PERSONAL DECLARATION OF PLAINTIFF

I make the following statements related to my personal experience with the California Regional Water Quality Control Board related to my home at 1554 Ninth Street, Los Osos California. My statements and claims are meant to rectify the RWQCB's EIR exemption flaws regarding on site wastewater systems addressed in Resolution R3-2008-0005 in general and specifically Attachment D. My statements and claims also affect DOES, like kind low income homeowners, and septic system owners in the County of San Luis Obispo, and owners of septic systems in the "Prohibition Zone" of the Los Osos water basin.

I complain that the Regional Water Quality Control Board Zone Three Staff DOES X through XX hereafter called the RWQCB3 have made errors and omissions in attachment D and omitted information from the State Secretary and Office of Public Records of the State of California. It is vital information relating to Nitrogen mitigation for septic systems based on a generic process of energy efficient, low energy footprint, low GHG, source separation of urine and feces as an improved mitigation to satisfying order 83-13 relating to nitrogen removal from wastewater in the Los Osos Prohibition Zone. This also relates to septics outside the Prohibition Zone but in the Los Osos groundwater basin, and

area within the groundwater basin circling the prohibition zone where no mitigation is required. Any claims I make towards advancing the generic mitigation of source separation would apply to any septic system in the County of San Luis Obispo as it directly relates to the RWQCB3 basin plan changes for septic systems proposed by them in R3-2008-0005 also.

CEQA- ENVIORMENTAL JUSTICE ISSUES

I complain that the California Environmental Quality Act Substitute Environmental Document Report for Basin Plan Amendment Regarding On site Wastewater Systems (Resolution No. R3-2008-0005) does not meet CEQA requirements for Environmental Justice documentation. The RWQCB3 is responsible for proving to the State Secretary evidence of compliance to Public Resources Code sections 71110, 71111, 71112, and 71113, etc. It has not included Environmental Justice mitigations in its CEQA substitute environmental document "R3-2008-0005 Attachment D" related to the Prohibition zone. I and others of my like predicament are suffering financial discrimination which is to be avoided as described in above PRC Code where the RWQCB3 is directed by State EPA to:

1) "Conduct our programs, policies, and activities that substantially affect human health or the environment in a manner that ensures the fair treatment of people of all races, cultures, and income levels, including minority populations and low-income populations of the state."

When I purchased my home in Los Osos in 2003 I was given in my packet of purchasing materials a copy of the "Los Osos Building Moratorium" **EXHIBIT 1**, a general prohibition from discharging more pollutants controlled by my not being able to add bedrooms or plumbing fixtures on to my house. I am a low income homeowner as evidenced by my historic social security records **EXHIBIT 2**. I considered this limitation **EXHIBIT 1** fair to me and not too excessive a financial burden as a new homeowner in the prohibition zone as the economic impact was known to me and I could live with my house the way it was. I wanted to further contribute to bettering the groundwater quality and voluntarily submitted a plan to the San Luis Obisbo County planning dept to remove nitrogen contamination form my waste stream by 75% to 85% by sequestering urine in a tank and installing a urine toilet to remove the pollutant mentioned in RWQCB3 Order 83-13. I did so by County Permit and Waterboard approval of plans for source separation of urine from feces construction project on my small 25 by 125 foot lot as (seen in plans and all related documents: **EXHIBIT 3**). After six months of use, on February 25, 2007, I showed the RWQCB3 my pumping and haulage tickets and septic system pumping proof, I requested a Porter Cologne.13269 waiver by certified letter and modified Settlement Agreement **EXHIBIT 4**. This was before receiving my notice of violation letter **EXHIBIT 5** March 21, 2007. I was sent the March 21,2007 letter totally ignoring my environmental mitigation request requiring that my property have 'zero discharge' in 2011 or even earlier in 2008. It was as if I had done nothing at all. I did not receive the "fair

treatment" mentioned in public resources code for my source separation request that involved PC13269 waiver. My request for financial assistance was also ignored twice. Not only did I receive any cooperation, I received no communication at all justifying my above claim for complete approval of my agreement sent as a condition of the resource handling project.

My urine separation documentation was reviewed by, County Health, County planning, and Harvey Packard RWQCB3 staff and all parties approved the system. I Claim the RWQCB3 does not qualify for exemption from the CEQA process until it presents the full environmental mitigation of source separation of urine and its social and financial impacts for low income homeowners in the prohibition zone, outside the Prohibition Zone but in the Los Osos Groundwater basin, and in the County of San Luis Obispo entirely. By ignoring my request for waiver and SEP program request for paperwork, the RWQCB3 staff hindered the Prohibition Zone community from removing 75 to 80 percent of the Nitrogen in their waste stream per site voluntarily purely for the peace of mind of not facing a CDO. By not presenting to the OPR the inherent energy efficiency and advanced resource management that 'Source Separation' of Urine represents, the RWQCB3 has misrepresented its claim for CEQA exemption.

It is an entirely new method of compliance in this County but has been studied in Europe for many years. The 'State of the Art' of Source Separation in Europe is well advanced as is shown in **EXHIBIT 6.** The most important study in the group of documents in **EXHIBIT 6** is the 78% acceptability of human waste source

separation using dual bowl toilets in Europe. Because of the advanced beneficial aspects of source separation relating to water conservation, energy conservation, urine to fertilizer economic regionalism, ESHA impacts, CEQA impacts, and social sustainability, I have sent this complaint to the State Secretary of the EPA, Attorney General Jerry Brown, and OPR preemptively to make them aware of the RWQCB3 staff's oversight. The County of San Luis Obispo has already agreed to review source separation in the LOWWP EIR and to compare it to other methods of basin nitrogen removal. And San Luis Obisbo GreenBuild Alternative Technology Technical Committee with help and input from Surfrider Foundation and the Sierra Club has agreed to evaluate it energetically with peer review.

PROHIBITION ZONE MODEL CEQA-EJ REVIEW

But before a basin wide source separation program can even be evaluated stakeholders must re-evaluate the prohibition zone model of enforcement because it does not meet Environmental Justice narrative standards. The prohibition zone enforcement model stymies modeling efficient energy solutions with low CO2 footprints for the total groundwater basin. The Prohibition Zone delineation is inherently discriminatory and stands out as a test case for environmental justice narrative Law. It divides equal residential polluters in two classes, lesser property owners and larger property owners where economic discrimination and racial discrimination directly relate to property size as is noted in the LOCSD study and US census data attached **EXHIBIT 7.** The present

basin plan update continues to allow unmitigated pollution outside the prohibition zone. Buried within the proposed basin plan changes are assumed prohibition zone requirements for a continued unscientific 'zero discharge order' within the economically disadvantaged prohibition zone area. I claim as fact that it is unfair treatment of the prohibition zone population relating to economic and racial data where the RWQCB3 is required by public resources code environmental justice law to:

2) " Promote enforcement of all health and environmental statutes within our jurisdiction in a manner that ensures the fair treatment of people of all races, cultures, and income levels, including minority populations and low-income populations of the state."

The RWQCB staff has not included a discussion and mitigation of this oversight of environmental law in the present CEQA exemption and the exemption is incomplete without mitigation of this issue. Further it is necessary to prevent skewing of the energetic analysis of least GHG impact solutions. Skewed enforcement of a select population condemns the State to over budgeting energy consumption to remove nitrogen when solutions like source separation, STEG cluster systems, and on site secondary treatment can do so with an energy footprint far less than a community sewer. All residential polluters in the Los Osos groundwater basin are identical polluters as described by the RWQCB3, all

discharging 375 gallons a day with a nitrogen content of waste being approx. 45mg/l. Regardless of property size this is a fact.

Looking at the level of Nitrogen discharge from homes outside the prohibition zone but in the groundwater basin you would empirically multiply 375 gal./day X 1700 Homes X .045 grams/liter X 4 Liters/gallon = 114,750 grams of nitrogen per day. This discharge is exempted, untreated and unmitigated. For the discharge of pollutants from 5000 properties inside the prohibition zone after the sewer is built, you multiply 1.2 Million gallons per day X .007 Grams/liter (Tri-W discharge permit) X 4 liters/gallon = 33,600 grams/day of remaining pollution going into the water basin at a cost of $2400.00 to $3000.00 a year per parcel. The dotted line on the map prepared by a previous scientific study on the basin boundaries in **EXHIBIT 8** shows the water basin edge. Many properties are outside the Prohibition zone but inside the groundwater basin?

Extrapolating from the two above calculations, after the sewer is built, 20 percent of the homes in the water basin will be discharging 70 percent of the Nitrogen pollution and paying nothing for mitigation. The homeowner's outside the Prohibition zone only requirement for exemption was that owners had more money or credit to by a larger piece of land to begin with, they pollute identically.

The RWQCB3 staff has ignored any substantive discussion, or use of "precautionary procedures" required by the State in its narrative of Environmental Justice compliance in their CEQA exemption request. The prohibition zone enforcement edicts should have been reviewed long before now for Environmental Justice compliance and adherence to the "precautionary principal"

mandated by State EPA. **EXHIBIT 9**. Now it is critical time that they do so because the present pattern of enforcement by the RWQCB staff in keeping intact the Prohibition Zone model and narrative "zero discharge" moratorium severely limits Greenhouse Gas mitigation and related energy consumption mitigation by limiting proper energetic modeling of all potential methods of pollutant removal throughout the whole groundwater basin. The RWQCB3 staff negligence of Environmental Justice skews any honest scientific environmental modeling to choose the least energetic solution that will meet AB32 GHG mandates. Even though there are presently over six large discharge permits in the basin with varying amounts of Nitrogen allowed, the RWQCB continues with the environmentally suspect "zero discharge order " in the PZ against a ethnically mixed poorer population. Added to the Environmental Justice litmus test is AB 32 Global warming 31662 Section(B) (2) & (6) mandates that the RWQCB3 consider a parallel precaution in the implementation of the Porter Cologne Act and its impacts on GHG mitigation. AB32 admonishes that the RWQCB3 to:

" Ensure that activities undertaken to comply with the (GHG) regulations do not disproportionately impact low-income communities."

And

"(6) Consider overall societal benefits, including reductions in other air pollutants, diversification of energy sources, and other benefits to the economy, environment, and public health".

By mandating the prohibition zone and narrative "zero discharge" order the RWQCB3 staff has limited mitigation of the energy component of the nitrogen removal solution for the LO groundwater basin. The County FSR states in their variety of plans for N removal that energy consumption will not be less than 1 million KWH per year causing 700 Tons of CO2 a year to operate. There are more elegant energy solutions but the narrative and impressionistic prohibition zone orders prevent their discussion. The RWQCB3 is further adding to the economic burden of an already discriminated against population by not adhering to the above AB32 sections. Continuing with the existing enforcement orders will economically "impact low-income communities" by causing excessive energy use not necessary to remove the nitrogen directly in conflict with AB 32 Global warming 31662 Section(B) (2) & (6) mandates. The RWQCB3 by its present enforcement policy, adds the further avoidable impacts of groundwater draws and archeological impacts both of which are unstudied and unmitigated. Any claim that there is no other legitimate way to clean up the water basin other than a typical community sewer is the RWQCB3 self fulfilling prophecy out of step with contemporary environmental law. It is out of step with future energy realities that are even recognized by the State Water Resources Control Board and Federal EPA. Many nitrogen reducing solutions are being left off the table by the RWQCB3's environmentally outdated enforcement policies. For example, source separation represented and approved on my property by the RWQCB3 is related to European advancements in component recycling of waste. If you looked at the energetic and nitrogen removing potential of source separation

applied to *all basin residential waste dischargers equally* (which you can't because of the prohibition zone model) utilizing a SS/STMP/Retrofit program you would remove an identical amount or more nitrogen from the basin wide residential waste stream than when compared to the 700 ton GHG/Yr. footprint of the LOWWP Community sewer. Source separation offers the same basin protection but with the added benefit of conserving ground water in the amount of 102,000 gallons a day basin wide and having no ESHA and few CEQA impacts because there is no in ground waste handling infrastructure off site. If well designed, a source separation maintenance plan could have a near zero net energy balance and have only positive impacts on basin groundwater balance. Sources of energy consumption like twice a year urine harvesting and basin wide composting from septics would be offset by carbon sequestering biomass development, like the attached proposed carbon sink forests **EXHIBIT 10** utilizing the urine-to-fertilizer environmental loop to grow marketable timber.

The urea polishing takes 1/50 the energy of Natural Gas intensive N fertilizer production. The IEA claims that Nitrogen fertilizer uses 475 quadrillion cubic feet of natural gas a year to produce crop fertilizer in the USA. All heat related food processing Nationwide uses 575 quadrillion cubic feet per year. Urine decontamination and constituent recycling would create natural gas energy savings by closing the resource loop from urine to N fertilizer. Source separation has been studied in Europe for over 25 years and is presently being implemented in areas of Sweden. The energy footprint of source separation, STMP, retrofit program would be less than 20% what the Counties estimate for energy

consumption in their proposed projects for N removal and water reclamation in the FSR.

Calculating the remaining nitrogen balance in the basin using a combination of source sequestering, Septic tank Management, and a coupled retrofit program, the remaining basin Nitrogen discharge for such a program is almost identical to the Community gravity sewer in the PZ with minimal environmental risks and no economic dislocation of property owners.

Calculating for the whole basin, 375 gpd X 6700 Homes basin wide X 0.25 N remaining in functioning septics (the rest is in the urine) X .045 grams/liter X 4 liters/gallon = 113,062 grams/day. This figure is even less than the allowed discharges for unmitigated septic systems outside the PZ but within the basin? As a blended retrofit program, source separation 'creates' 102,000 gallons a day of banked deep aquifer groundwater by one cup per flush urine bowl toilet flushing in dual flush dual bowl toilets **EXHIBIT 6.** Present groundwater recharge would be through existing septics after 80% of the Nitrogen had been removed from the household discharge by front end behavioral modification. Validating source separation would enhance regional agricultural economies and omit the stigma to farmers of piping treated reclaimed water to their properties as a long term commitment. Recycled urea fertilizer use would mimic the present system of liquid fertilizer application without any contracts or property binding commitments. The collapse of natural gas supplies from Canada and Mexico eminent over the next twenty five years as shown in EIA graph enclosed in **EXHIBIT 11.** , will increase spot shortages of nitrogen fertilizer. Regional fertilizer

from source separation may be the only fertilizer available for Los Osos Valley farmers at an acceptable cost. Source separation could have a 60 to 100 year life cycle if designed properly.

So if source separation is shown on a community and regional scale to be more environmentally compliant and cost efficient, the present changes to the basin plan must include the generic process. Source separation out performs many alternative systems and can also be used in conjunction with them for an added environmental advantage. Source separation should not languish as an alternative system waiting for approval in a planning document years away that the County will create as outlined in the Basin Plan update. It should be legitimized immediately, by waivers and RWQCB3 SEP programs. It is a behavioral method of removing nitrogen and then not discharging it to the impacted basin through the existing septic systems. It is the front end removal of Nitrogen before it enters the septic system that represents advanced Nitrogen mitigation for San Luis Obispo County that the county could use as a resource. Support of the infant source separation recycle industry is a potential long term sustainability commitment by Cal EPA.

AB32 COMPLIANCE VS. ZERO DISCHARGE ORDER

The parallel mandates of the zero discharge order in 2011 and AB32 GHG timeline for mitigation are entirely incompatible environmentally. How do you ship 1.5 million gallons out of the water basin a day and still meet APCD GHG

requirements and smog rules in 2011? The RWQCB3 staff has not even contacted the APCD about the issue. Further there has been no analysis of the impacts of drastically overdrafting the basin if the zero discharge order is implemented. The Waterboard has failed to promulgate other realistic solutions. Residential holding tanks only simply cannot be done without massive drafts to the groundwater basin. And that is why I consider the zero discharge order out of step with ongoing validation of changing CEQA requirements that are more holistic and sustainable.

In the least, to eliminate the Prohibition Zone boundaries, homeowners should be allowed proportional discharge on smaller lots related to one acre so the whole basin would have the equivalent discharge of one acre homes that the basin plan allows. I claim that proportional discharge related to lot area on my small lot *is consistent* with the revised basin plan update as outlined in my Waiver agreement and Community plan letter to the RWQCB3 relating to voluntary nitrogen reduction. Since the RWQCB3 never reviewed my certified mail request, or they did and chose to ignore it, then they have not met Environmental Justice Public Resources code to:

"3) Ensure greater public participation in the agency's development, adoption, and implementation of environmental regulations and policies."

In all, I consider the present environmental justice implementation in the Los Osos water basin out of balance, based on isolated enforcement by the

RWQCB3 to dictate specific solutions for nitrogen removal in the Los Osos groundwater basin without any regard to Environmental Justice mandates, energy consumption, GHG production, ESHA impacts, or archeological impacts.

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CEQA REGULATORY COMPLIANCE

It is a fact that the RWQCB3 has not met California Environmental Quality Act California Public Resources Code 21003.1. The RWQCB3 has omitted from its documentation adverse environmental effects of substantive changes in enforcement of Order 83-13. The change in enforcement mentioned is the change between a general building moratorium **EXHIBIT 1** covered and validated by historic MOU's with the County of San Luis Obispo **EXHIBIT 12** and the zero discharge order which has no MOU's or enforcement policy because it is environmentally unsound, discriminatory, and impossible to administrate. The environmental impacts of this change in enforcement have never been addressed to the State Secretary or OPR yet the RWQCB3 staff continues to claim exemption. Nor has the environmental mitigation of source separation been compared to the environmental impacts of the zero discharge order. The ZDO could be enforced this year if the County votes not to assume the sewer project which further opens the State to substantive legal challenges related to CEQA exemptions and AB32 compliance all of which are avoidable.

SOURCE SEPERATION -SWEPT UNDER THE

ENFORCMENT RUG BY THE RWQCB3 STAFF

The RWQCB3 has failed to inform the State Secretary and Office of Planning and Research of mitigation measures I have applied for relating to my property with the RWQCB3's approval that substantially mitigates the environmental impacts of the zero discharge order. California Public Resources Code 21003.1. States that the RWQCB3 shall supply the State Secretary and OPR with:

"(b) Information relevant to the significant effects of a project, alternatives, and mitigation measures which substantially reduce the effects shall be made available as soon as possible by lead agencies, other public agencies,"

The RWQCB3 staff has limited discussion of CEQA compliance by not supplying the State Secretary and OPR with my documentation which I submitted. In addition, the RWQCB3 staff also required a deed restriction, and tracking system for urine removal from the water basin **EXHIBIT 3**. Instead of receiving any credit for my 2500 dollar investment or any acknowledgment of what I needed to do the receive my PC13269 Waiver, I received the same form letter as everyone else in the Prohibition Zone did. **EXHIBIT 5**.

The RWQCB3 Staff showed no contractual good faith as outlined in their Supplemental agreement contract **EXHIBIT 13** that was proposed by the RWQCB staff for the PZ community in its entirety and posted on their web sight. Their contractual agreement was written to accommodate alterations in the agreement like my PC 13269 TEMPORARY 5 YEAR WAIVER for source separation. **EXHIBIT 3** as well as other solutions.

By not acknowledging in any form or way my submission for my P.C. 13269 waiver and by not creating a M.O.U. between agencies for urine sequestration, the RWQCB3 robbed me and all septic system utilizing landowners at large, of peace of mind, and reduced jointly in Los Osos our property evaluation **EXHIBIT 14**. The RWQCB3 staff has caused my property devaluation by allowing threat of fines against my property without following due process under California Government Code Section 65941.5. The Code so states:

"Not later than 30 days after a land use or land division application is received, the Agency must notify the project applicant or designated representative in writing either that the application is complete, or that items are necessary to complete the application. If you are not notified in writing, the application is considered complete."

Harvey Packard RWQCB Prosecution team claimed in a written correspondence to me that the RWQCB3 was subject to Section 65941.5 of Government Code **EXHIBIT 15**. Had the RWQCB3 followed the letter of the law they would have

avoided continuing nitrogen contamination from properties that desired to cooperate and source separate urine. I consider source separation a right of all homeowners in the Los Osos Prohibition zone as a method of temporary or long term compliance to Nitrogen contamination. I warned the RWQCB3 of problems related to a class action suit in the narrative and illogical zero discharge order in my cover letter to them that accompanied my Waiver agreement. I pointed out how giving me a waiver it would help overcome the RWQCB3's administration error by allowing 'proportional discharge' for source separator's within the prohibition zone which would remove the issue of regulatory takings and which would help equivocate economic impacts related to compliance and come nearer to EJ guidelines. Instead my actions were met with administrative silence.

In my mind the largest CEQA issue rests with ignoring the energy component of source sequestering. Source separation is the most energy efficient method to eliminate Nitrogen from the water basin that I have found as I have outlined in "MAKING LOS OSOS A POST CARBON CITY" **EXHIBIT 16** submitted to the County of San Luis Obispo EIR process for the LOWWP where I outlined the benefits of Community wide voluntary source separation coupled with a Septic Tank Management Plan and retrofit program. The Environmental mitigation using community source separation is way too large to be ignored. The benefits would include:

- *75% to 80% Nitrogen removal of all basin discharges.*

- *Total per day waste handling lowers to 20,000 Gallons instead of 1.3 million gallons using 5% or less energy to handle the waste stream.*
- *Emerging micro-contaminants and endocrine inhibitors are more removable using less energy being concentrated in urine and not mixed with millions of gallons of raw waste.*
- *Local plumbers and contractors keep implementation money in the local economy, stimulating the local economy. Supports economic and environmental regionalism with farmers and local contractors.*
- *Potential for zero net Green House CO2 production compared to 750 tons CO2 for the County LOWWP.*
- *Protects sacred Indian burial grounds from decimation by pipeline trenching. All digging can be done by hand onsite limiting landscaping impacts, 95% reduced Archeological impacts.*
- *No ESHA impacts for infrastructure construction, spillage or exfiltration.*
- *No potential for power failure induced spills like the recent CMC spill.*
- *No on site energy consumption.*
- *No I & I leakage or pipe failures due to earthquakes or liquefaction.*
- *Water handling reduced by a scale of 1000 percent.*
- *Proven continuation of the existing Los Osos groundwater balance using zero energy septic discharge with 80% of the Nitrogen removed.*
- *No streets torn up, dewatering, air pollution or resources used to build or repair infrastructure.*

- *Energy consumption of the Urea handling truck fleet (3 to 4) is equal to a gravity sewer maintenance fleet in CO2 emissions. Trucks are smaller and could be LPG or methane powered to reduce air pollution. No standby motor idling and small electric pumps could be used to reduce air pollution when on site for urine pumping only. Urine is picked up every six months or by electronic signal from the holding tank.*
- *Local farmers avoid Nitrogen fertilizer shortages that are expected to expand byproduct acceptability.*
- *Meets AB32 GHG 2020 standards in 2012 because system uses existing 1990 primary onsite septic treatment.*
- *Biomass CO2 fed by decontaminated urine creates wealth in terms of carbon credits and marketable raw materials.*
- *The program has a 100 year + extensive life cycle hardened from energy depletion. Wastewater energy failure standby time: STEP- 1day, Gravity - 20 min., Sequestering - ½ year*
- *SEQ./STMP/RETROFIT system engages small scale low CO2 footprint human labor in the treatment process limiting energy sinks.*
- *Ultra conservation of remaining groundwater does not negatively impact the recovery system in any way.*
- *102,000 gallons a day basin wide water savings from sequestering toilets. Helps eliminate the present basin overdraft at zero energy cost.*
- *Retrofit conservation, pollution abatement, and septic tank monitoring are simplified into the same simple energy efficient program.*

By officially ignoring generic groundbreaking solutions on an individual level, the RWQCB3 has caused me and others on septics economic hardship, and in my case, raised the scepter of potential personal injury by ignoring contractual and legal obligations that I have raised to legitimize source separation.

On a community level, the RWQCB3 staff actions towards source separation have harmed all residents of the State by not promulgating energy efficiency, social sustainability, financial sustainability, environmental justice narrative compliance and energy conservation inherent in urine sequestration and its potential reprocessing and recycling urine components. RWQCB3 staff has also withheld from the State Secretary this vital environmental information thus negating their claim for CEQA exemption. RWQCB3 staff was given many European studies and validations of the nitrogen recycling systems. **EXHIBIT 6**

INTER-AGENCY ENVIORMENTAL COMMUNICATION IS MISSING

The present Environmental Checklist **EXHIBIT 17** prepared by the RWQCB3 staff submitted to the public perpetuate the same historic lack of environmental review. The RWQCB3's non-communication with other agencies, like the APCD burdens the State with further environmental impacts in meeting requirements of State environmental law like the APCD and Cal EPA's required mitigation for

AB32 GHG reduction. If the State Secretary and OPR allow this level of environmental evaluation to continue then low income, middle income, and minority homeowners in the prohibition zone will be further burdened with unfair excessive costs and further environmental impacts that are omitted from the basin plan changes in the Substitute Environmental Document Report for Basin Plan Amendment Regarding On site Wastewater Systems (Resolution No. R3-2008-0005) that is now up for review.

A LINGERING CONTRACTUAL DISPUTE

My grievances arise out of a contractual dispute, a Porter Cologne Waiver as described in Section 13269 of the Porter-Cologne Act. No mention is made of facility size or financial threshold in Porter-Cologne. The RWQCB3 staff is irrational, they treat my discharge the same as a larger facility while ignoring my legal requests for treatment alternatives that larger facilities enjoy. The RWQCB3 2007 Settlement Agreement document is a standing contractual agreement presented to <u>all</u> residence of the prohibition zone and specifically the 45 CDO recipients by the RWQCB3. I have offered an environmentally friendly way to bring the 45 recipients into 80% compliance that was verifiable and comparable in nitrogen reduction in the approved discharge order of the defunct Tri-W sewer project **EXHIBIT 18**. That if these contractual issues are not resolved between prohibition zone owners like myself and the RWQCB staff, then their actions would continue to represent financial discrimination that has

resulted in financially defrauding me and others like me willing to source separate. We have been deprived of real estate equity by increased taxation and had our property values decreased when compared to neighboring costal communities by 100,000 dollars **EXHIBIT 19.** Our titles are further clouded by the RWQCB3 staff making claims about retroactive fines against our properties that are based upon orders containing historical oversights of CEQA requirements and maintenance for septics timelines mentioned in Order 83-12 that are only now being addressed twenty years later.

With over 20 existing home foreclosures in Los Osos and 75 standing tax liens **EXHIBIT 20** environmental, economic, and social impacts commingle and become an important part of CEQA analysis. Federal EPA calls addressing this triad, triple bottom line analysis or sustainability triad analysis. Real estate mortgage defaults have been to a degree caused by unfunded environmental mandates as seen in **EXHIBIT 21.** Narrative, environmentally unsound and uneconomic discharge orders inflicted on the overburdened urban poor reflect poorly on the State Board. All basin polluters should be treated the same relative to economic impacts of basin cleanup regardless of property size. The Proportional Discharge Model of enforcement was offered as a social mitigation with positive environmental and economic consequences when applied to emerging energy efficient groundwater solutions. It was a triple bottom line mitigation that to me was a victim of some people looking backwards for a solution. Do we really have that luxury?

I, Steven Paige, am a Plaintiff in the above-entitled action. I have read the foregoing personal declaration and know the contents thereof. The same is true of my own knowledge, except as to those matters which are therein alleged on information and belief, and as to those matters, I believe it to be true.

I declare under penalty of perjury that the foregoing is true and correct and that this declaration was executed at Los Osos, California.

Signed Steven Paige

Dated APRIL 1, 2008

Los Osos Building Moratorium

San Luis Obispo County Department of Planning and Building

On Friday, January 8, 1988, the California Regional Water Quality Control Board (RWQCB) imposed a moratorium on new sources of sewage discharge (and increases in the volume of existing sources) in the community of Baywood-Los Osos. The moratorium was imposed through the provisions of a Memorandum of Understanding executed between the county and the RWQCB in December, 1978, and imposes a variety of responsibilities on the county. The purpose of this memo is to set forth official Department of Planning and Building policy on the implementation of the moratorium by staff.

1. Area where moratorium applies. The area subject to the moratorium is shown on the attached map, and is known as the prohibition area. The provisions of the moratorium do not apply outside of the prohibition area.

2. Effect of moratorium on the permit process:

   a. Construction involving new or expanded septic systems prohibited. The primary effect of the moratorium is that this office is prohibited from issuing any permits for new on-site sewage disposal systems (commonly called "septic" systems) within the prohibition area, We are also prohibited from issuing permits for expansion of the capacities of any existing systems. These mandates (for our purposes) translate into the following specific requirements:

      (1) Independent structures without toilets or other plumbing fixtures (e.g. detached garages) may be approved.

      (2) Additions to existing buildings which would normally (in circumstances other than the moratorium) require accompanying expansion of on-site sewage disposal (septic) systems shall not be approved, even where the existing septic system was originally oversized and could accommodate the addition without expansion.

      (3) Proposed living area (not bedroom) additions to existing dwellings will be processed per normal procedures: if they would not normally require accompanying septic system expansion, they may be approved. However, only living area additions that are open to the "core" of the house (kitchen, living room or dining room), that have large cased openings (no doors), and that do not have closets will be approved. If you have any questions about these requirements, please call Bob Mourenza, Supervising Plans Examiner, at 781-5709 before you complete your design.

      (4) Any change in occupancy of commercial structures which would increase the "fixture unit" requirements per the Uniform Plumbing Code shall not be approved.

EXHIBIT 11

COUNTY GOVERNMENT CENTER • SAN LUIS OBISPO • CALIFORNIA 93408 • (805)781-5600 • 1-800-334-4636
EMAIL: ipcoplng&slonet.org FAX: (805) 781-1242 WEBSIT: http://www.slocoplanbldg.com

Department of Planning and Building
San Luis Obispo County

County Government Center
San Luis Obispo
California 93408
(805) 549-5600

Paul C. Crawford, AICP
Director

January 21, 1988

Mr. Roger Briggs
California Regional Water Quality Control Board
1102A Laurel Lane
San Luis Obispo, CA 93401

Dear Mr. Briggs:

SUBJECT: LOS OSOS MORATORIUM

This is intended to summarize the conclusions reached at our meeting on January 21, 1988, which included John Goni and Jay Kano of your staff, Tim Mazzacano, county Director of Environmental Health, Fred Norton and Doug Morris of my staff, you and I. We met to clarify the provisions of your Board's order of January 8, and agreed upon the following points, all of which resulted from the basic understanding that the order of the Regional Water Quality Control Board prohibits this office from issuing any construction permits which would result in new sewage discharge or increases in discharge from existing sewage disposal systems within the prohibition area.

1. Independent structures without toilets or other plumbing fixtures (e.g. detached garages) may be approved.

2. Additions to existing buildings which would normally (in circumstances other than the moratorium) require accompanying expansion of on-site sewage disposal (septic) systems shall not be approved, even where the existing septic system was originally oversized and could accommodate the addition without expansion.

3. Proposed living area (not bedroom) additions to existing dwellings will be processed per normal procedures: if they would not normally require accompanying septic system expansion, we will approve them.

4. Any change in occupancy of commercial structures which would increase the "fixture unit" requirements per the Uniform Plumbing Code shall not be approved.

EXHIBIT 1.2

5. Alterations of existing buildings which propose additional plumbing fixtures, including but not limited to water supply fixtures, drain or disposal fixtures, shall not be approved. No replacement of existing fixtures shall be approved except where replacement is in-kind or involves a reduction in the actual number of fixtures. No "credit" will be allowed for fixtures which use less water.

6. Commercial shell buildings may undergo internal modifications through tenant improvements, limited only by the design capacity of the originally-approved and installed septic system.

7. Swimming pools and hot tubs/spas may be approved.

8. Holding tanks shall not be allowed as a method of sewage disposal.

9. No "exotic" disposal systems shall be allowed as an alternative to the moratorium.

10. Repair and/or replacement of existing septic systems will be approved as usual.

11. An expired building permit shall not be reissued.

12. Exceptions to any of the above "prohibitions" may be granted by the Regional Water Quality Control Board.

Please notify me as soon as possible if your understanding of any of the above points differs from mine.

Sincerely,

Paul C. Crawford

PAUL C. CRAWFORD
Director of Planning and Building

1801k/2

EXHIBIT

1,3

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION

RESOLUTION NO. 83-13

Revision and Amendment of Water Quality Control Plan by the Addition of a Prohibition of Waste Discharge from Individual Sewage Disposal Systems Within the Los Osos/Baywood Park Area, San Luis Obispo County

WHEREAS, the California Regional Water Quality Control Board, Central Coast Region (hereafter Regional Board), adopted the Water Quality Control Plan for the Central Coastal Basin (hereafter Basin Plan) on March 14, 1975; and,

WHEREAS, the Regional Board, after notice and public hearing in accordance with Water Code Section 13244, periodically revises and amends the Basin Plan to ensure reasonable protection of beneficial uses of water and prevention of pollution and nuisance; and,

WHEREAS, in protecting and enhancing water quality, the Basin Plan specifies certain areas where the discharge of waste, or certain types of waste, is prohibited; and,

WHEREAS, Article 5, Chapter 4, Division 7, of the California Water Code defines criteria for such prohibition areas (Section 13240 et seq.); and,

WHEREAS, Los Osos/Baywood Park is an unincorporated community, with a 1980 population of 10,933 persons located south of the City of Morro Bay, in San Luis Obispo County; and,

WHEREAS, current zoning will accommodate a population in excess of 27,000 people and an average residential lot size of about 6600 ft^2; and,

WHEREAS, on-site soil absorption or evapotranspiration systems are the sole means of wastewater disposal in the Los Osos/Baywood Park area; and,

WHEREAS, the Los Osos/Baywood Park area soil permeability is rapid and there are substantial areas with high groundwater; and,

WHEREAS, the majority of lots are too small to provide adequate dispersion of individual sewage disposal system effluent; and,

EXHIBIT
1.4

WHEREAS, the San Luis Obispo County Environmental Health Department has provided documentation concerning the problem of liquid waste disposal in the Los Osos/Baywood Park area; and,

WHEREAS, the County of San Luis Obispo is preparing an environmental impact report (EIR) in accordance with the California Environmental Quality Act and a project report that identifies adverse environmental impacts from continued use of septic tanks in the Los Osos/Baywood Park area and discusses alternatives to existing wastewater management practices; and,

WHEREAS, "Los Osos-Baywood Park/Phase I Water Quality Management Study" cites conditions which constitute contamination and pollution as defined in Section 13050 of the California Water Code; and,

WHEREAS, chemical analyses of wells in Los Osos/Baywood Park indicates 38% of the shallow wells tested in the Phase I study, taking water from the Old Dune Sands deposits portion of the qauifer, contain nitrate concentrations which exceed State Health Department Drinking Water Standards of 45 milligrams per liter; and,

WHEREAS, bacterial analyses of 42 wells tested in the Phase I study resulted in 26 wells indicating total coliform in violation of State Health Drinking Water Standards, and 2 wells indicating fecal coliform in violation of Basin Plan limits for groundwater; and,

WHEREAS, surface water bacterial analyses tested in the Phase I study indicated total and fecal coliform levels exceeding Basin Plan recommended limits for water contact recreation (REC-1); and,

WHEREAS, a letter from the California Health and Welfare Agency, Department of Health Services, states their concerns regarding the high nitrate levels in the waters of Los Osos/Baywood Park area, and recommends adequate measures be taken to correct the nitrate problems to bring the waters into compliance with California Drinking Water Standards; and,

WHEREAS, a letter from the San Luis Obispo County Health Agency Director cites violation of the public health limit for nitrates and recommends elimination of shallow groundwater usage and adoption of a discharge prohibition; and,

WHEREAS, the Regional Board is obligated to include a program of implementation for achieving water quality objectives in its Basin Plan; and,

WHEREAS, present and anticipated future beneficial uses of Los Osos/Baywood Park creeks include recreation and aquatic habitat; and,

EXHIBIT

1.5

WHEREAS, Los Osos Basin groundwaters are suitable for agricultural, municipal, domestic, and industrial water supply; and,

WHEREAS, a Regional Board staff report finds beneficial uses of Los Osos ground and surface waters are adversely affected by individual sewage disposal system discharges, there appears to be a trend of increasing degradation, and public health is jeopardized by occurrences of surfacing effluent; and,

WHEREAS, drafts of proposed revisions and amendments of the Basin Plan, prohibiting discharges from Los Osos/Baywood Park individual sewage disposal systems, have been prepared and provided to interested persons and agencies for review and comment; and,

WHEREAS, Regional Board staff has prepared documents and followed appropriate procedures to satisfy the environmental documentation requirements of both the California Environmental Quality Act, under Public Resources Code Section 21080.5 (Functional Equivalent), and the Federal Clean Water Act of 1977 (PL 92-500 and PL 95-217), and the Regional Board finds adoption of this prohibition area will not have a significant adverse effect on the environment; and,

WHEREAS, on September 16, 1983, in the San Luis Obispo City Council Chambers, 990 Palm Street, San Luis Obispo, California, after due notice, the Regional Board conducted a public hearing at which evidence was received pursuant to Section 13281 of the California Water Code concerning the impact of discharges from individual sewage disposal systems on water quality and public health; and,

WHEREAS, pursuant to Section 13280 of the California Water Code, the Regional Board finds that discharges of wastes from new and existing individual disposal systems which utilize subsurface disposal in the affected area will result in violation of water quality objectives; will impair beneficial uses of water; will cause pollution, nuisance, or contamination; and will unreasonably degrade the quality of waters of the State; and,

WHEREAS, the Regional Board finds the aforestated conditions in need of remedy to protect present and potential beneficial uses of water and to prevent pollution and nuisance.

NOW, THEREFORE, BE IT RESOLVED, that the Water Quality Control Plan, Central Coastal Basin, be amended as follows:

Page 5-66, after Item 7, following the legal description for Pasatiempo Pines (added by Resolution 83-09), insert the following prohibitions:

EXHIBIT

1.6

"8. Discharges of waste from individual and community sewage disposal systems are prohibited effective November 1, 1988, in the Los Osos/ Baywood Park area, and more particularly described as:

"Groundwater Prohibition Zone

(Legal description to be provided for area prescribed by Regional Board).

"Failure to comply with any of the compliance dates established by Resolution 83-13 will prompt a Regional Board hearing at the earliest possible date to consider adoption of an immediate prohibition of discharge from additional individual and community sewage disposal systems."

Discharges from individual or community systems within the prohibition area in excess of an additional 1150 housing units (or equivalent) are prohibited, commencing with the date of State Water Resources Control Board approval.

BE IT FURTHER RESOLVED, that the above area is consistent with the recommendations of the staff report as shown on "Attachment A."

BE IT FURTHER RESOLVED, that the Regional Board does intend standard exemption criteria, first paragraph of Page 5-67 of the Basin Plan, to apply to this action.

BE IT FURTHER RESOLVED, that compliance with the above prohibition of existing individual or community sewage disposal systems shall be achieved according to the following time schedule:

Task	Compliance Date
Begin Design	November 1, 1984
Complete Design	November 1, 1985
Obtain Construction Funding	December 1, 1985
Begin Construction	April 1, 1986
Complete Construction	November 1, 1988

BE IT FURTHER RESOLVED, that reports of compliance or noncompliance with schedules shall be submitted to the Regional Board within 14 days following each scheduled date unless otherwise specified, where noncompliance reports shall include a description of the reason, a description and schedule of tasks necessary to achieve compliance, and an estimated date for achieving full compliance.

EXHIBIT

1.7

Help Us Keep Yo● Earnings Record Accu●te

You, your employer and Social Security share responsibility for the accuracy of your earnings record. Since you began working, we recorded your reported earnings under your name and Social Security number. We have updated your record each time your employer (or you, if you're self-employed) reported your earnings.

Remember, it's your earnings, not the amount of taxes you paid or the number of credits you've earned, that determine your benefit amount. When we figure that amount, we base it on your average earnings over your lifetime. If our records are wrong, you may not receive all the benefits to which you are entitled.

▼ **Review this chart carefully** using your own records to make sure our information is correct and that we've recorded each year you worked. You're the only person who can look at the earnings chart and know whether it is complete and correct.

Some or all of your earnings from **last year** may not be shown on your *Statement*. It could be that we still were processing last year's earnings reports when your *Statement* was prepared. Your complete earnings for last year will be shown on next year's *Statement*. **Note:** If you worked for more than one employer during any year, or if you had both earnings and self-employment income, we combined your earnings for the year.

▼ **There's a limit on the amount of earnings on which you pay Social Security taxes each year.** The limit increases yearly. Earnings above the limit will not appear on your earnings chart as Social Security earnings. (For Medicare taxes, the maximum earnings amount began rising in 1991. Since 1994, **all** of your earnings are taxed for Medicare.)

▼ **Call us right away** at **1-800-772-1213** (7 a.m.–7 p.m. your local time) if any earnings for years **before last year** are shown incorrectly. If possible, have your W-2 or tax return for those years available. (If you live outside the U.S., follow the directions at the bottom of Page 4.)

Your Earnings Record at a Glance

Years You Worked	Your Taxed Social Security Earnings	Your Taxed Medicare Earnings
1965	$ 314	Medicare began in 1966
1966	250	$ 250
1967	0	0
1968	0	0
1969	0	0
1970	1,116	1,116
1971	0	0
1972	2,397	2,397
1973	0	0
1974	0	0
1975	0	0
1976	6,074	6,074
1977	1,213	1,213
1978	4,355	4,355
1979	7,326	7,326
1980	12,593	12,593
1981	0	0
1982	0	0
1983	0	0
1984	12,607	12,607
1985	15,297	15,297
1986	11,217	11,217
1987	13,409	13,409
1988	12,827	12,827
1989	14,943	14,943
1990	$ 13,178	$ 13,178
1991	7,865	7,865
1992	0	0
1993	0	0
1994	0	0
1995	664	664
1996	11,573	11,573
1997	17,872	17,872
1998	4,809	4,809
1999	4,614	4,614
2000	19,521	19,521
2001	0	0
2002	1,632	1,632
2003	21,456	21,456

EXHIBIT

2.1

Total Social Security and Medicare taxes paid over your working career through the last year reported on the chart above:

Estimated taxes paid for Social Security:		Estimated taxes paid for Medicare:	
You paid:	$19,873	You paid:	$4,493
Your employers paid:	$3,562	Your employers paid:	$806

Note: You currently pay 6.2 percent of your salary, up to $87,900, in Social Security taxes and 1.45 percent in Medicare taxes on your entire salary. Your employer also pays 6.2 percent in Social Security taxes and 1.45 percent in Medicare taxes for you. If you are self-employed, you pay the combined employee and employer amount of 12.4 percent in Social Security taxes and 2.9 percent in Medicare taxes on your net earnings.

mongoboo

From: "Harvey Packard" <Hpackard@waterboards.ca.gov>
To: <mongoboo@charter.net>
Sent: Monday, March 27, 2006 1:17 PM
Subject: Re: Alternative to Pumping-Steve Paige

Mr. Paige,

You have submitted some interesting material. It seems clear that removing urine from the waste stream would significantly reduce the amounts of nitrogen and phosphorus being discharged to the environment.

My main question has to do with verification or enforcement of the terms of the CDO. If we were to accept your proposal as an alternative to septic-tank pumping every other month, how would we verify that the home's occupants really are separating their wastes? If the bidet is right next to the toilet, what assurance do we have that the bidet is actually being used? Are there accepted data on urine production that could be compared to the amount pumped from the urine tank?

Harvey Packard, Division Chief and Enforcement Coordinator
Central Coast Regional Water Quality Control Board
895 Aerovista Place, Suite 101
San Luis Obispo, CA 93401
Phone: (805) 542-4639
Fax: (805) 788-3558

>>> "mongoboo" <mongoboo@charter.net> 3/26/2006 11:05 AM >>>
Dear Mr. Packard,

I wanted to thank you for the time you took to see my daughter and I the other day. I moved out here to Los Osos reciently and got embroiled in all the bickering and legal haggeling. Here's a bumper sitcker: LAWERS DON'T CLEAN WATER, THEY CLEAN POCKETBOOKS. I decided to step back and instead look at a better solution for my own property and trust in the system (You) to want to act it. I believe it's a good plan. Here are some more validating hyperlinks related to separation.

I am concerned about the Air Pollution issue. I keep on thinking I must have made a mistake about my figures relating to NOx emissions from hauling and 25% going back into the water basin yet I can't find any. Here's where I got the data: http://www.epa.gov/oar/oaqps/gr8water/3rdrpt/ Has there ever been a study done on the effects of the fifty year operation of the Morro Bay power plant? http://www.duke-energy.com/businesses/plants/own/us/western/morrobay/announcements/FDOC.pdf
How does the 260 tons of NOx a year Allowed for MB effect your montoring program when potentially 25% is going back into the Bay if the federal studies are right? I can't find reference to it in the Basin Plan.

Using separation short term is an excellent way to test the potential of behavior modification. It is unlikely there could be a better opppurtunity to test motivation than the Los Osos CDO's. Let me know if you require licenced engineering on the storage system. I have read the septic tank operation would be improved by supplying a better Carbon/bio-solids to Nitrogen raito in the septic tank. Everything I have been reading says that the bioreaction is improved by lowering the TN by 50% in the tank. Have you seen anything to the contrary?

Behavior modification and separation.
http://www.iwaponline.com/wst/04801/0057/048010057.pdf
Constituent verification.
http://www.medscape.com/medline/abstract/14998039
IWA Publication
http://www.iwaponline.com/wst/03509/wst035090153.htm
Life cycle assessment for large scale projects.

EXHIBIT
3.1

http://pubs.acs.org/cgi-bin/abstract.cgi/esthag/2000/34/i01/abs/es990003f.html
State of research in Sweden.
http://www.iees.ch/EcoEng011/EcoEng011_F1.html

Again, thank you for considering my sustainable alternative.

Steve Paige

EXHIBIT
3.2

mongoboo

From: "Harvey Packard" <Hpackard@waterboards.ca.gov>
To: <mongoboo@charter.net>
Cc: "Allison Millhollen" <AMillhollen@waterboards.ca.gov>
Sent: Tuesday, May 02, 2006 2:16 PM
Subject: Re: Peak Oil: Life After the Oil Crash—Shipping SewageSluge.

Steve, I apologize for taking so long to respond.

Yes, Cal Gov. Code 65943 (a) applies to applications for Water Board permits. Note that the 30 days is a requirement to inform you that your application is complete, not to approve or disapprove the project.

But, you are requesting approval of a project in response to a **draft** Water Board action. Not only has the Water Board has not taken any action on the the CDOs, staff is not even recommending the bimonthly pumping at this time. So we can't consider your proposal as an alternative to pumping.

But, having said that, we don't object if you want to try your system out. You will probably need a county building permit. Refer county staff to me if they need Water Board input into the permitting process, and I will tell them we have no objections to your project.

Harvey Packard, Division Chief and Enforcement Coordinator
Central Coast Regional Water Quality Control Board
895 Aerovista Place, Suite 101
San Luis Obispo, CA 93401
Phone: (805) 542-4639
Fax: (805) 788-3558

>>> "mongoboo" <mongoboo@charter.net> 5/1/2006 6:29 PM >>>
Hi Mr. Packard,

The real issue is not how much it is going to cost to ship the sluge to Santa Marina but if we can get the diesel to do it.

I have installed the septic tank riser on my solids side for easy observation. It ws pumped in 2003 when I bought the place. Scum layer is about 3" thick and the Solids are 2 feet from the outlet. I would like to offer that you can inspect my system easer now. You are welcome to come on site anytime you like to see if there are any problems with my plans, besides the shipping unknowns. I talked to Shirley Bianchi about that. She's on the APCD board. She hasn't gotten back to me yet. I have prepared a pumping log but I was wondering if we should alter the plans to increase the size of the storage tank to limit the number of trips per year to one. With my plan, two 5000 gallon LPG powered water trucks could ship all the high TN waste per year for Los Osos with an average of 200 trips per year each. Ergo no diesel particulate pollution and 1/10 the greenhouse gasses. 600 gallons per houshold instead of 9000. Sounds like the science is still out on whole tank pumping.

This read is like scary Si-Fi.... We are asking for failure in basin managment if we depend on lots of energy input for any community system. Read the article. They are expecting Ammonia shortages 10 years out for Agriculture because it relies on Natural Gas. Mabe the Swedes are on to something sequestering and recycling urine constituents.

What's your take on Cal Gov. Code 65943 (a)? I haven't heard from you for over 30 days?

http://www.lifeaftertheoilcrash.net/

EXHIBIT

3.3

Construction Permit

San Luis Obispo County Department of Planning and Building

County Government Center San Luis Obispo, California 93408 Telephone: (805) 781-5600

Applicant : PAIGE STEVEN **Permit :** Septic Repair-Residential

Permit #: PMT2005-03320 **Project #:** PMT2005-03320 **Issued:** 5/11/2006 **Expires:** 5/11/2007

Project Address:
01554 9TH ST LSOS

Lot Size:

Insp. Area: 02
Setbacks:

Community: LSOS

Owner: PAIGE STEVEN
1554 9TH ST LOS OSOS CA 93402-1725
Phone: 528-4738

Parcel(s) for this project: 038-372-042 **Occupancy Class** **Types of Construction:**

APPLICABLE CODES

2001 California Building Code (1997 UBC and California amendments)
2001 California Electric Code (2002 NEC and California amendments)
2001 California Mechanical Code (2000 IAPMO UMC and California ammendments)
2001 California Plumbing Code (2000 IAPMO UMC and California ammendments)
County Building and Construction Ordinance - Title 19
County Land Use Ordinance - Title 22
County Coastal Zone Land Use Ordinance - Title 23
California Title 24: California State Energy and Accessibility Standards

PROJECT DESCRIPTION

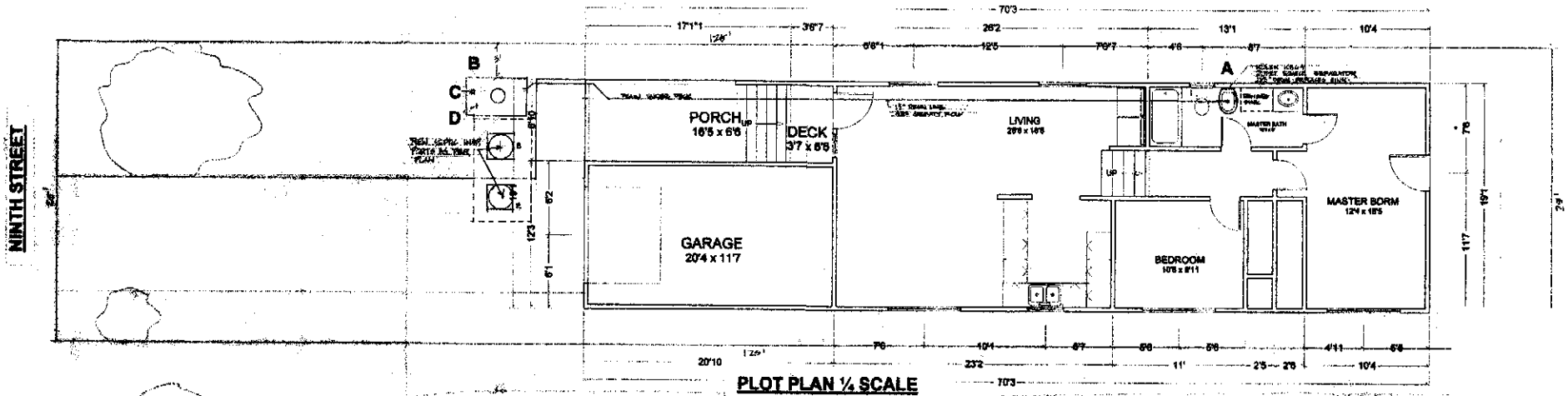
SEPTIC REPLACEMENT (OK PER BARRY TOLLE)

SPECIAL REQUIREMENTS

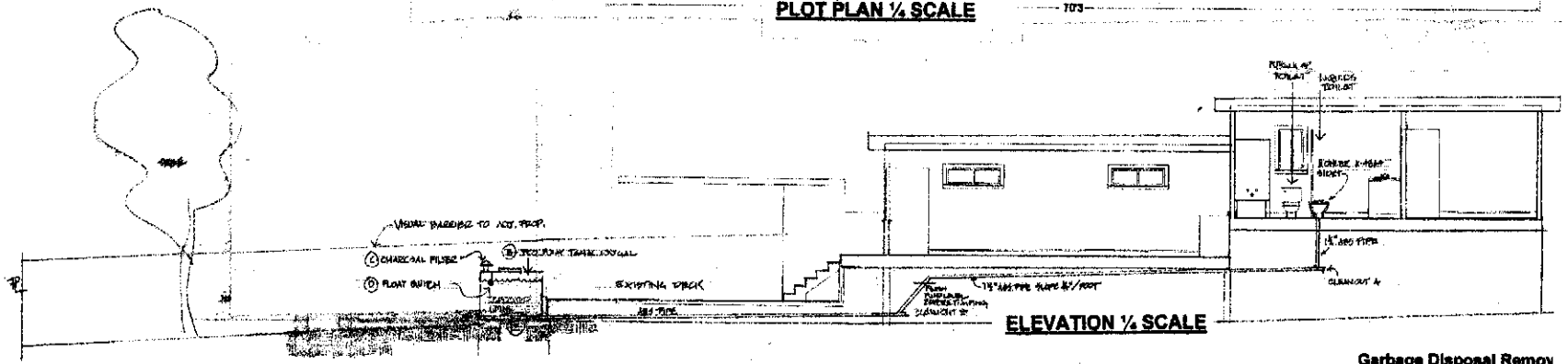
Prior to Foundation
None
Prior to Frame
None
Prior to Final
None

EXHIBIT
3.4

Initials: _____ page 1 of 2



PLOT PLAN ¼ SCALE



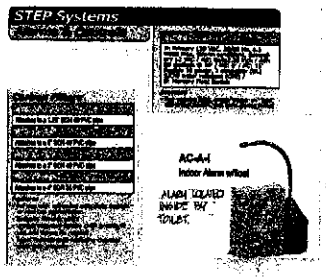
ELEVATION ¼ SCALE

EXHIBIT 3,5

C CHARCOAL AIR FILTER

E RETROFIT TANK PORTS

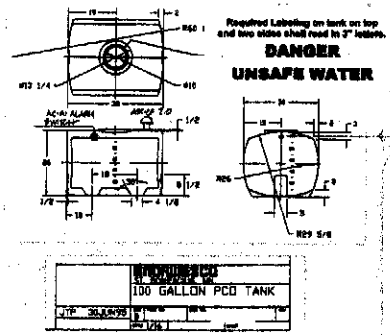
Tank ports shall be installed for continuous inspection of solids and scum thickness. Tank Shall be pumped before final inspection and every two years thereafter or when solids occupy over 16 inches in the bottom of the tank whichever comes first.



Install Zabel Alarm System as shown At 80 gallon mark on tank level.

D FLOAT SWITCH ASSEMBLY

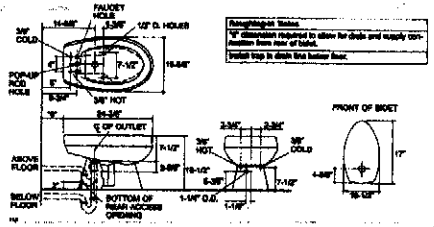
B STORAGE TANK



CODES/STANDARDS APPLICABLE

Specified model meets or exceeds the following:

- ASME/ANSI A112.19.3/
- IAPMO/UPC
- Canadian Standards Association (CSA)
- State of Massachusetts



Garbage Disposal Remov

This alternative plan proposal is outlined in the CC the prohibition order in Los Osos California for both AS recommended in RWQCB Resolution R3-12 this alternative shall require the removal of the garbage disposal for the period from the date of final inspection.

Deed Restriction

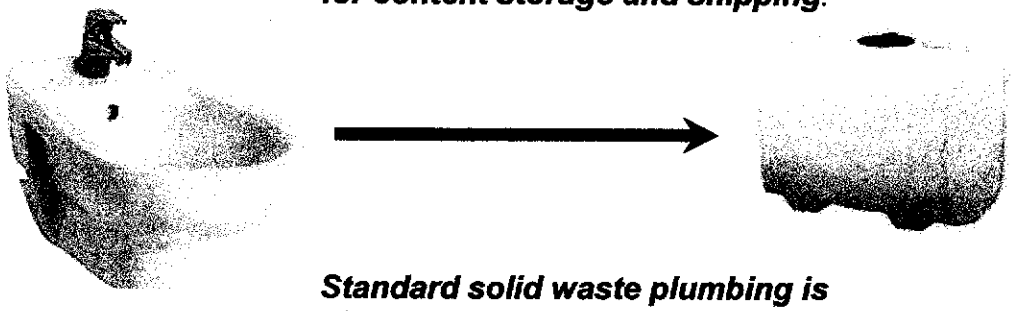
Conditional to final inspection, a deed restriction requiring the new owner keep the source separation plumbing system in place and garbage disposal prohibition till the prohibition is lifted by the RWQCB. A maintenance contract must be in place for area removal at time of sale and a covenal for use required.

SEPARATED SOURCE NITROGEN STORAGE PLAN FOR COMPLIANCE TO RWQCB ORDER R3-2008-R32008	
TEMPORARY ALTERNATIVE MEASURES INSTALLATION	
OWNER: STEVEN PAUL	
1954 NINTH STREET	
LOS OSOS, CA	
OWNER: STEVEN PAUL	
1954 NINTH ST.	
LOS OSOS, CALIFORNIA	
PROJECT LOCATION: 1954 NINTH STREET	
LOS OSOS, CA	
DATE: 3-15-2006	PG. 1 OF PAGES

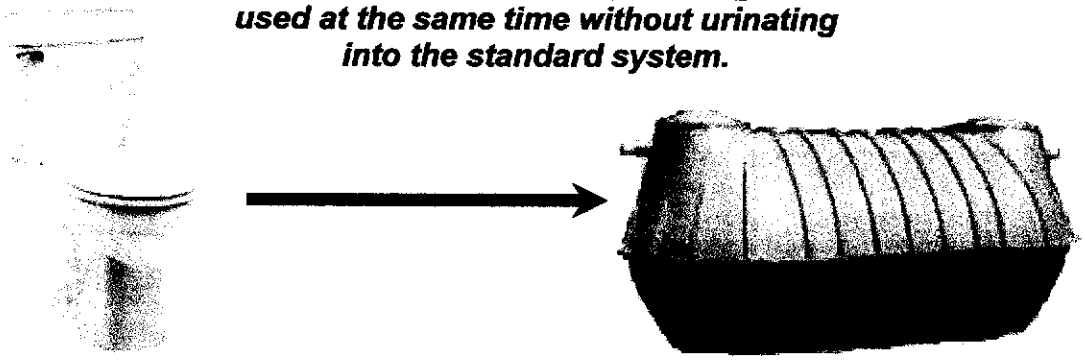
EXHIBIT 1

NITROGEN SEQUESTERING HOMEOWNERS MANUAL

A urine only plumbing system is added to your existing household plumbing for content storage and shipping.



Standard solid waste plumbing is used at the same time without urinating into the standard system.



WHY SEQUESTER URINE SEPARATELY?

