Application of D/Q in REMP Air Sampler Placement

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Why is this a concern?

- Some licensees have recently been challenged during REMP inspections regarding placement of REMP air samplers
- “Observation” that existing sampling locations are not in accordance with guidance in NUREG-1301/1302

NUREG-1301/1302 Guidance

- Table 3.12-1, model REMP sampling guidance for airborne radioiodines and particulates --
  - Three samples from close to the three SITE BOUNDARY locations, in different sectors, of the highest calculated annual average ground-level D/Q;
    - Exercise caution with elevated release points... *highest D/Q may be well beyond site boundary!*

NUREG-1301/1302 Guidance (cont.)

- One sample from the vicinity of a community having the highest calculated annual average ground-level D/Q; and
- One sample from a control location, as for example 15 to 30 km distant and ***in the least prevalent wind direction***
  - Note that this location is not based on D/Q, but rather on wind direction

Control Selection Criterion

- What is intended by "...*least prevalent wind direction*..."?
- How is this determined?
  - Annual average wind rose information
  - Should use long-term 5 to10-year data set; ideal data set is that used to determine your long-term annual average X/Q and D/Q
- Seems straight-forward... or is it?

Wind Rose Plot

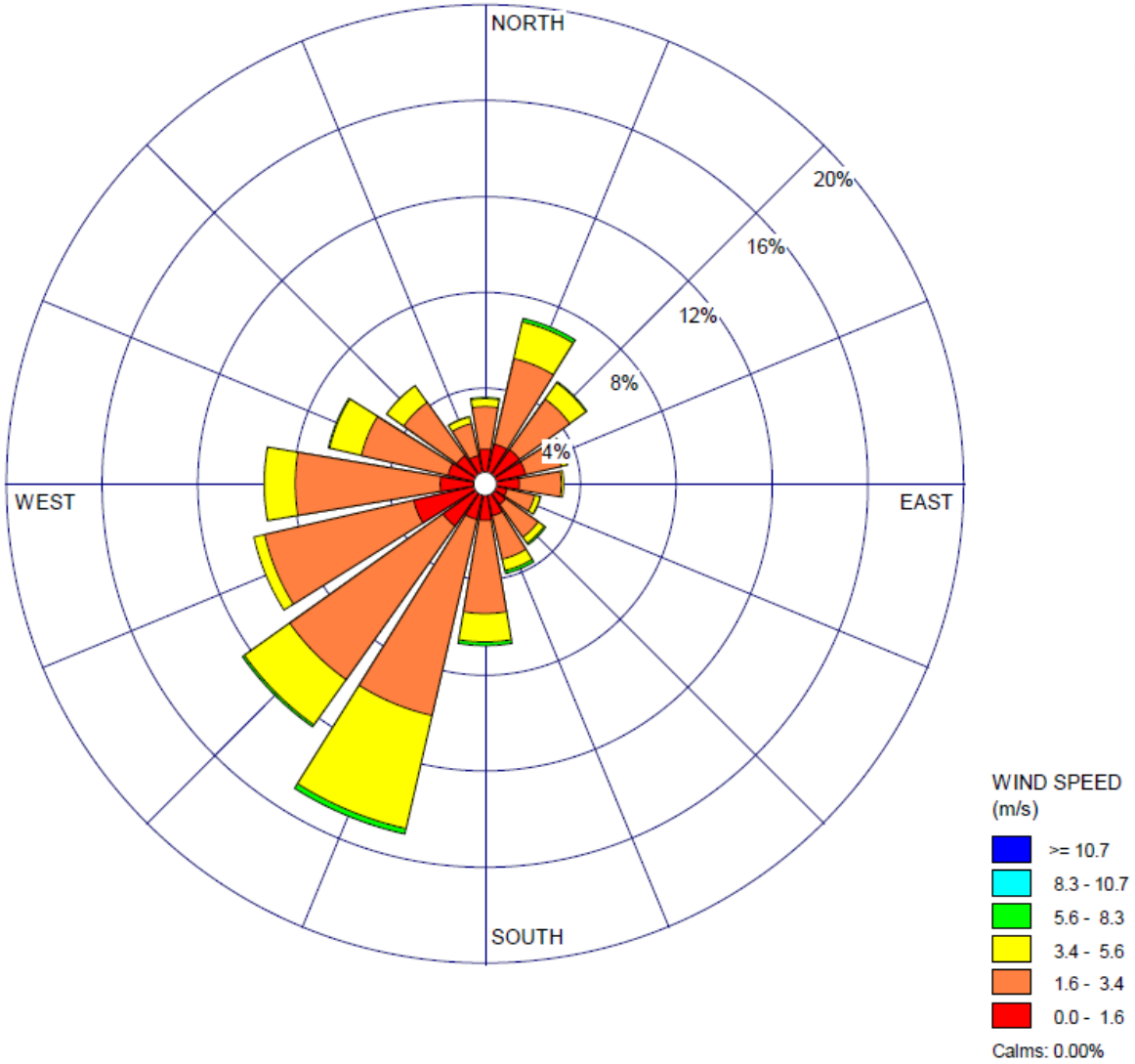
- Wind data are binned into 16-petal "flower" graph to depict wind frequencies
  - Compass Wind Direction Sectors
  - Discrete Wind Speed Categories
- Usually determined at lower and upper elevations of meteorological tower
- Often delineated by stability class

