# APPENDIX C

# Methodology and Results for Project Health Risk Assessment at Project-Specific Uprail Locations Between Roseville, CA and the Oregon and Nevada Borders

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# Memorandum

**Environmental Resources Management**

1277 Treat Boulevard
Suite 500
Walnut Creek, CA 94597
(925) 946-0455
(925) 946-9968 (fax)

**Re:** Valero Crude By Rail Project

**From:** Cheri Velzy, ERM

**cc:** Lynn McGuire, ERM

**Date:** 22 June 2015

**Subject:** Methodology and Results for Project Health Risk Assessment at Project-Specific Uprail Locations between Roseville, California, and the Oregon and Nevada Borders

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At the request of the City of Benicia (City), ERM performed a health risk assessment to evaluate cancer and chronic non-cancer risks of locomotive emissions from project crude trains traveling between Roseville, California, and the Oregon and Nevada borders. The City requested modeling using the ISC model with available meteorological data near these routes. However, meteorological data for ISC are not available for all the routes. The California Air Resources Board has compiled meteorological data for use with the latest United States Environmental Protection Agency (EPA) dispersion model, AERMOD, which is an update to the ISC model. Since AERMOD-ready processed meteorological data are available for all the selected uprail route locations, ERM used AERMOD to perform the health risk assessment. In addition, updated Office of Environmental Health Hazard Assessment (OEHHA) health risk guidelines, which were released in March 2015, were used in this health risk assessment, and those guidelines recommend the use of AERMOD.

The health risk assessment modeled five locations along the three Union Pacific Railroad lines that run from the Roseville Rail Yard to the Oregon and Nevada borders. These lines, with the locations modeled, include:

- Roseville North Route through Redding to the Oregon border
  - Chico
  - Redding
- Feather River Canyon Route
  - Marysville
- Truckee Route to the Nevada border
  - Auburn
  - Truckee

Attachment 1 includes the train-specific data and calculations for the emissions used in the health risk assessment, and the modeling assumptions.

## *AERMOD*

The EPA AERMOD dispersion model was used to estimate diesel particulate matter (DPM) pollutant concentrations for the health risk assessment. Processed meteorological data for AERMOD were available for all the selected uprail locations. The locomotive emissions were modeled as a series of volume sources to represent a line source. A grid was established around the track area modeled, and additional discrete receptors were placed on residences near the tracks not coinciding with a grid point.

### *Meteorological Data*

The following meteorological data sets were used with the modeled track areas:

- Chico – Chico Municipal Airport
- Redding – Redding Municipal Airport
- Marysville – Yuba County Municipal Airport
- Auburn – Auburn Municipal Airport
- Truckee – Truckee-Tahoe Airport

## *RISK CALCULATIONS*

Cancer and chronic health risks are calculated for DPM, the pollutant of concern in locomotive emissions. The approach makes use of the concentrations predicted by dispersion modeling using AERMOD. The resulting concentrations at each receptor are referred to as "$\chi/Q$", (ground-level concentrations per emission rate). Detailed risk calculation methodologies are presented in Attachment 2.

## *RISK ASSESSMENT RESULTS*

The results of the analysis are shown in Table 1. This table presents the results at the point of maximum impact (PMI), which in some cases does not coincide with a residential location. However, the risk at all residential locations would be less than that at the PMI. The modeling grid used in the health risk assessment provided sufficient

coverage to capture the risks at nearby residential locations. Figures showing the cancer and chronic hazard index results at the PMI are included in Attachment 3, Figures 1 through 5.

