Fish Surveys in the Roza-Sunnyside Board of Joint Control Irrigation Drain Network: Summary of Major Findings for 2001

July 2001

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Executive Summary

The abundance and distribution of fish in the Roza-Sunnyside Board of Joint Control drainage network was studied in Corral Creek, Snipes Creek, Spring Creek, and Sulphur Creek wasteways, and in Granger Drain during the summer and fall of 2000 and during the winter and spring of 2001. Redd counts were conducted for adult salmon and steelhead trout, while electrofishing surveys were conducted to describe fish communities.

Adult salmon placed 92 redds in Sulphur Creek Wasteway and 69 redds in the lower Snipes and Spring creeks in October and November of 2000. One to two steelhead trout were observed in Sulphur Creek Wasteway on at least three occasions during the spawning season (February-April), but spawning activity was not observed. A dead steelhead kelt was found in Sulphur Creek Wasteway in June 2001, along with two dead (male and female) adult spring chinook salmon. A trout redd and a spawning male rainbow trout were found in Snipes Creek Wasteway, and a rainbow/steelhead trout was seen on a redd in Spring Creek Wasteway. Signs of steelhead spawning activity were scarce, as adult fish were not abundant in the drainages surveyed.

Electrofishing surveys were conducted in 2000 and 2001. The fish communities in Granger Drain and Sulphur Creek Wasteway and associated subdrains were dominated by native minnows and suckers, whereas juvenile salmonids were the most abundant fish species observed in Snipes Creek Wasteway and in lower Spring Creek Wasteway in both 2000 and 2001. Upper Spring Creek Wasteway supports a naturally-reproducing population of brown trout, a non-native salmonid.

The coho spawning in Sulphur Creek Wasteway apparently did not reproduce successfully, based on the low density of emergent fry (0.07 fish/100m^2) observed during surveys. In contrast, 4.73 fish/100m^2 juvenile coho were observed in lower Snipes and Spring creek wasteways.

The geology and gradient of the lower Yakima Basin influences the suitability of salmonid habitat in the various drainages. Corral, Snipes, and Spring creeks occur in natural drainages dominated by Columbia River Basalts, and these areas appear to have suitable physical habitat conditions for salmonids, as salmonids appear to have some

success spawning and rearing in these waterways. Sulphur Creek Wasteway and Granger Drain occur in areas dominated by lacustrine sedimentary deposits such as silt and sand, and these watersheds do not provide suitable salmonid habitat. Sulphur Creek Wasteway and Granger Drain do not occur in historic, natural stream channels that discharged to the Yakima River, rather they are man-made, excavated waterways. In contrast, Corral, Spring, and Snipes creeks contain some features consistent with historic stream channels.

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Introduction

Since the late 1800's through the 1950's, a network of canals, pumping plants, and laterals were developed to distribute irrigation water to agricultural lands within the Roza and Sunnyside divisions of the Yakima Reclamation Project, a federal irrigation project located in the Yakima River Basin of central Washington State. The Roza and Sunnyside divisions provide irrigation water to a combined total of 176,570 acres of agricultural and municipal land in the Project. Most of the acreage lies north and east of the Yakima River in the lower Yakima Valley (Figure 1), with the Roza district serving higher-elevation lands just uphill of the Sunnyside division along the same stretch of the Yakima River. Combined, the two irrigation districts divert up to 891,576 acre-feet of water from the Yakima River annually, amounting to about 5 feet of water diverted for every acre of land. The Roza-Sunnyside Board of Joint Control (RSBOJC) was formed in 1997 to improve the management of irrigation facilities used jointly by the two divisions.

Along with the water distribution system, a network of drains and wasteways was needed to convey irrigation return flows back to the Yakima River. Water that is diverted, but not used consumptively by plants or lost to evaporation, is considered irrigation return flow. Generally, irrigation practices have led to return flows accounting for as much as 50% of the water that is diverted (Lentz 1974). Thus, the drainage network is nearly as extensive as the delivery network, and some of the drains carry significant amounts of flow, particularly during the irrigation season. Major drains within the RSBOJC include Spring Creek and Snipes Creek wasteways, Sulphur Creek Wasteway and its numerous subdrains, Granger Drain and Moxee Drain. These as well as other smaller drains return both surface and subsurface water from RSBOJC lands directly to the Yakima River.

Fish from the Yakima River are able to access some areas within the RSBOJC drainage networks. The extent of anadromous and resident fish distribution, and the seasonality of fish use of drains, had not been studied prior to this project. Salmonids have been observed spawning in the drainage network for over a decade (Cuffney et al.

1997); however, there has not been an assessment of the success of the spawning activity. Beginning in May 2000 through May 2001, fish surveys were initiated to describe species presence, distribution, abundance, and habitat conditions in the RSBOJC drainage network. Survey participants included RSBOJC staff, Washington Dept. of Fish and Wildlife (WDFW), and Patrick A. Monk, consulting fish biologist.

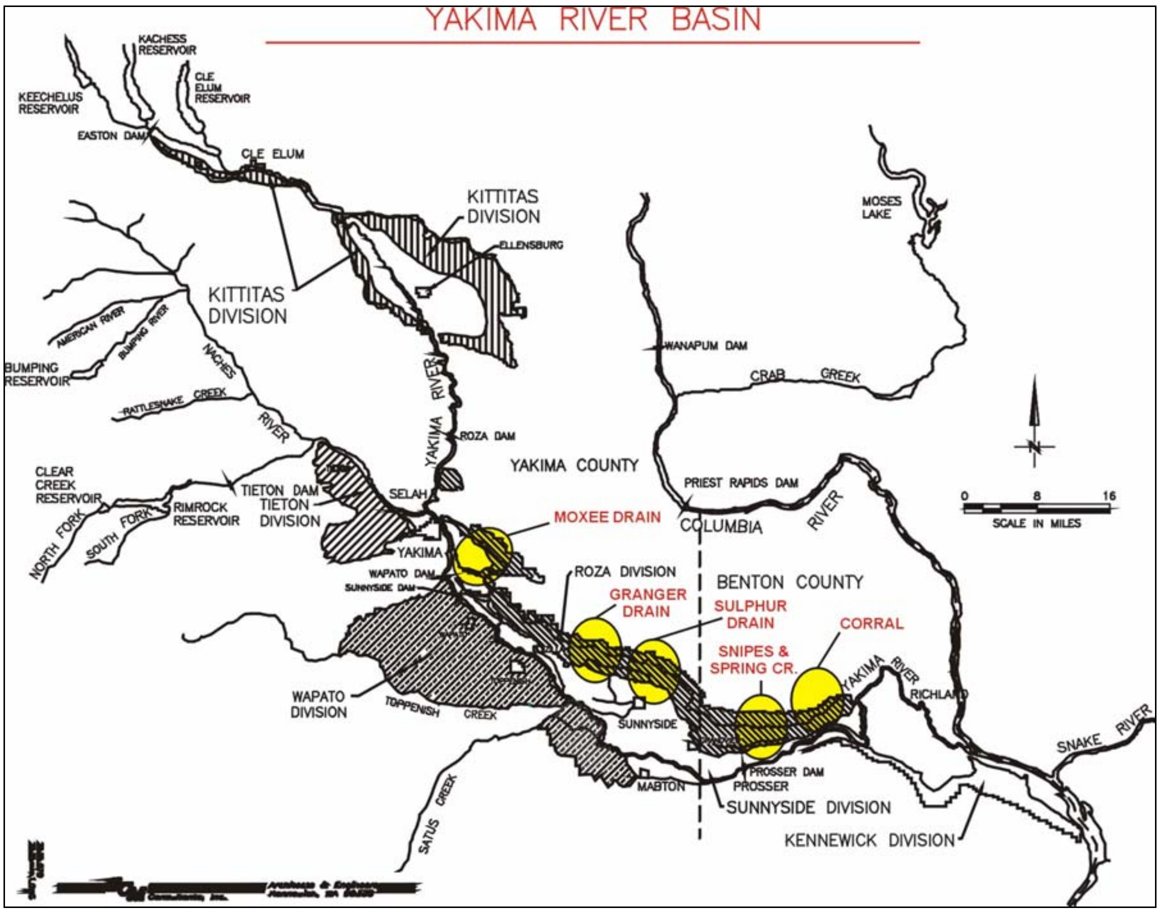

Figure 1. Irrigation divisions of the Yakima Project, Washington. The Roza and Sunnyside divisions are located primarily on the east side of the lower Yakima River.

Methods

Study Area

The study area included four major RSBOJC drainage networks: Granger Drain, which enters the Yakima at river-mile (RM) 83.0, with a drainage area of 39,500 acres; Sulphur Creek Wasteway (RM 61.0), which has a drainage area of about 102,400 acres; Spring Creek Wasteway, which drains an area of 26,500 acres; and Snipes Creek Wasteway, which drains about 21,800 acres. Spring and Snipes creeks enter the Yakima River jointly at RM 41.8. Additionally, a small isolated drain near Prosser, Washington, subdrain 52.8 (RM 47.0) and Corral Creek (RM 33.8), a Roza Irrigation District facility, were also surveyed on a limited basis.

We chose sites at different locations to sample a broad geographic area. Sample sites within each waterway were selected for a variety of reasons, including flow conditions on the day of the survey, prior knowledge of fish use, access, connectivity with the Yakima River, and drain channel conditions. Subsurface drains, or drains that flowed long distances underground through pipes (> 1,000 feet), were excluded from surveys. We were only able to survey wadeable streams due to backpack electrofishing water depth restrictions, so the lower mainstem of Sulphur Creek Wasteway was only surveyed outside of the irrigation season or when flows in the channel were low due to irrigation district operations.

Fish Survey Data Collection

Spawning surveys. Spawning surveys were conducted by walking predetermined routes of anadromous access on various waterways twice during the spawning season to make visual observations of adult salmonids, redds, and salmonid carcasses. Observations of live fish and carcasses, identified to species, were recorded. Redds were marked during the initial surveys with survey tape, which was later removed during the final surveys. This allowed us to estimate the temporal and spatial distribution of spawning. Surveys were conducted for salmon during October and November of 2000, while steelhead trout spawning surveys were conducted in February and March of 2001.

In Sulphur Creek Wasteway, all spawning surveys took place from Tear Road up to the end at Sheller Road, a distance of about 4.8 kilometers (Figure 2). In Spring Creek Wasteway, spawning surveys were conducted from the mouth up to the Old Inland Empire highway crossing, a distance of about 1 kilometer. On Snipes Creek Wasteway, salmon spawning surveys were conducted from the mouth up to the Benton Canal siphon crossing, a distance of about 3 kilometers. Steelhead trout spawning surveys on Snipes Creek Wasteway were conducted from the mouth up to the Roza Canal, a distance of about 6.5 kilometers. Other sites that were visited for spawning fish were lower Corral Creek, the lower end of Granger Drain (Figure 3), and lower Moxee Drain.

Electrofishing surveys. The drainage network was also sampled for fish by electrofishing with a backpack electrofishing unit. Generally, fishing proceeded in an upstream direction, with 2-3 people netting stunned fish as they became apparent in the water column. When flows or turbidities were high, it became difficult to observe stunned fish and catch them with a net. In such circumstances, a beach seine was deployed to create a barrier across the entire width of the waterway, then electrofishing commenced in a downstream direction to the barrier net. Stunned fish were picked up with dip nets or swept by the current to the barrier net and captured.

Once captured, fish were identified to species, counted, measured to the millimeter for total length (TL), and then released. Occasionally clove oil was used to anesthetize fish to prevent injury during handling. Afterwards, fish were allowed to recover before being released. When large numbers of the same species were captured at a single location, only a sub-sample of that species was measured for TL. Following each electrofishing pass, the time of fishing was recorded in seconds, and the length of the survey transect was measured to the nearest meter.

