CUDDY & FEDER LLP

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White Plains, New York 10601
Tel 914.761.1300 Fax 914.761.5372
www.cuddyfeder.com

November 22, 2013

BY EMAIL & FEDEX
Chairman Robert Stein
and Members of the Connecticut Siting Council
Connecticut Siting Council
10 Franklin Square
New Britain, Connecticut 06051

Re: Docket 437 - D&M Plan
New Cingular Wireless PCS, LLC ("AT&T")
111 Second Hill Road, Bridgewater, Connecticut

Dear Chairman Robert Stein and Members of the Connecticut Siting Council:

On behalf of New Cingular Wireless PCS, LLC ("AT&T"), please accept for review and Council approval this Development Management Plan ("D&M Plan") filing for the captioned Facility as approved in Docket 437.

Tower, Compound & Other Equipment

Enclosed are fifteen (15) sets of 11" x 17" construction drawings being filed in accordance with the Council's Decision and Order dated September 5, 2013 ("Decision and Order"). Two full-sized sets of the construction drawings will follow under separate cover. The D&M Plan incorporates a 160' monopole as provided for in the Siting Council's Order No. 1 in this Docket. AT&T will mount twelve (12) panel antennas at a centerline height of 156' as depicted on the drawings prepared by CHA. The D&M Plan also includes construction plans for the site clearing, drainage, and erosion and sedimentation control measures consistent with the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control as amended.

Incorporated in the D&M Plan please also find measures to be utilized at the site for the protection of wood turtles, a state special concern species. Please also note the proposed planting plan included in the D&M Plan for areas to the north of the access drive and compound will enhance the "edge effect" habitat located along the margins of this small forest block to provide food, cover and nesting sites for avian species.

Attached to this letter please also find a geotechnical study of the approved tower location as well as a design analyses and calculations for the tower and foundation. Specifications for AT&T's antennas, remote radiohead units, surge arrestors and generator are provided as well. A drainage report for AT&T's access drive is also included.

Required Notifications

In accordance with the provisions of RCSA Section 16-50j-77, AT&T hereby notifies the Council of its intention to begin site work immediately after Council approval of the D&M Plan. Construction of the tower and other site improvements will commence upon issuance of a local building permit. The supervisor for all construction related matters on this project is Bryon Morawski of SAI. Mr. Morawski is located at 500 Enterprise Drive, Suite 3A, Rocky Hill, CT 06067 and can be reached by telephone at (860) 513-7223.

We respectfully request that this matter be included on the Council's next available agenda for review and approval.

Thank you for your consideration of the enclosed.

Very truly yours,

Daniel M. Laub

Enclosures

cc: Robert Reibe, Property Owner
Michele Briggs, AT&T
Consultant Team
Bryon Morawski, SAI
Christopher B. Fisher, Esq.

CERTIFICATE OF SERVICE

I hereby certify that on this day, a copy of the foregoing and attached was sent electronically and by overnight mail to the Connecticut Siting Council with copy to:

Robert Reibe
111 Second Hill Road
Bridgewater, CT 06752

Dated: November 22, 2013

Daniel M. Laub

ATTACHMENT 1

DR. CLARENCE WELTI, P.E., P.C.

GEOTECHNICAL ENGINEERING

227 Williams Street · P.O. Box 397
Glastonbury, CT 06033-0397

(860) 633-4623 / FAX (860) 657-2514

September 10, 2013

Mr. Peter LaMontagne
Centerline
95 Ryan Drive, Suite #1
Raytham, MA 02767

**Re: Geotechnical Study for Proposed AT&T Tower Site No.1252, Bridgewater
111 Second Hill Road, Bridgewater, CT 06752**

Dear Mr. LaMontagne:

1.0 Herewith is the data from the test boring taken at the above referenced site. One test boring was drilled at the proposed tower center to a depth of 31.5 feet. *The boring was drilled by Clarence Welti Associates, Inc. and sampling was conducted by this firm solely to obtain indications of subsurface conditions as part of a geotechnical exploration program. No services were performed to evaluate subsurface environmental conditions.*

2.0 The **Subject Structure** will be a monopole tower with a height of 160 feet. The tower site is located at the northeast corner of an existing residential parcel. There is about 6 feet of topographic relief across the proposed 100' x 100' tower parcel.

3.0 Geologically the site soils are of glacial moraine origin. The soils consist of medium compact to dense fine sand and silt with trace clay and gravel to 31+ feet below grade.

3.1 The **Soils/Rock Cross Section** from the boring is generally as follows:

Topsoil to 8"

Fine to medium SAND, little Silt to 2 feet, medium compact

Fine SAND and SILT, trace Clay and Gravel to 31+ feet, medium compact to dense

3.1 The **Ground Water Table** was not evident in the borehole at the completion of the boring. The soils below about 8 feet had water contents at or close to saturation.

4.0 In general the criteria for tower support is that the foundation capacity would exceed the loads, which might collapse the tower. **Movements from strains in the soils should be limited to differential settlement (or lateral movements of less than ½").**

5.0 The logical foundation for the proposed tower would be with a large mat. The weight of the mat would provide the required resistance to over turning. The mat could be placed on the natural inorganic soils at least 3.5 feet below finished grades for frost protection. The soil may be sensitive to remolding when wet. To address this condition there should be a minimum 8" layer of 3/8" crushed stone beneath the foundation. The allowable loading on crushed stone atop the natural inorganic soils can be 2 Tons/sf.

5.1 Summary of design parameters:

Parameter	Value
Allowable Bearing Pressure	2 Tons/sf
Soil Unit Weight (natural soils above water table)	125 pcf
Soil Unit Weight (natural soils below water table)	63 pcf
Soil Unit Weight (backfill)	125 pcf
Angle of Internal Friction	32°
At rest coefficient	0.45
Active coefficient	0.28
Sliding Coefficient, concrete on crushed stone	0.6
Frost Protection Depth	3.5 feet

6.0 This report has been prepared for specific a application to the subject project in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made. In the event that any changes in the nature, design and location of structures are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing.

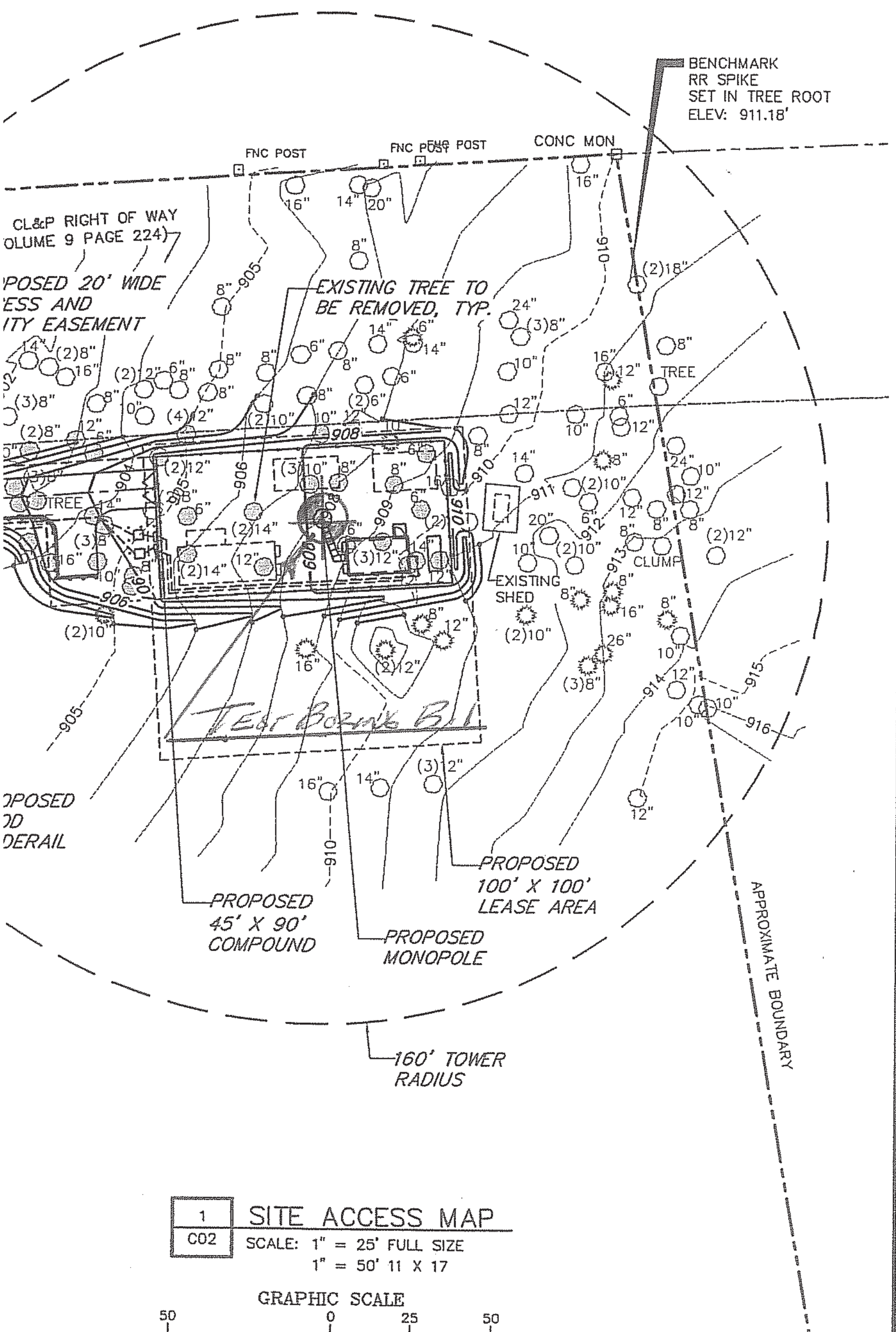
The analyses and recommendations submitted in this report are based in part upon data obtained from referenced explorations. The extent of variations between explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

Dr. Clarence Welti, P.E., P.C., should perform a general review of the final design and specifications in order that geotechnical design recommendations may be properly interpreted and implemented as they were intended.

If you have any questions please call me.

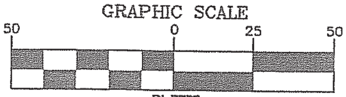
Very truly yours,

Max Welti, P. E.



1	SITE ACCESS MAP
C02	SCALE: 1" = 25' FULL SIZE 1" = 50' 11 X 17

GRAPHIC SCALE



at&t
Your world. Delivered.

NEW CINGULAR WIRELESS PCS, LLC
500 ENTERPRISE DRIVE
ROCKY HILL, CT 06067

Drawing Copyright © 2010

CHA

2139 Silas Deane Highway, Suite 212 · Rocky Hill, CT 06067-2336
Main: (860) 257-4557 · www.chacompanies.com

CHA PROJECT NO:
18301 – 1071 – 43000

NO.	SUBMITTAL		
0	12/23/10	ISSUED FOR CSC CERTIFICATE	
	BY: JDM	CHK: PAL	APP'D: JPS
1	01/25/11	MOVED ROAD	
	BY: PAL	CHK: PAL	APP'D: PAL

IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS THEY ARE ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, TO ALTER THIS DOCUMENT.

SITE ID:
SR1252
SITE NAME:
BRIDGEWATER
SITE ADDRESS:
111 SECOND HILL ROAD
BRIDGEWATER, CT
06752
LITCHFIELD COUNTY

SHEET TITLE
SITE ACCESS MAP

SHEET NUMBER
C02

CLARENCE WELTI ASSOC., INC.
P.O. BOX 397
GLASTONBURY, CONN 06033

CLIENT	SAI
PROJECT NAME	AT&T CELL TOWER
LOCATION	111 SECOND HILL ROAD, BRIDGEWATER, CT.
SURFACE ELEV.	
HOLE NO.	B-1

	AUGER	CASING	SAMPLER	CORE BAR.
TYPE	HSA		SS	
SIZE I.D.	3.75"		1.375"	
HAMMER WT.			140 lbs	
HAMMER FALL			30"	

OFFSET
LINE & STA.
N. COORDINATE
E. COORDINATE

GROUND WATER OBSERVATIONS
AT none FT. AFTER 0 HOURS
AT FT. AFTER HOURS

START DATE 8/29/13
FINISH DATE 8/29/13

DEPTH	SAMPLE NO.	BLOWS/6"	DEPTH	A	STRATUM DESCRIPTION + REMARKS	ELEV.
0	1	3-5-9-12	0.00'-2.00'		TOPSOIL	0.7
					BR. FINE-MED. SAND, LITTLE SILT	2.0
	2	15-13-15-17	2.00'-4.00'		GREY/BR. FINE SAND AND SILT, TRACE CLAY	
5	3	15-13-14-14	4.00'-6.00'			10.0
10	4	8-12-13	10.00'-11.50'		GREY FINE SAND AND SILT, TRACE CLAY & GRAVEL	
15	5	7-12-14	15.00'-16.50'			
20	6	9-10-13	20.00'-21.50'			
25	7	15-16-21	25.00'-26.50'			
30	8	13-15-25	30.00'-31.50'			31.5
					BOTTOM OF BORING @ 31.5'	
35						

LEGEND: COL. A:RECOVERY "
SAMPLE TYPE: D=DRY A=AUGER C=CORE U=UNDISTURBED PISTON S=SPLIT SPOON
PROPORTIONS USED: TRACE=0-10% LITTLE=10-20% SOME=20-35% AND=35-50%

DRILLER: J. BREWER
INSPECTOR:

SHEET 1 OF 1 HOLE NO. B-1

ATTACHMENT 2

TransAmerican Power Products, Inc.
2427 Kelly Lane
Houston, Texas 77066
PH: 281–444–8277 / FX: 281–444–7270

Page 1 of 2		Job Number:	23513-0649
Eng: MFP		Customer Ref:	CP-0247
		Date:	11/12/2013
Structure:	160-FT MONOPOLE		
Site:	281862 BRIDGEWATER		
Location:	LITCHFIELD CO., CT / 41°33'17.9", -73°22'15.2"		
Owner:	AMERICAN TOWER		
Revision No.:	Revision Date:		

DESIGN

Building Code:	2003 INTERNATIONAL BUILDING CODE	
Design Standard:	TIA/EIA-222-F 1996	
Wind Speed Load Cases:	FASTEST MILE WIND SPEED	
Load Case #1: 80	MPH Design Wind Speed	
Load Case #2: 69	MPH Wind with	0.5" Ice Accumulation
Load Case #3 50	MPH Service Wind Speed	

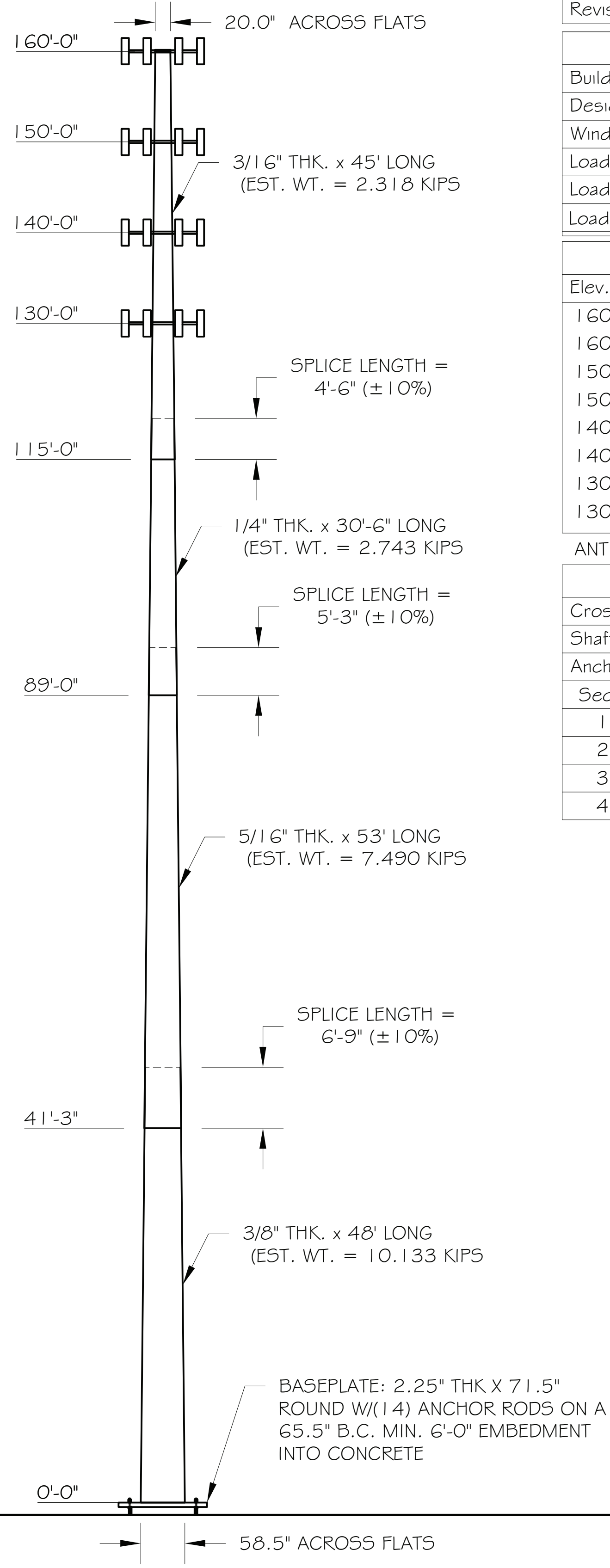
EQUIPMENT LIST

Elev.	Description
160	(12) PANEL ANTENNAS (105 FT2 / 1800 LBS)
160	T-ARM MOUNTS
150	(12) PANEL ANTENNAS (105 FT2 / 1800 LBS)
150	T-ARM MOUNTS
140	(12) PANEL ANTENNAS (105 FT2 / 1800 LBS)
140	T-ARM MOUNTS
130	(12) PANEL ANTENNAS (105 FT2 / 1800 LBS)
130	T-ARM MOUNTS

ANTENNA FEED LINES ROUTED ON THE INSIDE OF THE POLE

STRUCTURE PROPERTIES

Cross-Section: 18-SIDED			Taper: 0.25000 in/ft		
Shaft Steel: ASTM A572 GR 65			Baseplate Steel: ASTM A572 GR 50		
Anchor Rods: 2.25 in. A615 GR. 75 X 7'-0" LONG					
Sect.	Length (ft)	Thickness (in)	Splice (ft)	Top Dia. (in)	Bot Dia. (in)
1	45.00	0.1875	4.50	20.00	31.25
2	30.50	0.2500	5.25	29.75	37.38
3	53.00	0.3125	6.75	35.56	48.81
4	48.00	0.3750	0.00	46.50	58.50



STATE OF CONNECTICUT
MICHAEL F. PLAHOVINSAK
No. 25849
PROFESSIONAL ENGINEER
LICENSED
11.12.13

MICHAEL F. PLAHOVINSAK, P.E. LIC. #25849
614-398-6250 / mike@mfpeng.com

BASE REACTIONS FOR FOUNDATION DESIGN

Moment:	3550 ft-kip
Shear:	30 kip
Axial:	40 kip

TransAmerican Power Products, Inc.
2427 Kelly Lane
Houston, Texas 77066
PH: 281-444-8277 / FX: 281-444-7270

Page 2 of 2		Job Number:	23513-0649
Eng: MFP		Customer Ref:	CP-0247
		Date:	11/12/2013
Structure:	160-FT MONOPOLE		
Site:	281862 BRIDGEWATER		
Location:	LITCHFIELD CO., CT / 41°33'17.9", -73°22'15.2"		
Owner:	AMERICAN TOWER		
Revision No.:	Revision Date:		

FOUNDATION NOTES:

1. ALL FOUNDATION CONCRETE SHALL USE TYPE II CEMENT AND ATTAIN A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI AT 28 DAYS. CONCRETE SHALL HAVE A MAXIMUM WATER/CEMENT RATIO OF 0.46 AND SHALL BE AIR ENTRAINED 6% (±1.5%). ALL CONCRETE CONSTRUCTION SHALL BE IN ACCORDANCE WITH ACI 318, "THE BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE", LATEST EDITION.

2. ALL REINFORCING STEEL SHALL CONFORM TO ASTM A615 VERTICAL BARS SHALL BE GRADE 60, AND TIES OR STIRRUPS SHALL BE A MINIMUM OF GRADE 40. THE PLACEMENT OF ALL REINFORCEMENT SHALL CONFORM TO ACI 315, "MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES", LATEST EDITION.

