



Public Hygiene Lets Us Stay Human (PHLUSH)

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Toilet availability is a human right and well-designed sanitation systems restore health to our cities, our waters and our soils.

Disaster Sanitation Planning Resources

Toilet system options for communities at risk of a pipe-breaking seismic event

DRAFT updated 3/15/18. Please comment on line or send suggestions to our disaster sanitation team at info@plash.org

Purpose of this list Recent research in the management of human “waste” can inform decisions about Cascadia Subduction Zone (CSZ) quake preparedness and overall community resilience in the face of climate change. Included here are regional, national and international reports, case studies, online knowledge bases, libraries and portals. Most documents have appeared within the past four years and are free and open source unless otherwise indicated.

Crowdsourcing experience and expertise Since sewer infrastructure, wastewater treatment treatment plants, and onsite septic systems are not compromised in most emergencies, sanitation hasn't received much attention from emergency managers in the US. Those in the Pacific Northwest who are preparing for a CSZ seismic event, however, are poised to make important contributions to the field of emergency sanitation.

Disaster Sanitation study groups Local study groups can imagine and articulate disaster scenarios and assess available resources and technical reports to design appropriate toilet systems. Emergency management volunteers working in a handful of study groups focusing on specific ecosystems and demographics, should be able to address these eight issues to propose disaster sanitation strategies and to identify desired follow on training.

- 1. INFRASTRUCTURE VULNERABILITIES**
- 2. OVERVIEW OF TOILET SYSTEMS AND TECHNOLOGIES**
- 3. HYGIENE AND PATHOGEN CONTROL**
- 4. TREATMENT OF URINE AND FECES**
- 5. REUSE OF URINE AND FECES**

- 6. MESSAGING AND ADVOCACY**
- 7. CURRENT CODES AND REGULATIONS**
- 8. PROTOTYPING DISASTER TOILET SYSTEM**

1. INFRASTRUCTURE VULNERABILITIES

Resilient Washington State: A Framework for Minimizing Loss and Improving Statewide Recovery after an Earthquake.

Washington State Seismic Safety Committee. (November 2012). http://www.dnr.wa.gov/Publications/ger_ic114_resilient_washington_state.pdf

The Oregon Resilience Plan: Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami. Oregon Seismic Safety Policy Advisory Commission (February 2013). http://www.oregon.gov/oem/Documents/Oregon_Resilience_Plan_Final.pdf "Water and Wastewater Systems" (Section 8, pp. 203-240) details risk to structures and estimates recovery timeframes.

"Emergency Water Supplies - What You Should Know: The Oregon Resilience Plan for Water and Wastewater Systems."

<http://www.resiliencenw.org/2012files/EmergencyWaterSupplies-WhatYouShouldKnow/EmerH2OSuppliespresentation%28v1%29Handout.pdf>

(slide presentation) Mark Knudson, P.E. Tualatin Valley Water District. ResilienceNW 2012.

Infrastructure Report Card - Wastewater D+. American Society of Civil Engineers. 2017.

<https://www.infrastructurereportcard.org/wp-content/uploads/2017/01/Wastewater-Final.pdf> This respected report gives US wastewater infrastructure a grade of D+. The nation's 14,748 wastewater treatment plants serve 76% of the population and the most critical infrastructure systems for protecting public health and the environment. By 2017, more than 56 million new users will be connected to centralized systems. Treatment plants located on coastal areas at the bottom of watersheds are vulnerable to earthquakes and to sea level rise associated with climate change. In 2012 Superstorm Sandy in 2012 disabled several plants causing the release of hundreds of millions of gallons of untreated sewage into waterways. Over 800,000 miles of public sewers and 500,000 miles of private lateral sewers connect private property to public sewer lines. Each conveyance systems is susceptible to structural failure, blockages, and overflows. The public rarely understands or appreciate wastewater treatment. Aging systems, increased users and more stringent water quality measures mean increases in ratepayer fees, which rarely cover true costs. The report notes, however, that "when properly treated and processed biosolids become nutrient rich organic material that can be applied as fertilizer or, through the use of anaerobic digesters and centrifuges, can be pelletized and incinerated at high pressure and temperature for use as energy."

- **Infrastructure Report Card for Oregon.** ASCE. 2017. <https://www.infrastructurereportcard.org/state-item/oregon/> Wastewater infrastructure needs an investment of \$3.89 billion over the next 20 years.
- **Infrastructure Report Card for Washington.** ASCE Seattle Section, 2013. <https://www.infrastructurereportcard.org/wp-content/uploads/2016/10/2013ReportCardWA.pdf> Includes water but not wastewater infrastructure.

Clean Watersheds Needs Survey 2012. USEPA. 2016

https://www.epa.gov/sites/production/files/2015-12/documents/cwns_2012_report_to_congress-508-opt.pdf Data are broken down by state and by type of infrastructure need.

Septic Infrastructure in the United States. by Brett Walton for Circle of Blue, 2016.

<http://www.circleofblue.org/septic-infrastructure-in-america/> .Brett Walton reports how these aging systems are an overlooked source of water pollution and disease transmission — such as fecal bacteria, norovirus, cryptosporidium and hookworm. Each story in the five-part series make up a comprehensive assessment of the problem: the “nitrogen bomb” caused by these leaks, leading to ecosystem collapse in bays and marshes in Long Island; disease outbreaks due to inadequate sanitation in rural Alabama; population growth that overtaxes the environment’s ability to absorb the waste; insufficient data collection to fully understand the magnitude of the problem; a hodgepodge of state regulations but no federal standards, and nearly nonexistent inspections of these septic systems by local government. The Society of Environmental Journalists awarded Walton first place for Outstanding Explanatory Reporting for this series.

“EPA Announces National Wastewater Nutrient Pollution Census” Brett Walton. Circle of Blue. September, 2016.

<http://www.circleofblue.org/2016/water-quality/epa-announces-national-wastewater-nutrient-pollution-census/> The EPA announces new approach to tracking nitrogen and phosphorus removal at wastewater facilities.

“A Toilet, but No Proper Plumbing: A Reality in 500,000 U.S. Homes”. By Sabrina Tavernese. *New York Times*. Sept 26, 2016.

https://www.nytimes.com/2016/09/27/health/plumbing-united-states-poverty.html?_r=1 Article looks at race, poverty, state regulations and the lack of sanitation but never questions the use of drinking water for flushing.

An Unsolicited Design Review of Composting Toilets & Composting Methods. Mathew Lippincott and Molly Danielsson, Unpublished

Manuscript. 2010? <http://greywateraction.org/wp-content/uploads/2014/11/an-unsolicited-design-review-sm.pdf> A short critique of sewers is found on pp 4-7 of this system wide look at existing infrastructure, the alternatives and how they might work right down to the household level. Good talking points with citations.

The Orphan Tsunami of 1700: Japanese Clues to a Parent Earthquake in North America. Brian F. Atwater et al. U.S. Geological Survey, 2005. Prepared in cooperation with the Geological Survey of Japan, the University of Tokyo, and the University of Washington. 2005; revised, 2015. <https://pubs.er.usgs.gov/publication/pp1707> Compelling writing attractively laid out in 134 pages with full-color historic maps from Japan. Free download of entire book.

US Climate Resilience Toolkit. NOAA, NASA, USGS, USDA, and others. <https://toolkit.climate.gov/> Developing site provides scientific reports, information, and expertise to help people manage their climate-related risks. Tools help citizens, communities, businesses, resource managers, planners, and government policy makers to identify problems, determine vulnerabilities, investigate options, evaluate risks and costs and take action. For sanitation, use search terms such as wastewater treatment, water supply, nutrient runoff, sea level rise and geographic names.

Oregon Water/Wastewater Agency Response Network (ORWARN). <http://www.orwarn.org/> ORWARN is composed of member utilities that provide voluntary assistance to each other during emergency incidents. It organizes rapid, short-term deployment of emergency services, i.e. personnel, equipment and materials required to restore critical operations to utilities damaged in natural or man-made events.

Washington Coastal Hazards Resilience Network. <http://www.wacoastalnetwork.com/> CHRN is a network of hazards and climate change practitioners from federal and state government agencies, Tribes, academic institutions, consulting firms, and nonprofit organizations that are involved in coastal hazards management and/or producing risk and hazard assessments for marine shorelines in Washington State.

Natural Hazards Center. University of Colorado. <https://hazards.colorado.edu/> This national and international clearinghouse has focused on the social science and policy aspects of disasters since 1976. The Center collects and shares research and experience related to preparedness for, response to, recovery from, and mitigation of disasters. Library, research, resources, grants, including Quick Response grants to document disasters as they unfold.

A guide to mainstreaming disaster risk reduction and climate change adaptation. International Federation of Red Cross and Red Crescent Societies. 2013. 56 pages.
http://www.ifrc.org/PageFiles/40786/DRR%20and%20CCA%20Mainstreaming%20Guide_final_26%20Mar_low%20res.pdf Good discussion of the intersection of the twin goals. See pp 36-38 for WASH.

Oregon Water Science Center <https://www.usgs.gov/centers/or-water/science> Makes available to the public data about Oregon's ecosystems to foster better decision making. Monitors surface and groundwater and water quality. Map overlays show street layout, topography, and other factors.

Estimated Depth to Ground Water in the Portland, Oregon https://or.water.usgs.gov/projs_dir/puz/overview_maps/sir20085059_plate1.pdf
The darker the color on the map, the deeper the groundwater.

Willamette Basin Groundwater Study. USGS and the Oregon Water Resources Department (OWRD)
https://or.water.usgs.gov/projs_dir/willgw/willpage.html Research on the water resources of the Willamette Valley.

