

SCWA Easements

- █ Owned In Fee-Engineered Channel
- █ Easement Engineered Channel
- █ Easement Modified Channel
- █ Easement Natural Channel

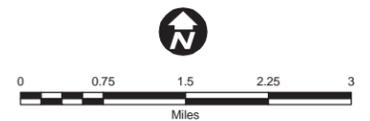
Elevation, ft.

- | | |
|--|--|
| █ Below Sea level | █ 500 - 1,000 |
| █ 0 - 25 | █ 1,000 - 1,500 |
| █ 25 - 50 | █ 1,500 - 2,000 |
| █ 50 - 75 | █ 2,000 - 2,500 |
| █ 75 - 100 | █ Above 2,500 |
| █ 100 - 250 | |
| █ 250 - 500 | |

- SCWA Flood Control Zone Boundary
- █ Water Bodies
- ~ Streams
- City Limits
- Reach Maps Index

Figure 4-42

Petaluma River Watershed



1:105,000



Sources:
Sonoma County Water Agency
County of Sonoma
California Spatial Information Library



Vegetation Type

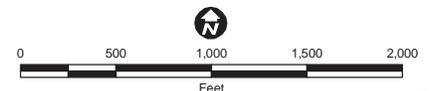
- Blackberry Scrub
- Mixed Riparian Scrub
- Riparian Woodland (full canopy)
- Riparian Woodland (up to 75% canopy)
- Riparian Woodland (up to 25% canopy)
- Riparian Forest
- Ruderal
- Willow Scrub
- Developed

—|—| SMP Maintenance Reaches

Sources:
Sonoma County Water Agency
County of Sonoma
AirPhotoUSA, 2005

FIGURE 4-43

Reaches and Vegetation Zone 2A (1 of 5)



1 inch equals 1,000 feet

Lichau Creek – Reaches 3 & 2

JURISDICTION: City of Petaluma owned, SCWA maintenance easement

LOCATION: Reach 3: Redwood Highway to McDowell Blvd. crossing

Reach 2: McDowell Blvd. crossing to Highway 101

ADJACENT LAND USE: Commercial business park north and south of creek

UPSTREAM: Lichau Cr. modified channels not routinely maintained by SCWA

LENGTH: Lichau 3: 1,115 ft.

Lichau 2: 1,152 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:

Lichau 3: 115 ft.

Lichau 2: 115 ft.

AVERAGE TOP-OF-BANK WIDTH: Lichau 3: 103 ft.

Lichau 2: 82 ft.



(b) Lichau Creek, lower Reach 3, looking downstream to McDowell Blvd. crossing. Taller willows to left indicate edge of active channel further to left. Tall willows grow on natural crowning levee that separates the active channel (left) with the adjacent bench-floodplain to right. McDowell Blvd. bridge is a single span crossing that won't catch debris during high flows. Earthen southern bank (2:1) seen to left (October 26, 2008).

MAINTENANCE HISTORY



(a) Lichau Cr. upper Reach 3, looking upstream to Redwood Hwy. crossing. Water in near ground from adjacent Lichau pond to left; Lichau Cr. channel in distance to right beyond cattails; note broad channel bed with cattails between pond and creek channel (Jan 9, 2008).

PHYSICAL CONDITIONS

Reach setting: Lichau Cr. is the largest northern tributary to the Petaluma River, draining large area of Sonoma Mtn. to east; modified but non-engineered reach upstream; Reaches 3/2 are wide linear floodways engineered to accommodate large floodwaters; lower Reach 2 narrows toward Hwy 101 crossing.

Active channel: low-flow active channel is wide (16-24 ft) set within broad floodway channel (~100 ft.); thalweg is 15 ft below top-of-bank; flow depths of 6-24 in. observed in Oct. 2008/Jan. 2009; back channels observed in bench-floodplain within floodway.

Bed sediments/texture: array of sediment textures distributed across floodway cross-section, with silts, sands, some gravels in active low-flow channel, fine sands along crown-levee (photo b), and mix of sands/silts across bench-floodplain within overall floodway.

Bank structure: banks are earthen; southern bank of both reaches is steeper than northern bank; south bank ranges from 1:1 in upper/mid Reach 3 and Reach 2 with some vertical sections (photo c) to 2:1 in lower Reach 3 (photo b); northern bank is generally 1:1 and stepped down onto bench-floodplain north of active channel.

Lichau Creek – Reaches 3 & 2

Water quality: adjacent pond that captures stormwater drains to upper Reach 3; flows in active channel appear clear (Jan 09); little trash seen

Channel processes: one of the larger floodways seen in entire SMP Program Area; floodway

is wide enough to experience floodplain type depositional processes in the wide bench north of the active channel; secondary back channels are observed in bench-floodplain that convey flows under higher river stages.

BIOLOGICAL CONDITIONS

Vegetation composition: Bank vegetation is primarily riparian woodland upstream, gradually becoming ruderal near the lower downstream portion of Reach 2 (photo d). Areas of dense mixed riparian growth (blackberry) noticed mostly along the southern banks (photo c). Mixed riparian wetland vegetation comprises 90% and 95% of the vegetation within the floodway for Reaches 3 and 2, respectively.

Riparian corridor and canopy closure: a dense riparian woodland provides up to 75% canopy cover along the majority of Reach 3 and upper Reach 2 (photos b/c). Lower Reach 2 has little canopy cover (0-5%)

Instream habitat: Low-flow channel provides a series of riffles/runs throughout; adjacent bench-floodplain (best seen in photo c) provides wide expanse of riparian habitat suitable for a myriad of birds, amphibians, etc. Bench-floodplain is inundated with moderate storm events and provides a wet environment for some duration following storms.

Listed species with potential to occur: known migratory habitat for steelhead, potential habitat for western pond turtle.



(c) Lichau Cr. upper Reach 2 looking downstream from McDowell Blvd. crossing; steep bank (1:1) to left, wide active channel (+20 ft.), and wide bench-floodplain to right (+50 ft) with mature riparian trees. (Jan 8, 2008).



(d) Lichau Cr. lower Reach 2 looking downstream toward Hwy. 101; elevated floodplain seen to center-right of photo constricts lower Reach 2 channel from north; lower Reach 2 channel becomes straighter, narrower, and deeper in final section of reach toward Hwy 101 (October 26, 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Immediate management considerations at Lichau Cr. Reaches 3 and 2 focus on vegetation management, with the selective thinning and removal of cross limbs that border the low-flow channel (photo b) and are found throughout the bench-floodplain north of the low-flow channel. Floodway appears large enough, and McDowell Blvd. bridge set high enough that loss of channel capacity does not appear to yet be an issue. However, over the longer-term sediment accumulation will continue on the bench-floodplain, so hydraulic conditions and available flood capacity should be evaluated annually. Other considerations include the shearing and vertical sections of the southern bank, which may need stabilization over time. The southern bank throughout Reaches 3 and 2 should be annually inspected for further erosion and bank retreat. The lower section of Reach 2 becomes narrow and incised heading toward Hwy. 101. This section should similarly be inspected for additional bed and bank erosion.

Lichau Creek – Reach 1

JURISDICTION: City of Petaluma owned, SCWA maintenance easement

LOCATION: Highway 101 to Stony Point Rd crossing

ADJACENT LAND USE: Manufactured homes to south, open-space/agriculture to north

UPSTREAM: Lichau 2

LENGTH: 652 ft

CHANNEL EASEMENT CORRIDOR WIDTH: 73 ft

AVERAGE TOP-OF-BANK WIDTH: 49 ft



(b) Lichau Cr looking upstream from near Stony Point Rd.; linear and incised channel conditions continue through reach downstream of photo a to photo b site; riprap seen along both northern and southern banks, with gravel augmented southern top-of-bank area seen to right (Jan. 08, 2009).

MAINTENANCE HISTORY



(a) Lichau Cr. upper Reach 1 looking upstream toward Hwy 101 from top of southern bank; channel is linear and deep within hardened incised banks; riparian trees grow along toe of southern bank inset within channel; top of southern bank has been augmented/heightened 5 ft. with additional gravel placement, seen to right (Jan 08, 2009).

PHYSICAL CONDITIONS

Reach setting: lowermost section of Lichau Creek, where Lichau Cr. crosses lower Petaluma River floodplain and joins the mainstem river; Lichau Cr. is confined within a linear alignment flowing directly to Petaluma River; agricultural area to north and trailer type home park to south. Wide bench-floodplains observed in Reaches 3/2 upstream no longer present.

Active channel: active channel is wide (20-25 ft) incised within overall channel, 15-20 ft. deep below top-of-banks in upper reach (photo a) and 10-15 ft. deep in lower reach (photo c), slow moving water, depths 1-3 ft. observed in Jan. 2009.

Bed sediments/texture: some sands observed along lower banks of upper reach, and finer sediments and silts observed within emergent vegetation in lower reach (photo c).

Bank structure: northern banks are generally earthen with some rip-rap support; southern banks are rip-rapped throughout with gravel extension (photos a/b); bank slopes are steep to north (1:1) and near vertical, and less steep to south (2:1) (photo c).

Water quality: stagnant pools were observed in both reaches in Oct. 08, with shallow slow moving water in Jan 09, no trash observed.

Lichau Creek – Reach 1

Channel processes: linear “shooting” reach where fast moving stormflows enter the confined and linear channel from upstream Reach 2 and “shoot” straight downstream

toward the Petaluma River; some backwatering may occur depending upon Petaluma River level when flows merge.

BIOLOGICAL CONDITIONS

Vegetation composition: Outer bank vegetation is primarily ruderal (photo c), though riparian woodland growth is observed along the toe of the southern active channel bank (photo a). Density of riparian trees is greatest in upper reach and decreases downstream. Emergent wetland vegetation comprises 70% of the in-channel area, most strongly in the lower reach (photo c).

Riparian corridor and canopy closure: Dense riparian forest in upper reach provides up to 75% canopy cover; this corridor gradually becomes more of a riparian woodland, and canopy is decreased to approximately 25%. The area nearest to the Stony Point Rd crossing has little to no cover (0-5%).

Instream habitat: linear “shooting” reach provides wet instream habitat, though not as complex or varied as the broader floodway upstream in Reaches 3 and 2; best habitat occurs at confluence with Petaluma River, where areas along the river margin provide a mix of wetted conditions and bank forms.

Listed species with potential to occur: Reach is a migratory corridor for steelhead, potential habitat for western pond turtle.



(c) Looking upstream from Stony Point Rd. crossing; note steep near vertical banks to left (north) and banks to right (2:1) not quite as steep; rip-rap supports banks to both sides; riparian trees seen inset within channel in distance, in near ground more emergent in-stream channel vegetation; in Jan 09, channel flows are generally less than 2 ft. deep (Jan. 08, 2009).



(d) Lichau Cr. confluence with Petaluma River, downstream of SCWA maintenance reach (Jan. 08, 2009).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations of Lichau Cr. Reach 1 focus on the potential flooding to the neighborhood immediately south of the channel. The southern channel bank has been heightened 5 ft. with placement of gravel, though this gravel is unconsolidated. No cross limb vegetation is observed in the channel. Some moderate development of cattails at the lower end of reach near Stony Point Rd. crossing. These cattails and any accumulated sediment depositing there should be evaluated for potential removal if conveyance capacity is reduced. Riparian tree plantings along the top of the northern and southern banks would benefit by making the riparian vegetation corridor denser and linking the corridor between the Petaluma River mainstem downstream and the wider riparian sections of Lichau Cr. observed upstream in Reaches 3 and 2.



Vegetation Type

- Blackberry Scrub
- Mixed Riparian Scrub
- Riparian Woodland (full canopy)
- Riparian Woodland (up to 75% canopy)
- Riparian Woodland (up to 25% canopy)

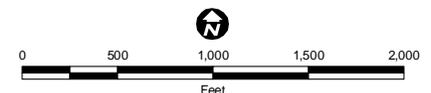
- Riparian Forest
- Ruderal
- Willow Scrub
- Developed

—|—| SMP Maintenance Reaches

Sources:
 Sonoma County Water Agency
 County of Sonoma
 AirPhotoUSA, 2005

FIGURE 4-44

Reaches and Vegetation Zone 2A (2 of 5)



1 inch equals 1,000 feet

Corona Creek – Reaches 7 & 6

JURISDICTION: City of Petaluma owner; SCWA maintenance easement

LOCATION: Reach 7: N. Ely Road to Telford Lane

Reach 6: Telford Lane to Sonoma Mountain Pkwy.