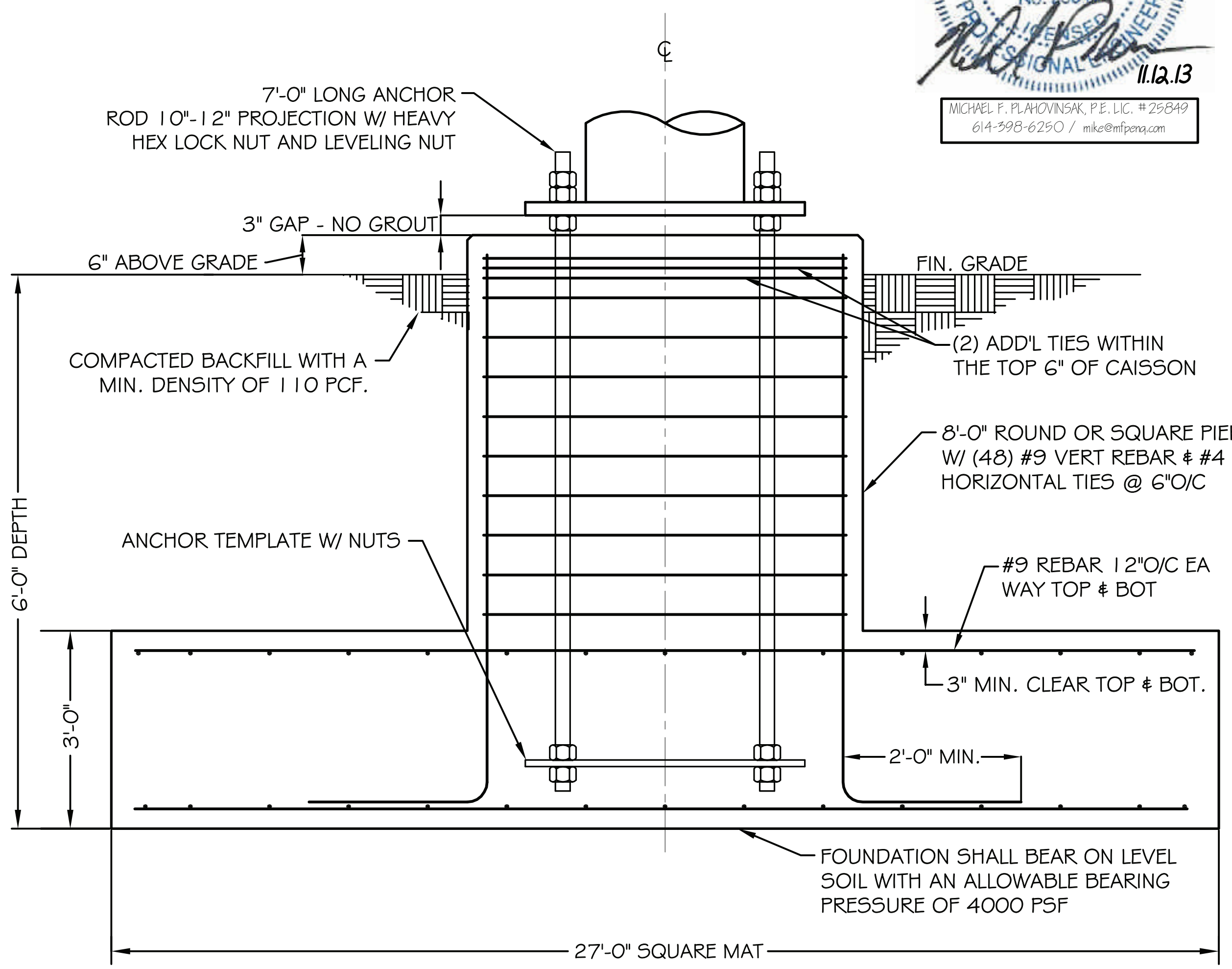
4. THE CONTRACTOR SHALL DETERMINE THE MEANS AND METHODS TO SUPPORT THE EXCAVATION DURING CONSTRUCTION. THE CONTRACTOR SHALL READ THE GEOTECHNICAL REPORT AND SHALL CONSULT THE GEOTECHNICAL ENGINEER AS NECESSARY PRIOR TO CONSTRUCTION.

3. FOUNDATION DESIGN IS BASED ON GEOTECHNICAL REPORT BY:
ENGINEER: DR. CLARENCE WELTI, PE
REPORT NO.: N/A (DATED 9/10/13)

4. ESTIMATED CONCRETE VOLUME = 89 CUBIC YARDS.

5. THE FOUNDATION HAS BEEN DESIGNED TO RESIST THE FOLLOWING APPLIED LOADS:
MOMENT: 3550 FT*KIPS
SHEAR: 30 KIPS
AXIAL: 40 KIPS

MICHAEL F. PLAHOVINSAK, P.E. LIC. #25849
614-398-6250 / mike@mfpeng.com



SPREAD FOOTING

Tower Input Data

This tower is designed using the TIA/EIA-222-F standard.
The following design criteria apply:

- Tower is located in Litchfield County, Connecticut.
- Basic wind speed of 80 mph.
- Nominal ice thickness of 0.5000 in.
- Ice density of 56 pcf.
- A wind speed of 69 mph is used in combination with ice.
- Temperature drop of 50 °F.
- Deflections calculated using a wind speed of 50 mph.
- A non-linear (P-delta) analysis was used.
- Pressures are calculated at each section.
- Stress ratio used in pole design is 1.333.
- Local bending stresses due to climbing loads, feedline supports, and appurtenance mounts are not considered.

Tapered Pole Section Geometry

Section	*Elevation ft*	*Section Length ft*	*Splice Length ft*	*Number of Sides*	*Top Diameter in*	*Bottom Diameter in*	*Wall Thickness in*	*Bend Radius in*	*Pole Grade*
L1	160.00-115.00	45.00	4.50	18	20.0000	31.2500	0.1875	0.7500	A572-65 (65 ksi)
L2	115.00-89.00	30.50	5.25	18	29.7500	37.3800	0.2500	1.0000	A572-65 (65 ksi)
L3	89.00-41.25	53.00	6.75	18	35.5666	48.8100	0.3125	1.2500	A572-65 (65 ksi)
L4	41.25-0.00	48.00		18	46.4983	58.5000	0.3750	1.5000	A572-65 (65 ksi)

Tapered Pole Properties

Section	*Tip Dia. in*	*Area in^2*	*I in^4*	*r in*	*C in*	*I/C in^3*	*J in^4*	*It/Q in^2*	*w in*	*w/t*
L1	20.3085	11.7909	584.7409	7.0334	10.1600	57.5532	1170.2512	5.8966	3.1900	17.013
	31.7321	18.4861	2253.4860	11.0272	15.8750	141.9519	4509.9372	9.2448	5.1700	27.573
L2	31.3520	23.4082	2573.6556	10.4725	15.1130	170.2942	5150.6977	11.7063	4.7960	19.184
	37.9566	29.4627	5131.6760	13.1812	18.9890	270.2441	10270.1044	14.7341	6.1389	24.556
L3	37.4474	34.9677	5490.6624	12.5152	18.0679	303.8913	10988.5496	17.4872	5.7097	18.271
	49.5630	48.1035	14293.9563	17.2166	24.7955	576.4743	28606.7209	24.0563	8.0406	25.73
L4	48.9294	54.8983	14754.9603	16.3738	23.6212	624.6501	29529.3355	27.4544	7.5237	20.063
	59.4025	69.1833	29530.0742	20.6344	29.7180	993.6764	59099.0048	34.5982	9.6360	25.696

Feed Line/Linear Appurtenances - Entered As Area

Description	*Face or Leg*	*Allow Shield*	*Component Type*	*Placement ft*	*Total Number*		*C_AA_A ft^2/ft*	*Weight plf*
1 5/8"	C	No	Inside Pole	160.00 - 0.00	18	No Ice	0.00	0.92
						1/2" Ice	0.00	0.92
1 5/8"	C	No	Inside Pole	150.00 - 0.00	18	No Ice	0.00	0.92
						1/2" Ice	0.00	0.92
1 5/8"	C	No	Inside Pole	140.00 - 0.00	18	No Ice	0.00	0.92
						1/2" Ice	0.00	0.92
1 5/8"	C	No	Inside Pole	130.00 - 0.00	18	No Ice	0.00	0.92
						1/2" Ice	0.00	0.92

Discrete Tower Loads

Description	*Face or Leg*	*Offset Type*	*Offsets: Horz Lateral Vert ft ft ft*	*Azimuth Adjustment °*	*Placement ft*		*C_AA_A Front ft²*	*C_AA_A Side ft²*	*Weight K*
(12) Panel w/ mounting (105 ft2 / 1800 lbs)	C	None		0.0000	160.00	No Ice	105.00	105.00	1.80
						1/2" Ice	125.00	125.00	2.34
(12) Panel w/ mounting (105 ft2 / 1800 lbs)	C	None		0.0000	150.00	No Ice	105.00	105.00	1.80
						1/2" Ice	125.00	125.00	2.34
(12) Panel w/ mounting (105 ft2 / 1800 lbs)	C	None		0.0000	140.00	No Ice	105.00	105.00	1.80
						1/2" Ice	125.00	125.00	2.34
(12) Panel w/ mounting (105 ft2 / 1800 lbs)	C	None		0.0000	130.00	No Ice	105.00	105.00	1.80
						1/2" Ice	125.00	125.00	2.34

Load Combinations

Comb. No.	*Description*
1	Dead Only
2	Dead+Wind 0 deg - No Ice
3	Dead+Wind 90 deg - No Ice
4	Dead+Wind 180 deg - No Ice
5	Dead+Ice+Temp
6	Dead+Wind 0 deg+Ice+Temp
7	Dead+Wind 90 deg+Ice+Temp
8	Dead+Wind 180 deg+Ice+Temp
9	Dead+Wind 0 deg - Service
10	Dead+Wind 90 deg - Service
11	Dead+Wind 180 deg - Service

Maximum Member Forces

Section No.	*Elevation ft*	*Component Type*	*Condition*	*Gov. Load Comb.*	*Force K*	*Major Axis Moment kip-ft*	*Minor Axis Moment kip-ft*
L1	160 - 115	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	5	-13.83	0.00	0.00
			Max. Mx	3	-9.02	-525.90	0.00
			Max. My	2	-9.02	0.00	525.90
			Max. Vy	3	21.01	-525.90	0.00
			Max. Vx	2	-21.01	0.00	525.90
L2	115 - 89	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	5	-18.43	0.00	0.00
			Max. Mx	3	-13.53	-1078.81	0.00
			Max. My	2	-13.53	0.00	1078.81
			Max. Vy	3	22.78	-1078.81	0.00
			Max. Vx	2	-22.78	0.00	1078.81
L3	89 - 41.25	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	5	-29.61	0.00	0.00
			Max. Mx	3	-24.30	-2210.27	0.00
			Max. My	2	-24.30	0.00	2210.27
			Max. Vy	3	26.07	-2210.27	0.00
			Max. Vx	2	-26.07	0.00	2210.27
L4	41.25 - 0	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	5	-45.58	0.00	0.00

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Mx	3	-39.47	-3537.37	0.00
			Max. My	2	-39.47	0.00	3537.37
			Max. Vy	3	29.18	-3537.37	0.00
			Max. Vx	2	-29.18	0.00	3537.37

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	160 - 115	46.289	10	2.7825	0.0000
L2	119.5 - 89	24.448	10	2.1652	0.0000
L3	94.25 - 41.25	14.420	10	1.5766	0.0000
L4	48 - 0	3.439	10	0.6664	0.0000

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
160.00	(12) Panel w/ mounting (105 ft2 / 1800 lbs)	10	46.289	2.7825	0.0000	17261
150.00	(12) Panel w/ mounting (105 ft2 / 1800 lbs)	10	40.538	2.6556	0.0000	8630
140.00	(12) Panel w/ mounting (105 ft2 / 1800 lbs)	10	34.927	2.5188	0.0000	4314
130.00	(12) Panel w/ mounting (105 ft2 / 1800 lbs)	10	29.594	2.3620	0.0000	2875

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	160 - 115	117.990	2	7.0960	0.0000
L2	119.5 - 89	62.385	2	5.5250	0.0000
L3	94.25 - 41.25	36.817	2	4.0250	0.0000
L4	48 - 0	8.787	2	1.7025	0.0000

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
160.00	(12) Panel w/ mounting (105 ft2 / 1800 lbs)	2	117.990	7.0960	0.0000	6940
150.00	(12) Panel w/ mounting (105 ft2 / 1800 lbs)	2	103.353	6.7732	0.0000	3469
140.00	(12) Panel w/ mounting (105 ft2 / 1800 lbs)	2	89.069	6.4251	0.0000	1732
130.00	(12) Panel w/ mounting (105 ft2 /	2	75.493	6.0262	0.0000	1152

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
	1800 lbs)					

ole Design Data

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P K	Allow. P_a K	Ratio $\frac{P}{P_a}$
L1	160 - 115 (1)	TP31.25x20x0.1875	45.00	0.00	0.0	37.926	17.8166	-9.02	675.71	0.013
L2	115 - 89 (2)	TP37.38x29.75x0.25	30.50	0.00	0.0	39.000	28.4205	-13.53	1108.40	0.012
		H1-3+VT (1.33 CR) - 2								
L3	89 - 41.25 (3)	TP48.81x35.5666x0.3125	53.00	0.00	0.0	39.000	46.4305	-24.30	1810.79	0.013
L4	41.25 - 0 (4)	TP58.5x46.4983x0.375	48.00	0.00	0.0	38.449	69.1833	-39.47	2659.99	0.015

Pole Bending Design Data

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
L1	160 - 115 (1)	TP31.25x20x0.1875	525.90	47.872	37.926	1.262	0.00	0.000	37.926	0.000
L2	115 - 89 (2)	TP37.38x29.75x0.25	1078.82	51.494	39.000	1.320	0.00	0.000	39.000	0.000
L3	89 - 41.25 (3)	TP48.81x35.5666x0.3125	2210.27	49.396	39.000	1.267	0.00	0.000	39.000	0.000
L4	41.25 - 0 (4)	TP58.5x46.4983x0.375	3537.37	42.718	38.449	1.111	0.00	0.000	38.449	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
L1	160 - 115 (1)	TP31.25x20x0.1875	21.01	1.179	26.000	0.091	0.00	0.000	26.000	0.000
L2	115 - 89 (2)	TP37.38x29.75x0.25	22.78	0.802	26.000	0.062	0.00	0.000	26.000	0.000
L3	89 - 41.25 (3)	TP48.81x35.5666x0.3125	26.07	0.561	26.000	0.043	0.00	0.000	26.000	0.000
L4	41.25 - 0 (4)	TP58.5x46.4983x0.375	29.18	0.422	26.000	0.032	0.00	0.000	26.000	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	160 - 115 (1)	0.013	1.262	0.000	0.091	0.000	1.278	1.333	H1-3+VT
L2	115 - 89 (2)	0.012	1.320	0.000	0.062	0.000	**1.334**	1.333	H1-3+VT
L3	89 - 41.25 (3)	0.013	1.267	0.000	0.043	0.000	1.280	1.333	H1-3+VT
L4	41.25 - 0 (4)	0.015	1.111	0.000	0.032	0.000	1.126	1.333	H1-3+VT

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$SF*P_{allow}$ K	% Capacity	Pass Fail
L1	160 - 115	Pole	TP31.25x20x0.1875	1	-9.02	900.72	95.8	Pass
L2	115 - 89	Pole	TP37.38x29.75x0.25	2	-13.53	1477.50	100.0	Pass
L3	89 - 41.25	Pole	TP48.81x35.5666x0.3125	3	-24.30	2413.78	96.1	Pass
L4	41.25 - 0	Pole	TP58.5x46.4983x0.375	4	-39.47	3545.77	84.5	Pass
							Summary	
						Pole (L2)	100.0	Pass
						RATING =	**100.0**	**Pass**

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Job	Page
160-ft monopole - MFP #23513-0649	BP-F
Project 281862, Bridgewater	**Date** 11/06/2013
Client TAPP (CP-0247)	**Designed by** Mike

Anchor Rod and Base Plate Calculation

TIA/EIA-222-F 1996

Applied Base Reactions			*Plate Geometry*			*Bolt Geometry*	
Moment	3537 ft-kips		B.C.	65.5 in		Pole Dia.	58.5
Shear	29 kips		Fy	50 ksi		Bolt Dia.	2.25
Axial	39 kips		Diameter	71.5 in Round		No. Bolts	14
			Thickness	2.25 in		Bolt Grade	#18J

Anchor Rod Calculation

Bolt Moment of Inertia	7507.9375	in^4
Max Bolt Tension	185.1	kips
Max Bolt Compression	187.9	kips
Combined Force	190.3	kips
Allowable Bolt Capacity	195.0	kips

Base Plate Calculation

Plate Moment	452.0	in-kip
Bend Plane	13.1	in
Plate Capacity	553.7	in-kip

Anchor Rods Are Adequate	**97.6%**	☑
Base Plate is Adequate	**81.6%**	☑

ATTACHMENT 3

SR 1252
Access Road Drainage Report

SAI Bridgewater
111 Second Hill Road
Bridgewater, CT 06752

CHA Project Number: 18301.1071.43000

Prepared for:
SAI Communications
500 Enterprise Drive
Rocky Hill, CT 06067

Prepared by:

CHA

2139 Silas Deane Highway
Rocky Hill, Connecticut 06067
(860) 257-4557

10/28/2013

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TABLES

APPENDICES

FIGURES

1.0 INTRODUCTION

The project site is located on Second Hill Road in the town of Bridgewater, Connecticut. The site is located on property owned by Robert Reibe. The subject parcel is bounded by Second Hill Road to the West, and residential parcels to the North, South and East. Site access will come from Second Hill Road, where a new access drive is proposed to the site.

The proposed work includes the installation of a fenced gravel compound for a telecommunications tower, construction of a gravel access drive to the tower site (350 linear feet), and installation of a stormwater collection system consisting of vegetated drainage swales, and a storm drain culvert.

This report addresses the design of drainage swales, and storm drain culverts to protect the access road from washout, safely convey stormwater flows, and protect outfall locations from erosion. This report does not address the design of groundwater controls or slope stabilization, as site geotechnical information was not available at the time of this report.

Refer to the proposed D&M Drawings submission, being developed concurrently with this report and under a separate cover, for specific site details.

2.0 HYDROLOGIC EVALUATION

Existing Watershed Characteristics

The Connecticut United States Geological Survey (USGS) Coventry Quandrangle Map indicates that the cellular tower and compound are located down grade of a local high point. Topography is varied in the surrounding area and includes small topographic ridges, natural swales, flatlands, and wetlands. Existing topography contributing to site drainage consists of elevations ranging from 940' above mean sea level (AMSL) just south of the proposed cell tower location (at the localized high point) to 890' AMSL at Second Hill Road. Existing drainage patterns run in a northwesterly direction across the site from the high point at Second Hill, to a cross culvert just north of the site, which carries drainage to the west under Second Hill Road. Existing slopes are generally mild and typically less than 6% within the site drainage areas. See Figure 1 – USGS Map.

Aerial photography and a site field visit indicate that the existing land use at the site consists primarily of open fields and farm land surrounded by forested area. See Figure 2 – Aerial Map.

Project site soil characteristics were determined using the United States Department of Agriculture (USDA) Soil Conservation Service Soil Survey for Litchfield County, Connecticut (1970). The site is comprised entirely of soils belonging to Hydrologic Soil Groups (HSG) C (See Appendix A). Below is a brief description of hydrologic soil group C:

Group C – Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

A summary of the soil composition is shown in Table 1 below.

Table 1 - Soil Analysis Summary

Unit Symbol – Unit Name	Hydrologic Soil Group
WyB – Woodbridge stony fine sandy loam, 3-8% Slopes	C
PdB – Paxton Stony Fine Sandy Loam, 3-8% Slopes	C
PbB – Paxton Fine Sandy Loam, 3-8% Slopes	C

Design Methodology

In order to design the proposed swales and culverts, peak flows (Q) for the 10- and 25-year design storms were calculated using the Rational Method (Q=CIA). Composite runoff coefficients (C) were developed from an analysis of existing land use and typical C-values provided in Tables 6-3 and 6-5 of the Connecticut Department of Transportation (ConnDOT) Drainage Manual, dated October 2000 (See Appendix B). Times of concentration (T_c) were computed using standard NRCS TR-55 Methodology (See Appendix C). Rainfall intensities (I) were determined from Table B-2.1 of the ConnDOT Drainage Manual and the computed T_c values. A frequency factor (C_f) was used to refine the calculated peak flow for the 25-year design storm as prescribed in Table 6-2 in Section 6.9.5 of the ConnDOT Drainage Manual.

Proposed Condition Hydrology

For the purposes of the proposed condition analysis, two (2) drainage areas (DA) were developed to quantify the peak stormwater runoff rates to the proposed design points (DP). Drainage areas were determined through review of the existing topographic survey of the site (See D&M Drawing submission), the Connecticut USGS Coventry Quadrangle Map and a field visit to the site.

A summary of the results for the proposed condition hydrologic analysis is shown in Table 2 below. See Figure 3 – Drainage Areas.

