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Using Compost to Improve Post-fire Water Quality

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University of California, Riverside

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Acknowledgements

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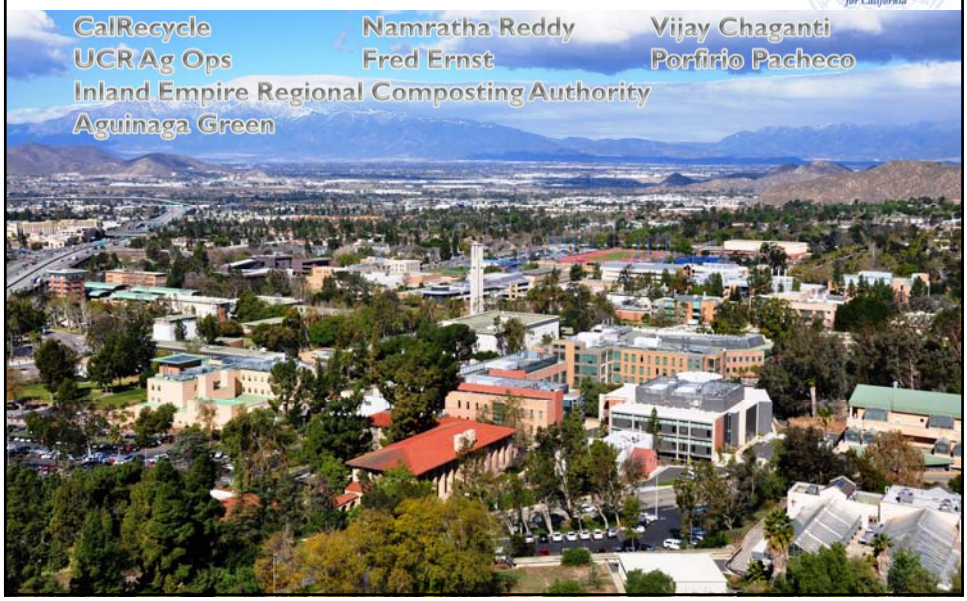

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Freeway Complex Fire, Nov. 2008

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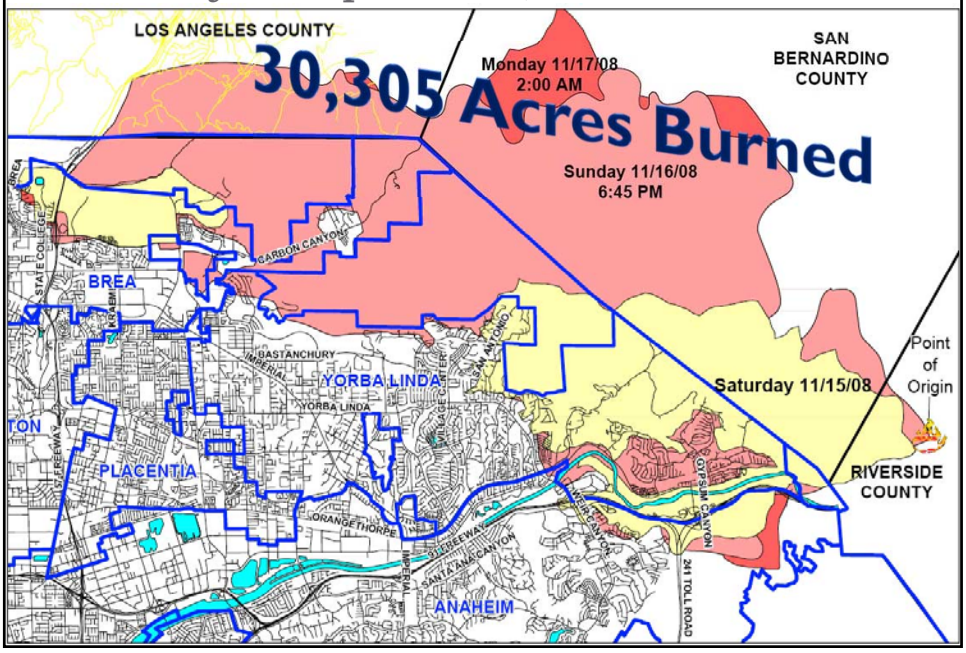
Freeway Complex Fire, Nov. 2008