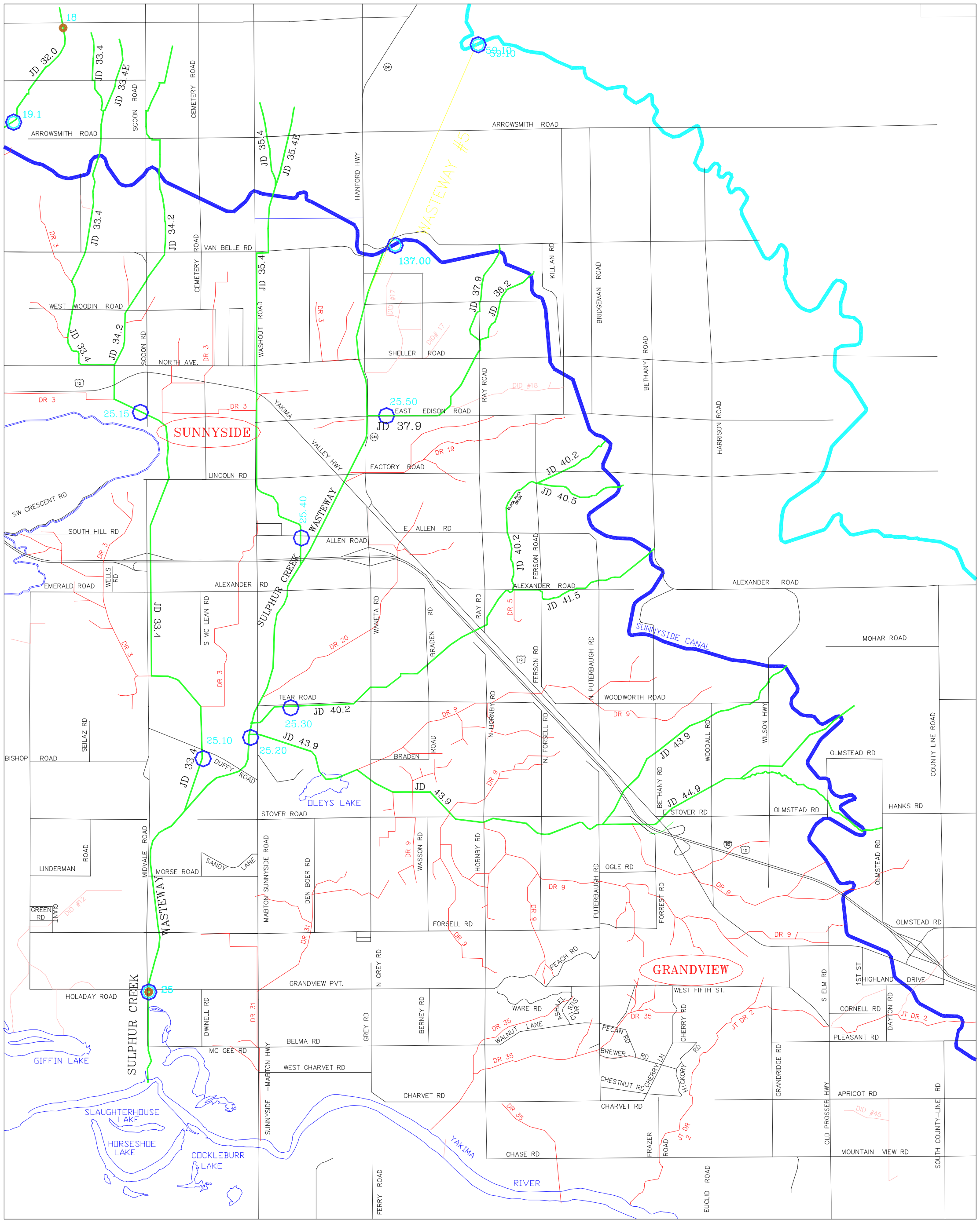

Figure 2. Sulphur Creek Wasteway map.

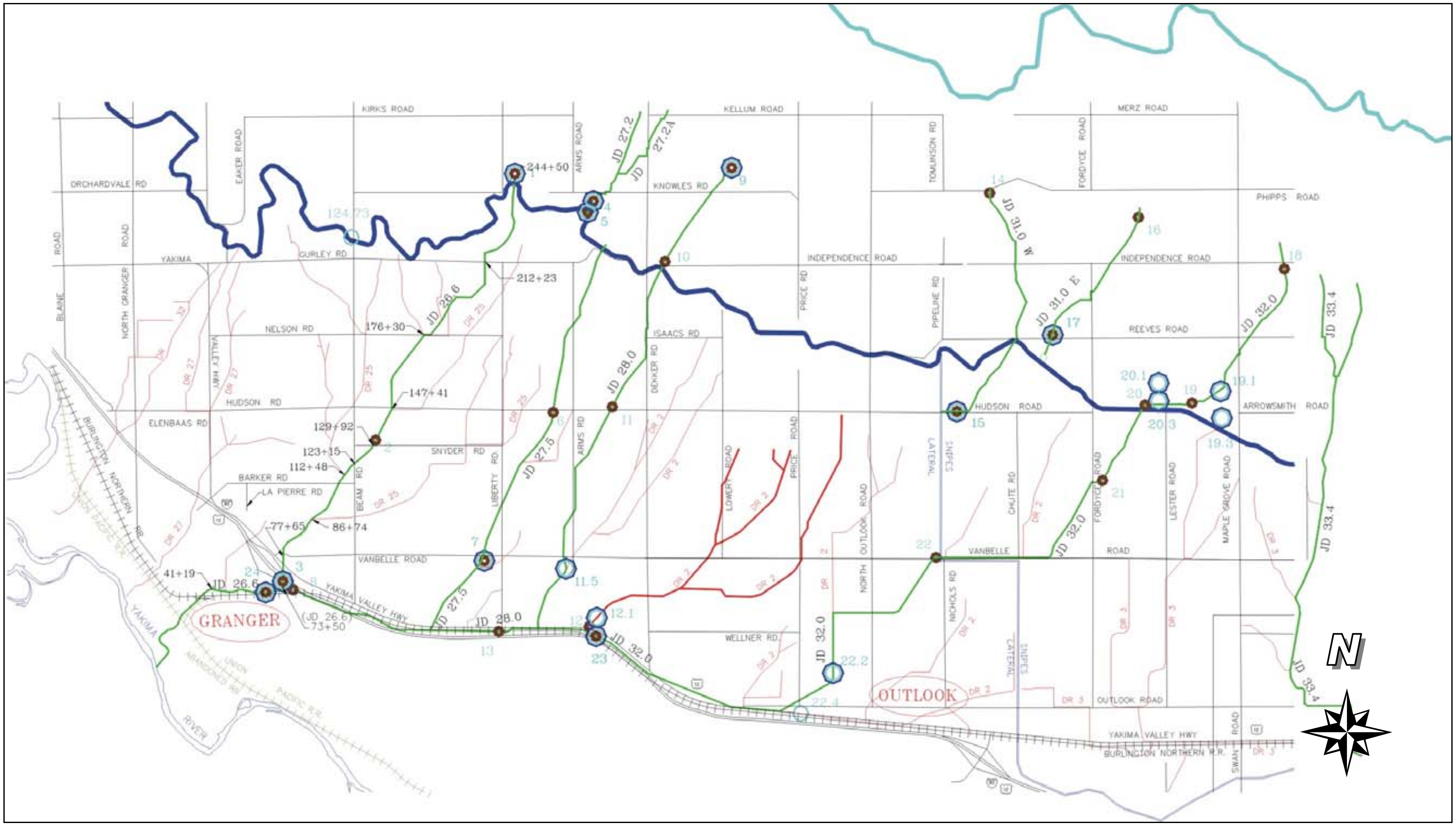

Figure 3. Granger Drain and main laterals JD 26.6, 27.5, 28.0.

Electrofishing Survey Data Analysis

Samples were taken from a number of different locations within each drainage network. Data collected during 2000 were grouped separately from data collected in 2001. Sampling in 2000 occurred from late May through August representing summer conditions, while sampling in 2001 occurred February through May, representing late winter and spring time conditions.

For each drainage surveyed, data was combined across dates and locations to estimate the relative density (# of fish/square-meter of habitat surveyed) of fish in the area sampled. Density was calculated by averaging across sites in each drainage to obtain the average number of each species captured per surface area sampled. The area sampled was estimated by multiplying the length of each survey transect in meters by the average stream width in meters as measured by S.P. Cramer and Associates (Romey and Cramer 2001) and reported in Appendix A. Finally, the index of density was multiplied by 100 to estimate the number of fish captured per 100 square-meters to ease the interpretation of data.

Results

Spawning Surveys

Salmon Spawning Surveys. In 1999 salmon were observed congregating in the Sulphur Creek Wasteway near the terminus at Sheller Road. In response, exploratory spawning surveys were initiated during the fall of 1999. Included in the 1999 surveys were Sulphur Creek, Spring Creek, Snipes Creek, and Corral Creek wasteways. The spawning surveys were expanded in the fall of 2000, as large numbers of salmon were again observed returning to the wasteways.

Sulphur Creek Wasteway was incompletely surveyed in early November 1999. Eight coho redds were found within 300 meters of the upper end of the wasteway, but no attempts were made to survey other areas in the wasteway in 1999. Spawning surveys were conducted on October 23rd November 21st. The results are reported in Table 1. During the October 23rd survey, 47 redds (many with fish on them), 27 carcasses, and over 150 live fish were observed. In contrast, on the final surveys in November four live fish were observed, indicating that the spawning activity was nearly concluded. Thus, spawning occurred over about a 5-6 week period, initiating just prior to the end of the irrigation season (October 20th), lasting until late November. By combining data sources, it is estimated that between 300 and 500 salmon (mostly coho) entered Sulphur Creek Wasteway in the fall of 2000.

Spawning surveys were also conducted in Snipes Creek Wasteway (including lower Spring Creek) in 1999 and 2000. Partial surveys conducted in October 1999 revealed 35 salmon redds in lower Snipes/Spring creek drainage. During the fall of 2000, systematic surveys were conducted on November 1st and 30th. Redd, carcass, and fish data are summarized in Table 1. Spawn timing was similar to that observed in Sulphur Creek Wasteway.

In Spring Creek Wasteway, no redds were found upstream of the Hess Road culvert. Lower Spring Creek proper, below Hess Road, contained about 5 redds/100 meters of channel length surveyed (29 redds over a distance of about 600 meters).

Table 1. Summary of spawning survey data collected for selected drainages during 2000.[1]

Site	Reach	Date	New Redds	Carcasses	Live Fish
Sulphur Ck					
	Tear-Allan Rd	10/23/00	21	4	16
	Allan-Sheller Rd	10/23/00	26	23	150
	Tear-Allan Rd	11/21/00	13	25	2
	Allan-Sheller Rd	11/21/00	32	174	2
		total	***92***		
Snipes/Spg Ck	Mouth-BNSF	11/1/00	37	18	15
	BNSF-Benton Canal	11/1/00	2	2	0
	Mouth-BNSF	11/30/00	22	4	4
	BNSF-Benton Canal	11/30/00	8	5	1
		total	***69***		

[1] Snipes Creek includes lower Spring Creek. Carcasses and live fish were predominantly coho salmon, although one fall chinook carcass was found in Snipes Creek. Earlier surveys identified four fall chinook carcasses in Sulphur Creek.

The lack of salmon redds in Spring Creek Wasteway in habitat directly upstream of the Hess Road culvert indicates the culvert is a passage barrier for adult salmon, given the relatively high density of redds immediately below the culvert.

Spawning surveys were also conducted in the lower section of Corral Creek in 1999 and 2000. In 1999, four redds were observed in the Creek at the confluence with the Yakima River. In 2000, one redd was observed at the same location, along with one live coho salmon. Riparian vegetation growth along the lower creek consists of very dense stands of Russian olive trees, making spawning surveys difficult and ineffective.

Spawning salmon were not observed congregating at the mouth of Granger Drain in late October or early November of 2000. Other drains and wasteways were not surveyed for spawning adult salmon.

Steelhead trout spawning surveys. Sulphur Creek Wasteway was surveyed for spawning steelhead on February 22nd, March 9th and 16th, 2001. One adult steelhead was observed in the pool at Sheller Road in February, and two adults were observed at the same location during electrofishing surveys in March. One incompletely formed redd was found about 100 meters downstream of the Sheller Road terminus, however fish were not observed on the redd. No other redds were found in the wasteway, although a spawned-out steelhead carcass was found in mid-June at the Sheller Road location.

Lower Spring and all of Snipes creeks were surveyed on February 23rd and March 8th, 2001; in addition a partial survey of Snipes Creek was conducted on April 8th. One small redd, likely a trout, was found on Snipes Creek near the Old Inland Empire highway bridge. During the electrofishing surveys, a mature male rainbow trout was captured in Snipes Creek. Habitat crews that were surveying the drains found a rainbow/steelhead trout (estimated TL = 432 mm, or 17 inches) upstream of Hess Road in Spring Creek Wasteway in February. No other spawning trout were observed in Spring Creek Wasteway.

In conclusion, a handful of rainbow/steelhead trout were observed in Sulphur Creek and Spring/Snipes wasteways. Two small redds were found that did not appear characteristic of larger steelhead trout; unlike salmon, large concentrations of spawning trout were not observed in the wasteways.

Electrofishing Surveys

Table 2 lists the common and scientific names of all fish species captured, combined across all dates during the 2000-01 sampling periods. Twenty-one fish species common to the inland Northwest were captured, nine of which are non-native fishes introduced from eastern North America and Europe (Wydowski and Whitney 1979).

During the late spring and summer of 2000 over two linear kilometers of drainage networks were surveyed, with an area of 6,142 square-meters. During the 2000 sampling period 723 individual fish were captured, representing 16 different species (Table 3). During the 2001 sampling period just over three linear kilometers of drainage networks were surveyed, with an area of 8,518 square-meters. Table 4 shows that 566 individual fish from 18 taxa were captured in 2001. Results specific to each drain for various sampling periods are discussed below.

Table 2. Common and scientific names of the 21 fish species found during surveys of the Roza-Sunnyside drainage network.

Common Name	Scientific Name
brown trout*	*Salmo trutta*
coho salmon	*Oncorhynchus kisutch*
rainbow/steelhead trout	*O. mykiss*
chinook salmon	*O. tshawytscha*
carp*	*Cyprinus carpio*
chiselmouth	*Acrocheilus alutaceus*
redside shiner	*Richarsonius balteatus*
longnose dace	*Rhinichthys cataractae*
speckled dace	*R. osculus*
northern pikeminnow (squawfish)	*Ptychocheilus oregonensis*
largescale sucker	*Catostomus macrocheilus*
mountain sucker	*C. platyrhynchus*
bridgelip sucker	*C. columbianus*
brown bullhead*	*Ictalurus nebulosus*
mosquitofish*	*Gambusia affinis*
black crappie*	*Pomoxis nigromaculatus*
largemouth bass*	*Micropterus salmoides*
smallmouth bass*	*M. dolomieui*
bluegill*	*Lepomis macrochirus*
pumpkinseed*	*L. gibbosus*
sculpin	*Cottus spp.*

* indicates a non-native fish species.