Table 2 – Hydrologic Analysis Summary

Drainage Area/ Design Point	Area (acres)	Runoff Coefficient (C)	Tc (min)	Rainfall Intensity (I) (in/hr)		Peak Discharge (Q) (cfs)	
				10 year	25 year	10 year	25 year[1]
DP 1	0.97	0.29	20	3.6	4.2	1.0	1.3
DP 2[2]	1.06	0.29	21	3.5	4.1	1.1	1.4

[1]Frequency Factor for 25-year recurrence interval is 1.1. (Table 6-2 of ConnDOT Drainage Manual)
[2]DP1 is also tributary to DP2

3.0 HYDRAULIC EVALUATION

3.1 CULVERT

Basis of Design

In accordance with the design criteria and procedures set forth in Section 8.3 of the ConnDOT Drainage Manual, culverts shall be designed to:

- Allow for continuous flow and safe conveyance of the 25-year design storm peak flow.
- Have a HW/D ratio less than 1.5 (The hydraulic performance of a culvert is commonly expressed as a ratio of headwater depth (HW), which equals the depth of water measured from the invert of the culvert, to the culvert diameter (D) as HW/D).
- Have a minimum diameter of 18 inches.

Design Methodology

The proposed culverts were analyzed using Haestad Methods CulvertMaster Computer Software (Version 3.1). This program was utilized to compute the headwater elevation and discharge velocity of the culverts (evaluating both inlet and outlet control equations), see Appendix D.

The pipe flow capacity was calculated using:

- Manning's Equation for velocity (V) using equation 7.6 of the ConnDOT Drainage Manual.
- The Continuity Equation for flow capacity (Q) using equation 7.5 of the ConnDOT Drainage Manual.

See Appendix E for culvert capacity calculations.

Design Summary

The access road design required one (1) culvert (at DP DA 1) for stormwater conveyance, see Figure 4 – Drainage Design. The culvert at DP DA 1 will be an 18" diameter HDPE pipe culvert, 50 feet in length, set at a slope of approximately 2.0 percent. See Table 3 on the following page for a summary of the results of the culvert analysis; See Figure 5 – Details.

Table 3 – Culvert Analysis

Culvert	Length (ft)	Slope (%)	Diameter (inches)	Roughness Coefficient (unitless)	25-year Peak Design Flow (cfs)	Provided Flow Capacity[2] (cfs)	Computed HW (in)	HW/D Ratio (in/in)
DP 1	50	2.0	18	0.012	1.3	17.3	5	0.28

[1]Manning's n referenced from CulvertMaster.
[2]See Appendix E for culvert capacity calculations.

Based on the analysis, an 18" HDPE pipe culvert at DP DA 1 will allow for continuous passage of the 25-year frequency design storm, with a calculated HW/D ratio less than 1.5.

3.2 SWALES

Basis of Design

In accordance with the design criteria and procedures set forth in Sections 7.3 and 7.6 of the ConnDOT Drainage Manual, roadway swales shall be designed:

- To safely convey the 10-year frequency design storm peak flow without causing erosive damage.
- With a lining that is sufficient to resist the shear forces created from the transportation of storm flows (The permissible or critical shear stress in a swale defines the force required to initiate movement of the channel bed or lining).

Additionally, in accordance with Chapter 5, Section 6, Permanent Lined Waterway, of the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control by The Connecticut Council on Soil and Water Conservation in Cooperation with the Connecticut Department of Environmental Protection (CTDEP), swales shall be designed with a minimum freeboard of 0.25 feet (3 inches) if no out-of-bank damage would be expected.

Design Methodology

Flow capacity of the swales was determined from the following:

- Velocity (V) – Equation 7.6 of the ConnDOT Drainage Manual (Manning's Equation)
- Flow capacity (Q) – Equation 7.5 of the ConnDOT Drainage Manual (The Continuity Equation).

See Appendix F for swale sizing calculations.

Swale lining was determined by the following:

- Average Shear Stress (τ) – Equation 7.11 of the ConnDOT Drainage Manual
- Maximum Shear Stress (τ_d) – Equation 7.12 of the ConnDOT Drainage Manual
- Lining Category (Material) and Type – Table 7-4 of the ConnDOT Drainage Manual and information provided by product manufacturers.

See Appendix G for shear stress calculations.

Design Summary

For drainage area 1 (DA 1), a 1-foot wide flat bottom trapezoidal swale with 3:1 side slopes was selected to convey stormwater. The swale depth varies from 0.5 feet at the tower compound to about 3 feet deep where the swale meets to the proposed culvert inlet. For drainage area 2 (DA 2), a 1.5-foot wide flat bottom trapezoidal swale with 3:1 side slopes was selected. The swale depth is roughly 2 feet and was controlled by the access drive culvert discharge elevation and surrounding topography. See Figure 4 – Drainage Design and Figure 5 – Details.

See Table 4 below for a summary of the results of the swale analysis.

Table 4 – Swale Hydraulic Analysis

Swale	Slope (ft/ft)	Manning's n[1] (unitless)	Velocity (ft/s)	10-yr Peak Design Flow (cfs)	Provided Flow Capacity (cfs)	Depth of Flow (in)	Provided Freeboard @ 10-year Peak Flow (in)
DP 1	0.05	0.036	2.7	1.0	1.2	2.8	3.2
DP 2	0.01	0.036	1.4	1.1	42.0	4.0	20

[1]Manning's n determined from the values listed in Table 7-4 of the ConnDOT Drainage Manual.

To determine the type of lining necessary to armor the swales and protect against erosive forces imparted by stormwater flows, shear stresses were calculated. A vegetated turf reinforcement mat (TRM) lining was selected to armor the swales in order to withstand the calculated shear stresses. See Table 5 below for a summary of the results of the calculated shear stress and channel lining analysis. See Appendix H for product information on the selected TRM.

Table 5 – Shear Stress and Channel Lining Analysis

Swale	Calculated Shear Stress (lb/ft^2)	Vegetated Turf Reinforcement Mats[1]	
		Permissible Shear Stress[2] (lb/ft^2)	Classification
DP 1	0.72	8.0	Landlock TRM 450[3]
DP 2	0.16	8.0	Landlock TRM 450[3]

[1]TRM was selected to withstand the calculated shear stresses.
[2]Permissible shear stress for lining material is provided by the product manufacturer.
[3]See Appendix H for product information.

Based on the analyses, each of the swales will be capable of safely conveying the 10-year peak storm flows calculated for their respective drainage area, provide the required 3 inches of freeboard, and withstand calculated shear stresses.

3.3 OUTLET PROTECTION

Basis of Design

In accordance with the design criteria and procedures set forth by the ConnDOT Drainage Manual, outlet protection shall be designed to reduce the erosive potential at all discharge points.

Design Methodology

Due to the residential nature of the site, a high performance turf reinforcement mat (HPTRM) was selected to protect against erosion at both site discharge points. A product was selected to withstand the anticipated outlet velocities and shear stresses based on manufacturer provided information. Sizing of the mat was based on manufacturer guidelines.

Design Summary

A Pyramat HPTRM was selected for outlet protection at the discharge points. Based on manufacturer information, the product can withstand outlet velocities up to 25 ft/s and shear streses of 12 lb/ft^2. Sizing recommendations provided by the manufacturer suggest a outlet pad with a length and width which is 5 times the culvert diameter (or swale bottom dimension). Therefor the selected outlet structure is a 7.5 foot long by 7.5 foot wide Pyramat HPTRM; See Figure 5 – Drainage Details. See Appendix H for product information on the selected HPTRM.

Table 6 below summarizes the minimum outlet protection requirements.

Table 6 – Outlet Protection Requirements

Design Point	Structure	Diameter (in)	Outlet Velocity (ft/sec)	Shear at Outlet (lb/ft^2)	Outlet Type	Minimum Dimensions
DP 1	Culvert	18	5.5	1.3	Pyramat[2] HPTRM	7.5ft x 7.5ft
DP 2	Swale[1]	18	1.5	1.4		

[1]Diameter used for swales is the bottom channel width.
[2]See Appendix H for product information on the selected HPTRM.

Based on analysis of proposed outfall locations, calculated discharge velocities and shear stresses will be less than the permissible values provided by the manufacturer for the selected product. A 7.5 foot long by 7.5 foot wide Pyramat HPTRM is sufficient to reduce the erosive potential at all discharge points.

4.0 ACCESS ROAD DESIGN

The typical access road design consists of a 12" compacted gravel surface. This design will be used for the crowned section of roadway between the existing garage structure and the cell tower compound. Between the existing garage structure and Second Hill Road the access road must be pitched to the north to avoid stormwater ponding along the south side of the proposed access drive. Due to the proximity of the existing wetlands and existing topography, a culvert installation is not possible. To reduce the erosive potential of the roadway and sediment transport, a grass paver driveway surface is proposed between the existing garage and Second Hill Road. This will help reduce erosion and improve infiltration in the area.

5.0 INSPECTION AND MAINTENANCE

Inspection and maintenance of the stormwater collection system (swales, storm drain culverts, and outlet protection) is critical to maintaining proper function. A visual inspection of all components is required annually and after major storm events. A visual inspection of the swale TRM lining should be completed semi-annually and after major storm events.

The following maintenance tasks should be completed during the inspection process:

- Removal of any organic matter, trash/debris, or obstructions found in swales or outlet protection mats.
- Removal of any accumulated sediment found in the culvert, swales or outlet protection mats.
- Removal of any potential obstructions at culvert inlet/outlet points
- Replacement of vegetation (seeding) or TRM lining material that may have washed away or eroded during large storm events.

Careful inspection and proper maintenance on a regular basis will enable the system to safely convey stormwater flows and reduce the risk of system backup or overflow during major storm events.

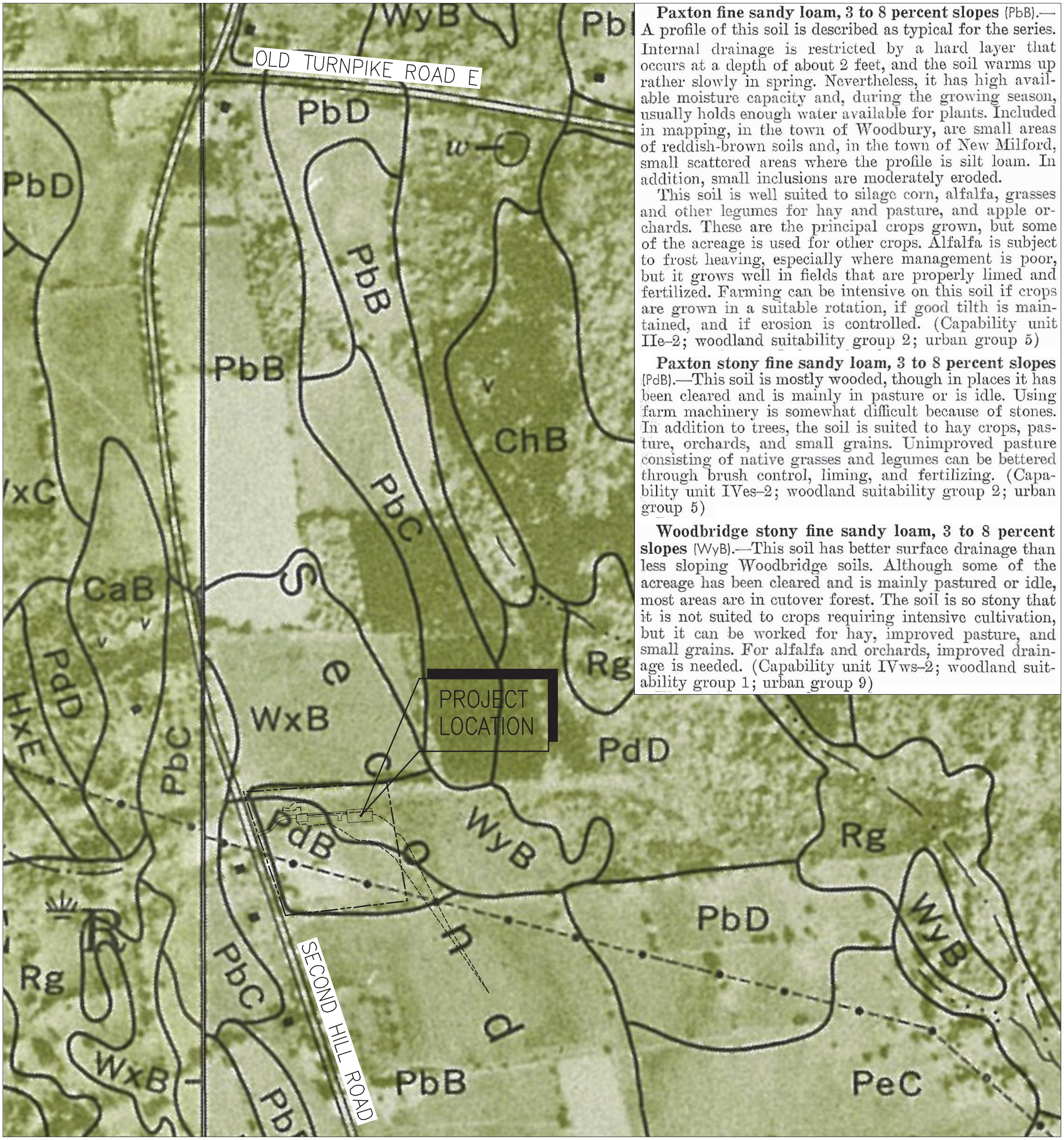
6.0 CONCLUSION

All proposed drainage improvements (swales, culverts, outlet protection) have been designed in accordance with the engineering guidelines established in the ConnDOT Drainage Manual. Based on the analysis, the following design parameters are recommended:

- A culvert is required at DP DA 1 to convey flows underneath the proposed access drive. The culvert shall be an 18" diameter HDPE pipe culvert which is 50 feet in length, and set at a slope of 2.0%. The culvert will be capable of safely conveying the 25-year design storm peak flow with an HW/D ratio less than 1.5.
- The swale at DA 1 shall be a trapezoidal swale with 3:1 side slopes and a 1-foot flat bottom which varies in depth from 0.5 feet to about 3 feet. The swale at DA 2 shall be a trapezoidal swale with 3:1 side slopes and a 1.5-foot flat bottom which is 2 feet deep. Both swales will be lined with a vegetated TRM in order to meet the ConnDOT requirements for safely conveying the 10-year design storm peak flows while withstanding the calculated shear stresses. They will also meet the DEEP requirement of providing 0.25 feet of freeboard.
- Outlet protection for at both discharge points shall be a 7.5 foot long by 7.5 foot wide Pyramat HPTRM. This will meet the ConnDOT requirements to provide erosion protection at outfall locations.

APPENDIX A

USDA Soil Survey Map and Soil Descriptions



Paxton fine sandy loam, 3 to 8 percent slopes (PbB).—A profile of this soil is described as typical for the series. Internal drainage is restricted by a hard layer that occurs at a depth of about 2 feet, and the soil warms up rather slowly in spring. Nevertheless, it has high available moisture capacity and, during the growing season, usually holds enough water available for plants. Included in mapping, in the town of Woodbury, are small areas of reddish-brown soils and, in the town of New Milford, small scattered areas where the profile is silt loam. In addition, small inclusions are moderately eroded.

This soil is well suited to silage corn, alfalfa, grasses and other legumes for hay and pasture, and apple orchards. These are the principal crops grown, but some of the acreage is used for other crops. Alfalfa is subject to frost heaving, especially where management is poor, but it grows well in fields that are properly limed and fertilized. Farming can be intensive on this soil if crops are grown in a suitable rotation, if good tilth is maintained, and if erosion is controlled. (Capability unit IIe–2; woodland suitability group 2; urban group 5)

Paxton stony fine sandy loam, 3 to 8 percent slopes (PdB).—This soil is mostly wooded, though in places it has been cleared and is mainly in pasture or is idle. Using farm machinery is somewhat difficult because of stones. In addition to trees, the soil is suited to hay crops, pasture, orchards, and small grains. Unimproved pasture consisting of native grasses and legumes can be bettered through brush control, liming, and fertilizing. (Capability unit IVes–2; woodland suitability group 2; urban group 5)

Woodbridge stony fine sandy loam, 3 to 8 percent slopes (WyB).—This soil has better surface drainage than less sloping Woodbridge soils. Although some of the acreage has been cleared and is mainly pastured or idle, most areas are in cutover forest. The soil is so stony that it is not suited to crops requiring intensive cultivation, but it can be worked for hay, improved pasture, and small grains. For alfalfa and orchards, improved drainage is needed. (Capability unit IVws–2; woodland suitability group 1; urban group 9)

N

USDA SOIL SURVEY MAP AND DESCRIPTIONS
SCALE: 1" = 500'

GRAPHIC SCALE
1000 0 500 1000
IN FEET

Drawing Copyright © 2013

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CHA PROJ. NO. – 18301-1071-43000

SHEET TITLE:
APPENDIX A

DATE:
10/28/10

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DATE: 10/22/2013 12:39 PM FILE: V:\PROJECTS\ANY\WIREDATA\SAI CINGULAR\18301\SITES\1071 BRIDGEWATER 1252\DRAINAGE\WORKING\SOILS MAP\SOIL_MAPS.DWG

APPENDIX B

Composite Runoff Coefficient Calculations

Drainage Area/ Design Point	Area (sf)															Total Area (sf)	Total Area (Acres)	Average C
	HSG A			HSG B			HSG C			HSG D			Gravel	Asphalt	Building			
	F	A	S	F	A	S	F	A	S	F	A	S						
DA 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36850.55	0.00	0.00	0.00	0.00	5236.39	99.38	0.00	42186.32	0.97	0.29
DA 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2842.91	0.00	0.00	0.00	0.00	472.72	38.57	455.49	3809.68	0.09	0.27
DP 2*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39693.46	0.00	0.00	0.00	0.00	5709.11	137.95	455.49	45996.00	1.06	0.29

*DP2 = DA1+DA2

Surface Type	Runoff Coefficient (C)[3]		
	Flat (F) 0 - 1%	Average (A) 2 - 6%	Steep (S) > 6%
HSG A	0.09	0.14	0.18
HSG B	0.12	0.17	0.24
HSG C	0.16	0.21	0.31
HSG D	0.2	0.25	0.38
Gravel	0.85		
Asphalt	0.95		
Building	1.00		

[3]C-values obtained from Tables 6-3 and 6-5 of the ConnDOT Drainage Manual

APPENDIX C

Time of Concentration Calculations

CHA, Inc.

Time of Concentration (Tc)

Project:	SAI - BRIDGEWATER	Job No.	18301-1071	By	JDM	Date	10/28/2013
Location:	Bridgewater, CT			Checked	KDT	Date	

PROPOSED — Subarea: DA 1

		High	Low	Run	Slope
Sheet	AB	942	929.5	300	0.042
Shallow	BC	929.5	900.5	584.31	0.050
Channel	CD	900.5	897	53.31	0.066

1. Sheet Flow

Segment ID		**A-B**			
1. Surface Description (Chap. 6, Table C-1)		Grass			
2. Manning's roughness coeff., 'n' (Chap. 6, Table C-1)		0.150			
3. Flow length, L (total L ≤ 150 ft	ft	300			
4. Two-year 24-hour rainfall, P_2 (Chap. 6, Table B-1)	in	3.2			
5. Land Slope, s	ft/ft	0.042			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	hr	0.293	0.000	0.000	0.293

2. Shallow Concentrated Flow

Segment ID		**B-C**			
7. Surface description (Paved or Unpaved)		U			
8. Flow length, L	ft	584			
9. Watercourse slope, s	ft/ft	0.050			
10. Average velocity, V (figure 3-1)	ft/s	3.594			
11. $T_t = \frac{L}{3600\,V}$	hr	0.045		0.000	0.045

3. Channel Flow

Segment ID		**C-D**			
12. Cross sectional flow area, a	ft^2	1.25			
13. Wetted perimeter, p_w	ft	4.2			
14. Hydraulic radius, $r = a/p_w$	ft	0.30			
15. Channel slope, s	ft/ft	0.066			
16. Manning's roughness coefficient, n		0.035			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	ft/s	4.862			
18. Flow Length, L	ft	53			
19. $T_t = \frac{L}{3600\,V}$	hr	0.003	0.000	0.000	0.003

20. Total Tc For Watershed or Subarea (Add Steps 6, 11, and 19) **hr = 0.34** **min = 20.48**

CHA, Inc.