Developing flood-Inundation maps for Johnson Creek, Portland, Oregon. A.J. Stonewall and B.A. Beal. U.S. Geological Survey Scientific Investigations Report 2017–5024. 26 p. 2017. <https://doi.org/10.3133/sir20175024>

Puget Sound wastewater carries emerging contaminants: Pharmaceuticals, personal care compounds detected in effluent and fish. NOAA Fisheries Science Center. https://www.nwfsc.noaa.gov/news/features/wastewater_carries_contaminants/index.cfm Wastewater treatment fails to remove some contaminants that are among the of the most dangerous released into Pacific Northwest bodies of water. Review of Meador *et al* study entitled "Contaminants of emerging concern in a large temperate estuary" in *Environmental Pollution*, June 2016.

2. OVERVIEW OF TOILET SYSTEMS AND TECHNOLOGIES

Compendium of Sanitation Systems and Technologies. Elizabeth Tilley, Lukas Ulrich, Christoph Lüthi, Philippe Reymond and Christian Zurbrügg. Eawag, International Water Associates and Water Supply and Sanitation Collaborative Council. 2014. Free download of ground-breaking 176-p work. <http://www.iwa-network.org/wp-content/uploads/2016/06/Compendium-Sanitation-Systems-and-Technologies.pdf> Concise document presents tested technologies in a way that helps communities make informed decisions. Part 1 describes different system configurations for a variety of contexts. Part 2 consists of 52 illustrated Technology Information Sheets that cover advantages, disadvantages, applications and the appropriateness of each to various situations.

“Planning & Design of Sanitation Systems and Technologies”. Coursera MOOC. Free six-week online course begins periodically. Presented by Eawag-Sandec and EPFL in collaboration with the World Bank and WHO. <https://www.coursera.org/learn/sanitation> Launched in 2013 and regularly updated. The course introduces integrated sanitation planning for both cities and informal settlements. Within systems thinking context, presents sanitation planning frameworks and detailed information on systems and technologies. Key modules are based on the *Compendium of Sanitation Systems and Technologies*.

Sanitation, Wastewater Management and Sustainability: from Waste Disposal to Resource Recovery. Andersson, K., Rosemarin, A., Lamizana, B., Kvarnström, E., McConville, J., Seidu, R., Dickin, S. and Trimmer, C. Nairobi and Stockholm: United Nations Environment Programme and Stockholm Environment Institute. 2016. <https://www.sei-international.org/publications?pid=2997> Free download. Richly illustrated 150-page report offers a new conceptual framework for planning and investing in sustainable systems, centring on resource recovery and reuse. It examines the social, governance, economic, health, environmental and technological dimensions of sustainable sanitation and wastewater management and resource recovery. Excellent ideas, arguments, knowledge and concrete, and real-world examples for urban and rural development planners working in both the North and the South, as well as investors, civil engineers, practitioners, and students.

Using tenure to build a "sanitation cityscape": narrowing decisions for targeted sanitation interventions. Pippa Scott, Andrew Cotton, M Sohail. *Environment and Urbanization*, Vol 27(2), 1-18. 2015. <http://journals.sagepub.com/doi/10.1177/0956247815569415> The Sanitation Cityscape is a sanitation planning framework that maps what is happening to fecal material on a citywide scale and why. Based on Dakar, Senegal, it offers an approach for policymakers and practitioners to narrow the decision-making process for citywide service provision with sanitation appropriate to a mix of urban needs.

Clean Water, Healthy Sound: A Lifecycle Analysis of Alternative Wastewater Treatment Strategies in the Puget Sound Area.

Cascadia Green Building Council. September 2011. 143 pp.

https://living-future.org/wp-content/uploads/2016/11/Clean_Water_Healthy_Sound.pdf Free download. This study provides insight on the pros and cons of four commonly proposed decentralized and distributed treatment systems and how they relate to conventional practices at different density scales. Overall environmental impacts associated with each wastewater treatment system are compared and analyzed using Life Cycle Assessment (LCA). On the basis of treatment analysis results, the work concludes that lower-energy systems (composting toilets and constructed treatment wetlands) have fewer negative environmental impacts compared to the baseline centralized system, while more energy-intensive

decentralized treatment systems (recirculating biofilter and membrane bioreactors) have substantially greater negative impacts. Highlights optimal solutions for building and district-scale treatment alternatives that rely on passive, low-energy systems and gravity-fed conveyance.

A Collection of Contemporary Toilet Designs. from The Water Engineering and Development Centre (WEDC), Loughborough University, UK, 2014. Available from Amazon.com <https://wedc-knowledge.lboro.ac.uk/details.html?id=21302> Free download of overview here. [http://wedc.lboro.ac.uk...Contemporary Toilet Designs.pdf](http://wedc.lboro.ac.uk...Contemporary_Toilet_Designs.pdf) This collection of non-conventional designs is the result of research supported by Sandec, the Department of Water and Sanitation in Developing Countries at the Swiss Federal Institute of Aquatic Science and Technology (Eawag). It covers a wide range of contemporary toilet designs along with a valuable list of website links where additional information about each design can be sought.

Workshop on Emergency Sanitation in Delft. Workshop on Emergency Sanitation in Delft. WASTE, the Netherlands, 2012. Workshop on Emergency Sanitation in Delft. WASTE, the Netherlands. <http://www.susana.org/en/resources/library/details/1562> A consortium of organisations (The Netherlands Red Cross, WASTE, OXFAM GB, the IFRC, and UNESCO-IHE) brought together for three days private manufacturers, humanitarian organizations, and researchers to foster the development of sanitation designs and systems to tackle problems. The focus was on Raised latrines, Desludging equipment, and disposal and treatment not ecosan. Includes "Flat packing Composting Toilet for temporary communities lacking sanitation infrastructure" by Hamish Skermer of Natural Event.

The Application of Ecological Sanitation for Excreta Disposal in Disaster Relief: Experience, Selection and Design. Author: Katherine Kinstedt Project Work Completed: April. Supervisor: Stefan Deegener Professor: Prof. Dr. Ralf Otterpohl. Institute of Wastewater Management and Water Protection. 39 pages, 2012. Free download from SuSanA Library. <http://www.susana.org/en/resources/library/details/1506> Good Survey questionnaire in Appendix 2. Several examples of disaster relief situations where Ecosan methods are employed are investigated. Statistics about these case studies are presented along with successful and challenging aspects of the implementation. Four forms of Ecosan, urine diverting dehydration toilets (UDDT), Arborloo, biodegradable bags and composting toilets are discussed in six countries (Bolivia, Haiti, Chad, Philippines, New Zealand and Bangladesh). UDDTs had the widest extent of implementation and their flexible design makes them a good option for areas where excavation is difficult or there is a high chance of groundwater pollution (such as in flood prone regions). The composting processes offer the best success with reuse of excreta material as compost. Unfortunately though, these processes were quite complicated and do not necessary provide groundwater protection. Introduces Porta Preta as a rapidly deployable and inexpensive Ecosan solution has been proposed, the Porta Preta, an inexpensive, simple and portable design, providing some hygienization of the waste. The urine is diverted and both the feces and the urine undergo a lacto-fermentation process. Biochar is added also to the feces to eliminate odor and facilitate the reuse of the excreta as a soil additive. Fixed costs approx \$70 for the first month serving a household of five. Monthly cost = \$0.80 per user per month.

A Sewer Catastrophe Companion - Dry Toilets for Wet Disasters. Molly Danielsson and Mathew Lippincott, PNCA (Pacific Northwest College of Art), 2012. 24 pages. Licensed under Creative Commons Attribution-Share Alike 3.0, 2012. Free download from SuSanA Library. <http://www.susana.org/en/resources/library/details/2449> Endorsed by the Portland Bureau of Emergency Management, this is a DIY toilet system

that does not rely on a coordinated and timely response by authorities. This guide allows individuals, households, apartment buildings and neighborhood to plan ahead. This flexible system is built around ubiquitous and freely available 5-gallon buckets.

The SOIL Guide to Ecological Sanitation. Sustainable Organic Integrated Livelihoods (SOIL), Sherburne NY, 2011.

<http://www.susana.org/en/resources/library/details/1421> The SOIL Guide was created in response to increasing requests from individuals and organizations interested in starting ecological sanitation (EcoSan) projects across the globe. This first edition focuses on urine diversion toilets (also called UD toilets or dry composting toilets).

Piloting ecological sanitation (EcoSan) in the emergency context of Port-au-Prince, Haiti, after the 2010 earthquake. A. Kilbride, S. Kramer & N. Preneta, Haiti, 2013. Free download.

<https://www.oursoil.org/soil-presents-at-wedc-2013-piloting-ecological-sanitation-ecosan-in-the-emergency-context-of-port-au-prince-haiti-after-the-2010-earthquake/> EcoSan was an effective emergency sanitation intervention that was comparatively lower cost than other options and ensured complete and safe treatment of wastes. The authors recommend that future emergency relief efforts with similar starting conditions (high water table, concentrated populations, and limited or non-existent access to waste treatment facilities) consider EcoSan as a low-cost and ecologically sound alternative to traditional emergency sanitation approaches.

