

An assessment of air parcel trajectories affecting Tucson, Green Valley, Saguaro NP East and the proposed Rosemont Copper mine site

Robert A. Maddox

Rosemont consultants have argued the following regarding pollutant transport to the Rosemont site (Section 4.7, pp. 27-28, of the FEIS reference JBR Environmental Consultants Inc. 2012e):

“Transport of emissions to the Rosemont site from Tucson and Interstate 10 (I-10) to effect[sic] background concentrations at the site is highly unlikely as illustrated by wind roses for the Rosemont site (Figures 3.2 through Figure 3.4) and for the Tucson airport (Figure 4.1).

Any emissions transported toward Rosemont from the north or northwest, such as from the Tucson metropolitan area, would have to travel over or around the higher elevations in those directions. Any emissions transported toward Rosemont from the east would have to overcome the frequent, relatively strong winds from the west. The wind rose from the Tucson airport shown in Figure 4.1 exhibits a pronounced southeasterly component directing emissions away from the site. The primary Tucson winds and their accompanying emissions tend to blow away from the Rosemont location, which is at a distance of approximately 30 miles and over elevations greater than those at the Rosemont site.”

The Rosemont consultants have tried to infer complex, 4-dimensional air parcel transports from simple (i.e., single point and single vertical level) wind roses. This entire section is simply not meteorologically correct or defensible, nor is it appropriate to the very complex terrain of the Rosemont site and the nearby Sky Islands. This entire section amounts to naive hand-waving, without any sound meteorological evidence presented in support of the arguments made. The Rosemont consultants' claim that the Tucson metropolitan area and the I-10 corridor are isolated meteorologically from the Rosemont site is unsubstantiated.

I have examined these issues making use of the state-of-art HYSPLIT – Hybrid Single Particle Lagrangian Integrated Trajectory Model developed at NOAA's Air Resources Laboratory (http://www.arl.noaa.gov/HYSPLIT_info.php). This model enables the user to compute 4-dimensional, air parcel trajectories produced by a number of forecast models. I have done the following using HYSPLIT:

- * Computed air parcel trajectories for 18-hours beginning at 8 pm MST (03 UTC) each day to examine air flows during the most stable time of the day, when pollutant concentrations are usually highest.
- * Used the HYSPLIT variant driven by the NWS NAM forecast model at 12 km resolution.
- * Computed trajectories for three air parcels that were initially at 1) the northeast portion of the Rosemont project area to the west of the Barrel Canyon USGS stream gauge (shown in red below), 2) in Green Valley, Arizona, at the junction of W. Duval Mine Rd. and W. Continental Rd. (shown in blue below), and 3) at the intersection of Alvernon and I-10, where the TEP generating plant is located (shown in green below).

- * Computed the 4-dimensional, forecast trajectories for air parcels that were initially at 20 m above the surface.
- * Considered the trajectory information only during the period that the tracked parcels remained within 500 m of the surface.
- * Considered the months of February, July, August, and October of 2009 to obtain a reasonable sample (i.e., 120 days and 360 separate trajectories) of flow regimes that affect both the Tucson metropolitan area and the Rosemont project site.

Figure 1 illustrates the output from HYSPLIT for one of the days studied – February 1, 2009 – the “stars indicate the starting points of the trajectories and the colored lines are the spatial representation of the paths while the bottom panel shows the height of the parcel above the model’s terrain. This was a stable night and early morning with the parcels remaining very close to the ground while they went their separate ways.

