Version 9.1
24 July 2015

Changes from version 8.5:

- ***Summary of changes***
  - Repositioned most "line-of-sight" sensors and some close-in sensors, because simulations by various models suggest that these sensors might be saturated.
  - Additional sensors required by the new layouts: one MiniRAE at 200-m arc (the rest is just reshuffling).
  - New sensor locations to be surveyed: behind 1.1, 1.5, 6.5, and 12.5 (all inside urban pad); all sensor locations beyond urban pad remains the same.
  - Layout 2's sensor placement is now very similar to layout 1's.

- ***For mock urban layout 1*** (requiring one more Canary from 200-m arc, see below):
  - Moved Jaz behind 2.5 to behind 6.5.
  - Moved Jaz behind 4.3 to behind 6.2.
  - Moved Jaz behind 4.4 to behind 6.8.
  - Moved Jaz between 6.4 and 6.5 to behind 7.1 (at 0.3 m); moved Canary behind 6.2 to behind 7.1 (at 3 m).
  - Moved Jaz between 6.6 and 6.7 to behind 7.5 (at 0.3 m); moved Canary behind 6.8 to behind 7.5 (at 3 m).
  - Moved MiniRAE behind 7.1 to top of 11.3.
  - Moved MiniRAE behind 7.5 to top of 11.5.
  - Moved MiniRAE behind 1.2 to before 1.2 (on apron).
  - Moved MiniRAE behind 1.4 to before 1.4 (on apron).
  - Moved Jaz before 1.2 (on apron) to behind 1.1.
  - Moved Jaz before 1.4 (on apron) to behind 1.5.
  - Swapped MiniRAE behind 12.2 and Canary to the left along pad perimeter.
  - Swapped MiniRAE behind 12.8 and Canary to the right along pad perimeter.
  - Moved one Canary from 200-m arc to behind 12.5, and replaced the Canary with one *extra* MiniRAE.

- ***For mock urban layout 2*** (requiring one more Canary from 200-m arc, see below):
  - Made sensor placement consistent with layout 1, with these exceptions:
  - Moved Jaz before 2.5 closer to 2.5 (by 5').
  - Moved Jaz and Canary behind 7.5 to behind 2.5, and moved Canary behind 7.1 to behind 2.5; i.e., there are now one Jaz (at 0.3 m) and two Canary (at 3 and 7.6 m) behind 2.5.

- **Removed "minimum" layouts as we now have sufficient CONEX containers.**

- **Added sensor inventory and drawings (created by GRAPHER) for arcs for completeness.**

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Changes from version 8.4:

- Repositioned sonic anemometers (slightly away from Conex containers).

Changes from version 8.3:

- Changed grid centerline to 345 deg.
- Add SI units.

Changes from version 8:

- Added sensors on mock urban pad but outdoor to the "standard" layouts, based on Steve Hanna's April 5 recommendations. Adapted this sensor placement to the "minimal" layouts, with some minor adjustments.
- Further shuffled sensors on perimeter and inside of the mock urban pad. Specifically, moved 4 Jaz from perimeter to inside, and 2 Canary from inside to perimeter.
- Changed sensor symbols, to make it easier to distinguish between sensor types.
- Added sonic layouts, based on Steve Hanna's April 3 recommendations.

Changes from version 7:

- Added "minimum" layouts 1 and 2 (see p. 4 and 5), where each requires exactly 40 20' CONEXs and 20 40' CONEXs, in addition to the structures required for the indoor study.
- Removed two rows of structures (and some more on the edges for minimum layout 2) as a result. (But lambda-p remains roughly the same at ~0.18.) Also slightly adjusted structures in remaining rows.
- For minimum layout 2, did not renumber structures so that those additional structures that were removed are easily identified.

Changes from version 6.1:

- Reduced row spacing to ~22' (from ~32'). (According to Andy Wiborg's 4/2/15 email, 20' is required for the trucks to maneuver.)
- Made apron 200' and mock urban pad 400' again.
- Added two rows of containers (4 extra 40' and 9 extra 20' CONEXs) because the rows are now closer. (Did not change lateral container spacing.)