Conventional “from” Wind Rose

- Most common depiction of wind frequencies generated and used by meteorologists
- Illustrates the direction ***from*** which the wind is blowing
- “Bigger petals” show the direction from which the wind blows more frequently

Conventional “from” Wind Rose

-- which is the “least prevalent” direction?

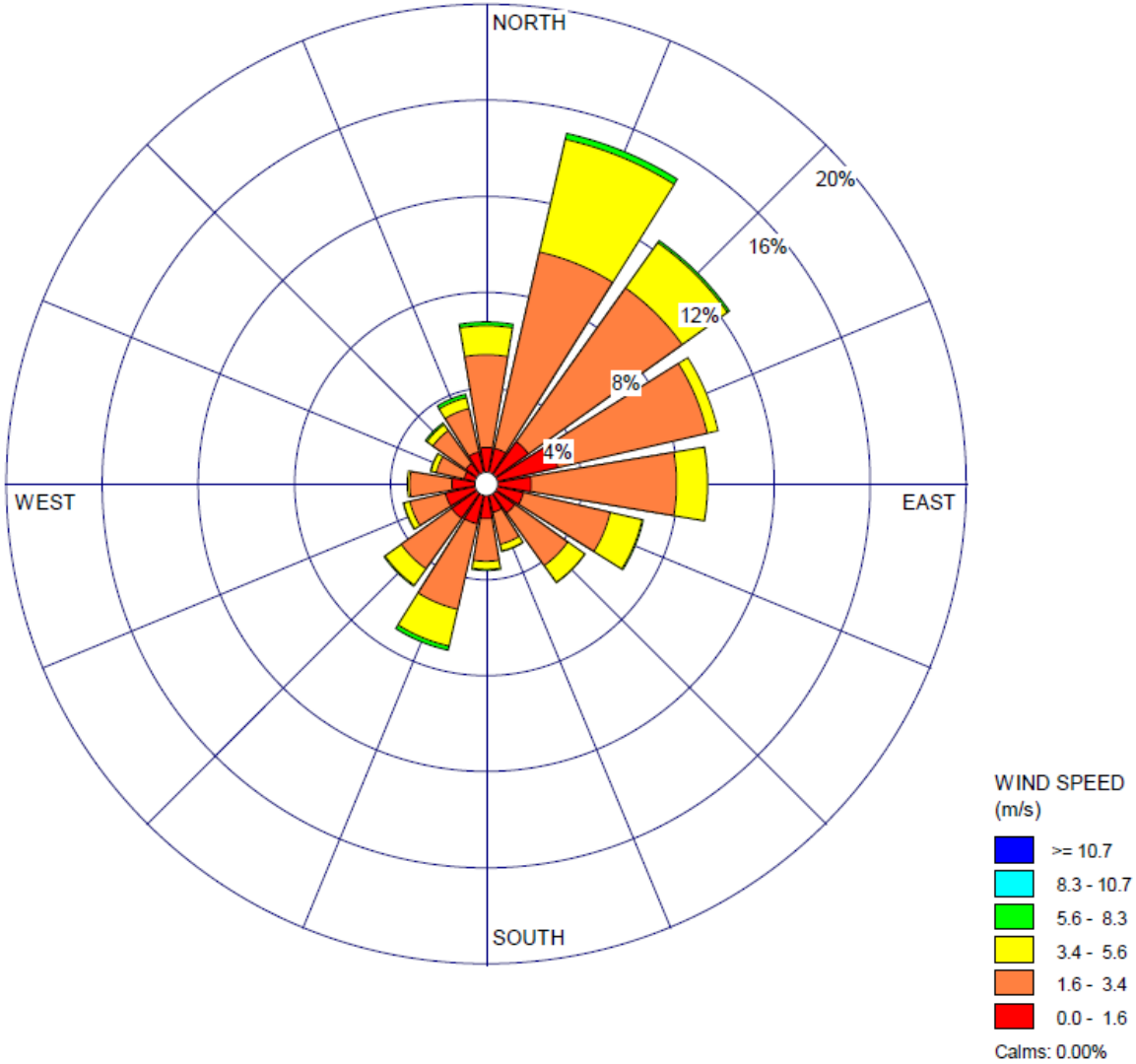


Non-Conventional “to” Wind Rose