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Freeway Complex Fire, Nov. 2008

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K-rail

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Facing slopes in Temecula, CA

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Experimental Site

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Controlled burn – Summer 2009

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Controlled burn

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After the burn

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Riverside Station 1 Fire Crew

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Installed Slope
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Collection Basin
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Bins

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Maintenance
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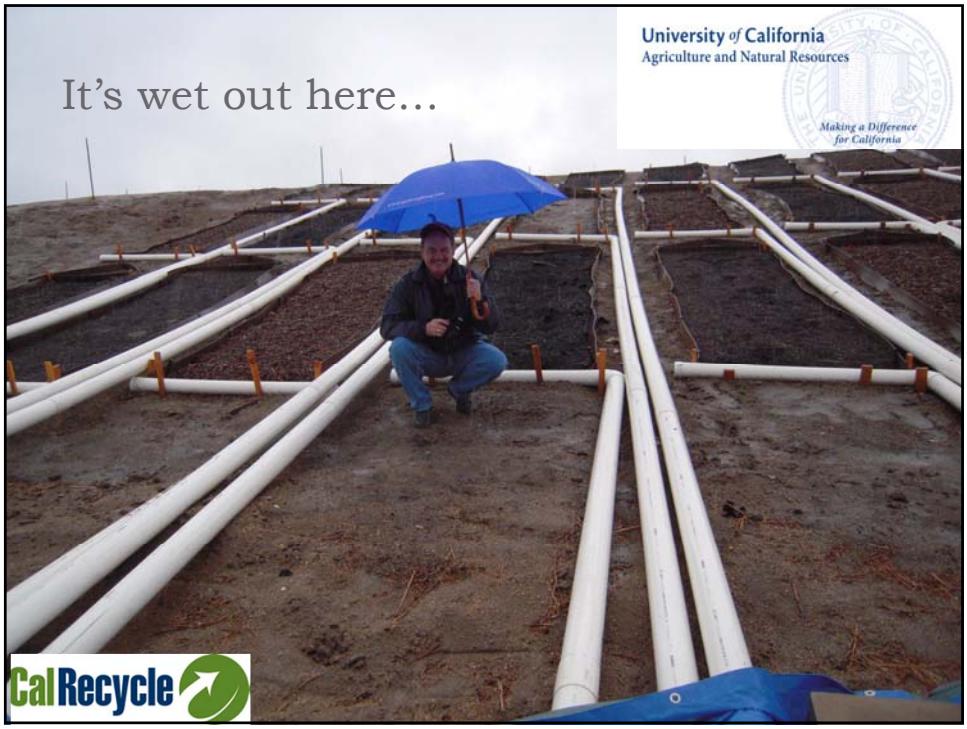
It's wet out here…
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…but still dry in there
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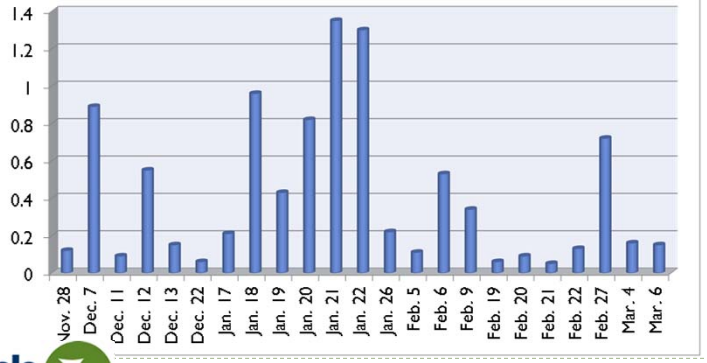
Four captured events (mm)

- December 15, 2009, 12.5 mm fell over 48 hours
- January 19, 2010, 32 mm fell over 36 hours
- January 21, 2010, 39 mm fell over 36 hours
- January 23, 2010, 49 mm storm fell over 36 hours



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INCLUDED 66% OF ANNUAL RAINFALL