Table 3. Density of fish captured in electrofishing surveys of the RSBOJC drainage network during surveys conducted in 2000.

2000 DATA	***Granger Drain***		***Sulphur Creek***		***Spring Creek***		***Snipes/Spring Creek***		***52.8***	
	m sq =	1277.2	m sq =	1833.3	m sq =	1164.9	m sq =	1661.75	m sq =	205
	N	Density/ 100 sq. meters	N	Density/ 100 sq. meters	N	Density/ 100 sq. meters	N	Density/ 100 sq. meters	N	Density/ 100 sq. meters
brown trout					*2*	*0.17*				
coho	2	0.16					43	2.59		
rainbow/steelhead			*4*	*0.22*			*3*	*0.18*		
carp			12	0.65			1	0.06		
chiselmouth	*4*	*0.31*								
redside shiner	5	0.39	60	3.27	16	1.37				
longnose dace	*1*	*0.08*					*6*	*0.36*		
speckled dace	78	6.11	258	14.07	68	5.84	4	0.24	25	12.20
northern pikeminnow	*15*	*1.17*	*19*	*1.04*			*2*	*0.12*		
largescale sucker	8	0.63	6	0.33			1	0.06		
mountain sucker			*24*	*1.31*						
bridgelip sucker	1	0.08	24	1.31			14	0.84		
mosquitofish			*3*	*0.16*						
largemouth bass			4	0.22						
smallmouth bass			*1*	*0.05*			*4*	*0.24*		
pumpkinseed			5	0.27						
	114		420		86		78		25	723

Table 4. Density of fish captured in electrofishing surveys of the RSBOJC drainage network during surveys conducted in 2001.

2001 DATA	***Granger Drain***		***Sulphur Creek***		***Spring Creek***		***Upper Snipes Creek***		***Snip/Spg***	
	m sq =	838.4	m sq =	4118.9	m sq =	805.2	m sq =	1104.9	m sq =	1650.75
	N	Density/ 100 sq. meters	N	Density/ 100 sq. meters	N	Density/ 100 sq. meters	N	Density/ 100 sq. meters	N	Density/ 100 sq. meters
brown trout					*8*	*0.99*				
coho			4	0.10			19	1.72	78	4.73
rainbow/steelhead							*1*	*0.09*	*1*	*0.06*
chinook									1	0.06
carp			*5*	*0.12*						
chiselmouth			122	2.96			1	0.09	1	0.06
redside shiner			*6*	*0.15*						
longnose dace	1	0.12	1	0.02					8	0.48
speckled dace	*17*	*2.03*	*45*	*1.09*	*82*	*10.18*			*8*	*0.48*
northern pikeminnow	1	0.12	27	0.66						
mountain sucker	*2*	*0.24*	*1*	*0.02*			*25*	*2.26*	*6*	*0.36*
bridgelip sucker	1	0.12	29	0.70			33	2.99	1	0.06
largemouth bass			*1*	*0.02*					*2*	*0.12*
smallmouth bass			12	0.29			1	0.09	5	0.30
brown bullhead			*1*	*0.02*						
black crappie							3	0.27		
bluegill			*1*	*0.02*						
sculpin	3	0.36								
	25		257		90		83		111	566

Granger Drain

During the 2000 season Granger Drain was surveyed in five locations: at the mouth, and in subdrains 26.6, 27.5, 28.0, 32.0, and DR2 (Figure 2). Each location was surveyed on May 25 and August 11, 2000, except at the mouth and DR2, which were only surveyed in May. Approximately 1,277 square-meters of Granger Drain was sampled during this period. During 2001 Granger Drain was surveyed on April 10; 838 square-meters were sampled at the mouth, in DR 2, and in subdrain 26.6.

Except at the confluence with the Yakima River, salmonids were not observed in Granger Drain. At the mouth of the drain, common minnow and sucker species, two juvenile coho salmon, and sculpin were captured (Tables 3, 4, and 5).

Table 5. Fish species captured at sample sites located within Granger Drain.

	Granger Drain											
	mouth		26.6		27.5		28		32		DR 2	
	N[1]	density.[2]	N	density	N	density	N	density	N	density	N	density
coho	2	1.18										
chiselmouth	2	1.18	1	0.98	1	0.59						
redside shiner	5	2.94										
longnose dace					1	0.59	1	0.49				
speckled dace	1	0.59			69	40.59					7	1.75
northern pikeminnow	6	3.53	8	7.84							1	0.25
largescale sucker			7	6.86	1	0.59						
bridgelip sucker											1	0.25

[1] N = # of fish captured of that species in all samples.

[2] Density expressed as number of fish captured per 100 square-meters of channel.

Granger Drain flows through a series of seven closely-spaced culverts in the City of Granger, just upstream (< 0.5 kilometer) from the confluence with the Yakima River, which cumulatively are likely fish passage barriers for juvenile and adult anadromous fish (Romey and Cramer 2001). Although anadromous salmonids are blocked from accessing Granger Drain due to the culverts in Granger, the habitat upstream of Granger is not suitable salmonid habitat (Romey and Cramer 2001). The drain is an artificial water way that was developed around the turn of the century to maintain the productivity of agricultural land that was becoming water-logged and alkali following the onset of irrigation in the lower valley (O. Perala, pers. comm.). Upstream of the culverts in Granger, the fish community was dominated by speckled dace, but associated with other minnows and suckers (Table 5). Fish survey data and habitat data indicate Granger Drain does not have suitable habitat for salmonids (Romey and Cramer 2001).

Sulphur Creek Wasteway

Electrofishing surveys of Sulphur Creek Wasteway (Figure 3) and its associated subdrains were conducted on June 14, August 8, and August 11, 2000. Fish were sampled at ten sites in seven locations in the network, with no site sampled more than once. The locations were: mainstem, 33.4, 34.2, 35.4, 40.2, 43.9, 46.4, and DR 9. Overall, 1,833 square-meters of the drainage network were surveyed, yielding a total of 420 individual fish of twelve different species (Table 3). Native minnows and suckers were the most abundant fishes observed. Four rainbow trout were captured during electrofishing surveys of Sulphur Creek during the summer of 2000. Two of the individuals were captured on August 11th in the mainstem of the wasteway at its Sheller Road terminus. These two individuals appeared to be adult rainbow trout (TL = 360, 263). In addition to the adults, two juvenile rainbow trout were captured during the surveys, one (TL = 134) on June 14 in subdrain 43.9, and another (TL = 111) on August 11 at a different location in the same subdrain, about 5 kilometers upstream of confluence of the subdrain with the mainstem of Sulphur Creek Wasteway. Other notable results in 2000 included a localized distribution of mountain suckers observed in subdrain 46.4. In this subdrain, the abundance of mountain suckers relative to other fish was quite high (Table 6), and in hindsight, the bridgelip suckers captured at a different site within that drain may have been misidentified; some may have been mountain suckers. Mountain suckers were not captured at any other location during the Sulphur Creek Wasteway drainage surveys, as they are uncommon in the lower Yakima River and more common in the upper basin (Patten et. al 1970).

Electrofishing surveys conducted in 2001 sampled nearly two linear kilometers of the wasteway, or about 4,118 square-meters. Surveys were focused on the mainstem of Sulphur Creek Wasteway, due to the large number of salmon observed spawning in the wasteway during the fall of 2000, and the interest in the fate of the spawn (see discussion below). During the late winter and early spring sampling period 566 fish of 18 different taxa were captured. Surveys were conducted on March 15th, prior to the irrigation season, and on April 19th, after the irrigation season was initiated. Four juvenile coho salmon were captured, of those three were found in March: one was a yearling smolt (TL = 169), one was a sub-yearling (TL = 49), and the other, a 74-mm fish was intermediate in size, most likely a yearling fish. No other salmonids were captured during the winter and spring surveys. The fish community in 2001, similar to 2000, was dominated by the relatively abundant and common minnow and sucker species.

Table 6. Electrofishing data collected in Subdrain 46.4, August 2000.

	Subdrain 46.4	
	N[1]	density[2]
speckled dace	13	10.83
mountain sucker	24	20.00
bridgelip sucker	5	4.17
mosquitofish	3	2.50
largemouth bass	2	1.67

[1] N = # of fish captured of that species in all samples.

[2] Density expressed as number of fish per 100 square-meters of channel.

Upper Spring Creek Wasteway

This section discusses data collected from upper Spring Creek, *above* the fish passage barrier culvert on Hess Road. Upper Spring Creek was surveyed on May 24 and August 24, 2000. Five different sites were sampled, from lower to upper reaches; the combined length of the surveys was 1,165 square-meters; an additional 805 square-meters were sampled on April 12, 2001.

The data collected between the two sampling periods were consistent. Overall, speckled dace were the most abundant species in both years; brown trout were also caught in both years, while redside shiners were only found in 2000 (Tables 3 and 4).

Figure 4 displays length frequency data for brown trout captured in upper Spring Creek. Both sub-yearling (<50 mm) and adult fish (>300 mm) were captured in the wasteway, indicating natural reproduction of these fish was occurring. McMicheal et al. (1999) reported on the existence of a brown trout population in the mainstem Yakima River near Benton City, which have occasionally been mistaken for bull trout during fish surveys of the lower mainstem Yakima River. Genetic tests conducted by Washington Department of Fish and Wildlife confirmed the fish were brown trout (McMicheal, pers. comm.). Brown trout are native to Europe and were introduced to North America (Wydowski and Whitney 1979), and they prefer warmer, more turbid water than salmonids native to the Pacific Northwest (18-24°C, 65-75°F). Brown trout were only captured at the uppermost Spring Creek sampling location at McCreadie Road. An adult brown trout was observed, but not captured, during surveys of lower Spring Creek Wasteway below the Hess Road culvert.

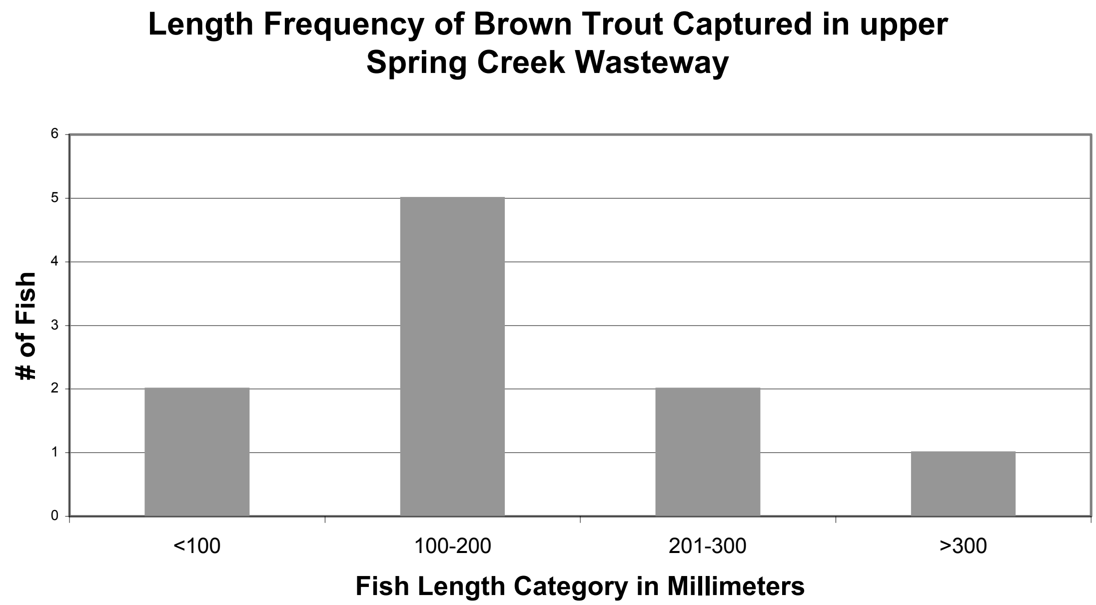

Figure 4. Data indicating brown trout in Spring Creek Wasteway are naturally reproducing, as both adult and sub-yearling fish were found in the upper portion of the waterway.

Snipes/Spring Creek and Upper Snipes Creek

For the purposes of this discussion, Snipes/Spring includes the lower portion of Spring Creek, from the confluence of the two waterways up to the fish passage barrier culvert at Hess Road, a distance of 588 meters (Romey and Cramer 2001), and the lower portion of Snipes Creek, below the Old Inland Empire Highway bridge. Spring Creek was included for this discussion because of the habitat in the two waterways near their confluence is all relatively similar, and fish can move freely between the two channels, while their movement in to upper Spring Creek is restricted.

Snipes/Spring was surveyed by electrofishing on May 24 and June 16, 2000. 1,104 square-meters of the lower, middle, and upper reaches were sampled, up to the Roza Canal. All data collected in 2000 in Snipes Creek was grouped under the heading “Snipes/Spring” in Table 3, while the 2001 data was split between the Snipes/Spring data and the upper Snipes Creek data. In 2001, upper Snipes Creek and Snipes/Spring was surveyed on March 8, April 12, and May 30, 2001. The three survey trips covered about 1,651 square-meters of habitat for Snipes/Spring, and about 1,105 square-meters in upper Snipes Creek.

Snipes/Spring and upper Snipes sites were notable for the high abundance of coho salmon in 2000 and 2001. Coho were found in all reaches of the creek surveyed, but were most abundant towards confluence with the Yakima River. In contrast to the other drains, speckled dace were found in low abundance in Snipes Creek (Tables 3 and 4).

