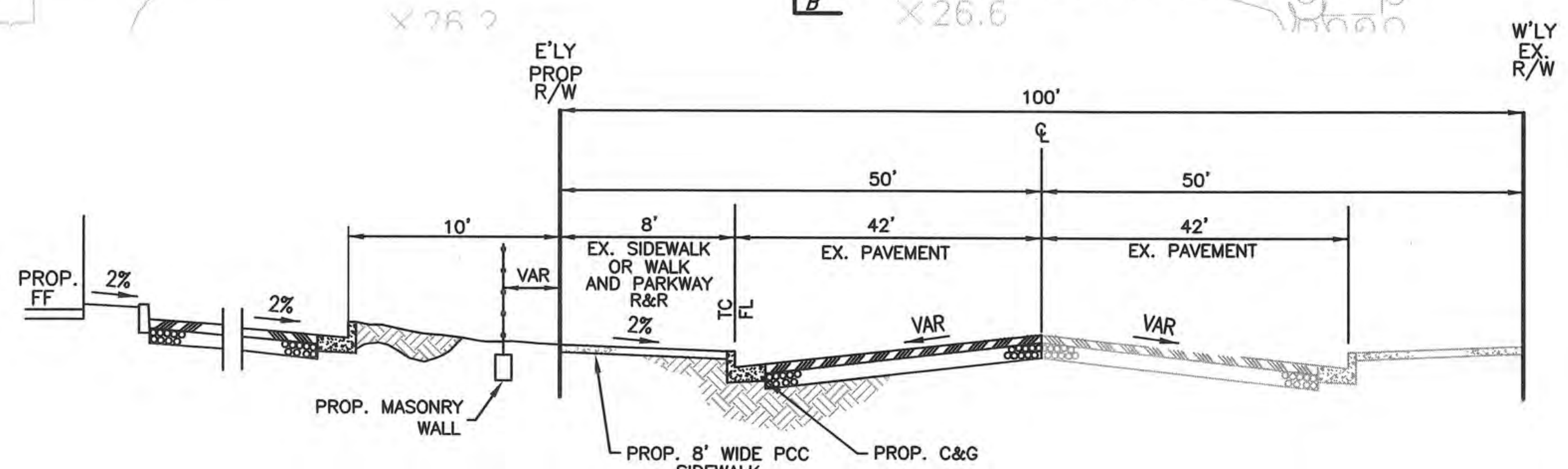
CALPAK
GRADING PLAN
DETAILS

SHEET 3 OF 11

SCALE: AS SHOWN | DRAWN BY: DSK | CHECKED BY: AM

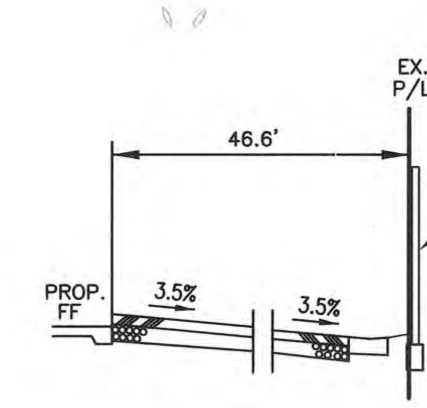
CITY OF CARSON





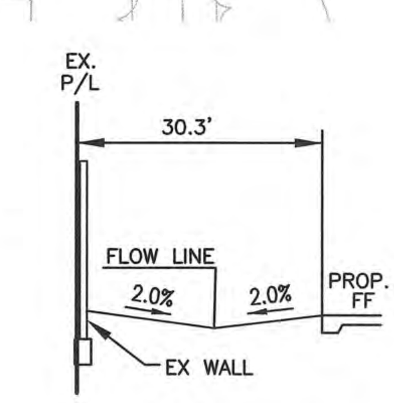
MAIN STREET TYPICAL SECTION

N.T.S.



TYPICAL SECTION B

N.T.S.



TYPICAL SECTION C

N.T.S.

SCALE: 1" = 20'

0 10 20 40

CONSTRUCTION NOTES:

1. CONST. 6" CURB ONLY PER SPPWC STD. PLAN NO. 120-2 TYPE A1-150(6).
2. CONST. 0" CURB ONLY PER SPPWC STD. PLAN NO. 120-2 TYPE A1-150(6).
3. CONST. 6" CURB AND GUTTER PER SPPWC STD. PLAN NO. 120-2 TYPE A3-150(6) W=18".
4. PROP. HDPE DRAIN LINE SEE UTILITY PLAN HEREIN.
5. TERMINATE THE PROPOSED CURB TO A ZERO INCH CURB FACE AT THE LOCATION SHOWN.
6. CONSTRUCT A FULL FACE TO ZERO FACE TRANSITION IN 4' IN THE LOCATIONS SHOWN.
7. CONSTRUCT 0" TO 6" VERTICAL TRANSITION IN THE LOCATIONS SHOWN.
8. CONST. 0" CURB AND GUTTER PER SPPWC STD. PLAN NO. 120-2 TYPE A3-150(6) W=18".
9. CONST. PCC RAMP, SEE ARCHITECTURAL PLANS.
10. INSTALL DETECTABLE WARNING SURFACE IN THE LOCATION SHOWN AND PER DETAIL SHEET 3.
11. INSTALL 4" THICK PCC SIDEWALK PER SPPWC 112-1, SEE LANDSCAPE PLAN FOR COLOR AND TEXTURE.
12. INSTALL PCC STAIRS, SEE ARCHITECTURAL PLANS FOR DETAILS.
13. PROPOSED TRANSFORMER LOCATION PER SEPARATE PLANS.
14. INSTALL 6" PVC SDR-35 SEWER LATERAL TO THE GRADES SHOWN.
15. PROPOSED WALL, SEE LANDSCAPE PLANS.
16. CONST. 6" CURB ONLY PLANTER DIAMONDS PER SPPWC STD. PLAN NO. 120-2 TYPE A1-150(6).
17. INSTALL 6" SDR-35 PVC DRAIN LINE, SLOPE SHALL BE 1%.
18. INSTALL PCC U-CHANNEL IN ACCORDANCE WITH DETAIL, SEE SHEET 3.
19. INSTALL 6" PCC CONCRETE PAVING SURFACE IN ACCORDANCE TO SOILS REPORT, SEE LANDSCAPE PLANS FOR SCORING PATTERN, COLOR AND TEXTURE.
20. INSTALL 4' LONG CONCRETE PARKING BLOCKS IN THE LOCATIONS SHOWN.
21. CONSTRUCT AND PAINT ADA PARKING AREA PER DETAIL, SEE SHEET 3.
22. PAINT PARKING STALLS IN ACCORDANCE TO COUNTY OF LOS ANGELES STANDARDS.
23. INSTALL CONCRETE RIBBON GUTTER IN THE LOCATIONS SHOWN AND PER DETAIL, SEE SHEET 3.
24. PROPOSED PCC WALL AND GATE, SEE ARCHITECTURAL PLANS.
25. INSTALL BROOKS 3'X3' AREA DRAIN BOX TO THE GRADES SHOWN. INSTALL KRISTAT FLO-GARD FILTER PER MANUFACTURERS RECOMMENDATIONS Qbmp:0.1 CFS. SEE SHEET 11.
26. INSTALL 5'X5' JUNCTION STRUCTURE TO THE GRADES SHOWN PER SPPWC STD 320-1.
27. PROPOSED FENCE LINE, SEE LANDSCAPE PLANS FOR DETAILS AND SPECIFICATIONS.
28. PROPOSED TRASH ENCLOSURE, SEE ARCHITECTURAL PLANS.
29. JOIN TO BUILDING PLUMBING SEE MEP PLANS.
30. PAINT BLUE ADA PATH OF TRAVEL STRIPING, 2 COATS.
31. PROPOSED BUILDING, SEE ARCHITECTURAL PLANS FOR STRUCTURAL SECTION CONFIRM PAD-FINISH FLOOR SECTION PRIOR TO GRADING.
32. CONTRACTOR TO CONSTRUCT TROWELED FLOW LINE.
33. CONTRACTOR TO CONSTRUCT 1:1 MAX GUNITE PCC SLOPE IN THE LOCATIONS SHOWN.
34. PROPOSED GATE, SEE ARCHITECTURAL PLANS.
35. PROPOSED GATE POCKET, SLOPE 1% TO DRAIN, SEE ARCHITECTURAL PLANS.
36. PROPOSED OPEN SPACE, SEE LANDSCAPE PLANS FOR IMPROVEMENTS.
37. RAISE TO FINISH GRADE PER GREEN BOOK STANDARDS.

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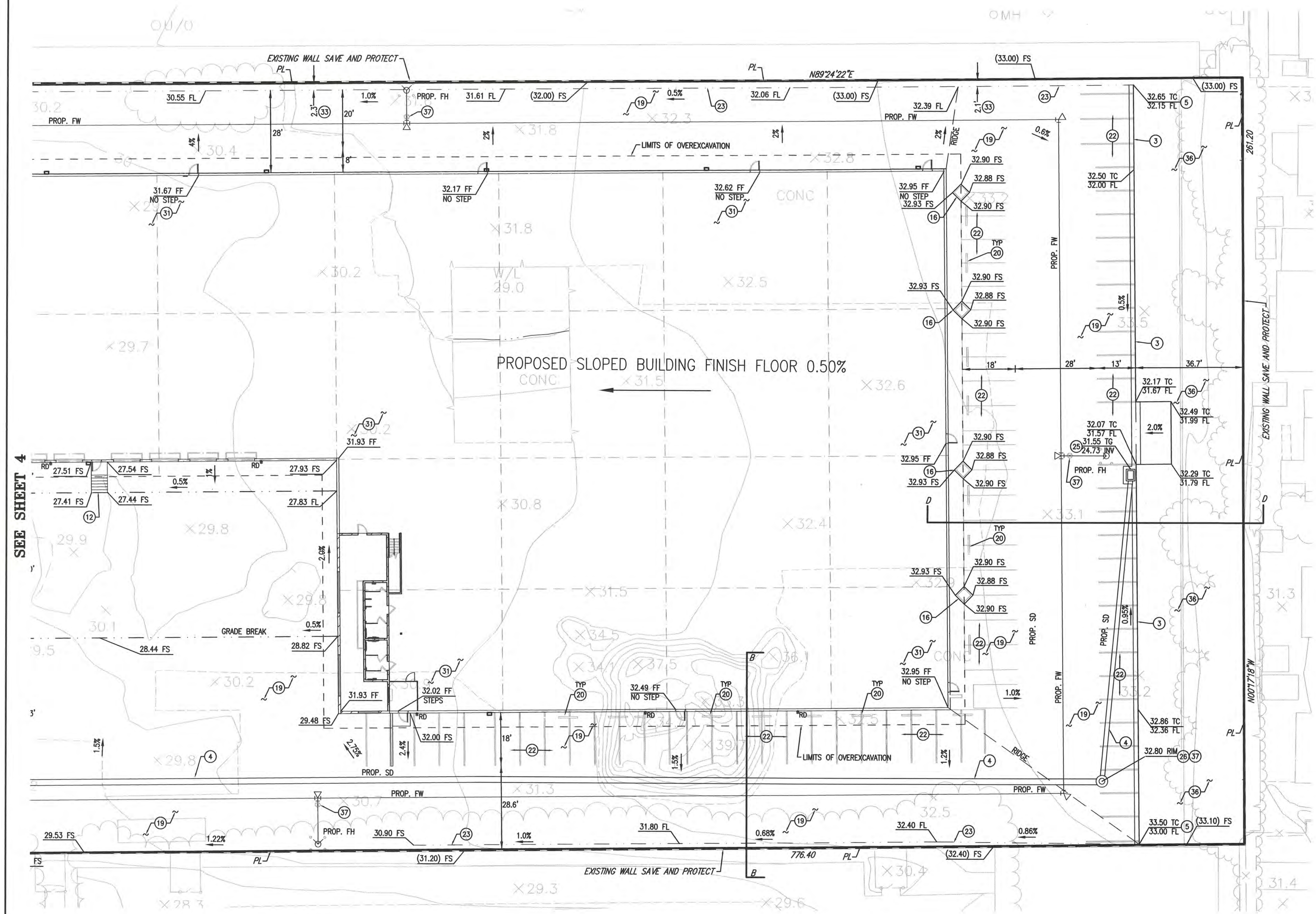
ENGINEER ______ DATE 5/2/2018
RCE 33520 EXP. DATE 6-31-18

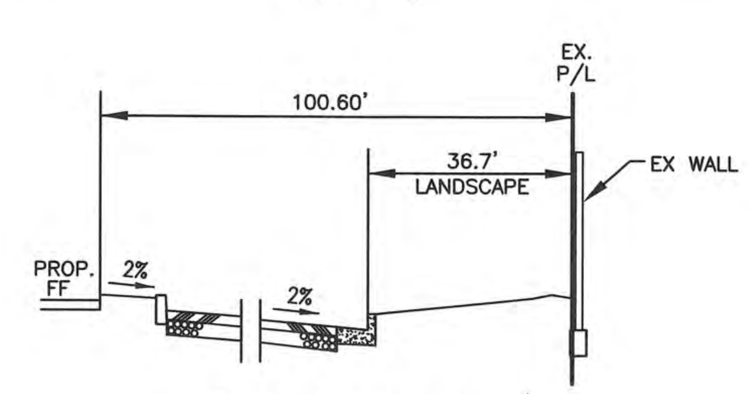
CALPAK
GRADING PLAN

SHEET 4 OF 11

SCALE: AS SHOWN | DRAWN BY: DSK | CHECKED BY: AM

CITY OF CARSON





TYPICAL SECTION D

N.T.S.

CONSTRUCTION NOTES:

(1) CONST. 6" CURB ONLY PER SPPWC STD. PLAN NO. 120–2 TYPE A1–150(6).

(2) CONST. 0" CURB ONLY PER SPPWC STD. PLAN NO. 120–2 TYPE A1–150(6).

(3) CONST. 6" CURB AND GUTTER PER SPPWC STD. PLAN NO. 120–2 TYPE A3–150(6) W=18".

(4) PROP. HDPE DRAIN LINE SEE UTILITY PLAN HEREIN.

(5) TERMINATE THE PROPOSED CURB TO A ZERO INCH CURB FACE AT THE LOCATION SHOWN.

(6) CONSTRUCT A FULL FACE TO ZERO FACE TRANSITION IN 4' IN THE LOCATIONS SHOWN.

(7) CONSTRUCT 0" TO 6" VERTICAL TRANSITION IN THE LOCATIONS SHOWN.

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(9) CONST. PCC RAMP, SEE ARCHITECTURAL PLANS.

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(12) INSTALL PCC STAIRS, SEE ARCHITECTURAL PLANS FOR DETAILS.

(13) PROPOSED TRANSFORMER LOCATION PER SEPARATE PLANS.

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(20) INSTALL 4' LONG CONCRETE PARKING BLOCKS IN THE LOCATIONS SHOWN.

(21) CONSTRUCT AND PAINT ADA PARKING AREA PER DETAIL, SEE SHEET 3.

(22) PAINT PARKING STALLS IN ACCORDANCE TO COUNTY OF LOS ANGELES STANDARDS.

(23) INSTALL CONCRETE RIBBON GUTTER IN THE LOCATIONS SHOWN AND PER DETAIL, SEE SHEET 3.

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(28) PROPOSED TRASH ENCLOSURE, SEE ARCHITECTURAL PLANS.

(29) JOIN TO BUILDING PLUMBING SEE MEP PLANS.

(30) PAINT BLUE ADA PATH OF TRAVEL STRIPING, 2 COATS.

(31) PROPOSED BUILDING, SEE ARCHITECTURAL PLANS FOR STRUCTURAL SECTION CONFIRM PAD–FINISH FLOOR SECTION PRIOR TO GRADING.

(32) CONTRACTOR TO CONSTRUCT TROWELED FLOW LINE.

(33) CONTRACTOR TO CONSTRUCT 1:1 MAX GUNITE PCC SLOPE IN THE LOCATIONS SHOWN.

(34) PROPOSED GATE, SEE ARCHITECTURAL PLANS.

(35) PROPOSED GATE POCKET, SLOPE 1% TO DRAIN, SEE ARCHITECTURAL PLANS.

(36) PROPOSED OPEN SPACE, SEE LANDSCAPE PLANS FOR IMPROVEMENTS.

(37) RAISE TO FINISH GRADE PER GREEN BOOK STANDARDS.

SOILS NOTE:

PER THE SOILS ENGINEER, THE UPPER 5 FEET OF SITE SOILS WITHIN THE PROPOSED BUILDING AND 5 FEET OUTSIDE THE FOOTPRINT SHALL BE REMOVED AND PLACED AS ENGINEERED FILL.

SCALE: 1" = 20'

0 10 20 40

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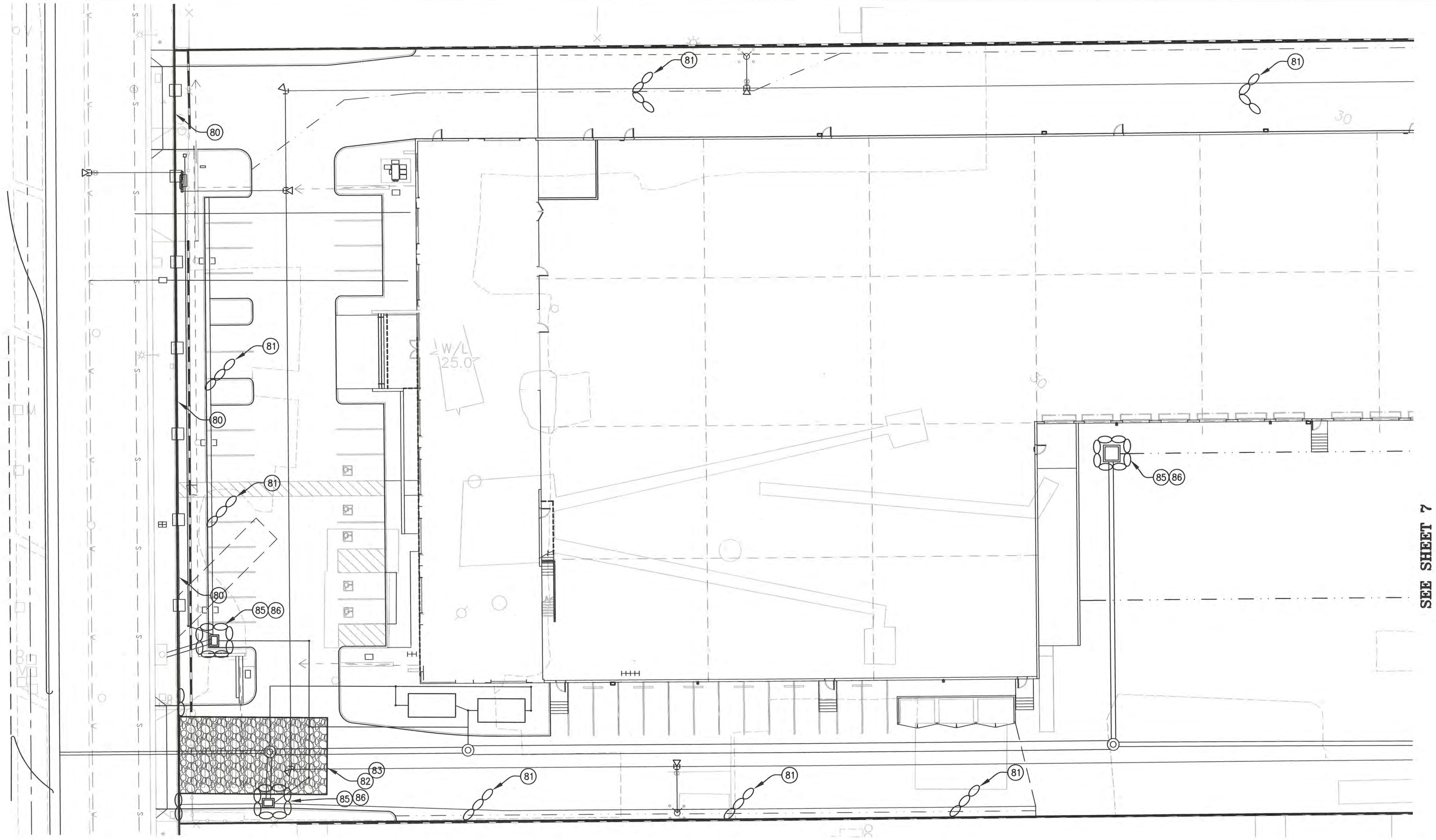
ENGINEER ______ RCE 33520 DATE 5/2/2018 EXP. DATE 6–31–18

CALPAK GRADING PLAN

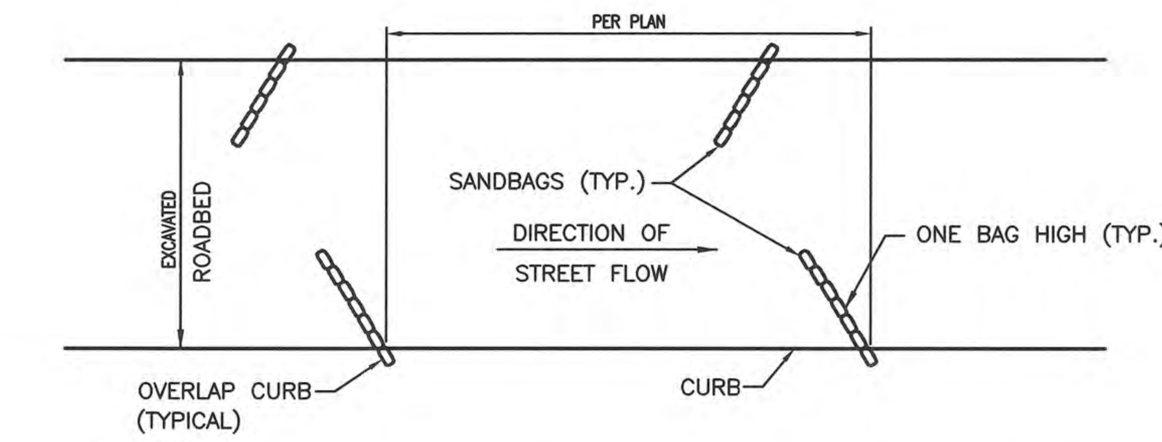
SHEET 5 OF 11

SCALE: AS SHOWN | DRAWN BY: DSK | CHECKED BY: AM

CITY OF CARSON



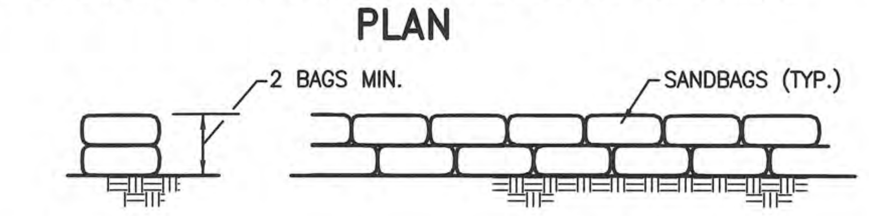
SEE SHEET 7



NOTE:

1. REQUIREMENTS FOR AND SPACING OF VELOCITY REDUCERS FOR STREETS WITH GRADES OF MORE THAN 4% SHALL BE AS SHOWN ON THE EROSION CONTROL PLAN.

PLAN



TYPICAL SECTION

TYPICAL ELEVATION

1. GRAVEL BAGS ARE ENCOURAGED OVER THE USE OF THE SANDBAGS AND MAY BE REQUIRED IN AREAS WHICH ARE PARTICULARLY SENSITIVE TO SEDIMENT DEPOSITION.

REFER: CALIF. STORMWATER BMP HANDBOOK – CONSTRUCTION SE-4

SANDBAG VELOCITY REDUCER

N.T.S.

CONSTRUCTION NOTES:

(80) PLACE 4' HIGH SILT FENCING PER CALIF. STORMWATER BMP HANDBOOK – CONSTRUCTION (SE-1)

(81) CONSTRUCT SANDBAG VELOCITY REDUCER BARRIER PER CALIF. STORMWATER BMP HANDBOOK – CONSTRUCTION (SE-4)

(82) CONSTRUCT STABILIZED CONSTRUCTION ENTRANCE/EXIT PER CALIF. STORMWATER BMP HANDBOOK – CONSTRUCTION (TC-1)

(83) INSTALL ENTRANCE/OUTLET TIRE WASH PER CALIF. STORMWATER BMP HANDBOOK – CONSTRUCTION (TC-3)

(84) SANDBAGS, (2) TWO BAGS HIGH PER CALIF. STORMWATER BMP HANDBOOK – CONSTRUCTION (SE-8)

(85) CONSTRUCT SANDBAG CHECK DAM PER CALIF. STORMWATER BMP HANDBOOK – CONSTRUCTION (SE-8)

(86) INSTALL FABRIC IN FRAME OF PROPOSED AREA DRAINS.

(87) PROVIDE STREET SWEEPING AND VACUUMING ON DAILY BASIS WHEN SEDIMENT TRACK IS VISIBLE PER CALIF. STORMWATER BMP HANDBOOK – CONSTRUCTION (SE-7)

(88) STOCKPILE/ MATERIAL STORAGE AREA/ CONCRETE WASHOUT/ SOILD AND CONCRETE WASTE MANAGEMENT AREAS TO BE PROTECTED BY STRAW BALE BARRIER (SE-9), FIBER ROLLS (SE-5) OR TEMPORARY SILT DIKE (SE-12) PER THE CONTRACTOR'S PREFERENCE AND PER THE CALIF. STORMWATER BMP HANDBOOK – CONSTRUCITON (WM-1 THROUGH WM-10)

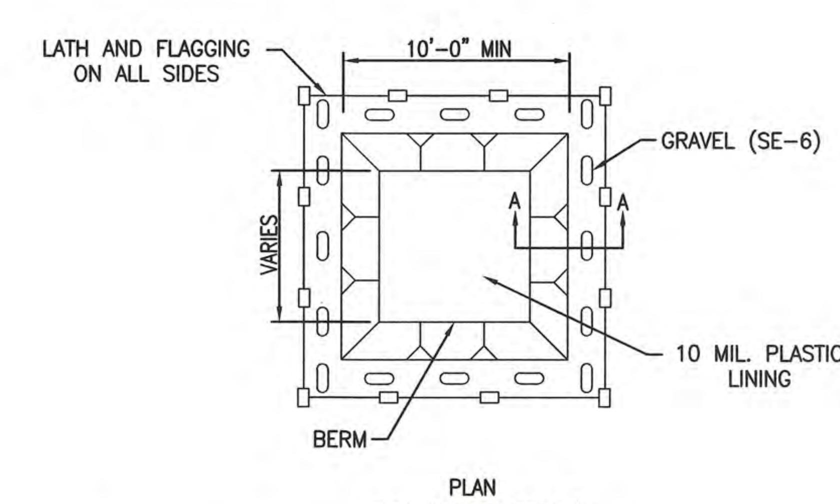
(90) SEPTIC WASTE MANAGEMENT – CHEMICAL PORTABLE TOILETS. MAY BE RELOCATED PER THE QSP AND CONTRACTORS PREFERENCE.