Table 1 includes reference to risk thresholds of 10 in one million for cancer risk and 1.0 for chronic hazard index (per Assembly Bill 2588 air toxic "hot spots" public notification thresholds). Two of the subject air districts between Roseville and the California border (Feather River and Shasta) have not published risk thresholds for cancer risk and chronic hazard impacts for CEQA purposes. Butte County has proposed these risk thresholds, but they have not been adopted yet. Placer County has included these risk thresholds in its health risk assessment methodology in its CEQA Handbook. However, the State's AB2588 stationary source notification thresholds are applicable in these jurisdictions and correspond to levels below which public notification of risk is deemed unnecessary. There are no similar thresholds for mobile sources. Therefore, many districts have utilized the stationary source notification thresholds for non-stationary sources for comparison purposes. The risk threshold values listed in AB2588 are also equivalent to the Bay Air Air Quality Management District's CEQA thresholds of 10 in one million (cancer risk) and 1.0 (chronic hazard index), and have been used for both stationary and mobile sources. These thresholds are referenced in the HRA impact analysis presented in the 2014 Crude by Rail Project DEIR. Thus, they are shown here for comparison of the health risk impacts from the emissions in uprail locations from the project rail activity. All values are less than their comparative risk thresholds.

***Table 1 Maximum Cancer Risk and Chronic Hazard Index near Rail Tracks from Locomotive DPM Emissions at Uprail Locations in California***

| Location of Estimated Health Impact | Cancer Risk (per million) | Chronic Hazard Index | DPM Annual Average Concentration ($\mu g/m^3$) |
|---|---|---|---|
| Marysville - eastern | 5.5 | 0.0011 | 0.0052 |
| Marysville - western | 4.9 | 0.0009 | 0.0047 |
| Chico | 5.5 | 0.0011 | 0.0052 |
| Redding | 6.3 | 0.0012 | 0.0060 |
| Auburn – eastern | 4.6 | 0.0009 | 0.0043 |
| Auburn - western | 5.2 | 0.0010 | 0.0050 |
| Truckee | 4.5 | 0.0009 | 0.0043 |
| AB2588 Risk Threshold | 10 | 1 | N/A |

*Attachment 1*

*Modeling Data, Assumptions, and Emission Factors*

**Crude by Rail Project**
**Locomotive DPM Emissions for CEQA Modeling**

**Year 2015 Annual Locomotive DPM Emissions - 100 Railcars per Day**

| Parameter | Value | Unit | Reference |
|---|---|---|---|
| Additional Annual Tank Cars due to Project | 36,500 | Cars/year | Based on Project Description assume 2 (50 tank cars each) per day |
| Maximum Net Freight Weight | 106 | short tons/car | TRN Spec Sheet-1 |
| Annual Freight Transported due to Project | 3,861,700 | short tons/year | Based on Project Description (multiplication of cars * freight weight) excludes weight of empty car |
| Weight of Empty Tank Car | 37 | short tons/car | TRN Spec Sheet-1 |
| Total Annual Weight of Empty Tank Cars | 1,357,800 | short tons/year | |
| Annual Gross Weight Hauled | 5,219,500 | short tons/year | Freight Weight + Empty Railcar Weight |
| Number of Railcars per Train | 50 | Cars/train | |
| Length of Line Source | Varies | feet | Model Source Dependent |
| Average Fuel Efficiency[1] | 1005 | ton-mi/gal | EPA-420-R-92-009 with fuel and ton-mile information for UP. |
| Average Train Size | 50 | cars/train | Project Description |
| Length of Railcars | 60 | ft | Spec Sheet |
| Number of Trains per Day | 2 | trains/per day | |

[1]Based on data collected by the Association of American Railroads for revenue ton-miles and fuel consumption.
Thus dividing g/gal emission rates by average fuel efficiency gives approximate g/ton-mile emission rates.
This factor in all emission estimates has been corrected to 1005 ton-mile per gallon based on a comment from BAAQMD in September 2014.