Separating your solid waste from your liquid waste using a small modification in your behavior will sequester 60% to 80% of the nitrogen released by your septic tank. Nitrogen sequestering requires an initial investment that is offset by reduced pumping, hauling, or septic treatment costs. In California, some groundwater basins are impacted by Nitrates and Nitrites reaching drinking water or protected environmental waters like Bays or Estuaries. Urea and ammonia found in liquid human waste can remain concentrated if sequestered and potentially marketed as a safe, sustainable form of liquid fertilizer after bacterial treatment and deodorizing.

Sequestering reduces water consumption by up to 1.5 gallons per flush saving valuable groundwater or imported water. Concentrated waste is easier to ship, reduces air pollution from trucking and reduces owners waste shipping costs by 90% if required to ship septic contents because of Nitrogen impacts. Remaining septic contents have an improved Carbon to Nitrogen ratio that is necessary for solids reduction by bacterial digestion.

EXHIBIT

3.6

Section 1- Plan Sets

The below 'Project Description' and 'Project Design Standards' should be included on your plan set along with system drawings by a licensed contractor for residential systems or a licensed engineer or architect.

Project Description

This project describes an alternative storage, pumping, and disposal plan for a reduction of Water borne Nitrogen loading on the subject's property to reduce the Nitrogen content in septic outfall by 50 % to 80% per year.

Urine is proposed to be removed from the waste stream before entering the septic tank by direct source separation of the urine and feces utilizing human behavior as a separation mechanism. The urine is then stored separately and then pumped by a Class 42 hauling contractor and disposed of as a portion of the compliance plan for the following property:

---

1. **This project is based on the following assumptions:**
1. Federal Data from the EPA ONSITE WASTEWATER TREATMENT SYSTEMS MANUAL EPA/625/ROO/008

2. The physical principal that matter cannot either be created or destroyed ad hoc.

3. Normal laws of mathematics i.e. multiplication and percentage calculations are the rule.

4. Data on TN (Total Nitrogen) differences between urine and feces where urine contains 75% TN and feces 25% TN123 in the toilet waste stream.

5. Federal mandate in Section 503 of the Federal Clean Waters Act that Agency's 'promulgate' sustainable and alternative on site sewage disposal systems.

COPY CUT AND PASTE ON PLAN SETS

EXHIBIT
3,7

Project Design Standards

1. Bidet or waste separating toilet shall be installed as approved for disposal of liquid human byproducts and water as per ASME/ANSI AI12.19.2M. Bidets with 1 ½ inch drain and are considered .5 fixture units when calculating installation and venting requirements. Bidets can be plumbed out an exterior wall horizontally if necessary for slab installation. All sequestering systems shall be vented as per local adopted code.
2. ABS or other UPC approved waste line systems shall be installed as per code adopted by the County where the property is situated.
3. Waste Storage tank shall be non-corrosive meeting 'PCO' standards for liquid corrosives and liquid fertilizer handling. Storage is in a portable above ground or below ground tank and shall be rated as such. All above ground tanks shall be labeled: 'NON-POTABLE WATER'. Sumps and sump pumps shall be NSF approved or approved for installation by the system engineer.
4. Float Alarm and Alarm systems shall be installed along with a float valve as backup to prevent overfilling of the urine storage tank. All alarm lights or auditory devices shall be designed for corrosive environments if exposed to waste products. Alarms shall signal when contents of tank are 90% full. If alarm fails, empty contents as soon as waste backs up into bidet.
5. Before final inspection there will be an initial Septic Tank Pumping.
6. The owner will supply receipts of haulage of sequestered urine to the responsible agency or by verification of the responsible local agency employees. Haulage shall continue as the alarm system so warns until the subject property complies with required groundwater water quality standards by other method. If standards allow normal septic system function the system can be installed to utilize the sale of recycled nitrogen waste bi-products if proof of contractual arrangement with the purchaser are given to the local agency.
7. A deed restriction shall contain all requirements and manuals so as to become part of a home sale title report if home is sold. The transferee will be disclosed in the disclosure report the nature and design of the system and it's operation, including human behavioral inputs. A copy of the recorded deed restriction and manual will be available for final inspection.

COPY CUT AND PASTE ON PLAN SETS

EXHIBIT
3.8

NITROGEN SEQUESTERING PARALLEL PLUMBING SYSTEMS
INSTALLATION, MAINTENANCE AND ADMINISTRATIVE VERIFICATION MANUAL

Section 2- Household Operation:

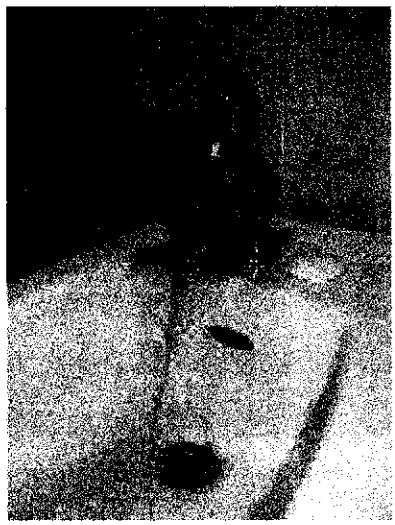
1. All persons in your household should attempt to urinate in the sequestering bidet or dual function toilet. Sometimes this is difficult to do. If your solids and liquid 'calling' happens at the same time, use the regular toilet. If you wish, you can toilet train yourself to manipulate both functions.

2. **If you are using a bidet for nitrogen sequestering, the normal function for body cleaning has been disabled.** No hot water is available and there is no upward water stream for cleaning. Further, the water stream is controlled by a spring loaded valve that goes off when you release it.

3. Label the fixture " For liquid human waste only. Do not dispose of toilet paper in the urnal." in 36 Pt. type above the fixture. Your installed system should come with this placard.

4. The reason for installing a sitting position urinal is to accommodate urination by both genders. Regular urinals may also be used for sequestering if the adaptation is for commercial use gender specific restrooms.

5. **Female use of the bidet requires not using toilet paper in the bidet but transferring the waste toilet paper to the regular toilet.** Consequently, both waste devices should be conveniently located next to each other or there should be an identified container the contents of which can be transferred to the regular toilet. Follow the manufacturer's recommendations for urine sequestering toilets.



6. By conserving water during the flushing action you will increase the length of time between pumping intervals for the sequestering tank. Push the spring valve long enough to wash out the surface of the bidet bowl. Do not try to flood the bowl. **Normally there is no standing water in the Bidet even during flushing.**

7. The Bidet should be cleaned often with disinfectant. Try to limit the amount of water you clean with as all the water runs directly into the sequestering tank.
Urine usually contains fewer pathogens than solid waste because of its higher acidity. Care

EXHIBIT
3.4

EXHIBIT 1

should be taken when washing any toilet or urinal to prevent contamination. Wash your hands liberally after cleaning the device.

8. A small mesh screen should be inserted in the drain to prevent objects from clogging the drain and prevent mistaken toilet paper use from clogging the smaller diameter drain system.

9. When the sequestering tank is full a light will signal that it needs to be pumped. You will need a certified waste hauler to transfer the waste to an approved processing sewage facility.

10. At the time of pumping the waste handler will give you a record of the amount of liquid in the tank. Keep all records of the amount of waste sequestered and shipped away from your property. Fill out the report on the last page. These reports may be sent to the responsible agency if that agency so requires. Agencies may require testing for nitrogen taken from samples of the sequestered fluid at time of pumping by the certified waste handler. Testing for nitrogen can be performed by any independent laboratory.

11. If the pumping light fails, the waste will automatically back up into the bowl because of a fail safe float valve in the sequestering tank. Call the pumper and repair the light as soon as possible.

12. Begin the sequestering process again when the tank is empty. Swedish studies indicate that stored urine self disinfects over time.

13. Be sure to call a professional plumber if you are having storage or plumbing problems.

14. The sequestering system should be disclosed to any purchaser of the home as an alternative septic device. The owner of record is responsible for transferring to the new owner all legal records and conditions required by public agencies if the device is considered part of the septic permitting process for the home listed below.

15. The owner responsible for transferring this information to the next purchaser of the home where it is installed is:

Owner_____

Owner_____

Address of Installation_____

_____

EXHIBIT
3.10

Parallel Nitrogen Sequestering Pumping Log

Site Address_____

Owner's Permit Number_____

Date of Pumping	Gallons Pumped	Waste Operators License Number	Waste Hauler Signature	Mg/L TN

EXHIBIT

3.11

END OF DOCUMENT

Alternative Compliance Improvement Validation

Author: Steven Paige

Date: 3/21/2006

Property Location:

1554 Ninth Street, Los Osos, California

Owner of Record:

Steven Paige

Alternative System Designer:

Steven Paige

Installer:

Steven Paige, Owner/Installer Contractors License, Cl 385994

Subject to:

Alternative compliance to Order R3-2006 Central Coast Regional Quality Control Board INTERIM COMPLIANCE REQUIREMENTS set forth in paragraph B-3 "Other Methods" of Compliance.

As per the CRWQCB Staff report dated March 13, 2006 the benchmark reduction of nitrates was investigated by the RWQCB and a standard of 22 percent nitrate reduction was assumed by the six bi-monthly pumpings per year, per household (Pg. 2 Paragraph 2).

EXHIBIT
3.12

Project description:

This project describes an alternative storage, pumping, and disposal plan for a reduction of Water borne Nitrogen loading on the subject's property to reduce the loading by 22% or more on a yearly average.

Urine is proposed to be removed from the waste stream before entering the septic tank by direct source separation of the urine and feces utilizing human behavior as a separation mechanism. The urine is then stored separately and then pumped by a Class 42 hauling contractor to Santa Maria and disposed of as is the total septic effluvium plan.

This project is based on the following assumptions:

1. Federal Data from the EPA ONSITE WASTEWATER TREATMENT SYSTEMS MANUAL EPA/625/ROO/008

2. The physical principal that matter cannot either be created or destroyed ad hoc.

3. Normal laws of mathematics i.e. multiplication and percentage calculations are the rule.

4. Data on TN (Total Nitrogen) differences between urine and feces where urine contains 75% TN and feces 25% TN[123] in the toilet waste stream.

5. Federal mandate in Section 503 of the Federal Clean Waters Act that Agency's 'promulgate' sustainable and alternative on site sewage disposal systems, that State Agencies are bound to be consistent with Federal Law, and that Federal law supersedes State law in this respect.

EXHIBIT

3.13

Project Design Standards:

1. Bidet installed is approved for disposal of liquid human byproducts and water as per ASME/ANSI A112.19.2M Bidets have a 1 ½ inch drain and are considered .5 fixture units simplifying installation. Bidets can be plumbed out an exterior wall(See Plan).
2. ABS plumbing to UPC 2000 as adopted by the County of San Luis Obispo.
3. Waste Storage tank is non-corrosive meeting PCO standards for liquid corrosives and liquid fertilizer handling. Storage is in a portable above ground tank.
4. Septic tank improvements described meet NSF Section 46 testing and standards.
5. Charcoal filter, Float Alarm and Remote Alarm are NSF Section 46 compliant and approved.
6. Before final inspection there will be an initial Septic Tank Pumping and monitoring quarterly thereafter with re-pumping required after "sludge level is within eight inches of the outlet device" (as per RWQCB resolution 83-12). This is consistent with previous water board rulings.
7. The owner will verify with receipts the haulage of sequestered urine for verification by the RWQCB if desired. Haulage shall continue quarterly or as the alarm system so warns until the subject property complies with water quality standards equivalent to WASTE DISCHARGE/RECYCLED WATER REQUIREMENTS ORDER NO. R3-2002-0108 onsite or is connected to a community sewer approved by the RWQCB.
8. A deed restriction should contain all requirements and manuals as per this Alternative Plan so as to become part of a home sale title report if home is sold. The transferee will be disclosed in the disclosure report the nature and design of the system and it's operation, including human behavioral inputs. A copy of the restriction and manual should be necessary for final inspection.

EXHIBIT
3.14

Description of household pollutant reduction:

Urine containing 58% of the household nitrate production is separated from all other wastes unilaterally before going into the septic tank. 78% of TN comes from toilet wastes[1]. 75% TN is held in urine content.[123] 78% X 75% =58%. Also 58% >22% therefore urine separation exceeds the criteria set by the RWQCB mandatory pumping program.

Removal of Garbage disposal will render the pollutant reduction further to 5% more reduction in TN, 28% reduction in BOD(5), and 37% reduction in solids[5]. Hence the total reduction is 73% reduction in TN, 28% reduction in BOD, and 37% reduction in solids entirely by behavioral source separation.

Source separation of trash products is an example of successful behavioral modification to augment sustainability and logic would assume that human waste source separation would have the same results. Persons not desiring to this option could continue with dictated pumping.

Offsite Airshed Pollutant Reduction

The estimated amount of waste haulage per household per year is 9000 gallons. 6 haulings x 5000 households x 120 roundtrip miles to Santa Maria (not including pump out pollution and idle time) =3.6 Million diesel truck miles per year added to the San Luis Obispo Airshed.

NOx is produced by diesel truck effluvium shipping and is equal to 12.8 grm/mi[6] X 3,600,000 miles X 1/2.8 grm/oz X 1/16 oz/lbs X 1/2200 lbs/ton = 467 Tons of Atmospheric Nitrogen released. With 116 tons of Nitrogen settling out of the air and going back into the watershed! What this really means is that for every pound of Nitrogen you are hauling you are dumping five pounds back into the bay because there is only 78 grams of N per truck load and 384 grams are going into the Bay from the diesel exhaust. Contrarily, source separation cuts haulage per household by a factor of 400 gal/9000 gal. or 96% Then- 467 Tons X 4% = 18 Tons of NOx air pollution from hauling urine separate. That's a big difference not even considering the traffic congestion.

Of the air NOx in the airshed it has been shown by the lengthily and encompassing study of Chesapeake Bay that 22 to 25 percent of the NOx returns to the watershed mechanically when air NOx is released in the adjacent area.

EXHIBIT

3.15

My informational source for this claim is in : Atmospheric Deposition, A Handbook for Watershed Managers, Office of Wetlands, Oceans, and Watersheds U.S. Environmental Protection Agency Washington, DC 20460 EPA-453/R-01-009 September 2001 see:http://www.epa.gov/airtrends/nitrogen.html)

This table from the above citation summarizes N loading and percentages.

Atmospheric Nitrogen Loads Relative to Total Nitrogen Loads in Selected Great Waters*

Waterbody	Total Nitrogen Load (million kg/yr)	Atmospheric Nitrogen Load (million kg/yr)	Percent Load From the Atmosphere
Albemarle-Pamlico Sounds	23	9	38
Chesapeake Bay	170	36	21
Delaware Bay	54	8	15
Long Island Sound	60	12	20
Narragansett Bay	5	0.6	12
New York Bight	164	62	38
Based on ADN loads from the watershed only (excluding direct nitrogen deposition to the bay surface):			
Waquoit Bay, MA	.022	.0065	29
Based on ADN directly to the waterbody (excluding ADN loads from the watershed):			
Delaware Inland Bays	1.3	.28	21
Flanders Bay, NY	.36	.027	7
Guadalupe Estuary, TX	4.2 - 15.9	.31	2 - 8
Massachusetts Bays	22 - 30	1.6 - 6	5 - 27
Narragansett Bay	9	.4	4
Newport River Coastal Waters, NC	.27 - .85	.095 - .68	>35
Potomac River, MD	35.5	1.9	5
Sarasota Bay, FL	.6	.16	26
Tampa Bay, FL	3.8	1.1	28

ADN = atmospheric deposition of nitrogen

*Table from *Deposition of Air Pollutants to the Great Waters—3rd Report to Congress*. EPA-453/R-00-005, June 2000. Original literature references included in the report.

It is a fair assumption that the truck hauling NOx would follow on these percentages.

EXHIBIT

3.16

Salt Water Intrusion Reduction

For tank pumping the quantity of water removed from the hydrologic cycle of Estero Bay and removed from recharge is: 9000 Gallons/yr. X 5000 Households =45 million gallons per year. The impact of this withdrawal is unknown but it is the equivalent of almost two months usage for the whole community. Source separation could avoid legal complaints by water purveyors for the huge draw against groundwater recharge.

Source separation including .2 liter urine wash down per flush for a family of three would probably not exceed 400 gallons per year. So 400 X 5000 households =1.1 Million Gallons but the water conservation from saved toilet flushes 6 X 1.6 gal/flush x 365 days x 5000 households =17.5 Million gallons/yr saved by not being withdrawn. The net gain to basin hydrology in any case would be over 15 Million gallons per year. There would be no net withdrawal.

The motivational feedback to not flush lots of water with urine is that pumping would occur less often costing the homeowner less money.

2% EPA Benchmark Affordability Reached

The benchmark cost according to the EPA should not exceed 4% of yearly income of a family for both water and sewer cost. For sewer cost alone the amount would be 2%. The income of 33% of the families at Baywood Elementary earn below $28,000 per year with many being one income single parents like myself. $28,000 X 2% X 1/12 = $46.00/ MO. Or $138.00 per quarterly pumping compared to $800.00 for the tank pumping requirement. This would approximate the pumping cost of 100 gallons. Standard portable toilets cost approx $60.00 to service. Hence source separation would meet the low income community needs were Septic pumping does not.

Behavioral Motivation

Behavioral motivation is primarily monetary. The secondary motivation would be environmental awareness. Source separation could be eventually resource oriented where urine is reprocessed onto liquid fertilizer for agricultural users. Swedish studies involving resource source separation and contaminant removal are well documented and available from the author at the request of your department.

EXHIBIT

3.17

CONCLUSION

It is hoped by this permit application that both yourselves and the RWQCB will consider source separation and pumping as an alternative to septic pumping. It is understood that any approval for an alternative would have to meet the RWQCB needs if applied throughout the community. I think the plan for my property does that. This plan would make Los Osos cutting edge in resource management in line with advanced studies and pilot projects being carried out in Sweden and elsewhere without the risk of the project unknowns of using human urea as a resource. It sets up waste separation behaviors that are the most energy efficient way of processing human groundwater Nitrogen pollution (see enclosed study). Pending your approval, I have five other prohibition zone homeowners waiting for a similar installation.

The main reasons for approving my plan are:

1) 60 % nitrate removal compared to 22%.
2) Lower cost per household.
3) No groundwater withdrawal.
4) Uses off the shelf industry standardized equipment.
5) Creates advanced environmental awareness.
6) 1/10 the traffic and air pollution generated.
7) Possible resource management in the future.
8) Much lower energy consumption requirements.
9) Economic advantage for many small local retrofitting contractors.

Thank you for your consideration. It is my intention to avoid a CDO on my property by making improvements immediately. Your prompt attention is necessary to prevent devaluation of my property and potential legal encumbrances caused by your inaction. Lets act now to save our Bay!

Please feel free to call me at:

Steve Paige

805-215-9025 cell

805-528-4738 Home

EXHIBIT

3.18

1)Nutrients in urine: energetic aspects of removal and recovery M. Maurer*, P. Schwegler and T.A. Larsen EA WAG, Environmental Engineering, Uberlandstrasse 133, CH-8600 Dubendorf, Switzerland
2) Siegrist et al. et aI, 1976 2Beckerus et aI, 1998 3Jonsson et aI, 1997, Medcalf and Eddy, 2003
3) Department of Nutritional Sciences NS 160University of California, Berkeley Unit III: HUMAN PROTEIN NEEDS
4) 3 & 2 page 2.
5) Federal Data from the EPA ONSITE WASTEWATER TREATMENT SYSTEMS MANUAL EPA/625/ROO/008
6) http://www.epa.gov/air/airtrends/aqtrnd99/fr_table.html
7) EPA 832-B-97-004 Financial Capability Assessment

EXHIBIT

3.19

WHEN RECORDED MAIL TO
Name STEUEN PAIGE
Street 1554 NINTH ST.
Address LOS OSOS CA.
City LOS OSOS
State CA
Zip 93402

RECORDING REQUESTED BY
SAME.

JULIE RODEWALD
San Luis Obispo County – Clerk/Recorder
Recorded at the request of
Public

SK
10/19/2006
10:50 AM

DOC#: 2006074005

Titles: 1 Pages: 9

Fees	31.00
Taxes	0.00
Others	0.00
PAID	$31.00

SPACE ABOVE THIS LINE
FOR RECORDER'S USE

DEED RESTRICTION
WASTE NITROGEN SEQUESTERING

NOTICE is hereby given that:

1) The undersigned is owner of the interest stated below in the property hereinafter the following described real property in the County of San Luis Obispo, **State of** California:
Lot 35 in Block 91 of the Town of El Moro, in the un-incorporated area of the County of San Luis Obispo, State of California, according to Wood's Revised Map of El Moro, filed for record February 11, 1901 in Book A, Page 80 of maps, in the office of the County Recorder of said County.

2) The NAME (including that of the undersigned), ADDRESS and NATURE OF TITLE of every person owning any interest in such property is as follows:
STEUEN PAIGE, OWNER, SOLE AND SEPERATE
1554 NINTH ST. LOS OSOS CA 93401

3) To comply with Regional Water Quality Control Board Region 3, Resolution 83-13 and 83-12 and subsequent resolutions made upon the above subject property the parties above have made interim alternative Septic system improvements to enhance basin water quality for as long as there is not a sewer lateral supplied to the property or to such a time that the above water board deems necessary.

4) A work of improvement on the property hereinafter described was PERMITTED UNDER:
SAN LUIS OBISPO COUNTY PERMIT NO 2005-03320
5) The name of the CONTRACTOR, if any, for such work of improvement was:
STEVE PAIGE CONSTRUCTION CC-385914

7) THE IMPROVEMENTS ARE DESCRIBED AS:
A nitrogen sequestering system that isolates urine into a separate holding tank for transfer outside Morro Bay Estuary Watershed by a County ce

EXHIBIT
3.20

utilizes human behavior modification to remove 50 to 80% of the total nitrogen component in the waste stream from entering the ground from the above described property as it is located in the Morro Bay Estuary Watershed and subject to RWQCB-3 actions to protect groundwater. The system and actions required to operate it are the subject of this deed restriction. The system and actions are described in the attached manual (EXHIBIT 1).

8) COVENANTS AND RESTRICTIONS HEREWITH ARE BASED ON SYSTEM COMPONENTS AND THEIR OPERATION and may be subject to proof of operation to the following controlling agencies: County of San Luis Obispo Building Department, Regional Water Quality Control Board Region 3, Los Osos community Service District. Each agency should be contacted prior to title transfer and queried about the Agencies historic relation to the improvement described above.

STATE OF CALIFORNIA
COUNTY OF SAN LUIS OBISPO
The undersigned, being duly sworn, say(s) that he/she/they is/are the owner(s) of the aforesaid interest or estate in the property described in the foregoing notice; that he/she/they has/have read the same and know(s) the contents thereof; that the facts stated are true; and that he/she/they executed the same in his/her/their authorized capacity(ies).

Signature of Individual Owner:

Dated: OCT / 4 / 2006

Signed: Steven Raps / Steven Raps / Steven Raps

IN the County of: SAN LUIS OBISPO

NOTARY SIGNATURE

SUBSCRIBED AND SWORN TO_____

before me on_____

Signature_____

Name_____

see attached document

(This area for official notarial seal)

EXHIBIT
3.21

AL'S SEPTIC PUMPING SERVICE,INC.
P.O. BOX 6996
LOS OSOS, CA 93412
528-0432 541-8283 773-0123 927-1722

Invoice

Date	Invoice #
8/21/2007	7551

Bill To	Job Address
Steve Page 1554 9th Street Los Osos, CA. 93402	Steve Page 1554 9th Street Los Osos, CA. 93402

P.O. No.	Terms	Due Date	Maintenance	Leach Failure	Escrow	Other
PL8/20/07	Net 30	9/20/2007	XXX			

Description	Qty	Rate	Amount
Service call to expose and pump septic holding tank and 100 gallon sequestered urine tank. Septic tank and sequestered tank operating at normal level. Tank has access to liquid side of septic tank and sequestered urine tank. Crews exposed solid side of septic tank and backfilled. Owner will remediate brick area over access lid.			
Pumping and disposal of septic tank- transport to Santa Maria Treatment plant.		325.00	325.00
Service call/labor		75.00	75.00
Thank you ! We appreciate your business !			
Please include the invoice number or job address with your payment. Thank you.			
We gladly accept MasterCard or VISA, just call the office.			

fd P/A # 4610 8/29/07

To be paid in full upon receipt. All invoices not paid within 30 days subject to finance charge 1.5%

Total	$400.00
Payments/Credits	$0.00
Balance Due	$400.00

License # 883281

EXHIBIT

4.1

Frank Lyon Jr.

AL'S SEPTIC PUMPING SERVICE,INC.
P.O. BOX 6996
LOS OSOS, CA 93412
528-0432 541-8283 773-0123 927-1722

Invoice

Date	Invoice #
8/21/2007	7570

Bill To	Job Address
Steve Page 1554 9th Street Los Osos, CA. 93402	Steve Page 1554 9th Street Los Osos, CA. 93402

P.O. No.	Terms	Due Date	Maintenance	Leach Failure	Escrow	Other
PL8/20/07	Net 30	9/20/2007	XXX			

Description	Qty	Rate	Amount
Service call to pump exposed sequestered urine holding tank. Tank has access. 100 gallons Charges were included with pumping of septic holding tank			

To be paid in full upon receipt. All invoices not paid within 30 days subject to finance charge 1.5%

Total	$0.00
Payments/Credits	$0.00
Balance Due	$0.00

License # 883281

EXHIBIT

A.2

Monday, Feburary 25, 2007
RE: Nitrogen Sequestering
1554 9TH St. Los Osos

Dear Mr. Packard and fellow prosecution team members,

I would like to thank you for allowing my alternative nitrogen sequestering system to help meet 80% reduced discharge goals for nitrogen from my property. I also thank County of San Luis Obispo and Barry Tolle for permitting it. I enclose all plans, permits, and support graphics, writings and deed restrictions for your review. I recently reached the 45 gallon (quarterly) mark on my sequestering confirming that 100 gallon pumping will be required twice a year for my daughter and myself.

Creek Labs has performed the following content test (attachment 1) to confirm the estimated total nitrogen removal per year after including flush volume with the urine. I have entered this figure into the form that is part of my deed restriction (attachment 2). According to the EPA wastewater handbook sequestering urine reduces nitrogen discharge by 60 to 80 % per household. The 96 mg/l figure accounts for flush water and evaporative dilution in the sequestering tank.

Basically I have two requests:
I am requesting a jl; from orders based on ruling 83-13. With the proviso that I still adhere to the building moratorium restrictions. I invite you or your staff to come to my home and look over the system at your convenience. I would love to show you how simple and foolproof it is.

I would like to talk to you about setting up SEP grants for nitrogen sequestration on multiple properties in the prohibition zone based on the approval of our final settlement accord. There would be several subsidiary goals for the SEP programs implementation. As you know the sequestering goes beyond the required standards and interim compliance.

1. Develop generic design for three types of systems using NSF 40 and 41, approved equipment. Parallel gravity collection and storage, Parallel pumped collection and storage, and direct storage to accommodate all potential situations. The plans would be made available to plumbing and C-42 contractors for free in autocad or pdf format over the internet.
2. Develop 'sequestering waiver' public outreach using MS PowerPoint, public television, and local public venues. With water board prosecution team and stakeholders panel to answer questions.
3. Develop Cold Fusion on line web data base for participants in the program.
4. Develop group shipping contracts to lower cost.
5. Research recycling markets with the goal to lower cost of shipping to zero.
6. Assist owner's in the permitting process and create a comprehensive list of cooperative and licensed subcontractors.
7. Create a County-Waterboard MOU for the implementation of a vacant lot retrofit program to further reduce nitrogen impacts and allow limited building based on nitrogen removal and water conservation. Under proposition 218 law, the PZ vacant lots, unless you can build on them, cannot be included in the cost of the sewer using the majority vote methodology. A retrofit program with sequestering

EXHIBIT

4.3

can be redundant and safely manage new construction while grandfathering the vacant lots into the majority vote and assessment process.

My settlement agreement to attach to the waiver covers what I see as a legal elephant in the room in the CDO process for the PZ that has been pointed out to me by legal consultation. The issue that stands out is 'regulatory takings' issues related to the zero discharge order and lots of varying sizes.

For us both to come up with a legal path for proportional discharge enhances the water board's position relative to 'takings' challenges and insures economic equality of enforcement impacts among homeowners. Agreeing to proportional discharge for sequesterer's benefits the board by allowing an avenue that quiets legal challenges for 'regulatory takings' related to the zero discharge order.

We both have an overriding need to be given the waiver or exemption because of our economic situation. I am a single dad raising a child on limited income. All of my assets are invested in my home. I own it free and clear. Hence my overriding concern to keep the title clean of encumbrances and improve its value. It represents my retirement income. This agreement does that for me.

Included in the settlement agreement, is a very new water conservation concept having to do with immediate water conservation and discharge linkage. In essence, a water conservation clause in our agreement would tie residential 'water banking' directly to 'discharge banking'. If I reduced water consumption by 10% or more that 'discharge' saved could be banked to be added to proportional discharge after 2011 or 2013 if the sewer did not get completed as in a future TSO for the new County project. Who knows what the world will look like in five years. This would be added insurance. Proof of reduced discharge would be by comparing pre-settlement water bills on a monthly basis to new. If I didn't reach the 10% conservation level I would be given no credit for that month. Reporting would be voluntary by myself on a form we made up and attached into this agreement. That would be an added incentive for anyone repeating this solution. I presently use 2 units of water a month.

Without the waiver, I don't think there would be much interest in the benefits of the sequestering settlement. With the waiver you essentially have a very big carrot to encourage stakeholders to use behavior modification and sequestering and water conservation immediately. It could be administered by website database. I believe we could get State SEP funds and construction credit retrofits to finance this state of the art method of nitrogen reduction in the Los Osos community.

It would be easy to use Cold Fusion in a webpage data base and create a website where stakeholders could review discharge banking credits and total N sequestered by just logging in. John Barta in Morro Bay could be approached to write the code for it. He presently has created a Cold Fusion based website for the National Board of Real Estate Exchangers that is infinitely more complicated. He is an old friend of mine. An electronic data base would probably be easier for your office. I could help put it together. I look forward to meeting with you and working out the details of my unique settlement with your team. Please feel free to call me and set up a date as early as possible so I can avoid the CDO process entirely by insuring my continued cooperation with reduced Nitrogen discharge and its progressive validation. The settlement agreement is self explanatory.

EXHIBIT

4.4

Yours Truly,

Steve Paige
528-4738 / 215-1925 cell.
shpaige@sbcglobal.net

Action Benefits:	Owner's Benefit	Boards Benefit
Sequestering removes 80% of impacting Nitrogen and reduces water consumption by 10 %	yes	yes
This 'Proportional discharge' settlement becomes a regulatory avenue protecting the board from 'Regulatory Takings' class actions by homeowners for inequitable enforcement.		yes
Owner receives a waiver and has no fear of cumulative fines or levies that would attach to home equity	yes	
Sequestering saves on hauling costs and air pollution and is an immediate benefit to the groundwater basin.	yes	yes
Agreement protects owner in event the sewer construction cannot meet the required time line; waiver is extended with limited proportional discharge modified by 'discharge banking'.	yes	
Sequestering is cheaper than secondary treatment and more likely to meet CEQA 'parallel standards' litmus test for NOx and PM 10 pollution compared to community wide pump and ship plans mentioned at the CDO hearing.	yes	yes
Sequestering does not impact owner's sewer connection later on or create Prop. 218 beneficial use challenges that interim onsite secondary waste treatment could.	yes	yes

EXHIBIT
4.5

Dated December 7, 2006
In the Matter of:
Discharges of Waste From Individual or Community Sewage Disposal Systems in the Los Osos/Baywood Park Prohibition Zone, CCRWQCB Resolution No. 83-13 Basin Plan, p. IV-67

SUPPLEMENTAL AGREEMENT TO PC 13269 TEMPORARY 5 YEAR WAIVER

(Draft, for Settlement Discussions Only)

The undersigned Parties stipulate and agree as follows:

1. _____ own(s) and operate(s) an on-site wastewater treatment and disposal system (Septic System) and nitrogen sequestering system at _____(Site) in Los Osos, California.

A. PC 13269 TEMPORARY WAIVER TIMELINE

2. The Site is a residence located within the prohibition zone established by Resolution No. 83-13. The Septic System consists of a septic tank that discharges wastewater to an on-site subsurface disposal facility. _____ is/are referred to in this Order as "Discharger."

Said discharger has made reasonable, energy conserving, and economically relevant efforts to remove waterborne nitrogen from the sites discharge by a method described in this agreement and exhibits.

1. This agreement is mutually signed then preparation of equipment is completed.
2. When the discharger receives the status of final inspection from the County of San Luis Obispo for parallel waste sequestering improvements, the discharger will record a deed restriction described in **Exhibit A**,
3. After proof of recording of said deed restriction and sequestering manual the Prosecution Team will issue a 13269 temporary five year waiver for actions and levies existing and proposed by the Water board against the discharger within 60 days.
4. When a sewer connection is available to the discharger, the Water board may cancel the waver and this agreement.

B. TEMPORARY WAIVER VERIFICATION OF COMPLIANCE

3. The discharger will verify by pumping and shipping tickets and test of the sequestered waste for total waterborne nitrogen. At each pumping from the sequestering tank the log of the volume of the waste will be sent to the Water board or designated third party by letter or electronic submission. The total nitrogen in the waste product within the sequestering tank will be tested yearly by a certified laboratory and that a report of the nitrogen density will be sent to the

EXHIBIT 4.6

i) The owner may conserve water use by the owner or occupant verifiable by water billing to the percentage of discharge required.

ii) The owner may reduce the amount of pollutants in the waste discharge by on site treatment provided the site meets groundwater separation standards described by the County of San Luis Obispo septic criteria or is engineered.

iii) The owner may install a greywater system under permit as per State approved Greywater Standards: APPENDIX G, GRAYWATER SYSTEMS Title 24, Part 5, California Administrative Code to exempt that portion of discharge from the proportional discharge requirement. Waterborne nitrogen in random greywater sampling may not exceed 7ml/l average.

iiii) The owner may choose any other method or methods to make the smaller parcel pollutant proportion of the waste stream consistent by percentage of total with that allowed for one acre parcels as described in RWQCB3 DRAFT STAFF REPORT FOR REGULAR MEETING OF MARCH 31, 2000 Prepared on February 29, 2000 ITEM NUMBER: 16

F. DISCHARGE BANKING FOR PROPORTIONAL DISCHARGE AFTER FIRST WAIVER PERIOD

13. For the sake of this agreement 'water banking' or conservation is directly to related 'discharge banking'. If the owner reduces water consumption by 10% or more that 'discharge' saved will be banked and added to proportional discharge after 2011 or later if the sewer is not completed as per a future TSO for the County project under AB 2701. Proof of reduced discharge is by comparing pre-settlement water bills from the year previous on a monthly basis to new bills. The owner must reach a 10% conservation level from matched previous years billing associated by date of signing of this document to receive the credit. Reporting is required by showing water billing to the board. At the end of the first waiver period, as described herein, all months that qualify as over 10% reduction in discharge will be averaged and the average will be allowed as an addition to the proportional discharge until the sewer is connected to the property or other method of discharge is certified.

EXHIBIT 4.9

CONDITIONS OF AGREEMENT

15. The water board so states that this Agreement results from action being taken for the protection of natural resources and the environment and as such is exempt from the provisions of the California Environmental Quality Act if proven to be in compliance with (Sections 15307, 15308, 15043 and 15321, Chapter 3, Division 6, Title 14, California Code of Regulations, "CEQA") and all other sections of Title 14. In addition, the Septic System is an existing on site facility

that may be covered under provisions of federal law and this Agreement allows no expansion of discharge beyond that previously existing system so the actions required herein are exempt from the provisions of CEQA (Section 15301, Chapter 3, Division 6, Title 14, California Code of Regulations).

16. The language of this Agreement has been reviewed and approved by the Central Coast Regional Water Quality Control Board (Regional Board).

The Discharger has the choice of with the following requirements:

17. I the event that that a community sewer is available,

a. Upon completion of a sewer project, The owner may agree to connect to the community sewer but still reserves the right to sequester urine and manage its contents with third parties as a recyclable commodity.

b. After the Water Board provides notice of the expected availability date to the Discharger and no later than 90 days before the expected availability date, the Discharger may submit the following information; either:

i. A statement that the Discharger agrees to connect to the community wastewater treatment plant and sewer system within 60 days after the community wastewater collection and treatment system becomes available for connection to the Site; or

ii. A statement that the Discharger agrees to connect to the community wastewater treatment plant and sewer system within 60 days after the community wastewater collection and treatment system becomes available for connection to the Site but will continue to sequester and ship urine to third parties licensed to handle, detoxify, and discharge liquid human waste. All mineral rights are retained by the owner for minerals within the waste stream to the point at which they leave the owner's property.

iii. The owner may propose and alternative method of compliance. Any proposed alternative must be adequate to meet standards of agreed to discharges described in this agreement from the Septic System by the proportional discharge date and must include a proposed monitoring and reporting plan. If the alternative involves a discharge of waste that could affect waters of the State, the report shall be in the form of a report of waste discharge. "Waters of the State" is defined in Water Code Section 13050(e). "Report of waste discharge" means are port that complies with Water Code Section 13260 and, if applicable, Water Code Section 13376.

EXHIBIT 4.10

ADDITIONAL INTERIM COMPLIANCE REQUIREMENTS FOR SEPTIC CONTENT TESTING AND PUMPING IF SO REQUIRED.

19. By three months after the entry of this Agreement, the Discharger shall

(1) have the contents of the Septic System pumped or certify that the Septic System has been tested in conformance with EPA standards for solids and scum layers that require no pumping or is pumped if so required.

(2) obtain a report by the County of San Luis Obispo or a septic tank pumper that either describes recommended repairs to the Septic System or states that no repairs are necessary.
If the Discharger disagrees with any repair recommendation, the Discharger shall provide justification to the Executive Officer no later than four months after the entry of this Agreement explaining why the repairs are not necessary. Unless the Staff Prosecution Team agrees, in writing, that any recommended repair is not necessary, the Discharger shall provide documentation no later than the first day of the next full calendar month following 180 days after the entry of this Agreement, that the Discharger has complied with these pumping, inspection and repair requirements. Until the community wastewater collection and treatment system is available to the Site and/or all unpermitted discharges from the Septic System cease, the Discharger shall have three months from every third anniversary of the entry of this Agreement to satisfy the same pumping, inspection and repair requirements.

(See Section C. 6.)
For the purposes of this Agreement, "entry of this Agreement" shall mean the date that the Executive Officer executes this Agreement. The Staff Prosecution Team agrees that it will notify the Discharger of the date of entry and serve the Discharger by mail with a copy of the fully executed Agreement after execution by the Executive Officer.

D. PROVISIONS

22. All reports, receipts, notifications and other documents the Discharger submits pursuant to this Agreement (including Paragraph A.2 of this Agreement) shall be accompanied by a statement from the Discharger stating: "I certify under penalty of perjury that the attached documents were prepared at my request or under my supervision, and to the best of my knowledge are true, accurate and complete. I understand that there are significant penalties for providing false or incomplete information, including the possibility of criminal fines or imprisonment."

23. Discharger shall inform any subsequent owner or occupant at the Site of

EXHIBIT 4.11

this Agreement and provide a copy of the Agreement. For the purposes of this Agreement, the Discharger understands that he or she is liable for the use of the Septic System, while the Discharger owns the Site, including but not limited to use of the Septic System by any tenant or any other person occupying the Site.

24. Compliance dates may be extended by the Executive Officer provided there is reasonable progress in implementing a wastewater collection and treatment system for the community. The Executive Officer may also extend the due date for any interim or reporting requirements for circumstances beyond the Discharger's reasonable control. In the event that the Regional Board or the Executive Officer issues any order to the County of San Luis Obispo or the Los Osos Community Services District which includes a time schedule for the construction and operation of a community wastewater collection and treatment system (Time Schedule Order) which is intended to serve the Site, the Executive Officer will revise the compliance dates in this Agreement to be consistent with any compliance dates in such Time Schedule Order.

25. Notifications

All written submissions and notifications shall be provided to the parties as follows:
For the Staff Prosecution Team:
Los Osos Staff Prosecution Team
895 Aerovista Place, Suite 101
San Luis Obispo, California 93401
For the Discharger:

_____

Any Party may change the designee or address for notifications but no such change is effective until it is actually received by the party sought to be charged with its contents.

26. Modifications

This Agreement may be modified only upon written consent by the Parties hereto and the approval of the Executive Officer or as provided for by law.
In the event that the Staff Prosecution Team enters into a subsequent agreement with any discharger in the prohibition zone which is set forth on the Prohibition Boundary Map, Attachment A of Central Coast Water Board Resolution No. 83-13, *Revision and Amendment of Water Quality Control Plan by the Addition of a Prohibition of Waste Discharge from Individual Sewage Disposal Systems Within the Los Osos/Baywood Park Area, San Luis Obispo County* which contains terms which are materially different from those in this Agreement and which may be applicable to the Site or Discharger, the Discharger may request that this Agreement be amended to include those terms, and upon such request, the Staff

EXHIBIT 4.12

Prosecution Team will make those modifications and submit them for approval and execution by the Executive Officer as a modification of the Agreement. This paragraph does not apply to terms in any subsequent agreements which are based on any unique personal circumstances applicable to the other discharger.

27. Remedies for Failure to Comply with this agreement

The Parties agree that the provisions of this Agreement shall be enforced as an order issued by the Executive Officer pursuant to California Water Code section section 13269.

Neither of the Parties waive any rights or defenses that they may have with regard to any action to enforce the terms of this Agreement.
The Staff Prosecution Team agrees that it will consider the cooperation of the Discharger in entering into this Agreement, as compared with any other discharger who has been issued a cease and desist order or any adjudicated order, or who is recalcitrant or non-cooperative, as a factor in such action including the timing of such action, and the amount of any liability that should be imposed through such enforcement action.

Prior to the initiation of any formal action to enforce this Agreement or the Basin Plan Prohibition against the Discharger (except for actions to address an imminent or substantial threat to water quality or an emergency requiring immediate action to protect the public health, welfare or safety), the Staff Prosecution Team agrees that it will meet-and-confer with the Discharger or a group of other settling dischargers regarding such action, and the Parties will negotiate in good faith to try and resolve any proposed enforcement action. No negotiated resolution of any enforcement action is required or guaranteed by this provision.

The failure of the Staff Prosecution Team to enforce any provision of this Agreement shall neither be deemed a waiver of such provision nor in any way affect the validity of this Agreement. The failure of the Staff Prosecution Team to enforce any such provision shall not preclude it from later enforcing the same or any other provision of the Agreement or the Basin Plan. Nor oral advice, guidance, or suggestions or comments by employees or officials of any Party regarding matters covered by this Agreement shall be construed to relieve any Party of its obligations required by this Agreement.

EXHIBIT 4.13

28. Termination of Agreement and waiver

This Agreement shall terminate when the Discharger:

1) Connects the Site to a community wastewater collection and treatment system and both parties agree to terminate the waiver.

(B) Funds generated by the payment of the fee shall be deposited in the Waste Discharge Permit Fund for expenditure, upon appropriation by the Legislature, by the state board or appropriate regional board for the purpose of carrying out activities limited to those necessary to establish and implement the waiver program pursuant to this section. The total amount of annual fees collected pursuant to this section shall not exceed the costs of those activities necessary to establish and implement waivers of waste discharge requirements pursuant to this section.

(C) In establishing the amount of a fee that may be imposed on irrigated agriculture operations pursuant to this section, the state board shall consider relevant factors, including, but not limited to, all of the following:
(i) The size of the operations.
(ii) Any compliance costs borne by the operations pursuant to state and federal water quality regulations.
(iii) Any costs associated with water quality monitoring performed or funded by the operations.
(iv) Participation in a watershed management program approved by the applicable regional water quality control board.

(D) In establishing the amount of a fee that may be imposed on silviculture operations pursuant to this section, the state board shall consider relevant factors, including, but not limited to, all of the following:
(i) The size of the operations.
(ii) Any compliance costs borne by the operations pursuant to state and federal water quality regulations.
(iii) Any costs associated with water quality monitoring performed or funded by the operations.
(iv) The average annual number of timber harvest plans proposed by the operations.

(5) The state board or a regional board shall give notice of the adoption of a waiver by publication within the affected county or counties as set forth in Section 6061 of the Government Code.

(b)(1) A waiver in effect on January 1, 2000, shall remain valid until January 1, 2003, unless the regional board terminates that waiver prior to that date. All waivers that were valid on January 1, 2000, and granted an extension until January 1, 2003, and not otherwise terminated, may

EXHIBIT 4.16

establish conditions of a waiver. Subdivision (c) shall not apply to the extent that it is inconsistent with any waiver or other order or prohibition issued under this division.

(e) The regional boards and the state board shall require compliance with the conditions pursuant to which waivers are granted under this section.

(f) Prior to renewing any waiver for a specific type of discharge established under this section, the state board or a regional board shall review the terms of the waiver policy at a public hearing. At the hearing, the state board or a regional board shall determine whether the discharge for which the waiver policy was established should be subject to general or individual waste discharge requirements.

EXHIBIT

4.13

Solicitation of Proposals for Supplemental Environmental Projects and Qualification Criteria

Under the authority of the California Water Code (CWC), the State Water Resources Control Board (SWRCB) and Regional Water Quality Control Boards (RWQCBs) may issue administrative civil liability complaints (ACLCs) to dischargers in response to violations of waste discharge requirements, discharge prohibitions, enforcement orders, or other orders of the Boards. Assessments collected through the ACLC process are required by the CWC to be paid to the SWRCB Cleanup and Abatement Account (CAA) or other account as specified in law. The SWRCB administers the CAA, and funds are used to address important water quality cleanup and abatement activities throughout the state.

As an alternative to depositing ACLC assessments in the CAA, the SWRCB's Water Quality Enforcement Policy recognizes that ACLC assessments may be used for important and valuable water quality improvement projects within the Region in which the assessment was made. These are known as Supplemental Environmental Projects (SEPs). SEPs have been used in every region in the state. SEPs are projects that (1) enhance the beneficial uses of the waters of the state, (2) provide a benefit to the public at large, and (3) are not otherwise required or would be greatly accelerated by the funding provided by the ACLC assessment. Examples of SEPs include pollution prevention projects, environmental restoration programs, environmental auditing, public awareness and education activities, watershed assessments, watershed management facilitation services, and non-point source program implementation.

The State Board Enforcement Policy states: "Any public or private entity may submit a proposal to the SWRCB (or to the RWQCB for transmittal to the SWRCB) for a SEP that they propose to fund through this process. Staff at the SWRCB shall evaluate each proposal and maintain a list of candidate SEPs that satisfy the general criteria in subsection C of this section. The list of candidate SEPs shall be made available on the Internet along with information on completed SEPs and SEPs that are in-progress. When a RWQCB is considering allowing a discharger to perform a SEP in lieu of some or all of a monetary assessment, the RWQCB should direct the discharger to the list of candidate SEPs. The discharger may select a SEP from the list of candidate SEPs or may propose a different SEP that satisfies the general criteria for SEPs."

The SWRCB is accepting project proposals for SEPs from interested parties and the general public. Proposals should include a project title, identification of the entity that would be responsible for project implementation, a brief description of the project, including an explanation of how the project satisfies the general criteria listed in Attachment A to this letter, the estimated cost for project completion and contact information. As appropriate, proposals should also identify the particular water body, beneficial use and/or pollutant to be addressed by the project. A suggested format is included as Attachment "B" to this letter. Proposals will be accepted on an on-going basis. Proposals should be submitted by mail, email or fax to:
State Water Resources Control Board ,CAEU, ATTN: SEP Proposal
1001 I Street, P.O. Box 100
Sacramento, CA 95812
myoungs@swrcb.ca.gov fax: 916-341-5896

For questions regarding the SWRCB list of SEPs, contact Margie Youngs at 916-341-5890

EXHIBIT 4.14

Attachment A

From Section IX.C of the State Water Resources Control Board Water Quality Enforcement Policy:

"C. General SEP Qualification Criteria

All SEPs approved by the SWRCB or RWQCB must satisfy the following general criteria:

(a) An SEP shall only consist of measures that go above and beyond the obligation of the discharger. For example, sewage pump stations should have appropriate reliability features to minimize the occurrence of sewage spills in that particular collection system. The installation of these reliability features following a pump station spill would not qualify as an SEP.

(b) The SEP should directly benefit or study groundwater or surface water quality or quantity, and the beneficial uses of waters of the State. Examples include but are not limited to:

(i) monitoring programs;
(ii) studies or investigations (e.g., pollutant impact characterization, pollutant source identification, etc.);
(iii) water or soil treatment;
(iv) habitat restoration or enhancement;
(v) pollution prevention or reduction;
(vi) wetland, stream, or other waterbody protection, restoration or creation;
(vii) conservation easements;
(viii) stream augmentation;
(ix) reclamation;
(x) public awareness projects (e.g., industry specific, public-awareness activity, or community environmental education projects such as watershed curriculum, brochures, television public service announcements, etc.);
(xi) watershed assessment (e.g., citizen monitoring, coordination and facilitation);
(xii) watershed management facilitation services; and
(xiii) non-point source program implementation.

(c) The SEP shall not directly benefit the SWRCB or RWQCB functions or staff. For example, SEPs shall not be gifts of computers, equipment, etc. to the SWRCB or RWQCB.

(d) The SEP shall not be an action, process or product that is otherwise required of the discharger by any rule or regulation of any entity (e.g., local government, California Coastal Commission, United States Environmental Protection Agency, United States Army Corps of Engineers, etc.) or proposed as mitigation to offset the impacts of a discharger's project(s)."

EXHIBIT 4, 20

California Regional Water Quality Control Board
Central Coast Region

Linda S. Adams
Secretary for Environmental Protection

Internet Address: http://www.waterboards.ca.gov/centralcoast
895 Aerovista Place, Suite 101, San Luis Obispo, California 93401
Phone (805) 549-3147 • FAX (805) 543-0397

Arnold Schwarzenegger
Governor

March 21, 2007

EXHIBIT
5.1

Steven Paige
1554 9TH ST
LOS OSOS, CA 93402 1725

Dear Steven Paige:

NOTICE OF VIOLATION OF SEPTIC SYSTEM DISCHARGE PROHIBITION AT 1554 9TH ST, LOS OSOS/BAYWOOD PARK, SAN LUIS OBISPO COUNTY

In 1983, the Central Coast Regional Water Quality Control Board adopted a prohibition of all new and existing septic system discharges in an area known as the Los Osos/Baywood Park prohibition zone. The prohibition is based on substantial evidence that septic systems harm water quality and public health. Ongoing monitoring shows that water quality and public health continue to be threatened by septic system discharges.

The Water Boards' mission includes enforcing the laws and regulations designed to protect and enhance water quality and its uses (water supply, recreation, and shellfishing, for example). Although property owners and occupants (including tenants) are ultimately responsible for their septic system discharges, the Water Board has not previously enforced the prohibition against individual property owners and occupants because your local governments, San Luis Obispo County and the Los Osos Community Services District, were making progress towards building a community wastewater system to replace individual septic systems. Unfortunately, a community wastewater system has not yet been built. In light of this, we are now enforcing the prohibition against all individual property owners and occupants in the Los Osos/Baywood Park prohibition zone.

Our records show that you own and/or occupy improved property at the address, within the prohibition zone. Since there is not a community wastewater system available to your property, we conclude that your property has a septic system that discharges waste[1] within the prohibition zone. **You are hereby notified that your septic system discharge violates State law and you are subject to further enforcement.**

San Luis Obispo County, through the process provided by Assemblyman Sam Blakeslee's special legislation (AB 2701), has begun planning, designing, and building a community wastewater collection and treatment system. The Water Board supports the County and considers a community system to be the most feasible solution to the septic system prohibition. We hope that this process will succeed. However, because this process is in its beginning

[1] Septic systems are designed to discharge wastewater. Wastewater flows from the house to a septic tank, where most of the solids in the wastewater are removed. Wastewater overflows or is pumped from the septic tank into an underground disposal field (leachfield or seepage pit) and eventually to underlying groundwater.

Closing the nutrient cycle

Summary from a unique research project in Sweden

by Mats Johansson and Mirjam Nykvist

Mats and Mirjam are both systems ecologists and are working in VERNA Ecology with new techniques for wastewater treatment.

Malmgårdsv. 14
SE-116 38 Stockholm
SWEDEN
Tel.:+46 8 641 75 00
Fax:+46 8 702 12 80
e-mail: verna@verna.se

VERNA Ecology is a member of the network Swedenviro Consulting-group
Info: http:www.swedenviro.com

Abstract

The method to separate human urine to use as fertilizer is now tested on a fullscale in Sweden.

In 1995, the Understenshöjden housing estate was built in the Stockholm suburb of Björkhagen. Shortly afterwards, the conversion of the Palsternackan estate in Enskede was completed. Urine-separating toilets were installed in both these estates.

The Stockholm Water Company initiated a dialogue with the two housing companies, HSB National Federation and AB Stockholmshem. The three partners agreed to launch a four year research and development project.

Some of the mian findings and conclusions of this project were summarised in a report: "Urine separation — closing the nutrient cycle" which was published in June 2000. (see end of article for more info). This presents the state of knowledge in Sweden on urine-separating toilets and systems for the recirculation of urine as an agricultural fertilizer.

Figure 1: Ecovillage Understenhöjden, Sweden - one of the project sites

Background ***The history of urine separation in Sweden***

In the 1970s several products and toilets were developed, including urine-separating insets, with a focus on holiday houses.

In the early 1990s the first urine-separating toilets in sanitary porcelain were produced.

EXHIBIT 6.1

Technical [redacted] social aspects:

- Size and function of urine tanks and piping networks in the residential area.
- Practical experience of the function of urine separatign systems.
- Residents attitudes to urine-separating toilets.
- This research was carried out by The Swedish Institute of Agricultural Sciences, Department of Agricultural Engineering.

FAQ's Frequently asked questions and answers about urine separation

By summarizing the conclusions from the project a number of frequently asked questions have been addressed in the report. The answers correspond to the Swedish environment and the conclusions may not always be adequate if directly transferred to situations in other countries.

Does urine separation involve any hygienic risks?

If the workers handling the urine are careful and the recommendations for storage and risk minimazation are followed, it is considered that the hygienic risks of urine separation are negligible. When it comes to hygienic risks it should, however, be pointed out that nothing is completely risk-free.

Does medicine residue represent a risk in human urine?

Almost all substances that occur in medicines are degradable by the microorganisms that are naturally present in the soil and absorption by the plants is probably negligible.

What effect does source-separated urine have on nutrient discharges?

When a urine separating system is introduced, nitrogen discharge into water is reduced by about 60% irrespective of the type of treatment. In the case of phosphorus, the reduction depends on the type of treatment of the wastewater as a whole. Where the treatment plant ensures efficient phosphorus removal the reduction is marginal, but where the plant does not provide phosphorus removal the reduction may be almost 50%.

How much water does urine separation save?

The amount of water saved may vary between 5 — 40 litres per person per day depending on individual habits and the toilet with which the comparison is made.

How much plant nutrients is recirculated to farmland when a urine separating system is used?

Assuming that residents spend an average about 15 hours at home every day, about 1,6 kg of nitrogen and 0,2 kg of phosphorus is recirculated per person per year. In the case of highly motivated residents, it may be as much as 2-2,5 kg of nitrogen and 0,25 kg of phosphorus per person per year.

How does energy consumption in a urine separating system compare with that in a conventional system?

In an efficient urine separating system located less than 30-40 km from the farmland, the fertilizer value of the urine in itself represents a saving in energy compared with transportation and application.

How much nitrogen is lost in a urine separating system from toilet to field?

Where the system is properly designed nitrogen losses are very small, less than 1 % from the toilet, via collection tanks, transportation and storage to application. The losses associated with application are less than 10 % and may, if the best available technology is used, be as low as 1 — 2 %.

What effect does human urine have as a fertilizer?

The effect of urine applied to a spring crop corresponds to 80-90% of the effect with the same amount of nitrogen in the form of mineral fertilizer. Human urine can be applied in growing crop with good results.

What should the capacity of the urine tank be when urine separation is introduced in a housing area?

On average, the amount of liquid produced by the Dubbletten model is 1.5 litres per person per day, while the Wost Man Ecology DS model produces 2.5 litres.

What is the greatest environmental advantage of urine separation today?

In the short term the urine separation systems are most useful as a complement to

EXHIBIT 5.3

individual [redacted]age treatment systems.

More information about the report "Urine separation — closing the nutrient cycle" can be provided by:

The Stockholm Water Company
Stockholm Vatten AB
SE-106 36 Stockholm
Sweden
Phone: +46 8 522 120 00
Fax: +46 8 522 120 02

From september 2001 the report will be available on their web-page: http://www.stockholmvatten.se as an Acrobat reader document.

Contact information for other members of the project group:

Swedish Institute for Disease Control

- Caroline Schönning, caroline.schonning@smi.ki.se
- Thor-Axel Stenström thor-axel-stenstrom@smi.ki.se
- Info: http://www.smi.ki.se

The Swedish Institute of Agricultural Sciences, Department of Agricultural Engineering

- Håkan Jönsson, hakan.jonsson@lt.slu.se
- Info: http://www.lt.slu.se

The Swedish Institute for Agricultural and Environmental Engineering

- Lena Rodhe, lena.rodhe@jti.slu.se
- Info: http://www.jti.slu.se

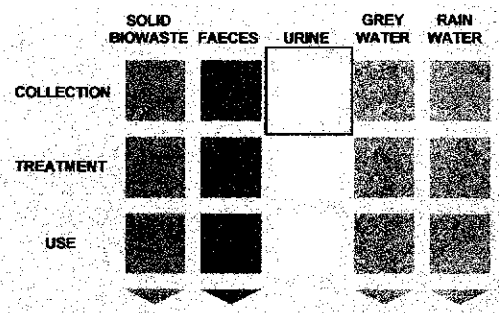
--> *To table of contents*

EXHIBIT 6,4

01 Urine Diversion

B.1 Toilets

- Urine and faeces separated at source before mixing
- Urine and faeces can be handled separately and specifically
- Excellent nutrient recovery and recycling potential
- System configurations with or without flushing water
- Reduced nutrient pollution of aquatic environment



B.1 Toilets

A General Description

B Urine Diversion System Components

B.1 Toilets
B.2 Waterless urinals
B.3 Piping and Storage

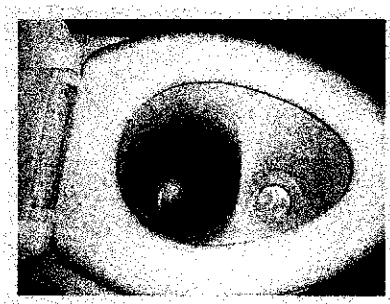
B.1.1 Functional principles

The urine diversion toilet differs from an ordinary toilet as it attempts to collect the urine separately from the faeces for potential reuse applications. It offers the same comfort and functional service as regular toilets. Simple designs of urine diverting seated pedestal toilets and squatting plates are available as self-constructed or prefabricated. Flush and non-flush systems offer appropriate technology options for simple and complex environments. Toilets are commonly constructed of sanitary porcelain, concrete, fibreglass or plastic. These toilets may be introduced with construction of new sanitation systems or complement the existing system with minor modification. Distinguished urine diversion toilet designs include: the urine diversion flush toilet (similar to the WC), the waterless toilet with urine collection funnel, and a vacuum toilet system.