– PROVIDE WIND EROSION CONTROL OVER ENTIRE SITE PER CALIF. STORMWATER BMP HANDBOOK – CONSTRUCTION (WE-1)

WM-1 MATERIAL DELIVERY & STORAGE = WM-1

WM-9 SANITARY/SEPTIC WASTE MANAGEMENT = WM-9

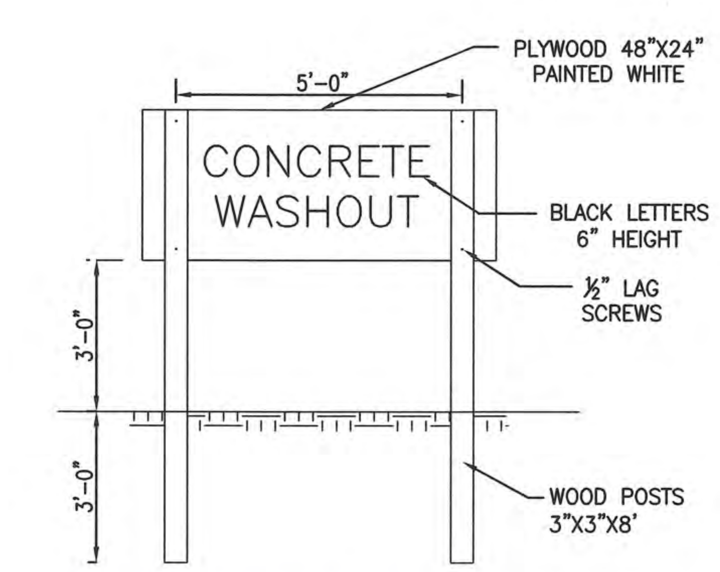
NOTE: NO TRUCK WASHING PERMITTED



(BMP-WM-8)

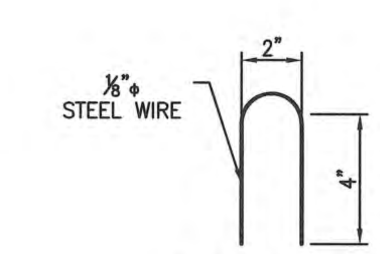
CONCRETE WASTE MANAGEMENT (WATER PROOF)

N.T.S.



CONCRETE WASHOUT SIGNED DETAIL (OR EQUIVALENT)

N.T.S.



STAPLE DETAIL

N.T.S.

SCALE: 1" = 20'

0 10 20 40

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ENGINEER ______ RCE 33520

DATE 5/2/2018

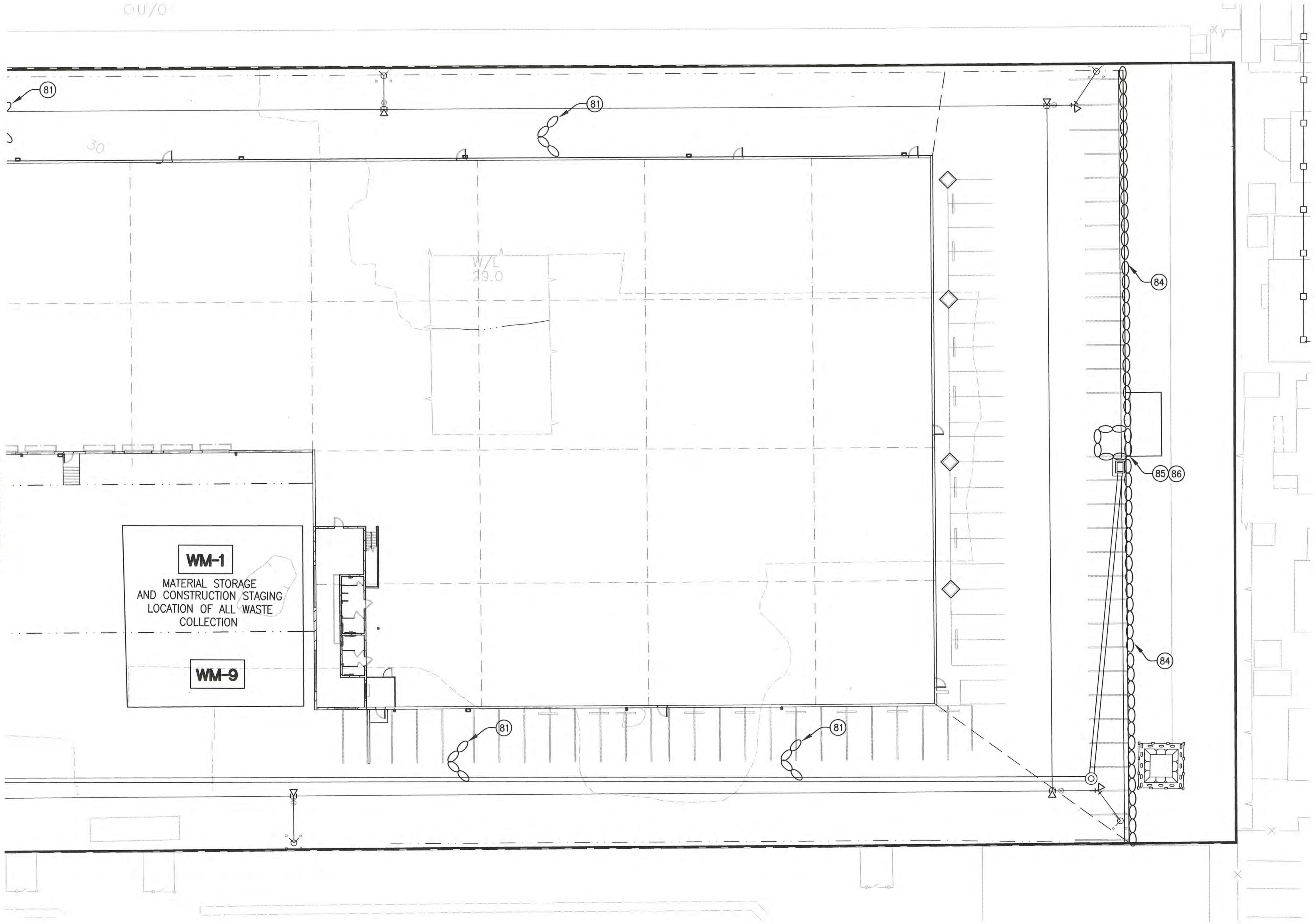
EXP. DATE 6-31-18

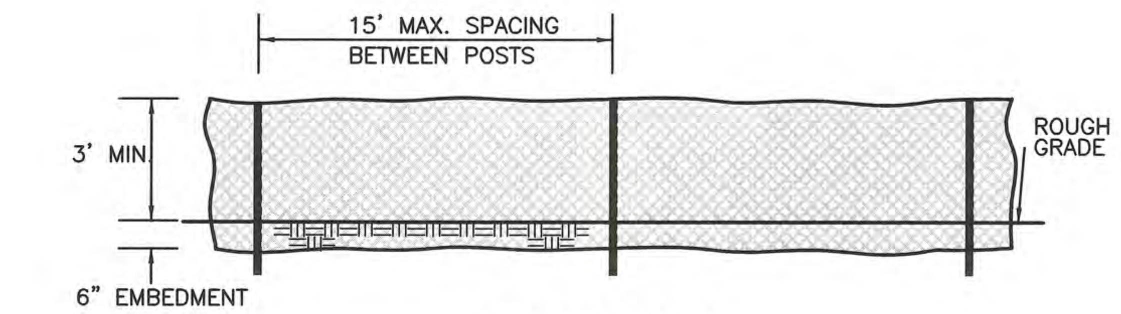
CALPAK
GRADING PLAN
EROSION CONTROL PLAN

SHEET 6 OF 11

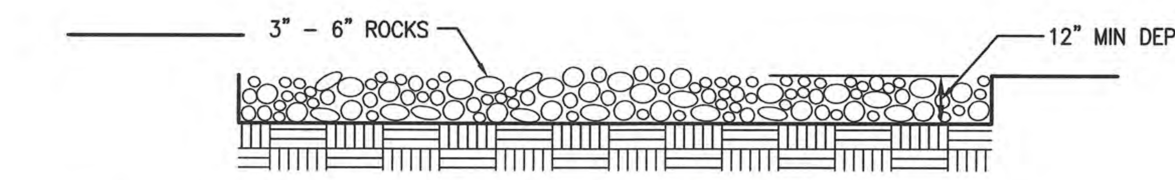
SCALE: AS SHOWN | DRAWN BY: DSK | CHECKED BY: AM

CITY OF CARSON

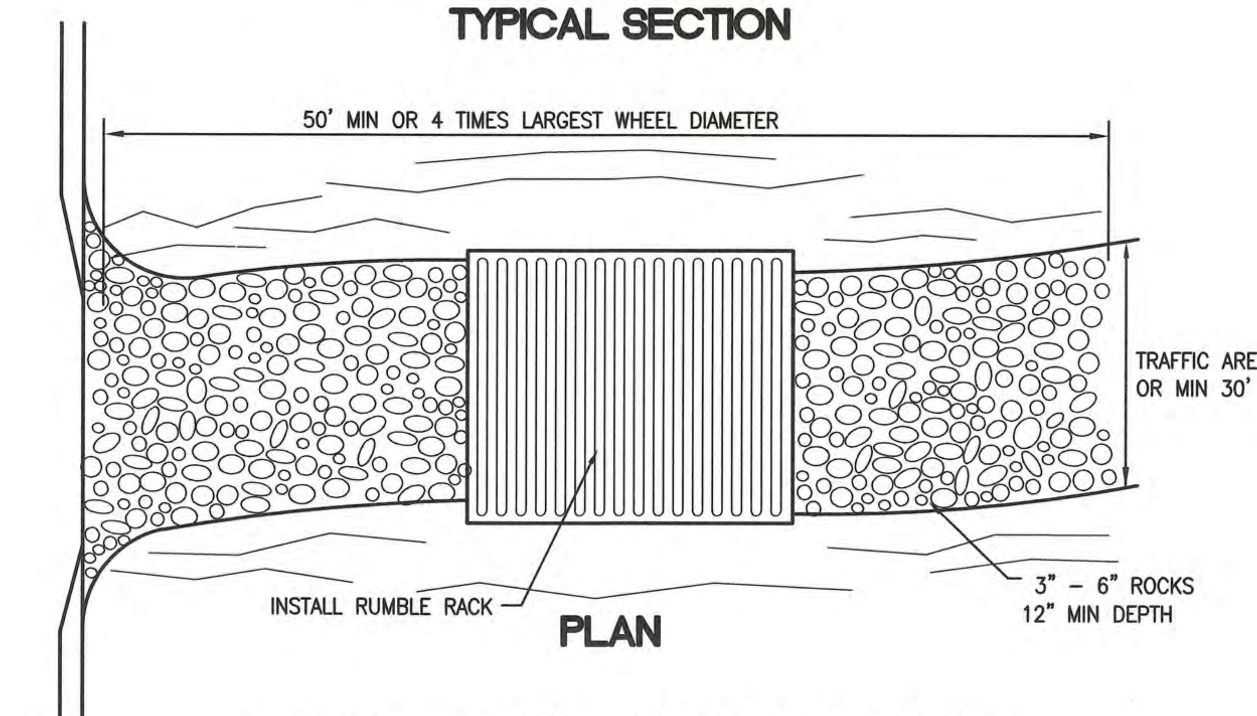




SILT FENCE
N.T.S.

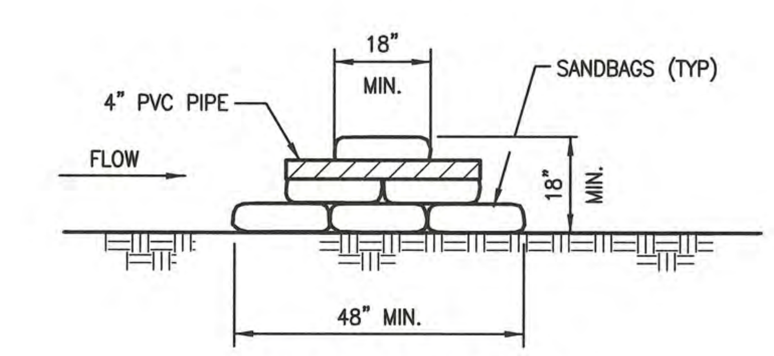


TYPICAL SECTION

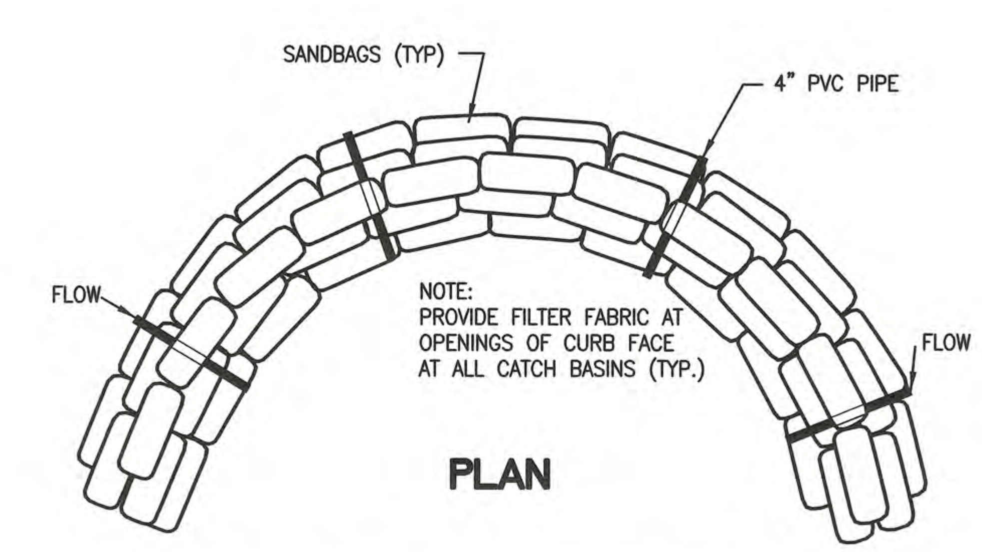


PLAN

STABILIZED CONSTRUCTION ENTRANCE



TYPICAL SECTION



PLAN

REFER: CALIF. STORMWATER BMP HANDBOOK - CONSTRUCTION SE-10

SANDBAG CHECK DAM
N.T.S.

SCALE: 1" = 20'
0 10 20 40

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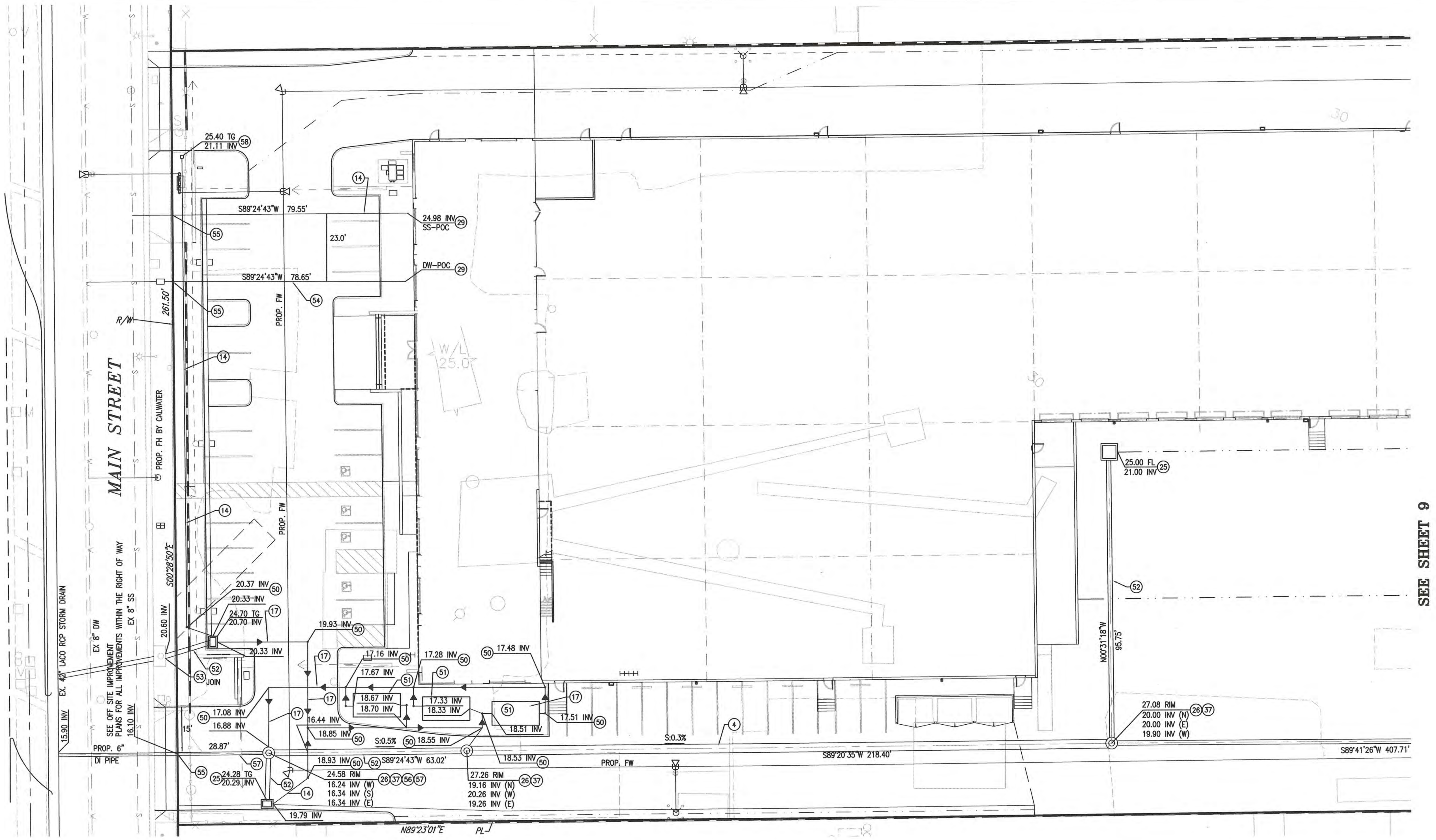
CALPAK
GRADING PLAN
EROSION CONTROL PLAN

SHEET 7 OF 11

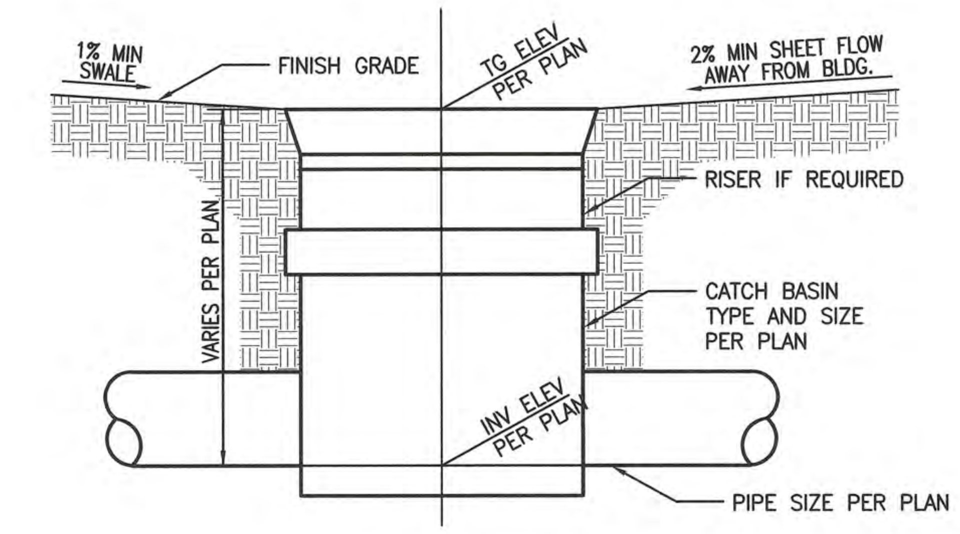
SCALE: AS SHOWN | DRAWN BY: DSK | CHECKED BY: AM

CITY OF CARSON



CONSTRUCTION NOTES:

- (4) — INSTALL 36" HDPE DRAIN LINE TO THE GRADES SHOWN AND PER TYPICAL TRENCHING SECTION.
- (14) — INSTALL 6" PVC SDR-35 SEWER LATERAL TO THE GRADES SHOWN.
- (17) — INSTALL 6" SDR-35 PVC DRAIN LINE, SLOPE SHALL BE 1%.
- (25) — INSTALL BROOKS 4'X4' AREA DRAIN BOX TO THE GRADES SHOWN. INSTALL ABTECH SMART SPONGE FILTER PER MANUFACTURERS RECOMMENDATIONS.
- (26) — INSTALL 5'X5' JUNCTION STRUCTURE TO THE GRADES SHOWN PER SPPWC STD 320-1.
- (29) — JOIN TO BUILDING PLUMBING SEE MEP PLANS.
- (50) — INSTALL AREA DRAIN CLEANOUT PER DETAIL, SHEET 3.
- (51) — INSTALL 8X18 FILTERRA-CONTECH PEAK DIVERSION TREATMENT SYSTEM.
- (52) — INSTALL 18" HDPE DRAIN LINE TO THE GRADES SHOWN AND PER TYPICAL TRENCHING SECTION.
- (53) — JOIN TO EXISTING CATCH BASIN PER GREEN BOOK STANDARDS.
- (54) — INSTALL 3" PVC C-900 AWWA WATER LINE, 42" MIN. COVER.
- (55) — JOIN TO OFF SITE SYSTEM, UNDER SEPARATE COVER.
- (56) — INSTALL 18" INLINE TIDEFLEX.
- (57) — INSTALL 8" DI DRAIN LINE, SLOPE SHALL BE 0.5%.
- (58) — INSTALL NDS 12"X12" AREA DRAIN BOX PER DETAIL, SHEET 8.



AREA DRAIN DETAIL
NTS

SCALE: 1" = 20'
0 10 20 40

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TWO WORKING DAYS BEFORE YOU DIG
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A PUBLIC SERVICE BY UNDERGROUND SERVICE ALERT

REVISIONS

NO	DATE	INITIAL	DESCRIPTION	APP	DATE

OWNER/DEVELOPER:
XEBEC BUILDING COMPANY
3010 OLD RANCH PARKWAY STE 480
SEAL BEACH, CA 90740
(562) 546-0260

PREPARED BY :
KES TECHNOLOGIES INC
CIVIL ENGINEERING
LAND PLANNING AND SURVEYING
1 VENTURE STE 130
IRVINE, CALIFORNIA 92618
PHONE (949) 339-5331
FAX (866) 426-2201

REGISTERED PROFESSIONAL ENGINEER ALI MONSHIZADEH C67874 EXP. 06/30/2019 CIVIL STATE OF CALIFORNIA

I hereby certify that:

1. These plans have been prepared under my supervision:
2. The grading shown hereon will not divert drainage from its natural downstream course or obstruct the drainage of adjacent properties:
3. All specimen trees located on this property are shown:
4. Existing ground contours and elevations were obtained by field survey on/aerial topography flown on MAY, 2016

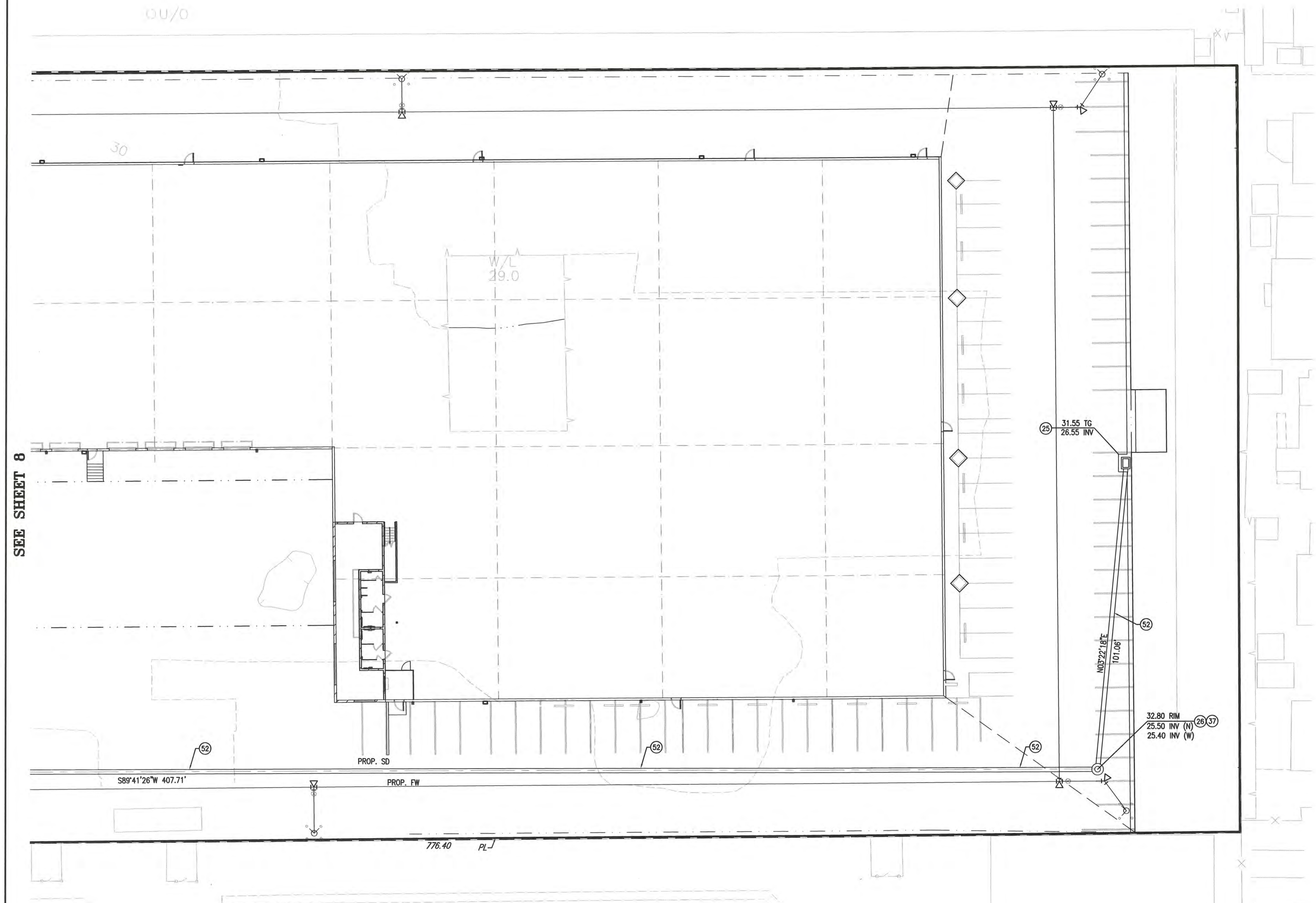
ENGINEER RCE 33520 DATE 5/2/2018 EXP. DATE 6-31-18

CALPAK
GRADING PLAN
UTILITY IMPROVEMENT PLAN

SHEET 8 OF 11

SCALE: AS SHOWN | DRAWN BY: DSK | CHECKED BY: AM

CITY OF CARSON



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(26)— INSTALL 5'X5' JUNCTION STRUCTURE TO THE GRADES SHOWN PER SPPWC STD 320-1.