| **Source Type - Mode** | **2015 PM10 Locomotive Emissions Factor** | |
|---|---|---|
| | **Value** | **Unit** |
| Line Source - Running Full[1] | 3.4 | g/gal fuel |
| Line Source - Running Empty[1] | 3.4 | g/gal fuel |
| Total | | |
| 1. Emission Factors for large line haul Locomotives in calendar year 2015.<br>Source: EPA-420-F-09-025, April 2009 | | |

| Locomotive Line Haul - Line Source (As Separated Volume Source) | | | | | |
|---|---|---|---|---|---|
| Track Length Considered for Modeling | | 20,640 | feet | 3.9 | miles |
| Length of the Line Source, $L_{RS}$ | | 20,640 | ft | 3.9 | miles |
| Width of the Line Source, W (Width of one track + 3 m on each side)* | | 30 | ft | 9.1 | m |
| Source Type | | Line source represented by separated volume sources, Elevated source not on or adjacent to a building | | | |
| Length of the Side of the Line/Volume Source = W | | 30 | ft | 9.1 | m |
| Spacing of Separated Volume Source Along Line (c/c) | Fairfield, Dixon, Sacramento, and Placer | 59 | ft | 18.1 | m |
| | Auburn, Chico, Marysville, Redding and Truckee | 60 | ft | 18.3 | m |
| Starting Location | | Offset Half Volume Width | | | |
| Release Height (stack height of 15 ft + avg. vertical plume rise)* | | 45.8 | ft | 13.95 | m |
| Initial Lateral Dimension (SYINIT) = 2W/2.15 | | 27.62 | | 8.42 | m |
| Initial Vertical Dimension (SZINIT) = Release Height/4.3 | | 10.64 | | 3.24 | m |
| Number of Volume Sources Modeled: | | | | | |
| | Fairfield | 51 | volume sources/line | 51 | volume sources/line |
| | Dixon | 50 | volume sources/line | 50 | volume sources/line |
| | Sacramento | 51 | volume sources/line | 51 | volume sources/line |
| | Placer | 52 | volume sources/line | 52 | volume sources/line |
| | Auburn | 376<br>351 | volume sources/line | 376<br>351 | volume sources/line |
| | Chico | 384 | volume sources/line | 384 | volume sources/line |
| | Marysville | 201<br>160 | volume sources/line | 201<br>160 | volume sources/line |
| | Redding | 478 | volume sources/line | 478 | volume sources/line |
| | Truckee | 344 | volume sources/line | 344 | volume sources/line |

*Appendix C3, Health Risk Assessment for the Southern, California Intermodal Gateway (SCIG), Pg 23/89, http://www.portoflosangeles.org/EIR/SCIG/DEIR/APPENDIX_C3.pdf

Release parameters obtained from Railyard studies such as

http://www.arb.ca.gov/railyard/hra/env_sheila_admrpt.pdf

http://www.arb.ca.gov/railyard/hra/sr_oak_rpt.pdf

* Average of day time and night time release height for arriving and departing line haul in Table 4-1. http://www.arb.ca.gov/railyard/hra/env_richmond_admrpt.pdf

*Attachment 2*

# *Health Risk Calculation Methodology using the Updated OEHHA Guidelines*

## *ATTACHMENT 2*

## *HEALTH RISK CALCULATIONS*

OEHHA, the state agency that establishes procedures for calculating health risk from toxic air contaminants, updated its guidelines on 6 March 2015 for estimating health risks. This update requires explicit consideration of the effect of toxic air contaminant concentrations on infants, children, and adults. The updated OEHHA guidelines have different values to account for varied breathing rates in different age groups. This results in an overall increase in breathing volume over a 70-year period.

Equation [1] is the approach used to calculate cancer risk per the updated OEHHA guidelines. The updated OEHHA guidelines also require age sensitivity factors (ASFs) to reflect increased cancer risk susceptibility in younger age groups, which are applied to cancer risks calculated over the exposure duration of each age bin. These age-specific breathing rates and ASFs were used in this current analysis, and are shown in Table A1-1.