Changes from version 5.1:

- Shifted the entire obstacle array south by 40'. So the apron is now 160', the mock urban pad is 440', but the total size of the pad remains the same.
- Made row 10 all 20' CONEXs.
- Added row 11 for place holders of 10 cars.
- Removed designation of "if available" CONEXs (enclosed by dotted line), because it is now assumed we always have enough containers.
- Adjusted sensors on the left and right sides of urban pad slightly to account for the fact that mock urban pad is now 440' long.
- Made all CONEXs 8' wide (rather than 10').

Changes from version 5:

- Reduced the symbol size for the tank.
- Moved the concrete pad and tank slightly south, so that the pad center to the southern and northern edges of the mock urban pad is exactly 100' and 300', respectively.
- Added hypothetical sampling grid inside the mock urban pad.

Changes from version 4:

- Numbered all structures inside the mock urban pad for easy identification.
- Added sensors surrounding mock urban pad. (Sensors inside pad and inside structures have not been assigned yet.)

Chlorine Sensor Inventory

			Inside urban pad		*Outside urban pad*							
	Detection range		Indoor[3]	Outdoor	Urban pad perimeter	200 m ring[4]	500 m arc (90 deg)	1 km arc (90 deg)	2 km arc (90 deg)	5 km arc (90 deg)	11 km arc (90 deg)	Total required
Jaz	100 - 100,000 ppm	Surface[1]		15	0							16
		Elevated[2]		1								
Canary	10 - 10,000 ppm	Surface[1]	8	3	4	3						20
		Elevated[2]		2								
MiniRAE	1 - 2,000 ppm	Surface[1]	22	2	13	14	20	19	20			126
		Elevated[2]		6	4	6						
ToxiRAE	1 - 50 ppm	Surface[1]	4							19	20	43
		Elevated[2]										
		Total	34	29	21	23	20	19	20	19	20	205
	Total **surface** locations			20	16	16	19	18	19	18	19	

Notes:

[1]Instrument deployed at the lowest level (e.g., 0.3 m)

[2]Instrument deployed at higher levels (e.g., 3 m, 6 m, or CONEX roof).

[3]Sensors deployed inside structures might be at different heights. See LBNL's plan (and Renjie Chan's 3/18/15 email) for more details.

[4]Note uneven sensor distribution along the ring.

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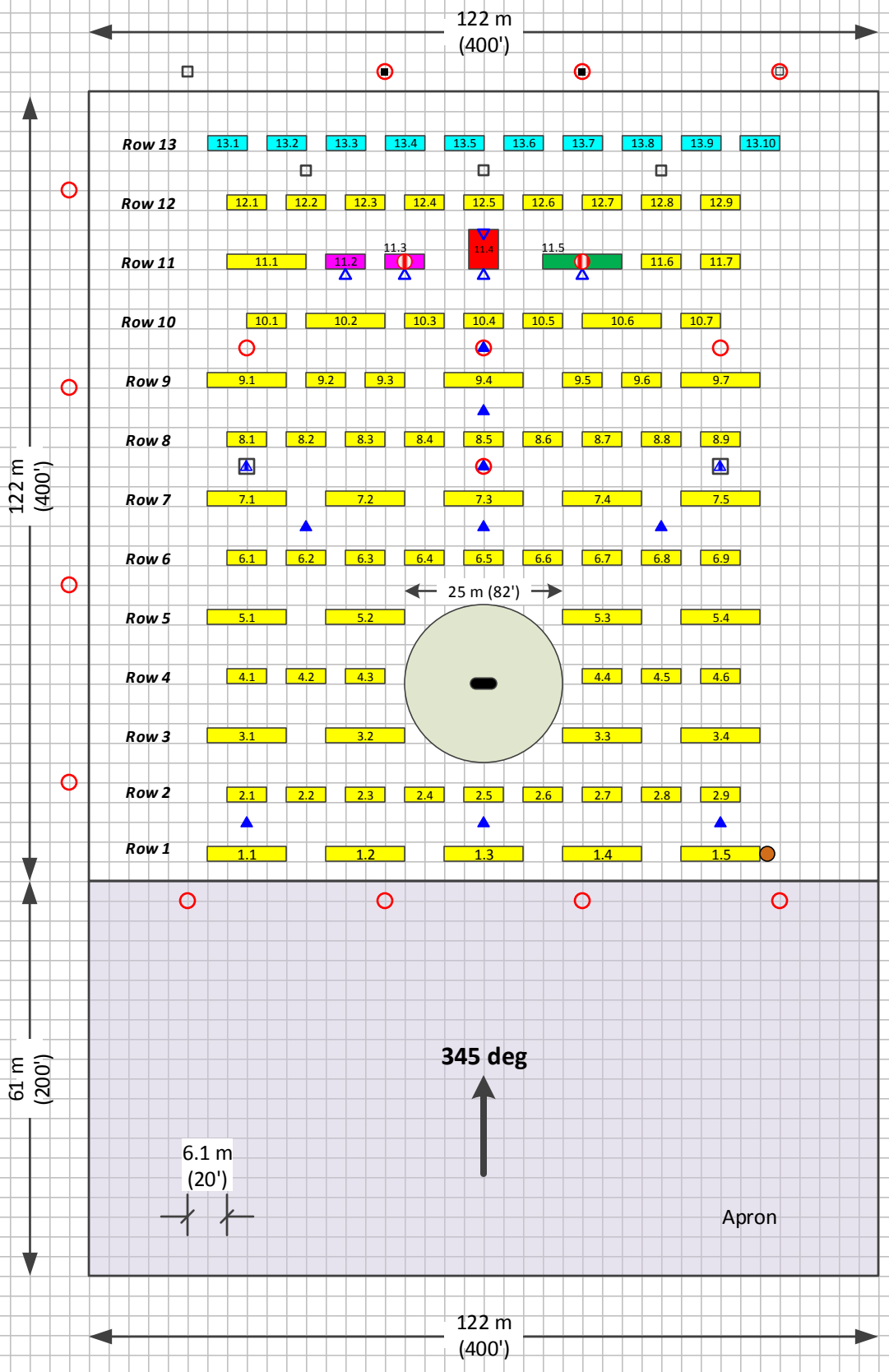
Mock Urban Layout 1
(No tall structure upwind)