ADJACENT LAND USE: Single family residential

UPSTREAM: Corona Creek headwaters

LENGTH: Corona 7: 713 ft.

Corona 6: 799 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:

Corona 7: 111 ft.

Corona 6: 106 ft.

AVERAGE TOP-OF-BANK WIDTH: no data



(b) Lower Reach 7 looking upstream from Telford Lane; similar to upper Reach 7, abundant cattail vegetation in linear channel; lack of canopy cover with no woody riparian vegetation along banks (August 26, 2008).

MAINTENANCE HISTORY



(a) Upper Reach 7 looking downstream from N. Ely Road; linear trapezoidal channel with abundant in-channel emergent vegetation growth of cattails; banks have willow scrub and grass vegetation (August 26, 2008).

PHYSICAL CONDITIONS

Reach setting: upstream of Riesling Rd. Corona Cr. is a natural headwater tributary; downstream of Riesling Rd, and into Reach 7 (downstream of Ely Rd.) the creek becomes a linear trapezoidal channel that drains runoff from the neighboring residential areas.

Active channel: active channel width is consistent in both reaches; bed is 6-12 ft wide and 4-6 ft deep, with flow depths less than 1 ft. Sediment has likely accumulated to a depth of 1 foot throughout both reaches, at the base of the cattails. Bed gradient is stabilized by hardened crossings at both ends of the reaches.

Bed sediments/texture: pebbles and coarser sands observed in Reach 7, with sediments fining to mostly silts and fine sands downstream in Reach 6.

Bank structure: symmetrical earthen banks sloped at 2:1 or 1.5:1 throughout; banks are approx 4-6 ft high from channel bed.

Water quality: perennial in both reaches with flows exhibiting good water clarity observed on August 26, 2008. Stagnant areas within cattails encourage growth of algae (photo d). Earthen bed and banks provide some filtration of runoff.

Corona Creek – Reaches 7 & 6

Channel processes: linear channel alignment for both reaches; cattail and other in-channel vegetative growth trap and cause sedimentation. Ample space for conveyance of flood flows.

BIOLOGICAL CONDITIONS

Vegetation composition: active channel is characterized by 100% wetland emergent vegetation, dominated by cattail growth; ruderal vegetation including fennel, annual grasses, and star thistle grow along bank areas (photos b/ c); a mixture of willow scrub, oak, and willow trees are also located on bank areas (photos a/d).

Riparian corridor and canopy closure: riparian growth is minimal and provides 0-25% shading along the reaches.

Instream habitat: Habitat denuded by overabundance of cattails in the channel.

Listed species with potential to occur: None



(c) Upper Reach 6 looking downstream from Telford Lane; similar to upstream in Reach 7, in-channel abundant cattail conditions continue in Reach 6 (August 26, 2008).



(d) Reach 6 looking upstream from Sonoma Mountain Pkwy. Similar to upstream reaches, abundant cattail growth continues through Reach 6. Note algae growth around the cattails (bright green in the channel) toward the crossing (August 26, 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Corona Creek Reaches 7 and 6 focus on removal of instream cattail vegetation to reduce instream flow resistance and improve flood conveyance. Planting of additional riparian trees along the streambanks that could mature and provide shade to channel would particularly benefit these two reaches. Other considerations include providing a potential low-flow channel (with alternating bar forms to provide sinuosity) to enhance in-channel habitat and improve sediment transport functions.

Corona Creek – Reaches 5 & 4

JURISDICTION: City of Petaluma owner; SCWA maintenance easement

LOCATION: Reach 5: Sonoma Mountain Pkwy to Wellington Place
Reach 4: Wellington Place to Railroad tracks (north of N. McDowell Blvd.)

ADJACENT LAND USE: Single family residential; park open space

UPSTREAM: Corona Reach 6

LENGTH: Corona 5: 845 ft.
Corona 4: 487 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:
Corona 5: 107 ft.
Corona 4: 121 ft.

AVERAGE TOP-OF-BANK WIDTH: no data



(b) Mid Reach 5 looking upstream at pedestrian footbridge; dense cattail growth through the channel bed with thick willow growth at the toe of the stream banks and the channel margin (August 26, 2008).

MAINTENANCE HISTORY



(a) Reach 5 looking downstream from Sonoma Mountain Parkway crossing; like upstream reaches, large stands of cattails in channel, but unlike upstream reaches, now with willows too (August 26, 2008).

PHYSICAL CONDITIONS

Reach setting: mid-portion of the engineered Corona Creek system; like upstream Reaches 7 and 6, linear engineered trapezoidal channel continues in Reaches 5 and 4. Reaches 5 and 4 are wider than upstream reaches to convey larger flows.

Active channel: both reaches - channel bed 8-12 ft wide, 6-10 ft deep, with flow depths about 1 ft deep. Reach 4 includes a secondary parallel channel to the south of the primary channel, with the two channels joining near railroad crossing.

Bed sediments/texture: silts and fine sands throughout both reaches.

Bank structure: symmetrical earthen bank slopes with 1:1 slopes; riprap is located along banks near crossings and culverts.

Water quality: perennial with slow flows exhibiting good water clarity, except in spot locations with abundant duckweed growth (photo d).

Channel processes: cattail and other vegetative growth in channel traps sediment (see photos); pool feature with duckweed located west of crossing on Reach 4 (photo d).

Corona Creek – Reaches 5 & 4

BIOLOGICAL CONDITIONS

Vegetation composition: woody vegetation dominated by willow scrub is present in channel and along banks; wetland vegetation, including cattails, is abundant throughout both reaches (particularly Reach 5); wetland vegetation comprises 20-60% of the channel growth, increasing downstream as riparian vegetation becomes less dominant; ruderal vegetation is observed on top of bank areas.

Riparian corridor and canopy closure: abundant riparian growth (mostly willows) provides 50-75% canopy cover across the channels (photo b).

Instream habitat: small riffle pool feature located in Reach 5 provides in-channel habitat for amphibians, otherwise abundant cattail stands limits aquatic habitats.

Listed species with potential to occur: Reach 4 is potential habitat for western pond turtle.



(c) Lower Reach 5 looking upstream from Wellington Place crossing; abundant instream cattail vegetation and willow growth obstructs the channel (August 26, 2008).



(d) Reach 4 looking downstream from Wellington Place. Large pool with abundant duckweed growth (August 26, 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Corona Reaches 5 and 4 focus on selective vegetation removal and/or thinning to improve flow conveyance and maintain canopy closure. Other considerations include providing low-flow channel features to improve transport of fine sediments, with potential alternating bar forms to provide sinuosity to this linear channel.

Corona Creek – Reaches 3, 2 & 1

JURISDICTION: City of Petaluma owner; SCWA maintenance easement

LOCATION: Reach 3: Railroad crossing to N. McDowell Blvd.
Reach 2: N. McDowell Blvd. to Reach 1 (near Sonoma Ct)
Reach 1: Near Sonoma Ct. to conduit confluence with Capri Creek Reach 2 at Highway 101

ADJACENT LAND USE: Reach 3: pasture, open space
Reach 2: residential
Reach 1: freeway, commercial

UPSTREAM: Corona 4

LENGTH: Corona 3: 138 ft.
Corona 2: 1,022 ft.
Corona 1: 3,240 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:
Corona 3: 111 ft.
Corona 2: 52 ft.
Corona 1: 82 ft.

AVERAGE TOP-OF-BANK WIDTH: Corona 3: no data
Corona 2: 45 ft.
Corona 1: 60 ft.



(b) Reach 2 looking downstream from the N. McDowell Blvd crossing; riprap covers the bank walls at the crossing and trees provide shade (August 26, 2008).

MAINTENANCE HISTORY



(a) Reach 3, looking upstream from the N. McDowell Blvd. crossing; note pooling, dense willow scrub and in-channel vegetation (August 26, 2008).

PHYSICAL CONDITIONS

Reach setting: lowest portions of the engineered Corona Cr. system; transitional from higher alluvial sections upstream (Reaches 5 and 4) moving toward valley bottom confluence with Petaluma River (downstream of Capri Cr. confluence).

Active channel: Active channel bed width is 4-10 ft wide, 4-6 ft deep, with flow depths 6 inches to 1 ft deep (Photo b)

Bed sediments/texture: mostly silts and fine sands with Reach 1 becoming finer in texture and a depositional environment

Bank structure: symmetrical earthen banks with slopes at 2:1 and 1:1, with riprap near crossings and conduits (photo a); confluence with Capri Creek Reach 2 is grouted and riprapped

Water quality: Slow moving perennial flows and stretches of no canopy cover encourage growth of algae and duckweed, as seen in the photos.

Channel processes: low flow channel reaches with occasional pools; lower reach has large in-channel benches supporting cattail growth; a small sediment wedge is forming at the south side of the confluence with Capri Creek Reach 2.

Corona Creek – Reaches 3, 2 & 1

BIOLOGICAL CONDITIONS

Vegetation composition: banks are vegetated with ruderal vegetation including Himalayan blackberry, iceplant, ivy, and grasses; wetland vegetation comprises approximately 75% of the total channel reaches and is dominated by cattail growth.

Riparian corridor and canopy closure: 0-25% canopy closure provided by a mixture of mature willows, ash, eucalyptus oaks, redwoods, and maple riparian vegetation along top of banks (photo b).

Instream habitat: poor quality instream habitat due to overgrowth of algae and urban contaminants potentially conveyed in runoff from surrounding development.

Listed species with potential to occur: All three reaches are potential habitat for western pond turtle.

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations include selective bar grading/skimming where necessary, but should include alternating bar forms that provide sinuosity as currently observed in Reach 1. Other considerations include removal of cattails and planting of more riparian vegetation (if capacity allows) to provide additional shade to inhibit cattail growth where no canopy cover currently exists.

Capri Creek – Reaches 4 & 3

JURISDICTION: Owned and maintained by SCWA

LOCATION: Reach 4: Sonoma Mountain Parkway to Maria Drive
Reach 3: Maria Drive to N. McDowell Blvd.

ADJACENT LAND USE: Single family residential and recreational open space

UPSTREAM: Capri Creek headwaters

LENGTH: Capri 4: 1,601 ft.
Capri 3: 1,573 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:
Capri 4: 168 ft.
Capri 3: 146 ft.

AVERAGE TOP-OF-BANK WIDTH: no data



(a) Reach 4 at Sonoma Mountain Pkwy, looking downstream; Wide channel easement, with gently sloping banks; channel is ephemeral and dry, but abundant emergent vegetation in the channel indicates shallow groundwater or high soil moisture (August 26, 2008).



(b) Reach 4 at Maria Drive, looking upstream; willow scrub observed along banks of the entire reach, note sand, gravel, and cobble in streambed (August 26, 2008).

MAINTENANCE HISTORY

PHYSICAL CONDITIONS

Reach setting: Upstream of Reaches 4 and 3, Capri Cr. tributaries drain undeveloped headwater slopes on Sonoma Mtn.; Reaches 4 and 3 are engineered trapezoidal channels that take Capri Cr. through the suburban Petaluma neighborhood. The engineered Capri Cr. likely follows close to the historic stream course.

Active channel: Channel bed is 6-12 ft and 3-4 ft. below top of banks; channel is shallow with no pools, but retains shallow groundwater at the base of the channel, as noted by abundant emergent vegetation (photos a/d).

Bed sediments/texture: sand, pebbles, and cobbles in Reach 4 (photo b), fining to sands and silts downstream in Reach 3.

Bank structure: symmetrical trapezoidal channel, with earthen banks, gently sloped at 3:1.

Water quality: dry channel, no flow observed, no trash, earthen bed, banks, and wide channel easement provide filtering functions during higher flow conditions.