Equation [1]:

$$\text{Cancer Risk} = ER \times SF \times ({}_i\sum \chi/Q \times (ED_i/AT) \times ASF_i \times BR_i \times EF \times [1/1000])$$

*where:*

$\chi/Q$ = Concentration modeled for unit emission rate [$(\mu g/m^3)/(g/s)$]
ER = Emission rate of DPM
SF = cancer slope factor for DPM [$(mg/kg\ BW\text{-}day)^{-1}$]
$ED_i$ = exposure duration in age bin i [years]
AT =averaging period (70 years for lifetime cancer risk)
$ASF_i$ = Age sensitivity factor in age bin i
$BR_i$ = Breathing rate in age bin i [liters (L) of air per kg of body weight per day]
EF = exposure frequency (days per 365 days)
[1/1000] = Conversion factor: mg/1000 μg

*Table A1-1 Factors Applied to HRA Based on Updated OEHHA Guidelines*

| Age Bins (i) | Exposure Duration[1] (years) | Age Sensitivity Factor[1] | Breathing Rates[2] (L/kg BW-day) |
|---|---|---|---|
| 3rd Trimester | 0.25 | 10 | 361 |
| 0 < 2 Years | 2 | 10 | 1,090 |
| 2 < 16 Years | 14 | 3 | 745 |
