Bay Area Biosolids Management:
Challenges, Opportunities, and Policies

Prepared for

Bay Area Clean Water Agencies

By

M.Cubed

FINAL

March 2009

Prepared for:

Bay Area Clean Water Agencies

Michele Pla, Executive Director
(510) 547-1174
www.bacwa.org

Prepared by:

M.Cubed

Principal Author:

David Mitchell

M.Cubed
5358 Miles Avenue
Oakland, CA 94618
(510) 547-4369
mitchell@mcubed-econ.com

Executive Summary

Biosolids, a derivative of the treatment of municipal sewage at wastewater treatment facilities, are an important resource management issue for the Bay Area. At present, the Bay Area generates approximately 196,000 dry-tons of biosolids each year. By 2030, Bay Area biosolids production is projected to increase to 229,000 dry tons. At the same time that regional biosolids production is increasing, traditional management approaches are becoming more difficult and more expensive to implement. Bay Area wastewater agencies are confronting an increasingly challenging management and regulatory environment.

Communicating the growing importance of biosolids management to the Bay Area, its role in regional resource management, recycling, and renewable energy objectives, the potential regional economic benefits of biosolids reuse, and ways to ensure its safety and allay public concern is an important task for managers of Bay Area wastewater agencies. This paper, commissioned by Bay Area Clean Water Agencies (BACWA), provides an overview of biosolids issues that wastewater agencies and other interested parties can utilize when participating in forums where biosolids management is under discussion.

The paper is organized into six main sections. Section 1 provides background information on biosolids regulation and safety in California. Section 2 presents information on Bay Area biosolids production and traditional management approaches. Section 3 discusses trends in local land use restrictions and other emerging challenges to traditional Bay Area biosolids management. Section 4 deals with public concerns about biosolids, while Section 5 explores sustainable solutions for biosolids management. Lastly, Section 6 reviews existing policies and considers new policy options to promote cost-effective, sustainable, and environmentally responsible biosolids management. This Executive Summary provides highlights and key findings from each of these subject areas.

Beneficial Uses of Biosolids

When first hearing the term “biosolids” many people associate it with waste. While this is a natural association since biosolids are a byproduct of sewage treatment, it is an inaccurate one. In fact, biosolids are a tremendous resource. Most biosolids are beneficially recycled rather than disposed of. Over 80% of the Bay Area’s biosolids, for example, are beneficially used in some manner. Because biosolids are comprised of nutrient rich organic materials, they are most commonly used as a soil amendment and fertilizer. In addition to agricultural applications, biosolids can be used in mine reclamation, restoration of fire ravaged land, and forestry applications. They can also be used to produce compost and commercial fertilizer products. In the Bay Area, biosolids are extensively used in landfills as alternative daily cover (ADC). Biosolids are also used to generate bioenergy, which reduces demand for fossil fuels.

Regulation of Biosolids

Federal, State, and local regulations govern the management and use of biosolids. At the federal level, biosolids are regulated under the Clean Water Act (CWA). Under CWA regulations, biosolids applied to the land must meet risk-based pollutant limits, and technologically based controls for pathogens and vector attraction. Their use is also subject to application, monitoring, management, reporting, and recordkeeping

requirements designed to protect public health and the environment. US EPA Region 9 oversees biosolids management in California. In addition, at the State level, Water Quality Order No 2004-0012-DWQ established additional regulatory requirements for the application of biosolids to land for use as a soil amendment in agricultural, silvicultural, horticultural, and land-reclamation activities. Numerous other State regulatory agencies, including the Department of Health Services, State and Regional Water Quality Control Boards, the California Integrated Waste Management Board (CIWMB), the California Air Resources Board, and local Air Districts also regulate certain aspects of treatment, use, and disposition of biosolids. At the local level, county and municipal land use ordinances may regulate biosolids recycling and other disposition.

Biosolids Safety

Acceptance of the beneficial use of biosolids has been debated for many years. Because biosolids derive from municipal sewage, a question of whether dangerous pathogens and potentially toxic substances known to be present in sewage also will be present in biosolids is sometimes raised. Federal regulations define two classes of biosolids relative to pathogen content. Pathogens in Class A biosolids are below detectable levels – Class A biosolids are essentially pathogen free. Class B biosolids may have low levels of pathogens which rapidly die-off when applied to soils, and are considered equally safe as Class A biosolids when specified management practices are followed. A third category of biosolids is called Exceptional Quality or EQ biosolids. EQ biosolids meet the most stringent requirements for pathogens (Class A), pollutant concentrations (High Quality), and vector control (defined process control), and are safe for unregulated use.