(29)— JOIN TO BUILDING PLUMBING SEE MEP PLANS.

(50)— INSTALL AREA DRAIN CLEANOUT PER DETAIL, SHEET 3.

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(55)— JOIN TO OFF SITE SYSTEM, UNDER SEPARATE COVER.

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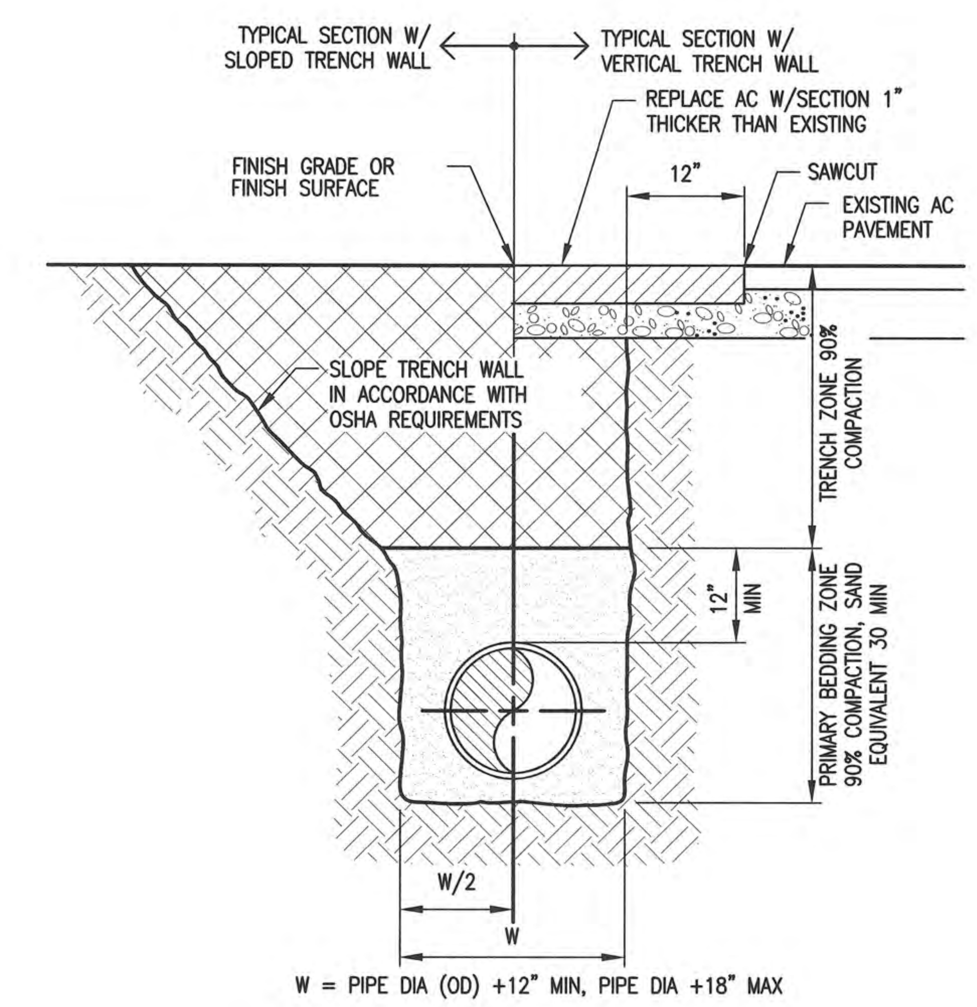

NOTE:

1. ALL TRENCHING & CONSTRUCTION OPERATIONS SHALL COMPLY WITH OSHA REQUIREMENTS.
3. REMOVE AND REPLACE EXIST SURFACE MATERIAL TO THE SATISFACTION OF THE OWNER. COMPLY WITH LOCAL JURISDICTION FOR PAVEMENT REPAIR.
3. SLOPING TRENCH WALL SECTION SUBJECT TO OWNER'S APPROVAL.

TYPICAL UTILITY TRENCH SECTION

NTS

SCALE: 1" = 20'

0 10 20 40

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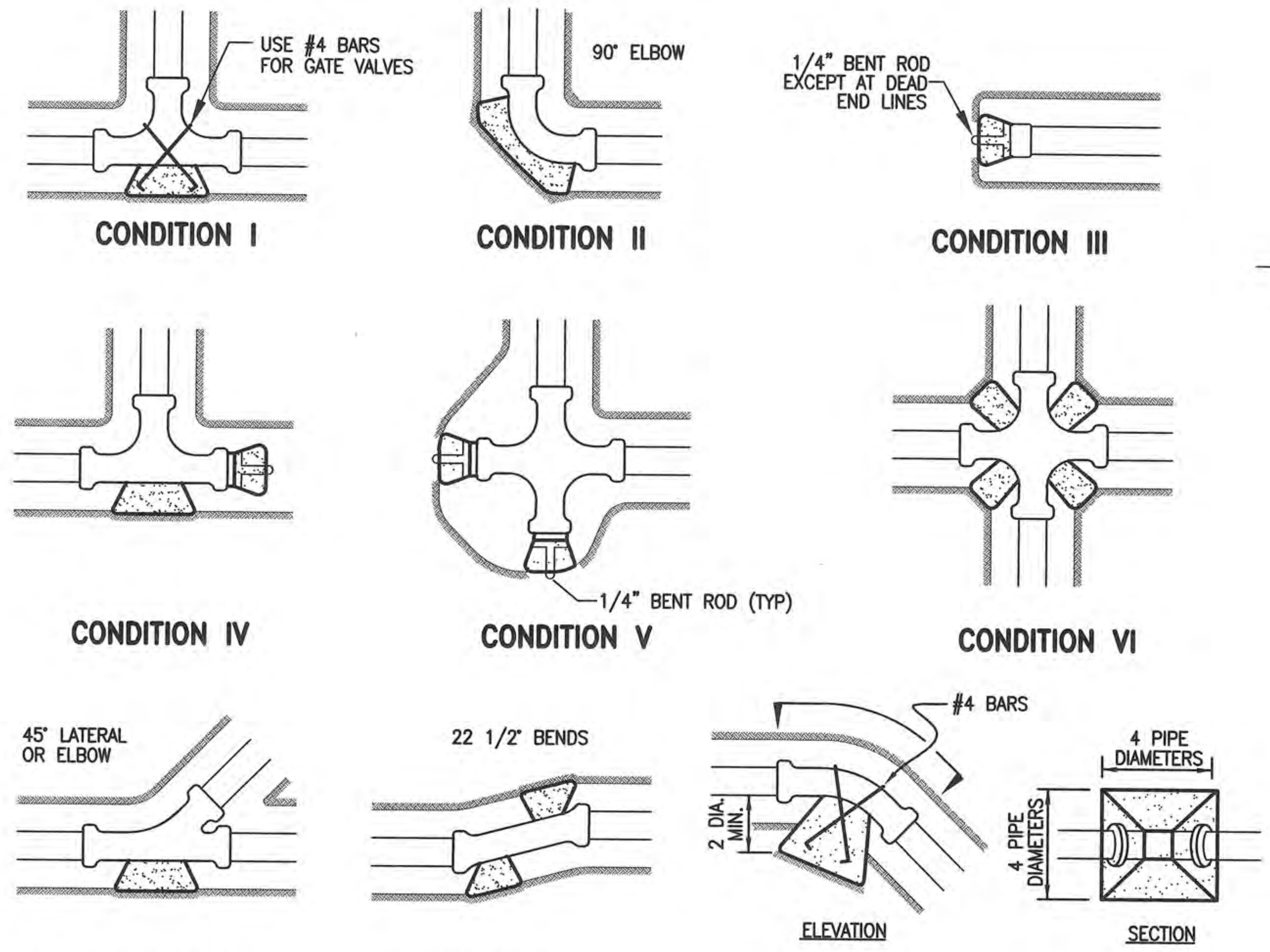
ENGINEER ____ DATE 5/2/2018
RCE 33520 EXP. DATE 6-31-18

CALPAK
GRADING PLAN
UTILITY IMPROVEMENT PLAN

SHEET 9 OF 11

SCALE: AS SHOWN | DRAWN BY: DSK | CHECKED BY: AM

CITY OF CARSON



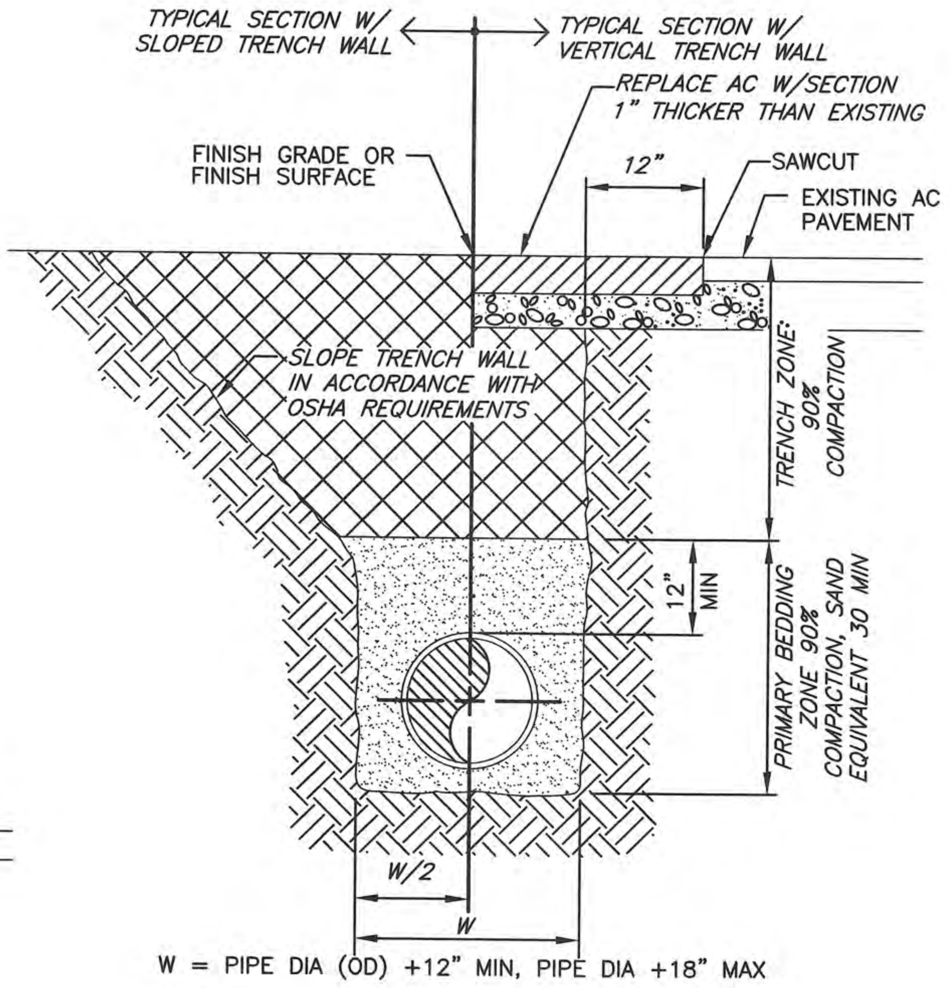
THRUST BLOCK BEARING AREA IN SQUARE FEET								
PIPE SIZE	CONDITION							
	I	II	III	IV	V	VI	VII	VIII
4"	2.7	3.8	2.7	2 @ 2.7	2 @ 2.7	4 @ 1.1	2.1	2 @ 1.1
6"	5.6	7.9	5.6	2 @ 5.6	2 @ 5.6	4 @ 2.2	4.3	2 @ 2.2
8"	9.6	13.6	9.6	2 @ 9.6	2 @ 9.6	4 @ 3.8	7.4	2 @ 3.8

THRUST BLOCK DETAILS

NTS

NOTES:

1. *THRUST BLOCK AREAS BASED ON 150 PSI PRESSURE AND 1,500 PSF ALLOWABLE SOIL PRESSURE WITH 36" OF COVER MINIMUM. ADDITIONAL BEARING AREA REQUIRED FOR SPECIAL CONDITIONS SHALL BE APPROVED BY THE DISTRICT ENGINEER.*
2. *THRUST BLOCK BEARING FACES SHALL BE PLACED AGAINST UNDISTURBED SOIL, APPROVED COMPACTED BACKFILL OR CLASS 100-E-100 SLURRY.*
3. *THRUST BLOCKS SHALL BE CLASS 560-C-3250 CONCRETE, UNLESS SPECIFIED OTHERWISE.*
4. *TO FACILITATE FUTURE REMOVAL OF THRUST BLOCKS AND LINE EXTENSIONS:*
   A. *INSTALL 1/4" BENT ROD HANDLES.*
   B. *USE CARDBOARD SEPARATORS BETWEEN BLOCKS, IF NEEDED.*
5. *CONCRETE SHALL NOT EXTEND ONTO FLANGE OR ADJOINING PIPE.*
6. *ALL REINFORCING STEEL SHALL BE #4 BARS.*
7. *FOR VERTICAL UP BENDS USE CONDITION VII AND VIII.*



W = PIPE DIA (OD) +12" MIN, PIPE DIA +18" MAX

NOTE:

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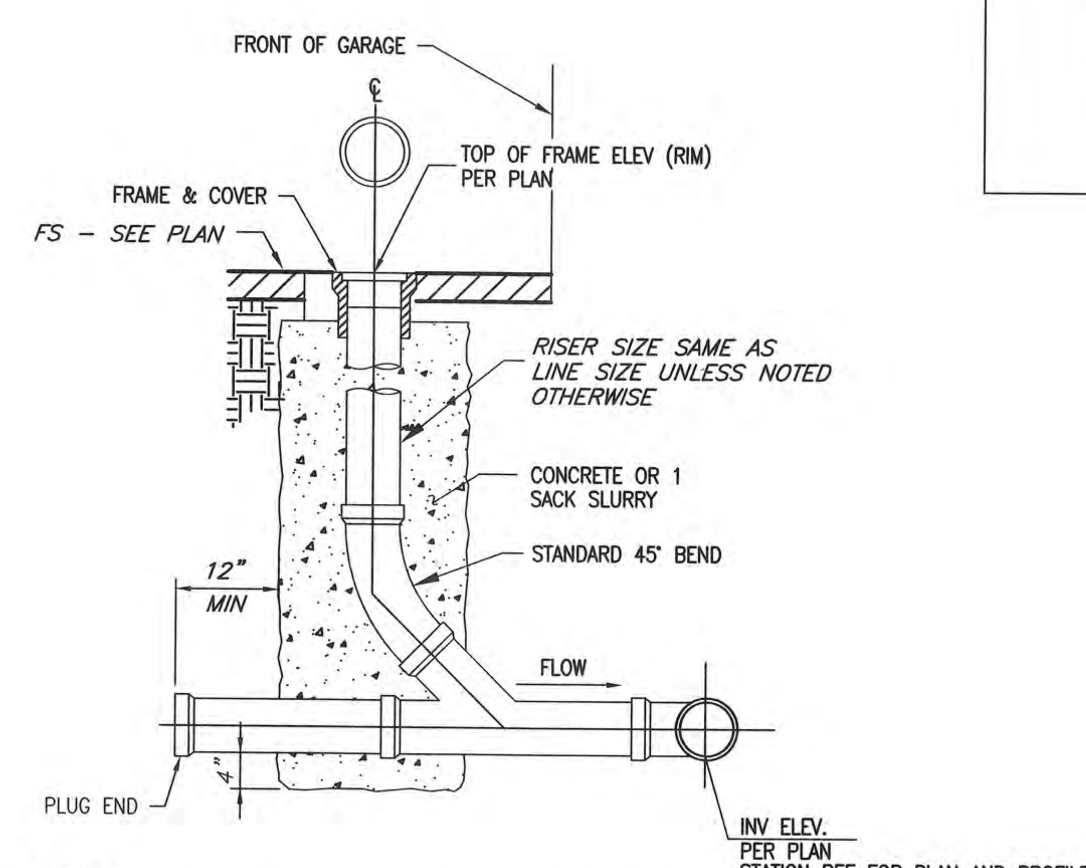
2. REMOVE AND REPLACE EXIST SURFACE MATERIAL TO THE SATISFACTION OF THE OWNER. COMPLY WITH LOCAL JURISDICTION FOR PVMT REPAIR.
3. SLOPING TRENCH WALL SECTION SUBJECT'S TO OWNER'S APPROVAL.

TYPICAL TRENCH DETAIL

NTS

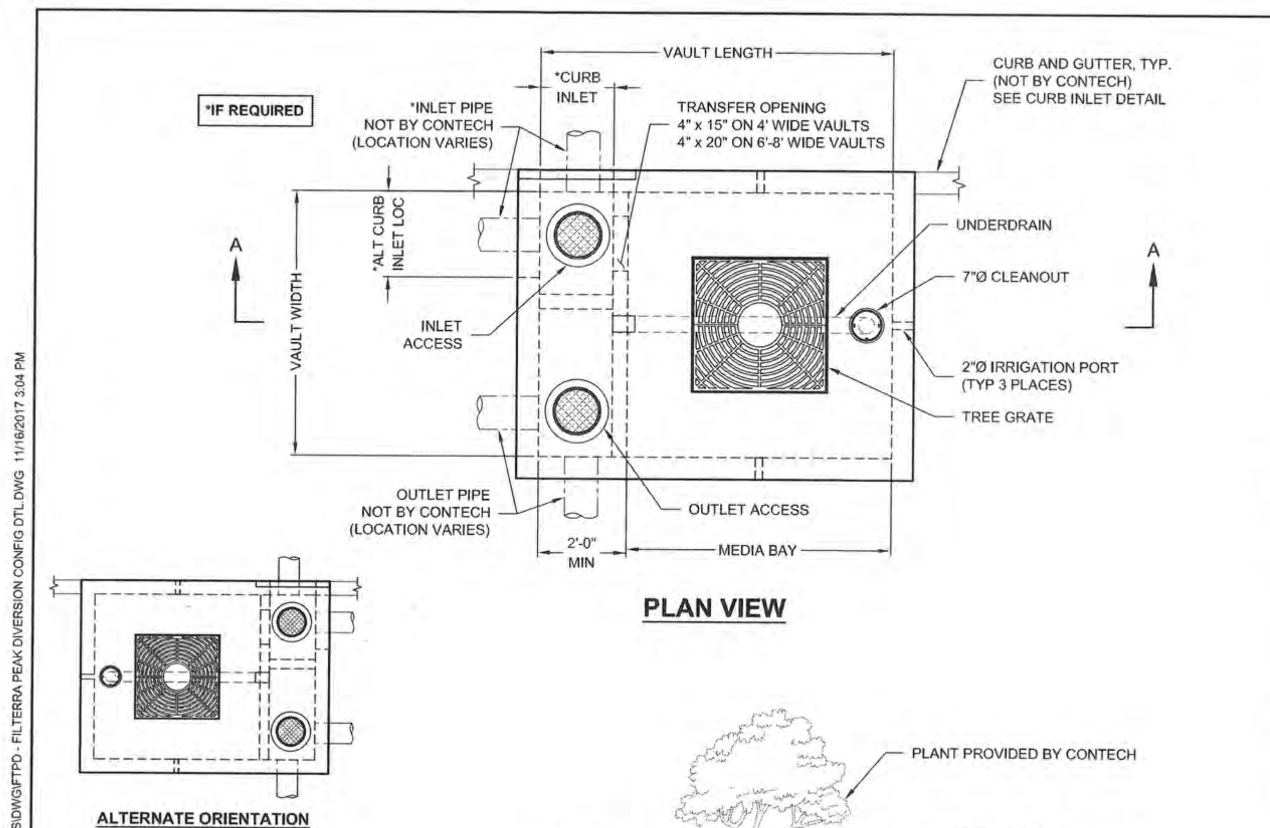


NOTE:

FRAME AND COVER SHALL BE ALHAMBRA FOUNDRY NO. A-1240 OR EQUAL, WITH THE WORD "SEWER" EMBOSSED ON COVER AS REQUIRED.

AREA DRAIN CLEANOUT DETAIL

NTS



FTPD STANDARD HEIGHT CONFIGURATION							
DESIGNATION (OPTIONS: -P, -T, -PT)	AVAILABILITY	MEDIA BAY SIZE	VAULT SIZE (W x L)	WEIR LENGTH/ MAX CURB OPENING	*MAX BYPASS FLOW (CFS)	INLET/ OUTLET ACCESS DIA	TREE GRATE QTY & SIZE
FTPD0404	N/A CA	4 x 4	4 x 6	1'-8"	1.4	12"/12"	(1) 3' x 3'
FTPD04045	CA ONLY	4 x 4.5	4 x 6.5	1'-8"	1.4	12"/12"	(1) 3' x 3'
FTPD0406	N/A MID-ATL	4 x 6	4 x 8	1'-8"	1.4	12"/12"	(1) 3' x 3'
FTPD045058	MID-ATL ONLY	4.5 x 5.83	4.5 x 7.83	1'-8"	1.4	12"/12"	(1) 3' x 3'
FTPD0604	ALL	6 x 4	6 x 6	1'-8"	1.4	12"/12"	(1) 3' x 3'
FTPD0606	ALL	6 x 6	6 x 8	1'-8"	1.4	12"/12"	(1) 3' x 3'
FTPD0608	ALL	6 x 8	6 x 10	1'-8"	1.4	12"/12"	(1) 4' x 4'
FTPD0610	ALL	6 x 10	6 x 12	1'-8"	1.4	12"/12"	(1) 4' x 4'
FTPD0710	ALL	7 x 10	7 x 13	2'-6"	2.1	24"/24"	(1) 4' x 4'
FTPD08105	ALL	8 x 10.5	8 x 14	3'-0"	2.5	24"/24"	(1) 4' x 4'
FTPD08125	ALL	8 x 12.5	8 x 16	3'-0"	2.5	24"/24"	(2) 4' x 4'

N/A = NOT AVAILABLE

FTPD-D DEEP OPTION CONFIGURATION							
DESIGNATION (OPTIONS: -P, -T, -PT)	AVAILABILITY	MEDIA BAY SIZE	VAULT SIZE (W x L)	WEIR LENGTH/ MAX CURB OPENING	*MAX BYPASS FLOW (CFS)	INLET/ OUTLET ACCESS DIA	TREE GRATE QTY & SIZE
FTPD0404-D	N/A CA	4 x 4	4 x 6	1'-8"	4.6	12"/12"	(1) 3' x 3'
FTPD04045-D	CA ONLY	4 x 4.5	4 x 6.5	1'-8"	4.6	12"/12"	(1) 3' x 3'
FTPD0406-D	N/A MID-ATL	4 x 6	4 x 8	1'-8"	4.6	12"/12"	(1) 3' x 3'
FTPD045058-D	MID-ATL ONLY	4.5 x 5.83	4.5 x 7.83	1'-8"	4.6	12"/12"	(1) 3' x 3'
FTPD0604-D	ALL	6 x 4	6 x 6	1'-8"	4.6	12"/12"	(1) 3' x 3'
FTPD0606-D	ALL	6 x 6	6 x 8	1'-8"	4.6	12"/12"	(1) 3' x 3'
FTPD0608-D	ALL	6 x 8	6 x 10	1'-8"	4.6	12"/12"	(1) 4' x 4'
FTPD0610-D	ALL	6 x 10	6 x 12	1'-8"	4.6	12"/12"	(1) 4' x 4'
FTPD0710-D	ALL	7 x 10	7 x 13	2'-6"	6.8	24"/24"	(1) 4' x 4'
FTPD08105-D	ALL	8 x 10.5	8 x 14	3'-0"	8.2	24"/24"	(1) 4' x 4'
FTPD08125-D	ALL	8 x 12.5	8 x 16	3'-0"	8.2	24"/24"	(2) 4' x 4'