LEGENDS

- 20' CONEX
- 40' CONEX
- 20' CONEX, 2 wide x 3 tall
- Trailer, ***indoor***
- 40' CONEX, ***indoor***
- 20' CONEX, 2 wide x 3 tall, ***indoor***
- Vehicle
- Scrubber
- Tank
- Concrete pad
- 1 Jaz @ 0.3 m & 2 MiniRAE @ 3 & 6 m (tower)
- 1 Jaz @ 0.3 m & 2 Canary @ 3 & 7.6 m (tower)
- 1 Jaz @ 0.3 m & 1 Canary @ 3 m (tower)
- Jaz @ 0.3 m
- Jaz @ building intakes
- Jaz @ 2x3 stack roof, flush with upwind edge
- MiniRAE @ CONEX/trailer roof, flush with upwind edge
- 1 Canary @ 0.3 m & 2 MiniRAE @ 3 & 6 m (tower)
- 1 Canary & 1 MiniRAE collocated @ 0.3 m
- Canary @ 0.3 m
- MiniRAE @ 0.3 m

Total resources required

Indoor study:
- 1 40' CONEX
- 6 20' CONEX
- 2 20' trailers

Outdoor study:
- 24 40' CONEX
- 53 20' CONEX
- 10 vehicles

Sensors on pad perimeter:
- 0 Jaz
- 4 Canary
- 17 MiniRAE

