

CHAPTER 3

EROSION IN THE LAS VEGAS WASH

Introduction

As described in Chapter 1, the Las Vegas Wash (Wash) has experienced considerable change as a result of development of the Las Vegas Valley (Valley). Erosion has created dramatic and far-reaching effects in the Wash. Excessive erosion along the Wash has resulted in loss of wetlands and wildlife habitat, loss of property, damage to infrastructure, excessive sediment transport to Lake Mead and water quality concerns in the Wash and Lake Mead.

The Wash is a natural channel that drains the entire 1,600-square-mile Valley. The Valley is about 50 miles long and is five to 25 miles wide. Figure 3.1 shows a satellite image of the Las Vegas Valley Hydrographic Basin and indicates the location of Las Vegas Wash and tributaries. The Wash discharges into Las Vegas Bay at Lake Mead.

In August 1999, the Stormwater and Erosion Study Team, in cooperation with the Las Vegas Wash Coordination Committee, sponsored an Engineering Workshop that discussed and developed recommendations regarding erosion in the Wash. Details of the workshop, which includes prototype design and siting of erosion control structures, are discussed in greater detail by the Erosion and Stormwater Study Team in Chapter 7.

History

The Wash was formed during the Miocene and Pleistocene Epochs, within the last 25 million years. The flood plain of the Wash was formed as a result of filling of the Valley by sediments derived from erosion of the surrounding ranges and higher elevations. The majority of these sediments consist of easily eroded silts and clays with minor amounts of sand and