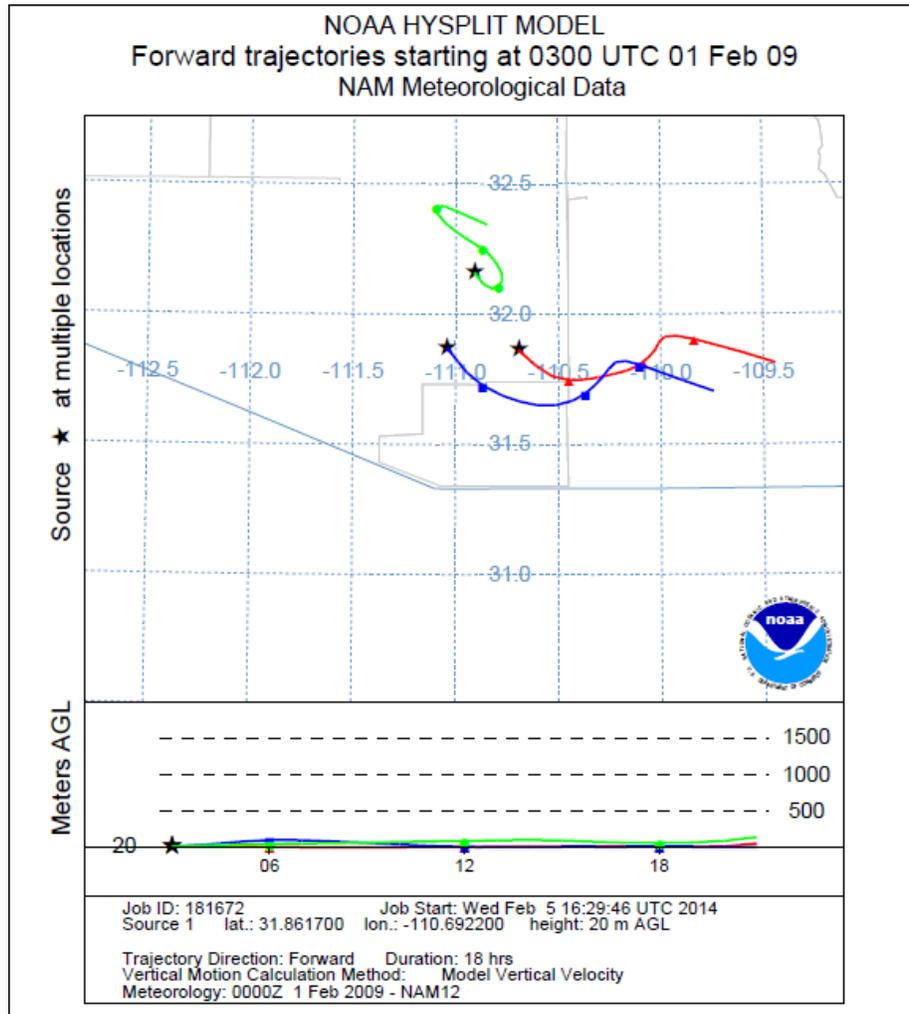


Figure 1

Parcels that began at I-10 and Alvernon and that moved over the Rosemont project area occurred 11 times during the study period (i.e., about 9 percent of the days). An example is shown in Figure 2.

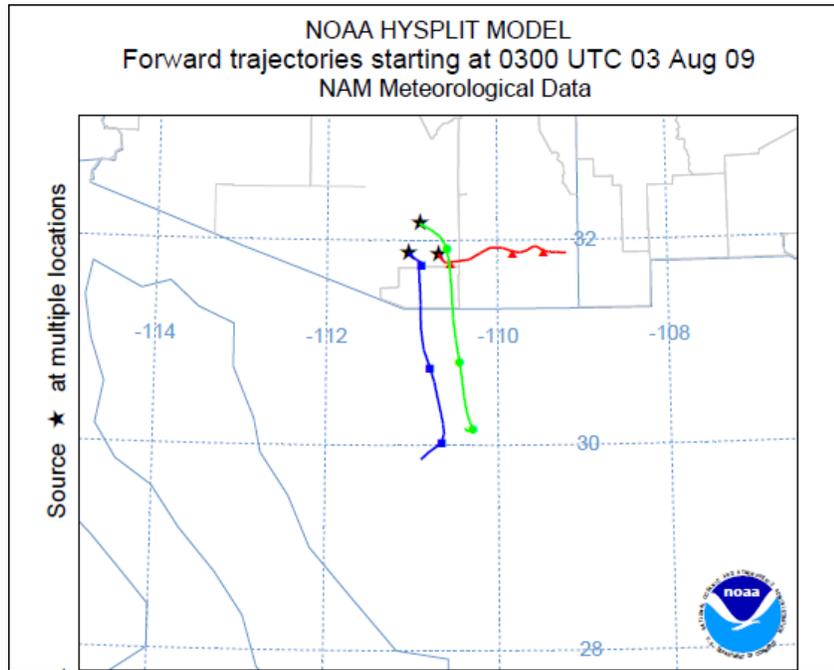


Figure 2

Parcels that began in Green Valley and that moved were over the Rosemont project area occurred 18 times during the study period (i.e., about 15 percent of the days). An example is shown in Figure 3.