Time of Concentration (Tc)

Project:	SAI - BRIDGEWATER	Job No.	18301-1071	By	JDM	Date	10/28/2013
Location:	Bridgewater, CT			Checked	KDT	Date	

PROPOSED

Subarea: DA 2

		High	Low	Run	Slope	
Sheet	AB	942	929.5	300	0.042	From DA-1
Shallow	BC	929.5	900.5	584.31	0.050	From DA-1
Channel	CD	900.5	897	53.31	0.066	From DA-1
Channel	DE	896	895	120	0.008	From DA-2

1. Sheet Flow

	Units	Segment ID: A-B			
1. Surface Description (Chap. 6, Table C-1)		Grass			
2. Manning's roughness coeff., 'n' (Chap. 6, Table C-1)		0.150			
3. Flow length, L (total L ≤ 150 ft	ft	300			
4. Two-year 24-hour rainfall, P_2 (Chap. 6, Table B-1)	in	3.2			
5. Land Slope, s	ft/ft	0.042			
6. $T_t = \frac{0.007 (nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	hr	0.293	0.000	0.000	0.293

2. Shallow Concentrated Flow

	Units	Segment ID: B-C			
7. Surface description (Paved or Unpaved)		U			
8. Flow length, L	ft	584			
9. Watercourse slope, s	ft/ft	0.050			
10. Average velocity, V (figure 3-1)	ft/s	3.594			
11. $T_t = \frac{L}{3600 V}$	hr	0.045		0.000	0.045

3. Channel Flow

	Units	Segment ID: C-D	D-E		
12. Cross sectional flow area, a	ft^2	1.25	1.500		
13. Wetted perimeter, p_w	ft	4.2	4.7		
14. Hydraulic radius, $r = a/p_w$	ft	0.30	0.32		
15. Channel slope, s	ft/ft	0.066	0.008		
16. Manning's roughness coefficient, n		0.035	0.035		
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$	ft/s	4.862	1.815		
18. Flow Length, L	ft	53	120		
19. $T_t = \frac{L}{3600 V}$	hr	0.003	0.018	0.000	0.021

20. Total Tc For Watershed or Subarea (Add Steps 6, 11, and 19) **hr = 0.36**

min = 21.59

APPENDIX D

CulvertMaster Output Data

Culvert Calculator Report
BRIDGEWATER CULVERT

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	899.00	ft	Headwater Depth/Height	0.41	
Computed Headwater Elevation	897.61	ft	Discharge	1.30	cfs
Inlet Control HW Elev.	897.57	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	897.61	ft	Control Type	Entrance Control	

Grades

Upstream Invert	897.00	ft	Downstream Invert	896.00	ft
Length	50.00	ft	Constructed Slope	0.020000	ft/ft

Hydraulic Profile

Profile	S2		Depth, Downstream	0.29	ft
Slope Type	Steep		Normal Depth	0.29	ft
Flow Regime	Supercritical		Critical Depth	0.43	ft
Velocity Downstream	5.47	ft/s	Critical Slope	0.004182	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.012	
Section Material	Corrugated HDPE (Smooth Interior)		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	1				

Outlet Control Properties

Outlet Control HW Elev.	897.61	ft	Upstream Velocity Head	0.15	ft
Ke	0.20		Entrance Loss	0.03	ft

Inlet Control Properties

Inlet Control HW Elev.	897.57	ft	Flow Control	N/A	
Inlet Type	Beveled ring, 33.7° bevels		Area Full	1.8	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

APPENDIX E

Culvert Capacity Calculations

CULVERT CAPACITY
By CHA Inc.

JOB DATA

Project: SAI - Bridgewater
Calc. by: JDM
Date: 10/15/13
Pipe at: Culvert 1

EQUATIONS:

Manning's Equation, $V = (1.49/n)R^{2/3}S^{1/2}$
$Q = VA$
Froude Number = $V/(gd)^{1/2}$

INPUT:

Diameter (D) =	1.50	ft	
Depth of flow (d) =	1.40	ft	
Manning's n =	0.012		from CulvertMaster
Slope of pipe (s) =	0.0200	ft/ft	

OUTPUT:

Angle (a) =	1.04	radians						
Wet Perimeter (P) =	3.93	ft						
Area of Flow (A) =	1.72	sq. ft.						
Hydr. Radius (R) =	0.44	ft						
Velocity of Flow (V) =	10.1	fps						
Flow Capacity (Q) =	17.3	cfs	=	11,185,348	gpd	=	**7767.6**	gpm
Froude Number (F) =	1.50	>1, supercritical flow						

APPENDIX F

Swale Sizing Calculations

TRAPAZOIDAL RIPRAP SWALE SIZING
CHA, Inc.

PROJECT DATA:

Project:	18301-1071
Calc. by:	JDM
Date:	October 2013
Swale ID:	DA 1

EQUATIONS:

Manning's Equation, $V = (1.49/n)R^{2/3}S^{1/2}$
Froude number, $F = V/(gd)^{1/2}$
$Q = VA$
$d75 = 12(118QS_b^{13/6}R/P)^{2/5}$

INPUT:

Base width (b) =	1.0	ft	
Sideslope (z) =	3	on 1	
Depth of flow (d) =	0.25	ft	
Swale Depth=	0.50	ft	
Manning's n =	0.036		TRM
Slope of ditch (s) =	0.0500	ft/ft	

OUTPUT:

Wet Perimeter (P) =	2.58	ft
Area of Flow (A) =	0.44	sq. ft.
Hydr. Radius (R) =	0.17	ft
Freeboard =	0.25	ft
Velocity of Flow (V) =	2.8	fps
Flow Capacity (Q) =	1.23	cfs
Froude number, F =	0.99	<1, subcritical flow

NOTE: Verify Mannings n - See Table 7-2 of the ConnDOT Drainage Manual

TRAPAZOIDAL RIPRAP SWALE SIZING
CHA, Inc.

PROJECT DATA:

Project:	18301-1071
Calc. by:	JDM
Date:	October 2013
Swale ID:	DA 2

EQUATIONS:

Manning's Equation, $V = (1.49/n)R^{2/3}S^{1/2}$
Froude number, $F = V/(gd)^{1/2}$
$Q = VA$
$d75 = 12(118QS_b{}^{13/6}R/P)^{2/5}$

INPUT:

Base width (b) =	1.5	ft	
Sideslope (z) =	3	on 1	
Depth of flow (d) =	1.75	ft	
Swale Depth=	2.00	ft	
Manning's n =	0.036		TRM
Slope of ditch (s) =	0.0080	ft/ft	

OUTPUT:

Wet Perimeter (P) =	12.57	ft
Area of Flow (A) =	11.81	sq. ft.
Hydr. Radius (R) =	0.94	ft
Freeboard =	0.25	ft
Velocity of Flow (V) =	3.6	fps
Flow Capacity (Q) =	41.95	cfs
Froude number, F =	0.47	<1, subcritical flow

NOTE: Verify Mannings n - See Table 7-2 of the ConnDOT Drainage Manual

APPENDIX G

Shear Stress Calculations

Calculated Shear Stresses						Vegetated Turf Reinforcement Mat	
Swale	Slope (ft/ft)	Hydraulic Radius (ft)	Max Flow Depth[1] (ft)	Average Shear Stress (lb/ft^2)	Max. Shear Stress (lb/ft^2)	Permissible Shear Stress[2] (lb/ft^2)	Classification
DA 1	0.05	0.16	0.23	0.49	0.72	8.00	Landlock TRM 450
DA 2	0.01	0.23	0.33	0.11	0.16	8.00	Landlock TRM 450

[1]Max flow depth based on flow depth of 10-year design storm.

[2]Permissible shear stress for lining materials is provided by the manufacturer.

Unit Weight of Water=	62.4	lb/ft^3

APPENDIX H

TRM and HPTRM Product Data

Now Featuring X3 Fiber Technology!

SI® Geosolutions

Product Data Sheet

LANDLOK® TRM 450

LANDLOK® TRM 450 is manufactured at an SI Geosolutions' facility having achieved ISO-9002 certification for its systematic approach to quality. **LANDLOK® TRM 450** turf reinforcement mat (TRM) ***features X3™ technology*** that consists of a dense web of crimped, interlocking, multi-lobed polypropylene fibers positioned between two biaxially oriented nets and mechanically bound together by parallel stitching with polypropylene thread. The TRM is designed to accelerate seedling emergence, exhibit high resiliency, and possess strength and elongation properties to limit stretching in a saturated condition. Every component of the TRM is stabilized against chemical and ultraviolet degradation which are normally found in a natural soil environment. Furthermore, the TRM contains no biodegradable components. **LANDLOK® TRM 450** conforms to the property values listed below[1] that have been derived from manufacturing quality control and independent testing performed by SI Geosolutions' GAI-LAP accredited and third-party laboratories:

PROPERTY	TEST METHOD	MARV[2] ENGLISH	MARV[2] METRIC
Physical			
Mass/Unit Area	ASTM D6566	10.0 oz/yd^2	340 g/m^2
Thickness	ASTM D6525	0.50 in	12.7 mm
Light Penetration (% Passing)	ASTM D6567	20%	20%
Color	Visual	Green	
Mechanical			
Tensile Strength	ASTM D6818	400 x 300 lb/ft	5.8 x 4.3 kN/m
Tensile Elongation	ASTM D6818	50% (max)	50% (max)
Resiliency	ASTM D6524	90%	90%
Flexibility	ASTM D6575	0.026 in-lb (avg)	30,000 mg-cm (avg)
Durability			
UV Resistance @ 1000 hrs	ASTM D4355	80%	80%
Performance			
Shear Stress[3]	Large Scale	8 lb/ft^2	383 Pa
Manning's "n"[4]	Calculated	0.025	0.025
Seedling Emergence[5]	ECTC Draft Method #4	3 in	75
Roll Size		6.5 ft x 138.5 ft	2.0 m x 42.2 m

NOTES

1. The property values listed are effective 3/01/2004 and are subject to change without notice.
2. MARV indicates minimum average roll value calculated as the typical minus two standard deviations. Statistically, it yields a 97.7% degree of confidence that any sample taken during quality assurance testing will exceed the value reported.
3. Maximum permissible shear stress has been obtained through vegetated testing programs featuring specific soil types, vegetation classes, flow conditions, and failure criteria. These conditions may not be relevant to every project nor are they replicated by other manufacturers. Please contact SI Geosolutions for further information.
4. Calculated as typical values from large-scale flexible channel lining test programs with a flow depth of 6 to 12 inches.
5. Calculated as average plant height obtained with tall fescue grass seed in sand 14 days after seeding.

SELLER MAKES NO WARRANTY, EXPRESS OR IMPLIED, CONCERNING THE PRODUCT FURNISHED HEREUNDER OTHER THAN AT THE TIME OF DELIVERY IT SHALL BE OF THE QUALITY AND SPECIFICATION STATED HEREIN. ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE IS EXPRESSLY EXCLUDED, AND, TO THE EXTENT THAT IT IS CONTRARY TO THE FOREGOING SENTENCE, ANY IMPLIED WARRANTY OF MERCHANTABILITY IS EXPRESSLY EXCLUDED. ANY RECOMMENDATIONS MADE BY SELLER CONCERNING THE USES OR APPLICATIONS OF SAID PRODUCT ARE BELIEVED RELIABLE AND SELLER MAKES NO WARRANTY OF RESULTS TO BE OBTAINED. IF THE PRODUCT DOES NOT MEET SI GEOSOLUTIONS' CURRENT PUBLISHED SPECIFICATIONS, AND THE CUSTOMER GIVES NOTICE TO SI GEOSOLUTIONS BEFORE INSTALLING THE PRODUCT, THEN SI GEOSOLUTIONS WILL REPLACE THE PRODUCT WITHOUT CHARGE OR REFUND THE PURCHASE PRICE.

Product Data Sheet

PYRAMAT®

PYRAMAT is manufactured at one of SI Geosolutions' facilities that have achieved ISO-9002 certification for its systematic approach to quality. **PYRAMAT** high performance turf reinforcement mat (HPTRM) is a three-dimensional, lofty, woven polypropylene geotextile that is available in green or tan which is specially designed for erosion control applications on steep slopes and vegetated waterways. The matrix is composed of polypropylene monofilament yarns ***featuring X3™ technology*** woven into a uniform configuration of resilient pyramid-like projections. The material exhibits very high interlock and reinforcement capacity with both soil and root systems, demonstrates superior UV resistance, and enhances seedling emergence. The HPTRM conforms to the property values listed below[1] that have been derived from quality control testing performed by one of SI Geosolutions' GAI-LAP accredited laboratories:

		MARV[2]	
PROPERTY	**TEST METHOD**	**ENGLISH**	**METRIC**
Physical			
Mass/Unit Area	ASTM D6566	13.5 oz/yd^2	455 g/m^2
Thickness	ASTM D6525	0.4 in	10.2 mm
Light Penetration (% Passing)	ASTM D6567	10%	10%
Color	-	Green, Tan	
Mechanical			
Tensile Strength	ASTM D6818	4,000 x 3,000 lb/ft	58.4 x 43.8 kN/m
Tensile Elongation	ASTM D6818	65% (max)	65% (max)
Resiliency	ASTM D6524	80%	80%
Flexibility	ASTM D6575	0.534 in-lb (avg)	615,000 mg-cm (avg)
Durability			
UV Resistance @ 3000 hrs	ASTM D4355	90%	90%
Performance			
Manning's "n" (Unvegetated)	Calculated	0.028	0.028
Shear Stress[3]	Large Scale	12 lb/ft^2	574 Pa
Velocity[3]	Large Scale	25 ft/s	7.6 m/s
Bench Scale Shear[4]	ECTC Draft Method #3	6 lb/ft^2	287 Pa
Seedling Emergence[5]	ECTC Draft Method #4	750%	750%
Roll Size		8.5 ft x 90 ft	2.59 m x 27.4 m

NOTES

1. The property values listed are effective 7/01/2004 and are subject to change without notice.
2. MARV indicates minimum average roll value calculated as the typical minus two standard deviations. Statistically, it yields a 97.7% degree of confidence that any sample taken during quality assurance testing will exceed the value reported.
3. Maximum permissible shear stress and velocity have been estimated from actual vegetated testing programs with standard PYRAMAT featuring specific soil types, vegetation classes, flow conditions, and failure criteria. These conditions may not be relevant to every project nor are they replicated by other manufacturers. Large scale tests with PYRAMAT X3 will be completed by Fall 2004. Please contact SI Geosolutions for further information.
4. Calculated as a typical values under unvegetated flow conditions in sand.
5. Calculated as average plant biomass with tall fescue grass seed in sand 14 days after seeding versus traditional round monofilament HPTRMs.

SELLER MAKES NO WARRANTY, EXPRESS OR IMPLIED, CONCERNING THE PRODUCT FURNISHED HEREUNDER OTHER THAN AT THE TIME OF DELIVERY IT SHALL BE OF THE QUALITY AND SPECIFICATION STATED HEREIN. ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE IS EXPRESSLY EXCLUDED, AND, TO THE EXTENT THAT IT IS CONTRARY TO THE FOREGOING SENTENCE, ANY IMPLIED WARRANTY OF MERCHANTABILITY IS EXPRESSLY EXCLUDED. ANY RECOMMENDATIONS MADE BY SELLER CONCERNING THE USES OR APPLICATIONS OF SAID PRODUCT ARE BELIEVED RELIABLE AND SELLER MAKES NO WARRANTY OF RESULTS TO BE OBTAINED. IF THE PRODUCT DOES NOT MEET SI GEOSOLUTIONS' CURRENT PUBLISHED SPECIFICATIONS, AND THE CUSTOMER GIVES NOTICE TO SI GEOSOLUTIONS BEFORE INSTALLING THE PRODUCT, THEN SI GEOSOLUTIONS WILL REPLACE THE PRODUCT WITHOUT CHARGE OR REFUND THE PURCHASE PRICE.

INSTALLATION GUIDELINES

FOR LANDLOK® TRMs AND PYRAMAT® HPTRMs

BEFORE YOU BEGIN

Thank you for purchasing high quality Landlok® Turf Reinforcement Mats (TRMs) and Pyramat® High Performance Turf Reinforcement Mats (HPTRMs) from Propex. We're committed to offering the best erosion control products in the industry.

It is important to follow these installation guidelines for a successful project. (Note: Construction shall be performed in accordance with the specific project bid documents, construction drawings, and specifications.) In addition, we suggest that a pre-installation meeting be held with the construction team and a representative from Propex. This meeting shall be scheduled by the contractor with at least two weeks notice. Also, Propex suggests that installation monitoring of our TRMs and HPTRMs be performed by a qualified independent third party.

SITE PREPARATION

- Grade and compact area of TRM/HPTRM installation as directed and approved by Engineer. Subgrade shall be uniform and smooth. Remove all rocks, clods, vegetation or other objects so the installed mat will have direct contact with soil surface.
- Prepare seedbed by loosening the top 2-3 in (50-75 mm) minimum of soil.
- Incorporate amendments such as lime and fertilizer and/or wet the soil, if needed.
- Do not mulch areas where mat is to be placed.

SEEDING

- Apply seed to soil surface before installing mat. Disturbed areas shall be reseeded.
- When soil filling, first install the mat, apply seed and then soil-fill per guidelines (see page 8).
- Consult project plans and/or specifications for seed types and application rates.

INSTALLATION GUIDELINES

FOR LANDLOK® TRMs AND PYRAMAT® HPTRMs

INSTALLATION ON STABLE SOIL SLOPES

- Excavate a 12 x 6 in (300 x 15 mm) minimum longitudinal anchor trench 2-3 ft (600-900 mm) over crest of slope (see Figure 2).
- Install top end of mat into trench and secure to bottom using suggested ground anchoring devices (see Tables 1 and 2 on page 7) spaced every 12 in (300 mm) minimum. Backfill and compact soil into trench (see Figure 2).
- Unroll mat down slope. Landlok® 1051 shall have the geotextile on bottom.
- Overlaps shall be 6 in (150 mm) minimum and anchored every 18 in (450 mm) minimum along the overlap. Secure using suggested ground anchoring devices shown in Table 1 for appropriate frequency and pattern. Overlaps are shingled away from prevailing winds (see Figure 1).
- Unroll mat in a manner to maintain direct contact with soil. Secure mat to ground surface using ground anchoring devices (see Table 1). Anchors shall be placed in accordance with the Anchor Pattern Guide on page 7.
- Excavate a 12 x 6 in (300 x 150 mm) key anchor trench at toe of slope (see Figure 3).
- Place bottom end of mat into key anchor trench at toe of slope and secure to bottom of trench using suggested ground anchoring devices (see Tables 1 and 2) spaced every 12 in (300 mm) minimum. Backfill and compact soil into trench (see Figure 3).
- If the potential for standing and/or flowing water exists at the toe of slope, the key anchor trench at the toe detail (see Figure 3) is not sufficient. Consult the project engineer for the appropriate detail.
- Irrigate as necessary to establish/maintain vegetation. Do not over-irrigate.