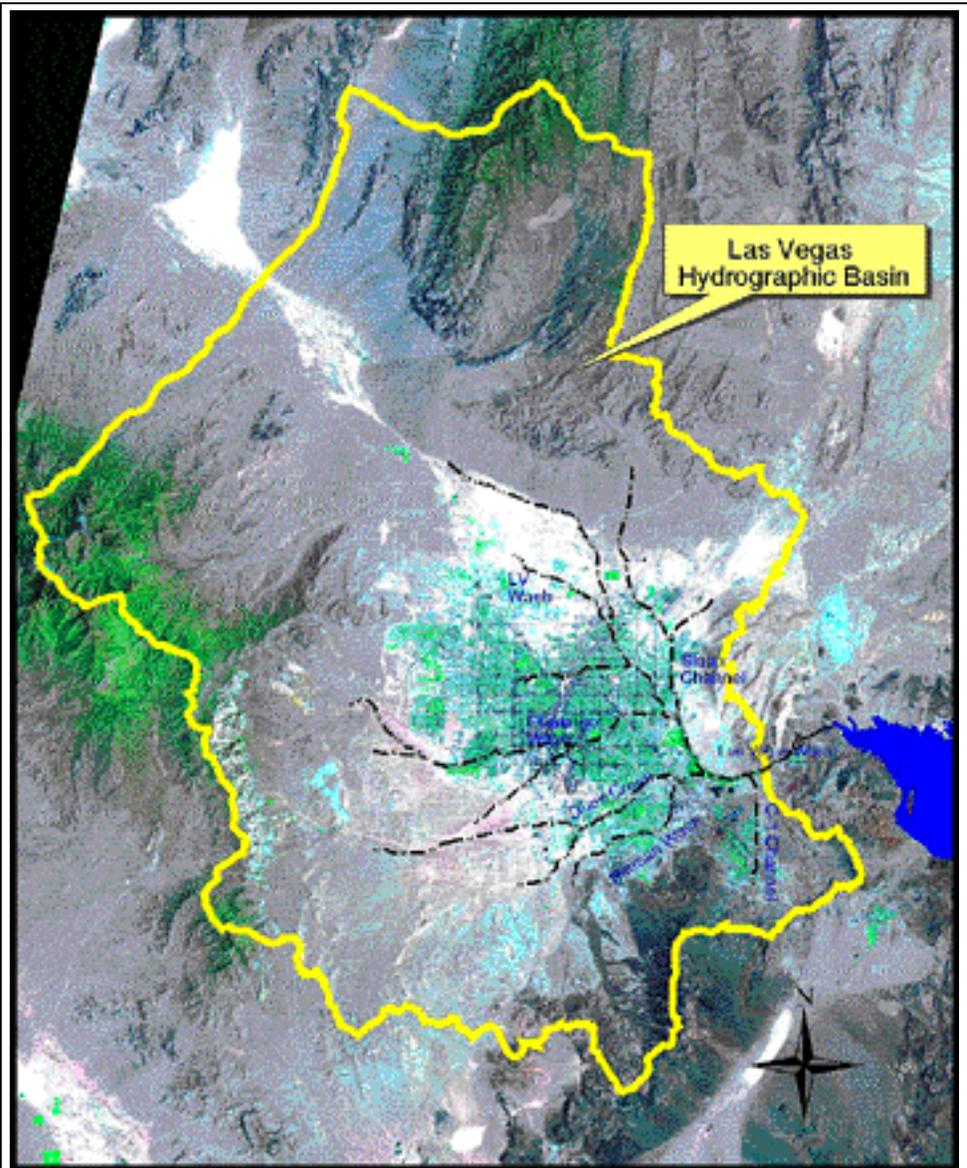


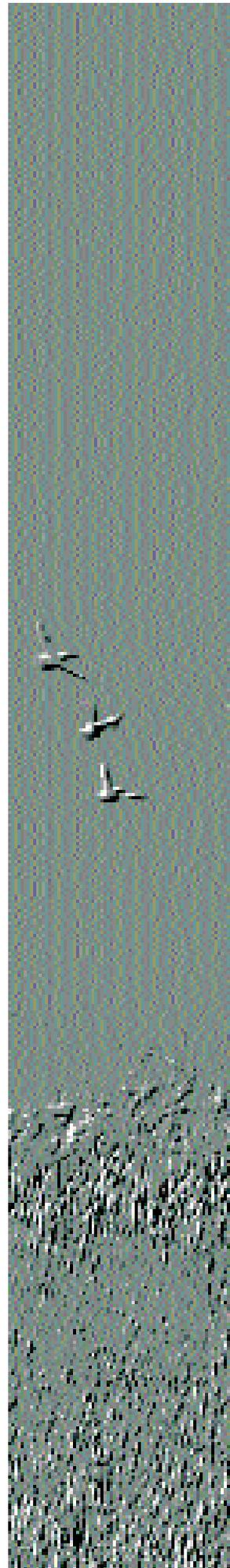
Figure 3.1 - Satellite image of Las Vegas Valley Hydrographic Basin depicting the Las Vegas Wash and associated tributaries.

gravel. Geologic evidence indicates that the Wash has undergone at least three natural cycles of down-cutting and subsequent back-filling prior to modern development.

The ancient stream course of the Wash can be traced from Indian Springs south to Corn Creek Springs, Tule Springs, Big Springs and into the Colorado River. During the period 6,000 to 14,000 years ago, Indian Springs, Corn Creek Springs, Tule Springs, Big Springs and numerous springs in the vicinity of present day Las Vegas apparently were active and drained into the Wash. Later, with increased tempera-

ture, decreased precipitation and lowered water table, spring activity decreased. The Wash has apparently been dry for the last 1,000 to 4,000 years. The latest phase of back-filling of the Wash began about 2,500 years ago.

The flow from the springs originally supported grassy meadows, mesquites and other phreatophytes along the small tributary washes. The plant growth entirely consumed the flow from the springs. Except for occasional flood flows there was no flow down the Wash (USBR, 1982). Prior to urbanization of the Valley, the Wash was defined by an evenly graded, stable flood plain typical of arid environments. Figure 3.2 shows an aerial photo of the Las Vegas Wash in 1950, prior to perennial flow and substantial wetland development.



1950s – 1960s

During the late 1950s, increased wastewater volumes resulted in a perennial flow in Las Vegas Wash that meandered through the southeast part of the Valley to Las Vegas Bay of Lake Mead. This was the first time in more than 2,500 years that flow in the Wash reached this far downstream. As a result of these flows (approximately 15 cubic feet per second in 1960), wetland vegetation and wildlife habitat expanded. The wetlands served to control erosion until increasing wastewater flows in the late 1960s began to erode the channel in the lower reach of the Wash.