Container-based sanitation: assessing costs and effectiveness of excreta management in Cap Haitien. Haiti Sebastien Tilmans, Kory Russel, Rachel Sklar, Leah Page, Sasha Kramer and Jennifer Davis. *Environment & Urbanization*. Vol 27(1): 89–104. 2015. International Institute for Environment and Development (IIED). 104 pages. <http://journals.sagepub.com/doi/full/10.1177/0956247815572746> Abstract: *Container-based sanitation (CBS) is an alternative sanitation option in urban areas where on-site sanitation and sewerage are infeasible. It quantifies the excreta generated weekly in a dense urban slum,(1) the proportion safely removed via container-based public and household toilets, and the costs associated with these systems. The paper concludes with a discussion of planning and policy implications of incorporating CBS into the menu of sanitation options for rapidly growing cities.*

The world can't wait for sewers - Advancing container-based sanitation businesses as a viable answer to the global sanitation crisis. J. Shepard, C. Stevens, C., G. Mikhael, G. Ernst & Young. *Water and Sanitation for the Urban Poor*. 11p. 2017.

<http://www.susana.org/en/knowledge-hub/resources-and-publications/library/details/2756> Labor-intensive, decentralized toilet systems are likely generate small business opportunities following a devastating earthquake.

Design of a Portable Ecological Sanitation Toilet for Disaster Relief.

<http://www.susana.org/en/knowledge-hub/resources-and-publications/library/details/1507> Katherine Kinstedt. Institute of Wastewater Management and Water Protection at the Technical University of Hamburg-Harburg, Germany. 3p. 2012. The easily-transportable Porta Preta Kit contains parts for a container based urine-diverting system. Fecal matter undergoes a lactofermentation process using biochar facilitate use of the treated product as a socio additive.

Ecological sanitation in refugee camps: implementing urine diversion dry toilets in Dollo Ado, Ethiopia. P. Ngala, M. Burt, S. Gonzaga & A. Bastable. WEDC Conference. 5p. 2014. <http://wedc.lboro.ac.uk/resources/conference/37/Ngala-1919.pdf> The choice of sanitation technology in a crisis depends on terrain, social and cultural norms, and experience of emergency response teams. Response mechanisms must consider environmental impact and sustainability of technologies selected.

Urine Diverting Dry Toilets: Principles, Operation and Construction. S. Deegener and M Samwel, Women in Europe for a Common Future, WECF). 2015. 44 p. <http://www.susana.org/en/resources/library/details/430> First half of manual discusses advantages of UDDTs over flush toilets and pit latrines, provides options on diversion, treatment and sanitization, and reuse in agriculture. Last half is on construction and has detailed plans, photos, and comparisons of materials.

The Application of Ecological Sanitation for Excreta Disposal in Disaster Relief: Experience, Selection and Design. Katherine Kinstedt. Institute of Wastewater Management and Water Protection at Technical University of Hamburg-Harburg, Germany. 39p. 2012. <http://www.susana.org/en/knowledge-hub/resources-and-publications/library/details/1506>

Excreta Disposal in Emergencies: A Field Manual. by Peter Harvey, WEDC, Loughborough University, UK, 2007. 250 pages. http://reliefweb.int/sites/reliefweb.int/files/resources/Excreta_Disposal_in_Emergencies_-_Complete.pdf Technical overview of many options including eco san.

Technical options for excreta disposal in emergencies. World Health Organization. 2013. Technical Note 14. http://www.who.int/water_sanitation_health/publications/2011/tn14_tech_options_excreta_en.pdf

The Johns Hopkins and Red Cross Red Crescent Public Health Guide in Emergencies. 2007. 580 pages. <http://reliefweb.int/report/world/johns-hopkins-and-red-cross-red-crescent-public-health-guide-emergencies-second-edition> See Chapter 8 for Water, sanitation and hygiene in emergencies. Info on diseases, community involvement, excreta disposal, water quality, hygiene and vector control.

Emergency Sanitation Project Final Report. International Federation of Red Cross and Red Crescent Societies (IFRC). WASTE, Oxfam Great Britain, USAID, 2015. <https://watsanmissionassistant.wikispaces.com/file/view/ESP+Final+Project+Report+June+2015+v2.pdf> Report on processes and products launched in several countries. Includes alternative toilet options, biodegradable bags, non-stick coating, latrine pit linings, superstructures, and raised latrines, household and communal handwashing, desludging, sludge treatment with ammonia, lime, lactic acid, bio additives, worms, anaerobic digestion, and heat treatment.

High Altitude and Cold Weather Sanitation

- **Solutions for Mountain Regions.** EcoSan Club of Austria. *Sustainable Sanitation Practice*. Issue 08. 2011. <http://www.ecosan.at/ssp/issue-08-solutions-for-mountain-regions>
- **"Denali climbers may soon have to carry their poop instead of tossing it in crevasses."** Verge. March 8, 2018. <https://www.theverge.com/2018/3/8/17093206/denali-national-park-human-waste-regulations-clean-mountain-can-e-coli>
- **Denali National Park Clean Climb Program Education, Climber Management, Removal of Waste: An Historical Overview.** Roger Robinson. 68 slides. 2017. <https://www.slideshare.net/sustainablesummitsinitiative/roger-robinson-denali-national-parks-clean-climb-program>
- **Human Waste in the Wild** GoogleGroup <https://groups.google.com/forum/#!forum/managing-human-waste-in-the-wild>
- **Sustainable Summits Conference 2018** <https://www.sustainable-summits2018.org/sustainable-summits-conference-en> Explores human impact on mountain regions and how to manage it.

The Sphere Handbook, Humanitarian Charter and Minimum Standards in Humanitarian Response. The Sphere Project, 2011. <http://www.spherehandbook.org/en/how-to-use-this-chapter-1/> The Sphere Standards used by humanitarian workers worldwide have limited application in the US. However, they present a framework for procedures and decision making regarding hygiene promotion, water supply, excreta disposal and vector control. Chapter 1: Minimum standards in water supply, sanitation and hygiene promotion. For example, the Excreta disposal standard has two parts 1: Environment free from human feces. 2: Appropriate and adequate toilet facilities. Appendices include: Needs assessment checklists, numbers of toilets required in institutions, transmission mechanisms for various diseases, and a decision tree for treatment and storage of household water.

Sustainable Sanitation in Cities: A framework for action. Lüthi, C., Panesar, A., Schütze, T., Norström, A., McConville, J., Parkinson, J., Saywell, D., Ingle, R. Sustainable Sanitation Alliance (SuSanA), International Forum on Urbanism (IFoU), Papiroz Publishing House, 2011. 164 pages. <http://www.susana.org/en/resources/library/details/1019> report of the Sustainable Sanitation Alliance (SuSanA) and the International Forum on Urbanism analyzes the situation of urban sanitation within an urban development framework.

1.A Knowledge Hubs for Alternative Sanitation

Sustainable Sanitation Alliance (SuSanA). <http://www.susana.org/en/> SuSanA is an open international alliance of practitioners, policy makers, researchers, and academics dedicated to a systems approach to sanitation provision. understanding viable and sustainable sanitation solutions. The overarching goal of the SuSanA is to contribute to the achievement of current and future international development goals (SDGs). SuSanA maintains an online library of thousands of reports, case studies, videos and photos

Sustainable Sanitation Alliance (SuSanA) Forum. <http://forum.susana.org/> With a free membership in the 8000+ member strong Forum, researchers and practitioners can address questions and comments to experts throughout the world.

Sustainable Sanitation and Water Management Toolbox. <http://www.sswm.info/> New, more intuitive and user-friendly edition of the Toolbox was released in March 2018. Documents and tools close the look by linking "Sustainable Sanitation, Water Management & Agriculture". Multi-lingual site combines clarity on the fundamental concepts with a myriad of practical tools for planning and implementation.

Akvopedia Sanitation Portal http://akvopedia.org/wiki/Main_Page Open source wiki designed to improve projects through knowledge exchange. Companion site is the Water Portal.

Sustainable Sanitation for the 21st Century. <http://www.sustainablesanitation.info/> Authors Jan-Olof Drangert, Caroline Schönning, and Björn Vinnerås offer a sourcebook, a set of powerpoints and other source support material for training of professionals for the sanitation and water sector. Each of 25 modules of free 6 week course is clearly laid out and combines illustrated explanatory source materials and links to further reading with a slide presentation.

Decentralized Water Resources Collaborative (DWRC) <http://www.decentralizedwater.org/default.asp> As neighborhood and cluster wastewater systems adopt remote sensing and monitoring of unmanned facilities and treatment technologies such as membrane bioreactors, they are becoming more viable alternatives to centralized wastewater treatment. Decentralized Collaborative offers information on case studies, monitoring, performance, cost, and other aspects of these systems. Begun as cooperative effort funded by the U.S. EPA to support research and development on decentralized wastewater and stormwater systems.

EcoSanRes <http://www.ecosanres.org/index.htm> Stockholm Environment Institute's early research, publications, factsheets, graphics, and ecosan resources focus on the developing world.

Cape Cod EcoToilet Center. East Falmouth, MA. <https://capecodecotoiletcenter.com/> The center was founded by Earle Barnhardt and Hilde Mangy as part of The Green Center to introduce more people to "sustainable sanitation" technologies.

Watershed Management Group. <https://watershedmg.org/> Tucson, Arizona-based WMG develops community-based solutions for the long-term prosperity of people and health of the environment. They offer a variety of services and workshops in composting toilet systems, rainwater and greywater harvesting, and desert gardening.

Water Environment Research Foundation (WERF) <http://www.werf.org/> Formed in July 2016 as the result of the merger of Water Environment Research Foundation and the WaterReuse Research Foundation, conducts research to treat and recover beneficial materials from wastewater, stormwater, and seawater including water, nutrients, energy, and biosolids. WERF materials inform policymakers and the public on the science, economic value, and environmental benefits of wastewater and recovering its resources, as well as the feasibility of new technologies. WERF administers the EPA grant supporting this effort with a combination of sub-grants to the individual partners and through competitive Request for Proposals (RFP). Contractors include qualified universities, consulting firms, non-profits, municipalities, and others.

