

## **DONALD MOORE TESTIMONY INTRODUCTION**

My name is Donald Moore; I am a registered Geologist (Number 6076) and Certified Hydrogeologist (Number 461) in the State of California. I have been a practicing professional geologist and hydrogeologist since 1991. I worked for the State of California beginning in 1974 and had my own water well drilling company beginning in 1977 (licensed water well drilling contractor 331123) before I earned my professional registrations. I have located and drilled over 1,500 groundwater wells including 300 in perched groundwater. Since 1983 I have owned and operated Geoimagery, a sole proprietorship, which specializes in aerial photography for remote sensing.

I have prepared the following presentation that demonstrates the extensive and lengthy presence of riparian features on the Woods Irrigation Company.

This presentation builds on data recently developed by me and Kenneth Lajoie for the SWRCB CDO hearings for Mussi et al. and Pak and Young, from maps published as early as (approximately) 1909, aerial photography from 1937 and 1940 and from my 36 years of photo-geology experience.

I have developed this presentation by starting with the oldest maps, the 1909 (approximate) Woods Bros. Map and by adding successively older data to confirm a pattern of development that provided continuous water conveyance to lands throughout the irrigation company's service area.

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### **WIC EXHIBIT 2-2A: 1909 Woods Bros. Map**

Exhibit 2-2A is a map drawn circa 1909, the oldest of area-specific maps, and encompasses what is now the Woods Irrigation District. The map shows irrigation canals and their associated head gates and dams in 1909. This map was used throughout my interpretation process as a way to cross check known historic man-made features and historic riparian features which I correlated aerial photographs. The man-made features on this 1909 map were used to convey water for irrigation throughout the existing Woods Irrigation District.

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**WIC EXHIBIT 2-2B: 1914 Map of San Joaquin Delta**

Exhibit 2-2B is a map drawn in 1914 of the San Joaquin Delta, and encompasses what is now the Woods Irrigation District. The map shows irrigation canals and their relation rivers and sloughs. This map was used throughout my interpretation process as a way to cross check known historic man-made features and historic riparian features which I correlated aerial photographs. The man-made features on this 1914 map were used to convey water for irrigation throughout the existing Woods Irrigation District.

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**WIC EXHIBIT 2-2C: 1911/1913 Holt 7.5 Minute USGS Quadrangle Map**

This U.S. Geological Survey Holt Quadrangle (scale 1:31,680) covers the western portion of the Woods Irrigation District. It was surveyed in 1911 and published in 1913. Therefore, the features shown on the map existed in 1911. This map, and the Stockton Quadrangle to the east, was used to confirm my interpretation of aerial photographs and identify known water conveyance and riparian features at the time the map was compiled in 1911.

**WIC EXHIBIT 2-2D: 1911/1913 Stockton 7.5 Minute USGS Quadrangle Map**

This U.S. Geological Survey Stockton Quadrangle (scale 1:31,680) covers the eastern portion of the Woods Irrigation District. It was surveyed in 1911 and published in 1913. Therefore, the features shown on the map existed in 1911. This map, and the Holt Quadrangle to the west, was used to confirm my interpretation of aerial photographs and identify known water conveyance and riparian features at the time the map was compiled in 1911.

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## **WIC EXHIBIT 2-2E: 1937 Aerial Photograph Overlay**

Individual black and white aerial photographs, dated 1937, were rectified and stitched into a seamless aerial photograph mosaic, resulting in an "aerial photograph map". The 1937 aerial photograph map was registered and overlain onto the 2005 color National Agricultural Image Program base. The Woods Irrigation District map was registered to fit and overlain on the photographic base. This map provided a basis from which to evaluate natural and man-made features that aided in the interpretation of the riparian elements that existed in 1937 and historic and man-made riparian features that existed prior to 1937.

