

SAMPLE RESULTS AND DISCUSSION

The results of the sample analysis yielded consistent data throughout the season for major ion chemistry, perchlorate and THM results. The fecal coliform data yielded the most variation as might be expected from a living constituent that is sensitive to changes in environmental conditions.

Fecal Coliforms

The results for the fecal coliform sampling demonstrate elevated concentrations, with respect to shallow groundwater, in all surface waters sampled at Duck Creek, Flamingo Wash, and Sloan Channel. Fecal coliform samples collected from groundwater sites consistently remained at significantly lower levels than the corresponding surface waters. Almost all of the groundwater samples from the boreholes and monitor well sites returned non-detection results (Figures 18-20). Anomalous results were encountered in one of the Flamingo borehole samples during only one event (FLAMIN NELLIS BH). This anomaly is assumed to be the result of sample contamination.

Samples collected in July followed several significant rain events and yielded elevated concentrations for the surface water sites on all three tributaries (Table 1). High concentrations following flood events are consistent with earlier findings reported by the Las Vegas Wash Coordination Committee Annual Report (LVWCC, 2003) and Clark County Regional Flood Control District Annual Report (CCRFCD, 2003). The corresponding groundwater samples remain unchanged from previous samples, suggesting that high coliform counts in surface water are the result of storm water and urban runoff. When compared to the high coliform counts in both the upstream and downstream sites it is evident that there was no coliform contribution from shallow groundwater along this reach of Flamingo Wash.

Fecal coliforms were present at low levels in half of the samples collected from the Domino Estate dewatering outfall sample site. All coliform samples collected from the Maple Cleaners environmental remediation monitor well yielded non-detection results. The accompanying surface sample sites (DK APT BRIDGE, DK MT VISTA) were consistently higher than shallow groundwater samples.

The Sloan Channel borehole samples also yielded low fecal coliform results. In the majority of channel samples collected at the Sloan Channel the fecal coliform count decreases between the up gradient and the down gradient sites. This suggests that the inflow of groundwater has reduced rather than enhanced fecal coliform counts in the channel.

Collected	Duck Creek				Flamingo Wash			Sloan Channel		
	DOMINO	DK APT BRIDGE	MAPLE MW-2	DK MTN VISTA	FLAMINGO/LAMB	FLAMINGO/NELLIS	FLAMINGO/NELLIS BH	SLOAN BH	SLOAN CHAR	SLOAN ORCH
03/03	6	44	NS	110	NS	NS	NS	NS	NS	NS
04/03	39	1400	NS	3600	4300	2900	<5	NS	600	1200
05/03	< 5	255	<5	215	555	<5	<5	<10	900	220
06/03	< 5	320	<5	420	265	380	155	**	535	75
07/03	< 5	1040	<5	21000	100010	66673	NS	<100	5200	130
08/03	< 5	4000	<5	1333	13333	10000	NS	7	84167	190
09/03	**	**	<1*	**	**	**	**	**	**	**
10/03	<2	590	<2	<200	660	230	<10	NS	NS	NS
11/03	<1	593	<1	620	<400	<400	550	5900	<400	300
12/03	<1*	<1*	<1*	**	**	**	**	**	**	**

Table 1. Results of fecal coliform sampling. Results are normalized to a count per 100 ml.* Results based on total coliform result. Data not returned for fecal coliform sample. Bold-faced italicized results are suspect for sample contamination. NS – No Sample**

