



# **Urban Ecological Interaction:** Air, Water, Light and New Transit at the Human Scale of Barcelona's Superilles

ICAUDT 2016: 18<sup>th</sup> International Conference on Advanced Urban Designing and Transportation

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UNIVERSITY OF OREGON  
Urban Interactions Lab





**3rd**

densest city, behind Athens and Madrid

**5th**

Worst air pollution index in Europe, behind two Macedonia cities, Turino and Kiev

# The Problem

## Density and Automobile Congestion

*One of densest in Europe*

**16,000**

people / square kilometer (41,000/sq mi)

**36,000** Eixample

**50,000** Sagrada Familia



*Goal:  
healthy  
urban environment*



*Goal:*  
***inclusive design***

*children, seniors, different abilities  
and backgrounds*



***social interaction***  
***Festes de Gracia***

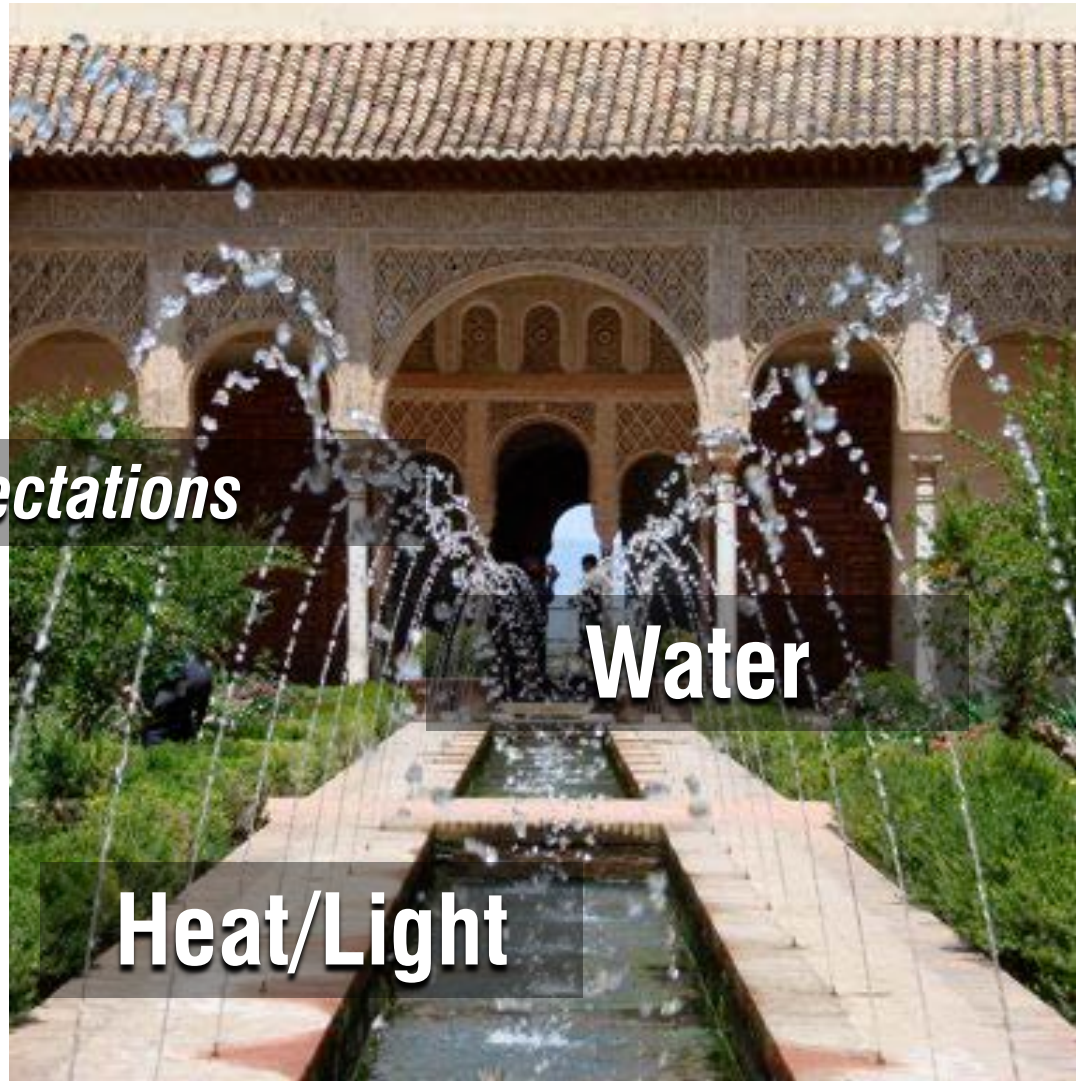
**Air**



*expectations*

**Water**

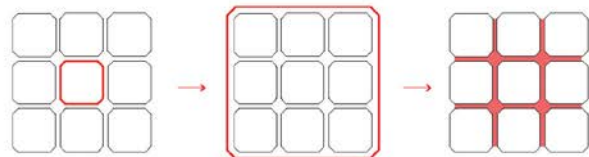
**Heat/Light**



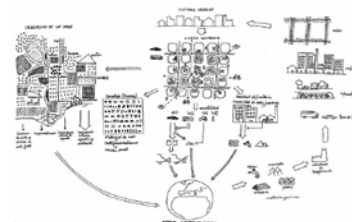
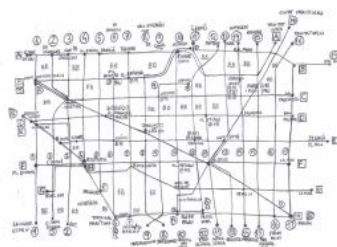


***Scales of social interaction***  
***Gracia***





*superilla*



**B**  
ECOLOGIA  
**N**



Ajuntament  
de Barcelona

# **BACKGROUND**

**Urban Ecology**

# Avaluació Situació Actual

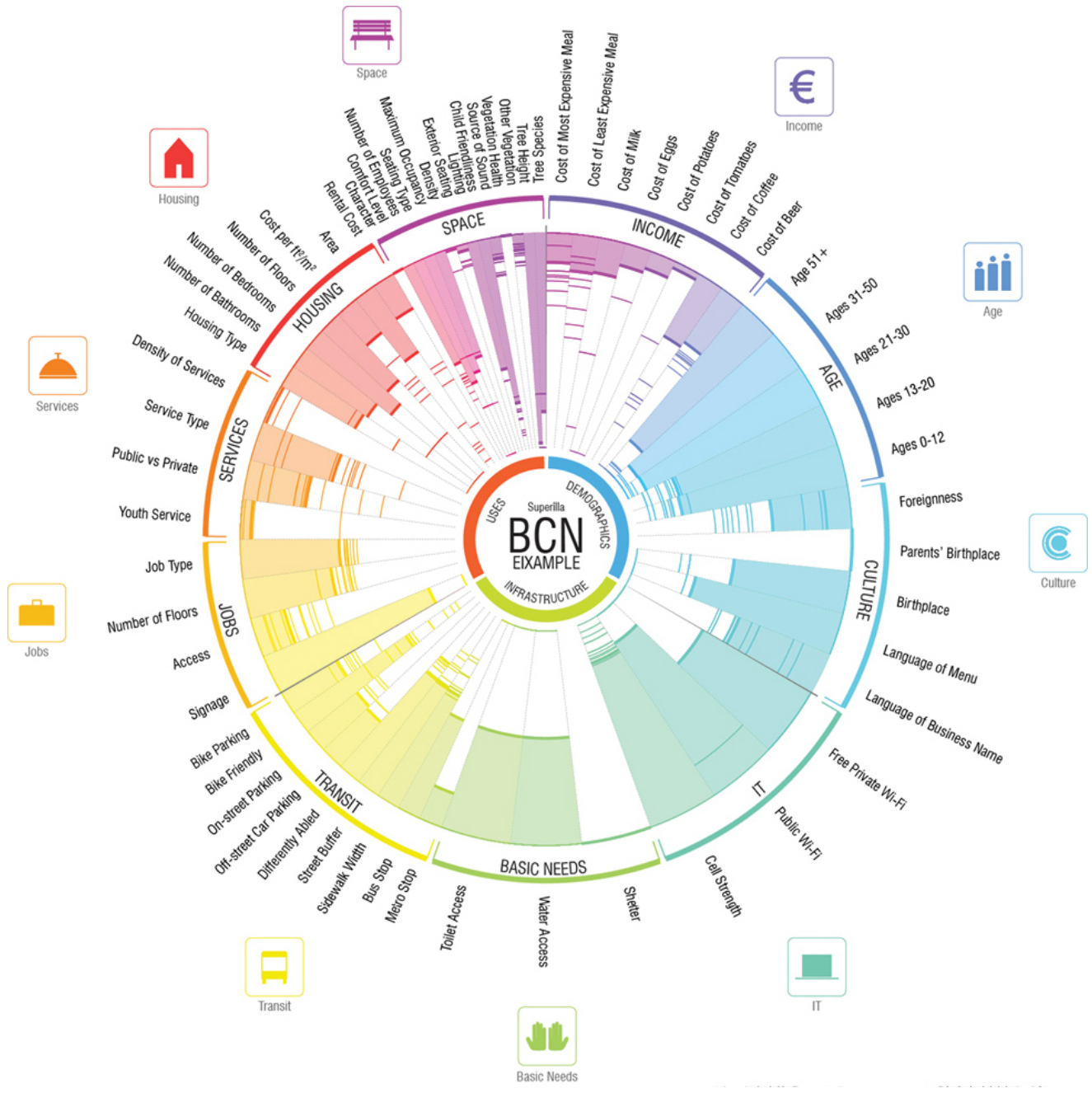
## Certificació del grau de sostenibilitat urbana

