

CHANNEL EROSION STUDY, SAN DIEGO CREEK, 2015

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Executive Summary

Until recently, eroding stream channels have furnished most of the sediment going into Newport Bay. The worst of this began when the new San Diego Creek (SDC) trunk channel was completed to the Bay in 1965. But starting in the 1980s, efforts were made to stabilize these eroding channels and that effort has continued to the present so that few channels are now significantly unstable. Most new urban developments feature non-erodible hardened channels or subsurface concrete drainageways. The addition of several floodwater retention structures in the SDC basin have not only trapped much of the sediment yield from upstream but also possibly reduced downstream channel erosion by reducing stormflow peaks. Parts of two large channels, Borrego and Serrano Creeks, continue to be unstable but Borrego has been improved since the 2006 channel study. Overall, there has been a dramatic decrease in the length of unstable channels since the 1980s and a significant decrease since 2006.

Background of the Study

The study was begun in 1981 as a reaction to a sediment source study of San Diego Creek (SDC) and Newport Bay (Boyle Engineering, 1981) which erroneously stated that channel erosion was not important. Rather, the sediment entering Newport Bay was attributed to upland sources, largely on agricultural and urbanizing land (Trimble, 1981). A subsequent study showed that although stream channel erosion had been important for a long time (Hoag, 1983), it was the creation of the large SDC trunk channel in the mid-1960s that allowed the sediment to reach the Bay in large quantities and thus create much more severe sedimentation problems there (Trimble, 2003).

Overall Scope and Methods of the Study

The major long-term methodology of this study was to establish baselines by instrumented surveys of over 100 channel cross sections. These were periodically resurveyed over the period since 1983 and the surveys were augmented by oblique ground photography. Such surveys and photos formed the basis of several reports for Orange County and also for the scientific publications mentioned earlier. (Trimble, 1997, 2003, 2004, 2005, 2006). For the study this year, all reasonably accessible channels in agricultural and urbanized areas were visited and

inspected during the periods 12-15 and 22-24 February 2015. As in the 2006 Channel Study, no resurveys were performed because no survey sites were deemed to have changed significantly. Additionally, vegetation has become too rank in many places to permit resurveys without significant cutting. Rather, the main issue is the significant reduction of eroding earthen channels and their transformation to either stabilized open channels or to hardened subsurface conduits. Because of extremely high land costs, most present urbanization includes subsurface channels that allow full economic use of the land. Channel conditions of interest are discussed in the following sections and are keyed to the map (Fig. 1.). Channels not mentioned have not changed significantly since the 2006 study.