Chris Canaday's appropriate low cost technologies. California-born researcher manages a nature preserve in Ecuador where he is married into an indigenous community.

- **Simple urine-diverting dry toilets built with recycled or readily available materials.** Sustainable Sanitation Practice Issue 6. Ecosan Club Austria, 2011. <http://www.susana.org/en/knowledge-hub/resources-and-publications/library/details/968> Models include a portable toilet for squatting made from a barrel, portable wood and linoleum, a permanent toilet and portable urinal made from two plastic bottles for use for poor communities, disaster relief camps, and events.
- **A Free Minimalist Urine-diverting Dry Toilet (UDDT) for the Unhoused, Poor or Disaster-stricken.** PHLUSH blog, October 14, 2013. <http://www.phlush.org/?s=Chris+Canaday> A simple plastic bottle urinal is coupled with instructions on using breathable woven plastic bags to contain feces away from flies, animals and children and allow it to desiccate and control vectors.
- **The Shitty State of Human Sanitation** in Chekhov's Kalashnikov: Citizen Journalism strikes back. Part 1: The Problem. 2014. <http://www.chekhovskalashnikov.com/water-sanitation/> Part 2: The Solution <http://www.chekhovskalashnikov.com/human-waste-disposal/>

IRC WASH tools <https://www.ircwash.org/wash-tools> Tools and guidance for governments, NGOs and donor agencies developed by IRC and their partners around the world. Includes a few 'off the shelf' tools but most provide a practical starting point for tailored solutions.

Wikipedia Sanitation Project Implemented by the Sustainable Sanitation Alliance with funding from the Bill & Melinda Gates Foundation, this project monitors editing of articles based on recent quality research.

- Container-based sanitation https://en.wikipedia.org/wiki/Container-based_sanitation
- Urine-diverting dry toilet https://en.wikipedia.org/wiki/Urine-diverting_dry_toilet
- Composting toilets https://en.wikipedia.org/wiki/Composting_toilet

1.B Urinals

Technology review of urine diversion components. Overview of waterless urinals, urine diversion toilets, urine storage and reuse systems. von Münch, E., Winker, M. Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, 2011.

<http://www.susana.org/en/resources/library/details/875> Written for those new to the topic of urine diversion or ecological sanitation, this work discusses purposes of urine diversion, its benefits and challenges, urine precipitation, urine treatment and reuse in agriculture. Includes supplier information and indicative costs. Hard copies available on request from ecosan@giz.de.

'Volume of a Human Bladder'. The Physics Factbook: An encyclopedia of scientific essays. <https://hypertextbook.com/facts/2001/DanielShaw.shtml>

Wurinatu - a Flowery Public Urinal for Women. <http://inodoroseco.blogspot.com/> On is Inodoroseco blog, Chris Canaday shows how to make a number of low-cost, no-cost urinals from recycled containers. Chris is generous about answering questions and can be reached through the Sustainable Sanitation Alliance Forum.

Uridan Waterless. European producer of high quality waterless urinals. <http://www.uridan.com/en/>

L'Uritonnoir. <http://www.uritonnoir.com/en/> Designed by Studio Faltazi, this urinal for events consists of a hay bale with an easy to make plastic urinal inserted. 2-min video shows how to construct and use and reuse in a rural situation. Sells online for 20€.]

1.C Vendors, Kits and DIY Plans

Disclaimer: For information only NOT endorsements. Please note that while most "composting toilets" may initiate a composting process, additional composting or other treatment is required.

- **AirHead Composting Toilet.** <http://airheadtoilet.com/> Separates urine within bowl into bottle that is easily emptied. Has handle to mix feces with carbon material. Small fan helps desiccates contents. Designed by a sailor who exhibits annually at the Port Townsend Wooden Boat Festival. Coast Guard approved and used widely in RVs.
- **Barrel Compost Toilets** <http://www.tinosecolodge.gr/news/barrel-compost-toilets/>
- **BoonJon Portable Composting Toilet.** http://www.c-head.com/BoonJon_system.html United States. Sold as kits with different models, sizes, and finishes.
- **Borealis Systems: A Low Cost Site-Built Composting Toilet System.** R.L. Crosby, Willow, AK, 2009. <http://biorealis.com/composter/rotating/> Do-it-yourself container based system features: 1. Batch feed: No contact between finished compost and fresh waste. Material removed is fully aged and can be handled safely. 2. Modular: Modules can be added or removed to accommodate any requirement- single family, multi-family, institutional. 3. Low maintenance: No moving parts; only non-corroding materials in contact with wastes. Periodic maintenance is removing, emptying and replacing a plastic drum. 4. Removed material is aged, light, odor-free humus. 5. Low energy use: Aeration/evaporation system uses exhaust air from existing household ventilation system or is added. 6. Simple Design: Can be locally built, no specialized tools or skills, using 55 gal drums. Lends itself to local self-help solutions, creation of local jobs, small business opportunities. Plans available for a small fee.
- **Composting Toilets Made From Wheelie Bins.** by Samuel Alexander. Permaculture Research Institute. July 30, 2014. Illustrated instructions for making a low cost aerated toilet with a leachate drain. <https://permaculturenews.org/2014/07/30/composting-toilets-made-wheelie-bins/>
- **Clivus Multrum.** US, France, Australia. <http://www.clivusmultrum.com/>

- **EcoTech Carousel Composting Toilet System.** Norway. <https://ecotechproducts.net/product/ecotech-carousel-composting-toilet-system/> From a toilet stool—either waterless or micro-flush—a connection pipe drains through the floor to one of four chambers enclosed in an outer tank. Excrement and toilet paper products enter one chamber at a time. When one chamber is full, the entire inner chamber is moved so the next chamber can fill. Excess liquid drains to an outer container.
- **Envirolet Eco Sanitation Systems.** <http://www.envirolet.com/> Various products for markets in the US, Canada, Europe and Finland.
- **Nature's Head Composting Toilet.** <https://compostingtoiletsusa.com/natureshead/?gclid=CPnMgPiPo8wCFYVrfgodM48DmA> Similar to AirHead but requires more disassembly to empty urine bottle.
- **Omick Barrel Composting Toilet System** http://www.omick.net/composting_toilets/barrel_toilet.htm A toilet seat and ventilation system are fitted directly on top of a 55 gallon polyethylene barrel which serves as a composting chamber, eliminating the need to empty buckets, which facilitates permitting in some jurisdictions. It's being pilot tested by the Arizona Department of Environmental Quality and funded by an Environmental Protection Agency grant to the Tucson-based [Watershed Management Group](#).
- **Phoenix Composting Toilet.** Advanced Composting Systems LLC. United States. <http://www.compostingtoilet.com/> Company products found in many US state and national parks.
- **Relieve: Compost Toilets in Time of Need.** Relieve. 2011. <http://www.composttoilets.co.nz/index.php/instructions/> Instructions on how to build a two bucket household system with additional wheelie bin dehydration and treatment. The work of this New Zealand Permaculture group following the March 2011 Christchurch earthquake inspired the adoption of the system by PHLUSH and the City of Portland. More resources on organization's site
- **Rota Loo Composting toilet systems.** Australia. <http://earthwiseharmony.com/PRODUCTS/EH-Rota-Loo-Composting-Toilet-Systems.html> Individual bins on the internal carousel allow the waste to compost away from fresh input. The bins are easily removed for emptying when compost is hygienized.
- **SanCor Eco Sanitation.** Canada. <https://www.sancor.ca/> Dealers in [Envirolet](#) and [Santerra Green](#).
- **Santerra Green** <https://composting-toilet.com/> Waterless and low-water composting toilets.
- **Separate Waterless Toilets.** <http://www.separett.com/> Swedish producer of several models of urine diverting toilets
- **SunMar.** United States and Canada. <http://www.sun-mar.com/prod.html>
- **Toilet Tech Solutions.** United States. <http://www.toilettech.com/> All urine is diverted and treated onsite by native or engineered soil. Fecal matter and toilet paper are consumed by invertebrates (TTS-Decompose), or dried and burned onsite (TTS-Waste Away) leaving little residue. Seattle-based Toilet Tech owner Geoff Hill completed his PhD on waterless human waste management in 2013.
- **A Tour around my Toilet.** Chris Smaje in *Resilience* (blog). March 29, 2016. <http://www.resilience.org/stories/2016-03-29/a-tour-around-my-toilet/> Addressed to a western audience, this article shows a workable urine diverting container based sanitation system. There is sufficient info to design and build a toilet using twin IBCs (intermediate bulk containers) for longer term treatment/containment of feces. For neighborhood level disaster preparedness, emergency managers might use IBCs to store water. A manual fork lift could serve several neighborhoods. The seat used is a Separett Privy 501.