- Less-common depiction of wind direction frequencies
- Illustrates the direction ***toward*** which the wind is blowing
- “Bigger petals” show the direction toward which the wind blows more frequently
- Easier visualization of the most-affected downwind sectors

Non-conventional “to” Wind Rose

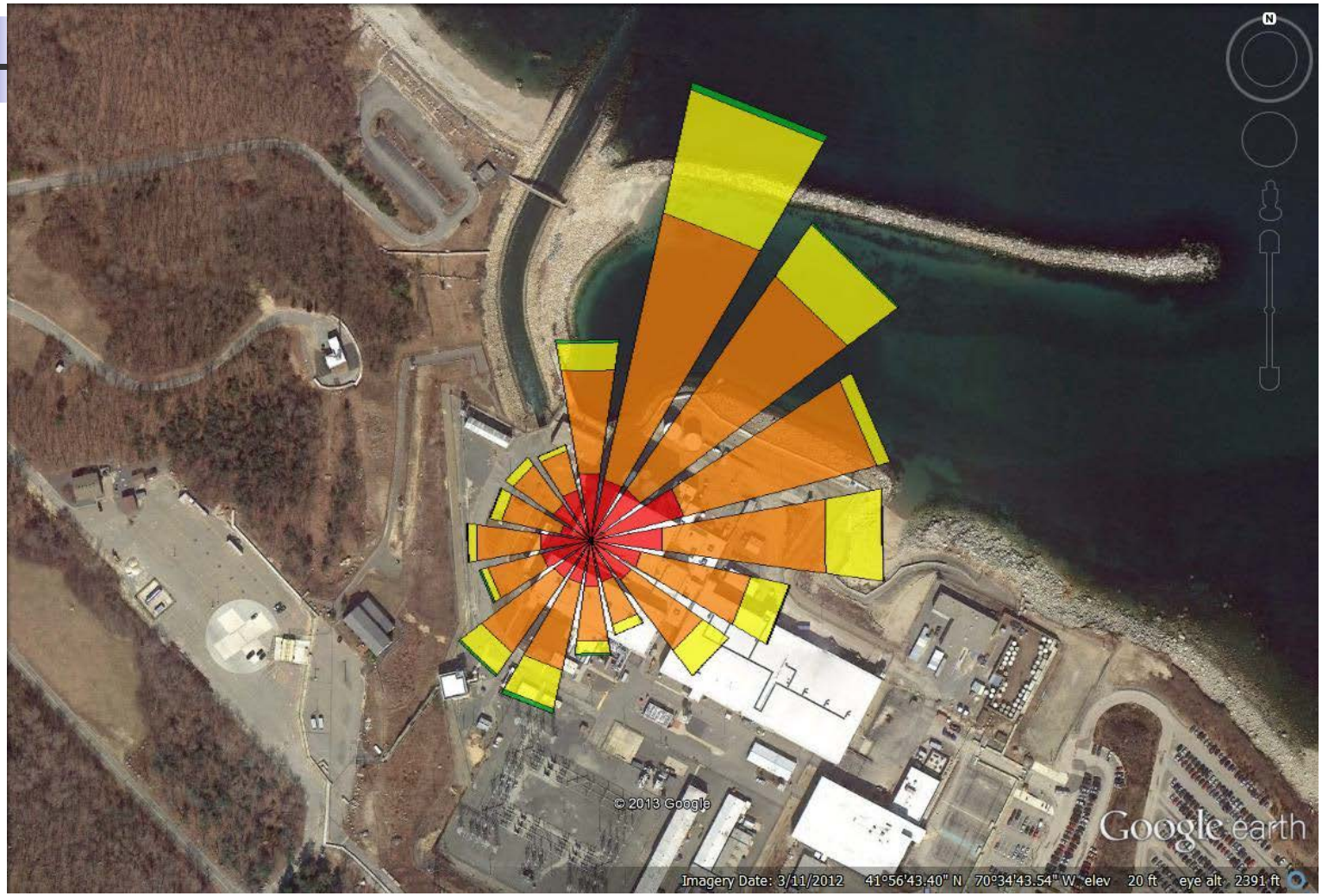
-- which is the “least prevalent” direction?



