Alluvial Fans

150 Years of Flood Control, Urbanization, and Politics in Los Angeles

Los Angeles County Department of Public Works
Topics to be Addressed

- Historic Perspectives
- Current Practices and Constraints
- Concerns for the Future
Historical Perspectives
Regional Characteristics

- From the San Gabriel Mountains to the Pacific Ocean, Los Angeles is an Alluvial Fan

- The San Gabriel Mountains are rising as quickly as the Himalayas and are some of the most highly erosive mountains in the world

- Fires and debris production are a natural part of the natural environment of Southern California
Historic Fire Boundaries
1890-1996
Alluvial Fan Flooding
1815-1884

- Floods occurred in 1815, 1822, 1825, 1832-33, 1842, 1851-52, 1859, 1862, 1867-68, 1873-74, 1883-84

- The Los Angeles River changed course from the Ballona Creek outlet in the Santa Monica Bay down to San Pedro Bay during the storms of 1825

- The San Gabriel River changed course from Wilmington Lagoon to Alamitos Bay in 1867-68

- Floods were not constricted by infrastructure, allowing the water to spread out over the fan, percolate, and recharge ground water
Rivers in Los Angeles

Sketch map of area in vicinity of Los Angeles.
Alluvial Fan Urbanization
1890-1910

- Railroads arrived and built levees and bridges. The railroad companies also added economic and political forces within Los Angeles.

- Word of the climate spread and people came from around the world to live in Los Angeles.

- Farms replaced open rangeland, brush thickets, and riparian vegetation – check dams and other local flood protection were added.

- City streets and buildings added impervious surfaces in the watershed, causing increased runoff.
Alluvial Fan Urbanization
1890-1910

Check Dams in San Gabriel Canyon - 1910

Pacific Electric Railway Trestle and Levee
Alluvial Fan Flooding

1914

Urbanization
- The population grew from 15,000 in 1870 to 790,000 in 1914, most of the population was unfamiliar with the historic flooding
- Agriculture and urbanization had significantly changed land uses in the region

Economics
- Property values within Los Angeles County increased from $74.8 million in 1900 to $200 million in 1910
- 1.5 million citrus trees produced a $20 million/yr industry
- Los Angeles Harbor and railroads supplied the country with imports and agricultural products
Flooding in 1914

- Heavy rainfall in January 1914
- A three day storm began February 18, 1914, and caused regional flooding
- The Los Angeles Harbor filled with sediment
- Arroyo Seco residents tried to protect their homes
- Orchards and fields were destroyed
- Livestock drowned
- The storm caused $10 million in flood damages
Flooding in 1914

Bank Erosion Drops House in Los Angeles River

Flooding Destroys Railroad Bridge in Los Angeles

Flooding in Compton
Politics - Continued

- The Los Angeles County Flood Control District (FCD) was formed in 1915
- Flooding in 1916 reminded voters of the flood control needs and $4.43 million in bonds was approved in 1917
- Drought in the early 1920s led to a water conservation focus and caused fights for water project funding
Alluvial Fan Urbanization
1915-1934

Flood Control Measures to Prevent Flooding

- Installation of more check dams
- Brush, rock, and wooden pilings used to reinforce levees
- Construction of thirteen dams and hundreds of check dams
## Dams Completed by 1934

<table>
<thead>
<tr>
<th>Dam</th>
<th>Drainage Area (mi²)</th>
<th>Date Completed</th>
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<tbody>
<tr>
<td>Devil's Gate Dam</td>
<td>31.90</td>
<td>06/01/1920</td>
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<tr>
<td>San Dimas Dam</td>
<td>16.20</td>
<td>09/01/1922</td>
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<tr>
<td>Live Oak Dam</td>
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<td>11/01/1922</td>
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<td>Santa Anita Dam</td>
<td>10.80</td>
<td>03/01/1927</td>
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<tr>
<td>Sawpit Dam</td>
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<tr>
<td>Puddingstone Dam</td>
<td>33.10</td>
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<tr>
<td>Sierra Madre Dam</td>
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<tr>
<td>Thompson Creek Dam</td>
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<tr>
<td>Puddingstone Diversion Dam</td>
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<td>Pacoima Dam</td>
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<tr>
<td>Big Dalton Dam</td>
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<td>08/01/1929</td>
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<tr>
<td>Big Tujunga Dam</td>
<td>82.30</td>
<td>07/01/1931</td>
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<tr>
<td>Cogswell Dam</td>
<td>39.20</td>
<td>04/01/1934</td>
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Alluvial Fan Urbanization
1915-1934

Urbanization

- Population tripled from 1915 to 1934
- La Canada population went from 150 in 1908 to several thousand in the early 1930s

