APPENDIX D

Noise and Vibration Calculations

Noise and Vibration Calculations

Noise Formulas

Noise Distance Attenuation

Hard Site

Ni = No - 20 * LOG(Di/Do)

Ni = attenuated noise level of interest
No = reference noise level
Di = distance to receptor (Di>Do)
Do = reference distance

Source: (Bolt, Beranek, and Newman, 1971)

Summation of Noise Levels

Equation: Ns=10 x LOG10((10^(N1/10))+(10^(N2/10))+(10^(N3/10))+(10^(N4/10)))

Ns = Noise Level Sum
N1 = Noise Level 1
N2 = Noise Level 2
N3 = Noise Level 3
N4 = Noise Level 4
=10*LOG(SUM(10^(UserRange/10)))
Source: California Department of Transportation, Technical Noise Supplement, 2013

Construction Equipment Noise Levels	
Construction Equipment	**Noise Level at 50 feet (dBA, leq)**
Backhoe	73.6
Compressor (air)	73.7
Crane	72.6
Dozer	77.7
Flat Bed Truck	70.3
Gradall	79.4
Grader	81.0
Front End Loader	75.1
Impact Pile Driver	94.3
Roller	73.0
Drill Rig Truck	72.1
SOURCE: Federal Highway Administration, *Roadway Construction Noise Model* , Version 1.1, 2008.	

Phased Construction Noise Levels	
Construction Equipment	**Noise Level at 50 feet (dBA, Leq)**
Gravel Access Road Installation	
Dozer	77.7
Roller	73.0
Front End Loader	75.1
Backhoe	73.6
Combined Noise Level	**81.3**
Site Preparation	
Dozer	77.7
Grader	81.0
Roller	73.0
backhoe	73.6
Front End Loader	75.1
Combined Noise Level	**84.1**
Pile Driving/Module Mounting	
Crane	72.6
Impact Pile Driver	94.3
Gradall	79.4
Flat Bed Truck	70.3
Backhoe	73.6
Combined Noise Level	**94.5**
Electrical Wiring	
Compressor (air)	73.7
Crane	72.6
Backhoe	73.6
Gradall	79.4
Combined Noise Level	**81.8**
Conduit Line Installation	
Drill Rig Truck	72.1
Gradall	79.4
Combined Noise Level	**80.1**
SOURCE: Federal Highway Administration, *Roadway Construction Noise Model* , Version 1.1, 2008.	

Phased Construction Noise Levels	
Construction Phase	**Combined Noise Level at 50 feet (dBA, Leq)**
Gravel Road Construction	81.3
Site Preparation	84.1
Pile Driving/Module Mounting	94.5
Electrical Wiring	81.8
Conduit Line Installation	80.1

EXISTING AMBIENT NOISE LEVELS AT MONITORING LOCATIONS		
Noise Monitoring Site	**Noise Monitoring Location**	**Noise Level (dBA, Leq)**
1	CSUB Student Housing East	50.7
2	Residences (8200 Kroll Wy)	61.8
3	Residences (8225 Birmingham St)	51.6
4	Residences (8221 Newcastle St)	49.9
SOURCE: TAHA, 2026.		

CONSTRUCTION NOISE LEVELS AT SENSITIVE RECEPTORS - TYPICAL CONSTRUCTION						
Sensitive Receptors	**Distance (feet) from Center of Site**	**Intervening Building /a/**	**Reference Noise Level (dBA, Leq (8-hour))**	**Construction Noise at Receptor from Center of Site (dBA, Leq (8-hour))**	**Existing Ambient (dBA, Leq)**	**Exceed 80 dBA, Leq (8-hour) Threshold?**
CSU Student Housing East located north of Kroll Wy.	300	0	84.1	68.5	50.7	No
Residences located east of the project site	400	0	84.1	66.0	61.8	No
Residences located east of the project site and north of Kroll Wy.	460	0	84.1	64.8	51.6	No
The Vineyard Park	750	4.5	84.1	56.1	51.6	No

/a/ -4.5 dB for on intervening row of buildings and -1.5 dB for each subsequent row.
SOURCE: TAHA, 2026.