Public concern has mostly focused on land application of Class B biosolids. Responding to this concern, EPA commissioned the National Research Council (NRC) to evaluate the safety of current regulations. After 18 months of study, the NRC concluded there was "no documented scientific evidence that the [federal] rule has failed to protect public health." The State of California also extensively reviewed the sufficiency of the Part 503 Rule to protect public health as part of its Programmatic Environmental Impact Report Covering General Waste Discharge Requirements for Biosolids Land Application. It concluded that potential impacts to human health from land application of Class B biosolids complying with the Part 503 Rule would be less than significant.[1]

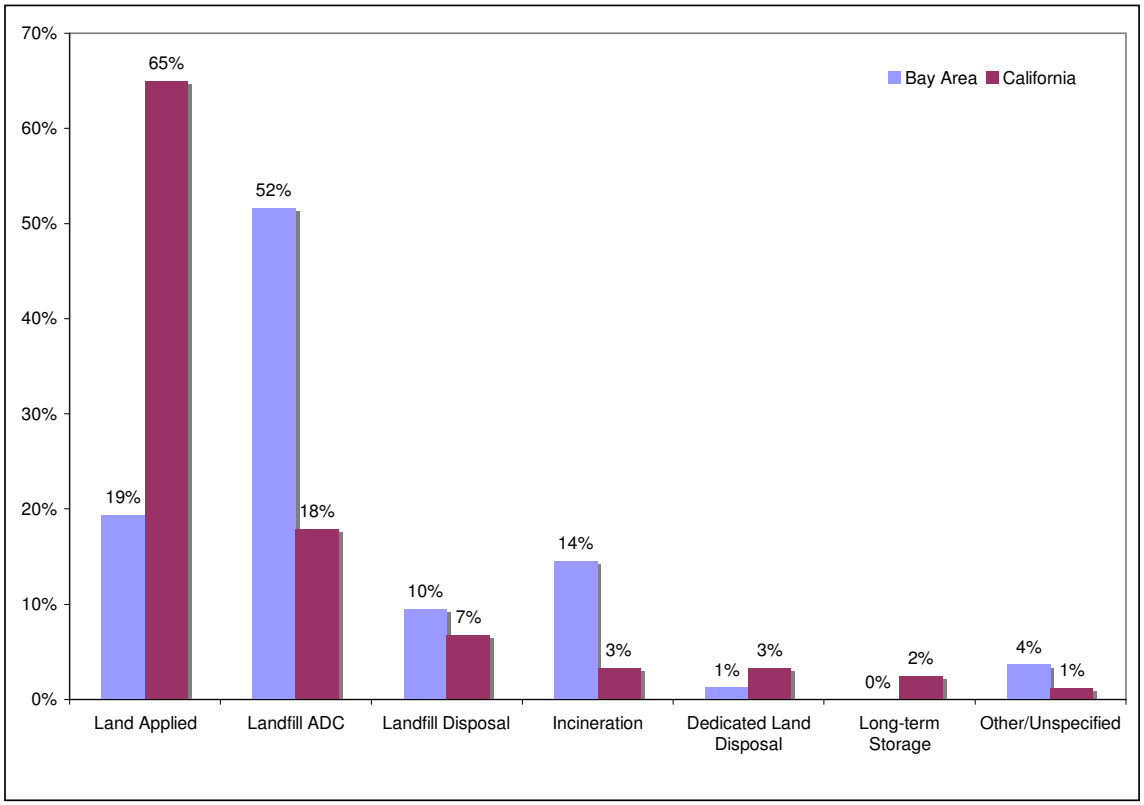
Current Bay Area Biosolids Management

At present, Bay Area biosolids are predominantly used as landfill ADC. Two other management practices – land application and thermal oxidation (or incineration) – account for most of the remaining biosolids produced in the region. Figure ES1 compares Bay Area management practices to the State as a whole as of 2007. Compared to all of California, the Bay Area relies much more on landfill ADC and much

[1] California State Water Resources Control Board, "Final Environmental Impact Report Covering General Waste Discharge Requirements for Biosolids Land Application." June 30, 2000. Chapter 5: Public Health. Only in the case of potential impact from ingestion of pathogenic organisms in crops grown on land application sites or animals fed with crops grown on land application sites were impacts found to be potentially significant. In this instance, Water Quality Order No 2004-0012-DWQ imposes additional mitigation measures in the land application of biosolids to reduce this risk to less than significant.

less on land application. This is largely due to the Northern California's wet winters, which precludes land application due to environmental concerns.

