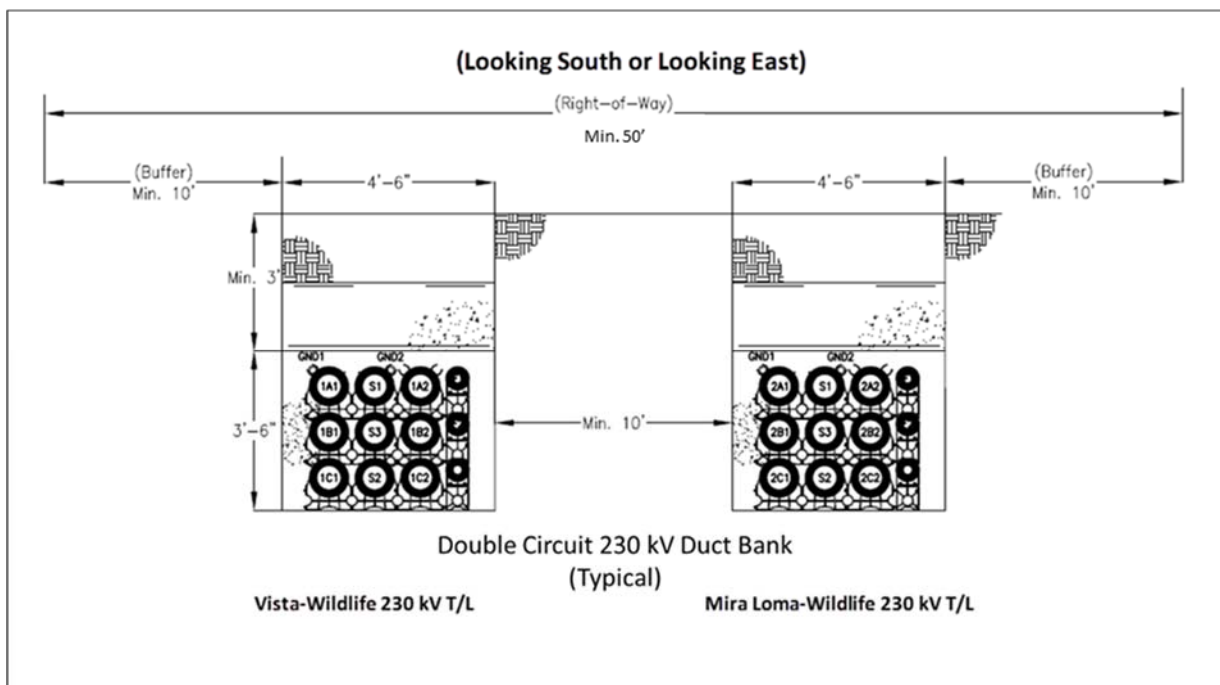


Riverside Transmission Reliability Project (RTRP) Hybrid Route
EMF Analysis for the Underground Segment

In response to the CPUC Data Request #4 on A. 15-04-013, the following EMF analysis is based on preliminary engineering design with a set of assumptions. The purpose of the EMF analysis is not to predict the actual magnetic field levels of the underground construction transmission line (T/L) segment, but to compare various design options for no-cost and low-cost field reduction measures.

Typical cross-sectional of the proposed 230 kV T/L construction method is shown in the figure below. Magnetic field levels at the edge of the right-of-way (ROW) were evaluated for no-cost and low-cost field reduction measures.

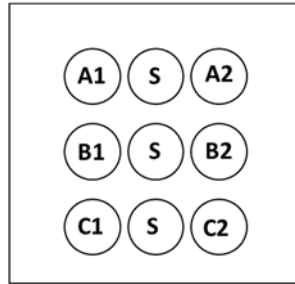


Assumptions in EMF Analysis:

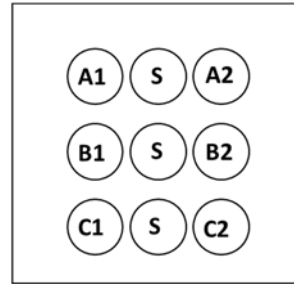
- Forecasted peak load flows for Year 2024 are used in EMF calculations
- Vista-Wildlife and Mira Loma-Wildlife 230 kV T/L have opposite load flow directions under normal operating conditions
- Each T/L circuit has two sub-circuits
- Edges of duct banks were assumed to be at least 10 feet from ROW edges
- Evaluations are done for majority of the underground segment, not for areas with vault or horizontal directional drillings (HDD)
- Magnetic field strength was calculated at a height of 1 meter (3.28 feet) above ground
- Underground T/L cables are assumed to be flat and infinitely long
- Terrain was assumed to be flat
- EMF unit is milliGauss (mG)

Four options of phase cable arrangement were chosen for evaluation for the range of EMF levels. EMF levels of all other arrangement options would be equivalent or fall in between these four options.

Option 1 (ABC-ABC and ABC-ABC)

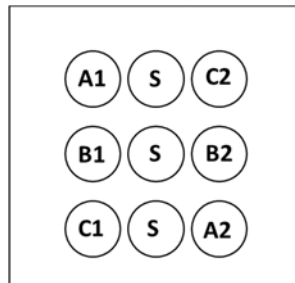


Vista-Wildlife 230 kV T/L

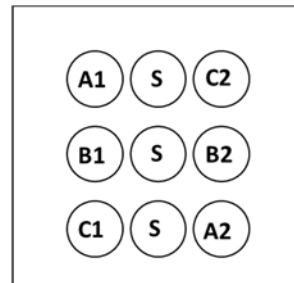


Mira Loma-Wildlife 230 kV T/L

Option 2 (ABC-CBA and ABC-CBA)

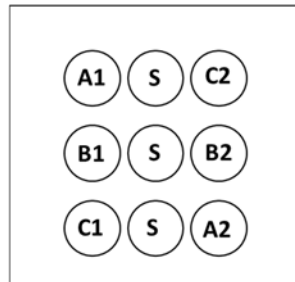


Vista-Wildlife 230 kV T/L

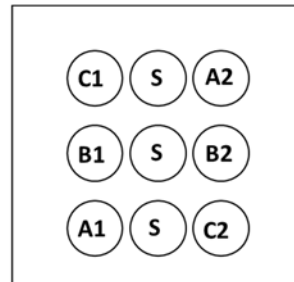


Mira Loma-Wildlife 230 kV T/L

Option 3 (ABC-CBA and CBA-ABC)

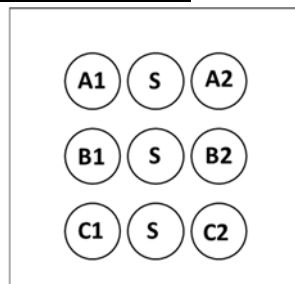


Vista-Wildlife 230 kV T/L

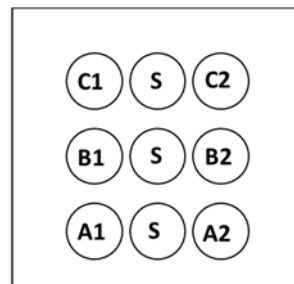


Mira Loma-Wildlife 230 kV T/L

Option 4 (ABC-ABC and CBA-CBA)