Figure 5 shows the frequency distribution of the TL of coho salmon in Snipes Creek Wasteway observed throughout the 2001 sampling period. During March and April, two year classes of fish were observed in the creek: swim-up fry (TL <50mm) and smolt-sized coho (TL > 100mm). By late May the larger yearling smolts had exited the creek and only sub-yearling fish were observed, which had increased in their average size from 40 mm in early March to an average of 97 mm in late May (Figure 6). These data suggest some coho salmon spawn and rear successfully in Snipes Creek, however the productivity of the run has not been determined.

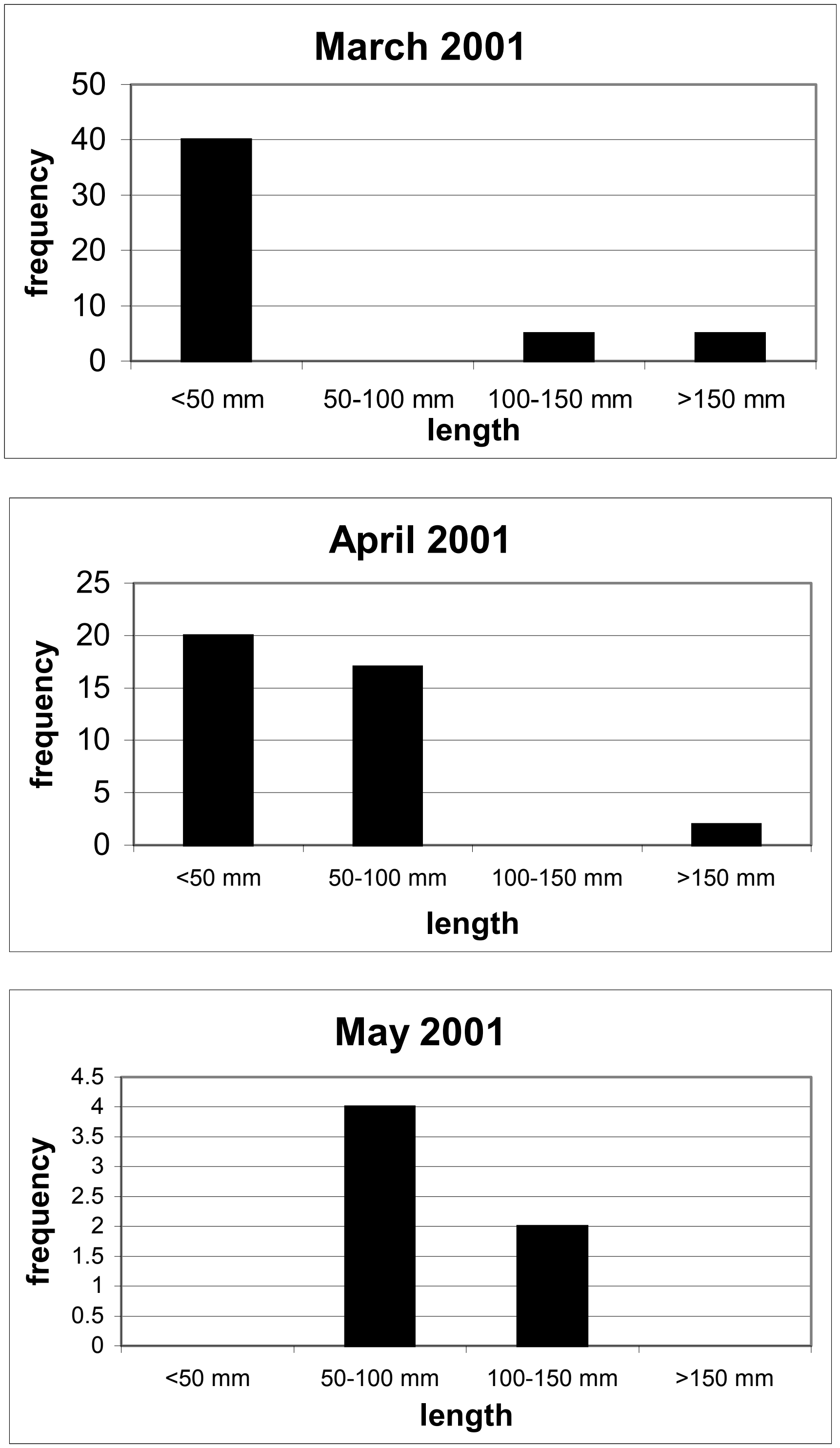

Figure 5. Frequency distribution of juvenile coho salmon total length on different sampling dates in Snipes Creek Wasteway during the spring of 2001.

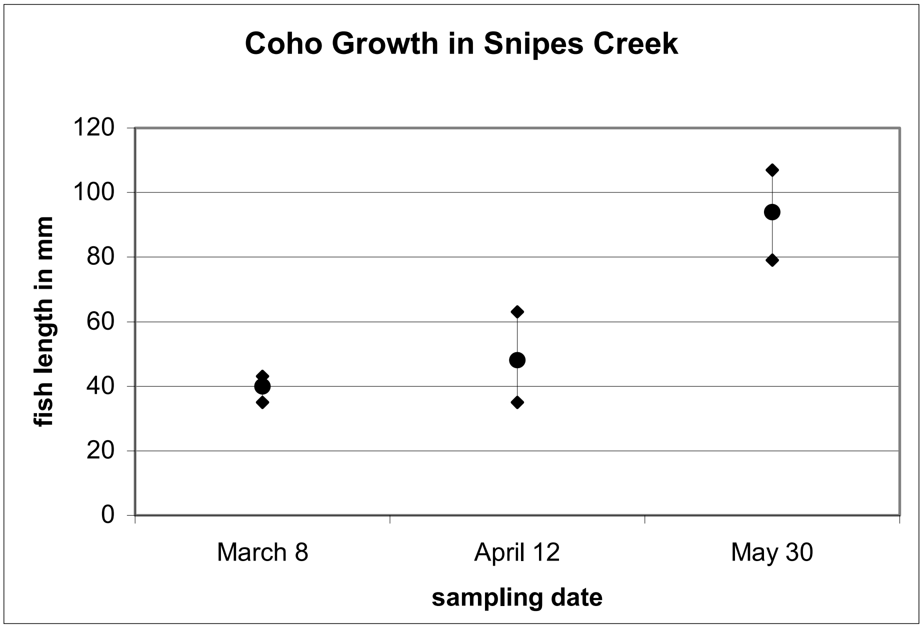

Figure 6. Sub-yearling coho growth in Snipes Creek during the spring of 2001. Average fish length increased from 40 mm in March to 97 mm by late May.

Discussion

The RSBOJC drainage network was developed for a variety of purposes. Wasteways and spillways were designed to carry water in the event of a canal break or to absorb fluctuations in demand for irrigation water. Drains were excavated to maintain the productivity of the soils. None of these facilities were developed for the expressed purpose of providing fish and wildlife habitat, but animals are present and using the habitat that is available. The following discussion focuses on the abundance of salmonid progeny and the factors influencing their survival in the drainage network.

Coho fry abundance. The large number of salmon redds that were observed in Sulphur Creek Wasteway and the Snipes/Spring system received public and media attention. Resource management agencies, including the RSBOJC, were interested in the success or failure of the progeny of the spawners. While quantitative estimates of egg-to-fry survival from redds deposited in the various waterways were not developed, the electrofishing surveys did indicate that survival of coho eggs and alevins was relatively much higher in Snipes/Spring than in the Sulphur Creek Wasteway system. In Sulphur Creek, three subyearling coho were captured; the area surveyed was 4,118.9 square-meters, for a density of 0.07 fish/100 square-meters. In contrast, densities of subyearling coho in the Snipes/Spring location throughout the 2001 season were 4.73 fish/100 square-meters (Figure 7) (note in Table 3 that in 2000, Snipes/Spring densities were similar for subyearling fish, at 2.59 fish/100 square-meters). The results are notable because the number of redds placed in the two systems was similar, Sulphur Creek had 92 while Snipes/Spring had 69 (Table 1). Assuming the sampling of adult spawning and juvenile rearing provided representative indices of fish abundance in each stream, then production of juvenile coho per spawner was only about 1/60 in Sulphur Creek of what it was in the Snipes/Spring system (Figure 7). The low juvenile abundance in Sulphur Creek compared to Snipe/Spring creeks indicates that survival of eggs and alevins in Sulphur Creek was very low, and unlikely to support a self-sustaining population.

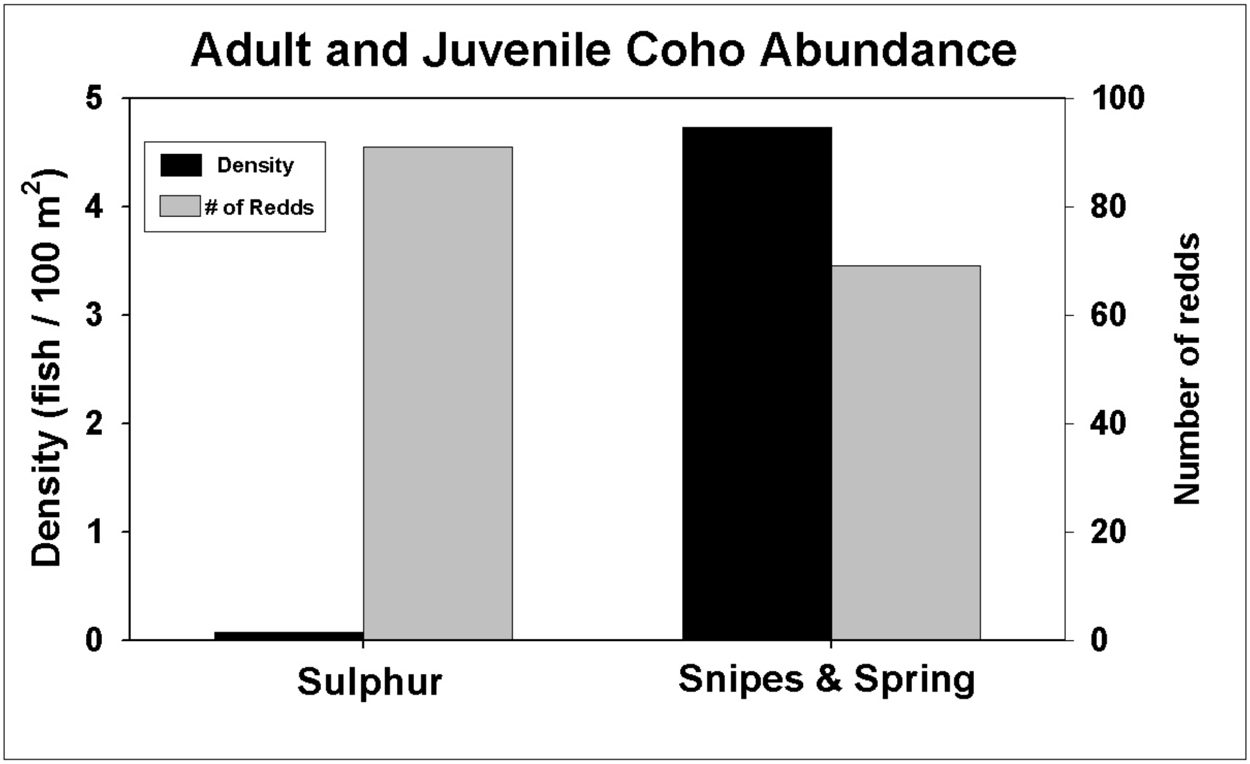

Figure 7. Comparative abundance of juvenile and adult coho observed in Sulphur Creek and Snipes/Spring Creek drains. Adults spawned in the fall of 2000 and juveniles were sampled in the spring of 2001.

Factors influencing fish distribution. Ecologists have long recognized that geology and climate (modified by topography) are the factors most strongly influencing both aquatic and terrestrial habitat conditions, and consequently of organisms (Curtis 1959). The climate is fairly uniform throughout the RSBOJC network, however there are variations in both the topography and in the geology of the lower Yakima River Basin (Molenaar 1985). Figure 8 shows the geology of the lower basin and the locations of various drains. "Sedimentary deposits" of glaciofluvial, lacustrine, and eolian origin, and "Columbia River Basalts" of volcanic origin are the two principal formations found in the RSBOJC area of jurisdiction.