Sensors over pad & outdoor:
- 16 Jaz
- 5 Canary
- 8 MiniRAE

Lambda-p ~ 0.18

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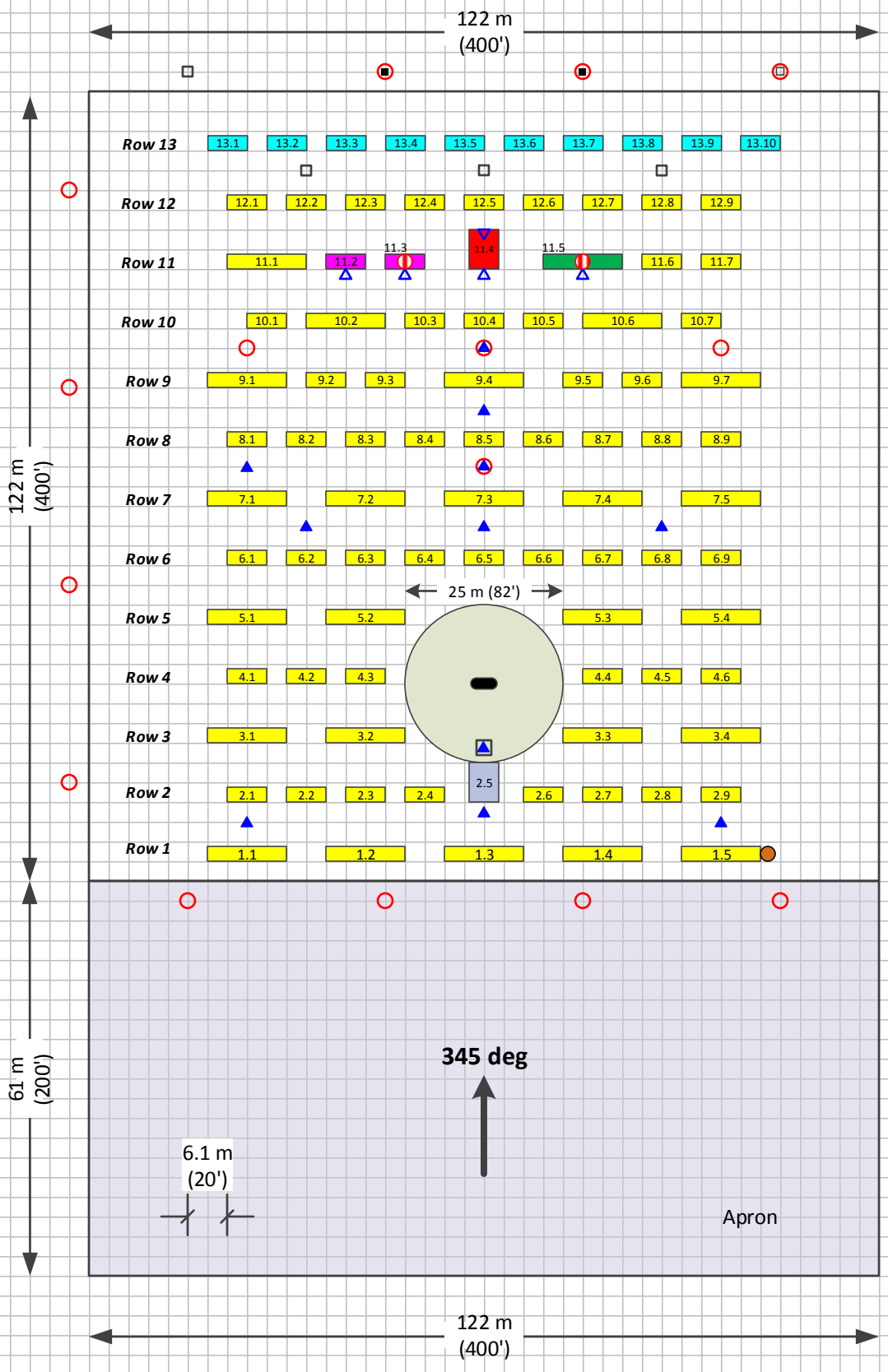
Mock Urban Layout 2
(Tall structure upwind)



LEGENDS

- 20' CONEX
- 40' CONEX
- 20' CONEX, 2 wide x 3 tall
- Trailer, ***indoor***
- 40' CONEX, ***indoor***
- 20' CONEX, 2 wide x 3 tall, ***indoor***
- Vehicle
- Scrubber
- Tank
- Concrete pad
- 1 Jaz @ 0.3 m & 2 MiniRAE @ 3 & 6 m (tower)
- 1 Jaz @ 0.3 m & 2 Canary @ 3 & 7.6 m (tower)
- 1 Jaz @ 0.3 m & 1 Canary @ 3 m (tower)
- Jaz @ 0.3 m
- Jaz @ building intakes
- Jaz @ 2x3 stack roof, flush with upwind edge
- MiniRAE @ CONEX/trailer roof, flush with upwind edge
- 1 Canary @ 0.3 m & 2 MiniRAE @ 3 & 6 m (tower)
- 1 Canary & 1 MiniRAE collocated @ 0.3 m
- Canary @ 0.3 m
- MiniRAE @ 0.3 m