3. HYGIENE AND PATHOGEN CONTROL

Centers for Disease Control and Prevention Materials

- **Show Me the Science - How to Wash Your Hands.** <https://www.cdc.gov/handwashing/show-me-the-science-handwashing.html>
- **Show Me the Science - When & How to Use Hand Sanitizer.**
<https://www.cdc.gov/handwashing/show-me-the-science-hand-sanitizer.html>
- **Safe and Healthy Diapering for Emergency Settings.** CDC Print-and-Go Fact Sheet.
<https://www.cdc.gov/healthywater/emergency/hygiene-handwashing-diapering/diapering-emergency-settings.html>
- **Planning Checklist for Diapering Stations in Shelters.** CDC Print-and-Go Fact Sheet.
<https://www.cdc.gov/healthywater/emergency/pdf/diapering-in-emergency-settings-checklist508c.pdf>

Menstrual Hygiene Management in Emergencies

<https://www.mailman.columbia.edu/become-student/departments/sociomedical-sciences/programs/menstrual-hygiene-management-emergencies>

MHM in Emergencies project is a collaboration between Columbia University's Mailman School of Public Health, International Rescue Committee and Research for Health in Humanitarian Crises. See especially *MHM in Emergencies Toolkit: The Mini Guide*. 34p. Columbia University and International Rescue Committee. 2017. <https://www.mailman.columbia.edu/sites/default/files/pdf/mhm-emergencies-mini-toolkit.pdf>

Emergency treatment of drinking-water at the point of use. World Health Organization. WEDC. Technical Notes on Drinking-Water, Sanitation and Hygiene in Emergencies. 4p. http://www.who.int/water_sanitation_health/publications/2011/tn5_treatment_water_en.pdf

Global Water Pathogen Project. www.waterpathogens.org GWPP is knowledge resource and hub on water pathogens which will guide the goals for sanitation and achieving safe water using the power of new information technology and tools. GWPP areas of research include Indicators and Microbial Source Tracking; Bacteria, Viruses, Protists, Helminths (40 Pathogens); Persistence; Sanitation Technology and Disinfection; and Risk Assessment.

Microbial source tracking in impaired watersheds using PhyloChip and machine-learning classification. EA Dubinsky, SR Butkus, GL Andersen. *Water Research*. Nov 15. 9p. 2016.

<https://www.ncbi.nlm.nih.gov/pubmed?cmd=Search&doptcmdl=Citation&defaultField=Title%20Word&term=Dubinsky%5Bauthor%5D%20AND%20Microbial%20source%20tracking%20in%20impaired%20watersheds%20using%20PhyloChip%20and%20machine-learning%20classification> As sources of fecal indicator bacteria are difficult to identify in watersheds with various non-point sources, researchers developed a source tracking test using the PhyloChip microarray that distinguishes fecal bacteria from humans, birds, ruminants, horses, pigs and dogs with a single test. The test identified bacteria in a California watershed with antiquated septic infrastructure and at popular beaches during dry and rainy periods. Results show PhyloChip microarray data can outperform conventional single marker tests.

Focus on Microbial Source Tracking. Washington Department of Ecology. 5p. Feb 2012.

<https://fortress.wa.gov/ecy/publications/documents/1203010.pdf> Microbial source tracking (MST) is a set of techniques used to determine sources of fecal bacteria introduced into water bodies by humans, wildlife, or domestic animal sources.

Microbial Indicators - "Workhorses" in the Field of Health-related Water Quality Testing. A. Farnleitner and A. Blanch. Editorial. In: J.B. Rose and B. Jiménez-Cisneros, (eds) Global Water Pathogens Project. Michigan State University, E. Lansing, MI, UNESCO. August 2017.

<http://www.waterpathogens.org/node/partIIeditorial> Two-page WSUP policy brief here.

<https://www.wsup.com/insights/modelling-faecal-pathogen-flows-in-urban-environments-a-proposed-approach-to-inform-sanitation-planning/>

Faecal Pathogen Flows and Their Public Health Risks in Urban Environments: A Proposed Approach to Inform Sanitation

Planning. Freya Mills, Juliet Willetts, Susan Petterson, Cynthia Mitchell, and Guy Norman. *International Journal of Environmental Research and Public Health*. 2018. <https://www.ncbi.nlm.nih.gov/pubmed/29360775> An early concept-stage model that could be used to predict the effect of different sanitation interventions on pathogen flows through urban environments to predict effects on disease risk. Designed to build a practical model to help urban policymakers and funders definitively link specific sanitation interventions to health outcomes. See also 2p WSUP brief here.

<https://www.wsup.com/insights/modelling-faecal-pathogen-flows-in-urban-environments-a-proposed-approach-to-inform-sanitation-planning/>

Berkeley Lab Scientist Invents Portable DNA Extraction Kit, Helps Haiti. Julie Chao. Lawrence Berkeley National Laboratory News Center. October 28, 2013. <http://newscenter.lbl.gov/2013/10/28/berkeley-lab-scientist-invents-portable-dna-extraction-kit-helps-haiti/> An inexpensive PhyloChip kit to test presence of pathogens was developed by Berkeley's Gary Andersen collaboration with Sasha Kramer of SOIL in Haiti.

4. TREATMENT OF URINE AND FECES

Design and Technologies of Decentralised Treatment Facilities. Water Services Trust Fund (WSTF), Nairobi, Kenya, 2015. Manuals and further documents developed in the context of GIZ's Water Sector Reform Programme. Water Services Trust Fund (WSTF), 2015.

<http://www.susana.org/en/resources/library/details/2448> Extensive documentation of planning and construction various decentralized systems in Kenya.

"Composting" Issue 26 of *Sustainable Sanitation Practice*. 36 pp. <http://www.ecosan.at/ssp/issue-26-composting> Initial article "Lessons learned – how to produce quality compost" summarizes the basic requirements for sustainable composting of biogenous wastes including feces.

Composting of separately collected biowaste in Vienna - an example of BAT Low cost composting options: Case-study of the Municipalities of Argos–Mycenae and Nafplio, Greece; Planting tests with wastewater treatment sludge compost in China.

Ascaris and Escherichia coli Inactivation in an Ecological Sanitation System in Port-au-Prince, Haiti. David Berendes, Karen Levy, Jackie Knee, Thomas Handzel, Vincent R. Hill, PLOS One 2015. 10 pages.

<http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0125336> This study evaluated the microbial die-off in a latrine waste composting system in Port-au-Prince, Haiti. Temperature data and samples were collected from compost aged 0 – 12+ months. Findings indicate that the Haitian EcoSan composting process was effective in inactivating *E. coli* and *Ascaris* spp. in latrine waste within sixteen weeks. Study is one of the first to document efficacy of an ecological sanitation system under field conditions and provides insight into composting methods and monitoring for other international settings.

Thermophilic composting of human wastes in uncertain urban environments: A case study from Haiti. S. Kramer, N. Preneta & A. Kilbride, SOIL. 36th WEDC International Conference, Nakuru, Kenya. 6 pages.

<https://www.oursoil.org/soil-presents-at-wedc-2013-thermophilic-composting-of-human-wastes-in-uncertain-urban-environments-a-case-study-from-haiti/> The January 2010 Haiti earthquake left nearly 1.5 million Port-au-Prince residents living in camps without access to sanitation. The first treatment facility constructed post-earthquake was a thermophilic composting site designed to treat the wastes from 20,000 earthquake victims living in camps. Despite multiple hurricanes, a cholera epidemic, and political unrest, the SOIL composting facilities have treated over 500,000 gallons of human waste in the past three years, converting it to pathogen free compost, over 10,000 gallons of which has been sold for use in agriculture and reforestation projects. The experience of thermophilic composting in Haiti is unique in scale and duration and can have global implications for waste treatment in both emergency and development contexts.

Bacterial community structure transformed after thermophilically composting human waste in Haiti. Y.M. Piceno, G. Pecora-Black, S. Kramer, M. Roy, F.C. Reid, E.A. Dubinsky, et al. PLoS ONE 12(6). 2017. <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0177626>

Vermicomposting toilets, an alternative to latrine style microbial composting toilets, prove far superior in mass reduction, pathogen destruction, compost quality, and operational cost. Geoffrey B. Hill and Susan A. Baldwin *in Waste Management*.

Vermistabilization of sewage sludge (biosolids) by earthworms: converting a potential bihazard destined for landfill disposal into a pathogen-free, nutritive and safe biofertilizer for farms. Sinha, R.k., Herat, S., Bharambe, G., et al., 2009. *Waste Management & Research* 28, 872–881.

The Effectiveness and Safety of Vermi-Versus Conventional Composting of Human Feces with *Ascaris suum* Ova as Model Helminthic Parasites. Geoff B. Hill, Cecilia Lalander, Susan A. Baldwin. *Journal of Sustainable Development*, 2013.

http://solvita.com/wp-content/uploads/2013/04/Vermi_vs_composting_humanfeces_JSD.pdf Abstract: Composting toilets have been promoted for management of human waste at remote sites in parks and alpine areas of recreation, but they may not be effective for producing a stable and safe end product. Vermicomposting has been shown to result in a more degraded final product but its effectiveness for pathogen destruction was unclear due to conflicting information in the literature. This study sought to resolve the debate on whether or not vermicomposting could produce a hygienic end product that would be safe for disposal locally. Vermicomposting was tested for destruction of the model pathogens, helminthic parasites. Despite these improvements in fecal matter processing, vermicomposting was found

ineffective at reducing *Ascaris suum* ova concentration and viability. Decentralized vermicomposting can efficiently stabilize and mature fecal matter; however prior to unrestricted end product use, an additional sanitation step is necessary.

Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management. Clive A. Edwards, Norman Q. Arancon, Rhonda L. Sherman, CRC Press, 2010. 623 pages, \$129.95.
<https://www.crcpress.com/Vermiculture-Technology-Earthworms-Organic-Wastes-and-Environmental-Management/Edwards-Arancon-Sherman/p/book/9781439809877> Definitive work on how earthworms and microorganisms interact to break down organic wastes on a commercial basis. Focuses on innovative vermiculture technology that turns organic waste into a value-added environmentally friendly products that can improve soil fertility and productivity on a large scale.