Generating Wind Rose Plots

- Software programs use meteorological data to generate frequency distributions for wind rose
- WRPLOT View from Lakes Environmental is freeware available to generate wind roses
  - http://www.weblakes.com/products/wrplot
- Allows creation of KML file to overlay onto Google Earth map images

Overlay onto Site Aerial Photo



Control Location Selection -- Based on Wind Rose Information

- Intent of "least prevalent wind direction"?
  - Shortest petal on "from" wind rose? *NO! This depicts the sector from which the wind blows lowest amount of time. Little impact on downwind concentrations.*
  - Longest petal on "from" wind rose? *Possibly, as this shows predominant upwind sector.*
  - Longest petal on "to" wind rose? *NO! This depicts the most-affected downwind sector.*
  - Shortest petal on "to" wind rose? ***Likely the best candidate, as this depicts least-affected downwind sector.***

Control Location Selection -- Alternate Approach

- Does the control sampler have to be in the “least prevalent wind direction”? ***Not Necessarily!***
- Intent is to have the control station in the least-affected (i.e., *lowest D/Q*) location
  - Use conventional D/Q tables to evaluate various locations... switchyard, substation, corporate office, etc.
  - Select location independent of “least prevalent wind direction”
  - Could be in cross-wind direction as long as it meets low D/Q criterion

Alternate Approach Methodology

- NUREG allows for control to be at 15 to 30 km distance
- Determine D/Q values at 15 km in each landward sector, as this meets NUREG criterion for control location
- Evaluate D/Q at potential sampling locations under consideration; if D/Q value is less than the lowest D/Q at 15 km, location meets NUREG criterion for a “control” sampler

Other Considerations

- Which tower elevation to use?
  - Ground-level, Mixed-mode release points = lower (10-meter) level
  - Elevated release points = upper level
  - May result in different highest D/Q (indicator) and lowest D/Q (control) sectors for ground-level vs. elevated releases

Pilgrim Station Example

- Control location was established during pre-operation years... over 40 years of history
- Located 39.7 km Northwest of plant... *not* in least-prevalent wind direction
  - Ground-level release D/Q = 3.92E-12 m^{-2}
  - Elevated release D/Q = 4.81E-12 m^{-2}

Ground-level Release Evaluation

- Ground-level release D/Q = 3.92E-12 m^{-2}
- 15 km D/Q values by sector

Sector	D/Q	Sector	D/Q
N	4.38E-11	S	4.95E-11
NNE	1.07E-10	SSW	7.69E-11
NE	5.31E-11	SW	6.50E-11
ENE	4.53E-11	WSW	4.81E-11
E	7.42E-11	W	4.76E-11
ESE	5.47E-11	WNW	3.74E-11
SE	4.53E-11	NW	1.97E-11
SSE	2.84E-11	NNW	*1.59E-11*