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Randomized Complete Block Plot Design

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Control 1	GWC 1" 2	BS 2" 3	GWF 2" 4	BS 1" 5	GWF 1" 6	GWC 2" 7	GWF Inc 8	GWC Inc 9	BS Inc 10
GWC 2" 11	BS 2" 12	BS 1" 13	Control 14	GWC 1" 15	GWF 2" 16	GWC Inc 17	GWF 1" 18	BS Inc 19	GWF Inc 20
BS Inc 21	GWF 1" 22	GWC 2" 23	BS 2" 24	GWF 2" 25	GWC 1" 26	GWF Inc 27	Control 28	BS 1" 29	GWC Inc 30

Direction of slope

BS (Biosolids)
GWF (Green Waste Fines)
GWC (Green Waste Coarse)
Control

1" = Compost applied @ 1" depth
2" = Compost applied @ 2" depth
Inc = compost Incorporated at 2" depth application

#'s 1-30 are plot numbers

Materials

- Greenwaste compost fines
- Greenwaste compost overs
- Biosolids compost
- No compost

Rates

- 1 inch
- 2 inches
- 2 inches incorporated

3:1 slope

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Total Runoff Depth

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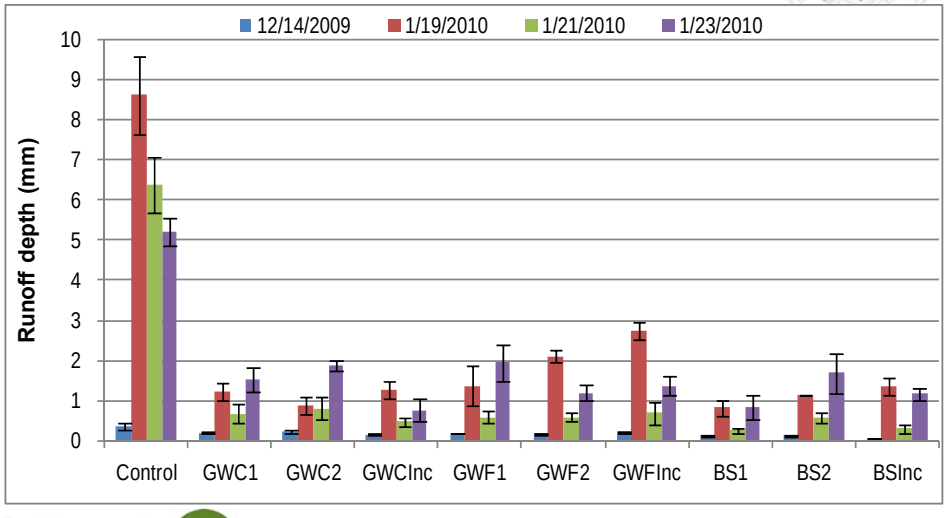

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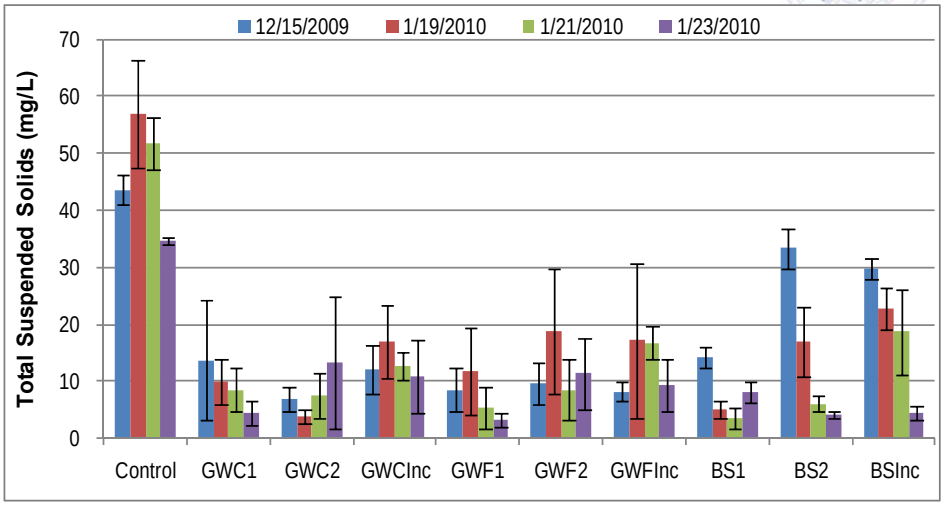
Total Suspended Solids



