

Kennedy/Jenks Consultants

Engineers & Scientists

Groundwater Extraction and Treatment to Protect a Groundwater Supply

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2008 PNWS - AWWA Conference
TACOMA WASHINGTON

Overview



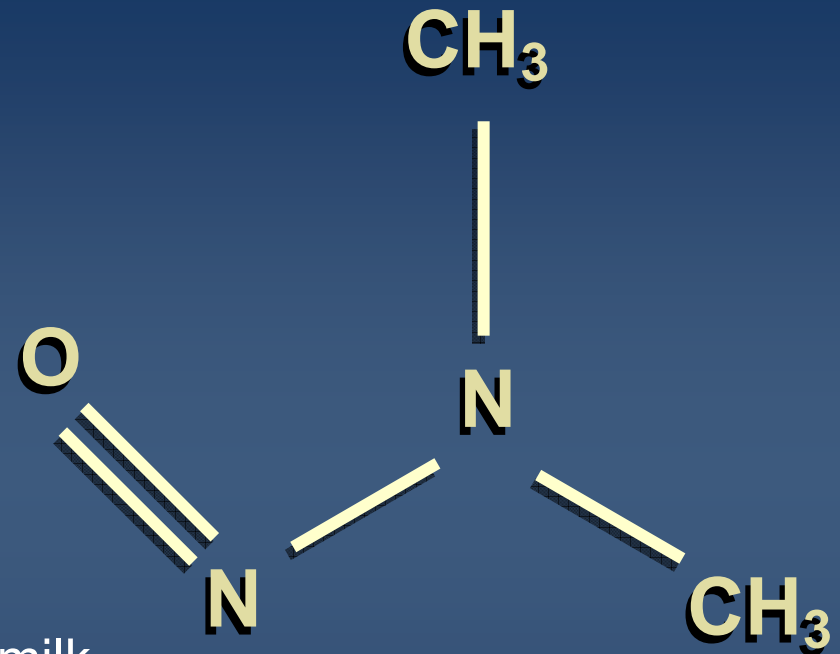
- ▼ Background
- ▼ Facility Design & Construction
- ▼ Performance



N-Nitrosodimethylamine (NDMA)



- ▼ Semi-volatile organic chemical
- ▼ UMCR 2 list
- ▼ Sources
 - | Rocket fuel production
 - | Chloramination
 - Wastewater
 - Reclaimed water (aquifer recharge)
 - Some surface water
 - | Meat, cured meat, fish, beer, milk, cheese
 - | Tobacco smoke
 - | Precursors - IX resins & cationic polymers with amine groups



NDMA Health Considerations



- ▼ EPA – probable human carcinogen
- ▼ California – human carcinogen
- ▼ 10^{-6} Cancer Risk
 - | EPA – 0.7 ppt (0.0007 $\mu\text{g}/\text{l}$)
 - | California – 3 ppt (0.003 $\mu\text{g}/\text{l}$)
- ▼ No MCL
- ▼ California Notification Level – 10 ppt (0.01 $\mu\text{g}/\text{l}$)
- ▼ Response Level – 200 ppt (0.2 $\mu\text{g}/\text{l}$)