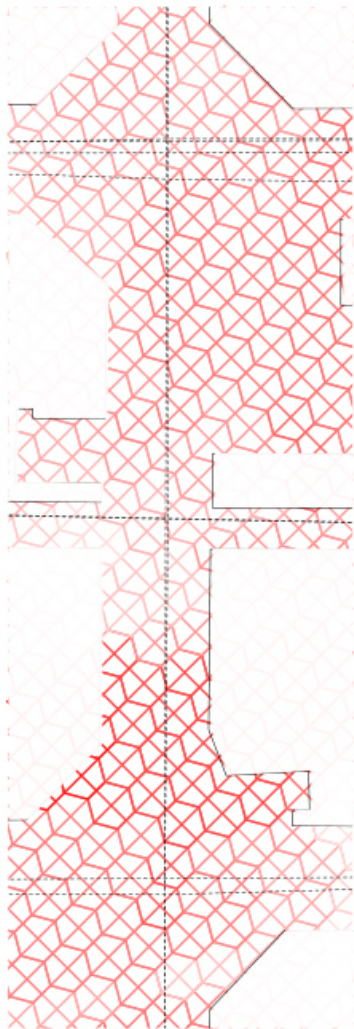
Superilla Pilot Barri de La Maternitat i Sant Ramon Districte de Les Corts.



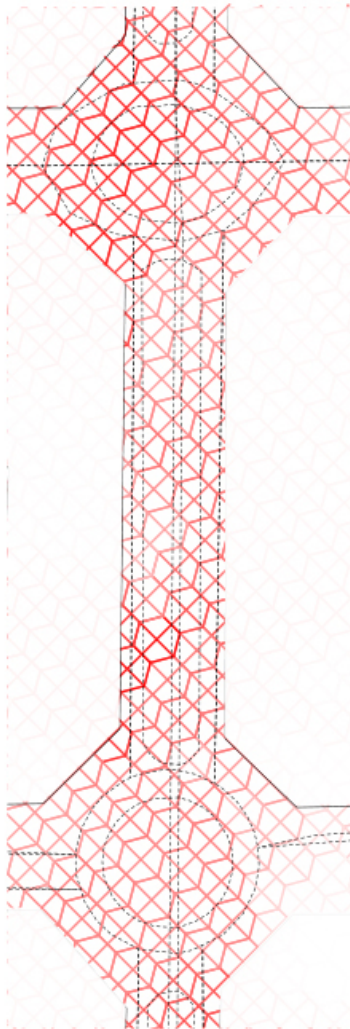
		OCUPACIÓ DEL SÒL		eix 1 1/3%		QUALIFICACIÓ FINAL  (suma % parcials eixos) <b>53%</b>
eix 1 COMPACITAT I FUNCIONALITAT		Puntuació assolida: 20 Puntuació màxima àmbit: 20 Resultat: <b>100%</b>	<b>A</b>	Resultat parcial: 21,8% Puntuació: 111 punts (sobre 170)		
		ESPAI PÚBLIC I HABITABILITAT	Puntuació assolida: 62,5 Puntuació màxima àmbit: 100 Resultat: <b>62,5%</b>			<b>C</b>
		MOBILITAT I SERVEIS	Puntuació assolida: 28,5 Puntuació màxima àmbit: 50 Resultat: <b>57%</b>			<b>C</b>
eix 2 COMPLEXITAT		COMPLEXITAT URBANA	Puntuació assolida: 15,5 Puntuació màxima àmbit: 40 Resultat: <b>38,8%</b>	<b>D</b>	eix 2 1/3%	
		ESPAIS VERDS I BIODIVERSITAT	Puntuació assolida: 20,7 Puntuació màxima àmbit: 40 Resultat: <b>51,8%</b>	<b>C</b>	Resultat parcial: 15,1% Puntuació: 36,2 punts (sobre 80)	
eix 3 EFICIÈNCIA		METABOLISME URBÀ	Puntuació assolida: 28,9 Puntuació màxima àmbit <sup>1</sup> : 60 Resultat: <b>48,2%</b>	<b>D</b>	eix 3 1/3%	<b>C</b> SUFICIENT

<sup>1</sup> Sobre el total dels indicadors amb informació

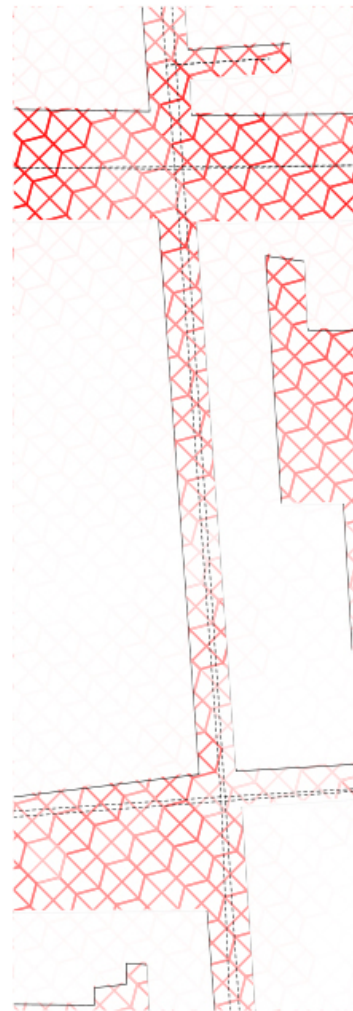




E1+E2



B2+C2



A2+B2

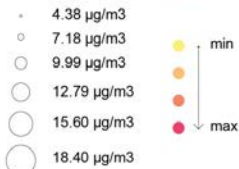
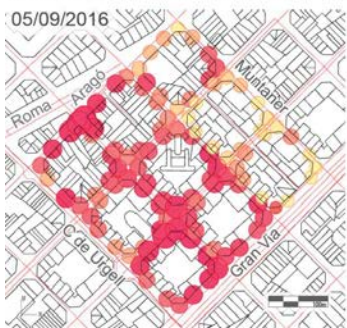
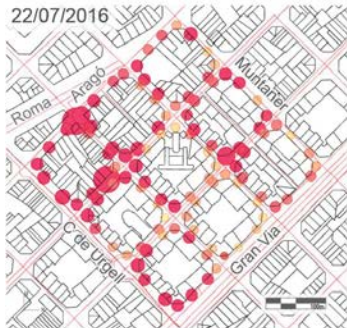
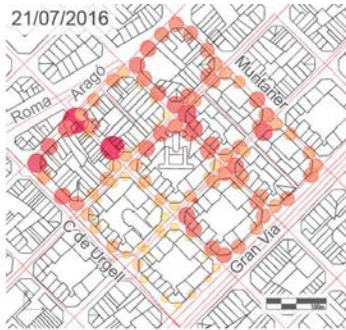
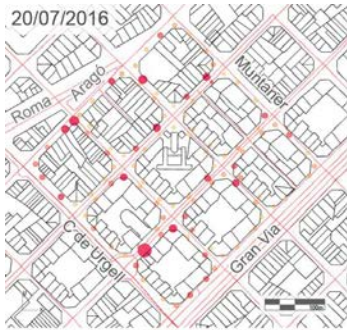




***PM Air Pollution***  
***Urban Design & Computing Lab***

Carrer del Comte d'Urgell

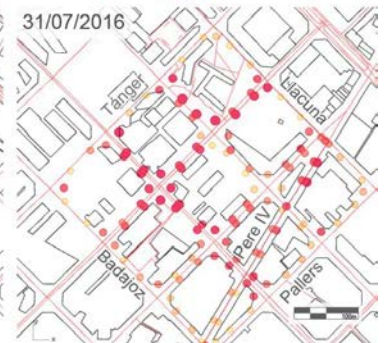
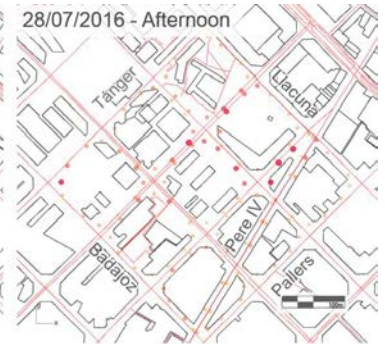
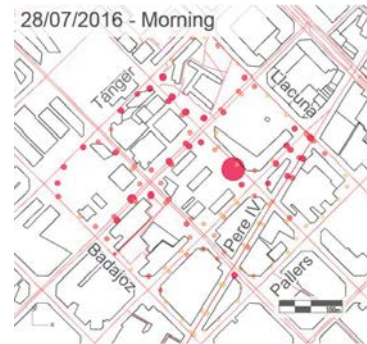
Gran Via de les Corts Catalanes



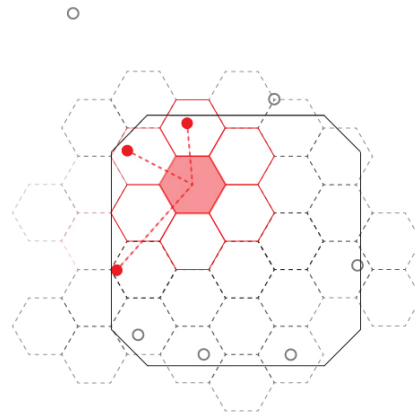
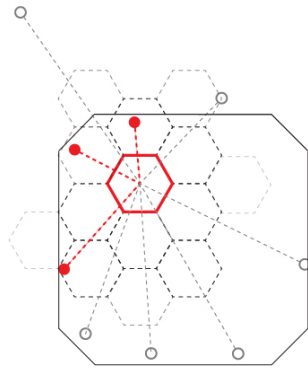
**Legend**  
Calculated PM2.5Dylos