Figure ES 1. Bay Area and California Biosolids Management Practices (2007)



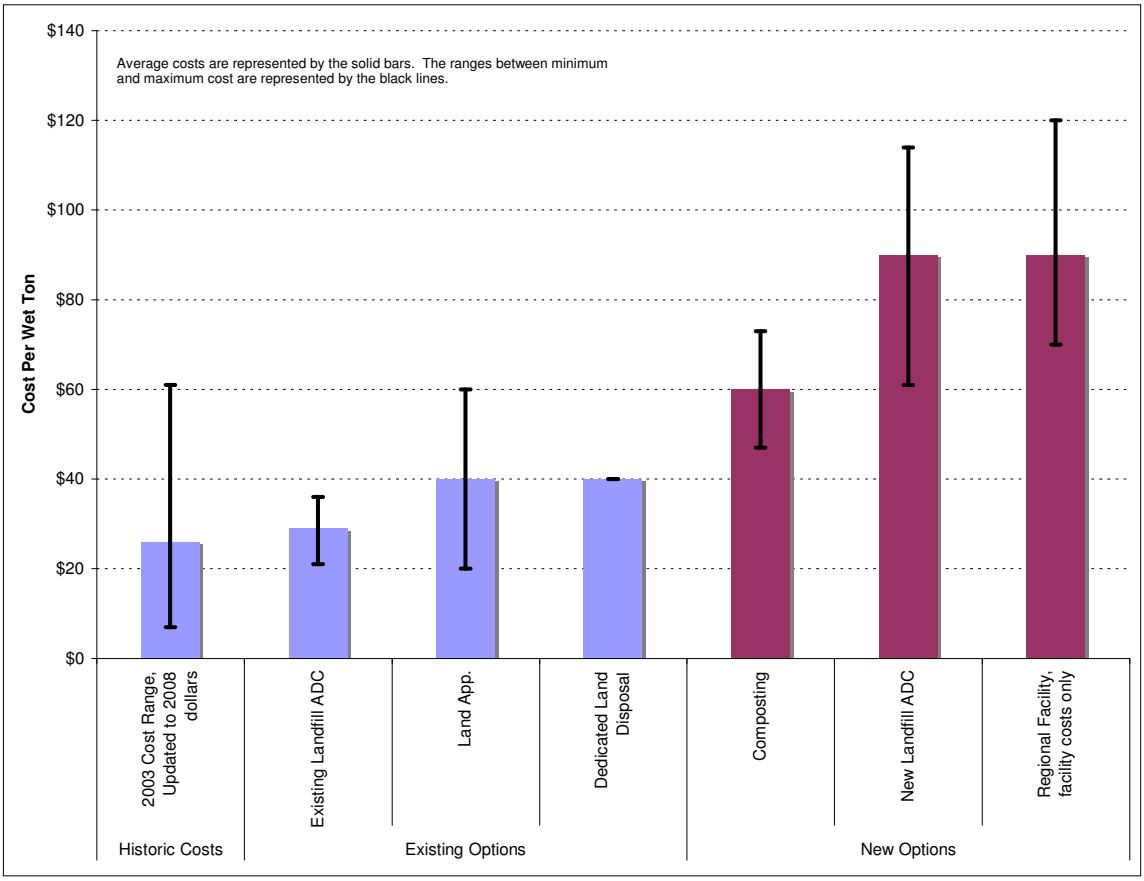
Challenges Confronting Bay Area Biosolids Management

Effective management of the Bay Area's biosolids will continue to require a mix of management options. No single management option will work for all Bay Area wastewater agencies. In fact, challenges to the continuation of traditional management practices will require an expanded portfolio of management options. The following is a listing of the most pressing challenges facing biosolids management in the Bay Area:

- **Limited ADC Capacity:** Insufficient ADC capacity at landfills within 200 miles of San Francisco will require continuation and expansion of land application programs as well as development of regional or individual agency Class A programs or other advanced processing. According to recent BACWA surveys, Bay Area production of biosolids is presently about 70% greater than available permitted capacity for biosolids in regional landfills. Without alternatives to landfill disposal and beneficial use, Bay Area wastewater agencies will face growing competition for limited landfill capacity, higher costs, and longer hauling distances.