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Concentration

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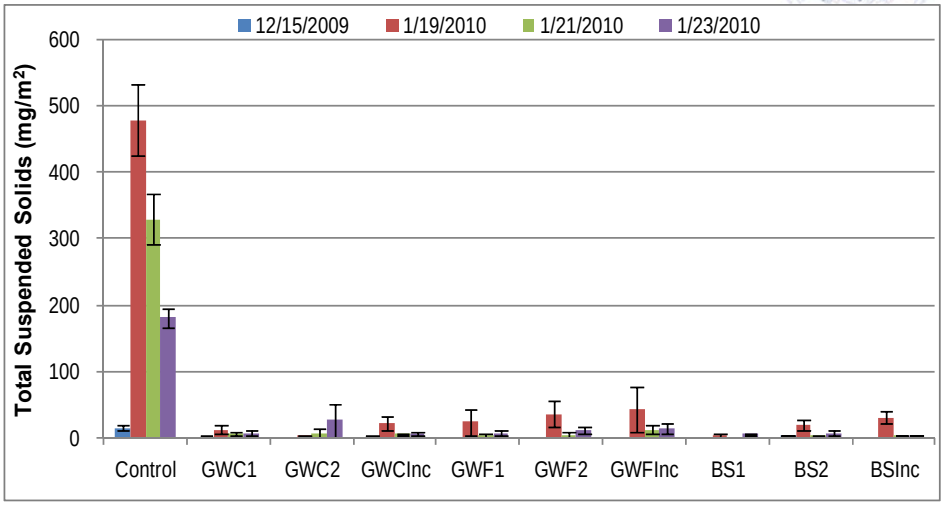
Total Suspended Solids



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Exported Mass

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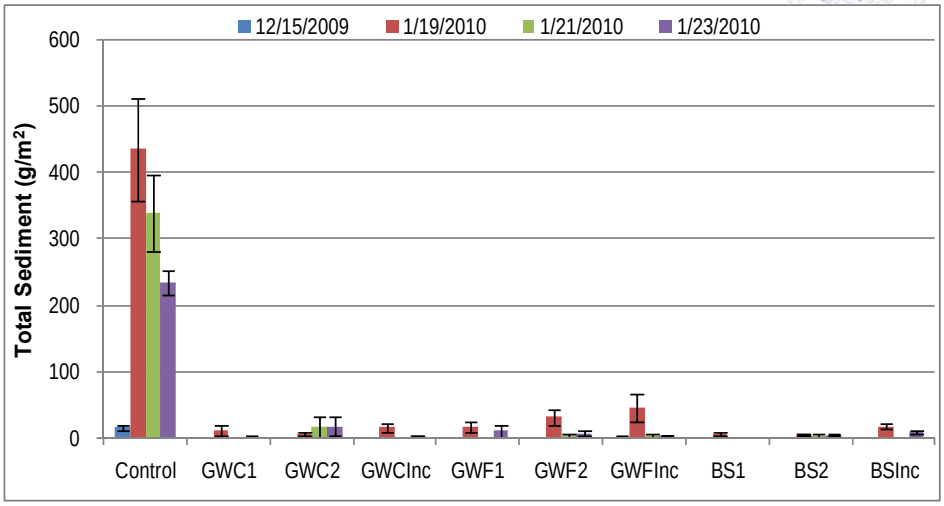
Total Solids