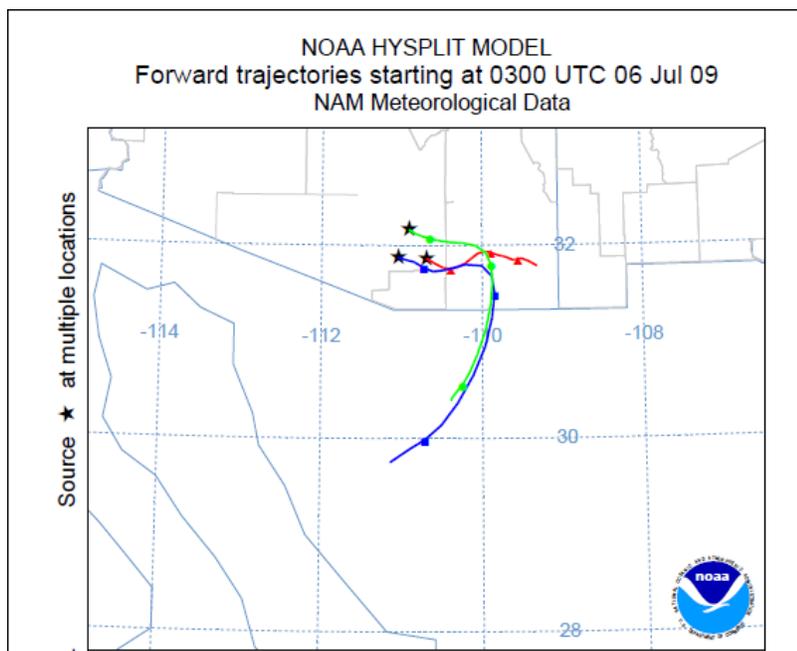


Figure 3

Parcels that began at the Rosemont site and moved over Green Valley occurred on 3 of the days studied (i.e., about 3 percent of the days). An example is shown in Figure 4 (note that this parcel turns northwestward after crossing Green Valley and then affects the western portion of the Tucson metropolitan area).

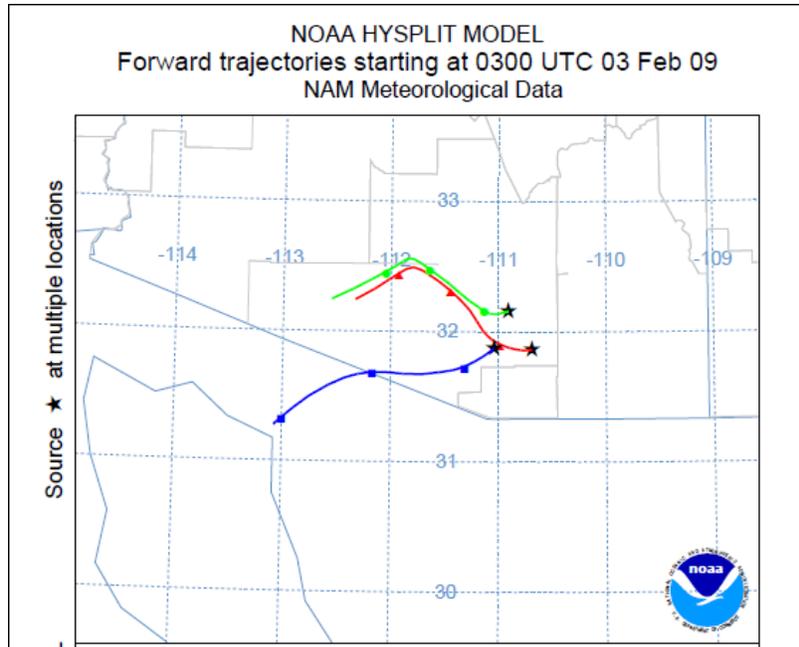


Figure 4

Parcels that began at the Rosemont site and **moved across portions of the Tucson metropolitan area**, below 500 m, occurred on 31 days (i.e., about 26 percent of the days). An example is shown in Figure 5.