# CSIC Air Pollution Research

## Xavier Querol and MariCruz Guillon

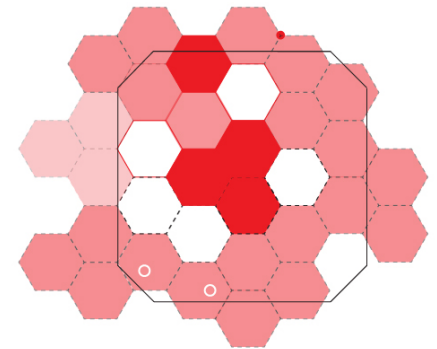


**Legend**  
Calculated PM2.5Dylos



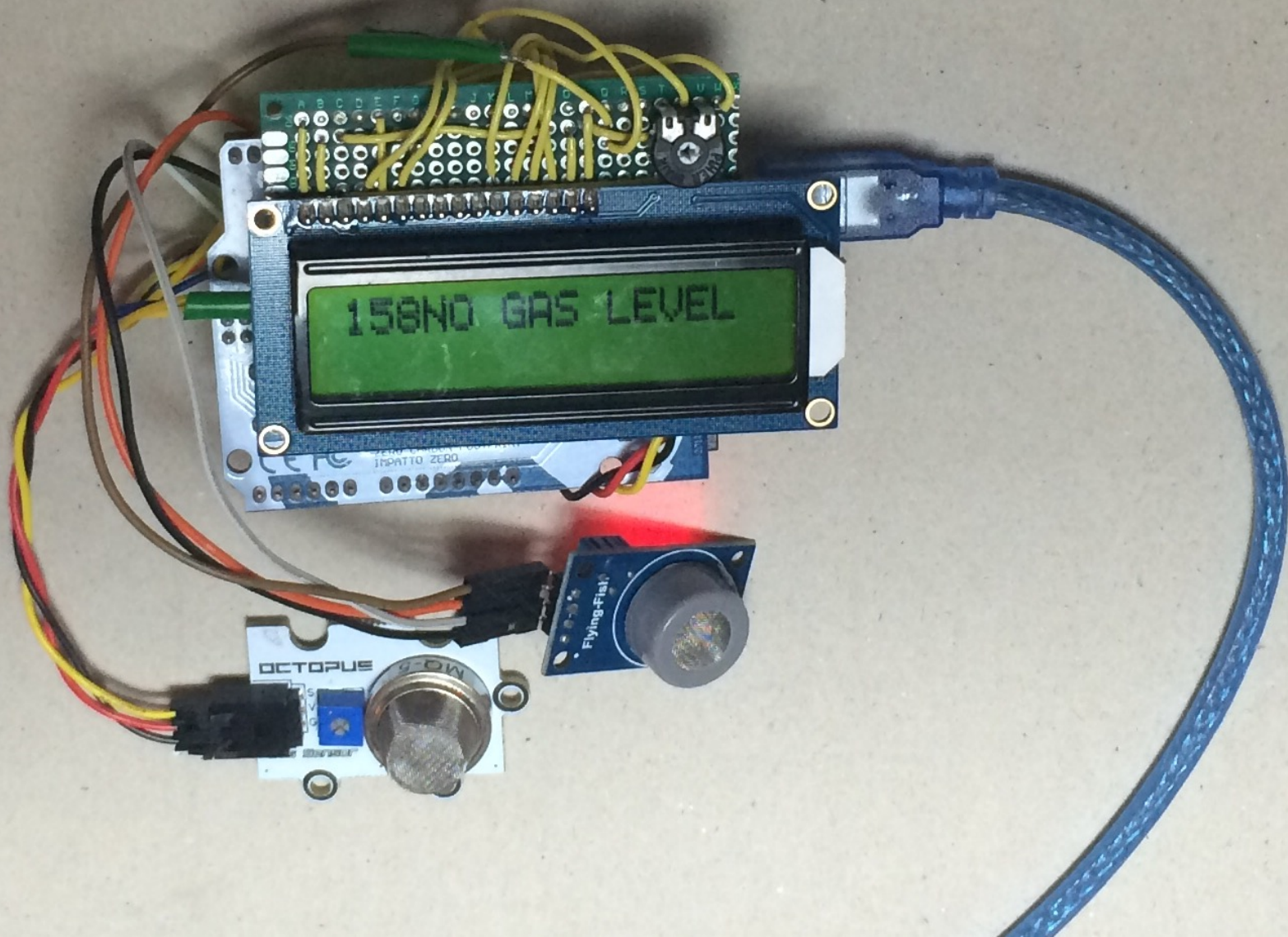
$$\frac{[0.50] + [0.25] + [0.40]}{3.0} = 0.38$$

0.38





# METHODOLOGY



A person wearing a dark green jacket is shown from the chest down, holding a smartphone in their right hand and a small, white, rectangular data collection device in their left hand. The device has a red button and some wires. The background is a busy city street with cars, a motorcycle, and buildings. The text "Data Collection" is overlaid in a white, italicized font on a dark grey rectangular background.

***Data Collection***



Diagonal

Carrer de Badajoz

Carrer de Ilacuna

Poblenou  
Comparison Area

*study areas*

Eixample Esquerra  
Primary Study Area

Carrer de Aragó

Muntaner

Gran Via de les Corts Catalanes

Carrer de Urbell

200 m

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File Edit View Insert Format Data Tools Add-ons Help Last edit was made on August 2 by Sam Clagett

philipjsperanza@

Comments

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1											Temperature	Humidity				
2	CATEGORY			Water	Water	Water	Water	Water	Water	Water	Water	Water	Light & Heat	Light & Heat	Light & Heat	Light & Heat
3	SUBCATEGORY															
4	Quality			Occupancy	Occupancy	Occupancy	Soil Type			Slope			Reflectivity	Shading	Shading	Reflectivity
5	Indicator			Building Area	Floors	Building Type							Surface Temp	Sun / Shade	Canopy Density	Facade Material
6	Phenomena vs Fixed			Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Phenomena	Phenomena	Phenomena	Phenomena	Fixed	Fixed
7	On-site vs Off-site			Off-site	Off-site	Off-site	Off-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site
8	Public vs Private			Private	Private	Private	Public	Public	Public	Public	Public	Public	Public	Public	Public	Public
9	Student Name			Chaz	Chaz	Chaz	Joel MN	Joel MN	Joel MN	Joel MN	Chaz	Chaz	Craig	Craig	Andrew	Andrew
10	Data Dictionary	Long	Lat	Building Area	Floors	Residential, Hotel	1. Paleozoic slat	X axis, N-S	Y axis, E-W	Degree	Celsius	Percentage	Fahrenheit	1 = shade, 2 = f	1 = nothing or w	11 = trees 10 =
11	Point 1	2.1577165	41.38442	154	5	Res	3	11.1	0.6	1.3	28	58	82	1	2	9
12	Point 2	2.1580249	41.3841967	300	5	Res	3	0.1	2.7	0.1	28	56	82	1	4	8
13	Point 3	2.1582288	41.3839451	880	6	Res	3	3.1	0.7	3.3	28	54	80	1	3	9
14	Point 4	2.1584541	41.3837539	152	5	Res	3	4	3.3	5.2	28	54	89	2	4	8
15	Point 5	2.1588108	41.3835748	984	5	Office	3	2.7	0.1	2.7	28	53	83	2	2	5
16	Point 6	2.159138	41.3833394	260	2	Daycare	3	3	3.4	4.4	29	52	81	1	3	8
17	Point 7	2.1593794	41.3830818	480	6	Res	3	3.5	2.8	4.4	29	52	80	1	3	9
18	Point 8	2.1595457	41.383281	340	5	Res	3	4.5	2	4.9	29	51	90	3	4	9
19	Point 9	2.159256	41.383436	468	5	Res	3	3.7	3.9	5.2	30	52	79	1	3	9
20	Point 10	2.15891	41.3836775	986	5	Res	3	3.8	3.5	4.9	30	49	80	1	4	8
21	Point 11	2.1587223	41.3839532	841	5	Res	3	3.2	5.6	2.4	30	47	83	2	3	8
22	Point 12	2.158446	41.3841202	504	8	Res	3	2.9	2.6	3.6	30	47	97	3	2	10
23	Point 13	2.1581054	41.3842671	638	8	Res	3	2.7	2.9	3.9	31	46	88	2	1	9
24	Point 14	2.1578157	41.3844985	728	5	Res	3	2.6	3	3.6	30	46	81	1	3	8
25	Point 15	2.157577	41.3847843	625	5	Res	3	3.6	3	4.7	30	45	81	1	4	8
26	Point 16	2.1573249	41.3849775	650	7	Res	3	4.2	1.9	4.6	29	45	80	1	1	8
27	Point 17	2.1569493	41.3851566	414	7	Res	3	2.8	1.3	3.1	28	47	82	2	4	8
28	Point 18	2.156598	41.3854403	1104	7	Res	3	2.9	2.6	3.9	28	48	79	1	4	9
29	Point 19	2.1563137	41.3856376	325	7	Res	3	1	1.2	1.6	28	48	80	1	3	9
30	Point 20	2.1573678	41.3863137	672	7	Res	3	2.6	1	2.7	28	49	80	1	5	5
31	Point 21	2.1576843	41.3861487	384	7	Res	3	1.5	3	1.6	28	52	80	1	5	8
32	Point 22	2.1579766	41.3859354	759	7	Res	3	1.9	0.8	2	28	52	81	1	3	6
33	Point 23	2.1582261	41.3856657	136	7	Res	3	1.8	2.5	2	28	53	80	1	4	5
34	Point 24	2.1584728	41.3854645	492	7	Res	3	2.2	3.5	4.1	28	53	82	1	4	6
35	Point 25	2.158784	41.3853337	550	7	Res	3	2.6	2.8	3.7	29	52	91	3	1	5
36	Point 26	2.15913	41.3850801	1110	7	Res	3	3.2	3.5	4.7	30	51	81	2	4	9