- **Fewer Counties Allowing Biosolids Land Application:** The number of California counties with bans on Class B biosolids land application nearly doubled between 1999 and 2008. Twenty-one of California's 58 counties now have restrictions on land application of Class B biosolids. Other counties may follow suit. Opponents to land application in Solano County, for example, have advocated banning Class B land application in the county. A BACWA study found that increasing land application would require longer hauling distances (e.g. Nevada) and much higher costs.
- **Tighter Air Quality, Land Application, and Landfilling Regulations:** Recently enacted and proposed regulatory requirements are narrowing management options for the Bay Area's biosolids. AB 2640 and the San Joaquin Valley Unified Air Pollution Control District's Rule 4565 are two examples of recent legislative and regulatory initiatives expected to make it more difficult to use biosolids for land application or as landfill ADC. While there are 31 landfill sites serving the Bay Area permitted for biosolids, only five sites are currently willing to accept them for use as ADC, and only three have capacity to increase biosolids beneficial use. As another example, an analysis of regulatory feasibility for a regional biosolids-to-energy facility identified 23 air quality and emission requirements applicable to the facility. Air quality restrictions are impacting other management options, as well. Compliance with AB 32 requirements – the legislation governing California's response to global climate change -- ultimately may favor certain biosolids management practices over others.
- **Rising Biosolids Management Costs:** Regulatory and land use trends are driving up the costs of biosolids management for the Bay Area. Biosolids treatment and management generally accounts for half the overall costs of wastewater treatment. Figure ES2 shows the cost trajectory for Bay Area biosolids management. As biosolids management options narrow, Bay Area wastewater agencies are finding it more difficult to control costs, which ultimately impacts all our citizens through increased user fees.

Figure ES2. Bay Area Biosolids Management Costs



- **Public Perceptions of Biosolids:** Overarching each of the challenges just listed are the publics' perceptions about biosolids. These perceptions impact to some degree all of the biosolids management options the Bay Area currently relies upon. Increasing the publics' awareness of and knowledge about biosolids management issues in the Bay Area is one of the most important tasks confronting biosolids management. Without informed public discussion, the region is unlikely to implement optimal management policies. Policies aimed at placating negative public perceptions about biosolids are a more likely outcome. For example, recent land use restrictions in Kern and Imperial Counties received widespread public support even though there is no documented scientific evidence that land application of Class B biosolids when conducted according to the prescribed regulations has resulted in any adverse human health impacts or posed a significant risk to the environment.

Addressing Public Concerns about Biosolids Management

Increasing public understanding of biosolids issues requires a regional investment in public information. Public resistance to biosolids management practices often derives from fundamental misunderstandings about and lack of confidence in biosolids regulatory requirements and oversight. Public acceptance of biosolids management practices is dependent on public confidence that they do not pose substantial risks to

public health or the environment. When discussing the safety of biosolids, it is important to emphasize matching appropriate technology and regulations to intended use. There is a large body of research showing that biosolids use is safe for all intended uses when paired with the appropriate management practices.

Communicating objective information to the public and involving stakeholders is a key part of the National Biosolids Partnership's (NBP) national model for a biosolids Environmental Management Strategy (EMS). In order to comply with the national model, a facility EMS must provide meaningful opportunities for interested parties to express their views and perspectives regarding current and proposed biosolids management practices, including concerns about environmental impacts, biosolids program performance, and potential areas of improvement. It must also establish and maintain a proactive communications program to provide on-going information about its biosolids management program and its EMS to interested parties, as well as procedures for receiving and responding to requests for information or complaints.

The approach embedded in the national EMS model, and followed by Bay Area wastewater agencies, conforms to basic community value-based decision-making principles, including:

- Involving the public in all phases of project planning, including developing and selecting alternatives;
- Listening and responding to public concerns with respect and incorporating community values into the decision criteria;
- Acknowledging and validating fears and concerns and addressing them with accurate information and, if necessary, changes in project design.
- Disseminating adequate and understandable information about the proposed project and its role in regional wastewater management to a broad array of public forums;
- Explaining how the project contributes to fundamental community needs or desires, such as sustainable resource use, prevention of water pollution, environmental protection and enhancement, reduced dependence on fossil fuels, and promotion of local agriculture; and
- Incorporating concepts of environmental justice, fairness, and equity into the decision-making process.

Implementing Sustainable Solutions

Bay Area wastewater agencies are focused on developing sustainable management strategies for the region's biosolids. In this regard, biosolids management programs are helping to meet landfill diversion goals for the region, supporting sustainable agriculture, and promoting the development of bioenergy. Opportunities for transforming biosolids into marketable commodities are also being explored.