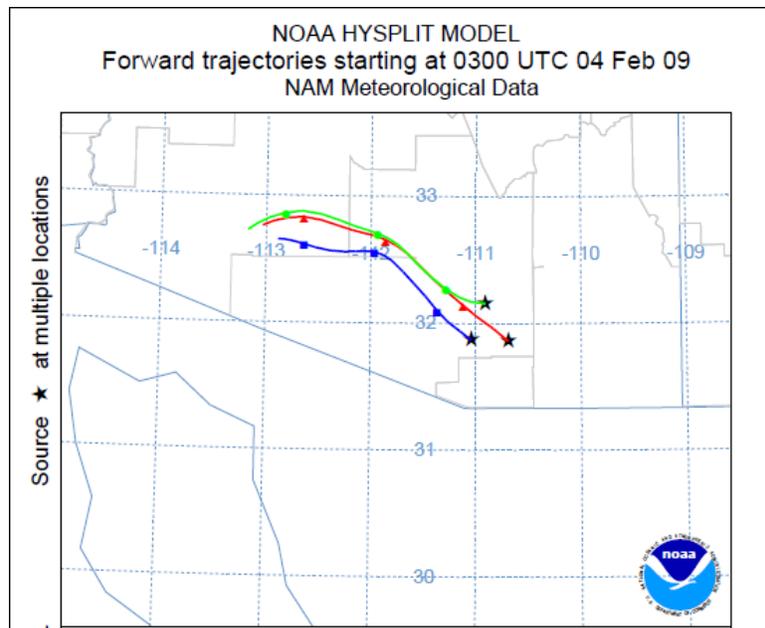


Figure 5

Parcels that began at the Rosemont site and moved across portions of Saguaro NP East occurred on 20 days (i.e., about 17 percent of the days). An example is shown in Figure 6.

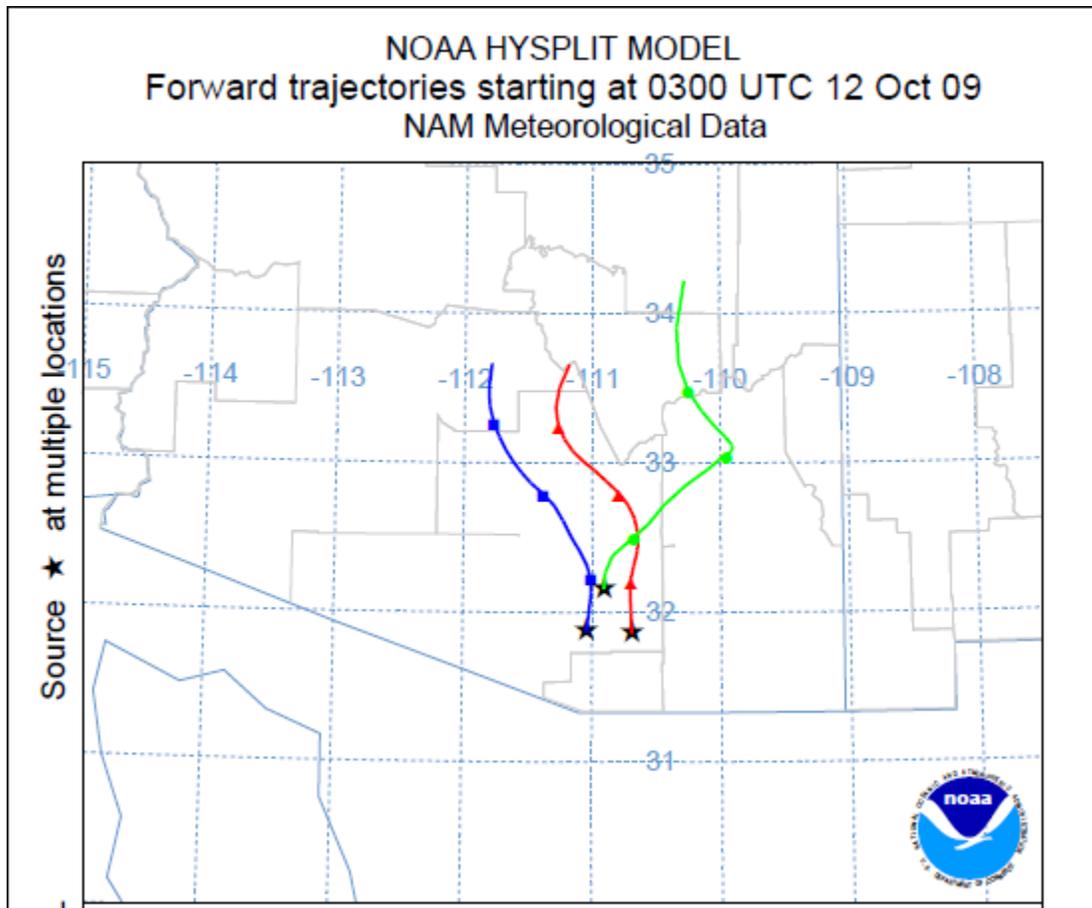


Figure 6

Air flow interactions between the Rosemont site and the Tucson/Green Valley/Saguaro NP East areas occurred on **74 of the days considered** (62 percent of the days). Nine days had double interactions. Rosemont consultants arguments and conclusions (Section 4.7, pp. 27-28, of the FEIS reference JBR Environmental Consultants Inc. 2012e) regarding air flow interaction between these regions, based simply on the wind roses, are simply **not valid**.