| 16 < 70 Years | 54 | 1 | 290 |

[1]Use of a 70-year exposure duration and ASFs listed here is consistent with the methodology used in the HRA analysis prepared for the initial DEIR.
[2]The 2014 Crude by Rail Project DEIR HRA analysis used a recommended breathing rate of 302 liters/kilogram of bodyweight per day (L/kg BW-day). These age-specific breathing rates represent the 95th percentile rates for each age bin. Due to potential differences in implementation of the guidance on breathing rates by individual air districts, use of 95th percentile for all ages is considered conservative.

Chronic health hazard index is simply the modeled DPM concentration divided by the OEHHA Reference Exposure Level (REL) for DPM, which is 5 $\mu g/m^3$.

*Attachment 3*

*(Figure 1 through Figure 5)*

Created By: Date: 6/1/2015 Project: 0274904

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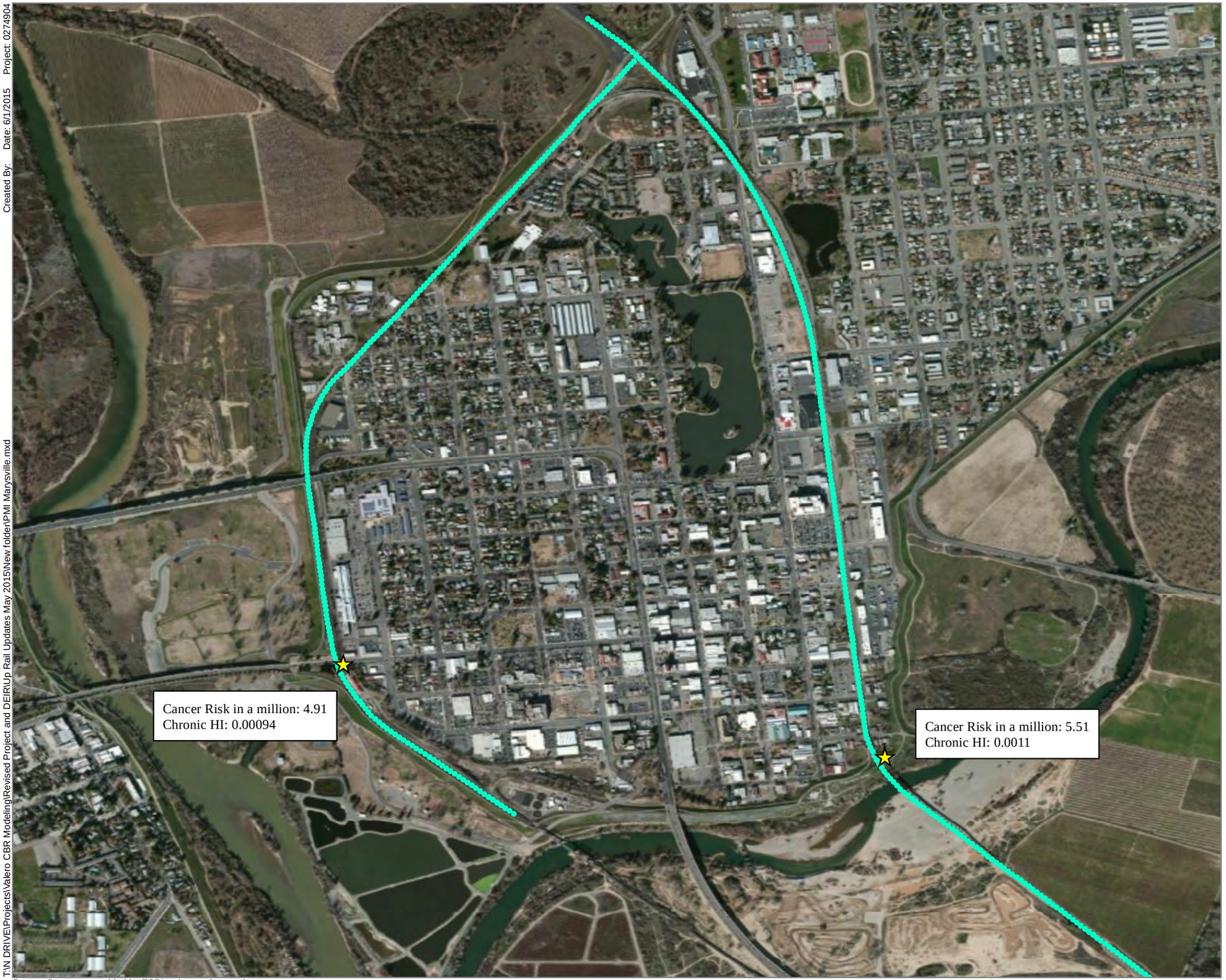