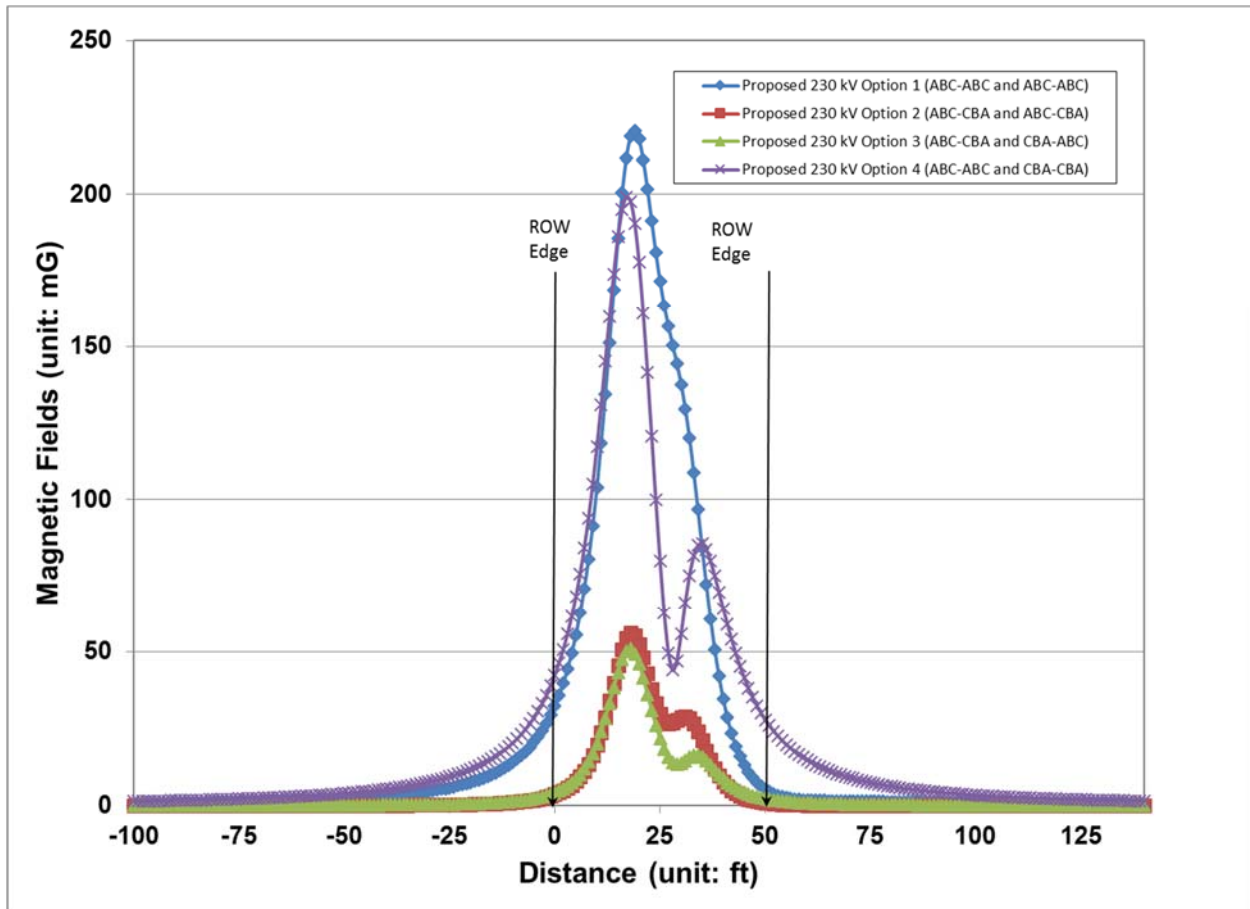
Vista-Wildlife 230 kV T/L



Mira Loma-Wildlife 230 kV T/L

*Note: S = Spare conduits

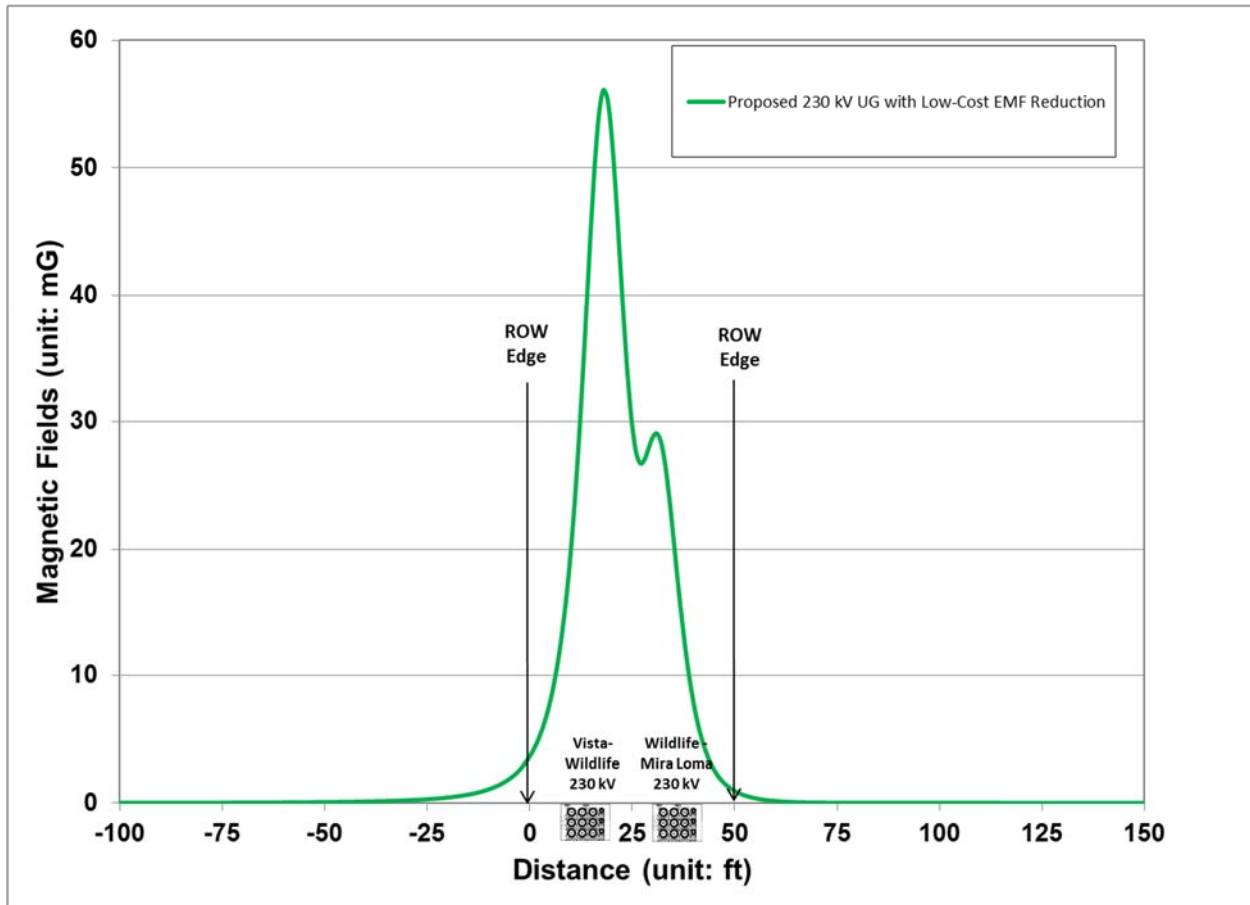
Calculated EMF:



Design Options	Left ROW (mG)	% Reduction Compared to Previous Option	Right ROW (mG)	% Reduction Compared to Previous Option
Proposed 230 kV Option 1 (ABC-ABC and ABC-ABC)	32.4		5.3	
Proposed 230 kV Option 2 (ABC-CBA and ABC-CBA)	3.6	88.9	0.9	83.0
Proposed 230 kV Option 3 (ABC-CBA and CBA-ABC)	4.2	Less than 15% Increase	2.3	Increase
Proposed 230 kV Option 4 (ABC-ABC and CBA-CBA)	42.4	Increase	27.9	Increase

Design Options	Peak Magnetic Field Values within ROW (mG)
Proposed 230 kV Option 1 (ABC-ABC and ABC-ABC)	220
Proposed 230 kV Option 2 (ABC-CBA and ABC-CBA)	56
Proposed 230 kV Option 3 (ABC-CBA and CBA-ABC)	51
Proposed 230 kV Option 4 (ABC-ABC and CBA-CBA)	198

Option 2 is the best design option if it is deemed feasible to implement during the final engineering phase. The low-cost EMF reduction measure of phasing using Option 2 configuration is recommended. The graph below shows the detailed graph for Option 2.



Design Options	Left ROW (mG)	% Reduction	Right ROW (mG)	% Reduction
Proposed 230 kV UG with Low-Cost EMF Reduction	3.6		0.9	

Conclusion

Option 2 is the best possible phase cable arrangement with significant field reduction at edges of ROW. Option 3 is the next best option. The no-cost or low-cost measure of arrange conductors to reduce magnetic field is recommended if it is deemed feasible to implement during the final engineering design phase.