Elevated Release Evaluation

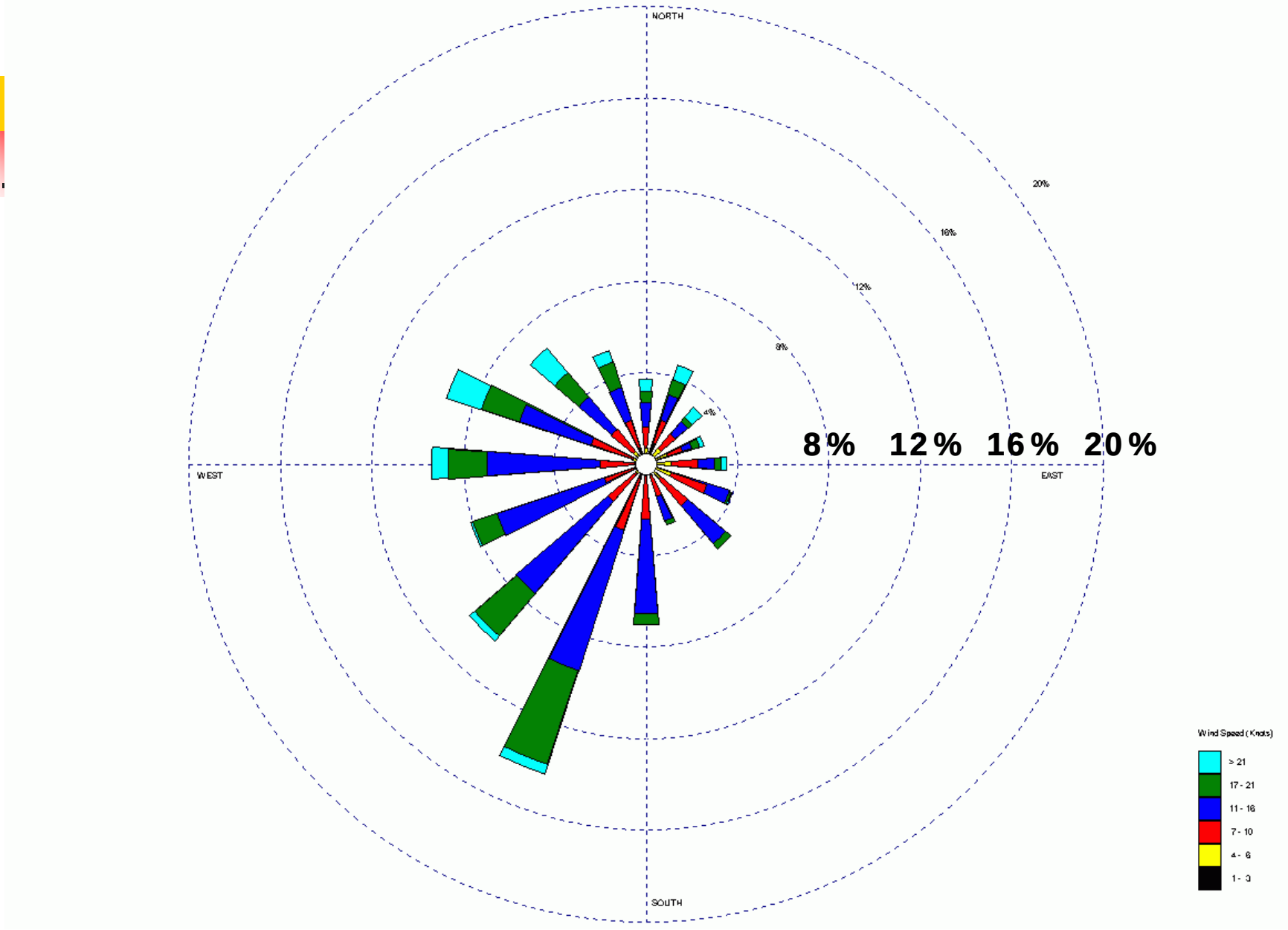
- Elevated release D/Q = 4.81E-12 m^{-2}
- 15 km D/Q values by sector

Sector	D/Q	Sector	D/Q
N	2.94E-11	S	7.54E-11
NNE	8.84E-11	SSW	5.97E-11
NE	5.18E-11	SW	3.83E-11
ENE	3.17E-11	WSW	2.98E-11
E	5.96E-11	W	2.52E-11
ESE	6.47E-11	WNW	2.57E-11
SE	4.71E-11	NW	2.26E-11
SSE	3.56E-11	NNW	*1.63E-11*