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Exported Mass

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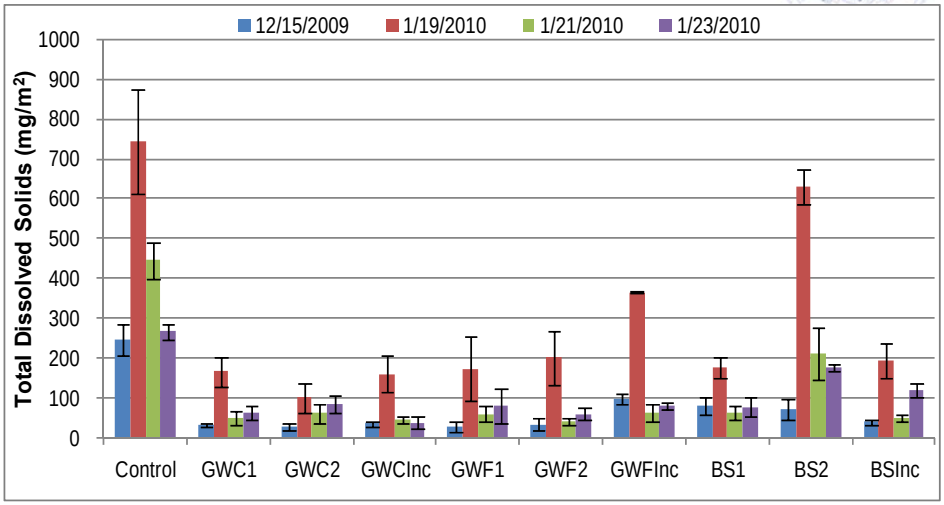
Total Dissolved Solids



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Exported Mass

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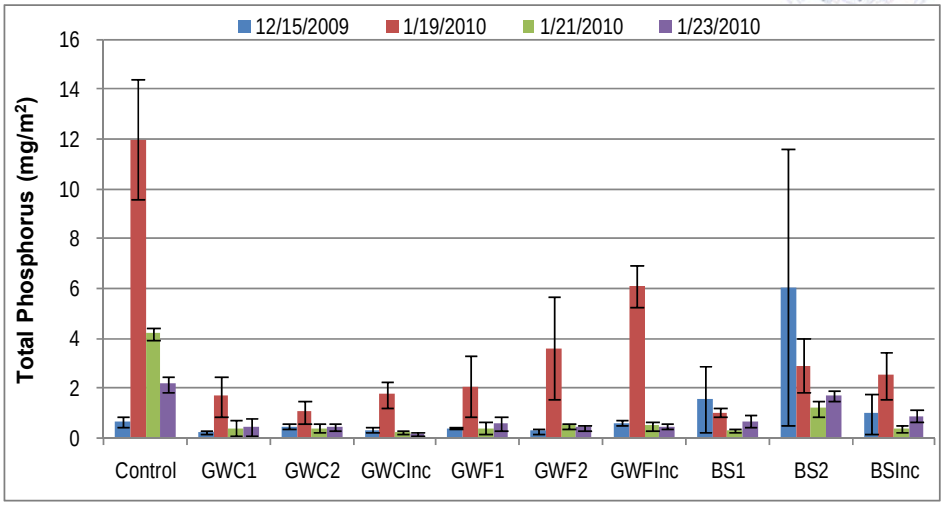
Total Dissolved Phosphorus



CalRecycle Exported Mass

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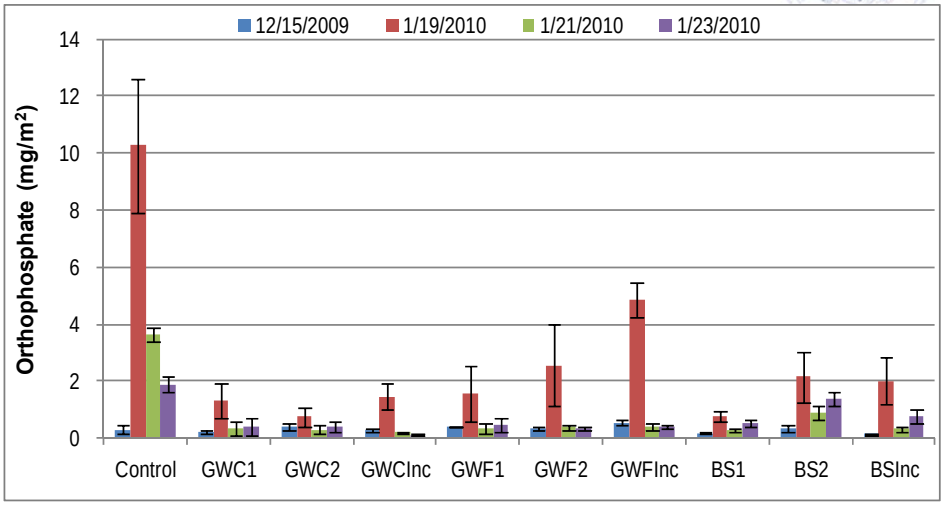
Orthophosphate