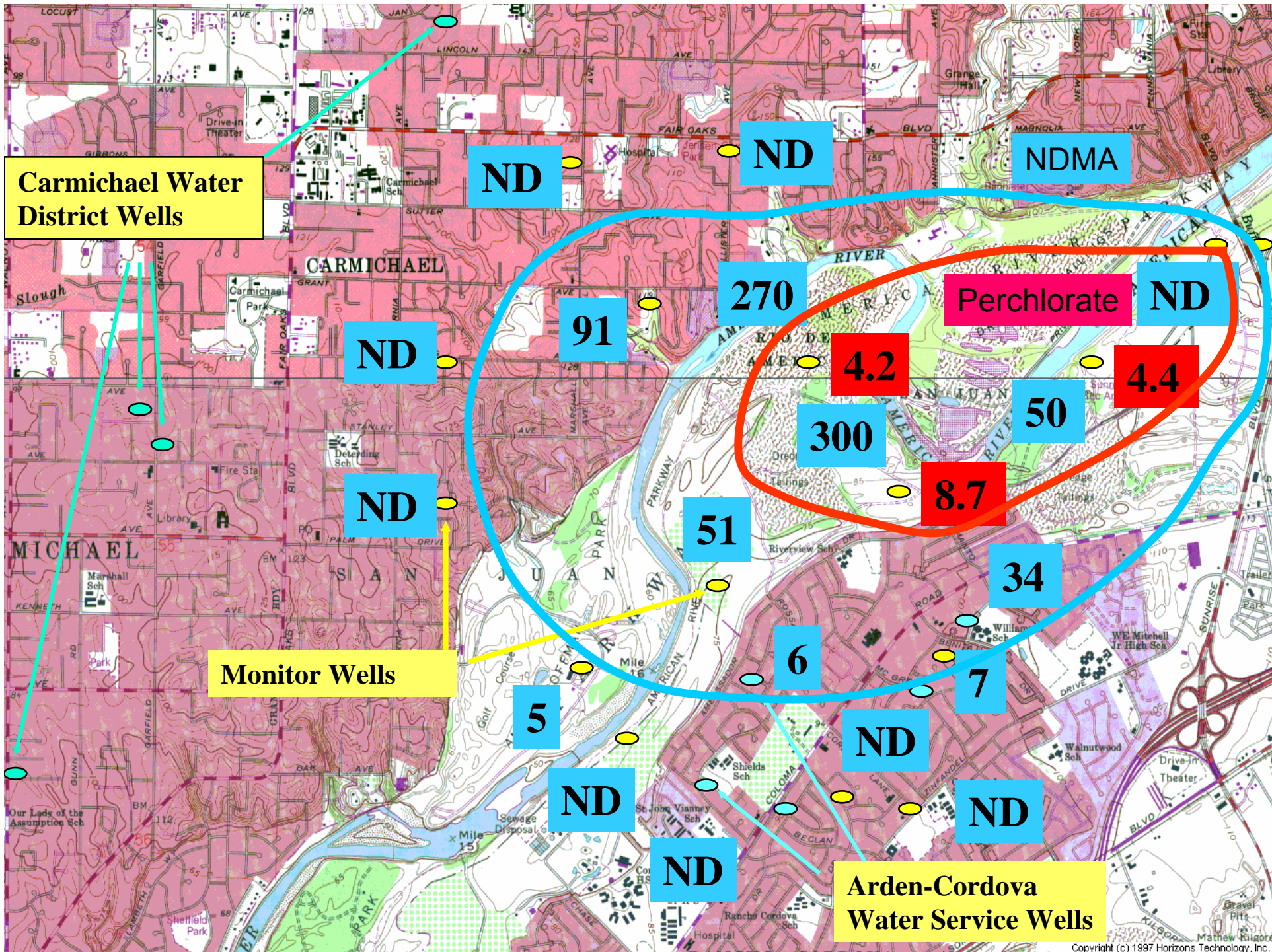


Aerojet Contaminant Plume



- ▼ 1998 NDMA found in groundwater in Rancho Cordova
- ▼ 2004 new contaminant plume discovered
 - | Found while drilling a replacement well
 - | In monitoring wells in Carmichael WD on north side of the American River





Contaminant Plume



- ▼ Plume Migrating Between 500 to 800 feet per Year
- ▼ Contaminants
 - | NDMA
 - | Perchlorate
 - | TCE
 - | 1,4-dioxane