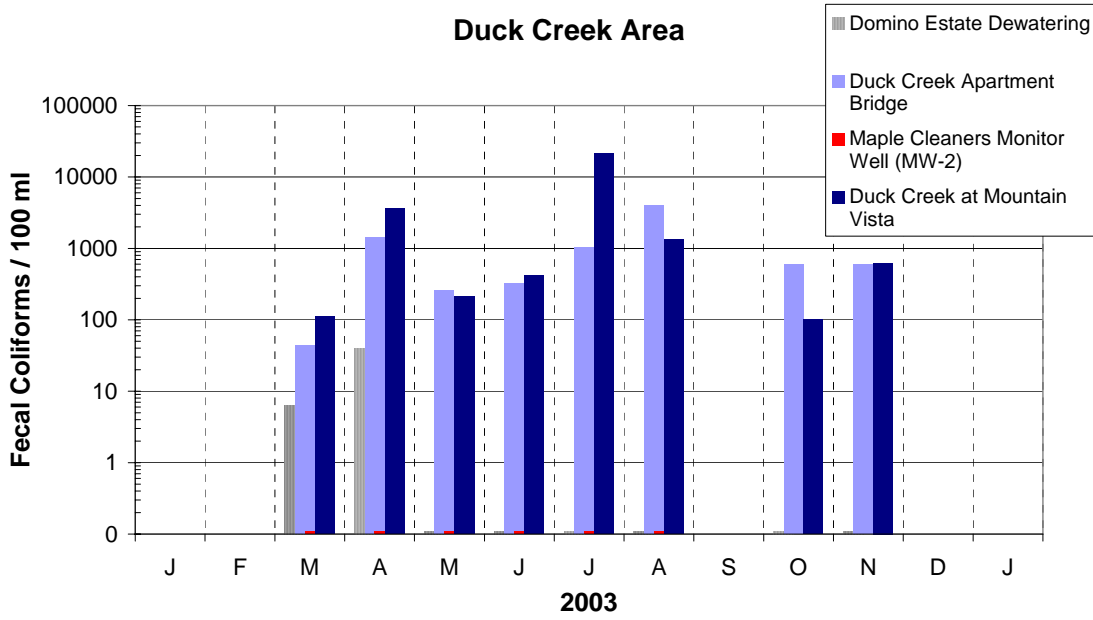


Figure 18. Chart detailing the results of Fecal Coliform sampling in the Duck Creek study area.

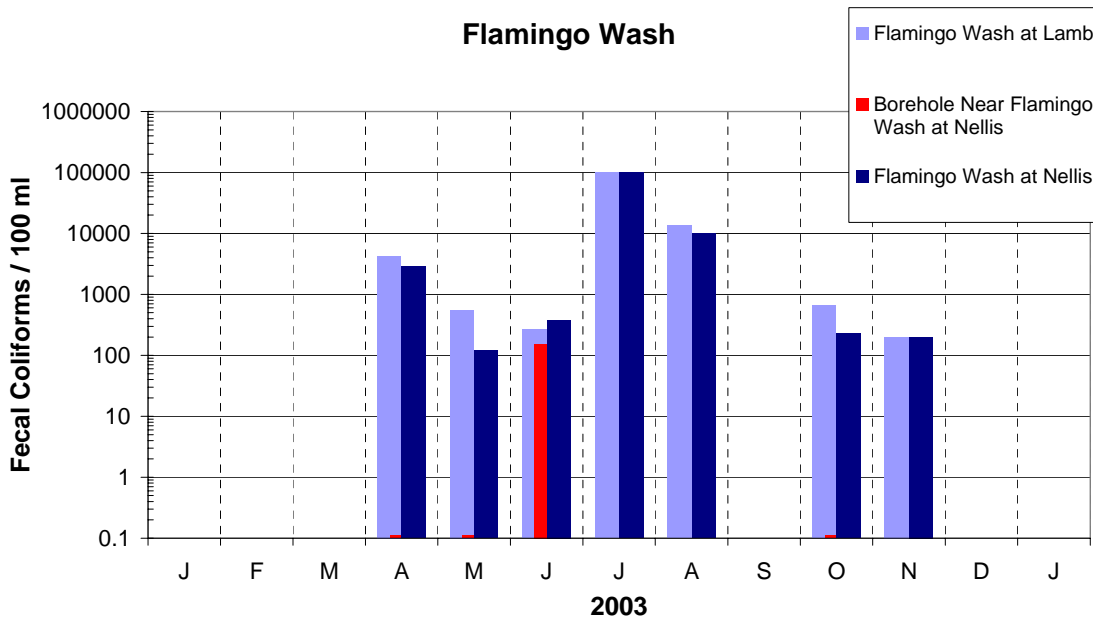


Figure 19. Chart detailing the results of Fecal Coliform sampling in the Flamingo Wash study area.