Figure 3.3 shows an aerial photo of the Las Vegas Wash indicating a vast amount of wetland vegetation along the Wash channel.

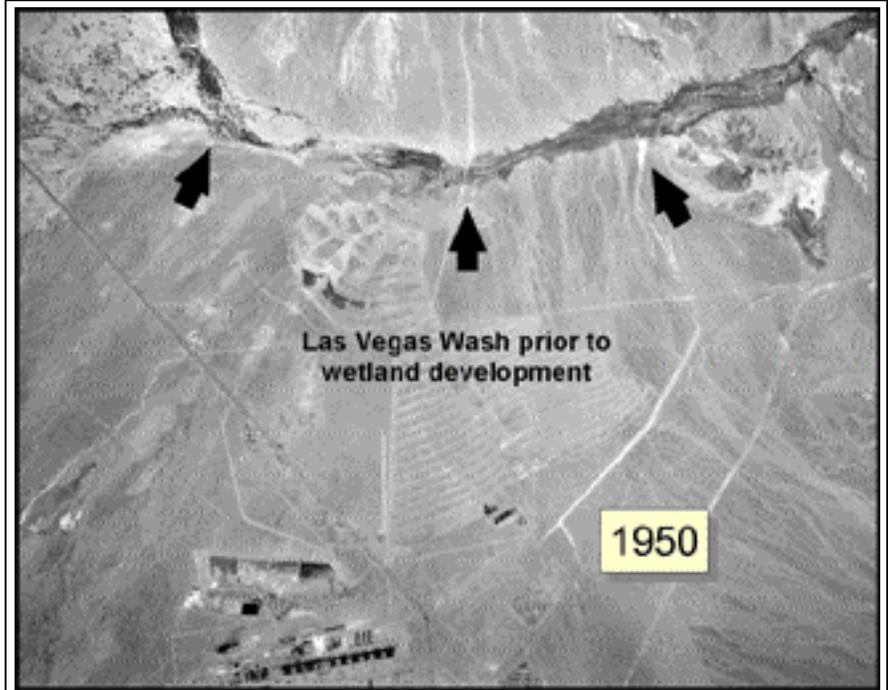


Figure 3.2 – Aerial photo of Las Vegas Wash, 1950.

1960s – 1970s

As discussed in Chapter 1, History of Las Vegas Wash, in the late 1960s and early 1970s wastewater flow ranged between 25 and 39 cubic feet per second (cfs) and erosion became evident at two sites, the tributary from Three Kids Mine and the culverts at the Northshore Road crossing. At these sites, lateral flow was confined, thereby increasing flow velocities and erosion potential. From these sites, headcut erosion was initiated, increasing vertically and laterally upstream.

Removal of the culverts and construction of Northshore Bridge allowed a series of headcuts to move upstream resulting in erosion and disruption of



Figure 3.3 – Aerial photo of Las Vegas Wash, 1981.





Figure 3.4 – Historic view of Las Vegas Wash from Northshore Road, 1975 (Pat A. Glancy, USGS).



Figure 3.5 – Historic view of Las Vegas Wash from Northshore Road, 1985 (Pat A. Glancy, USGS).



Figure 3.6 – View of Las Vegas Wash from Northshore Road, 1999 (Pat. A. Glancy, USGS).

Telephone Line and Pabco Roads and the need to tunnel the Las Vegas Lateral water supply pipeline deep beneath the channel.