- **Solid Waste Management and AB 939**: Beneficial use of Bay Area biosolids through land application, landfill ADC, energy production, and recycling into compost is helping the Bay Area meet landfill diversion goals established by the California Integrated Waste Management Act (AB 939) of 1989. Under AB 939, municipalities and counties were required to divert from landfills up to 50 percent of their solid waste by 2000. Less than 3% of the Bay Area's biosolids are now

disposed of in landfills. Over 80% are beneficially reused as landfill ADC or recycled through land application.

- **Increasing Agricultural Land Productivity**: Biosolids provide a renewable, nutrient rich source of fertilizer and soil conditioner that can be managed in ways that benefit local agriculture. Land application of biosolids provides benefits to Bay Area agriculture by improving soil productivity, through increased organic matter, moisture holding capacity, and soil tilth. Such use reduces dependence on inorganic fertilizers and the high energy demands for their production. Long-term land application of biosolids has also been shown to enhance soil microbial activity and increase soil macro nutrients with no adverse toxicity effects on the soil microbial community. In its review of Solano County land application regulations, the Solano County Grand Jury highlighted these benefits, noting that "biosolids application has been shown to increase yields of hay approximately 4-fold over untreated, undisked fields." The Statewide General Order also found that Class B land application was the most environmentally sound option for biosolids management.
- **Biosolids-to-Energy:** Biosolids are a source of renewable bioenergy. Latent energy in biosolids can be harnessed indirectly via the capture and combustion of methane produced in digestion processes or directly via combustion of the biosolids themselves. With a bioenergy value of 10,000 to 12,000 BTUs per pound of volatile solids, biosolids are a significant potential source of bioenergy for the region. Most Bay Area wastewater agencies already capture a portion of this energy through anaerobic digestion. Additionally many Bay Area wastewater agencies are now exploring the feasibility of a regional biosolids-to-energy (B2E) facility capable of providing 100% beneficial reuse of the region's biosolids.
- **Commercial Products from Biosolids**: Other options for sustainable reuse of biosolids involve transforming biosolids into one or more marketable commodities. Examples include bulk and packaged compost, pelletized fertilizer, and inputs into the production of cement, bricks and glass. Bay Area wastewater agencies already convert some biosolids into Class A compost and several agencies are upgrading their treatment facilities to increase production of Class A biosolids.

Regional Approaches to Biosolids Management

Biosolids disposal and reuse decisions frequently involve disparate localities and communities spanning multiple political jurisdictions. Biosolids management is seldom just a local issue; it is regional in nature. Additionally, several of the more promising opportunities for reusing biosolids, such as B2E, composting, and pelletization, can best be realized through regional approaches that harness the economies of scale associated with these technologies. This is also true for marketing new products and providing information to the public. Regional coordination and action will also facilitate State and federal partnerships to provide funding needed to advance the state-of-the-art of biosolids management in the Bay Area.

Given the potentially substantial benefits and synergies associated with developing regional solutions to biosolids management, Bay Area wastewater agencies have been evaluating the feasibility of a regional biosolids processing facility. Two types of facility are being investigated: (1) a regional drying facility for the production of Class A biosolids with potential commercial outlets, and (2) a regional biosolids-to-energy facility

capable of producing surplus bioenergy for the region. The initial planning-level work has identified a number of potential benefits of a regional processing facility, including:

- More robust and diversified options for managing the Bay Area's biosolids;
- Greater regional control over biosolids management and reuse decisions;
- Advancing the state-of-the-art in sustainable resource management and bioenergy production in the Bay Area;
- Harnessing economies of scale and reducing technology redundancy among agencies; and
- Opportunities to form State and federal partnerships and cost-sharing agreements.

Need for New State Policies Supporting Biosolids Management

Biosolids management is an issue that concerns every municipality, whether in the Bay Area, elsewhere in California, or across the nation. In this respect, biosolids management is an issue of State and national importance. A number of State and federal funding programs that could apply to biosolids management already exist, but other initiatives are warranted. Examples of several new policy options aimed at promoting sustainable management of biosolids that could be considered include:

- **State Incentive to Promote Biosolids Composting**: To promote the composting of biosolids, the State could provide production or tax incentives to the composting industry to partially offset initial capital costs and stimulate expansion. Possible incentives could include: (1) low interest loans to meet emission standards, (2) tax credits for composting companies, and (3) regional tipping fees dedicated to expansion of composting facilities.
- **Eliminating Barriers to B2E:** The State could create incentives for wastewater treatment facilities to invest in B2E technologies by expediting and reducing the cost of utility interconnection, eliminating economic penalties, including standby charges, removing size limitations for net metering, and allowing water and wastewater utilities to self generate and provide power within their own systems. Existing regulatory and permitting requirements should also be consolidated and rationalized to facilitate development and installation of new biosolids conversion technologies.
- **Creating Incentives for B2E and Other Biosolids Products:** The State could amend Diversion Credit policies to award higher credit to projects that transform biosolids to bioenergy or other useful products. It could also direct more state funding and leverage federal funding for research, development, and demonstration projects for alternative uses and markets for biosolids, including expanding funding eligibility under the Emerging Renewables Program.
- **State Incentives for Private Sector Investment:** The State could create private sector grants and tax credits for the creation of new technologies supporting alternative applications of biosolids, such as biosolids-based fuel production, B2E technologies, materials production, and commercial product development.