**Legend**

PMI

Marysville Rail Sources

0 500 1,000 2,000 Feet

Source: Basemap provided by ESRI web mapping services

**Figure 1**
*Marysville Rail Segments: Point of Maximum Impact (PMI) Cancer Risk and Chronic HI*

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Project: 0274904
Date: 6/1/2015
Created By:
T:\N DR\VE\Projects\Valero CBR Modeling\Revised Project and DEIR\Up Rail Updates May 2015\New folder\PMI Chico.mxd

**Legend**

PMI

Chico Rail Sources

N

0 1,100 2,200 4,400 Feet

Source: Basemap provided by ESRI web mapping services

ERM

**Figure 2**
*Chico Rail Segments:*
*Point of Maximum Impact (PMI)*
*Cancer Risk and Chronic HI*

Created By: Date: 5/29/2015 Project: 0274904

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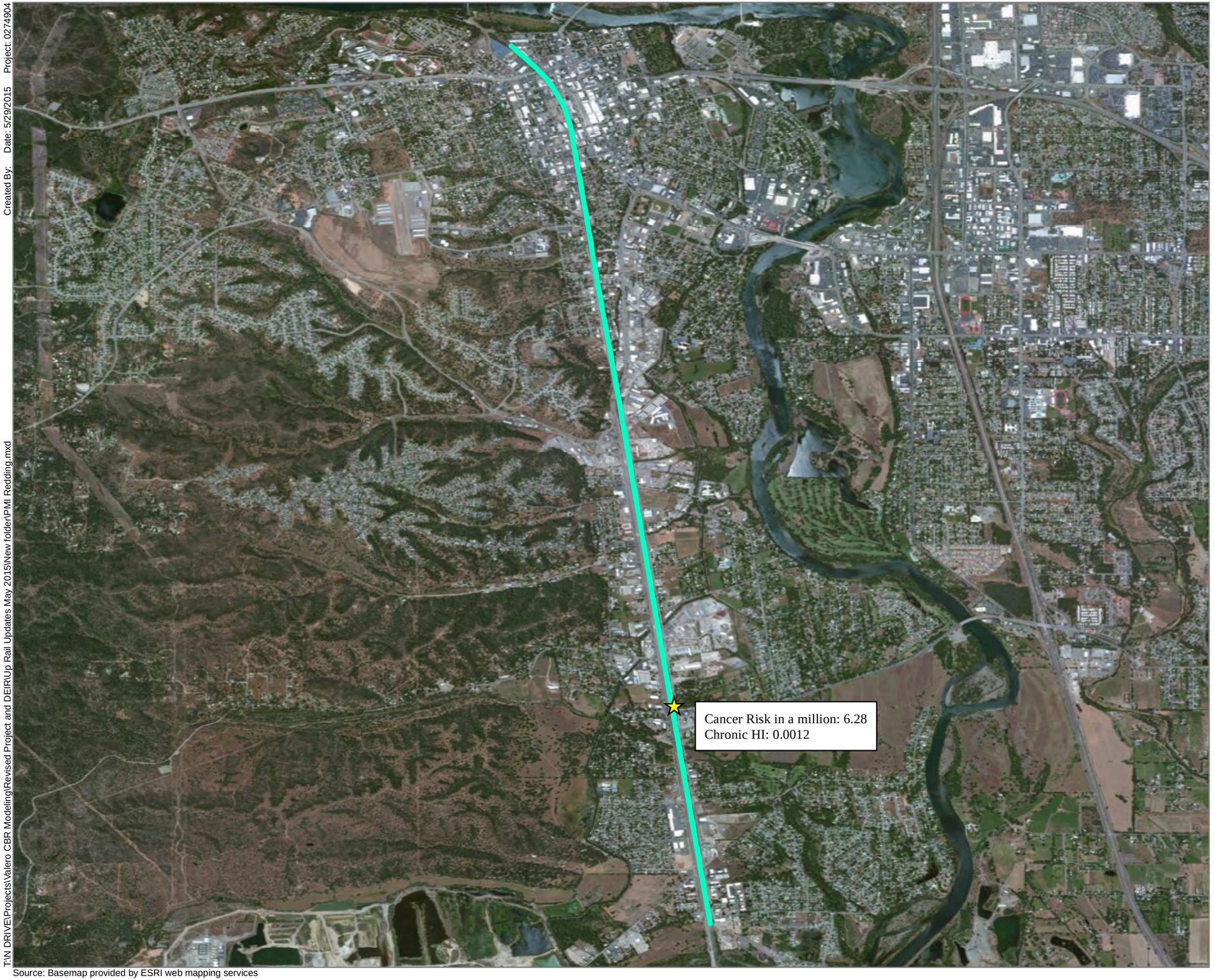