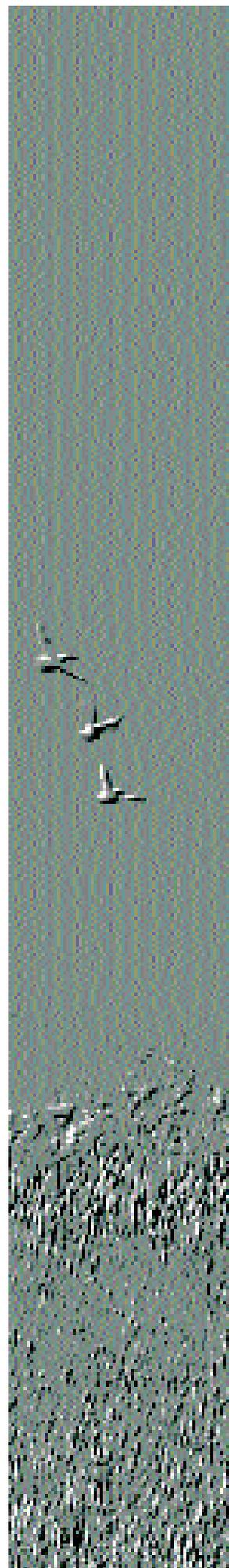
1970s – 1980s

During the early to mid 1970s, erosion became more evident in the lower reaches of the Wash (downstream from Three Kids Wash). The reaches above Three Kids continued to be dominated by wetlands habitat. The flood plain was still relatively flat and broad during this period and flourished with vegetation and wildlife fed by the gradually increasing flows from upstream. Figure 3.4 – 3.6 are a series of photos taken at Northshore Road in the lower reach of the Wash. These photos show conditions in 1975, 1985, and 1999.

1980s – 1990s

By the early 1980s average daily flow in the Wash had increased to about 100 cfs. These flows were sufficient to down-cut the channel creating an unstable, relatively narrow flow path. Numerous erosional headcuts were active along the reach from Pabco Road to Lake Mead by the early 1980s. The summer of 1984 included extended monsoonal periods and multiple flash flood events that greatly widened the flow path and effectively destroyed the majority of wetlands downstream of Pabco Road. Estimated total sediment removal from the late 1960s through 1984 amounts to over 4 million cubic feet (Glancy, 1999). Figure 3.7 shows a historical elevation profile along the Wash from the Clark County Advanced Wastewater Treatment Facility to the intake at Lake Las Vegas.

Current average daily flows in the Wash are approximately 240 cfs. Recent flood events in July and September 1998 and July 1999 have taken advantage of increasingly unstable conditions and caused catastrophic erosion in some reaches of the Wash. Continued erosion has resulted in the loss of about