Looking Forward

Bay Area biosolids management is at a crossroads. While the region has made great strides in beneficially using it biosolids, its traditional management approaches are confronting a number of challenges. Opportunities to beneficially use biosolids for landfill ADC are narrowing and local land use and air quality regulations are impacting the ability to use biosolids in land application. Meanwhile, the region's population – and hence its production of biosolids -- continues to increase. These trends are causing biosolids management costs to escalate. Responding to these management challenges, Bay Area wastewater agencies are working to develop new outlets and sustainable uses for the region's biosolids. These efforts include potential development of a regional biosolids processing or bioenergy facility; development of commercial products and markets for biosolids; and continuation of beneficial land application and ADC uses. Successfully transitioning to the next generation of biosolids management practices will require a range of public policies, including creating incentives for B2E and other biosolids products, removing regulatory barriers to biosolids energy conversion, and promoting private sector investment in biosolids technologies and markets.

1. Introduction

Communicating the growing importance of biosolids management to the Bay Area, its role in regional resource management, recycling, and renewable energy objectives, the potential regional economic benefits of biosolids reuse, and ways to ensure its safety and allay public concern is an important task for managers of Bay Area wastewater agencies. This paper, commissioned by Bay Area Clean Water Agencies (BACWA), provides an overview of biosolids issues that wastewater agencies and other interested parties can utilize when participating in forums where biosolids management is under discussion.

The paper is organized into six main sections. This section provides background information on biosolids regulation and safety in California. Section 2 presents information on Bay Area biosolids production and traditional management approaches. Section 3 discusses trends in local land use restrictions and other challenges to traditional Bay Area biosolids management. Section 4 deals with public concerns about biosolids, while Section 5 explores sustainable solutions for biosolids management. Lastly, Section 6 reviews existing policies and considers new policy options to promote cost-effective, sustainable, and environmentally responsible biosolids management.

1.1. What are Biosolids

The Environmental Protection Agency (EPA) describes biosolids as the "nutrient-rich organic materials resulting from the treatment of domestic sewage in a [wastewater] treatment facility." Through treatment and processing, sewage sludge is converted to a safe and beneficial organic product that can be recycled and used to fertilize soils (see Figure 1). The controlled land application of biosolids completes a natural cycle in the environment. Sewage sludge is converted to biosolids, which can be used as valuable fertilizer and soil conditioner, instead of taking up space in a landfill or other disposal facility or having to be incinerated. More than 55% of the biosolids generated in the United States are reused through some form of land application.[2]

Biosolids are used throughout the United States to fertilize fields for crop production. Use of biosolids reduces farm production costs and replenishes the organic matter in soils that has been depleted over time. The organic matter improves soil structure by increasing the soil's ability to absorb and store moisture. Nutrients found in biosolids, such as nitrogen, phosphorus and potassium, are necessary for crop production and growth. Agricultural use of biosolids has been shown to produce significant improvements in crop growth and yield.

Biosolids are also being used for mine reclamation, forestry, and even home gardening. Biosolids have been particularly successful at regenerating the soil layer of highly disturbed mine soils. Additionally, the organic matter, inorganic matrix and nutrients present in the biosolids have been shown to reduce the bioavailability of toxic substances often found in mined soils. In forestry applications, biosolids have been found to promote rapid timber growth. Composted biosolids are being sold or distributed for use on lawns and home gardens.

Biosolids are regulated at the federal, state, and local levels. At the federal level, biosolids are regulated under the Clean Water Act (CWA). The part of the CWA addressing biosolids is found in Title 40 of the Code of Federal Regulations, Part 503.