	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
1											1		2	3	1	2
2	Light & Heat	Light & Heat	Light & Heat	Light & Heat	Light & Heat	Light & Heat	Light & Heat	Air	Air	Air	Air	Air	Air	Air	Air	Air
3															Sound	Sound
4	Reflectivity	Shading	Shading	Reflectivity	Width	Height	H/W Ratio								Noise Level	Noise Source
5	Surface Temp	Sun / Shade	Canopy Density	Facade Material	Fixed	Fixed	Fixed	PM 0.5	PM 2.5	Tree Species	wind speed (wind	wind direction (w	smell intensity	smell	DB	Water, Wind, Ve
6	Phenomena	Phenomena	Fixed	Fixed	Off-site	Off-site	Off-site	phenomena	phenomena	phenomena	phenomena	phenomena	phenomena	phenomena	phenomena	Fixed
7	On-Site	On-Site	On-Site	On-Site	Public	Public	Public	on site	on site	on site	on-site	on-site	on-site	on-site	On-site	On-Site
8	Public	Public	Public	Public	Paul	Paul	Paul	public	public	public	public	public	public	public	public	Public and Priv
9	Craig	Craig	Andrew	Andrew	Find nearest buil	height of nearest	height of nearest	building face	Derek	Derek	Betty Lou	Betty Lou	Betty Lou	Betty Lou	Anu	Anu
10	Fahrenheit	1 = shade, 2 = f	1 = nothing or w	11 = trees 10 =				[0.x]	[0.x]	Tree type : 1-Pla	[0.x]	[0,360]	[1.5]	type[construction	db levels	Sum of all the
11	82	1	2	9	27	22	0.81	1584	192	1	-1	-1	2	2	2	46
12	82	1	4	8	20	22	1.1	1340	126	1	-1	-1	2	3	3	50
13	80	1	3	9	19	20	1.05	1361	108	1	-1	-1	2	2	2	47
14	89	2	4	8	46	22	0.48	1396	154	1	-1	-1	3	6	4	44
15	83	2	2	5	45	16	0.36	1354	129	1	-1	-1	2	2	2	46
16	81	1	3	8	20	10	0.5	1407	98	1	-1	-1	2	2	2	44
17	80	1	3	9	16	28	1.75	1018	70	1	-1	-1	3	2	2	46
18	90	3	4	9	45	28	0.62	1307	101	1	-1	-1	1	8	4	46
19	79	1	3	9	45	22	0.49	1362	171	4	-1	-1	2	4	4	43
20	80	1	4	8	21	22	1.05	1309	119	4	-1	-1	3	2	2	42
21	83	2	3	8	104	20	0.19	1480	127	4	-1	-1	2	1	1	51
22	97	3	2	10	67	32	0.48	1305	151	1	2.6	-1	2	2	2	53
23	88	2	1	9	72	28	0.39	1029	101	5	-1	188	2	2	2	50
24	81	1	3	8	104	20	0.19	1193	94	1	-1	172	3	6	4	44
25	81	1	4	8	21	24	1.14	1130	77	1	-1	170	2	6	4	48
26	80	1	1	8	45	24	0.53	1211	112	4	-1	181	1	8	4	41
27	82	2	4	8	45	20	0.44	1277	154	1	-1	124	2	5	4	42
28	79	1	4	9	16	20	1.25	1393	150	4	-1	166	2	2	2	42
29	80	1	3	9	20	20	1	1095	84	1	4.3	187	1	8	4	45
30	80	1	5	5	46	24	0.52	1050	80	1	4.4	151	1	8	4	50
31	80	1	5	8	45	22	0.49	1018	98	1	3.6	181	1	8	4	44
32	81	1	3	6	19	19	1	1130	42	1	-1	164	1	8	4	46
33	80	1	4	5	20	20	1	1067	93	1	-1	170	2	2	2	49
34	82	1	4	6	25	22	0.88	1328	189	4	2.3	181	3	2	2	48
35	91	3	1	5	55	26	0.47	1296	105	5	5.1	179	3	2	2	54
36	81	2	4	9	27	26	0.96	1032	80	1	-1	147	2	7	4	40

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philippisperanza@

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Comments

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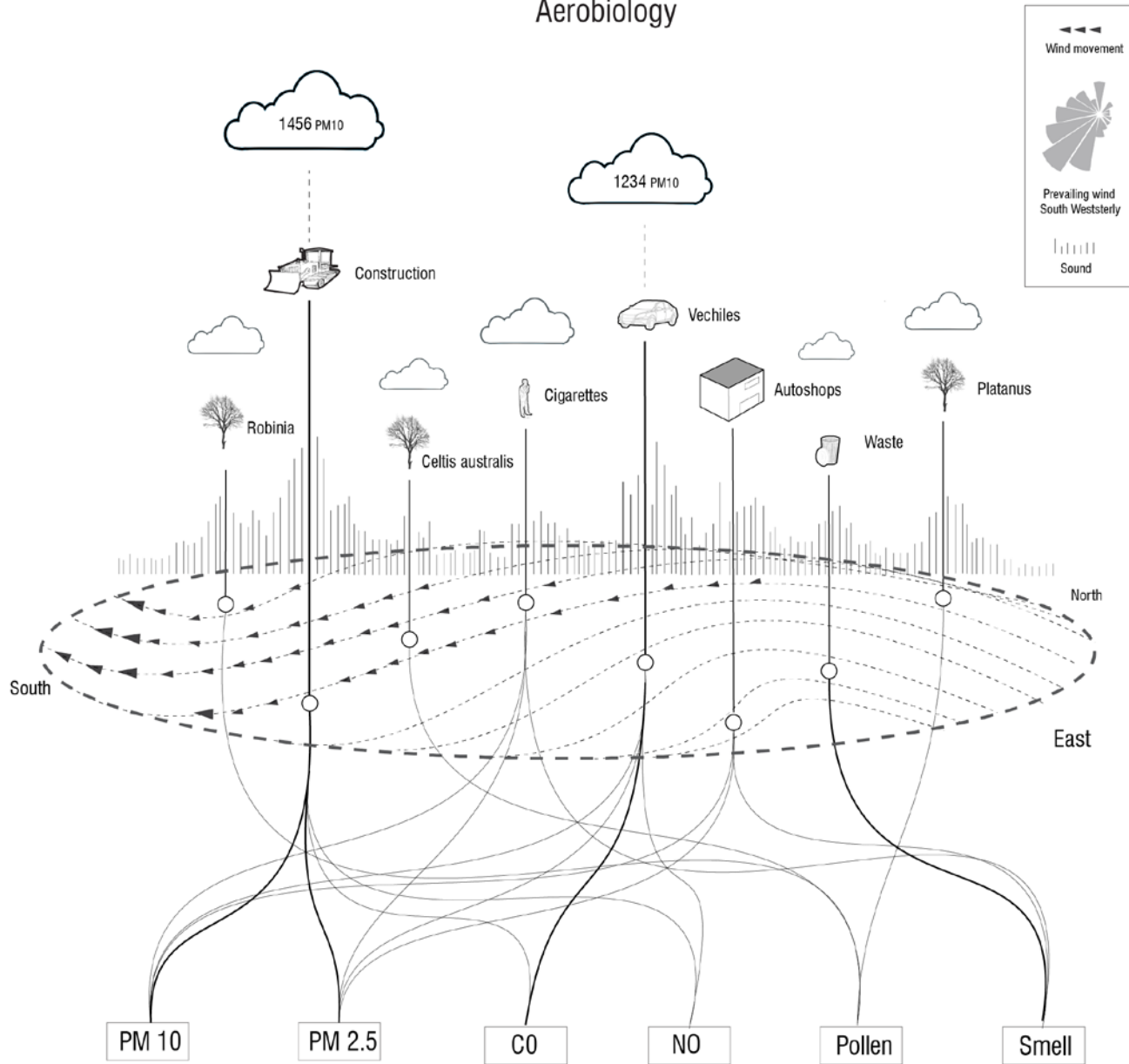
	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI
1				1		2	3	1	2	2a	2b	2c	2d	2e	1	2
2	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air
3								Sound	Sound						NO	CO
4								Noise Level	Noise Source						NO (arduino)	CO (arduino)
5	PM 0.5	PM 2.5	Tree Species	wind speed (wind	wind direction (wind	smell intensity	smell	DB	Water, Wind, Vegetation	Water	Wind	Vegetation	People+Animal	City	NO Levels	CO Levels
6	phenomena	phenomena	phenomena	phenomena	phenomena	phenomena	phenomena	phenomena	Fixed	phenomena	phenomena	phenomena	phenomena	phenomena	phenomena	phenomena
7	on site	on site	on site	on-site	on-site	on-site	on-site	On-site	On-Site	On-site	On-site	On-site	On-site	On-site	on-site	on-site
8	public	public	public	public	public	public	public	public	Public and Private	public	public	public	public	public	public	public
9	building face	Derek	Derek	Betty Lou	Betty Lou	Betty Lou	Betty Lou	Anu	Anu	Anu	Anu	Anu	Anu	Anu	Josh	Josh
10	[0,x]	[0,x]	Tree type : 1-Pla	[0,x]	[0,360]	[1,5]	type[construction	db levels	Sum of all the sc	0/1	0/1	0/1	0/1	0/1	[0,x]	[0,x]
11	1584	192	1	-1	-1	2	2	46	2					1	121	121
12	1340	126	1	-1	-1	2	3	50	2				1	1	118	121
13	1361	108	1	-1	-1	2	2	47	2				1	1	126	117
14	1396	154	1	-1	-1	3	6	44	2				1	1	117	100
15	1354	129	1	-1	-1	2	2	46	3		1		1	1	117	100
16	1407	98	1	-1	-1	2	2	44	2				1	1	112	94
17	1018	70	1	-1	-1	3	2	46	1					1	110	94
18	1307	101	1	-1	-1	1	8	46	1					1	113	100
19	1362	171	4	-1	-1	2	4	43	2				1	1	124	100
20	1309	119	4	-1	-1	3	2	42	2				1	1	118	94
21	1480	127	4	-1	-1	2	1	51	2				1	1	112	94
22	1305	151	1	2.6	-1	2	2	53	3		1		1	1	117	100
23	1029	101	5	-1	188	2	2	50	3		1		1	1	126	94
24	1193	94	1	-1	172	3	6	44	1					1	118	81
25	1130	77	1	-1	170	2	6	48	1					1	113	81
26	1211	112	4	-1	181	1	8	41	1					1	116	81
27	1277	154	1	-1	124	2	5	42	2				1	1	113	81
28	1393	150	4	-1	166	2	2	42	1					1	112	81
29	1095	84	1	4.3	187	1	8	45	1					1	114	81
30	1050	80	1	4.4	151	1	8	50	2				1	1	109	81
31	1018	98	1	3.6	181	1	8	44	2				1	1	111	81
32	1130	42	1	-1	164	1	8	46	1					1	108	81
33	1067	93	1	-1	170	2	2	49	2		1			1	113	81
34	1328	189	4	2.3	181	3	2	48	1					1	124	100
35	1296	105	5	5.1	179	3	2	54	3		1		1	1	132	121
36	1032	80	1	-1	147	2	7	40	1					1	131	100