Channel processes: linear channel alignment, wide easement provides ample higher bank and floodplain areas to convey flows. Cattails and other in-channel vegetative growth encourage sedimentation in the channel.

Capri Creek – Reaches 4 & 3

BIOLOGICAL CONDITIONS

Vegetation composition: Reach 4 supports a mix of oak, redwood, and willow trees which provide some canopy cover over the channel area (photo a); Reach 3 is devoid of shade-providing riparian vegetation (photos c/d). Ruderal grasses dominate the channel banks along both reaches. In-channel vegetation is comprised of nearly 85% wetland species.

Riparian corridor and canopy closure: Channel corridor is maintained as open space with little riparian vegetation, primarily grasses. Canopy cover is between 0-25%, decreasing downstream.

Instream habitat: Instream habitat is limited by linear channel homogeneity and influence of surrounding development; aquatic habitat is limited by ephemeral nature of stream; reaches however are near to headwaters areas and provide an important conduit from the lowland areas upstream.

Listed species with potential to occur: potential habitat for western pond turtle.



(c) Reach 3, looking downstream from Maria Dr.; very wide channel easement, gently sloping banks, and in-channel scrub willow vegetation, with a lack of any woody riparian canopy over the channel (August 26, 2008).



(d) Mid Reach 3 looking downstream; linear channel alignment and wide gently sloping banks (August 26, 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Capri Creek Reaches 4 and 3 focus on in-channel vegetation removal to reduce resistance and reduce instream sediment accumulation. Currently, there is ample conveyance capacity due to the broad channel alignment in Reaches 4 and 3. However, the sediment load from upstream of sand appears high and may accumulate over time in the channel. Planting of riparian trees to provide additional canopy cover in Reach 3 would be advantageous.

Capri Creek – Reach 2

JURISDICTION: N. McDowell to railroad crossing: SCWA owned and maintained.
Railroad to Hwy 101: City of Petaluma owned, SCWA maintained.

LOCATION: N. McDowell Blvd. to confluence with Corona 1 at Highway 101

ADJACENT LAND USE: Commercial and multi-family residential

UPSTREAM: Capri 3

LENGTH: 1,030 ft

CHANNEL EASEMENT CORRIDOR WIDTH: 47 ft

AVERAGE TOP-OF-BANK WIDTH: 28 ft



(b) Reach 2 at N. McDowell Blvd., looking downstream; earthen bank slopes with mature riparian trees (August 26, 2008).

MAINTENANCE HISTORY



(a) N. McDowell Blvd. crossing of parallel culverts entering Reach 2; looking upstream to reach Capri 3 and headwater areas (August 26, 2008).

PHYSICAL CONDITIONS

Reach setting: above ground portion of reach is linear trapezoidal channel between N. McDowell Blvd. and railroad. Channel flows in a culvert beneath the railroad and parking lots before day-lighting at confluence with Corona Creek.

Active channel: active channel is 6-12 ft wide, 4-6 ft. deep (photos a/c). Reach is perennial, likely due to surrounding urban development and being lower in the watershed than reaches 4/3 upstream.

Bed sediments/texture: sands and silts collecting in patches with some loose riprap cobbles that have locally eroded (photo c).

Bank structure: asymmetrical bank slopes with steeper (1:1) slopes on one side and gentler (2:1) slopes on the opposite side.

Water quality: relatively trash free; sediment deposits in patches with emergent wetland; vegetation slows groundwater infiltration and contaminant filtration functions.

Channel processes: linear channel alignment with flows contained within engineered banks; cattail growth and associated sedimentation in sequences; southern bank observed to be undercut in one location; (photo d).

Capri Creek – Reach 2

BIOLOGICAL CONDITIONS

Vegetation composition: banks exhibit ruderal grasses and large mature trees throughout the reach (photos b/c); in-channel vegetation is dominated by patches of cattail growth where the channel is exposed to sunlight (photo d); wetland vegetation comprises 95% of in-channel growth (photo b).

Riparian corridor and canopy closure: canopy closure between 0-50% is provided by willow, oak, and eucalyptus trees primarily along the northern channel banks.

Instream habitat: some aquatic habitat supported in pools and slow moving water within the channel. Surrounding residential and industrial areas likely deter species from this reach; culverts downstream at railroads and Hwy 101 and upstream at N. McDowell Blvd bound this reach.

Listed species with potential to occur: potential habitat for western pond turtle.



(c) Mid Reach 2 looking downstream, locally eroded riprap found on channel bed and banks of the trapezoidal channel (August 26, 2008).



(d) Reach 2 at railroad crossing, looking upstream. Dense cattails and emergent wetland vegetation fill the channel; ruderal grasses and shrubs are established along bank areas (August 26, 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Capri Reach 2 focus on removal of in channel cattail vegetation in the lower reach, upstream of the railroad crossing (photo d). Much of the reach is shaded by mature riparian trees, preventing abundant cattail development in the channel, but this is not the case at the lower reach. The lower portion of the reach would benefit from the planting of additional riparian vegetation to inhibit cattail growth.

Capri Creek – Reach 1 & Jessie Lane Creek – Reach 1

JURISDICTION: Owned and maintained by SCWA

LOCATION: Capri 1: Highway 101 to Petaluma River confluence
Jessie 1: Petaluma Blvd. to Petaluma River confluence.

ADJACENT LAND USE: Capri 1: commercial retail (outlets) to north, open space to south
Jessie 1: commercial, car repair lot to south and storage unit facility to north

UPSTREAM: Capri 1: upstream is Capri 2
Jessie 1: culvert beneath Petaluma Blvd.

LENGTH: Capri 1: 591 ft.
Jessie 1: 827 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:
Capri 1: 100 ft.
Jessie 1: 83 ft.

AVERAGE TOP-OF-BANK WIDTH: Capri 1: 50 ft.
Jessie 1: 36 ft.



(b) Capri Cr. Reach 1 looking upstream from lower reach near Petaluma River confluence; abundant in-channel emergent vegetation, and some sediment accumulation (October 23, 2008).

MAINTENANCE HISTORY



(a) Capri Cr. Reach 1, looking downstream from culvert outfalls just downstream of Hwy 101 (at factory outlet mall); trapezoidal channel with cattail growth and some bars of fine sediment deposited; deep channel within steep banks (Jan 8, 2009)

PHYSICAL CONDITIONS

Reach setting: Capri Reach 1 and Jessie Lane Reach 1 join the Petaluma River very near each other (see Figure 4-44); Capri Cr. is a west flowing creek draining parts of Petaluma east of Hwy 101, but does not have an extensive headwaters in the hills to the east. Jessie Lane Cr. is a very local drainage channel, only collecting runoff from the immediate Petaluma Blvd. area.

Active channel: Capri Cr. Reach 1 channel bed is 12-16 ft wide and is 10-12 ft. deep in upper reach (photos a/b), and has an approximate low-flow water depth of 1-2 ft. Jessie Lane Cr. is 4-8 ft. wide, 3-6 ft deep, and is ephemeral with no water flowing between storm events.

Bed sediments/texture: Capri Cr. Reach 1 has sands and silts through most of the reach with some sloughed riprap and large boulders at Petaluma River confluence. Jessie Lane Cr. has mostly sand and fine sand sediments.

Bank structure: Capri Cr. Reach 1 banks are earthen and steep, generally 1:1 in photo a, and 2:1 in photo b. Jessie Lane Cr. banks are earthen, sloped 2:1 with max. height of 6 ft.

Water quality: Capri Cr. Reach 1 has stagnant pools upstream of cattail and sediment deposits (photos a/b). Jessie Lane Cr. had no flow, but concern regarding disposed trash and refuse from adjacent auto shop (photo c).

Capri Creek – Reach 1 & Jessie Lane Creek – Reach 1

Channel processes: Capri Cr. Reach 1 is a linear trapezoidal channel, somewhat incised below steep banks in upper reach, with sequence of cattail/sediment deposits that becomes more continuous downstream

(photo b). Jessie Lane Cr. is essentially a small ephemeral drainage mostly covered in blackberry with riparian scrub growth blocking most of the channel (photo c).

BIOLOGICAL CONDITIONS

Vegetation composition: Capri Cr. Reach 1 banks are vegetated with ruderal growth (photos a/b). Emergent wetland species, mostly cattail and tule cover 80% of the in-channel area (photo b). Jessie Lane Cr. supports areas of dense riparian scrub (blackberry) covering both banks and the entire channel in locations (photo c), and with some ruderal growth along banks in the lower reach. Jessie Lane reach is characterized as having 95% emergent wetland vegetation growth in-channel (photo c).

Riparian corridor and canopy closure: In Capri Cr. Reach 1 occasional oak trees along banks provide some canopy cover, but not much (0-15%, photo b). In Jessie Lane Cr. woody riparian growth is limited and provides approximately 0-15% cover along the reach (photos c/d), with canopy cover increasing downstream.

Instream habitat: in-stream habitat along Capri Cr. Reach 1 is impacted due to excessive cattail growth which is blocking flows to and from the Petaluma River. Similarly, Jessie Lane Cr. is impacted from excessive blackberry growth, though this is a small ephemeral channel and would not support as much habitat as Capri Cr.

Listed species with potential to occur: potential habitat for western pond turtle. Known occurrence of steelhead in Petaluma River downstream of Capri and Jessie Lane Creeks.



(c) Jessie Lane Creek, near Petaluma Blvd. looking downstream; abundant blackberry covers banks and the entire channel; auto shop to right is potential source of trash and refuse that enter the channel (Jan 8, 2009).



(d) Jessie Lane Creek, looking downstream toward confluence with Petaluma River. Ephemeral channel is dry, leaf litter across channel bed, adjacent trees provide cover (October 23, 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Capri Cr. Reach 1 focus on removing cattails and associated sediment deposits, especially in the lower reach where cattails and accumulating sediment become more prominent. Capri Cr. Reach 1 would also benefit from additional riparian plantings along the high banks, particularly on the south side to provide more shading to the channel to inhibit in-channel emergent vegetation growth where no canopy currently exists. Management considerations for Jessie Lane focus on blackberry removal and thinning to improve flow conveyance. Importantly at Jessie Lane Cr. potential threats to water quality are observed from trash and refuse apparently transported from the auto shop. May be worthwhile for SCWA to contact the auto shop to describe the problem and seek their commitment to improve trash conditions.



Vegetation Type

- Blackberry Scrub
- Mixed Riparian Scrub
- Riparian Woodland (full canopy)
- Riparian Woodland (up to 75% canopy)
- Riparian Woodland (up to 25% canopy)
- Riparian Forest
- Ruderal
- Willow Scrub
- Developed
- SMP Maintenance Reaches

Sources:
Sonoma County Water Agency
County of Sonoma
AirPhotoUSA, 2005

FIGURE 4-45

Reaches and Vegetation Zone 2A (3 of 5)



1 inch equals 1,000 feet

Washington Creek – Reach 7

JURISDICTION: City of Petaluma owned, SCWA maintenance easement

LOCATION: Catenacci Ct. downstream to Sonoma Mtn. Parkway crossing

ADJACENT LAND USE: Dense single family residential (newer development)

UPSTREAM: Non maintained reach of Washington Cr. and headwaters areas further upstream

LENGTH: 1,826 ft

CHANNEL EASEMENT CORRIDOR WIDTH: 88 ft

AVERAGE TOP-OF-BANK WIDTH: no data



(b) Mid Reach (May 06, 2008)

MAINTENANCE HISTORY



(a) (May 06, 2008)

PHYSICAL CONDITIONS

Reach setting: Reach 7 is the upper most maintained reach along Washington Cr., upstream of Reach 7 the creek passes through a park and then ascends to its headwaters in a more natural form; Reach 7 represents a transition from the non-engineered areas upstream, to the very heavily impacted and engineered urban reaches downstream of Reach 7.

Active channel: upper reach channel is generally 4-8 ft. wide and 2-3 ft. below adjacent banks (photos a/b); in lower reach active channel widens to 8-10 ft. wide, and 3-5 ft. below adjacent top of banks, flows are ephemeral in Reach 7; overall channel easement is wide and provides for adjacent trails.