Contaminant Plume Known Extent

**Low-level NDMA
contamination**

American River

*Year
2005*

Dewey Tank & Well

Winding Way Well

Ladera Well

Barrett Road Well

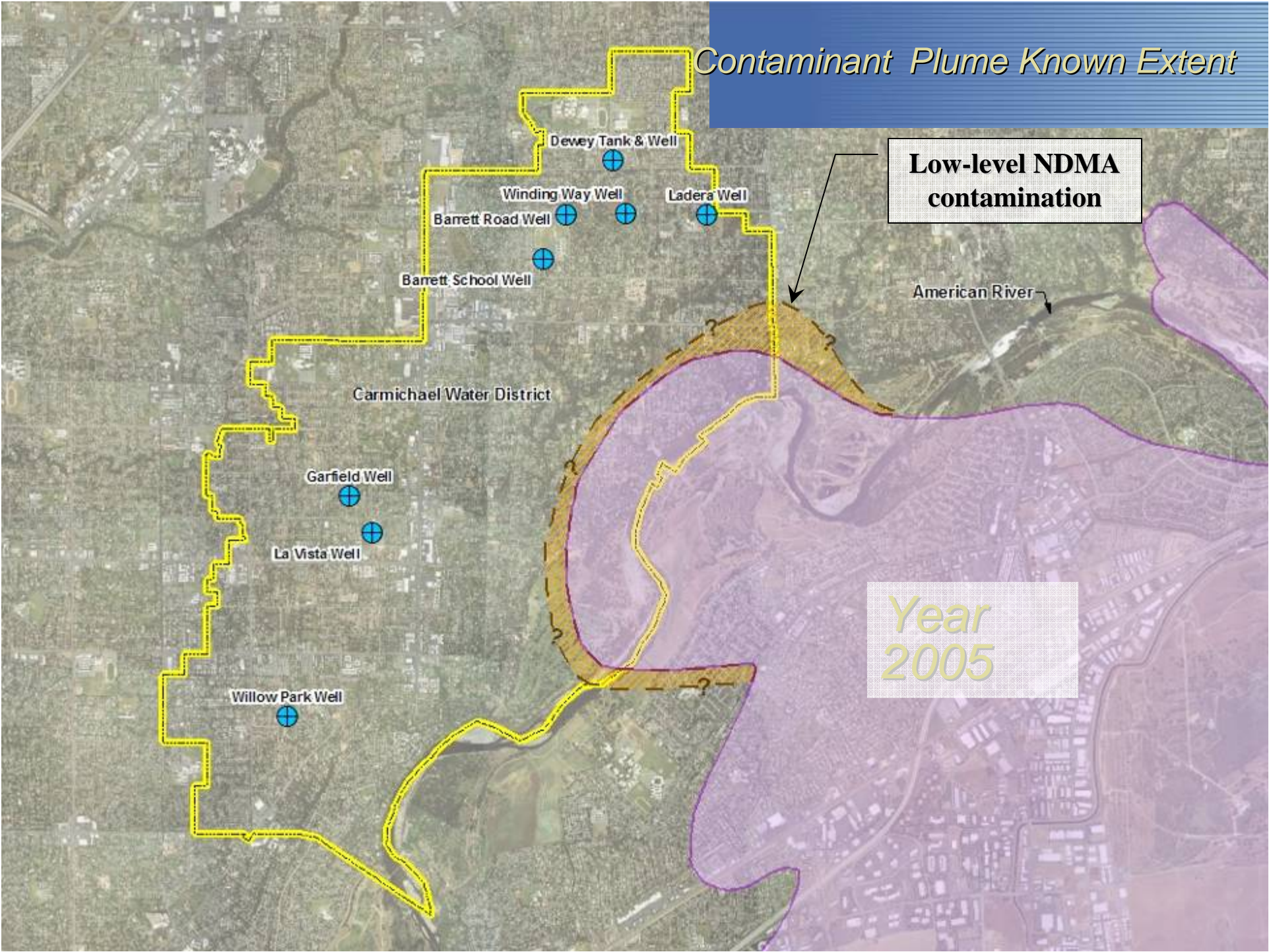