Development of a continuous single chamber vermicomposting toilet with urine diversion for on-site application. C. Buzie-Fru, PhD thesis, Hamburg University of Technology (TUHH), Hamburg, Germany, 2010. 135 pages.
<http://www.susana.org/en/resources/library/details/1333> A laboratory scale flow-through model reactor for the treatment of faecal matter by vermicomposting is presented. The system was setup to investigate conditions likely to be experienced in urine diverting dry (UDD) sanitation systems based on vertical loading, continuous-flow vermicomposting. Testing was designed to utilize the feeding habits and reproductive cycles of the earthworm *Eisenia foetida*. Fecal matter tainted with differently colored non-biodegradable glass markers and fed continuously in thin layers to the upper part of the reactor flows down and subsequently comes in contact with upward migrating earthworms.

Terra Preta Sanitation (TPS) Handbook. Women in Europe for a Common Future. July, 2015.
<http://www.wecf.eu/english/publications/2015/terrapreta-handbook.php> This handbook provides an account of main theories of Terra Preta formation and principles of Terra Preta Sanitation concerning material recycling and soil fertility improvement. This first edition of provides an authoritative account of the main theories of Terra Preta formation and the principles of TPS concerning material recycling and soil fertility improvement. It takes full account of the extensive developments which have occurred since the outset of the ecological sanitation approach.

The Earth Moved: On the Remarkable Achievements of Earthworms. Amy Stewart Algonquin Books of Chapel Hill, 2005.
<http://www.amystewart.com/books/the-earth-moved/> See especially "Garbage into Gold" and "Public Duties" pp 148-174. Available in print, e-reader, and audible.com.

To assess the impact of black soldier fly (*Hermetia illucens*) larvae on faecal reduction in pit latrines. IJ Banks PhD thesis, London School of Hygiene & Tropical Medicine, 2014. <http://researchonline.lshtm.ac.uk/1917781/> Black soldier fly larvae (BSFL) efficiently reduce food-waste and animal manure, and produce valuable prepupae, high in protein and fat, supporting investigation into a novel BSFL FSM method. The study evaluated faecal matter reduction (FMR), and prepupal production capacity, when reared on FS under different conditions. Black soldier fly larvae were found to develop successfully on fresh human faeces, effectively reducing waste and converting it to prepupal biomass.

New concepts for on-site sanitation based on bio-additives and pit design. J. Ensink et al. London School of Hygiene and Tropical Medicine (LSHTM), London, UK and Bearvalley Ventures, UK 2013. T<http://www.susana.org/en/resources/library/details/1743> his is library of background documents for a grant funded by the Bill and Melinda Gates Foundation.

A Low Cost Site-Built Wastewater Treatment System. R.L. Crosby, Biorealis Systems, Inc, Willow, AK, 2009, updated 2013. http://biorealis.com/biofilter/drumbiofilter/#surge_pump This simple wastewater treatment system developed can be owner-built from locally available materials at a fraction of the cost of typical existing commercial units, while providing performance equal to, or superior to systems costing far more.

5. REUSE OF URINE AND FECES

Closing the Loop: Ecological Sanitation for Food Security.

http://www.undp.org/content/undp/en/home/librarypage/environment-energy/water_governance/closing-the-loop-ecological-sanitation-for-food-security/ United Nations overview illustrates how current sanitation practice is putting the world at risk of disease and starvation and how cycling nutrients through ecosan practice can restore health to soils, water and people.

Urine – the yellow gold: Safe re-use of human urine from ecosan toilets to increase your yields.

<http://www.wecf.eu/english/publications/2010/urine-flyer.php> Women in Europe for a Common Future, 2015. Two page flyer carries the latest info on urine separation and application on plants.

Natural Fertilizer Market Assessment Project. https://projects.sare.org/sare_project/ow14-020/?page=narrative&view=print Nicole Cousino, [The Give Back Project](#). Final Report for Western SARE Project Number: OW14-020.

Analysis of Pharmaceuticals in Food Crops Grown in Urine and Struvite-Fertilized Soil by Liquid Chromatography-Tandem Mass Spectrometry. <http://richearthinstitute.org/wp-content/uploads/2015/10/Pharmaceuticals-in-Urine-and-Related-Products-ACS-Poster.pdf> Poster of research by The Rich Earth Institute and universities.

Utilizing Human Urine as a Liquid Fertilizer in Agriculture David Crowweller, 2016?

<http://forum.susana.org/media/kunena/attachments/65/UrineResearchDocument.pdf> A Case Study of Brinjal (Aubergine) cultivation in India. 15 p. Citations.

Visit to the nation's 1st wastewater facility producing struvite commercially. PHLUSH blog, April 18, 2011. An introduction to the Ostara technology used by Clean Water Services in Oregon.

BIOUREA <http://www.huussi.net/en/activities/on-going-projects/biourea/> Ongoing joint project of Tampere University of Applied Sciences, Global Dry Toilet Association and the Finnish Environment Institute on large scale utilisation of toilet based fertiliser products. Key objectives are to develop and test technologies for collection and management, acquire official acceptance and permit for using these fertilizers in agriculture in Finland, and to demonstrate the efficiency and safety of product use. Funded by the Ministry of Environment to promote the recycling of nutrients and to improve the health status of the Archipelago Sea.

Australia Leads the World with Wheelie Bin Compost Toilets. by Geoff Lawton. Permaculture Research Institute. October 15, 2014. <https://permaculturenews.org/2014/10/15/australia-leads-world-wheelie-bin-compost-toilets/> Following a pilot test, 258 wheelie bin toilets were legally deployed at a festival site in re-purposed shipping containers. The result was a significant reduction in waste-water truck movements, the transportation of hundreds of port-a-loos and showers to and from the site and a dramatic reduction in waste being sent to the treatment plant. Fertilizer produced goes to a native tree planting program on site. A gravel reed bed grey water treatment facility complements the system.

The Humanure Handbook. <http://www.weblife.org/humanure/> Joseph Jenkins. 1999. Popular early work on container-based sanitation, composting and reuse. Free download for nonprofit use has links to individual sections.

6. MESSAGING AND ADVOCACY

"The Taboo Secret to Better Health" Molly Danielsson Winter, TEDx Bend, 2016.

https://www.ted.com/talks/molly_winter_the_taboo_secret_to_healthier_plants_and_people?language=en With elegance and charm, Winter argues that advanced potty training and a desire to ask the right questions is a prerequisite for the innovation that can master excreta reuse, restore dwindling water supplies and bring health and well being. This compelling overview of the situation and has nearly a million and a half views.

Restorative Sanitation: Why wait until disaster strikes? PHLUSH, 2013.

<http://www.phlush.org/nine-actions-for-you-to-take/borrow-restorative-sanitation-display/> Portable exhibit with four 60" x 18" self-standing panels entitled SEPARATE, CONTAIN, COMPOST and WASH HANDS, which illustrate the twin bucket emergency toilet system. Based on *A Sewer Catastrophe Companion*, endorsed by the Portland Bureau of Emergency Management, and funded by the East Multnomah Soil and Water Conservation District, the exhibit is available from PHLUSH. Contact info@phlush.org to request loan and shipment. Groups that wish to replicate the exhibit may request high resolution pdfs.

PHLUSH Public Toilet Advocacy Kit, 65 pages, 2015. <http://toolkit.phlush.org/> The purpose of the Public Toilet Advocacy Toolkit is to strengthen the capacity of citizen advocates and city officials to provide and maintain great public toilets - including alternative facilities - that make communities livable, respect human dignity and promote health and well-being. Tools from the *Toolkit* include:

- Bring Stakeholders Together to Plan <https://drive.google.com/file/d/0B5Q56ATMstzITzdfRTIRZEFGcnc/view>
- Understand Codes and Regulations <https://drive.google.com/file/d/0B5Q56ATMstzISDRhRC1FRnZPd1E/view>
- Mobilize Support from Residents, Business and Local Officials <https://drive.google.com/file/d/0B5Q56ATMstzIUkV1VUN4ajgySFE/view>
- Orchestrate Media Advocacy and Work with Journalists <https://drive.google.com/file/d/0B5Q56ATMstzIMUxROGxhaGRMdzQ/view>

“Are we doing the right thing? Critical questioning for city sanitation planning.” Institute for Sustainable Futures, Sydney, Australia.

And SVN, The Netherlands. 2016?

http://www.snv.org/public/cms/sites/default/files/explore/download/isf_snv_-_learning_paper_-_critical_questioning_for_city_sanitation_planning_0.pdf Looks at theories of planning, how projects fail, and how to mobilize skills, capacity, motivation, and financing.

Zombie Preparedness. Centers for Disease Control and Prevention. Office of Public Health Preparedness and Response.

<https://www.cdc.gov/phpr/zombie/index.htm> What the CDC first began as a tongue-in-cheek campaign to engage new audiences with preparedness messages has proven to be a very effective platform. This site is a repository of materials to reach and engage audiences on all hazards preparedness via “zombie preparedness”.

“How the Pacific Northwest is preparing for a catastrophic tsunami.” Gwen Ifill, PBS, 2016.

<https://www.youtube.com/watch?v=jOZv5pjne6s> Compelling 9 minute PBS video segment.

Climate Narrative. Breakthrough Strategies and Solutions. <http://www.climatenarrative.org/> Tested messaging to engage Americans on Climate Change. Includes guide and free training.