Total resources required

Indoor study:
- 1 40' CONEX
- 6 20' CONEX
- 2 20' trailers

Outdoor study:
- 24 40' CONEX
- 58 20' CONEX
- 10 vehicles

Sensors on pad perimeter:
- 0 Jaz
- 4 Canary
- 17 MiniRAE

Sensors over pad & outdoor:
- 16 Jaz
- 5 Canary
- 8 MiniRAE

Lambda-p ~ 0.18

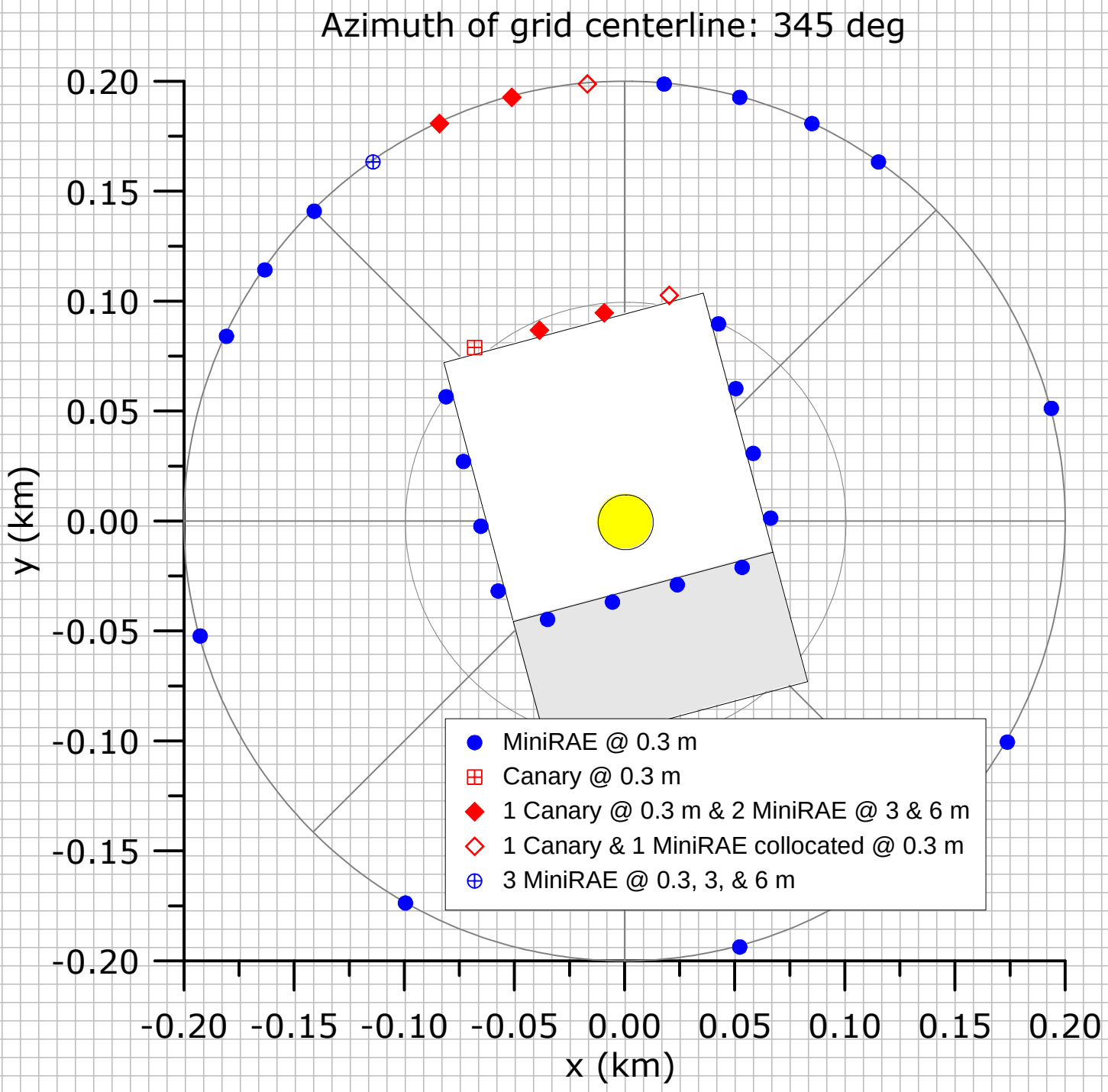


Figure pasted from "JR II Cl2 point sensors 200 m ring.grf"