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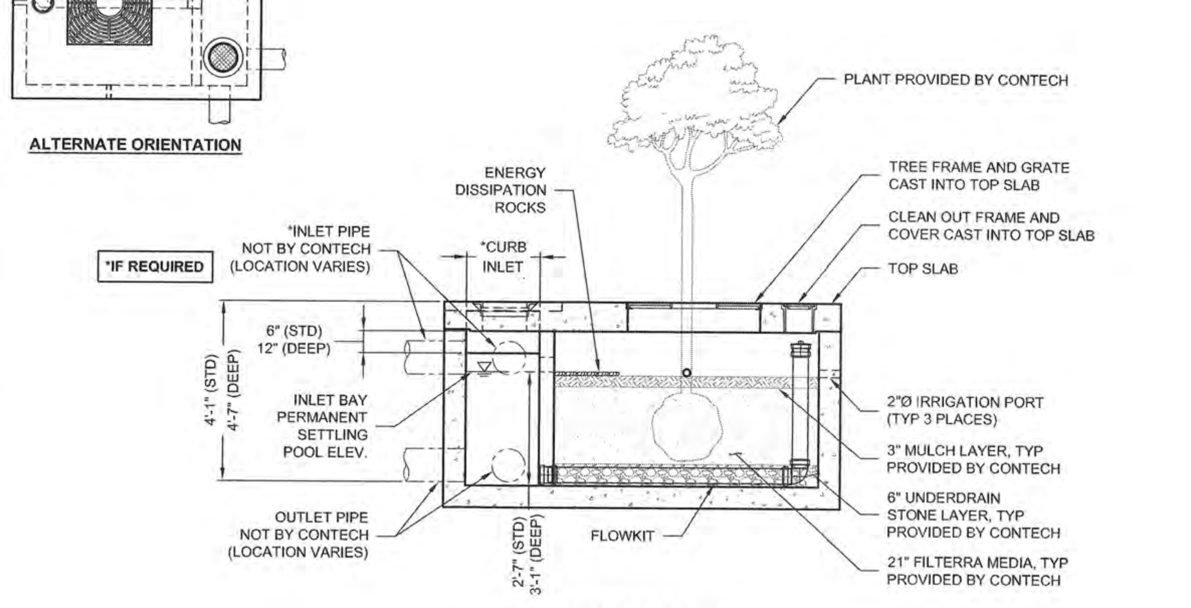
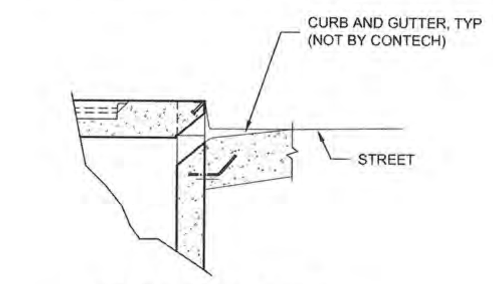
*MAX BYPASS FLOW IS INTERNAL WEIR FLOW . SITE SPECIFIC ANALYSIS IS REQUIRED TO DETERMINE CURB INLET FLOW CAPACITY



SECTION A-A
(STANDARD DEPTH SHOWN)



CURB INLET DETAIL

INTERNAL PIPE CONFIGURATION MAY VARY DEPENDING UPON OUTLET LOCATION.

filterra

CONTECH
ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

FILTERRA PEAK DIVERSION (FTPD) CONFIGURATION DETAIL

DIGALERT
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TWO WORKING DAYS BEFORE YOU DIG
TOLL FREE 1-800-227-2600
A PUBLIC SERVICE BY UNDERGROUND SERVICE ALERT

REVISIONS					
NO	DATE	INITIAL	DESCRIPTION	APP	DATE

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3010 OLD RANCH PARKWAY STE 480
SEAL BEACH, CA 90740
(562) 546-0260

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C67874
EXP. 06/30/2019
CIVIL
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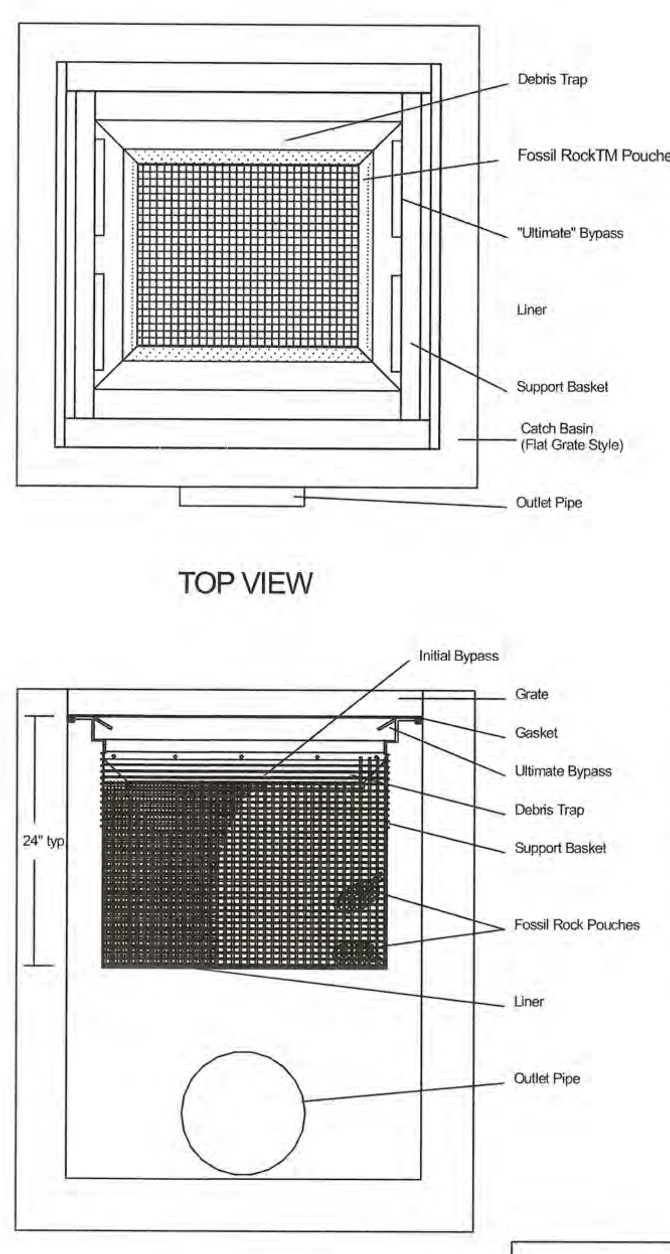
ENGINEER
DATE 5/2/2018
RCE 33520 EXP. DATE 6-31-18

CALPAK
GRADING PLAN
UTILITY DETAILS

SHEET 10 OF 11

SCALE: AS SHOWN | DRAWN BY: DSK | CHECKED BY: AM

CITY OF CARSON

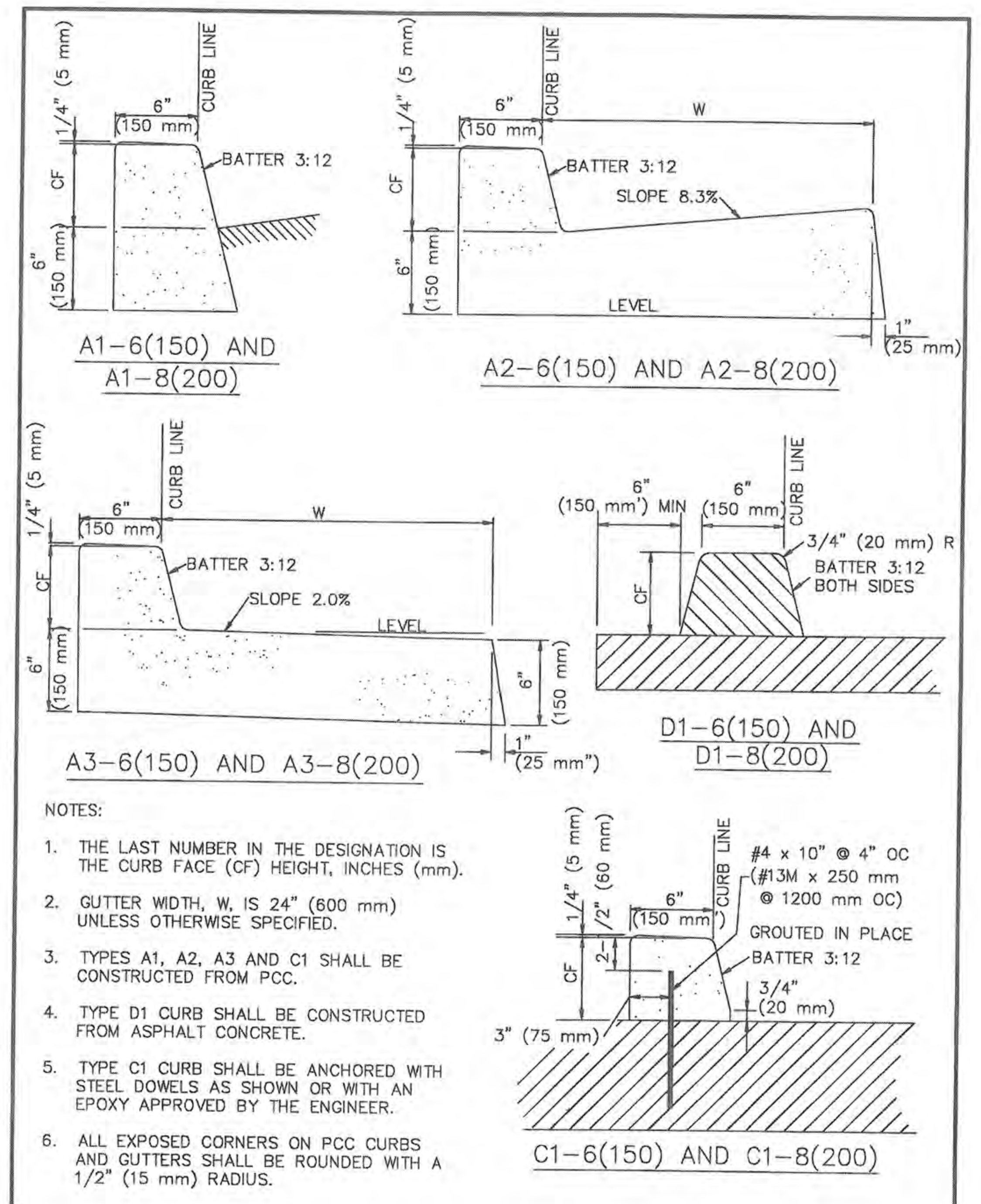


NOTES:

1. Flo-Gard™+PLUS (frame mount) high capacity catch basin inserts are available in sizes to fit most industry-standard catch basin sizes and styles (see specifier chart). Refer to the Flo-Gard™+PLUS (wall mount) insert for devices to fit non-standard or combination style catch basins.
2. Filter insert shall have both an "initial" filtering bypass and "ultimate" high-flow bypass feature.
3. Filter assembly shall be constructed from stainless steel (Type 304).
4. Allow a minimum of 2'-0" of clearance between the bottom of grate and top of inlet or outlet pipe(s). Refer to the Flo-Gard™ insert for "shallow" installations.
5. Filter medium shall be Rubberizer® installed and maintained in accordance with manufacturer recommendations.

FLO-GARD™+PLUS
CATCH BASIN FILTER INSERT
(Frame Mount)
FLAT GRATED INLET
FILTER SIZE 4'X4'
KriStar Enterprises, Inc., Santa Rosa, CA (800) 579-8819
06/04

US PATENT



NOTES:

1. THE LAST NUMBER IN THE DESIGNATION IS THE CURB FACE (CF) HEIGHT, INCHES (mm).
2. GUTTER WIDTH, W, IS 24" (600 mm) UNLESS OTHERWISE SPECIFIED.
3. TYPES A1, A2, A3 AND C1 SHALL BE CONSTRUCTED FROM PCC.
4. TYPE D1 CURB SHALL BE CONSTRUCTED FROM ASPHALT CONCRETE.
5. TYPE C1 CURB SHALL BE ANCHORED WITH STEEL DOWELS AS SHOWN OR WITH AN EPOXY APPROVED BY THE ENGINEER.
6. ALL EXPOSED CORNERS ON PCC CURBS AND GUTTERS SHALL BE ROUNDED WITH A 1/2" (15 mm) RADIUS.

STANDARD PLAN FOR PUBLIC WORKS CONSTRUCTION

PROMULGATED BY THE PUBLIC WORKS STANDARDS INC. GREENBOOK COMMITTEE 1994 REV. 1996, 2009	CURB AND GUTTER – BARRIER	STANDARD PLAN 120–2
	USE WITH STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION	SHEET 1 OF 1

EROSION AND SEDIMENT CONTROL PLAN (ESCP) GENERAL NOTES:

1. IN CASE OF EMERGENCY, CALL GREG HOOK AT 562-546-0260
   i.PLEASE FILL IN NAME AND NUMBER
2. TOTAL DISTURBED AREA 4.66 AC WDID # TBD
   RISK LEVEL (2)
3. A STAND-BY CREW FOR EMERGENCY WORK SHALL BE AVAILABLE AT ALL TIMES DURING THE RAINY SEASON (NOVEMBER 1 TO APRIL 15). NECESSARY MATERIALS SHALL BE AVAILABLE ON-SITE AND STOCKPILED AT CONVENIENT LOCATIONS TO FACILITATE RAPID CONSTRUCTION OF EMERGENCY DEVICES WHEN RAIN IS IMMINENT.
4. EROSION CONTROL DEVICES SHOWN ON THIS PLAN MAY BE REMOVED WHEN APPROVED BY THE BUILDING OFFICIAL IF THE GRADING OPERATION HAS PROGRESSED TO THE POINT WHERE THEY ARE NO LONGER REQUIRED.
5. GRADED AREAS ADJACENT TO FILL SLOPES LOCATED AT THE SITE PERIMETER MUST DRAIN AWAY FROM THE TOP OF SLOPE AT THE CONCLUSION OF EACH WORKING DAY. ALL LOOSE SOILS AND DEBRIS THAT MAY CREATE A POTENTIAL HAZARD TO OFF-SITE PROPERTY SHALL BE STABILIZED OR REMOVED FROM THE SITE ON A DAILY BASIS.
6. ALL SILT AND DEBRIS SHALL BE REMOVED FROM ALL DEVICES WITHIN 24 HOURS AFTER EACH RAINSTORM AND BE DISPOSED OF PROPERLY.
7. A GUARD SHALL BE POSTED ON THE SITE WHENEVER THE DEPTH OF WATER IN ANY DEVICE EXCEEDS TWO FEET. THE DEVICE SHALL BE DRAINED OR PUMPED DRY WITHIN 24 HOURS AFTER EACH RAINSTORM. PUMPING AND DRAINING OF ALL BASINS AND DRAINAGE DEVICES MUST COMPLY MUST COMPLY WITH THE APPROPRIATE BMP FOR DEWATERING OPERATIONS.
8. THE PLACEMENT OF ADDITIONAL DEVICES TO REDUCE EROSION DAMAGE AND CONTAIN POLLUTANTS WITHIN THE SITE IS LEFT TO THE DISCRETION OF THE FIELD ENGINEER. ADDITIONAL DEVICES AS NEEDED SHALL BE INSTALLED TO RETAIN SEDIMENTS AND OTHER POLLUTANTS ON SITE.
9. DESILTING BASINS MAY NOT BE REMOVED OR MADE INOPERABLE BETWEEN NOVEMBER 1 AND APRIL 15 OF THE FOLLOWING YEAR WITHOUT THE APPROVAL OF THE BUILDING OFFICIAL.
10. STORM WATER POLLUTION AND EROSION CONTROL DEVICES ARE TO BE MODIFIED, AS NEEDED, AS THE PROJECT PROGRESSES, THE DESIGN AND PLACEMENT OF THESE DEVICES IS THE RESPONSIBILITY OF THE FIELD ENGINEER. PLANS REPRESENTING CHANGES MUST BE SUBMITTED FOR APPROVAL IF REQUESTED BY THE BUILDING OFFICIAL.
11. EVERY EFFORT SHOULD BE MADE TO ELIMINATE THE DISCHARGE OF NON-STORM WATER FROM THE PROJECT SITES AT ALL TIMES.
12. ERODED SEDIMENTS AND OTHER POLLUTANTS MUST BE RETAINED ON-SITE AND MAY NOT BE TRANSPORTED FROM THE SITE VIA SHEET FLOW, SWALES, AREA DRAINS, NATURAL DRAINAGE COURSES, OR WIND.
13. STOCKPILES OF EARTH AND OTHER CONSTRUCTION-RELATED MATERIALS MUST BE PROTECTED FROM BEING TRANSPORTED FROM THE SITE BY THE FORCES OF WIND OR WATER.
14. FUELS, OILS, SOLVENTS, AND OTHER TOXIC MATERIALS MUST BE STORED IN ACCORDANCE WITH THEIR LISTING AND ARE NOT TO CONTAMINATE THE SOILS AND SURFACE WATERS. ALL APPROVED STORAGE CONTAINERS ARE TO BE PROTECTED FROM THE WEATHER. SPILLS MUST BE CLEANED UP IMMEDIATELY AND DISPOSED OF IN A PROPER MANNER. SPILLS MAY NOT BE WASHED INTO THE DRAINAGE SYSTEM.
15. EXCESS OR WASTE CONCRETE MAY NOT BE WASHED INTO THE PUBLIC WAY OR ANY OTHER DRAINAGE SYSTEM. PROVISIONS SHALL BE MADE TO RETAIN CONCRETE WASTES ON-SITE UNTIL THEY CAN BE DISPOSED OF AS SOLID WASTE.
16. DEVELOPERS/CONTRACTORS ARE RESPONSIBLE TO INSPECT ALL EROSION CONTROL DEVICES AND BMPS ARE INSTALLED AND FUNCTIONING PROPERLY IF THERE IS A 50% OR GREATER PROBABILITY OF PREDICTED PRECIPITATION, AND AFTER ACTUAL PRECIPITATION. A CONSTRUCTION SITE INSPECTION CHECKLIST AND INSPECTION LOG SHALL BE MAINTAINED AT THE PROJECT SITE AT ALL TIMES AND AVAILABLE FOR REVIEW BY THE BUILDING OFFICIAL (COPIES OF THE SELF-INSPECTION CHECK LIST AND INSPECTION LOGS ARE AVAILABLE UPON REQUEST).
17. TRASH AND CONSTRUCTION-RELATED SOLID WASTES MUST BE DEPOSITED INTO A COVERED RECEPTACLE TO PREVENT CONTAMINATION OF RAINWATER AND DISPERSAL BY WIND.
18. SEDIMENTS AND OTHER MATERIALS MAY NOT BE TRACKED FROM THE SITE BY VEHICLE TRAFFIC. THE CONSTRUCTION ENTRANCE ROADWAYS MUST BE STABILIZED SO AS TO INHIBIT SEDIMENTS FROM BEING DEPOSITED INTO THE PUBLIC WAY. ACCIDENTAL DEPOSITIONS MUST BE SWEPT UP IMMEDIATELY AND MAY NOT BE WASHED DOWN BY RAIN OR OTHER MEANS.
19. ANY SLOPES WITH DISTURBED SOILS OR DENUDED OF VEGETATION MUST BE STABILIZED SO AS TO INHIBIT EROSION BY WIND AND WATER.
20. AS THE ENGINEER/QSD OF RECORD, I HAVE SELECTED APPROPRIATE BMPS TO EFFECTIVELY MINIMIZE THE NEGATIVE IMPACTS OF THIS PROJECT'S CONSTRUCTION ACTIVITIES ON STORM WATER QUALITY. THE PROJECT OWNER AND CONTRACTOR ARE AWARE THAT THE SELECTED BMPS MUST BE INSTALLED, MONITORED, AND MAINTAINED TO ENSURE THEIR EFFECTIVENESS.

__________ ______________________ ______________ CIVIL ENGINEER/QSD
SIGNATURE DATE

21. THE FOLLOWING NOTES MUST BE ON THE PLAN:
    AS THE PROJECT OWNER OR AUTHORIZED AGENT OF THE OWNER, "I CERTIFY THAT THIS DOCUMENT AND ALL ATTACHMENTS WERE PREPARED UNDER MY DIRECTION OR SUPERVISION IN ACCORDANCE WITH THE SYSTEM DESIGNED TO ENSURE THAT A QUALIFIED PERSONNEL PROPERLY GATHER AND EVALUATE THE INFORMATION SUBMITTED. BASED ON MY INQUIRY OF THE PERSON OR PERSONS WHO MANAGE THE SYSTEM OR THOSE PERSONS DIRECTLY RESPONSIBLE FOR GATHERING THE INFORMATION, TO THE BEST OF MY KNOWLEDGE AND BELIEF, THE INFORMATION SUBMITTED IS TRUE, ACCURATE, AND COMPLETE. I AM AWARE THAT SUBMITTING FALSE AND/ OR INACCURATE INFORMATION, FAILING TO UPDATE THE ESCP TO REFLECT CURRENT CONDITIONS, OR FAILING TO PROPERLY AND/OR ADEQUATELY IMPLEMENT THE ESCP MAY RESULT IN REVOCATION OF GRADING AND/OR OTHER PERMITS OR OTHER SANCTIONS PROVIDED BY LAW."

__________ ______________________ ______________
OWNER OR AUTHORIZED REPRESENTATIVE (PERMITTEE) DATE

22. DEVELOPERS/CONTRACTORS ARE RESPONSIBLE TO INSPECT ALL EROSION CONTROL DEVICES AND BMPS ARE INSTALLED AND FUNCTIONING PROPERLY AS REQUIRED BY THE STATE CONSTRUCTION GENERAL PERMIT. A CONSTRUCTION SITE INSPECTION CHECKLIST AND INSPECTION LOG SHALL BE MAINTAINED AT THE PROJECT SITE AT ALL TIMES AND AVAILABLE FOR REVIEW BY THE BUILDING OFFICIAL.

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XEBEC BUILDING COMPANY
3010 OLD RANCH PARKWAY STE 480
SEAL BEACH, CA 90740
(562) 546-0260

PREPARED BY :
KES TECHNOLOGIES INC
CIVIL ENGINEERING
LAND PLANNING AND SURVEYING
1 VENTURE STE 130
IRVINE, CALIFORNIA 92618
PHONE (949) 339-5331
FAX (866) 426-2201

REGISTERED PROFESSIONAL ENGINEER — ALI MONSHIZADEH — C67674 — EXP. 06/30/2019 — CIVIL — STATE OF CALIFORNIA

I hereby certify that:
1. These plans have been prepared under my supervision:
2. The grading shown hereon will not divert drainage from its natural downstream course or obstruct the drainage of adjacent properties:
3. All specimen trees located on this property are shown:
4. Existing ground contours and elevations were obtained by field survey on/aerial topography flown on MAY, 2016

ENGINEER ______ DATE 5/2/2018
RCE 33520 EXP. DATE 6-31-18

CALPAK
GRADING PLAN
DETAILS

SHEET 11 OF 11

SCALE: AS SHOWN | DRAWN BY: DSK | CHECKED BY: AM

CITY OF CARSON

Contech Engineered Solutions LLC
9025 Centre Pointe Drive, Suite 400
West Chester, OH 45069
Phone: (513) 645-7000
Fax: (513) 645-7993
www.ContechES.com

Re: Calpak – Carson, CA

To Whom It May Concern,

This letter is to address the use of Filterra Biofiltration devices at the Calpak site at 17706 S. Main Street, Carson, CA. A study by Geosyntec evaluated equivalent performance between conventional biofiltration BMPs meeting the criteria of the MS4 Permit (specifically Attachment H) and Filterra systems as an alternate biofiltration BMP. Equivalency was determined based on the factors that influence the performance of stormwater BMPs including capture efficiency, volume reduction and concentration reduction. The methodology and resulting study are defined in the attached document.

By utilizing Contech's equivalency sizing spreadsheet for Catchments A1, A2, A3, and A4, it has been determined that a total Filterra Media footprint of 423 square feet is required. The spreadsheets for each subcatchment is attached herein. For this site, all four subareas will be collected into a single storm drain and split between three separate Filterra devices. Each Filterra unit has a media area of 18'x8', for a total of 432 square feet. This area exceeds the required 423 square feet.

This methodology matches the sizing for Filterra systems that have been approved in the City of Industry, Compton, and Vernon under the same regulations. We hope this will aid in the approval of the Filterra systems for this project in Carson.

Sincerely,

Katie Husk, E.I.
Contech Engineered Solutions LLC
Khusk@conteches.com
503-258-3149
11815 NE Glenn Widing Drive
Portland, OR 97220

Filterra Sizing Tool

Applicable in the Area Goverened by the Los Angeles County MS4 Permit

(NPDES PERMIT NO. CAS004001; ORDER NO. R4-2012-0175)

For final design please contact:
Alexandra Dubrock - Stormwater Consultant
adubrock@conteches.com
Phone: 949-217-4663

Contact Information		**Project Information**	
Engineer of Record Name	Daryl Kessler	Project Name	CalPak
Engineer of Record Company Name	KES Technologies, Inc.	Project Location	Carson, CA
Engineer of Record Office Zip Code	92618	Catchment Name	Total area / 3

Drainage Area Inputs		
Drainage Area	**67663**	ft^2
Runoff coefficient	**0.844**	-
Time of concentration	**30**	min
Long term reliable infiltration rate	**0.00**	in/hr
85th percentile, 24-hour depth (see hyperlink below)	**0.95**	in
LA County Rainfall Depth Analysis		
Filterra Configuration (Select from Drop-Down)	**Offline**	

Refer to "Filterra Configurations" tab for descriptions and standard details for download.

Constants		
LAX Airport 85th Percentile, 24-hour depth (for reference only)	1.02	in
Filterra hydraulic loading capacity	1.45	gpm/ft^2
Outputs		
Stormwater Quality Design Volume	4,521	ft^3
Design Rainfall Intensity for Equivalent Long Term Capture	0.320	in/hr
Site Scaling Factor	0.93	-
Stormwater Quality Design Flow Rate	0.39	cfs
Design Alternatives Available	**Stand Alone Filterra Permitted**	

Design Recommendations

Primary Recommendation - Stand Alone Filterra

Adjusted Filterra Design Intensity	0.340	in/hr
Stormwater Quality Design Flow Rate	0.42	cfs
Required Filterra Area	130	ft^2
Filterra Model ID	**FT 18x8**	

Alternative Recommendation - Filterra + Infiltration Storage

Required Filterra Area	122	ft^2
Filterra Model ID	**FT 16x8**	
ChamberMaxx volume	0	ft^3
ChamberMaxx count	**0**	chambers

To be constent with approval of the Filterra Bioretention System as an alternative biofiltration specification granted by the Los Angeles Regional Water Quality Control Board on October 9, 2017, Filterra use is subject to the following conditions:

1. Filterra systems must be designed and sized following the methodology in Section 4 of the August 2015 report prepared by Geosyntec Consultants, entitled "Filterra Equivalency Analysis and Design Criteria" which is the basis for this design tool.
2. Filterra systems use an engineered biofiltration media. Filterra systems, including the engineered biofiltration media, must be provided by the manufacturer. No substitution of materials/media is allowed.
3. Filterra is only applicable as an alternative on-site biofiltration design in situations where a project applicant has demonstrated that it is technically infeasible to retain 100 percent of the SWQDv on-site.
4. Hydromodification requirements of Section VI.D.7.c.iv of the Los Angeles County MS4 Permit must be considered separately regardless of what type of biofiltration is used.
5. Operation and maintenance of Filterra systems must be conducted consistent with the recommendations in the Filterra maintenance manual provided by Contech Engineered Solutions.
6. In the area governed by the Los Angeles Region Phase I stormwater permit, conventional biofilters must be sized to treat 1.5X the SWQDV. This results in an average annual capture rate of 93%. Filterra systems sized using this tool will also treat at least 93% of the average annual runoff volume.