CONSTRUCTION NOISE LEVELS AT SENSITIVE RECEPTORS - PILE DRIVING						
Sensitive Receptors	**Distance (feet) from Center of Site**	**Intervening Building /a/**	**Reference Noise Level (dBA, Leq (8-hour))**	**Construction Noise at Receptor from Center of Site (dBA, Leq (8-hour))**	**Existing Ambient (dBA, Leq)**	**Exceed 80 dBA, Leq (8-hour) Threshold?**
CSU Student Housing East located north of Kroll Wy.	300	0	94.5	78.9	50.7	No
Residences located east of the project site	400	0	94.5	76.4	61.8	No
Residences located east of the project site and north of Kroll Wy.	460	0	94.5	75.2	51.6	No
The Vineyard Park	750	4.5	94.5	66.5	51.6	No

/a/ -4.5 dB for on intervening row of buildings and -1.5 dB for each subsequent row.
SOURCE: TAHA, 2026.

CONSTRUCTION NOISE LEVELS AT SENSITIVE RECEPTORS - CONDUIT LINE INSTALLATION						
Sensitive Receptors	**Distance (feet) from Center of Site**	**Intervening Building /a/**	**Reference Noise Level (dBA, Leq (8-hour))**	**Construction Noise at Receptor from Center of Site (dBA, Leq (8-hour))**	**Existing Ambient (dBA, Leq)**	**Exceed 80 dBA, Leq (8-hour) Threshold?**
CSU Student Housing East located north of Kroll Wy.	200	0	80.1	68.1	50.7	No
Residences located east of the project site	420	0	80.1	61.6	61.8	No
Residences located east of the project site and north of Kroll Wy.	390	0	80.1	62.3	51.6	No
The Vineyard Park	1,400	0	80.1	51.2	51.6	No

/a/ -4.5 dB for on intervening row of buildings and -1.5 dB for each subsequent row.
SOURCE: TAHA, 2026.

OPERATIONAL NOISE LEVELS AT SENSITIVE RECEPTORS						
Sensitive Receptors	**Distance (feet)**	**Intervening Building /a/**	**BESS Reference Noise Level (dBA, CNEL)**	**BESS Noise Level at Sensitive Receptors**	**Existing Ambient (dBA, CNEL)**	**Incremental**
CSU Student Housing East located north of Kroll Wy.	830	0	82	33.2	53	None
Residences located east of the project site	400	0	82	39.5	53	None
Residences located east of the project site and north of Kroll Wy.	800	0	82	33.5	53	None

/a/ -4.5 dB for on intervening row of buildings and -1.5 dB for each subsequent row.
SOURCE: TAHA, 2026.

Vibration Formulas

Vibration PPV Attenuation

Equation: PPVequip = PPVref x (25/D)^1.5
PPV (equip) is the peak particle velocity in in/sec of the equipment adjusted for distance
PPV (ref) is the reference vibration level in in/sec at 25 feet from Table 12-2
D is the distance from the equipment to the receiver.

Source: Federal Transit Administration, Transit Noise and Vibration Impact Assessment, September 2018.

Vibration Velocities for Construction Equipment

Equipment	PPV at 25 Feet ((In/Sec)	PPV at 100 Feet (In/Sec)	PPV at 200 Feet (In/Sec)	PPV at 300 Feet (In/Sec)
Impact Pile Driver (upper)	1.518	0.190	0.067	0.037
Impact Pile Driver (typical)	0.644	0.081	0.028	0.015
Drilling	0.089	0.011	0.004	0.002
Large Bulldozer	0.089	0.011	0.004	0.002
Loaded Truck	0.076	0.010	0.003	0.002
Excavator	0.040	0.005	0.002	0.001
Small Bulldozxer	0.003	0.000	0.000	0.000

Source: FTA, Transit Noise and Vibration Impact Assessment, September 2018.