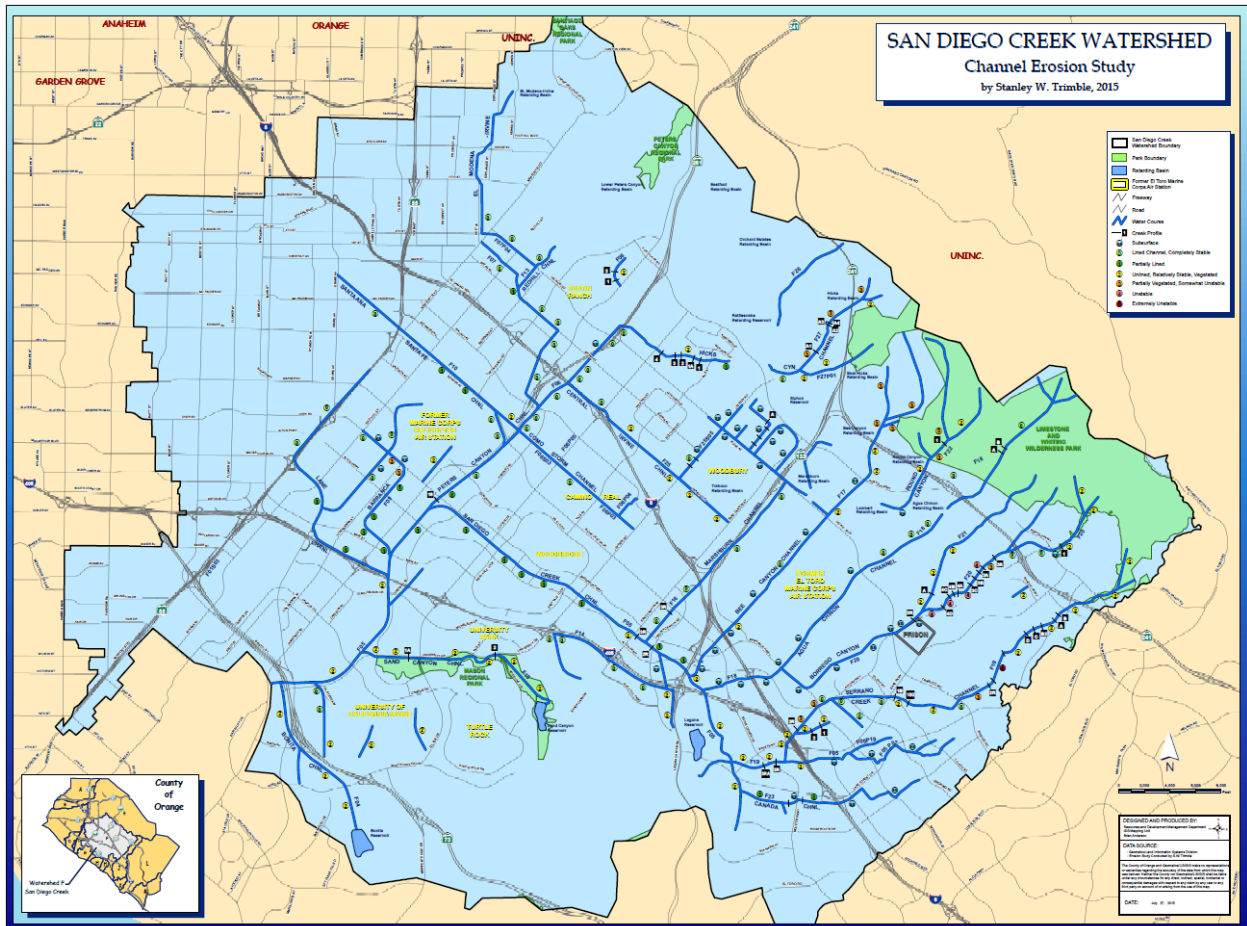


Figure 1. San Diego Creek Watershed Study Area

Channels Stabilized or Eliminated

The biggest change in this category was the elimination of unstable to extremely unstable channels in the large area to the northeast of the intersection of Jeffrey Road and Irvine Blvd

(Fig. 1, middle right). Formerly a nursery, the area is now densely urbanized with subsurface channels.

Portions of Barranca Channel near Alton Parkway, Barranca Parkway, and Von Karman Avenue (Fig. 1, lower left) which were already lined and stable, have been converted to subsurface channels. The main channel of Barranca (F09), previously somewhat unstable, has been lined and is now stable. In the same area along McArthur and along 405 Freeway, Lane Channel, previously somewhat unstable, is now lined and stable.

Near its confluence with San Diego Creek (Fig1, lower middle), formerly eroding Bee Canyon Channel (F17) has been routed in a hardened channel, subsurface some reaches. Just to the northwest, the lower part of Marshburn Channel (F16) has also been restrained to a hardened channel. At the beginning of this study in 1981, this reach was especially unstable.

The formerly unstable reach of Borrego Creek just upstream of Irvine Blvd and west of the county prison (Fig. 1, mid-lower right) has been routed subsurface and part of the flow has been diverted to the proposed Great Park on the former El Toro airbase. Also, formerly unstable Bee Canyon Channel (F17) between the retarding basin and Irvine Blvd (Fig. 1, middle right) has been routed subsurface in conjunction with urbanization

The reach of Serrano Creek between Trabuco Road and Bake Avenue (Fig.1, lower right), has become more stable apparently as the result of prior treatment and increasing vegetation. Canada Channel (F23) between Interstate 5 and FO5 (just south of Lake Forest Drive) appears to be more stable than ever. This channel appears to be almost in a “natural “state and in some places may actually be described as “pretty”.