The battle between westerly and easterly winds hypothesized by Rosemont consultants (see quote above) to occur between the site and the I-10 corridor to the northeast is also not meteorologically sound. Local winds are determined by the scale of the meteorological forcing (i.e., the local pressure gradients present). When large scale forcing dominates for easterly winds all of southeastern Arizona is affected. The situation can only be evaluated using 4-dimensional air parcel trajectories. There was an extended period during February 2009 when winds over southeastern Arizona had an easterly component (e.g., winds from the northeast or southeast quadrants).

Two cases of stable, near surface trajectories affected the Rosemont site from I-10 (trajectories were done as explained above). These followed frontal passages from the east (sometimes referred to as

“backdoor” fronts) during February 2009. Figure 7 shows one of these cases (Rosemont consultants estimate that such events occur less than 5 percent of the time during an entire year, which may be a low estimate, since they have not considered 4-dimensional air flows).

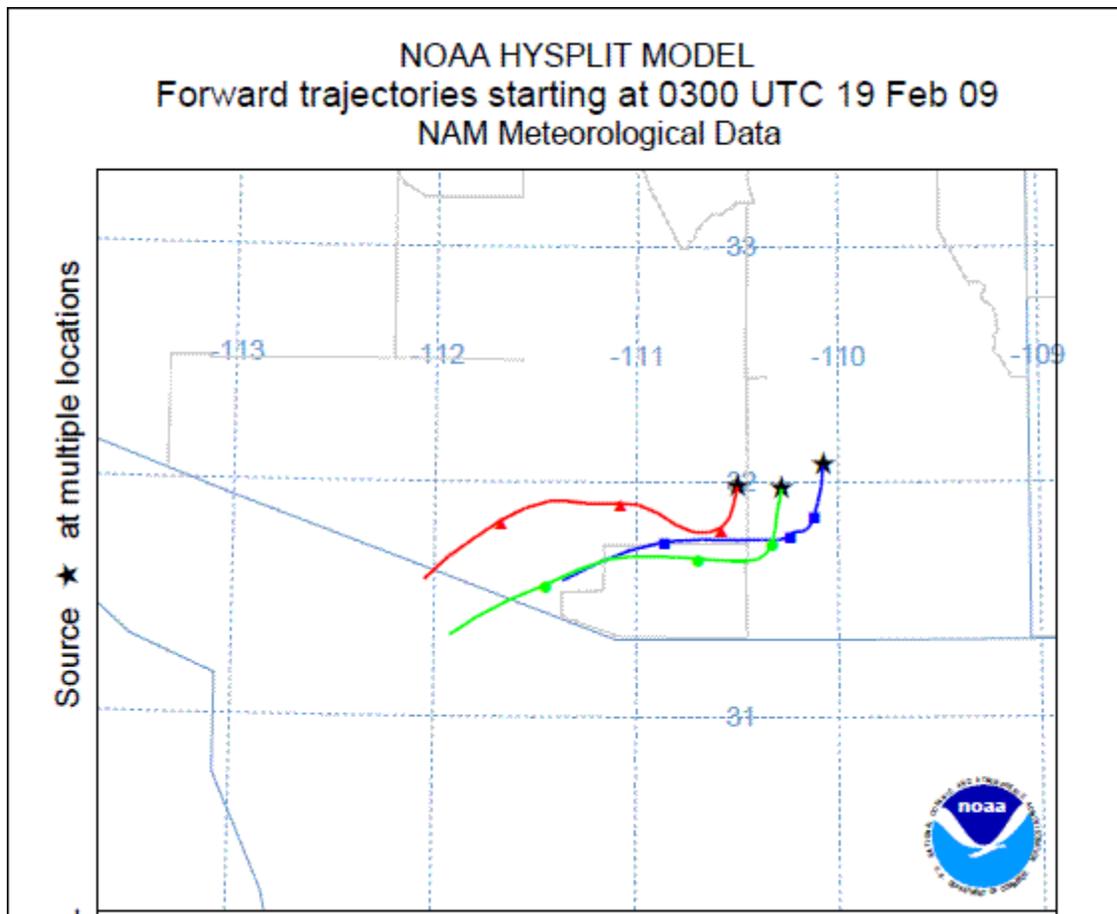


Figure 7 – The parcel trajectories begin at: (a) I-10 on ridge west of Benson, Arizona (shown in red), (b) I-10 at the San Pedro River (shown in green), and (c) I-10 at the Texas Canyon rest area (shown in blue).