What Figure 8 does not show is the distribution of soils of glaciofluvial origin in contrast to soils of lacustrine or eolian origin. Nearly all of the land irrigated by the RSBOJC lies on the east side of the Yakima River at a higher elevation than the river

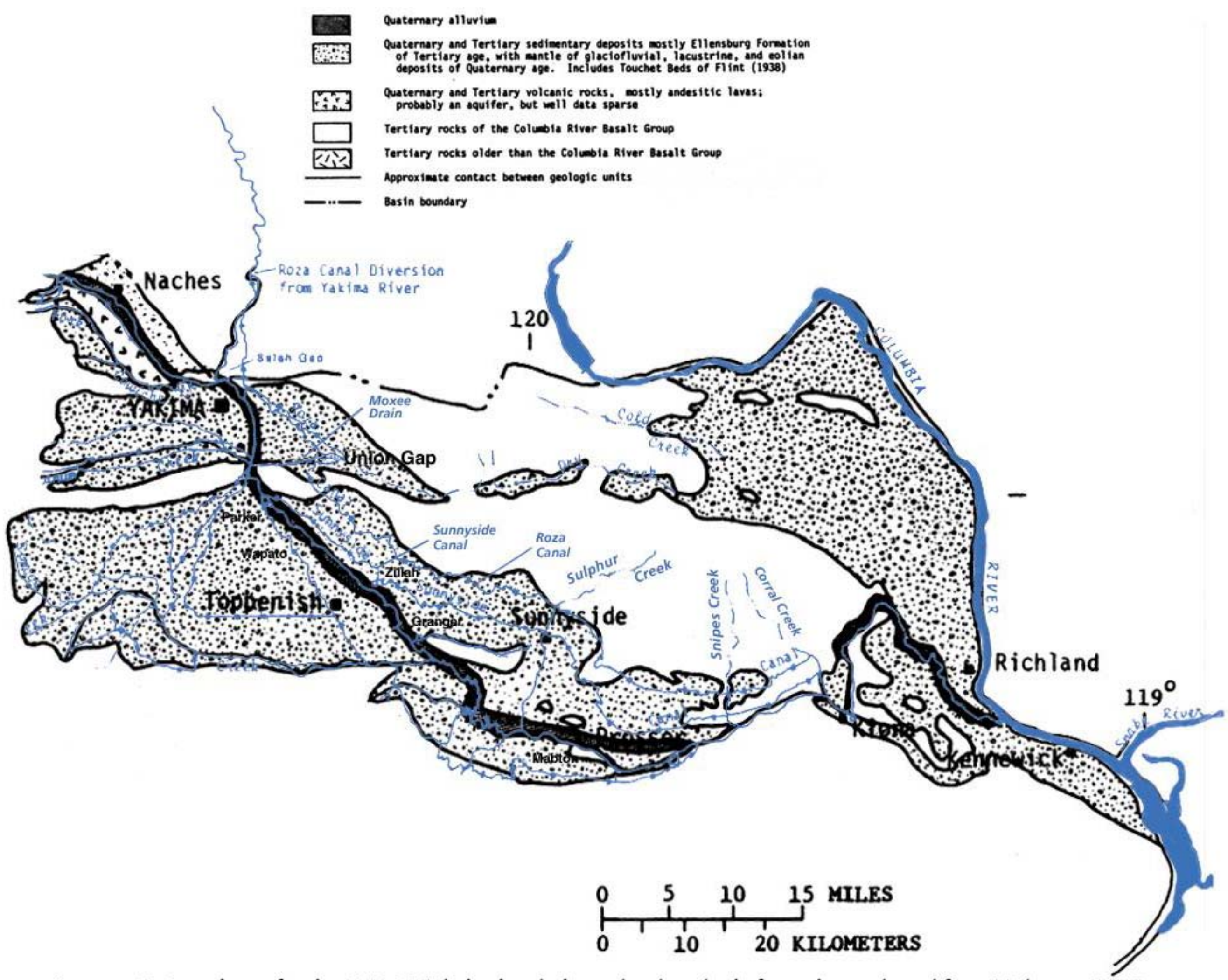

Figure 8. Locations of major RSBOJC drains in relation to local geologic formations, adapted from Molenaar (1986).

floodplain. Thus, the origin of the sedimentary deposits in the RSBOJC are primarily lacustrine (lake-origin) and eolian (wind blown soils). In other words, these areas contain fine silts and sands that were deposited during the formation of a lake which backed up the Yakima Valley from the Columbia River as a consequence of the Missoula Floods, or they are fine, wind blown soils (Molenaar 1985). In contrast, most of soils in the river floodplain lying to the west of the Yakima River in the vicinity of Toppenish and Wapato are cobbles, gravels, and sands of glaciofluvial origin—sediments deposited by glacial activity and through the work of the Yakima River.

Distinguishing among the origins of various soils is important because the geology of the lower valley is the template from which habitats are drawn. As Figure 8 illustrates, Corral Creek and Snipes Creek (Spring Creek is not shown, but it is a tributary to Snipes Creek) flow through areas dominated by Columbia River basalts. In contrast, almost all of Sulphur Creek Wasteway, Granger Drain, and Moxee Drain flow through sedimentary deposits of fine silt.

S.P. Cramer and Associates (Romey and Cramer 2001) found salmonid habitat conditions in the drains flowing through basalt dominated zones, namely Spring, Snipes, and Corral creeks, all had suitable substrate, gradient, and other habitat conditions which could support salmonids. Habitat conditions in Sulphur, Granger, and Moxee drains were found to be generally unsuitable for salmonids. High levels of substrate embeddedness and low gradients were primary factors diminishing habitat suitability in the Sulphur, Granger, and Moxee drains (Romey and Cramer 2001). Their findings are corroborated by the results of the fisheries surveys, which showed that in Snipes and Spring creek wasteways, salmonids appear to find some success spawning and rearing, while in Sulphur Creek Wasteway and Granger Drain salmonids are absent or spawners are unsuccessful.

Geology and topography (i.e. gradient) are likely the principal factors responsible for influencing fish habitat quality and quantity in the RSBOJC drain network. Granger Drain and Sulphur Creek Wasteway exist within a geologic landscape—fine silts, clays, and sands—that does not provide for suitable salmonid habitat. In addition to having a geologic template that is unsuitable for salmonids, there is no evidence that these waterways historically provided anadromous fish habitat. Streams, whether they are intermittent or perennial, create alluvial fingerprints on the landscape. The General Land Office surveyed the Yakima Basin in the 1800's prior to the development of irrigated agriculture in the lower valley. Their surveys did not report any evidence of stream alluvium, stream channels, or stream connections in the vicinity of modern day Granger Drain or Sulphur Creek Wasteway (Onni Perala, pers. comm.). Furthermore, these waterways exist in the lowest precipitation zone of the Yakima Basin. The mean annual precipitation in Sunnyside is less than 10 inches, the Rattlesnake Hills to the east receive about 15 inches of precipitation annually, and there are no perennial streams flowing from these hills to the Yakima or Columbia Rivers (Molenaar 1985). Indeed, all of the evidence suggests that that these drains are constructed channels in areas where the geology and climate is unlikely to produce suitable salmonid habitat.

It is important to measure habitat features in addition to sampling fish, because fish distribution and abundance can be influenced by other factors. For example, in Sulphur Creek Wasteway it may be that adult coho salmon are falsely attracted in to the wasteway, because it contains water conveyed directly from the upper Yakima River, which is unique in it's chemical constituents. Because salmon rely on their sense of smell and the chemical signature of the water to find their home stream (Hasler et al. 1978), conveying water from the upper to lower Yakima River may attract fish homing to the upper basin, particularly fish of hatchery origin, which are known to have higher rates of straying than wild fish (Lister et al. 1981). Hatchery salmonids which stray in to Moxee Drain, Granger Drain, or Sulphur Creek Wasteway to spawn are unlikely to find habitat conditions suitable for producing the next generation of returning salmon, and juveniles which may seek rearing habitat in these waterways may not find conditions required to sustain them.

Acknowledgements

The Roza-Sunnyside Board of Joint Control and the U.S. Bureau of Reclamation funded the study. Jim Cummins of Washington Department of Fish and Wildlife provided crucial assistance and enthusiasm during the surveys of drains; John Easterbrooks, Richard Visser and Ted Clausing from the WDFW Region 3 office were supportive of the effort. Neal Hull and the drain maintenance crew helped us learn the lay of the land and assisted in the data collection efforts. Bill Rice, Stu Mckenzie, Onni Perala, and others provided valuable and meticulous review comments. Any errors in the report are my own.

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Appendix A. Average drain width data used to estimate stream area surveyed and develop indices of the relative abundance of fishes in the drainage network.

		Data		Mean
Drain	**Reach**	**Length (m)**	**Width (m)**	**Depth (m)**
Corral	1	709	2.5	0.24
	2	--	--	--
	3	652	2.2	0.20
	4	1450	2.2	0.32
Corral Total		**2812**	**2.3**	**0.27**
Granger	1	481	5.1	0.57
	2	840	3.5	0.55
	3	215	3.2	0.62
	4	1907	3.4	0.57
	5	367	1.7	0.42
	6	156	2.3	0.30
Granger Total		**3966**	**3.4**	**0.55**
JD 27.5	1	100	2.2	0.15
JD 28.0	1	100	3.1	0.15
JD 33.4	1	3844	3.3	0.63
JD 35.4	1	1211	1.9	0.20
JD 35.4*	1	1916	2.6	0.19
JD 37.9	1	1596	2.0	0.30
JD 40.2	1	1325	2.5	0.43
	2	2192	2.9	0.39
	3	681	2.9	0.58
	4	534	2.6	0.38
	5	439	2.0	0.41
	6	391	2.1	0.35
	7	603	2.3	0.26
	8	1200	1.7	0.10
JD 40.2 Total		**7365**	**2.5**	**0.39**
JD 43.9	1	3320	3.3	0.50
	2	701	3.3	0.64
	3	610	2.6	0.37
	4	632	1.8	0.24
	5	920	--	--
	6	1682	1.7	0.30
JD 43.9 Total		**7864**	**2.3**	**0.37**
JD 44.9	1	1610	1.9	0.37
	2	704	2.1	0.55
JD 44.9 Total		**2315**	**2.0**	**0.45**
JD 46.4	1	1627	2.0	0.29
Moxee	1	1239	4.8	0.51
	2	471	3.3	0.35
	3	1124	4.1	0.39
	4	1695	3.1	0.50
Moxee Total		**4529**	**3.9**	**0.46**
Snipes	1	176	3.8	0.32
	2	543	2.8	0.23

	3	115	2.8	0.25
	4	229	2.8	0.25
	5	1389	2.4	0.33
	6	803	2.1	0.30
	7	2272	3.4	0.49
	8	1025	3.0	0.33
Snipes Total		**6552**	**2.9**	**0.37**
Spring	1	1262	3.3	0.36
	2	925	3.9	0.42
	3	690	3.3	0.37
	4	642	3.1	0.31
	5	818	3.2	0.35
	6	840	0.8	0.25
Spring Total		**5176**	**3.3**	**0.36**
Sulphur	1	3905	7.0	0.65
	2	1615	5.6	0.65
	3	462	7.5	0.49
	4	2080	5.3	0.44
	5	2386	5.0	0.37
	6	759	7.6	0.38
Sulphur Total		**11207**	**5.8**	**0.46**
Grand Total		**62179**	**3.1**	**0.39**

Appendix B. Fisheries data collected during surveys of the RSBOJC drainage network.

date	drain	site	spp	TL	count	meters
8/24/00	spring	spring	rs	135	16	45
8/24/00	spring	spring	rs	100	16	45
8/24/00	spring	spring	rs	130	16	45
8/24/00	spring	spring	rs	99	16	45
8/24/00	spring	spring	rs	133	16	45
8/24/00	spring	spring	rs	94	16	45
8/24/00	spring	spring	rs	91	16	45
8/24/00	spring	spring	rs	100	16	45
8/24/00	spring	spring	rs	101	16	45
8/24/00	spring	spring	rs	84	16	45
8/24/00	spring	spring	rs	90	16	45
8/24/00	spring	spring	rs	100	16	45
8/24/00	spring	spring	rs	101	16	45
8/24/00	spring	spring	rs	89	16	45
8/24/00	spring	spring	bt	135	2	45
8/24/00	spring	spring	bt	140	2	45
8/24/00	spring	spring	sd	75	68	45
8/24/00	spring	spring	sd	72	68	45
8/24/00	spring	spring	sd	66	68	45
8/24/00	spring	spring	sd	79	68	45
8/24/00	spring	spring	sd	60	68	45
8/24/00	spring	spring	sd	79	68	45
8/24/00	spring	spring	sd	60	68	45
8/24/00	spring	spring	sd	61	68	45
8/24/00	spring	spring	sd	60	68	45
8/24/00	spring	spring	sd	89	68	45
8/24/00	spring	spring	sd	54	68	45
8/24/00	spring	spring	sd	54	68	45
8/24/00	spring	spring	sd	35	68	45
8/24/00	spring	spring	sd	62	68	45
8/24/00	spring	spring	sd	66	68	45
8/24/00	spring	spring	sd	63	68	45
8/24/00	spring	spring	sd	72	68	45
8/24/00	spring	spring	sd	55	68	45
8/24/00	spring	spring	sd	56	68	45
8/24/00	spring	spring			0	37
8/24/00	spring	spring			0	70
8/24/00	spring	spring			0	60
8/11/00	sulphur	sulphur	rb	360	2	100
8/11/00	sulphur	sulphur	rb	263	2	100
8/11/00	sulphur	sulphur	npm	319	9	100
8/11/00	sulphur	sulphur	npm	300	9	100
8/11/00	sulphur	sulphur	npm	190	9	100
8/11/00	sulphur	sulphur	npm	220	9	100
8/11/00	sulphur	sulphur	sd	59	4	100
8/11/00	sulphur	sulphur	sd	60	4	100
8/11/00	sulphur	sulphur	sd	53	4	100
8/11/00	sulphur	sulphur	sd	58	4	100

