Appendix D. Pre-2013 Historic Conditionally Accepted Polymeric Membrane Filters (Post-2013 Polymeric Membranes no longer need to be Conditionally Accepted)

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Polymeric Membrane Filters

Polymeric Membrane Filters

Many of the membrane filters listed below were originally approved with maximum flux rates based on studies under which performance data was generated. However, references to maximum flux rates are no longer deemed necessary since they become self-limiting from a filter run and operational perspective. If operational parameters (e.g. flux, TMP) adversely impact filtration performance from a turbidity compliance or operational perspective, process control measures will likely be necessary to reliably insure compliance.

Many earlier conditions of acceptance for membrane filters included integrity tests. It has since been determined that such testing will no longer be required as a condition of acceptance for any of the listed membrane technologies. However, DDW still recognizes integrity testing to be a valuable diagnostic tool and recommends its use for hollow fiber membranes when deemed appropriate by operational personnel.

1. Asahi-Kasei - MUNC-620A and MUDC-620A

Description: Asahi-Microza & Water Processing Division hollow fiber polyvinylidene fluoride (PVDF) membrane/ bioreactor filtration treatment units with a nominal 0.1 micron pore size. The membranes operate under vacuum. Acceptance has been granted for the following membrane designations: MUNC-620A and MUDC-620A

References:

- Conditional acceptance letter dated May 8, 2007 from CDPH for the hollow fiber MUNC-620A membrane.
- Conditional acceptance letter dated July 19, 2007 from CDPH for the hollow fiber MUDC-620A membrane.
- Report “Assessing the Ability of the MicrozaTM Membrane Bioreactor to Meet Existing Water Reuse Criteria” submitted by MWH, Consulting Engineers, dated March 2007, outlining study results conducted for compliance with the Water Recycling Criteria. This report evaluated the MUNC-620A membrane.
- Report “Assessing the Ability of the MicrozaTM (MUDC-620A Membrane Bioreactor to Meet Existing Water Reuse Criteria” submitted by MWH, Consulting Engineers, dated June 2007, outlining study results conducted for compliance with the Water Recycling Criteria. This report evaluated the MUDC-620A membrane.

Comments: Tested using an MBR process comprised of an anoxic tank followed by an aerobic tank, followed by the submerged membrane tank.

Installations: Unknown

2. **Alfa Laval Ashbrook Simon-Hartley - IMAS**
(Formally Ashbrook Simon-Hartley)

Description: Ashbrook Simon-Hartley Integrated Membrane Activated Sludge (IMAS) filtration treatment unit utilizing the spiral wound (Spirasep) polyethersulfone ultrafiltration membrane module with nominal 0.05 micron pore size. The membranes operate under vacuum.

References:
- Conditional acceptance letter dated January 25, 2007 from CDPH.
- Report submitted entitled "Pilot/Demonstration System" (undated) outlining study results conducted at Eastern Municipal Water District.

Comments: System utilizes separate biological and membrane filtration units but marketed as a package plant.

Installations: Unknown

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3. **Bord na Mona Environmental Products - PuraM**

Description: UF made of polyethersulfone with nominal pore size of 0.05 microns.

References:
- Conditional acceptance letter dated July 29, 2011 from CDPH.
- Report submitted entitled "Bord na Mona PuraM Membrane Bioreactor Wastewater Reuse Technology Third Party Testing Final Report".

Comments: Flat membrane plates in cassettes vertically submerged in MBR.

Installations: Unknown

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4. **DOW – SFD 2860**
(Formally SFX 2860)

Description: Dow Pressurized Ultrafiltration Membrane

References:
- Conditional acceptance letter for the SFX 2860 module dated September 8, 2008 from CDPH for recycled water applications.

- Approved for compliance under the SWTR by letter dated July 17, 2008 from CDPH.
- CDPH letter dated October 26, 2011 regarding membrane name change to SFD-2860.

Comments: Utilizes a 0.03 micron pressure driven polyvinylidene fluoride (PVDF) hollow fiber membrane.

Installations: Unknown

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5. DOW – SFX 2880

Description: Dow Pressurized Ultrafiltration Membrane

References:
- Conditional acceptance letter for the 2880 module dated December 3, 2009 from CDPH for the upsized SFX 2880.