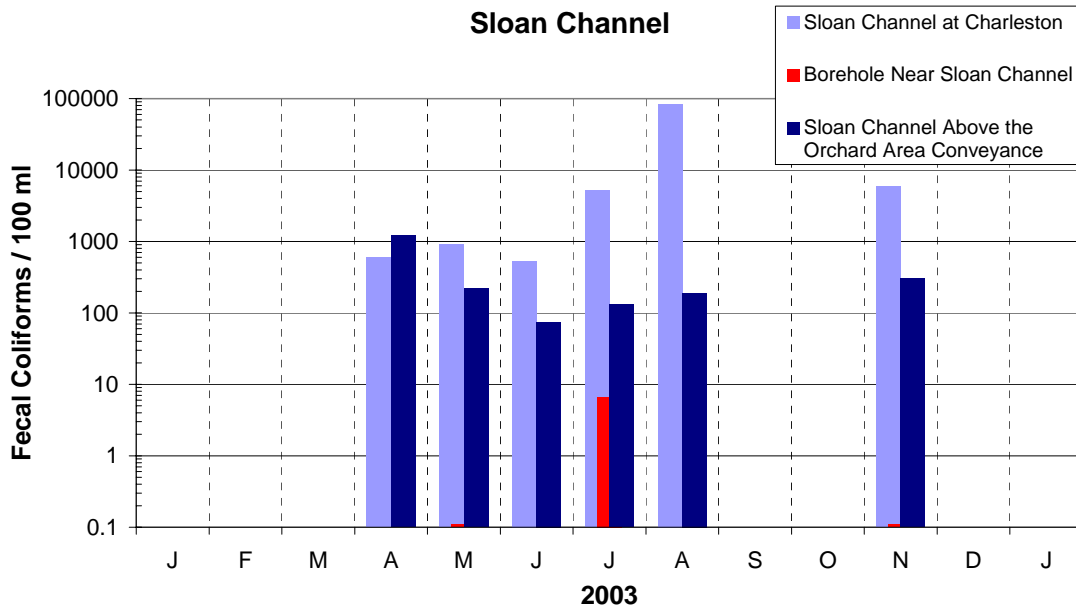


Figure 20. Chart detailing the results of Fecal Coliform sampling in the Sloan Channel study area.

Pharmaceuticals and Personal Care Products

Most sample results for PPCPs were below detection in the low ppt range; however, PPCP compounds were consistently present at some sites. At the Domino Estate, Sulfamethoxazole (Bactrim), an antibiotic administered to horses and people, was detected at concentrations from 23 to 37 ppt. Progesterone appeared in all of the samples from the Duck Creek area, with exception to the January suite, where the limit of detection was set above the results from subsequent samples (Table 2). Caffeine was present sporadically in several of the surface water sites; however, this compound is very common and could easily come from urban refuse or contact with field or lab technicians.

Table 2 shows that Oxybenzone was present in several samples collected in the same two day period. Oxybenzone is an ingredient in sunscreen and appeared in concentrations that exceeded what would be expected in the absence of any other indicators of human influence, suggesting contamination of the sample. Dr. Snyder suspects sampling or analytical error. Additional rounds of PPCP samples have been collected to support the results from the initial sampling. The boreholes along both Flamingo Wash and Sloan Channel exhibit a distinct lack of pharmaceutical tracers that would indicate influence from septic systems. The Flamingo borehole yielded an 11 ppt result for Sulfamethoxazole, barely above the limit of detection and may represent analytical error or sample contamination.