8/11/00	sulphur	sulphur	npm	270	9	100
8/11/00	sulphur	sulphur	npm	226	9	100
8/11/00	sulphur	sulphur	npm	213	9	100
8/11/00	sulphur	sulphur	npm	200	9	100
8/11/00	sulphur	sulphur	npm	196	9	100
8/11/00	sulphur	sulphur	rs	117	2	100
8/11/00	sulphur	sulphur	rs	109	2	100
8/11/00	sulphur	33.4	rs	100	5	32
8/11/00	sulphur	33.4	cp	340	4	32
8/11/00	sulphur	33.4	npm	190	5	32
8/11/00	sulphur	33.4	cp	405	4	32
8/11/00	sulphur	33.4	cp	275	4	32
8/11/00	sulphur	33.4	smb	55	1	32
8/11/00	sulphur	33.4	lrs	75	2	32
8/11/00	sulphur	33.4	rs	41	5	32
8/11/00	sulphur	33.4	rs	102	5	32
8/11/00	sulphur	33.4	lrs	490	2	32
8/11/00	sulphur	33.4	cp	289	4	32
8/11/00	sulphur	33.4	npm	192	5	32
8/11/00	sulphur	33.4	rs	94	5	32
8/11/00	sulphur	33.4	rs	96	5	32
8/11/00	sulphur	33.4	npm	97	5	32
8/11/00	sulphur	33.4	npm	108	5	32
8/11/00	sulphur	33.4	ps	121	1	32
8/11/00	sulphur	33.4	npm	92	5	32
8/11/00	sulphur	33.4			0	48
8/11/00	sulphur	33.4			0	48
8/11/00	sulphur	33.4	sd		1	30
8/11/00	granger	32			0	20
8/11/00	granger	32			0	25
8/11/00	granger	28			0	60
8/11/00	granger	27.5	sd	62	40	50
8/11/00	granger	27.5	sd	52	40	50
8/11/00	granger	27.5	sd	48	40	50
8/11/00	granger	27.5	sd	39	40	50
8/11/00	granger	27.5	sd	52	40	50
8/11/00	granger	27.5	sd	57	40	50
8/11/00	granger	27.5	sd	50	40	50
8/11/00	granger	27.5	sd	63	40	50
8/11/00	granger	27.5	sd	52	40	50
8/11/00	granger	27.5	cmo	80	1	50
8/11/00	granger	27.5	sd	45	40	50
8/11/00	granger	27.5	sd	52	40	50
8/11/00	granger	27.5	sd	53	40	50
8/11/00	granger	27.5	sd	73	40	50
8/11/00	granger	27.5	sd	61	40	50
8/11/00	granger	27.5	lrs	125	1	50
8/11/00	granger	26.6			0	23
8/8/00	sulphur	46.4	mns	110	24	50
8/8/00	sulphur	46.4	mns	110	24	50

8/8/00	sulphur	46.4	mns	107	24	50
8/8/00	sulphur	46.4	mns	101	24	50
8/8/00	sulphur	46.4	sd	110	13	50
8/8/00	sulphur	46.4	sd	65	13	50
8/8/00	sulphur	46.4	mns	92	24	50
8/8/00	sulphur	46.4	mns	85	24	50
8/8/00	sulphur	46.4	sd	60	13	50
8/8/00	sulphur	46.4	sd	36	13	50
8/8/00	sulphur	46.4	sd	70	13	50
8/8/00	sulphur	46.4	mns	110	24	50
8/8/00	sulphur	46.4	mns	106	24	50
8/8/00	sulphur	46.4	sd	73	13	50
8/8/00	sulphur	46.4	mns	102	24	50
8/8/00	sulphur	46.4	mns	125	24	50
8/8/00	sulphur	46.4	mns	116	24	50
8/8/00	sulphur	46.4	sd	70	13	50
8/8/00	sulphur	46.4	mns	92	24	50
8/8/00	sulphur	46.4	mns	90	24	50
8/8/00	sulphur	46.4	mns	108	24	50
8/8/00	sulphur	46.4	mns	90	24	50
8/8/00	sulphur	46.4	mns	85	24	50
8/8/00	sulphur	46.4	mns	118	24	50
8/8/00	sulphur	46.4	mns	90	24	50
8/8/00	sulphur	46.4	sd	36	13	50
8/8/00	sulphur	46.4	mns	95	24	50
8/8/00	sulphur	46.4	mns	94	24	50
8/8/00	sulphur	46.4	sd	70	13	50
8/8/00	sulphur	46.4	mns	85	24	50
8/8/00	sulphur	46.4	sd	64	13	50
8/8/00	sulphur	46.4	sd	62	13	50
8/8/00	sulphur	46.4	sd	73	13	50
8/8/00	sulphur	46.4	lmb	225	2	10
8/8/00	sulphur	46.4	lmb	236	2	10
8/8/00	sulphur	46.4	brs	110	5	10
8/8/00	sulphur	46.4	brs	123	5	10
8/8/00	sulphur	46.4	brs	111	5	10
8/8/00	sulphur	46.4	brs	119	5	10
8/8/00	sulphur	46.4	brs	113	5	10
8/8/00	sulphur	46.4	msq	25	3	10
8/8/00	sulphur	46.4	msq	21	3	10
8/8/00	sulphur	46.4	msq	19	3	10
8/8/00	sulphur	43.9	sd		2	30
8/8/00	sulphur	43.9	brs	166		44
8/8/00	sulphur	43.9	sd		61	44
8/8/00	sulphur	43.9	rb	134		44
8/8/00	sulphur	35.4			0	70
8/8/00	sulphur	34.2			0	36
6/16/00	snipes	snipes	co	138	4	68
6/16/00	snipes	snipes	co	127	4	68
6/16/00	snipes	snipes	lrs	103	1	68

6/16/00	snipes	snipes	brs	89	12	68
6/16/00	snipes	snipes	co	112	4	68
6/16/00	snipes	snipes	brs	132	12	68
6/16/00	snipes	snipes	brs	98	12	68
6/16/00	snipes	snipes	co	110	4	68
6/16/00	snipes	snipes	brs	96	12	68
6/16/00	snipes	snipes	co	115	4	84
6/16/00	snipes	snipes	smb	152	1	84
6/16/00	snipes	snipes	co	94	4	84
6/16/00	snipes	snipes	co	104	4	84
6/16/00	snipes	snipes	co	107	4	84
6/16/00	snipes	snipes	co	110	1	100
6/16/00	snipes	snipes	suk	36	1	100
6/16/00	52.8	52.8	sd	55	25	82
6/16/00	52.8	52.8	sd	50	25	82
6/16/00	52.8	52.8	sd	70	25	82
6/16/00	52.8	52.8	sd	60	25	82
6/16/00	52.8	52.8	sd	91	25	82
6/16/00	52.8	52.8	sd	90	25	82
6/16/00	52.8	52.8	sd	75	25	82
6/16/00	52.8	52.8	sd	77	25	82
6/16/00	52.8	52.8	sd	67	25	82
6/16/00	52.8	52.8	sd	61	25	82
6/16/00	52.8	52.8	sd	62	25	82
6/16/00	52.8	52.8	sd	49	25	82
6/16/00	52.8	52.8	sd	78	25	82
6/16/00	52.8	52.8	sd	81	25	82
6/16/00	52.8	52.8	sd	54	25	82
6/14/00	sulphur	DR9	rs	130	7	40
6/14/00	sulphur	DR9	rs	150	7	40
6/14/00	sulphur	DR9	sd	81	23	40
6/14/00	sulphur	DR9	sd	60	23	40
6/14/00	sulphur	DR9	rs	105	7	40
6/14/00	sulphur	DR9	rs	100	7	40
6/14/00	sulphur	DR9	sd	51	23	40
6/14/00	sulphur	DR9	sd	49	23	40
6/14/00	sulphur	DR9	sd	65	23	40
6/14/00	sulphur	DR9	rs	86	7	40
6/14/00	sulphur	DR9	sd	54	23	40
6/14/00	sulphur	DR9	sd	45	23	40
6/14/00	sulphur	DR9	sd	60	23	40
6/14/00	sulphur	DR9	rs	60	7	40
6/14/00	sulphur	DR9	sd	64	23	40
6/14/00	sulphur	DR9	sd	54	23	40
6/14/00	sulphur	DR9	sd	49	23	40
6/14/00	sulphur	DR9	sd	75	23	40
6/14/00	sulphur	DR9	sd	52	23	40
6/14/00	sulphur	DR9	sd	47	23	40
6/14/00	sulphur	DR9	sd	50	23	40
6/14/00	sulphur	DR9	sd	27	23	40

6/14/00	sulphur	DR9	sd	50	23	40
6/14/00	sulphur	DR9	sd	47	23	40
6/14/00	sulphur	DR9	sd	53	23	40
6/14/00	sulphur	DR9	sd	54	23	40
6/14/00	sulphur	DR9	sd	49	23	40
6/14/00	sulphur	DR9	rs	55	7	40
6/14/00	sulphur	DR9	sd	45	23	40
6/14/00	sulphur	DR9	sd	50	23	40
6/14/00	sulphur	43.9	npm	231	3	31
6/14/00	sulphur	43.9	brs	240	2	31
6/14/00	sulphur	43.9	brs	290	2	31
6/14/00	sulphur	43.9	npm	258	3	31
6/14/00	sulphur	43.9	npm	145	3	31
6/14/00	sulphur	43.9	ps	70	1	31
6/14/00	sulphur	43.9	cp		12	31
6/14/00	sulphur	43.9	rs	125	46	29
6/14/00	sulphur	43.9	rs	117	46	29
6/14/00	sulphur	43.9	rs	123	46	29
6/14/00	sulphur	43.9	rs	121	46	29
6/14/00	sulphur	43.9	rs	124	46	29
6/14/00	sulphur	43.9	rs	90	46	29
6/14/00	sulphur	43.9	rs	120	46	29
6/14/00	sulphur	43.9	rs	87	46	29
6/14/00	sulphur	43.9	rs	101	46	29
6/14/00	sulphur	43.9	rs	110	46	29
6/14/00	sulphur	43.9	rs	97	46	29
6/14/00	sulphur	43.9	rs	128	46	29
6/14/00	sulphur	43.9	rb	111	1	29
6/14/00	sulphur	43.9	sd	60	142	29
6/14/00	sulphur	43.9	sd	47	142	29
6/14/00	sulphur	43.9	sd	57	142	29
6/14/00	sulphur	43.9	sd	46	142	29
6/14/00	sulphur	43.9	sd	58	142	29
6/14/00	sulphur	43.9	sd	59	142	29
6/14/00	sulphur	43.9	sd	72	142	29
6/14/00	sulphur	43.9	sd	58	142	29
6/14/00	sulphur	43.9	sd	77	142	29
6/14/00	sulphur	40.2	brs	450	7	56
6/14/00	sulphur	40.2	npm	257	2	56
6/14/00	sulphur	40.2	lrs	152	2	56
6/14/00	sulphur	40.2	brs	104	7	56
6/14/00	sulphur	40.2	lrs	151	2	56
6/14/00	sulphur	40.2	brs	134	7	56
6/14/00	sulphur	40.2	brs	149	7	56
6/14/00	sulphur	40.2	lmb	82	2	56
6/14/00	sulphur	40.2	brs	103	7	56
6/14/00	sulphur	40.2	brs	100	7	56
6/14/00	sulphur	40.2	sd	66	4	56
6/14/00	sulphur	40.2	brs	98	7	56
6/14/00	sulphur	40.2	cp	300	4	56

6/14/00	sulphur	40.2	npm	65	2	56
6/14/00	sulphur	40.2	brs	100	7	56
6/14/00	sulphur	40.2	lmb	85	2	56
6/14/00	sulphur	40.2	ps	60	2	56
6/14/00	sulphur	40.2	ps	64	2	56
6/14/00	sulphur	40.2	sd	80	4	56
6/14/00	sulphur	40.2	sd	63	4	56
6/14/00	sulphur	40.2	sd	41	4	56
6/14/00	sulphur	40.2	cp	350	1	53
6/14/00	sulphur	40.2	lrs	85	2	53
6/14/00	sulphur	40.2	brs	115	12	53
6/14/00	sulphur	40.2	brs	123	12	53
6/14/00	sulphur	40.2	sd	64	8	53
6/14/00	sulphur	40.2	sd	57	8	53
6/14/00	sulphur	40.2	sd	32	8	53
6/14/00	sulphur	40.2	sd	66	8	53
6/14/00	sulphur	40.2	brs	96	12	53
6/14/00	sulphur	40.2	brs	90	12	53
6/14/00	sulphur	40.2	brs	85	12	53
6/14/00	sulphur	40.2	sd	62	8	53
6/14/00	sulphur	40.2	ps	67	1	53
6/14/00	sulphur	40.2	brs	99	12	53
6/14/00	sulphur	40.2	sd	54	8	53
6/14/00	sulphur	40.2	brs	75	12	53
6/14/00	sulphur	40.2	brs	57	12	53
6/14/00	sulphur	40.2	brs	80	12	53
6/14/00	sulphur	40.2	sd	61	8	53
6/14/00	sulphur	40.2	sd	63	8	53
6/14/00	sulphur	40.2	brs	85	12	53
6/14/00	sulphur	40.2	lrs	89	2	53
6/14/00	sulphur	40.2	brs	88	12	53
6/14/00	sulphur	40.2	brs	77	12	53
6/14/00	sulphur	35.4			0	30
5/25/00	granger mouth		rs	83	5	50
5/25/00	granger mouth		rs	38	5	50
5/25/00	granger mouth		rs	102	5	50
5/25/00	granger mouth		co	51	2	50
5/25/00	granger mouth		co	64	2	50
5/25/00	granger mouth		cmo	191	2	50
5/25/00	granger mouth		cmo	171	2	50
5/25/00	granger mouth		npm	330	6	50
5/25/00	granger mouth		npm	191	6	50
5/25/00	granger mouth		npm	159	6	50
5/25/00	granger mouth		npm	273	6	50
5/25/00	granger mouth		npm	184	6	50
5/25/00	granger mouth		rs	55	5	50
5/25/00	granger mouth		sd	75	1	50
5/25/00	granger mouth		npm	145	6	50
5/25/00	granger mouth		rs	100	5	50
5/25/00	granger	26.6	npm	229	8	30