Bed sediments/texture: channel bed comprised nearly entirely of sands, with medium to coarse sands upstream (photos a/b), and finer sands downstream. Sandy bed provides good infiltration/recharge capacity when intermittent flows do arrive.

Bank structure: broad trapezoidal channel cross section with gently sloping earthen banks, typically 3:1 or more (photos b/c), but steeper with a more box like incised channel upstream in the upper reach (photo a).

Water quality: dry intermittent channel shows no appreciable water quality issues, no trash observed, sandy bed is great groundwater recharge source.

Channel processes: upper and mid reach are depositional in nature with sands collecting

Washington Creek – Reach 7

and filling the defined low-flow channel. In the upper reach, some culvert outfalls are buried from accumulating sediment (photo a);

lower reach appears less depositional, but upper reach sands will be transported down to the lower reach over time.

BIOLOGICAL CONDITIONS

Vegetation composition: The upper reach is dominated by willow scrub vegetation along the channel and ruderal vegetation along the higher banks (photos a/b). Instream willows growing in clusters as seen in photo b. Downstream, in-channel vegetation becomes dominated by blackberry, with some grasses remaining on the higher banks (photo c). Several riparian trees (oaks, alders, cottonwoods) have been planted along the gentle and wide upper banks throughout the mid reach, in the park-like setting. Over time these trees will mature and provide increasing shade and cover.

Riparian corridor and canopy closure: upper reach canopy closure provided by willows is strong, up to 75% in several locations (photos a/b), moving downstream, lack of mature riparian trees decreases canopy closure to 25% or less (photo c). Over time, planted trees in mid-reach will provide increasing canopy cover.

Instream habitat: Aquatic habitat is limited due to ephemeral nature of flows, but the sandy bed stream is well defined and does provide a concentrated pathway for flows.

Listed species with potential to occur: none



(c) Lower Reach 7 looking downstream toward Sonoma Mtn. Parkway. Note transition in channel form and vegetation from upper reach, channel now dominated by blackberry and other grasses on high banks, presence of willows providing riparian cover is diminished; overall cross-section is broad with gently sloping banks (May 6, 2008).



(d) Lower Reach 7 at Sonoma Mtn. Parkway. Culvert and immediate upstream area are clear of any deposited sediment and do not require any maintenance (May 6, 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Reach 7 Washington Creek focus on the sections of the upper reach where abundant sand deposition has buried some drainage culvert outfalls (photo a). Some sediment removal may be necessary to clear these outfall locations. Some of the in-channel willow clusters mid-reach should be observed for potential channel blockage, but at the current time, this issue does not appear pressing (photo b). Over time the planted riparian trees in the mid-channel section will mature and provide additional shade and cover. Additional planting opportunities for the lower reach which does not have any appreciable mature riparian cover should be evaluated (photo c).

Washington Creek – Reaches 6 & 5

JURISDICTION: Reach 6 – Upper 700 ft. owned by City of Petaluma with SCWA maintenance easement; remainder of Reach 6 and Reach 5 owned and maintained by SCWA

LOCATION: Reach 6: Sonoma Mtn. Parkway to Maria Dr.
Reach 5: Maria Dr. to N. McDowell Blvd.

ADJACENT LAND USE: Single family residential to north, E. Washington Blvd. along south

UPSTREAM: Washington Creek Reach 7

LENGTH: Washington 6: 1,699 ft.
Washington 5: 1,418 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:
Washington 6: 45 ft.
Washington 5: 36 ft.

AVERAGE TOP-OF-BANK WIDTH:
Washington 6: 39 ft.
Washington 5: 20 ft.



(b) Lower Reach 6 looking upstream from Maria Dr.; photo shows how creek is directly adjacent to E. Washington Blvd.; banks are steep and the channel is linear without much internal complexity (Aug 26, 2008).

MAINTENANCE HISTORY



(a) Reach 6 looking downstream from below Sonoma Mtn. Parkway crossing. Trapezoidal linear channel parallels E. Washington Blvd. along southern bank (left). Much of Reach 6 has riparian woodland with up to 75% canopy; but photo shows an open section with mostly blackberry and scrub/grass banks. (Aug. 26, 2008).

PHYSICAL CONDITIONS

Reach setting: Downstream of the more natural Reach 7, Reaches 6 and 5 become a very linear urban channel, lower 500 ft. of Reach 5 is hardened with concrete banks, channel remains dry until confluence with East Washington Creek in lower Reach 5.

Active channel: 6-8 ft wide channel bed inset within a 20-30 ft. top of bank width; channel is 3-5 ft. deep in upper Reach 6, increasing to 6-8 ft. deep in lower Reach 6; similarly upper Reach 5 is 3-5 ft. deep and increases to 6-8 ft. deep at lower end.

Bed sediments/texture: channel bed is mostly sand, as derived from sandy Reach 7 upstream; downstream of E. Washington Creek confluence, finer sediments are introduced.

Bank structure: trapezoidal channel banks, typically at 1:1 or 2:1 as shown in photos. Hardened banks of riprap or concrete downstream of E. Washington Cr. confluence.

Water quality: in late Aug. 2008, Reach 6 and upper Reach 5 are dry; channel becomes wet at E. Washington Creek confluence. Water quality concerns for urban inputs and pollutants draining immediately from adjacent roadways.

Washington Creek – Reaches 6 & 5

Channel processes: linear channel with few bed features, some shallow sand deposits in places, but overall, abundant deposition not

indicated; intermittent channel becomes more perennial downstream of E. Washington confluence.

BIOLOGICAL CONDITIONS

Vegetation composition: Much of Reach 6 is riparian woodland consisting of oaks, eucalyptus, and willows, with greater vegetation coverage typically on the northern bank away from the roadway. In places, bank vegetation in Reach 6 is more ruderal, with grasses and blackberry (photo a). Reach 5 is mostly riparian woodland upstream of the E. Washington Cr. confluence, becoming ruderal and willow scrub downstream of confluence.

Riparian corridor and canopy closure: In Reach 6 up to 75% canopy cover with large oaks and riparian woodland vegetation, and eucalyptus; Reach 5 has less canopy coverage, up to 50% in upper Reach 5, decreasing to 25% or none in lower Reach 5.

Instream habitat: Reaches 6 and 5, are urban areas, but the channel does provide an important corridor between the lower Washington Cr. and Petaluma River zones downstream with the less disturbed headwater areas upstream of Reach 7. Dry conditions above the E. Washington Cr. confluence prevent any meaningful aquatic habitat in upper reach area.

Listed species with potential to occur: potential habitat for western pond turtle in Reach 5.



(c) Upper Reach 5 looking downstream from Maria Dr. Compared to Reach 6 upstream, upper Reach 5 is shallower. Upper Reach 5 is dry (Aug. 26, 08), but becomes wet in its lower section (photo d), presumably from collective urban flows, and input from confluence of East Washington Creek, downstream of this photo, and upstream of photo d.



(d) Lower Reach 5 looking upstream from N. McDowell Blvd. Upstream of crossing, banks are concrete for 500 ft. to confluence with East Washington Creek. Channel flow is stagnant 6-12" deep, with algae collecting, but not much sediment collecting (Aug. 26, 2008)

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Reach 6 of Washington Creek focus on sediment management in the open, non riparian woodland sections of the reach (photo a) where blackberry dominates some bank and channel sections. Overall, sediment deposition in Reaches 6 and 5 is not abundant and does not appear to be problematic. In lower Reach 5, downstream of the E. Washington Cr. confluence, water quality conditions appear poor due to stagnant flow conditions with algae collecting. E. Washington Cr. introduces finer sediments to Washington Cr. but deposition is not accumulating. Apparently sediments are being transported through Reaches 6 and 5 and are being deposited in Reaches 4 and 3 downstream (see those sheets for reference).

Washington Creek – Reach 4

JURISDICTION: Owned by City of Petaluma with SCWA maintenance easement

LOCATION: N. McDowell Blvd. to Hwy 101

ADJACENT LAND USE: Shopping center and parking area to north, E. Washington Blvd. to south

UPSTREAM: Washington Creek Reach 5

LENGTH: 903 ft

CHANNEL EASEMENT CORRIDOR WIDTH: 30 ft

AVERAGE TOP-OF-BANK WIDTH: 60 ft



(b) Reach 4 looking downstream, just downstream of photo a; this area flooded in 2005/06 into the parking lot and Big 5 store to the right; in-channel emergent vegetation of cattails and water plantain has vigorously returned, along with some renewed sediment deposited (Aug. 26, 2008).

MAINTENANCE HISTORY



(a) Reach 4 looking downstream from N. McDowell; this section has experienced past flooding in 2005/6 with overbank flows out of channel to right into parking lot and Big 5 store; channel was cleared of sediment and vegetation in 2006, cattail growth and some sediment has returned (Aug. 26, 2008).

PHYSICAL CONDITIONS

Reach setting: Similar to Reaches 6/5 upstream, Reach 4 is bound to the south by E. Washington Dr. (photo a); this reach historically accumulates sediment and has flooded previously in 2005/06.

Active channel: 12-16 ft wide, 3-5 ft. deep beneath northern bank at shopping center parking lot in upper reach (photo b), and 2-4 ft. deep in lower reach (photo d);

Bed sediments/texture: channel bed contains a mix of mostly sand, with some silt; lower reach has more even distribution of deposited sediments across the entire bed width.

Bank structure: southern bank hardened along E. Washington Dr.; otherwise earthen banks of 2:1 slope along northern side of channel.

Water quality: in late Aug. 2008, Reach 4 had some ponding downstream of McDowell, but became dry further downstream; potential sediment quality concerns due to gas station concentrations along McDowell Blvd.

Channel processes: linear channel with few bed features, vigorous cattail growth in upper reach and renewed sediment deposition throughout reach; in lower reach sediments deposit as planar feature across entire bed width.

Washington Creek – Reach 4

BIOLOGICAL CONDITIONS

Vegetation composition: In-channel emergent vegetation in the upper reach consists of cattails, tule, and water plantain that grow in the wet/moist environment with pools downstream of N. McDowell Blvd. Vegetation along banks includes oaks, eucalyptus, and Lombardy poplars; there are also areas of willow scrub and ruderal vegetation along the banks of the lower reach.

Riparian corridor and canopy closure: thin and intermittent woodland corridor; canopy closure between 0-25%.

Instream habitat: Reach 4 is constrained in each direction, immediately downstream is Hwy 101, beyond that there is a large drop structure (10-15 ft. high) at the top of Reach 3 which presents a barrier, similarly the culvert crossing at N. McDowell Rd above the reach is also hardened; areas to the north (parking lot) and south (E. Washington Dr.) are also hardened surfaces with traffic. As such the habitat surrounding of the reach is quite constrained. In-stream, the channel is historically depositional with the low-flow channel often being filled with sediment and creating a planar depositional channel bed.

Listed species with potential to occur: potential habitat for western pond turtle.



(c) Lower Reach 4 looking upstream; tall Lombardy poplar trees seen in distance; in the lower reach the low-flow channel is less defined, and recently deposited sediments are distributed more evenly across the entire channel bed; willow scrub and ruderal vegetation fill channel bed (Aug. 26, 08).



(d) Lower Reach 4 looking downstream to Hwy. 101 crossing; soil to right is from a non-SCWA transportation project during the summer of 2008; sediment has been collecting in channel to left (Aug. 26, 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Reach 4 of Washington Creek focus on sediment removal immediately downstream of the N. McDowell crossing and further downstream throughout the reach. As described above, this reach is historically depositional (possibly due to the gentle gradient upstream of the large drop structure downstream in Reach 3) and has experienced past flooding (2005/06); due to this heightened propensity to collect sediment and flood, this reach requires careful evaluation each season. Current recommendation is to remove sediment throughout the reach including at the upper end just downstream of McDowell, but also at the lower end of the reach near Hwy. 101.