Comments: Utilizes a 0.03 micron pressure driven polyvinylidene fluoride (PVDF) hollow fiber membrane.

Installations: Unknown

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6. Dynatec Systems – Norit CoOMP-F4385-0625

Description: Dynatec Dynalift™ Membrane Bioreactor

References:
- Conditional acceptance letter dated October 21, 2009 from CDPH for recycled water applications.
- Submittal included information indicating that the Dynalift MBR system utilizes the Norit CoOMP-F4385-0625, 0.03 micron, PVDF tubular membrane which has been previously accepted by CDPH for other manufactured systems. The only difference is that the module diameter has been expanded to accommodate 355 ft^2.

Comments: Utilizes a 0.03 micron tubular membrane located externally from the bioreactor. Unit operates under pressure ranging from 1.0 to 5.0 psi and a typical flux rate of 20 to 45 gallons per square foot per day.

Installations: Unknown

7. ECONITY – ECONITY CF-series

Description: Microfiltration Membrane

References:
- Conditional acceptance letter dated October 24, 2012 from CDPH for recycled water applications.
- Report entitled “Assessing the Ability of the ECONITY CF-series Membrane Bioreactor to Meet California’s Title 22 Water Reuse Criteria”, prepared by MWH, and dated October 2012.

Comments: Utilizes a 0.4 micron pressure driven high density polyethylene (HDPE) hollow fiber membrane.

Installations: Unknown

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8. GE/ZENON - Cycle-Let (Thetford)

Description: Membrane (“Ultra") filtration (originally marketed as Thetford Cycle-Let); complete package unit including pretreatment, biological oxidation, membrane ultra-filtration, GAC and U.V.

References:
- CDPH acceptance memorandum to LARWQCB dated November 12, 1993 regarding the Water Gardens Project.
- Report entitled "Evaluation of the Thetford Cycle-Let Reclamation System's Ability to Meet Title 22”, prepared by Engineering-Science, dated August 1991.
- Report entitled "Thetford Systems Inc. Cycle-Let Wastewater Treatment and Recycling System – Water Garden Project, Santa Monica, CA" dated July 1993 prepared by CDM

Comments: Membrane approved has average pore size of .005 micron. Tested on municipal wastewater.

Installations: "Water Gardens" (Santa Monica), Sony Music Campus (Santa Monica).

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9. GE/ZENON - ZeeWeed / Zenogem 500 Series

Description: PVDF with nominal pore size 0.04 microns.

References:
- Conditional acceptance letter dated August 12, 1999 from CDPH.
- Draft Final Report “California DHS Certification Testing-for GE/ZENON (ZeeWeed) Membrane” prepared by Montgomery Watson (1/8/99).
- Report entitled "Assessing the Ability of Membrane Bioreactor to Meet Existing Water Reuse Criteria (GE/ZENON Environmental, Inc.)" prepared by Montgomery Watson (March 2001).
- Letter dated February 17, 2005 from CDPH re-designated formulation of membrane to PVDF-UF (OCP).
- Email dated April 12, 2012 from CDPH allowing membrane formulation changes to include PVDF-UF (OCP, SMC, FLOw).

Comments: Includes 500a, 500b, 500c and 500d membrane systems. Tested in MBR process with high solids loading.

Installations: Unknown

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10. GE/ZENON - ZeeWeed 1000 UF

Description: Submerged Hollow Fiber Ultrafiltration Membrane

References:
- Conditional acceptance letter dated October 12, 2001 from CDPH.
- Report entitled “California Department of Health Services Certification Testing For GE/ZENON ZeeWeed 1000 Membrane”, prepared by Montgomery Watson (June 2001). This report was prepared for demonstrating compliance with the California Surface Water Treatment Rule.

Comments: Approval based on use of the hollow fiber polymer “ZeeWeed 1000 UF Membrane” with a 0.02 micron nominal pore size. Tested on raw surface water.

Installations: Unknown

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11. GE/ZENON - ZeeWeed 1000 V4

Description: vacuum driven, polyvinylidene fluoride hollow fiber with direct flow and outside-in operation.