Formerly Stable Channels now Slightly Destabilized

Two stream reaches, formerly stable, were noted to have undergone moderate channel erosion. Between West Yale Loop and Jeffrey Road (Fig 1, lower middle), San Diego Creek appears to be degrading slightly with erosion apparent at the base of the grassed banks sloping down to the sandy channel (Figure 2). If this continues, some conservation treatment might be appropriate. The other slightly destabilized channel is Central Irvine Channel (F25) between Sand Canyon Blvd and Peters Canyon Wash (Fig 1, middle, Figure 3). Here, some vertical erosion is evident and some sort of treatment should be considered.



Figure 2. San Diego Creek between West Yale Loop and Jeffrey Road looking downstream and showing mild channel erosion. Note that the base of the grassed slopes is eroded away in some areas.



Figure 3. Central Irvine Channel near Culver Ave. looking upstream and showing mild channel erosion.

Remaining Unstable Channels

Two quite unstable stream reaches remain in the basin. The first of these is Borrego Creek (F20) starting several hundred feet below 241 Freeway and extending down to the subsurface inlet several hundred feet upstream of Irvine Blvd (Fig. 1, mid-lower right). This reach has been extensively studied and reported on in Trimble, 2004, 2005, 2006. The good news is that the huge and extremely unstable “Baker Ranch Gully” (Trimble, 2005) has been recently ameliorated to some degree. First, most of the flow is now diverted through a box and discharges of only 50-200 cubic feet/second (cfs) will be permitted to flow down the old gully. The gully itself has been modified with the left bank being smoothed and armored with “soilcrete”, a soft, concrete-like material (Figure 4). The right bank, on U.S. Government land, remains unmodified and is still extremely unstable being undercut and almost vertical in some places. The gully remains vulnerable, not only the right bank, but the left bank remains vulnerable because the stream could undercut it at the base below the soilcrete. I recommend that flows through the gully not exceed 50 cfs until results can be determined.



Figure 4. The Baker Ranch Gully looking downstream. The left bank on the Baker Ranch side has been smoothed and armored but the right bank on the U.S. government side has not been treated.

The downstream reach from the gully mouth (also the box channel outlet) appears to have changed little since 2006. The cut bank on the Federal (right) side, which retreated so rapidly during the period 1992-2005, does not appear to have changed. However, the new routing of the majority of stormflow through the upstream box channel may allow higher peaks through this section and could possibly cause new downstream erosion.

The reach from the old archery range down to the new inlet above Irvine Ave appears to have changed little except for some scouring at the old stream crossing near the gate to the FBI installation. There is also an unstable high cut bank several hundred feet below the old archery range on the left side.

Given the changes I have seen, I changed the channel erosion category ("5") of Borrego Creek to a "4" on the new channel map but the whole reach bears watching, especially during any wet years.

The other unstable channel reach in the basin is Serrano Creek (F19) between Dimension Ave. and Trabuco Road (Fig.1, lower right), particularly the upper half of this reach. The stream has cut down through soil and soft rock leaving many highly unstable cliffs, some over 30 feet high (Figure 5). Attempts to stabilize this reach in the past with grade control structures (dams) have not worked and the debris of the dams is still in the channel, some parts hanging from channel walls. Indeed, the stream in many places has cut to more than ten feet below the level when the dams were built. Also, many trees have been undercut and have fallen or are about to fall into the stream. On the east side, massive slope failures have threatened homes along Sharmila, within the Autumnwood Homeowners Association. While this channel instability is problematic from the standpoint of destabilizing adjacent property and furnishing downstream sediment, it is perhaps even more problematic in terms of public safety. There is an access road paralleling the valley on the west side which is used for recreation by the public, including children, for walking, jogging and biking. However, there are no fences to keep people away from the high and unstable cliffs often less than a hundred feet from the path. Moreover, the often dense vegetation permits people to approach these cliffs without seeing them.



Figure 5. Serrano Creek a few hundred feet below Dimension Road looking over the top of a cliff into the canyon. The cliffs are 25-30 feet high and are undercut and unstable and are often just a few feet from the pedestrian trail which parallels the creek on the west side.

Overall Decrease of Unstable Channel Conditions, 2006-2015

One task of this ongoing channel study has been to periodically categorize stream channels on the basis of erosional stability (Trimble, 1988). Channels are evaluated on a continuum from Completely Stable (0) to Extremely Unstable (5). Measurements from the Channel Maps of 1987, 1998, 2006, and 2015 show an overall significant decrease in the lengths of unstable channels (Table 1).