**Legend**

- Redding Rail Sources

N

0 1,550 3,100 6,200 Feet

Source: Basemap provided by ESRI web mapping services

ERM

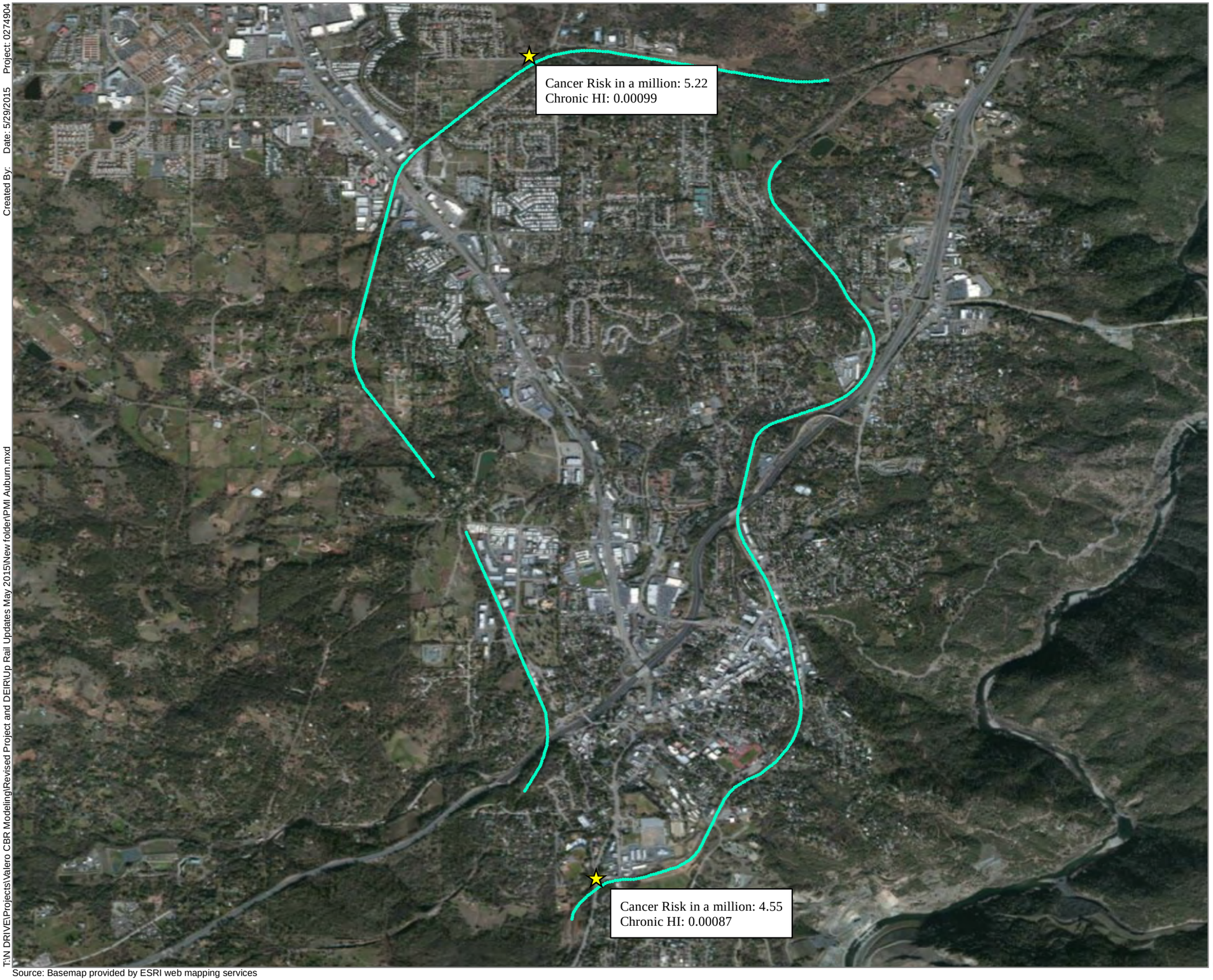
**Figure 3**
*Redding Rail Segments:*
*Point of Maximum Impact (PMI)*
*Cancer Risk and Chronic HI*

Project: 0274904

Date: 5/29/2015

Created By:

T:\N DRIVE\Projects\Valero CBR Modeling\Revised Project and DEIR\Up Rail Updates May 2015\New folder\PMI Auburn.mxd