The urine diversion **flush toilet** has a partition in the toilet bowl isolating a bowl for urine in the front, and a bowl for faeces in the rear. Some designs allow for each bowl to be flushed separately. The collection of undiluted urine is also possible.

The urine diversion **waterless toilet** is a very simple configuration adapted to a drop toilet whereby the urine is captured in a bowl in the front of the toilet and drained off to a storage container or leaching pit. The waterless toilet requires no water for flushing the faecal fraction, although small doses may be used to flush the urine.

Urine diversion as a component of ***vacuum*** sewerage systems is still very much in development. A pilot project in Berlin, Germany expects minute water consumption and efficient collection of highly concentrated flow streams of urine and brownwater at a reasonable cost.



A modern waterless separation toilet has been developed in the China-Sweden Erdos Eco-Town Project (for contact see table 2).
The toilet is designed for use in multi-storey buildings and allows dry faeces collection and separate urine collection.
Made from ceramics, it has the comfort and aesthetics of a modern flush toilet.
It is equipped with a flushing device for ash and a mecanism to seal off the drop shaft.

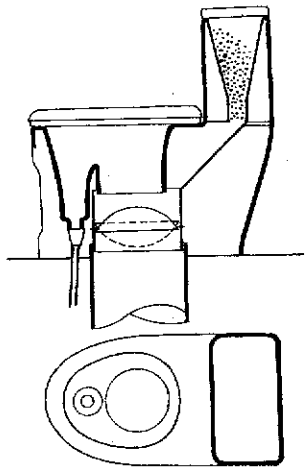


Figure 1: Modern waterless separation toilet made from ceramics. *(source: SEI)*

B.1.2 Handling and maintenance

The primary differences in toilet design, function and application will influence the operation and maintenance of each system. User diligence is required for proper function. Toilet paper should be placed in the rear bowl or in a waste bin beside the toilet. Anal cleansing water should also be kept separate from urine collection. Flush water should be kept to a minimum so as not to dilute the urine.

Regular inspection of the toilet, pipe connections and storage tank are encouraged. Environmentally friendly cleaning products are suggested when cleaning the toilet.

Flush toilet systems will require water and additional plumbing to transport the collected urine. Blockages due to precipitates may occur at the u-bend in the toilet but are easily cleared with a plumber's snake or a caustic soda (NaOH) solution. The precipitates are mainly magnesium-ammonium phosphate (MAP) caused by mixing the urine with water containing magnesium or calcium ions (hard water). These may be avoided if urine is not mixed with the

gtz ecosan program recycling oriented wastewater management and sanitation systems
commissioned by Federal Ministry for Economic Cooperation and Development

water.

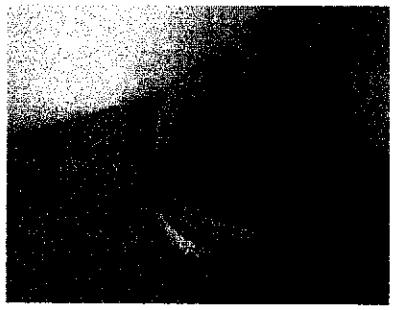


Figure 2: Waterless urine diversion toilet in Tanzania *(source??)*

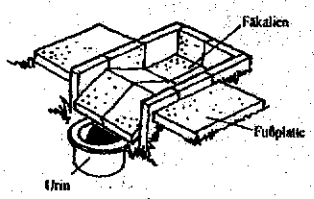


Figure 3: Early model of urine diverting squatting toilet used in China *(source??)*

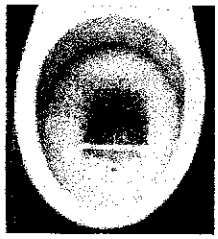


Figure 4: Urine diversion toilet with dual flush function *(Wost Man Ecology)*

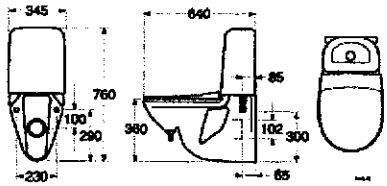


Figure 5: Drawings of Gustavsberg 393U urine diversion flush toilet *(Gustavsberg)*

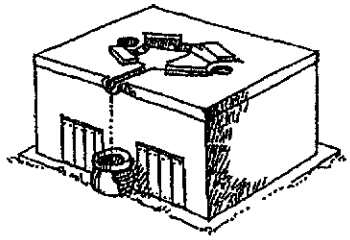


Figure 6: Vietnamese double vault dehydrating toilet with urine diversion *(Esrey et. al. 1998)*

With urine collection schemes, urine tanks must be emptied once capacity of the system is reached. Details concerning urine transport, storage and application are further described in separate datasheets.

B.1.3 Extent of application

Separately collecting urine from faeces has been done for thousands of years in different parts of the world with various motivation and system solutions. The Chinese used urine diversion toilets to collect and apply the urine as a local fertiliser.

Urine diversion flush toilets are relatively new, invented by the Swedes in the 1990's. Their application was first adopted in eco-villages and holiday homes. Today, there is growing interest to include urine diversion in many homes and public buildings throughout Europe. The limiting factor of flush systems is the required source of water and sewerage infrastructure.

Waterless urine diversion toilets are used world-wide, mainly in rural and suburban areas, where use of the collected urine and faeces is honoured.

Toilets have been built indoors as well as outdoors serving individual families or entire communities. Projects where toilets have been self-constructed by the community have proven successful and economical.

B.1.4 Economic data

Toilet designs vary considerably in complexity and application potential resulting in a wide range of prices.

Urine diversion flush toilet prices range from 400 EUR to 675 EUR.

Urine diversion waterless toilet and squatting plate cost between 8 EUR to 750 EUR.

Savings from reduced water and wastewater demand can equate to a 30%.

B.1.5 Design information

Careful planning and appropriate design selection is essential for practical application of urine diversion toilets. Necessary requirements include: water for flush systems, adequate space and structural support, quality materials and workmanship. Metals should be avoided within the system as they are prone to corrosion when in contact with urine. Durable plastics are a viable alternative. Ventilation of urine collection is discouraged to prevent volatile nitrogen losses. Only a small venting for pressure equalisation of the storage containers should be used. Urine diversion flush toilets come as wall-hung and floor models. Specific connections parts may be necessary for proper installation. Installation following manufacturer's instructions is recommended to ensure precise fit. Easily accessible and removable connections can help in case replacement is required.

The choice of toilet design will also influence the system capacity. Flush toilets with greater volumes of flush water will require larger piping and storage containers. Table 2 presents some values of flush volumes and design features of various manufactured toilet designs.

Urine diversion dry toilets come as pedestal seats and squatting plates, and should be applied in accordance with the cultural norms of the intended user. They may be manufactured or sometimes self constructed from concrete, porcelain, or plastic.

Some urine diversion dry toilets require electrical fans for ventilation, thus demanding a reliable source of adequate power. More information on urine diverting dehydration toilets is given in the data sheet "dehydration toilets".

B.1.6 Strengths and weaknesses

Performance

Urine diversion toilets are quite successful in separating urine and faeces at the point of excretion, with 60-90 % efficiency reported. On average 1.5 l of urine (plus flush water) can be collected per person per day. Urine diversion flush toilets demand less water per flush than conventional flush toilets, securing water savings of 50 %. Blockages in the toilet drain have been problematic in some flush toilets, where urine flow is reduced. Here, precipitation may occur as a result of the conversion of urea to ammonium, increasing the pH, promoting the formation of calcium phosphate and magnesium-ammonium phosphate precipitates.

Health impact

Urine diversion toilets offer minimal hygienic risk with proper management.

Environmental impact

Urine diversion flush toilet can reduce water consumption for flushing considerably (up to 40L/person/day, or 50%) compared to conventional flush toilet. They can also result in significant energy savings in wastewater treatment plants by rendering tertiary treatment superfluous, as well as in the production of fertiliser.

EXHIBIT 6.4

Technical suitability

Urine diversion toilet options are available for most applications to meet the socio-economic, technical capacity and climatic conditions of people around the world. Urine diversion toilets and squatting plates may be self-constructed with local resources, minimal space and skilled labour. Prefabricated toilets are also available from a number of manufacturers (see Table 2) and can be easily installed. Urine diversion toilets require additional attention in proper operation and maintenance requirements. No water, or very little water is required for flushing. Modifying existing conventional sanitation system to include urine diversion is possible. Permits and approvals for construction and implementation may be required; consult with local officials.

Costs and Benefits

Urine diversion toilets normally require an initially higher investment cost for materials and skilled construction as compared to conventional toilets. Produced in small numbers, the availability of urine diversion toilets is limited. Operation and maintenance costs are comparable to conventional toilets. Simple low cost solutions usually require more manipulation and care – with higher cost solutions manipulation and care can be reduced. Energy, water and wastewater cost savings can be appreciated by users and service suppliers.

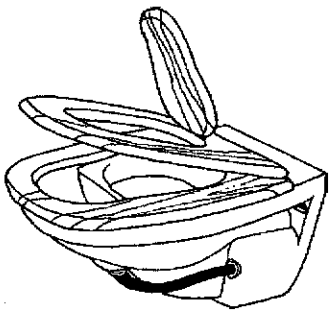


Figure 7: Toilet seat adapted for small children *(Dubbletten)*

Socio-cultural suitability:

The majority of users are satisfied with the simplicity in urine diversion toilet function and the comfort of in-house convenience. Waterless urine diversion toilets have been acknowledged for their role in reducing foul odours as a result of a drier faecal fraction. Issues being addressed with the urine diversion toilet include: accommodating men who prefer to stand when urinating and small children discouraged by large toilet seats.

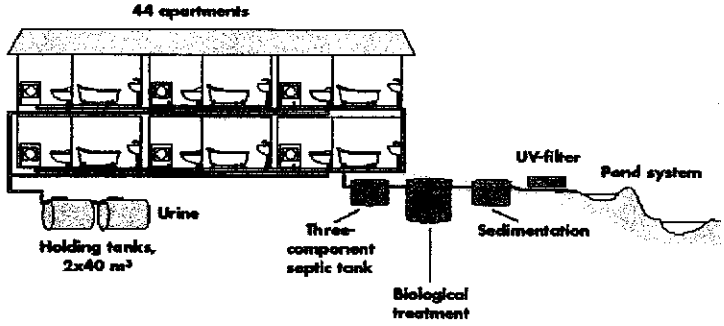


Figure 8: Wastewater treatment system at Understenhöjden ecovillage, Sweden *(Illustration by Kim Gutekunst)*

Successful adoption of urine separated toilets has been linked to user motivation. Catering to the needs and the cultural preferences (i.e. seated or squatting, wet or dry anal cleansing) of the user is also critical for acceptance.

B.1.7 Further reading

Drangert, J., 2003. *Requirements on Sanitation Systems – The Flush Toilet Sets the Standard for Ecosan Options.* GTZ - Proceedings of the 2nd International Conference on Ecological Sanitation, 2003:

This paper compares three systems: WC, Pit latrine and Urine-diverting toilet.

SwedEnviro Report No 2001.1 Market survey - extremely low flush toilets plus urine diverting toilets and urinals, for collection of black water and/or urine *http://www.swedenviro.se/svenska/pdf-filer/engmarknadsoversikt.PDF*

Different systems are described and compared. (Water toilet with gravity flow, vacuum toilets, urine diverting toilets and urinals)

B.1.8 Manufacturers

See table 1.and 2

B.1.9 Good practice examples

1. The Understenhöjden ecovillage in Björkhagen, a suburb of Stockholm, Sweden was completed in 1995. The 160 residents themselves decided for an alternative wastewater system whereby, the 44 apartments were outfitted with Dubbletten dual flush urine diversion toilets connected to two 40 m³ holding tanks. All the urine is used as fertiliser for cereal crops. Wastewater is treated separately. Residents are generally satisfied with the achievement. The Stockholm Water Company was the project owner and was responsible for the practical implementation of the project. For more information contact: Stockholm Vatten AB SE-106 36 Stockholm, Sweden. Tel: +46 8 522 120 00, Fax: +46 8 522 120 02,
email: info@stockholmvatten.se

2. The classic example from Vietnam is the double-vault dehydrating toilet with urine diversion which originated in the 1950's. The valued human excreta was used as a fertiliser and became a key component of a rural sanitation programme for disease prevention and increased food production. Today, hundreds of thousands of rural households in northern Vietnam enjoy these benefits.

3. The Letrina Abonera Seca Familiar (Lasf) is a modified version of the Vietnamese double vault toilet, introduced to Guatemala in 1978. The concept has also been adopted in El Salvador and Mexico where tens of thousands of urine diversion toilets are constructed and promoted by independent manufacturers. César Añorve is one of 15 independent small-scale manufacturers in Mexico that produce and promote urine diversion toilets.

4. The Plasternacken Project is located a few kilometres south of Stockholm. In connection with a renovation in 1995 priority was given to environmentally sound construction materials, greenhouses for the residents and a sewerage system based on urine separation. For more information have a look at *Mat Johannsson: Urine Separation – closing the nutrient cycle. Vatten , HSB Stockholm* .

5. Pilot project "Lambertmühle zu Burscheid"
Sanitation concept with urine separating toilets and waterless urinals, brown-water treatment in rotting chamber/compost separator, greywater treatment in reed-bed filters. The concept was developed by the Technical University Hamburg Harburg and Otterwasser GmbH Lübeck.

http://www.otterwasser.de/english/concepts/lande.htm#concept

6. South-Africa, Eastern Cape
Moulded plastic urine-diversion pedestals are widely used for urine diversion. At the moment there is unfortunately no

EXHIBIT 6.7

urine use, it is led instead to shallow soakpits.

7. Pilot project "GTZ House No 1" in Eschborn, Germany
Urine separating toilets and waterless urinals will be implemented in the middle part of house no. 1. The urine will be collected in holding tanks and used as fertiliser by a local farmer. Faeces and greywater will be disposed into the sewerage system.
See project data sheets for details on other projects world-wide.

B.1.10 References

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[6] Drangert, J., 2003. *Requirements on Sanitation Systems – The Flush Toilet Sets the Standard for Ecosan Options.* GTZ - Proceedings of the 2nd International Conference on Ecological Sanitation, 2003.

[7] SwedEnviro *Report No 2001.1 Market survey - extremely low flush toilets plus urine diverting toilets and urinals, for collection of black water and/or urine* http://www.swedenviro.se/svenska/pdf-filer/engmarknadsoversikt.PDF

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[16] Novaquatis. 2004. *NoMix Tool*; interactive Flash-application presentation of nutrient cycle and modern wastewater management. http://www.novaquatis.eawag.ch/english/NoMixtool_e.html

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EXHIBIT 4.8

technical data sheets for ecosan components

authors: GTZ ecosan team (Christine Werner, Nathasith Chlarawatchai, Florian Klingel, Patrick Bracken)

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Table 1: Manufactured urine diversion toilet options - flushed separation toilets

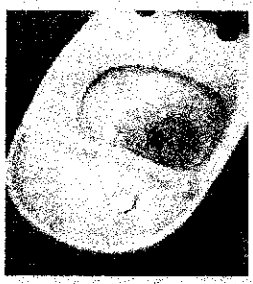
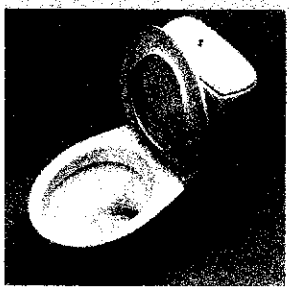
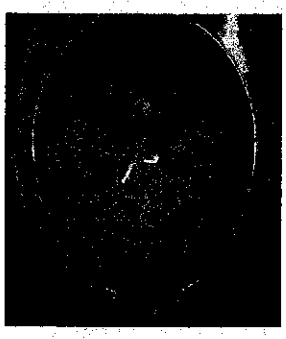
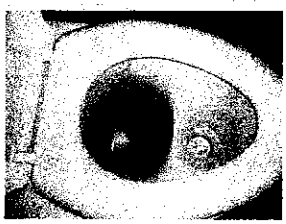
WC – Dubbletten		• Separate bowls • Independent 0,1l urine flush, 4-6 l solids flush • Child seat • Wall or floor mounted • Sanitary porcelain • 700 EUR (mounting hardware and seat cost extra)	BB Innovation & Co AB Carl Larsson V30 SE-168 50 Bromma Sweden Tel: +46 (0)380-42103 Fax: +46 (0)380-42101 http://www.dubbletten.nu/
WM-DS		• Single bowl divided with wall into two • Variable (0-0.7 l) urine flush volume, 3 l solids flush (also adjustable) • Floor mounted • Sanitary porcelain • 600 EUR (includes seat and rubber device for connection to urine diversion)	Wost Man Ecology Sprängarvägen 18, SE-132 38 Saltjö-Boo Sweden Tel:+46 (0)8-715 13 20 Fax:+46 (0)8-715 13 21 http://www.wost-man-ecology.se/
Gustavsberg Nordic 393U		• Separate bowls • Single 2 l small flush, 4 l large flush, 10% flush for urine bowl • Wall mounted • Sanitary porcelain • 720 EUR (includes seat and metal attachments)	AB Gustavsberg Box 440 SE-134 29 Gustavsberg Sweden Tel: +46 (0)8-570 39 100 Fax: +46 (0)8-570 32 036 http://www.gustavsberg.com/
Roevac No Mix		• Two separate outlets • Urine collected undiluted by means of a mechanical plug open when user is seated • 1 l urine flush, 6 l solids flush • Wall mounted • Sanitary porcelain • 1.080 EUR (includes mounting hardware and seat)	Roediger Vakuum- und Haustechnik GmbH Kinzigheimer Weg 104-106 D-63450 Hanau Germany Tel: +49-6181-309-275 Fax: +49-6181-309-280 http://www.roevac.com/

Table 2: Manufactured urine diversion toilet options - waterless separation toilets

Ceramics dry separation toilet with ash flushing device (toilet used in the Erdos Dong Sheng Project)		• Waterless urine separation toilet • Modern design in ceramcis • Drop hole for faeces sealed by lid, that opens after use • Flushing device for ash • 100 Euro	Chaozhou Meilong Ceramics Co. Ltd., Guangdong Province, China http://www.meilongco.com/ http://meilong888.cn.alibaba.com meilong888@vip.163.com Contact Erdos Project: Xiao Jun, Project Manager Tel./Fax.: +86-477-398 2155 Email: xiao.jun@sei.se

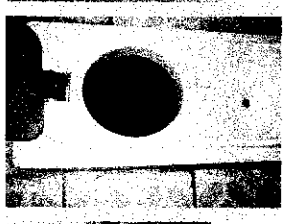
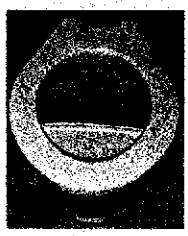
Separett Villa 9000		• Waterless toilet • Wall or floor mounted • Front urinal funnel with 2 m Ø32 mm hose attached • Impact-resistant high-gloss polypropylene • Fan power consumption of 0.396 kWh/24h • 700 EUR	Separett AB Skinnebo SE-330 10 Bredaryd Sweden Tel: +46(0)371-712 20 Fax: +46(0)371-712 60 http://www.separett.com/
WM Ekologen		• Front urine bowl with rear faeces drop pipe • Minimal urine flush • Sanitary porcelain • 300 EUR	Wost Man Ecology Sprängarvägen 18, SE-132 38 Saltjö-Boo Sweden Tel:+46 (0)8-715 13 20 Fax:+46 (0)8-715 13 21 http://www.wost-man-ecology.se/
Chinese squatting plate		• Sanitary porcelain or ABS plastic • Sliding lid offers hands free operation • 8 EUR	Lin Jiang Jsgx@public.nn.gx.cn
Mexican dry separation toilet made from concrete		• Polished concrete • 13 EUR • Moulds made from fibreglass are available for around 200 EURO (see Photo).	César Añorve Centro de Innovación en Tecnología Alternativa Ave. San Diego No. 501 Col. Vista Hermosa, C.P. 62290 Cuernavaca, Morelos MEXICO Tel./fax: (52-777) 322 8638 e-mail: acua@terra.com.mx
South African		• Plastic	Contact:

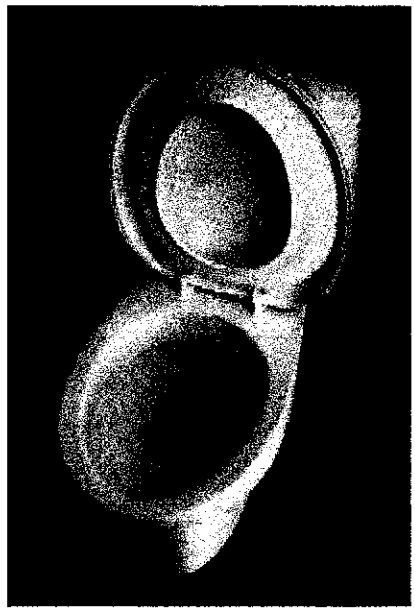
EXHIBIT 4.10

Wost Man Ecology
WM-DS

Model
WM-DS

Function
The toilet works like an ordinary water closet, and is connected to existing water and sewage pipes. A special urine pipe is also connected. The toilet bowl is divided by a wall, where the rear part is for faeces and paper and the front part is for urine.

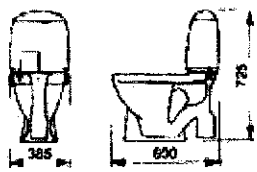
Water consumption
The flush water volume is 3.5 litres for the large and 0-0.7 litres for the small flush. By adjusting the float, the amount of water for the large flush can be increased or decreased. The small flush is easily adjusted by how long and hard the push button is pressed. The daily water consumption for flushing this toilet is estimated at 4-7 litres per person. Measurements have shown that the amount of the combined urine + flush water from the toilet is about 2.5 litres per person.



Other consumption
None.

Design
The toilet is floor-mounted and made of porcelain with a seat and lid of plastic. The seat is of standard design.

Measure	mm
Back to front	650
Width	350
Height	770
Sit height	410



Installation
To install the toilet, three connections are required: water R15, faeces water 110 mm, and urine outlet 50 mm. The toilet is fixed to the floor with four screws.

The outlet connection is placed 110 mm from the wall. (All measurements are calculated to the centre of the holes from the wall.) The urine outlet is placed best directly under the toilet, i.e., 500 mm out from the wall, but it is also possible to connect the urine tube somewhere behind the toilet, e.g., in the wall. There is great flexibility, and the idea is that it should be easy to replace a conventional WC with this urine-diverting toilet without any major operations.

The recommendation from the manufacturer is a sewage pipe of 110 mm with a 1% slope. The urine pipe should be at least 50 mm.

EXHIBIT 6.11

EXHIBIT 6/12

RoedigerVakuum + Haustechnik

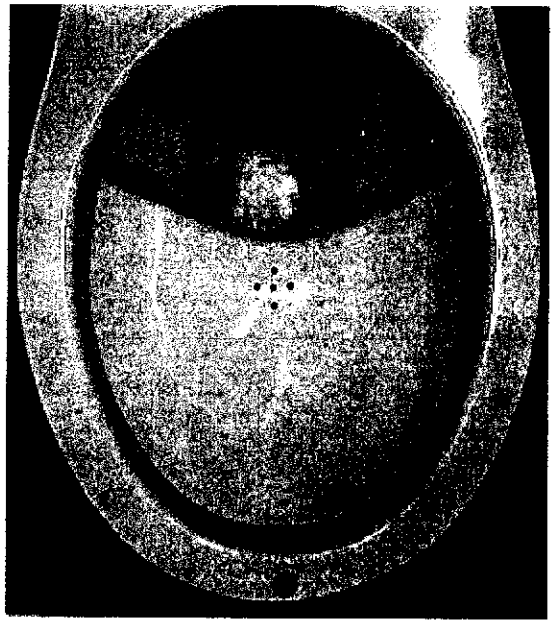
Roevac No Mix Toilet

Model
Roevac No Mix Toilet

Function
This patented toilet has two separate outlets: one conventional outlet for faeces and paper placed in the rear part of the toilet bowl, and one for urine, which is closed mechanically. When the toilet seat is in use, a plug is opened by a lever. Urine flows to the foreward outlet. When the person stands up, the plug closes again. The two parts of the toilet bowl are not separated by a barrier. As soon as the toilet is flushed the urine plug is closed. When needed, faeces and paper is washed away through the rear outlet. Urine is taken away undiluted. An incorrect use, e.g., by children, is not possible. According to the manufacturer, paper and faeces cannot enter the urine outlet.

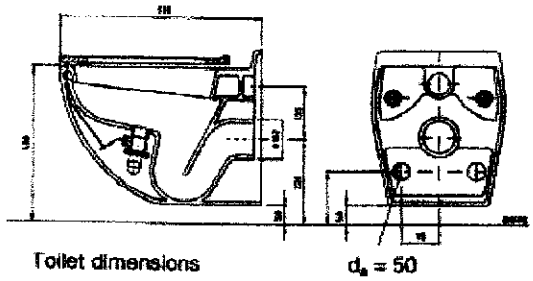
Water consumption
The flush water volume for the small flush is zero and for the large flush around 6 litres. This amount cannot be affected through adjustment of flushing time, etc. The daily water consumption per person is estimated at 6 litres with this toilet.

Other consumption
None.



Design
The toilet is made of sanitary porcelain and is at present available as wall mounted. A floor-mounted model will be commercially available at the end of 2001.

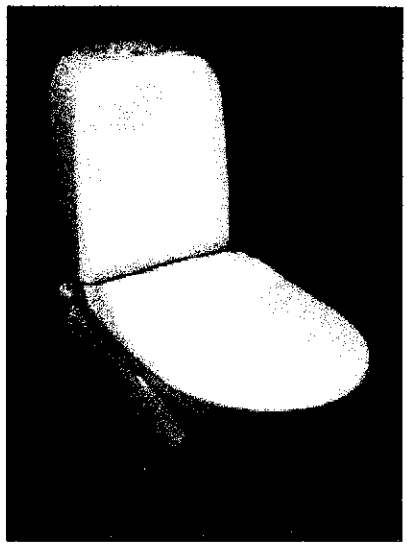
Measure	mm
Back to front	530
Width	340
Height	350



Toilet dimensions $d_a = 50$

Sketch from the side and from the back of Roediger No mix toilet.

Gustavsberg
Nordic



Model
Nordic 393 U

Function
The toilet consists of two bowls where the rear is for faeces and paper while the fore is for urine. The flushing is triggered by a push button.

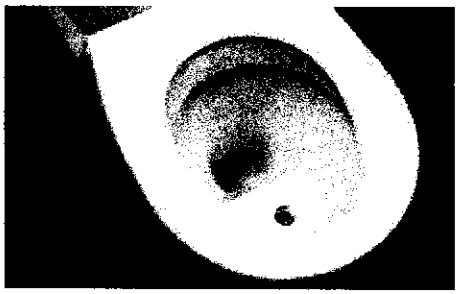
Water consumption
The toilet has a large and a small flush of 4 and 2 litres, respectively. When the toilet is flushed, about 10% of the flush water volume ends up in the urine bowl. The estimated daily flush water consumption is 14 litres per person. The flush volume can easily be adjusted.

Other consumption
None.

Design
The toilet is wall mounted and made of porcelain. The standard seat and lid are of white propylene plastic. There is also a hard seat with plastic or stainless steel attachments available as an option.

Installation
The toilet is fixed with bolts to the wall. The bolt projection should be 50±2 mm. Incoming water connection is with a R 1/2" thread.

Measure	mm
Back to front	640
Width	345
Height	760



The fore bowl is for urine and in the rear bowl faeces and paper is flushed down.

EXHIBIT 6,13

BB Innovation & Co AB

Dubbletten

Model
Dubbletten

Function
The toilet is urine diverting and the construction is based on two well-separated bowls, a rear for faeces and a fore for urine. The faeces bowl has a collar that effectively stops the flush water from the large bowl from reaching the urine bowl. The toilet is flushed with two independent flush systems. The toilet is equipped with a trap to prevent stench.

Water consumption
The toilet is flushed with 4 l for the large flush and 1.5-2 dl for the small flush. The large flush can be adjusted to between 4 and 6 litres, by adjustment of the float. The small flush is affected by how long the push button is pressed. The daily water consumption for this toilet is estimated at 5-7 litres per person. Measurements have shown that the volume of urine + flush water from the small flush is 1.5-2 litres/person/day.

Other consumption
None.

Design
The toilet is made of porcelain, with lid and seat of birch or plastic. The seat is constructed so that children, too, can sit in the proper position for proper sorting of urine and faeces. The toilet is available in two models, wall mounted or floor mounted.

Measure (mm)	Wall mounted	Floor mounted
Back to front	570	680
Width	370	340
Height	400	805
Sit height	365	415

Installation
The floor-mounted model is fixed to the floor with screws, and the wall-mounted model is attached via a reinforcing fixture behind the reservoir. The toilet is connected to incoming water with a 1/2" connection. The outlet connection is 110 mm and the urine outlet connection is 75 mm.

EXHIBIT 6,13

Waterless

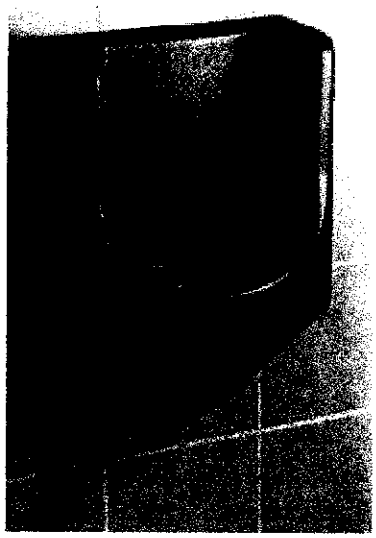
No-flush

Model
Waterless No-flush

Function
The urinal does not use any water for flushing, and is entirely based on gravity. The urinal has a coating that is liquid repellent and therefore hostile to bacteria. The urine passes through a trap with an oil-based liquid that acts as a stench barrier. The urine, which is heavier than the liquid, sinks down through the liquid and then down the drain.

Water consumption
No water is consumed in flushing this urinal.

Other consumption
The barrier liquid with the brand name BlueSeal, that constitutes the stench barrier in the trap, contains mineral oils and aliphatic alcohols. It is over 95% biodegradable. Yearly consumption of this liquid is about a litre in an average-sized household.

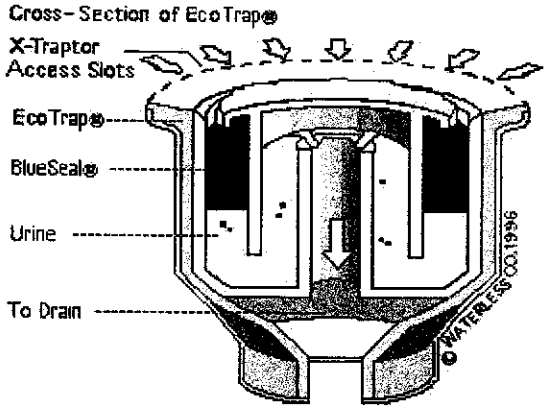


Design
The urinal is wall-mounted and made of high performance composite.

Measure	mm
Back to front	254/356
Width	457
Height	711

Installation
The outlet connection is 2". The installation is done with two mountings and a gasket.

The slope of the sewage pipe should be 2%. The manufacturer recommends ABS-pipes or other approved plastic pipes.



The figure shows the trap (EcoTrap) in section, where the urine, which is heavier than the barrier liquid (BlueSeal), sinks down through the liquid and further down the drain.

EXHIBIT 6,14

Urimat Handels AG

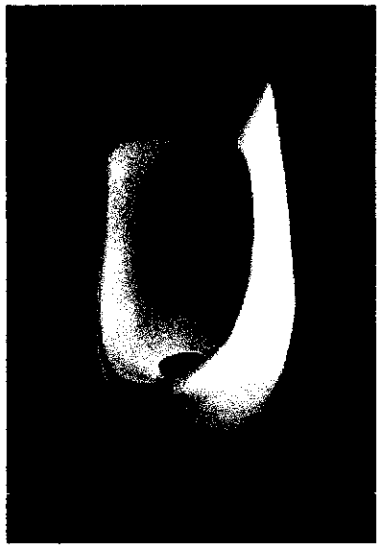
Urimat

Model
Urimat

Function
The urinal has no trap, but instead a patented stench trap insert in the form of a float. The urine passes into the cylindrical inner piece of the pan and from there to the overflow chamber, whereby the float rises and seals the inlet opening against a flexible sealing lip. When the urine in the overflow chamber reaches a certain level, it flows into the drain of its own accord. Every time the urinal is used, an electromagnet draws the float down again to ensure complete emptying of any residual urine.

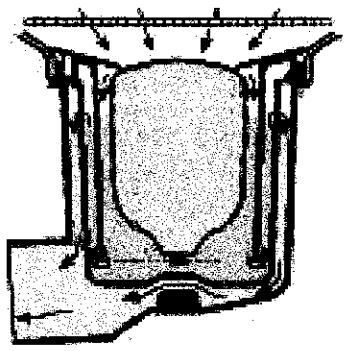
Water consumption
No water is consumed in flushing this urinal.

Other consumption
The urinal requires a supply of electricity to keep the float down while in use.
However, this only consumes 0,0027 kWh per visit.



Design
The urinal is made of acrylic and is wall mounted. It is also available in ceramic. An advanced model with a lit advertising display is available. When a person approaches the urinal, the advertising is illuminated with a backlight.

EXHIBIT 6,15



The urinal has no trap but a patented stench barrier in the form of a float.

Measure	mm
Back to front	389,6
Width	410
Height	880

Installation
The urinal is fixed to the wall and connected to a power source. The urinal is not connected to water, but only to the sewage system with a 50-mm connection. There are no special requirements for slope or distance to the tank. Sewage pipes of polyethene or polypropylene, 50 mm, are recommended.

Reese A/S

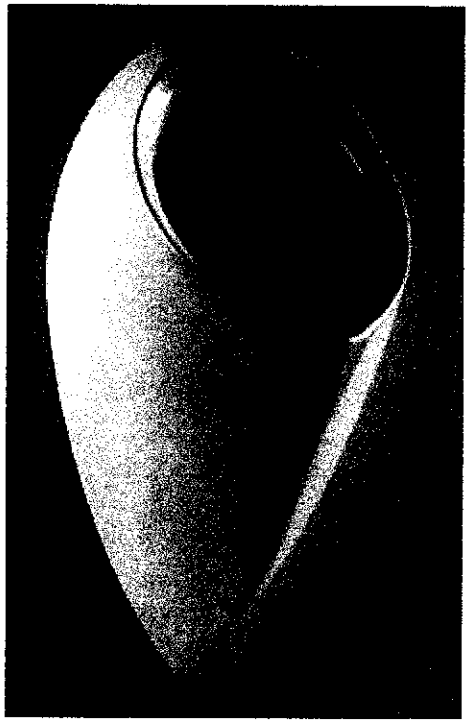
Uridan non water system

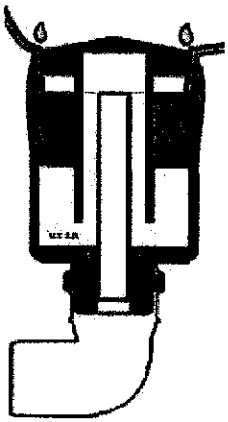
Model
Uridan non water system

Function
The urinal uses no water for flushing, but is completely based on gravity. The urine passes through a trap with a liquid with a lower density than water, which works as a stench barrier. Urine, which is heavier than the liquid, sinks down through the liquid and further down the drain.

Water consumption
The urinal consumes no water.

Other consumption
The barrier liquid in the water lock needs to be changed after 5000-7000 visits (i.e. once a year in a one-family-household). At each change 0.3 l liquid is used. The liquid has the brand name Urilock and is, according to the manufacturer, environmentally friendly.





The urine passes through a trap with a liquid with a lower density than water, which acts as a stench barrier. As urine is heavier than the liquid is sinks down through the liquid and further down the drain.

Design
The urinal is made of impact resistant fibreglass, with a hard and smooth surface. It is available in two standard colours, granite and white, and can be floor- or wall-mounted.

Measure	mm
Back to front	394
Width	412
Height	790

EXHIBIT 6.16

F. Ernst Ingenieur AG

Ernstsystems

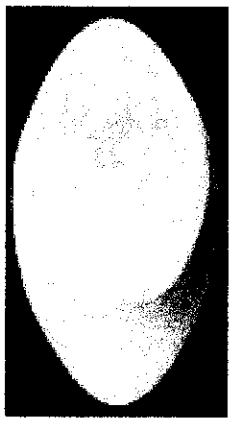
waterfree urinals

Model
System Ernst model 3000 and 4000

Function
The urinal does not use any water for flushing; it is entirely based on gravity. The urine passes through an odour lock with a sealing liquid that works as a stench barrier. The urine, which is heavier than the liquid, sinks down through the liquid and further down the drain. The urinal is treated with a disinfectant coating to prevent the growth of bacteria that cause the stench.

Water consumption
The urinal consumes no water.

Other consumption
The sealing liquid is filled up each week; annual consumption is about 1,3 litres. The liquid is biologically degradable.



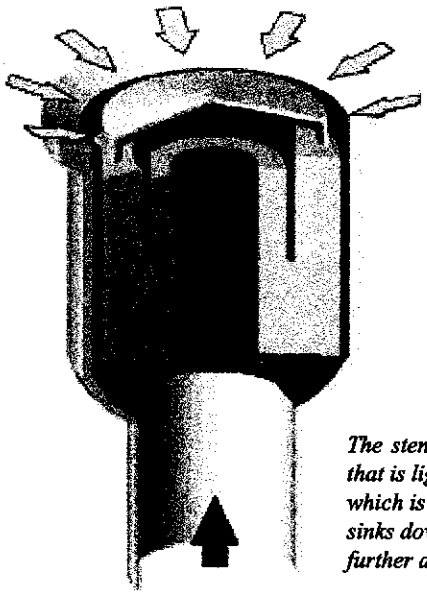
Modell 3000

Modell 4000

Design
The urinals are made of glass fibre reinforced polyester. White is the standard colour, and a number of different colours can be chosen for an extra cost. There is also a new model in sanitary porcelain, model 5000.

Measure	Model 3000	Model 4000
Back to front	290	290
Width	505	505
Height	960	680

Installation
The urinal is bolted to the wall with screws and plugs, which are included. The outlet connection is 50 mm. The pipe from the urinal can be connected to the sewage system straight through the wall or be connected just above the floor.



The stench trap consists of a liquid that is lighter than water. The urine, which is heavier than the liquid, sinks down through the liquid and further down the drain.

EXHIBIT 6,17

Environ. Sci. Technol. 2006, 40, 4838–4844

Considering User Attitude in Early Development of Environmentally Friendly Technology: A Case Study of NoMix Toilets

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Urine source separation (NoMix technology) has been proposed as a sustainable alternative to centralized wastewater treatment systems. Radical changes necessitate an early inclusion of sociological expertise, thus offering a real chance for transdisciplinary collaboration. The practical aim of our survey is to find out how users accept and use existing NoMix toilets and how this could be encouraged. We collected 1249 questionnaires from 2002 to 2004 in one Swiss school and one Swiss research institute. The technological immaturity of NoMix toilets was noted by many. Nevertheless, acceptance was high: 72% liked the idea and 86% would move into apartments with NoMix toilets. Moreover, most users found that NoMix toilets equal conventional toilets with respect to design (78%), hygiene (84%), and smell (78%). Like many other innovations, the NoMix technology only functions properly if it is used adequately, which we demonstrate for water saving and sitting to urinate. Many users adopted this behavior, e.g., 72% sat. Because perception and use of NoMix toilets is subjective, it can be influenced with certain measures such as good information and cleaning, or discussions with peers. We discuss the importance of social psychology for understanding the factors that influence the acceptance of environmentally friendly innovations.

Introduction

Urine Source Separation. Our Central European wastewater management system disposes of wastewater with acceptable environmental impact. Nevertheless, professionals increasingly question the centralized system's sustainability. Major criticisms concern its inflexibility and infrastructure costs, water and nutrient wastage, and loss of untreated wastewater through combined sewer overflows and leaky pipes (*1*, *2*). Additionally, wastewater treatment always lagged behind environmental problems such as eutrophication or, more recently, discharges of micropollutants (e.g., pharmaceuticals, *3*, *4*). Moreover, if sludge is not reused in agriculture due to fears of toxicity (*5*), other means for phosphorus recycling are needed (*6*). Source control and waste design are alternatives (*7*), with a plausible starting point being the toilet.

Although urine constitutes less than 1% of domestic wastewater, it typically contains 80% of nitrogen and 50% of phosphorus (*8*). Urine can be separated from wastewater with NoMix toilets or waterfree urinals, with the eventual effect of replacing nutrient removal at treatment plants (*9*). By separating only 50% of the urine, compact, energy-efficient treatment technologies without nitrification, denitrification, and phosphorus removal are possible, because the remaining nutrients are removed through sludge (*10*). The NoMix technology can save energy and can even transform wastewater management from an energy-consuming to an energy-producing process (in one example from consuming 11.5 W/person to producing 2.3 W/person; *10*). Furthermore, the NoMix technology can contribute to phosphorus recycling (*11*) and removal of micropollutants (*12*); and a family of four could save ca. 80 L of toilet-flush water/day (*8*). By investing about $260–440 (U.S.)/person in the NoMix technology, we estimate that the total annual costs would equal those of typical conventional wastewater treatment systems (*13*). This is a challenging, but not impossible benchmark. With more stringent nutrient emission targets, even higher investments can be tolerated.

To sum it up: The NoMix technology cannot do much that cannot be achieved with end-of-pipe technology, but it can do it more energy-efficiently, and high nutrient removal efficiency is feasible with the simplest possible wastewater treatment. Hence, the inherent difficulties of setting nutrient emission targets to aquatic ecosystems (*14*) can be avoided, thereby implementing the precautionary principle also in countries where environmental protection has little priority. Perhaps most important is the ability of the NoMix technology to question the prevailing paradigm of end-of-pipe technology as the only way to manage wastewater. Breaking this paradigm has far-reaching consequences for regions where sewer-based wastewater management is unsuitable (*15*). The applicability of urine source separation to other contexts such as dry toilets (*16*), offers a cost-efficient nutrient containment scheme in areas where sewers and treatment plants are out of the question (*17*).

Sociological Research to Study a Toilet. Real-world sociological research in an early phase of technology development is mandatory for all environmentally friendly technologies that affect people in daily life to identify the most efficient means to optimize acceptance and compliance. Social psychology offers theories and many studies to explain acceptance and adoption of innovations by users. For instance, "The Theory of Planned Behavior" (*18*) is a theoretical framework to systematically identify factors influencing behavioral choices and has been successfully applied to environmentally friendly behavior (e.g., *19*, *20*).

The NoMix technology is a radical technological system change that necessitates an early inclusion of sociological expertise. This also offers the chance of integrating social with natural and engineering sciences. Sweden pioneered the NoMix technology starting in 1980 (*21*). In Switzerland, NoMix toilets were introduced in a few small pilot projects of the research project Novaquatis (www.novaquatis.eawag.ch) from 1997 to the present. The European NoMix toilets were developed by small firms at low costs. Unfortunately, little sociological research has been published, but experience shows that NoMix toilets have practical drawbacks. Hence, our study aims at finding out whether people accept the existing NoMix toilets and use them as required. If not, we want to find reasons for noncompliance, and how we could influence acceptance, behavior, or technology. A first focus group study (*22*) and preliminary questionnaire survey (*23*) found high acceptance for NoMix toilets, while few users would accept increased inconvenience or costs.

Because the larger Swiss pilot projects are conducted in organizations, the quantitative surveys are restricted to these; and because little is known, they are exploratory. Therefore,

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and because toilet use might be gender-specific, we included demographic variables although they often only weakly explain environmentally friendly behavior (for references see *24*). Moreover, uncertainties regarding urine transport, treatment, or application in agriculture are very high, which also influences acceptance.

Research Questions. The practical aim is to find out whether users accept existing NoMix toilets, how they use them in daily life, and to find influential factors. The underlying question is whether real-world implementation with imperfect solutions is possible at this early stage of technology introduction or whether large investments by sanitary firms to optimize NoMix toilets are needed (*25*). The specific questions are (1) How high is acceptance of NoMix toilets and which factors (e.g., socio-demography, length and frequency of usage, information, discussions) influence acceptance? (2) How do people perceive and use NoMix compared with conventional toilets and what are the influential factors? (3) What do people know about NoMix toilets, why do they like the idea, and which information sources are important?

Materials and Methods

NoMix Sanitary Installations. The first modern NoMix toilets were invented by small Swedish firms in the 1990s (*21*; www.dubbletten.nu, www.wost-man-ecology.se, www.gustavsberg.com). They consist of two bowls; the urine is flushed away in the front with little water (ca. 0.15 L, depending on the model) and collected in a storage tank. The feces are flushed to the sewers with a larger flush (4−6 L). Hence, these models can save flushing water if the urine-soiled toilet paper is disposed of in a separate bin after urinating (ca. 0.15 L flush instead 3 l). The German firm Roediger (www.roevac.com) recently invented a NoMix toilet with a closing mechanism for the urine drain, which only opens when one sits. The advantage is that undiluted urine can be collected, that the toilet paper is flushed away as in conventional toilets, and that the design is modern. Disadvantages are that they consume as much water as any conventional dual-flush toilet (3−6 L) and that one has to fully sit to urinate, whereas with the Swedish models a crouching position suffices. Urine from men can also be collected with waterfree urinals (discussed in Supporting Information, p S-7).

Setting and Questionnaires. We collected data from autumn 2002 until spring 2004 in the only two Swiss organizations with NoMix toilets at that time: a vocational/design school in a Swiss German city and Eawag (Swiss Federal Institute of Aquatic Science and Technology). In the school, one of three conventional toilets was replaced with a NoMix toilet in a women's bathroom and one of two toilets in a men's bathroom. In 2002, the women tested a model from Roediger and the men tested one from Gustavsberg; in 2003 the models were swapped. At Eawag, two conventional toilets (one of two for men, one of one for women) were replaced with NoMix toilets from Dubbletten in 2000. Being located near a cafeteria and auditorium, they were easily accessible to visitors. At Eawag, (but only in 2003 in the school) the users were asked to dispose of urine-soiled toilet paper in a bin after urinating. Additionally, three waterfree urinals replaced the existing water-flushed urinals in both settings.

We used a short questionnaire (S) for people having used the NoMix toilet a few times and a longer questionnaire (L) for several months of usage (Supporting Information, Table S-1). We asked the following types of questions: (1) demographic data (gender, age, education), length and frequency of usage of NoMix toilets, (2) acceptance (are NoMix toilets a good idea, willingness to move into apartments with NoMix toilets, willingness to pay, NoMix toilets as discussion topic), (3) do people perceive and use NoMix toilets differently than conventional ones (regarding design, hygiene, smell, sitting, flushing, disposal of toilet paper), change of opinion with time, and (4) knowledge, preference, and information sources (what do people know, reasons for liking NoMix toilets, different information sources). Questions on urinals were not included. Most questions were in closed multiple-choice format.

Sample Description and Statistics. We collected 1249 questionnaires. For details of data collection, response rates, toilet and urinal visits, and information material see the Supporting Information (p S-2). We are confident that the school results are representative for Swiss German organizations with mainly young adults as visitors. The Eawag results are highly representative for employees (89% response rate) and visitors. However, the setting is unique, since Eawag is studying urine separation.

For demographic details see Table S-2 (Supporting Information). There were strong differences between the settings: School respondents were younger, had a lower education level (most were students of design introductory courses or apprentices), and had used NoMix toilets for shorter time, but more frequently than Eawag users. We operated with varying sample sizes because we often analyzed only a subset and because respondents did not answer all questions.

We analyzed data with a generalized linear model approach, mostly with forward stepwise logistic regression (details in Supporting Information, pp S-2 and 3). We present modeling information (Tables 2 and 3, and Tables S-3 and 4, Supporting Information) and parameters of final models (Tables S-5−19, Supporting Information). We used simple indices (I) as explanatory variables in some analyses by adding the values of individual answers: I Design/Hygiene/Smell (index for opinion on design, hygiene, smell: the higher, the higher the opinion), and I Our Information (having read an increasing number of our information sources).

Results

Acceptance of NoMix toilets. Acceptance was very high: 72% of the long-term users ($N = 480$) finding the idea convincing, 86% being willing to move into apartments with NoMix toilets, but only 28% being willing to pay nearly the double price for a NoMix toilet than for a conventional toilet (Table 1, Figure 1a). Having discussed NoMix toilets in a negative manner with others was most strongly correlated with significantly lower acceptance (Figure 1b). This variable "discussion" was added first to the model (step = 1) for two measures of acceptance, A (idea) and B (apartment), explaining ca. 20% of variance (Nagelkerke R^2), and second for C (willingness to pay; Table 2). A positive perception of design, hygiene, and smell was also positively correlated with acceptance (e.g., NoMix toilet is good idea, I. Design/Hygiene/Smell = 5.86±0.08; not good idea, 4.74±0.20; the index is a sum of the answers to the opinion of design, hygiene, and smell; scale of 3−9) as well as an increasing number of information sources (e.g., 83% that did not read any information liked the idea, but 94% that read ≥2 sources liked the idea). Fewer younger and less well-educated respondents would pay more for NoMix toilets (Table 2C).

Peer Pressure. Because discussing NoMix toilets was the most important explanatory variable, we also analyzed it separately. Here, setting (school/Eawag) and increased information were the explaining variables (Table 2D, Figure 1c). The NoMix toilet was discussed by 63% (46% in the school, 78% at Eawag; Table 1). Most comments were favorable (44%) or neutral (43%; Table 1). However, the 13% negative discussions were most strongly correlated with low acceptance (Figure 1b).

Perception of Design, Hygiene, and Smell. Most users found that NoMix toilets are the same as or better than

TABLE 1. Frequencies: Overview of Respondents Who Answered Various Dependent Variables on the NoMix Toilet in a Positive Manner[a]

variable	(A) setting		(B) gender		(C) information		(D) All (N)
	school	Eawag	women	men	no	yes	
acceptance of NoMix toilet (Table 2)							
idea of NoMix toilet is convincing	72%	73%	67%	80%	41%	74%	72% (451)
would move into apartment with NoMix	87%	85%	86%	86%	62%	87%	86% (460)
willing to pay more for NoMix toilet	15%	39%	24%	33%	11%	28%	28% (412)
discussed NoMix toilet with others	46%	78%	62%	64%	27%	64%	63% (480)
comments were neutral or positive	93%	84%	84%	91%	83%	87%	87% (297)
perception of NoMix toilet compared with conventional toilet (Table 3)							
design NoMix same/better	83%	73%	75%	81%	80%	78%	78% (1097)
hygiene NoMix same/better	93%	77%	85%	84%	86%	84%	84% (1043)
smell NoMix same/better	90%	70%	79%	78%	78%	78%	78% (1041)
behavior on NoMix toilet (Table S-3, Supporting Information)							
willing to sit on NoMix to urinate	64%	79%	75%	67%	53%	74%	72% (1069)
did not have to sit differently	90%	81%	81%	91%	91%	85%	85% (948)
used small flush after urinating	83%	86%	84%	86%	80%	85%	85% (915)
disposed of toilet paper in bin	6%	58%	38%	42%	0%	42%	40% (301)
knowledge and information (Table S-4, Supporting Information)							
knows purpose of NoMix toilet	80%	86%	83%	83%	53%	85%	83% (1184)

[a] We show frequencies of groups that often differed significantly in logistic regression: (A) setting, (B) gender, (C) users that had (not) read our information material, and (D) frequencies over all groups (N: total sample sizes, excluding missings). Tables refer to the detailed logistic regression models. Note: despite differences between some groups, these may not have been important enough to be included by the logistic regression model.

conventional toilets regarding design (78%), smell (78%), and hygiene (84%; Table 1, Figure 1d). There were some weak differences between groups (gender, education, information). However, the most striking result is a highly significant ($P < 0.001$) more negative opinion of Eawag users, and setting was always added first to the logistic regression model. Therefore, we also analyzed these two settings independently (Table 3).

In the school, the models of design, hygiene, and smell explained maximally 10% of variance (Table 3A). If users read nothing about NoMix toilets they had a more negative opinion than if they read our information (18% vs 6% found the hygiene worse; smell, 31% vs 9%). Moreover, 14% of Gustavsberg users said the toilet smelled worse than conventional toilets, but only 6% of Roediger users.

At Eawag, perception of design was correlated with education (results not presented) and gender: 32% of women, but 22% of men found the design worse (Table 3B). Interestingly, only 17% of visitors (S-questionnaires) found the hygiene or smell worse, but 32% of Eawag employees (L-questionnaires) found the hygiene worse and 50% (!) found the smell worse. Most long-term users (85%) did not change their opinion with time; but if they did, they mostly adopted a more positive view (design 82%, hygiene 60%, smell 58%).

Behavior. For detailed results of users of NoMix toilets regarding willingness to sit, sitting position, flushing, disposal of urine-soiled toilet paper after urinating, and also waterfree urinals see the Supporting Information (pp S-6–8; Table S-3).

Information. Information was very important for acceptance, discussions with others, perception, and behavior, and enhanced the knowledge about the purpose of NoMix toilets: Most respondents (83%, Table 1) knew the purpose of NoMix toilets, and in logistic regression, the number of information sources (including external information) was added first (Supporting Information, Table S-4). Only 68% of users knew the purpose if they had not read any information, but 93% and 98% knew the purpose if they received information from 1 or ≥2 sources. Second, our own information contributed to knowledge, and third was the contribution of a high education level (Supporting Information, p S-9).

We then analyzed which of our information material contributed to knowledge about the purpose of NoMix toilets (L-questionnaire). Besides the number of information sources, the instructions for use in the toilet cabin containing a very short rationale for urine separation were most important: Only 69% of people that had not read them knew the purpose, but 94% of those who had read them knew the purpose (Supporting Information, Table S-4B). Our arguments for urine separation were all mentioned: benefits for wastewater treatment plants, improved water pollution control (nutrients, micropollutants), nutrient recycling (fertilizer), and water saving, albeit to differing degrees between the school and Eawag. For a discussion on the reasons for liking urine separation see Supporting Information (p S-9 and 10).

Discussion

Theoretical Background. The NoMix toilet is an innovation that affects people in their intimate daily life. Since it does not yet equal modern sanitary standards and necessitates behavioral changes, acceptance cannot be taken for granted. Social psychology helps to explain the acceptance of such innovations and to find influential factors.

The "Theory of Planned Behavior" (TPB) by Ajzen (*18*) was frequently applied to explain environmentally friendly behavior such as solid waste recycling (e.g., *19*, *20*). TPB postulates that behavioral choices are mainly influenced by (A) attitude toward the behavior, (B) subjective norm (i.e., perception of social pressure), and (C) perceived behavioral control (i.e., ability to perform the behavior). Some authors postulate that additional factors such as moral norm, past experience, situational factors (e.g., inconvenience), and the consequences of the behavior (e.g., that it is rewarding) also influence behavior (*20*, *24*). Others suggest clustering factors into environmental, situational (e.g., socio-demographic), and psychological variables (*26*). In any case, the decision of individuals for e.g., solid waste recycling can be understood as a set of preconditions that include sufficient motivation, knowledge, and the ability to overcome the inconveniences (for references see *20*, *27*). Motivation includes social pressure, economic, and altruistic aspects. Knowledge includes practical information on how to recycle. Inconveniences could be that people find recycling messy. Therefore, to increase the number of people willing to recycle (or sit on NoMix toilets) a first research aim is to find the factors with the strongest negative or positive influence.

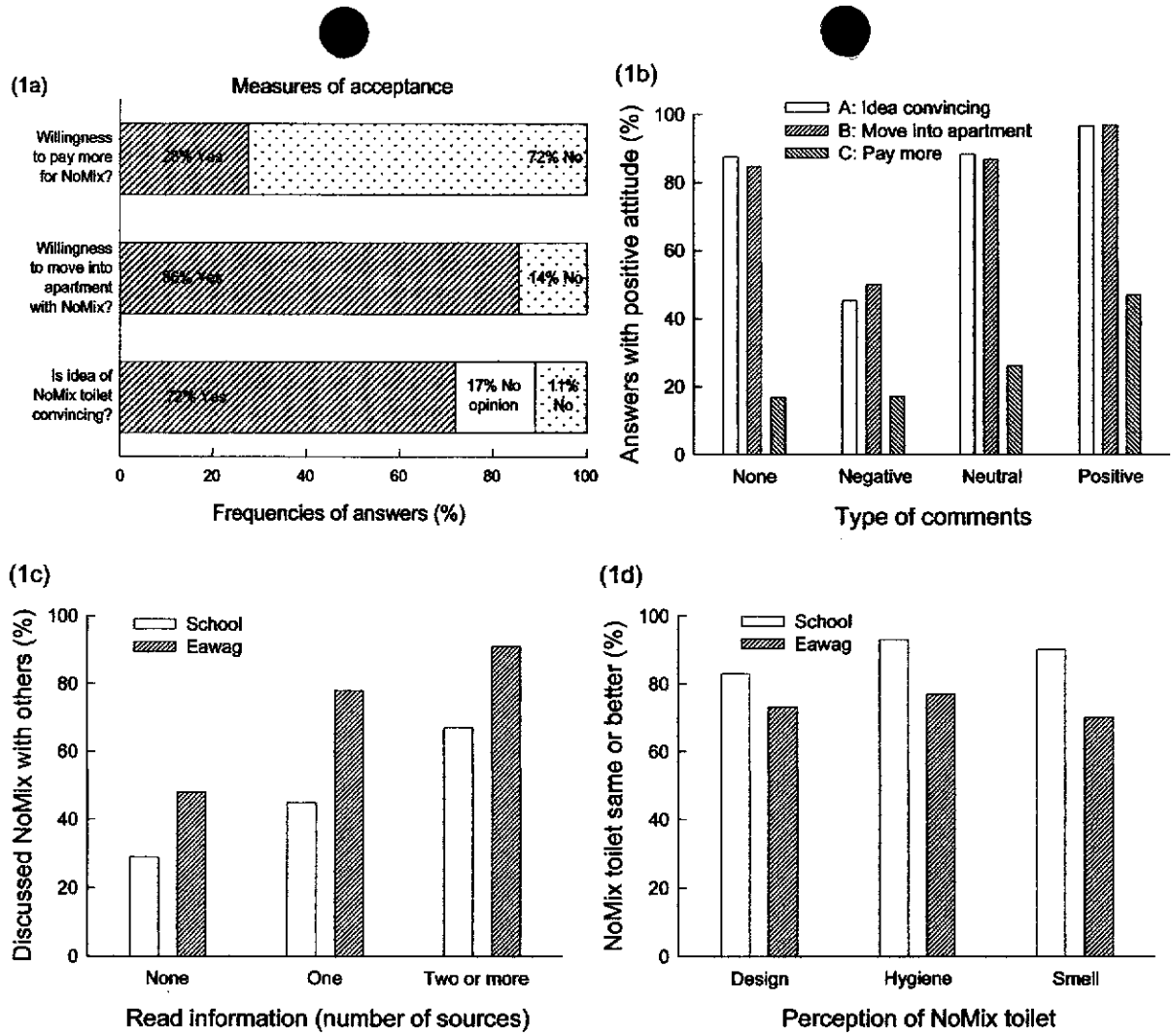

FIGURE 1. Acceptance and Perception. (1a) Frequencies of answers from long-term users concerning acceptance, (1b) answers indicating a positive attitude in relation to discussions with others, (1c) frequencies of people having discussed NoMix toilets in relation to the number of information sources they had read, and (1d) frequencies of respondents considering NoMix toilets the same as or better than conventional toilets regarding design, hygiene, and smell in the two settings.