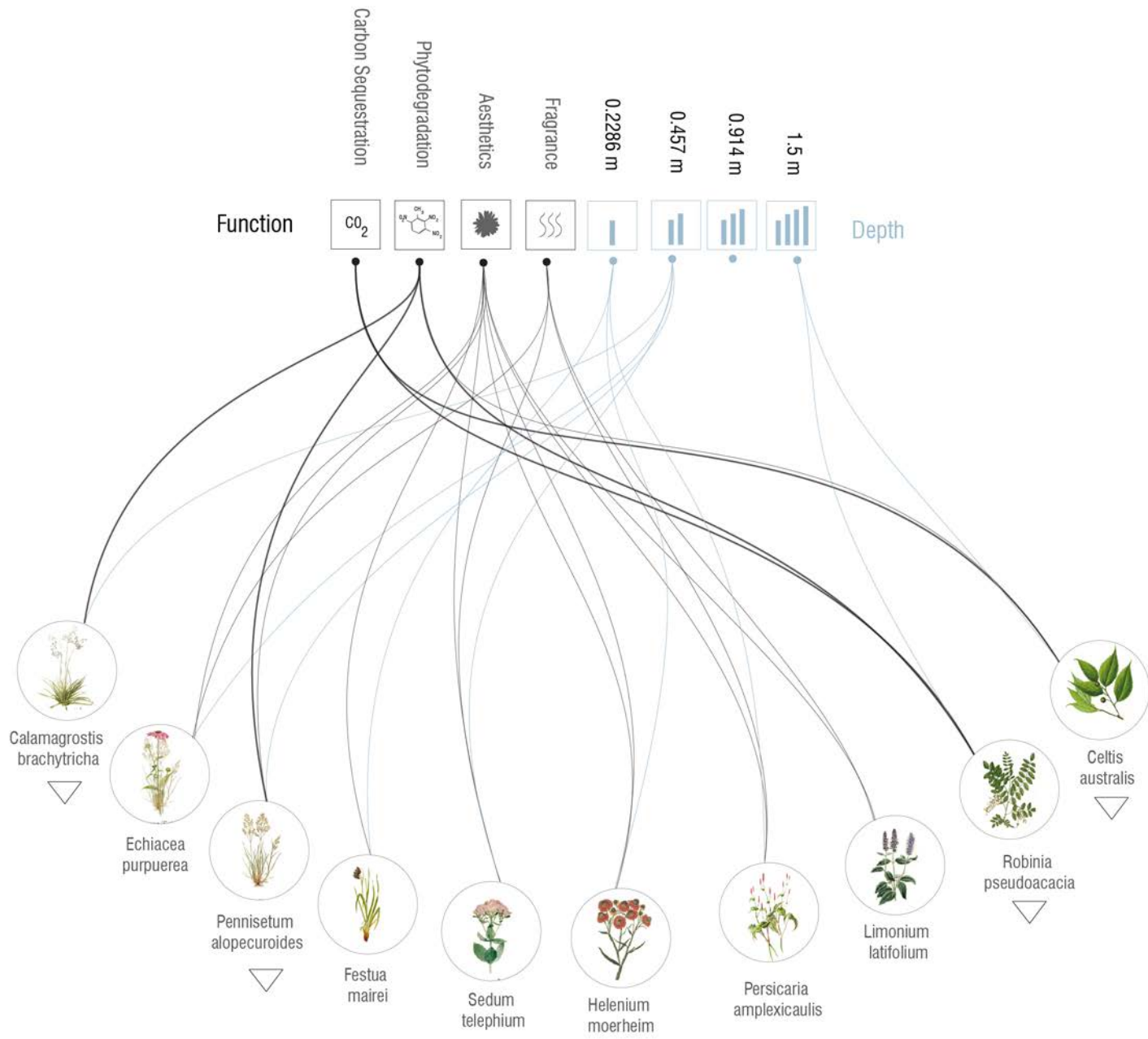




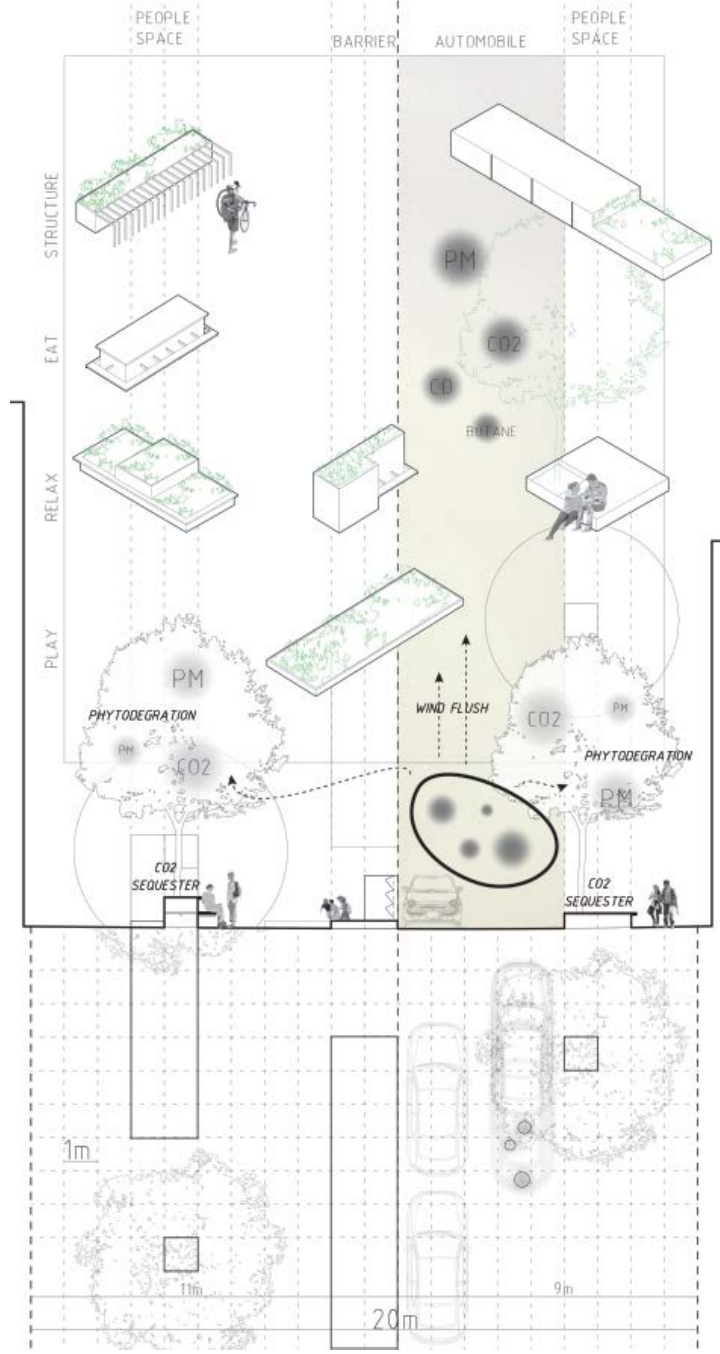
**AIR**

# Aerobiology