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## **WIC EXHIBIT 2-2F: 1940 Aerial Photograph Overlay**

Individual black and white aerial photographs, dated 1940, were rectified and stitched into a seamless aerial photograph mosaic, resulting in an "aerial photograph map". The 1940 aerial photograph map was registered and overlain onto the 2005 color National Agricultural Image Program base. The Woods Irrigation Map was registered to fit and overlain on the photographic base. This map provided a basis from which to evaluate natural and man-made features that aided in the interpretation of the riparian elements that existed in 1940 and historic riparian features that existed prior to 1940.

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## **WIC EXHIBIT 2-2G: 1937 Aerial Photograph Mosaic: Digitally Enhanced**

Figure 2G is a digitally enhanced image of 2E using a Photoshop tool called a "directional filter". This is an effective tool to enhance linear features and assist in interpreting geomorphic features. The computer enhancement creates an effect similar to that of low sun angle photography. The filter is most effective when applied perpendicular to topography. Very subtle features that might otherwise be overlooked are strongly enhanced and can be readily identified. The linear features identified on this mosaic are interpreted to be historic channels and sloughs and in some cases, man-made ditches or channels. These features are further identified on Exhibits 2K and 2L.



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### **WIC EXHIBIT 2-2H: 1940 Aerial Photograph Mosaic: Digitally Enhanced**

Figure 2H is a digitally enhanced image of 2F using a Photoshop tool called a "directional filter". This is an effective tool to enhance linear features and assist in interpreting geomorphic features. The computer enhancement creates an effect similar to that of low sun angle photography. The filter is most effective when applied perpendicular to topography. Very subtle features that might otherwise be overlooked are strongly enhanced and can be readily identified. The linear features identified on this mosaic are interpreted to be historic channels and sloughs and in some cases, man-made ditches or channels. These features are further identified on Exhibits 2K and 2L.

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### **WIC EXHIBIT 2-2I: 1937 Aerial Mosaic: Digitally Enhanced and Blended**

The enhanced 1937 aerial photograph mosaic, Exhibit 2E, has had its opacity reduced to 40% to allow viewing the underlying 2005 color NAIP photograph. Additionally, the 1937 overlay received a non-linear contrast stretch and the NAIP photograph received a linear contrast stretch.

This technique allows very subtle riparian features that might otherwise be overlooked to be enhanced and readily identified. Additionally, the two enhanced layers now combine to intensify relief features. This technique provides another tool to interpret existing and historic riparian features.

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### **WIC EXHIBIT 2-2J: 1940 Aerial Mosaic: Digitally Enhanced and Blended**

The enhanced 1940 aerial photograph mosaic, Exhibit 2E, has had its opacity reduced to 60% to allow viewing the underlying 2005 color NAIP photograph. Additionally, the 1940 overlay received a non-linear contrast stretch and the NAIP photograph received a linear contrast stretch.

This technique allows very subtle riparian features that might otherwise be overlooked to be enhanced and readily identified. Additionally, the two enhanced layers now combine to intensify relief features. This technique provides another tool to interpret existing and historic riparian features.

## **WIC EXHIBIT 2-2K: Composite Map of Riparian Features**

Exhibit 2K is a compilation of historic riparian features within the Woods Irrigation District. The blue lines represent my interpretation of historic riparian features – sloughs and creeks, which existed and carried water prior to human landscape alteration.

The red lines represent interpreted historic riparian features as drawn by Brian Atwater in 1982 and by Ken Lajoie in 2010. The large red areas correspond to Lajoie's map of clastic soils composed of mainly sands and silts that were deposited along significant natural channels.

My interpretation of historic riparian features using conventional aerial photographic enhancement techniques confirm and amplify the number of historic riparian features that carried water within the Woods Irrigation District prior to the construction of man-made water conveyance systems.