5/25/00	granger	26.6	npm	171	8	30
5/25/00	granger	26.6	npm	140	8	30
5/25/00	granger	26.6	npm	159	8	30
5/25/00	granger	26.6	npm	203	8	30
5/25/00	granger	26.6	npm	183	8	30
5/25/00	granger	26.6	npm	140	8	30
5/25/00	granger	26.6	npm	140	8	30
5/25/00	granger	26.6	cmo	178	1	30
5/25/00	granger	26.6	lrs	184	7	30
5/25/00	granger	26.6	lrs	229	7	30
5/25/00	granger	26.6	lrs	127	7	30
5/25/00	granger	26.6	lrs	83	7	30
5/25/00	granger	26.6	lrs	83	7	30
5/25/00	granger	26.6	lrs	108	7	30
5/25/00	granger	26.6	lrs	108	7	30
5/25/00	granger	27.5	sd		29	30
5/25/00	granger	27.5	lnd	83	1	30
5/25/00	granger	28	sd	90	1	30
5/25/00	granger	DR2	brs	200	1	200
5/25/00	granger	DR2	sd	90	7	200
5/25/00	granger	DR2	sd	10	7	200
5/25/00	granger	DR2	sd	65	7	200
5/25/00	granger	DR2	sd	45	7	200
5/25/00	granger	DR2	sd	95	7	200
5/25/00	granger	DR2	sd	65	7	200
5/25/00	granger	DR2	sd	60	7	200
5/25/00	granger	DR2	npm	135	1	200
5/24/00	spring	spring	brs	390	1	91
5/24/00	spring	spring	npm	290	2	91
5/24/00	spring	spring	co	125	7	91
5/24/00	spring	spring	npm	220	2	91
5/24/00	spring	spring	smb	150	2	91
5/24/00	spring	spring	co	125	7	91
5/24/00	spring	spring	co	135	7	91
5/24/00	spring	spring	smb	165	2	91
5/24/00	spring	spring	co	120	7	91
5/24/00	spring	spring	co	120	7	91
5/24/00	spring	spring	co	100	7	91
5/24/00	spring	spring	sd	90	1	91
5/24/00	spring	spring	co	85	7	91
5/24/00	spring	spring	rb	27	3	91
5/24/00	spring	spring	rb	29	3	91
5/24/00	spring	spring	rb	31	3	91
5/24/00	spring	spring			0	50
5/24/00	snipes	snipes	co	80	25	84
5/24/00	snipes	snipes	co	105	25	84
5/24/00	snipes	snipes	co	110	25	84
5/24/00	snipes	snipes	co	90	25	84
5/24/00	snipes	snipes	co	100	25	84
5/24/00	snipes	snipes	co	110	25	84

5/24/00	snipes	snipes	co	100	25	84
5/24/00	snipes	snipes	co	90	25	84
5/24/00	snipes	snipes	co	90	25	84
5/24/00	snipes	snipes	co	80	25	84
5/24/00	snipes	snipes	co	100	25	84
5/24/00	snipes	snipes	co	140	25	84
5/24/00	snipes	snipes	co	120	25	84
5/24/00	snipes	snipes	co	120	25	84
5/24/00	snipes	snipes	co	90	25	84
5/24/00	snipes	snipes	co	80	25	84
5/24/00	snipes	snipes	co	80	25	84
5/24/00	snipes	snipes	co	80	25	84
5/24/00	snipes	snipes	co	90	25	84
5/24/00	snipes	snipes	co	80	25	84
5/24/00	snipes	snipes	co	85	25	84
5/24/00	snipes	snipes	co	85	25	84
5/24/00	snipes	snipes	suk		4	55
5/24/00	snip/spg	snip/spg	smb	210	1	67
5/24/00	snip/spg	snip/spg	co	80	6	67
5/24/00	snip/spg	snip/spg	lnd	40	6	67
5/24/00	snip/spg	snip/spg	cp	240	1	67
5/24/00	snip/spg	snip/spg	co	130	6	67
5/24/00	snip/spg	snip/spg	co	125	6	67
5/24/00	snip/spg	snip/spg	co	130	6	67
5/24/00	snip/spg	snip/spg	co	75	6	67
5/24/00	snip/spg	snip/spg	co	90	6	67
5/24/00	snip/spg	snip/spg	sd	90	3	67
5/24/00	snip/spg	snip/spg	lnd	55	6	67
5/24/00	snip/spg	snip/spg	brs	135	1	67
5/24/00	snip/spg	snip/spg	lnd	55	6	67
5/24/00	snip/spg	snip/spg	sd	55	3	67
5/24/00	snip/spg	snip/spg	lnd	55	6	67
5/24/00	snip/spg	snip/spg	sd	60	3	67
5/24/00	snip/spg	snip/spg	lnd	50	6	67
5/24/00	snip/spg	snip/spg	lnd	45	6	67
5/30/01	snipes	snipes	mns	90	6	88
5/30/01	snipes	snipes	brs	97	9	88
5/30/01	snipes	snipes	brs	92	9	88
5/30/01	snipes	snipes	brs	91	9	88
5/30/01	snipes	snipes	mns	90	6	88
5/30/01	snipes	snipes	brs	98	9	88
5/30/01	snipes	snipes	brs	80	9	88
5/30/01	snipes	snipes	brs	82	9	88
5/30/01	snipes	snipes	mns	90	6	88
5/30/01	snipes	snipes	mns	77	6	88
5/30/01	snipes	snipes	co	102	5	88
5/30/01	snipes	snipes	co	90	5	88
5/30/01	snipes	snipes	brs	89	9	88
5/30/01	snipes	snipes	brs	80	9	88
5/30/01	snipes	snipes	mns	75	6	88

5/30/01	snipes	snipes	mns	69	6	88
5/30/01	snipes	snipes	brs	78	9	88
5/30/01	snipes	snipes	co	92	5	88
5/30/01	snipes	snipes	co	107	5	88
5/30/01	snipes	snipes	co	79	5	88
5/30/01	spring	snip/spg	mns	230	4	66
5/30/01	spring	snip/spg	mns	195	4	66
5/30/01	spring	snip/spg	mns	210	4	66
5/30/01	spring	snip/spg	sd	95	3	66
5/30/01	spring	snip/spg	ck	78	1	66
5/30/01	spring	snip/spg	sd	84	3	66
5/30/01	spring	snip/spg	lnd	67	7	66
5/30/01	spring	snip/spg	lnd	75	7	66
5/30/01	spring	snip/spg	lnd	78	7	66
5/30/01	spring	snip/spg	lnd	70	7	66
5/30/01	spring	snip/spg	lnd	95	7	66
5/30/01	spring	snip/spg	lnd	68	7	66
5/30/01	spring	snip/spg	sd	61	3	66
5/30/01	spring	snip/spg	lnd	72	7	66
5/30/01	spring	snip/spg	co	94	1	66
5/30/01	spring	snip/spg	mns	200	4	66
5/30/01	snipes	snip/spg	sd	57	3	180
5/30/01	snipes	snip/spg	lnd	62	1	180
5/30/01	snipes	snip/spg	sd	88	3	180
5/30/01	snipes	snip/spg	sd	55	3	180
4/10/01	granger	DR2	sd	97	9	52
4/10/01	granger	DR2	sd	71	9	52
4/10/01	granger	DR2	sd	70	9	52
4/10/01	granger	DR2	sd	35	9	52
4/10/01	granger	DR2	sd	75	9	52
4/10/01	granger	DR2	sd	63	9	52
4/10/01	granger	DR2	sd	50	9	52
4/10/01	granger	DR2	sd	35	9	52
4/10/01	granger	DR2	sd	43	9	52
4/10/01	granger	26.6	sd	40	6	90
4/10/01	granger	26.6	sd	37	6	90
4/10/01	granger	26.6	sd	48	6	90
4/10/01	granger	26.6	sd	47	6	90
4/10/01	granger	26.6	sd	42	6	90
4/10/01	granger	26.6	sd	44	6	90
4/10/01	granger	mouth	cot	71	3	96
4/10/01	granger	mouth	cot	69	3	96
4/10/01	granger	mouth	cot	70	3	96
4/10/01	granger	mouth	brs	165	1	96
4/10/01	granger	mouth	mns	155	2	96
4/10/01	granger	mouth	mns	165	2	96
4/10/01	granger	mouth	npm	92	1	96
4/10/01	granger	mouth	sd	68	2	96
4/10/01	granger	mouth	sd	71	2	96
4/10/01	granger	mouth	lnd	40	1	96

4/10/01	granger	26.6				30
4/12/01	snipes	snip/spg	mns	95	1	18
4/12/01	snipes	snip/spg	brs	78	1	18
4/12/01	snipes	snip/spg	co	59	17	18
4/12/01	snipes	snip/spg	co	57	17	18
4/12/01	snipes	snip/spg	co	37	17	18
4/12/01	snipes	snip/spg	co	45	17	18
4/12/01	snipes	snip/spg	co	45	17	18
4/12/01	snipes	snip/spg	co	40	17	18
4/12/01	snipes	snip/spg	co	40	17	18
4/12/01	snipes	snip/spg	co	45	17	18
4/12/01	snipes	snip/spg	co	59	17	18
4/12/01	snipes	snip/spg	co	49	17	18
4/12/01	snipes	snip/spg	co	52	17	18
4/12/01	snipes	snip/spg	co	46	17	18
4/12/01	snipes	snip/spg	co	41	17	18
4/12/01	snipes	snip/spg	smb	67	1	18
4/12/01	snipes	snip/spg	co	61	17	18
4/12/01	snipes	snip/spg	co	58	17	18
4/12/01	snipes	snip/spg	co	43	17	18
4/12/01	snipes	snip/spg	sd	50	1	18
4/12/01	snipes	snip/spg	lnd	64	1	18
4/12/01	snipes	snip/spg	co	47	17	18
4/12/01	spring	spring	bt	310	8	65
4/12/01	spring	spring	bt	226	8	65
4/12/01	spring	spring	bt	205	8	65
4/12/01	spring	spring	bt	196	8	65
4/12/01	spring	spring	bt	185	8	65
4/12/01	spring	spring	bt	176	8	65
4/12/01	spring	spring	bt	51	8	65
4/12/01	spring	spring	sd	85	34	65
4/12/01	spring	spring	sd	55	34	65
4/12/01	spring	spring	sd	67	34	65
4/12/01	spring	spring	sd	60	34	65
4/12/01	spring	spring	sd	58	34	65
4/12/01	spring	spring	bt	50	8	65
4/12/01	spring	snip/spg	lmb	125	1	21
4/12/01	spring	snip/spg	co	58	19	21
4/12/01	spring	snip/spg	co	47	19	21
4/12/01	spring	snip/spg	smb	72	1	21
4/12/01	spring	snip/spg	co	55	19	21
4/12/01	spring	snip/spg	co	61	19	21
4/12/01	spring	snip/spg	co	63	19	21
4/12/01	spring	snip/spg	co	62	19	21
4/12/01	spring	snip/spg	co	50	19	21
4/12/01	spring	snip/spg	co	39	19	21
4/12/01	spring	snip/spg	co	40	19	21
4/12/01	spring	snip/spg	co	50	19	21
4/12/01	spring	snip/spg	co	50	19	21
4/12/01	spring	snip/spg	cmo	75	1	21

4/12/01	spring	snip/spg	co	35	19	21
4/12/01	spring	snip/spg	co	45	19	21
4/12/01	spring	snip/spg	co	47	19	21
4/12/01	spring	snip/spg	co	35	19	21
4/12/01	spring	snip/spg	co	47	19	21
4/12/01	spring	snip/spg	co	38	19	21
4/12/01	spring	snip/spg	co	40	19	21
4/12/01	spring	snip/spg	co	52	19	21
4/12/01	snipes	snipes	mns	65	19	51
4/12/01	snipes	snipes	co	50	4	51
4/12/01	snipes	snipes	mns	72	19	51
4/12/01	snipes	snipes	mns	74	19	51
4/12/01	snipes	snipes	mns	62	19	51
4/12/01	snipes	snipes	co	47	4	51
4/12/01	snipes	snipes	co	178	4	51
4/12/01	snipes	snipes	smb	108	1	51
4/12/01	snipes	snipes	mns	91	19	51
4/12/01	snipes	snipes	mns	60	19	51
4/12/01	snipes	snipes	co	152	4	51
4/12/01	snipes	snipes	brs	66	4	51
4/12/01	snipes	snipes	mns	88	19	51
4/12/01	snipes	snipes	brs	72	1	51
4/12/01	snipes	snipes	mns	78	19	51
4/12/01	snipes	snipes	mns	80	19	51
4/12/01	snipes	snipes	mns	79	19	51
4/12/01	snipes	snipes	mns	96	19	51
4/12/01	snipes	snipes	mns	60	19	51
4/12/01	snipes	snipes	mns	75	19	51
4/12/01	snipes	snipes	mns	75	19	51
4/12/01	spring	spring	sd		48	65
4/19/01	sulphur	40.2				28
4/19/01	sulphur	sulphur	brs	390	33	130
4/19/01	sulphur	sulphur	brs	320	3	130
4/19/01	sulphur	sulphur	brs	335	3	130
4/19/01	sulphur	sulphur	sd	60	6	130
4/19/01	sulphur	sulphur	sd	68	6	130
4/19/01	sulphur	sulphur	sd	48	6	130
4/19/01	sulphur	sulphur	sd	65	6	130
4/19/01	sulphur	sulphur	sd	69	6	130
4/19/01	sulphur	sulphur	sd	62	6	130
4/19/01	sulphur	sulphur	co	61	1	130
4/19/01	sulphur	sulphur	bg	94	1	105
4/19/01	sulphur	sulphur	smb	75	1	105
4/19/01	sulphur	sulphur	brs	85	1	105
4/19/01	sulphur	sulphur				35
4/19/01	sulphur	37.9	sd	68	17	30
4/19/01	sulphur	37.9	sd	62	17	30
4/19/01	sulphur	37.9	sd	70	17	30
4/19/01	sulphur	37.9	sd	68	17	30
4/19/01	sulphur	37.9	sd	55	17	30