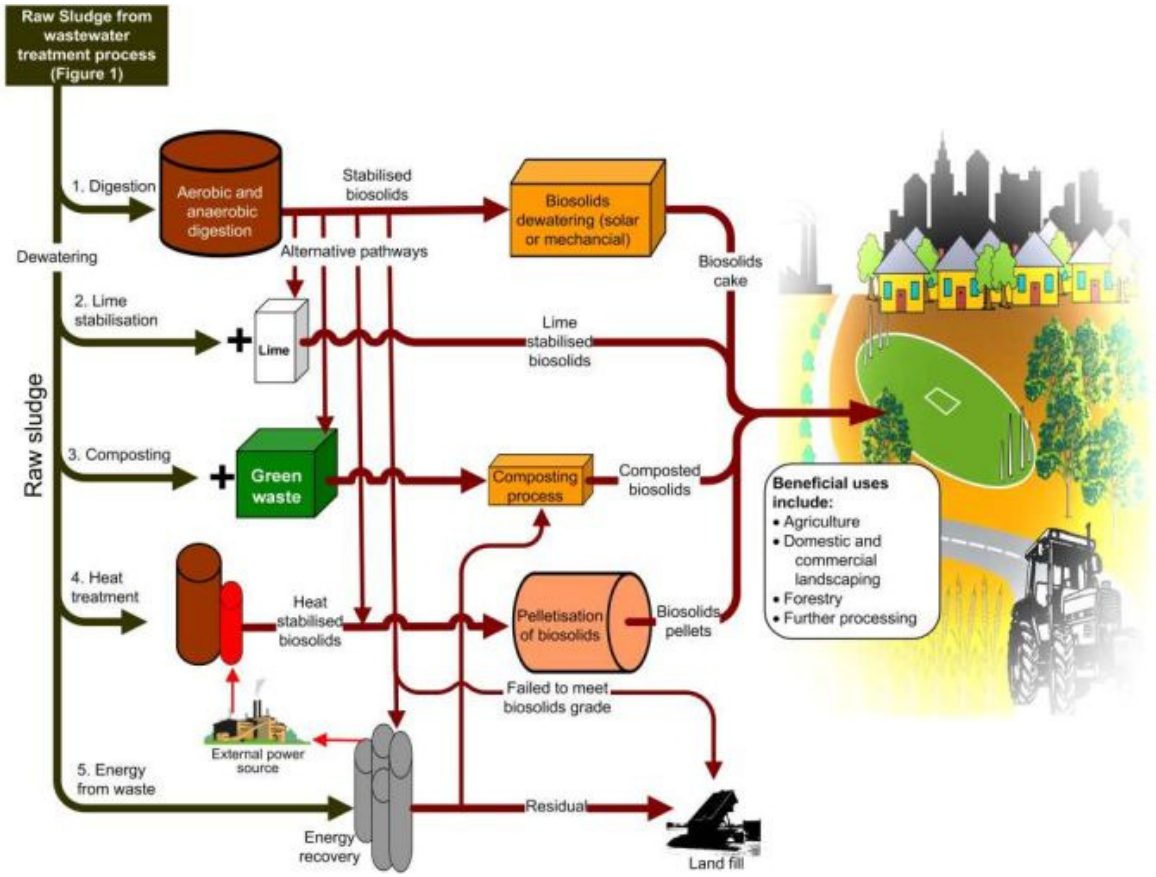
[2] http://www.nebiosolids.org/uploads/pdf/NtlBiosolidsReport-20July07.pdf

For this reason, federal regulations of biosolids are commonly referred to as the Part 503 Rule. The Part 503 Rule creates the federal framework for the final use or disposal of sewage sludge, including sewage sludge that has been converted to biosolids. In California, numerous State regulatory agencies, including the Department of Health Services, State and Regional Water Quality Control Boards, the California Integrated Waste Management Board (CIWMB), and the California Air Resources Board, also regulate certain aspects of treatment, use, and disposal of biosolids. In some parts of California, local ordinances may also govern the use or disposal of biosolids. Due to the many agencies, issues, and perceptions associated with biosolids management, the regulatory environment in California is very dynamic.

Federal regulations define two classes of biosolids relative to pathogen destruction. Pathogens in Class A biosolids are below detectable levels for essentially all pathogens. Class B biosolids may have low levels of pathogens which rapidly die-off when applied to soils, and are considered equally safe as Class A biosolids when specified management practices are followed. A third category of biosolids is called Exceptional Quality or EQ biosolids. EQ biosolids meet the most stringent requirements for pathogens (Class A), pollutant concentrations (High Quality), and vector control (defined process control), and are safe for unregulated use.

Biosolids applied to the land must meet risk-based pollutant limits specified by the Part 503 Rule. These pollutant limits, combined with application, monitoring, reporting, and recordkeeping requirements are designed to protect public health and the environment. In California, Water Quality Order No 2004-0012-DWQ regulates the discharge of biosolids to land for use as a soil amendment in agricultural, silvicultural, horticultural, and land-reclamation activities. The general order is in some aspects more stringent than the federal Part 503 Rule.