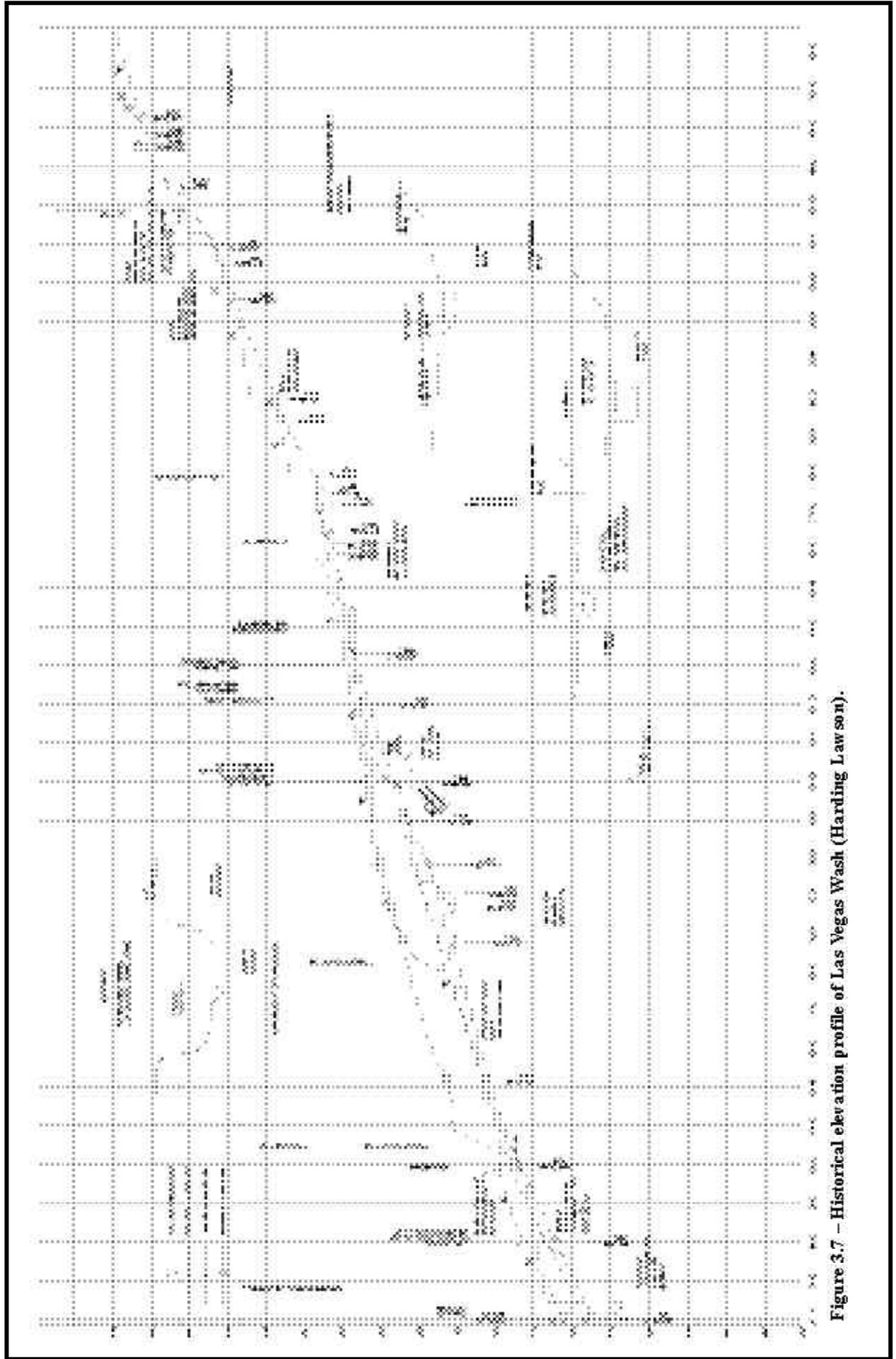
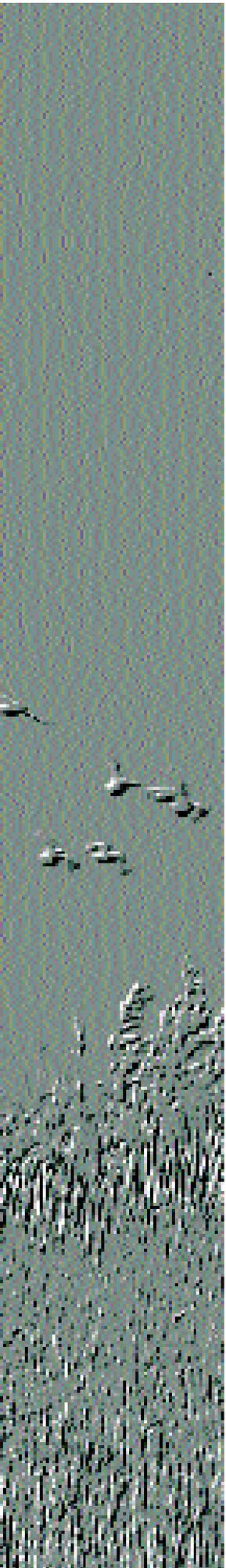


Figure 3.7 – Historical elevation profile of Las Vegas Wash (Harding Lawson).

Headcutting is the erosion of a streambed that occurs at a steep section of the channel and migrates upstream due to the water eroding the bed material. The upstream advance of gully and vertical channel downcutting by erosion, is the primary form of erosion in the lower Wash.