Traffic Noise and Haul Truck Noise Modeling

REPORT:	**INPUT TRAFFIC FOR TNM VEHICLES (LAeq)**		
TNM VERSION:	3.2.8741.34338	REPORT DATE:	21 April 2026
CALCULATED WITH:	TNM v3.2.8741.34338	CALCULATION DATE:	4/21/2026 2:46:22 PM
CASE:	CSU Bakersfield Ground Mount Solar and Battery Project Stockdale Hwy Existing	ORGANIZATION:	
ANALYSIS BY:	kbartholow	PROJECT/CONTRACT:	

Roadway Name	Road Segment Start Point		Auto		Medium Truck		Heavy Truck		Bus		Motorcycle	
	Name	No.	Volume [Veh/hr]	Speed [mph]	Volume [Veh/hr]	Speed [mph]	Volume [Veh/hr]	Speed [mph]	Volume [Veh/hr]	Speed [mph]	Volume [Veh/hr]	Speed [mph]
Stockdale Hwy EB	Point-0	22	624	50	13	50	6	50	0	0	0	0
	Point-1	23	624	50	13	50	6	50	0	0	0	0
	Point-3	24	624	50	13	50	6	50	0	0	0	0
Stockdale Hwy WB	Point-4	25	624	50	13	50	6	50	0	0	0	0
	Point-5	26	624	50	13	50	6	50	0	0	0	0
	Point-7	27	624	50	13	50	6	50	0	0	0	0

REPORT:	**Results: Sound Levels - No Barrier Objects**		
TNM VERSION	3.2.8741.34338	REPORT DATE:	21 April 2026
CALCULATED WITH:	TNM v3.2.8741.34338	CALCULATION DATE:	4/21/2026 2:46:22 PM
CASE:	CSU Bakersfield Ground Mount Solar and Battery Project Stockdale Hwy Existing	ORGANIZATION:	
UNITS:	English	ANALYSIS BY:	kbartholow
DEFAULT GROUND TYPE:	Pavement	PROJECT/CONTRACT	
ATMOSPHERICS:	68°F, 50%	Average pavement type shall be used unless a state highway agency substantiates the use of a different type with approval FHWA.	
PAVEMENT TYPE(S) USED:	Average		

Receiver				Modeled Traffic Noise Levels				
				LAeq		Increase over Existing		
Name	No.	Nb. R.R.	Existing LAeq	Calc.	Absolute Criterion	Calc.	Relative Criterion	Type of Impact
			dBA	dBA	dBA	dBA	dBA	
Residences South of Stockdale Hwy	4	1	---	68.4	0.0	---	---	Sound Level

REPORT:	**INPUT TRAFFIC FOR TNM VEHICLES (LAeq)**		
TNM VERSION:	3.2.8741.34338	REPORT DATE:	28 May 2026
CALCULATED WITH:	TNM v3.2.8741.34338	CALCULATION DATE:	5/28/2026 5:41:02 PM
CASE:	CSU Bakersfield Ground Mount Solar and Battery Project_HaulTrucks	ORGANIZATION:	
ANALYSIS BY:	kbartholow	PROJECT/CONTRACT:	

Roadway Name	Road Segment Start Point		Auto		Medium Truck		Heavy Truck		Bus		Motorcycle	
	Name	No.	Volume [Veh/hr]	Speed [mph]	Volume [Veh/hr]	Speed [mph]	Volume [Veh/hr]	Speed [mph]	Volume [Veh/hr]	Speed [mph]	Volume [Veh/hr]	Speed [mph]
Kroll Wy EB	Point-19	0	0	0	0	0	2	15	0	0	0	0
	Point-1	1	0	0	0	0	2	15	0	0	0	0
Stockdale Hwy EB	Point-0	22	0	0	0	0	2	50	0	0	0	0
	Point-1	23	0	0	0	0	2	25	0	0	0	0
	Point-3	24	0	0	0	0	2	25	0	0	0	0
Stockdale Hwy WB	Point-4	25	0	0	0	0	2	25	0	0	0	0
	Point-5	26	0	0	0	0	2	50	0	0	0	0
	Point-7	27	0	0	0	0	2	50	0	0	0	0
Kroll Wy WB	Point-0	2	0	0	0	0	2	15	0	0	0	0
	Point-17	3	0	0	0	0	2	15	0	0	0	0

REPORT:	**Results: Sound Levels - No Barrier Objects**		
TNM VERSION	3.2.8741.34338	REPORT DATE:	28 May 2026
CALCULATED WITH:	TNM v3.2.8741.34338	CALCULATION DATE:	5/28/2026 5:41:02 PM
CASE:	CSU Bakersfield Ground Mount Solar and Battery Project_HaulTrucks	ORGANIZATION:	
UNITS:	English	ANALYSIS BY:	kbartholow
DEFAULT GROUND TYPE:	Pavement	PROJECT/CONTRACT	
ATMOSPHERICS:	68°F, 50%	Average pavement type shall be used unless a state highway agency substantiates the use of a different type with approval FHWA.	
PAVEMENT TYPE(S) USED:	Average		