FILTERRA EQUIVALENCY ANALYSIS AND DESIGN CRITERIA

Pursuant to:

Los Angeles County MS4 Permit (Order R4-2012-0175)

Prepared for

CONTECH Engineered Solutions

Prepared by

Geosyntec consultants

engineers | scientists | innovators

621 SW Morrison Street, Suite 600
Portland, Oregon 97205

August 2015

TABLE OF CONTENTS

1 INTRODUCTION

The Los Angeles County MS4 Permit (Order No. R4-2012-0175) (MS4 Permit) defines "biofiltration" based on specific design and sizing criteria[1]. In addition, the MS4 Permit allows the Los Angeles County Regional Water Quality Control Board (Regional Board) Executive Officer to approve alternate biofiltration design criteria. The purpose of this analysis was to develop a design basis for Filterra systems such that these systems will provide reasonably equivalent performance to biofiltration BMPs as defined in the MS4 Permit. This report is provided to the Executive Officer of the Regional Board to support approval of alternative design criteria for Filterra systems. This report describes the basis for evaluating equivalency, details the design approach and equivalency criteria for Filterra systems to achieve equivalent performance to conventional biofiltration, and provides the supporting rationales for these equivalency criteria.

The remainder of this report is organized as follows:

Section 2 – BMP Descriptions

Section 3 – Basis and Methodology for Evaluating Equivalency

Section 4 – Filterra Design Approach and Equivalency Criteria

Section 5 – Discussion and Conclusions

Section 6 – References

Appendix A – Design Assumptions for Conventional Biofiltration

Appendix B – SWMM Modeling Methodology and Assumptions

Appendix C – Datasets and Analysis Methods for Pollutant Treatment Evaluation

Appendix D – Results of BMP Treatment Performance Evaluation

[1] BMPs sized and designed per these criteria are referred to in this memorandum as "traditional biofiltration."

2 BMP DESCRIPTIONS

2.1 Conventional Biofiltration

Biofiltration (also known as bioretention with underdrain) consists of shallow landscaped depressions that capture and filter stormwater runoff through a planted engineered media. These facilities function as soil and plant-based filtration systems that remove pollutants through a variety of physical, biological, and chemical treatment processes. Biofiltration facilities normally consist of a ponding area, mulch layer, planting soils, and plantings (see typical schematic in Figure 1). An optional gravel layer added below the planting soil coupled with an upturned elbow (or similar hydraulic control approach) can provide additional storage volume for infiltration. As stormwater passes down through the planting soil, pollutants are filtered, adsorbed, and biodegraded by the soil and plants. As defined in Attachment H of the 2012 Los Angeles County MS4 Permit, biofiltration designs must meet a number of specific criteria to be considered "biofiltration" as part of compliance with the MS4 Permit. Conventional biofiltration is typically designed as a "volume-based" BMP, meaning that is it sized based on capture of the runoff from a specific size of storm event.

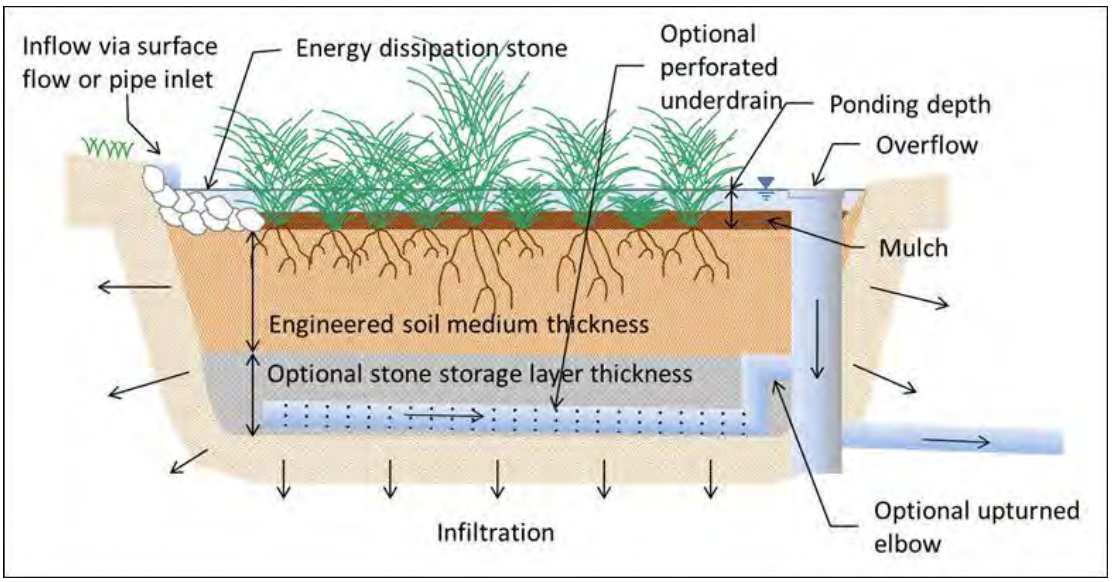

Figure 1. Cross sections of typical biofiltration system

2.2 Filterra Systems

Filterra systems include engineered filter media topped with mulch housed in a precast concrete curb inlet structure with a tree frame and grate cast in the top slab. In addition to the water quality filtering/sorption of stormwater, the engineered media and mulch supports the growth of a tree or other type of plant (see typical configuration in Figure 2). There are three key components of the Filterra system that contribute to pollutant removal: mulch, engineered filter media, and vegetation and other system biota. Filterra systems can be configured so that underdrains discharge into downstream retention storage systems. In contrast to conventional biofiltration, the media filtration rates of Filterra systems are substantially higher, and therefore the footprint of these systems tends to be substantially smaller than conventional biofiltration systems. As a result of smaller footprints, the amount of volume reduction (via infiltration and evapotranspiration) that is typically observed in these systems when not coupled with infiltration systems tends to be relatively low. Because these systems provide relatively limited ponded water volume above the surface of the media, they are typically sized as "flow-based" BMPs based on a design intensity of rainfall rather than "volume-based" BMP based on a design storm depth.

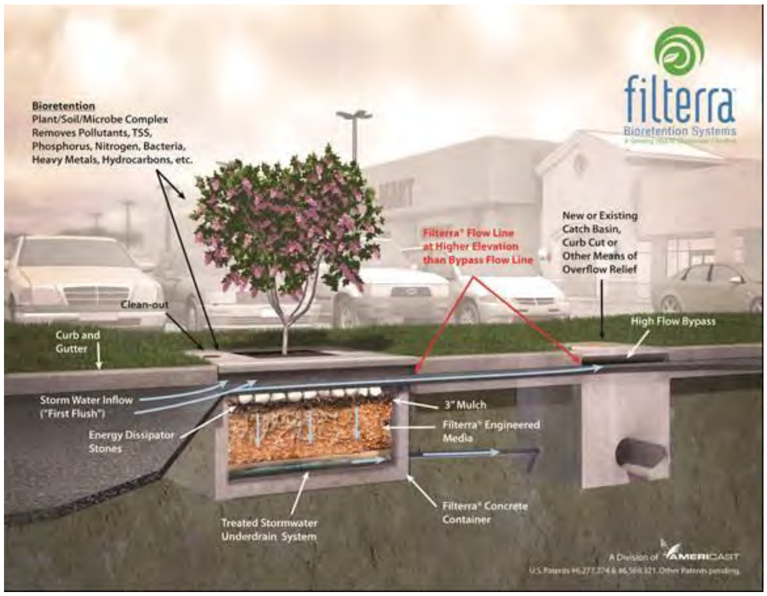

Figure 2. Diagram of the Filterra system (Contech, 2015 via web).

3 BASIS AND METHDOLOGY FOR EVALUATING EQUIVALENCY

3.1 Basis for Equivalency

Equivalency was evaluated between conventional biofiltration BMPs meeting the criteria of the MS4 Permit (specifically Attachment H) and Filterra systems as an alternate biofiltration BMP. Equivalency was determined based on the factors that influence the pollutant load reduction performance of stormwater BMPs:

- **Capture efficiency**: The percent of long term stormwater runoff volume that is "captured" and managed by the BMP (i.e., treated or reduced; not overflowed or bypassed).
- **Volume reduction**: The percent of long term stormwater runoff volume that is "lost" or "reduced" in the BMP to infiltration and evapotranspiration.
- **Concentration reduction**: For the volume that is treated and not reduced, the average difference in concentration between the influent volume and the treated effluent volume.

The equivalency analysis consisted of three parts:

1) The baseline performance of conventional biofiltration (capture efficiency, volume reduction, and concentration reduction) was estimated.
2) Applying the same methods as used to evaluate the performance of conventional biofiltration, sizing criteria were developed for Filterra (accompanied by supplemental infiltration systems, where needed) such that Filterra systems will provide equivalent performance to conventional biofiltration.
3) A design methodology for Filterra systems was developed to ensure consistent application of the equivalent sizing criteria in the design of Filterra systems.

The following subsections provide information about this analysis.

3.2 Methods and Assumptions for Establishing Baseline Biofiltration Performance

The following subsections summarize the methods and assumptions that were used to evaluate the baseline performance of conventional biofiltration BMPs consistent with Attachment H of the MS4 Permit.

3.2.1 Hydrologic Performance (Capture Efficiency and Volume Reduction)

Attachment H of the MS4 Permit specifies a number of criteria that influence the hydrologic performance of the conventional biofiltration BMPs:

- 6 to 18-inch ponding area above media
- Optional layer of mulch
- 2 to 3 feet of engineered filter media (2 feet typical) with a design infiltration rate of 5 to 12 inches/hour; the Attachment H specification calls for a mix of 60 to 80% fine sand and 20 to 40% compost

- Gravel storage layer below the bioretention media to promote infiltration
- Underdrain placed near the top of the gravel layer (or an infiltration sump otherwise provided via an equivalent hydraulic control approach) in cases where underlying soil allows incidental infiltration
- Underdrain discharge to the storm drain
- Capacity (including stored and filtered water) adequate to biofilter 150 percent of the portion of the SWQDv not reliably retained.

Within the bounds established by these criteria, a relatively wide range of actual biofiltration designs could result as a function of site infiltration conditions as well as designer and local jurisdiction preferences. An example of potential design variability is illustrated in Appendix A. For the purpose of this analysis, representative design assumptions were developed within the range of potential design assumptions. These assumptions are also presented in Appendix A with supporting rationales. Long term continuous simulation SWMM modeling was conducted using 15 years of 5-minute resolution precipitation data, as described in Appendix B, to estimate the long term capture efficiency and volume reduction of the baseline biofiltration design scenario for a range of site infiltration rates. Biofiltration BMPs will tend to provide more volume reduction when installed in sites with higher incidental infiltration rates. Table 1 describes the baseline hydrologic performance of biofiltration BMPs.

Table 1. Baseline Biofiltration Hydrologic Performance

Site Soil Infiltration Rate, in/hr	Long Term Capture Efficiency (percent of total runoff volume)	Long Term Volume Reduction (percent of total runoff volume) (ET + Infiltration)
0	92 to 94%[1] (93% capture is representative)	4%
0.01		6%
0.05		11%
0.15		22%
0.30[2]		35%

1 - Capture efficiency varies slightly as a function of soil infiltration rate (and associated differences in design profile) and land use imperviousness. These differences are relatively minor and are considered to be less important than the variability in performance that may result from different design approaches and maintenance conditions that may be encountered. Therefore a single baseline value of 93 percent long term capture was used in this analysis.
2 - A maximum soil infiltration rate of 0.3 inches per hour was evaluated because for soil infiltration rates greater than 0.3 inches per hour the MS4 Permit requires that infiltration be evaluated.

3.2.2 Pollutant Treatment

Pollutant treatment performance was evaluated based on analysis of bioretention with underdrain studies in the International Stormwater BMP Databases. Analyses were conducted based on all studies (28 studies) and a screened subset of studies that were considered to be most representative of Attachment H design criteria (16 studies). Additionally, two recent studies from the University of Maryland were added which followed rigorous protocols and evaluated systems sharing many similarities to Attachment H design criteria. Biofiltration research in California is very limited. Two recent monitoring studies were conducted in the San Francisco Bay area (led by the San Francisco Estuary Institute) on systems with media composition, sizing and design that would conform to Attachment H of the Los Angeles MS4 Permit. While these studies did not collect flow weighted composite influent and effluent samples, they were included in the data set.

Treatment performance was characterized using a moving window bootstrapping method that accounts for the influence of influent concentration on effluent concentration and characterizes the relative uncertainty in performance estimates within each range of influent quality. Both the median and mean summary statistics were evaluated using these methods. Additionally, literature on the influence of biofiltration design variables on performance was summarized to support the criteria that were used to select the 20 BMP studies that were included in the screened dataset. The pollutant treatment evaluation was based on total suspended solids, total phosphorus, total nitrogen, total copper, and total zinc. Influent concentrations characteristic of single family, multi family, commercial, and light industrial land uses were applied to estimate effluent concentrations and concentration change.

Generally, biofiltration provided good removal of TSS, moderate removal of copper and zinc, and generally showed export of nutrients. Export of nutrients tended to be greater when influent concentrations were low. Also, the dataset that was screened to include studies more similar to Attachment H design criteria (i.e., 5 to 12 inches per hour, with compost) showed substantially greater frequency of observed export of nutrients.

Details about pollutant treatment analyses are provided in Appendix C, and results of these analyses are provided in Appendix D.

3.3 Filterra Analysis to Determine Equivalent Design Criteria

The following paragraphs describe the analyses that were conducted for Filterra systems to determine the sizing criteria under which Filterra systems provide equivalent performance to conventional biofiltration.

3.3.1 Capture Efficiency

Filterra capture efficiency is a function of the design precipitation intensity used in sizing the Filterra system and the time of concentration (Tc) of the tributary area. Continuous simulation modeling using the SWMM model, with 15 years of 5-minute resolution precipitation, as described in Appendix B, was used to determine the relationship between design precipitation intensity, Tc, and long term capture efficiency (Figure 3). Based on this chart, the design guidance presented in Section 4 requires that approved methods, appropriate for the site, are used for calculating Tc and selecting a runoff coefficient equation to convert the design intensity to a design flowrate.

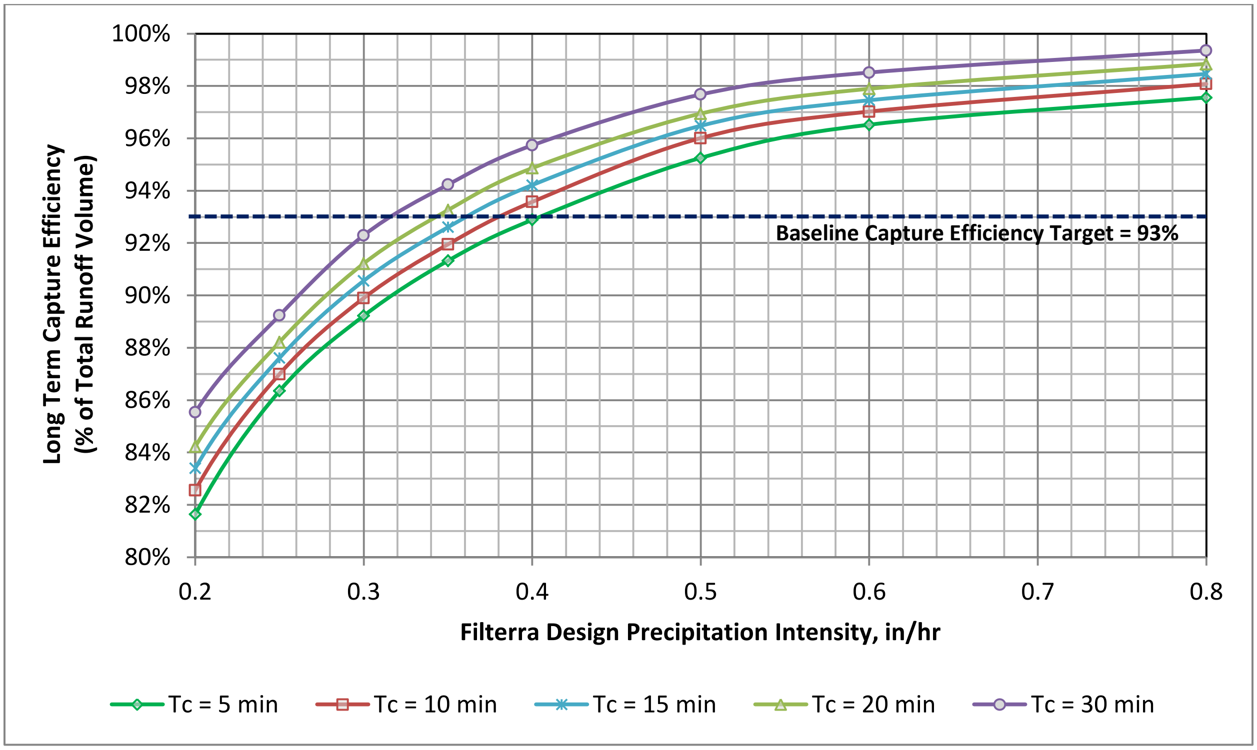

Figure 3. Chart of Filterra Capture Efficiency

3.3.2 Volume Reduction (Filterra and Supplemental Infiltration Storage)

Filterra systems, sized within the range needed to match conventional biofiltration capture efficiency, were estimated to provide approximately 1 percent long term volume reduction via evapotranspiration from soil pores (determined from SWMM modeling described above). This relatively small value is a function of the relatively small surface area of typical Filterra systems.

For site conditions in which conventional biofiltration BMPs would achieve appreciable volume reduction, supplemental infiltration systems (located either upstream or downstream of Filterra systems) may be needed to result in volume reduction equal to what would be achieved by conventional biofiltration BMPs under the same site conditions. Volume reduction is a function of the storage volume provided, the surface area of the storage/soil interface, and the infiltration rate of the soil (and associated drawdown time of the stored water). As described in Appendix B, SWMM modeling was conducted to determine the long term volume reduction of supplemental infiltration storage as a function of storage volume (with a reasonable surface area) and soil infiltration rate (Figure 4). The supplemental retention volume is specified as a fraction of the site-specific SWQDv, which is a standardized calculation in each jurisdiction and accounts for different precipitation depths around Los Angeles County as well as infiltration rates. The design methodology (Section 4) also provides guidance about the allowable depth of the supplemental retention storage systems so that stored water will infiltrate in a reasonable amount of time.

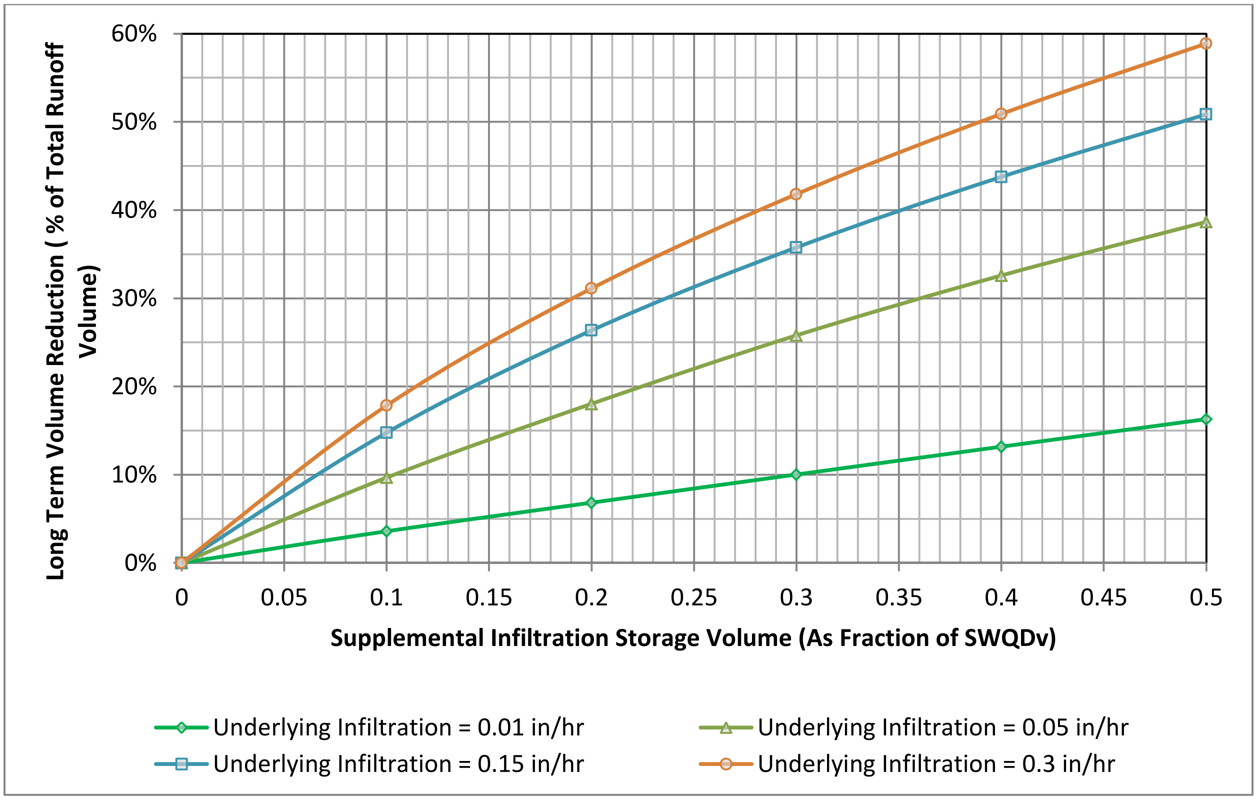

Figure 4. Chart of Volume Reduction in Supplemental Infiltration Storage

3.3.3 Pollutant Treatment

Filterra performance data were analyzed using the same moving window bootstrapping methods used for conventional biofiltration. Data from 6 third party studies conducted over the last 11 years (including some studies monitored periodically since 2007) were utilized in this analysis. This analysis sought to determine whether Filterra performance is reasonably similar to the treatment performance of conventional biofiltration BMPs under representative ranges of influent quality. This analysis was based on the same pollutant and land uses described above for conventional biofiltration.

The following bullets summarize the comparison of pollutant concentration reduction for conventional biofiltration and Filterra systems. Detailed comparison tables and plots are provided in Appendix D.

- **TSS:** Filterra performed somewhat better than conventional biofiltration systems for TSS across all representative land use concentrations considered. Both systems showed relatively strong performance for TSS.
- **Copper and Zinc:** Performance was generally similar between Filterra and conventional biofiltration for copper and zinc. Filterra showed better performance for some representative influent concentrations and conventional biofiltration showed better concentration reductions for others. In general, both provided moderate concentration

reductions of metals. The sample size for Filterra for sites with high metals concentrations is somewhat small, which results in wider confidence intervals for land uses with higher concentrations. Specifically, there was only one study (Port of Tacoma TAPE, station POT2) that had high zinc concentrations; this site was notable/unique in its high concentrations and the degree of dissolved zinc as a fraction of total zinc. For this site, average zinc influent concentrations were approximately 1,000 ug/L of which approximately 85 percent was dissolved zinc, on average. The concentration reductions for this site were still moderate (approximately 50 percent average removal).

- **Nitrogen and Phosphorus:** Filterra systems appear to provide much better pollutant concentration reduction than conventional biofiltration for nitrogen and phosphorus. Filterra does not appear to exhibit the export issues that were noted for conventional biofiltration within the representative range of land use concentrations considered. Variability in pollutant reduction performance was also lower for Filterra.

Given these findings, Filterra are expected to provide similar or better pollutant concentration reduction for all pollutants across the representative site conditions considered.

3.3.4 Additional Capture In Lieu of Volume Reduction

As described in Section 3.3.2 and Section 4, one approach for matching the pollutant load reduction of conventional biofiltration is to provide supplemental infiltration storage upstream or downstream of Filterra systems to match the volume reduction that would be achieved by conventional biofiltration.

For Filterra applications with minor deficiencies in volume reduction compared to conventional biofiltration, another option is to capture and treat additional long term runoff volume (via increased sizing) to achieve equivalent load reductions in lieu of providing supplemental infiltration storage. As a simple approach for minor volume reduction deficiencies, the pollutant treatment performance of Filterra systems for TSS was used as a simple method. Based on a minimum removal efficiency of 80 percent (actual performance is expected to be higher), a BMP must treat and discharge 5 parts of water for every 4 parts of water that would be lost to infiltration or ET. This means that for every 1 percent of volume reduction deficit, 1.25 percent of long term volume must be treated or 0.25 percent additional capture for every 1 percent of volume reduction deficit. This concept is illustrated in Figure 5. Calculations of required additional capture efficiency are provided in Table 2.