Washington Creek – Reach 3

JURISDICTION: SCWA owned and maintained channel

LOCATION: Upstream of Madison St. to the Hwy 101 off-ramp to E. Washington St. (see Figure 4-45)

ADJACENT LAND USE: Single family residential north of creek and multi-family residential and open space south of creek

UPSTREAM: CalTrans owned reach between Reach 3 and Hwy 101; Reach 4 upstream of Hwy 101

LENGTH: 1,195 ft

CHANNEL EASEMENT CORRIDOR WIDTH: 101 ft

AVERAGE TOP-OF-BANK WIDTH: 44 ft



(b) Mid Reach 3 at westward bend in channel, bend zone characterized by much deposition along bed and abundant cattail growth. Man on right of photo is standing on 2-4 ft of accumulated sediment on channel bed (May 06, 2008).

MAINTENANCE HISTORY



(a) Upper Reach 3 downstream of Hwy 101 off ramp - looking downstream. Note grouted riprap and steep bank; 12-15 ft channel width at bed, stagnant water with algae (May 06, 2008)

PHYSICAL CONDITIONS

Reach setting: Reach 3 is bound by the large concrete drop structure beneath the Hwy 101 off ramp (upstream) and the hardened culvert crossing at Madison St. (downstream); between these structures the reach is characterized by sediment deposition at the westward channel bend (photo b), cattail growth (photos b, c, d), and large trash items.

Active channel: upper reach 12-15 ft wide bed, narrowing to 8-10 ft wide channel in lower reach, water depth ~ 1 ft. deep, with stagnant backwatering behind 3 dense cattail stands

Bed sediments/texture: some large boulders downstream of drop structure, but mostly medium and fine sands with some fining to sands and silts downstream.

Bank structure: steep armored banks in upper reaches; bank slopes ~ 1:1; (photo a), transitioning to earthen banks in lower reach with broad upper bench (occupied by access road) as seen in the left side of photo d.

Water quality: reach is impacted from stagnant water, algae growth, and large trash items (couches and computer monitors in creek or along banks) (observed 5/06/08).

Channel processes: flows are accelerated through drop structure at upper reach, downstream toward channel bend, flows overtop low flow channel on to northern bank – reducing velocity – and causing deposition within low flow channel (photo b), above the

Washington Creek – Reach 3

crown of northern bank, and on to access road (photo d).

BIOLOGICAL CONDITIONS

Vegetation composition: Vegetation in this reach is primarily ruderal areas along the adjacent uplands and higher banks, and some intermittent riparian woodland along the banks. Channel canopy is not well developed with 0 to 25% canopy closure over the creek. There are also areas of willow scrub and blackberry (along southern bank). Approximately 25% of this reach has emergent wetland vegetation (primarily tule and cattail) located in 3-4 large stands that block the channel.

Riparian corridor and canopy closure: thin and intermittent woodland corridor; canopy closure between 0-25%.

Instream habitat: Reach 3 in lower watershed remains perennial in most years; habitat is limited by generally shallow and stagnant flow through emergent vegetation growth across the channel bottom, lack of canopy, and large drop structure and hardened banks at upper reach.

Listed species with potential to occur: potential habitat for western pond turtle.



(c) mid Reach 3 looking downstream, exemplifies typical reach section with dense cattail stand blocking flow creating a stagnant pool in channel, steep bank to left covered in blackberry, most of bank to right covered in grasses with occasional riparian woodland like oak tree seen to right (May 06, 2008).



(d) lower Reach 3, looking upstream from Madison St., abundant sediment and vegetation shown upstream of crossing causes partial blockage of culvert entrance; in distance access road provides bench and shows evidence of flows exceeding the low-flow channel (May 06, 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

In the fall of 2008 sediment and vegetation were removed from the immediate Madison St. crossing area (area of photo a). SCWA maintenance crews also removed trash from the channel. Maintenance considerations for Reach 3 now focus on removing the accumulated sediment that is collecting at the bend in the channel, downstream of the drop structure (area of photo b). Sediment removal at this location is not extensive or reach-scale, but rather, is smaller and more focused to reduce the accumulated sediment just at the channel bend. The accumulated sediment is causing some flows to exceed the channel and flow out on the adjacent bench where the access road passes. The sediment removal work will incorporate retaining and enhancing the existing geomorphic in-channel features while reducing down the accumulated sediments. Recommended sediment removal at the location shown in photo b can be integrated with additional on-site restoration and planting activities.

Washington Creek – Reaches 2 & 1

JURISDICTION: Owned and maintained by SCWA

LOCATION: Reach 2: Madison St. downstream to Holly Lane
Reach 1: Holly Lane downstream to Petaluma River confluence

ADJACENT LAND USE: Single family residential, toward Petaluma River some parkland along northern bank area

UPSTREAM: Washington Creek Reach 3

LENGTH: Washington 2: 310 ft.
Washington 1: 1,027 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:
Washington 2: 70 ft.
Washington 1: 68 ft.

AVERAGE TOP-OF-BANK WIDTH:
Washington 2: 33 ft.
Washington 1: 44 ft.



(b) Mid Reach 1, man is pointing toward failed culvert outfall that is destabilizing southern bank, sheet-piled flood wall runs along southern bank above failed culvert, on northern banks, grassy access road area provides overbank capacity, with recently deposited sands observed beneath man (May 06, 2008).

MAINTENANCE HISTORY



(a) Reach 2 looking downstream from Madison St. crossing to Holly Lane crossing. Note in channel willow growth and sediment accumulating at downstream end of crossing, hardened banks (May 06, 2008)

PHYSICAL CONDITIONS

Reach setting: Reach 2 is an intermediate short reach between the Madison St. and Holly Ln. crossings, Reach 1 is the lowest section of Washington Creek that meets the Petaluma River. Importantly, Reach 1 experiences tidal flows, Reach 1 is also part of the large USACE Petaluma River flood control project and has large flood walls along its far upper southern bank.

Active channel: upper reach 12-15 ft wide bed, narrowing to 8-10 ft wide channel in mid reach, and then widening again at Petaluma River confluence. Water depth 1-2 ft. deep under low flow conditions, Reach 1 is a wide channel corridor.

Bed sediments/texture: some large cobbles and boulders in upper reach eroded from local riprap, most of channel bed is sand, with sand also deposited on overbank bench (photo b), downstream toward Petaluma River confluence, finer muddy sediments observed in areas experiencing tidal flows.

Bank structure: large channel cross-section, with hardened flood wall along southern edge of channel corridor, inset within corridor, riprap and other hardened culvert outfalls (photo b), northern bank is earthen and more gently sloped (photo b).

Washington Creek – Reaches 2 & 1

Water quality: expected that salinity of lower Reach 1 reflects brackish conditions of fluvial/tidal transition.

Channel processes: estuarine condition where creek flows meet fluctuating tidal base level,

higher streamflows emerging above bank on to northern bench, failed culvert (photo b) causing flow deflection and bank erosion on opposite bank.

BIOLOGICAL CONDITIONS

Vegetation composition: Bank vegetation is primarily ruderal (grasses) along the northern channel margin and bank, and more riparian woodland along the southern channel margin. Channel canopy is not well developed, with 25 to 50% canopy closure over the creek. There are also areas of willow scrub and blackberry (along southern bank). Approximately 10% of this reach has emergent wetland vegetation (primarily tule and cattail) and the lower reach has brackish-tolerant vegetation that sustains under tidal flow conditions.

Riparian corridor and canopy closure: In upper reach, large oaks and riparian woodland vegetation provide some channel canopy closure (up to 50% max).

Instream habitat: Lower Washington Creek is perennial due to its lower watershed setting and its tidal condition at its lower end. Connection to the larger Petaluma River provides habitat corridor to baylands downstream. Crossing at Holly Lane may pose barrier to fish.

Listed species with potential to occur: salmonids are not known from these reaches, but are known from the Petaluma River downstream, potential habitat for western pond turtle.



(c) mid Reach 1 looking downstream, bank erosion next to man caused by flow deflection from failed culvert seen in photo b (May 06, 2008).



(e) lower Reach 1 at confluence of Washington Creek and Petaluma River, flood wall protection of Petaluma River seen in distance above opposite bank (May 06, 2008).



(d) mid Reach 1 looking downstream, channel shows sign of tidal flows, as seen in cut-bench on bank to left – transitional area with vegetation that is brackish tolerant (May 06, 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Reach 1 Washington Creek focus on the immediate priority of repairing the failed culvert outfall noted in photo (b). This failed culvert is causing bank erosion in its immediate location along the southern bank and is also deflecting flows to the northern bank and causing erosion there (photo c). Maintenance of that culvert is likely the responsibility of the USACE as part of their flood management improvements to the reach. SCWA may inquire to USACE as to the status of maintenance or repair of the failed culvert.

East Washington Creek – Reaches 5 & 4

JURISDICTION: Owned by City of Petaluma, SCWA maintenance easement

LOCATION: Reach 5: Downstream of Petaluma Airport (photos a/d) to Garfield Dr.
Reach 4: Garfield Dr. (photos b/c) downstream to Ely Blvd.

ADJACENT LAND USE: Single family residential

UPSTREAM: Culverts beneath airport, headwater slopes further upstream (photo a)

LENGTH: East Washington 5: 589 ft.
East Washington 4: 1,408 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:
East Washington 5: 180 ft.
East Washington 4: 125 ft.

AVERAGE TOP-OF-BANK WIDTH:
East Washington 5: 65 ft.
East Washington 4: 36 ft.



(d) Reach 5 looking downstream to Garfield Dr. (Oct 1, 2007); photo taken after maintenance activities in Sept. 2007 removed accumulated sediment, thinned in-channel vegetation, and excavated low-flow channel.

- (a) Reach 5 looking upstream toward airport (May, 2007) prior to Fall 2007 maintenance central channel occluded with ample willow and blackberry vegetation (compare to photo d)
- (b) Reach 4 looking upstream to Garfield Dr. culvert (May 2007); prior to Fall 2007 maintenance culvert capacity reduced over 50% by deposited sediment (compare to photo e)
- (c) Reach 4 looking downstream from Garfield Dr. (May 2007); prior to Fall 2007 maintenance (compare to photo e)

PHYSICAL CONDITIONS

Reach setting: uppermost engineered reach of E. Washington Creek; reach occupies alluvial fan zone downstream of headwater slopes; reaches occupy a wide channel easement, which is favorable in reducing the flood threat to adjacent structures; historically these reaches have been highly depositional downstream of the airport and Garfield Dr.; the lower reach maintains an open low-flow channel and appears somewhat steeper and less depositional.

East Washington Creek – Reaches 5 & 4

Active channel: following Sept. 07 maintenance activities, low-flow channels excavated to be 4-8 ft. wide and 2-3 ft. deep; low-flow active channels reside within a very wide overall channel easement. Reach 5 and upper Reach 4 are intermittent in most years and run dry in the summer months with isolated pools remaining year round.

Bed sediments/texture: medium and fine sands; vegetation traps sandy sediments.

Bank structure: slopes are earthen, grass covered, and gently sloped in Reach 5 and upper Reach 4 (< 3:1) (photos d/e); in lower Reach 4 banks steepen and heighten (photo f).

Water quality: upper reaches are largely ephemeral; more intermittent/perennial flows begin in lower Reach 4, beside sediment accumulation in upper reaches, no other water quality issues observed, most of watershed upstream of reaches and airport is undeveloped.

Channel processes: Reach 5 below airport and upper Reach 4 below Garfield Dr. are highly depositional, Sept. 2007 maintenance activities addressed the past sediment accumulation (photos d/e); more open channel environment persists toward Ely Rd. crossing without as much deposition.

BIOLOGICAL CONDITIONS

Instream habitat: Aquatic habitat is limited due to ephemeral nature of flows, but excavated low-flow channel aids in collecting flows into channel rather than previous condition of shallow diffuse flows across deposited sediment. Lower Reach 4 with a more defined channel (4-6 ft wide and 1-2 ft deep) provides some run potential (photo f).

Vegetation composition: Vegetation includes areas of riparian woodland on the outer banks with no canopy closure over the creek and small stretches of riparian woodland along the creek with 25-75% canopy closure. The upper reach is dominated by willow scrub and ruderal vegetation occurs along the banks. Prior to the Sept. 07 maintenance, approximately 50% of the channel was filled with emergent plants (cattail and tule) that partially or fully blocked water flow. That degree of coverage is far less now following the 2007 maintenance (photos d/e).