Receiver				Modeled Traffic Noise Levels				
				LAeq		Increase over Existing		
Name	No.	Nb. R.R.	Existing LAeq	Calc.	Absolute Criterion	Calc.	Relative Criterion	Type of Impact
			dBA	dBA	dBA	dBA	dBA	
Residences North of Kroll Wy	2	1	61.8	39.8	0.0	-22.0	10.0	Sound Level
Residences South of Stockdale Hwy	4	1	68.4	52.1	0.0	-16.3	10.0	Sound Level
CSUB Student Housing East	5	1	50.7	45.8	0.0	-4.9	10.0	Sound Level
Residences South of Kroll Wy	4	1	61.8	39.5	0.0	-22.3	10.0	Sound Level

Noise Monitoring Data

Site 1: CSU Student Housing East

Session Report

2/19/2026

Information Panel

Name	CSUB Solar Farm_ST-1
Start Time	2/12/2026 1:27:08 PM
Stop Time	2/12/2026 1:42:08 PM
Device Name	BGS100001
Model Type	SoundPro DL
Device Firmware Rev	R.13J
Comments	

Summary Data Panel

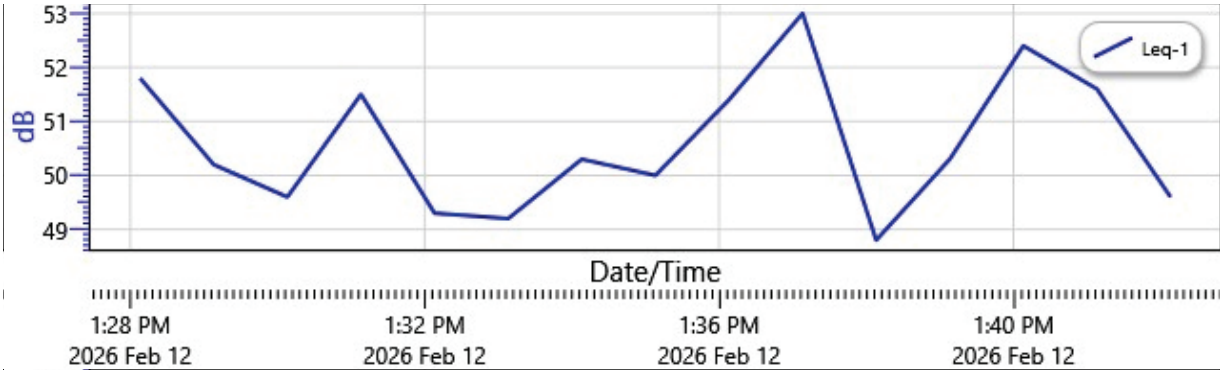
Description	Meter	Value	Description	Meter	Value
Leq	1	50.7 dB			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	SLOW	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	A
Response	2	SLOW			

Logged Data Table

Date/Time	Leq-1
2/12/2026 1:28:08 PM	51.8
1:29:08 PM	50.2
1:30:08 PM	49.6
1:31:08 PM	51.5
1:32:08 PM	49.3
1:33:08 PM	49.2
1:34:08 PM	50.3
1:35:08 PM	50
1:36:08 PM	51.4
1:37:08 PM	53
1:38:08 PM	48.8
1:39:08 PM	50.3
1:40:08 PM	52.4
1:41:08 PM	51.6
1:42:08 PM	49.6

Logged Data Chart

CSUB Solar Farm_ST-1: Logged Data Chart



Site 2: Residences (8200 Kroll Way)

Session Report

2/19/2026

Information Panel

Name	CSUB Solar Farm_ST-2
Start Time	2/12/2026 1:48:45 PM
Stop Time	2/12/2026 2:03:45 PM
Device Name	BGS100001
Model Type	SoundPro DL
Device Firmware Rev	R.13J
Comments	