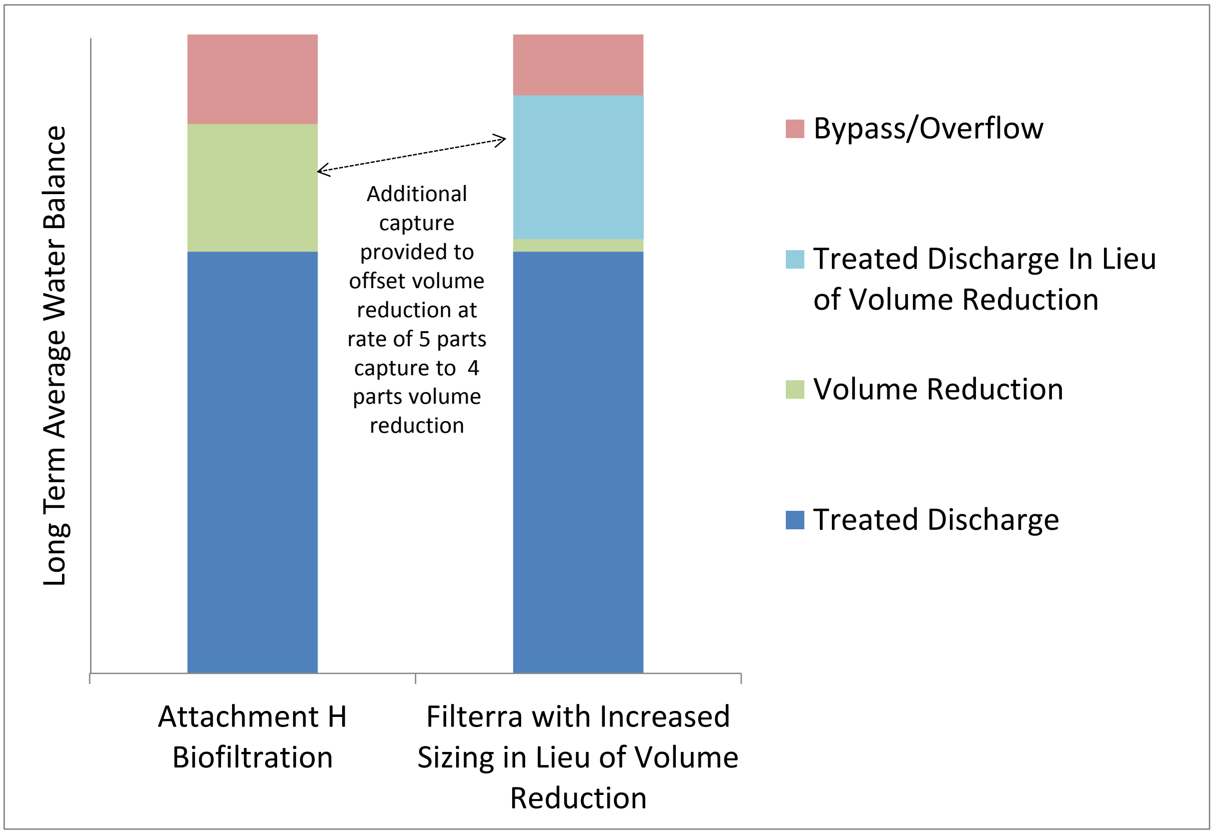

Figure 5. Illustration of Additional Capture In Lieu of Volume Reduction (Not to scale)

Table 2. Additional Capture Efficiency in Lieu of Volume Reduction

Site Soil Infiltration Rate, in/hr	Attachment H Biofiltration Long Term Volume Reduction[1, 2]	Filterra Long Term Volume Reduction[1] (ET only)	Volume Reduction Deficit	Additional Capture Efficiency in Lieu of Volume Reduction[3]	Adjusted Target Capture Efficiency
0	4%	1%	3%	0.8%	93.8%
0.01	6%	1%	5%	1.3%	94.3%
0.05	11%	1%	10%	2.5%	95.5%
0.10	16.5%	1%	15.5%	3.9%	96.9%
0.15	22%	1%	21%	5.3%	98.3%
0.30	35%	1%	34%	8.5%	N/A

1 – Based on modeling of ET from soil pores and standing water.
2 – Includes infiltration losses, where feasible
3 – Required additional capture calculated at a rate of 1 part additional for every 4 parts volume reduction deficit.

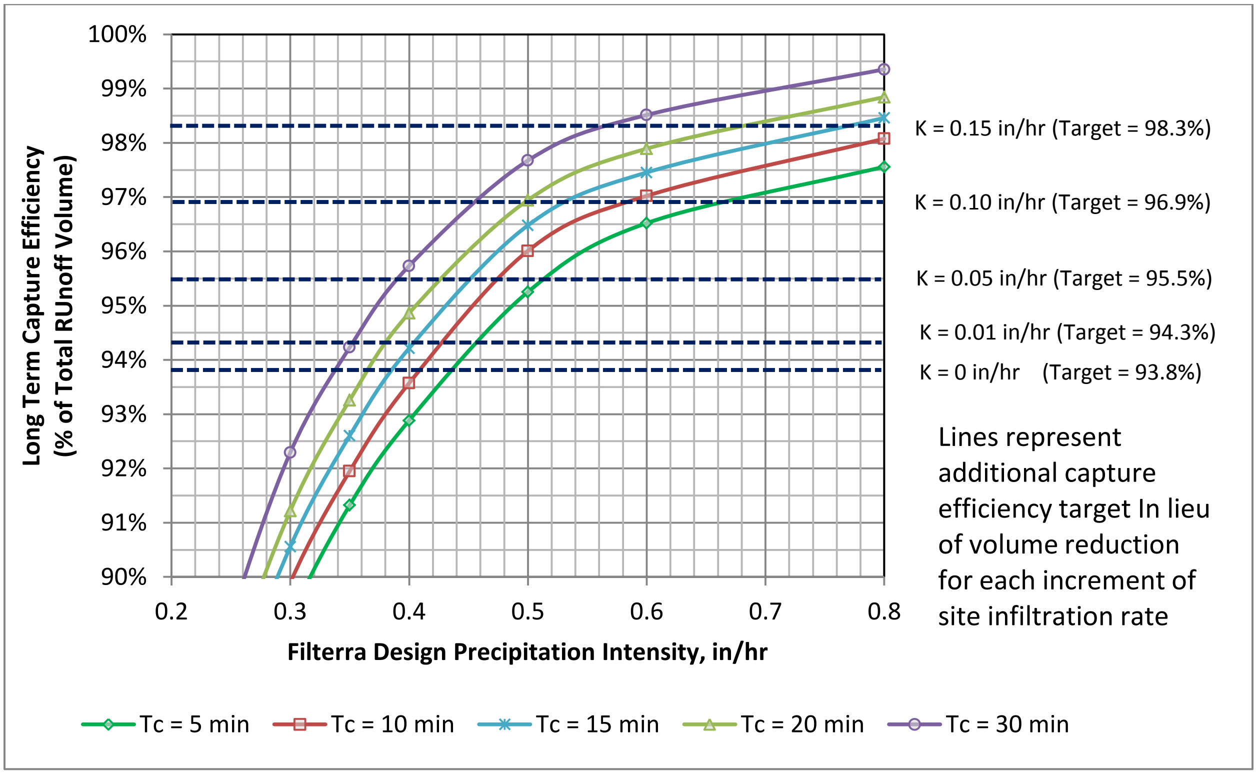

Figure 6. Additional Capture Targets In Lieu of Volume Reduction (same chart as Figure 4, with adjusted axis limits)

4 DESIGN METHODOLOGY AND EQUIVALENCY CRITERIA

In order to apply the equivalency relationships developed in Section 3, a standardized design methodology was developed. As a result of applying this design methodology, Filterra systems are expected to perform equivalently to conventional Attachment H biofiltration. This methodology consists of three parts, as described below.

Part A - Characterize Site and Determine Key Attributes

1. Delineate the tributary area to each Filterra BMP.

2. Estimate the imperviousness of the tributary area; use this value to estimate a runoff coefficient for use in stormwater quality design flowrate (SWQDf) and stormwater quality design volume (SWQDv) calculations. The runoff coefficient shall account for imperviousness and be based on standard methods acceptable to the reviewing jurisdiction.

3. Calculate the time of concentration (Tc) for each Filterra tributary area using methods acceptable to the local jurisdiction.

4. Estimate the long term reliable infiltration rate of the soils underlying each BMP location using appropriate methods, subject to the approval of the reviewing agency.

5. Determine local 85th percentile, 24-hour precipitation depth for the project. The 85th percentile, 24-hour rain event shall be determined from the Los Angeles County 85th percentile precipitation isohyetal map[2] or analysis of local long term precipitation data.

6. Calculate the SWQDv for each Filterra tributary area, using locally-approved methods.

7. Calculate the site "Scaling Factor" as the ratio of the project-specific 85th percentile, 24-hour storm event to the LAX 85th percentile, 24-hour storm event (1.02 inches).

Part B – Design Filterra for Equivalent Long Term Capture Efficiency

8. Consult Design Table 1 to determine the appropriate Filterra Design Precipitation Intensity associated with the Tc for each tributary area. For Tc less than 5 minutes, round up to 5 minutes. For Tc greater than 30 minutes, round down to 30 minutes. Interpolation between values in this table is permissible.

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[2] http://www.ladpw.org/wrd/publication/engineering/Final_Report-Probability_Analysis_of_85th_Percentile_24-hr_Rainfall1.pdf

Design Table 1 - Filterra Design Chart for Equivalent Long Term Capture Efficiency

Time of Concentration of Tributary Area, minutes	Filterra Design Precipitation Intensity, inches per hour[1]
5	0.41
10	0.38
15	0.36
20	0.34
30	0.32

1 - Sizing requirements are based on Filterra size required to achieve a target capture efficiency of 93% of long term runoff volume at the Los Angeles Airport gage. For different locations, the site scaling factor must be applied.

9. Apply the rational method to determine the design flowrate required for each Filterra.

$$Q_{required} = \text{Runoff Coefficient (unitless)} \times \text{Filterra Design Precipitation Intensity (in/hr)} \times \text{Site Scaling Factor (unitless)} \times \text{Tributary Area (ac)} \times (43560 \text{ sq-ft/ac}/(12 \text{ in/ft} \times 3600 \text{ sec/hr}))$$

10. Select a Filterra model with a treatment flow rate that is equal to or greater than the design flowrate based on a maximum treatment flow rate of 1.45 gallons per minute per square foot of Filterra surface area. This is equivalent to a treatment rate of 140 inches per hour.

Part C, Option 1 - Design for Equivalent Long Term Volume Reduction

The design of a Filterra system must mitigate for deficiency in volume reduction compared to conventional biofiltration. As one option, the designer may include supplemental infiltration, either upstream or downstream of the Filterra to compensate for the volume reduction deficit between conventional biofiltration and Filterra systems.

11. Consult Design Table 2 to determine the fraction of the SWQDv that needs to be provided in supplemental retention. It is appropriate to linearly interpolate within this table. For long term reliable infiltration rates greater than 0.3 inches per hour, full infiltration of the SWQDv must be considered.

Design Table 2 - Supplemental Infiltration Volume for Equivalent Long Term Volume Reduction

Estimated Long Term Reliable Infiltration Rate below Site, inches per hour	Long Term Volume Reduction Deficit, % of Long Term Runoff	Required Supplemental Infiltration Storage Volume as Fraction of Local SWQDv, unitless[1]
0	3%	Not a feasible option; see Part C, Option 2
0.01	5%	0.15
0.05	10%	0.11
0.15	21%	0.17
0.3	34%	0.26

1 – Values are not expected to follow a continually increasing trend. A 2.1 foot effective depth is assumed for supplemental storage.

12. Multiply the site-specific SWQDv for each Filterra Tributary area calculated above by the ratio from Design Table 2 to determine the required supplemental retention volume. Design Table 2 is based on the assumption that the Contech ChamberMaxx product will be used, with an equivalent storage depth of 2.1 feet. Shallower or deeper storage would require different sizing factors. Supplemental calculations can be provided to demonstrate that an alternative storage configuration would provide equivalent long term volume reduction.

Part C, Option 2 - Design for Additional Capture In Lieu of Volume Reduction

As an alternative option, the designer may increase the size of the Filterra systems to provide additional capture in lieu of providing supplemental infiltration volume.

13. Consult Design Table 3 to determine the adjusted design precipitation intensity needed to compensate for volume reduction deficiency.

Design Table 3 – Upsizing of Filterra to Provide Additional Capture Efficiency in Lieu of Volume Reduction

Time of Concentration of Tributary Area, minutes	Site Infiltration Rate				
	0 in/hr Target Capture Efficiency = 93.8%	**0.01 in/hr** Capture Efficiency Target = 94.3%	**0.05 in/hr** Capture Efficiency Target = 95.5%	**0.10 in/hr** Capture Efficiency Target = 96.9%	**0.15 in/hr** Capture Efficiency Target = 98.3%
	Adjusted Filterra Design Precipitation Intensities, in/hr				
5	0.44	0.46	0.52	0.66	NA
10	0.41	0.43	0.48	0.58	NA
15	0.39	0.41	0.45	0.53	0.76
20	0.37	0.38	0.43	0.50	0.68
30	0.34	0.35	0.39	0.46	0.56

NA = additional capture is not a viable option to offset volume reduction in these cases.

14. Apply the rational method to determine the adjusted design flowrate required for each Filterra.

$$Q_{required} = \text{Runoff Coefficient (unitless)} \times \text{Adjusted Filterra Design Precipitation Intensity (in/hr)} \times \text{Site Scaling Factor (unitless)} \times \text{Tributary Area (ac)} \times (43560 \text{ sq-ft/ac}/(12 \text{ in/ft} \times 3600 \text{ sec/hr}))$$

15. Select a Filterra model with a treatment flow rate that is equal or greater than $Q_{required}$ based on a maximum treatment flow rate of 1.45 gallons per minute per square foot of Filterra surface area (140 inches per hour).

5 DISCUSSION AND CONCLUSIONS

5.1 Key Observations and Findings

This analysis and associated research yielded a number of key observations:

- The baseline level of capture efficiency and volume reduction provided by conventional biofiltration BMPs, if effectively designed per Attachment H, is relatively high. This establishes a relatively high baseline standard for Filterra systems to meet in providing equivalent performance.
- There is substantial leeway within the Attachment H criteria and local implementation guidance that is expected to result in design variations of conventional biofiltration throughout Los Angeles County. These variations are expected to result in fairly important variations in hydrologic performance. Additionally, variations in operations and maintenance conditions over time (i.e., decline in media rates, reduction in active storage volume from sedimentation) are also expected to influence performance.
- It is possible to design Filterra systems to match the capture efficiency of conventional biofiltration BMPs. This requires larger sizes of Filterra systems than was required for treatment control BMPs under the previous MS4 Permit. This also requires a commitment to regular maintenance consistent with Filterra standard maintenance requirements.
- Filterra systems alone are not expected to match the volume reduction performance provided by conventional biofiltration that is effectively designed, even in lined systems. However, it is possible for Filterra systems to mitigate for deficiency in volume reduction via either supplemental infiltration storage or increasing the size of Filterra systems to increase their capture efficiency thereby providing equivalent load reductions.
- For water that is treated and released, Filterra performance studies generally showed similar or better concentration reduction compared to conventional biofiltration. Filterra performance tended to be less variable in most cases. Filterra systems also did not exhibit the potential for major nutrient export that is relatively common in conventional biofiltration.
- When studies from the International BMP Database were screened to best match conventional biofiltration designs per Attachment H (specifically compost and sand fractions), the treatment performance tended to decline somewhat. This is consistent with findings related to use of compost in biofiltration media from other studies. This indicates that there is still progress to be made in addressing nutrient export issues in conventional biofiltration systems. For example, in Western Washington results of rigorous testing of media comprised of sand and compost conforming to local specifications have led to limitations on the use of biofiltration in nutrient sensitive watersheds and have stimulated research into alternative media blends.

Overall, if Filterra systems are designed based on the methodology and criteria presented in Section 4 and effectively operated and maintained these systems are expected to match or exceed the performance of conventional biofiltration within a reasonable margin of uncertainty.

5.2 Reliability and Limitations

There are a number of uncertainties that influence the reliability of the findings presented in this report. These are addressed in the paragraphs below.

Modeled hydrologic performance estimates. Performance estimates were based on models which were not calibrated. This introduces some uncertainty. This uncertainty was mitigated by applying identical input parameters and modeling approaches for conventional biofiltration and Filterra systems, as appropriate. This has the effect of offsetting the majority of potential sources of bias.

Treatment performance estimates for conventional biofiltration. Treatment performance estimates were based on peer reviewed studies from the International BMP Database and other peer reviewed third party studies that were selected to be representative of the BMPs being compared. Due to limited sample size of conventional biofiltration monitoring studies and some deficiencies in documentation of these studies, it was not possible to quantitatively evaluate whether performance estimates are specifically representative of Attachment H biofiltration. Additionally, performance has been observed to vary greatly from site to site, indicative of the importance of design factors such as sizing, media composition, sources of media components, and other design factors. The screened and unscreened datasets analyzed are believed to provide reliable information about the range of potential performance that may be expected from conventional biofiltration in Los Angeles County; however they are not intended to be used as a predictive tool for any one variation of biofiltration design. Reliability of these data was improved through the application of robust statistical methods that account for the influence of influent concentration and provide a quantification of uncertainty.

Treatment performance estimates for Filterra systems. Filterra systems have been evaluated in a range of sites and climates; however none of these sites were in Los Angeles and not all studies are necessarily representative of the influent quality from typical Los Angeles land uses. Additionally, the sample size of Filterra datasets is still somewhat low in comparison to conventional biofiltration BMPs. These factors are mitigated to a large extent by the standardized design that accounts for rainfall intensity/duration differences and ensures consistency in media composition of Filterra systems. These factors improve the transferability of findings between regions. Additionally, the reliability of Filterra performance data was improved by applying the same robust statistical methods as used for conventional biofiltration, which help adjust for differences in influent quality between studies.

TSS removal as a surrogate for additional capture in lieu of volume reduction. For small deficiencies in volume reduction, a TSS treatment removal rate of 80 percent was used to calculate required additional capture efficiency in lieu of volume reduction. A multi-parameter approach would be more complex and would need to account for the export of nutrients in conventional biofiltration as well as the observation that metals performance tends to vary substantially with influent concentration (i.e., where influent concentration is relatively low, the removal efficiency tends to be lower, but the resulting effluent concentration is still below typical water quality standards). Given that this approach is only intended to offset minor volume reduction (up to about 20%), this is considered to be a reasonable approach.

Sensitivity to site conditions. The effectiveness of volume reduction processes is particularly sensitive to estimates of site infiltration rate. It may not be possible to anticipate, with certainty, what the final long term infiltration rate will be in the post construction condition. This limitation is largely mitigated for the purpose of this analysis because the uncertainty in infiltration rate influences the design and performance of conventional biofiltration and Filterra with infiltration storage similarly. Additionally, estimating the site infiltration rate is now a standard part of developing a BMP plan for a site, therefore approaches for developing this estimate should improve in reliability with time. Finally, both systems provide excellent TSS treatment prior to infiltration and long term infiltration rates should therefore be more reliable.

Variability in design and construction process. The analyses and criteria presented in this report are based on the assumption that the BMPs will be effectively designed and constructed consistent with a typical standard of care. It is inherent that design of non-proprietary conventional biofiltration BMP provides a greater degree of freedom and associated professional judgment as part of preparing design calculations, design drawings, and specifications. This introduces a wider potential range of resulting designs. Some may be better than average, some may be worse. Additionally, there are typically a number of specialized elements in the construction of a biofiltration BMP that may introduce variability in as-built condition as a result of contractor preferences and/or quality control issues. There are many examples of biofiltration facilities that have failed due to design and construction issues. In comparison, there is likely to be substantially less variability in the design and construction of Filterra system compared to biofiltration BMPs.

Sensitivity to operations and maintenance. Both types of systems are susceptible to decline in performance over time. **Neither system will work if they are not regularly and effectively maintained.** Filterra systems may be more susceptible to rapid clogging because of their relatively small footprint. However, this is mitigated by Filterra having a standard maintenance plan that has been informed by feedback from O&M of numerous facilities.

Overall, the analyses are believed to result in reliable design assumptions. Where substantial uncertainties exist, the analyses and assumptions have tended to err on the side of estimating somewhat higher performance for conventional biofiltration and somewhat lower performance for Filterra systems, which likely results in more conservatism in Filterra equivalency sizing.

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APPENDIX A – CONVENTIONAL BIOFILTRATION DESIGN ASSUMPTIONS FOR PERFORMANCE MODELING

The following criteria from Attachment H were considered to be important for evaluating pollutant load reduction performance of "conventional biofiltration" scenarios:

- 6 to 18-inch ponding area above media
- Optional layer of mulch
- 2 to 3 feet of engineered filter media (2 feet typical) with a design infiltration rate of 5 to 12 inches/hour; the Attachment H specification calls for a mix of 60 to 80% fine sand and 20 to 40% compost
- Gravel storage layer below the bioretention media to promote infiltration
- Underdrain placed near the top of the gravel layer (or an infiltration sump otherwise provided via an equivalent hydraulic control approach) in cases where underlying soil infiltration rates allow
- Underdrain discharge to the storm drain
- Total physical water storage volume sized to be equal to at least the stormwater quality design volume (SWQDv = runoff volume from the 85th percentile, 24-hour storm event)
- Capacity (including stored and filtered water) adequate to biofilter 150 percent of the portion of the SWQDv not reliably retained.

Within the bounds established by these criteria, a relatively wide range of actual biofiltration designs could result as a function of site infiltration conditions as well as designer and local jurisdiction preferences. An example of potential design variability is illustrated in Table A.1 below. For the purpose of this analysis, representative design assumptions were developed within the range of potential design assumptions. These assumptions are also presented in Table A.1 with supporting rationales.

Table A.1 Biofiltration Design Assumptions from Various Sources and Selected Representative Design Assumptions

Design Assumption	Design References					Selected Representative Design Assumption	Rationale for Selected Design Assumption
	MS4 Permit Attachment H	Los Angeles County LID Manual, static method	Los Angeles County LID Manual, routing method	City of Los Angeles LID Manual	Ventura County TGM		
Ponding Depth, ft	0.5 to 1.5	0.5 to **1.5**	0.5 to **1.5**	0.5 to **1.5**	0.5 to **1.5**	1.5	Many designers will utilize deepest depth allowable because of space efficiency.
Media Depth, ft	2 to 3	**2** to 3	**2** to 3	**2** to 3	**2** to 3	2	Typical design approach is to use minimum depth due to cost of media.
Gravel "sump" depth below underdrain, ft	Not specified; narrative	Not specified, narrative	Not specified, narrative	At least 1 feet; up to **2** feet if soils allow incidental infiltration	**0.5** minimum below underdrain	Depth that would drain in 24 hours. For example, 1.5 ft if site infiltration rate estimated at just less than 0.3 in/hr	Approach produces a reasonable design that considers infiltration rates; Attachment H states that volume infiltrated within 24 hours can be considered retained.
Media Filtration Rate, in/hr	5 to 12	**5** to 12	**5** to 12	**5** to 12	1 to 12 **(5)**	5	Representative of long term operation after some clogging
Allowable Routing Period for Biofiltration Treatment, hrs	Not specified	Routing is not part of simple method	Allows routing of **24-hour** design hydrograph from LA County HydroCalc model	**3** hours, unless using a routing model	Depth up to ponding depth (**1.5 ft**) can be considered routed	6 hours[1]	Based on evaluation of storm durations for events similar to design event. See footnote 1.
Resulting Footprint Factor at 0.3 in/hr Infiltration Rate, in/hr (% of impervious area)	Not enough information to calculate	7.5%	1.4%	2.4% (1.4% with routing similar to LA County)	2.8%	2.0%	Calculated based on assumptions.

Note: where a range of guidance is allowed, the bolded number indicates the value that was used in calculations. The design values were selected based on developing the most economical and space-efficient design that meets the applicable criteria.

1 – The allowable routing period was estimated based on the typical storm duration associated with events similar to the 85th percentile, 24-hour storm depth (1.0 inches at LAX). This was estimated in two ways. For days with precipitation totals between 0.9 and 1.1 inches, the total number of hours with rainfall was tabulated (average = 11 hours; 10th percentile = 6 hours). This does not consider dry periods between hours with rainfall, therefore is somewhat conservative in estimating the period of time available for routing biofiltered water during a given day. For unique precipitation events, separated by 6 hour dry period (potentially spanning across breaks in calendar days), with precipitation totals between 0.9 and 1.1 inches, the total storm durations were tabulated (average = 16 hours; 10th percentile = 7 hours). Based on this analysis, a 6 hour routing period is considered to be defensible and conservative in estimating the amount of water that can be routed through a biofiltration system during typical storm events similar to the design storm event.

APPENDIX B – SWMM MODELING METHODOLOGY AND ASSUMPTIONS

Equivalency Scenarios

The relative performance of Filterra systems and conventional biofiltration was compared under the following climate and site conditions:

- Climate (and associated precipitation and ET): Los Angeles
- Land Use (and associated imperviousness and runoff quality): Multi-family Residential
- Soil infiltration rate: 0, 0.01, 0.05, 0.15, and 0.3 inches per hour
- A hypothetical 1-acre catchment was used for this analysis and was not varied.

For conventional biofiltration, the sizing and design criteria described in Appendix A were followed.

For Filterra systems, all combinations of the following sizing criteria were evaluated for each combination of climate and site conditions:

- Design precipitation intensity: 10 sizing increments were evaluated between 0.1 and 0.8 inches per hour.
- Catchment time of concentration: 5 increments were evaluated between 5 minutes and 30 minutes
- Downstream retention storage volume: 5 increments were evaluated between 0% (absent) and 50% of the runoff from the 85th percentile, 24-hour storm event.

Specific SWMM modeling representations of each combination of site conditions and BMP parameters are described in this Appendix.

Overview of SWMM Analysis Framework

SWMM was used to estimate the long-term capture efficiency and volume reduction from conventional biofiltration BMPs and Filterra systems for each scenario. SWMM compartmentalizes its computations based on several physically-based processes including surface runoff, evaporation, infiltration, and flow routing. A conceptual representation of the SWMM model framework used for this analysis is provided in Figure B.1. Within this framework, parameters were adjusted for each scenario to account for soil condition and BMP sizing and design attributes.

In SWMM, subcatchment elements are used to generate a runoff hydrograph. Input data defining the surface characteristics include subcatchment area, imperviousness, width, depression storage, surface roughness, surface slope, and infiltration parameters. SWMM performs a mass balance of inflows and outflows to determine runoff from a subcatchment. The inflows to this mass balance are precipitation and any runoff directed from another subcatchment. The outflows from the mass balance include evaporation, infiltration, and runoff. The runoff parameters assumed for this analysis are discussed in this Appendix.