Riparian corridor and canopy closure: 5-15 ft. wide corridor on each bank; canopy closure between 25%-50%

Listed species with potential to occur: limited potential for listed amphibians and/or fish during the dry season when maintenance is likely to occur due to dry channel conditions. Potential habitat for western pond turtle.



(e) Reach 4 looking upstream to Garfield Dr. (9/28/07); photo taken after maintenance activities in Sept. 2007 removed accumulated sediment from culvert and channel, thinned in-channel vegetation, and excavated low-flow channel. Note channel sinuosity and preserved riparian trees following maintenance activities.

East Washington Creek – Reaches 5 & 4



(f) Lower Reach 4 looking upstream from Ely Blvd. (May, 2007); open low flow channel emerges in lower reach; channel slope appears to steepen toward Ely Blvd. crossing; reaches 5 and 4 both have wide easements.

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for East Washington Creek, Reaches 5 and 4 focus on monitoring the channel sections that underwent sediment removal, vegetation thinning, low-flow channel formation, and culvert clearing in Sept. 2007. Understanding the rate of willow colonization and re-growth, as well as sediment accumulation following the past maintenance work will help SCWA managers forecast future maintenance needs better. As of Fall 2008, the maintenance work conducted in Fall 2007 still looks very good and the channels are in good working condition. In general, the very wide easement provided in Reaches 5 and 4 presents an opportunity to enhance the corridor through other channel restoration efforts including additional tree plantings and shading on the higher banks.

East Washington Creek – Reaches 3, 2 & 1

JURISDICTION: Reaches 3-2: SCWA owned and maintained channel

Reach 1: Owned by City of Petaluma, SCWA maintenance easement

LOCATION: Ely Blvd. downstream to Washington Cr. confluence

ADJACENT LAND USE: Single family residential (Reaches 3, 2) and multi-family residential in lower Reach 2 and 1

UPSTREAM: East Washington Creek 4

LENGTH: East Washington 3: 1,379 ft.

East Washington 2: 1,183 ft.

East Washington 1: 1,153 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:

East Washington 3: 58 ft.

East Washington 2: 65 ft.

East Washington 1: 79 ft.

AVERAGE TOP-OF-BANK WIDTH:

East Washington 3: 30 ft.

East Washington 2: 32 ft.

East Washington 1: 40 ft.



(b) Reach 3 looking upstream; note steep banks undercut at base provides potential for bank slumping and failure, sequences of cattails and sediment bars, overall narrow easement and close proximity to homes and backyards (Jan. 2007)

MAINTENANCE HISTORY

Bank erosion was repaired in Fall 2006 near location of photo (b), repair work was permitted through 2006 interim agreements, site work occurred on non-jurisdictional waters above OHW. Vegetation removal work at Maria Drive (photo d) occurred in 2005.



(a) looking downstream from Ely Blvd.; note armored banks, steeper trapezoidal channel, and much narrower easement width than Reach 4 upstream (Jan. 2007).

PHYSICAL CONDITIONS

Reach setting: broad and gentle sloping cross-section of Reach 4 upstream changes dramatically at Ely Blvd. crossing where Reach 3 becomes a very linear and narrow trapezoidal channel (photo b); deposition near Maria Dr. crossing has reduced and filled the channel cross section (photo d)

Active channel: 6-8 ft wide, 1-2 ft deep; constricted by sediment wedges and cattails (photos b, c); or significant deposition of fines further downstream (photo d); Reaches 1, 2, and 3 are perennial though flows diminish into summer/fall

Bed sediments/texture: medium and fine sands upstream fining to silts and mud downstream;

Bank structure: steep armored and earthen slopes in upper reaches; bank slopes ~ 1:1; (photos a, b); Reach 2 banks lessen in height and steepness (photo d)

Water quality: lower reaches impacted from stagnant water, high in-channel sedimentation and turbidity (observed 1/12/07).

East Washington Creek – Reaches 3, 2 & 1

Channel processes: linear channel alignment creates mostly a straight run with some blockage from a sequence of depositional bars in Reach 3; deposition of fines increases downstream until more blockage and

aggradation occurs (photo d). Steep banks with little strengthening vegetation that are undercut by creek flows at base have potential to slump and erode into creek

BIOLOGICAL CONDITIONS

Vegetation composition: Vegetation in this reach is primarily ruderal areas along the creek banks, and riparian woodland that ranges from 0 to 50% canopy closure over the creek. There are also some small areas of willow scrub. Approximately 35% of this reach has emergent wetland vegetation (primarily tule and cattail) blocking the channel

Riparian corridor and canopy closure: 5-15 ft wide corridor on each bank; canopy closure between 25%-50%.

Instream habitat: Reaches 1, 2, and 3 remain perennial in most years; habitat is limited by generally shallow flow through emergent vegetation growth across the channel bottom and by lack of canopy.

Listed species with potential to occur: potential habitat for western pond turtle.



(c) mid Reach 2 looking upstream from McGregor Ave. note steep banks beneath access road and in-channel sediment and vegetation; in terms of depth and height of banks, mid Reach 2 is transitional between the deeper channel upstream (photo b) and the shallower channel downstream (photo d) (May 2007).



(d) lower Reach 2, looking downstream from Maria Dr.; channel cross section shallowed and filled from abundant deposition; finer sediments (sands, silts, mud) accumulate here compared to coarser sediments upstream; cattails and other vegetation recently cut, but stalks show return (Jan. 2007)

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for East Washington Creek Reaches 1, 2, and 3 focus on sediment management in lower Reach 2 and Reach 1 (photo d). These reaches are historically depositional due to the lessening of channel slope moving downstream along the Petaluma Plain toward the Washington Creek confluence and the Petaluma Valley floor. Other considerations include the potential for bank slumping in Reach 3 where steep, relatively unvegetated banks, are weakened and undercut by the stream below. Where banks have slumped in Reach 3 they have been recontoured and strengthened using bio-engineered stabilization approaches. Additional opportunities for bank strengthening through planting appropriate bank vegetation exist, as well as top of bank tree plantings to improve shading. Vegetation management includes removal of cattails and other in-channel persistent growth in lower Reach 2 and Reach 1. In general, Reaches 1, 2, and 3 are far more constrained due to their very narrow easement width compared to Reaches 4 and 5 upstream and have fewer opportunities for corridor enhancement than do upstream reaches.

Lynch Creek – Reach 1

JURISDICTION: City of Petaluma owned, SCWA maintenance easement

LOCATION: Highway 101 to Petaluma River confluence

ADJACENT LAND USE: Single family residential to south and open space to north

UPSTREAM: Non-SCWA maintained reach of Lynch Cr.

LENGTH: 1,277 ft

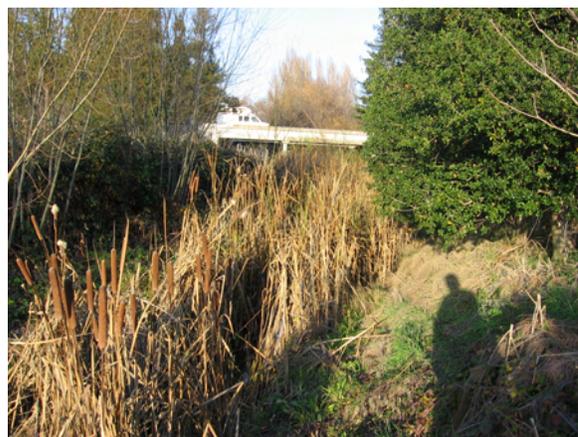
CHANNEL EASEMENT CORRIDOR WIDTH: 132 ft

AVERAGE TOP-OF-BANK WIDTH: 51 ft



(b) Stagnant water between areas of in-channel vegetation growth. Mid-reach, looking upstream (October 26, 2008).

MAINTENANCE HISTORY



(a) Lynch Cr. Reach 1, upper reach looking upstream to Hwy 101 crossing; abundant cattail growth blocks channel bed; steep banks and relatively deep channel (Jan. 8, 2009).

PHYSICAL CONDITIONS

Reach setting: Similar to Washington, Corona, and Lichau creeks, Lynch Cr. drains Sonoma Mtn. westward toward the Petaluma River; Reach 1 is the lowermost stream reach, just above the Petaluma River confluence.

Active channel: active channel bed is 12-20 ft wide, 12-16 ft. below top of banks.

Bed sediments/texture: silts and mud are deposited among cattail stands downstream of Hwy (photo a); but reach includes sands too and some pebbles and coarser sediments mixed with sloughing riprap at Petaluma River confluence (photo d).

Bank structure: banks are earthen and generally steep (1.5:1 – 2:1) with trapezoidal form; bank heights of 12-16 ft.

Water quality: water moves slowly; stagnant pools form between areas of in-channel vegetation growth (photos a, b, c)

Channel processes: Reach 1 is a straight connecting reach to the Petaluma River confluence; channel profile is governed by hardened drop structure at Petaluma River confluence (photo d) which maintains a gentle gradient upstream through the reach, resulting in deposited sediments and cattail growth through reach (photos a/b).

Lynch Creek – Reach 1

BIOLOGICAL CONDITIONS

Vegetation composition: bank vegetation is primarily ruderal (grasses) along the northern bank and mixed riparian scrub (willow scrub and blackberry) along the southern bank and in some channel locations. Emergent wetland vegetation, primarily cattails, covers approximately 75% of the in-channel area.

Riparian corridor and canopy closure: Willow and mixed riparian scrub provide a 15-20% cover along the reach, increasing near the upstream Hwy 101 crossing (photo a).

Instream habitat: high drop structure at Petaluma River (photo d) controls connectivity to the River either during higher tide stages or otherwise higher river stages; instream habitats are limited by several cattail thickets which block flows.

Listed species with potential to occur: Reach is a migratory corridor for steelhead, potential habitat for western pond turtle.



(c) Rip-rapped and grouted confluence with Petaluma River (October 26, 2008).



(d) Looking downstream at banks and canopy cover near upstream end of reach (October 26, 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Lynch Cr. Reach 1 focus on vegetation and sediment removal downstream of the Hwy 101 crossing where a thick and tall cattail stand has developed (photo a). Additional cattail and sediment removal may be warranted further downstream. Opportunities to plant riparian trees along the southern bank that would mature and provide increased canopy closure should be evaluated in combination with any vegetation and sediment removal project.



Vegetation Type

- Blackberry Scrub
- Mixed Riparian Scrub
- Riparian Woodland (full canopy)
- Riparian Woodland (up to 75% canopy)
- Riparian Woodland (up to 25% canopy)

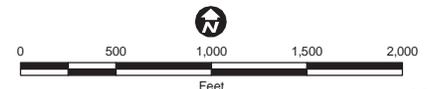
- Riparian Forest
- Ruderal
- Willow Scrub
- Developed

SMP Maintenance Reaches

Sources:
Sonoma County Water Agency
County of Sonoma
AirPhotoUSA, 2005

FIGURE 4-46

Reaches and Vegetation Zone 2A (4 of 5)



1 inch equals 1,000 feet

McDowell Creek – Reaches 2 & 1

JURISDICTION: Owned and maintained by SCWA

LOCATION: Reach 2: Caulfield Lane to Lakeville Hwy
Reach 1: Lakeville Hwy to ~250 ft downstream

ADJACENT LAND USE: Reach 2: Residential on east and Hwy 101 on west
Reach 1: Parking lot on east and field on west

UPSTREAM: McDowell 3- underground conduit

LENGTH: McDowell 2: 2,051 ft.
McDowell 1: 525 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:
McDowell 2: 54 ft.
McDowell 1: 112 ft.

AVERAGE TOP-OF-BANK WIDTH: McDowell 2: 61 ft.
McDowell 1: 71 ft.



(b) Mid Reach 2 looking upstream. The active channel is distinguished by the green band of rushes, sedges, and grasses. There was shallow surface water flowing through the dense emergent vegetation in this section of the reach (Aug 2008).

MAINTENANCE HISTORY



(a) Top of Reach 2, looking downstream. The concrete beam in the foreground is the top of the culvert system that marks the beginning of "daylighted" McDowell Cr. Channel is straight and confined between an access road on east side and Hwy 101 on the west side (Aug, 2008).