Summary Data Panel

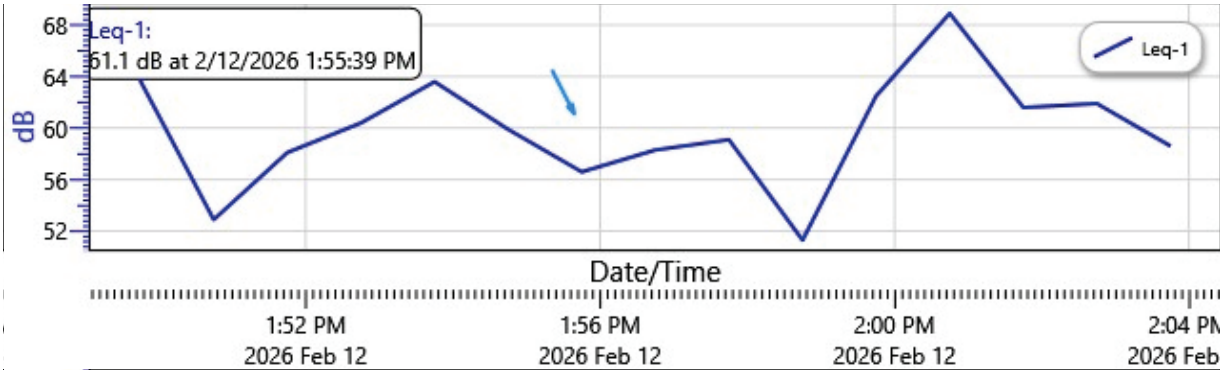
Description	Meter	Value	Description	Meter	Value
Leq	1	61.8 dB			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	SLOW	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	A
Response	2	SLOW			

Logged Data Table

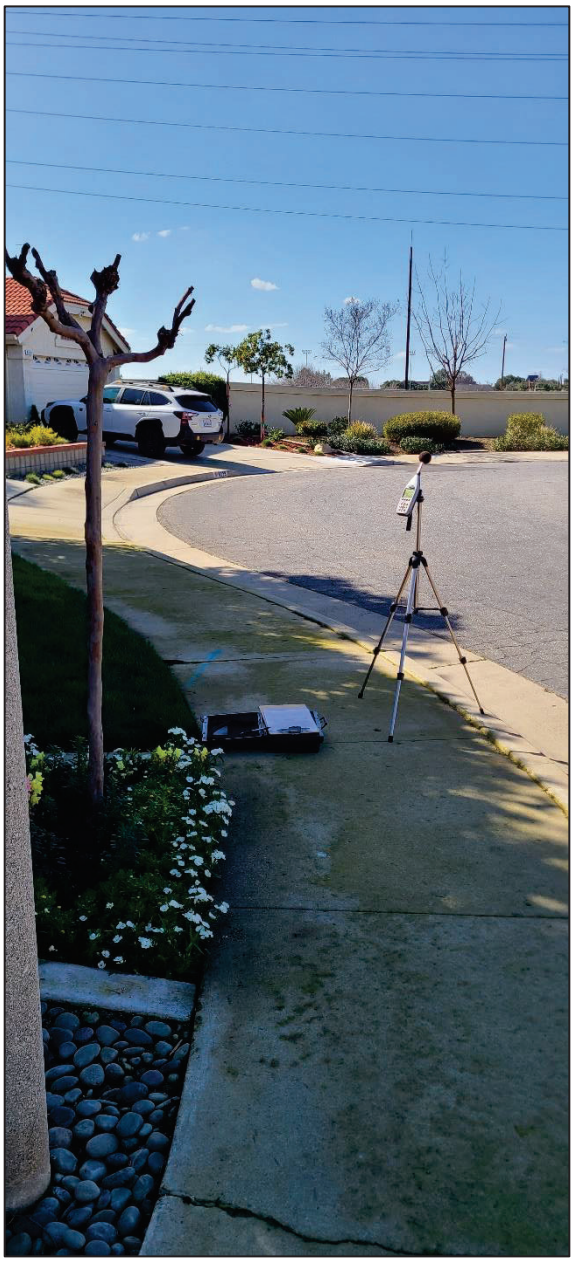
Date/Time	Leq-1
2/12/2026 1:49:45 PM	63.7
1:50:45 PM	52.9
1:51:45 PM	58.1
1:52:45 PM	60.4
1:53:45 PM	63.6
1:54:45 PM	59.9
1:55:45 PM	56.6
1:56:45 PM	58.3
1:57:45 PM	59.1
1:58:45 PM	51.3
1:59:45 PM	62.5
2:00:45 PM	68.9
2:01:45 PM	61.6
2:02:45 PM	61.9
2:03:45 PM	58.6