References:

- Conditional acceptance letter dated October 26, 2011 from CDPH for recycled water use.
- Conditional acceptance letter dated June 30, 2011 from CDPH for potable water use.

Comments: Acceptance based on testing conducted for potable water usage.

Installations: Unknown

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12. GE/ZENON - ZeeWeed 1500

Description: vacuum driven, polyvinylidene fluoride hollow fiber with direct flow and outside-in operation.

References:
- Conditional acceptance letter dated October 26, 2011 from CDPH for recycled water use.
- Conditional acceptance letter dated June 30, 2011 from CDPH for potable water use.

Comments: Acceptance based on testing conducted for potable water usage.

Installations: Unknown

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13. Hytachi - HPTM

Description: Submerged flat sheet, nominal pore size of 0.1 microns. PVDF membrane on a PET nonwoven fabric.

References:
- Conditional acceptance letter dated May 26, 2011 from CDPH.
- Report entitled “Assessing the Ability of the HPT Hitatchi Membrane Bioreactor to Meet the Existing California Water Reuse Criteria” dated May 2011.

Comments: Virus seeding showed 3.9-log reduction in seeded MS2. Housed in elements and modules for a MBR system.

Installations: Unknown

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14. Huber Technology – VRM MBR

Description: Huber Vacuum Rotation Membrane VRM® Bioreactor (MBR) utilizing the Polyethersulfone flat sheet NADIR P-150F ultrafiltration membrane with nominal pore size of 0.038 micron. Submerged membrane operates under vacuum.

References:
- Conditional acceptance letter dated June 22, 2006 from CDPH.
- Report entitled "Assessing the Ability of the Huber Vacuum Rotation Membrane VRM® Bioreactor and Membrane Clearbox® to Meet Existing Water Reuse Criteria" prepared by Montgomery-Watson-Harza (April 2006).

Comments: Tested in MBR process with high solids loading.

Installations: Unknown

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15. Hydranautics – HYDRAcap UF

Description: Hydranautics HYDRAcap Ultrafiltration Membrane

References:
- Conditional acceptance letter dated April 1, 2008 from CDPH.
- Approved for compliance under the SWTR (letter dated October 19, 1999).

Comments: Utilizes a 0.2 micron polyethersulfone hollow fiber membrane.

Installations: Unknown

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16. Hydranautics – HYDRAsub/MRE SADF MBR

Description: Hydranautics HYDRAsub®/MRE's Sterapore SADF® MBR

References:
- Conditional acceptance letter dated September 23, 2009 from CDPH.
- Report "Assessment of the Hydrasub®/Sterapore SADF® Membrane Bioreactor to Meet Water Reuse Criteria" submitted by HDR, Consulting Engineers, dated August 2009, outlining study results conducted for compliance with the Water Recycling Criteria.

Comments: Utilizes the HSE25 0.4 micron polyvinylidene Fluoride reinforced hollow fiber membrane. MBR process is preceded by a 1-mm wedge wire screen and operates under vacuum pressure. Pilot study demonstrated the unit's ability to achieve 3-log virus removal at the 50th percentile.

Installations: Unknown

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17. Ionics, Inc. – Norit X-Flow

Description: Norit X-Flow Hollow Fiber Ultrafiltration 0.05 micron, Polyethersulfone Membrane.

References:

- Conditional acceptance letter dated October 21, 2003 from CDPH.
- Approved for compliance under the SWTR based on report entitled "Draft Final Report, California Department of Health Services Certification Testing for Ionics UF Membrane" prepared by Montgomery-Watson (June 2001).
- Performance study conducted at Gwinnett County, Georgia using secondary effluent; "Membrane Pilot and Demonstration-Scale Treatment for Water Reclamation at Gwinnett County, Georgia" (CH2M HILL, 2001).

Comments: Acceptance specific to the Ionics filtration technology tested using the Norit X-Flow S225, 0.05 micron, polyethersulfone hollow fiber membrane. Tested on secondary effluent.