PHYSICAL CONDITIONS

Reach setting: McDowell Cr. appears to have a limited watershed with most surface flow coming from localized urban runoff from the immediate surrounding areas; Reach 2 is not tidally influenced due to tide gates downstream of Lakeville Hwy, while Reach 1 is strongly tidal and hydraulically connected to the Petaluma River throughout the year.

Active channel: 2-8 ft wide through Reach 2 with wider sections in the upper reach and below the East Fork confluence, and narrower sections in the middle reach; channel depth 4-6 ft., below banks; flow depths ranging from 2-4" along vegetated portions and 6-18" in open areas. Reach 1 active channel is ~20 ft wide with water depth depending on tides.

Bed sediments/texture: Silt and fine muds dominate the bed in both reaches.

Bank structure: In Reach 2 slopes are generally between 2:1 or 1:1, 4-6 ft.; banks are earthen with riprap support (photo b). In Reach 1 the banks are closer to 3:1 or 4:1 with soil over riprap (photo d).

Channel processes: This channel has been straightened in both reaches and maintains a trapezoidal geometry. Reach 2 contains a common pattern of longer runs dominated by shallow diffuse flow, punctuated by smaller

McDowell Creek – Reaches 2 & 1

pools that are clear of emergent vegetation. Reach 2 appears to be aggrading with small bars visible at bends and wedges, visible where emergent vegetation covers the channel.

Water quality (qualitative): either green and turbid (runs) or covered with algae (pools).

BIOLOGICAL CONDITIONS

Instream habitat: Habitat for fish is limited by the dominance of shallow dry season flows; degraded water quality, lack of habitat complexity and a lack of a physical connection to the Petaluma River and marsh due to tide gates at Reach 1 (photo d). Reach 2 does maintain some aquatic habitat that could be used by amphibians, there is no deep water refuge and the channel contains almost no complexity. Reach 1 habitat is more similar to a tidal slough than a fluvial system and likely supports an assemblage of warm water fish and other aquatic species known from the Petaluma River.

Vegetation composition: The reaches support a very narrow and sparse riparian corridor along the upper 500 ft of Reach 2 consisting of a mix of shrubs (coyote brush, etc) and coast live oaks, liquid amber, and arroyo willow (photos a and b). Most of the riparian corridor and channel is dominated by herbaceous species with rushes, sedges, curly doc, and hairy willow herb in the channel and fennel, teasel, annual grasses and an array of other weedy species along the upper banks and beyond (photo b and c).

Riparian corridor and canopy closure: very limited canopy closure ranging from 0% (photos c and d), which is the dominant situation to 25-50% in the upper portions of Reach 2 (photo a).

Listed species with potential to occur: salmonids are not known from these reaches, but juvenile steelhead could be found in Reach 1, potential habitat for western pond turtle.



(c) Reach 2 downstream of the confluence with the East Fork of McDowell Cr, looking downstream. Active channel is distinguished by the green tules, sedges, and grasses. This part of the Reach supported shallow surface water in August 2008, which was diffused through the dense vegetation.



(d) Reach 1 looking downstream from above the tide gates. Channel form and vegetation in this reach reflects tidal processes and is much different than the upstream channel forms which are protected from tidal action by the tide gates. SCWA ordinarily does not perform maintenance activities in the area subject to tides below the tide gates (Aug 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for McDowell Creek Reach 2 and 1 focus on Reach 2 due to the historically limited management by SCWA in the tidally influenced Reach 1. In Reach 2 future management will likely include vegetation and/or sediment removal at key deposits and sediment wedges to increase channel capacity (if capacity is compromised). Sediment deposits in Reach 2 should be evaluated for their potential removal. Reach 2 would also be a good candidate reach for canopy enhancement as there is virtually no canopy along most of the reach.

East Fork McDowell Creek – Reach 1

JURISDICTION: Owned in-fee and maintained by SCWA

LOCATION: St Francis Dr. to McDowell Creek confluence

ADJACENT LAND USE: 75% Residential with a vacant field occupying 25% along the lower southern side of the channel

UPSTREAM: Series of Storm Drains

LENGTH: 1,311 ft

CHANNEL EASEMENT CORRIDOR WIDTH: 73 ft

AVERAGE TOP-OF-BANK WIDTH: 34 ft



(b) Middle of East Fork Reach 1 looking across the channel. This was just one of a few storm drain outfalls entering the channel from both sides. Most of the outfalls are surrounded by sacrete or grouted rip-rap (Aug 2008).

MAINTENANCE HISTORY



(a) East Fork looking downstream from pipe at the top of Reach 1 near St. Francis Dr. This pipe is the conduit for all flows into the reach and appears to be 60" in diameter. Note the dense vegetation all around the pipe outlet. In August 2008, a steady trickle of water was coming from the pipe and feeding the downstream channel,

PHYSICAL CONDITIONS

Reach setting: East Fork Reach 1 is a tributary to McDowell Creek. The East Fork drains runoff from the residential neighborhood upstream to the north/east, but does not drain a large watershed; East Fork, Reach 1 has its confluence with McDowell Cr. in the lower portion of McDowell Cr. Reach 2, which then drains south toward McDowell Reach 1 and the Petaluma River marsh.

Active channel: 10 ft wide, 6-8 ft. deep below banks, with flow depths ranging from 6- 12". (photos c and d).

Bed sediments/texture: dominated by a mix of gravel, sand, and silt.

Bank structure: bank slopes are generally between 2:1 or 1:1 with rip-rap and/or soil; sacrete and grouted rip-rap are found around the primary culvert outfall (photo a) as well as a number of secondary outfalls (photo b) and at the confluence.

Channel processes: this channel has been straightened and is not connected to any headwater lands, but rather drains the local developed watershed. Channel appears to be aggrading in some areas with in-channel gravel bars (photo c) and a depositional

East Fork McDowell Creek – Reach 1

wedge just above the McDowell Cr. confluence.

Water quality (qualitative): degraded with a strong brown coloration (photo d) and multiple algae clumps.

BIOLOGICAL CONDITIONS

Instream habitat: Habitat in this reach is limited by the dominance of shallow, uniform runs broken up by occasional mid-channel bars. Most of the channel has maintained its shallow flat trapezoidal geometry which leads to a lack of complexity in the channel; however the mid-channel bar and some undercut banks create some habitat complexity. Should be noted that the lower reaches (photo d) where flows were wider and deeper were teeming with *Gambusia* and other warm water fish.

Vegetation composition: The reaches support a narrow, but dense riparian corridor along most of its length, which is dominated by oaks along the banks (photo b and d). There are very few willow or alders along the toe of slope and understory is dominated by ivy, fennel and grasses with some tules in the channel at breaks in the canopy (photo b and d).

Riparian corridor and canopy closure: 10-15 ft. wide corridor on each bank with canopy closure ranging from 0-50% with about half the channel nearing 50% closure.

Listed species with potential to occur: salmonids are not known from this reach and occurrence is highly unlikely due to lack of spawning or rearing habitat upstream and the presence of tide gates downstream; potential habitat for western pond turtle.



(c) Middle of East Fork Reach 1 looking downstream at a small mid-channel gravel bar. Three small bars, including this one, were observed along the Reach 1 during surveys in August 2008.



(d) Lower East Fork Reach 1 just upstream from the confluence with McDowell Creek Reach 2. Note both the wide flat channel and amount of water in the channel. The lower portion of the East Fork appears to be controlled by the sediment wedge at the confluence with McDowell Cr. which seems to be backing-up water from the East Fork (Aug. 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for the East Fork of McDowell Creek focused on removal of sediment and emergent vegetation at the top of the channel directly downstream from the 60" culvert (primary outfall) and removing sediment at the confluence with McDowell Cr. where the sediment wedge appears to be causing backwatering. The numerous culvert outfalls entering the East Fork from adjoining residential areas should be checked regularly and maintained as necessary. Additional canopy planting at the upper end and lower end of the reach could increase the habitat viability for riparian species.

Adobe Creek – Reaches 4 & 3

JURISDICTION: Reach 4: Owned in-fee and maintained by SCWA. Reach 3: Owned by City of Petaluma, maintained through easement agreement by SCWA

LOCATION: Reach 4: ~250 ft upstream Calle Ranchero to Sartori Dr.
Reach 3: Sartori Dr to Lakeville Hwy.

ADJACENT LAND USE: Reach 4: Residential and Park
Reach 3: Residential

UPSTREAM: Adobe Creek Watershed

LENGTH: Adobe 4: 1,062 ft.
Adobe 3: 781 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:

Adobe 4: 125 ft.

Adobe 3: 114 ft.

AVERAGE TOP-OF-BANK WIDTH: Adobe 4: 77 ft.

Adobe 3: 54 ft.



(b) Looking downstream approximately 500 ft from the top of Reach 4. Although most of both Reach 4 and 3 are dry, both reaches support a handful of pools, this being the longest (approx 50 ft long) and deepest (max 3 ft). Three foothill yellow legged frogs were observed in this pool on 07/03/08. Just downstream the channel goes dry again.

MAINTENANCE HISTORY



(a) Top of Reach 4 looking downstream into the area where SCWA's maintenance easement begins (after the bend). Stream bed comprised of gravel, cobbles, coarse sand. Channel is dry with shallow subsurface flows likely. Bedrock outcrop observed to left (07/03/08).

PHYSICAL CONDITIONS

Reach setting: Adobe Creek is perhaps the most ecologically intact watershed in Zone 2A. Upstream of Reach 4 at the Adobe Cr Golf Course the channel transitions from steep rocky topography into an alluvial fan; Reaches 4 and 3 represent the transition from the alluvial fan into the flatter alluvial plain; downstream Reach 2 transitions from a fluvial dominated system to a tidal system.

Active channel: 8-10 ft wide through both reaches with a narrower low flow channel 2-4 ft wide, channel 2-5 ft. deep; water depths ranging from 0-3 ft (photos a and b) with multiple dry sections and a few pools; largest pool is in Reach 4 (photo b).

Bed sediments/texture: coarse gravel bed stream with cobbles and sand matrix (photo a), fining to a mix of pebbles, gravels and coarse sand in Reach 3 (photos c and d);

Bank structure: banks are generally earthen at ~ 2:1 slopes with a mix of toe-of-slope bars forming intermittently; mild channel erosion undercuts banks in some locations (photo b).

Channel processes: Channel receives flows from headwater lands that are undeveloped and have intact riparian corridor; these reaches are dominated by coarse material with little deposition of fines. Reaches 4 and 3

Adobe Creek – Reaches 4 & 3

show limited signs of bank stability or problematic sediment aggradation.

Water quality (qualitative): Channel was dry in many places, pools and other surface waters do not appear stagnant in August 2008.

BIOLOGICAL CONDITIONS

Instream habitat: Instream habitat in Reach 4 displays a high degree of complexity with pools, undercut banks, root wads, riffles, and proper size salmonid spawning gravels at a few locations. The channel becomes straighter and more uniform downstream into Reach 3 (photo d). Large pool in upper Reach 4 supports adult FYLF as well as possible juvenile steelhead (observation not confirmed). Smaller pools in Reach 4 contained significant numbers of pacific tree frog tadpoles, warm water fish, etc.

Vegetation composition: Both reaches support a narrow, but dense riparian corridor stretching from the toe-of-bank to above the top-of-bank; vegetation ranges from willows and alders along the toe of slope to oaks and maples further up the bank (photos a and d); in areas where the canopy is broken (photo c) grasses, sedges, and cattails are found along the toe-of-bank and into the dry channel bed.

Riparian corridor and canopy closure: 10-20 ft. wide corridor on each bank with canopy closure ranging from 50%-75% in Reach 4 and 0%-50% in Reach 3; in reach 3 the right bank (looking downstream) becomes void of riparian cover as you move downstream.

Listed species with potential to occur: Steelhead are known from these reaches with over summering pools in Reach 4 and perhaps some possible spawning and rearing in Reach 4 (though better spawning habitat is further upstream); adult FYLF were observed in the large pool in Reach 4 during site visit in Aug 2008, Reach 3 is potential FYLF habitat. Both reaches are potential habitat for California red-legged frog and western pond turtle.