CalRecycle Exported Mass

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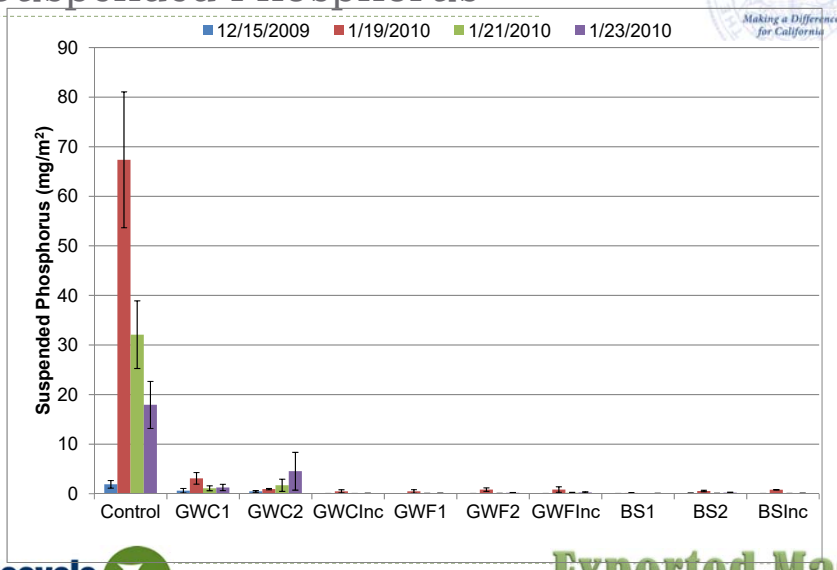
Suspended Phosphorus



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Exported Mass

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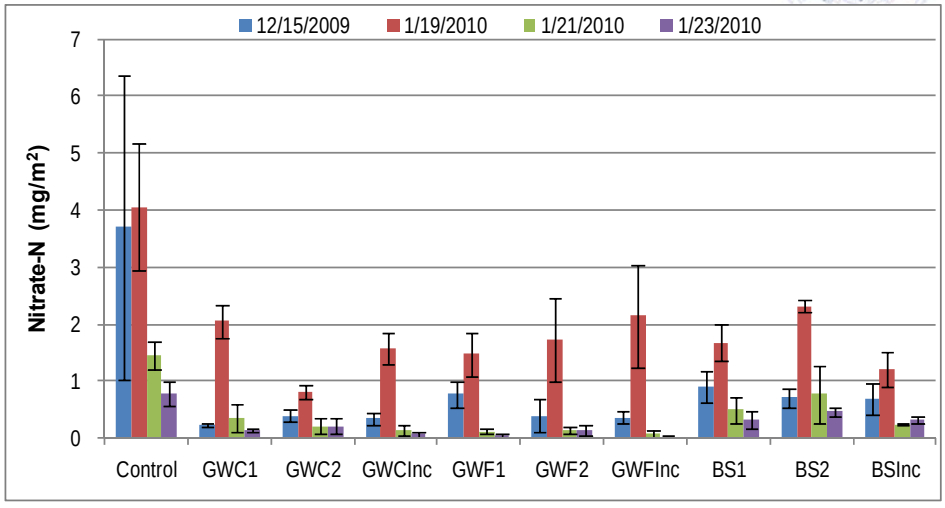
Nitrate-nitrogen