Barrett School Well

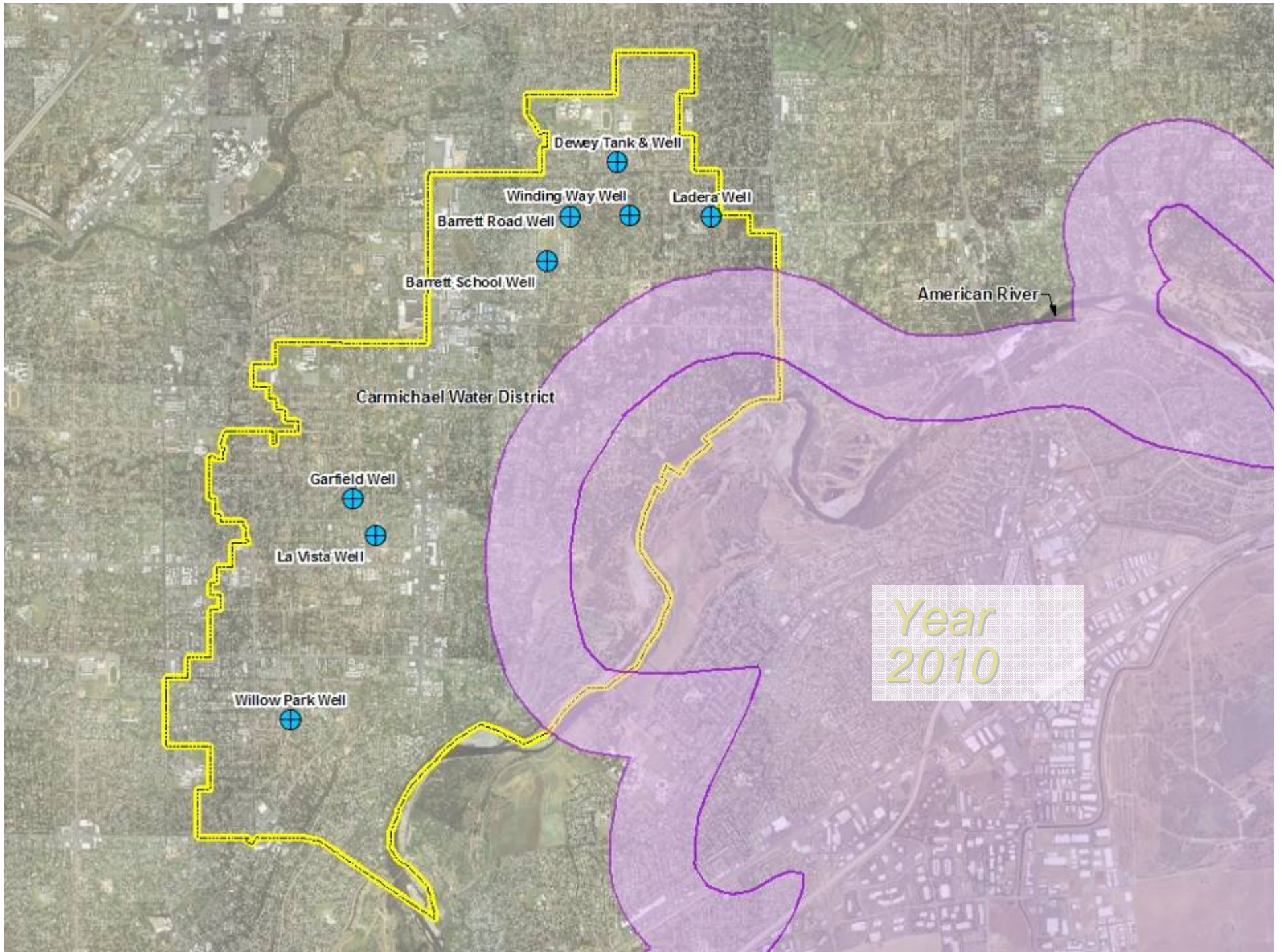
Carmichael Water District

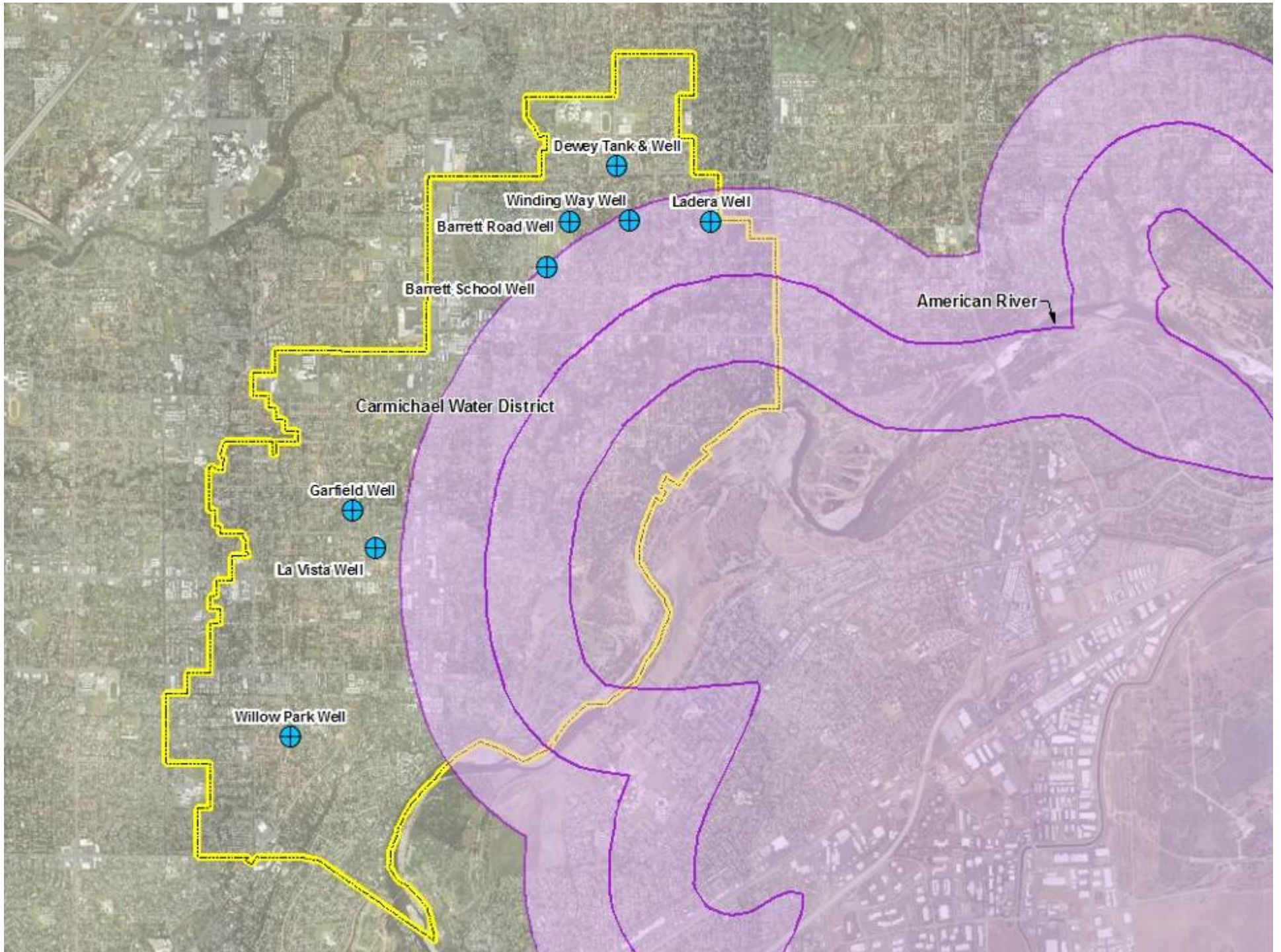
Garfield Well

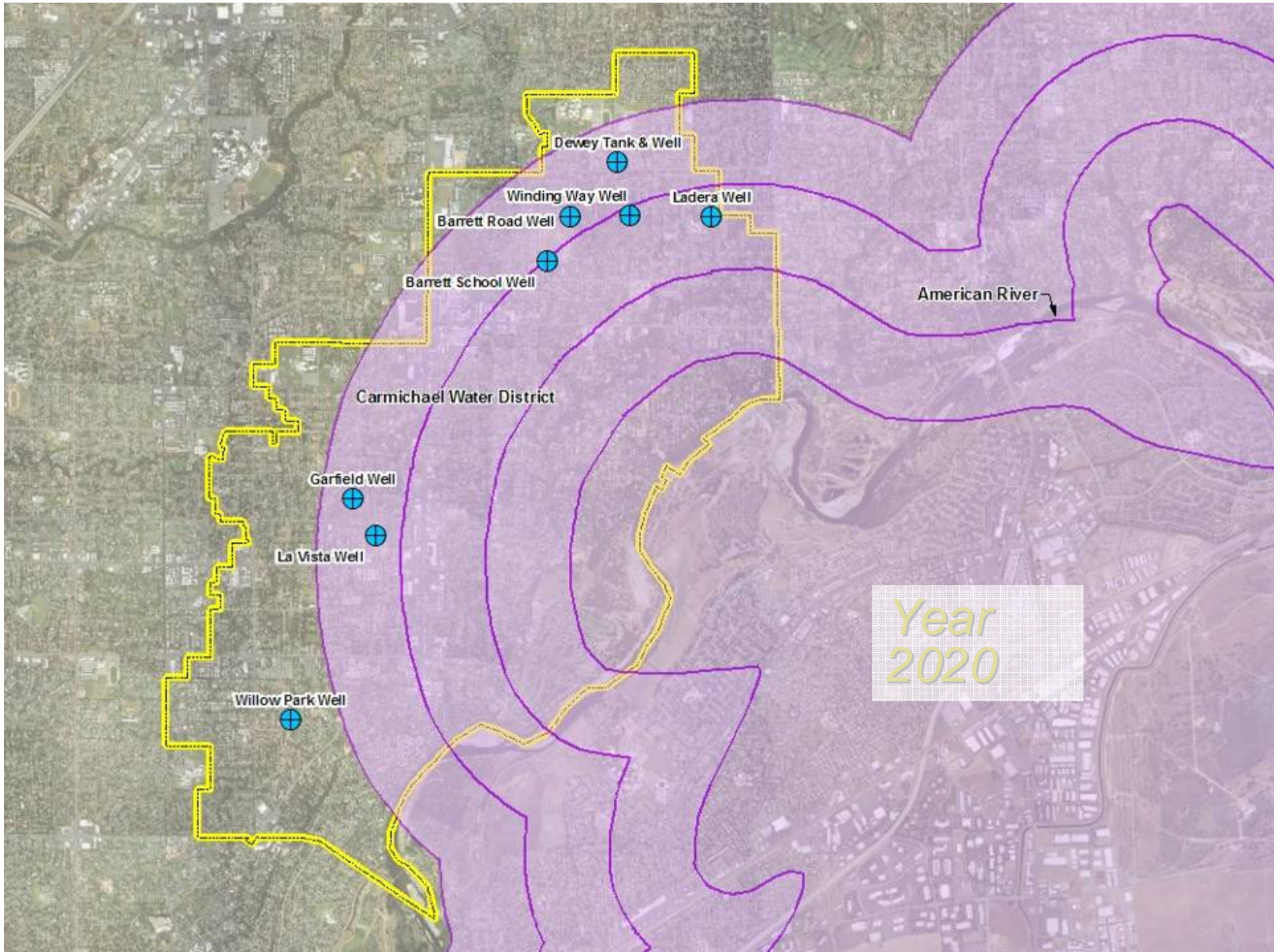