	Date	Sample Site	Caffeine	Sulfamethoxazole	Oxybenzone	Progesterone ESI	Progesterone APCI
			ppt	ppt	ppt	ppt	ppt
Duck Creek	1/28/2003	DOMINO	ND	37	ND	ND	ND
	1/29/2003	DK APT BRIDGE	ND	ND	ND	ND	ND
	1/29/2003	DK MTN VISTA	11	ND	ND	ND	ND
	4/22/2003	DOMINO	ND	23	ND	ND	20
	4/22/2003	DK APT BRIDGE	ND	ND	ND	ND	12
	4/22/2003	DK MTN VISTA	ND	ND	ND	ND	20
	5/21/2003	DOMINO	ND	36	ND	12	24
	5/21/2003	MAPLE MW-2	ND	ND	SE	ND	12
	5/21/2003	DK APT BRIDGE	74	ND	10	11	20
	5/21/2003	DK MTN VISTA	31	ND	21	13	22
	10/29/2003	DOMINO	ND	ND	ND	ND	ND
	10/29/2003	MAPLE MW-2	ND	ND	ND	ND	ND
	10/29/2003	DK APT BRIDGE	ND	ND	ND	ND	ND
	10/29/2003	DK MTN VISTA	ND	ND	ND	ND	ND
Flamingo	4/22/2003	FLAMINGO/ LAMB	22	ND	ND	13	17
	4/22/2003	FLAMINGO/ NELLIS BH	ND	ND	ND	ND	ND
	4/22/2003	FLAMINGO/ NELLIS	20	ND	ND	11	ND
	5/22/2003	FLAMINGO/ NELLIS BH	ND	11	SE	ND	ND
	10/30/2003	FLAMINGO/ LAMB	42	ND	ND	ND	ND
	10/30/2003	FLAMINGO/ NELLIS BH	ND	ND	ND	ND	ND
	10/30/2003	FLAMINGO/ NELLIS	36	ND	ND	ND	ND
Sloan	4/22/2003	SLOAN CHAR	77	ND	ND	ND	26
	4/22/2003	SLOAN ORCH	ND	ND	ND	ND	ND
	5/22/2003	SLOAN BH	ND	ND	SE	ND	ND
	11/20/2003	SLOAN CHAR	170	ND	ND	ND	ND
	11/20/2003	SLOAN ORCH	97	ND	ND	ND	ND
	11/29/2003	SLOAN BH	ND	ND	ND	ND	ND

Table 2. Results of Pharmaceuticals and Personal Care Products analysis. Concentrations are in ppt. SE-Dr. Snyder suspects sampling or analytical error in sample.

Major Ion Chemistry

Major ion chemistry can demonstrate interaction between shallow groundwater and surface water. If the surface water derives entirely from irrigation runoff there would be significant compositional differences between the shallow groundwater chemistry and the channel water because shallow groundwater is significantly more saline than runoff or system water. However, the proportions of EC, sulfate, and calcium are similar between shallow groundwater and surface water, which indicates they share a common source. Figures 21 and 22 demonstrate this relationship. Similarly, the EC in the Maple Cleaners well is around 7000 $\mu\text{S}/\text{cm}$, and the EC in nearby Duck Creek is between 4000 $\mu\text{S}/\text{cm}$ and 5000 $\mu\text{S}/\text{cm}$. This suggests that the surface water is saline groundwater diluted by irrigation runoff.

Trihalomethanes

Initial results for THM analysis exhibit low concentrations of chloroform in two of the groundwater samples (Table 3). THMs indicate the presence of water that originated in the municipal supply and arrived either through infiltration of irrigation water or from ISDS contribution to the shallow system.