Table 1: Total Miles of Channel by Erosional Stability Condition

	Condition 3	Condition 4	Condition 5
1987	27.6	5.7	3.8
1998	24.5	6.0	9.3
2006	6.5	0.5	1.8
2015	3.2	1.4	0.5

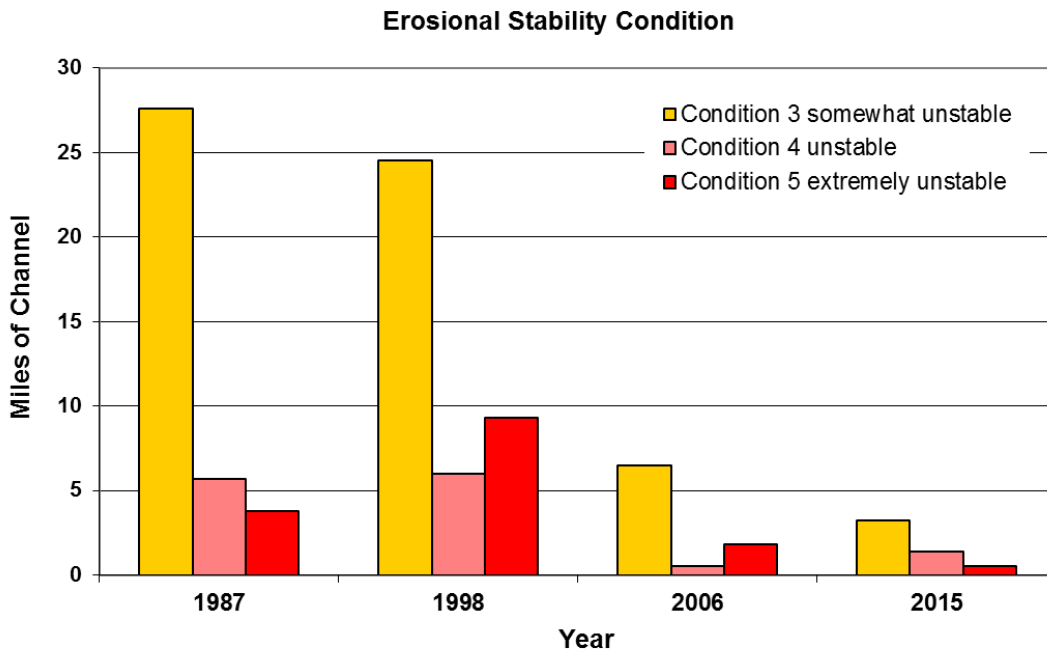


FIGURE 6. Total Miles of Channel by Erosional Stability Conditions.

The large increase of Condition 5 in 1998 is the result of an extremely wet year 1997-1998 which destabilized formerly stable stream reaches. Most of that destabilization was in the Borrego Wash and Serrano creek but much of that was later stabilized. (Federico, 2003; Trimble, 2005). The increase of Condition 4 for 2015 is largely the result of Condition 5 channels, especially Borrego and Serrano, being upgraded to Condition 4. The reduction of condition 3 2006-2015 is due both to channel improvements and also due to the removal from consideration of the natural channels tributary to the Bee canyon and Round Canyon retarding basins. This is because most of the sediment produced and transported by these channels will

be removed in the retarding basins. However it should be recalled that some channel reaches of San Diego Creek and Central Irvine Channel have been downgraded from Condition 0 to Condition 1 or 2 and this does not show up in the table.

The overall decrease of unstable channel from 1987 to 2006 is remarkable. Note that channels range from large to small so there cannot be an exact relationship between the condition given here and volume of eroded material. But there can be no doubt that volumes of channel erosion have drastically declined since 1987.

Conclusions

Channel erosion in San Diego Creek has been greatly curtailed over the past three decades. Most of this has been attained by hardening channels or by directing streams through concrete underground conduits. As a result, the length of eroding channels has been sharply reduced. This should be reducing the sediment yield to Newport Bay and recent sediment transport measures in the SDC appear to support this conclusion.

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