TABLE 2. Acceptance: Stepwise Forward Logistic Regression of (A) "Is Idea of NoMix Toilets Convincing?," (B) "Willingness to Move into Apartment with NoMix Toilet," (C) "Willingness to Pay More for NoMix Toilet," and (D) "Having Discussed NoMix Toilet With Others" as Most Important Explanatory Variable[a]

		(A) idea ($N = 299^b$)				(B) apartment ($N = 363$)				(C) pay more ($N = 328$)				(D) discussion ($N = 373$)			
sources of variation	d.f.	step	χ^2	R^2	P	step	χ^2	R^2	P	step	χ^2	R^2	P	step	χ^2	R^2	P
discussion	3	1	30.0	0.191	***	1	43.5	0.210	***	2	14.1	0.237	**	not included in analysis			
l. design/hygiene/smell	1	2	9.2	0.245	**	2	12.3	0.265	***	4	5.8	0.291	*				
no. inform. sources[c]	2	3	7.0	0.286	*					3	9.0	0.270	*	2	19.7	0.232	***
age	1					3	12.4	0.319	***	1	44.0	0.183	***				
l. our Information[d]	1					4	8.7	0.355	**					3	4.9	0.247	*
education	2									5	6.1	0.312	*				
setting	1													1	49.3	0.170	***
full model	(11)		46.1	0.286	***		76.9	0.355	***		79.1	0.312	***		74.0	0.247	***

[a] N: sample sizes, d.f.: degrees of freedom, step: order of inclusion of variable in model. For each step and final model we show χ^2: deviance change (is analogous to (explained) "Sums of Squares" in ordinary regression), R^2: Nagelkerke R^2 (approximates R^2 in ordinary regression: proportion of variance in dependent variable explained by independent variables), and significance levels: * = $P < 0.05$, ** = $P < 0.01$, *** = $P < 0.001$. Variables without "step" were not included in model. Details in Supporting Information. [b] 77 people without opinion were excluded. [c] Variable includes external information (mass media, etc.). [d] Index contains only our own information.

Acceptance of NoMix toilets. Acceptance of the NoMix toilets was very high (Table 1, Figure 1a), with little differences among groups. One exception is willingness to pay: at Eawag, 39% would pay substantially more for NoMix toilets compared with only 15% of the younger, less well-educated, and presumably less well-off school users. It is striking that despite the more negative attitude of Eawag employees regarding practical aspects, 85% of Eawag users would move into apartments with NoMix toilets. The most promising measures to increase the already high acceptance are discussions with peers and information, apart from the more obvious measure of hygienic, odor free toilets (Table 2, Figure 1b).

TABLE 3. Perception: Stepwise Forward Logistic Regression of Design, Hygiene, Smell[a]

		design				hygiene				smell			
sources of variation	d.f.	tep	χ^2	R^2	P	step	χ^2	R^2	P	step	χ^2	R^2	P
(A) School			($N = 364$)				($N = 358$)				($N = 357$)		
our information	1					1	3.4	0.024	+	1	12.6	0.068	***
toilet type	1									2	6.0	0.100	*
full model	(2)		Model not significant				3.4	0.024	+		18.6	0.100	***
(B) Eawag ($N = 531$)													
education	2	1	10.1	0.027	**								
gender	1	2	4.6	0.039	*								
questionnaire type	1					1	11.7	0.033	**	1	67.8	0.170	***
our information	1									2	6.1	0.184	*
full model	(5)		14.7	0.039	**		11.7	0.033	**		73.9	0.184	***

[a] Because of highly significant differences between school (A) and Eawag (B), we analyzed these separately. For explanations see Table 2. Analysis of "toilet type" only in school (Roediger vs Gustavsberg).

Peer Pressure. In TPB, social pressure to perform a behavior (subjective norm) is one of the three modeled factors (*18*), and various examples of peer pressure are reported. For instance, 45% of 100 female students left the bathroom without hand washing when alone, but only 9% when not alone (*28*). Because the use of NoMix toilets is hardly observed by colleagues, one might expect that peer pressure is not important here. However, this speculation is not supported by the results: NoMix toilets were extensively discussed by users, especially at Eawag (Table 1, Figure 1c), and the few negative discussions were most strongly correlated with low acceptance (Figure 1b). In future pilot projects, information events could offer the opportunity for peer discussions.

Information. Information was not only important for acceptance, but also for discussions with others (Figure 1c), perception, behavior, and to increase the knowledge about the purpose of NoMix toilets. We found that even the instructions for use in the toilet cabin containing a very short rationale for urine separation already sufficed. This confirms other studies, which also found that minimal additional information increased the positive response of users (*29*). Moreover, because the different user groups mentioned different reasons for finding urine source separation convincing (Supporting Information, pp S-9−10), our strategy to offer several arguments makes sense.

Demography. The demographic variables gender, age, and education were rarely included in the models. This is supported by the literature. Although researchers consistently use demographic variables to understand environmental behavior, the relationships are often weak (*19, 24, 30*).

Perception and Use of NoMix Toilets. Environmentally friendly behavior can be normative, and practical aspects were often better predictors of e.g., waste recycling than altruistic environmental concern (*20, 26, 30*). Similarly, ease of use was of high importance for correct operation and acceptance of water-saving appliances, highlighting the need for efficient and practical design (*29*). Sitting on NoMix toilets to urinate and disposing of toilet paper in a bin are such issues. We shortly discuss the most important findings below (details of behavior are provided in the Supporting Information, pp S-6−8).

Design, Hygiene, and Smell. Most users had a positive perception, with ca. 80% finding the design, hygiene, and smell of NoMix toilets the same as or better than the same attributes for conventional toilets (Tables 1 and 3, Figure 1d). In comparison, professionals from sanitary firms generally find that the design of NoMix toilets does not equal that of other modern toilets. Interestingly, Eawag employees had a distinctly more negative opinion than Eawag visitors and school users. This indicates that the perception of practical aspects is subjective, which is supported by the positive relationship between information and hygiene/smell in the school. In the pilot projects, we occasionally received complaints of bad smell, which was mainly caused by poor maintenance of the waterfree urinals. Possibly, Eawag employees remembered such instances, which also led to some confounding between NoMix toilets and urinals.

Consequences of Behavior. Sitting. If people do not sit on NoMix toilets to urinate, less urine is collected, which reduces the advantages of the technology. Many women (75%) in our survey were willing to sit (Table 1), compared with a British study, where 85% voided by crouching (*31*). The two most promising measures to enhance sitting on public NoMix toilets are again good information and clean toilets. Men might be reluctant to sit, but in public places ca. 70% use the urinals. Future research should specifically address questions concerning waterfree urinals and men's behavior in households.

A further question is whether the human anatomy differs so strongly that a flexible toilet design is needed. However, because 85% of the NoMix toilet users did not sit differently than on conventional toilets (Table 1), and because we found no differences between the distinctly different Roediger and Gustavsberg toilet, an inflexible NoMix toilet design seems to suffice.

Disposal of Toilet Paper. To save water, it is necessary to use the bin to dispose of urine-soiled toilet paper. We speculate that this is a normative behavior, where motivation increases if it is a socially accepted priority. If people do not adopt this behavior, the Swedish NoMix toilets may even consume more water than conventional dual-flush toilets, because a large flush (6 L) is used where a small flush (3 L) would suffice. In our case, compliance is high enough to result in a small water saving effect of the Swedish toilets: 58% of Eawag users disposed of urine-soiled paper in the bin and flushed with 0.15 L of water (Table 1), while 42% used 6 L of water after urinating. In this example, the outcome is a water saving effect of 84 L per 100 usages compared with conventional dual-flush toilets, where 85% would use the small flush (3 L) after urinating. However, as long as we do not know how representative our results are, both systems should be available for choice.

Conceptual Considerations. *Setting.* We found strong differences between school and Eawag users, e.g., regarding the opinion of design, hygiene, and smell (Figure 1d). Presumably, this was not caused by the toilet types, because the most strongly differing toilets were used within the school (Roediger vs Gustavsberg), where we only detected one difference (smell). Second, the strong discrepancy between Eawag employees and visitors cannot be explained by toilet design. Rather, the perception might be subjective, and studies in other settings are needed to draw objective conclusions. Interestingly, the differences disappeared when it came to acceptance. People obviously differentiated

between practical drawbacks of NoMix toilets and generally finding urine separation a good idea.

Our study is seriously restricted because of its limitation to organizations. The main drawback of NoMix toilets is precipitation of urine crystals, which eventually blocks the pipes (*32*). Blockages can be removed by cleaning personnel in organizations. However, the focus group survey indicates that people are reluctant to accept increased maintenance in private homes (*22*), which needs to be backed with further quantitative surveys. Therefore, we recommend introducing NoMix toilets in homes only after carefully considering possible technical drawbacks or strong awareness-raising among household members.

Future Research. In exploratory studies, causal relationships cannot be established. For instance, people with an initially negative attitude toward NoMix toilets could have selectively ignored information they perceived as irrelevant. This was suggested in a recycling study (*30*), while other studies confirmed that information actively increased environmentally friendly behavior (*33*). To establish causal relationships also for NoMix toilets, different treatments of the most important influential factors could be tested among identical user groups. For instance, one group could receive no information, a second group could receive an information leaflet, and a third group might visit an information event. Because the current NoMix pilot projects are limited to small user groups, an intelligent experimental setup is needed.

Introducing NoMix toilets. Research is now confronted with the problem that more pilot projects are needed to develop the NoMix technology (e.g., urine treatment) and to open a market for private industries. However, implementing an immature technology that affects people in daily life, without the appropriate sensitization and incentives, might result in a severe backlash (see ref *16* for user satisfaction of dry toilets). Larger sanitary firms are convinced that users only accept technologies that equal today's standards ("perfect technology"), which necessitates large investments in an uncertain market (*25*). Understandably, sanitary firms are reluctant to carry this risk. However, our results suggest that introducing the existing NoMix toilets might not affect people as negatively as anticipated.

Despite the technological immaturity of NoMix toilets, which was well noted by many, and despite uncertainties regarding urine handling (e.g., processing), acceptance of NoMix toilets was extremely high in our two organizational settings. Obviously, people are open for this innovation, especially if they can choose among various arguments to find the personally most convincing ones. Research must now validate how representative our results are in other settings, quantify the environmental advantages, and carefully assess the pros and cons of NoMix toilets.

Early Development of Environmentally Friendly Technology. Involving users in technology development is an important environmental issue. Many examples show that nonsustainable impacts of daily life behavior can only be avoided with the cooperation of users: correct use of water-saving appliances in washrooms (*29*), disposal of domestic sanitary waste in bins rather than toilets (*34*), correct maintenance of dry toilets (*16*), or more generally the environmental consequences caused by nonrecycling of household wastes (*19, 20, 26, 27, 30*), personal car use (*24*), or energy wastage in households (*35*). Some environmentally responsible behavior is "difficult", because it necessitates fundamental behavioral changes, such as reducing automobile use (*24*). Other technologies, e.g., water or energy saving appliances, bring economic advantages to users without any loss of comfort. Nevertheless, such devices are installed far less than they could be. Social psychology helps to better understand environmentally relevant behavior and must be included in an early research stage to avoid producing technological innovations that simply do not appeal to consumers.

The NoMix technology is currently in the early stage of development. It is an example of a technology with strong environmental advantages that will, however, only work with user acceptance and some behavioral changes. Finally, because of its innovative character and mutual dependencies between research and society, the NoMix technology offers a real chance to integrate social with natural and engineering sciences. A simple toilet may thus support transdisciplinary collaboration, an area where better performance is urgently needed.

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Supporting Information Available

Details on data collection, response rate, and statistical analysis (pp S-2−3); questionnaires (Table S-1); sample description (Table S-2); additional results and discussion on behavior (sitting, flushing, disposal of toilet paper) including urinals (pp S-6−8); additional results and discussion on knowledge and information (pp S-9−10); and detailed logistic regression models (Tables S-5−19). This material is available free of charge via the Internet at http://pubs.acs.org.

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EXHIBIT 6.25

Impact of separate urine collection on wastewater treatment systems

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Abstract Wastewater treatment should not only be concerned with urban hygiene and environmental protection, but development of a sustainable society must also be considered. This implies a minimisation of the energy demand and potential recovery of finite minerals. Urine contains 80% of the nitrogen (N) and 45% of the phosphorus (P) in wastewater. Separate collection and treatment would improve effluent quality and save energy in centralised biological nutrient removal (BNR). BNR processes are not optimal to treat water with very low N concentration resulting from separate urine collection. Relying on nutrient removal through sludge production, methanation of the sludge, subsequent nutrient removal from the digestion effluent results in optimised and more sustainable wastewater treatment. This paper quantitatively evaluates this option and discusses the potential.

Keywords Energy; nutrients; Sharon/Anammox; struvite; urine; wastewater

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Introduction

Wastewater treatment has slowly changed over the last century from a system for prevention of diseases in urban society towards a system for protecting the natural environment. In recent years, society started to demand that technical systems contribute to the "sustainability" of the same society. Although "sustainability" can not be quantified easily, it is generally accepted that recovery of resources from waste contributes to an increased sustainability.

Nutrients (ammonium and phosphate) and organic carbon can potentially be recovered form municipal wastewater. However, the dilute nature of wastewater makes recovery economically and energetically expensive. Several studies have shown that up to 80% of the total N load and around 45% of the total P load in municipal wastewater originate from urine (Larsen and Gujer, 1996; Hanæus *et al.*, 1997). Experience from ecological villages in Sweden showed that separate urine collection can be done efficiently (Hanæus *et al.*, 1997; Jönsson *et al.*, 1997). Separate urine collection largely improves the potential for nutrient recovery, because the concentrations of N and P are a hundred times higher than in wastewater. On the other hand, in e.g. The Netherlands, the nutrients in human waste amount to less than 20% of the amount in animal manure. From a societal point of view, nutrient recovery from animal manure should get prime attention, because manure can be collected more easily and can be treated locally on a large scale.

The importance of urine separation is recognised but the effect on central treatment processes has not yet been quantified. Separate urine collection would not be worthwhile if it only had a marginal impact on central wastewater treatment systems. Improvement of the overall wastewater management system should be a stronger driving force than nutrient recovery alone. If it can be shown that advanced treatment processes would benefit from separate urine collection, then wastewater treatment in general would benefit form urine separation. Most advanced wastewater treatment works operate according to variants of the modified UCT process. For this study we chose the BCFS® process (Biological/Chemical Phosphorus and Nitrogen removal) as a conventional reference process. The treatment

plant at Hardenberg in The Netherlands is taken as an example, because a calibrated model was available (Meijer *et al.*, 2001). The system as such is already fully optimised for biological N and P removal and produces good effluent quality (current annual average: 3.5 gN_{tot}/m^3, 0.5 gNH_4-N/ m^3, 0.15 gP/m^3).

The N content of bacteria is between 9% and 12% and the P content is between 1% and 3% of the volatile suspended solids (Ekama and Marais, 1984). This means that for wastewater with an influent COD:N:P ratio of approximately 100:5:1 almost all the N and P will be used for cell growth (with the yield factor Y_H = 0.63 gCOD/gCOD). If urine were collected separately, the influent nutrient load could then be reduced to match this cell growth requirement. The N and P normally removed through nitrification/denitrification and dephosphatation, e.g. in a BCFS® process, could then be removed by collecting a large percentage of urine separately. The N and P remaining in the influent could be removed through waste activated sludge production at short solid retention times. A major decrease in the influent N and P load would allow for simple treatment processes that will not be effective if all urine remains diluted in wastewater. This paper evaluates quantitatively the advantages of separate urine collection for the design, operation and sustainability aspects of a centralised wastewater treatment system. Hereto we made use of sub-systems already applied at large scale.

Methodology

Influent characteristics

Average Dutch influent flow rates and concentrations were used for this study (CBS, 2000; STOWA, 2002). Influent concentrations for chemical oxygen demand, total nitrogen, ammonium and total phosphorus were COD_{tot} = 537 $gCOD/m^3$, N_{tot} = 50 gN/m^3, NH_4^+ = 40 gN/m^3 and P_{tot} = 8 gP_{tot}/m^3. The COD, N and P fractions in influent wastewater were divided into different model components, similar to Hao *et al.* (2001). The current wastewater influent at Hardenberg (8,500 m^3/d) is still less than the design flow rate. At the current flow rate, the total N effluent concentration is much lower than the effluent standard of 10 gN/m^3. The flow rate was maximised to the extent that the system just complied with the effluent demand and was determined by iteration to be 13,500 m^3/d. Effects of changing influent nutrient loads were compared to this reference (zero scenario).

Modelling urine separation

Urine contributes only a small volume to the total wastewater volume. However, the water currently used to flush urine is a significant fraction of the total. Urine flush water was assumed to be 35 l/p.d (Jönsson *et al.*, 1997). Therefore, if 100% urine separation could be achieved, wastewater discharge to the treatment works could be reduced by 36.25 l/p.d (including 1.25l/p.d urine). Modern source separation toilets use a small amount of flush water. The production of urine (including flush water) was assumed 2 l/p.d.

From the influent nitrogen concentration, 40 gN/m^3 can be attributed to urine. Nitrogen in urine is mainly present as urea, $CO(NH_2)_2$. This soluble compound rapidly hydrolyses to NH_4^+ and HCO_3^-. The N-load contributed by urine was assumed to consist of soluble ammonium (S_NH4) only (Helström *et al.*, 1999 and Hellström and Johansson, 1999). At 100% urine separation, the total N influent concentration would drop from 50 gN/m^3 to 11.4 gN/m^3 (including the effect of the decreased flow rate). The ammonium concentration at different urine separation efficiencies was determined according to Eq. (1):

$$NH_{4\_25} = (NH_{4\_00} \times V_{00} - 0.25 \times NH_{4\_urine} \times I)/V_{25} \quad (1)$$

Where, NH_{4_25} = ammonium concentration in wastewater with 25% urine collected

separately (gN/m^3), NH_{4_00} = ammonium concentration in wastewater without urine separation (gN/m^3), V_{00} = wastewater flow rate without urine separation (m^3), NH_{4_urine} = ammonium load in urine (12 gN/p.d), I = number of individuals connected to treatment plant (45,000, at flow rate = 13,500m^3/d) and V_{25} = wastewater flow rate with 25% urine collected separately.

The phosphorus and COD concentration due to separate urine collection was determined in the same way. The inflow concentration of P_{tot} was 8 gP/m^3 in wastewater without urine separation. The phosphorus load from urine was assumed 1 gP/p.d. At 100% urine separation, the total influent phosphorus concentration would then be 5.3 gP/m^3. Separate urine collection will lead to a small decrease in the COD load discharged to wastewater treatment works (12 gCOD/p.d @ 100% urine separation).

Modelling the BCFS® process

Hao *et al.* (2001) modelled the BCFS® process at Hardenberg. We used the computer software package AQUASIM 2.0 (Reichert, 1998) to implement the dynamic simulation of the BCFS® process model, which is schematically represented in Figure 1.

The total volume of the five compartments is 10,000 m^3. A secondary settling tank (2,800 m^3) is downstream of the final aeration basin. Mixed liquor is returned to different reactors and the settled sludge return rate was equal to the inflow. Waste activated sludge was withdrawn from the clarifier's sludge compartment. In all simulations of the BCFS® process the total suspended solids concentration (TSS) was kept constant at 5,000 g/m^3. In practice, solids retention time (SRT) controls the TSS. In the simulations a TSS equal to 5,000 g/m^3 was maintained by adjusting the SRT. The sludge volume index of existing BCFS® processes is below 120 ml/g. It was assumed that the sludge will separate and settle well in the secondary settling tank. A conservative temperature, common for the colder half of the year in north-west Europe, of 12°C was used for all simulations.

Treatment optimisation and model integration

A second set of simulations was done to evaluate a proposed system for treatment of separately collected urine and wastewater. Figure 2 presents a flow diagram for the integration of existing processes. Effluent concentrations and removal efficiencies for different process units were based on literature information. The aerobic reactor was simulated as described above. The sum of influent wastewater (Q_1), the pre-thickener overflow (Q_4) and effluent from the Sharon/Anammox process (Q_{10}) gives the influent flow rate and concentrations (Q_3) as shown in Figure 2. The aerobic reactor had a volume of 1000 m^3 (hydraulic retention time of two hours). The volume of the clarifier's sludge compartment was assumed 10% of the volume of the aerobic reactor.

Based on the substrate ratio required for bacterial growth (COD:N:P = 100:5:1) it is clear that nutrients are present in excess of the requirement; N_{exc} = 24 g/m^3 and P_{exc} = 1.5 g/m^3. According to these figures, nutrients remaining in wastewater after 60% urine

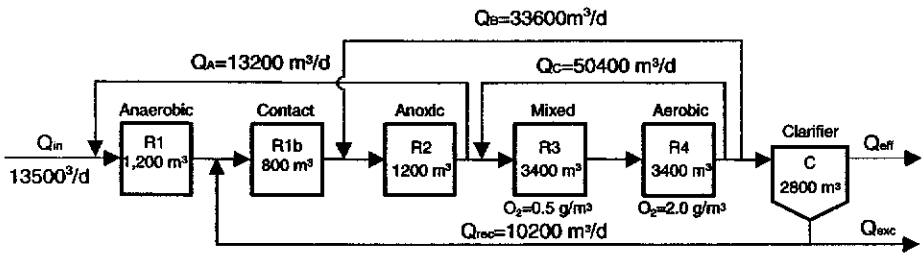

Figure 1 Schematic process diagram of the Hardenberg wastewater treatment works

separation could be removed with waste sludge. Waste sludge should be gravity thickened (TSS = 25 kg/m^3, Tchobanoglous, 1991) before entering anaerobic digestion (Q_5). We assumed that 100% of slowly biodegradable COD (X_S) and 90% of the COD of bio-mass (X_H and X_I) can be transformed into bio-gas (Q_{12}). The CH_4:CO_2 ratio was assumed 65:35 for this study (Malina and Pohland, 1992). Digested sludge (Q_6) can be thickened (80 kg/m^3) and dewatered (200 kg/m^3) before incineration. Supernatant and centrate (Q_7) are mixed with the separately collected urine stream. The COD concentration in anaerobic digester supernatant is normally around 1,200 g/m^3 (Stowa, 2000, 25). It could be assumed that no gaseous nitrogen escapes the digester and that at steady state, all nitrogen entering the digester leaves as either NH_4^+, or nitrogen in dewatered sludge (Q_{13}).

Struvite ($MgNH_4PO_4.6H_2O$) precipitates naturally in urine or in anaerobic sludge digesters and downstream piping. Relatively low phosphate concentrations can be expected form anaerobic digester supernatant; P_{tot} = 50 g/m^3. In this case, supernatant and filtrate is combined with urine; P_{tot} = 800 gP/m^3. Addition of MgO would increase pH sufficiently to precipitate struvite from the combined stream (Q_8) and yield a constant effluent concentration of 18 gP/m^3 (Schuiling, 1999). Recovered struvite could be used as fertiliser (Q_{15}).

The mixture of urine (9,000 gNH_4^+-N/m^3) and supernatant (1,200 gNH_4^+-N/m^3) leaving the sruvite crystalliser (Q_9) would still contain around 2,400 gNH_4^+-N/m^3. Recent development of the Sharon/Anammox technology made removal of highly concentrated NH_4^+ from wastewater more sustainable. Up to 95% of the influent ammonium is removed as nitrogen gas (Q_{14}) and only 5% of the influent total nitrogen leaves the combined process (STOWA, 2000–25). The effluent from these processes would be returned to the aerobic reactor (Q_{10}). A combination of computer simulation and mass balance calculations was used to evaluate the performance of this integrated process.

Assessment of energy demand

The energy consumption of integrated separate urine and wastewater treatment was evaluated. The energy consumption of a BCFS® process without urine separation or pre-settling was used as a reference. Energy consumption of the two processes was determined theoret-

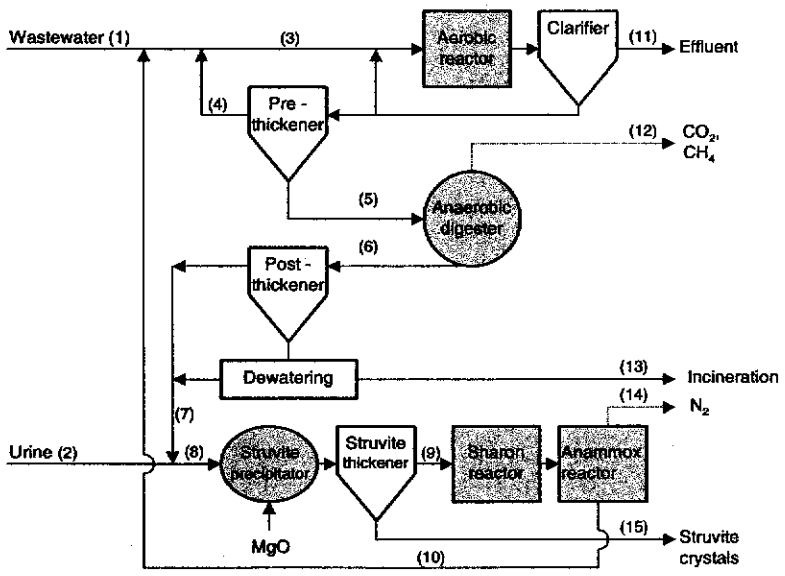

Figure 2 Proposed process flow diagram to treat wastewater and urine separately (Flow numbers refer to subscripts in the text, Q_1, Q_2, Q_3, etc.)

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ically, based on aeration (E_{aer}), sludge dewatering (E_{dew}), sludge incineration (E_{inci}), pumping (E_{pump}), mixing of tank reactors (E_{mix}) and methane gas (E_{CH_4}) produced by the anaerobic sludge digestion. The total net energy requirement (E_{net}) can be expressed as:

$$E_{net} = E_{aer} + E_{dew} + E_{inci} + E_{pump} + E_{mix} + E_{heat} - E_{CH_4} \quad (2)$$

The total oxygen requirement is the sum of oxygen required for sludge production in the aerobic reactor and the oxygen required in the Sharon process. The oxygen requirement for the aerobic reactor was simulated with a full activated sludge model in AQUASIM. Oxygen requirement for the Sharon process was based on the stoichiometric ratio, 1.82 g O_2/gNH_4-N influent (STOWA, 2000).

The calculation of energy involved in incineration, dewatering and methane combustion was described by van Loosdrecht *et al.* (1997). Energy required for pumping and mixing is usually neglected in estimations. The total recirculation flow of the BCFS® process is almost tenfold the simple aerobic reactor and becomes significant when processes are compared. Pump rates were based on average daily flows. The mixing of anaerobic and anoxic compartments in the BCFS® process has to be compared to mixing in the struvite precipitator and Sharon/Anammox reactor. Furthermore, the anaerobic digester requires a considerable amount of mixing. The power requirement of mixing was based on an average figure of 10 W/m^3 mixed volume (Grady and Lim, 1980).

Results and discussion

Effect of urine separation on nutrient removal in a BCFS process

The effects of separate urine collection on an existing BCFS process with raw wastewater were simulated. The main results are shown in Figure 3.

Due to a decrease in the number of autotrophic bacteria (nitrifiers), effluent ammonium concentration ($NH_4^+{}_{eff}$) increases slightly with increasing urine separation. Effluent nitrate concentration (NO_{3_eff}) decreases with increasing urine separation. The COD/TKN ratio increases with increasing urine separation and therefore the denitrification potential increases. Less nitrate is produced (less ammonium oxidation) while the capacity to reduce nitrate increases. While NO_{3_eff} decreases non-linearly, the amount of nitrogen gas produced decreases linearly with increasing urine separation. Total N in the effluent (N_{tot_eff}) is the sum of ammonium, nitrate and nitrogen contained in suspended solids (not settled in the clarifier). The model predicts N_{tot_eff} = 3.2 g/m^3 at 50% urine separation, which is the current effluent concentration at Hardenberg, at influent flow rate of 8,500 m^3/d compared

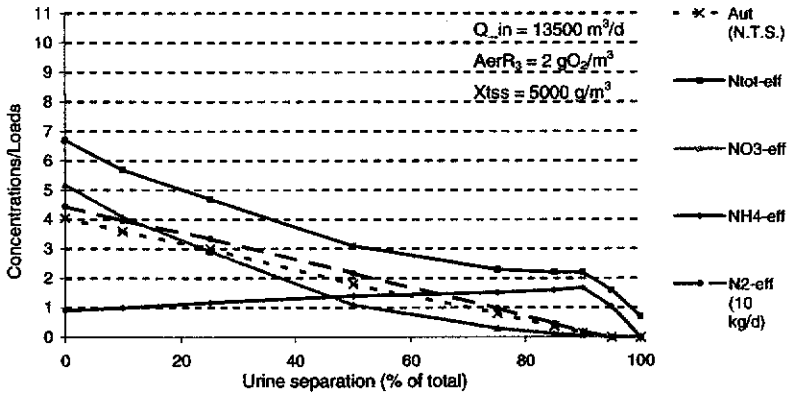


Figure 3 Effects of urine separation on N removal in advanced UCT-type (Figure 1) wastewater treatment processes

to 13,500 m^3/d in the model simulations. The N removal capacity of a BCFS process can be increased by 60% with 50% urine separation. One observes a substantial decrease in N_{tot_eff} with urine separation up to 50%. The decrease is less obvious above 50% urine separation.

Virtually all phosphate had already been removed in the case of zero urine separation and urine separation therefore had little effect on the P-removal efficiency.

Effect of urine separation on nutrient removal through increased sludge production

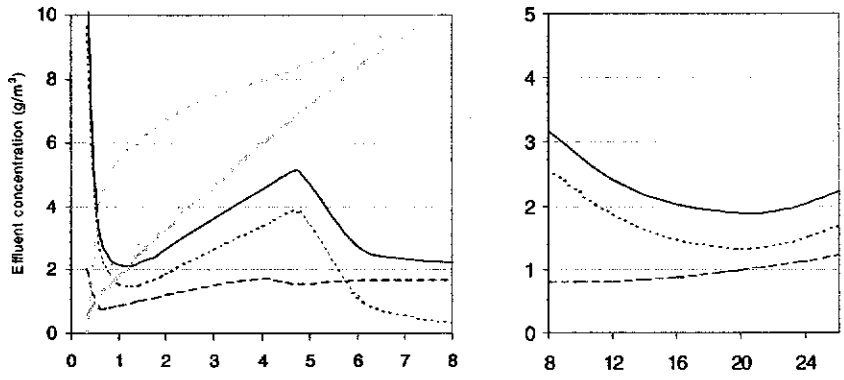
In the second set of simulations, the effect of urine separation on nutrient removal through sludge production was evaluated. Hereto a short SRT is preferable. At too high sludge withdrawal rates (short SRTs), sludge growth rate limits the process. The relation between SRT and sludge production in an aerobic zone integrated with other processes (Figure 2), with 75% of urine collected separately, is shown in Figure 4(a). The figure shows a drastic increase in effluent nutrient concentrations (little sludge produced, but much COD in effluent) at SRT < 0.5 days. The oxygen consumption is also an indication of the sludge activity at low SRT. Higher SRT and resulting lower waste sludge removal results in higher effluent nutrient concentrations. The optimum SRT is around one day. Nitrification starts at SRT ≅ 5 d for a temperature of 12°C.

Temperature of wastewater also determines the growth rate of bacteria and sludge formation. Figure 4(b) shows that the effluent concentrations of N and phosphorus vary relatively little because of changing temperature. Temperature variations are not too important at SRT = 0.8 d. The figure also shows that working with 12°C gives a conservative estimate of the sludge production and related nutrient removal.

Figure 5 illustrates the effect of increased urine separation efficiency. This leads to a lower nutrient load in the final effluent (Q_{11}, Figure 2). Higher urine separation also results in more nitrogen gas (Q_{14}, Figure 2) and struvite production (Q_{15}, Figure 2). However, at urine separation efficiencies > 75%, the unavailability of ammonium limits sludge production, as can be seen from the increased COD load in the effluent. Limiting sludge production also leads to higher effluent N_{tot} and P_{tot} concentrations.

Energy balance

Table 1 gives a brief summary of energy requirements for different scenarios. The total energy requirement of separate urine and wastewater treatment is shown for urine separation efficiencies of 50%, 65%, 75% and 85%. The energy demand of the reference system is also shown.



(a) Sludge retention time (d) (b) Temperature (°C)

Figure 4 Effects of (a) Sludge retention time, with T = 12°C, and (b) Temperature, with SRT = 0.8 d, on nutrient removal at 75% urine separation N_{tot} —— NH_4 ···· P_{tot} – – – – X_TSS (1:2500) —·—·— O_2_net (1:20) ·····

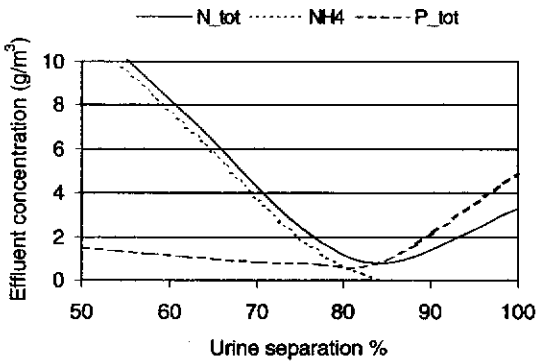


Figure 5 Effluent concentrations as a function of urine separation efficiencies for the flow scheme of Figure 2, with T = 12°C and SRT = 0.8 d

Table 1 Summary of energy requirements for urine separation system and reference systems. (Negative number for total energy indicate net production)

Urine separation	0	50	65	75	85	%
Digested sludge mass	2,111	1,917	1,888	1,881	1,760	kg/d
Urine mass	0	45,000	58,500	67,500	76,500	kg/d
Total energy	15,302	–6,204	–5,671	–5,467	–4,666	MJ/d
	6.25	–1.60	–1.46	–1.41	–1.20	W/pers

The energy requirement for sludge handling (in the integrated processes) is still less than the reference system (where less of the produced sludge is transformed to methane, due to a higher sludge age and lower degradable fraction). The amount of energy generated via methane combustion in the integrated processes is more than three times the potential of the reference system. The energy requirement for aeration in the reference system is four times as high as the combined energy requirement for aeration of urine and activated sludge production. The model shows that a net energy production is possible with separate treatment of urine and wastewater. The continuous power demand for treatment of normal wastewater (including dilute urine) in the reference process is around 6 W/p. The potential net power generation (resulting from methane combustion and low aeration) is more than 1 W/p.

Conclusions

1. Advanced biological nutrient removal processes would benefit from separate collection and treatment of urine. Total nitrogen effluent concentrations could be reduced from 7.5–2.5 gN/m^3 at around 60% urine separation. Separation efficiencies over 60% show little further improvement, because the process is not optimal for low ammonium influent concentrations.
2. Existing processes can be integrated and optimised to treat urine and wastewater on central scale, with more than 60–70% urine separation. Effluent with very low ammonium, nitrate and phosphate concentrations can be produced (all less than 1g/m^3).
3. The actual nutrient content of particulate influent COD and nutrient content of sludge strongly influence the nutrient removal efficiency. Default values of N and P content in sludge suggest that complete nutrient removal is possible with 75% urine separation.
4. Urine separation decreases the energy requirement for wastewater treatment radically. Where advanced BNR processes require around 6 W/p, an integrated process to treat urine and wastewater separately could produce more than 1 W/p. The energy available for separate collection and transport of urine may therefore not exceed 7 W/p.

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EXHIBIT
C.33

Transformation of conventional systems into sustainable water and wastewater concepts for urbanised areas

H. RISSE, H. HERBST

Keywords: rainwater use, stepwise installation of urine separation, anaerobic wastewater treatment

Abstract:

In cities of industrialised countries, conventional water and wastewater systems already exist and must be in use furthermore for many years These centralised systems represent a high amount of sunk costs. However is it possible to modify the conventional water an wastewater system to a sustainable system. The main steps of transformation are: Installing rainwater collection systems, using rainwater for all purposes which do not require potable water, stepwise installing urine separation toilets, urine storage- and treatment systems, transformation of aerobic wastewater treatment plants into combined anaerobic – aerobic wastewater treatment plants, reuse of the biologically treated water in arid regions. By rainwater collection and use, 15 to 35% of the per capita fresh water demand can be substituted. The installation of urine separation toilets and treatment systems opens up the possibility of a highly efficient nutrient (N + P + K) recovery/recycling. If the Nitrogen concentration in the wastewater decreases a significant part of the BOD_5/COD can be eliminated anaerobically. The 100% realisation of this concept will take several decades. To proceed stepwise starting with rainwater collection and urine separation is the most promising way.

1) Situation

The big cities in Europe and in the industrialised world use central water supply and wastewater treatment systems as a result of a historical development during more than 100 years. The dominating technical components are flush toilets, gravity sewers and aerobic wastewater treatment using activated sludge systems. Especially the big water- and sewer systems incorporate very big capital costs and need a very long time for capital return. The systems main disadvantages are:

- approximately 30% of the potable water is used for toilet flushing
- high energy demand for aerobic wastewater treatment
- nutrient loss in conventional wastewater treatment plant
- emission of endocrine-disrupting substances and metabolites of human pharmaceutics
- high investments for storm water drainage and -treatment
- loss of rainwater as a high quality resource

2) Principial solutions

In the recent years, new water concepts which are easily applicable in rural areas and municipalities without water infrastructure have been developed [OTTERPOHL 2001; LANGE 2000]. In cities of industrialised countries, conventional water and wastewater systems already exist and must be in use furthermore for many years These centralised systems represent a high amount of sunk costs. However is it possible to modify the conventional water an wastewater system to a sustainable system. The existing sewers and fresh/potable water supply systems, the drinking water treatment plants and also sewage treatment plants remain in use. The transformation of this existing system starts at the beginning of the wastewater flow. The main steps of transformation are:

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a) Installing rainwater collection systems, storage tanks and rainwater treatment and distribution systems in every house, using rainwater for all purposes which do not require potable water

b) Stepwise installing urine separation toilets, urine storage- and treatment systems, starting with the municipal buildings, offices, train stations, restaurants, industrial plants and small enterprises where the utilisation frequency is high.

c) Transformation of aerobic wastewater treatment plants into combined anaerobic – aerobic wastewater treatment plants

d) Reuse of the biologically treated water in arid regions

Figure 1 shows the principle of a transformed conventional water- and wastewater system.

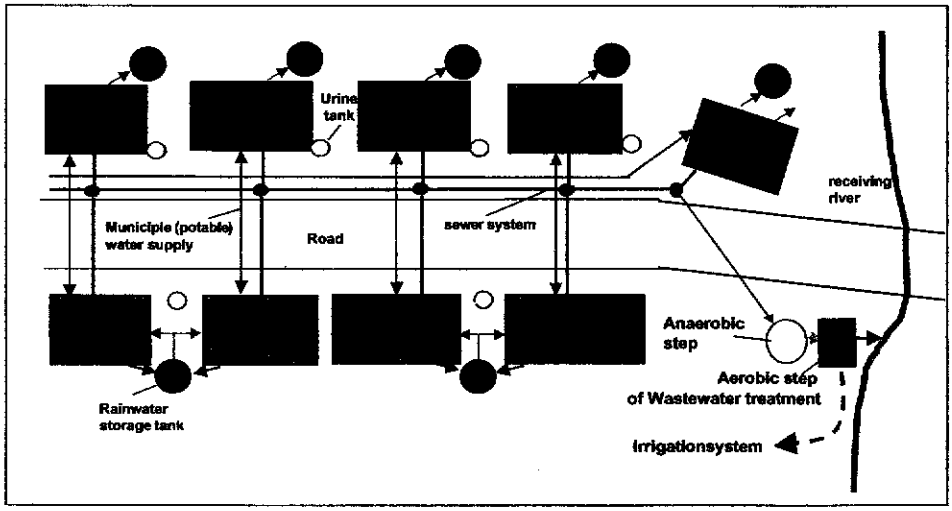

Figure 1: Scheme of transformation of conventionally water supply - and wastewater system in to a more sustainable system for densely populated areas of towns and big cities

3) Possible Advantages

a) Collection and use of rainwater:
By rainwater collection and use, 15 to 35% of the per capita fresh water demand can be substituted. Hereby, important progress is made, especially if the water resources are stressed and/or difficult and expensive potable/fresh water preparation technologies, such activated carbon filtration, ozone treatment or membrane filtration, are required
Due to the low salt content and the low carbonate concentration in rainwater, it is possible to significantly reduce the amount of washing agents.
A high number of rainwater collecting systems in a city/town can lead to an important reduction of storm water effluents. If for example in a city of a 20 km² area with a 20% share of roofage, 20% of the roofage are connected to rainwater storage tanks, the volume of collectable rainwater during a typical rainstorm of 100 l/s x ha reaches aprox. 6.100 m³, whereby the stormwater effluent can be reduced in the range of some m³/s! (s. figure 2)

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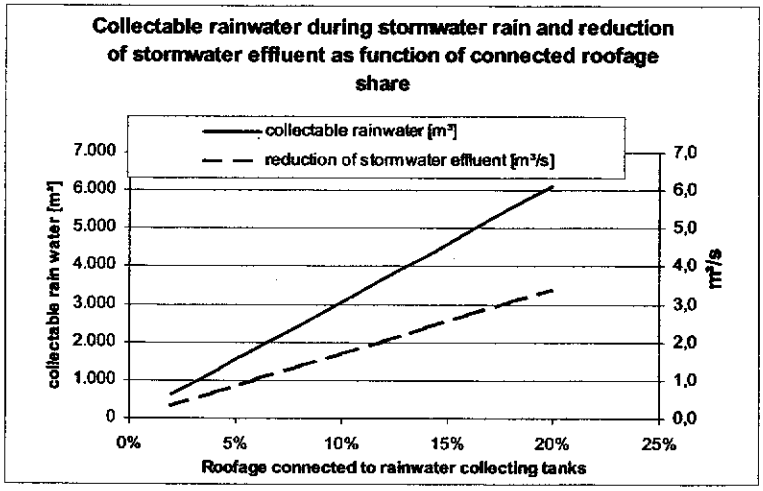

Figure 2: Calculated effect of a stepwise installation of rainwater collection systems on the reduction of stormwater effluent and collectable rainwater for a typical rainstorm of 100 l/s x ha and 15 min rainfall time, $\psi = 0{,}85$, $\phi = 0{,}5$

b) Stepwise installation of urine separation:
The installation of urine separation toilets and treatment systems opens up the possibility of a highly efficient nutrient (N + P + K) recovery/recycling (s. figure 3), which saves the fossil - geological phosphate resources. The collectable nutrient amount of municipal buildings, schools, companies and restaurants is approximately 20% of the total nitrogen and up to 15% of the total phosphorus bulk. The amount of the nutrients which can be recycled increases with a growing number of installed urine separation toilets in private households.
Due to the urine separation, the nutrient bulk in the wastewater treatment plant decreases significantly (s. figure 4). At a defined level of urine separation, nitrogen- and phosphorus removal on a central wastewater treatment becomes dispensable. The lower Nitrogen concentrations enable a simplification of the treatment process. Furthermore, the emissions of endocrine-disrupting substancesand metabolites decrease significantly due to urine separation.

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c) Combined anaerobic – aerobic treatment systems
If the Nitrogen concentration in the wastewater decreases, the BOD_5 to N ratio is increasing and a significant part of the BOD_5/COD can be eliminated anaerobically. The energy demand of the wastewater treatment can be reduced importantly due to the anaerobic BOD_5/COD degradation. The decreasing potential of energy demand for combined anaerobic –aerobic wastewater treatment plants ranges between 30 to more than 50%. The anaerobic BOD_5/COD degradation also opens up the possibility of a significant increase of biogas production with the perspective of energetic self-supply of wastewater treatment plants by electricity production in biogas engines. The increasing potential of biogas production ranges between 40 to 60% at ambient temperatures in comparison to conventional sludge digestion of both primary and excess sludge. In theory, such plants can serve as power plants with a significant energy excess due decreasing energy demand for aeration.
A significant reduction of the excess sludge production due to the anaerobic pre-treatment can also be expected.
An aerobic preliminary treatment must be carried out in either case. The size of this aerobic preliminary treatment step can be reduced and the operation cost can be significantly lowered.

d) Reuse of the biological treated water in arid climates
The lower salt concentration (Cl, PO_4, NH_4, SO_4) of the treated wastewater due to urine separation, lower washing agent use, rainwater utilisation and the lower $FeCl_3$ demand for PO_4-P-precipitation is an important advantage for irrigation. In comparison to reuse of conventional wastewater, the salt content of the irrigated soils could increase slower.
If membrane filtration systems are used for biomass return the quality of the filtrated wastewater is very high.

4) Consideration of the realisation of the concept

Technical Aspects

The main technical basics are well developed. A lot of the necessitated system components are available on the market, especially urine separation toilets and small rainwater collection and treatment plants. Investigations have also shown that an anaerobic pre-treatment of municipal wastewater at ambient climate conditions is also possible [Bodik 2000, Chernicharo 1998, Herdova 2000, Risse 2001].

The amount of the required additional house installations for a rainwater collection and utilisation system is a function of the quantity of the collectable rainwater, the rainfall high/a and the roofage. In some buildings in Europe constructed in the first years of the 20th century, existing cisterns can be reactivated [Herbst 2002]. For rain-water utilisation in the household, two strictly separate pipe systems are necessary.

Devices for urine storage must be adapted to the local conditions. In northern Europe the maximum ground temperature of the ground is about 10 °C. In mediteranean countries the ground temperature exceeds 20°C in summer. To prevent odours and NH3-emissions, a cooling of the stored urine could be necessary. Especially the logistics for urine transport and urine treatment plants must installed. The urine transport can be executed by suction lorries which are normally used for transport of liquid wastes. The urine can be used as a liquid fertilizer. A treatment by Struvite-precipitation to generate a solid fertilizer is also possible.

The nutrient concentrations in the inflow of the existing wastewater treatment plants decrease significantly after the installation of a great number of urine separation devices (Figure 4). Low nutrient concentrations allow to reduce the aeration volume and the air flow into the activated sludge tanks of existing WWT. If the TKN-concentration in the influent of WWT is lower than 35 to 40 mg/l and the BOD_5/N-ratio in the influent to the aerobic biologic step becomes bigger than 5, An anaerobic pre-treatment stage can be installed. The

anaerobic treatment step is to install between the mechanical pre-treatment and the main aerobic treatment stage. For anaerobic pre-treatment of municipal wastewater in ambient climates, fixed bed reactors are especially suitable, in subtropical and tropical climates USAB-reactors are a suitable and economic solution [Risse 2001; Chernicharo, 1998].
Due to anaerobic pre-treatment, these activated sludge tanks are no more necessary for aerobic treatment and thus can be modified into anaerobic reactors. The residual amount of COD/BOD_5 after anaerobic pre-treatment is usally high enough for Nitrogen-elimination. Lower PO_4-P-concentration in the influent due to increased urine-separation allows a reduction of the salts for P-precipitation and decreased excess sludge production. Lower sludge production due to anaerobic pre-treatment can reduce the amount of sludge disposal significantly [Risse 2001]. The lower aeration of the activated sludge lowers the energy demand (Figure 3) and can reduce the replacement investment demand for aeration systems.

The collection and the treatment of bio-waste should be done separately from the wastewater collection since the transport of crushed bio-waste would require more wastewater. A co-fermentation of the bio-waste in the digesters of municipal wastewater treatment plants has energetic advantages, but also disadvantages if the mixed sludge (municipal + digested bio-waste) cannot be disposed to agricultural areas.

Non-technical aspects and possible time schedule

The 100% realisation of this concept will take several decades. A forced system transformation would make no sense, a "growing of a new system in to an older system" without a "break down" of the old system must be conducted instead. To proceed stepwise starting with rainwater collection and urine separation is the most promising way .

Important for the realisation is a suitable administrative/legislative framework. One administrative problem for the realisation of this system is that the urine separation and the rainwater collection / utilisation must be done by private investments of the building ownerswhile the owners of the sewers and treatment plants are usually municipalities, municipality companies or, in many cases, private companies.

Furthermore it should be taken into consideration to give special grants for both urine separation- and treatment and also rainwater collection systems during their first years systems to accelerate the system transformation.

The rainwater collection and utilisation can be realised in every family housebut the biggest amounts of rainwater per collection unit are collectable at buildings with large roofage (supermarkets, municipal buildings, church, factories...) In some cases there is more collectable rainwater than can be used in the building. This "excess" rainwater from some roofs can serve to supply other water consumers.

The urine separation should be start at big municipal buildings, offices, schools, industrial plants, train stations and restaurants (figure 2) . In these places the separation toilets have a high utilisation frequency and the male users urine can be collect with low investments due to the existing urinals. The depreciation time of the investment costs for these efficient places/buildings are shorter than for private households. Also the amount of separated urine from these places is higher than from private households.

The possibility and the advantages of anaerobic pre-treatment of low loaded wastewater, especially of municipal wastewater is not well known in Europe, but in Brazil there are more than 300 municipal anaerobic wastewater treatment plants in operation or under construction [CHERNICHARO, 2001] More tests on a technical scale and more information is necessary for the European context.

EXHIBIT
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5) Summary and preview

In summary it can be fixed that a modification of existing conventional wastewater systems into more sustainable water and wastewater systems for densely settled areas in the industrialised world is possible. The technical realisation should start with designing by installing urine separation toilets, collecting systems and rainwater collection and utilisation systems starting with the big sources such as municipal buildings, restaurants, schools and factories. At these places the economic feasibility is better than in private households and the time required for significant changes could be relatively short. A problem is the low identification with a new system in public buildings since users change constantly and an orientation of users is hardly possible. This concept also creates the possibility to install recycling systems for significant amounts of nutrients in a relatively short time. Amounts of urine separation of nearly 50% are possible. The pace of the transformation process depends on the pace of flat renovation / modernisation.
In the future a supply of different waters according to different qualities and purposes in both private households and public buildings should be achieved. Figure 5 shows the sheme of the complete transformed water- and wastewater system. This system can be adapted to different hydrolgical situations.

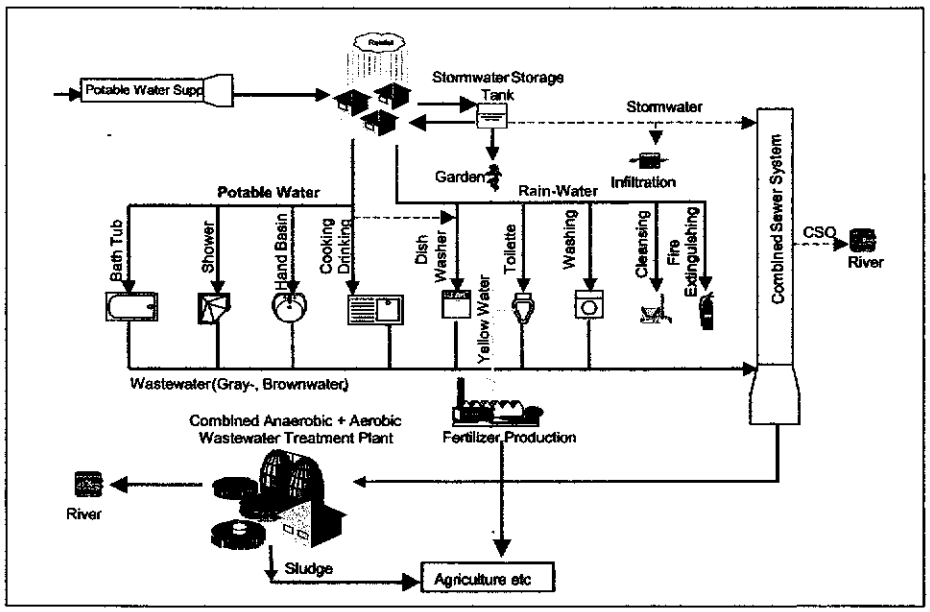

Figure 5: Perspective of a water supply according to different water qualities and purposes in private households, principal wastewater transport and treatment in highly populated urban areas [Herbst, H.; Hiesl, H. 2001; Herbst, H.; Hiesl, H. 2002; modificated Herbst, H., Risse, H. 2003].

EXHIBIT 6.40

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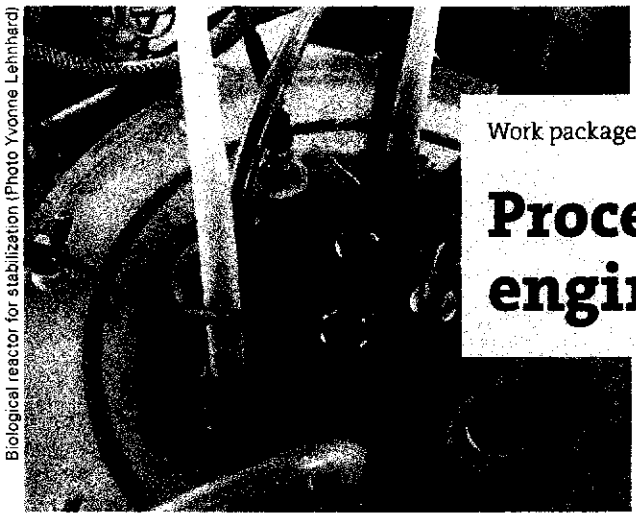


Biological reactor for stabilization (Photo Yvonne Lehnhard)

Work package Nova 4

Process engineering

Research background

The bulk of the nutrients from human metabolism are excreted in urine – in particular, nitrogen (N), phosphorus (P) and potassium (K). These nutrients are desirable in agriculture, but not in waterbodies (where only K causes no harm). It may therefore make sense to separate urine from wastewater and use it for fertilizer production.

Fresh urine is slightly acidic, with a pH of 6–7. However, the high concentration of biologically degradable substrate promotes rapid bacterial growth. As a result, the chemical composition of urine undergoes significant changes during collection and storage. Since urea is hydrolysed to ammonia and carbon dioxide, the pH rises sharply – to more than 9 (cf. Nova 2). In addition, urine contains organic micropollutants, especially pharmaceutical residues and hormones, which are equally unwelcome in waterbodies and in agriculture (Nova 5).

The various treatment processes serve widely differing purposes: urine can be stabilized and its volume reduced; nitrogen and phosphorus can be recovered or removed; and bacteria, viruses and micropollutants can be eliminated [1]. However, it is not possible to achieve all the different objectives using a single process; a decision is thus required as to what is desirable and what is necessary.

In general, urine treatment may involve biological (Nova 4-1), chemical (Nova 4-2, 4-3) or physical (Nova 4-3) processes. The advantages and disadvantages of the various methods are discussed in detail in [1].

Nova 4-1: Biological processes – stabilization

(Kai Udert, Tove A. Larsen, Willi Gujer)

Nova 4-1 was concerned with the development of a biological process for urine stabilization [2]. Bacteria cultured in a reactor not only decompose organic compounds in urine but also convert a portion of the ammonium to nitrite or nitrate (nitrification). This leads to the production of acid, which lowers the pH of the urine from more than 9 to about 6, preventing losses of ammonia. At the same time, the biological processes eliminate unpleasant odours.

With this process, a solution of ammonium nitrate or ammonium nitrite is obtained. The nitrogen compound ammonium nitrate is a commercial fertilizer. Ammonium nitrite, in contrast, is toxic to soil organisms. However, it can readily be converted to nitrate through chemical oxidation with oxygen at a low pH value [3] or, using another biological process, to a harmless nitrogen gas and water [2].

Nova 4-2: Chemical processes – phosphorus precipitation

(Mariska Ronteltap, Max Maurer, Willi Gujer)

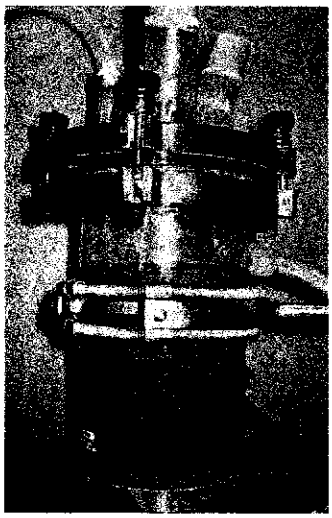
The chemical conditions in stored urine (i.e. high pH values) promote the precipitation of phosphorus in the form of poorly soluble phosphorus-containing salts. This leads to encrustation and clogging of pipes (Nova 2). However, the process can also be used for phosphorus recovery.

With controlled addition of magnesium, phosphorus can be recovered in the form of struvite ($MgNH_4PO_4$, magnesium ammonium phosphate, MAP). This is attractive, as two significant wastewater nutrients (P and N) are thus transformed into a single solid product, which is, moreover, a well-established slow-acting multicomponent fertilizer.

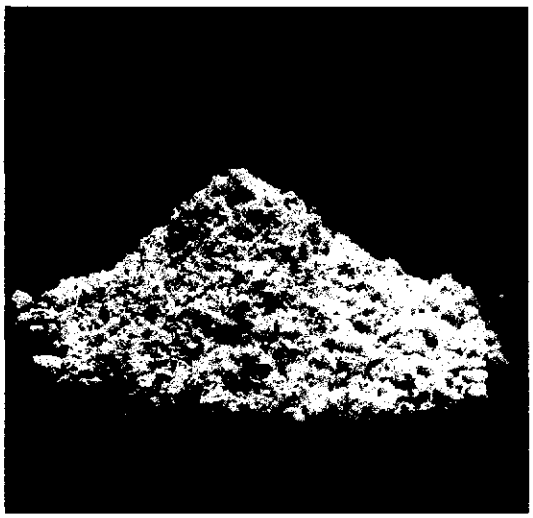
Nova 4-2 investigated in detail the process whereby struvite is produced from urine [4]. It was shown that the rate of phosphorus elimination depends crucially on the degree of dilution, but generally reaches 98 %. The product obtained is largely free of pharmaceuticals and hormones, and no heavy metals could be detected [5].

Although struvite can be used directly as a fertilizer, it is not suitable for further processing in the phosphorus industry [1]. In a Novaquatis follow-up project, other precipitation products are being studied that would be suitable for further processing of this kind. Thus, both options can be kept open.

EXHIBIT 6.42



Murky mixture: Magnesium-chloride is added to urine (Photo Yvonne Lehnhard)



Clean product: A pure nutrient powder is obtained (urine-based fertilizer struvite) (Photo Mariska Ronteltap)

Clean bill of health: Analysis of micropollutants (Photo Yvonne Lehnhard)

Nova 4-3: Physical processes – membrane technology

(Wouter Pronk, Markus Boller)

Nova 4-3 considered various urine treatment scenarios, focusing on membrane technologies. The aims of these methods are threefold: (1) to separate organic micropollutants from nutrients, (2) to concentrate the nutrient solution (volume reduction) and (3) to remove or destroy bacteria and viruses. In addition, micropollutants can also be eliminated via the chemical process of ozonation.

The membrane technology of nanofiltration was tested in the laboratory. The process is only effective if urea in fresh urine is not hydrolysed. If this can also be successfully prevented in practice – e.g. through acidification – nanofiltration can be used to produce a urea solution (without phosphorus). This solution is largely unproblematic: a large proportion of the organic micropollutants can be separated from the nutrients, and bacteria and viruses are eliminated [6]. In the nanofiltration process, the nutrients are not concentrated – in a further project, vacuum evaporation was employed for this purpose. With this process, the volume of a urea solution was reduced by 90 % at 78 °C [1].