7. CURRENT CODES AND REGULATIONS

Water Efficiency and Sanitation Standard for the Built Environment. WE Stand 2017, IAMPO/ANSI. \$70.00. Ask your library to order!

http://iapmmembership.org/index.php?page=shop.product_details&flypage=flypage_iapmo.tpl&product_id=1143&category_id=6&option=com_virtuemart&Itemid=3&vmcchk=1&Itemid=3 This important new American National Standard provides minimum requirements for water use practices that maintain protection to public health, safety, and welfare. It applies to residential and commercial building indoors and outdoors. It contains the first set of comprehensive codified requirements for composting and urine diversion toilets, and progressive provisions for uses of graywater generated from clothes washers in landscape irrigation.

Opportunities for Achieving Next Generation Water Infrastructure in California, Oregon and Washington.

<http://www.recodenow.org/wp-content/uploads/2017/12/17-1120ReWaterTop10-1.pdf> Recode, International Living Future Institute, Oregon

Environmental Council, 2017. Working with a broad spectrum of stakeholders, the authors identify barriers and offer a coherent approach to creating and testing solution pathways. Noting the rapidly changing world of the treatment of drinking water, greywater and blackwater, they focus on performance codes rather than prescriptive process-oriented codes.

Recode. <http://www.recodenow.org/> Recode is an Oregon nonprofit that works to ensure access to and accelerate adoption of sustainable building and development practices. Recode drafted composting toilet and urine-diverting composting toilet code for IAPMO's 2015 Green Plumbing and Mechanical Code Supplement, which is the foundation for the 2017 National Standard for water efficiency. Recode also contributed to the composting toilet and light straw clay sections of Oregon's 2011 Reach Code, which legalized site built and non-NSF composting toilets. Among Recode's partners are the International Living Futures Institute, the Oregon Environmental Council and the Bullitt Foundation.

Rules and Regulations For Onsite Wastewater Treatment Systems. Oregon Department of Environmental Quality.

<http://www.oregon.gov/deq/Residential/Pages/Onsite-Rules.aspx>

- **Groundwater protection in Oregon.** Oregon DEQ. <http://www.oregon.gov/deq/wq/programs/Pages/GWP.aspx>
- **Graywater** <http://www.oregon.gov/deq/wq/programs/Pages/Water-Reuse-Graywater.aspx>
- **Fact Sheet: Water Reuse: Using Our Water Wisely. Oregon DEQ. 2011**
<http://www.oregon.gov/deq/FilterPermitsDocs/waterreuse.pdf>
- **Fact Sheet: Considerations for Installing a Composting Toilet System.** Molly Winter (Recode) for Oregon DEQ. 2017
<http://www.oregon.gov/deq/FilterDocs/os-compostingtoilets.pdf>

Water Conserving On-site Wastewater Treatment Systems: Recommended Standards and Guidance for Performance, Application, Design, and Operation & Maintenance. Washington State Department of Health Wastewater Management Program, July 2012. 64 pages. <http://www.doh.wa.gov/portals/1/Documents/Pubs/337-016.pdf> Includes recommended standards for composting, incinerating, vault and pit toilets and greywater system. The Preface states: *The recommended standards contained in this document have been developed for statewide application. Regional differences may, however, result in application of these technologies in a manner different than it is presented here. In some localities, greater allowances than those described here may reasonably be granted. In other localities, allowances that are provided for in this document may be restricted. In either setting, the local health officer has full authority in the application of this technology, consistent with Chapter 246-272A WAC and local jurisdictional rules.*

Breaking 2018 developments in Washington State code change:

- **Reclaimed Water Rule adopted** The Reclaimed Water Rule setting design and construction requirements for advanced treatment of sewage, and its use for irrigation, toilet flushing, and related uses was signed into effect January 23. Under the new rule, both DOH and Ecology may issue permits. Health will issue permits for reclaimed water projects linked to on-site sewage system permits and continue to assist Ecology with reclamation projects and permits associated with permits they issue. See Reclaimed Water Chapter 173-219 WAC. <https://ecology.wa.gov/DOE/files/2e/2e59fa6e-b5ab-4612-ba13-a56b23ba7b40.pdf>

- State Board of Health directs the Department of Health to begin rule revision on On-site Sewage Systems. The State Board of Health has directed us to begin rule revision of WAC 246-272A, the On-site Sewage System rule. Last revised in 2005, we are required to review the rule every four years to determine if it still meets its intent to protect public health and ground and surface waters. The review process included many diverse stakeholders and identified a number of key issues, including design, maintenance, and monitoring requirements that need updating in the rule. See info on WAC 246-272A here. <http://app.leg.wa.gov/wac/default.aspx?cite=246-272a>

A Northwest Vision for 2040 Water Infrastructure. Center for Sustainable Infrastructure. Evergreen State College. 2017. <http://www.evergreen.edu/sites/default/files/CSI-2040-Water-Report.pdf>

Policy Making for Healthy, Resilient Water Systems in The Puget Sound. Cascadia Green Building Council. 2011. https://living-future.org/wp-content/uploads/2016/11/Water_Policy_Brochure.pdf Good information on the counties, including Clark.

Advocating a Living Future: Advocacy Resources-Water Regulation for Resilience. Kresge Foundation & International Living Future Foundation, Dec 2015. https://living-future.org/wp-content/uploads/2016/10/Advocating_A_Living_Future.pdf Through education, innovation and advocacy Living Building Challenge and Living Community Challenge project teams are demonstrating how to achieve net positive water but regulatory norms and the inexperience of regulators hinders or blocks adoption of resilient water systems.

King County Title 28.84.050—Sewage Disposal Rules and Regulations

https://www.kingcounty.gov/council/legislation/kc_code/38_Title_28.aspx King County has recently relaxed their code to allow a value of zero for capacity charges for systems that are “engineered to function without discharging into the metropolitan sewage facilities”. Should a “zero discharge system” experience three discharge events to the metropolitan sewage facilities during any 15-year period, “the structure shall then be immediately converted to a conventional capacity charge calculation” and “assessed the full 15-year capacity charge rate applicable during the year of the third discharge event”.

SFD Manual Volume 1 and 2 Version 2.0 SFD Promotion Initiative. SuSanA, GIZ, Bill & Melinda Gates Foundation, 2017.

<http://www.susana.org/en/knowledge-hub/resources-and-publications/library/details/2357> “Shit Flow Diagrams” <http://sfd.susana.org/> are a new way of visualizing excreta management in cities and towns. Here's how to create an SFD. <http://sfd.susana.org/toolbox/how-to-make-a-sfd>

Fecal Sludge Management: Systems Approach for Implementation and Operation. L. Strande, M. Ronteltap, D. Brdjanovic, D. (Eds.) IWA, 2014. <http://www.susana.org/en/knowledge-hub/resources-and-publications/library/details/2100> Onsite sanitation functions as an intermediate or permanent standalone solution, or in combination with sewer-based systems. The appropriate and adequate management of fecal sludge deriving from onsite technologies is imperative for the protection of human and environmental health.

Northwest EcoBuilding Guild Code Innovations Database <http://www.ecobuilding.org/code-innovations/> This regularly-updated resource from Olympia WA organization is for code officials, the building industry and the public to share information about successfully permitted projects and evolving green codes.

Decentralized Water Policy Council. <https://oaec.org/our-work/projects-and-partnerships/ca-decentralized-water-policy-council/> In partnership with the California Onsite Water Association (COWA), this policy initiative of the Occidental Arts and Ecology Center and California County Regulators is seeking to make changes in water regulations acknowledged by Californians across disciplines and roles.

Plumbers without Borders <http://www.plumberswithoutborders.org/> Founded by Washington State plumbers, this dynamic nonprofit supports volunteers who engineer waterless toilet systems internationally, where there is a much larger body of evidence for the performance of next generation technologies.

Greywater Action. <https://greywateraction.org/> Greywater Action is a collaborative of educators who teach residents and tradespeople about affordable and simple household water systems that dramatically reduce water use and foster sustainable cultures of water. Includes resource lists for greywater reuse, rainwater harvesting and composting toilets.

The True Poo on Composting Toilets. By Amanda Christmann *Elephant Journal* May 9, 2016. <https://www.elephantjournal.com/2016/05/the-true-poo-on-composting-toilets/> Advice for this situation: *if your laws are unreasonable or outdated, don't be afraid to educate your city council or community on the benefits and mitigated risks.*

Legalizing the Tiny House: Bringing rogue housing in from the cold. <http://www.sightline.org/2016/06/27/legalizing-the-tiny-house/> Alyse Nelson. *Sightline*. June 27, 2016 Building codes, manufactured home codes, recreational vehicle certification and zoning codes in Cascadia make tiny-house dwellers a band of outlaws. Good info on codes and excellent ongoing discussion. Recently Oregon and Washington have instituted certification processes for self-built RVs. See Chapter 296-150R Washington Administrative Code.

Guidance for Performance, Application, Design, and Operation & Maintenance: Tier Two and Three Greywater Subsurface Irrigation Systems. Washington State Department of Health. Division of Environmental Health. Office of Shellfish and Water Protection. June 2012. 40pp. <http://www.doh.wa.gov/Portals/1/Documents/Pubs/337-063.pdf> Adopted in December 2010, Chapter 246-274 Washington Administrative Code allows greywater to be diverted from buildings for seasonal subsurface irrigation when flows are less than 3,500 gallons per day.

Useful Links Related to Greywater Reuse, Recycling, and Water Conservation. Washington State Department of Health. Regulations and systems design. <http://www.doh.wa.gov/CommunityandEnvironment/WastewaterManagement/GreywaterReuse/GreywaterLinks>

Collaborating to Legalize Graywater Reuse in Oregon. <http://www.recodenow.org/portfolio/legalizing-reuse-of-graywater-in-oregon/> Recode, 2012. Recode led coalition that successfully legalized external graywater re-use year round within greenhouses and seasonally for outdoor plants and collaborated with the team that legalized internal graywater reuse (for flushing toilets and cooling mechanical systems).