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Exported Mass

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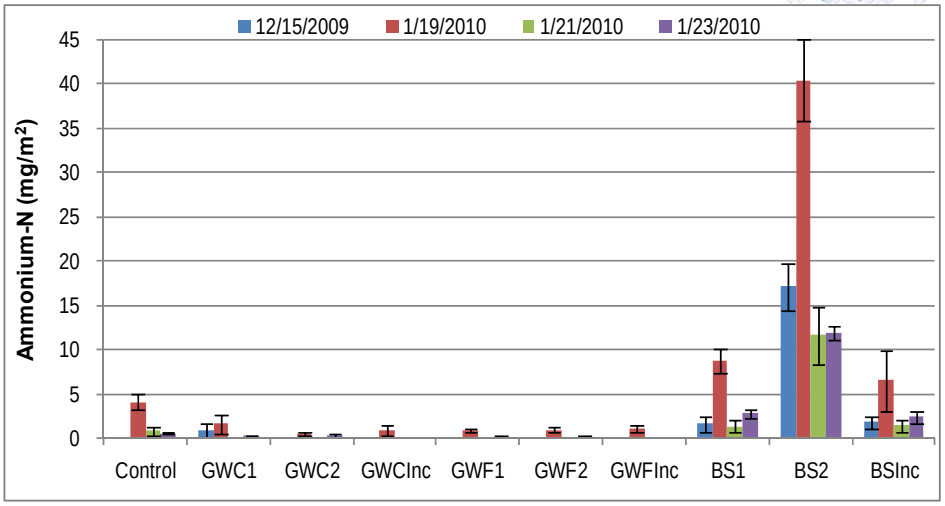
Ammonium-nitrogen



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Exported Mass

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Conclusions

- Compost mulches effectively reduce runoff pollution
- Runoff is reduced
  - Absorb water
  - Protect the soil
  - Promote infiltration
- Normalized pollutant export declined after two storms
  - Studies limited to one or two storm events will exaggerate pollutant losses from mulched plots.
- I" was as effective as 2" and retained more pollutants
  - Biosolids compost applied to 2" depth (B5) exported more TDS and NH_4^+-N than did the 1" application, as well as more Cd, Cr, Cu, and Mo.
- Incorporation is unnecessary

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Conclusions

- Compost blankets reduced
  - Runoff by 86%
  - Total dissolved solids (TDS) by 88%
  - Total suspended solids (TSS) by 96%
  - Total solids (TS) by 97%
  - Total dissolve phosphorus (TDP) by 72%
  - Orthophosphate (OP) 77%
  - Suspended phosphorus (SP) 98%
  - Nitrate (73%)
- Surface mulching and incorporation performed similarly
- Applying 2" offered no benefits over 1", and increased some pollutant losses
- Results similar for greenwaste compost "overs" (>3/8") and "fines" (<3/8")

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Conclusions

- Metal exports from all plots were mostly in suspended form. Mo was the exception.
  - Elevated flow rates in the controls often diluted metal concentrations below detection limits, but observations of metals where they were detected suggest that untreated soil metal exports were comparable to or higher than those with composts applied.
  - All compost treatments reduced losses of suspended Cd, Cu, Cr, Pb, Ni, and Zn compared to the controls based on novel Kaplan-Meier nonparametric approach.

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Significant improvements over controls

Pollutant	Fine GWC	Coarse GWC	BSC
TDS	IMPROVED	IMPROVED	IMPROVED
TSS	IMPROVED	IMPROVED	IMPROVED
TS	IMPROVED	IMPROVED	IMPROVED
TDP	IMPROVED		
OP	IMPROVED		
NH_4^+-N	IMPROVED	IMPROVED	
NO_3^--N	IMPROVED	IMPROVED	

Only one significant increase observed in experiment:
2" biosolids compost increased NH_4^+-N losses

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Conclusions

- Significant decreases for all coarse greenwaste compost treatments were shown in TDS, TSS, TS, TDP, OP, NH_4^+-N, and NO_3-N.
- Fine greenwaste compost treatments performed similarly although, compared to the controls, improvements in TDP and OP, while substantial, were not always statistically significant.
- Metal losses were observed more frequently in the runoff from the biosolids compost treatments than from the greenwaste compost plots, but values were frequently below detection limits.

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