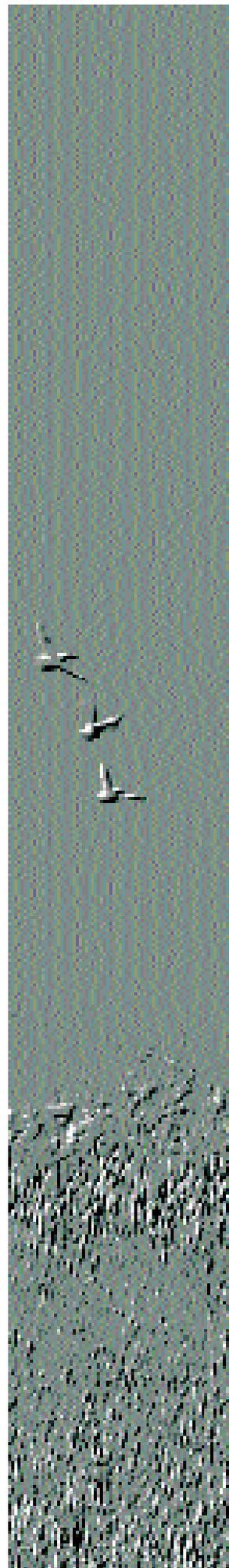
1,800 acres of the established wetlands and viable wildlife habitat. Other undesirable impacts of erosion on the Wash include dramatically increased sediment loading to Las Vegas Bay of Lake Mead, potential impacts to water quality in the Wash and Lake Mead, required infrastructure modifications, loss of property and destruction of road crossings.

Sediment erosion was covered in great detail by the Sediment Subcommittee of the Lake Mead Water Quality Forum. In their 1998 report, the Sediment Subcommittee indicated that the sedimentation rate for the time period of March 19 – 25, 1997 was 1400 to 1600 tons per day as measured by total suspended solids at a sample collection point above Lake Las Vegas. That amount of sediment being carried downstream during that time period by the Wash is 20 times greater than that reported in 1991 by Tipton & Kalmbach Inc. Of the sediment sampled in March 1997, 90 percent of the total suspended solids discharged to Lake Mead are inorganic, indicating that streambed erosion is a major contributor.

Erosion Control

The physical condition and soils of the Wash were mapped as they existed in 1981. Due to ever increasing daily flows, on the order of five times the flow that initiated erosion, the stream system is no longer in equilibrium. A properly functioning equilibrium in a stream system is a balance between sediment erosion and sediment deposition. Imbalance in the Wash has been evident when high peak flows remove more sediment than is deposited during low flows. This imbalance has reduced the area of the floodplain, reduced retention times, minimized spreading of water on the floodplain, and drained existing ground water into adjacent channels.

In the early 1980s it was determined that the Las Vegas Lateral (Lateral), the main drinking water supply pipeline for the Valley, was threatened by erosion in the Wash. A study was conducted to determine characteristics of the Wash in relation to proposed pipeline crossing alternatives. Part of the goal was to determine a stable equilibrium slope for the Wash which generally determines at what slope erosion will not occur based on flow and sediment load from upstream. For the reach from the Las Vegas Lateral upstream to Pabco Road the stable equilibrium slope was determined to be approximately 0.0035 vertical feet per horizontal foot. Resulting headcut will total 157 feet if no erosion control is in place, assuming this equilibrium slope from the Lake Las Vegas intake to the Clark County Advanced Wastewater Treatment Plant, based on projected wastewater flow amounts. Furthermore, lateral erosion has been determined to be approximately 22 feet for every foot of vertical streambed erosion.



During design, a series of flood events further threatened the Lateral, prompting the construction of a temporary Grace Control Structure (GCS) by the Colorado River Commission. The GCS, constructed in 1984, was a rip rap grouted structure approximately 7 feet high by 450 feet in length and was designed to last about two years. Photos taken after completion of the GCS show extensive wetlands development in areas behind the structure (Figure 3.8).

The GCS was left in place after the Lateral relocation was completed (1987) and required only minor repairs until flood events in 1996-1998 resulted in an extensive breach of the GCS and increased erosion of the Wash above the abandoned Lateral.