**WIC EXHIBIT 2-2L: Man-Made Conveyance Systems as Shown on 1909, 1911 and 1914 Maps and Natural Features**

Exhibit 2L shows man-made conveyance systems in the form of canals and irrigation ditches mapped onto the 1937 mosaic (Exhibit 2E). The bold red lines are from the 1909 Wood Bros. Map (Exhibit 2A) showing irrigation features; the black lines are from the 1911/1913 USGS Holt and Stockton Quadrangles (Exhibits 2C and 2D); orange lines represent data from the 1914 Map of San Joaquin County (Exhibit 2B), and the blue and red lines are interpreted as historic primary riparian features (Exhibit 2K).

The man-made features, most of which are linear, represent water conveyance systems that were used as irrigation systems and carried water from at least 1909 through 1914. There appears to be very good correlation between the canals and ditches and what I have interpreted to be historic riparian features such as sloughs and creeks. It is clear that the water conveyance systems originate from surface water features, and carry water to agricultural operations throughout the current Woods Irrigation District.

There is major natural channel which trends northeast along the Dunkle property which is evident on the 1911 Stockton Quadrangle. The channel is also evident on the 1909 map. Using the scale on the Stockton Quadrangle, the natural channel is 10 to 20 feet wide and extends from its confluence near Middle River to where it turns due north, a distance of 1,300 linear feet. Therefore, there is ample evidence to suggest that this is a major, natural riparian feature.

**WIC EXHIBIT 2M: Man-Made Conveyance Systems as Shown on 1909, 1911 and 1914 Maps and Pre 1937 and Natural Features**

Exhibit 2M shows man-made conveyance systems in the form of canals and irrigation ditches mapped onto the 1937 mosaic (Exhibit 2E). The bold red lines are from the 1909 Wood Bros. Map (Exhibit 2A) showing irrigation features; the black lines are from the 1911/1913 USGS Holt and Stockton Quadrangles (Exhibits 2C and 2D); orange lines represent data from the 1914 Map of San Joaquin County (Exhibit 2B), and the blue and red lines are interpreted as historic primary riparian features (Exhibit 2K).

The man-made features, most of which are linear, represent water conveyance systems that were used as irrigation systems and carried water from at least 1909 through 1937. There appears to be very good correlation between the canals and ditches and what I have interpreted to be historic riparian features such as sloughs and creeks. It is clear that the water conveyance systems originate from surface water features, and carry water to agricultural operations throughout the current Woods Irrigation District.

The green lines represent the primary irrigation features that are identifiable on the 1937 aerial photographs. Therefore, these water conveyance features were constructed between 1914 and 1937 within the Woods Irrigation District. Based on all of the data, including the relationships between man-made structures and natural riparian features, I believe that the all of these features were used to distribute water throughout the district beginning before 1909.

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**WIC EXHIBIT 2-2N: Historic Groundwater Map of the San Joaquin Valley**

The area highlighted in blue indicates the area of this study. The map legend indicates this is all in an area of artesian water. Artesian conditions imply that groundwater is at or very near the surface, which, when combined with overflow and tidal influences indicates that the channels and sloughs that I have identified before 1909 were carrying water, thereby creating riparian conditions.

## **DONALD MOORE TESTIMONY CONCLUSION**

Based on the data developed by Kenneth Lajoie and myself (for use in the SWRCB CDO hearings for Mussi et al. and Pak and Young), analysis of 1937 and 1940 aerial photographs and enhanced aerial photographs, and other historical maps and documents I conclude:

1. The main north-south channels identified on Exhibit 2L are natural riparian features. These features have been present throughout recent geologic time and were there long before modern man. Confirmation of the presence of these channels is evident in the fluvial features identified on the aerial photographs.
2. Evidence that these features existed through at least 1914 can be derived from various historical maps dated (approximately) from 1909 through 1914. Their continued existence is evidenced by the canals and ditches along these fluvial features and which indicate the presence of water. This suggests there was no period of time when these features did not contain water connected to other Delta channels. The water in these natural features flowed along the same historical routes that were present before the arrival of man.