Also tested in the laboratory were the membrane-based process of electrodialysis and the chemical process of ozonation. With the aid of electrodialysis, micropollutants can be largely separated from ammonium, phosphorus and potassium, as can microorganisms such as bacteria. At the same time, the nutrient solution is concentrated roughly fourfold [7]. If ozonation is additionally performed, the fertilizer produced is highly likely to be acceptable as regards both hygiene and contamination with pharmaceuticals and hormones.

In a follow-up project, electrodialysis and ozonation are being tested on a pilot scale for the treatment of urine collected at the Basel-Landschaft cantonal library in Liestal [8] (cf. Nova PP). The nutrient solution produced here contains 12 g N, 0.65 g P and 5.7 g K per litre.

Conclusions

The wide variety of urine treatment processes available offers substantial flexibility. For example, if a rural setting calls only for stabilization, to prevent the release of ammonia when fertilizer is applied, a one-step biological treatment should be sufficient. But if nutrients are to be recycled in a metropolis – as would be advisable in areas with a general lack of fertilizers – the demands are higher, and various processes will need to be combined. Nutrients can, however, also be eliminated – e.g. to protect sensitive receiving waters from excessive nutrient loads.

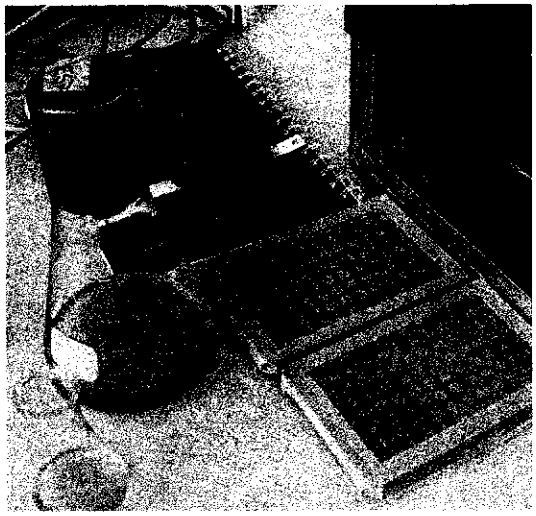
All the processes will require further development before they can be implemented in practice. But thanks to the Nova 4 research, we now know precisely what processes are currently available, for what purposes they are suitable, and in what respects they need to be optimized.

In many cases, separate removal or recycling of nutrients is preferable to the existing practice. This also applies to the energy requirements associated with these processes [1, 9].

EXHIBIT 6.43

6.44

Test battery: The hand is holding the algal assay (Photo Yvonne Lehnhard)



True colours: Reddish colour changes of the YES test indicate the presence of estrogens (Photo Yvonne Lehnhard)

High tech in the lab: Samples are loaded for chromatography (Photo Y. Lehnhard)

in the Poseidon project for wastewater were to be adapted for the analysis of urine. However, control measurements indicated that this approach was unsuitable for this purpose. Using other methods from Nova 4-3, however, it was possible to measure individual substances [5].

Nova 5-4: Contribution of urine source separation to water pollution control

(Judit Lienert, Beate Escher, Karin Güdel, Timur Bürki)

Nova 5-4, which was co-financed by the Federal Office for the Environment (FOEN; www.bafu.admin.ch), investigated whether urine source separation can contribute to water pollution control. The differences observed between 212 active ingredients (corresponding to 1409 pharmaceutical products) were immense. For example, urinary excretion of X-ray contrast agents was 90–100 %, compared with only 6 % for one cancer drug and 98 % for another. On average, 64 % of the active ingredient ingested was excreted in the urine. Also on average, 42 % was transformed in the body and excreted as metabolites, which were mainly found in the urine [7].

Using a screening method, it was possible to assess the environmental hazard posed by excreted pharmaceuticals. The method is based on literature data, e.g. on the chemical properties and metabolism of the active ingredient, and on the quantities of medicines sold. It was developed with reference to drugs used in cardiology (beta-blockers). In the case of these agents, the Nova 5-1 test battery revealed an unexpected effect: they inhibit the photosynthesis of algae [4]. The method was subsequently applied to the (avian) influenza drug tamiflu, which is metabolized to 75 % in the human body (data not published). For tamiflu, the ecotoxicological hazard estimated with the screening method would appear to be low.

Another 42 substances were then investigated [8]. In 34 cases, the toxic potential was reduced by metabolism in the human body. The ecotoxicological hazard of each of these substances after being metabolized tended to be low. However, there were some exceptions: ibuprofen, in particular, which is found in numerous analgesic drugs, poses a relatively high risk to the environment. Considerable differences were found in the site of activity: some substances developed their toxic potential mainly in the urine, others in the faeces. While the screening method has its limitations, we estimate on the basis of the limited data known to us that the ecotoxicological hazard potential associated with pharmaceuticals in urine and faeces is of about the same magnitude.

Conclusions

It was demonstrated by chemical and ecotoxicological analysis that pharmaceuticals and hormones can be removed from urine with the aid of treatment processes studied in Nova 4. However, not all methods were equally effective [5]. Many pharmaceuticals occur only in trace amounts that can barely be measured by chemical analysis. Chemical methods are valuable, for example, in characterizing the degradation processes of individual substances. Ecotoxicological tests are suitable for estimating the overall toxicity of natural urine samples [1, 2]. However, it needs to be borne in mind that, in certain bioassays, effects may be produced merely by natural urine components [5].

Urine source separation can help to protect waterbodies from micropollutants. However, even if it were to be fully implemented, not all pharmaceuticals and hormones would be prevented from entering wastewater [7]. On the basis of estimations and limited data, we assume that urine source separation would remove about half of the ecotoxicological hazard potential [8].

EXHIBIT
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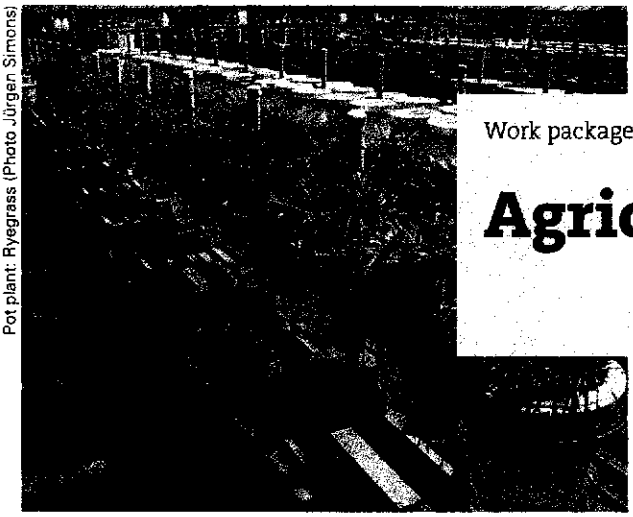

Pot plant: Ryegrass (Photo Jürgen Simons)

Work package Nova 6

Agriculture

Research background

In Switzerland, nutrients from human urine could supply around 37 % of the nitrogen, 20 % of the phosphorus and 15 % of the potassium demand currently met by artificial mineral fertilizers [1]. The original aim of Nova 6 was to study the possibilities and problems of this type of urine recycling. Unfortunately, funding could not be secured for these research projects. However, with the aid of external partners, two key questions were investigated: Would a urine-based fertilizer be well received by farmers and the public? And is treated urine as effective as artificial fertilizers?

Nova 6-1: Is urine-based fertilizer found acceptable?

(Judit Lienert, Michel Haller, Alfred Berner, Michael Stauffacher, Tove A. Larsen)

In 2000, 467 questionnaires were sent to Swiss farmers, with four categories being distinguished: organic or integrated (IP) farming, and with or without vegetable production [1]. The response rates for the individual groups varied and were low overall (127 responses received). Although the results are thus not representative, they do provide important initial evidence.

Urine-based fertilizers were favourably viewed by 57 % of respondents, and 42 % would purchase such products – especially those who already buy additional fertilizers. As this mainly applies to IP and vegetable farming, these would probably be the most promising markets. However, no farmers would be prepared to pay a higher price than for conventional fertilizers. Most prefer a nitrogen fertilizer in the form of ammonium nitrate. In addition, a granulate is preferred to a liquid formulation, and a urine odour is rejected. A key requirement is that the urine-based fertilizer should be hazard-free, with 30 % expressing concerns that it could contain micropollutants, e.g. pharmaceutical residues.

Consumers' attitudes appear to be similarly favourable (Nova 1). However, this group would likewise only buy food grown with urine-based fertilizers if it was hazard-free. High priority is therefore given to the elimination of pathogens and medicines from urine – for example, among the participants of a focus group study (Nova 1, [2]). Of 501 people surveyed at the BL cantonal library (Nova PP), two thirds would also use a urine-based fertilizer in their own garden or buy vegetables to which it had been applied (results not yet published). The other third was opposed to urine-based fertilizers on the grounds of distaste or health concerns.

Nova 6-2: Pot experiments with urine-based fertilizers

(Jürgen Simons, Joachim Clemens)

In a Bonn University dissertation project, the suitability of Nova 4 urine products as fertilizers was assessed in greenhouse experiments [3, 4]. Ryegrass *(Lolium multiflorum italicum)* and red clover *(Trifolium pratense)* were used as test plants. The study compared seven different nitrogen-enriched substrates – including untreated urine and the products of Nova 4-1 (bioreactor) and Nova 4-3 (nanofiltration, electrodialysis) – with an artificial fertilizer (calcium ammonium nitrate). In addition, five phosphorus fertilizers, including struvite (MAP; Nova 4-2), were compared with the artificial fertilizer superphosphate.

Plants treated with urine-derived nitrogen showed practically the same yield as those receiving the mineral fertilizer, with the same uptake of nitrogen from the soil. Differences between the products tested can be explained by differences in pH and the resultant ammonia losses. Thus, plants fertilized with acidified urine (pH 4) showed a significantly higher yield than those receiving untreated urine (pH 9).

The phosphorus fertilizers tested differed from the artificial fertilizer – both in yield and in phosphate uptake. Phosphates precipitated with magnesium, including the struvite from Eawag (MAP), produced comparable values to the artificial fertilizer. In contrast, phosphate fertilizers from sewage sludge – precipitated with iron, for example – produced significantly poorer results. In general, the struvites from decentralized wastewater treatment were more homogeneous than those from the wastewater treatment plant – with regard to composition and fertilizer efficiency. As the differences cannot be fully explained, further research is required, e.g. to analyse and optimize the production processes.

EXHIBIT

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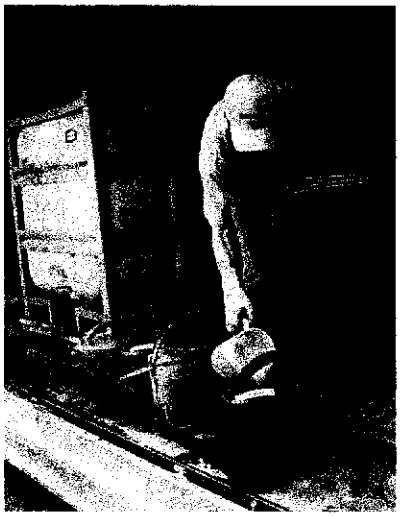
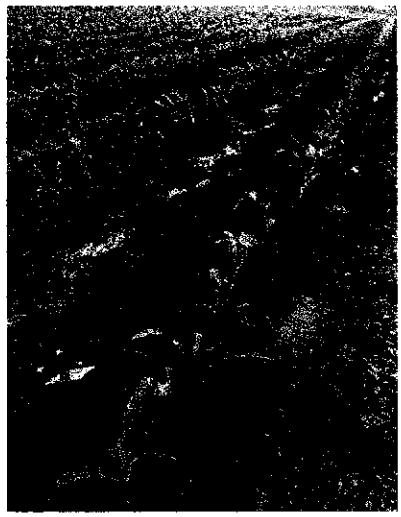
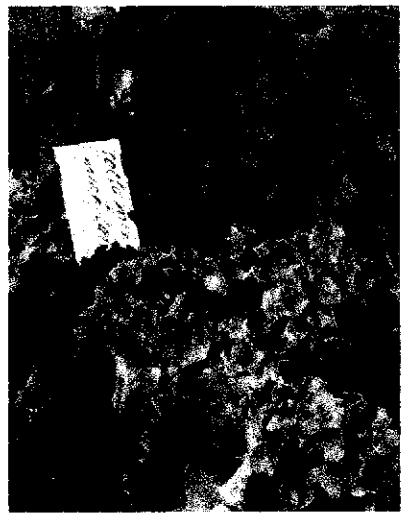


The right dose of fertilizer: "Urevit" is carefully measured out (Photo Martin Koller)



Slurry versus urine: Treatment of maize plants in a field test (Photo Martin Koller)



Smart vegetables: Many consumers accept a urine fertilizer (Photo Yvonne Lehnhard)

Nova 6-3: Field tests with urine-based fertilizers

(Martin Koller, Alfred Berner, Wouter Pronk, Steffen Zuleeg, Markus Boller, Judit Lienert)

Following electrodialysis and ozonation treatment, urine from the BL cantonal library is to be used as a fertilizer (Nova PP). In 2006, the Research Institute of Organic Agriculture (FiBL; www.fibl.org) was therefore commissioned by Novaquatis to study the urine's fertilizer properties. The tests were carried out at an IP site – using fodder maize, which has a high nitrogen requirement. Here, the urine-based fertilizer "Urevit" was compared with cattle slurry, "Kompogas" anaerobic digester liquid, commercial organic fertilizer (feathermeal) and synthetic fertilizer (ammonium nitrate). "Urevit" is more stable than untreated urine, the nutrient content is about three times higher, and the product is – as far as is measurable – free of bacteria, viruses and micropollutants.

The key finding is that "Urevit" is suitable for use as a fertilizer. After the main growth period, maize treated with "Urevit" showed the same height and leaf colour as that treated with a mineral fertilizer; both groups were superior to the plants treated with cattle slurry or feathermeal. Since leaf colour in maize is closely correlated with nitrogen supply, "Urevit" and mineral fertilizer initially act equally rapidly. However, the "Urevit"-treated plants – like those receiving "Kompogas" or feathermeal – had a significantly (15 %) lower yield than maize treated with mineral fertilizer. Nitrogen was presumably lost when "Urevit" was applied, but such losses could be controlled by optimizing urine processing and spreading. Today, fertilizers are often applied using trailing hoses. If "Urevit" was distributed to farmers free of charge, the costs of this spreading method would be roughly the same as for ammonium nitrate – making "Urevit" an economically attractive option for farmers.

The Basel-Landschaft utilities agency (AIB; cf. Nova PP) received provisional approval from the Federal Office for Agriculture (FOAG; www.blw.admin.ch) to use "Urevit" as a fertilizer – definitive approval can only be granted when stringent quality requirements are met. As an interim step, the fertilizer could be used for non-agricultural purposes, e.g. for ornamental plants at local horticultural firms.

Conclusions

In the course of Nova 6, important contacts were established with agricultural partners, e.g. the FOAG (Nova 6-3), FiBL (Nova 6-1, 6-3) and Agroscope Reckenholz-Tänikon Research Station (ART; www.art.admin.ch). Representatives of this sector approve of the cautious approach adopted by Novaquatis; in this way, polemical debates – of the kind that led to the ban on the use of sewage sludge in Swiss agriculture – can be avoided. Farmers and consumers (Nova 6-1) are sympathetic to the idea of urine-based fertilizers. However, both groups emphasize that it is essential to eliminate any risks – e.g. posed by micropollutants. Such substances need to be effectively removed (Nova 4). But since absolute safety can never be attained, ecotoxicological studies (Nova 5) in subsequent projects should be accompanied by a broader social debate – also involving agricultural representatives, consumer groups and the major food retailers.

Thanks to Nova 6, we now know how farmers and the public can be expected to react, and what steps should be taken in introducing a urine-based fertilizer on the Swiss market. We also know that urine-based products are suitable for use as fertilizers and are generally comparable to artificial fertilizers. Still, fertilizers are currently very inexpensive – at least in industrialized countries. The question therefore arises to what extent costly fertilizer production processes, as implemented on an experimental scale in Novaquatis, would be worthwhile. In the numerous parts of the world (e.g. Africa, China) where nutrients are in short supply, however, the case for using urine as a fertilizer is compelling.

EXHIBIT
6.47

List of Novaquatis peer-reviewed publications

- Überblick
- Arbeitspakete
- Interaktives Lernspiel
- Personen
- o Publications
  - Peer-reviewed
  - Other publications
  - Theses'
  - Newspaper/magazine
  - Radio/TV
- Links
- Internal

General

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Nova 5 – Micropollutants

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Nova 6 – Agriculture

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EXHIBIT 6,60

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2001-08-19

Urine separation - Swedish experiences

Abstract

Urine is the urban waste fraction containing the largest amounts of nutrients. It contains approximately 70% of the nitrogen and 50% of the phosphorous and potassium in all household waste and wastewater fractions. During the 1990-ies, urine separation has been thoroughly investigated in several research projects in Sweden. In these measurement between 50% and 85% of the urine has been source separated, depending on the motivation and dedication of the inhabitants.

The initial problems connected with the system, mainly stoppages in the toilet u-bend, have now largely been overcome and now the system functions without any large problems.

The urine is sanitised by enclosed storage and recommendations have been developed. The storage period recommended depends on which crops that are to be fertilised, storage conditions and type of system.

The fertilising effect of urine to cereals has for nitrogen been found to be close to that for chemical fertiliser (~90%) and for phosphorous to be equal to that for chemical fertiliser. The measured ammonia emissions after fertilisation to cereal crops has been 5%±5%. If the system is correctly designed, the ammonia emissions from collection, transport and storage are insignificant (<1%).

The environmental effects of urine separation have been investigated in several studies. They have all concluded that compared to a conventional sewage system, urine separation will recycle much more plant nutrients, especially nitrogen and will have lower water emissions of nutrients. Generally, urine separation has also been found to save energy. Urine separation has in all studies been found preferable to the conventional system form an environmental point of view.

Urine separation is now well documented and can be recommended for implementation under most conditions.

Introduction

Urine is the urban waste fraction containing the largest amounts of nutrients. It contains approximately 70% of the nitrogen and 50% of the phosphorous and potassium in all household waste and wastewater fractions, while the flow of urine is comparatively small (Figure 1).

This means that it is interesting to separate the urine at the source, i.e. the toilet. The urine separating toilets, that were re-invented in Sweden in the 1980-ies, made the construction of urine separating systems possible. In these, the urine is source separated. The urine is then piped to collection tanks, stored and used as a fertiliser for agricultural and horticultural crops.

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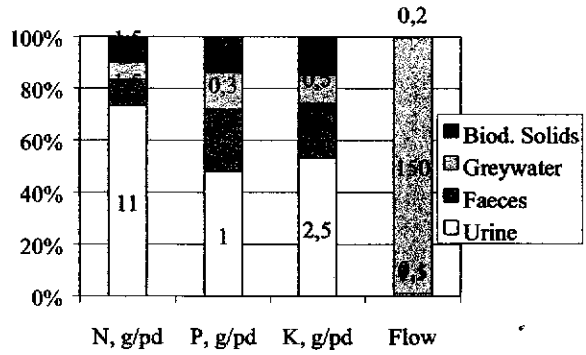

Figure 1. Distribution of nutrient flows, in grams per person and day (g/pd), and mass flow, in kg per person and day, of household waste and wastewater in Sweden (SEPA, 1995; Sonesson & Jönsson, 1996; Kärrman et al., 1999).

Research in Sweden

Urine separation received much interest from researchers in Sweden during the 1990-ies. There were three important research groups. The largest group was centred in the Uppsala-Stockholm region and consisted of researcher from SLU (Swedish University of Agricultural Sciences), SMI (Swedish Institute for Infectious Disease Control), JTI (Swedish Institute for Agricultural and Environmental Engineering) and KTH (Royal Institute of Technology). Below the research centres are listed, which aspects that they mainly have been studying and the names of the most active researchers.

- SLU, SMI, JTI, KTH
  - Hygiene, function, i.e. degree of separation, functional problems, fertilising effects, resource usage, emissions, developing countries
  - *At SLU; H. Jönsson, B. Vinnerås, at SMI; C. Schönning (prev. Höglund), T.A. Stenström and at JTI A. Richert Stintzing*
- Luleå Technical University
  - Exergy analysis, storage, drying, nitrification
  - *D. Hellström, E. Johansson, J. Hanaeus*
- Gothenburg University
  - Algae growth, conc. (struvite, ion ex, freezing, etc)
  - *M. Adamsson, B.B. Lind, Z. Ban, S. Bydén*

In addition to these groups some individual researchers in other places have also been active.

To finance this research the housing and agricultural sectors have made the largest contributions. The water and wastewater sector has also made a large contribution, while the contributions by other sectors of society, for example the environmental sector, have been small. The most important financing bodies have been: BFR (Swedish Council for Building Research), SLF (Swedish Farmers Foundation for Agricultural Research), VA-FORSK (Swedish Municipalities Sewage Research Program), Swedish Board of Agriculture, Stockholm Water Inc., National Cooperation of HSB and Stockholmshem Inc.

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Results

The results presented below are mainly based the research done by the group centred around SLU and SMI. The results presented below are presented in more detail by Jönsson et al (2000), Höglund (2001), Jönsson et al. (1997), Jönsson et al. (1999) and Johansson et. al. (2001), Lindgren (1999) and Vinnerås (2001).

Hygiene

The hygienic research carried out is described by Caroline Schönning in another paper at this seminar, therefore the results are here given extremely short. Pathogens were found to die off during storage and recommendations have been developed for how the urine should be sanitised via storage before being used as a fertiliser. The storage period recommended depends on which crops that are to be fertilised, storage conditions and type of system (small or large system).

Toilet - function and degree of separation

The function of the toilet and the degree of separation have been studied in measurements in five different housing districts with all together 315 inhabitants (Table 1). Most of the measurements have lasted around 30 consecutive days. The apartments in most of the districts were rented, but the eco-village Understenshöjden was tenant owned. The inhabitants in Understenshöjden had decided themselves that they wanted a urine separating sewage system in the eco-village. In the other districts, the house owner had installed urine separation without asking the tenants. Thus, the inhabitants of Understenshöjden were much more informed, motivated and dedicated than the inhabitants in the other districts. The tenants in Miljöhuset, on they other hand, knew very little about urine separation and why they had urine separating toilets. One reason for this is that they on average moved much more frequently than in the other houses. As is seen in Table 1 the motivation and dedication by the inhabitants have a profound impact on the percentage of urine actually being source separated.

Table 1. Investigated housing districts, and the calculated percentage of source separated nutrients in each district. In some measurements some phosphorous or nitrogen was probably lost in the collection and handling of the samples. Thus, these numbers are minimum figures and in the table they are given in italics

	Understens-höjden	Palster-nackan	Hushagen	Ekoporten	Miljöhuset
Inhabitants	160	50	8	35	62
Toilet	BB Dn	BB Dn	WM DS	BB Dn	BB Dn
Apartment type	Tenant owned eco-village	Rented	Rented	Rented	Rented
Urine-N collected, %	78	59	65	*>62*	46
Urine-P collected, %	74	61	*>65*	62	*>40*
Urine-K collected, %	95	70	58	87	49

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The conclusions from these measurements are:

- Motivation, information and feedback are important for the amount of urine actually being source separated!
  - Normally 60-90% of the urine produced is source separated.
- Avoid metals in the system. Urine is very corrosive and at excretion the concentrations of heavy metals are very low. Metals in the system cause contamination, which is easy to detect.
- The nutrient content of the source separated urine, mixed with 1-2 parts of flush water, expressed as the N:P:K ratios in % is approximately 0.3:0.03:0.1.
- If the inhabitants are at home 16 h/day the systems should be dimensioned for a flow of:
  - 1,5 litre/person, day (550 litre/person, year) if the toilet Dubbletten by BB Innovation & Co Inc. is used, and
  - 2,5 l/pd (910 l/py) if the toilet DS by Wost Man Ecology Inc. is used.
- The amount of flush water saved by a urine separating system depends on the motivation. Savings of 80% are possible, but so far only up to 50% has been measured.

The function of the toilets were studied in two questionnaires, one in 1997 to 96 households and one following up in 1999 to 73 households. The two toilets studied were Dubbletten and DS. The most important problem found was that stoppages normally appeared in the u-bend of the toilet after a short time. These stoppages were a big problem, since the users did not know how to clear them. Studies of the stoppages showed that 76% of them mainly consisted of precipitation, mainly calcium and magnesium ammonium phosphates, forming on hairs and fibres. These stoppages could easily be cleared with a mechanical snake or with caustic soda. The remaining 24% of the stoppages consisted of precipitation on the pipe wall, which could efficiently be cleared with caustic soda. From talking to users, now when they know how to clear the stoppages, they say that the stoppages are not a problem any more. Like stoppages in the u-bend of the shower, they appear once or a few times a year and are easy to clear.

Some users also complained about inadequate flushing of the urine bowl and of odours. However, these problems were small, and the toilet manufacturers have been trying to deal with them, so they might not exist on new installations.

The following recommendations were derived from the studies:

- The flow from the urine bowl should not be hindered by anything (hairs and fibres should be flushed away by the water when cleaning the toilet).
- It should be possible to use a mechanical snake to clear the urine u-bend.
- The urine u-bend should be easy to access and disassemble (which probably will not be needed, but just in case).
- The urine bowl should suit also men urinating while standing up, otherwise the percentage of urine actually separated will drop.
- The toilet should be comfortable and easy to use (try it before purchase)
- The flush of the urine bowl should be effective and use little water ($\leq$0.1 l/urination).
- The toilet or system should contain no metal in contact with the urine mixture.
- The toilet should be easy to clean.

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Pipes and tanks

Measurements and observations by video and naked eye of pipes and tanks have resulted in the following results and recommendations:

- Installations must be water tight (pipes should be welded or similar). Ground water leaking in was the most frequent problem found!
- Horizontal pipes should have a slope of at least 1% and a diameter of ≥75 mm (preferably 110 mm), because sludge continuously precipitates from the urine mixture. The sludge is easy to flush away.
- The pipes should have good opportunities for inspection and cleaning.
- The system should not be ventilated. If it is correctly constructed the total ammonia emission from collection, transport and storage is <1%.
- The tanks should be filled from the bottom and have the man hole close to the incoming pipe.

Fertilising effect

The fertilising effect of source separated urine has been investigated in two pot experiments, a three year field experiment and a one year field demonstration.

Source separated human urine is a well balanced complete fertiliser and its nutrients are readily available to plants. The nitrogen effect was found to be close to that for chemical fertiliser (~90%). It varied between 70% and more than 100% between different years. The phosphorous effect was equal to that for chemical fertiliser.

In the experiments, the ammonia emission after spreading varied between less than 1% and 10%. It averaged around 5%. No toxic effects have been observed in these or other experiments with cereals. The urine has been spread on the soil or in the growing crop. However, the nitrogen in stored urine is mainly found as ammonia and it is well known that some crops easily burn if ammonia is applied on the plants themselves.

The concentrations of heavy metals in source separated urine are very low. For example the Cd/P ratio was around 2 mg Cd per kg of P. In spite of this, the European Union (EU) only allows the use of source separated urine in conventional farming, but not in organic farming. It is very important that urine in the future also will be allowed in organic farming.

Emissions and resource usage

The computer package ORWARE was used to model and simulate the urine separating sewage system of Palsternackan, where the faecal water (faeces, paper and flush water) and greywater were treated in the central sewage treatment plant in Stockholm. The calculated environmental effects and resource usage of this system were compared to those calculated for a conventional sewage system, using conventional toilets and treating all wastewater, including the urine, in the central treatment plant. In both systems 50% of the generated sewage sludge was assumed to be spread on arable land and 50% was assumed to be landfilled.

Urine separation decreased the emissions of nitrogen and phosphorus to water by 55% and 33%, respectively. A large fraction of the plant nutrients were recycled, instead of being led to the treatment plant. Thus, the urine separating system, compared to the conventional system, recycled 27 times more plant available nitrogen, 35% more phosphorus and 25 times more potassium.

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The levels of heavy metals were very low in the urine. Mercury, cadmium and lead were all below their detection limits, 0.0004, 0.0013 and 0.027 mg/l respectively. These values corresponded to: <1 mg Hg/kg P, <4 mg Cd/kg P and <89 mg Pb/kg P. In the measurements at Ekoporten, performed after this ORWARE study, the detection limit for cadmium was lowered and it was found that the Cd/P ratio was 2 mg Cd/kg P. Thus, urine is a very clean fertiliser.

Energy, 24 MJ/person and year, was required for transporting the urine mixture 33 km with a truck and trailer to a farm and for spreading it as a fertiliser. However, the decreased nutrient load on the sewage system meant that 31 MJ/person and year were saved in the sewage system. In addition, the source separated urine replaced mineral fertilisers, which would have required 75 MJ/person and year to produce. Thus, urine separation saved in total 82 MJ/person and year. A sensitivity analysis showed that the urine mixture could be transported 220 km by truck and trailer before the urine separating system used as much energy as the conventional one.

Urine separation has also been investigated in a number of other environmental systems analyses using the methods life cycle assessment and mass flow analysis. These studies have been using a variety of data and assumptions. Considering the environmental impacts and the use of natural resources, they have all concluded that urine separation is preferable to the conventional sewage system (Bengtsson et al., 1997; Bjuggren et. al., 1998; Kärrman et. al, 1999; Kärrman & Jönsson, 2001; Jernlid & Karlsson, 1997; Tidåker & Jönsson, 2001; Tillman et al., 1997). Therefore, the conclusion that the sewage system is improved if it is supplemented with urine separation seems robust. It seems to hold under most conditions and assumptions. Urine separation improves the sewage system more, when the reduction achieved in the sewage treatment is low.

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From waste treatment to integrated resource management

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Abstract Wastewater treatment was primarily implemented to enhance urban hygiene. Treatment methods were improved to ensure environmental protection by nutrient removal processes. In this way, energy is consumed and resources like potentially useful minerals and drinking water are disposed of. An integrated management of assets, including drinking water, surface water, energy and nutrients would be required to make wastewater management more sustainable. Exergy analysis provides a good method to quantify different resources, e.g. utilisable energy and nutrients. Dilution is never a solution for pollution. Waste streams should best be managed to prevent dilution of resources. Wastewater and sanitation are not intrinsically linked. Source separation technology seems to be the most promising concept to realise a major breakthrough in wastewater treatment. Research on unit processes, such as struvite recovery and treatment of ammonium rich streams, also shows promising results. In many cases, nutrient removal and recovery can be combined, with possibilities for a gradual change from one system to another.

Keywords Energy; exergy; minerals; sanitation; sustainability; wastewater

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Introduction

Water is used as a medium for waste transportation. The association between sanitation and wastewater results from the historic development of urban hygiene. After the discovery of waterborne diseases, faeces was removed from cities with rain water sewers, which already existed in many cases. This resulted in wastewater treatment to protect both downstream users and surface waters. From this point of view, modern centralised wastewater treatment is very effective. In Europe and North America, water borne diseases are not a significant cause of illness or death any more. Nutrient removal has also become standard technology in wastewater treatment in the last decade.

The responsibility for ensuring safe and good quality wastewater effluent usually rests with an organisation, such as a municipality or water board. The degree of treatment, control and test procedures are agreed upon, standardised and enforced on a national scale. Centralisation of treatment works have until now ensured their relative success. Furthermore, it is generally believed that high-tech biological treatment processes need a reasonable scale. Operation, control and maintenance of wastewater treatment plants are specialised professions. Sludge treatment and incineration also require good control structures. It is still widely understood that the scale of large centralised treatment plants makes them more affordable.

Nevertheless, carbon, nitrogen, phosphorus and sulphur removal requires relatively large amounts of resources (energy and chemicals). Potentially useful minerals are usually disposed of. Removal technologies have to be changed to make wastewater management more affordable and sustainable in terms of nutrient management. This will involve application of presently available technologies as well as completely new concepts in urban water and solid waste management. This has not only technical but also social implications. We report on the conference "From nutrient removal to recovery" where state-of-the-art technology and new concepts were demonstrated.

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Integrated resource management

The important resources involved in wastewater are water, energy and minerals. Apart from being used as transport medium, clean water is the main source of animal and plant life, as well as an important habitat. Water is therefore historically the most important resource, with primary emphasis on purification (Larsen and Gujer, 1997). After solving the problems with urban hygiene, the importance once placed thereon gradually shifted towards environmental protection. In some cases nowadays, "sustainable" wastewater treatment seems to be limited to ever-increasing effluent quality standards. Different life cycle assessments show that current investments in wastewater treatment are justified by the improved effluent quality (e.g. Roeleveld *et al.*, 1997). This is true in comparison to other polluters in developed countries. However, there is doubt about the validity of the LCA methodology and general statements on environmental impact deduced from such assessments (e.g. Ayres, 1995). "Environment" also means many different things to different people or cultures. Effluent quality can not be the only criterion of sustainable wastewater treatment. Apart from protecting the water resources, future developments must also consider all other resources, including capital, energy and nutrients.

Energy is limited and its use has become more important in the last decade. Furthermore, energy production causes pollution. Waste in the form of COD contains potential energy (e.g. through methane production). Energy is in fact consumed in wastewater treatment to destroy potential energy. Currently, around 5W/p is *consumed* in wastewater treatment, mostly through oxidation. If methane were produced with all available BOD in municipal wastewater, around 4W/p could be *generated* continuously. When this is put in perspective of the total energy consumption in Western Europe of around 5kW/p, it might seem insignificant. However, future scenarios could change the importance of energy consumption in wastewater treatment. Technology involved in all spheres of society, including wastewater management, has to be improved or replaced to realise more sustainable societies as a whole.

Accessibility of energy and sophisticated technology made nutrients widely available for agriculture. In wealthy societies, nutrients from human excretion have therefore lost their value and are now being treated as waste. This leads to high costs for wastewater treatment and causes natural resources to be used faster than their natural recovery rate. A consequence of this approach, is that nutrients might not be available anywhere and at anytime. Evidence for this can already be seen in the problems that developing countries face when adopting the Western approach to sanitation and wastewater treatment (Ujang and Buckley, 2002). An important requirement for sustainable wastewater management is therefore that it should be feasible under poor economic conditions.

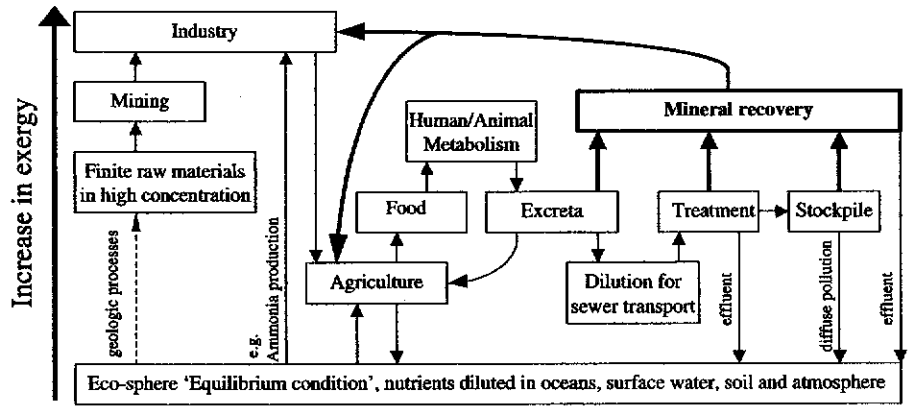

Figure 1 Relation between industry, agriculture, nutrients and sanitation

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Although nutrient *removal* is an important aspect of modern wastewater treatment, removal techniques currently applied do not allow for proper *recovery* of these nutrients (minerals). The most important minerals are considered to be nitrogen (N) and phosphorus (P). However, other minerals such as potassium (K) and sulphur (S) should also be taken into account. Recovery techniques are not necessarily limited to end-of-pipe solutions. Complete mineral cycles must be integrated, from mineral production to final use. Figure 1 shows different facets involved in mineral and nutrient cycles: Raw materials are usually mined and processed in industry to produce industrial fertiliser, which is spread out on farmland. Agricultural products (food) contain minerals, which is taken up in the metabolism of animals and humans. Most of these minerals are excreted via faeces and urine. In most urban societies, human excreta are removed through sewers. Minerals are diluted in sewers by a factor of more than 100 and have to be removed in treatment plants to protect surface waters. If global consumption occurs at a higher rate than natural recovery (or anthropogenic removal) processes, dilute minerals accumulate in the eco-sphere (or stockpiles).

Various routes are available for recovering minerals from waste. The first is obvious: prevention of dilution. Urine separation is a means of direct recovery, as 80% of the nitrogen, 50% of the phosphorus and 70% of potassium in municipal wastewater originate from urine. Lienert *et al.* (2003) show that (Swiss) farmers are in general willing to accept a urine-based fertiliser, provided it fulfils the function of industrial fertiliser and does not involve smell, inconvenience or risk. Phosphorus can also be recovered from liquid solutions with various techniques requiring resources in the process.

Fossil fuels and phosphate rock are theoretically renewable resources, but the rates of these natural renewal processes are on a geologic time scale. Recovery of finite minerals is technically possible, even from dilute sources such as sea water, but this would be far too energy intensive. Good quality ore for phosphorus, potassium and sulphur are all limited. Furthermore, production of these minerals co-produces waste, e.g. 1 kg of P produced leads to 2 kg gypsum, contaminated with heavy metals and radioactive elements. To give the phosphate industry a sustainable future, phosphate would have to be recovered and recycled (Driver *et al.*, 1999). Recovery and recycling is currently rather expensive and has to have a political drive to be realised. The Swedish EPA for example proposes that 25% of P in wastewater be recycled to agriculture in 2015 and 40% in 2025 (Kvarnström *et al.*, 2003).

The natural resources for nitrogen are extensive and universally accessible. However, in order to be accessible to plants and most micro-organisms, atmospheric nitrogen has to be converted to ammonia or nitrate; either industrially or naturally by N-fixing organisms. The amount of ammonia technically produced is of the same magnitude as the natural nitrogen fixation, or even greater. Industrial processes require 35 to 50 MJ kg_N^{-1} in the form of fossil fuel for energy supply (Maurer *et al.*, 2002).

In densely populated areas, our aquatic environment has to be protected from excessive nitrogen loads. This is conventionally done with nitrification/denitrification processes, also consuming much energy. The benefit of removal or recovery must not be annulled by the demands of the removal/recovery process. We need to find shortcuts in the mineral cycles, requiring the smallest amount of resources to recycle available resources (bold lines in Figure 1).

Three different "levels" of research can be identified in attempts to find these shortcuts, as shown in Figure 2.

Firstly, there is an integration of different systems involving resources (of which wastewater management is only one part) to consider complete cycles. Then there is work being done on improving the efficiency of processes, within an existing paradigm or bridging dif-

Hellström assumes that urine can be used directly as fertiliser. Nutrient recovery by other recovery processes (such as reverse osmosis) could prove to be much less efficient, due to a higher overall exergy demand.

Another example of this approach is the evaluation of nitrogen recovery via different routes. Nitrogen is abundantly present in the atmosphere and only energy is required for industrial ammonia fertiliser production in the Haber/Bosch process. Nitrogen removal is therefore an indirect way of ammonia recovery. The Sharon/Anammox process is the most efficient technique of biological nitrogen removal (Van Dongen *et al.*, 2001). Ammonia can also be recovered directly in various techniques. The best available techniques involved in these alternative routes are illustrated in Figure 2.

Figure 3 shows that direct recovery can also be less sustainable (e.g. air stripping), whereas other routes are clearly more viable (thermal volume reduction). Maurer *et al.* (2003) show that the energy required for the indirect recovery (Sharon/Anammox and production via the Haber/Bosch processes) is 60% higher than energy required for direct recovery via thermal volume reduction of urine, but 60% lower than for air stripping. The notion of "energy" used for this comparison includes the production of chemicals as well as primary energy required for electricity production, so that it in fact approaches an exergy comparison.

In the current debate on nutrient recovery, three different approaches can be distinguished:

1. The "conventional" approach (N: nitrification/denitrification, P: direct application of sludge or extraction of P from treatment plants/sludge).
2. Direct use of urine/faeces in agriculture.
3. Production of a urine-based fertilizer, including volume reduction, removal of micropollutants and attention to specific nutrient demand in agriculture.

Besides exergy, other important issues form part of any discussion on different recovery techniques of nutrients from waste. Theses issues determine the strengths and weaknesses of the different approaches:

- Micropollutants may be a concern in (2), but by definition not in (3). In (1), micropollutants may be a concern for P, but not for N.
- Industrial fertiliser composition is designed on specific plant needs and maximum uptake rates, which could differ considerably from urine, black water, or sewage sludge. Limitation of one nutrient and oversupply of another could again lead to diffuse pollution. This is most significantly a problem for (2).
- Animal manure is a problem in many places with intensive bio-industries and is potentially a greater and more concentrated source of nutrients than municipal wastewater. Resources in wastewater (and its potential recovery) can not be viewed in isolation. For (2), this is a problem due to the limited possibilities of transport. The same is true for the recycling of P via sewage sludge (1). For the other options, transport is possible.

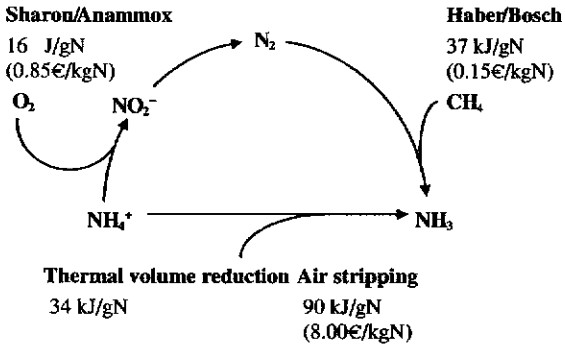

Figure 3 Nitrogen removal is low-cost and indirect ammonia recovery

- Costs of recovery is at the moment much higher than efficient removal (8 times for the case of air stripping of ammonia in Figure 2). Although cost differences and decisions could change in future scenarios, current costs govern water boards, municipalities and agriculture. Furthermore, the cost to pay for any process has to be "earned" with other economic activities. In a consumer driven economy, higher costs can often be associated with a higher exergy consumption.

To summarise, exergy considerations support approach (2), whereas today's economic reality favours approach (1). Experience with new technology, probably based on transition scenarios (see below) would be necessary in order to advance approach (3), which combines a number of advantages.

The strength of the systems approach lies in not only taking one aspect like nutrient recycling into account, but in considering the entire system. Besides nutrient recycling, water pollution control remains of paramount interest. With separate treatment of urine and/or faeces, a number of problems like eutrophication and oxygen depletion could be dramatically improved. Source separating measures can also be adapted to different contexts. Low-tech versions are relevant in rural areas, whereas more high-tech variations can be adapted to urban conditions and even integrated into the existing conventional system (Larsen and Gujer, 1997; Rauch *et al.*, 2003). Source separation is also interesting with regard to household water polluters other than the toilet. If effluent from toilets, washing machines and dishwashers are collected separately, 85% of the COD, N and P in municipal wastewater can be addressed with integrated on-site, or in-pipe, high-tech technologies (Larsen and Gujer, 2001). In non-arid climates, cities will probably still need a drainage system, but simple treatment plants would be sufficient for polishing grey water.

The transition phase from one paradigm to another is also important. Localised treatment applications could first be targeted at hospitals (including treatment of pharmaceutical residues and hormones), public buildings such as airports, shopping areas, sport stadiums (places with high human "strike rate") or office buildings (integrating urban irrigation, landscaping and fertilisation). Innovative use of ideas proposed for new systems can already improve existing systems.

Improvement and optimisation of the conventional treatment system

Sewers may remain an efficient transport method of waste in densely populated urban environments. We expect that in the near future, sewers with centralised treatment plants will still be the most common way of sanitation and waste management. Efforts to improve the system are therefore justified, although this also enforces the system. This is also true for arid regions, provided that wastewater is integrated with irrigation. A process such as the combined upflow anaerobic sludge bed/rotating biological contacter (UASB/RBC) can be used for primary treatment. This process produces an effluent with partial nitrification and *E. coli* removal, suitable for irrigation in parts of the world with less stringent regulations (Tawfik *et al.*, 2003). This is a simple process, requiring little resource input and recycling some nutrients to agriculture.

Some problems prevent direct use of sewage sludge or manure. Where heavy metal and micropollutant content are of no concern, sewage sludge could be directly used as fertiliser even though it is not very efficient. Sewage sludge can only recover a maximum of 30% of the nutrients available in wastewater. Sludge transportation is also a very inefficient (and uneconomical) way to transport nutrients. One should also keep in mind that cities import food from areas outside their own direct agricultural region. Food import/export is a global phenomenon, just as industrial fertiliser import/export is. This obviously limits the direct application of nutrients recovered from waste. Space around cities is to a large extent also not used for agriculture, but rather for industries, transport, recreation, etc.

Over-application of sewage sludge or manure leads to build up of minerals on farmland, which leads to diffuse pollution. The plant availability of nutrients in sewage sludge is also fairly uncertain. Seyhan *et al.* (2003) show that lime stabilised sludge performed well in comparison to triple super phosphate in pot experiments. Sludge application based on phosphorus needs could prevent the over application of any material.

A way of solving the transport problem is to concentrate the nutrients at the treatment plant, which makes truck transport more feasible. Struvite (magnesium ammonium phosphate) is one such product, which can be produced with relatively simple technology. Although it is generally known that struvite is a good slow release fertiliser, it's nutritional value for different crops is unknown. The N:P:K ratio in struvite available to plants still has to be researched (Burns *et al.*, 2003).

Phosphorus accumulating organisms present a low-cost low-energy option for phosphorus concentration from dilute wastewater. Lesjean *et al.* (2003) show how current centralised biological nutrient removal plants could be further optimised with a membrane bio-reactor to recover high amounts of phosphorus with sewage sludge. Up to 99% phosphorus removal was achieved with relatively low sludge production.

Hao and Van Loosdrecht (2003) evaluate a system for optimal use of the resources in wastewater. This process removes a part of the ammonium load via the CANON process (based on the principle of the Sharon/Anammox), uses COD for methane production and recovers phosphorus as struvite. Wilsenach and Van Loosdrecht (2003) show that even partial urine separation could improve nitrogen removal and phosphorus recovery significantly on a centralised scale. This holds for both existing and new treatment concepts, where a main advantage is a net energy production from increased methane production. The immediate benefits of separate urine collection for present wastewater treatment plants provide a bridge between the existing system and possible future systems, such as complete urine separation.

Removal and recovery of minerals are not necessarily fundamentally different. Acid mine drainage is one of the most serious pollutants from mining. Muraviev (2003) demonstrates an ion exchanger to extract and concentrate sulphate from acidic mine wastes to produce K_2SO_4 fertiliser. Addition of KOH to the waste also removed metal ions and increased the pH. This is a perfect example of combining mineral removal and mineral recovery in treatment.

Unit processes for recovery and removal of nutrients

Within existing systems, parts of the system are often a bottleneck for further improvement. Improvements to unit processes are mostly focussed on removal/recovery of nutrients in higher concentrations than municipal wastewater. The capabilities of the phosphate industry to process recovered P is limited because they are set up for utilisation of large quantities of calcium phosphate. Calcium phosphate recovery from liquid waste is technically possible, but might not be the most efficient way. Wastewater treatment boards seem to chose the route of struvite recovery, being a cheap and simple process and requiring less exergy. In Japan, struvite recovery from central treatment plants is becoming more profitable. Shimamura *et al.* (2003) describe a two tank fluidised bed reactor for struvite recovery from anaerobic digester supernatant. Yoshino *et al.* (2003) show that high struvite production is also possible from a similar effluent, but using a continuously stirred tank reactor. Struvite in Japan is used for the fertilisation of rice. If micropollutants (or the perception thereof) are a serious concern, struvite could possibly be used in agriculture outside food production, e.g. for the flower industry, animal feed production, plants used for starch production, etc. Although these might be small markets, it is not necessarily a disadvantage. The availability of nutrients from wastewater is also relatively small and between 10–30% of the

total nutrient flow in many societies. Re-use of sewage sludge presents many problems, such as heavy metal content or organic pollutants. One solution is that of phosphorus recovery from sewage sludge, with supercritical water (Stendahl and Jäfverström, 2003). This is impressive technology, removing all organic matter from sludge and allowing phosphorus recovery. Although it is claimed that energy consumption is similar to sludge incineration, the technique would probably have limited application. Capital and operational costs are high and some technical problems could be expected, e.g. corrosion. Many regions will simply apply treated sludge directly to land.

Treatment of source separated urine could make it a good fertiliser. Udert *et al.* (2003) show that oxidation and partial nitrification of urine reduces the pH sufficiently to prevent ammonia evaporation. This is an interesting option, and hopefully more work will be done to compare the fertilising potential of treated urine with that of industrial fertiliser or struvite.

Conclusion

Dilution is never a solution for pollution. In fact, dilution destroys exergy and makes the treatment of wastewater costly. Waste streams must therefore be managed in ways that keep them as concentrated as possible. Concentrated streams also enable easier recovery of energy and minerals.

Another important aspect is the fact that sanitation is not intrinsically linked to sewer systems and end-of-pipe wastewater treatment. They proved to be an efficient and powerful solution, however they are also costly and contain many severe disadvantages.

Wastewater engineers are solving problems created elsewhere. All societies (wealthy and developing) should be made conscious of the fact that wealthy consumption patterns are not sustainable and that technology alone can not solve all technical problems. Highly expensive removal/recovery techniques might not be sustainable. Solutions have to be found with respect to the integrated system: E.g. sanitation ensures hygiene and comfort, while waste treatment protects water bodies and enables recycling of resources. The wastewater engineer of the future should rather be a resource engineer, concerned with both water management and minimisation of exergy losses.

The conference showed that many developments are taking place related to making waste and water management more sustainable. More innovative concepts are clearly needed. Concepts based on source separation and separate handling/treatment are expected to create the most important breakthroughs in water and waste treatment. Such concepts are now becoming feasible. It is also clear that existing wastewater treatment plants would benefit from partial source separation. This provides good opportunities for a gradual change in the systems.

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Table DP-1. Profile of General Demographic Characteristics: 2000

Geographic Area: Baywood-Los Osos CDP, California

[For information on confidentiality protection, nonsampling error, and definitions, see text]

Subject	Number	Percent
Total population	**14,351**	**100.0**
SEX AND AGE		
Male	6,889	48.0
Female	7,462	52.0
Under 5 years	615	4.3
5 to 9 years	887	6.2
10 to 14 years	968	6.7
15 to 19 years	978	6.8
20 to 24 years	745	5.2
25 to 34 years	1,337	9.3
35 to 44 years	2,212	15.4
45 to 54 years	2,547	17.7
55 to 59 years	818	5.7
60 to 64 years	517	3.6
65 to 74 years	1,300	9.1
75 to 84 years	1,125	7.8
85 years and over	302	2.1
Median age (years)	42.9	(X)
18 years and over	11,246	78.4
Male	5,271	36.7
Female	5,975	41.6
21 years and over	10,739	74.8
62 years and over	3,018	21.0
65 years and over	2,727	19.0
Male	1,153	8.0
Female	1,574	11.0
RACE		
One race	13,881	96.7
White	12,667	88.3
Black or African American	92	0.6
American Indian and Alaska Native	99	0.7
Asian	655	4.6
Asian Indian	5	-
Chinese	36	0.3
Filipino	482	3.4
Japanese	76	0.5
Korean	23	0.2
Vietnamese	8	0.1
Other Asian [1]	25	0.2
Native Hawaiian and Other Pacific Islander	10	0.1
Native Hawaiian	5	-
Guamanian or Chamorro	2	-
Samoan	1	-
Other Pacific Islander [2]	2	-
Some other race	358	2.5
Two or more races	470	3.3
Race alone or in combination with one or more other races: [3]		
White	13,086	91.2
Black or African American	163	1.1
American Indian and Alaska Native	279	1.9
Asian	823	5.7
Native Hawaiian and Other Pacific Islander	31	0.2
Some other race	483	3.4

Subject	Number	Percent
HISPANIC OR LATINO AND RACE		
Total population	**14,351**	**100.0**
Hispanic or Latino (of any race)	1,292	9.0
Mexican	1,002	7.0
Puerto Rican	25	0.2
Cuban	18	0.1
Other Hispanic or Latino	247	1.7
Not Hispanic or Latino	13,059	91.0
White alone	11,871	82.7
RELATIONSHIP		
Total population	**14,351**	**100.0**
In households	14,277	99.5
Householder	5,892	41.1
Spouse	3,116	21.7
Child	3,682	25.7
Own child under 18 years	2,839	19.8
Other relatives	596	4.2
Under 18 years	187	1.3
Nonrelatives	991	6.9
Unmarried partner	342	2.4
In group quarters	74	0.5
Institutionalized population	-	-
Noninstitutionalized population	74	0.5
HOUSEHOLD BY TYPE		
Total households	**5,892**	**100.0**
Family households (families)	3,879	65.8
With own children under 18 years	1,644	27.9
Married-couple family	3,116	52.9
With own children under 18 years	1,196	20.3
Female householder, no husband present	567	9.6
With own children under 18 years	341	5.8
Nonfamily households	2,013	34.2
Householder living alone	1,508	25.6
Householder 65 years and over	718	12.2
Households with individuals under 18 years	1,776	30.1
Households with individuals 65 years and over	1,888	32.0
Average household size	2.42	(X)
Average family size	2.91	(X)
HOUSING OCCUPANCY		
Total housing units	**6,214**	**100.0**
Occupied housing units	5,892	94.8
Vacant housing units	322	5.2
For seasonal, recreational, or occasional use	159	2.6
Homeowner vacancy rate (percent)	0.8	(X)
Rental vacancy rate (percent)	1.9	(X)
HOUSING TENURE		
Occupied housing units	**5,892**	**100.0**
Owner-occupied housing units	4,116	69.9
Renter-occupied housing units	1,776	30.1
Average household size of owner-occupied units	2.42	(X)
Average household size of renter-occupied units	2.43	(X)

- Represents zero or rounds to zero. (X) Not applicable.

[1] Other Asian alone, or two or more Asian categories.

[2] Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.

[3] In combination with one or more of the other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.

Source: U.S. Census Bureau, Census 2000.

EXHIBIT

7.1

Table DP-2. Profile of Selected Social Characteristics: 2000

Geographic area: Baywood-Los Osos CDP, California

[Data based on a sample. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see text]

Subject	Number	Percent
SCHOOL ENROLLMENT		
Population 3 years and over enrolled in school	**3,733**	**100.0**
Nursery school, preschool	248	6.6
Kindergarten	220	5.9
Elementary school (grades 1-8)	1,347	36.1
High school (grades 9-12)	755	20.2
College or graduate school	1,163	31.2
EDUCATIONAL ATTAINMENT		
Population 25 years and over	**10,134**	**100.0**
Less than 9th grade	346	3.4
9th to 12th grade, no diploma	462	4.6
High school graduate (includes equivalency)	1,712	16.9
Some college, no degree	2,755	27.2
Associate degree	1,116	11.0
Bachelor's degree	2,276	22.5
Graduate or professional degree	1,467	14.5
Percent high school graduate or higher	92.0	(X)
Percent bachelor's degree or higher	36.9	(X)
MARITAL STATUS		
Population 15 years and over	**11,730**	**100.0**
Never married	2,545	21.7
Now married, except separated	6,619	56.4
Separated	181	1.5
Widowed	922	7.9
Female	733	6.2
Divorced	1,463	12.5
Female	863	7.4
GRANDPARENTS AS CAREGIVERS		
Grandparent living in household with one or more own grandchildren under 18 years	**232**	**100.0**
Grandparent responsible for grandchildren	148	63.8
VETERAN STATUS		
Civilian population 18 years and over	**11,147**	**100.0**
Civilian veterans	2,009	18.0
DISABILITY STATUS OF THE CIVILIAN NONINSTITUTIONALIZED POPULATION		
Population 5 to 20 years	**2,802**	**100.0**
With a disability	247	8.8
Population 21 to 64 years	**7,858**	**100.0**
With a disability	1,045	13.3
Percent employed	65.7	(X)
No disability	6,813	86.7
Percent employed	80.1	(X)
Population 65 years and over	**2,750**	**100.0**
With a disability	900	32.7
RESIDENCE IN 1995		
Population 5 years and over	**13,438**	**100.0**
Same house in 1995	7,289	54.2
Different house in the U.S. in 1995	5,984	44.5
Same county	3,343	24.9
Different county	2,641	19.7
Same state	2,066	15.4
Different state	575	4.3
Elsewhere in 1995	165	1.2

Subject	Number	Percent
NATIVITY AND PLACE OF BIRTH		
Total population	**14,154**	**100.0**
Native	12,988	91.8
Born in United States	12,855	90.8
State of residence	8,450	59.7
Different state	4,405	31.1
Born outside United States	133	0.9
Foreign born	1,166	8.2
Entered 1990 to March 2000	368	2.6
Naturalized citizen	662	4.7
Not a citizen	504	3.6
REGION OF BIRTH OF FOREIGN BORN		
Total (excluding born at sea)	**1,166**	**100.0**
Europe	288	24.7
Asia	605	51.9
Africa	-	-
Oceania	10	0.9
Latin America	205	17.6
Northern America	58	5.0
LANGUAGE SPOKEN AT HOME		
Population 5 years and over	**13,438**	**100.0**
English only	11,927	88.8
Language other than English	1,511	11.2
Speak English less than "very well"	573	4.3
Spanish	630	4.7
Speak English less than "very well"	167	1.2
Other Indo-European languages	258	1.9
Speak English less than "very well"	63	0.5
Asian and Pacific Island languages	582	4.3
Speak English less than "very well"	321	2.4
ANCESTRY (single or multiple)		
Total population	**14,154**	**100.0**
Total ancestries reported	*17,459*	*123.4*
Arab	72	0.5
Czech[1]	97	0.7
Danish	205	1.4
Dutch	323	2.3
English	2,918	20.6
French (except Basque)[1]	562	4.0
French Canadian[1]	163	1.2
German	2,887	20.4
Greek	19	0.1
Hungarian	125	0.9
Irish[1]	1,955	13.8
Italian	887	6.3
Lithuanian	58	0.4
Norwegian	540	3.8
Polish	281	2.0
Portuguese	213	1.5
Russian	243	1.7
Scotch-Irish	416	2.9
Scottish	640	4.5
Slovak	29	0.2
Subsaharan African	22	0.2
Swedish	389	2.7
Swiss	92	0.6
Ukrainian	28	0.2
United States or American	504	3.6
Welsh	187	1.3
West Indian (excluding Hispanic groups)	53	0.4
Other ancestries	3,551	25.1

-Represents zero or rounds to zero. (X) Not applicable.

[1]The data represent a combination of two ancestries shown separately in Summary File 3. Czech includes Czechoslovakian. French includes Alsatian. French Canadian includes Acadian/Cajun. Irish includes Celtic.

Source: U.S. Bureau of the Census, Census 2000.