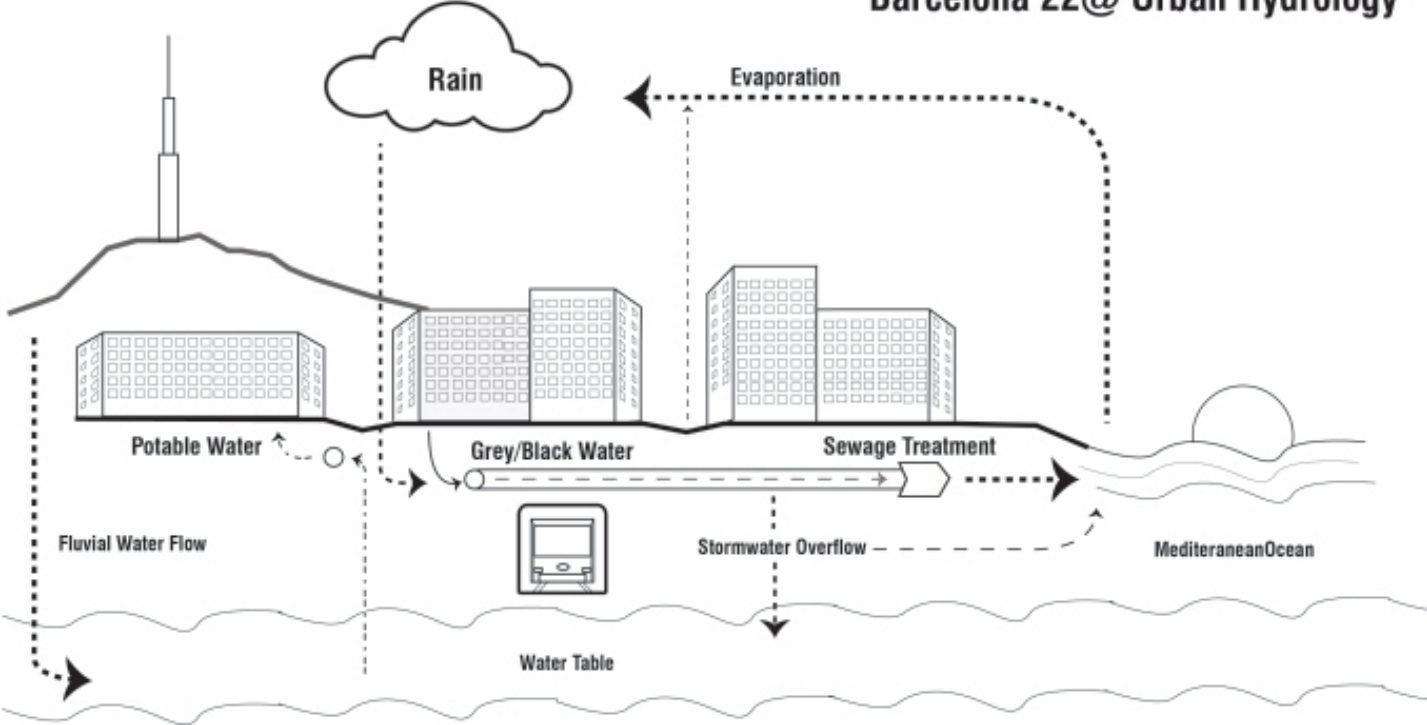


# A BREATH OF FRESH AIR

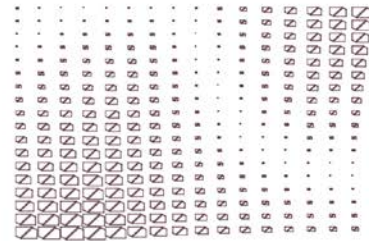
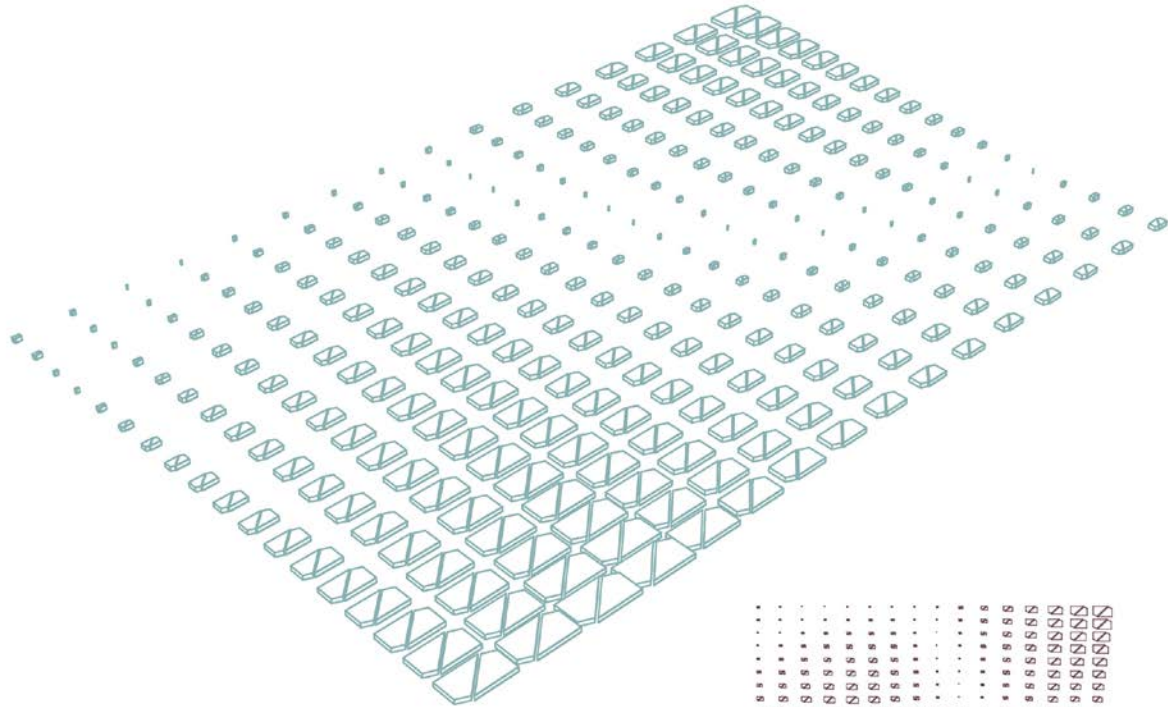