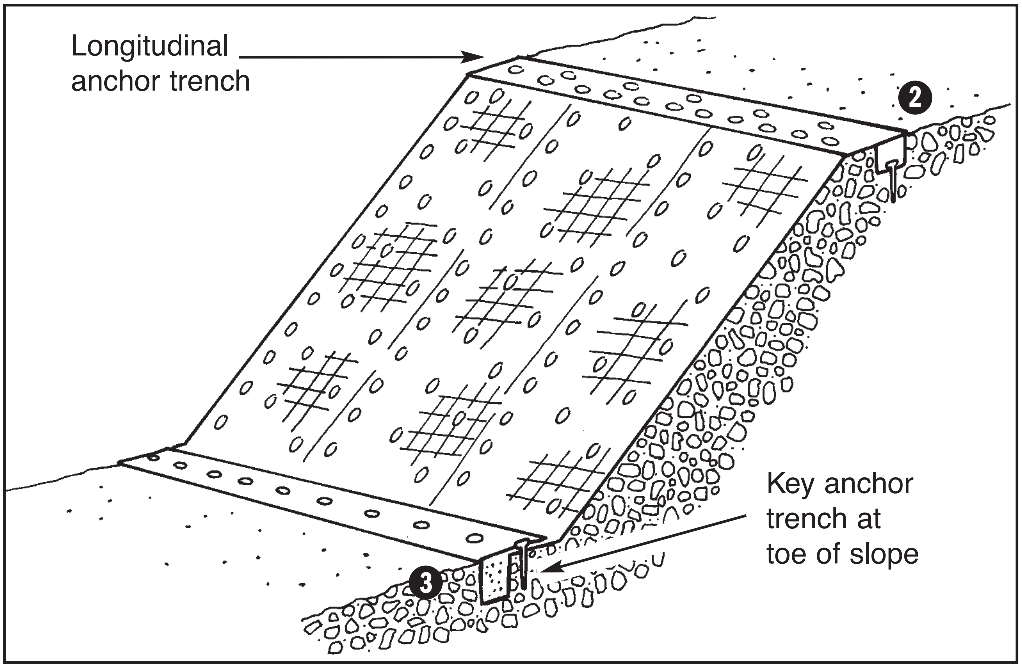


FIGURE 1

Installation of permanent turf reinforcement mat on slope

- Overlaps 6 in (150 mm) minimum
- Space anchors 18 in along overlaps down the slope
- Anchor pattern shall be in accordance with the "Anchor Pattern Guide" found on page 7

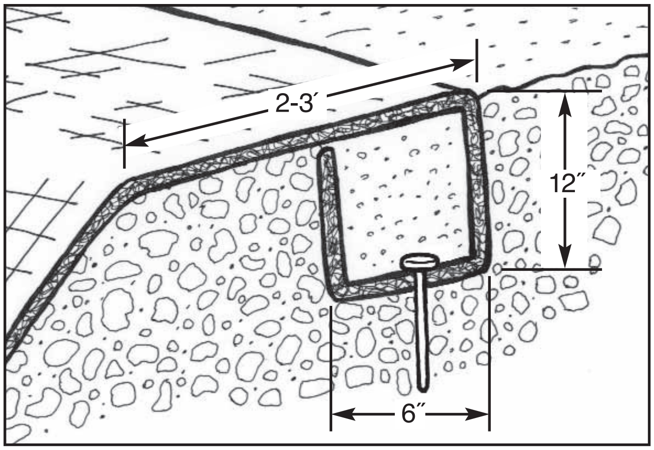


FIGURE 2

Longitudinal anchor trench at top of slope

- Space anchors 12 in (300 mm) along bottom of trench

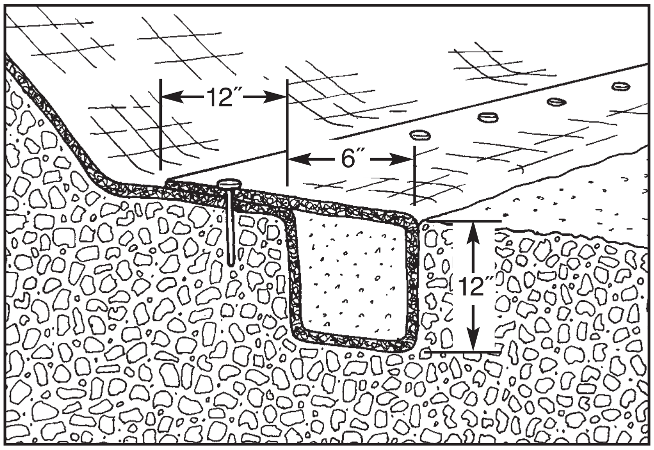


FIGURE 3

Key anchor trench at toe of slope

INSTALLATION IN STORM WATER CHANNELS

- Figure 4 shows general installation layout and details for TRMs and HPTRMs in storm water channels.
- Excavate an initial anchor trench 12 in (300 mm) minimum deep and 12 in (300 mm) minimum wide across the channel at downstream end of project (see Figure 5). Deeper initial anchor trench is needed in channels that have the potential for scour.
- Excavate longitudinal anchor trenches 12 in (300 mm) minimum deep and 6 in (150 mm) minimum wide along both sides of the installation to bury edges of mat (see Figure 6). The trench shall be located 2-3 ft (600-900 mm) over crest of slope.
- Place roll end into the initial anchor trench and secure with anchoring devices at 12 in (300 mm) minimum intervals (see Figure 5). Position adjacent rolls and secure in anchor trench in same manner. Backfill and compact soil into trench.
- Unroll mat in the upstream direction over the compacted trench.
- Continue installation as described above, overlapping adjacent rolls as follows:
  - Roll edge: 6 in (150 mm) minimum with upslope mat on top. Secure with one row of ground anchoring devices on 12 in (300 mm) minimum intervals (see Figure 7).
  - Roll end: 12 in (300 mm) minimum with upstream mat on top. Secure with two rows of ground anchoring devices staggered 12 in (300 mm) minimum apart on 12 in (300 mm) minimum intervals (see Figure 8).
- Fold and secure mat rolls snugly into intermittent check slots. Lay mat in the bottom and fold back against itself. Anchor through both layers of blanket or mat at 1 ft (300 mm) intervals then backfill and compact soil (Figure 9). Continue rolling upstream over the compacted slot to the next check slot or terminal anchor trench. Check slots are placed at 25 to 30 ft (7.6 to 9.1 m) intervals perpendicular to flow.

INSTALLATION GUIDELINES

FOR LANDLOK® TRMs AND PYRAMAT® HPTRMs

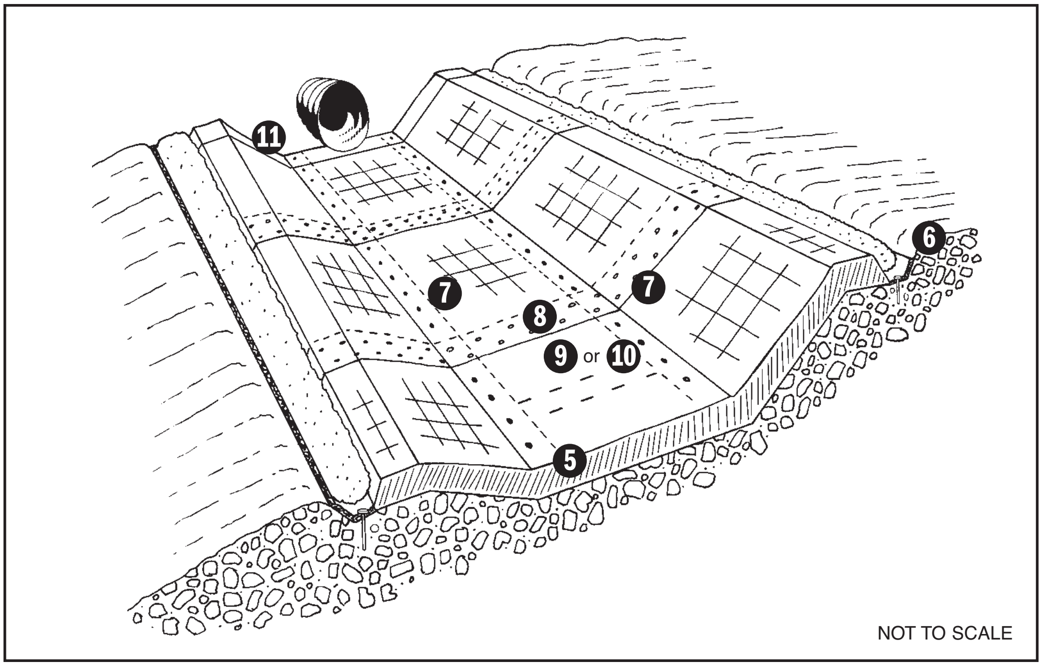


FIGURE 4 Installation of TRMs & HPTRMs in storm water channels

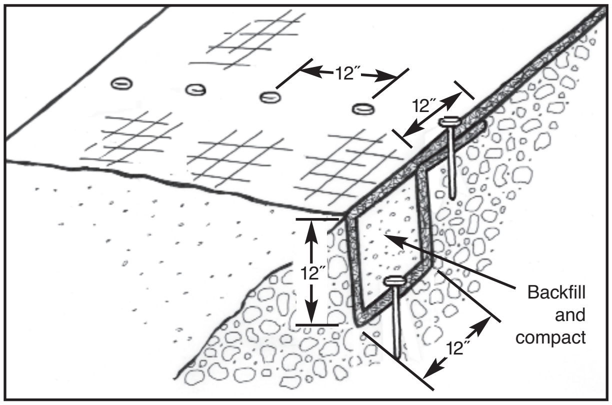


FIGURE 5 Initial anchor trench (downstream) detail

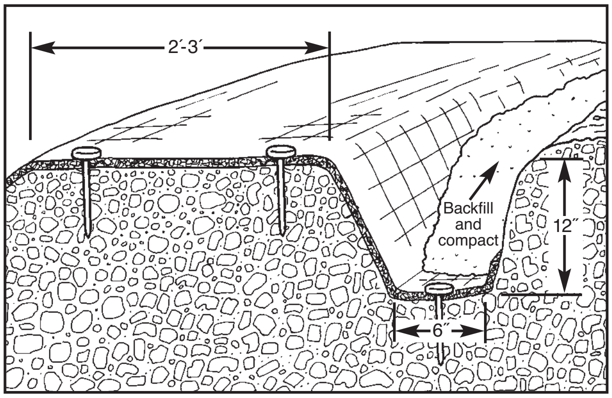


FIGURE 6 Longitudinal anchor trench detail (trapezoidal channel)

- An alternate method to the intermittent check slot is the simulated check slot. This method includes placing two staggered rows of anchors on 4 in (100 mm) centers at 30 ft (9.1 m) intervals (see Figure 10).
- Excavate terminal anchor trench 12 in wide x 12 in deep (300 x 300 mm) minimum across the channel at the upstream end of the project (see Figure 11). Deeper terminal anchor trench is needed in channels that have the potential for scour.
- Anchor, backfill and compact upstream end of mat in 12 x 12 in (300 x 300 mm) minimum terminal anchor trench (see Figure 11). Unroll mat in downstream direction over compacted trench with a minimum 2 ft (600 mm) lap. Secure with anchors in accordance with Figure 8.
- Secure mat using suggested ground anchoring devices (see Tables 1 and 2 on page 7) for appropriate frequency and pattern (see Anchor Pattern Guide on page 7).
- Seed and fill with soil for enhanced performance. See Soil Filling Section on page 8.
- When using Landlok® 1051, seed after installing mat and then fill with soil.
- Irrigate as necessary to establish/maintain vegetation. Do not over irrigate.

NOTE: If you encounter roll with factory overlap, install factory seam such that it shingles in the direction of the flow of water. Place anchoring devices in accordance with Figure 8 “Overlap at roll end” on page 5.

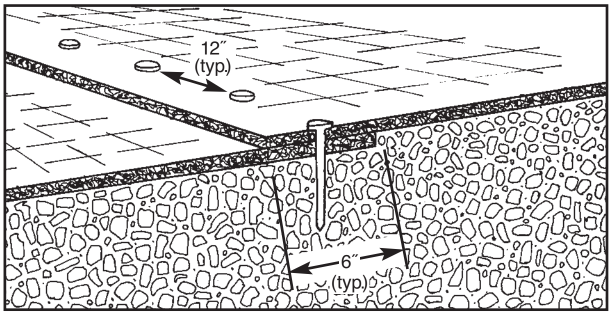


FIGURE 7 Overlap at roll edge

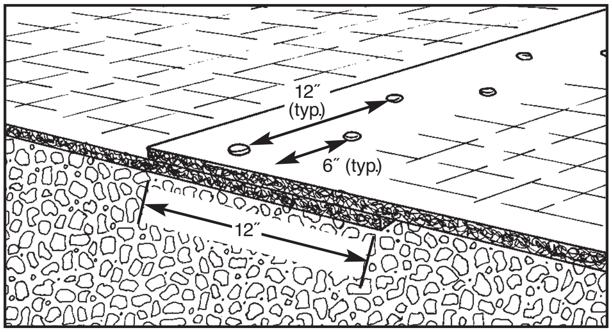


FIGURE 8 Overlap at roll end

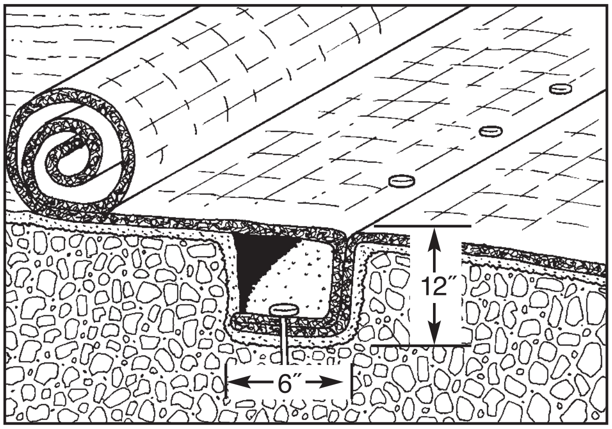


FIGURE 9 Intermittent check slot (channels)

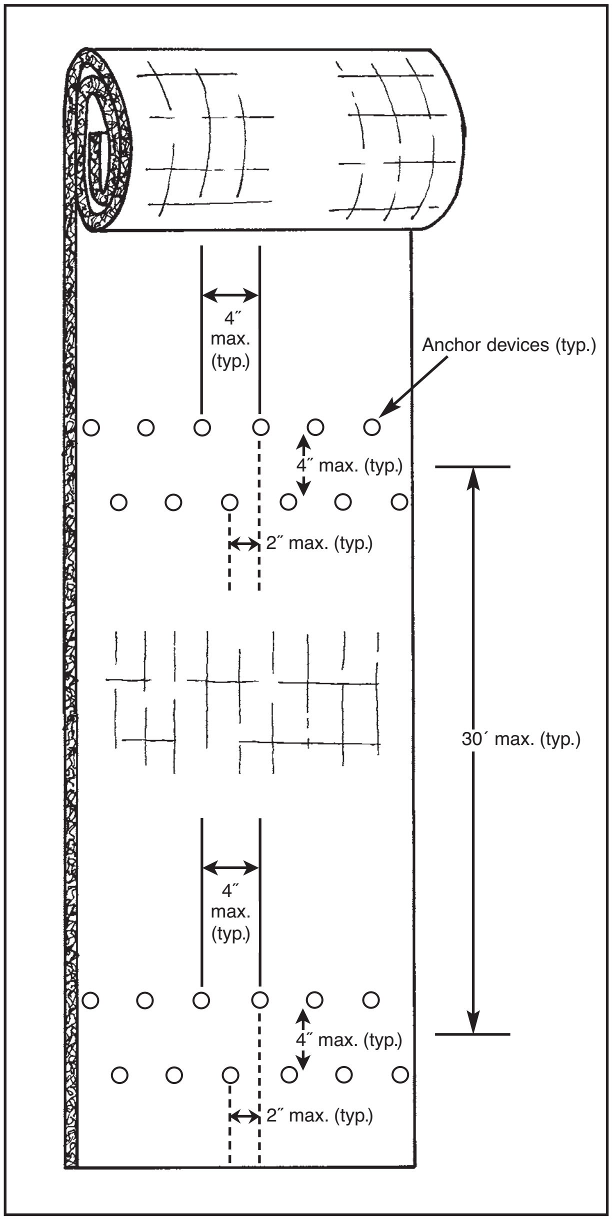


FIGURE 10 Simulated check slot

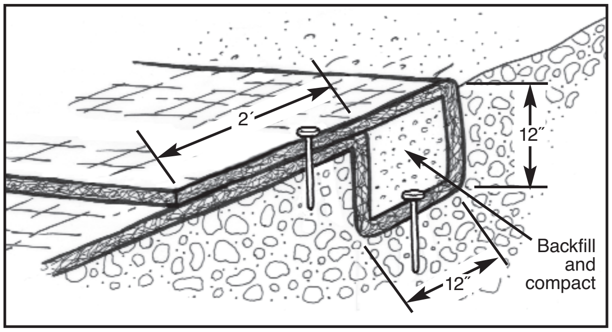


FIGURE 11 Terminal anchor trench (upstream) detail

SPECIAL TRANSITION GUIDELINES

- Rock Riprap
  - Excavate an anchor trench 12 x 12 in (300 x 300 mm) minimum at the transition between the mat and the rock riprap.
  - Place roll end into anchor trench and secure with suggested anchoring devices at 12 in (300 mm) minimum intervals. Position adjacent rolls and secure in anchor trench in same manner.
  - Backfill the anchor trench with rock riprap.
  - Place rock riprap as specified, extending approximately 3 ft (1 m) minimum beyond the anchor trench onto the mat.
- Concrete
  - Alternative 1: Concrete Apron
    - Place ready mixed concrete directly onto a 3 ft (0.9 m) wide minimum strip of mat.
  - Alternative 2: Concrete Backfill
    - Excavate an anchor trench 12 x 12 in (300 x 300 mm) minimum at the edge of the concrete structure.
    - Place roll end into anchor trench and secure with suggested anchoring devices at 12 in (300 mm) minimum intervals. Position adjacent rolls and secure in anchor trench in same manner.
    - Backfill trench with concrete slurry.
  - Alternative 3: Bolt to Structure (HPTRMs Only)
    - Cast threaded dowel in fresh ready mix concrete or install expanding bolt into cured concrete. Then affix HPTRM with washer (minimum 2 in or 50 mm diameter) or batten strip and bolt.
- Pipe Inlets/Outlets (HPTRMs Only)
  - Review the construction drawings and project specifications to evaluate the required area to be treated.
  - Excavate an anchor trench 12 x 12 in (300 x 300 mm) minimum above the pipe to bury end of HPTRM roll. The trench shall be located a minimum 2-3 ft (600-900 mm) above the pipe inlet/outlet.
  - Backfill and compact soil into trench.
  - Cut HPTRM to meet project requirements, slope length and pipe diameter.
  - Unroll HPTRM down the slope and secure around pipe circumference with ground anchoring devices spaced 6 in (150 mm) minimum. Also, the HPTRM can be secured around the pipe in a 12 x 12 in (300 x 300 mm) minimum trench filled with concrete slurry.

GROUND ANCHORING DEVICES

- Ground anchoring devices are used to secure the mat to the soil using the suggested anchor device (see Tables 1 and 2 on page 7) at a minimum frequency and pattern shown on the Anchor Pattern Guide on page 7.
- U-shaped wire staples or metal geotextile pins can be used to anchor mat to the ground surface. Wire staples should be a minimum thickness of 8 gauge (4.3 mm). Metal pins should be at least 0.20 in (5 mm) diameter steel with a 1 1/2 in (38 mm) steel washer at the head of the pin. Wire staples and metal pins should be driven flush to the soil surface. All anchors should be between 6-24 in (150-600 mm) long and have sufficient ground penetration to resist pullout. Longer anchors may be required for loose soils. Heavier metal stakes may be required in rocky soils.

TABLE 1: SUGGESTED GROUND ANCHORING DEVICE SELECTION*

		DEGRADABLE STAKES	WIRE STAPLES	METAL PIN/WASHERS OR NAIL/WASHERS	PERCUSSION DRIVEN ANCHORS
PRODUCT	LANDLOK® ECBs	●	●		
	LANDLOK® TRMs		●	●	
	PYRAMAT®		●	●	●
APPLICATION	SLOPES	●	●	●	●
	BANKS			●	●
	CHANNELS		●	●	●

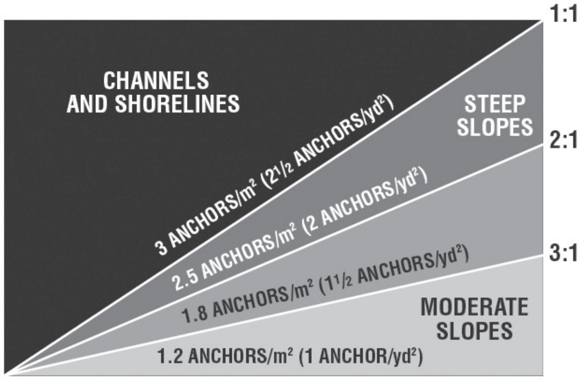
TABLE 2: SUGGESTED LENGTHS OF GROUND ANCHORING DEVICES*

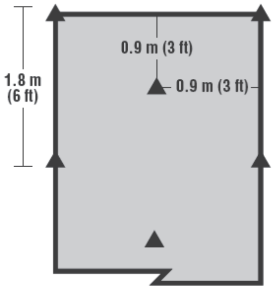
		6-INCH	12-INCH	18-INCH	24-INCH
SOIL TYPES	ROCKY	●			
	CLAYEY	●	●		
	SILTY		●	●	
	SANDY			●	●

*The performance of ground anchoring devices is highly dependent on numerous site/project specific variables. It is the sole responsibility of the project engineer and/or contractor to select the appropriate anchor type and length. Anchoring shall be selected to hold the mat in intimate contact with the soil subgrade and resist pullout in accordance with the project's design intent.

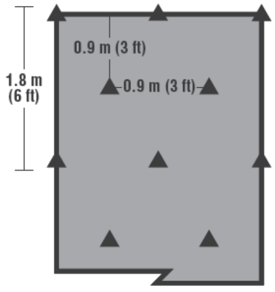
ANCHOR PATTERN GUIDE

- The shaded areas in the diagram provide anchor suggestions based on slope gradient and/or anticipated flow conditions. When the correct number of anchors has been determined, refer to the four illustrations below to establish anchor pattern. Increased anchoring may be required depending upon site conditions.