In July 1998, the Southern Nevada Water Authority (SNWA) and Clark County Parks & Recreation entered into a cooperative agreement to permanently repair the GCS site. During this process, a flood event in September 1998 caused extensive erosion in the Wash and resulted in the entire Wash flow passing under the abandoned Lateral by early October (Figure 3.9). Realizing that continued erosion may result in loss of the abandoned Lateral and the remaining GCS, the

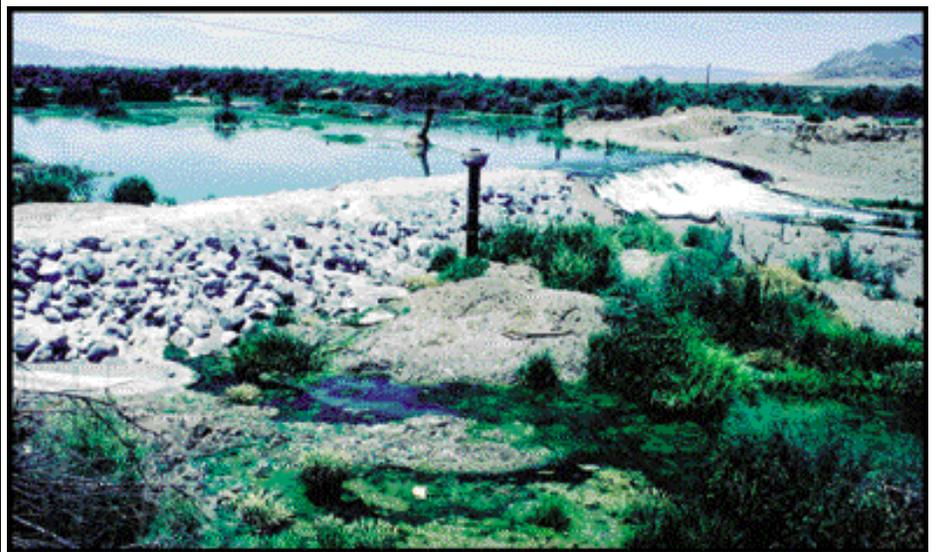


Figure 3.8 – Grade Control Structure at Las Vegas Lateral, 1985 (Pat A. Glancy, USGS).

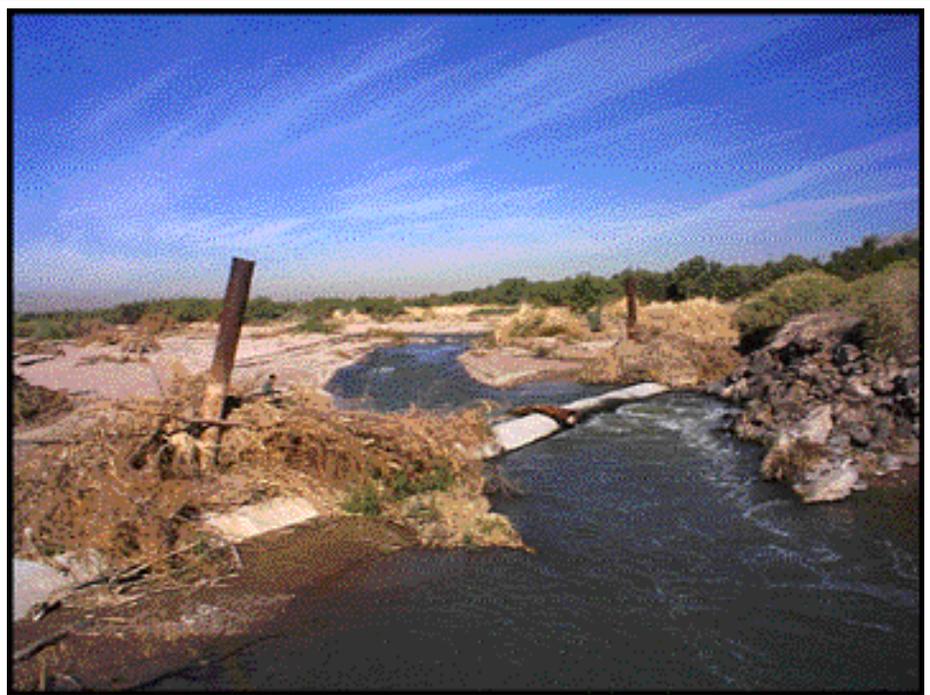


Figure 3.9 – Las Vegas Wash flowing under abandoned Lateral, October 1998 (Southern Nevada Water Authority).