EXHIBIT

7.2

Table DP-3. Profile of Selected Economic Characteristics: 2000

Geographic area: Baywood-Los Osos CDP, California

[Data based on a sample. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see text]

Subject	Number	Percent
EMPLOYMENT STATUS		
Population 16 years and over	**11,538**	**100.0**
In labor force	7,250	62.8
Civilian labor force	7,222	62.6
Employed	6,931	60.1
Unemployed	291	2.5
Percent of civilian labor force	4.0	(X)
Armed Forces	28	0.2
Not in labor force	4,288	37.2
Females 16 years and over	**6,168**	**100.0**
In labor force	3,486	56.5
Civilian labor force	3,472	56.3
Employed	3,315	53.7
Own children under 6 years	**901**	**100.0**
All parents in family in labor force	492	54.6
COMMUTING TO WORK		
Workers 16 years and over	**6,830**	**100.0**
Car, truck, or van - - drove alone	5,355	78.4
Car, truck, or van - - carpooled	789	11.6
Public transportation (including taxicab)	95	1.4
Walked	109	1.6
Other means	82	1.2
Worked at home	400	5.9
Mean travel time to work (minutes)[1]	22.2	(X)
Employed civilian population 16 years and over	**6,931**	**100.0**
OCCUPATION		
Management, professional, and related occupations	2,660	38.4
Service occupations	1,258	18.2
Sales and office occupations	1,657	23.9
Farming, fishing, and forestry occupations	73	1.1
Construction, extraction, and maintenance occupations	654	9.4
Production, transportation, and material moving occupations	629	9.1
INDUSTRY		
Agriculture, forestry, fishing and hunting, and mining	103	1.5
Construction	407	5.9
Manufacturing	502	7.2
Wholesale trade	131	1.9
Retail trade	720	10.4
Transportation and warehousing, and utilities	227	3.3
Information	269	3.9
Finance, insurance, real estate, and rental and leasing	392	5.7
Professional, scientific, management, administrative, and waste management services	808	11.7
Educational, health and social services	1,728	24.9
Arts, entertainment, recreation, accommodation and food services	663	9.6
Other services (except public administration)	397	5.7
Public administration	584	8.4
CLASS OF WORKER		
Private wage and salary workers	3,889	56.1
Government workers	1,837	26.5
Self-employed workers in own not incorporated business	1,181	17.0
Unpaid family workers	24	0.3

Subject	Number	Percent
INCOME IN 1999		
Households	**5,908**	**100.0**
Less than $10,000	296	5.0
$10,000 to $14,999	322	5.5
$15,000 to $24,999	793	13.4
$25,000 to $34,999	791	13.4
$35,000 to $49,999	914	15.5
$50,000 to $74,999	1,269	21.5
$75,000 to $99,999	792	13.4
$100,000 to $149,999	484	8.2
$150,000 to $199,999	100	1.7
$200,000 or more	147	2.5
Median household income (dollars)	46,558	(X)
With earnings	4,444	75.2
Mean earnings (dollars)[1]	55,321	(X)
With Social Security income	1,929	32.7
Mean Social Security income (dollars)[1]	12,045	(X)
With Supplemental Security Income	265	4.5
Mean Supplemental Security Income (dollars)[1]	7,556	(X)
With public assistance income	94	1.6
Mean public assistance income (dollars)[1]	3,964	(X)
With retirement income	1,492	25.3
Mean retirement income (dollars)[1]	20,497	(X)
Families	**3,791**	**100.0**
Less than $10,000	79	2.1
$10,000 to $14,999	157	4.1
$15,000 to $24,999	347	9.2
$25,000 to $34,999	453	11.9
$35,000 to $49,999	592	15.6
$50,000 to $74,999	946	25.0
$75,000 to $99,999	616	16.2
$100,000 to $149,999	393	10.4
$150,000 to $199,999	78	2.1
$200,000 or more	130	3.4
Median family income (dollars)	55,838	(X)
Per capita income (dollars)[1]	24,838	(X)
Median earnings (dollars):		
Male full-time, year-round workers	39,311	(X)
Female full-time, year-round workers	31,450	(X)

Subject	Number below poverty level	Percent below poverty level
POVERTY STATUS IN 1999		
Families	**190**	**5.0**
With related children under 18 years	164	9.2
With related children under 5 years	88	13.0
Families with female householder, no husband present	**76**	**14.6**
With related children under 18 years	69	20.8
With related children under 5 years	40	47.6
Individuals	**1,205**	**8.5**
18 years and over	921	8.2
65 years and over	141	5.1
Related children under 18 years	245	8.4
Related children 5 to 17 years	128	5.8
Unrelated individuals 15 years and over	652	20.4

-Represents zero or rounds to zero. (X) Not applicable.

[1]If the denominator of a mean value or per capita value is less than 30, then that value is calculated using a rounded aggregate in the numerator. See text.

Source: U.S. Bureau of the Census, Census 2000.

EXHIBIT

7.3

Table DP-4. Profile of Selected Housing Characteristics: 2000

Geographic area: Baywood-Los Osos CDP, California

[Data based on a sample. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see text]

Subject	Number	Percent	Subject	Number	Percent
Total housing units	**6,175**	**100.0**	**OCCUPANTS PER ROOM**		
UNITS IN STRUCTURE			**Occupied housing units**	**5,851**	**100.0**
1-unit, detached	4,810	77.9	1.00 or less	5,620	96.1
1-unit, attached	150	2.4	1.01 to 1.50	130	2.2
2 units	236	3.8	1.51 or more	101	1.7
3 or 4 units	225	3.6			
5 to 9 units	88	1.4	**Specified owner-occupied units**	**3,329**	**100.0**
10 to 19 units	82	1.3	**VALUE**		
20 or more units	71	1.1	Less than $50,000	22	0.7
Mobile home	513	8.3	$50,000 to $99,999	61	1.8
Boat, RV, van, etc	-	-	$100,000 to $149,999	298	9.0
			$150,000 to $199,999	1,130	33.9
YEAR STRUCTURE BUILT			$200,000 to $299,999	1,168	35.1
1999 to March 2000	56	0.9	$300,000 to $499,999	527	15.8
1995 to 1998	77	1.2	$500,000 to $999,999	107	3.2
1990 to 1994	145	2.3	$1,000,000 or more	16	0.5
1980 to 1989	1,406	22.8	Median (dollars)	209,800	(X)
1970 to 1979	2,927	47.4			
1960 to 1969	965	15.6	**MORTGAGE STATUS AND SELECTED MONTHLY OWNER COSTS**		
1940 to 1959	525	8.5			
1939 or earlier	74	1.2	With a mortgage	2,414	72.5
			Less than $300	-	-
ROOMS			$300 to $499	42	1.3
1 room	73	1.2	$500 to $699	145	4.4
2 rooms	234	3.8	$700 to $999	348	10.5
3 rooms	481	7.8	$1,000 to $1,499	1,055	31.7
4 rooms	1,396	22.6	$1,500 to $1,999	500	15.0
5 rooms	1,768	28.6	$2,000 or more	324	9.7
6 rooms	1,255	20.3	Median (dollars)	1,308	(X)
7 rooms	629	10.2	Not mortgaged	915	27.5
8 rooms	218	3.5	Median (dollars)	307	(X)
9 or more rooms	121	2.0			
Median (rooms)	5.0	(X)	**SELECTED MONTHLY OWNER COSTS AS A PERCENTAGE OF HOUSEHOLD INCOME IN 1999**		
Occupied housing units	**5,851**	**100.0**			
YEAR HOUSEHOLDER MOVED INTO UNIT			Less than 15.0 percent	1,150	34.5
1999 to March 2000	1,120	19.1	15.0 to 19.9 percent	449	13.5
1995 to 1998	1,610	27.5	20.0 to 24.9 percent	365	11.0
1990 to 1994	1,090	18.6	25.0 to 29.9 percent	373	11.2
1980 to 1989	1,265	21.6	30.0 to 34.9 percent	220	6.6
1970 to 1979	646	11.0	35.0 percent or more	757	22.7
1969 or earlier	120	2.1	Not computed	15	0.5
VEHICLES AVAILABLE			**Specified renter-occupied units**	**1,801**	**100.0**
None	239	4.1	**GROSS RENT**		
1	2,000	34.2	Less than $200	22	1.2
2	2,342	40.0	$200 to $299	44	2.4
3 or more	1,270	21.7	$300 to $499	175	9.7
			$500 to $749	432	24.0
HOUSE HEATING FUEL			$750 to $999	654	36.3
Utility gas	5,109	87.3	$1,000 to $1,499	389	21.6
Bottled, tank, or LP gas	23	0.4	$1,500 or more	42	2.3
Electricity	605	10.3	No cash rent	43	2.4
Fuel oil, kerosene, etc	-	-	Median (dollars)	819	(X)
Coal or coke	-	-			
Wood	98	1.7	**GROSS RENT AS A PERCENTAGE OF HOUSEHOLD INCOME IN 1999**		
Solar energy	8	0.1			
Other fuel	8	0.1	Less than 15.0 percent	234	13.0
No fuel used	-	-	15.0 to 19.9 percent	189	10.5
			20.0 to 24.9 percent	182	10.1
SELECTED CHARACTERISTICS			25.0 to 29.9 percent	254	14.1
Lacking complete plumbing facilities	17	0.3	30.0 to 34.9 percent	165	9.2
Lacking complete kitchen facilities	-	-	35.0 percent or more	691	38.4
No telephone service	7	0.1	Not computed	86	4.8

-Represents zero or rounds to zero. (X) Not applicable.

Source: U.S. Bureau of the Census, Census 2000.

EXHIBIT

7.4


Los Osos CSD
Population and Median Household Income
Population (Total = 14,351)
628
801
1264
1355
1432
1557
1605
1761
1806
2142
$ Median Household Income
Prohibition Zone
Exempt from Prohibition Zone
Outside Prohibition Zone
River/Creek
Ocean/Bay
N
W
E
S
$59,306
Pacific Coast GIS Consulting

EXHIBIT

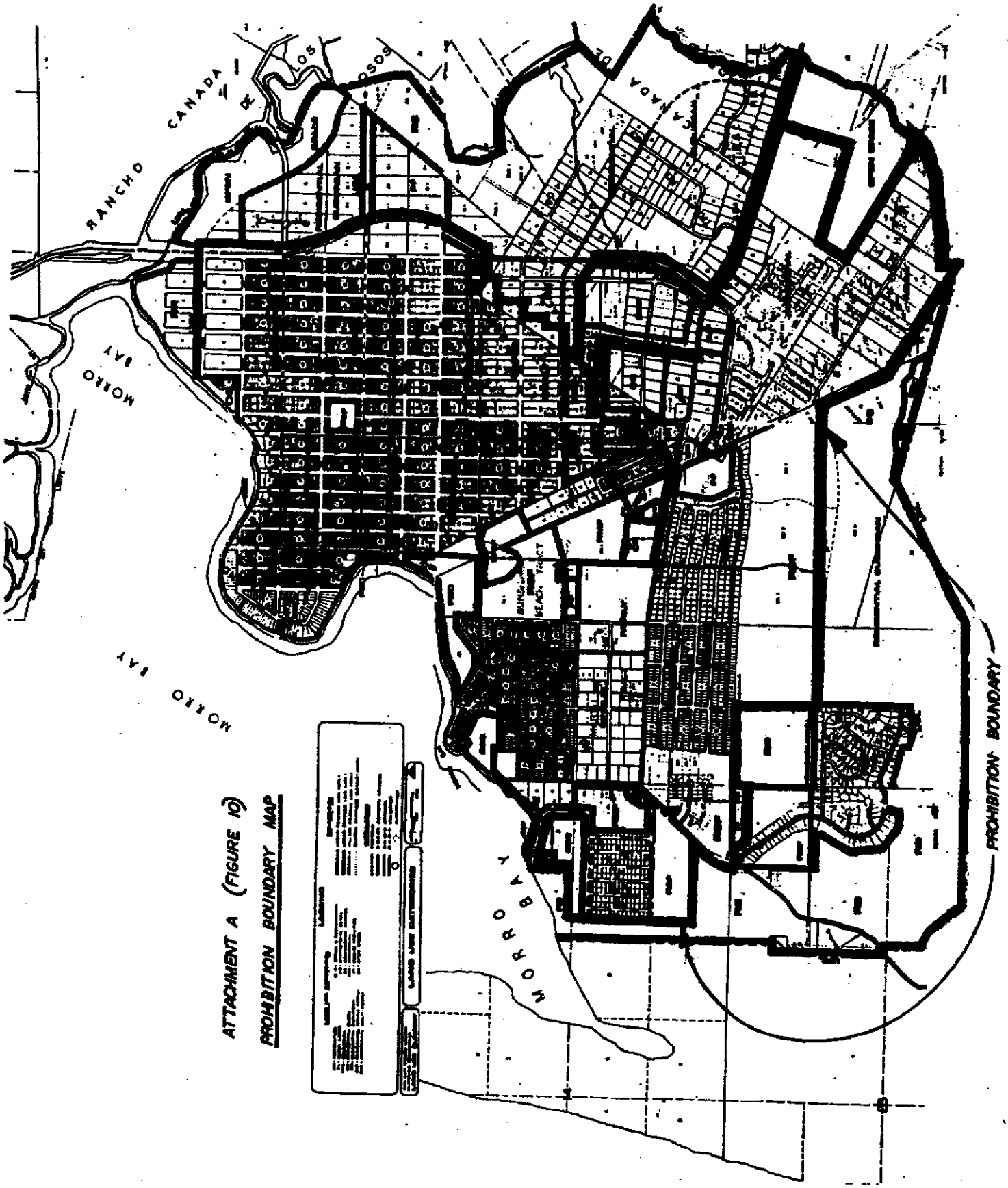
7.5

APPENDIX A-30

Los Osos Baywood Park Individual and Community Sewage Disposal System Prohibition Area

EXHIBIT

7.6

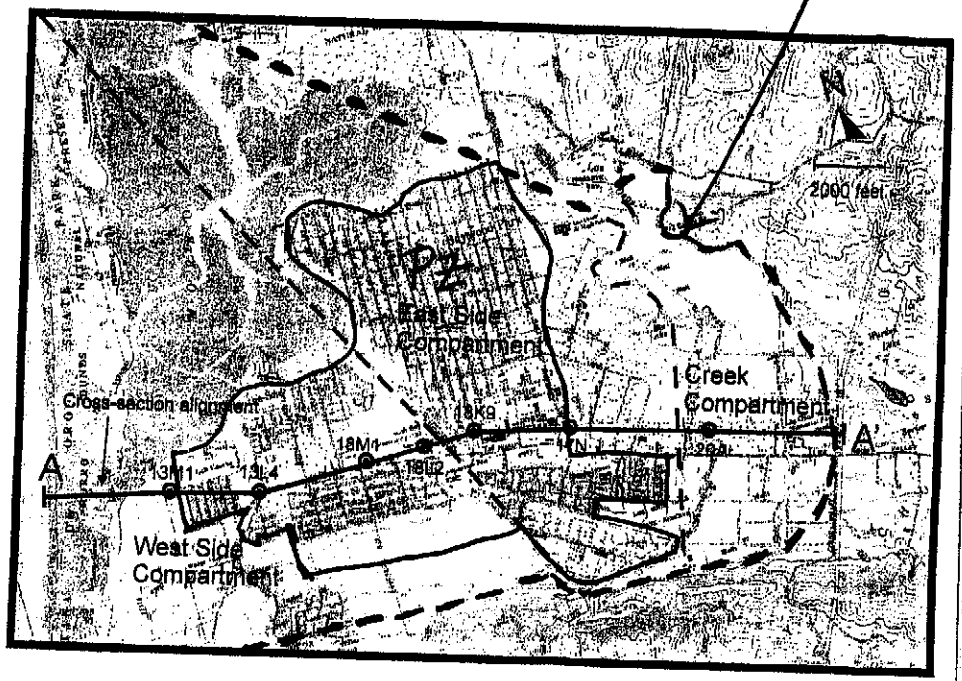


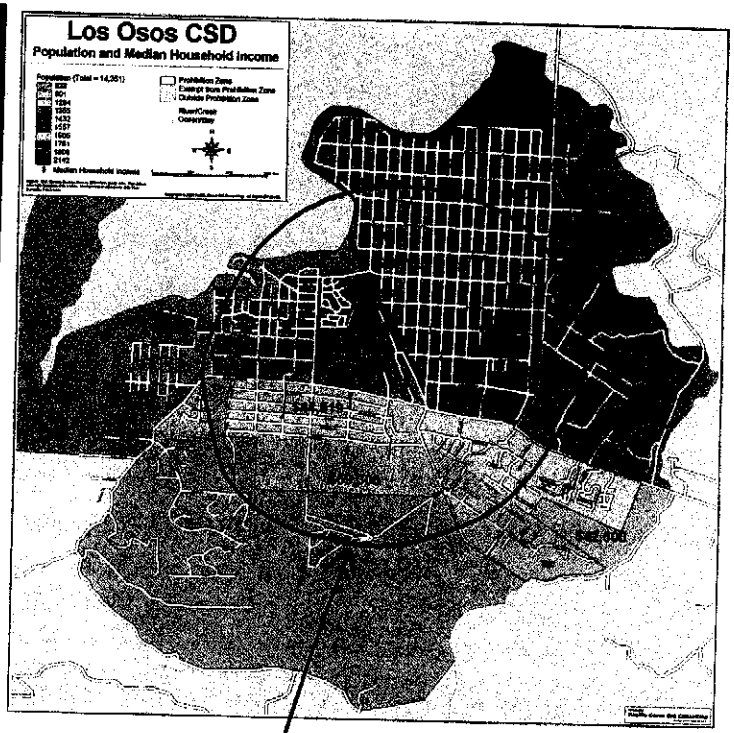
ATTACHMENT A (FIGURE 10)
PROHIBITION BOUNDARY MAP

EXHIBIT

7.7

GROUNDWATER BASIN BOUNDERY





MOST LOW INCOME HOUSING HERE.

EXHIBIT 8.1

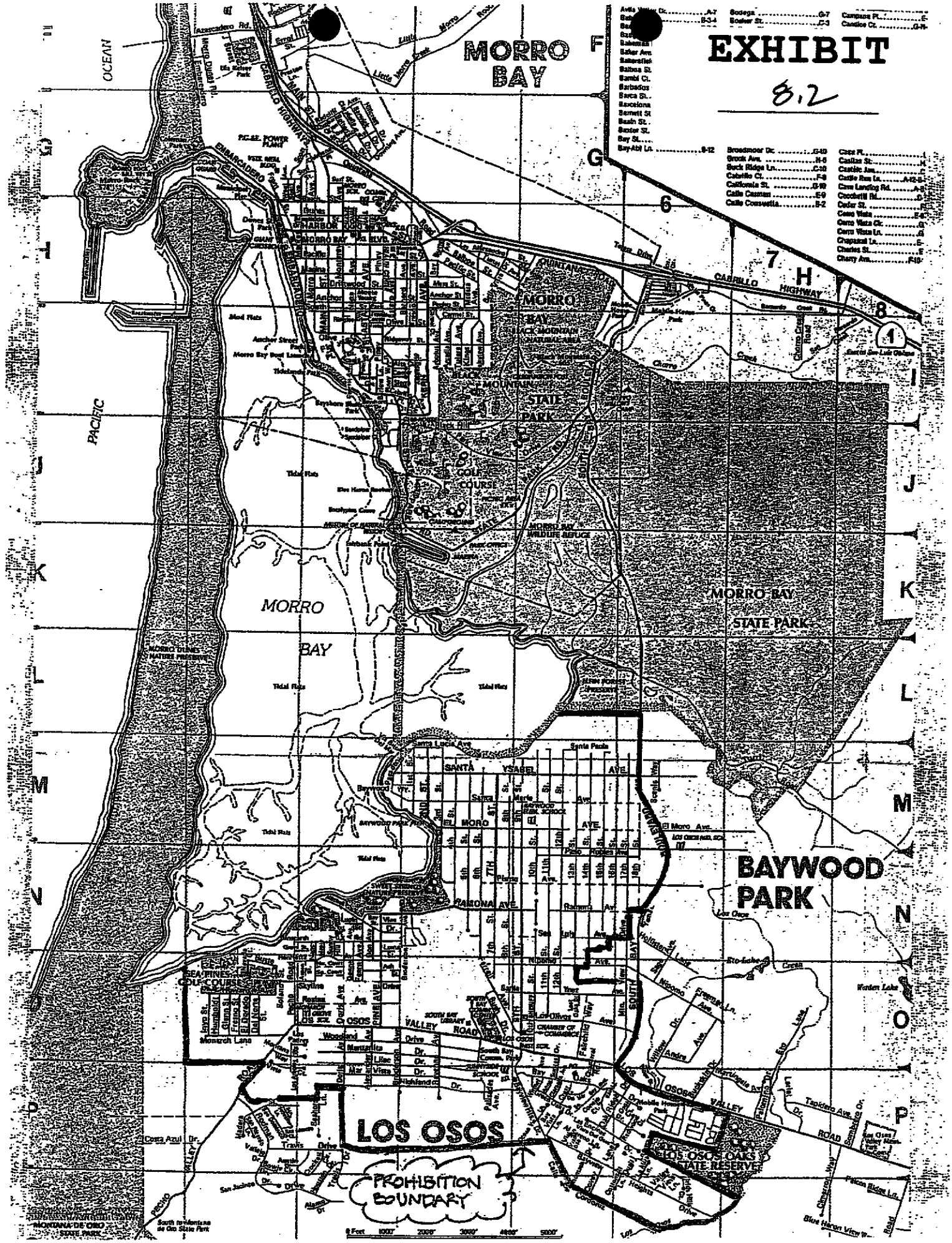


EXHIBIT
8.2
MORRO BAY
OCEAN
PACIFIC
MORRO BAY STATE PARK
MORRO BAY WILDLIFE REFUGE
MORRO BAY
MORRO BAY STATE PARK
BAYWOOD PARK
LOS OSOS
LOS OSOS OAKS STATE RESERVE
PROHIBITION BOUNDARY
SANTA YSABEL AVE.
MORRO AVE.
RAMONA AVE.
SOUTH BAY BOULEVARD
LOS OSOS VALLEY ROAD
EMBARCADERO
QUINTANA ROAD
CABRILLO HIGHWAY
SEA PINES GOLF COURSE
MORRO DUNES NATURAL PRESERVE
MONTAÑA DE ORO STATE PARK

California Environmental Protection Agency

INTRA-AGENCY ENVIRONMENTAL JUSTICE STRATEGY

AUGUST 2004

EXHIBIT

9.1

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9.3

INTRODUCTION

The California Environmental Protection Agency (Cal/EPA or Agency) is committed to the achievement of environmental justice. Environmental justice (EJ) is defined in California law (Government Code section 65040.12) as "the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws and policies."

Pursuant to Public Resources Code (PRC) sections 71110-71113, Cal/EPA has developed the intra-agency (agency-wide) strategy to identify and address any gaps in existing programs, policies, and activities that may impede the achievement of environmental justice. The strategy is the overarching environmental justice vision document for our boards, departments, and office (BDOs); it sets forth the Agency's environmental justice vision, mission, core values, goals, and objectives that will guide Cal/EPA's BDOs in integrating environmental justice into our programs, policies, and activities.

The Cal/EPA intra-agency EJ strategy is the product of a multi-year collaboration between the Cal/EPA Interagency Working Group on Environmental Justice (IWG or Working Group), the Cal/EPA Advisory Committee on Environmental Justice (Advisory Committee), and other EJ stakeholders (including community, local government, business, industry, and Tribal representatives). The strategy provides the foundation for addressing environmental justice issues and shall be reviewed regularly and revised as necessary in consideration of evolving environmental justice issues, programs, policies, and activities.

EXHIBIT
9, 4

BACKGROUND INFORMATION

Public Resources Code sections 71110-71113 charged Cal/EPA with the following activities:

- Conduct our programs, policies, and activities that substantially affect human health or the environment in a manner that ensures the fair treatment of people of all races, cultures, and income levels, including minority populations and low-income populations of the state.
- Promote enforcement of all health and environmental statutes within our jurisdiction in a manner that ensures the fair treatment of people of all races, cultures, and income levels, including minority populations and low-income populations of the state.
- Ensure greater public participation in the agency's development, adoption, and implementation of environmental regulations and policies.
- Improve research and data collection for programs within the agency relating to the health of, and environment of, people of all races, cultures, and income levels, including minority populations and low-income populations of the state.
- Coordinate its efforts and share information with the United States Environmental Protection Agency (U.S. EPA).
- Identify differential patterns of consumption of natural resources among people of different socio-economic classifications for programs within the agency.
- Consult with and review any information received from the [Interagency] Working Group on Environmental Justice established to assist the Cal/EPA in developing an agency-wide strategy pursuant to section 71113.
- Develop a model environmental justice mission statement for Cal/EPA's BDOs.
- Consult with, review, and evaluate any information received from the [Interagency] Working Group on Environmental Justice pursuant to section 71113 and in development of its model environmental justice mission statement.
- Develop an agency-wide strategy for identifying and addressing any gaps in existing programs, policies, or activities that may impede the achievement of environmental justice.

EXHIBIT 4.5

On May 24, 2004, the IWG met to discuss the staff-proposed draft IWG recommendations, which were based on many of the concepts and recommendations in the Advisory Committee's report. The draft IWG recommendations presented goals and objectives with broad concepts and themes, reflecting a comprehensive, long-term overarching vision to encompass all of the EJ activities conducted by Cal/EPA's BDOs. An overarching vision would provide Cal/EPA's BDOs the guidance and flexibility to address the many complex and varied issues necessary to achieve environmental justice in BDO-specific activities. Cal/EPA ensured the public availability of these draft IWG recommendations one month prior to the IWG's public meeting.

At its May 24, 2004, meeting the IWG received written and heard oral public comments on the draft recommendations. At the conclusion of the meeting, the IWG approved staff's proposal as the Working Group's recommendations to the Secretary for an intra-agency environmental justice strategy and recommended that the Secretary consider the public comments received for incorporation, as appropriate, into the strategy.

On July 7, 2004, Cal/EPA released the draft intra-agency EJ strategy for a 30-day public comment period. The comments received were reviewed by Cal/EPA and incorporated, as appropriate, into this strategy. Cal/EPA's *Responses to Major Comments on the July 2004 Draft Intra-agency Environmental Justice Strategy* is available at www.calepa.ca.gov/EnvJustice.

Cal/EPA recognizes the challenges in addressing and achieving environmental justice and acknowledges the necessity to seek emerging opportunities to make environmental justice a tangible and consistent part of the way Cal/EPA's BDOs performs our regulatory functions. In this spirit, Cal/EPA presents this intra-agency environmental justice strategy as an overarching vision to help guide our BDOs in decision-making processes and approaches to advance environmental justice.

EXHIBIT 9.7

STRATEGIC DIRECTION

Cal/EPA's environmental justice mission, vision, core values, and four strategic goals provide the foundation upon which our BDOs will be guided in integrating environmental justice into all our environmental programs, policies, and activities.

Mission

To accord the highest respect and value to every individual and community, by developing and conducting our public health and environmental protection programs, policies, and activities in a manner that promotes equity and affords fair treatment, accessibility, and protection for all Californians, regardless of race, age, culture, income, or geographic location.

Vision

All Californians, regardless of race, age, culture, income, or geographic location, are protected from environmental and health hazards, and afforded accessibility to and fair treatment in our decision-making processes.

Core Values

- Leadership
- Accountability
- Accessibility
- Responsiveness
- Coordination
- Collaboration
- Integrity
- Respect
- Objectivity
- Quality

Goals

1. Ensure meaningful public participation and promote community capacity-building to allow communities to effectively participate in environmental decision-making processes.

2. Integrate environmental justice into the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies.

3. Improve research and data collection to promote and address environmental justice related to the health and environment of communities of color and low-income populations.

4. Ensure effective cross-media coordination and accountability in addressing environmental justice issues.

EXHIBIT 9.8

ACHIEVING THE GOALS

The Cal/EPA intra-agency EJ strategy provides a comprehensive, long-term overarching vision, as reflected in our environmental justice goals. Our environmental justice goals and objectives outline steps necessary toward achieving Cal/EPA's environmental justice vision. Cal/EPA has purposely developed broad concepts and themes to guide our BDOs in the development of BDO-specific environmental justice objectives and work plans, with specific and measurable targets adapted to BDO-specific responsibilities and priorities. Cal/EPA believes this approach is necessary to address the complexity of environmental justice in a timely, deliberate, and coordinated manner.

This strategy represents the initial step in Cal/EPA's long-term environmental justice strategic planning process. Using this strategy as a guide, each of Cal/EPA's BDOs will:

- Review environmental programs, policies, and activities to identify and address any gaps that may impede the achievement of environmental justice.
- Prepare an environmental justice strategic plan, or review and update as appropriate an existing EJ strategic plan, reflecting BDO-specific purpose, mission, goals, and milestones to achieve the Cal/EPA overarching vision outlined in this strategy.
- Prepare, or review and update as appropriate, an environmental justice work or implementation plan. Performance measures that include specific commitments and deadlines will be identified in the plan to demonstrate the BDO's progress toward fulfilling the overarching goals and objectives of the Cal/EPA intra-agency EJ strategy. Cal/EPA's BDOs will develop and implement their EJ work or implementation plans with appropriate consideration of science-based approaches, cost-effectiveness, and programmatic solutions, and with clear statement of regulatory requirements for affected communities and businesses.

Cal/EPA and our BDOs will engage the Advisory Committee on Environmental Justice and other EJ stakeholders in the implementation of this strategy to identify and address any gaps in existing programs, policies or activities that may impede the achievement of environmental justice. To ensure intra-agency coordination, BDO-specific environmental justice strategies, work plans, and related implementation documents will be reviewed by the IWG, with input and recommendations from Advisory Committee members, before they are finalized.

The long-term strategic planning process is supplemented with short-term activities in Cal/EPA's EJ action plan (available at www.calepa.ca.gov/EnvJustice). Together, the intra-agency EJ strategy and interim EJ action plan form the "Two-Pathway Approach" that Cal/EPA is taking to implement environmental justice. The short-term activities of the EJ action plan will feed back into the long-term strategic planning process, and vice versa. These efforts will combine into an integrated EJ implementation mechanism for Cal/EPA. Cal/EPA will provide a triennial report to the Governor, the Legislature and the public on our BDOs' progress in achieving environmental justice.

EXHIBIT 9.9

Objectives for Goal 1: Public Participation and Community Capacity-Building

Goal 1 – Ensure meaningful public participation and promote community capacity-building to allow communities to effectively participate in environmental decision-making processes.

Meaningful public participation is critical to the success of efforts to address environmental justice. Community capacity-building, as described in the Advisory Committee's report, addresses the needs of communities for resources to increase their understanding of the technical and procedural aspects of environmental decision-making, in order to participate in a meaningful way. Goal 1 addresses how Cal/EPA will promote community capacity-building, increase the availability of information, and enhance public participation in our decision-making processes. The objectives for Goal 1 state procedures to ensure that public documents, notices, and hearings are concise, understandable, and readily accessible to the public in a timely manner, and provide guidance on when it is appropriate to provide translation for limited-English speaking populations.

Cal/EPA's objectives for Goal 1 are the following:

A. Develop policies and procedures for all Cal/EPA BDOs on meaningful public participation, with consideration of actions recommended in the Advisory Committee's report, including early outreach efforts and communication with stakeholders to identify issues, questions, and concerns. Such policies and procedures shall be reviewed on a regular basis and updated as necessary.

B. Ensure that staff training on environmental justice is current and available.

C. Collaborate with agencies both within and outside Cal/EPA to use resources effectively and enhance public participation opportunities.

D. Identify opportunities (such as grants, loans, etc.) to assist communities, Tribes, and local governments in enhancing their knowledge and understanding of, and participation in, environmental issues and governmental processes.

E. Enhance educational efforts and expand outreach to communities, Tribes, local government, local elected officials, and stakeholders working on environmental justice issues.

F. Develop a translation assistance guide for the Agency to ensure limited-English-speaking populations have access to Cal/EPA's decision-making processes.

G. Extend outreach efforts and conduct meetings in various rural regions of the State to ensure meaningful public, Tribal, and local government participation when State regulatory or policy decisions may disproportionately impact rural areas.

EXHIBIT 9, 10

H. Increase public access to information necessary for meaningful participation in environmental decision-making and to enhance public knowledge and understanding of environmental issues and governmental processes.

Objectives for Goal 2: Environmental Justice Integration

Goal 2 – Integrate environmental justice into the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies.

Goal 2 addresses how Cal/EPA will integrate environmental justice into all our public health and environmental protection programs (including permitting programs), policies, and activities. Goal 2 includes criteria for identifying and addressing any gaps in existing programs, policies, or activities that may impede the achievement of environmental justice.

The following criteria will guide Cal/EPA BDOs in identifying and addressing environmental justice gaps in regulatory programs (including permitting programs), policies, and activities:

I. Are environmental justice issues considered in developing and revising programs, policies, and activities?

II. In the development, adoption, and implementation of programs and policies, is it ensured that new environmental justice problems have not been created or existing environmental justice problems have not been worsened?

III. Have guidelines, procedures, and performance measures been established to ensure timely, equitable implementation and enforcement of programs, policies, and activities?

IV. Have data, tools, and procedures been collected and collaborated on to identify environmental justice problems?

V. Have actions been identified and prioritized to address environmental justice problems?

Cal/EPA's objectives for Goal 2 are the following:

A. Identify and address environmental justice issues when developing and revising programs (including permitting programs), policies, and activities.

B. Ensure adequate and fair deployment of enforcement resources.

C. Give high priority to actions (e.g., funding criteria) that will address environmental justice problems.

EXHIBIT 9, 11

D. Dedicate resources and identify staff members responsible for assuring that the Boards, Departments, and Office of Cal/EPA properly considers and addresses existing and potential environmental justice problems.

E. Identify where a precautionary approach is currently being used, or could be used, to address environmental justice issues.

F. Identify and address any disproportionate economic areas, including Tribal areas and rural counties, in development, adoption, implementation, and enforcement of environmental laws, regulations, and policies.

G. Consult with appropriate stakeholders including Tribes, local government and/or local elected officials, regarding their priorities and concerns prior to developing or revising program elements, rules, or policies.

Objectives for Goal 3: Research and Data Collection

Goal 3 – Improve research and data collection to promote and address environmental justice related to the health and environment of communities of color and low-income populations.

Goal 3 addresses how Cal/EPA will enhance research and data collection to support environmental justice efforts. The objectives for Goal 3 also state procedures for collecting, maintaining, analyzing, and coordinating information relating to an environmental justice strategy.

Cal/EPA's objectives for Goal 3 are the following:

A. Establish a Cal/EPA environmental justice clearinghouse.

B. Develop tools and approaches to assess and address adverse cumulative impacts.

C. Initiate and collaborate on community-based projects related to environmental justice.

D. Develop, promote and support efforts to collect community and environmental emissions/discharge, exposure, and health risk data (including data on and surrounding federal facilities) that will improve understanding of environmental justice problems, and lead to solutions and prevention of further problems.

E. Initiate, engage, and expand communication and collaboration with stakeholders and communities to build positive and effective working relationships.

EXHIBIT 9.12

Objectives for Goal 4: Cross-Media Coordination and Accountability

Goal 4 – Ensure effective cross-media coordination and accountability in addressing environmental justice issues.

Goal 4 addresses how Cal/EPA will improve cross-media coordination and ensure accountability in its environmental justice efforts. The objectives for Goal 4 state procedures and provide guidance for the coordination and implementation of environmental justice activities.

Cal/EPA's objectives for Goal 4 are the following:

A. Promote collaborative efforts between agencies (internal and external) towards the sharing of data and information relevant to environmental justice.

B. Ensure ongoing communication between Cal/EPA and external stakeholders.

C. Develop protocols for effective coordination within Cal/EPA and its BDOs, including regional offices, on environmental justice issues.

D. Identify and adopt mechanisms to ensure greater coordination with other federal, state, Tribal, and local agencies.

E. With input from external stakeholders, develop performance measures and conduct reviews to determine the success of environmental justice programs.

F. Ensure compliance with federal (Title VI, Civil Rights Act of 1964) and state (California Government Code section 11135) civil rights laws in making environmental decisions.

EXHIBIT 9.13

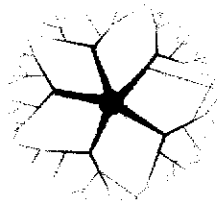
CONCLUSION

With this intra-agency environmental justice strategy, the California Environmental Protection Agency (Cal/EPA) provides the overarching vision and leadership toward ensuring all Californians benefit from a clean and healthy environment as a result of the operation or execution of our programs, policies, and activities. Cal/EPA is dedicated to the integration of environmental justice into our public health and environmental protection programs, policies, and activities.

In ensuring that all Californians are afforded fair treatment, accessibility, and protection in a clean, healthy environment, we are also improving the productivity of our workforce and, thus, helping to build a stronger economic climate in our State. The choice between jobs and the environment is a false choice, as is the choice between economic growth and environmental justice. We seek to build upon the mutually beneficial relationship between a clean, healthy environment and our economy, communities, and quality of life.

The Cal/EPA intra-agency environmental justice strategy's mission, vision, core values, goals and objectives shall provide the foundation upon which Cal/EPA and our boards, departments, and office will be guided in achieving environmental justice. As a living document, this strategy shall be reviewed regularly and revised as necessary in consideration of evolving environmental justice issues, programs, policies, and activities.

EXHIBIT 9.14



WASTEWATER FORESTS and a Carbon Sequestration Plan

by Daniel Wickham, Ph D. 1999, Edited and updated by Reinhold Ziegler 2006

Conventional wastewater treatment is based on a relatively simple premise: First, remove as much of the organic waste as possible through settling and filtration; second, convert the soluble organic matter into biological tissue that can be removed by physical means; and finally, destroy the rest through oxidation to carbon dioxide. While wastewater technology based on microbial treatment has done much to purify our waters, it has done so at a cost — in dollars and also in its effect on global atmospheric carbon balance.

In 1991, US water treatment systems collected some 35 billion gallons of wastewater each day, requiring some 72.8 million pounds of oxygen to oxidize the organic material in the wastewater. About one-third of the organic load goes to anaerobic digesters. Stabilizing the remaining soluble fraction in aeration basins takes about 48 million pounds of oxygen and some 26 million kilowatt hours (kwh) of electric power.

On average, 1.5 pounds of CO2 are produced for each kwh used. Just supplying the power to operate the aeration basins generates 19,500 tons of CO2 each day — 7,117,500 tons a year. Supplying the power to oxidize the sulfur and nitrogen in the wastewater, along with pumping and other costs, generates another 40,000 tons of CO2 per day - 14,600,000 tons per year. Ironically, the purpose of all this electricity is to create more CO2 through the oxidation of the organic carbon in the waste stream.

Virtually all of the 72 million pounds of oxygen eventually is converted to CO2 resulting in 97 million pounds of CO2. The aeration basins receive about two-thirds of that — 65 million pounds per day or 11,862,500 tons per year. Add that to the 14,600,000 tons released by the electricity and you have conventional aerobic treatment of domestic waste releasing over 26.5 million tons of CO2 into the atmosphere every year.

Adding in the industrial sewage treatment systems that oxidize the vast quantities of organic waste from food processing, pharmaceuticals, petroleum and such would conservatively raise the impact of conventional aerobic treatment to more than 50 million tons of CO2 per year (a huge amount but still only probably two or three percent of the total US releases).

EXHIBIT

10.1

A New Paradigm.

The premise behind conventional secondary treatment is the conversion of soluble organic matter to CO2 and biological cells, which can be physically removed from the wastewater. But who ever said bacteria were the only organisms capable of such a feat?

About 25 years ago a gentleman in Willits, California named Ed Burton developed a novel way to treat wastewater. Knowing that trees love wastewater, he proposed planting trees right over a leach device called the K-6 Ecochamber. Distribution pipes allow wastewater to pass through the system and be released directly to the tree's root zones. He installed a small forest at a wastewater treatment plant in Martinez, California in the late 1970s. This system still functions, providing unequivocal proof of the success of the technology. None of the units have ever clogged and the associated trees have shown spectacular growth rates. Redwoods planted with the units grew to 40 feet tall in as little as nine years. The wastewater at Martinez is treated, so the full advantage of using untreated effluent was never gained.

Burton grew trees with effluent coming directly from his home aerobic filter and digestion system with equal success. The fundamental treatment concept is identical to conventional secondary treatment: Conversion of soluble organic matter into cellular biomass. However, instead of growing a noxious, potentially pathogenic bacterial sludge that has to be disposed of at great expense, we obtain biomass in the form of valuable tree products. In areas without significant heavy metal content in their sewage, subsurface irrigated tree farms provide a constructive alternative to conventional treatment plants.

Forestry right now is still at the hunter- gatherer stage for most of the industry. While industrial tree farming exists, silviculturalists have never had access to unlimited supplies of nutrient-rich water for irrigation.

The Burton Plan.

The effluent from a typical 20 million gallon per day treatment plant serving about 100,000 people could be distributed to a plantation of redwoods of approximately 800 acres planted at 200 trees per acre. The growth rate of redwood irrigated with this nutrient-rich water would result in a standing inventory of timber of about 8 billion board feet in 60 years, or about 133 million board feet per year.

At $1 per board foot for redwood, the city in question could earn an increase in asset value of its wastewater treatment system of $133 million dollars every year. Conventional treatment plants simply depreciate in value. Concrete does not grow. A living treatment infrastructure such as a wastewater forest, however, increases in capacity and growth of the system is genetically pre-programmed.

One could grow 1,400,000 acres of trees in US wastewater plantations. Within 60 years, the amount of timber produced with such a system rises to the staggering quantity of 28 trillion board feet, or 460 billion board feet per year. Each board foot contains about two

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pounds of cellulose which draws about three pounds of CO2 from the atmosphere for its creation. These forests therefore would remove about 690 million tons of CO2 from the atmosphere each year.

Add that to the 50 million tons that the now unneeded aeration basins no longer release into the atmosphere and you get a net reduction of 740 million tons of CO2 per year - almost 15 percent of the total US release of CO2 And trees will tie up the carbon for centuries or even millennia so the yearly savings can compound themselves. Once a wastewater forest is planted and grown for a time it will sustain itself even if you stop irrigating it. You can now move the wastewater to a new plantation and remove yet more CO2.

New Hope for Mexico

The US has already built most of its infrastructure according to the old model. Mexico, however, like many developing countries has just begun building its wastewater treatment infrastructure. Over the next 50 years such countries will spend billions of dollars for the infrastructure to collect and treat their wastewater. Unlike the US they have the chance to do it correctly.

The 1997 conference on global warming in Kyoto introduced the concept of carbon dioxide credits. I like to imagine a "carbon dollar" that can be traded. But, as with paper dollars, a carbon dollar needs a bank to store it in. The wastewater plantation can be that bank. Mexico could invite the US — the worlds largest carbon dioxide emitter — to build its carbon dollar bank using Mexico's wastewater. What better way to finance the creation of Mexico's infrastructure?

The amount of credit for each tree could be worked on a sliding scale depending on the final use of the wood product. If left as forest habitat and unharvested the trees would get the maximum credit. If harvested for construction lumber, it would get the next level of credit because the wood will still tie up the carbon for many decades. Wood-based paper products, with a shorter cycle, would get a lesser credit.

Cut CO2, Not Trees.

The US, which produces 25 percent of the world's CO2 could reduce its CO2 emissions by 15 percent. Wastewater plantations on a worldwide basis have the potential to offset current CO2 emissions entirely.

Beyond the CO2 emissions or the profitability of such systems is an even more important consideration: the inherent ecological value of forests. A forest represents the most significant buffer that the earths surface can have. Western Australia cut its forests down years back and found that the soil water table moved to the surface. Without trees, the soil dried out and water began to evaporate from the surface. In the process, salt was left behind and the entire region was converted into a desolate salt desert.

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The fact that such a simple change in waste-water treatment can compound in so many ways makes a strong argument for re-analyzing all our industries.

What is Next?

Ed Burton Company (EBC) has developed an integrated residential waste-treatment system where carbon dioxide is sequestered by redwood trees. After years of work this system is being scaled up for a municipal waste-treatment system for a typical small town of 10,000 people acompanied by about 40 acres of a redwood forest, fed underground, by the nutrient rich effluent.

We are now seeking carbon sequestration funds which will be used to build the carbon bank made of redwood trees. For further information about this process, the aquaculture and forestry technology and the resultant greenhouse gas sequestration, we suggest that you contact the following individuals.

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Best Practices for Including Carbon Sinks in Greenhouse Gas Inventories

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ABSTRACT

There is growing interest and urgency in quantifying the storage capacity of carbon sinks for inclusion in greenhouse gas (GHG) emissions inventories because of the need to quantify and reduce an organization's carbon footprint. This is especially critical for entities with large areas of forested land, such as public agencies and land-based private companies, as the potentially significant amount of carbon dioxide removed from the atmosphere could be accounted for as a net reduction in an organization's annual GHG emissions. Although there are relatively few examples to draw from for incorporating forest carbon sinks in an organizational level GHG emissions inventory, this paper provides timely guidance and concrete examples in the following three areas: best practices for calculating carbon sinks, recent developments in carbon sink guidance and U.S. reporting programs, and recommendations for including carbon sinks in an organizational GHG emissions inventory.

Recent developments in U.S. GHG reporting programs are critical for considering if and how to include forest carbon sinks in an organizational level emissions inventory. This paper includes a review of the latest emissions inventory guidance in the IPCC *Good Practice Guidance for Land Use, Land Use Change and Forestry*, the GHG Protocol's *Land Use, Land-Use Change, and Forestry (LULUCF) Guidance for GHG Project Accounting*, ICLEI-Local Governments for Sustainability's *Urban Forestry Toolkit*, and the California Climate Action Registry and Chicago Climate Exchange requirements for emissions reduction forestry projects.

INTRODUCTION

Greenhouse gas (GHG) emissions accounting is an area of growing interest and concern for public agency and private organization managers because of the expanding opportunities in emissions reporting and GHG emission registries, the potential for carbon offsets production, and the growing pressure for GHG accountability in the public sector. Although it is quickly becoming more streamlined and standardized, the practice of GHG emissions accounting and reporting in the U.S. is still plagued with inconsistencies due to the variety of emerging policies and programs in different jurisdictions, and the disparity in reporting requirements for different public and private programs.

Carbon sequestration is the process of incorporating atmospheric carbon into plants, soils, and water. Those resources or processes that incorporate atmospheric carbon are commonly referred to as "carbon sinks" because of their ability to take up, as opposed to emit, GHG emissions. However, carbon sequestration calculations can be difficult to perform, due to data requirements, complexity of estimation methodologies and uncertainties. Many factors, including geographic location, temperature, humidity, and species dominance, will affect the rate of carbon sequestered by forested land in a given area. The calculation of affects impacting factors, but not directly connected with the carbon cycle or GHG effects, presents an additional level of complexity

This paper on GHG emissions accounting provides an overview of accounting and reporting protocols for emissions inventories that may include carbon sinks; a review of carbon sinks and recommendations

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for calculating carbon capture from biological sequestration; and insights into emerging standards and practices for carbon sinks reporting.

STANDARDS, PROTOCOLS AND PRINCIPLES

The current practice of GHG emissions accounting is guided by two main sources of standards and protocols:

- The Greenhouse Gas Protocol (GHG Protocol) of the World Resources Institute (WRI) and the World Business Council on Sustainable Development (WBCSD); and
- The technical reports and methodology guidelines of the Intergovernmental Panel on Climate Change (IPCC).

Although several programs for reporting, registering and trading emissions exist throughout the U.S. and abroad, they are mainly based on the standards and protocols of the GHG Protocol and IPCC guidelines, which are widely accepted as best practice in GHG emissions accounting. A third standard which is specific to cities and municipal agencies was developed by ICLEI-Local Governments for Sustainability (ICLEI).

In April 2007, the USEPA released an inventory of U.S. GHG emission inventories and sinks for 1990 through 2005 (the U.S. national GHG inventory). The inventory makes use of the IPCC guidelines including the updates presented in *2006 Guidelines for National Greenhouse Gas Inventories.* The inventory developed included a key category analysis for the Inventory which was consistent with IPCC's LULUCF guidelines for a Tier 1 approach. This analysis looks at prioritized sink/source categories considered to be a significant influence on the total national inventory either in terms of emissions or trends in emissions. The Tier 1 analysis quantitatively identifies key categories from LULUCF categories as well as other, while qualitatively assessment of source categories not captured in the quantitative analysis.

Accounting and Reporting Principles

According to the Corporate GHG Accounting and Reporting Module (WRI/WBCSD March 2004), the following principles should be applied to the process of accounting for and reporting GHG emissions:

- "Relevance - Ensure the GHG inventory appropriately reflects the GHG emissions of the organization and serves the decision-making needs of users – both internal and external to the organization;
- "Completeness - Account for and report on all GHG emission sources and activities within the chosen inventory boundary. Disclose and justify any specific exclusions;
- "Consistency - Use consistent methodologies to allow for meaningful comparisons of emissions over time. Transparently document any changes to the data, inventory boundary, methods, or any other relevant factors in the time series;
- "Transparency - Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies and data sources used; and
- "Accuracy - Ensure that the quantification of GHG emissions is systematically neither over nor under actual emissions, as far as can be judged, and that uncertainties are reduced as far as practicable. Achieve sufficient accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information."

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The GHG Protocol

The GHG Protocol is the pre-eminent standard for conducting a GHG emissions inventory. Launched in 1998, the GHG Protocol is a multi-stakeholder partnership of businesses, non-governmental organizations, governments, academics and others convened under WRI and WBCSD. Its mission is to develop and promote broad adoption of internationally accepted GHG accounting and reporting standards and protocols.

The GHG Protocol Initiative provides two reference documents as well as a set of tools for all corporations and other organizations to identify, calculate, and report GHG emissions based on the same set of standards. The GHG Protocol has been successful in establishing the "gold standard" in emissions inventories, and has guided the development of regulatory and voluntary GHG reporting and trading programs around the world. Most programs base their accounting and reporting requirements on the GHG Protocol including, but not limited to, the California Climate Action Registry, the Eastern Climate Registry (formerly known as the Regional Greenhouse Gas Registry) the EU Emissions Trading Scheme, the Chicago Climate Exchange, and the U.S. EPA Climate Leaders Program.

The GHG Protocol consists of two modules, or guidebooks, for developing GHG emissions inventories:

- The Corporate GHG Accounting and Reporting Module, first published in October 2001 (a revised edition published in 2004); and
- The Project GHG Accounting and Reporting Module, published in November 2005.

In addition to the two guidebooks, the GHG Protocol provides more than sixteen calculation tools that represent best practice with regard to calculating GHG emissions for specific industries and sectors. The calculation tools are consistent with the IPCC guidelines for preparing national emissions inventories.

Figure 1 summarizes the three different categories, or "scopes", of emissions under the GHG Protocol (adapted from the WRI GHG Protocol). As a general rule, data for direct emissions, including direct energy generation, wastewater treatment, travel in vehicles owned by the company/organization, fugitive GHG emissions, and landfill gas, should be reported. Indirect emissions from purchased electricity and steam are also included. GHG emissions from non-company-owned vehicles or other employee travel, waste disposal, outsourced activities, product use, and purchased materials are optional to report under most programs.

IPCC Guidelines and Methodology Reports

The IPCC was established by the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP) in 1988. The role of the IPCC is to provide independent assessments of the scientific, technical and socio-economic information relevant to understanding climate change, its potential impacts and options for adaptation and mitigation. These assessments are based on peer reviewed, published scientific and technical literature, compiled and reviewed by international scientific, policy and economic experts of the IPCC.

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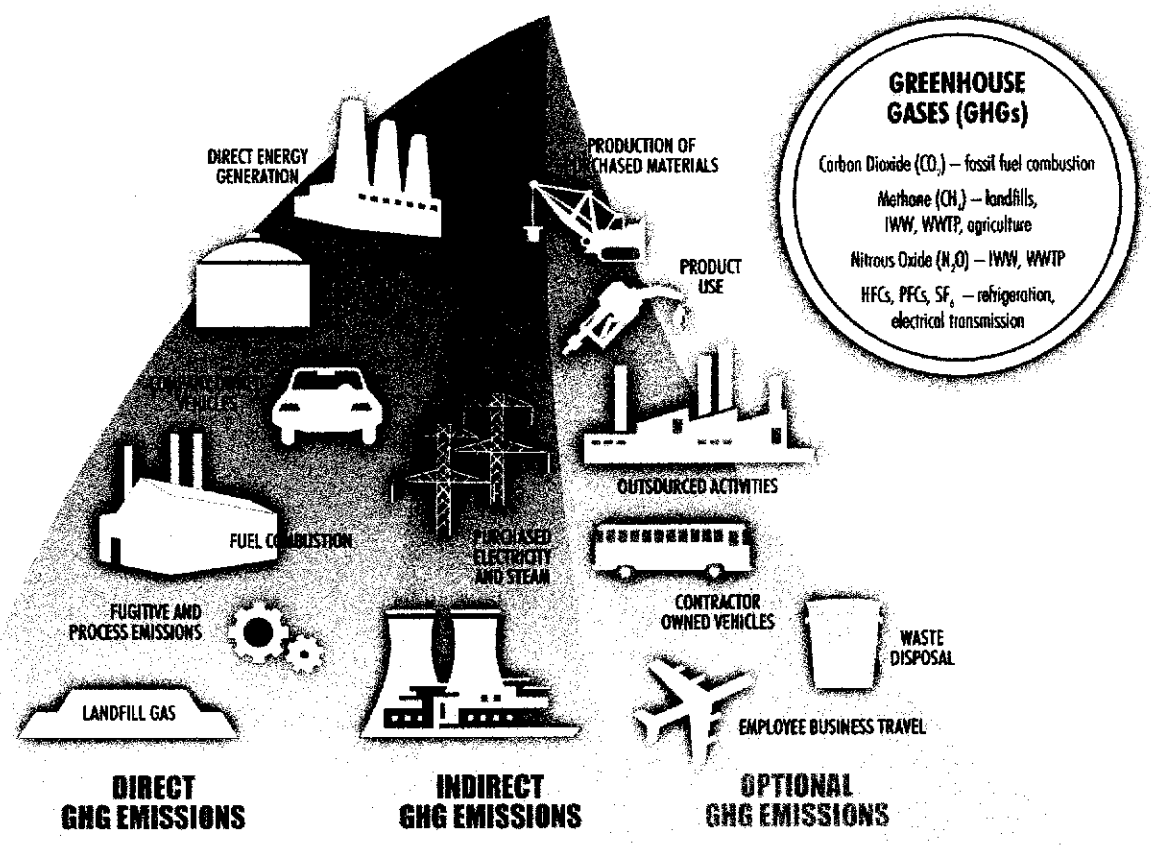

Figure 1. GHG Protocol Emissions Scopes

A main activity of the IPCC is to provide in regular intervals an assessment of the state of knowledge on climate change. The First IPCC Assessment Report was completed in 1990. The Second Assessment Report, Climate Change 1995, provided key input to the negotiations, which led to the adoption of the Kyoto Protocol in 1997. The Third Assessment Report was issued in 2001, and the Fourth Assessment Report was issued in 2007. The IPCC also prepares Special Reports and Technical Papers on topics where independent scientific information and advice is deemed necessary, and it supports the UN Framework Convention on Climate Change (UNFCCC) through its work on methodologies for National Greenhouse Gas Inventories.

IPCC Methodology Reports describe methodologies and practices for national greenhouse gas inventories and are used by Parties to the UNFCCC for preparing their national communications. The first IPCC Guidelines for National Greenhouse Gas Inventories were prepared in 1994 and revised in 1996. They are currently undergoing another major revision and new IPCC Guidelines for National Greenhouse Gas Inventories will be available in early 2007. In addition, the following Methodology Reports have been published:

- Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (2000);

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- Good Practice Guidance for Land Use, Land-Use Change and Forestry (2003); and
- Definitions and Methodological Options related to Inventory Emissions from Direct Human-Induced 'Degradation' of Forests and 'Devegetation' of other Vegetation Types (2003).

These documents provide additional guidance for national and corporate emissions accounting, and are considered the standard worldwide for best practice in emissions inventories.

ICLEI Cities for Climate Protection ™ Campaign

ICLEI – Local Governments for Sustainability (ICLEI) is an international membership association for local governments. This non-profit organization runs the Cities for Climate Protection ™ (CCP) campaign, a program for local governments promoting greenhouse gas (GHG) emission reductions. Participants in CCP are encouraged to conduct an emissions inventory with software created specifically for local government use.

Although primarily based on the same accounting principles as the GHG Protocol and IPCC standards there are some important distinctions to note about the CCP Program:

- ICLEI emissions inventories often include the residential, commercial and transportation sectors within the agencies jurisdiction, and do not limit inventory boundaries to operational or equity control;
- The CCP emissions inventory program also includes the solid waste sector, one that is typically not included, or optional, in other accounting programs;
- Emissions factors in the ICLEI software program may differ from IPCC and GHG Protocol; and
- The CCP program is policy-based and intended to aid local decision-makers. It is not intended for GHG reporting or regulatory purposes.

CARBON SEQUESTRATION AND CARBON SINKS

Carbon sequestration is the process of incorporating atmospheric carbon into plants, soils, and water. Those resources or processes that absorb atmospheric carbon are commonly referred to as "carbon sinks" because of their ability to absorb, as opposed to emit, GHG emissions. Practices and processes that sequester carbon dioxide from the atmosphere include:

- Conservation of riparian buffers;
- Conservation tillage on croplands;
- Grazing land management;
- Afforestation;
- Reforestation;
- Forest preservation or avoided deforestation;
- Forest management;
- Underground geologic depositories; and
- Oceanic uptake.

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Sequestration occurs in forests and soils primarily through photosynthesis. Carbon dioxide in the atmosphere is incorporated as fixed carbon into the roots, trunk, branches and leaves of trees, with roughly 50 percent of tree carbon storage occurring in the woody biomass (EPA 2007). The shedding of leaves does not constitute a large carbon release, as only 3% of tree carbon storage occurs in foliage, and most will be absorbed by the soil (ICLEI 2006). Carbon is released to both the soil and the atmosphere when the biomass decays. **Figure 2** shows the processes through which trees and soils gain and lose carbon. Soil carbon pools in forest lands and croplands can increase or decrease depending on inputs from plant-fixed carbon in leaves, stems and roots; human-related inputs (e.g., fertilizer); and type of management practice (e.g., conventional vs. conservation tillage) (EPA 2007a).