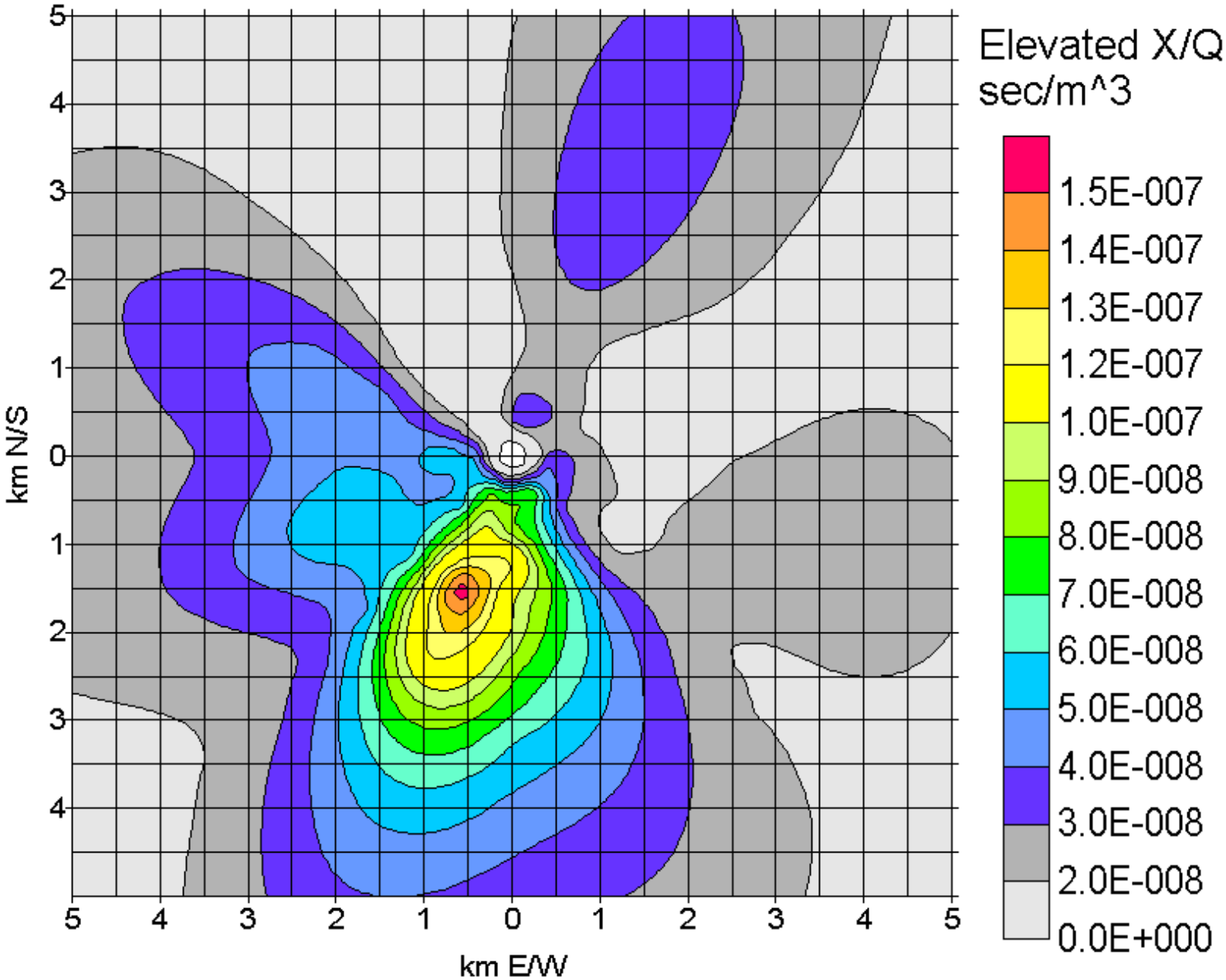
Concern with Elevated Release Points

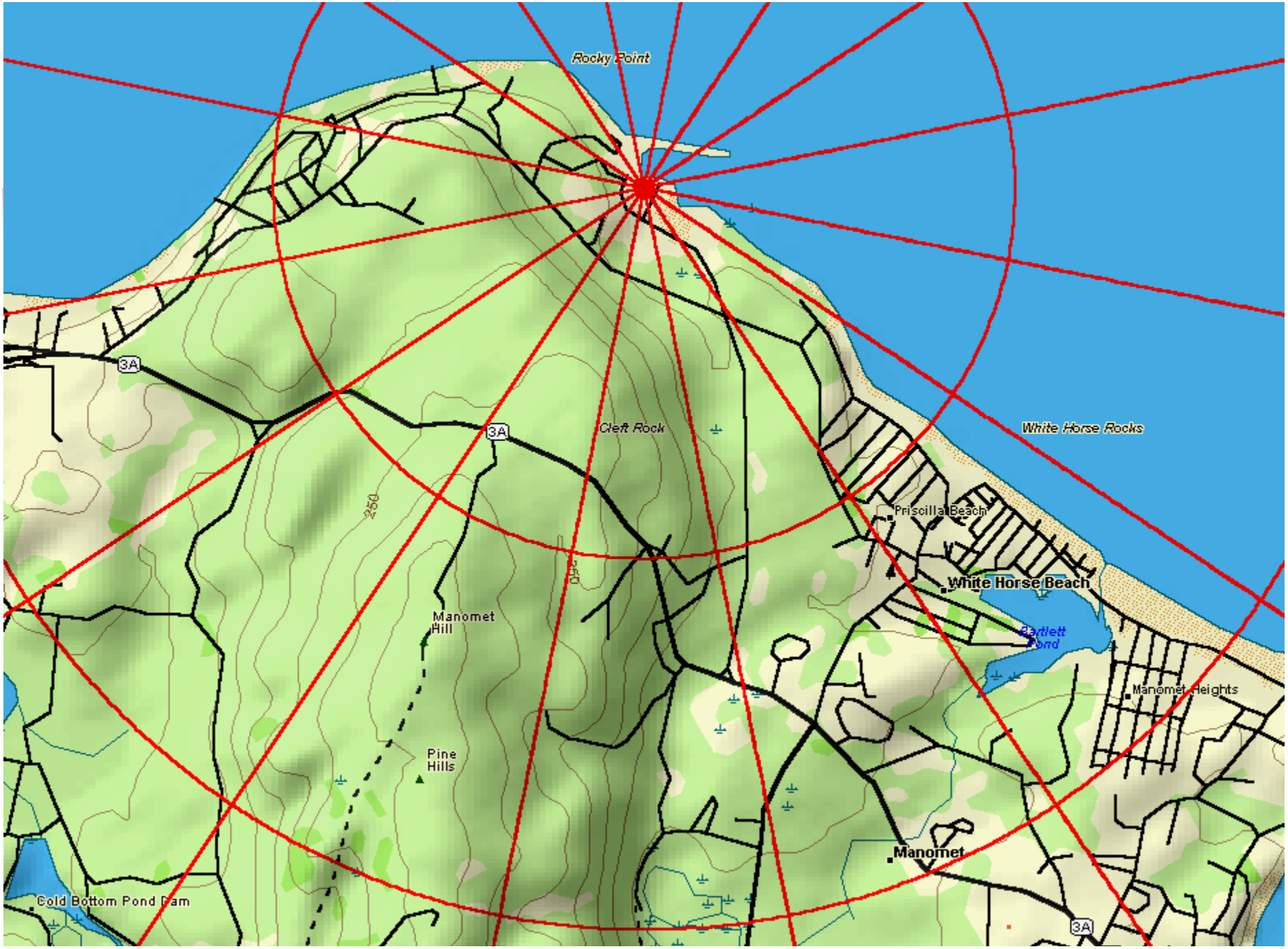
- Plume for elevated release point may not touch down for some distance beyond site boundary... important for indicator stations
- Local terrain in vicinity of station may effectively “push” the receptor upward into the plume
- Highest dispersion and deposition factors can occur in a non-downwind sector!