Installations: Unknown

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18. Koch Membrane Systems – Puron KMS-L1

Description: Koch Membrane Systems Puron™ Membrane Bioreactor (MBR) utilizing the Polyethersulfone hollow fiber KMS-L1 membrane with nominal 0.05 micron pore size. Submerged membrane operates under vacuum.

References:

- Conditional acceptance letter dated May 4, 2006 from CDPH and amended December 18, 2007 to allow for elongated fiber up to 2.0 meters.
- Report entitled "Assessing the Ability of the Puron™ Membrane Bioreactor to Meet Existing Water Reuse Criteria" prepared by Montgomery-Watson-Harza (March 2006).

Comments: Tested in MBR process with high solids loading.

Installations: Unknown

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19. Koch Membrane Systems – Puron SMP3

Description: Koch Membrane Systems PVDF ultrafiltration hollow nominal 0.03 micron pore size. Submerged membrane operates under vacuum. Fixed base with top ends of fibers individually sealed and move freely.

References:
- Conditional acceptance letter dated February 1, 2012 from CDPH.
- Report entitled "Final Report of the Koch Membrane Systems PURON SMP3 Membrane Bioreactor Title-22 Demonstration Testing" prepared by Trussell Technologies (December 2011).

Comments: None

Installations: Unknown

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20. Kruger - Neosep

Description: Flat sheet PVDF UF, average pore size of 0.08 micron. Operated under a vacuum.

References:
- Conditional acceptance letter dated October 12, 2006 from CDPH.
- Report entitled "Assessing the Ability of the Kruger Neosep Membrane Bioreactor to Meet Existing Water Reuse Criteria" (Aug 2006).

Comments: None

Installations: Unknown

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21. KUBOTA Corporation – Type 510, 515, B2-515, and H025-40

Description: Kubota Membrane Bioreactor (MBR); low pressure, 0.4 micron chlorinated polyethylene flat sheet membrane.

References:
- Conditional acceptance letter for the Type 510 dated March 18, 2003 from CDPH, amended April 29, 2004 for higher flux rate. Acceptance of the Type

515 membrane granted by letter dated July 5, 2005. Acceptance of the RM/RW Type B2-515 granted by letter dated April 29, 2009.
- Report entitled "Assessing the Ability of the Kubota Membrane Bioreactor to Meet Existing Water Reuse Criteria" prepared by Montgomery-Watson-Harza (February 2003).
- Conditional acceptance letter for the Type 515 dated July 5, 2005 from CDPH.
- Report entitled "Equivalency of The Kubota Type 515 and Type 510 Membrane Cartridges" (2005).
- CDPH letter dated February 25, 2011.
- Report entitled "Kubota Type H025-40 Membrane Module as an Alternative Filtration Technology for the Production of Recycled Water in California" dated November 15, 2010.

Comments: Tested in MBR process with high solids loading.

Installations: Unknown

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22. Litree Purifying Tech – Litree PVC UF

Description: Hollow fiber, Ultrafiltration, nominal pore size 0.01 microns.

References:
- Conditional acceptance letter dated January 9, 2013 from CDPH.
- Report entitled "Testing of Litree PVC Membrane System for Title 22 Conditional Approval" dated December 2012.

Comments: Showed >5.0-log Total Coliform reduction. Manufactured by Hainan Litree Purifying Technology Co. based in China. Flow direction is inside-out and can be configured for cross-flow or dead-end operation.

Installations: Unknown

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23. Meurer Research – Bio-Cel UP-150

Description: Submerged flat sheet, nominal pore size 0.04 microns.

References:
- Conditional acceptance letter dated May 5, 2011 from CDPH.

– Report entitled "Assessing the Ability of the MRI BIO-CEL Membrane Bioreactor to Meet the Existing California Water Reuse Criteria" dated April 2011.

Comments: Showed a 4.0-log MS2 reduction. Polyethersulfone membrane manufactured by Microdyn Nadir. Membrane housed in elements and cassettes located in MBR.

Installations: Unknown

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24. MITSUBISHI - MBR

Description: Mitsubishi Membrane Bioreactor (MBR) Sterapore HF 0.4 micron hollow fiber polyethylene

References:
– Conditional acceptance letter dated April 23, 2001 from CDPH.
– Report entitled "Assessing the Ability of Membrane Bioreactor to Meet Existing Water Reuse Criteria (Mitsubishi Rayon Co., Ltd.)" prepared by Montgomery-Watson (March 2001).