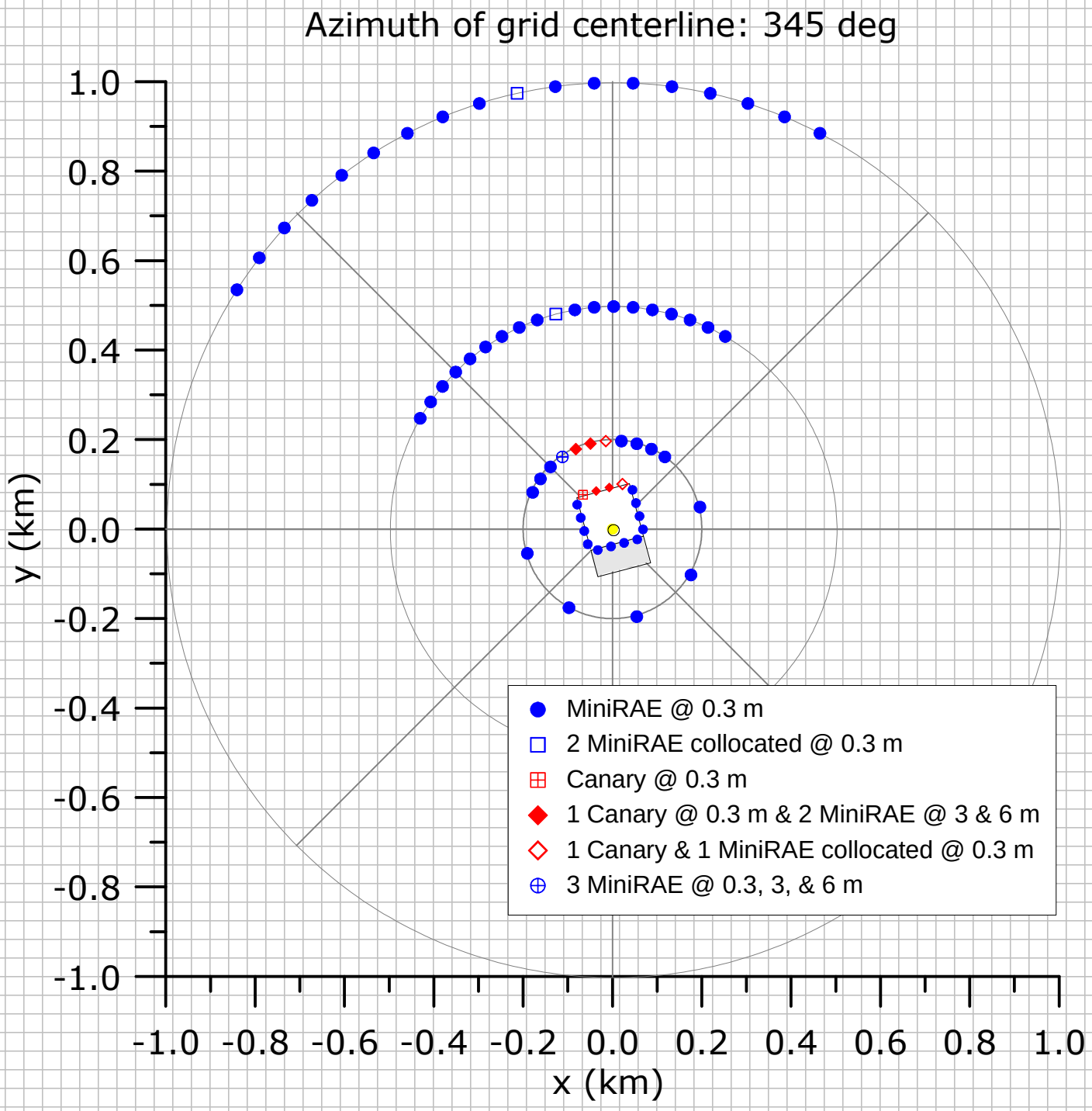


Figure pasted from "JR II Cl2 point sensors 200 500 1000 m rings.grf"