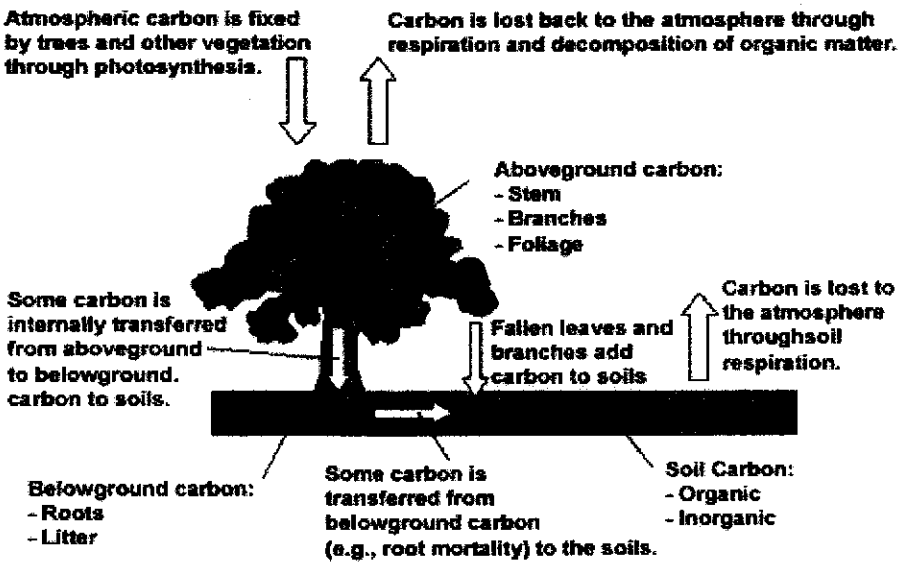

Figure 2. Carbon Sequestration in Trees and Soil. Source: EPA 2007a

Several factors affect how much carbon trees can absorb, including tree size, age and species. A mature tree can absorb up to 48 lbs of carbon dioxide a year (McAliney 1993). In fact, large trees at maturity can store approximately 1000 times more carbon dioxide than saplings (Nowak 2001). This difference highlights the importance of maintaining large tracts of healthy, mature forest, which will be much more useful in establishing carbon sinks than planting saplings. Different species of trees will also absorb different amounts of carbon dioxide (ICLEI 2006).

Another component that affects the carbon sequestration rates of forests is the amount of decomposition versus new growth occurring. If a forest is experiencing growth in the number and size of trees, it will function as a more effective sink because new growth will absorb carbon lost from decay. However, if the area of forested land is getting smaller (due to tree removal, disease, acid rain, etc.), net carbon storage will be lower, due to both a reduction of the sequestration rate, and the carbon released from tree removal and uprooting, and soil disruption.

Calculating Emissions Sinks from Forested Land

There is growing interest in quantifying the storage capacity of carbon sinks, especially in forested land area, because of the need to quantify and reduce an organization's carbon footprint. These calculations can be difficult to perform, however, as scientific investigations continue to develop and our understanding of how carbon cycles through the environment also improves. Many factors, including geographic location, temperature, humidity, and species dominance, will affect the rate of carbon sequestered by forested land in a given area.

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Table 1 provides examples of different methods for carbon sequestration in forest practices, the resultant effects on greenhouse gases, and the range of carbon sequestration rates provided by EPA (EPA 2007b). Notice particularly that forests provide a very long period of carbon sequestration before becoming saturated with carbon. Secondary forests and other types of degraded forests can become effective sinks when allowed to reestablish themselves as healthy productive forestland.

In looking at Table 1, it is important to note that while this paper focuses on the calculation of carbon sequestration from forest practices, the development, management, and maintenance of forests can result in some amount of carbon sources. For example, fuel combustion and mobile emission sources associated with preparing land for planting/reforestation, or optional GHG emission estimates associated with changes in product due to forest management practices. While all these emission sources can generally, easily be mitigated through combustion fuel selections, choices of equipment used, and review of management practices, they should be considered and included when developing a complete emission inventory.

Table 1. Methods and Rates for Carbon Sequestration in Forests. Source: EPA 2007b

Key Forestry Practices	Typical definition and some examples	Effect on greenhouse gases	Carbon sequestration rate in U.S. Metric tons CO_2 /acre/year	Time over which sequestration may occur before saturating
Afforestation [a]	Tree planting on lands previously not in forestry (e.g., conversion of marginal cropland to trees).	Increases carbon storage through sequestration.	0.6 – 2.6 [b]	90 – 120+ years
Reforestation [c]	Tree planting on lands that in the more recent past were in forestry, excluding the planting of trees immediately after harvest (e.g., restoring trees on severely burned lands that will demonstrably not regenerate without intervention).	Increases carbon storage through sequestration.	0.3 – 2.1 [d]	90 – 120+ years
Forest preservation or avoided deforestation	Protection of forests that are threatened by logging or clearing for development.	Avoids CO_2 emissions via conservation of existing carbon stocks.	Based on existing carbon stock	Depends on age of existing carbon stocks
Forest management	Modification to forestry practices that produce wood products to enhance sequestration over time (e.g., lengthening the harvest-regeneration cycle, adopting low-impact logging).	Increases carbon storage by sequestration and may also avoid CO_2 emissions by altering management. May generate some N_2O emissions due to fertilization practices.	0.6 – 0.8 [e] 0.2 [f]	If wood products included in accounting, saturation does not necessarily occur if C continuously flows into products

Note: Any associated changes in emissions of methane (CH_4) nitrous oxide (N_2O) or fossil CO_2 not included.

a) Values are for average management of forest after being established on previous croplands or pasture.
b) Values calculated over 120-year period. Low value is for spruce-fir forest type in Lake States; high value for Douglas Fir on Pacific Coast. Soil carbon accumulation included in estimate.
c) Values are for average management of forest established after clearcut harvest.
d) Values calculated over 120-year period. Low value is for Douglas Fir in Rocky Mountains; high value for Douglas Fir in Pacific Coast. No accumulation in soil carbon is assumed.
e) Select examples, calculated over 100 years. Low value represents change from 25-year to 50-year rotation for loblolly pines in Southeast; high value is change in management regime for Douglas Fir in Pacific Northwest. Carbon in wood products included.
f) Forest management here encompasses regeneration, fertilization, choice of species and reduced forest degradation. Average estimate here is not specific to U.S., but averaged over developed countries.
g) Assumed that carbon sequestration rates are same as average rates for lands under USDA Conservation Reserve Program.

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Best Practices for Carbon Sinks Accounting

Accounting for carbon sinks in emissions inventories is an evolving practice, and one with little guidance developed to date at the organizational level. This section provides an overview of the guidance and standards currently available on accounting for carbon sinks in emissions inventories, as well as a brief summary of the requirements for counting forestry projects as marketable carbon offsets.

IPCC Guidance

The IPCC's Good Practice Guidance for Land Use, Land Use Change and Forestry (LULUCF) provides guidance on estimation methodologies, quality assurance and control procedures, documentation and reporting, and quantification of uncertainties for carbon sinks accounting (IPCC 2003). This guidance is intended primarily for use in national GHG inventories as opposed to organizational level accounting. However, it provides the foundation for the estimation of GHG sinks on a smaller scale as utilized by other organizations and registries.

A preliminary element of determining carbon reductions from land use sequestration is the estimation of representative land use areas. Only broad descriptions are provided by IPCC as it is assumed each nation will use its own land use subcategories. The broad categories include forest land, crop land, grassland, wetlands, settlements, and "other". The main focus of this estimation is to determine the change in land uses over time. The actual estimation of GHG emissions sequestered or emitted is based on the following in relation to the land use categories defined by the nation or organization:

- Carbon assessments are done by the broad land use categories listed above;
- Uncertainties are also estimated and minimized where possible; and
- All emissions and calculations are reported and archived per the guidelines proved and quality control/assurance checks are implemented.

The first order approximations are calculated using **Equation 1**:

$$\Delta C = \sum_{ijk} \left[A_{ijk} \bullet \left(C_I - C_L \right)_{ijk} \right]$$

Where: ΔC = carbon stock change in the pool (tons of Carbon/year)

A = Area of Land (ha)

ijk = corresponds to climate type i, forest type j, management practice k, etc.

C_I = rate of gain of carbon (tonnes C ha-1 yr-1)

C_L = rate of loss of carbon (tonnes C ha-1 yr-1)

Additional information on quantification of carbon sinks associated with wetlands, cropland, grasslands, and other land uses can be found in Chapter 3 of the IPCC Good Practice Guidance for LULUCF (IPCC 2003).

GHG Protocol Guidance

The GHG Protocol provides guidance for organizational level inventory and reduction project accounting. The Land Use, Land-Use Change, and Forestry (LULUCF) Guidance for GHG Project Accounting (WRI/WBCSD 2006) was recently developed by the GHG Protocol to supplement existing guidance on project accounting. This document provides more specific guidance and uses more

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appropriate terminology and concepts to quantify and report GHG reductions from LULUCF project activities.

The LULUCF guidance document focuses on reforestation and forest management, and can be used for avoided deforestation project activities, although they are not explicitly discussed. The main components of carbon sinks accounting that are relevant for inventories at the entity level as provided in this document are summarized briefly below:

- Defining the assessment boundary: carbon sinks under the operational control and ownership of the organization should be included in the assessment. The significance of secondary effects should be determined at this step, such as emissions from fertilizer use in afforestation projects.
- Selecting a baseline procedure: project-specific or performance based procedure should be selected, depending on the data available.
- Identifying the baseline candidates: identify alternative land uses or management practices on forestlands in a specific geographic region in a given temporal range.
- Estimating the baseline GHG removals: account for the carbon stocks, the change in carbon stocks and the GHG removals associated with the baseline scenario.
- Applying a land use or management trend factor: estimate the rate at which land-use or management changes are occurring.
- Estimating and quantifying carbon stocks: identify living biomass, dead organic matter and soils to measure, and quantify through direct measurement, default values, or modeling.
- Monitoring and quantifying GHG reductions: to ensure that carbon sequestration is taking place, develop a monitoring and verification plan.
- Carbon reversibility management: intentional (harvesting) and unintentional activities (forest fires) can alter carbon stocks, and should be considered in management planning.
- Reporting GHG reductions and net carbon stocks: reporting requirements differ by program, and should be considered in developing data management and verification procedures.

<u>ICLEI Urban Forestry Toolkit</u>

The ICLEI CACP software for emissions inventories does not include a module for carbon sinks accounting, nor do they generally advise on including carbon sinks in a municipal emissions inventory. However, given the increased amount of interest from their local government members in including carbon sequestration in their carbon footprints and GHG reduction analysis, they recently developed guidance on this issue.

ICLEI's "Protocol for Including Urban Forestry in an Emissions Reduction Plan" focuses primarily on urban trees, or street trees, but can be applied to basic forestry sink accounting practices (ICLEI 2006). This document provides guidance on incorporating both the direct carbon dioxide sequestration and ambient climatic effects that shade, solar energy reflection and transpiration have on energy use in an emissions inventory and reduction plan. ICLEI recommends including these emissions as "other" emissions, outside of the sectors normally included.

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The Climate Registry

The Multi-State Climate Registry (MSCR), now known as The Climate Registry, is a new organization in development to provide a GHG registry for voluntary and mandatory GHG reporting, based on the combined interest of over thirty states and organizations including the California Climate Action Registry. According to a recently released work plan, the MSCR is anticipating a late 2007 launch date (Multi-State Climate Registry 2006). In a departure from existing U.S. based reporting programs at the organizational level, the MSCR has already indicated their intent to require the inclusion of carbon sinks in their GHG accounting and reporting program:

> "There is significant state/tribe interest in developing a rigorous accounting framework that could also quantify and characterize CO2 removals from the atmosphere. These removals, or sinks, might include terrestrial sequestration activities (e.g. forest or agricultural soil based activities) as well as geologic sequestration. The Multi-State Climate Registry would develop a comprehensive framework for accounting and reporting for sink activities, from both a project and entity approach, as soon as reasonably feasible during implementation." (Multi-State Climate Registry 2006)

Carbon Offsets

A carbon offset is a marketable commodity that represents the reduction in GHG emissions from a specific project undertaken by an organization. In order to be considered as a "carbon offset" project, a project must meet the criteria of *additionality*. Although subject to interpretation, additionality is defined by the GHG Protocol (WRI/WBCSD 2004) as "a criterion for assessing whether a project has resulted in GHG emission reductions or removals in addition to what would have occurred in its absence." Installing energy-saving light fixtures, adopting fuel-reduction protocols, or permanently protecting forestland for the express purpose of carbon sequestration would all be examples of *additional* measures an organization could take to reduce its carbon footprint.

Currently, the California Climate Action Registry (CCAR) accepts three types of forest projects as GHG reduction projects, including conservation-based forest management, reforestation, and conservation, or preventing the loss of forests to land use changes. Similar to other methodologies and requirements, the project must show long-term commitment to sustaining and maintaining the forest lands in order to qualify under CCAR. Also similar, what can be "counted" are those benefits in addition to the baseline or regulatory requirements already in place. For example, for a conservation project, the project must show there is no existing law or permit already requiring or allowing conservation of the proposed project area. On-going monitoring would be required to show the area has been protected.

The Chicago Climate Exchange (CCX) has also established rules and guidelines for estimating and issuing of carbon offsets, or Carbon Financial Instruments (CFI™), for forest carbon sequestering. CCX has grouped eligible projects into three types: forestation and forest enrichment; combined forestation and forest conservation projects in specified regions; and urban tree planting. Key elements of project eligibility include:

- As with other emission reductions associated with CCX, eligible projects include those initiated on or after January 1, 1990; and
- Projects must show long-term commitment and sustainability.

Actual CFI™ offsets earned are estimated based on the annual increase in carbon stocks during the CCX program years (2003 through 2010). Offset quantification methodologies vary based on the project size:

- For small to medium forestation projects, carbon accumulation is estimated using carbon accumulation tables or use of direct, in-field measurement and sampling; and

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- For large forestation projects, carbon accumulation is estimated using direct, in-field measurement and sampling or parameterized growth models.

CONCLUSIONS

Due to the potentially large amount of carbon dioxide sequestered by forested land acquired, maintained and managed by a variety of U.S. entities, it is recommended that these organizations consider including carbon sequestration from land acquisition activities in their emissions inventory and management planning. Several items to consider before moving forward with conducting a carbon sinks inventory and GHG management planning include:

- Data requirements can be extensive and include the location and size of forested properties, species composition, forest age, estimates of forest cover; and any management practices employed.

- Given the emerging practices and opportunities for reporting, it is very important that organizations follow the most up-to-date guidelines for carbon sinks accounting. Specifically, pay close attention to The Climate Registry as they intend to develop protocols for incorporating carbon sinks in annual emissions accounting; and

- Additional information and a detailed inventory of forested land will be required in order to prepare accurate, current sequestration rates and emission sinks calculations.

Although currently limited to national inventories and forestry organizations, more and more organizations will be attempting to report their carbon sinks as a component of annual GHG emissions inventories, and managing those emissions to maximize net emissions reductions over time.

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EXHIBIT

10.15

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KEYWORDS
Greenhouse gas emissions
Carbon sequestration
Carbon sinks
Emissions inventories
Climate change

EXHIBIT
10,15

EXHIBIT

11.1

America and Europe. In December 2006, however, Qatar announced that the LNG from one project originally targeted for Atlantic buyers had been sold to Asian buyers in the Pacific basin.

Africa and non-OECD Asia (excluding China and India) are expected to be important sources of natural gas production in the future. For each of the two regions, natural gas production in 2030 is projected to be some 10 trillion cubic feet above 2004 production levels. The two regions combined accounted for 14 percent of the world's natural gas production in 2004; in 2030, their combined share is projected to be 21 percent. A significant portion of the production from both regions is exported. In 2004, 26 percent of the natural gas production from the countries of non-OECD Asia (primarily from Brunei, Indonesia, Malaysia, and Myanmar [formerly Burma]) and 50 percent of the production from African countries was for export. In 2030, the export share of production from non-OECD Asia is projected to fall to 10 percent, as domestic consumption takes precedence over exports, whereas the export share of Africa's production is projected to increase. Several pipelines from North Africa to Europe are under consideration, and LNG export capacity in West Africa continues to expand.

Historically, the United States has been both the largest producer and the largest consumer of natural gas in North America, and Canada has been the primary source of U.S. natural gas imports. In 2004, Canada provided 85 percent of gross U.S. imports of natural gas. Although Canada's unconventional and Arctic production both are expected to increase over the projection period, and LNG imports into Eastern Canada are expected to begin by the end of the decade, those supply increases are not expected to be sufficient to offset a decline in conventional production in Canada's largest producing basin, the Western Sedimentary Basin. Gross U.S. imports of LNG are projected to exceed gross pipeline imports from Canada after 2015, and Canada's share of gross U.S. imports is projected to decline to 25 percent in 2030.

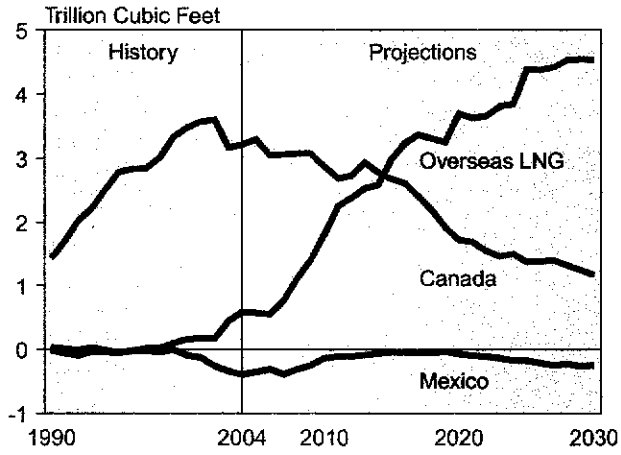
Rising natural gas prices are expected to make it economical for two major North American pipelines that have long been in the planning stages to come online. The first, a Canadian pipeline to transport natural gas from the MacKenzie Delta, is expected to become operational in 2012. The second, an Alaska pipeline, is expected to begin transporting natural gas from Alaska to the lower 48 States in 2018, contributing significantly to U.S. domestic supply. Alaska's natural gas production accounts for all of the projected growth in domestic U.S. conventional natural gas production from 2004 to 2030, with flows on the Alaska pipeline increasing to 2.2 trillion cubic feet in 2030. As a result, Alaskan production is projected to account for 22 percent of the increase in U.S. natural gas supply in 2030 relative to the 2004 total.

A large portion of North America's remaining technically recoverable resource base of natural gas consists of unconventional sources, which include tight sands, shale, and coalbed methane. With most of the large onshore conventional fields in the United States already having been discovered, the United States, like Canada, must look to these costlier sources of supply to make up for declines in conventional production. Unconventional production, especially from tight sands formations, is expected to be a significant source of U.S. incremental supply, increasing from 40 percent of total domestic production in 2004 to 50 percent in 2030 and accounting for 28 percent of the increase in U.S. natural gas supply in 2030 relative to the 2004 total.

By far the largest source of U.S. incremental natural gas supply (50 percent of the increase in 2030 relative to 2004) is expected to be LNG. Currently, the United States has five LNG import facilities in operation with a total peak capacity slightly above 5.8 billion cubic feet per day. Four additional facilities are under construction in the Gulf of Mexico. When completed, the four new terminals will more than double U.S. LNG import capacity. Peak annual U.S. LNG import capacity in 2030 is projected to reach 6.5 trillion cubic feet, with actual imports of 4.5 trillion cubic feet (Figure 46).

The growth of U.S. LNG imports is expected to be strong through most of the projection period. The significant

Figure 46. U.S. Net Imports of Natural Gas by Source, 1990-2030



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SAN LUIS OBISPO COUNTY
DEPARTMENT OF PLANNING AND BUILDING

VICTOR HOLANDA, AICP
DIRECTOR

October 10, 2006

Mr. Rob Shipe
(address n/a – request received via hand delivered request on 10/10/06)

Re: Request for Documents

Dear Mr. Shipe:

Enclosed are the items you personally requested on Tuesday, October 10, 2006, in our Permit Center. Your request resulted in 14 copies at a cost of $ .10/per copy which comes to a grand total of $1.40.

Upon remittance of the above amount, you may obtain the documents requested.

Please note, as of this date, there is no correspondence available between Matt Janssen of the County of San Luis Planning Department and the California Regional Water Quality Control Board regarding the Los Osos Moratorium.

Thank you.

Mary Velarde
Planning Department Secretary

Encl's: 2-21-84 Letter to Chuck Stevenson
Re: Implementation of Resolution 83-12 (2-pages)

Memo of Understanding
Regional Water Quality Control Board &
County of San Luis Obispo (3-pages)

1-21-88 Letter from Paul Crawford to Roger Briggs – RWQCB
Re: Los Osos Moratorium (2-pages)

2-8-88 Letter to Paul Crawford from William Leonard – RWQCB
(2-pages)

12-16-83 Letter from Kenneth Jones - RWQCB to Various (2-pages)

9-21-06 Letter from Victor Holanda – County of San Luis Obispo to
Roger Briggs – RWQCB (1-page)

EXHIBIT
12.1

COUNTY GOVERNMENT CENTER · SAN LUIS OBISPO · CALIFORNIA 93408 · (805) 781-5600
EMAIL: planning@co.slo.ca.us · FAX: (805) 781-1242 · WEBSITE: http://www.sloplanning.org

STATE OF CALIFORNIA
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD —
CENTRAL COAST REGION
1102 A LAUREL LANE
SAN LUIS OBISPO CALIFORNIA 93401
(805) 549 3147

GEORGE DEUKMEJIAN, Governor

JM SMO — SMAS —

February 21, 1984

RECEIVED

FEB 23 1984

S.L.O. COUNTY
PLANNING DEPT.

Mr. Chuck Stevenson
San Luis Obispo County
Planning Department
County Government Center
San Luis Obispo, CA 93408

Dear Mr. Stevenson:

SUBJECT: IMPLEMENTATION OF RESOLUTION 83-12

As per your request, enclosed are copies of the State Water Resources Control Board Guidelines for Mound Systems and Evapotranspiration Systems. All such systems permitted by San Luis Obispo County must be built to these standards. The Regional Board need not be consulted for approval of these systems unless a Basin Plan prohibition exemption is requested. For your information, the evapotranspiration system design calculations may be modified as described on page 8 of Resolution 83-12.

The general process for on-site system approval is as follows:

1. On-site disposal systems serving up to five dwelling units or designed for less than 2500 gallons per day are under the regulatory authority of San Luis Obispo County. The Regional Board, which has conditionally waived regulation of this size system, need not be informed of approval or denial of these systems.

2. Alternative on-site disposal systems (mound or evapotranspiration systems) must be built to meet state guidelines. The Regional Board need not be informed of system approval or denial.

3. All requests for variances from the Basin Plan prohibitions first are to be submitted to the County for review. If the County is willing to accept the request, the proposal is then submitted to the Regional Board by the County for approval, conditional approval, or denial. Submittals for Basin Plan prohibition exemptions must come from the County. The Regional Board will not consider a request that has been denied by the County.

EXHIBIT

12.2

4. The Regional Board may determine specific on-site systems serving more than five units or 2500 GPD are best subject to local control. In such cases, Regulatory control will be delegated to the County in writing. All such systems will be subject to County and Basin Plan criteria.

Any revisions to County ordinances or procedures should be discussed with this Board's staff to ensure that Basin Plan criteria are interpreted the same by all parties.

If you have any questions concerning interpretation of the Basin Plan criteria or approval of on-site systems, please contact John Goni of this Board's staff.

Very truly yours,

KENNETH R. JONES
Executive Officer

JG:bf

Enclosure

cc: San Luis Obispo County Health Dept.

EXHIBIT

12.3

MEMORANDUM OF UNDERSTANDING
REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION
AND
COUNTY OF SAN LUIS OBISPO

I. BACKGROUND

Section 13260 of the California Water Code authorizes the Regional Water Quality Control Board, Central Coast Region, (Regional Board), to regulate all discharges which could affect the quality of waters in the State, including discharges from individual sewage disposal systems. However, Section 13269 of the California Water Code permits the Regional Board to waive regulatory provisions as to a specific type of discharge where such a waiver is in the public interest.

Pursuant to the delegation of authority in Regional Board Resolution No. 70-1, the Executive Officer has waived reporting of waste discharges under specific conditions, including single family dwellings having individual on-site waste disposal systems.

The Regional Board encourages direct regulation by individual counties where such a policy is mutually beneficial. For dwellings involving five-family units or less, the Regional Board will waive consideration of discharge permits to County authorities. Waiver is conditional upon County administrative authorities enforcing the Regional Water Quality Control Plan, Central Coastal Basin (Basin Plan), prohibitions governing installation of individual sewage disposal systems and otherwise assuring favorable conditions wherever Basin Plan individual sewage disposal systems installation recommendations are not met.

The County of San Luis Obispo has adopted and implemented individual sewage disposal system regulations (Ordinance No._____) in conformity with the Basin Plan and said regulations are at least equal to waste discharge requirements that the Regional Board would establish.

In the County of San Luis Obispo, the Planning Director is the administrator of the individual sewage disposal system regulations.

II. PURPOSE

This Memorandum of Understanding defines cooperative roles for the County of San Luis Obispo and the Regional Board with respect to regulation of on-site sewage disposal systems and compliance with the purpose and intent of the Basin Plan and applicable County ordinances and regulations.

EXHIBIT

12.4

III. MANAGEMENT AND ADMINISTRATION

1. The County representative responsible for the administration of the applicable individual sewage disposal system ordinances and regulations shall assure that all approved systems comply fully with such ordinances and regulations.

2. When permits issued for individual sewage disposal systems comply fully with applicable County ordinances and regulations, the Regional Board need not be notified nor consulted.

3. When variance is being sought from County individual sewage disposal system regulation or where compliance with such regulation may be questionable or subject of dispute, the Regional Board's staff shall be consulted.

4. At any time that the County representative responsible for the administration of the individual sewage disposal system regulations feels the need to consult with or refer matters contained in this Memorandum of Understanding to the Regional Board, the Regional Board staff agrees to provide assistance.

5. No individual sewage disposal system approvals shall be issued which are not consistent with Basin Plan prohibitions unless prior approval of the Regional Board's Executive Officer is obtained.

6. The Regional Board will send the County new and amended Basin Plan sections relative to individual sewage disposal systems prohibitions and/or regulations.

7. Regional Board shall assume jurisdiction for all community sewage collection, treatment and disposal systems. Such community sewage and disposal systems are defined as any system having more than five dwellings being served by a common treatment and disposal system or any combination of commercial, industrial, or dwelling units having a total discharge in excess of 2,500 gallons per day regardless of the mode of treatment and disposal.

8. Individual sewage treatment and/or disposal systems alternatives to conventional septic tanks, leach fields, seepage pits and adsorption beds will be evaluated according to guidelines to be promulgated by the State Water Resources Control Board following a study of all such systems. In the interim, approval of alternative treatment and/or disposal systems shall be given only if the proponent will install such systems at one or two selected locations and shall provide adequate research and monitoring to demonstrate the efficiency of such alternative system. In addition, proponents shall provide bonds to the County sufficient to replace, repair or otherwise provide waste treatment and/or disposal for the properties involved. Final acceptance of such alternate systems shall rest with the County after consultation with the Regional Board staff.

EXHIBIT

12.5

9. This agreement shall be renegotiable upon the request of either party.

APPROVED:

CALIFORNIA REGIONAL WATER QUALITY
CONTROL BOARD, CENTRAL COAST REGION

By_____
HAROLD M. COTA, Ph.D., Chairman

Date_____

COUNTY OF SAN LUIS OBISPO

By_____
Chairman,
Board of Supervisors

Date_____

EXHIBIT

12.C

Department of Planning and Building
San Luis Obispo County

County Government Center
San Luis Obispo
California 93408
(805) 549-5600

Paul C. Crawford, AICP
Director

January 21, 1988

Mr. Roger Briggs
California Regional Water Quality Control Board
1102A Laurel Lane
San Luis Obispo, CA 93401

Dear Mr. Briggs:

SUBJECT: LOS OSOS MORATORIUM

This is intended to summarize the conclusions reached at our meeting on January 21, 1988, which included John Goni and Jay Kano of your staff, Tim Mazzacano, county Director of Environmental Health, Fred Norton and Doug Morris of my staff, you and I. We met to clarify the provisions of your Board's order of January 8, and agreed upon the following points, all of which resulted from the basic understanding that the order of the Regional Water Quality Control Board prohibits this office from issuing any construction permits which would result in new sewage discharge or increases in discharge from existing sewage disposal systems within the prohibition area.

1. Independent structures without toilets or other plumbing fixtures (e.g. detached garages) may be approved.

2. Additions to existing buildings which would normally (in circumstances other than the moratorium) require accompanying expansion of on-site sewage disposal (septic) systems shall not be approved, even where the existing septic system was originally oversized and could accommodate the addition without expansion.

3. Proposed living area (not bedroom) additions to existing dwellings will be processed per normal procedures: if they would not normally require accompanying septic system expansion, we will approve them.

4. Any change in occupancy of commercial structures which would increase the "fixture unit" requirements per the Uniform Plumbing Code shall not be approved.

EXHIBIT

12.7

5. Alterations of existing buildings which propose additional plumbing fixtures, including but not limited to water supply fixtures, drain or disposal fixtures, shall not be approved. No replacement of existing fixtures shall be approved except where replacement is in-kind or involves a reduction in the actual number of fixtures. No "credit" will be allowed for fixtures which use less water.

6. Commercial shell buildings may undergo internal modifications through tenant improvements, limited only by the design capacity of the originally-approved and installed septic system.

7. Swimming pools and hot tubs/spas may be approved.

8. Holding tanks shall not be allowed as a method of sewage disposal.

9. No "exotic" disposal systems shall be allowed as an alternative to the moratorium.

10. Repair and/or replacement of existing septic systems will be approved as usual.

11. An expired building permit shall not be reissued.

12. Exceptions to any of the above "prohibitions" may be granted by the Regional Water Quality Control Board.

Please notify me as soon as possible if your understanding of any of the above points differs from mine.

Sincerely,

Paul C. Crawford

PAUL C. CRAWFORD
Director of Planning and Building

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EXHIBIT

12.8

IIA

GEORGE DEUKMEJIAN, Governor

REGIONAL WATER QUALITY CONTROL BOARD—
OAST REGION
E
CALIFORNIA 93401

ruary 8, 1988

Paul Crawford
Luis Obispo County Planning & Building Dept.
nty Government Center
Luis Obispo, CA 93408

r Mr. Crawford:

JECT: LOS OSOS MORATORIUM

nk you for your letter of January 21, 1988, summarizing clusions of our meeting on that same date. The twelve iems ted in your letter correctly describe allowable and prohibited jects within the Baywood/Los Osos moratorium area. Allowable jects are also those with complete building permit lications submitted on or before January 8, 1988. You are o correct in your basic assumption projects which create new te discharges or increases in waste discharges will not be owed.

County Planning Department may make the initial determination which projects may proceed within the moratorium area. My ff will be available to assist you in making determinations on jects difficult to define. Any applicants desiring an mption from the moratorium must make their appeal to the ional Water Quality Control Board, and should contact my ff. To grant an exemption, the applicant must provide us with following information:

1. A building permit application was complete as of January 8, 1988; or

2. The project will not generate a new or increased waste discharge; or

3. The project will result in a water quality benefit.

RECEIVED
FEB 9 1988
S.L.O. COUNTY
PLANNING DEPT.

EXHIBIT

12.9

A copy of Resolution 83-12 is enclosed for your reference. If you have any questions concerning this matter, please contact Angela Charpentier at (805) 549-3147.

Very truly yours,

for KENNETH R. JONES
Executive Officer

AGC:emt

Enclosure - Resolution 83-12

EXHIBIT

12.14

California Regional Water Quality Control Board

Central Coast Region

Linda S. Adams
Secretary for Environmental Protection

895 Aerovista Place, Suite 101, San Luis Obispo, California 93401-7906
Phone (805) 549-3147 • FAX (805) 543-0397
http://www.waterboards.ca.gov/centralcoast

Arnold Schwarzenegger
Governor

ROUTING

September 5, 2006

Victor Holanda, Director
County of San Luis Obispo Building and Planning
County Government Center
San Luis Obispo, CA 93408

Dear Mr. Holanda:

PERMIT APPROVALS WITHIN THE LOS OSOS/BAYWOOD PARK PROHIBITION AREA

As you know, the Water Quality Control Plan (Basin Plan) prohibits wastewater discharges to on-site systems in Los Osos/Baywood Park. It has come to our attention that County Planning staff continues to approve projects within the Los Osos/Baywood Park Prohibition Area, which appear to be in violation of the Basin Plan on-site discharge prohibition.

There have been several projects recently noted by Water Board staff that shows the potential for an increase in wastewater being discharged to their on-site septic systems. For example, the residence at 591 Ramona obtained a minor use permit in May of 2004 for a 2,134 square foot **addition** to a single-family dwelling. This addition more than doubled the size of the existing single-family residence and causes concern that there is additional wastewater from the residence. Another example, the property at 2009 9th Street was an existing ~900 square-foot single family dwelling; permits were obtained in 2001-2002 for construction of a ~900 square-foot office and 900 square-foot residence on top having one bedroom and 1.5 baths. This change in use potentially may have increased wastewater from the property and brings into question the reliability of County Planning to adequately evaluate wastewater issues and permit such projects in the Los Osos/Baywood Park Prohibition area.

Therefore, at this time, we ask that no permits be approved within the Los Osos/Baywood Park Prohibition area without our written approval.

EXHIBIT

12.15

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SEP 07 2006
Planning & Bldg

If you have questions, please contact **Allison Millhollen at (805) 549-3882** or Harvey Packard at (805) 542-4639.

Sincerely,

Roger W. Briggs
Executive Officer

cc:

Mike Wulkan, Los Osos Land Use Projects
County of San Luis Obispo Building and Planning
County Government Center
San Luis Obispo, CA 93408

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EXHIBIT

12.16

SAN LUIS OBISPO COUNTY
DEPARTMENT OF PLANNING AND BUILDING

VICTOR HOLANDA, AICP
DIRECTOR

September 21, 2006

Roger Briggs
Executive Director
Regional Water Quality Control Board
895 Aerovista Place, Suite 101
San Luis Obispo, CA 93401-7906

Re: **Permit Approvals within the Los Osos/Baywood Prohibition Area**

Dear Mr. Briggs:

Thank you for your letter of September 5 regarding the above referenced subject. I understood that the Regional Water Quality Control Board (RWQCB) is concerned about the county's existing review process and subsequent Building Permit issuance of construction remodels, e.g. residential, in the Los Osos/Baywood Park prohibition area. However, I believe the examples you cited are conceivably inaccurate, and choose to discuss the fine points of those applications in a joint staff meeting.

With the objective of maintaining clean water and avoiding potential pollution within Los Osos/Baywood Park prohibition area, the County is prepared, effective immediately, not to issue any permits in this area without expressed written approval from the RWQCB. Because Building Permits are *ministerial* under the law, we will assume that the RWQCB staff understands the liability and consequences associated with delaying the issuance of *Building Permits*. Moreover and in the spirit of professional cooperation and good customer service we will assume the RWQCB staff will review building permit applications in a timely manner.

Finally, I have asked Matt Janssen of my staff to contact your office to arrange a meeting for the purpose of reviewing the moratorium exemption criteria developed in 1988, and to determine whether or not those criteria are still relevant.

Again, thank you for bringing this issue to my attention.

EXHIBIT
12.17

Sincerely,

Victor Holanda

Victor Holanda, AICP
Planning Director

Attachments: Letter from Paul Crawford to Roger Briggs (1/21/88)

Cc: Cheryl Journey, Chief Building Official
Matt Janssen, Coastal Zone Supervising Planner

For the Discharger:

[Settling Discharger]
[Mailing Address]
[City], CA [ZIP]

Any Party may change the designee or address for notifications but no such change is effective until it is actually received by the party sought to be charged with its contents.

Modifications

This Agreement may be modified only upon written consent by the Parties hereto and the approval of the Executive Officer or as provided for by law.

In the event that the Staff Prosecution Team enters into a subsequent agreement with any discharger in the prohibition zone which is set forth on the Prohibition Boundary Map, Attachment A of Central Coast Water Board Resolution No. 83-13, *Revision and Amendment of Water Quality Control Plan by the Addition of a Prohibition of Waste Discharge from Individual Sewage Disposal Systems Within the Los Osos/Baywood Park Area, San Luis Obispo County* which contains terms which are materially different from those in this Agreement and which may be applicable to the Site or Discharger, the Discharger may request that this Agreement be amended to include those terms, and upon such request, the Staff Prosecution Team will make those modifications and submit them for approval and execution by the Executive Officer as a modification of the Agreement. This paragraph does not apply to terms in any subsequent agreements which are based on any unique personal circumstances applicable to the other discharger.

Remedies for Failure to Comply

The Parties agree that the provisions of this Agreement shall be enforced as an order issued by the Executive Officer pursuant to California Water Code section 13304. The Parties acknowledge that pursuant to California Water Code section 13350, liability and remedies for violations of this Agreement are provided for including the authority of the Water Board to impose civil liability on a daily basis not to exceed $5,000 against the Discharger for each day the violation occurs. However, the Parties agree that California Water Code section 13350(e)(1)(A) does not require the Water Board to impose a required minimum penalty of $500 for each day of discharge in violation of this agreement. In the event the Water Board seeks to enforce this agreement pursuant to section 13350, the Water Board shall consider the factors set forth in California Water Code section 13327, pursuant to section 13350(f). Neither of the Parties waive any rights or defenses that they may have with regard to any action to enforce the terms of this Agreement.

In taking or recommending any action to enforce the terms of Section A of this Agreement or in taking any action with regard to the enforcement of the Basin Plan Prohibition, the Staff Prosecution Team agrees that it will consider the cooperation of the Discharger in

EXHIBIT

13.1

CMA Report

Listings as of 03/09/07 at 9:12pm Page

RESIDENTIAL

SOLD Properties

Address	City	Map	Bd	Bth	SqFt	LotSz	Year	Date	$/SqFt	CDOM	Orig Price	List Price	Sale Price	SP%LI
1219 16th St	Los Osos	631, J4	2	1	798	3125sf	1971	06/02/06	313.28	59	329,000	315,000	250,000	79.4
943 Nipomo Ave	Los Osos	631, H6	2	1	898	6250sf	1955	11/06/06	361.08	31	349,000	299,000	324,250	108.4
433 Lilac Dr	Los Osos	631, F7	2	1	900	5000sf	Unkn	02/17/06	383.33	10	395,000	395,000	345,000	87.3
1860 Maple Ave	Los Osos	631, F6	2	1	900	4000sf	1977	04/21/06	395.56	36	389,000	379,000	356,000	93.9
829 Ramona Ave	Los Osos	631, G5	2	1	664	5001sf	1954	07/20/05	549.70	88	395,000	387,500	365,000	94.2
1216 11th St	Los Osos	631, H1	2	1	0	5001sf		05/20/05	0.00	16	345,000	355,000	365,000	102.8
1713 14th St	Los Osos	631, J5	2	1	950	3125sf	1980	11/22/05	388.42	91	419,000	379,900	369,000	97.1
1438 12th St	Los Osos	631, H5	2	1	900	3125sf	Unkn	03/17/06	421.11	247	429,000	398,500	379,000	95.1
1964 11th St	Los Osos	631, H6	2	1	1000	1sf	1990	04/15/05	390.00	152	429,000	390,000	390,000	100.0
1567 8th St	Los Osos	631, H5	2	1	915	4687sf	Unkn	10/20/06	436.07	103	434,000	399,000	399,000	100.0
2045 Ferrell Ave	Los Osos	631, H6	2	1	925	4000sf	Unkn	05/16/05	432.43	35	410,000	399,900	400,000	100.0
1801 Pine Ave	Los Osos	631, G6	2	1	950	4800sf	1960	06/06/06	426.32	86	429,000	410,000	405,000	98.8
2142 Bush Dr	Los Osos	631, H6	2	1	900	4480.000ac	1971	10/03/05	455.56	33	425,000	425,000	410,000	96.5
660 Woodland Dr	Los Osos	631, G6	2	1	1000	9069sf	1975	09/29/05	410.00	44	429,000	429,000	410,000	95.6
1884 11th St	Los Osos	631, H6	2	1	0	3125sf	1972	07/21/05	0.00	25	419,000	419,000	419,000	100.0
1186 14th St	Los Osos	631, J4	2	1	0	0.106ac	1972	07/10/06	0.00	13	439,000	419,000	419,000	100.0
548 Mar Vista Dr	Los Osos	631, G7	2	1	770	5001sf	1969	05/06/05	557.14	55	429,000	429,000	429,000	100.0
1154 13th St	Los Osos	631, J4	2	1	700800	4688sf	Unkn	06/10/05	0.61	0	429,500	429,500	429,500	100.0
1921 Nancy Ave	Los Osos	631, F6	2	1	1000	4000sf	Unkn	05/19/06	429.90	46	449,900	439,900	429,900	97.7
318 Mar Vista Dr	Los Osos	631, F7	2	1	832	5500sf	1968	08/30/05	516.83	5	439,000	439,000	430,000	97.9
1931 Nancy Ave	Los Osos	631, F6	2	1	825	4000sf	Unkn	08/25/06	521.21	45	439,000	439,000	430,000	97.9
330 Highland Dr	Los Osos , 0		2	1	900	5001sf		03/25/05	483.33	0	425,000	425,000	435,000	102.4
1464 5th St	Los Osos	631, G5	2	1	965	6250sf	Unkn	07/19/06	453.78	2	437,900	437,900	437,900	100.0
316 Henrietta Ave	Los Osos	631, F6	2	1	1150	4000sf	Unkn	12/29/05	381.74	170	459,000	444,000	439,000	98.9
325 Highland Dr	Los Osos	631, F7	2	1	1000	5001sf		04/06/05	439.90	490	339,900	439,900	439,900	100.0
1871 Maple Ave	Los Osos	631, F6	2	1	952	4000sf	1968	09/29/06	472.69	13	439,900	439,900	450,000	102.3
1821 Fearn Ave	Los Osos	631, F6	2	1	900	1sf	1965	03/24/05	500.00	3	439,000	439,500	450,000	102.4
1658 5th St	Los Osos	632, H5	2	1	1300	3125sf	Unkn	07/22/05	350.00	4	469,000	469,000	455,000	97.0
1870 Nancy Ave	Los Osos	631, F6	2	1	900	4000sf	Unkn	09/06/06	550.00	30	514,900	514,900	495,000	96.1
1330 5th St	Los Osos	631, G4	2	1	1400	10001sf	1953	04/01/05	371.43	24	549,500	525,000	520,000	99.0
1254 Vista Del Osos	Los Osos	651, J1	2	1	1200	41300sf	1965	12/14/06	604.17	51	898,000	725,000	725,000	100.0
Listing Count 31		**Averages**			25950				16.16	65	439,435	426,977	419,369	98.2
					High 725,000				**Low** 250,000				**Median** 419,000	
Report Count 31		**Report Averages**			25950				428.41	65	439,435	426,977	419,369	

Presented By: James Shammas / Cornerstone Real Estate Phone: 805-440-9040

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F.O.A REQUEST IN PROGRESS.

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MAKING LOS OSOS A POST CARBON CITY
From a mechanical to a biological solution.

Los Osos can meet APCD GHG Requirements for 2020 in 2012 with a combined Resource Recovery /STMP/ Retrofit Program. AB 32, Nunez, The Global Warming Bill adds another level of EIR requirements best expressed in plain English in the preamble of the bill:
"The bill would require the state board to adopt a statewide greenhouse gas emissions limit equivalent to the statewide greenhouse gas emissions levels in 1990 to be achieved by 2020, as specified."
AB 32 recognizes that there is a link between regional and worldwide ecological impacts and that they both affect us. Sadly the LOWWP FSR does not recognize the importance of energy consumption in its designed projects. The Fine Screening Report is not AB32 compliant and has many fatal flaws related to energy consumption, potential ESHA impacts, energy shock, and Sustainability. The opportunity is to make Los Osos a 'Post Carbon City'. The EIR is the proper forum for requiring this. To reach the post carbon goal for California the critical path for any project should be:

Least Energy Consumed for Pollutants Removed

Right now the RWQCB3 present zero discharge order is not CEQA compliant to (Section 21080.5 CPRC). There has been no focused filing for exemption from CEQA with the Office of Planning and Research for the zero discharge order. And no contact with the APCD over implementation of the zero discharge order. If enforced as stated, the order would not comply to APCD GHG requirements and would go the way of the bi-monthly pumping plan. This action has removed 'on site' solutions from inquiry when they need to be considered because of dire energy and groundwater concerns. Secondly, RWQCB3 has chosen to ignore Urea Sequestering by denying economic assistance and SEP program requests for Sequestering. They have also ignored requests for a PC 13269 waiver for sequestering for my voluntary compliance. This planned or constructive negligence is to stifle the consideration of Sequestering-STMP-Retrofit combination. I challenge both agencies in this EIR critique to disprove that energy consumption is not a critical goal in basin cleanup. Energy consumption will critically dictate environmental and social cost both on the short term and long term.

Since the RWQCB3 board has claimed that each septic system is a waste handling "facility" with potential fines going back to 1988 then to be in compliance with AB32 the community pollutant removal plan is required to have the same energy footprint as the 1990 septics if it can be shown it can be done in a 'reasonable' manner. The existing septics for enforcement purposes are legitimate wastewater 'facilities' and have been treated under Porter Cologne Act enforcement as "facilities". The County of San Luis Obispo is mistaken by making the assumption that a zero net energy solution is not possible when it is not only possible but necessary for Sustainability and meeting EIR requirements for Global warming.

The energy footprint of Septic "facilities" was near zero in 1990 for CO2 gas production.

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Some CO2 was released by solids waste hauling and septic system repair. Under AB32 to be compliant with CEQA and APCD GHG regulations in 2011 the LOWWP project will have to have an energy footprint similar to the 1990 septics by 2020. The existing FSR plans work heavily against that goal. It ignores energy entirely, erroneously dismisses energy as a goal and ignores 'on site' zero energy contributions as a water recovery system.

To highlight a misleading County claim about septic tanks, both septic systems and community wastewater projects create the same amount of methane in the digestion of the bio-solids as addressed by the EPA and misconstrued in the LOWWP FSR. The information can be found here:
(http://epa.gov/climatechange/emissions/usinventoryreport.html).

Further, natural wetlands are responsible for approximately 76% of global methane emissions from natural sources, accounting for about 145 Tg of methane per year. Wetlands provide a habitat conducive to methane-producing (methanogenic) bacteria that produce methane during the decomposition of organic material. These bacteria require environments with no oxygen and abundant organic matter, both of which are present in wetland conditions. Methane production is natural and intrinsic to the airshed locality.

The LOWWP Fine Screening Report erroneously states that it cannot meet AB 32 standards by claiming that <u>any</u> waste removal plan will use energy. By ignoring the Source Separation-STMP-Retrofit combination, the County perpetuates an old myth about energy consumption and waste handling solutions. The LOWWP FSR erroneously states:

> "The VPAs will be selected with the consideration that sustainability is a stated goal for the community of Los Osos. The VPAs will contain options where wastewater will be disposed/reused as a resource to benefit the community. That said, the construction and operation of any wastewater project will consume energy, whereas Los Osos currently consumes no energy in treating its wastewater. However, due to the groundwater pollution resulting from the current situation, a wastewater project is necessary for the community."

The County failed to include that source separation is a 'reasonable' method of pollutant recovery and that it meets the near zero CO2 energy criteria of AB32 of 1990 septics. Source separation has been studied in Europe for 20 years. Source separation is accepted in Europe as a methodology for achieving sustainable pollutant recovery. Accompanying this document is a CD ROM to all board members that contains the scientific process and descriptions of Source separation implementation on Europe. A similar CD ROM was ignored by the County in the LOWWP FSR when the writer submitted it as part of his processing a legal permit for on site urea waste sequestering. The County mentions Urea sequestering in the EIR scoping for the first time and then ignores coupling it with 'on site' solutions in evaluation document.

Separating urine from the waste flow in a standard residence and creating a septic maintenance program would empirically remove 70 to 80 percent of Nitrogen impacting the Los Osos Basin while using near zero energy consumption. By sequestering urine

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and recycling its constituents, you close the nutrient cycle by stepping in ahead of the entropic process of total constituent mixing in regular wastewater. By sidestepping entropy, urea sequestering becomes the most sustainable method of constituent removal using 1/100 to 1/1000 the energy used in the LOWWP FSR plans. That is even before adding in the carbon credits from biomass creation and non organic fertilizer offsets.

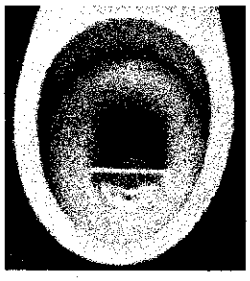
Urine contains 75% of the pollutants at 1/1000 the volume of ordinary household wastewater. Remove your garbage disposal discharge and compost your garbage and that figure goes to 82% using EPA data from the EPA wastewater handbook. A small amount of work, and no energy, removes 82 % of the pollutants from the LO basin. If your septic tank is emitting 35 mg/l Nitrogen and you remove 82% of the Nitrogen you are emitting 6.3mg/l from your existing septic tank. The TRI-W sewer project was approved at a discharge of 7mg/l. Using an aggressive Septic Maintenance Plan coupled with source separation waste recovery you would meet AB32 year 1990 CO2 emission standards and RWQCB basin plan goals simultaneously.

This near zero energy footprint waste recovery plan would also by its nature be a zero energy water reclamation plan that exceeds the present groundwater recharge plans in the FSR for both energy consumption and hydrological balance of basin water. Septics are a zero energy footprint groundwater recharge system basin wide that already has been built. Resource Recovery /STMP/ Retrofit avoids another fatal flaw in the LOWWP FSR by being impervious to problems brought on by possible future drastic water conservation to the sewer system design, an engineering fact not covered in the fine screening report and a fatal flaw in the design for gravity collection.

Resource Recovery /STMP/Retrofit Program would
Meet GHG/2020 Regulations in 2012.

On Site Development

1) Install one no-mix dual bowl toilet in each residence, multifamily unit, and commercial building with no mix waterless urinals in commercial buildings.
2) Install a 200 gallon tank for urea storage for each residence and increase the size of the tank 50 gallons for each additional bedroom over two. Commercial installations would be based on occupancy rating.



3) Install a phone in pump alarm at 80% capacity of the tank.
4) Install a filter vault after the existing septic tank
5) All homes in the total basin would be required to retrofit on sale or allow retrofitting to be paid for by construction offsets similar to the existing retrofit program. Inside the PZ and outside the PZ would be treated the same. Under this plan, water savings from the use of the sequestering toilets would offset 4 to 6 gallons per person per day or 1.40 gallons per urine only flush.

Would you 'toilet train' for $150 dollars a month in your pocket?

EXHIBIT

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Off Site Development

With the Resource Recovery STMP and Retrofit Program you close the biological nutrient loop and recycle it. And in doing so gain energy "credits" that pay for your energy "sinks" in handling the urea. This is not a sewer. The problem is solved with a recycling program. The program would look something like this:

1) Every six months a LOCSD or County maintenance worker comes to your property in his or her clean biodiesel or LPG powered 5000 gallon truck and pumps your sequestering tank, cleans your septic system filter, checks the health of your septic tank, and is gone. No tank replacements are required because the tanks have only 20% of the original pollutants. The filter vault is hand installed after your existing septic tank. Here's a hyperlink to many studies describing fully the Swedish no-mix recycling system.

2. Off site, the truck collects the urea from 25 other homes then returns to the County owned 'biomass processing facility' where the urea is converted to sustainable managed agriculture like redwood stands, bamboo, or switchgrass for biodiesel production. The biomass is a CO2 credit as is the urea fertilizer. The County becomes a leader in smart growth and sustainability in changing from a mechanical solution to a biological one to meet the GHG standards and Basin groundwater goals.

3) Second the County becomes a regional liquid fertilizer producer. Before the urea is used on crops it is polished of micro-pollutants (easier in it's concentrated form), deodorized and disinfected by solar collectors heating large insulated tanks. The product, organic urea fertilizer is 1/1000 the volume of Nitrogen laden wastewater so it can be trucked to farmers like normal fertilizer. This removes the stigma of commitment and piping costs involved with water exchanges. Farmers use the product at will shipped to their agricultural site at well below the cost of natural gas based urea fertilizer. The County has no pressing need to sell the fertilizer because of its own 'biomass factories'. Natural gas shortages will create shortages in the fertilizer market making the County product an acceptable alternative. Read about our near future in Richard Heinberg's Museletter's article: What Will We Eat as the Oil Runs Out?

4) Basin wide septic solids recovery and recycling would be the third part of the program. Most of the harmful hormonal, and drug constituents are polished out in the urea side of the system making the solids composting side relatively 'clean'. The compost is sold regionally to again meet AB 32 regional use promotion in the narrative of the Act.

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Estimated Benefits: Sequestering-STMP-Retrofit

- 75% to 85% P,N, and K removal from the whole basin is equivalent to zero discharge in the prohibition zone alone.
- Local plumbers and contractors keep implementation money in the local economy. Money doesn't go to one or two big out of state companies.
- GHG leading edge solutions would attract grant funding both public and private.
- 6 million dollar payback to the State, and 2 million dollar payback to the County is legitimized. Global Warming Law, Sustainability, and energy shock hardening requires the retirement of the community sewer concept for any other 'reasonable' alternative and was not a concern in the previous designs until recently. This would legally be a design update to new CEQA /APCD REGS to meet the EIR requirements.
- Protects the basin in economically fair manner using a sustainable studied and proven method.
- County or LOCSD is protected from large spillage fines by the RWQCB.
- No ESHA impacts in infrastructure construction, spillage or exfiltration.
- 95% reduced Archeological impacts.
- No potential large sewage spills or power failure induced spills.
- No on site energy consumption.
- No I & I leakage or pipe failures due to earthquakes or liquefaction.
- No gravity system pumping vault energy footprint.
- Proven in ground water recharge system using zero energy.
- No streets torn up and resources used to repair them. No EIR for pipe system.
- Energy consumption of Urea handling truck fleet is equal to sewer fleet to maintain flow of solids in a normal mixed wastewater sewer system.
- Carbon to nitrogen ratio in septic tanks becomes optimum with 80% reduced N going into the tank on input.
- Septic tank cleanout holding time can be increased by greywater systems.
- Local farmers are saved from Nitrogen fertilizer shortages.
- Cost per household goes to $50.00 per month, retrofits paid for by infill builders.
- Meets GHG 2020 standards in 2012.
- Biomass CO2 sinks (Farming) creates wealth in terms of carbon credits and marketable raw materials.
- All systems have an extensive life cycle hardened from energy depletion.
- SEQ./STMP/RETROFIT system engages small scale low CO2 footprint human labor and the community in the behavioral solution.
- Wastewater energy failure or resource shock: STEP= 1day, Gravity= 3 days, Sequestering = ½ year
- Ultra conservation does not negatively impact the recovery system.
- 102,000 gallons a day basin wide water savings from sequestering toilets.
- Retrofit and pollution abatement are simplified into the same program.

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- All septics in the basin are aggressively managed equally as pollutants are removed.
- Total process is sustainable.
- In a fuel pinch the Agency, LOCSD or County, could grow and process its own biodiesel or trade biodiesel crops for fuel in land lease obligations with farmers.
- Compliance is maintained by pumping ticket and water bill data base managed under the STMP. Non compliance for sequestering is subject to fines related to and earmarked for basin water cleanup. High water consumption and no urine storage ratio's could raise monthly costs to polluters. No water consumption and no storage means low occupancy rate. Low water consumption with 100 gal per 6/mo. sequestered urea means general compliance and the lowest processing costs.
- Avoids tax challenges and law suits for more energy intensive recovery systems.

Displacing non organic fertilizer with organic recycled urea, and creating "Biomass factories" (as proposed by Wickham, in his forested wastewater designs) would be energy credits for the whole program working toward zero net energy. Instead of money being spent on a paying for short life cycle infrastructure, it is spent on creating a CO2 sink or credit. The result is you have a sustainable method of solving the 83-13/ 83-12 (They were originally co-mingled.) problem in a way that is consistent with environmental justice narrative law. There must be equitable economic impacts for all basin water users. The PZ taxation implementation and enforcement has never met or been vetted for compliance with EJ law as required. County Counsel is ignoring this fact. I ask them to review it.

Instead of spending 200 million dollars on miles of potentially leaky sewer pipes and maintaining a sewer plant, you spend 35 to 70 Million on a total recycling system recycling urea and setting up basin wide methane capture solids reprocessing from septic tanks. The urea is recycled and the solids are recycled at a third the cost of the FSR-LOWWP with a net near zero energy budget. Well managed septic systems will average 10 year retention times between pumping (EPA wastewater handbook.)

The bill to each homeowner could be less than 50.00 dollars a month *and* the process meets AB-32 GHG APCD requirements for 2020 in 2011. Los Osos would become a leader in waste management and recycling. Los Osos would become a sustainable Post Carbon City closing the ecological loop of pollution into biomass.

Each home would use the reduced pollutant managed septic system normally. Each home is part of the groundwater recycling system that is energy free. Each Home reduces water consumption by 4 to 6 gallons per person per day or 6 X 17,000 or 102,000 gallons a day. That adds up to 36,500,000 gallons of banked groundwater yearly at no energy cost. Your relative clean septic discharge goes into your leachfield minus the 82% of removed pollutants. Some special on site cases would have to be made for low clearance to groundwater along the Bay. Even those homes would have already removed 70 or 80 percent of the pollutants before they reached the septic tank.

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Are we discriminating against the urban poor by excessively taxing existing homeowners for a community sewer in the smaller, poorer, Prohibition zone? No one wants to face that question. But you avoid it by implementing a basin wide septic maintenance plan that requires sequestering using dual bowl toilets and parallel storage. You then have achieved the same total N removal from the basin as the TRI-W waste discharge permit at 1/3 the cost with a greatly reduced or near zero energy footprint for pollutant removal.

A footnote on AB-32:

AB 32 Global warming 31662 Section(B)

(1) Design the regulations, including distribution of emissions allowances where appropriate, in a manner that is equitable, seeks to minimize costs and maximize the total benefits to California, and encourages early action to reduce greenhouse gas emissions.
(2) Ensure that activities undertaken to comply with the regulations do not disproportionately impact low-income communities.
(3) Ensure that entities that have voluntarily reduced their greenhouse gas emissions prior to the implementation of this section receive appropriate credit for early voluntary reductions.
(4) Ensure that activities undertaken pursuant to the regulations complement, and do not interfere with, efforts to achieve and maintain federal and state ambient air quality standards and to reduce toxic air contaminant emissions.
(5) Consider cost-effectiveness of these regulations.
(6) Consider overall societal benefits, including reductions in other air pollutants, diversification of energy sources, and other benefits to the economy, environment, and public health.
(7) Minimize the administrative burden of implementing and complying with these regulations.

Prepared for by Steve Paige
LOCAC Land use committee member.
SLO Green Build
LOCSD Waste Water Advisory Board Co-chair.
(All comments are my own opinion and do not reflect the opinion of any board or committee.)

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CALIFORNIA ENVIRONMENTAL QUALITY ACT SUBSTITUTE ENVIRONMENTAL DOCUMENT REPORT FOR BASIN PLAN AMENDMENT REGARDING ONSITE WASTEWATER SYSTEMS (RESOLUTION NO. R3-2008-0005)

The Central Coast Regional Water Quality Control Board (Central Coast Water Board) is proposing an amendment to the *Water Quality Control Plan, Central Coast Basin* (Basin Plan). The Basin Plan serves as the cornerstone for protection of waters of the State through identification of beneficial uses of surface and ground waters, establishment of water quality objectives to protect beneficial uses, and establishment of an implementation plan to achieve those objectives.

The California Resources Agency has certified the Basin Planning process as an exempt regulatory program for the purposes of complying with the California Environmental Quality Act (CEQA) and the CEQA Guidelines [§15251, Title 14, California Code of Regulation (CCR)]. The Water Board is exempt from the requirement to prepare an environmental impact report or negative declaration. Any Regional Board exempt regulatory program must satisfy the documentation requirements of §3775(a), Title 23, CCR. This report constitutes a substitute environmental document as set forth in §3775(a), Title 23, CCR. It contains the following:

1. A description of proposed activity and proposed alternatives,
2. An environmental checklist and a description of the proposed activity,
3. An environmental evaluation, and
4. A determination with respect to significant environmental impacts.