Logged Data Chart

CSUB Solar Farm_ST-2: Logged Data Chart



Site 3: Residences (8225 Birmingham Street)



Session Report

2/19/2026

Information Panel

Name	CSUB Solar Farm_ST_3
Start Time	2/12/2026 1:02:44 PM
Stop Time	2/12/2026 1:17:44 PM
Device Name	BGS100001
Model Type	SoundPro DL
Device Firmware Rev	R.13J
Comments	

Summary Data Panel

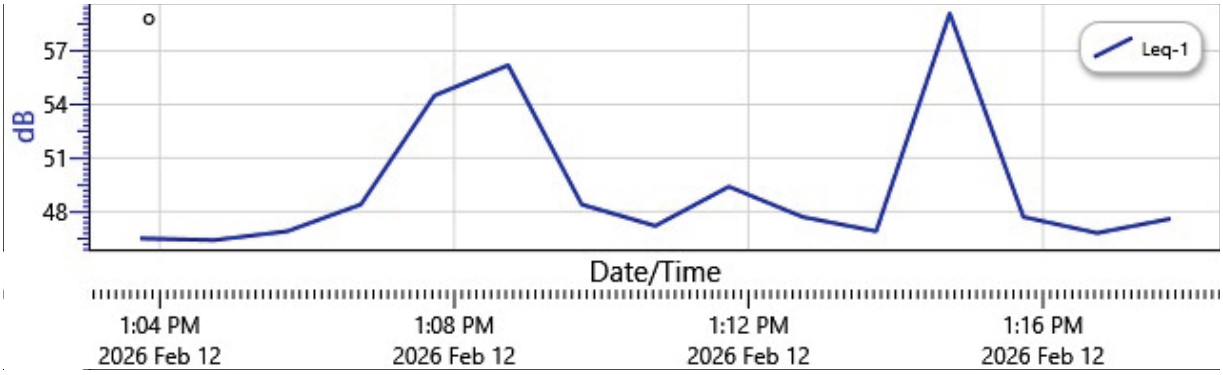
Description	Meter	Value	Description	Meter	Value
Leq	1	51.6 dB			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	SLOW	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	A
Response	2	SLOW			

Logged Data Table

Date/Time	Leq-1
2/12/2026 1:03:44 PM	46.5
1:04:44 PM	46.4
1:05:44 PM	46.9
1:06:44 PM	48.4
1:07:44 PM	54.5
1:08:44 PM	56.2
1:09:44 PM	48.4
1:10:44 PM	47.2
1:11:44 PM	49.4
1:12:44 PM	47.7
1:13:44 PM	46.9
1:14:44 PM	59.1
1:15:44 PM	47.7
1:16:44 PM	46.8
1:17:44 PM	47.6

Logged Data Chart

CSUB Solar Farm_ST_3: Logged Data Chart



Site 4: Residences (8221 Newcastle Street)

Session Report

2/19/2026

Information Panel

Name	CSUB Solar Farm_ST-4
Start Time	2/12/2026 12:40:23 PM
Stop Time	2/12/2026 12:55:23 PM
Device Name	BGS100001
Model Type	SoundPro DL
Device Firmware Rev	R.13J
Comments	

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	49.9 dB			
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	SLOW	Bandwidth	1	OFF
Exchange Rate	2	3 dB	Weighting	2	A
Response	2	SLOW			

Logged Data Table

Date/Time	Leq-1
2/12/2026 12:41:23 PM	47.5
12:42:23 PM	46
12:43:23 PM	46.3
12:44:23 PM	48.9
12:45:23 PM	48.4
12:46:23 PM	58
12:47:23 PM	47.5
12:48:23 PM	50.9
12:49:23 PM	46.5
12:50:23 PM	46.6
12:51:23 PM	46.1
12:52:23 PM	49.9
12:53:23 PM	48.1
12:54:23 PM	46.7
12:55:23 PM	46.2

Logged Data Chart

CSUB Solar Farm_ST-4: Logged Data Chart