Comments: Tested in MBR process with high solids loading.

Installations: Unknown

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25. Norit X-Flow - SXL-225

Description: Norit XigaTM and AquaflexTM Membrane Filtration Systems with a nominal 0.025 micron pore size. The membranes operate under positive pressure.

References:
– Conditional acceptance letter dated June 1, 2007 from CDPH. This acceptance was based on previous acceptance of this membrane (letter from CDPH dated March 14, 2006) for performance compliance under the California Surface Water Treatment Rule.

Comments: The Xiga configuration is horizontally mounted and the Aquaflex is vertically mounted. Both configurations utilize the SXL-225 hydrophilic polyethersulfone - polyvinylpyrolidine (FSFC) membrane.

Installations: Unknown

26. Parkson Corporation – Dynalift

Description: Dynalift™ System utilizing external PVDF tubular membranes (38 PRV modules manufactured by NORIT) with a nominal pore size of 0.03 micron. The tubular membranes operate under pressure and are placed externally from the bioreactor.

References:
- Conditional acceptance letter dated September 7, 2006 from CDPH.
- Report entitled "Assessing the Ability of the Dynalift™ Membrane Bioreactor to Meet Existing Water Reuse Criteria", utilizing the 38 PRV Modules, prepared by Montgomery-Watson-Harza (July 2006).

Comments: Tested in MBR process with high solids loading.

Installations: Unknown

27. PALL Corporation - XUSV-5203

Description: PVDF Hollow Fiber Microza Microfiltration 0.1 micron

References:
- Conditional acceptance letter dated January 10, 2000 from CDPH.
- Approved for compliance under the SWTR based on report entitled "California Department of Health Services Certification Testing for Pall (Microza) Microfiltration Membrane" prepared by Montgomery-Watson (July 1999).
- Performance study conducted at OCWD Water Factory 21 (SLS Report 7725) "Long-Term Testing of Pall Microza 0.1 um MF System on Secondary Effluent at Water Factory 21, Fountain Valley, CA" (September 23, 1998).

Comments: Tested on secondary effluent.

Installations: Unknown

28. PALL Corporation - USV-5203, USV-6203, UNA-620A, and UNA-620A-1

Description: Microza Microfiltration

References:

- Conditional acceptance letter dated July 19, 2004 from CDPH.
- Approved for compliance under the SWTR.
- UNA-620A-1 conditional acceptance letter dated January 3, 2007 from CDPH.

Comments: Tested on raw surface water.

Installations: Unknown

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29. SIEMENS (Memcor Products) - M10V, L10V, L20V

Description: Siemens Memcor M10V, L10V and L20V polyvinylidene fluoride (PVDF) hollow fiber membrane filtration treatment units with a nominal 0.1 micron pore size. The membranes operate under positive pressure.

References:
- Report submitted by MWH, Consulting Engineers, dated August 2004, outlining study results conducted for compliance with the Surface Water Treatment Rule.
- Conditional acceptance letter dated February 2, 2007 from CDPH.
- L20V conditional acceptance letter dated April 22, 2008 from CDPH.

Comments: Tested on raw surface water at the Aqua De Lejos Water Treatment Plant in Upland, California.

Installations: Unknown

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30. SIEMENS (Memcor Products) - S10V

Description: 0.1 micron Polyvinylidene Fluoride (PVDF) Hollow Fiber Micro-Filtration – Submerged Vacuum

References:
- Conditional acceptance letter dated January 10, 2000 from CDPH.
- Updated model numbers in letter from Siemens by letter dated August 8, 2007.

Comments: Tested on raw surface water.

Installations: Unknown

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31. SIEMENS (Memcor Product) - M10B and M10C

Description: 0.2 micron Polypropylene Hollow Fiber Micro-Filtration - Pressure Filtration

References:
- Conditional acceptance letter dated January 10, 2000 from CDPH.
- Approved under the SWTR using 0.2 micron membrane.
- Updated model numbers in letter from Siemens by letter dated August 8, 2007.