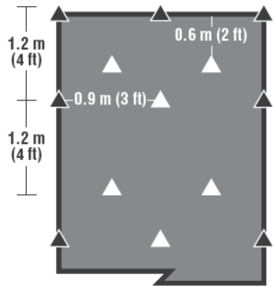




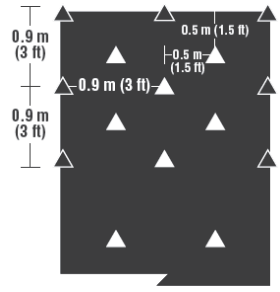
1.2 ANCHORS/m² (1 ANCHOR/yd²)



1.8 ANCHORS/m² (1½ ANCHORS/yd²)



2.5 ANCHORS/m² (2 ANCHORS/yd²)



3 ANCHORS/m² (2½ ANCHORS/yd²)

SOIL FILLING

- Soil filling is suggested for optimum performance.
- After seeding, spread and lightly rake 1/2 - 3/4 in (12-19 mm) minimum of fine site soil or topsoil into the mat and completely fill the voids using backside of rake or other flat tool.
- If equipment must operate on the mat, make sure it is of the rubber-tired type. No tracked equipment or sharp turns are allowed on the mat.
- Avoid any traffic over the mat if loose or wet soil conditions exist.
- Smooth soil-fill in order to just expose the top netting of matrix. Do not place excessive soil above the mat.
- Broadcast additional seed and install a Landlok® ECB above the soil-filled mat (if desired).
- Hydraulically-applied mulch or seed may be used as an alternate to soil-fill on select applications. Consult manufacturer's technical representative for more information.
- Consult manufacturer's technical representative or local distributor for installation assistance, particularly if unique conditions apply (sandy soils and infertile environments).

MAINTENANCE

All slopes, channels, banks and other transition structures shall be maintained to assure the expected design life of the reinforced vegetated system. Here are a few tips that should prove helpful:

- Monitoring
  - Should be conducted semi-annually and after major storm events. This should include: observing the condition of the vegetation; testing the irrigation system; checking condition of all permanent erosion control systems; observing sediment and debris deposits that need removal.
- Vegetation
  - Repair and maintenance of various types of vegetation shall be consistent with their original design intent, including:
    - Grass/Turf Areas: applications shall be maintained for adequate cover and height.
    - Mowing: grasses shall be mowed according to normal maintenance schedules as determined by local jurisdictions or maintenance agreements; operations shall not start until vegetation achieves a minimum height of 6 in (150 mm); mower blades shall be greater than 6 in (150 mm) above the mat.
    - Unvegetated Areas: shall be re-seeded and soil-filled (if applicable).
- Sediment and Debris Deposits
  - Accumulation of sediment and debris can reduce the hydraulic capacity of channels, clog inlet and outlet structures and can damage existing vegetation. Sediment and debris removal is a vital part of system maintenance.
    - Removal: shall be done carefully to avoid damage. When excavation is within 12 in (300 mm) minimum of matting, removal shall be done by hand or with a visual "spotter." If equipment must operate on the mat, make sure it is of the rubber-tired type. No tracked equipment or sharp turns are allowed on the mat.
      - Alternatively, "stake chasers" or some other form of permanent visual markers can be utilized to provide a visual marker for maintenance activities.
- Damaged Sections
  - Missing or damaged sections of the matting should be replaced per the installation guidelines.
    - Repairing Rips or Holes: these should be patched with identical matting material. First, carefully cut out the damaged section with a knife. Then replace and compact soil to the elevation of the surrounding subgrade and plant seed. Cut a piece of replacement material a minimum of 12 in (300 mm) larger than the rip or tear. Use ties to attach the replacement material to the existing material. At overlaps, the upstream and upslope material should be on top. Secure the replacement material with ground anchoring devices spaced every 6 in (150 mm) around the circumference of the repair and at the frequency and spacing shown in the Anchor Pattern Guide on page 7. Seed and soil fill replacement area.

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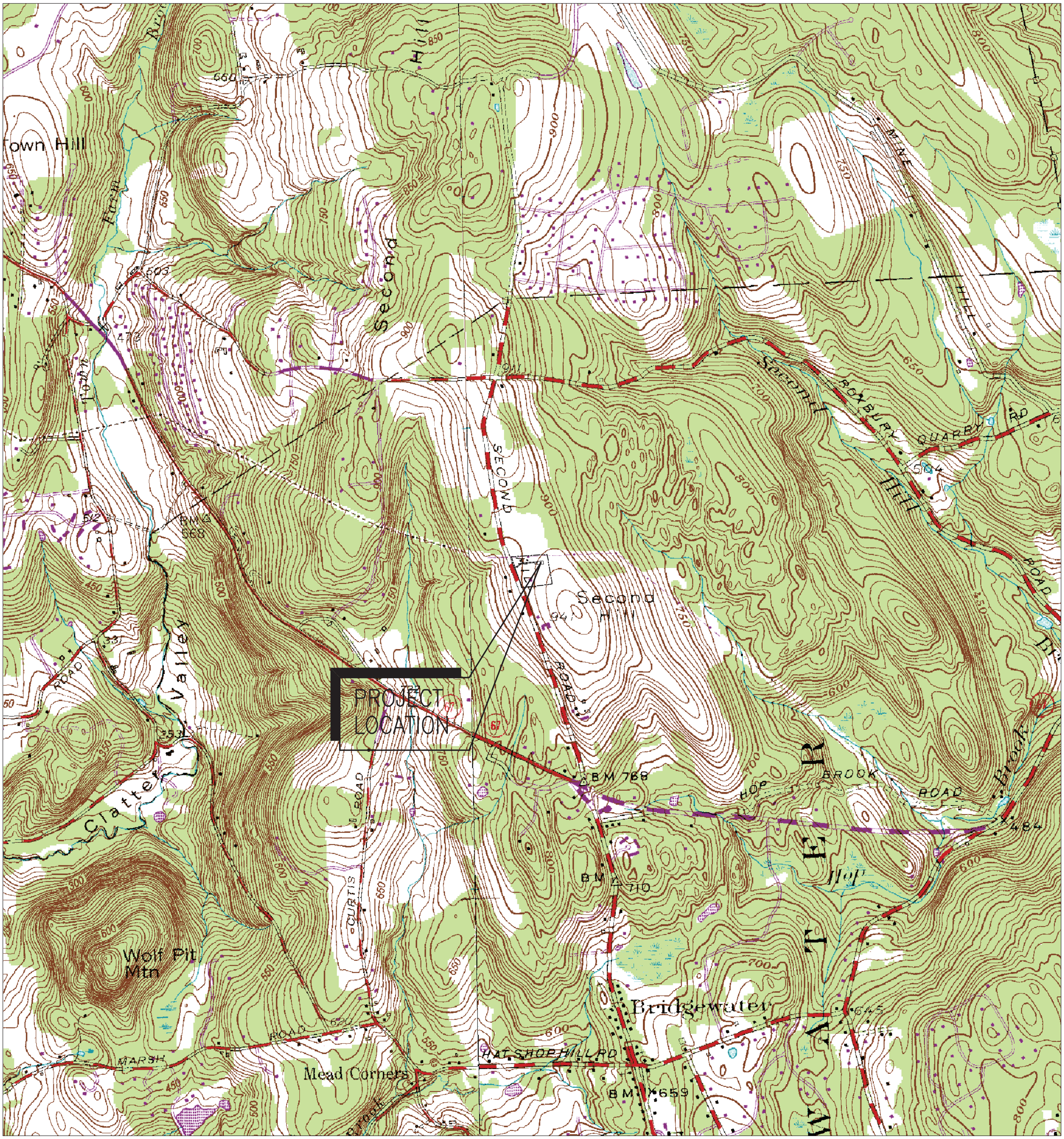
FIGURE 1

USGS Map



1989 USGS TOPO MAP: ROXBURY 41073-E3

SCALE: 1" = 2000'

GRAPHIC SCALE

2000 0 1000 2000

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CHA PROJ. NO. – 18301-1071-43000

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FIGURE 1

DATE:
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DATE: 10/22/2013 12:43 PM FILE: V:\PROJECTS\ANY\WIREDATA\SAI CINGULAR\18301\SITES\1071 BRIDGEWATER 1252\DRAINAGE\FIGURES\FIGURE_1-USGS.DWG

FIGURE 2

Aerial Map

N

2004 AERIAL PHOTOGRAPH

SCALE: 1" = 1000'

GRAPHIC SCALE

1000 0 500 1000

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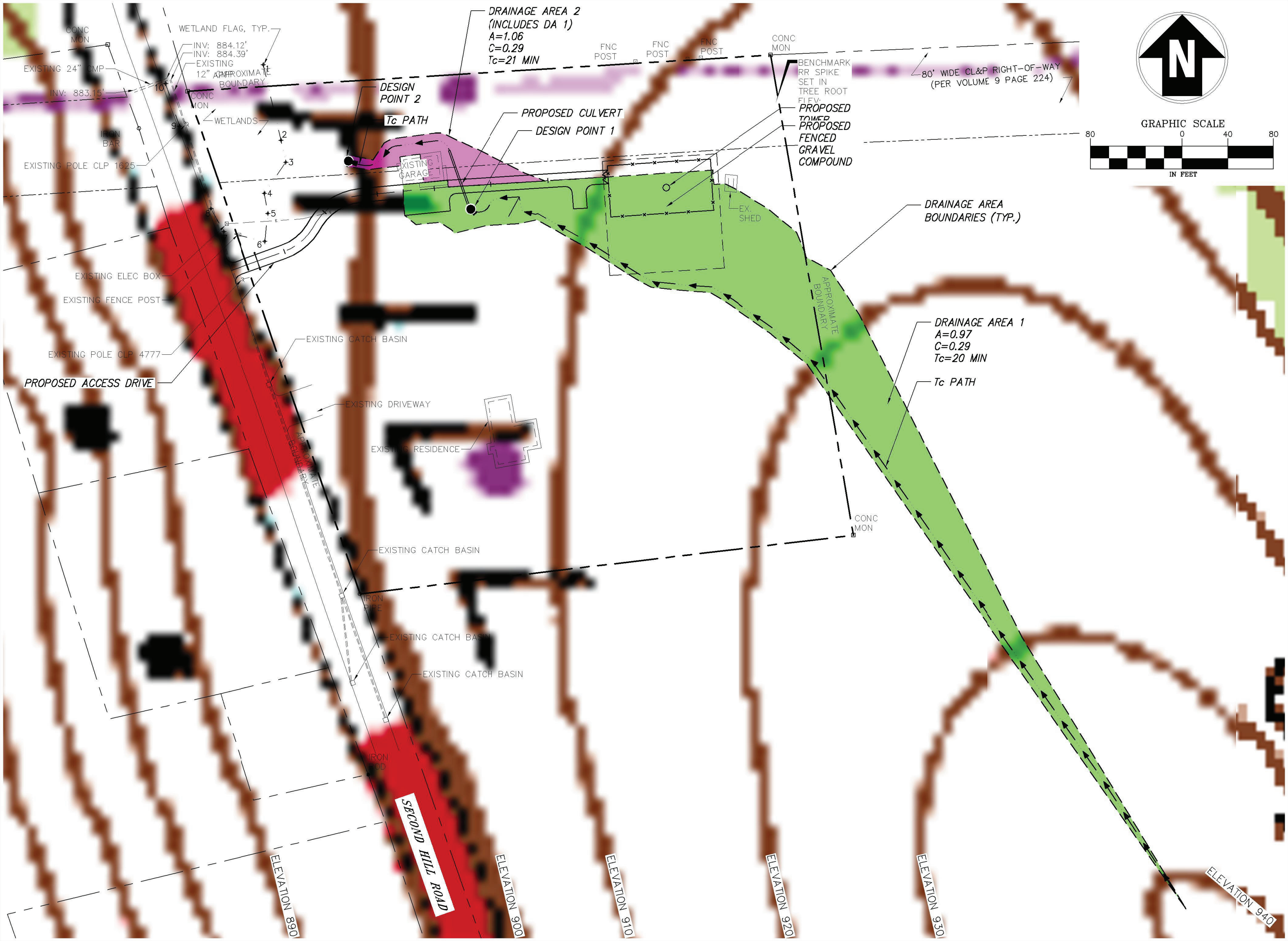
FIGURE 3

Drainage Areas



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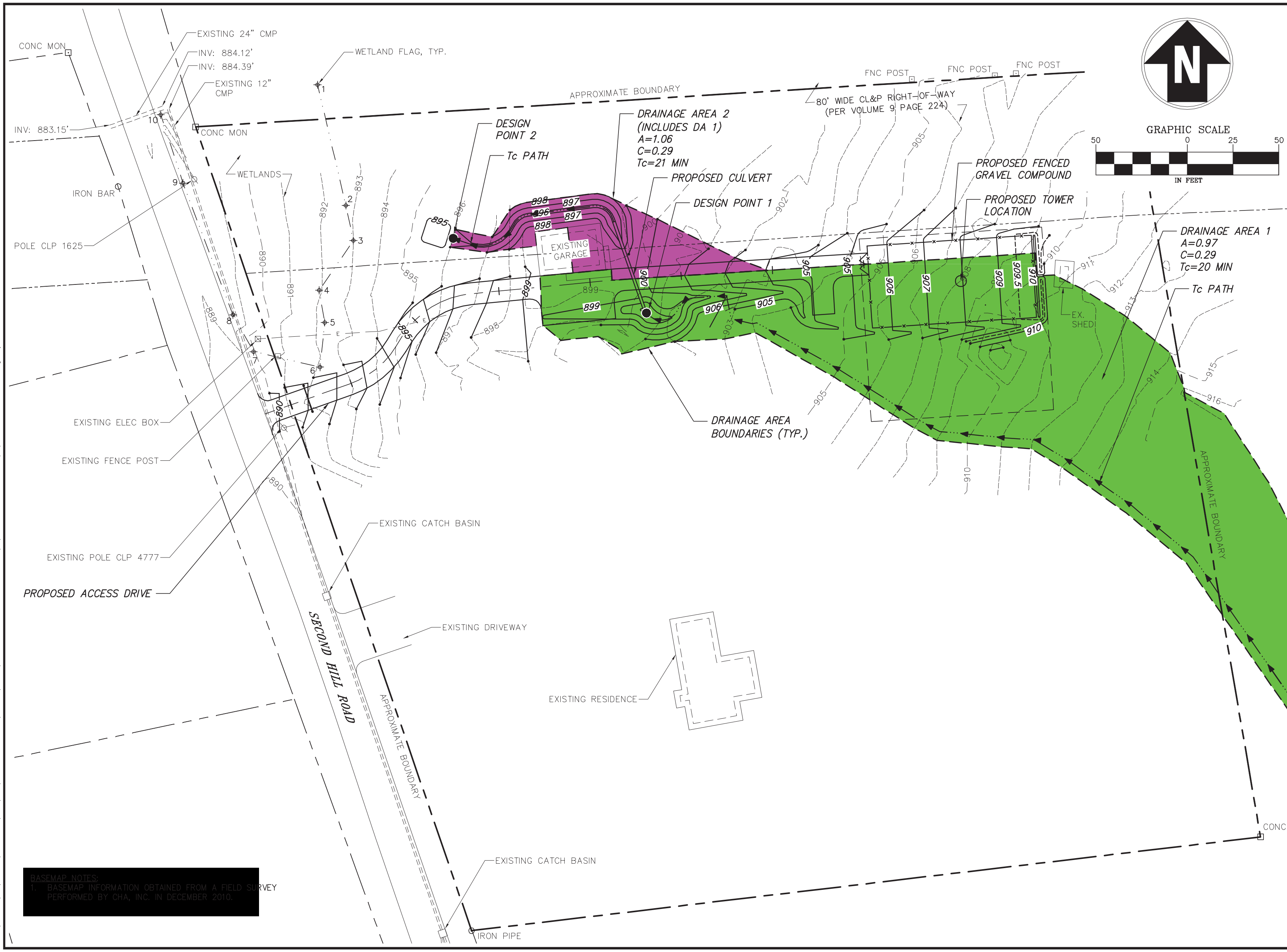
DRAINAGE AREAS
(OVERALL)

SHEET NUMBER
FIGURE 3A



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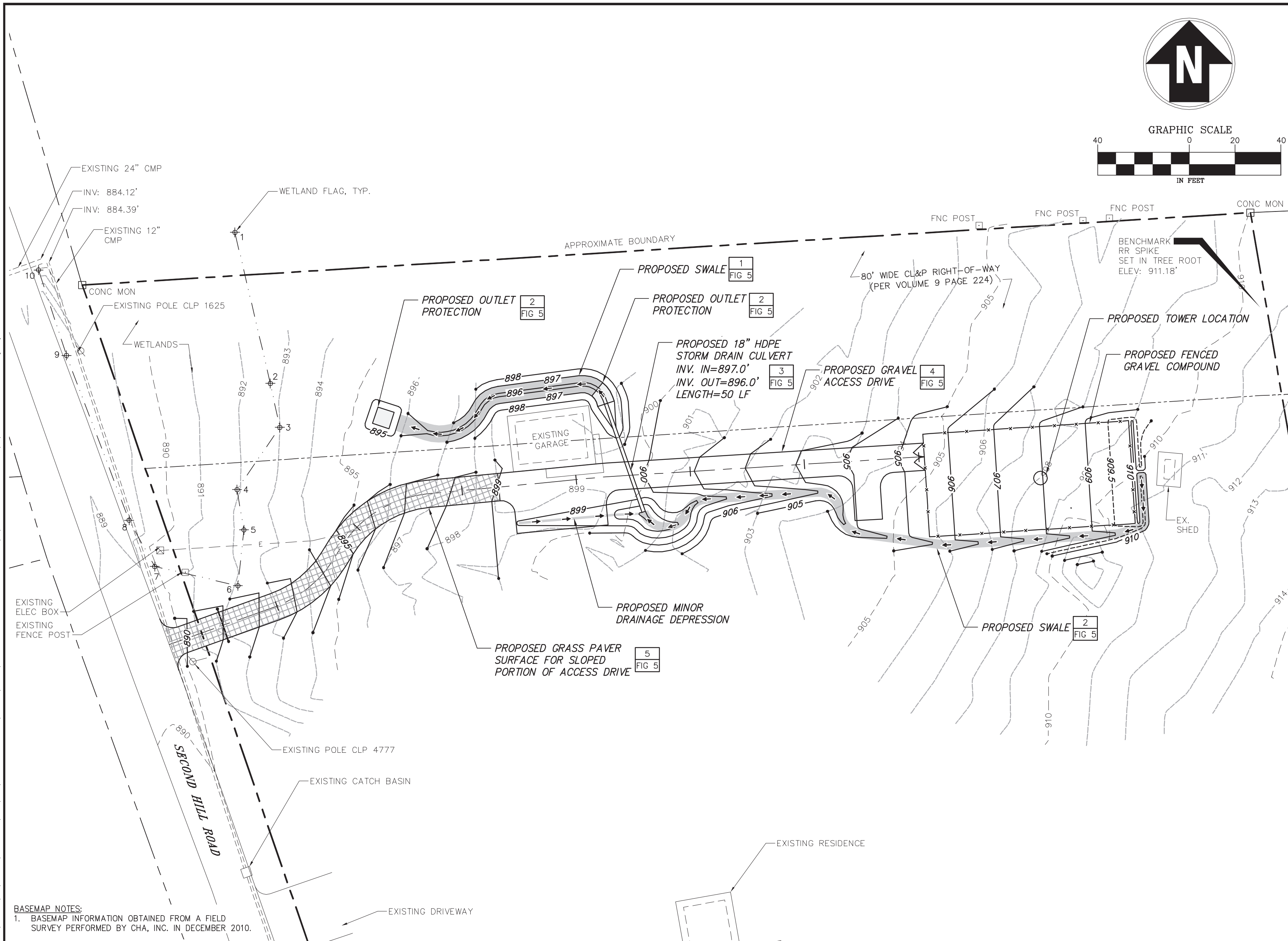
SHEET TITLE
DRAINAGE AREAS
(ENLARGED)

SHEET NUMBER
FIGURE 3B

File: V:\PROJECTS\ANY\WIREDATA\SAI CINGULAR\18301\SITES\1071 BRIDGEWATER 1252\DRAINAGE\FIGURES\FIGURE_3-DRAINAGE_AREAS.DWG Saved: 10/23/2013 1:29:41 PM Plotted: 10/28/2013 4:05:09 PM User: Montgomery, John

FIGURE 4

Drainage Design



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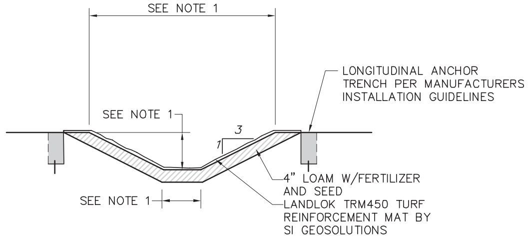
DRAINAGE DESIGN

SHEET NUMBER
FIGURE 4

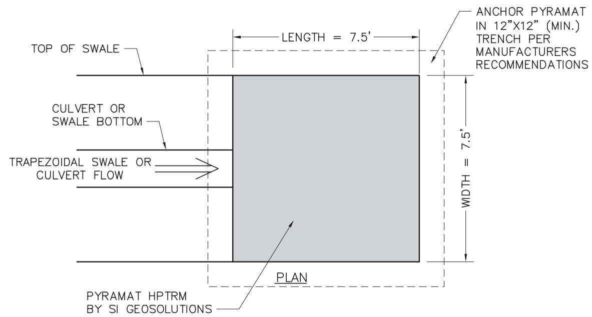
FIGURE 5

Details

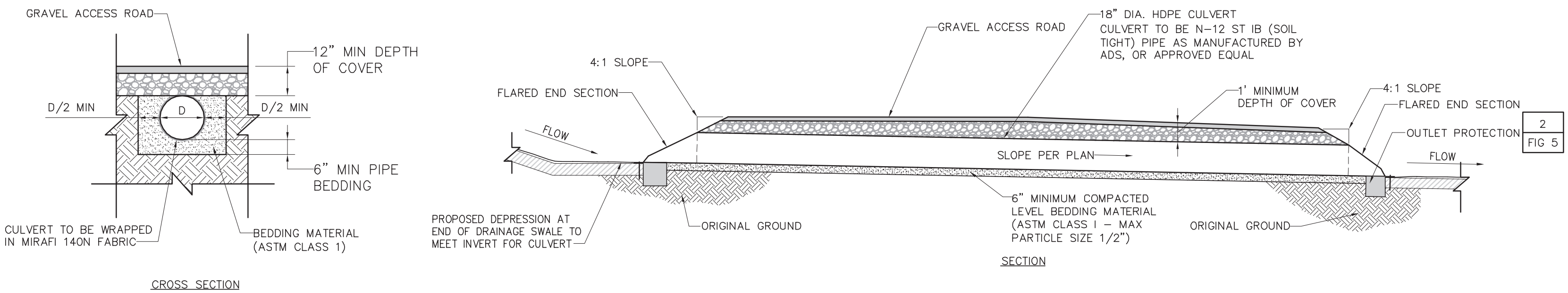


NOTES:
1. DIMENSION VARIES, REFER TO GRADING PLANS.
2. INSTALL PER MANUFACTURERS RECOMMENDATIONS.