La Vista Well

Willow Park Well









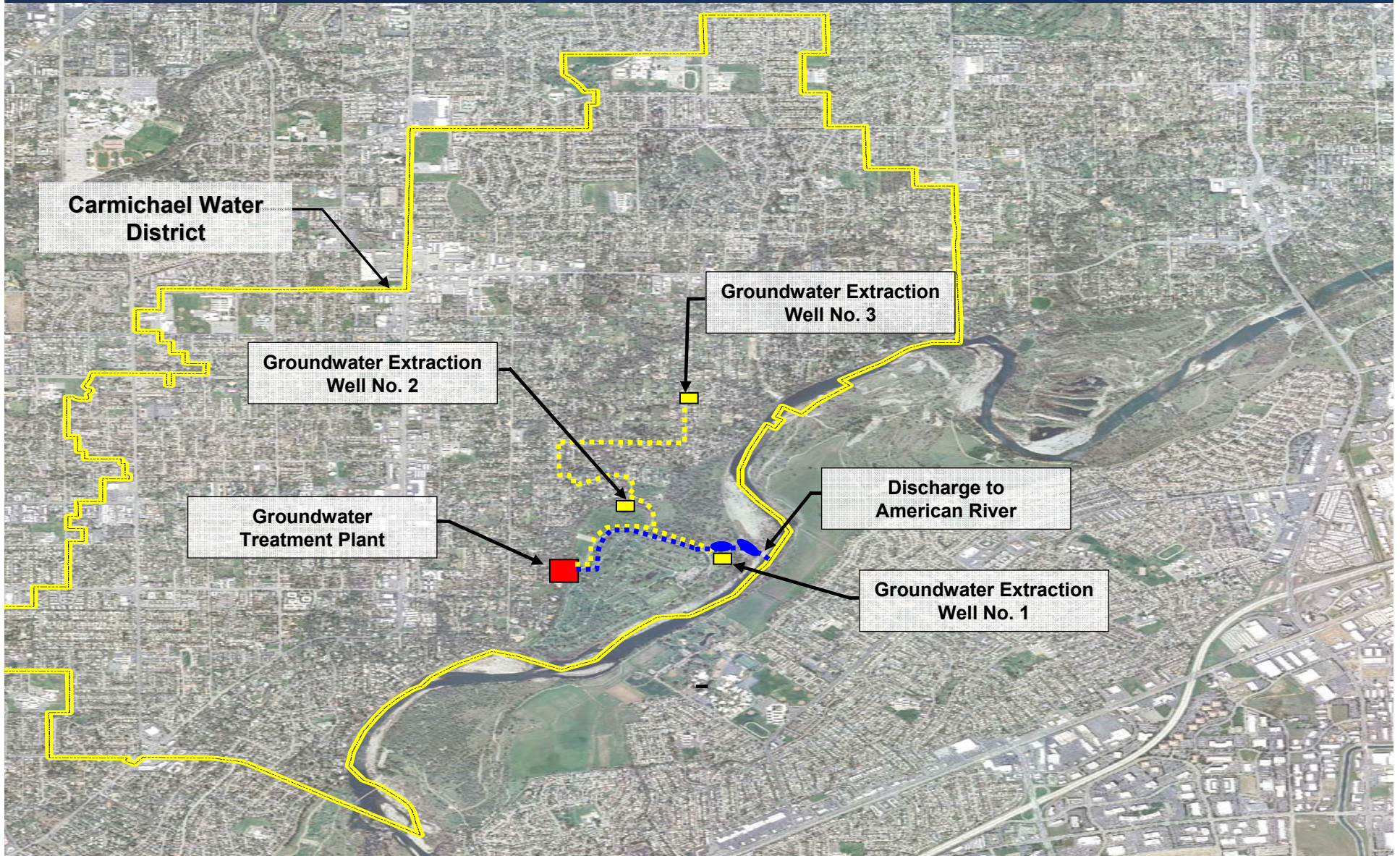
Cooperative Approach



- ▼ Carmichael WD & Aerojet jointly developed a remediation plan
- ▼ Carmichael WD had the ability to permit the facilities quicker
- ▼ Worked with Sacramento County to permit treatment facility at Ancil Hoffman Park
- ▼ Aerojet paying for the remediation