4/19/01	sulphur	37.9	sd	71	17	30
4/19/01	sulphur	37.9	sd	69	17	30
4/19/01	sulphur	37.9	sd	76	17	30
4/19/01	sulphur	37.9	sd	68	17	30
4/19/01	sulphur	37.9	sd	61	17	30
4/19/01	sulphur	37.9	npm	80	1	30
4/19/01	sulphur	40.2	sd	100	1	40
3/15/01	sulphur	sulphur	npm	158	4	200
3/15/01	sulphur	sulphur	npm	142	4	200
3/15/01	sulphur	sulphur	npm	128	4	200
3/15/01	sulphur	sulphur	npm	144	4	200
3/15/01	sulphur	sulphur	co	162	3	200
3/15/01	sulphur	sulphur	co	74	3	200
3/15/01	sulphur	sulphur	sthd	400	2	200
3/15/01	sulphur	sulphur	sthd	400	2	200
3/15/01	sulphur	sulphur	sd	71	9	200
3/15/01	sulphur	sulphur	sd	72	9	200
3/15/01	sulphur	sulphur	sd	61	9	200
3/15/01	sulphur	sulphur	sd	65	9	200
3/15/01	sulphur	sulphur	sd	57	9	200
3/15/01	sulphur	sulphur	sd	58	9	200
3/15/01	sulphur	sulphur	sd	53	9	200
3/15/01	sulphur	sulphur	sd	59	9	200
3/15/01	sulphur	sulphur	sd	45	9	200
3/15/01	sulphur	sulphur	co	49	3	200
3/15/01	sulphur	sulphur	npm	116	6	200.5
3/15/01	sulphur	sulphur	npm	96	6	200.5
3/15/01	sulphur	sulphur	brs	105	11	200.5
3/15/01	sulphur	sulphur	cmo	85	3	200.5
3/15/01	sulphur	sulphur	npm	123	6	200.5
3/15/01	sulphur	sulphur	smb	85	8	200.5
3/15/01	sulphur	sulphur	npm	103	6	200.5
3/15/01	sulphur	sulphur	brs	160	11	200.5
3/15/01	sulphur	sulphur	cmo	66	3	200.5
3/15/01	sulphur	sulphur	npm	119	6	200.5
3/15/01	sulphur	sulphur	brs	128	11	200.5
3/15/01	sulphur	sulphur	npm	76	6	200.5
3/15/01	sulphur	sulphur	smb	78	8	200.5
3/15/01	sulphur	sulphur	smb	71	8	200.5
3/15/01	sulphur	sulphur	smb	77	8	200.5
3/15/01	sulphur	sulphur	smb	78	8	200.5
3/15/01	sulphur	sulphur	smb	59	8	200.5
3/15/01	sulphur	sulphur	smb	85	8	200.5
3/15/01	sulphur	sulphur	smb	80	8	200.5
3/15/01	sulphur	sulphur	brs	124	11	200.5
3/15/01	sulphur	sulphur	brs	120	11	200.5
3/15/01	sulphur	sulphur	mns	142	1	200.5
3/15/01	sulphur	sulphur	brs	150	11	200.5
3/15/01	sulphur	sulphur	brs	110	11	200.5
3/15/01	sulphur	sulphur	brs	99	11	200.5

3/15/01	sulphur	sulphur	brs	92	11	200.5
3/15/01	sulphur	sulphur	brs	95	11	200.5
3/15/01	sulphur	sulphur	brs	104	11	200.5
3/15/01	sulphur	sulphur	cmo	72	3	200.5
3/15/01	sulphur	sulphur	sd	82	1	200.5
3/15/01	sulphur	sulphur	lnd	57	1	200.5
3/15/01	sulphur	33.4	bbh	212	1	
3/15/01	sulphur	33.4	brs	109	14	
3/15/01	sulphur	33.4	brs	120	14	
3/15/01	sulphur	33.4	brs	158	14	
3/15/01	sulphur	33.4	brs	108	14	
3/15/01	sulphur	33.4	brs	87	14	
3/15/01	sulphur	33.4	brs	44	14	
3/15/01	sulphur	33.4	brs	115	14	
3/15/01	sulphur	33.4	brs	198	14	
3/15/01	sulphur	33.4	brs	125	14	
3/15/01	sulphur	33.4	brs	103	14	
3/15/01	sulphur	33.4	brs	127	14	
3/15/01	sulphur	33.4	brs	145	14	
3/15/01	sulphur	33.4	brs	180	14	
3/15/01	sulphur	33.4	brs	173	14	
3/15/01	sulphur	33.4	cmo	80	119	
3/15/01	sulphur	33.4	cmo	120	119	
3/15/01	sulphur	33.4	cmo	117	119	
3/15/01	sulphur	33.4	cmo	115	119	
3/15/01	sulphur	33.4	cmo	185	119	
3/15/01	sulphur	33.4	cmo	70	119	
3/15/01	sulphur	33.4	cmo	60	119	
3/15/01	sulphur	33.4	cmo	125	119	
3/15/01	sulphur	33.4	cmo	125	119	
3/15/01	sulphur	33.4	cmo	135	119	
3/15/01	sulphur	33.4	cmo	77	119	
3/15/01	sulphur	33.4	cmo	73	119	
3/15/01	sulphur	33.4	cmo	121	119	
3/15/01	sulphur	33.4	cmo	134	119	
3/15/01	sulphur	33.4	cmo	138	119	
3/15/01	sulphur	33.4	cmo	106	119	
3/15/01	sulphur	33.4	cmo	100	119	
3/15/01	sulphur	33.4	cmo	106	119	
3/15/01	sulphur	33.4	cmo	58	119	
3/15/01	sulphur	33.4	cmo	115	119	
3/15/01	sulphur	33.4	cmo	115	119	
3/15/01	sulphur	33.4	cmo	75	119	
3/15/01	sulphur	33.4	cmo	75	119	
3/15/01	sulphur	33.4	cmo	74	119	
3/15/01	sulphur	33.4	cmo	65	119	
3/15/01	sulphur	33.4	cmo	76	119	
3/15/01	sulphur	33.4	cp	171	5	
3/15/01	sulphur	33.4	cp	175	5	
3/15/01	sulphur	33.4	cp	184	5	

3/15/01	sulphur	33.4	cp	216	5	
3/15/01	sulphur	33.4	cp	180	5	
3/15/01	sulphur	33.4	lmb	109	1	
3/15/01	sulphur	33.4	npm	132	16	
3/15/01	sulphur	33.4	npm	73	16	
3/15/01	sulphur	33.4	npm	125	16	
3/15/01	sulphur	33.4	npm	60	16	
3/15/01	sulphur	33.4	npm	129	16	
3/15/01	sulphur	33.4	npm	56	16	
3/15/01	sulphur	33.4	npm	155	16	
3/15/01	sulphur	33.4	npm	126	16	
3/15/01	sulphur	33.4	npm	76	16	
3/15/01	sulphur	33.4	npm	145	16	
3/15/01	sulphur	33.4	npm	145	16	
3/15/01	sulphur	33.4	npm	111	16	
3/15/01	sulphur	33.4	npm	116	16	
3/15/01	sulphur	33.4	npm	115	16	
3/15/01	sulphur	33.4	npm	115	16	
3/15/01	sulphur	33.4	npm	142	16	
3/15/01	sulphur	33.4	rs	60	6	
3/15/01	sulphur	33.4	rs	75	6	
3/15/01	sulphur	33.4	rs	60	6	
3/15/01	sulphur	33.4	rs	61	6	
3/15/01	sulphur	33.4	rs	100	6	
3/15/01	sulphur	33.4	rs	62	6	
3/15/01	sulphur	33.4	sd	54	11	
3/15/01	sulphur	33.4	sd	49	11	
3/15/01	sulphur	33.4	sd	55	11	
3/15/01	sulphur	33.4	sd	45	11	
3/15/01	sulphur	33.4	sd	42	11	
3/15/01	sulphur	33.4	sd	43	11	
3/15/01	sulphur	33.4	sd	40	11	
3/15/01	sulphur	33.4	sd	60	11	
3/15/01	sulphur	33.4	sd	50	11	
3/15/01	sulphur	33.4	sd	55	11	
3/15/01	sulphur	33.4	sd	39	11	
3/15/01	sulphur	33.4	smb	202	3	
3/15/01	sulphur	33.4	smb	80	3	
3/15/01	sulphur	33.4	smb	75	3	
3/8/01	spring	snip/spg	co	35	37	125
3/8/01	spring	snip/spg	co	39	37	125
3/8/01	spring	snip/spg	co	40	37	125
3/8/01	spring	snip/spg	co	37	37	125
3/8/01	spring	snip/spg	co	37	37	125
3/8/01	spring	snip/spg	co	38	37	125
3/8/01	spring	snip/spg	co	40	37	125
3/8/01	spring	snip/spg	co	42	37	125
3/8/01	spring	snip/spg	co	40	37	125
3/8/01	spring	snip/spg	co	41	37	125
3/8/01	spring	snip/spg	co	40	37	125

3/8/01	spring	snip/spg	co	40	37	125
3/8/01	spring	snip/spg	co	40	37	125
3/8/01	spring	snip/spg	co	37	37	125
3/8/01	spring	snip/spg	co	40	37	125
3/8/01	spring	snip/spg	co	42	37	125
3/8/01	spring	snip/spg	co	43	37	125
3/8/01	spring	snip/spg	co	40	37	125
3/8/01	spring	snip/spg	co	38	37	125
3/8/01	spring	snip/spg	co	39	37	125
3/8/01	spring	snip/spg	co	40	37	125
3/8/01	spring	snip/spg	co	41	37	125
3/8/01	spring	snip/spg	co	39	37	125
3/8/01	spring	snip/spg	co	42	37	125
3/8/01	spring	snip/spg	co	39	37	125
3/8/01	spring	snip/spg	co	40	37	125
3/8/01	spring	snip/spg	co	40	37	125
3/8/01	spring	snip/spg	co	35	37	125
3/8/01	spring	snip/spg	co	40	37	125
3/8/01	spring	snip/spg	co	41	37	125
3/8/01	spring	snip/spg	co	39	37	125
3/8/01	spring	snip/spg	co	40	37	125
3/8/01	spring	snip/spg	co	40	37	125
3/8/01	spring	snip/spg	co	41	37	125
3/8/01	spring	snip/spg	co	41	37	125
3/8/01	spring	snip/spg	co	43	37	125
3/8/01	spring	snip/spg	co	38	37	125
3/8/01	spring	snip/spg	smb	71	4	125
3/8/01	spring	snip/spg	smb	61	4	125
3/8/01	spring	snip/spg	smb	60	4	125
3/8/01	spring	snip/spg	smb	65	4	125
3/8/01	spring	snip/spg	sd	64	1	125
3/8/01	spring	snip/spg	co	43	4	55
3/8/01	spring	snip/spg	co	38	4	55
3/8/01	spring	snip/spg	co	43	4	55
3/8/01	spring	snip/spg	co	40	4	55
3/8/01	spring	snip/spg	rb	215	1	55
3/8/01	spring	spring				114
3/8/01	snipes	snipes	brs	115	10	70
3/8/01	snipes	snipes	brs	80	10	70
3/8/01	snipes	snipes	brs	77	10	70
3/8/01	snipes	snipes	brs	92	10	70
3/8/01	snipes	snipes	brs	100	10	70
3/8/01	snipes	snipes	brs	115	10	70
3/8/01	snipes	snipes	brs	98	10	70
3/8/01	snipes	snipes	brs	94	10	70
3/8/01	snipes	snipes	brs	95	10	70
3/8/01	snipes	snipes	brs	81	10	70
3/8/01	snipes	snipes	co	160	10	172
3/8/01	snipes	snipes	co	162	10	172
3/8/01	snipes	snipes	co	137	10	172

3/8/01	snipes	snipes	co	145	10	172
3/8/01	snipes	snipes	co	141	10	172
3/8/01	snipes	snipes	co	159	10	172
3/8/01	snipes	snipes	co	164	10	172
3/8/01	snipes	snipes	co	170	10	172
3/8/01	snipes	snipes	co	146	10	172
3/8/01	snipes	snipes	co	141	10	172
3/8/01	snipes	snipes	rb	230	1	172
3/8/01	snipes	snipes	cmo	115	1	172
3/8/01	snipes	snipes	bc	85	3	172
3/8/01	snipes	snipes	bc	85	3	172
3/8/01	snipes	snipes	brs	86	10	172
3/8/01	snipes	snipes	brs	73	10	172
3/8/01	snipes	snipes	brs	94	10	172
3/8/01	snipes	snipes	brs	70	10	172
3/8/01	snipes	snipes	brs	76	10	172
3/8/01	snipes	snipes	brs	75	10	172
3/8/01	snipes	snipes	brs	68	10	172
3/8/01	snipes	snipes	brs	82	10	172
3/8/01	snipes	snipes	brs	65	10	172
3/8/01	snipes	snipes	brs	62	10	172
3/8/01	snipes	snipes	bc	91	3	172