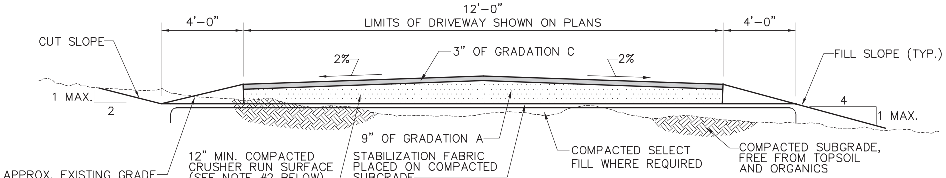
1 DRAINAGE SWALE
SCALE: N.T.S.



2 OUTLET PROTECTION
SCALE: N.T.S.



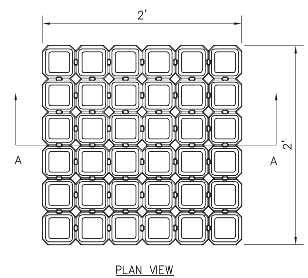
3 TYPICAL CULVERT INSTALLATION
SCALE: N.T.S.

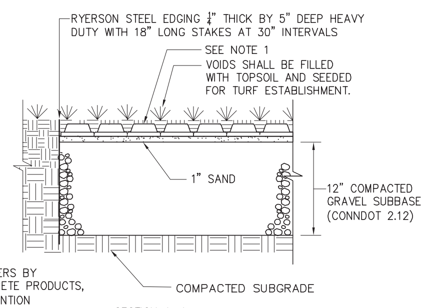


NOTES:
1. WHERE REQUIRED BY THE ENGINEER, THE PROPOSED DRIVEWAY BED SHALL BE OVER-EXCAVATED AND FILLED WITH BANK RUN GRAVEL. THE MATERIAL USED SHALL BE APPROVED BY THE ENGINEER. THE CONTRACTOR WILL BE PAID EXTRA FOR OVER- EXCAVATION AND BACKFILL WITH BANK RUN GRAVEL, ON A UNIT PRICE BASIS.
2. THE MATERIALS FOR THE ROLLED BANK GRAVEL SURFACE AND TRAFFIC-BOUND GRAVEL SURFACE SHALL CONSIST OF SOUND, TOUGH, DURABLE PARTICLES OF BANK OR CRUSHED GRAVEL. ALL MATERIALS SHALL BE FREE FROM THIN OR ELONGATED PIECES, LUMPS OF CLAY, LOAM, VEGETABLE MATTER, OR SAND. BINDER MAY BE ADDED AND INCORPORATED BY APPROVED METHODS AS SPECIFIED ELSE WHERE. THE BOTTOM 9" SHALL MEET GRADING "A" AND THE TOP 3" SHALL CONFORM TO GRADING "C".

	GRADATION		
	A	B	C
SQUARE MESH SIEVES	PERCENT PASSING BY WEIGHT (MASS)		
PASS 5" (125mm)		100	
PASS 3.5" (90mm)	100	90-100	
PASS 1.5" (37.5mm)	55-100	55-95	100
PASS 0.75" (19mm)			45-80
PASS 0.25" (6.3mm)	25-60	25-60	25-60
PASS #10 (2.0mm)	15-45	15-45	15-45
PASS #40 (425um)	5-25	5-25	5-25
PASS #100 (150um)	0-10	0-10	0-10
PASS #200 (75um)	0-5	0-5	0-5

4 CROWNED DRIVEWAY SECTION
SCALE: N.T.S.





NOTES:
1. 24" X 24" X 4" CHECKER BLOCK CONCRETE PAVERS BY HASTINGS ARCHITECTURAL & ORNAMENTAL CONCRETE PRODUCTS, 24" X 24" X 1.5" DRIVABLE GRASS BY SOIL RETENTION PLANTABLE CONCRETE SYSTEMS, OR APPROVED EQUAL

5 GRASS PAVER DRIVEWAY SECTION
SCALE: N.T.S.

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SHEET NUMBER
FIGURE 5

ATTACHMENT 4

HexPort Multi-Band Antenna

Model HPA-65R-BUU-H8

Hexport Multi-Band Antenna Array

The CCI Hexport Multi-Band Antenna Array is an industry first 6-port antenna with full WCS Band Coverage. With four high band ports and two low band ports, our hexport antenna is ready for 4X4 high band MIMO.

Modern networks demand high performance, consequently CCI has incorporated several new and innovative design techniques to provide an antenna with excellent side-lobe performance, sharp elevation beams, and high front to back ratio.

Multiple networks can now be connected to a single antenna, reducing tower loading and leasing expense, while decreasing deployment time and installation cost.

Full band capability for 700 MHz , Cellular 850 MHz, PCS 1900 MHz, AWS 1710/2170 MHz and WCS 2300 MHz coverage in a single enclosure.

Benefits

- **Includes WCS Band**
- **Reduces tower loading**
- **Frees up space for tower mounted E-nodes**
- **Single radome with six ports**
- **All Band design simplifies radio assignments**
- **Sharp elevation beam eases network planning**

Features

- High Band Ports include WCS Band
- Four High Band ports with two Low Band ports in one antenna
- Sharp elevation beam
- Excellent elevation side-lobe performance
- Excellent MIMO performance due to array spacing
- Excellent PIM Performance
- A multi-network solution in one radome

Applications

- 4x4 MIMO on High Band and 2x2 MIMO on Low Band
- Adding additional capacity without adding additional antennas
- Adding WCS Band without increasing antenna count

ISO 9001:2008
Quality Management Systems
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HexPort Multi-Band Antenna

Model HPA-65R-BUU-H8

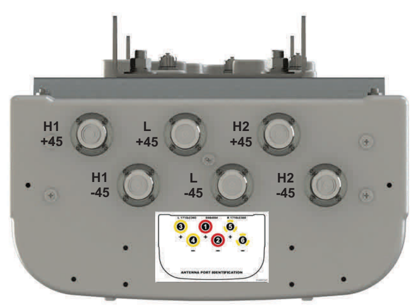
HPA-65R Multi-Band Antenna

Electrical Specifications

Frequency Range	2 X Low Band Ports which cover the full range from 698-894 MHz		4 X High Band Ports which cover the full range from 1710-2360 MHz			
	698-806 MHz	824-894 MHz	1850-1990 MHz	1710-1755/2110-2170 MHz		2305-2360 MHz
Gain	15.3 dBi	16.2 dBi	17.1 dBi	16.3 dBi	17.4 dBi	17.7 dBi
Azimuth Beamwidth (-3dB)	65°	61°	62°	68°	64°	60°
Elevation Beamwidth (-3dB)	10.1°	8.4°	5.6°	6.2°	5.0°	4.5°
Electrical Downtilt	2° to 10°	2° to 10°	0° to 8°	0° to 8°	0° to 8°	0° to 8°
Elevation Sidelobes (1st Upper)	< -17 dB	< -17 dB	< -19 dB	< -18 dB	< -18 dB	< -17 dB
Front-to-Back Ratio @180°	> 29 dB	> 28 dB	> 35 dB	> 35 dB	> 35 dB	> 35 dB
Front-to-Back Ratio over ± 20°	> 28 dB	> 27 dB	> 28 dB	> 27 dB	> 28 dB	> 28 dB
Cross-Polar Discrimination (at Peak)	> 24 dB	> 20 dB	> 25 dB	> 25 dB	> 25 dB	> 25 dB
Cross-Polar Discrimination (at ± 60°)	> 16 dB	> 14 dB	> 18 dB	> 18 dB	> 18 dB	> 18 dB
Cross-Polar Port-to-Port Isolation	> 25 dB	> 25 dB	> 25 dB	> 25 dB	> 25 dB	> 25 dB
VSWR	< 1.5:1	< 1.5:1	< 1.5:1	< 1.5:1	< 1.5:1	< 1.5:1
Passive Intermodulation (2x20W)	≤ -150dBc	≤ -150dBc	≤ -150dBc	≤ -150dBc	≤ -150dBc	≤ -150dBc
Input Power	500 Watts CW	500 Watts CW	300 Watts CW	300 Watts CW	300 Watts CW	300 Watts CW
Polarization	Dual Pol 45°	Dual Pol 45°	Dual Pol 45°	Dual Pol 45°	Dual Pol 45°	Dual Pol 45°
Input Impedance	50 Ohms	50 Ohms	50 Ohms	50 Ohms	50 Ohms	50 Ohms
Lightning Protection	DC Ground	DC Ground	DC Ground	DC Ground	DC Ground	DC Ground

Mechanical Specifications

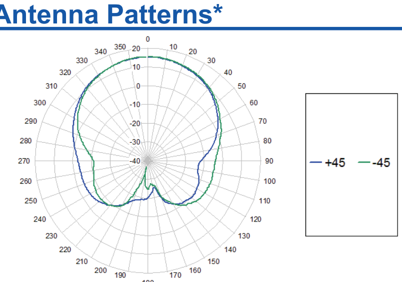
Dimensions (LxWxD)	92.4 x 14.8 x 7.4 inches (2348 x 376 x 189 mm)
Survival Wind Speed	> 150 mph
Front Wind Load	332 lbs (1479 N) @ 100 mph (161 kph)
Side Wind Load	193 lbs (860 N) @ 100 mph (161 kph)
Equivalent Flat Plate Area	13.0 ft^2 (1.2 m^2)
Weight (without Mounting)	68 lbs (31 kg)
RET System Weight	5.0 lbs (2.25 kg)
Connector	6; 7-16 DIN female long neck
Mounting Pole	2-5 inches (5-12 cm)



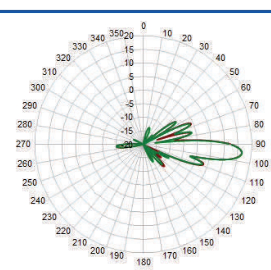
Bottom View

Rear View

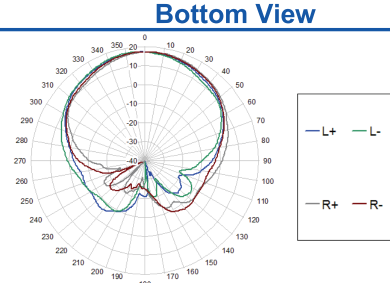
Antenna Patterns*



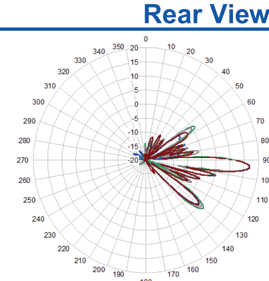
894 MHz Azimuth



Elevation 5°



1920 MHz Azimuth



Elevation 4°

*Typical antenna patterns. For detail information on antenna pattern, please contact us at info@cciproducts.com. All specifications are subject to change without notice.

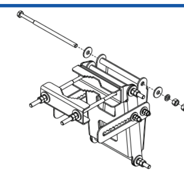
HexPort Multi-Band Antenna

Model HPA-65R-BUU-H8

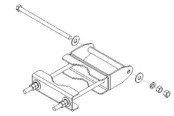
Ordering Information:

HPA-65R-BUU-H8	8 Foot Hexport Antenna with 65° Azimuth Beamwidth with Factory Installed Actuators (\3)
HPA-65R-BUU-H8-K	Complete Kit with Antenna, Factory Installed Actuators (3) and M03 Mounting Bracket
BSA-RET200	RET Actuator
BSA-M03	Mounting Bracket (Top & Bottom) with 0° through 10° Mechanical tilt Adjustment

M03 Top Mounting Bracket



M03 Bottom Mounting Bracket



RET [Remote Electrical Tilt] System

General Specification

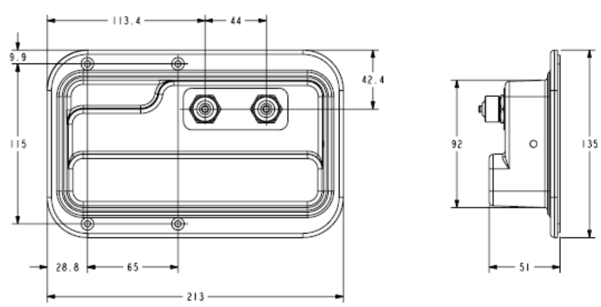
Part Number	BSA-RET200
Protocols	AISG 2.0
Adjustment Cycles	>10,000 cycles
Tilt Accuracy	±0.1°
Temperature Range	-40°C to +70°C

Electrical Specification

Interface Signal	Data | dc
Input Voltage Range	10-30 Vdc, Specifications at +24 VDC
Current consumption during tilting	120mA at Vin = 24V
Current consumption idle	55mA at Vin=24V
Hardware Interface	AISG - RS 485 A/B
Input Connector	1x8-pin Daisy Chain In Male
Output Connector	1x8-pin Daisy Chain Out Female

Mechanical Specification and Dimensions

Housing Material	ASA / ABS / Aluminum
Dimensions (H x W x D)	8 x 5 x 2 inches (213 x 135 x 51 mm)
Weight	1.5 lbs (0.68 kg)



Standards Compliance

Safety	EN 60950-1, UL 60950-1
Emission	EN 55022
Immunity	EN 55024
Environmental	IEC 60068-2-1, IEC 60068-2-2, IEC 60068-2-5, IEC 60068-2-6, IEC 60068-2-11, IEC 60068-2-14, IEC 60068-2-18, IEC 60068-2-27, IEC 60068-2-29, IEC 60068-2-30, IEC 60068-2-52, IEC 60068-2 -64, GR-63-CORE 4.3.1, EN60529 IP24

Regulatory Certification

AISG, FCC Part 15 Class B, CE, CSA US

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(addtoproject.aspx?id=32741&company=andrew)SBNH-1D6565C

Andrew® Dual Band Antenna, 698–896 MHz and 1710–2180 MHz, 65° horizontal beamwidth, RET compatible

- Interleaved dipole technology providing for attractive, low wind load mechanical package
- Internal next generation actuator eliminates field installation and defines new standards for reliability

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Documents/Tools (product_details.aspx?id=32741&tab=3)

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a%3Dt%26rct%3Dj%26q
2Fandrew%252Fproduct_details.aspx%253Fid%253D32741%26ei%3Dmz2BUr_5E6LNsQSusoIo%26usg%3DAFQjCNGJf9qP-

Electrical Specifications

Frequency Band, MHz	**698–806**	**806–896**	**1710–1880**	**1850–1990**	**1920–2180**
Gain, dBi	15.7	16.4	18.0	18.0	18.0
Beamwidth, Horizontal, degrees	71	67	58	57	59
Beamwidth, Vertical, degrees	8.6	7.8	5.5	5.1	4.8
Beam Tilt, degrees	0–11	0–11	0–7	0–7	0–7
USLS, typical, dB	15	15	16	16	16
Front-to-Back Ratio at 180°, dB	25	28	34	31	31
Front-to-Back Total Power at 180° ± 20°, dB	21	22	30	27	26
CPR at Boresight, dB	24	21	17	17	17
CPR at Sector, dB	11	8	9	8	9
Isolation, dB	30	30	30	30	30
Isolation, Intersystem, dB	35	35	35	35	35
VSWR | Return Loss, dB	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0
PIM, 3rd Order, 2 x 20 W, dBc	-150	-150	-150	-150	-150
Input Power per Port, maximum, watts	400	400	300	300	300
Polarization	±45°	±45°	±45°	±45°	±45°
Impedance	50 ohm	50 ohm	50 ohm	50 ohm	50 ohm

px%253Fid%253D32741%26ei%3Dmz2BUr_5E6LNsQSusoIo%26usg%3DAFQjCNGJf9qP-

General Specifications

Antenna Brand	Andrew®
Antenna Type	DualPol® dual band
Band	Multiband
Brand	DualPol® | Teletilt®
Operating Frequency Band	1710 – 2180 MHz | 698 – 896 MHz

Mechanical Specifications	
Color	Light gray
Connector Interface	7-16 DIN Female
Connector Location	Bottom
Connector Quantity, total	4
Lightning Protection	dc Ground
Radiator Material	Aluminum
Radome Material	Fiberglass, UV resistant
Wind Area, maximum	0.8 m² | 8.9 ft²
Wind Loading, maximum	879.0 N @ 150 km/h 197.6 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph

Dimensions	
Depth	181.0 mm | 7.1 in
Length	2449.0 mm | 96.4 in
Width	301.0 mm | 11.9 in
Net Weight	27.6 kg | 60.8 lb

Remote Electrical Tilt (RET) Information	
Adjustment Time, full range, maximum	30 s
Annual Failure Rate, maximum	0.01%
Power Consumption, idle state, maximum	2.0 W
Power Consumption, normal conditions, maximum	11.0 W
Power Input	10–30 V

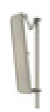
Protocol	3GPP/AISG 2.0 Multi-RET
RET Interface	RS-485 Female (daisy chain port ,1) | RS-485 Male (input port, 1)
RET Interface, quantity	1 female | 1 male
RET System	Teletilt®

Patterns- Show

Regulatory Compliance/Certifications

Agency	Classification
RoHS 2011/65/EU	Compliant by Exemption
China RoHS SJ/T 11364-2006	Above Maximum Concentration Value (MCV)

Included Parts



DB380-5083
Standard two point mounting system to secure BSA panels to pipes with an OD measuring 2.4-4.5" (60-115mm). Includes locking downtilt brackets and heavy guage pipe brackets to provide superior windload performance.