A variety of hydraulic flow routing elements exist in SWMM, but fundamentally, the program includes nodes (i.e., storage units, manholes, and outfalls) and links (i.e., conduits, pipes, pumps, weirs, orifices, and outlets). Storage units were used in this equivalency analysis to represent the storage and routing attributes of BMPs. The elements defining the storage volume and related discharge were adjusted based on the various sizing and design criteria evaluated in the equivalency scenarios, the details of which are discussed in this Appendix.

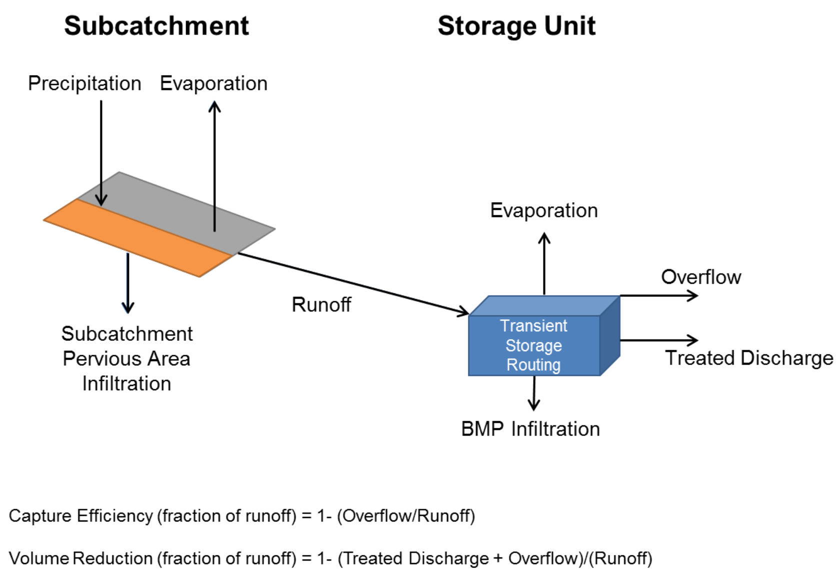

Figure B.1. Schematic SWMM modeling framework in support of equivalency analysis

SWMM was run in continuous simulation mode over a 15-year period (2000-2015). A continuous hydrograph of runoff was generated and routed through the model representations of BMPs. The results were tracked and reported in terms of long term runoff volume, long term volume lost in the BMP, long term volume bypassing or overflowing the BMP, and long term volume treated in the BMP. The 15-year period of record was selected based on the availability of high quality 5-minute resolution precipitation data, which are important for representing urban catchments with short time of concentration. To ensure comparability, the same forcing data (rainfall, ET) were applied to conventional biofiltration scenarios and Filterra scenarios.

Meteorological Inputs

Precipitation

Precipitation data utilized this study included continuous hourly precipitation data collected by the National Climatic Data Center (NCDC) and five-minute precipitation data from the Automated Surface Observation System (ASOS); both part of the National Oceanic and Atmospheric Administration (NOAA). The hourly precipitation datasets from NCDC provided an extensive record of precipitation data from 1948 through February 2015. NCDC precipitation datasets at major airports are known to be of high quality with few areas of missing or unreportable data and therefore were used as a quality standard to compare to the ASOS dataset as well as the basis for estimating long term precipitation statistics. The ASOS dataset does not receive the same level of quality review that the NCDC data and has considerably shorter period of data (ASOS dataset is from 2000 to February 2015). However, the ASOS data is collected at 5-minute intervals, providing considerably better temporal resolution for precipitation when modeling of urban BMPs, particularly for small catchments. Therefore, NCDC data were used to define the 85th percentile 24-hour sizing criteria and to validate the ASOS data, while the ASOS data was used as the input to comparative model simulations. The period of record of ASOS data (15 years) is less than ideal for characterizing long term averages, however because the same dataset was used for both conventional biofiltration and Filterra systems, this length if record is ample to provide a valid comparison of performance.

The Los Angeles Airport location was included in this analysis (NCDC: 045114, ASOS: KLAX). The 85th percentile 24-hour precipitation depth was determined using the entire length of record at the NCDC gage and compared to the values produced from the ASOS gages (Table B-1). In determining the 85th percentile, 24-hour depth, days with 0.1 inches or less were excluded from both datasets. The resulting 85th percentile, 24-hour depths are well matched between the NCDC and ASOS gage. Scatter plot comparisons of NCDC and ASOS datasets for monthly and 24-hour totals at each location also show good agreement (Figure B-1 and Figure B-2). This indicates that the ASOS data provide a reasonable estimate of absolute long term performance in addition to providing a reliable comparison between BMP types.

Table B.1. Summary of 85th percentile 24-hour storm depths.

Storms	Gage Location	85th Percentile 24-Hour Depth (in)
All NCDC Storms > 0.1 inch (1948-2015)	Los Angeles Airport (045114)	1.01
All ASOS Storms > 0.1 inch (2000-2015)	Los Angeles Airport (KLAX)	0.96

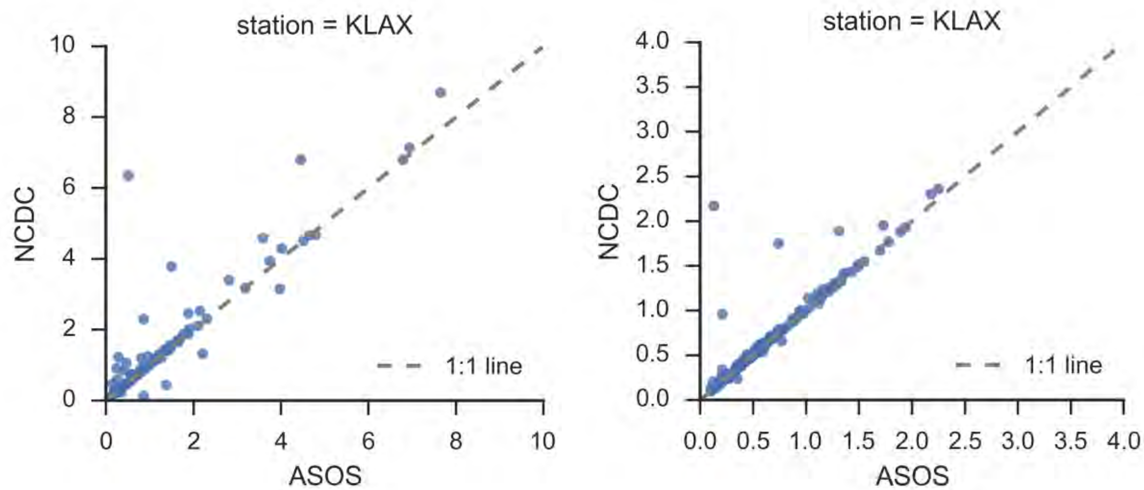

Figure B.2. Scatter plot comparisons of monthly (left) and daily (right) precipitation depths for NCDC and ASOS datasets.

ET Parameters

Reference ET values for Zone 4 of the California Irrigation Management Information System were used to estimate evaporation for all simulations (CDWR 2015). Zone 4 represents coastal areas; actual ET may be higher in inland areas and is likely higher on average in Southern California than the San Francisco Bay Area, however the influence of this assumption is minor and will tend to cancel out in comparison between BMP types. Average ET conditions were represented by setting the modeled evaporation values equal to 60% of the reference ET values to represent a mix of urban conditions with varied plant pallets and shading conditions based on guidance provided by CIMIS (CDWR 2015). The assumed ET values for this analysis are presented in Table B.2.

Table B.2. Assumed ET values for all scenarios

Month	Evapotranspiration Rates			60%
	inch / day	days / month	inch / month	inch / month
January	0.05	31	1.55	0.93
February	0.08	28	2.24	1.34
March	0.12	31	3.72	2.23
April	0.17	30	5.1	3.06
May	0.22	31	6.82	4.09
June	0.26	30	7.8	4.68
July	0.28	31	8.68	5.21
August	0.25	31	7.75	4.65

Month	Evapotranspiration Rates			60%
	inch / day	days / month	inch / month	inch / month
September	0.19	30	5.7	3.42
October	0.13	31	4.03	2.42
November	0.07	30	2.1	1.26
December	0.05	31	1.55	0.93
Total (year)		365	57.04	34.22

Runoff Parameters

The key SWMM parameters used to estimate surface runoff are subcatchment area, width, imperviousness, depression storage, surface roughness, surface slope, and infiltration parameters. The majority of surface characteristics were kept constant for both BMP systems and across all land use types. The values assumed for each of these parameters are in Table B.3. Imperviousness was varied for different land uses as described in the Ventura County Technical Guidance Manual for Stormwater Quality Control Measures (Larry Walker Associates and Geosyntec 2011) and is presented for each land use within Table B.3. Additionally, for Filterra simulations, the width parameter (defines the overland flow length for runoff to travel), were adjusted to reflect differences in time of concentrations. The values applied within the model were estimated through an iterative process during the modeling phase.

Runoff estimation is affected by losses to infiltration processes over pervious areas of the subcatchment. The Green-Ampt method of estimating infiltration was used to represent this process. Three input parameters were used to characterize infiltration with this method: initial deficit, saturated hydraulic conductivity, and suction head. These parameters represent surface conditions and are not necessarily related to the saturated infiltration processes that may occur below a BMP (typically several feet below the surface). Because the purpose of this equivalency analysis was to isolate differences between two BMP types, the subcatchment infiltration parameters were held fixed for all scenarios. Parameters were selected to represent typical urban conditions with disturbed urban soils (Table B.3).

Table B.3. Summary of SWMM parameters to represent runoff parameters

SWMM Runoff Parameters	Units	Values	Source/Rationale
Wet time step	seconds	150	Set to half the time steps of precipitation input data (300 seconds)
Dry time step	seconds	14,400	Equivalent to 4 hours.
Period of Record		January 2000-December 2014	Availability of ASOS data

SWMM Runoff Parameters	Units	Values	Source/Rationale
Percent of Impervious Area	percent	Multifamily Residential = 74	Los Angeles County Hydrology Manual (2006)
Impervious Manning's n	unitless	0.012	James and James, 2000
Pervious Manning's n	unitless	0.15	James and James, 2000 (mix of dense grass and mulched landscaping)
Drainage area	acres	1	Hypothetical for purpose of analysis
Width	feet	174 feet by default (equates to 250-ft path length) For Filterra scenarios, variable to represent different time of concentrations	Typical assumption for urban drainage patterns
Slopes	ft/ft	0.03 (represents average of roofs, landscaping, and streets)	Professional judgment
Evaporation	in / month	60% of reference ET values (Table B.4)	CIMIS (CWDR, 2015)
Depression storage, impervious	inches	0.02	James and James, 2000
Depression storage, pervious	inches	0.06	James and James, 2000
Saturated Hydraulic Conductivity (in/hr)	in/hr	0.15	EPA SWMM User's Manual for typical disturbed urban soils
Initial Moisture Deficit (in/in)	in/in	0.29	EPA SWMM User's Manual for typical disturbed urban soils
Maximum Suction Head (inches)	inches	8	EPA SWMM User's Manual for typical disturbed urban soils

BMP Representation

Both the conventional biofiltration BMPs and Filterra systems were simulated using a storage unit with outlets to represent infiltration losses (if present) and treated discharge, and a weir to represent overflow/bypass. The elevations of these elements within the storage unit were used to represent the design profiles of these systems. Storage compartments were broken into: evaporation storage (i.e., water stored in soil that is not freely drained); infiltration storage (i.e., water stored below the lowest outlet that can either infiltration or ET only); and freely drained storage (i.e., water that can drain through the underdrains of the system at a rate controlled by the media hydraulic conductivity). In some scenarios an additional storage unit was located downstream of the Filterra BMP to represent additional retention storage.

Conventional Biofiltration

Sizing criteria for the conventional biofiltration system was based on the runoff from the 85th percentile, 24-hour storm depth (1.0 for LAX). For each scenario, this depth was applied to the catchment area and imperviousness to compute an estimated runoff volume. Storage profiles for the conventional biofiltration system were established to represent typical profiles for conventional biofiltration consistent with what is required by Attachment H of the MS4 Permit, which are presented in Appendix A. The storage profiles included equivalent storage volumes provided in the ponding depth, media depth (divided between ET storage and freely drained storage), gravel layer, and placement of the underdrain system specific to the site conditions. Based on the equivalent storage depth in these profiles and the design storm runoff volume, the required footprints were calculated. For gravel, a porosity of 0.4 was assumed. For media, a porosity of 0.4 in/in was assumed, divided as 0.15 in/in soil suction storage (i.e. ET storage) and 0.25 in/in freely drained storage. The profiles used for this analysis and the typical footprints are presented in Table B.4.

For the purpose of estimating long term volume reduction and baseline capture efficiency, the entire pore volume was assumed to be immediately available. However, because water takes time to travel through the soil column, it is possible for a biofiltration BMP to overflow before the entire soil poor volume is utilized. Based on analysis of flow monitoring data, Davis et al. (2011) found that the volume immediately available within a storm is better represented by the bowl volume (surface ponding) and the freely drained pores within the root zone (approximately the top 1 foot of soil). To check whether this condition controlled, parallel model runs were conducted where the storage volume equaled the bowl volume plus freely drained pores in the soil root zone, and the drawdown time was adjusted for only this volume. The result was that this condition reduced capture efficiency by approximately 2 percent. This indicates that this condition controls performance relatively rarely, but is not negligible.

Table B.4. Summary of conventional biofiltration profiles

Infiltration Rate, in/hr	Retention Sump Depth (as gravel depth)[1], ft	Effective Water Storage in Retention Sump (ft)	Media Depth, ft	Effective Water Storage in Media[2], ft	Ponding Depth, ft	Total Effective Water Depth (ft)	Approximate Footprint Sizing Factor (Los Angeles)[3]
0.3	1.5	0.60	2	0.8	1.5	2.9	1.5%
0.15	0.75	0.30	2	0.8	1.5	2.6	1.6%
0.05	0.25	0.10	2	0.8	1.5	2.4	1.7%
0.01	0.05	0.02	2	0.8	1.5	2.32	1.7%
0	0	0.00	2	0.8	1.5	2.3	1.8%

1 Sump storage was determined based on the depth of water that would infiltrate in 24 hours based on guidance provided in Attachment H.
2 Media storage depth divided as 0.3 ft suction storage and 0.5 ft freely drained storage.
3 Expressed as BMP footprint as percent of tributary area; Multi-family density of 74% impervious was used as a representative value for simulations.

Filterra

An array of flow-based sizing increments were applied to define the physical dimensions of the Filterra system to be modeled in each scenario. Ten increments of uniform design intensities ranging from 0.1 inches/hour up to 0.8 inches/hour (0.1, 0.15, 0.2, 0.25, 0.3, 0.35, 0.4, 0.5, 0.6, 0.8) were established to represent a range of potential Filterra sizing criteria to achieve equivalency. For each scenario, the design intensity was applied to the catchment area and imperviousness to calculate the runoff flowrate. The treatment capacity of the Filterra system was set at 140 in/hr (or 0.0032 cu-ft/sec per sq-ft). Based on the required treatment flowrate and the Filterra treatment capacity, the required Filterra footprint was determined.[3] Similar to the conventional biofiltration system, a vertical profile was also established as an input to the model, including ponding depth, pore space in mulch and media, and underdrains (Table B.5). The volume of the Filterra system is negligible; however the entire volume was assumed to be available as a result of the very high infiltration rate of the Filterra media.

Further scenarios were developed for the Filterra system that included supplemental downstream retention. These supplemental storage volumes were sized based on a percentage of the runoff volume from the 85th percentile, 24-hour depth (0% (absent), 10%, 20%, 30%, 40%, 50%). For these scenarios, an additional storage unit was simulated and received the treated flow from the

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[3] In practice, designers would select a standard Filterra size that meets or exceeds the required design flowrate, therefore many systems will tend to be oversized in practice; the approach used for this equivalency analysis is conservative in that it assumes exactly the minimum size is used.

upstream Filterra storage unit. The profile of the Filterra system is described in Table B.5. The downstream retention unit was modeled with an assumed depth of 2.1 feet, based on typical Contech ChamberMaxx system geometry, assuming 6 inches gravel above and below the ChamberMaxx units.

Table B.5. Summary of profile for Filterra systems

Media Filtration Rate, in/hr	Gravel Underdrain[1], ft	Effective Water Storage in Retention Sump (ft)	Media Depth, ft	Effective Water Storage in Media[2], ft	Ponding Depth, ft	Total Effective Water Depth (ft)	Approximate Footprint Sizing for 0.3 in/hr scenario[3]
140	0.5	0.2	2	0.5	0.5	2.4	0.19%

1 Gravel layer based on typical Filterra design; all of the gravel layer was assumed to drain freely to the underdrain

2 Media storage depth divided as 0.3 ft suction storage and 0.5 ft freely drained storage.

3 Expressed as BMP footprint as percent of tributary impervious area (varies by land use and sizing increment; for example purposes only).

APPENDIX C – DATASETS AND ANALYSIS METHODS FOR POLLUTANT TREATMENT EVALUATION

Data Development and Analysis Framework

BMP performance is considered to be a function of BMP type, BMP design parameters, influent water quality characteristics, and other factors. As part of this analysis, it was necessary to develop a statistical description of BMP performance that accounted for the difference between conventional biofiltration and Filterra systems and also accounted for the influence of land use runoff quality (i.e., BMP influent quality) on the expected BMP performance. The data development and analysis framework used for this project included four steps:

1) Compile and review data from monitoring studies of conventional bioretention systems; then screen these studies to identify studies that are reasonably representative of conventional biofiltration designs that would meet the MS4 Permit requirements, particularly focusing on factors that would influence treated effluent quality.
2) Compile and review monitoring data from full-scale monitoring studies of Filterra systems.
3) Apply a common statistical analysis framework to analyze the data from both datasets.
4) Determine representative land use runoff quality.
5) Based on results from step 3 and 4, estimate the effluent quality expected for conventional biofiltration and Filterra systems for each pollutant for a range of land use types.

Compilation and Screening of Conventional Biofiltration Studies

The International Stormwater BMP Database (www.bmpdatabase.org) includes storm event monitoring data from 28 peer-reviewed studies of bioretention BMPs with underdrains. These data were used as the primary source for characterizing the treatment performance of conventional biofiltration BMPs in this study. In addition to the 28 studies from the International BMP Database, four peer-reviewed research studies (Davis 2007; Li and Davis 2009; David et al., 2011; Gilbreath et al. 2012) not contained in the International BMP Database were added to the sample pool for analysis. Two of these studies were conducted recently in the San Francisco Bay area, which has biofiltration design standards and media specifications nearly identical to Attachment H of the Los Angeles MS4 Permit. The two other additional studies were included due to their similarity to Attachment H design criteria and rigor of their analytical methods.

Screening Process for Developing Conventional Biofiltration Sample Pool

To our knowledge, there have yet to be any BMPs monitored in Southern California that have been constructed to the specific criteria of Attachment H. Additionally, the two studies monitored in the San Francisco Bay area (designed to very similar standards as Attachment H)

(David et al., 2011; Gilbreath et al. 2012) provide a relatively small sample size and did not monitor for nutrients. Therefore, it was necessary to broaden the scope of studies to represent conventional biofiltration.

In general, the bioretention BMPs in the International BMP Database are considered to be representative of the range of designs that could meet the MS4 Permit Attachment H requirements. Most of the bioretention studies in the BMP Database were completed fairly recently (most in the last 10 years) and have typically been designed, constructed, and/or monitored under the supervision of experienced researchers. Many of these systems have been designed with BMP profiles (i.e., ponding depth, media depth), media filtration rates, and media composition that are similar to the criteria in Attachment H. However, where design attributes indicated that performance would be expected to be poorer than Attachment H designs and/or representativeness could not be evaluated, these studies were screened out of the analysis pool for this study. Systems that were expected to achieve similar or better performance than a typical BMP designed per Attachment H were kept in the pool; this is a conservative approach when evaluating Filterra equivalency because it tends to establish a higher baseline for comparison than if these BMPs were excluded.

Screening criteria were developed based on professional judgment, as informed by review of literature and BMP performance studies. Our understanding of the influence of design parameters on bioretention performance was informed by studies in the BMP Database (see various summary reports at www.bmpdatabase.org), a recent evaluation by Roseen and Stone (2013), and review of recent bioretention media research in Washington State. A summary of the relevant findings are provided in the paragraphs below.

Roseen and Stone (2013) conducted an evaluation of biofiltration performance to determine how design criteria and media composition influence performance. As part of their research, they compiled site, design, and performance data for 80 field bioretention systems and 114 lab columns/mesocosms. Data from the International BMP Database were included in this pool as well as other research studies. Performance data were compiled as study summaries (e.g., study median influent, effluent, and removal efficiency). Roseen and Stone then utilized design information to categorizing systems into groups based on common combinations of factors. They then conducted a statistical evaluation of how performance was influenced by design factors such as presence/absence of mulch layers, use of compost in media, infiltration rate of media, ratio of tributary to biofiltration area, presence/absence of pretreatment, presence/absence of internal storage layers, etc. Roseen and Stone found that the presence of compost in mixes strongly influences the variability in performance and potential export of pollutants, including phosphorus, nitrogen, and copper. Systems without compost and/or with a high fraction of sand tended to provide the most consistent and best performance for these pollutants. Systems with an internal water storage zone tended to perform better for nutrients than systems without an internal water storage zone. Finally, they found that media flowrate and depth of media bed tended to have an influence on performance. Beyond these findings, the influence of other parameters was less conclusive.

Recent bioretention studies, many in Washington State (Herrera 2014b, 2015a, 2015b), have identified the potential severity of pollutant export of nitrogen, phosphorus, and copper from conventional biofiltration systems and have evaluated the potential sources of these issues. For example, a full scale field monitoring study in the City of Redmond (WA) observed export of nitrate on the scale of 100 mg/L higher than influent quality and dissolved copper on the scale of 10 to 20 ug/L higher than influent. Follow up research has shown that compost is consistently associated with export of copper, nitrogen and phosphorus, even when the highest quality compost products available are used in designs and at proportions as low as 10% of the media blend by volume. This research also found that some sand products can also contain elevated levels of phosphorus and copper. These studies are relevant because the standard biofiltration media specifications for Western Washington are very similar to Attachment H, calling for 60 to 65 percent sand and 35 to 40 percent compost. It should also be noted that the compost certification criteria in Washington State (Washington Department of Ecology, 2014) allow for half as much metals content as allowed in the Attachment H specification, therefore should theoretically have less potential for export of metals than compost meeting the Attachment H specification.

Based on these literature findings and best professional judgment, the following criteria were applied as part of screening bioretention studies:

- Systems with media filtration rates substantially higher than 12 inches per hour were excluded – while higher rate media has been found to provide good performance in some cases, the general trends observed by Roseen and Stone (2013) indicated a decline in performance for some parameters with increased infiltration rates.
- Systems with sizing factors (BMP area as fraction of tributary area) substantially smaller than the 3 to 5 percent (20:1 to 30:1 ratio of tributary area to BMP area) were excluded – this parameter is related to media filtration rate and is an indicator of the degree of hydraulic loading.
- Systems that were observed to have very infrequent underdrain discharge (i.e., mostly infiltration) were excluded – for these designs, the effluent that was sampled for water quality was likely not representative of the entire storm event.
- Systems with internal water storage zones were kept in the pool of data; these systems are believed to provide better control of nutrients than systems without internal water storage; Attachment H does not require internal water storage to be provided.

- Based on the findings of Roseen and Stone (2013) as well as recent research in Washington State, mixes with less compost and a higher fraction of sand than the Attachment H specification were kept in the sample pool because they are believed to provide more reliable performance and less potential for export of pollutants on average than a 70-30 sand/compost mix.
- Systems that contained media with experimental components were excluded.
- Finally, systems were excluded if there was not enough design information reported to be able to evaluate representativeness, and/or any other factors were noted by the original study researchers that were believed to contribute to poorer performance than average. For example, some studies were noted as underperforming studies due to construction issues, premature clogging, etc.

Overall, the screening that was applied is believed to improve the representativeness of the sample pool and generally increase the average performance of the sample pool compared to the entire pool of studies contained in the International BMP Database. As discussed above, establishing a higher baseline level of performance for conventional biofiltration is conservative in the context of this evaluation.

Screening Results

Table C.2 summarizes the number of data points for each constituent after applying screening to remove unrepresentative studies and without screening.

Table C.2. Summary of data points by parameter for conventional biofiltration BMPs

Constituent	Number of Screened Data Pairs	Number of Unscreened Data Pairs
Total Suspended Solids	234	354
Total Phosphorus	242	384
Total Nitrogen	71	184
Total Copper	190	216
Total Zinc	200	252

Inventory of Bioretention Studies and Screening Results/Rationales

Table C.4 (located at the end of this Appendix) provides an inventory of studies of bioretention with underdrains from the International BMP Database, screening results, and brief rationales for screening.

Compilation of Filterra Studies

Data were compiled from various field-scale Filterra monitoring studies from 2004 through 2014. The design of the Filterra system has not changed appreciably over time; therefore a screening step to determine representative studies was not necessary. The studies used in this analysis are summarized in Table 3 below. Full citations for these studies can be found in the references section.