(c) Lower Adobe Cr. Reach 4 looking downstream at Sartori Bridge and into upper Reach 3. Coarse gravel and cobbles are seen along the drier low flow channel upstream of the bridge, downstream of the bridge a large mass of cattails and willows are observed (background) (07/03/08).



(d) Adobe Cr. Reach 3 looking upstream from the Lakeville Hwy bridge. About 200 ft upstream of Lakeville Hwy the channel transitions from a gravel and cobble dominated system to a sand dominated system. Note the uniform wide, flat, bed at the bottom of reach (07/03/08).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Adobe Creek Reach 4 and 3 focus on improving habitat conditions for steelhead and FYLF. Additional canopy development along sections of Reach 3 could make this reach more hospitable for aquatic and riparian species as well. In mid Reach 4, mid channel depositional bars are observed to be collecting sediment and have substantial vegetation growth on them in the mid-channel location. These mid-channel bars have been graded in the past, and may require additional sediment removal and vegetation removal in the future. The incising sections of Reach 4 further upstream that are undercutting banks and exposing roots are not so severe as to warrant treatment at this time. It should be noted that base of bank depositional bars along Reach 4 and to a lesser degree

Adobe Creek – Reaches 4 & 3

Reach 3 may be reducing some channel capacity and/or impairing flow from drainage outfalls. If this issue continues, these bars may need to be reduced. Although photo a shows an eroding bank, this bank is upstream of SCWA's ownership/easement and chronic bank erosion was not noted from other sites within these reaches. Importantly, neither the Sartori Crossing nor the Lakeville Crossing appear to be heavily impaired by sediment during site visits in August and December 2008.

Adobe Creek – Reaches 2 & 1

JURISDICTION: Owned by City of Petaluma-
SCWA has maintenance
easement

LOCATION: Reach 2: Lakeville Hwy. to
South McDowell Blvd.
Reach 1: South McDowell Blvd.
to upper edge of salt marsh
plain

ADJACENT LAND USE: commercial / office parks

UPSTREAM: Adobe 3

LENGTH: Adobe 2: 797 ft.
Adobe 1: 1,513 ft.

CHANNEL EASEMENT CORRIDOR WIDTH:
Adobe 2: 140 ft.
Adobe 1: 157 ft.

AVERAGE TOP-OF-BANK WIDTH: Adobe 2: 97 ft.
Adobe 1: 116 ft.



(b) Mid Reach 2 - on the sandy, heavily vegetated bench/bar adjacent to the active channel. Debris lines mark past high water events; dense willow thicket provides good canopy but also presents flow obstructions; more fine sediment here than upstream reaches, but still pockets of gravels and coarse material. Reach 2 instream sediment basin is just downstream of this photo (Aug 2008).

MAINTENANCE HISTORY



(a) Mid Reach 2, looking upstream: Low flow channel is dry, with evidence of recent flow or shallow subsurface flow present with dark, wet, muds in lower pools; Higher depositional bench seen to left in photo with abundant vegetation growth (Aug 2008).

PHYSICAL CONDITIONS

Reach setting: Reach 2 and 1 continue the progression from a fluvial dominated system to a fluvial/estuarine system. Reach 2 includes an instream sediment basin and sediment removal area, just upstream of S. McDowell Blvd. Reach 1 extends to the Petaluma River Marsh, just beyond which the channel drains into the wide flat marsh plain. These lower Adobe Cr. reaches are low gradient depositional environments.

Active channel: 10-12 ft wide, when there is only a single channel in Reach 2 (photo a), lower Reach 2 and Reach 1 both contain multiple channels morphology (photos b/c); only a few isolated pools of shallow (1-2") standing water were observed in August 2008.

Bed sediments/texture: Reach 2 – mostly sand/silt with occasional gravel lens, fining downstream; Reach 1 – sand and silt, and organic matter.

Bank structure: slopes are generally earthen, 2:1 and often gentler at 3:1 or less. There may be rip-rap below the soil, but it was not exposed.

Channel processes: From Reach 2 to Reach 1 the channel transitions from fluvial dominated to tidally dominated; the channel is approximately 60ft wide from toe to toe and resembles a backwater swamp with braided

Adobe Creek – Reaches 2 & 1

channels, multiple 2-3 ft high bars, and dense willows and organic matter covering the bar surfaces. Unlike Reaches 4 and 3 upstream, these reaches appear to be actively

aggrading with significant sediment deposits and bars formed throughout both reaches.

Water quality (qualitative): There was very little surface water present in August 2008.

BIOLOGICAL CONDITIONS

Instream habitat: Aquatic habitat in these reaches was limited to a few shallow, isolated pools during field surveys in August 2008. During dry season the dense leaf litter and shade likely provide habitat for a wide suite of riparian and wetland species. During the rainy season, these reaches are key migration corridors for steelhead as they migrate upstream to spawning habitat in the upper watershed. The dense riparian canopy also provides habitat for a wealth of birds and other riparian species.

Vegetation composition: The reaches support an active bench-floodplain approximately 40-60 ft wide, stretching from the toe of one bank to the toe of the other bank. This bench-floodplain is dominated by an even age stand of willows with an understory of rushes, sedges, and a number of wetland obligate herbs. There were also a few stands of ludwigia observed in Reach 1 in August 2008.

Riparian corridor and canopy closure: 60-75 ft wide corridor from top of bank to top of bank with a dense bench-floodplain between the banks; canopy closure ranges from 50%-100% with most areas falling within the 50%-75% range.

Listed species with potential to occur: steelhead are known to migrate through this reach, but no rearing or spawning habitat exists; both reaches are potential habitat for California red-legged frog and western pond turtle; salt marsh harvest mice, clapper rail, and a number of other marsh species are known from locations nearby Reach 1.



(c) Lower Adobe Cr. Reach 1 looking upstream: channel is recently dried and the substrate is dominated by mud and organic matter. The depositional bench/bar to left in photo extends 50 feet (off photo) and is regularly inundated by riverine and estuarine flows (Aug 2008).



(d) Lower Adobe Cr Reach 1 looking upstream from below SCWA easement. SCWA's easement appears to extend to the edge of the willows in the background. The channel in the foreground, packed with cattails, is within the marshland complex adjacent to the Petaluma River (Aug 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Management considerations for Adobe Creek Reaches 2 and 1 focus on sediment removal at the instream sediment removal basin at the lower end of Reach 2, upstream of S. McDowell Blvd. Sediment removal at the basin was initiated during September 2008 and will continue in the summer 2009 maintenance season. In addition to sediment removal, many of the willow thickets that grow on the sediment deposits will also be thinned and removed. According to SCWA, they generally do not maintain Reach 1 below the drop structure downstream of S. McDowell Blvd. due to its proximity to the Petaluma Marsh, the wide cross-section, tidal influence, and lack of infrastructure downstream.



Vegetation Type

- Blackberry Scrub
- Mixed Riparian Scrub
- Riparian Woodland (full canopy)
- Riparian Woodland (up to 75% canopy)
- Riparian Woodland (up to 25% canopy)
- Riparian Forest
- Ruderal
- Willow Scrub
- Developed
- SMP Maintenance Reaches

Sources:
 Sonoma County Water Agency
 County of Sonoma
 AirPhotoUSA, 2005

FIGURE 4-47

Reaches and Vegetation Zone 2A (5 of 5)



1 inch equals 1,000 feet

Thompson Creek – Reach 1

JURISDICTION: Owned by the City of Petaluma, SCWA maintenance agreement

LOCATION: Westridge Drive downstream to Sunnyslope Road

ADJACENT LAND USE: Public parkway and single family residential

UPSTREAM: non-maintained Thompson Cr. headwaters

LENGTH: 1,856 ft

CHANNEL EASEMENT CORRIDOR WIDTH: 94 ft

AVERAGE TOP-OF-BANK WIDTH: 44 ft



(b) Upper Reach 1, downstream of photo (a); actively eroding bank seen with 5 ft. vertical face; this section of upper reach is steeper than the middle and lower reach sections downstream (Dec. 16, 2008).

MAINTENANCE HISTORY



(a) Thompson Cr. Reach 1, looking downstream from below Westridge Dr. Wide channel easement along parkway, gentle sloping banks, channel includes emergent cattails and willow vegetation (Dec. 16, 2008).

PHYSICAL CONDITIONS

Reach setting: Thompson Cr. is a north-flowing tributary of the Petaluma River, draining a relatively small watershed; Reach 1 collects runoff from the residential neighborhood immediately upstream (via culvert) and the immediately adjacent neighborhoods (Figure 4-47); further upstream the watershed is undeveloped; moving downstream the watershed is entirely developed.

Active channel: Reach 1 has a very wide corridor parkway easement (photos a/c); active channel within wide cross-section is relatively small, widths ranging from 2-8 ft. and generally 3-4 ft deep, with flow depths of 6-18 in; channel profile is noticeably steeper in upper reach than lower reach

Bed sediments/texture: mostly medium and fine sands, with some fines collecting in slow moving zones where cattails have developed downstream; sloughing riprap contributes cobbles near Sunnyslope crossing.

Bank structure: earthen slopes are very gentle (3:1 or greater, photo a); streambank at erosion spot of photo b is comprised of mostly clay with some sand and appears cohesive.

Water quality: generally clear and slow current observed (Oct. and Dec. 2008); stagnant water and algae growth between areas of emergent vegetation in lower reach.

Thompson Creek – Reach 1

Channel processes: upper Reach 1 is a steeper reach that shows some higher velocity conditions (including bank erosion, photo b); channel slope lessens in the mid reach zone

and the channel becomes more depositional, including pooling behind cattail blocks toward its lower end.

BIOLOGICAL CONDITIONS

Vegetation composition: the reach supports a narrow riparian corridor along most of the length, which is predominantly willows and oaks (photos c/d). The upper banks are mostly parkland grasses, with more scrub/ruderal grasses nearer to the channel (photo a); channel has sections of extensive blackberry growth in the mid reach (photo c), with some limited areas with blackberry growth (photo b). Emergent wetland vegetation is limited, though covering approximately 20% of the in-channel area in discrete blocks throughout the reach.

Riparian corridor and canopy closure: 10-15 ft. narrow corridor on each bank with canopy closure ranging from 15-20% through most of the reach and increasing to 75% at the far upper and lower ends of the reach.

Instream habitat: Culvert draining Thompson Cr. to the upper reach disconnects open stream to its headwater areas upstream; within reach, instream habitats include steeper channel chutes in the upper reach, and then more of a pool/run sequence in the mid and lower reach with pools being defined by cattail blocks.

Listed species with potential to occur: Potential habitat for California red-legged frog and western pond turtle.



(c) Mid Reach 1, looking downstream; central reach area has wide easement with gently sloping banks; active low flow channel is relatively narrow here (3-4 ft and 2-3 ft deep) with adjacent banks covered in blackberry (Dec. 16, 2008).



(d) Lower Reach 1, 500 ft upstream of Sunnyslope Rd.; channel is 4-6 ft. wide and 2-3 ft. deep; blackberry persists along with sections of dense cattails. Willows and other trees provide riparian canopy along the immediate channel zone (Dec. 16, 2008).

MANAGEMENT CONSIDERATIONS AND OPPORTUNITIES

Flood management considerations at Thompson Cr. Reach 1 do not appear critical at the time of the channel assessment. The wide parkway easement provides a wide corridor with gently sloping banks that appears to accommodate stormflows from this smaller watershed. The culvert crossing downstream at Sunnyslope Rd. is not currently impacted by sediment accumulation, but should be assessed annually for potential build up of sediments. In the upper reach there is one 50 ft. section of eroded bank (photo b). This bank erosion does not appear to present a flooding concern, but SCWA may want to monitor this erosion for additional bank retreat. Additionally, because this is a park area, the bank erosion presents a vertical 5+ ft. face that may pose a danger for park users. Vegetation management of reach may focus on blackberry removal in the mid reach locations (photo c) and also removal of cattail stands which are trapping sediment. These cattail stands occur as discrete 15-30 ft. sections throughout the reach.