**WATER**

# Barcelona 22@ Urban Hydrology

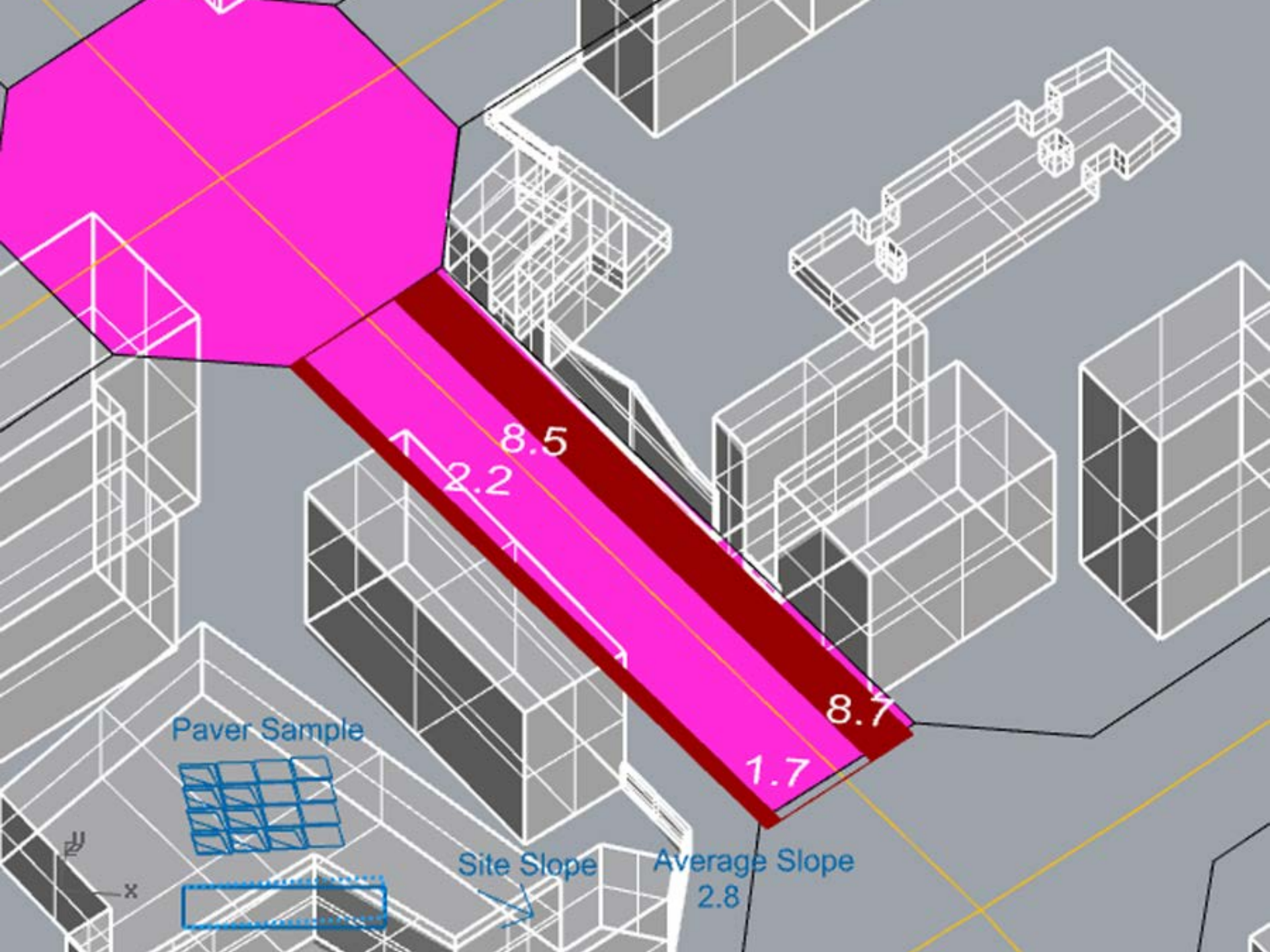


# PAVER PATTERNS



**HEAT / LIGHT**





8.5  
2.2

8.7

1.7

Paver Sample



Site Slope

Average Slope

2.8

# Carbon Sequesters

88 PM 2.5

TREE TYPOLOGIES

LONDON PLANE TREE

ROSEWOOD

MIMOSA

REDBUD

91 CO2

105 CO2

91 CO2

95 CO2

90 CO2

92 CO2

78 CO2

SOUND: 44

SOUND: 48

SMELL SOURCE: 1

SMELL SOURCE: 2

GAS: 118

GAS: 12

CO: 91

CO: 142

SMELL SOURCE: 1

SMELL SOURCE: 1

PM: 570

PM: 600

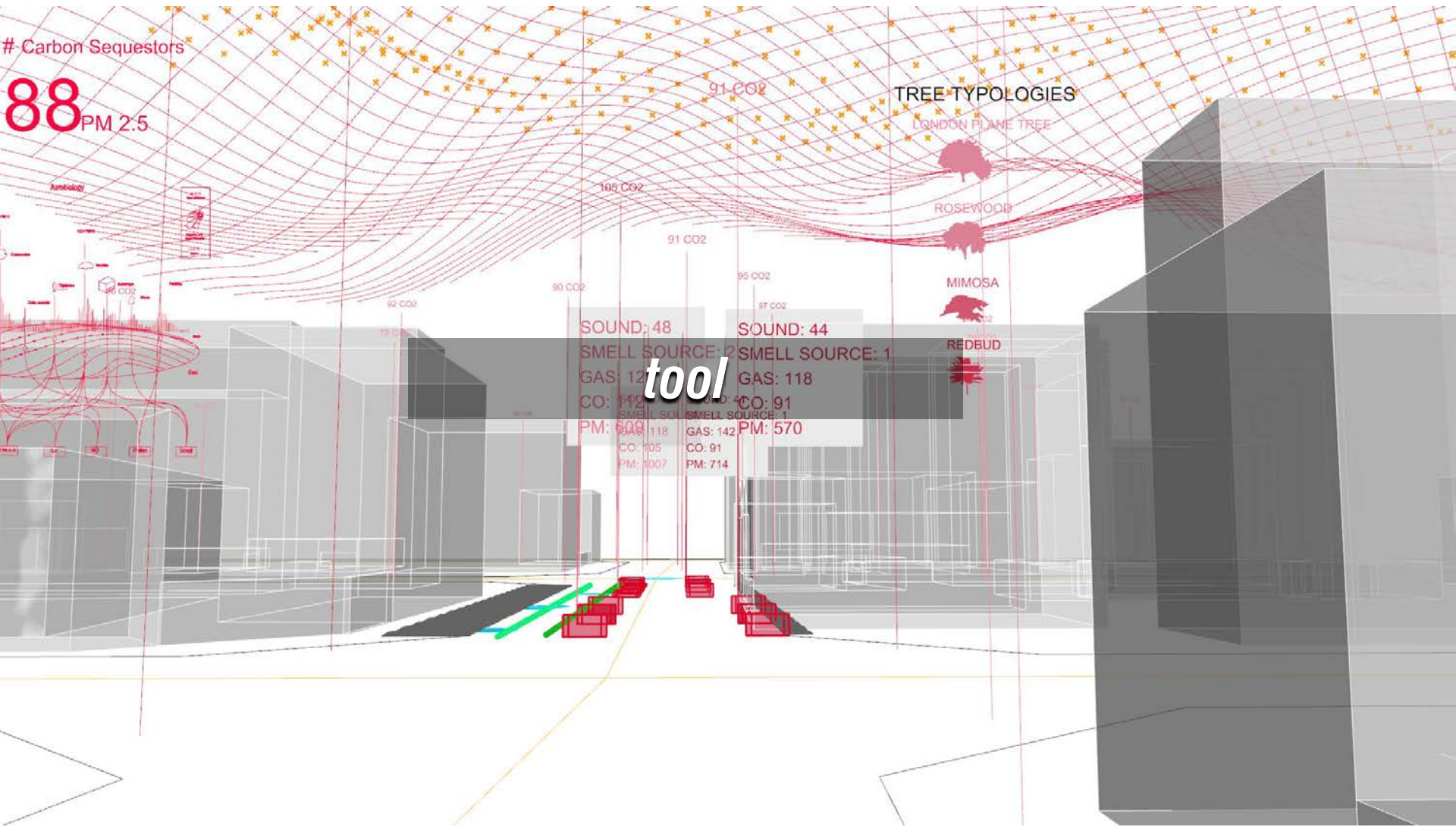
CO: 91

CO: 105

PM: 714

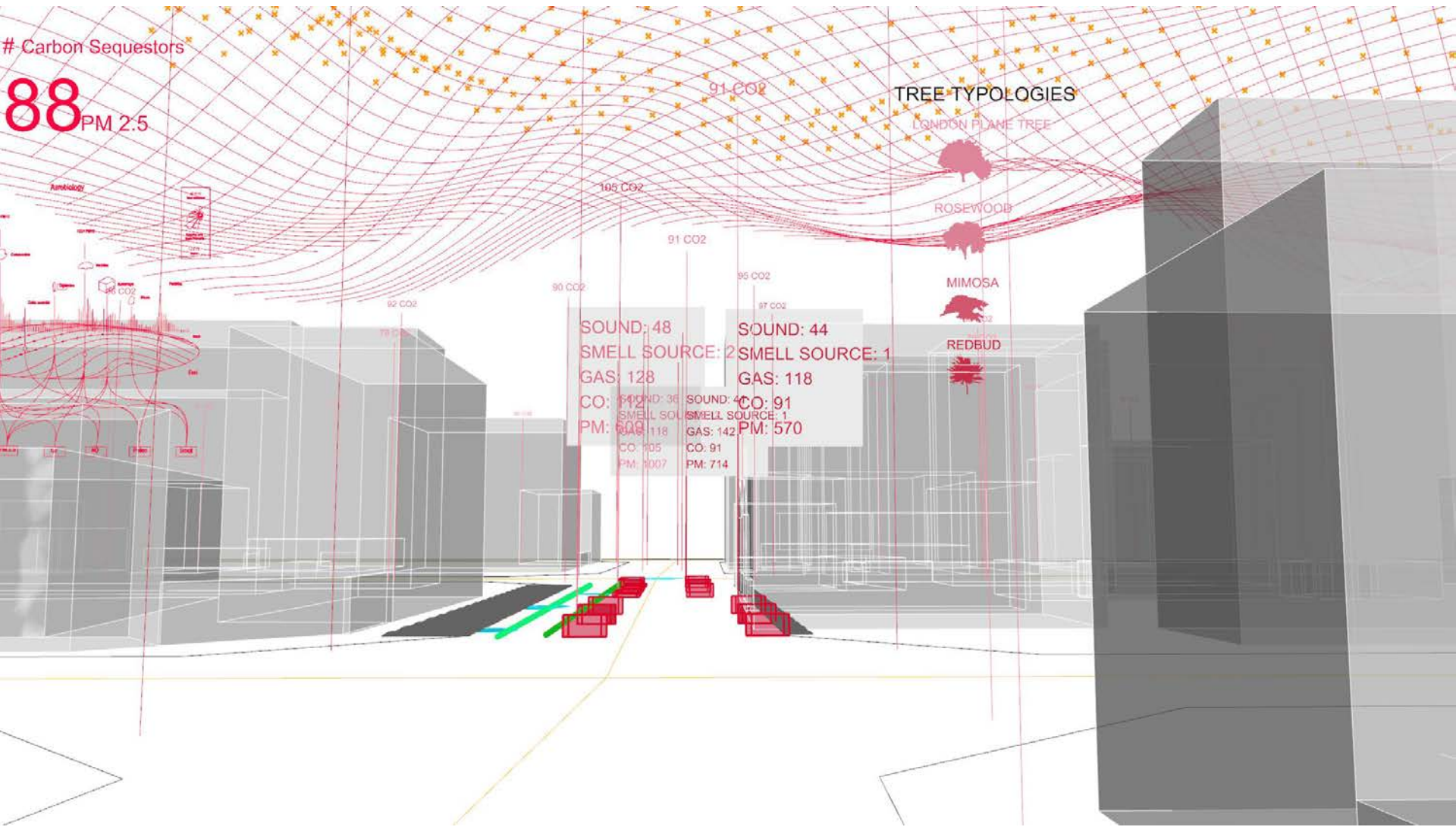
PM: 1007

tool



# Carbon Sequestors

88 PM 2.5



TREE TYPOLOGIES

LONDON PLANE TREE



ROSEWOOD

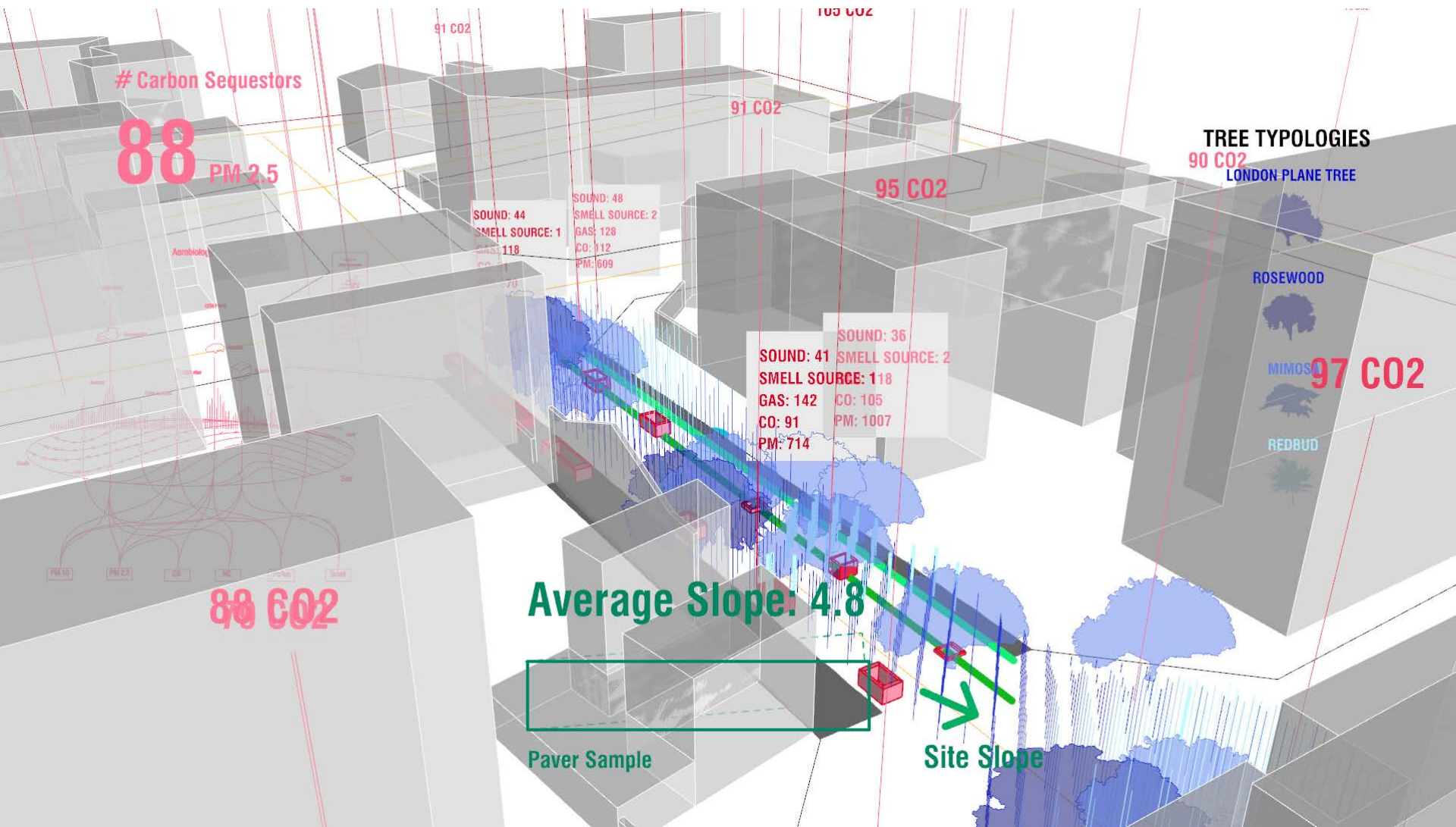


MIMOSA



REDBUD





# Carbon Sequestors

88 PM 2.5

CO: 103  
PM: 1007

CO: 91  
PM: 714

TREE TYPOLOGIES

LONDON PLANE TREE

ROSEWOOD

REDBUD

PM 10 PM 2.5 CO<sub>2</sub> NO<sub>2</sub> Pollen Smell