Figure 3.10 – Grade control structure site after emergency repairs completed, November 1998 (Southern Nevada Water Authority).



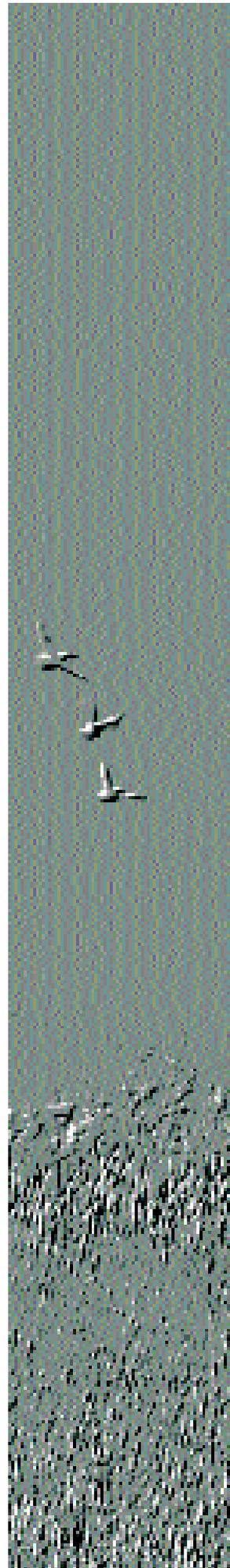
Figure 3.11 – Grade control structure site after July 1999 storm event (Southern Nevada Water Authority).

SNWA’s general manager declared an emergency action. Within four weeks emergency repairs were completed resulting in stabilization of the GCS. The emergency repair involved placing approximately 2,000 tons of rock rip rap below the abandoned lateral. Rock rip rap was granitic in composition and size ranged from approximately 2 to 4 feet in diameter. Design included a weir section adjacent to the abandoned lateral, a stilling basin and counterweir for energy dissipation. The upstream weir section keyed into the remaining abutments of the original GCS, constructed of rock rip rap with concrete grout. Upon completion, the emergency repair was approximately 100 feet wide and 90 feet long (Figure 3.10).

The July 8, 1999, flood event took place during the bidding process for permanent repairs to the GCS. Observation during the flood showed that the emergency repairs withstood greater than design flows prior to failure. Failure originated at the concrete grouted rock rip

rap abutments, from the original GCS, then progressively removed materials placed during emergency repairs. Floodwaters extensively altered the site resulting in postponement of the repairs and total redesign of the structure (Figure 3.11). The Las Vegas Lateral GCS is currently being redesigned and is planned for construction late- to mid-2000.

Similarly, the construction process for the Pabco Road GCS planned to be



built in the early 1990s has required redesign three times due to flood events altering the site. The Pabco Road GCS is currently being designed and is planned for construction in early 2000.

Recommendations of Clark County Comprehensive Planning's Las Vegas Wash Erosion Mitigation Plan include the construction of 15 grade control structures along the 9.5-mile reach of the Wash extending from the Advanced Wastewater Treatment Plant to Lake Las Vegas. These structures were anticipated to be placed at headcut locations, as they existed at the time, and to stabilize the Wash at the stable equilibrium slope of 0.0035.

Further recommendations for erosion control are discussed in Chapter 6, Erosion & Stormwater Study Team.

References

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Tipton & Klambach, Inc. (1991). Sediment Bedload Study for Lake Las Vegas.

U.S. Bureau of Reclamation (1982). Colorado River Basin Salinity Control Project, Point Source Division, Las Vegas Wash Unit, Nevada, Status Report.