Duck Creek Apartment Bridge

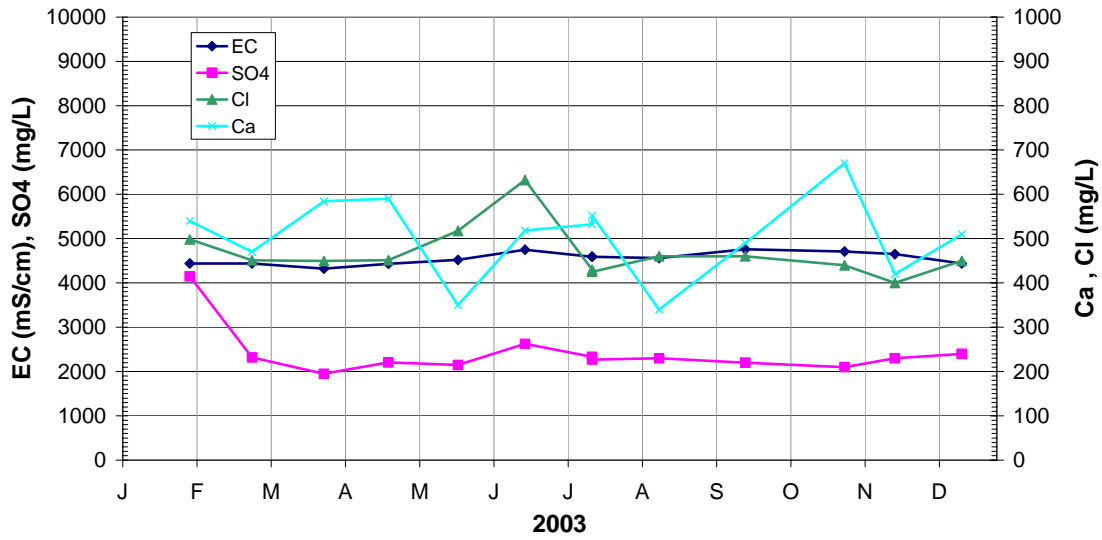


Figure 21. Chart detailing the results of cation and anion surface water sampling at Duck Creek near the apartment bridge. EC in units of $\mu\text{S}/\text{cm}$, all other ions in mg/l .

Maple Cleaners Monitor Well (MW-2)

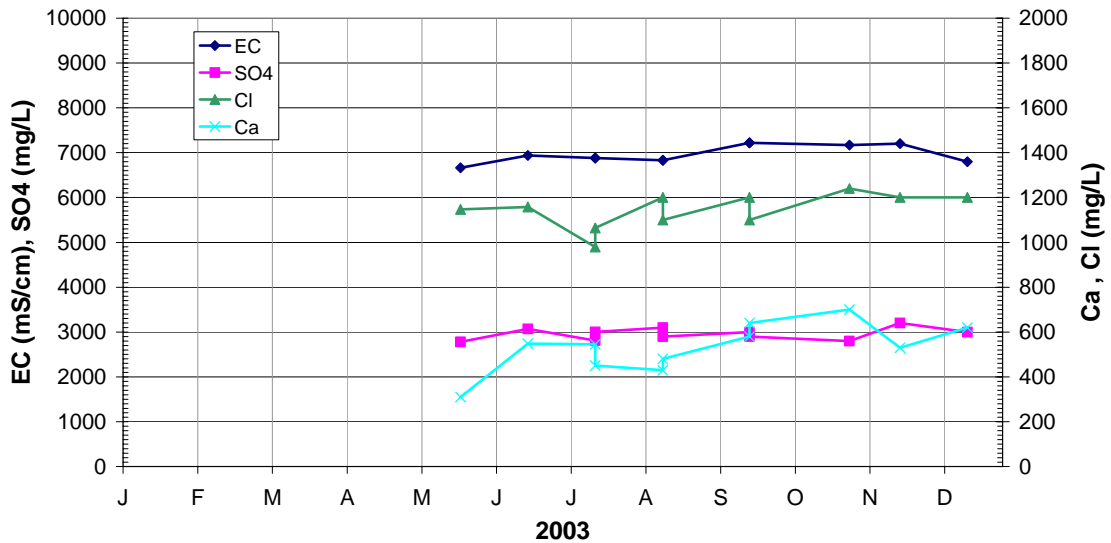


Figure 22. Chart detailing the results of cation and anion groundwater sampling at the Maple Cleaners Monitor Well (MW-2). Electroconductivity (EC) in units of $\mu\text{S}/\text{cm}$, all other ions in mg/l .

	Sample Site	Chloroform	Bromoform	Bromodichloro methane	Chlorodibromo methane	Total THM	
Collected		mg/L	mg/L	mg/L	mg/L	mg/L	
Duck Creek	05/21/03	DOMINO	0.0014	ND	ND	ND	0.0014
	05/21/03	MAPLE MW-2	ND	ND	ND	ND	ND
	11/19/03	DOMINO	0.001	ND	ND	ND	0.001
	11/19/03	DK APT BRIDGE	0.0008	ND	ND	ND	0.0008
	11/19/03	MAPLE MW-2	ND	ND	ND	ND	ND
	11/19/03	DK MT VISTA	ND	ND	ND	ND	ND
	12/17/03	DOMINO	0.0011	ND	ND	ND	0.0011
	12/17/03	DK APT BRIDGE	0.0008	ND	ND	ND	0.0008
	12/17/03	MAPLE MW-2	ND	ND	ND	ND	ND
	12/17/03	DK MT VISTA	ND	ND	ND	ND	ND
Flamingo	05/22/03	FLAMIN/NELLIS BH	0.0008	ND	ND	ND	0.0008
	11/20/03	FLAMIN/LAMB	ND	ND	ND	ND	ND
	11/20/03	FLAMIN/NELLIS	ND	ND	ND	ND	ND
	12/18/03	FLAMIN/LAMB	ND	ND	ND	ND	ND
	12/18/03	FLAMIN/NELLIS BH	ND	ND	ND	ND	ND
	12/18/03	FLAMIN/NELLIS	ND	ND	ND	ND	ND
Sloan	05/22/03	SLOAN BH	ND	ND	ND	ND	ND
	11/20/03	SLOAN/CHAR	ND	ND	ND	ND	ND
	11/20/03	SLOAN BH	ND	ND	ND	ND	ND
	11/20/03	SLOAN/ORCH	ND	ND	ND	ND	ND
	12/18/03	SLOAN/CHAR	ND	ND	ND	ND	ND
	12/18/03	SLOAN BH	ND	ND	ND	ND	ND
	12/18/03	SLOAN/ORCH	ND	ND	ND	ND	ND
	12/18/03	SLOAN/ORCH	ND	ND	ND	ND	ND