Table C.3. Inventory of studies and data points by parameter for Filterra systems

Pollutant (total count of data pairs)	Data Pairs by Study	Reference
Total Suspended Solids (n= 165)	11	TARP (2004-2005) : Yu and Stanford (2006)
	7	TARP Addendum (2006-2007): ATR Associates (2009)
	25	Perf. Over Time: Cal's Pizza (2008-2014): Americast (2009b; 2015)
	24	Perf. Over Time: Jiffy Lube (2008-2011): Americast (2009b; 2015)
	13	Perf. Over Time: Coliseum (2007-2014): Americast (2009b, 2015)
	29	NCDNR Fayetteville (2013-14): NCSU (2015a)
	22	TAPE Bellingham (2013): Herrera (2014a)
	34	TAPE Port of Tacoma (2009): Herrera (2009)
Total Phosphorus (n=146)	14	TARP (2004-2005) : Yu and Stanford (2006)
	6	TARP Addendum (2006-2007): ATR Associates (2009)
	71	Perf. Over Time: Cal's Pizza (2008-2014): Americast (2009b; 2015)
	33	NCDNR Fayetteville (2013-14): NCSU (2015a)
	22	TAPE Bellingham (2013): Herrera (2014a)
Total Nitrogen (n = 34)	34	NCDNR Fayetteville (2013-14): NCSU (2015a)
Total Copper (n = 112)	8	TARP (2004-2005): Yu and Stanford (2006)
	24	Perf. Over Time: Jiffy Lube (2008-2011): Americast (2009b; 2015)
	21	Perf. Over Time: Coliseum (2007-2014): Americast (2009b, 2015)
	13	NCDNR Fayetteville (2013-14): NCSU (2015a)
	29	TAPE Port of Tacoma (2009): Herrera (2009)
	17	TAPE Bellingham (2013): Herrera (2014a)

Pollutant (total count of data pairs)	Data Pairs by Study	Reference
Total Zinc (n = 120)	16	TARP (2004-2005): Yu and Stanford (2006)
	24	Perf. Over Time: Jiffy Lube (2008-2011): Americast (2009b; 2015)
	21	Perf. Over Time: Coliseum (2007-2014): Americast (2009b, 2015)
	13	NCDNR Fayetteville (2013-14): NCSU (2015a)
	29	TAPE Port of Tacoma (2009): Herrera (2009)
	17	TAPE Bellingham (2013): Herrera (2014a)

Key to acronyms:
TARP: Technology Acceptance Reciprocity Partnership
TAPE: Technology Acceptance Protocol-Ecology (Washington State)
NCDNR: North Carolina Department of Natural Resources
NCSU: North Carolina State University

Data Analysis Method

The most common ways to characterize BMP performance include (1) removal efficiency (percent removal) in various forms, and (2) effluent probability. In general, the effluent probability approach is recommended for evaluating BMP performance and applying BMP performance to pollutant load models (Geosyntec and Wright Water, 2009). This method involves conducting a statistical comparison of influent and effluent quality to determine if effluent is significantly different from influent. If effluent is significantly different from influent, then the effluent quality is characterized by a statistical distribution developed from all effluent data points. Probability plots are prepared indicating the probability that a certain effluent quality is achieved.

However, to isolate differences in performance between two BMP types, the effluent probability method requires the assumption that the influent quality was similar between the studies of the two BMP types being compared. This assumption is generally reliable for categorical analysis of BMPs in the International BMP Database because of the large number of studies in the most categories in the Database. However, when comparing BMP types with a relatively limited number of study sites (such as the Filterra dataset), this assumption may not be reliable.

To address these challenges and help ensure a valid comparison between conventional biofiltration and Filterra systems, a moving bootstrap method (Leisenring et al., 2009) was applied to both datasets. This method characterizes influent-effluent relationships such that the BMPs compared do not need to have been studied under conditions with similar influent quality. In this approach, all data pairs are used to form the total sample population. Then for each increment of influent quality, a subsample of the overall population is formed including only those data pairs that lie within a certain span of the selected influent quality. Applying bootstrap principles (Singh and Xie, 2008), the median and the confidence interval around the median is computed as well the mean and the confidence interval around the mean. Then a new increment of influent quality is selected and the process is repeated with a new subsample population until a statistical description of effluent quality has been developed for each increment of influent quality over the range of the data. Rules are also imposed regarding selection the initial span of the moving window and expansion the span of the window, if needed, to ensure monotonicity (i.e., ensure that effluent quality always increases or stays the same with increasing influent quality).

Resulting tables and plots from this analysis are presented in Appendix D.

Land Use Stormwater Quality Inputs and Assumptions

Representative stormwater runoff concentrations for the land use condition used in this analysis were developed based on the land use stormwater quality monitoring data reported in the Los Angeles County 1994-2000 Integrated Receiving Water Impacts Report, 2000 and Los Angeles County 2000-2001 Stormwater Monitoring Report, 2001(LA County 2000; LA County 2001). The median and mean runoff quality values from this dataset were used as representative influent water quality conditions for the purpose of evaluating BMP performance. These concentrations represent only one land use monitoring station in one geographic area; actual conditions for a given drainage area in a given region are anticipated to vary. Beyond the range of water quality presented in this table, this analysis did not attempt to characterize the uncertainty/variability in runoff water quality. This simplification is considered appropriate for evaluating equivalency in BMP performance.

Land use runoff quality is reported in Appendix D.

Table C.4. Inventory of conventional biofiltration studies from the International BMP Database and screening rationale

Source	Site Name	Sponsoring Entity	State	City	Selected?	Selection/Rejection Reasons
Int. BMP Database	Rocky Mount Grassed Bioretention Cell 1	North Carolina State	NC	Rocky Mount	Yes	Aligns with Att. H; Has internal water storage zone and underdrain
Int. BMP Database	Rocky Mount Mulch/Shrub Bioretention Cell 1	North Carolina State	NC	Rocky Mount	Yes	Aligns with Att. H; Has internal water storage zone and underdrain
Int. BMP Database	CHS_BioFilter	The Thomas Jefferson Planning District Commission	VA	Charlottesville	Yes	Aligns with Att. H; Has internal water storage zone, underdrain, and mulch layer (0.25 feet)
Int. BMP Database	Parks & Forestry Bioretention	City of Overland Park	KS	Overland Park	Yes	Aligns with Att. H; Has internal water storage zone, underdrain, and mulch layer
Int. BMP Database	Bioretention 6	Johnson County	KS	Shawnee	Yes	Aligns with Att. H; Has internal water storage zone and underdrain
Int. BMP Database	G2	North Carolina State	NC	Greensboro	Yes	Aligns with Att. H; Has underdrain, and mulch layer (7-10 cm)
Int. BMP Database	G1	North Carolina State	NC	Greensboro	Yes	Aligns with Att. H; Has underdrain, and mulch layer (7-10 cm)
Int. BMP Database	L1	North Carolina State	NC	Louisburg	Yes	Aligns with Att. H; Appropriate loading ratio
Int. BMP Database	Bioretention 3B	Johnson County	KS	Shawnee	Yes	Aligns with Att. H; Has internal water storage zone and underdrain
Int. BMP Database	Parking Lot Bioretention Cell	City of Fort Collins	CO	Fort Collins	Yes	Aligns with Att. H; Has internal water storage zone and mulch layer

Source	Site Name	Sponsoring Entity	State	City	Selected?	Selection/Rejection Reasons
Int. BMP Database	Bioretention Cells	Johnson County SMP	KS	Overland Park	Yes	Aligns with Att. H; Has internal water storage zone, underdrain, and mulch layer
Int. BMP Database	Bioretention Cell	Johnson County SMP	KS	Overland Park	Yes	Aligns with Att. H; Has internal water storage zone and underdrain
Int. BMP Database	Bioretention System (D1)	UNH/Cooperative Institute for Coastal and Estuarine Environmental Technology	NH	Durham	Yes	Aligns with Att. H; Has pretreatment, internal water storage zone, underdrain, and mulch layer
Int. BMP Database	UDFCD Rain Garden	Urban Drainage and Flood Control District	CO	Lakewood	Yes	Aligns with Att. H; Has internal water storage zone, underdrain, and compost layer
Int. BMP Database	Hal Marshall Bioretention Cell	City of Charlotte, North Carolina	NC	Charlotte	Yes	Aligns with Att. H; Has underdrain, and mulch layer
Int. BMP Database	Rocky Mount Grassed Bioretention Cell 2	The Cooperative Institute for Coastal and Estuarine Environmental Technology	NC	Rocky Mountain	Yes	Aligns with Att. H; Has internal water storage zone and underdrain
Li and Davis (2009)	Bioretention Cell 1	Prince George's County Department of Environmental Resources/ U of MD	MD	College Park	Yes	Aligns with Att. H
Li and Davis (2009)	Bioretention Cell 2	Prince George's County Department of Environmental Resources/U of MD	MD	Silver Spring	Yes	Aligns with Att. H
Davis (2007)	Bioretention Cell 1	Prince George's County Department of Environmental Resources/U of MD	MD	College Park	Yes	Aligns with Att. H
David et al. (2011)	Daly City Library Rain Gardens	San Francisco Estuary Institute	CA	Daly City	Yes	Aligns with Att. H
Gilbreath et al. (2012)	San Pablo Ave Green Streets	San Francisco Estuary Institute	CA	El Cerrito	Yes	Aligns with Att. H
Int. BMP Database	Bioretention Area	Virginia Department of Conservation and Recreation	VA	Charlottesville	No	Not enough design info provided
Int. BMP Database	Small Cell	North Carolina Department of Transportation	NC	Knightdale	No	Infiltration rate low; noted to be underperforming BMP by

Source	Site Name	Sponsoring Entity	State	City	Selected?	Selection/Rejection Reasons
						study researchers
Int. BMP Database	BRC_B	North Carolina State	NC	Nashville	No	Infiltration too low and undersized
Int. BMP Database	North cell	North Carolina State	NC	Raleigh	No	Media very different from Att. H
Int. BMP Database	WA Ecology Embankment at SR 167 MP 16.4	Washington State Dept. of Transportation	WA	Olympia	No	Linear design; lateral flow; not representative of typical biofiltration design
Int. BMP Database	Bioretention Cell	Delaware Department of Transportation	DE	Dover	No	Design is very different from Att. H
Int. BMP Database	East 44th St. Pond	City of Tacoma	WA	Tacoma	No	No design data
Int. BMP Database	Tree Filter	UNH/Cooperative Institute for Coastal and Estuarine Environmental Technology	NH	Durham	No	Design is very different from Att. H
Int. BMP Database	BRC_A	North Carolina State University	NC	Raleigh	No	Infiltration rate very low; noted to be a partially clogged/failing system
Int. BMP Database	Cub_Run_Bioretention	Fairfax County	VA	Fairfax	No	No design data provided
Int. BMP Database	South cell	North Carolina State University (BAE)	NC	Raleigh	No	Design is very different from Att. H
Int. BMP Database	R Street	City of Tacoma	WA	Tacoma	No	No design data provided

APPENDIX D – RESULTS OF POLLUTANT TREATMENT DATA ANALYSIS

The data analysis methods described in Appendix C were applied to the datasets described in Appendix C. The following pages present tabular and graphical results of this analysis.

Table D.1. Summary Statistics - Bioretention Studies and Filterra Studies

Median Statistics

Land Use	Pollutant	Units	Median Representative Runoff Quality	Conventional Biofiltration Effluent (Screened)		Conventional Biofiltration Effluent (Unscreened)		Filterra Effluent	
				Median	95th percentile UCL on Median	Median	95th percentile UCL on Median	Median	95th percentile UCL on Median
Commercial	TSS	mg/L	53	12	13.7	11	12	4.9	5
	Total Phosphorus	mg/L	0.27	**0.46**	0.55	0.26	0.37	0.06	0.08
	Total Nitrogen	mg/L	2.3	1.6	2.9	1.19	1.52	1	1.6
	Copper	ug/L	22	12	15	12	14	10	10
	Zinc	ug/L	192	35	44	36	40	70	77
High Density Single Family Residential	TSS	mg/L	61	12	15	12	13	5.0	5.0
	Total Phosphorus	mg/L	0.32	**0.47**	0.55	0.28	0.43	0.09	0.11
	Total Nitrogen	mg/L	2	1.6	2.9	1.2	1.5	1	1.6
	Copper	ug/L	11	5.3	5.9	5.3	6.4	5.5	6.0
	Zinc	ug/L	66	20	27	18	26	31	35
Light Industrial	TSS	mg/L	129	16	18	16	18	5.2	7.0
	Total Phosphorus	mg/L	0.3	**0.47**	0.55	0.27	0.42	0.09	0.11
	Total Nitrogen	mg/L	2.4	1.6	2.9	1.2	1.5	1.3	1.6
	Copper	ug/L	21	12	15	12	13.85	10	10
	Zinc	ug/L	366	35	44	36	40	80	95
Multi-family Residential	TSS	mg/L	24	10.8	12.5	9.9	9.9	3	3
	Total Phosphorus	mg/L	0.14	**0.39**	0.45	**0.21**	0.25	0.04	0.05
	Total Nitrogen	mg/L	1.5	**1.6**	2.9	1.2	1.5	0.9	1
	Copper	ug/L	12	5.6	6.1	5.6	6.6	5.5	6.0
	Zinc	ug/L	89	20	27	18	26	35	37

Mean Statistics

Land Use	Pollutant	Units	Mean Representative Runoff Quality	Conventional Biofiltration Effluent (Screened)		Conventional Biofiltration Effluent (Unscreened)		Filterra Effluent	
				Mean	95th percentile UCL on Mean	Mean	95th percentile UCL on Mean	Mean	95th percentile UCL on Mean
Commercial	TSS	mg/L	66	28	49	25	39	6.0	7.9
	Total Phosphorus	mg/L	0.39	**0.80**	1.3	**0.65**	1.0	0.11	0.14
	Total Nitrogen	mg/L	3.6	2.9	4.3	2.1	2.8	NA	NA
	Copper	ug/L	39	19	29	16	24	18	29
	Zinc	ug/L	241	65	145	59	108	69	105
High Density Single Family Residential	TSS	mg/L	95	28	49	25	39	6.0	8.5
	Total Phosphorus	mg/L	0.39	**0.80**	1.3	**0.65**	1.0	0.11	0.14
	Total Nitrogen	mg/L	3.0	2.9	4.3	2.1	2.8	NA	NA
	Copper	ug/L	15	13	21	13	19	12	19
	Zinc	ug/L	79	33	50	32	46	28	45
Light Industrial	TSS	mg/L	240	46	105	40	87	16	31
	Total Phosphorus	mg/L	0.41	**0.80**	1.3	**0.65**	1.0	0.11	0.14
	Total Nitrogen	mg/L	3.1	2.9	4.3	2.1	2.8	NA	NA
	Copper	ug/L	32	19	29	16	24	18	29
	Zinc	ug/L	639	NA	NA	59	108	168	285
Multi-family Residential	TSS	mg/L	46	18	28	18	27	6.0	7.9
	Total Phosphorus	mg/L	0.2	**0.8**	1.3	**0.6**	1.0	0.06	0.07
	Total Nitrogen	mg/L	2.1	**2.9**	4.3	**2.1**	2.8	1.1	1.5
	Copper	ug/L	12	10	15	9	14	9	15
	Zinc	ug/L	146	45	90	32	46	38	60

NA - Average values could not be computed for because the land use average influent is outside of the range of influent observed in monitoring studies.

Key to cell formatting

Red bold indicates median or mean effluent concentration higher than influent concentration. This is indicative of the potential for pollutant export.

Blue indicates upper confidence interval of effluent concentration is higher than the influent concentration. This is not a conclusive indicator, but is provided for reference.

Figure D.1 Moving Window Plots of Medians

Screened Biofiltration Dataset | **Unscreened Biofiltration Dataset** | **Filterra Dataset**

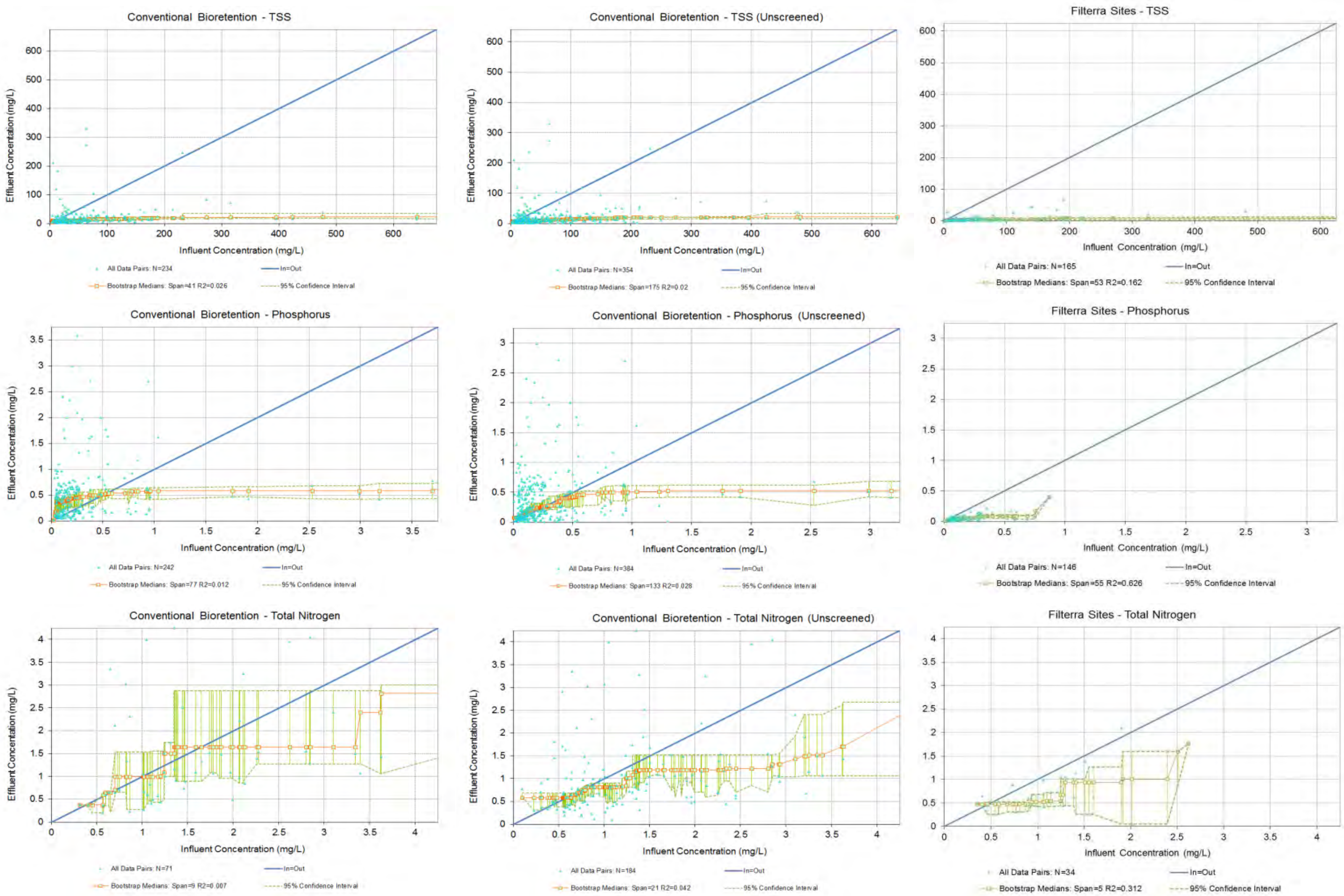

Figure D.1 Moving Window Plots of Medians

Screened Biofiltration Dataset **Unscreened Biofiltration Dataset** **Filterra Dataset**

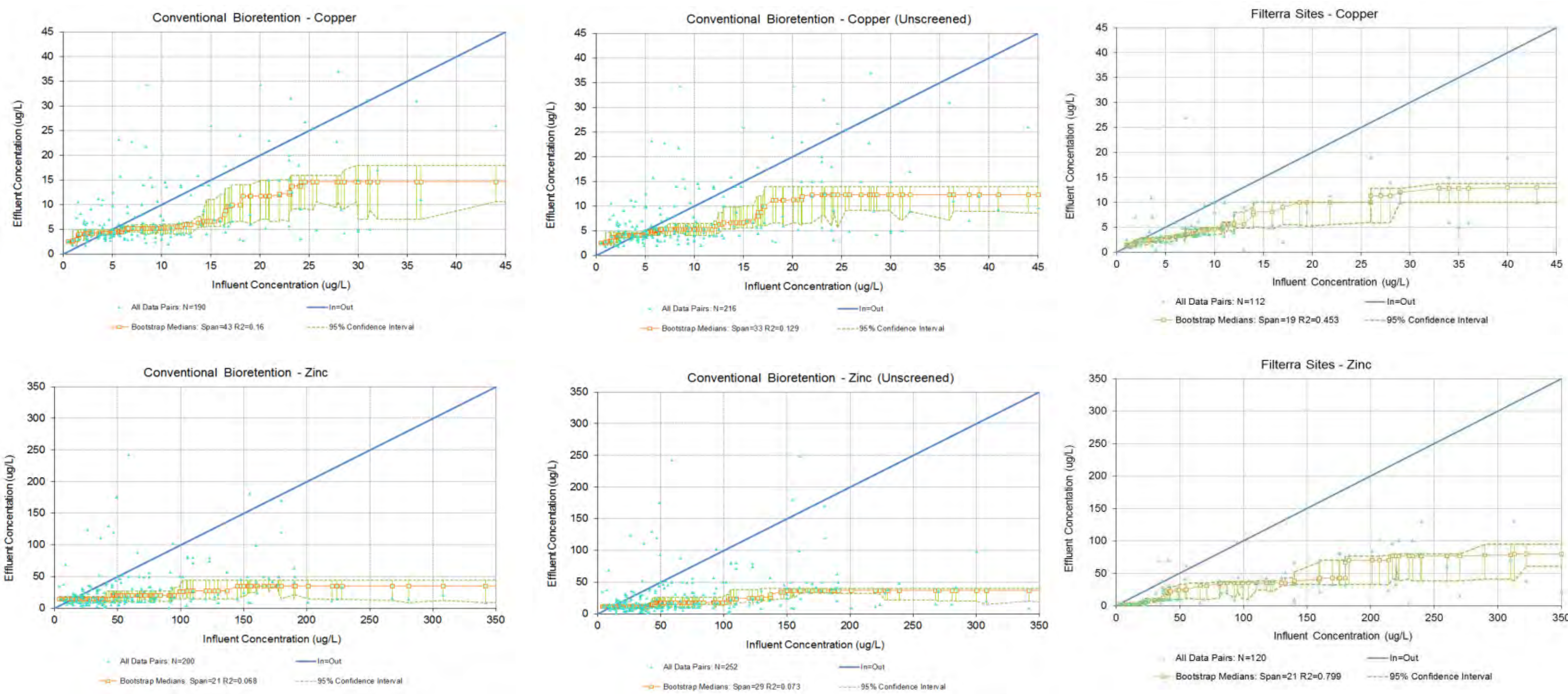

Figure D.2 Moving Window Plots of Means

Screened Biofiltration Dataset | **Unscreened Biofiltration Dataset** | **Filterra Dataset**

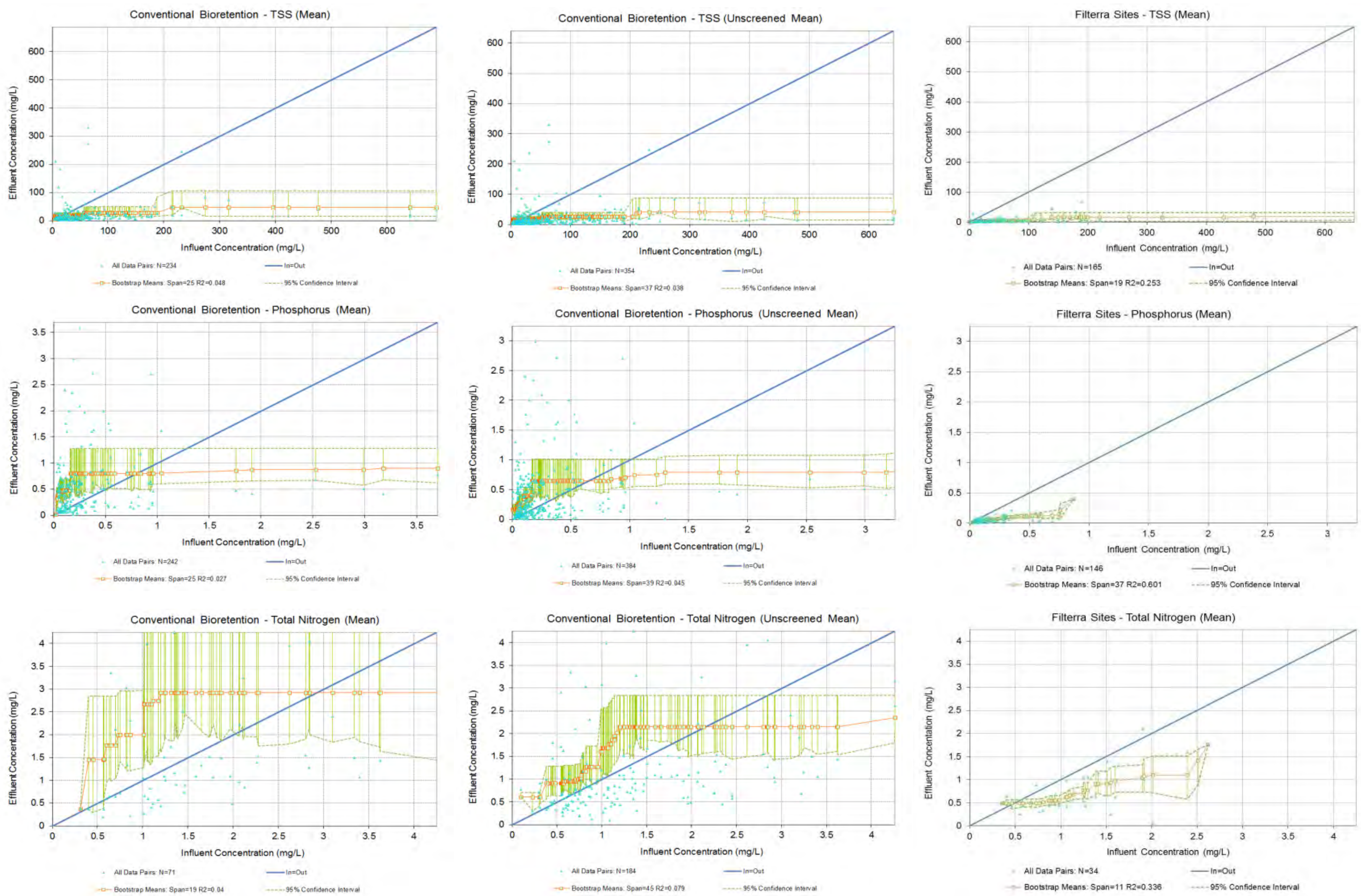

Figure D.2 Moving Window Plots of Means

Screened Biofiltration Dataset | **Unscreened Biofiltration Dataset** | **Filterra Dataset**