Initial Conceptual Plan



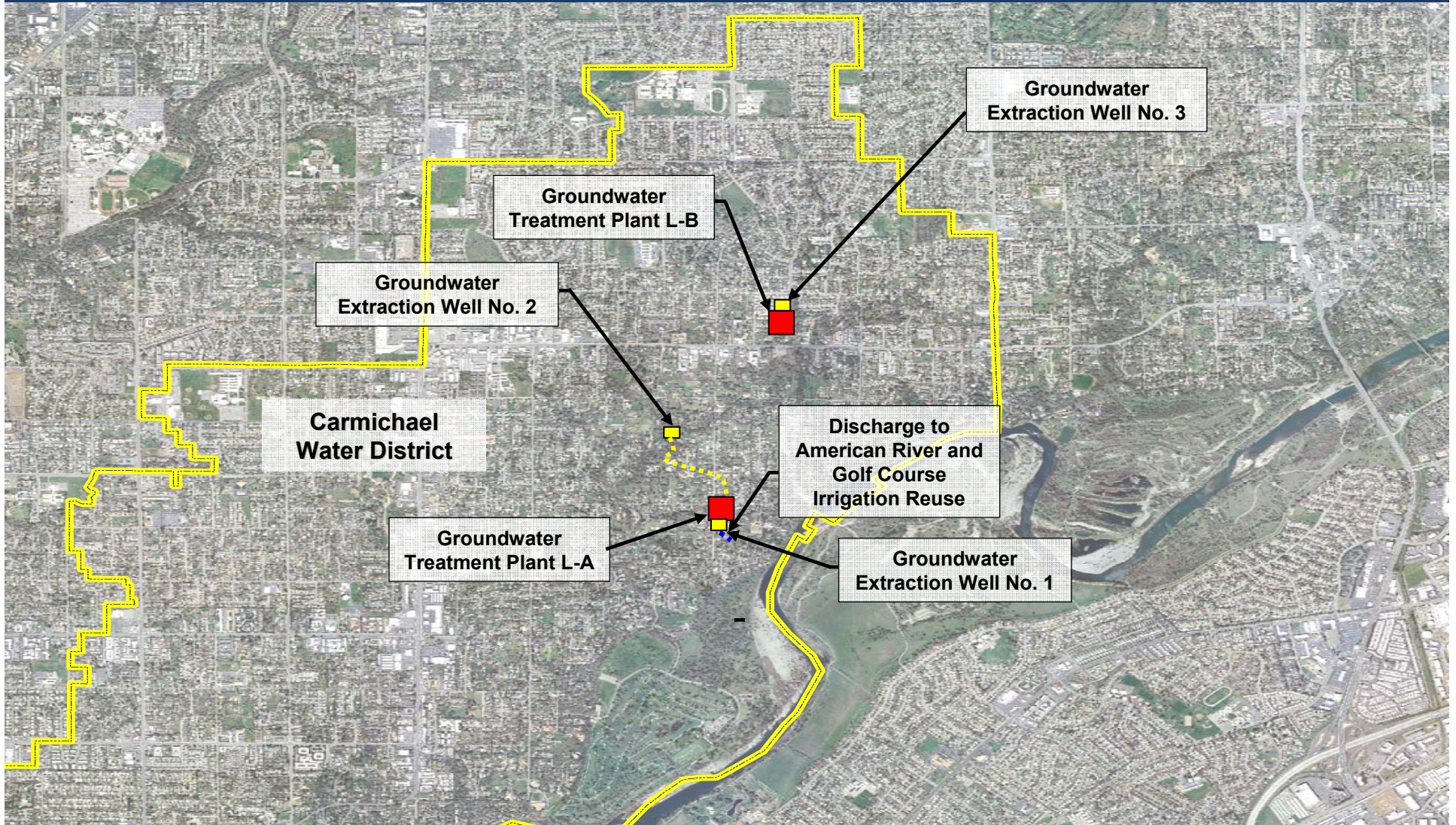
Preliminary Design



- ▼ Two treatment plants
- ▼ Bajamont – GET L-B
 - | 325 gpm extraction well (now 600 gpm)
 - | 1 future extraction well
 - | 1,000 gpm plant capacity
- ▼ Ancil Hoffman – GET L-A
 - | 600 gpm extraction well (now 800 to 1,200 gpm)
 - | 1 future extraction well
 - | 2,000 gpm treatment plant
 - | 1 MG reservoir and booster pump station