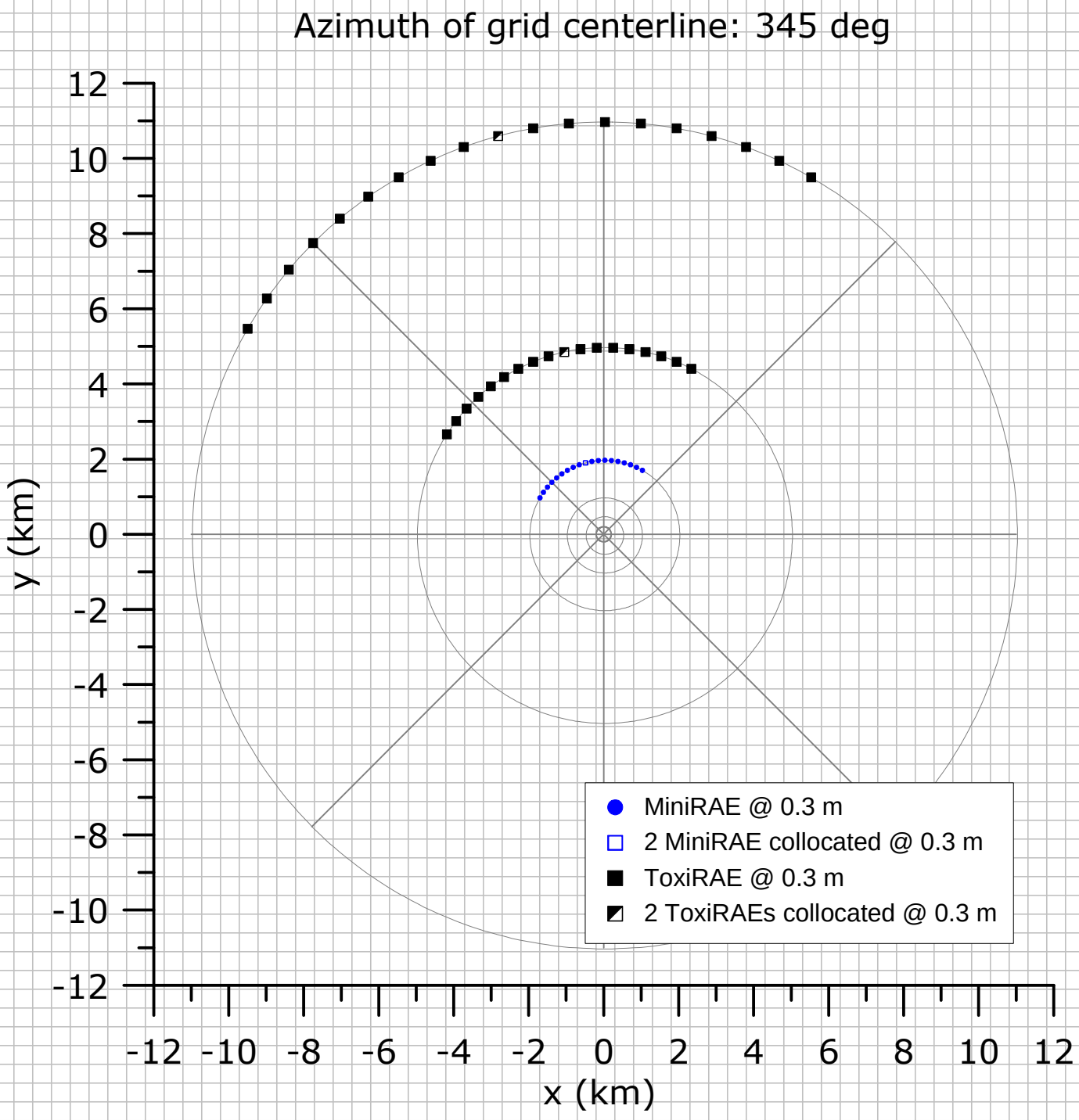


Figure pasted from "JR II Cl2 point sensors 2 5 11 km rings.grf"

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Assumptions (Steve Hanna's 4/3/2015 email):

1) This uses Joe's Version 8 Layout 2. I picked a 40 ft CONEX that is more or less in the middle of the array. It would be position 9.4 in the standard layout 2, or position 7.3 in the minimum layout. The second obstacle of interest is the 2 by 3 stack, just upwind of the concrete pad where the source tank was located.

2) It is assumed that the wind direction is lined up with the obstacle orientation, and the wind speed is high enough (> 2 m/s) that vortices will set up and persist around the obstacles. Of course some variability is expected. The experiments will take place after the chlorine clears away from the last record test.

3) Each obstacle design makes use of 13 to 15 sonic anemometers. If we have a total of 30 sonic anemometers, the studies of both obstacles can be conducted at the same time. Otherwise we could conduct the study with one obstacle during one week, and the study with the other obstacle during the second week.