Table 3. Table representing results of Trihalomethanes sampling. Detection limit is .0005 mg/L.

Perchlorate

Low perchlorate concentrations were found in both shallow groundwater and surface water. Concentrations are within the 5-17 ppb range found in the municipal supply over the past five years. The presence of perchlorate in shallow groundwater could be due to either infiltration of irrigation water or through ISDS discharge. Perchlorate channel water could be from groundwater base flow or surface runoff of municipal irrigation water. Historic perchlorate variation in municipal supply water and the variation in the perchlorate results of this study make determination of specific water contributions to surface water difficult without further research. The absence of pharmaceutical and fecal coliform indicators of ISDS influence would suggest that perchlorate results most likely indicate that these waters are impacted by irrigation surface runoff and infiltration.

CONCLUSIONS

Surface water and groundwater samples were collected down gradient from areas with a high density of ISDS. Samples were analyzed for anthropogenic tracers, general chemistry, and fecal coliform under the hypothesis that fecal coliform were discharged from ISDS to the shallow groundwater system and eventually contributed to the surface water in the tributary network. The presence of little more than traces of PPCP, in both the surface water and groundwater

samples collected during this study, suggests that processes of attenuation greatly reduces the concentrations of these ISDS source compounds. The presence of progesterone at a low level in the Maple Cleaner monitor well coupled with the absence of fecal coliform suggests that ISDS have influenced shallow groundwater chemistry and coliform attenuate more rapidly than PPCP. Based on comparative rates of attenuation, fecal coliforms are not a pervasive component of ISDS discharge away from the immediate vicinity of ISDS leach fields. Low concentration of fecal coliforms in shallow groundwater and significantly higher concentrations in streams suggest that it is unlikely that fecal coliforms in streams are derived from ISDS.

Likely sources for coliforms in the tributary network are from indigenous wildlife, direct human waste, and urban sources that contribute through surface runoff. Samples collected following flood events exhibited exceptionally high coliform counts. Subsequent samples collected showed elevated coliform counts suggesting that a terrestrial source outside the wash channels is likely and that flooding acts as a distribution mechanism throughout the tributary network.

SUGGESTED FURTHER RESEARCH

Additional recommended research involving an analysis of the tributary network would include a point source investigation of coliform in the inflows to the tributary network. A point source investigation could be as simple as a series of one time profiles to seek out the likely sources of the high coliform in the tributary network. A more detailed approach might involve a series of profiles to determine the hot spots and follow up with a network of regular interval monitoring stations and periodic profiles.

REFERENCES

LVWCC, Las Vegas Wash Coordination Committee 2002 Year End Report, Published by SNWA, 2003, 88p.

CCRFCD, Clark County Regional Flood Control District Annual Report, Published by CCRFCD, 2003.

ACKNOWLEDGEMENTS

I would like to thank Carrie Stowers with the Clark County Department of Air Quality and Environmental Management for the idea and funding for this research. This research was made possible with the help of Dr. Shayne Snyder SNWS River Mountains Facility, for providing PPCP analysis, Dick Barrett for help with the GIS analysis, Paul Kuvelis, SNWA Hydrologist, for help with field examinations and flow estimates of the three tributary channels.