1934 Flood Damages

- Fires burned hills above La Canada in November 1933
- 40 lives lost in debris floods
- $5 million in damage
- Gravel pit prevented damage downstream of Haines Canyon and led to the concept of Debris Basins
Alluvial Fan Flooding
New Year’s Eve 1934
Alluvial Fan Flooding
New Year’s Eve 1934

Boulders transported out of Dunsmuir Canyon in 1934 Event
Alluvial Fan Flooding
New Year’s Eve 1934

Haines Canyon Gravel Pit
January 1934

Haines Canyon Gravel Pit
December 1933
Alluvial Fan Urbanization
1935-1969

- Floods

  1938 – Major floods
  1943 – Heavy rain on a dry watershed
  1952 – Light rain on a wet watershed produced local flooding in the San Gabriel Valley
  1954 – A few homes were destroyed by debris
Flooding and Debris Flows – 1938

1938 – LA River near Elysian Park

1938 – Flooding in San Fernando Valley
Flooding and Debris Flows – 1938

1938 – Debris Basin Capacity

1938 – Debris Basin after storms
Politics

- 1935 – New Deal funding was available through the Los Angeles Army Corps of Engineers
- 1936 – The Flood Control Act was approved, providing $70 million for projects on the Los Angeles River, San Gabriel River, and Rio Hondo Channel
- 1938 – Flood Control Act was amended, adding Ballona Creek to the plan
Politics – Continued

- 1941 – Congress approved the Los Angeles Drainage Area (LACDA) comprehensive plan submitted by the Corps that was based on the FCD comprehensive plan

- No scandals, lawsuits, or interagency rivalries disrupted construction of the LACDA projects
Alluvial Fan Urbanization
1935-1968

Flood Control Construction
- Hansen, Lopez, Santa Fe, Sepulveda, and Whittier Narrows Dams
- 106 debris basins
- 350 miles of flood control channel and two thousand miles of storm drains

Economics
- $900 million dollars spent on bond issue storm drains to carry water from cities to the flood control channels
- Prevented extensive flood damage
Los Angeles District Comprehensive Plan
Alluvial Fan Flooding
1969

Flooding
- Dams overflowed
- Streets and buildings flooded
- 73 people lost their lives
- Debris buried 7 people in their beds
- $30 million dollars in damage

Economics
- $1 billion dollars of flood damage was prevented by the flood control system
Debris Damage in 1969

Glencoe Heights – January 22, 1969
Alluvial Fan Urbanization  
1970-2000

Flooding


- Although there was localized flooding during each of these events, including debris flows from canyons, the flood and debris control facilities prevented billions of dollars in damages
Current Practices and Constraints
Existing Flood Control Facilities
Types of Facilities – Debris Retaining Inlets
Types of Facilities – Stabilizers

Crib Dam in Wilson Canyon

Rail and Timber Structure – Observed in 1980
Types of Facilities – Debris Basins and Dams

Beatty Debris Basin

Dams – Pacoima Dam
Types of Facilities – Spreading Grounds

Rio Hondo Spreading Ground

Hansen Spreading Grounds
Types of Facilities – Spreading Grounds

Ben Lomond Spreading Ground

Forbes Spreading Ground
Debris Basin Cleanouts

- Debris basins are cleaned out every 5 or 6 years
- 12.5 million cubic yards removed from debris basins between 1921 and 2007
- $1.5 million per year for sediment removal
- Other costs include routine maintenance, environmental permits, etc…
Dam Cleanout History

- 84.3 million cubic yards removed from dams between 1920 and 2007 – Enough to cover 82 mi² with 1 foot of sediment
- Sediment removal from dams averages 1 million cubic yards per year
Economics

1. Population of 10.3 million in July 2006

2. Development has continued through this period, filling the coastal plain and the San Fernando and San Gabriel Valleys, with increased development pressure in the Antelope Valley and Santa Clarita regions

3. Median home prices increased to approximately $500k, estimated property value now over one trillion dollars
Alluvial Fan Urbanization
2000-2008

Politics

1. The environmental movement that began in the 1970s and has gained tremendous political power

2. Environmental awareness has shifted priorities from large engineered works to preserving the environment and working within natural constraints

3. Permitting and environmental documents have become more stringent as endangered species of plants and animals are identified in project areas

4. Focus on capital improvements and infrastructure has shifted to maintenance of existing systems
Concerns for the Future
Alluvial Fan Urbanization
The Future – 2010 and Beyond

Economics

• The population within Los Angeles County is expected to grow by 2 million between 2010 and 2020

• New development will mostly occur in the Santa Clara and Antelope Valleys on areas subject to alluvial fan conditions
Politics

- Environmental concerns and politics will require more permits, review, and mitigation for projects built to control debris and flooding.
- Environmental efforts will make construction of dams and large debris basins very difficult.
- Focus on protection and utilization of natural drainage will require agencies to evaluate new ways to protect citizens from debris and flood damage.
Questions