"Graywater ". Oregon Department of Environmental Quality. <http://www.oregon.gov/deq/wg/programs/Pages/Water-Reuse-Graywater.aspx> Definition, types, permitting, monitoring, technical assistance, and other regulations.

Reusing Graywater in Your Landscape: A Guide for Oregon Homeowners. State of Oregon Department of Environmental Quality.Graywater/Reuse Program, 2013. <http://www.oregon.gov/deq/FilterPermitsDocs/GraywaterGuideHomeowners.pdf>

State Rainwater Harvesting Laws and Legislation. National Conference of State Legislatures. <http://www.ncsl.org/research/environment-and-natural-resources/rainwater-harvesting.aspx> For current status of new legislation see Energy and Environmental Legislation Database.

Rainwater harvesting statutes and regulations. HarvestH2o. http://www.harvesth2o.com/statues_regulations.shtml Current webpage has a state by state listing of past and current efforts dealing with rainwater and greywater.

The American Rainwater Catchment Systems Association (ARCASA) http://www.harvesth2o.com/statues_regulations.shtml Membership nonprofit provides resources and information on rainwater collection, promote the advancement of rainwater conservation and work with state, county and other local governments.

Harvest H2o. HarvestH2o.com is dedicated to the advancement of sustainable water management practices for individuals, families, communities, and businesses.

A rainwater harvesting system reliability model based on nonparametric stochastic rainfall generator. Matt Basingera, Franco Montaltob, Upmanu Lalla. *Journal of Hydrology*. Vol 392, Issues 3–4, 15 October 2010, Pages 105–118. <http://www.sciencedirect.com/science/article/pii/S0022169410004786> The reliability with which harvested rainwater can be used as a means of flushing toilets, irrigating gardens, and topping off air-conditioner serving multifamily residential buildings in New York City was assessed using a new model. In a Bronx neighborhood, rooftop runoff into the sewer system were reduced by 28% over an average rainfall year, and potable water demand reduced by approximately 53%.

Rainwater Harvesting State Regulations and Technical Resources. Pacific Northwest National Laboratory for US DOE. June 2015 22 pages. http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-24347.pdf

8. PROTOTYPING DISASTER TOILET SYSTEMS

Citizen Science in Disaster Risk Management Summary Report of Workshop. RDR International Centre of Excellence: Community Resilience and Wellington Regional Emergency Management Office, Wellington, New Zealand. November 2015.

http://www.massey.ac.nz/massey/fms/Colleges/College%20of%20Humanities%20and%20Social%20Sciences/Psychology/Disasters/ICoE-CR/Publications/CitizenScience_2015workshop_minutes.pdf?235E6C43CF9AA7CC4013FE86618F128A This workshop brought together interested parties from across agencies, community groups, scientists, software developers and educators to explore the development, management and utilisation of citizen science projects in the context of Disaster Risk Management. The opening discussion of a new 'Citizen Science Network, speakers covered ethics, participation, community-based approaches and technologies. Key areas for development and research were identified.

Citizen science in hydrology and water resources: opportunities for knowledge generation, ecosystem service management, and sustainable development. *Frontiers in Earth Science*, October 2014.

https://www.researchgate.net/profile/Zed_Zulkafl/publication/266373436_Citizen_science_in_hydrology_and_water_resources_Opportunities_for_knowledge_generation_ecosystem_service_management_and_sustainable_development/links/543ba3f70cf24a6ddb978151/Citizen-science-in-hydrology-and-water-resources-Opportunities-for-knowledge-generation-ecosystem-service-management-and-sustainable-development.pdf Paper looks at role citizen science can play in the generation of new knowledge in relation to the water cycle and related ecosystem services, and the use of citizen science in decision-making. Includes 1. a critical review of literature on citizen science in a context of hydrology, water resources, and wider ecosystem services management. 2. explores the philosophy and motivations behind the citizen science approach. 3 reviews existing citizen science applications in hydrology and water resources sciences. 4. gives an overview of challenges and opportunities for citizen science for ecosystem services management and sustainable development and 5. case studies.

"Everybody wins: bridging the gap between scientific and local communities" Overseas Development Institute Panel, May 2014.

<https://www.odi.org/events/3929-knowledge-technology-science-community-disaster-resilience>

At-risk people and communities, humanitarian and development agencies and those with formal scientific and technological training are all producers and users of disaster risk knowledge – but with different ideas about what is useful or important information. The challenge is in bringing together this wealth of local and scientific knowledge to enable communities to become more resilient in the face of disasters.

Case Study 5: Competency Groups bring together scientific and local knowledge to develop collaborative flood risk modelling.

Humanitarian Futures, 2014. 3 page summary. <http://www.humanitarianfutures.org/wp-content/uploads/2014/05/CS5-Competency.pdf> See also

"Stopping floods on the cheap: A success story from Yorkshire." Oxford University. 2014.

<https://docs.google.com/document/d/1mmLd8wDHMs7rrPaSRBptYkFRUrKioOc8RTLTCy8yBU/edit> 4:21 min video. On successful citizen-rooted action to engage experts in solving a problem.

Citizen Science: Help make science happen by volunteering for a real research project.

<https://www.scientificamerican.com/citizen-science/> Current opportunities around the world are vetted and publicized by *Scientific American*.

Witness King Tides in Washington State. Washington Sea Grant. <http://washington.kingtides.net/> This website enables citizens to upload data and images. King Tides help people understand their current flooding and storm risks, and imagine what climate change impacts will look like in their own communities. Using smartphones and social media, participants capture and share images of the highest high tides of the year.

Children as Agents of Change for Disaster Risk Reduction: Lessons from El Salvador and the Philippines. Thomas Tanner and Katharine Haynes, May 2009.

https://www.researchgate.net/publication/228376320_Children_as_Agents_of_Change_for_Disaster_Risk_Reduction_Lessons_from_El_Salvador_and_the_Philippines Paper challenges assumption of top down preparedness and response efforts by examining how children's voices are represented and heard in disaster risk reduction (DRR) policy and decision-making spaces, and by assessing the level of capacity children have for preventing disasters vis-à-vis their parents.

Youth Participation in Disaster and Risk Reduction: A review of Case Studies from South East Asia. Abigail Brown, Adriana Calle Jorda, Mehlka Mustansir, Lou Perpes, Alexis Toulza. Sciences Po Paris Advocacy: Philosophy and practice - 2016. While children are extremely vulnerable to these disasters, they are integral parts of their communities and can have agency in prevention, response, and recovery if proper space is given to them. It is essential to include children in DRR initiatives. Measures to increase their awareness can foster kids' innovative capacity and creativity to benefit the community. Child-led DRR initiatives are thus a significant way to empower them and have a positive impact on activities carried out by adults. Contact PHLUSH Director [Abigail Brown](#) for details.

Youth participation in disaster risk reduction through science clubs in the Philippines. [Glenn Fernandez](#) and Rajib Shaw. 2011. This study examines how the Filipino youth can be actively involved in DRR through existing science clubs. In 2010, in cooperation with a partners PSYSC organised a national summer camp where science club members learned how to prepare for and respond to disasters. Topics included explanations of geological and hydro- meteorological hazards; recent major disasters in the Philippines; advances in Doppler radar and seismograph technology; the impact of disasters on national development; community-based disaster risk management; and activities that science clubs can actually do to help in building the disaster resilience of their community.

What is Human-Centered Design? IDEO. <http://www.designkit.org/human-centered-design> Launched in the 1980's by the firm IDEO, Human-centered design is a process informed by users that uses rapid prototyping and real-world testing. Methods section is a step-by-step guide to unleashing creativity, putting the people served at the center of the design process so they come up with new answers to difficult problems. Case studies are stories of innovation and impact that show how human-centered design gets real results.

Design Kit: The Course for Human-Centered Design IDEO.org and the Acumen Fund. <http://www.designkit.org/resources/5> Seven-week courses introduce to the concepts of human-centered design to those working towards social change. Participants apply HCD to design challenges of their own. Online course starts periodically.

The Field Guide to Human Centered Design. IDEO. <http://www.designkit.org/resources/1> Demonstrates IDEO's process with the key mindsets, 57 clear-to-use design methods for new and experienced practitioners, and from-the-field case studies of human-centered design in action. Helps understand the people you're designing for, to have more effective brainstorming, to prototype ideas, and to arrive at more creative solutions. Free download in 6 languages.

HCD Case Study: Clean Team: In-Home Toilets for Ghana's Urban Poor IDEO. <http://www.designkit.org/case-studies/1> IDEO developed a comprehensive sanitation system with a custom-designed stand-alone rental toilet as well as a waste-removal system, and the design work extended to the entire service ecosystem.

Characteristics of Human Centered Design. Rafiq Elmansy, Designorate, Feb 10, 2015. <http://www.designorate.com/characteristics-of-human-centered-design/> Short read with resource list.

User-centered Design. Grameen Foundation. <https://www.youtube.com/watch?v=6mcZKWhjr9o> 2:26 minute video on product failure and the 14 characteristics of successful launches.

What is human-centered design — and why does it matter? DevEx and Chemonics. November 2016. <https://www.youtube.com/watch?v=0bxtEqM2TQU> breaks down exactly what it is and why it matters for the global development community — and delves into some of the ways it could help organizations work more efficiently.

Human Centered Design: an Introduction Coursera. <https://www.coursera.org/learn/human-computer-interaction> This 4-week MOOC is taught by a UC San Diego team.



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