Comments: Tested on raw surface water.

Installations: West Basin MWD, Orange County Water District, City of Livermore, Dublin/San Ramon SD

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32. SIEMENS (Memcor Products) – S10T

Description: 0.2 micron Polypropylene Hollow Fiber Micro-Filtration – Submerged/Vacuum Filtration

References:
- Conditional acceptance letter dated January 10, 2000 from CDPH.
- Updated model numbers in letter from Siemens by letter dated August 8, 2007.

Comments: Tested on raw surface water.

Installations: Unknown

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33. SIEMENS (Memcor Products) – B10R, B30R and B40N

Description: 0.1 micron Polyvinylidene Fluoride (PVDF) Hollow Fiber Micro-Filtration – SBR/Vacuum Filtration; B30R formerly U. S. Filter/Jet Tech Products-Memjettm

References:
- Conditional acceptance letter dated October 7, 2002 from CDPH.
- Conditional acceptance letter dated November 18, 2005 from CDPH concerning the “B30R” module.

- Conditional acceptance letter dated October 29, 2008 from CDPH concerning the “B40N” module.

Comments: Tested in MBR process with high solids loading.

Installations: Unknown

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34. Sumitomo - Poreflon® SPMW-05B10

Description: Sumitomo Poreflon® Membrane Bioreactor

References:
- Conditional acceptance letter dated January 23, 2009 from CDPH for recycled water applications.
- Report “Assessing the Ability of the Sumitomo Poreflon® Membrane Bioreactor to Meet Existing Water Reuse Criteria” submitted by MWH, Consulting Engineers, dated December 2008, outlining study results conducted for compliance with the Water Recycling Criteria. This report evaluated the Poreflon® SPMW-05B10 membrane module with polytretafluoroehtylene hollow fiber membrane.

Comments: Utilizes a 0.2 micron hollow fiber membrane.

Installations: Unknown

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35. Toray MEMBRAY^{tm} – TMR 140

Description: Toray MEMBRAYTM Membrane Bioreactor

References:
- Conditional acceptance letter dated November 14, 2008 from CDPH (corrected copy dated January 7, 2009) for recycled water applications.
- Report “Assessing the Ability of the Toray MEMBRAYTM Membrane Bioreactor to Meet Existing Water Reuse Criteria” submitted by MWH, Consulting Engineers, dated October 2008, outlining study results conducted for compliance with the Water Recycling Criteria. This report evaluated the MEMBRAYTM TMR140 PVDF/PET Non-Woven flat sheet membrane.
- Conditional acceptance letter dated January 28, 2011 from CDPH for SaniBrane MBR. Report “Sanitherm MBR Title 22 Approval” dated September 2010.

Comments: Utilizes a 0.08 submerged flat sheet membrane.

Installations: Unknown

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36. TriSep Corporation – iSEP 500-PVDF

Description: iSEP 500 ultrafiltration membrane

References:
- Conditional acceptance letter dated November 14, 2012 from CDPH for recycled water applications.
- Report "Ovivo stormBLOX process with the iSEP 500-PVDF ultrafiltration membrane: Demonstration testing for California recycled water applications" submitted by Trussell Technologies, dated October 2012, outlining study results conducted for compliance with the Water Recycling Criteria.

Comments: Utilizes a 0.03 micron submerged spiral-wound flat-sheet membrane.

Installations: Santa Lucia Preserve Community Services District

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37. WesTech – Clearlogic MBR

Description: WesTech Clearlogic® Membrane Bioreactor

References:
- Conditional acceptance letter dated December 3, 2009 from CDPH for recycled water applications.
- Report "Clearlogic MBR Validation Report" submitted by Eco-Logic Engineers, dated September 2009, outlining study results conducted for compliance with the Water Recycling Criteria. This report evaluated the submerged Hollow Sheet™ PVDF membrane with a nominal pore size of 0.2 micron as manufactured by Alfa Laval.

Comments: MBR is preceded by a coarse screen and 2 mm perforated plate fine screen. Unit operates under gravity flow or low permeate pressure via a permeate pump.

Installations: Unknown