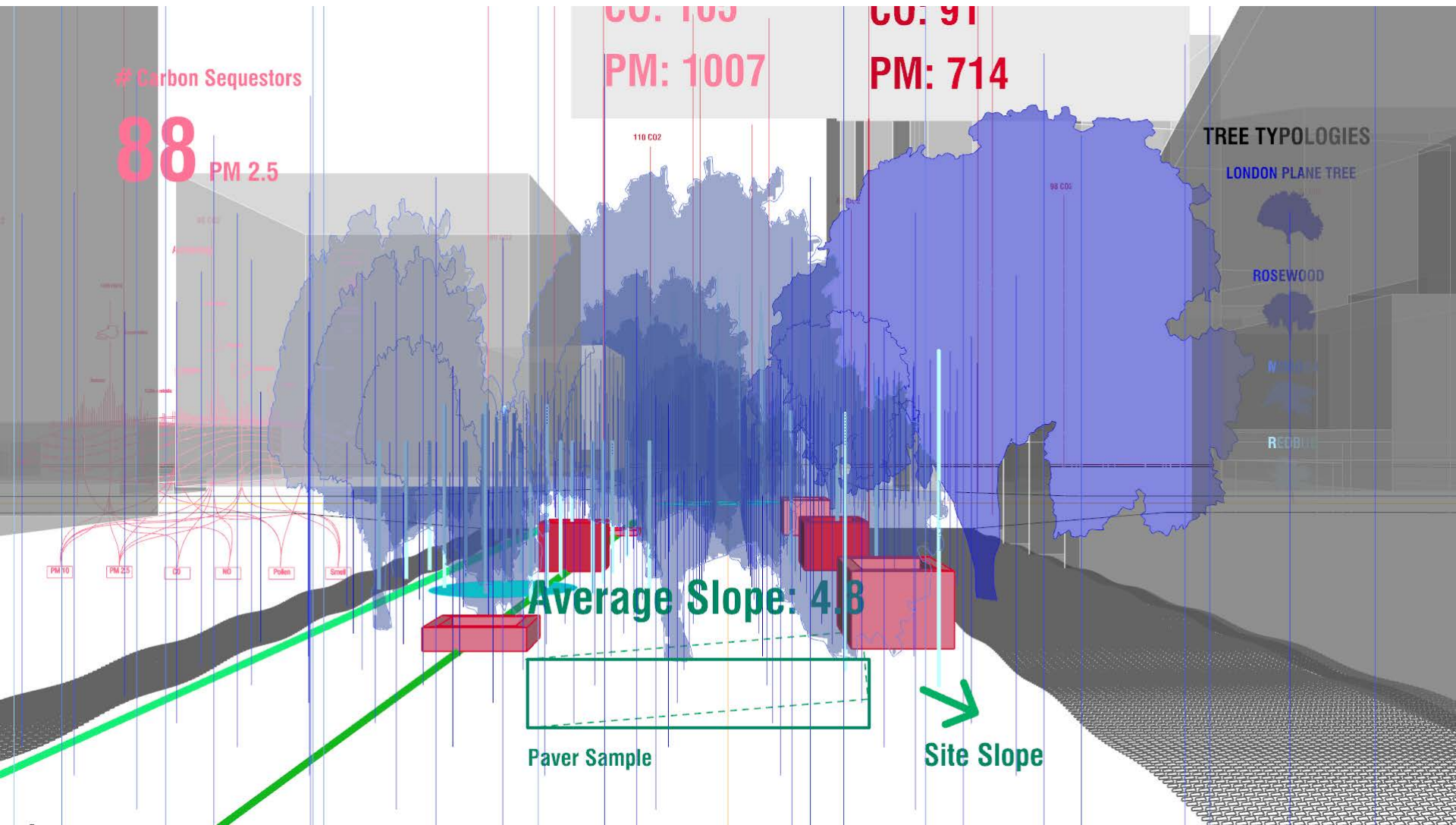
110 CO<sub>2</sub>

95 CO<sub>2</sub>

Average Slope: 4.3

Paver Sample

Site Slope





Occupancy



Wind Speed



Wind Direction



PM 2.5



PM 2.5 at 935

On-site PM 2.5 count

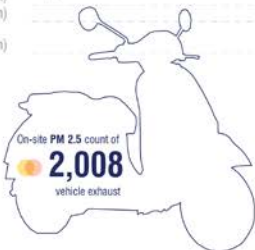


**HIGH 932**  
**AVG 582**



**166 unit occupancy**

(1.50 m)  
(1.00 m)  
(0.50 m)  
(0.25 m)  
(-0.25 m)  
(-0.50 m)  
(-1.00 m)



PM 2.5 (fine particles) primarily come from car, truck, bus and **off-road vehicle exhausts** (construction equipment) and in burning of fuels such as wood, heating oil or coal and natural sources such as forest and grass fires.

Street presented high levels of **Pollution & Density**





## **Urban Ecological Interaction:**

Air, Water, Light and New Transit at the Human Scale of Barcelona's Superilles

ICAUDT 2016: 18<sup>th</sup> International Conference on Advanced Urban Designing and Transportation

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