The environmental analysis contained in this Report for Basin Plan Amendment and accompanying documents, including the Environmental Checklist, the staff report and the responses to comments complies with the requirements of the State Water Board's certified regulatory process, as set forth in CCR, Title 23, §3775 et seq. All public comments were considered.

I. DESCRIPTION OF PROPOSED ACTIVITY

The purpose of this Resolution is to update and revise the Basin Plan sections pertaining to onsite wastewater system requirements. This section describes the changes proposed and alternatives to this proposal.

Chapters IV and V of the Water Quality Control Plan, Central Coast Basin (Basin Plan) specify criteria for siting, design and ongoing management of individual and community onsite wastewater disposal systems (commonly called septic systems). The Basin Plan criteria also recommend a variety of management measures intended to ensure long-term success of properly functioning systems and prevent water quality impacts from such systems. The existing Basin Plan criteria for onsite wastewater systems were last updated in 1983. During the past 25 years, implementation of those criteria has

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demonstrated revisions are needed to clarify vague language and, in some cases, strengthen language from recommendations to requirements. The proposed project (adoption of Resolution No. R3-2008-0005) will update and revise existing Basin Plan criteria for onsite wastewater systems. Most of the proposed revisions provide clarifying language to existing requirements without substantially changing such requirements. However, some revisions replace discretionary language of recommendations (should) with mandatory language of requirements (shall). By adopting the proposed resolution, language in the Basin Plan will be strengthened and clarified in a manner expected to result in improved long-term water quality protection in areas served by onsite wastewater systems. The proposed revisions are also expected to improve consistency and customer service by reducing the need for subjective interpretation of imprecise language. Updating the Basin Plan criteria for onsite wastewater systems will complete a Triennial Review list priority task, which has been backlogged for more than a decade.

Alternatives to this Project

1. Incomplete adoption of the proposed amendment

The Central Coast Water Board could amend only a portion of the existing Basin Plan criteria for onsite wastewater systems. The Basin Plan criteria could be amended with some of the proposed revisions or amended with different revisions. This alternative is not recommended as it would result in addressing only some of the needed clarifications or strengthening of the existing Basin Plan language and would not achieve the goals of effective long-term water quality protection in a clear and efficient manner. Adoption of different criteria can only be addressed relative to specified alternate criteria, such discussion is included in the response to comments included in the staff report. This alternative is not recommended.

2. Take no action

The proposed revisions to the Basin Plan criteria for onsite wastewater systems are needed to clarify vague and imprecise requirements and to strengthen requirements needed to protect water quality. Updating the onsite criteria has been prioritized on the Central Coast Water Board's Triennial Review List for many years. Failing to take action would result in ongoing confusion regarding requirements, utilization of staff time to individually clarify and interpret requirements, and inadequate long-term water quality protection in areas served by onsite wastewater systems. This alternative is not recommended.

II. APPLICABLE INFORMATON

1. **Lead Agency Name and Address**

Central Coast Water Board
895 Aerovista Place, Suite 101
San Luis Obispo, CA 93401-7906

2. **Contact Person and Phone Number:** Sorrel Marks (805) 549-3595

3. **Project Location:** Central Coast Region

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a) Conflict with or obstruct implementation of the applicable air quality plan?	☐	☐	☐	☒
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	☐	☐	☐	☒
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is not attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?	☐	☐	☐	☒
d) Expose sensitive receptors to substantial pollutant concentrations?	☐	☐	☐	☒
e) Create objectionable odors affecting a substantial number of people?	☐	☐	☐	☒
4. BIOLOGICAL RESOURCES -- Would the project:				
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☐	☒
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or US Fish and Wildlife Service?	☐	☐	☐	☒
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☐	☐	☐	☒
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☐	☐	☐	☒
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☒
5. CULTURAL RESOURCES -- Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?	☐	☐	☐	☒
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?	☐	☐	☐	☒

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c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☐	☐	☒
d) Disturb any human remains, including those interred outside of formal cemeteries?	☐	☐	☐	☒
6. GEOLOGY AND SOILS -- Would the project:				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:	☐	☐	☐	☒
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	☐	☐	☐	☒
ii) Strong seismic ground shaking?	☐	☐	☐	☒
iii) Seismic-related ground failure, including liquefaction?	☐	☐	☐	☒
iv) Landslides?	☐	☐	☐	☒
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☐	☒
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?	☐	☐	☐	☒
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?	☐	☐	☐	☒
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?	☐	☐	☐	☒
7. HAZARDS AND HAZARDOUS MATERIALS -- Would the project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☐	☒
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	☐	☐	☒
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☐	☒
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code §65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☐	☒

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e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒
h) Expose people or structures to a significant risk of loss injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?	☐	☐	☐	☒
8. HYDROLOGY AND WATER QUALITY –Would the project:				
a) Violate any water quality standards or waste discharge requirements?	☐	☐	☐	☒
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?	☐	☐	☐	☒
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner, which would result in substantial erosion or siltation on or off-site?	☐	☐	☐	☒
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner, which would result in flooding on- or off-site?	☐	☐	☐	☒
e) Create or contribute runoff water, which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	☐	☐	☐	☒
f) Otherwise substantially degrade water quality?	☐	☐	☐	☒
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?	☐	☐	☐	☒
h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?	☐	☐	☐	☒
i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?	☐	☐	☐	☒

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j)	Inundation by seiche, tsunami, or mudflow?	☐	☐	☐	☒
9.	**LAND USE AND PLANNING – Would the project:**				
a)	Physically divide an established community?	☐	☐	☐	☒
b)	Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☐	☒
c)	Conflict with any applicable habitat conservation plan or natural community conservation plan?	☐	☐	☐	☒
10.	**MINERAL RESOURCES -- Would the project:**				
a)	Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	☒
b)	Result in the loss of availability of a locally -important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?	☐	☐	☐	☒
11.	**NOISE -- Would the project result in:**				
a)	Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☐	☐	☒
b)	Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☐	☒
c)	A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☐	☒
d)	A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☐	☒
e)	For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒
f)	For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒
12.	**POPULATION AND HOUSING -- Would the project:**				
a)	Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☐	☒
b)	Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

EXHIBIT

17.7

c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
13. PUBLIC SERVICES --Would the project result in:				
a) Substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:	☐	☐	☐	☒
b) Fire protection?	☐	☐	☐	☒
c) Police protection?	☐	☐	☐	☒
d) Schools?	☐	☐	☐	☒
e) Parks?	☐	☐	☐	☒
f) Other public facilities?	☐	☐	☐	☒
14. RECREATION:				
a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	☒
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?	☐	☐	☐	☒
15. TRANSPORTATION/TRAFFIC -- Would the project:				
a) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections)?	☐	☐	☐	☒
b) Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways?	☐	☐	☐	☒
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?	☐	☐	☐	☒
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☐	☒
e) Result in inadequate emergency access?	☐	☐	☐	☒
f) Result in inadequate parking capacity?	☐	☐	☐	☒
g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?	☐	☐	☐	☒

EXHIBIT

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16. UTILITIES AND SERVICE SYSTEMS --Would the project:				
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	☐	☐	☐	☒
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒
d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?	☐	☐	☐	☒
e) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	☐	☐	☐	☒
f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?	☐	☐	☐	☒
g) Comply with federal, state, and local statutes and regulations related to solid waste?	☐	☐	☐	☒
17. MANDATORY FINDINGS OF SIGNIFICANCE				
a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	☐	☐	☐	☒
b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?	☐	☐	☐	☒
c) Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☐	☐	☒

IV. ENVIRONMENTAL EVALUATION (of checklist questions answered Potentially Significant Impact, Less than Significant with Mitigation Incorporation, or Less than Significant Impact): Not applicable.

EXHIBIT

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V. PRELIMINARY STAFF DETERMINATION

☐ The proposed project COULD NOT have a significant effect on the environment, and, therefore, no alternatives or mitigation measures are proposed.

☐ The proposed project MAY have a significant or potentially significant effect on the environment, and therefore alternatives and mitigation measures have been evaluated.

Signature	Date
Printed Name	For

EXHIBIT

17.10

B. EFFLUENT LIMITATIONS
(Discharge to Leachfields)

1. The annual average effluent shall not exceed 1.4 MGD.

2. Effluent discharged to the disposal system shall not exceed the following limitations:

Constituent	Units	Monthly (30-Day) Average	Daily Maximum
Settleable Solids	ml/l	0.1	0.5
BOD, 5-Day	mg/l	60	100
Suspended Solids	mg/l	60	100
Total Nitrogen (as N)	mg/l	7	10

C. RECYCLED WATER SPECIFICATIONS
(Reclamation (reuse) Requirements adopted under Water Code section 13523 apply in addition to Effluent Limitations specified above)

1. Discharger shall develop an Engineering Report on the Production, Distribution and Use of Recycled Water (Engineering Report) in conformance with Title 22 of the California Code of Regulations, for review and approval of the Executive Officer (after consultation with State and local Health Departments). The Engineering Report must be submitted no less than six months in advance of proposed reuse of wastewater.

2. Recycled water production and use shall at all times be in conformance with recycled water criteria established in Title 22, Division 4, Chapter 3 of the California Code of Regulations and the Engineering Report[T22, WC]. Recycled water shall be adequately oxidized, coagulated, clarified, filtered, disinfected[T22] and not exceed the following limitations:

Parameter	Units	Monthly Mean	Max.
BOD,	mg/l	30	90
Suspended Solids	mg/l	30	90
Turbidity[T22]	NTU	2*	5**
pH[BP]	units	In range 6.5-8.4	

* 24-hr mean value.[T22]

**Turbidity must not exceed 5 NTU more than 5% of the time within a 24-hr period and must not exceed 10 NTU.[T22]

3. The median number of coliform organisms in recycled water shall not exceed 2.2 MPN per 100 ml, as determined from the bacteriological results of the last 7 days for which analyses have been completed. The number of coliform organisms shall not exceed 23 MPN per 100 ml in more than one sample in any 30-day period and shall not exceed 240 MPN per 100 ml in any single sample.[T22]

4. Recycled water subject to a chlorine disinfection process shall include a CT (chlorine concentration times model contact time) of not less than 450 milligram-minutes per liter at all times with a model contact time of at least 90 minutes, based on peak dry weather design flow.[T22] Chlorine residual in reclaimed water shall equal or exceed 0.5 mg/l, as measured immediately after the chlorine contact zone.

5. Any alternative, comparable disinfection process must be approved by California Department of Health Services and the Executive Officer.

6. Delivery of reclaimed water for irrigation purposes shall cease as soon as possible and all wastewater shall be returned to the treatment and/or disposal system if:

   a. Disinfection of wastewater ceases at any time; or,

   b. Reclamation specifications are violated or threaten to be violated.

7. Recycled water shall be confined within the authorized reuse areas (approved by the Executive Officer after consultation with State and local health departments).

EXHIBIT
18.1

CMA Report

Listings as of 03/09/07 at 9:12pm Page

RESIDENTIAL

SOLD Properties

Address	City	Map	Bd	Bth	SqFt	LotSz	Year	Date	$/SqFt	CDOM	Orig Price	List Price	Sale Price	SP%LI
1219 16th St	Los Osos	631, J4	2	1	798	3125sf	1971	06/02/06	313.28	59	329,000	315,000	250,000	79.4
943 Nipomo Ave	Los Osos	631, H6	2	1	898	6250sf	1955	11/06/06	361.08	31	349,000	299,000	324,250	108.4
433 Lilac Dr	Los Osos	631, F7	2	1	900	5000sf	Unkn	02/17/06	383.33	10	395,000	395,000	345,000	87.3
1860 Maple Ave	Los Osos	631, F6	2	1	900	4000sf	1977	04/21/06	395.56	36	389,000	379,000	356,000	93.9
829 Ramona Ave	Los Osos	631, G5	2	1	664	5001sf	1954	07/20/05	549.70	88	395,000	387,500	365,000	94.2
1216 11th St	Los Osos	631, H1	2	1	0	5001sf		05/20/05	0.00	16	345,000	355,000	365,000	102.8
1713 14th St	Los Osos	631, J5	2	1	950	3125sf	1980	11/22/05	388.42	91	419,000	379,900	369,000	97.1
1438 12th St	Los Osos	631, H5	2	1	900	3125sf	Unkn	03/17/06	421.11	247	429,000	398,500	379,000	95.1
1964 11th St	Los Osos	631, H6	2	1	1000	1sf	1990	04/15/05	390.00	152	429,000	390,000	390,000	100.0
1567 8th St	Los Osos	631, H5	2	1	915	4687sf	Unkn	10/20/06	436.07	103	434,000	399,000	399,000	100.0
2045 Ferrell Ave	Los Osos	631, H6	2	1	925	4000sf	Unkn	05/16/05	432.43	35	410,000	399,900	400,000	100.0
1801 Pine Ave	Los Osos	631, G6	2	1	950	4800sf	1960	06/06/06	426.32	86	429,000	410,000	405,000	98.8
2142 Bush Dr	Los Osos	631, H6	2	1	900	4480.000ac	1971	10/03/05	455.56	33	425,000	425,000	410,000	96.5
660 Woodland Dr	Los Osos	631, G6	2	1	1000	9069sf	1975	09/29/05	410.00	44	429,000	429,000	410,000	95.6
1884 11th St	Los Osos	631, H6	2	1	0	3125sf	1972	07/21/05	0.00	25	419,000	419,000	419,000	100.0
1186 14th St	Los Osos	631, J4	2	1	0	0.106ac	1972	07/10/06	0.00	13	439,000	419,000	419,000	100.0
548 Mar Vista Dr	Los Osos	631, G7	2	1	770	5001sf	1969	05/06/05	557.14	55	429,000	429,000	429,000	100.0
1154 13th St	Los Osos	631, J4	2	1	700800	4688sf	Unkn	06/10/05	0.61	0	429,500	429,500	429,500	100.0
1921 Nancy Ave	Los Osos	631, F6	2	1	1000	4000sf	Unkn	05/19/06	429.90	46	449,900	439,900	429,900	97.7
318 Mar Vista Dr	Los Osos	631, F7	2	1	832	5500sf	1968	08/30/05	516.83	5	439,000	439,000	430,000	97.9
1931 Nancy Ave	Los Osos	631, F6	2	1	825	4000sf	Unkn	08/25/06	521.21	45	439,000	439,000	430,000	97.9
330 Highland Dr	Los Osos , 0		2	1	900	5001sf		03/25/05	483.33	0	425,000	425,000	435,000	102.4
1464 5th St	Los Osos	631, G5	2	1	965	6250sf	Unkn	07/19/06	453.78	2	437,900	437,900	437,900	100.0
316 Henrietta Ave	Los Osos	631, F6	2	1	1150	4000sf	Unkn	12/29/05	381.74	170	459,000	444,000	439,000	98.9
325 Highland Dr	Los Osos	631, F7	2	1	1000	5001sf		04/06/05	439.90	490	339,900	439,900	439,900	100.0
1871 Maple Ave	Los Osos	631, F6	2	1	952	4000sf	1968	09/29/06	472.69	13	439,900	439,900	450,000	102.3
1821 Fearn Ave	Los Osos	631, F6	2	1	900	1sf	1965	03/24/05	500.00	3	439,000	439,500	450,000	102.4
1658 5th St	Los Osos	632, H5	2	1	1300	3125sf	Unkn	07/22/05	350.00	4	469,000	469,000	455,000	97.0
1870 Nancy Ave	Los Osos	631, F6	2	1	900	4000sf	Unkn	09/06/06	550.00	30	514,900	514,900	495,000	96.1
1330 5th St	Los Osos	631, G4	2	1	1400	10001sf	1953	04/01/05	371.43	24	549,500	525,000	520,000	99.0
1254 Vista Del Osos	Los Osos	651, J1	2	1	1200	41300sf	1965	12/14/06	604.17	51	898,000	725,000	725,000	100.0
Listing Count 31		**Averages**			25950				16.16	65	439,435	426,977	419,369	98.2
					High 725,000				**Low** 250,000				**Median** 419,000	
Report Count 31		**Report Averages**			25950				428.41	65	439,435	426,977	419,369	

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20.1

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Previous 1 2

#	Details		Status	DOS	Listing Type	Street	City	ST	Zip	BD/BH	Price	Zestimate®	Prop	Map
51	Details		Active	-	Tax Lien	Rodman Dr	Los Osos	CA	93402	0 / 0		$1,179,726	UN	
52	Details		Active	-	Tax Lien	6th St	Los Osos	CA	93402	0 / 0		$532,005	UN	
53	Details		Active	-	Tax Lien	2nd St	Los Osos	CA	93402	0 / 0		$544,038	UN	
54	Details		Active	-	Tax Lien	10th St	Los Osos	CA	93402	0 / 0		$482,530	UN	
55	Details		Active	-	Tax Lien	Los Osos Va...	Los Osos	CA	93402	0 / 0		$484,500	UN	
56	Details		Active	-	Tax Lien	10th St	Los Osos	CA	93402	0 / 0		$394,000	UN	
57	Details		Active	-	Tax Lien	El Dorado St	Los Osos	CA	93402	0 / 0		$622,500	UN	
58	Details		Active	-	Tax Lien	14th St	Los Osos	CA	93402	0 / 0		$387,000	UN	
59	Details		Active	-	Tax Lien	14th St	Los Osos	CA	93402	0 / 0		$414,500	UN	
60	Details		Active	-	Tax Lien	12th St	Los Osos	CA	93402	0 / 0		$481,000	UN	
61	Details		Active	-	Tax Lien	12th St	Los Osos	CA	93402	0 / 0		$541,000	UN	
62	Details		Active	-	Tax Lien	16th St	Los Osos	CA	93402	0 / 0		$538,000	UN	
63	Details		Active	-	Tax Lien	11th St	Los Osos	CA	93402	0 / 0		$475,500	UN	
64	Details		Active	-	Tax Lien	12th St	Los Osos	CA	93402	0 / 0		$537,000	UN	
65	Details		Active	-	Tax Lien	Manzanita Dr	Los Osos	CA	93402	0 / 0		$438,500	UN	
66	Details		Active	-	Tax Lien	7th St	Los Osos	CA	93402	0 / 0		$358,500	UN	
67	Details		Active	-	Tax Lien	Los Osos Va...	Los Osos	CA	93402	0 / 0		$394,000	UN	
68	Details		Active	-	Tax Lien	13th St	Los Osos	CA	93402	0 / 0		$492,000	UN	
						Sell Homes for Fast Cash! Click here.								
69	Details		Inactive	-	Foreclosure	6th St	Los Osos	CA	93402	2 / 2	$310,000	$474,500	SF	
70	Details		Inactive	-	Foreclosure	10th St	Los Osos	CA	93402	3 / 2	$699,900		SF	
71	Details		Inactive	-	Preforeclosure	13th St	Los Osos	CA	93402	3 / 2			UN	
72	Details		Inactive	-	Preforeclosure	Ferrell Ave	Los Osos	CA	93402	3 / 2		$376,000	UN	

Real Estate Listing Results **51 - 72 of 72** **NEW!** Real estate discussion forum Previous 1 2

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20.2

Real Estate Listing Results **1 - 50** of **72** Show Map

Next

#	Details		Status	DOS	Listing Type	Street	City	ST	Zip	BD/BH	Price	Zestimate®	Prop	Map
1	Details		NEW	6	Foreclosure	15th St	Los Osos	CA	93402	3 / 2			UN	
2	Details		NEW	7	Foreclosure	Los Osos Va...	Los Osos	CA	93402	0 / 0	$396,900	$462,500	SF	
3	Details		Active	-	Foreclosure	11th St	Los Osos	CA	93402	3 / 2		$441,500	UN	
4	Details		Active	-	Foreclosure	17th St	Los Osos	CA	93402	0 / 0	$425,000	$451,000	SF	
						Sell Homes for Fast Cash! Click here.								
5	Details		Active	-	Preforeclosure	16th St	Los Osos	CA	93402	2 / 1			UN	
6	Details		Active	-	Preforeclosure	Henrietta Ave	Los Osos	CA	93402	2 / 1		$366,000	UN	
7	Details		Active	-	Preforeclosure	7th St	Los Osos	CA	93402	2 / 2			UN	
8	Details		Active	-	Preforeclosure	16th St	Los Osos	CA	93402	3 / 2			UN	
9	Details		Active	-	Preforeclosure	Lost Oak Dr...	Los Osos	CA	93402	2 / 2			UN	
10	Details		Active	-	Preforeclosure	El Morro Ave	Los Osos	CA	93402	2 / 1		$563,886	UN	
11	Details		Active	-	Preforeclosure	Bay Oaks Dr	Los Osos	CA	93402	0 / 0			UN	
12	Details		Active	-	Preforeclosure	13th St	Los Osos	CA	93402	3 / 2		$492,000	UN	
13	Details		Active	-	Tax Lien	Los Osos Va...	Los Osos	CA	93402	0 / 0			UN	
14	Details		Active	-	Tax Lien	Lucia Ave	Los Osos	CA	93402	0 / 0			UN	
15	Details		Active	-	Tax Lien	Bay Oaks Dr	Los Osos	CA	93402	0 / 0		$470,994	UN	
16	Details		Active	-	Tax Lien	Del Mar Dr	Los Osos	CA	93402	0 / 0			UN	
17	Details		Active	-	Tax Lien	Fearn Ave	Los Osos	CA	93402	0 / 0			UN	
18	Details		Active	-	Tax Lien	11th St	Los Osos	CA	93402	0 / 0			UN	
19	Details		Active	-	Tax Lien	7th St	Los Osos	CA	93402	0 / 0			UN	
20	Details		Active	-	Tax Lien	8th St	Los Osos	CA	93402	0 / 0		$533,992	UN	
21	Details		Active	-	Tax Lien	Del Norte St	Los Osos	CA	93402	0 / 0		$627,267	UN	
22	Details		Active	-	Tax Lien	13th St	Los Osos	CA	93402	0 / 0			UN	
23	Details		Active	-	Tax Lien	El Morro Ave	Los Osos	CA	93402	0 / 0		$563,886	UN	
24	Details		Active	-	Tax Lien	Bay Oaks Dr	Los Osos	CA	93402	0 / 0			UN	
25	Details		Active	-	Tax Lien	Mar Vista Dr	Los Osos	CA	93402	0 / 0			UN	
26	Details		Active	-	Tax Lien	11th St	Los Osos	CA	93402	0 / 0			UN	
27	Details		Active	-	Tax Lien	Santa Ynez ...	Los Osos	CA	93402	0 / 0			UN	
28	Details		Active	-	Tax Lien	Crockett Cir	Los Osos	CA	93402	0 / 0			UN	
29	Details		Active	-	Tax Lien	5th St	Los Osos	CA	93402	0 / 0			UN	
30	Details		Active	-	Tax Lien	10th St	Los Osos	CA	93402	0 / 0			UN	
31	Details		Active	-	Tax Lien	7th St	Los Osos	CA	93402	0 / 0			UN	
32	Details		Active	-	Tax Lien	Ave	Los Osos	CA	93402	0 / 0		$656,816	UN	
33	Details		Active	-	Tax Lien	6th St	Los Osos	CA	93402	0 / 0			UN	
34	Details		Active	-	Tax Lien	7th St	Los Osos	CA	93402	0 / 0			UN	
35	Details		Active	-	Tax Lien	Bay Oaks Dr	Los Osos	CA	93402	0 / 0			UN	
36	Details		Active	-	Tax Lien	11th St	Los Osos	CA	93402	0 / 0			UN	
37	Details		Active	-	Tax Lien	17th St	Los Osos	CA	93402	0 / 0			UN	
38	Details		Active	-	Tax Lien	Skyline Dr	Los Osos	CA	93402	0 / 0			UN	
39	Details		Active	-	Tax Lien	Los Osos Va...	Los Osos	CA	93402	0 / 0			UN	
40	Details		Active	-	Tax Lien	Bay Oaks Dr	Los Osos	CA	93402	0 / 0		$675,485	UN	
41	Details		Active	-	Tax Lien	8th St	Los Osos	CA	93402	0 / 0			UN	
42	Details		Active	-	Tax Lien	6th St	Los Osos	CA	93402	0 / 0			UN	
43	Details		Active	-	Tax Lien	11th St	Los Osos	CA	93402	0 / 0		$559,833	UN	
44	Details		Active	-	Tax Lien	6th St	Los Osos	CA	93402	0 / 0		$498,883	UN	

Comments Welcome

Municipal and Statewide Land Use Regulations and Housing Prices Across 250 Major US Cities[♦♦]

© Theo S. Eicher
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University of Washington

January 14 2008

Previous studies of housing price determinants focus either on specific regulations in particular cities/regions, or on cross sections that cover a subset of major cities and regulations. I examine the impact of over 70 indicators of land use regulations on housing prices in 250 major US cities from 1989 to 2006. Cost-increasing municipal regulations (zoning and permit approval delays) and statewide growth/density regulations are shown to be robustly associated with changes in housing prices. In addition, there is also a highly statistically significant effect of statewide executive, legislative, and judicial land use activities on housing prices. Land use regulations are shown to explain a different dimension of the housing price data than demand factors (income, population growth, and population density). However, the estimated increase in housing prices associated with regulations is, on average (over 250 cities), substantial larger than housing demand effects. While the estimated dollar cost associated with regulations may be sizable at times, the results are remarkably consistent with previous studies that were based on smaller cross sections.

[♦]Do not cite or distribute without permission.

[♦]I thank Hendrik Wolff and Kriss Sjobloom for helpful discussions on the topic.

EXHIBIT

21.1

Table 4a
Comparing Housing Price Increases in San Francisco and Major US Cities

	1989	2006	Percent Increase
Average Real US Housing Price (major cities)[1]	$167,640	$258,524	54%
Real Price of Housing in San Francisco[1]	$479,237	$806,700	68%

Table 4b
Sources of the Increase In Housing Prices in San Francisco and Major US Cities

	San Francisco	Major US Cities (average)
Real Increase In Housing Prices Due to:		
I) Autonomous Change in Housing Prices[6]	-$66,440	-$24,556
II) Increase in Income and Population	$60,144	$3,840
III) Density (Population per Square Mile)	$82,204	$8,624
IV) Land Use Restrictions and Regulations	$397,906	$101,977
IVa) State Wide Land Use Restrictions Imposed by Executive & Legislature[2]	$150,013	$43,024
IVb) Municipal Land Use Restrictions Upheld by Courts[3]	$123,759	$34,306
IVc) State Wide Growth Management and Residential Building Restrictions[4]	$59,923	$16,177
IVd) Approval Delay[5]	$63,211	$8,470

NOTES

1) Source: 1990 Census and 2006 PUMS Census. http://factfinder.census.gov/home/saff/main.html?_lang=en. Median Owner Occupied House adjusting price for the general level of inflation, expressing all data in 2006 dollars using the consumer price index. http://www.bls.gov/cpi/

2) The level of activity in the Executive and Legislative branches over the past ten years that is directed toward enacting greater statewide land use restrictions. Source: Foster and Summers (2005)

3) The tendency of appellate courts to uphold or restrain municipal land use regulation. Source: Foster and Summers (2005)

4) Involvement of state legislature in affecting residential building activities and/or growth management procedures Source: Gyourko *et al.* (2007).

5) Approval delay is the average time lag (in months) for a) relatively small, single-family projects involving fewer than 50 units; b) larger single-family developments with more than 50 units, and c) multifamily projects of indeterminate size. Lag times are due to the average duration of the review process, the time between application for rezoning and issuance of a building permit and the time between application for subdivision approval and the issuance of a building permit conditional on proper zoning being in place. Source: Gyourko *et al.* (2007).

6) Changes in housing prices when if there had been no changes in regulations or income or population. This effect is likely capturing the falling mortgage rates, relaxed lending practices and changes in the cost of construction.

EXHIBIT

21,2

Table3

Estimated Contributions to Change in Housing Prices 1989-2006 (in 2006 $))

CITY	Due to Income Growth	Due to Population Growth	Due to Density	Due to State Wide Regulations.	Due to Courts	Due to Growth Manage't	To Approval Delay	Due to Constant	TOTAL: Population + Income	TOTAL Regulation	Regulation Contribution Rank
Abilene Texas	-$2,318	$339	$610	$11,354	$9,305	$4,505	$927	-$7,493	-$1,979	$26,091	243
Akron Ohio	-$5,408	-$1,435	$2,124	$12,994	$5,325	$2,578	$3,807	-$8,575	-$6,842	$24,704	246
Albany Georgia	-$7,191	-$70	$1,071	$22,400	$12,238	$2,963	$1,875	-$9,855	-$7,261	$39,475	197
Albuquerque NM	-$3,045	$5,783	$3,475	$24,826	$20,346	$4,926	$2,026	-$16,384	$2,738	$52,124	167
Alhambra California	-$5,033	-$332	$38,976	$106,448	$87,236	$42,239	$19,160	-$46,833	-$5,366	$255,082	17
Amarillo Texas	-$1,533	$2,376	$1,517	$14,089	$11,546	$11,181	$885	-$9,298	$843	$37,701	208
Anaheim California	-$33,085	$18,083	$27,183	$113,161	$92,738	$59,870	$23,684	-$49,786	-$15,001	$289,453	11
Anchorage Alaska	-$11,964	$6,661	$288	$17,117	$28,055	$6,792	$8,813	-$22,592	-$5,304	$60,777	144
Ann Arbor Michigan	-$8,584	$850	$7,780	$54,743	$29,909	$14,482	$14,665	-$24,085	-$7,735	$113,799	68
Appleton Wisconsin	-$7,366	$1,146	$3,231	$28,180	$23,094	$7,455	$6,212	-$12,398	-$6,220	$64,941	138
Appleton Wisconsin	-$7,366	$1,146	$3,231	$28,180	$23,094	$3,727	$4,010	-$12,398	-$6,220	$59,011	150
Arlington Texas	-$8,812	$7,136	$4,672	$24,443	$20,032	$4,850	$2,763	-$16,131	-$1,676	$52,088	168
Arlington Heights ILL	-$24,242	-$724	$11,891	$51,236	$41,989	$10,165	$17,050	-$33,813	-$24,966	$120,440	62
Arvada Colorado	-$364	$4,170	$4,901	$45,359	$24,782	$11,999	$10,253	-$19,956	$3,806	$92,393	93
Asheville NC	$327	$5,692	$2,122	$20,408	$16,725	$4,049	$1,025	-$13,468	$6,018	$42,208	195
Atlanta Georgia	$11,266	$2,894	$4,574	$39,826	$21,759	$5,268	$6,446	-$17,522	$14,161	$73,298	124
Aurora Colorado	-$10,062	$7,158	$2,771	$38,710	$21,149	$10,240	$6,157	-$17,031	-$2,903	$76,256	121
Aurora Illinois	-$554	$15,040	$6,366	$26,198	$21,470	$20,791	$10,966	-$17,289	$14,487	$79,424	113
Austin Texas	$9,363	$9,346	$3,359	$22,992	$18,842	$9,123	$7,218	-$15,173	$18,710	$58,176	152
Avondale Arizona	$29,506	$34,949	$2,052	$41,674	$34,152	$11,024	$12,908	-$18,335	$64,455	$99,759	85
Bakersfield California	-$1,761	$18,719	$4,906	$53,050	$43,476	$14,034	$4,885	-$23,340	$16,958	$115,444	65
Baldwin Park CA	-$24,635	$6,597	$31,640	$77,665	$63,648	$10,273	$7,152	-$34,169	-$18,037	$158,738	41
Baltimore Maryland	-$4,195	-$2,409	$6,800	$25,477	$13,919	$10,109	$1,706	-$11,209	-$6,604	$51,211	171
Baytown Texas	-$6,258	$1,803	$1,583	$13,725	$11,248	$2,723	$689	-$9,058	-$4,455	$28,386	231
Beaumont Texas	-$1,905	$308	$879	$12,426	$10,183	$2,465	$1,768	-$8,200	-$1,597	$26,843	240
Beaverton Oregon	-$3,034	$13,029	$8,456	$33,349	$27,330	$26,466	$12,982	-$22,008	$9,994	$100,126	84
Bend Oregon	$19,257	$39,138	$3,707	$32,698	$26,797	$25,949	$5,885	-$21,579	$58,396	$91,329	95
Bethlehem PA	-$12,304	$360	$4,862	$37,780	$10,320	$14,991	$10,753	-$16,622	-$11,944	$73,845	123
Billings Montana	-$1,135	$3,892	$3,085	$10,198	$16,714	$16,186	$1,537	-$13,459	$2,756	$44,634	187
Birmingham Alabama	-$2,393	-$2,285	$907	$6,110	$15,023	$4,849	$1,535	-$8,065	-$4,678	$27,517	237
Bloomington Illinois	$3,896	$5,110	$3,110	$19,998	$16,389	$7,935	$4,018	-$13,198	$9,006	$48,341	175
Boise Idaho	$3,559	$11,003	$3,953	$12,058	$29,644	$14,354	$3,482	-$15,915	$14,562	$59,538	149
Boston MA	$1,863	$79	$33,067	$81,491	$44,523	$21,557	$15,122	-$35,853	$1,942	$162,694	39
Boynton Beach FL	-$8,403	$8,480	$5,888	$28,835	$23,631	$22,884	$7,242	-$19,029	$77	$82,592	105
Brownsville Texas	$226	$5,708	$1,171	$10,375	$8,502	$6,175	$2,996	-$6,847	$5,934	$28,049	235
Bryan Texas	$194	$2,981	$1,360	$17,404	$14,263	$10,359	$2,113	-$11,486	$3,175	$44,138	191
Buffalo New York	-$2,608	-$2,524	$3,686	$11,333	$9,288	$4,497	$712	-$7,479	-$5,131	$25,829	245
Cambridge MA	-$10,337	-$4,789	$57,173	$119,803	$65,454	$31,692	$17,552	-$52,709	-$15,127	$234,502	21
Carrollton Texas	-$7,698	$11,601	$5,334	$31,047	$25,444	$12,320	$2,924	-$20,489	$3,903	$71,735	126
Carson California	-$31,600	$2,653	$15,088	$94,699	$77,608	$37,577	$14,402	-$41,664	-$28,947	$224,287	24
Charleston SC	$5,114	$6,167	$1,598	$30,255	$37,192	$6,003	$4,559	-$19,966	$11,281	$78,008	118
Charlotte NC	-$4,480	$10,965	$3,235	$23,588	$19,331	$14,040	$4,147	-$15,567	$6,485	$61,105	143
Chesapeake Virginia	$6,238	$10,683	$1,013	$30,532	$25,021	$30,288	$10,480	-$20,149	$16,921	$96,320	89
Chicago Illinois	$1,010	-$354	$18,961	$30,570	$25,053	$18,195	$5,246	-$20,174	$657	$79,064	116
Chico California	$17,459	$21,088	$5,078	$57,494	$47,118	$15,209	$14,680	-$25,295	$38,547	$134,502	54
Chino California	$7,736	$13,061	$11,495	$95,265	$78,072	$25,201	$16,216	-$41,913	$20,798	$214,754	25
Chino Hills California	$15,081	$78,871	$7,070	$119,347	$97,808	$31,572	$35,969	-$52,508	$93,952	$284,696	12
Cincinnati Ohio	-$5,035	-$3,037	$3,537	$17,783	$7,287	$7,056	$4,019	-$11,735	-$8,072	$36,145	212
Clearwater Florida	-$10,485	$3,952	$6,335	$27,067	$22,182	$5,370	$7,138	-$17,863	-$6,532	$61,757	142
Cleveland Ohio	-$3,309	-$2,505	$3,335	$12,423	$5,090	$7,394	$1,014	-$8,198	-$5,814	$25,921	244

EXHIBIT 21,3

Table 3 Continued
Estimated Contributions to Change in Housing Prices 1989-2006 (in 2006 $)

CITY	Due to Income Growth	Due to Population Growth	Due to Density	Due to State Wide Regulations.	Due to Courts	Due to Growth Manage't	To Approval Delay	Due to Constant	TOTAL: Population + Income	TOTAL Regulation	Regulation Contribution Rank
College Station Texas	$8,804	$7,309	$2,144	$22,827	$18,707	$9,058	$1,720	-$15,065	$16,113	$52,313	166
Colorado Springs CO	$6,409	$8,781	$2,935	$39,943	$21,823	$5,283	$2,508	-$17,573	$15,190	$69,557	132
Columbia SC	$4,125	$3,246	$1,000	$21,141	$25,989	$12,583	$4,380	-$13,952	$7,371	$64,094	140
Columbus Ohio	-$4,630	$2,313	$3,427	$19,572	$8,020	$3,883	$3,195	-$12,917	-$2,316	$34,671	218
Compton California	-$6,080	$3,271	$20,669	$62,289	$51,048	$16,478	$7,822	-$27,405	-$2,810	$137,637	52
Corona California	$3,883	$48,263	$15,877	$100,835	$82,637	$26,675	$14,351	-$44,363	$52,145	$224,497	23
Corpus Christi Texas	-$6,287	$1,366	$1,355	$14,334	$11,747	$5,688	$900	-$9,459	-$4,921	$32,668	221
Dallas Texas	-$8,926	$3,011	$3,398	$19,048	$15,610	$3,779	$1,196	-$12,571	-$5,915	$39,634	196
Davie Florida	-$6,340	$20,726	$4,928	$38,537	$31,582	$15,292	$15,486	-$25,432	$14,386	$100,895	83
Dayton Ohio	-$4,281	-$2,092	$1,691	$12,175	$4,989	$2,416	$1,376	-$8,035	-$6,373	$20,956	249
Decatur Illinois	-$5,886	-$813	$1,091	$11,393	$9,337	$2,260	$715	-$7,519	-$6,700	$23,706	247
Denton Texas	$10,076	$6,142	$1,495	$19,276	$15,797	$7,649	$2,663	-$12,721	$16,218	$45,384	183
Denver Colorado	$182	$5,067	$5,331	$42,209	$23,061	$5,583	$11,308	-$18,570	$5,248	$82,161	106
Des Moines Iowa	-$1,937	$270	$2,054	$7,716	$12,647	$9,186	$1,550	-$10,185	-$1,667	$31,100	225
Detroit Michigan	-$2,177	-$1,936	$3,090	$15,047	$8,221	$1,990	$2,834	-$6,620	-$4,113	$28,093	234
Durham NC	-$1,136	$8,744	$2,617	$24,021	$19,686	$9,532	$6,938	-$15,853	$7,608	$60,177	146
East Orange NJ	-$31,982	-$4,487	$29,326	$52,636	$14,379	$13,924	$5,582	-$23,158	-$36,469	$86,520	100
Edison CDP NJ	-$10,244	$6,598	$9,519	$83,330	$22,763	$22,044	$21,858	-$36,662	-$3,645	$149,995	45
El Cajon California	-$157	$339	$17,459	$83,412	$68,358	$22,065	$26,535	-$36,698	$183	$200,370	32
El Monte California	-$30,325	$3,470	$33,736	$83,038	$68,051	$21,966	$15,062	-$36,533	-$26,855	$188,117	36
El Paso Texas	-$7,617	$2,417	$2,180	$17,774	$14,566	$3,526	$2,009	-$11,730	-$5,200	$37,876	205
Elizabeth New Jersey	-$8,492	$7,370	$26,438	$73,126	$19,976	$9,672	$3,061	-$32,172	-$1,122	$105,835	76
Evansville Indiana	-$5,938	-$873	$1,870	$6,335	$15,574	$2,514	$2,705	-$8,361	-$6,811	$27,127	238
Everett Washington	-$2,896	$10,355	$5,059	$49,125	$26,839	$25,991	$8,842	-$21,613	$7,460	$110,797	71
Fargo North Dakota	-$1,612	$3,749	$2,490	$10,217	$16,746	$4,054	$3,336	-$13,485	$2,137	$34,353	220
Farmington Hills MI	-$31,038	$4,573	$5,286	$61,184	$33,428	$16,185	$9,476	-$26,918	-$26,465	$120,273	63
Fayetteville Arkansas	$11,694	$8,382	$1,610	$10,679	$8,752	$4,237	$4,068	-$14,095	$20,075	$27,736	236
Fayetteville NC	$1,586	$13,221	$2,571	$17,951	$14,711	$3,561	$1,578	-$11,846	$14,807	$37,801	206
Flower Mound Texas	$14,502	$44,943	$2,664	$31,580	$25,881	$12,531	$9,914	-$20,841	$59,445	$79,906	111
Folsom California	$36,562	$55,538	$11,269	$102,905	$84,333	$13,611	$11,199	-$45,274	$92,100	$212,048	28
Fort Wayne Indiana	-$2,450	$4,977	$2,304	$7,040	$17,307	$8,380	$2,623	-$9,291	$2,527	$35,350	216
Fort Worth Texas	$2,417	$5,489	$1,848	$16,555	$13,567	$3,285	$2,079	-$10,926	$7,906	$35,486	215
Fremont California	$15,478	$14,447	$11,958	$129,466	$106,100	$85,621	$33,599	-$56,960	$29,925	$354,785	4
Fresno California	-$445	$8,820	$7,386	$47,259	$38,730	$18,753	$4,220	-$20,792	$8,375	$108,962	73
Gainesville Florida	-$11,426	$4,300	$2,341	$20,823	$17,065	$4,131	$2,615	-$13,742	-$7,126	$44,634	188
Gilbert Arizona	$16,832	$71,261	$8,406	$61,638	$50,514	$16,305	$19,092	-$27,118	$88,092	$147,549	47
Glendale Arizona	-$5,455	$13,101	$6,469	$44,589	$36,542	$11,795	$12,007	-$19,617	$7,646	$104,934	79
Grand Rapids MI	-$12,071	-$415	$3,709	$26,286	$14,361	$10,430	$2,421	-$11,565	-$12,485	$53,499	165
Green Bay Wisconsin	-$4,707	$170	$1,960	$25,822	$21,162	$6,831	$2,414	-$11,361	-$4,537	$56,228	158
Greensboro NC	-$14,042	$4,399	$2,344	$20,821	$17,064	$4,131	$4,968	-$13,741	-$9,643	$46,984	179
Gulfport Mississippi	$1,690	$7,436	$943	$7,695	$12,612	$6,107	$1,997	-$10,156	$9,126	$28,411	230
Hampton Virginia	-$1,997	$1,744	$3,335	$23,237	$19,043	$4,610	$1,167	-$15,335	-$253	$48,058	176
Henderson Nevada	$1,422	$48,936	$5,927	$40,316	$33,039	$15,997	$2,531	-$26,606	$50,358	$91,884	94
Hesperia California	-$17,917	$21,609	$2,690	$58,571	$48,000	$23,241	$8,091	-$25,769	$3,692	$137,903	51
Hialeah Florida	-$19,457	$2,905	$15,770	$28,202	$23,112	$16,786	$12,041	-$18,612	-$16,552	$80,142	110
High Point NC	$761	$5,067	$1,829	$18,974	$15,550	$3,764	$5,004	-$12,522	$5,827	$43,292	193
Hollywood Florida	$909	$5,034	$8,619	$31,912	$26,153	$18,994	$9,417	-$21,060	$5,943	$86,476	101
Honolulu CDP Hawaii	-$25,088	-$159	$18,095	$41,510	$68,037	$49,414	$54,037	-$54,788	-$25,247	$212,999	27
Houston Texas	-$3,755	$3,819	$3,109	$16,941	$13,884	$10,083	$7,659	-$11,180	$63	$48,567	174

EXHIBIT 21.4

Table 3 Continued

Estimated Contributions to to Change in Housing Prices 1989-2006 (in 2006 $)

CITY	Due to Income Growth	Due to Population Growth	Due to Density	Due to State Wide Regulations.	Due to Courts	Due to Growth Manage't	To Approval Delay	Due to Constant	TOTAL: Population + Income	TOTAL Regulation	Regulation Contribution Rank
Huntington Beach CA	-$23,758	$2,867	$35,135	$144,839	$118,699	$38,315	$31,526	-$63,723	-$20,891	$333,378	7
Huntsville Alabama	-$7,668	$776	$971	$9,892	$24,321	$7,851	$2,484	-$13,057	-$6,892	$44,548	189
Independence MI	-$5,501	$878	$1,240	$7,956	$19,561	$3,157	$1,399	-$10,501	-$4,623	$32,073	223
Irvine California	-$24,027	$45,659	$19,442	$143,735	$117,794	$76,046	$36,099	-$63,237	$21,632	$373,674	3
Jackson Mississippi	-$9,647	-$1,792	$1,523	$8,847	$14,500	$3,510	$1,555	-$11,677	-$11,439	$28,413	229
Jersey New Jersey	-$11,233	$2,493	$36,797	$66,158	$18,073	$26,252	$4,708	-$29,107	-$8,740	$115,191	66
Kalamazoo Michigan	-$13,986	-$2,195	$2,081	$22,018	$12,030	$8,737	$1,935	-$9,687	-$16,181	$44,720	186
Kansas Missouri	-$3,160	-$89	$1,239	$8,761	$21,540	$3,476	$4,181	-$11,564	-$3,249	$37,958	203
Kenner Louisiana	-$4,955	-$2,896	$4,828	$11,359	$18,618	$4,507	$1,426	-$14,993	-$7,851	$35,911	213
Kent Washington	-$5,211	$29,627	$5,917	$53,658	$29,316	$21,292	$17,070	-$23,607	$24,416	$121,335	59
Killeen Texas	$6,809	$7,240	$2,600	$18,709	$15,332	$3,712	$940	-$12,347	$14,049	$38,693	200
Lake Charles LA	-$1,885	$218	$1,318	$7,199	$11,799	$2,856	$1,266	-$9,501	-$1,666	$23,119	248
Lakeland Florida	-$2,754	$6,163	$2,086	$18,569	$15,218	$14,737	$3,342	-$12,254	$3,409	$51,865	169
Lakewood California	-$2,967	$13,316	$35,668	$110,253	$90,355	$29,166	$19,844	-$48,507	$10,349	$249,618	19
Lancaster California	-$49,830	$14,267	$3,224	$63,778	$52,268	$25,308	$12,458	-$28,060	-$35,563	$153,812	44
Lansing Michigan	-$10,492	-$1,912	$2,443	$22,577	$12,335	$8,959	$2,268	-$9,933	-$12,404	$46,139	180
Las Vegas Nevada	$6,697	$25,968	$8,893	$34,511	$28,282	$13,694	$7,367	-$22,775	$32,665	$83,854	104
Lawrence Kansas	$6,928	$6,115	$3,517	$10,889	$26,771	$8,641	$5,561	-$14,372	$13,043	$51,861	170
League Texas	$2,462	$16,536	$1,456	$21,696	$17,781	$4,305	$1,362	-$14,318	$18,998	$45,144	185
Lewisville Texas	-$14,913	$12,611	$2,626	$22,384	$18,344	$4,441	$2,249	-$14,772	-$2,303	$47,418	177
Lincoln Nebraska	$469	$3,826	$3,096	$9,462	$23,263	$3,754	$6,178	-$12,488	$4,295	$42,657	194
Livonia Michigan	-$8,449	-$402	$3,994	$42,048	$22,973	$22,246	$8,448	-$18,499	-$8,851	$95,715	90
Long Beach California	-$27,409	$5,701	$34,857	$110,274	$90,372	$29,172	$27,080	-$48,516	-$21,708	$256,898	16
Longview Texas	-$3,945	$1,724	$1,144	$15,383	$12,606	$9,156	$1,159	-$10,152	-$2,221	$38,304	201
Los Angeles CA	-$29,619	$5,878	$32,723	$119,058	$97,571	$31,495	$33,888	-$52,381	-$23,741	$282,013	13
Lynchburg Virginia	-$3,577	$502	$1,214	$17,169	$14,070	$3,406	$1,617	-$11,330	-$3,075	$36,262	211
McAllen Texas	$1,838	$6,419	$2,245	$15,397	$12,618	$9,164	$2,127	-$10,161	$8,257	$39,306	198
McKinney Texas	$31,510	$36,699	$2,226	$22,886	$18,755	$4,541	$9,292	-$15,103	$68,209	$55,473	159
Medford Oregon	-$1,543	$12,671	$5,161	$29,495	$24,171	$23,407	$7,716	-$19,465	$11,129	$84,789	103
Melbourne Florida	-$10,714	$5,318	$2,970	$22,894	$18,762	$13,627	$4,504	-$15,109	-$5,396	$59,788	148
Merced California	-$26,064	$9,318	$6,993	$55,194	$45,233	$21,901	$9,241	-$24,283	-$16,746	$131,569	55
Mesa Arizona	-$2,530	$14,611	$5,822	$43,200	$35,403	$11,428	$6,630	-$19,006	$12,081	$96,662	88
Mesquite Texas	-$7,268	$4,490	$2,552	$15,709	$12,874	$6,234	$3,386	-$10,367	-$2,778	$38,204	202
Miami Beach Florida	$107,918	-$4,825	$36,805	$59,515	$48,774	$23,616	$33,507	-$39,276	$103,093	$165,412	37
Miami Florida	-$1,559	-$39	$16,919	$32,892	$26,956	$13,052	$8,674	-$21,707	-$1,598	$81,573	107
Milwaukee Wisconsin	-$6,514	-$1,781	$5,285	$26,395	$21,631	$6,982	$2,836	-$11,613	-$8,295	$57,844	154
Miramar Florida	$5,697	$34,150	$6,849	$35,242	$28,882	$13,984	$14,752	-$23,258	$39,847	$92,860	92
Mobile Alabama	$1,208	-$107	$1,309	$7,728	$19,001	$3,067	$1,359	-$10,201	$1,102	$31,155	224
Mount Vernon NY	-$17,795	$3,453	$53,204	$63,567	$52,095	$25,224	$17,162	-$41,950	-$14,343	$158,048	42
Murfreesboro TN	-$4,411	$15,701	$2,788	$23,013	$28,290	$4,566	$2,312	-$15,187	$11,290	$58,181	151
Nampa Idaho	$11,225	$14,175	$2,973	$8,284	$20,367	$6,574	$2,497	-$10,934	$25,401	$37,722	207
Nashua NH	-$6,763	$4,450	$5,993	$60,431	$49,525	$7,993	$2,530	-$26,587	-$2,313	$120,478	61
New Bedford MA	-$11,040	-$444	$8,855	$52,909	$28,907	$13,996	$5,315	-$23,278	-$11,484	$101,127	81
New Haven Connecticut	-$16,202	-$869	$13,102	$37,863	$31,029	$15,024	$5,072	-$24,987	-$17,071	$88,988	98
New Rochelle NY	-$52,787	$6,510	$32,191	$89,398	$73,264	$35,474	$16,465	-$58,997	-$46,278	$214,601	26
New York New York	-$8,063	$6,751	$87,431	$62,999	$51,629	$12,499	$19,382	-$41,576	-$1,312	$146,510	48
Newark New Jersey	-$2,137	-$1,058	$20,894	$54,565	$14,906	$28,869	$7,309	-$24,006	-$3,194	$105,648	77
Newport News VA	-$728	$1,093	$3,323	$24,843	$20,360	$19,716	$4,991	-$16,395	$365	$69,910	130
Norfolk Virginia	$3,588	-$2,919	$5,252	$24,036	$19,698	$9,538	$3,169	-$15,862	$669	$56,441	156
Norman Oklahoma	-$2,162	$3,427	$530	$9,413	$15,428	$14,940	$4,413	-$12,424	$1,265	$44,194	190

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Table 3 Continued
Estimated to Change in Housing Prices 1989-2006 (in 2006 $)

CITY	Due to Income Growth	Due to Population Growth	Due to Density	Due to State Wide Regulations.	Due to Courts	Due to Growth Manage't	To Approval Delay	Due to Constant	TOTAL: Population + Income	TOTAL Regulation	Regulation Contribution Rank
O'Fallon Missouri	$11,616	$29,951	$3,725	$12,041	$29,603	$19,111	$2,117	-$15,892	$41,567	$62,871	141
Ogden Utah	-$2,258	$3,565	$2,513	$16,141	$19,842	$6,405	$3,344	-$10,652	$1,308	$45,733	182
Oklahoma City OK	-$3,374	$2,988	$731	$7,967	$13,059	$6,323	$2,401	-$10,516	-$386	$29,750	227
Olathe Kansas	$7,093	$14,494	$2,801	$12,854	$31,601	$10,201	$2,583	-$16,965	$21,588	$57,238	155
Omaha Nebraska	-$1,734	$2,067	$2,869	$8,462	$20,803	$13,430	$3,188	-$11,168	$333	$45,883	181
Orem Utah	-$9,169	$5,502	$5,824	$24,375	$29,964	$9,672	$4,387	-$16,086	-$3,666	$68,399	134
Orlando Florida	-$839	$7,497	$3,321	$27,511	$22,545	$10,916	$5,527	-$18,155	$6,658	$66,500	137
Oxnard California	-$9,392	$12,440	$25,076	$108,752	$89,125	$14,384	$34,597	-$47,847	$3,048	$246,858	20
Palatine Illinois	-$5,680	$22,371	$11,950	$46,060	$37,748	$18,277	$6,362	-$30,397	$16,690	$108,448	74
Palm Bay Florida	-$6,755	$8,964	$1,794	$23,845	$19,542	$18,924	$5,090	-$15,736	$2,209	$67,401	136
Palm Coast Florida	-$3,220	$43,496	$1,883	$31,789	$26,052	$6,307	$3,393	-$20,979	$40,276	$67,540	135
Palmdale California	-$24,276	$33,872	$3,408	$73,000	$59,825	$9,656	$7,334	-$32,117	$9,596	$149,814	46
Parma Ohio	-$7,678	-$636	$4,373	$20,058	$8,219	$3,980	$3,400	-$13,237	-$8,314	$35,657	214
Pasadena Texas	-$7,789	$2,816	$2,446	$14,307	$11,725	$5,677	$2,935	-$9,442	-$4,972	$34,645	219
Passaic New Jersey	-$62,862	-$1,151	$48,220	$77,523	$21,177	$20,508	$4,543	-$34,107	-$64,014	$123,751	58
Paterson New Jersey	-$43,917	$2,471	$40,930	$67,691	$18,492	$8,953	$7,084	-$29,781	-$41,446	$102,220	80
Pearland Texas	$6,399	$27,010	$1,906	$22,501	$18,440	$8,929	$4,050	-$14,849	$33,409	$53,920	163
Peoria Arizona	$16,625	$33,502	$1,788	$48,064	$39,390	$12,715	$16,095	-$21,146	$50,127	$116,264	64
Philadelphia PA	-$8,624	-$1,291	$8,456	$23,086	$6,306	$3,053	$4,832	-$10,157	-$9,914	$37,277	209
Phoenix Arizona	-$1,775	$9,967	$4,374	$42,530	$34,854	$16,876	$6,765	-$18,711	$8,191	$101,025	82
Pittsburgh PA	-$2,049	-$2,298	$3,109	$17,028	$4,652	$6,757	$1,069	-$7,492	-$4,347	$29,506	228
Plano Texas	-$11,894	$21,021	$5,808	$30,489	$24,987	$12,098	$4,594	-$20,121	$9,127	$72,169	125
Plantation Florida	-$9,339	$6,723	$8,290	$44,921	$36,814	$44,562	$9,590	-$29,645	-$2,617	$135,887	53
Plymouth Minnesota	-$1,773	$12,205	$4,596	$64,189	$35,069	$8,490	$6,448	-$28,240	$10,432	$114,197	67
Pomona California	-$15,235	$6,837	$16,773	$73,281	$60,056	$19,386	$11,656	-$32,241	-$8,398	$164,379	38
Pompano Beach FL	-$13,300	$12,164	$8,986	$34,019	$27,879	$20,248	$15,379	-$22,450	-$1,136	$97,525	87
Portland Oregon	$4,987	$5,186	$5,424	$26,332	$21,580	$26,122	$3,803	-$17,378	$10,173	$77,836	119
Portsmouth Virginia	$2,641	-$483	$3,308	$21,113	$17,303	$12,567	$2,519	-$13,933	$2,157	$53,501	164
Providence RI	-$9,998	$1,934	$16,757	$53,148	$29,037	$21,089	$1,780	-$23,383	-$8,064	$105,054	78
Quincy MA	-$4,392	$893	$13,269	$75,259	$41,118	$19,909	$6,930	-$33,111	-$3,499	$143,217	50
Racine Wisconsin	-$8,128	-$1,550	$4,176	$24,919	$20,421	$9,888	$1,043	-$10,963	-$9,677	$56,271	157
Raleigh NC	-$2,652	$13,385	$4,308	$27,814	$22,794	$11,037	$7,917	-$18,356	$10,733	$69,562	131
Redondo Beach CA	-$6,478	$5,804	$56,203	$162,224	$132,946	$21,457	$33,499	-$71,372	-$674	$350,127	5
Redwood California	$8,389	$17,071	$22,428	$163,683	$134,142	$64,950	$22,610	-$72,014	$25,459	$385,385	2
Reno Nevada	-$2,780	$16,380	$6,194	$40,683	$33,341	$16,143	$22,478	-$26,848	$13,600	$112,645	69
Richardson Texas	-$25,189	$7,444	$5,304	$30,422	$24,932	$6,036	$2,865	-$20,077	-$17,745	$64,255	139
Riverside California	-$12,675	$14,910	$10,191	$74,773	$61,278	$39,560	$13,771	-$32,897	$2,234	$189,383	35
Roanoke Virginia	-$1,638	-$781	$1,787	$16,334	$13,386	$6,481	$1,743	-$10,779	-$2,419	$37,945	204
Rochester New York	-$12,852	-$1,604	$4,151	$14,162	$11,606	$2,810	$1,245	-$9,346	-$14,456	$29,823	226
Rochester Hills MI	-$15,192	$7,207	$4,678	$60,072	$32,820	$15,891	$18,607	-$26,429	-$7,984	$127,390	57
Round Rock Texas	$17,282	$19,686	$3,396	$21,406	$17,543	$16,988	$3,898	-$14,127	$36,968	$59,835	147
Salem Oregon	$2,109	$6,488	$3,601	$21,671	$17,760	$12,899	$2,857	-$14,302	$8,597	$55,187	161
Salt Lake Utah	$9,276	$2,771	$2,100	$24,800	$30,486	$9,841	$4,983	-$16,366	$12,047	$70,108	129
San Antonio Texas	$2,507	$4,061	$2,252	$14,067	$11,528	$2,791	$4,181	-$9,283	$6,568	$32,566	222
SanBuenaventura CA	-$13,536	$7,461	$19,676	$118,425	$97,052	$46,992	$87,409	-$52,102	-$6,076	$349,878	6
San Diego California	$14,874	$8,115	$13,625	$102,563	$84,053	$27,132	$38,209	-$45,124	$22,989	$251,956	18
San Francisco CA	$57,582	$2,562	$82,204	$151,013	$123,759	$59,923	$63,211	-$66,440	$60,144	$397,906	1
San Jose California	-$4,626	$12,774	$23,236	$129,813	$106,385	$17,170	$20,648	-$57,112	$8,148	$274,016	14
San Leandro CA	$10,842	$18,782	$25,254	$107,530	$88,124	$42,669	$22,505	-$47,309	$29,624	$260,828	15
Santa Ana California	-$11,378	$11,306	$44,515	$100,508	$82,369	$13,294	$14,725	-$44,219	-$72	$210,896	29

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