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Ericsson IA Product Info (AIR: Active Integrated Radio):

Preliminary[0]	8' AIR (B2A/B5P/B12P)	8' AIR (B4A/B5P/B12P)	8' AIR (B30A/B5P/B12P)	6' AIR (B2A/ B5P/B12P)	6' AIR (B4A/ B5P/B12P)	6' AIR (B30A/B5P/B12P)	4' AIR (B2A/ B5P/B12P)	4' AIR (B4A/ B5P/B12P)	4' AIR (B30A/B5P/B12P)
Product Number	KRC 118 054/1	KRC 118 048/1	KRC 118 162/1	KRC 118 055/1	KRC 118 056/1	KRC 118 161/1	KRC 118 068/1	KRC 118 057/1	KRC 118 160/1
Active antenna/radio	PCS 2 TX / 4 RX	AWS 2 TX / 4 RX	WCS 2 TX / 4 RX	PCS 2 TX / 4 RX	AWS 2 TX / 4 RX	WCS 2 TX / 4 RX	PCS 2 TX / 4 RX	AWS 2 TX / 4 RX	WCS 2 TX / 4 RX
Bypass antenna	700/850 MHz +/- 45°	700/850 MHz +/- 45°	700/850 MHz +/- 45°	700/850 MHz +/- 45°	700/850 MHz +/- 45°	700/850 MHz +/- 45°	700/850 MHz +/- 45°	700/850 MHz +/- 45°	700/850 MHz +/- 45°
Antenna HBW	67° (700/850 MHz) 65° (PCS)	67° (700/850 MHz) 65° (AWS)	TBD	68° (700/850 MHz) 65° (PCS)	68° (700/850 MHz) 65° (AWS)	TBD	68° (700/850 MHz) 65° (PCS)	68° (700/850 MHz) 65° (AWS)	TBD
Antenna VBW	9.2° (700/850 MHz) 7.5° (PCS)	9.2° (700/850 MHz) 7.5° (AWS)	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Antenna Gain	14.4 dBd (700/850 MHz) 61.5 dBm (PCS)	13.9 dBd (700/850 MHz) 18 dBi (AWS)	TBD	13.4 dBd (700/850 MHz) 17.5 dBi (PCS)	13.4 dBd (700/850 MHz) 17.5 dBi (AWS)	TBD	11.9 dBd (700/850 MHz) 17 dBi (AWS)	11.9 dBd (700/850 MHz) 17 dBi (AWS)	TBD
Antenna Tilting Range	2-10° (700/850 MHz) 2-12° (PCS)	2-10° (700/850 MHz) 2-12° (AWS)	TBD	2-12° (700/850 MHz) 2-12° (PCS)	2-12° (700/850 MHz) 2-12° (AWS)	TBD	2-16° (700/850 MHz) 2-12° (PCS)	2-16° (700/850 MHz) 2-12° (AWS)	TBD
Interface	- Two optical fiber ports (CPRI) for active antenna/radio - One power connector, -48 V DC - Two 7/16 female connectors for passive antenna, with RET support (AISG 2.0)								
Number of UMTS carriers	Up to 4	N/A	N/A	Up to 4	N/A	N/A	Up to 4	N/A	N/A
LTE	Up to 20 MHz								
Supported Baseband	DUW (UMTS) DUL[1], DUS[2] (LTE)	DUL[1], DUS[2] (LTE)	DUL[1], DUS[2] (LTE)	DUW (UMTS) DUL[1], DUS[2] (LTE)	DUL[1], DUS[2] (LTE)	DUL[1], DUS[2] (LTE)	DUW (UMTS) DUL[1], DUS[2] (LTE)	DUL[1], DUS[2] (LTE)	DUL[1], DUS[2] (LTE)
Dimensions (HxWxD)	96"x13.3"x11.2" [3]	93.6"x12.1"x8.6"	96"x16.3"x11.2" [3]	85.8"x16.3"x11.2" [3]	85.8"x16.3"x11.2" [3]	85.8"x16.3"x11.2"[3]	60.7"x16.3"x11.2"[3]	60.7"x16.3"x11.2"[3]	60.7"x16.3"x11.2"[3]
Weight	200.2 lbs[3]	154 lbs	200.2 lbs[3]	171.6 lbs[3]	171.6 lbs[3]	171.6 lbs[3]	143 lbs[3]	143 lbs[3]	143 lbs[3]
HW Availability[4]	Jan. '14	Now	Jan. '15	Jan. '14	Jan. '14	Nov. '14	Apr. '14	Apr. '14	Feb. '15

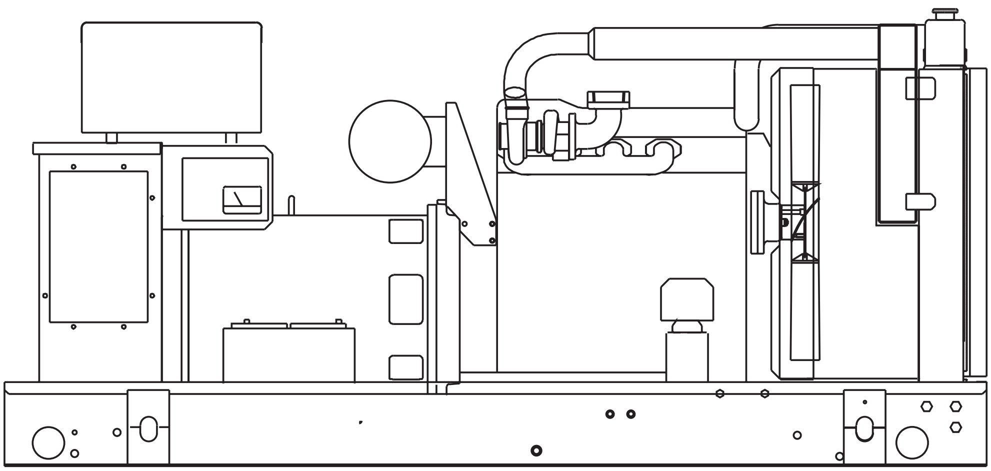
ATTACHMENT 5

SD050

Liquid Cooled Diesel Engine Generator Sets

Standby Power Rating
50KW 60 Hz / 50KVA 50 Hz

Prime Power Rating
44KW 60 Hz / 44KVA 50 Hz



Power Matched
GENERAC 2.4DTA ENGINE
Turbocharged/Aftercooled
Tier III Compliant

FEATURES

- **INNOVATIVE DESIGN & PROTOTYPE TESTING** are key components of GENERAC'S success in "IMPROVING POWER BY DESIGN." But it doesn't stop there. Total commitment to component testing, reliability testing, environmental testing, destruction and life testing, plus testing to applicable CSA, NEMA, EGSA, and other standards, allows you to choose GENERAC POWER SYSTEMS with the confidence that these systems will provide superior performance.

- **TEST CRITERIA:**
  - ✓ PROTOTYPE TESTED
  - ✓ SYSTEM TORSIONAL TESTED
  - ✓ ELECTRO-MAGNETIC INTERFERENCE
  - ✓ NEMA MG1 EVALUATION
  - ✓ MOTOR STARTING ABILITY
  - ✓ SHORT CIRCUIT TESTING
  - ✓ UL COMPLIANCE AVAILABLE

- **SOLID-STATE, FREQUENCY COMPENSATED DIGITAL VOLTAGE REGULATION.** This state-of-the-art power maximizing regulation system is standard on all Generac models. It provides optimized FAST RESPONSE to changing load conditions and MAXIMUM MOTOR STARTING CAPABILITY by electronically torque-matching the surge loads to the engine.

- **SINGLE SOURCE SERVICE RESPONSE** from Generac's dealer network provides parts and service know-how for the entire unit, from the engine to the smallest electronic component. You are never on your own when you own a GENERAC POWER SYSTEM.

- **ECONOMICAL DIESEL POWER.** Low cost operation due to modern diesel engine technology. Better fuel utilization plus lower cost per gallon provide real savings.

- **LONGER ENGINE LIFE.** Generac heavy-duty diesels provide long and reliable operating life.

- **GENERAC TRANSFER SWITCHES, SWITCHGEAR AND ACCESSORIES.** Long life and reliability is synonymous with GENERAC POWER SYSTEMS. One reason for this confidence is that the GENERAC product line includes its own transfer systems, accessories, switchgear and controls for total system compatibility.

GENERAC®
POWER SYSTEMS, INC.

APPLICATION
& ENGINEERING DATA

GENERATOR SPECIFICATIONS

TYPE .... Four-pole, revolving field
ROTOR INSULATION .... Class H
STATOR INSULATION .... Class H
TOTAL HARMONIC DISTORTION .... <3%
TELEPHONE INTERFERENCE FACTOR (TIF) .... <50
ALTERNATOR .... Self-ventilated and drip-proof
BEARINGS (PRE-LUBED & SEALED) 1
COUPLING .... Direct, Flexible Disc
LOAD CAPACITY (STANDBY) 100%
LOAD CAPACITY (PRIME) 110%

NOTE: Emergency loading in compliance with NFPA 99, NFPA 110. Generator rating and performance in accordance with ISO8528-5, BS5514, SAE J1349, ISO3046 and DIN6271 standards.

VOLTAGE REGULATOR

TYPE .... Full Digital
SENSING .... 3 Phase
REGULATION .... ± 1/4%
FEATURES .... Built into H-100 Control Panel, V/F Adjustable
Adjustable Voltage and Gain

GENERATOR FEATURES

- Revolving field heavy duty generator
- Quiet drive coupling
- Operating temperature rise 120°C above a 40°C ambient
- Insulation is Class H rated at 150°C rise
- All prototype models have passed three phase short circuit testing

CONTROL PANEL FEATURES

- TWO FOUR LINE LCD DISPLAYS READ:
  - Voltage (all phases)
  - Current (all phases)
  - Power factor
  - kW
  - kVAR
  - Transfer switch status
  - Engine speed
  - Low fuel pressure
  - Run hours
  - Service reminders
  - Fault history
  - Oil pressure
  - Coolant temperature
  - Time and date
  - Low oil pressure shutdown
  - High coolant temp shutdown
  - Overvoltage
  - Overspeed
  - Low coolant level
  - Low coolant level
  - Exercise speed
  - ATS selection
  - Not in auto position (flashing light)
- INTERNAL FUNCTIONS:
  - I^2T function for alternator protection from line to neutral and line to line short circuits
  - Emergency stop
  - Programmable auto crank function
  - 2 wire start for any transfer switch
  - Communicates with the Generac HTS transfer switch
  - Built-in 7 day exerciser
  - Adjustable engine speed at exerciser
  - RS232 port for GenLink® control
  - RS485 port remote communication
  - Canbus addressable
  - Governor controller and voltage regulator are built into the master control board
  - Temperature range -40°C to 70°C

ENGINE SPECIFICATIONS

MAKE .... GENERAC/DEERE
MODEL 4024HF285B
ENGINE FAMILY 8JDXL03.0113
CYLINDERS 4
DISPLACEMENT .... 2.4 Liter (149 cu.in.)
BORE .... 86 mm (3.4 in.)
STROKE .... 105 mm (4.1 in.)
COMPRESSION RATIO 18:1
INTAKE AIR .... Turbocharged/Aftercooled
NUMBER OF MAIN BEARINGS 5
CONNECTING RODS .... 4-Drop Forged Steel
CYLINDER HEAD .... Cast Iron
PISTONS .... 4-Aluminum Alloy
CRANKSHAFT .... Die Forged, Induction Hardened Steel

VALVE TRAIN

LIFTER TYPE .... Solid
INTAKE VALVE MATERIAL .... Heat Resistant Steel
EXHAUST VALVE MATERIAL .... Heat Resistant Steel
HARDENED VALVE SEATS .... Replaceable

ENGINE GOVERNOR

❒ ELECTRONIC .... Standard
FREQUENCY REGULATION, NO-LOAD TO FULL LOAD .... Isochronous
STEADY STATE REGULATION .... ±0.25%

LUBRICATION SYSTEM

TYPE OF OIL PUMP .... Gear
OIL FILTER .... Full flow, Cartridge
CRANKCASE CAPACITY .... 7.5 qts.

COOLING SYSTEM

TYPE OF SYSTEM .... Pressurized, Closed Recovery
WATER PUMP .... Pre-Lubed, Self-Sealing
TYPE OF FAN .... Pusher
NUMBER OF FAN BLADES 6
DIAMETER OF FAN .... 560 mm (22 in.)
COOLANT HEATER .... 120V, 1000 W

FUEL SYSTEM

FUEL .... #2D Fuel (Min Cetane #40)
(Fuel should conform to ASTM Spec.)
FUEL FILTER .... 5 Micron
FUEL INJECTION PUMP .... Bosch
FUEL PUMP .... Mechanical
INJECTORS .... Unit Type Multi-Hole, Nozzle
ENGINE TYPE .... Pre-combustion
FUEL LINE (Supply) .... 6.35 mm (0.25 in.)
FUEL RETURN LINE .... 6.35 mm (0.25 in.)

ELECTRICAL SYSTEM

BATTERY CHARGE ALTERNATOR .... 20 Amps at 12 V
STARTER MOTOR .... 12 V
RECOMMENDED BATTERY .... 12 Volt, 90 A.H., 27F
GROUND POLARITY .... Negative

Rating definitions - Standby: Applicable for supplying emergency power for the duration of the utility power outage. No overload capability is available for this rating. (All ratings in accordance with BS5514, ISO3046 and DIN6271). Prime (Unlimited Running Time): Applicable for supplying electric power in lieu of commercially purchased power. Prime power is the maximum power available at variable load. A 10% overload capacity is available for 1 hour in 12 hours. (All ratings in accordance with BS5514, ISO3046, ISO8528 and DIN6271).

GENERAC®
POWER SYSTEMS, INC.

SD050

OPERATING DATA

	STANDBY				PRIME			
	SD050				SD050			
GENERATOR OUTPUT VOLTAGE/KW-60Hz			**Rated AMP**				**Rated AMP**	
120/240V, 1-phase, 1.0 pf	50		208		44		183	
120/208V, 3-phase, 0.8 pf (NOTE: Consult your Generac dealer for additional voltages.)	50		173		44		153	
120/240V, 3-phase, 0.8 pf	50		150		44		133	
277/480V, 3-phase, 0.8 pf	50		75		44		66	
600V, 3-phase, 0.8 pf	50		60		44		53	
GENERATOR OUTPUT VOLTAGE/KVA-50Hz			**Rated AMP**				**Rated AMP**	
110/220V, 1-phase, 1.0 pf	40		182		35		159	
115/200V, 3-phase, 0.8 pf (NOTE: Consult your Generac dealer for additional voltage)	50		144		44		127	
100/200V, 3-phase, 0.8 pf	50		144		44		127	
231/400V, 3-phase, 0.8 pf	50		72		44		63	
MOTOR STARTING KVA								
Maximum at 35% instantaneous voltage dip with standard alternator; 50/60 Hz	**208/240/416V** 82/100		**480V** 93/113		**208/240/416V** 82/100		**480V** 93/113	
FUEL								
Fuel consumption—60 Hz — Load	**25%**	**50%**	**75%**	**100%**	**25%**	**50%**	**75%**	**100%**
gal./hr.	1.12	2.19	3.21	4.16	0.99	1.93	2.82	3.66
liters/hr.	4.25	8.3	12.13	15.76	3.74	7.3	10.68	13.87
gal./hr.	0.9	1.75	2.56	3.33	0.79	1.54	2.26	2.93
Fuel consumption—50 Hz — liters/hr.	3.4	6.64	9.71	12.61	2.99	5.84	8.54	11.1
Fuel pump lift	40"				40"			

	STANDBY	PRIME
COOLING		
Coolant capacity — System - US gal. (lit.)	4.5 (17.0)	4.5 (17.0)
Engine - US gal. (lit.)	2.75 (10.4)	2.75 (10.4)
Coolant flow/min. — 60 Hz - US gal. (lit.)	28 (106)	28 (106)
50 Hz - US gal. (lit.)	23 (87)	23 (87)
Heat rejection to coolant 60 Hz full load BTU/hr.	135,900	109,000
Heat rejection to coolant 50 Hz full load BTU/hr.	115,500	92,600
Inlet air — 60 Hz - cfm (m^3/min.)	7500 (212.4)	7500 (212.4)
50 Hz - cfm (m^3/min.)	6225 (176.3)	6225 (176.3)
Max. air temperature to radiator °C (°F)	60 (140)	60 (140)
Max. ambient temperature °C (°F)	50 (122)	50 (122)
COMBUSTION AIR REQUIREMENTS		
Flow at rated power — 60 Hz - cfm (m^3/min.)	166 (4.7)	140 (4.0)
50 Hz - cfm (m^3/min.)	140 (4.0)	120 (3.4)
EXHAUST		
Exhaust flow at rated output 60 Hz - cfm (m^3/min.)	448 (12.7)	380 (10.8)
50 Hz - cfm (m^3/min.)	380 (10.8)	320 (9.1)
Max recommended back pressure Inches Hg	2.2	2.2
Exhaust temperature 60 Hz (full load) °F (°C)	1044 (562)	925 (496)
Exhaust outlet size	2.5" O.D. Turbo	2.5" O.D. Muffler
ENGINE		
Rated RPM — 60 Hz / 50 Hz	1800 / 1500	1800
HP at rated KW — 60 Hz / 50 Hz	79 / 64	64 / 52
Piston speed — 60 Hz - ft./min. (m/min.)	1536 (1230)	1536 (1230)
50 Hz - ft./min. (m/min.)	1279 (1025)	1279 (1025)
BMEP — 60 Hz / 50 Hz - psi	189 / 181	151 / 147
DERATION FACTORS		
Temperature		
6.7% for every 10°C above - °C	25	25
4.0% for every 10°F above - °F	77	77
Altitude		
0.8% for every 100 m above - m	1067	1067
2.6% for every 1000 ft. above - ft.	3500	3500

STANDARD ENGINE & SAFETY FEATURES

SD050

- High Coolant Temperature Automatic Shutdown
- Low Coolant Level Automatic Shutdown
- Low Oil Pressure Automatic Shutdown
- Overspeed Automatic Shutdown (Solid-state)
- Crank Limiter (Solid-state)
- Oil Drain Extension
- Radiator Drain Extension
- Factory-Installed Cool Flow Radiator
- Closed Coolant Recovery System
- UV/Ozone Resistant Hoses
- Rubber-Booted Engine Electrical Connections
- Coolant Heater
- Secondary Fuel Filter
- Fuel Lockoff Solenoid
- Stainless Steel Flexible Exhaust Connection
- Battery Charge Alternator
- Battery Cables
- Battery Tray
- Vibration Isolation of Unit to Mounting Base
- 12 Volt, Solenoid-activated Starter Motor
- Air Cleaner
- Fan Guard
- Control Console
- Radiator Duct Adaptor
- Ischronous Governor

OPTIONS

- **OPTIONAL COOLING SYSTEM ACCESSORIES**
  - ❍ 208/240V Coolant Heater
- **OPTIONAL FUEL ACCESSORIES**
  - ❍ Flexible Fuel Lines
  - ❍ UL Listed Fuel Tanks
  - ❍ Base Tank Low Fuel Alarm
  - ❍ Primary Fuel Filters
- **OPTIONAL EXHAUST ACCESSORIES**
  - ❍ Critical Exhaust Silencer
- **OPTIONAL ELECTRICAL ACCESSORIES**
  - ❍ 2A Battery Charger
  - ❍ 10A Dual Rate Battery Charger
  - ❍ Battery, 12 Volt, 135 A.H.
- **OPTIONAL ALTERNATOR ACCESSORIES**
  - ❍ Alternator Upsizing
  - ❍ Alternator Strip Heater
  - ❍ Alternator Tropicalization
  - ❍ Voltage Changeover Switch
  - ❍ Main Line Circuit Breaker
- **CONTROL CONSOLE OPTIONS**
  - ❍ Digital Controller H100 (Bulletin 0172110SBY)
- **ADDITIONAL OPTIONAL EQUIPMENT**
  - ❍ Automatic Transfer Switch
  - ❍ Remote Relay Panels
  - ❍ Unit Vibration Isolators
  - ❍ Oil Make-Up System
  - ❍ Oil Heater
  - ❍ 5 Year Warranties
  - ❍ Export Boxing
  - ❍ GenLink® Communications Software
- **OPTIONAL ENCLOSURE**
  - ❍ Weather Protective
  - ❍ Sound Attenuated
  - ❍ Aluminum and Stainless Steel
  - ❍ Enclosed Muffler

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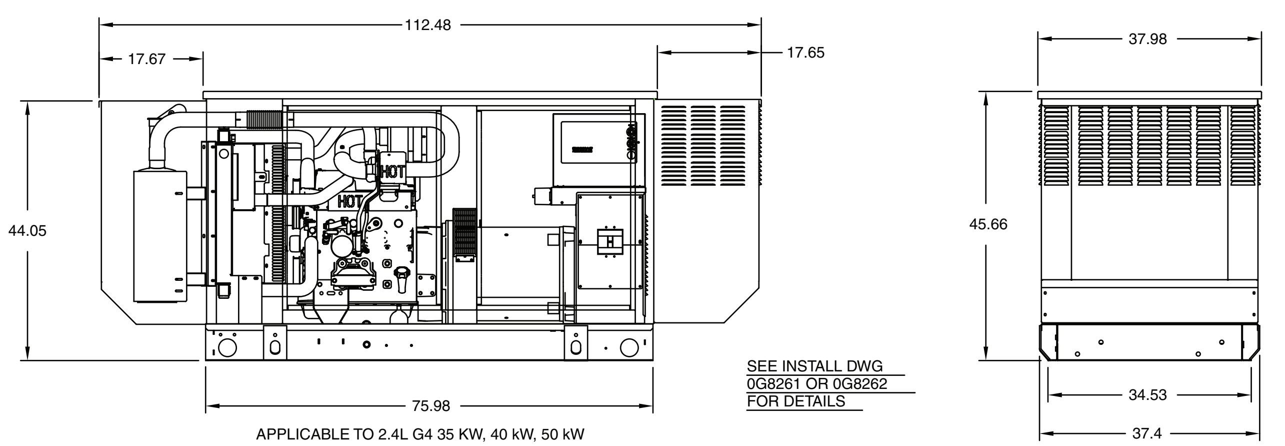
Design and specifications subject to change without notice. Dimensions shown are approximate. Contact your Generac dealer for certified drawings. DO NOT USE THESE DIMENSIONS FOR INSTALLATION PURPOSES.



APPLICABLE TO 2.4L G4 35 KW, 40 kW, 50 kW

LEFT SIDE VIEW, SOUND ATTENUATED ENCLOSURE.

REAR VIEW

mm [in]

WEIGHT: 2900 lbs.

GENERAC® POWER SYSTEMS, INC. • P.O. BOX 8 • WAUKESHA, WI 53187

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