Final Remedial Plan



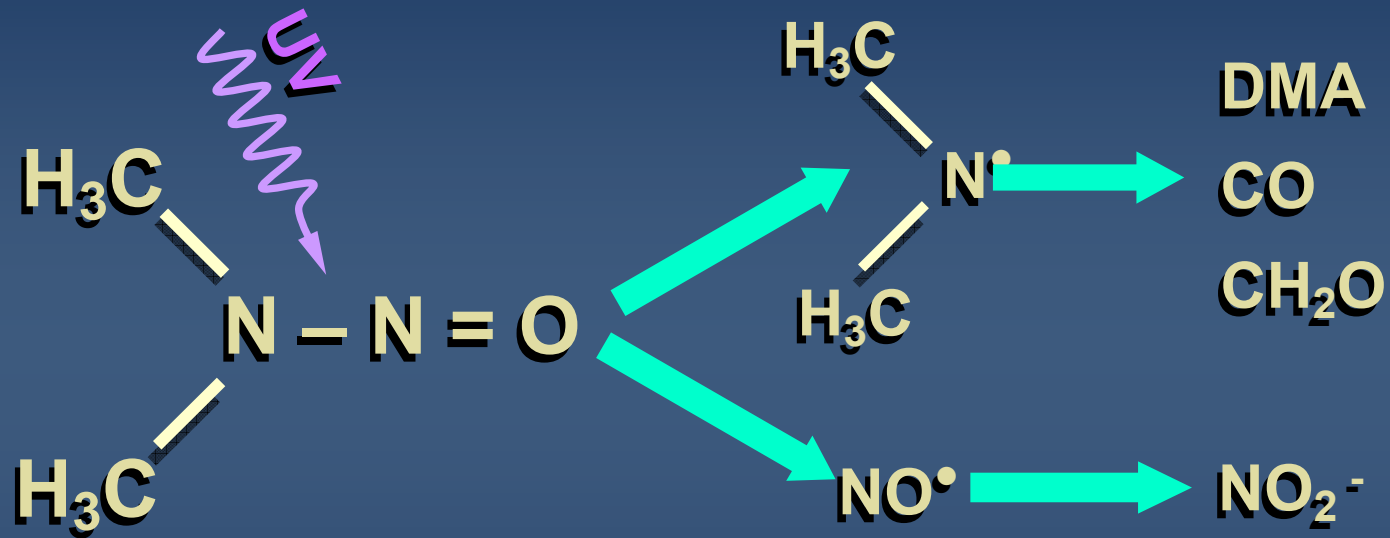
Contaminant Treatment



- ▼ NDMA
 - | UV
 - | UV/H₂O₂ (if reformation is a concern)
- ▼ Perchlorate
 - | IX (future)
- ▼ TCE
 - | UV/H₂O₂ (future if required)
 - | GAC scrubbing
- ▼ 1,4-dioxane
 - | UV/H₂O₂ (future if required)



Photolysis of NDMA



Source: Chow, 1973; Hanst et al., 1977



Bajamont Extraction Well



2008/02/11



Bajamont GET L-B



2007/03/14



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Bajamont GET L-B



Influent Bag Filters Effluent Inline Strainers



Unpressurized Reactor Low Pressure Lamp Option



180 kW Tower Reactor Option



90 kW Rayox UV Reactors



GAC



Performance



▼ Clean-up Levels

- | NDMA 1.3 ppt
- | Perchlorate 4 $\mu\text{g/l}$
- | TCE 0.5 $\mu\text{g/l}$
- | 1,4-dioxane 3 $\mu\text{g/l}$

▼ Startup

- | Influent NDMA 10 ppt
- | Effluent NDMA 1-2 ppt
- | Electrical Energy per Order (EE/O) 7 kWh/order/1000 gal



Current Issues



- ▼ Ancil Hoffman
 - | Clearwell deleted from project
 - | Will still use treated water for golf course irrigation
 - | Start construction 2008
- ▼ Perchlorate present in 3 of Carmichael's wells



Questions?



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