4) The design is similar to what is seen in the diagram showing the MUST sonic anemometer instrument placement in the Nelson et al. paper that I distributed yesterday (see their figure 2). There are two towers per obstacle, and the tower extends above the top of the obstacle (twice as high for the 40 ft CONEX and 2.4 m above the 7.6 m tall stacked structure). There are three or four sonic levels (1, 2, and 5 m for the 40 ft CONEX and 1, 2, 5, and 10 m for the stacked structure) on each tower. On the windward side, the tower is located 8 ft (one CONEX width) upwind and centered on the structure and 4 ft downwind. The downwind tower is sited so that it can pick up the recirculating eddy behind the obstacle, but not so close that it is measuring just the flow along the wall.

5) In addition to the two towers described above, there will be 7 single anemometers (on tripods or ?) which are at heights of 1 or 1.5 m above the surface. One of these is centered on the roof. Two are located on the surface on each side (at distances of 4 and 8 ft from the edge), and two are located farther downwind past the tower, at distances of 8 and 16 ft from the lee edge of the structure.

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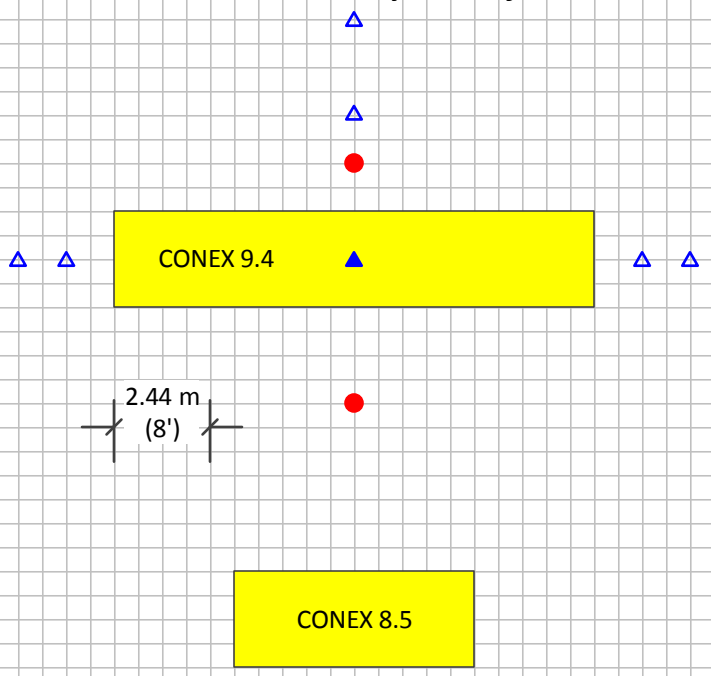
Sonic Plan 1

(with respect to mock urban standard layout 2, after all Cl_2 trials are done)



LEGENDS

Single sonic at 1 m

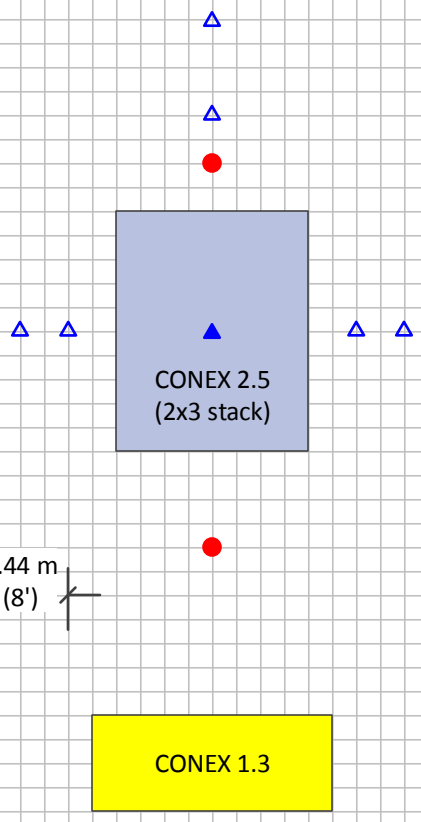
3 sonics at 1, 2, & 5 m

Single sonic on roof

Total resources required:
13 sonics

Sonic Plan 2

(with respect to mock urban standard layout 2, after all Cl_2 trials are done)



LEGENDS

Single sonic at 1 m

4 sonics at 1, 2, 5, & 10 m

Single sonic on roof

Total resources required:
15 sonics

Hypothetical sampling grid inside mock urban pad