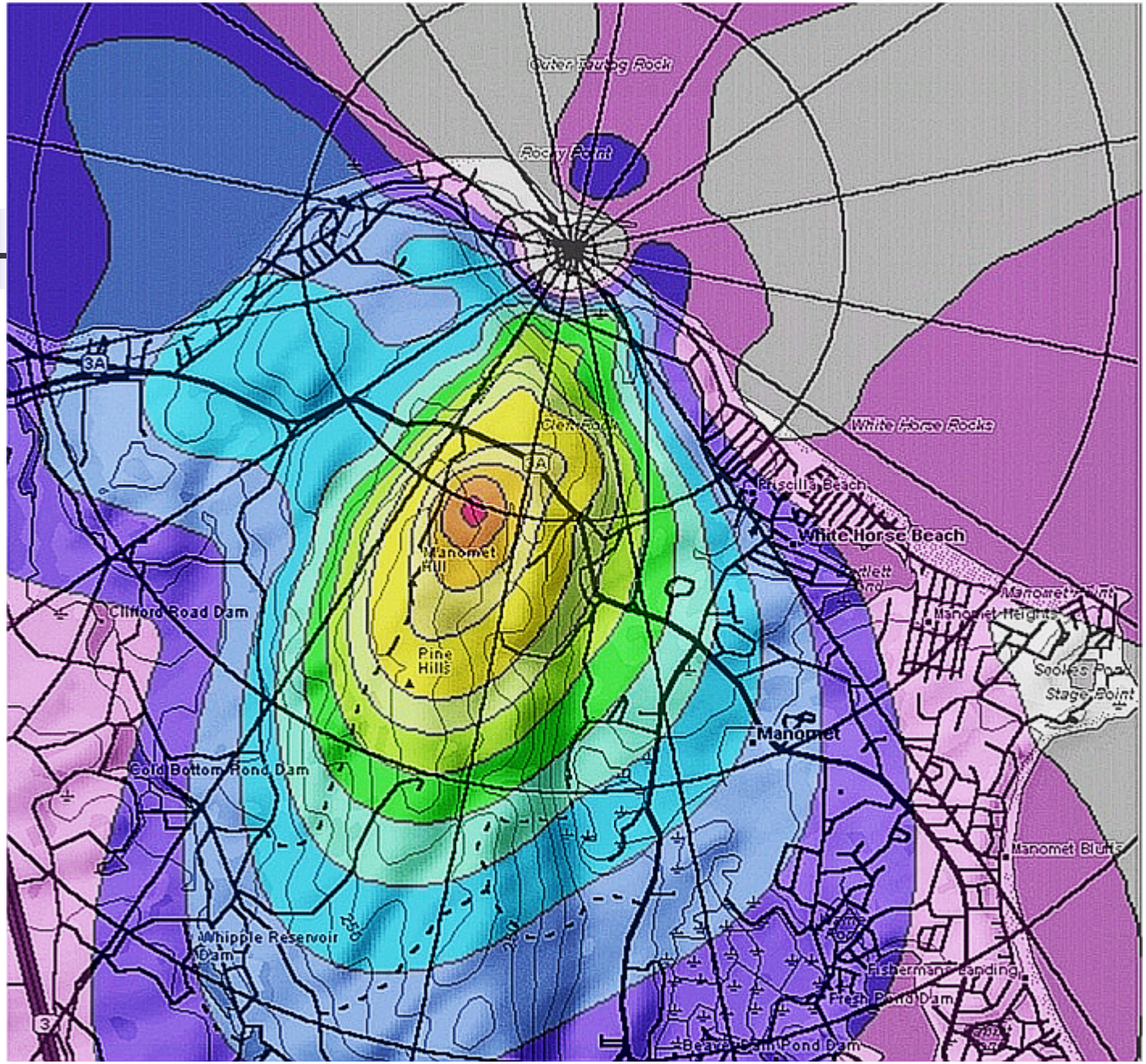
PNPS Wind Rose (from): All Classes



Pilgrim Station Elevated X/Q




Rocky Point
3A
3A
Cleft Rock
White Horse Rocks
250
250
Priscilla Beach
White Horse Beach
Bartlett Pond
Manomet Hill
Manomet Heights
Pine Hills
Manomet
Cold Bottom Pond Dam
3A


Outer Toutog Rock
Rocky Point
3A
Clark Rock
3A
White Horse Rocks
Priscilla Beach
White Horse Beach
Manomet Hill
Clifford Road Dam
Pine Hills
Manomet Point
Manomet Heights
Stage Point
Manomet
Gold Bottom Pond Dam
Manomet Bluffs
Whipple Reservoir Dam
Fisherman's Landing
Fresh Pond Dam
3
Beaver Dam Pond Dam

What about Carbon-14?

- C-14 doses usually dominate the maximum dose for particulates+iodines+tritium
- C-14 dose is based on X/Q, not D/Q
- Not an issue because --
  - Highest D/Q usually occurs in tandem with highest X/Q
  - NUREG-1301/1302 REMP sample placement guidance pre-dates the “requirement” for C-14 dose calculation that came about in 2010
  - No requirement to measure C-14 in REMP samples

Summary

- Indicator locations are straight-forward based on highest D/Q values
  - Exercise caution with elevated release points
- Best criterion to select control sampler location is based on low D/Q values
  - Second choice is downwind in the sector with the shortest petal on a “to” wind rose
  - Third choice is upwind in the sector with the longest petal on a “from” wind rose

Questions?