**Legend**

- Auburn Rail Sources

N

0 1,100 2,200 4,400 Feet

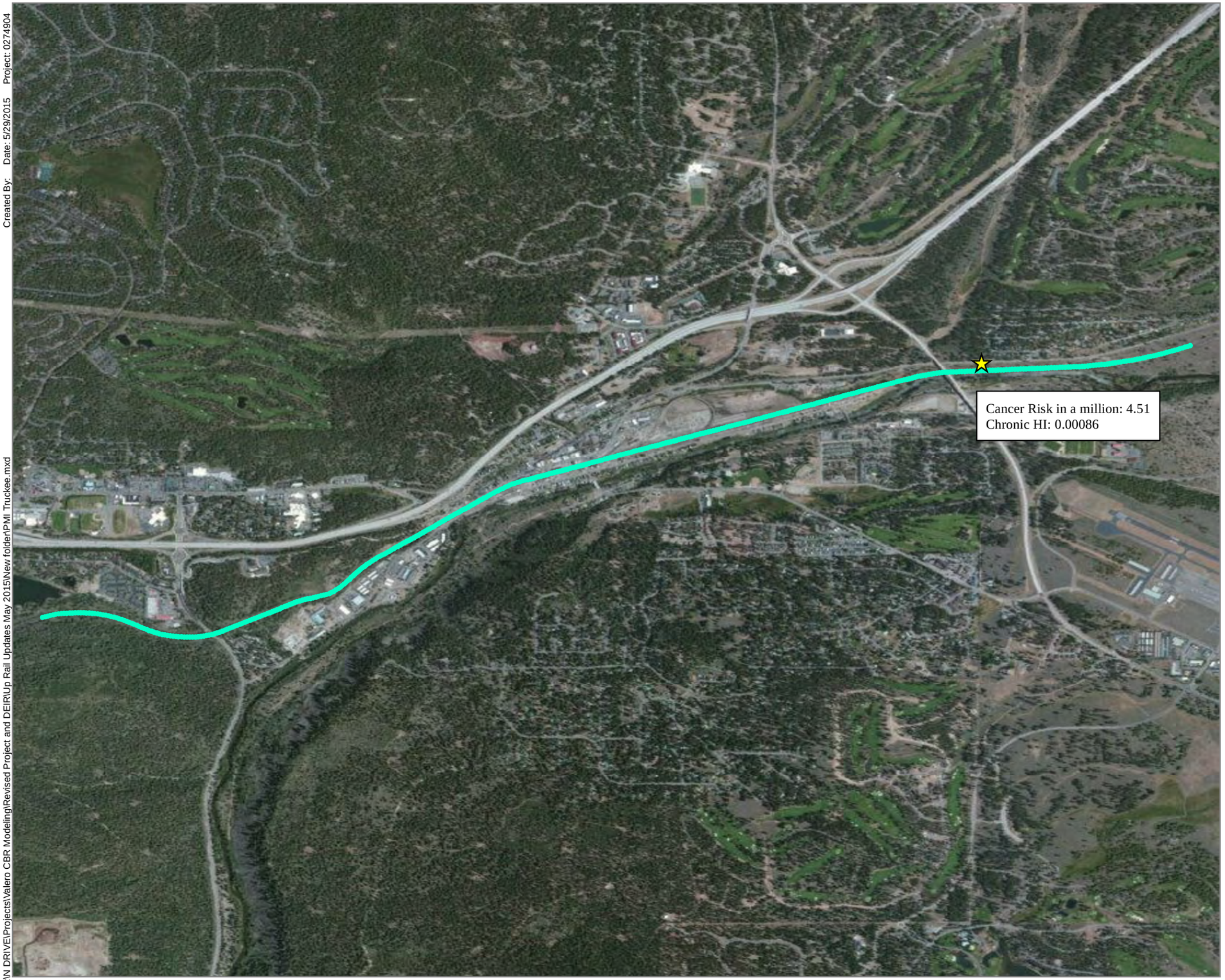
Source: Basemap provided by ESRI web mapping services

ERM

**Figure 4**
*Auburn Rail Segments:*
*Point of Maximum Impact (PMI)*
*Cancer Risk and Chronic HI*

Created By: Date: 5/29/2015 Project: 0274904

T:\N DRIVE\Projects\Valero CBR Modeling\Revised Project and DEIR\Up Rail Updates May 2015\New folder\PMI_Truckee.mxd



**Legend**

- Truckee Rail Sources

N

0 1,050 2,100 4,200 Feet

Source: Basemap provided by ESRI web mapping services

ERM

**Figure 5**
*Truckee Rail Segments:*
*Point of Maximum Impact (PMI)*
*Cancer Risk and Chronic HI*