Figure 1. Biosolids Production



1.2. Biosolids Safety

Public concerns about the safety of biosolids have focused mainly on land application of Class B biosolids. In response to this concern, EPA commissioned the National Research Council (NRC) to review the adequacy of the Part 503 rule in protecting public health and safety. In responding to its charge, the NRC searched for evidence on human health effects related to biosolids exposure, reviewed the risk assessments and technical data used by EPA to establish the chemical and pathogen standards, and reviewed the management practices of the Part 503 Rule. Following its 18-month long investigation, the NRC published its findings in 2002, concluding that there was "no documented scientific evidence that the Part 503 rule has failed to protect public health." However, NRC also concluded that in order to "assure the public and to protect public health, there is a critical need to update the scientific basis of the rule to (1) ensure that the chemical and pathogen standards are supported by current scientific data and risk-assessment methods, (2) demonstrate effective enforcement of the Part 503 rule, and (3) validate the effectiveness of biosolids-management practices."

Responding the NRC's findings and recommendations, EPA released a multi-year strategy to implement NRC recommendations. This strategy has four main objectives, aimed at addressing the scientific uncertainties and data gaps in the science underlying the Part 503 Rule: (1) determine potential risks of select pollutants, (2) measure pollutants of interest; (3) characterize potential volatile chemicals and bioaerosols from

land application sites; and (4) understand effectiveness of water/sludge treatment and risk management practices.

The CWA requires EPA to review the sewage sludge regulations every two years to identify additional pollutants in sewage sludge that may warrant regulation under section 405(d). Even though part 503 was promulgated in 1993, the first biennial review did not occur until 2003, following the release of the NRC report in 2002. EPA has conducted the review every two years since then. EPA identifies a suite of potential pollutants that may warrant regulation. The list is narrowed depending on standardized analytical methods, toxicity data, fate and transport information, and concentration data. If sufficient information for a pollutant exists a hazard index is developed and if a pollutant has an index value of one or more, it becomes a candidate for risk assessment. Based on the results of the screening analyses for the 2005 review, EPA had identified nine chemicals for which it will conduct a more refined risk assessment and risk characterization process. EPA conducted a statistically significant Target National Sewage Sludge Survey (TNSSS) and released a report on its findings in January 2009. This TNSSSS updated concentrations of a broad number of constituents in biosolids across the nation. A comprehensive risk assessment will now be undertaken for the nine identified constituents of concern. The risk assessment will serve as a basis for determining whether to propose amendments to existing biosolids regulations for any of these constituents.

The State of California also extensively reviewed the sufficiency of the Part 503 Rule to protect public health as part of its Programmatic Environmental Impact Report Covering General Waste Discharge Requirements for Biosolids Land Application. With one exception, it concluded that potential impacts to human health from land application of Class B biosolids complying with the Part 503 Rule would be less than significant.[3] This included possible impacts due to (1) direct contact with pathogenic organisms at biosolids land application sites; (2) contact with pathogenic organisms in irrigation runoff from biosolids land application sites; (3) ingestion of biosolids-derived metals in crops grown on land application sites or animals fed with crops grown on land application sites; (4) ingestion of biosolids-derived organic compounds in food, soils, animals, dairy products, or wildlife; (5) ingestion of groundwater contaminated by biosolids-derived pollutants or pathogens; (6) exposure to aerosols and wind-blown particulates from biosolids stockpiling, composting, or land application; and (7) contact with biosolids spilled during transport from point of generation to application site. Only in the case of potential impact from ingestion of pathogenic organisms in crops grown on land application sites or animals fed with crops grown on land application sites were impacts found to be potentially significant. In this instance, Water Quality Order No 2004-0012-DWQ imposes additional mitigation measures in the land application of biosolids to reduce this risk to less than significant.

While research into the safety of biosolids reuse is ongoing, no compelling scientific evidence that existing regulations are inadequate for the protection of human health and the environment has yet to emerge. A recent study completed by University of Arizona researchers, for example, looked at the impact of biological aerosols on residents living near biosolids land application sites. The study concluded that risk of microbial infection for residents living near biosolids land was very low.[4] Other studies of composting

[3] California State Water Resources Control Board, "Final Environmental Impact Report Covering General Waste Discharge Requirements for Biosolids Land Application." June 30, 2000. Chapter 5: Public Health.

[4] http://cals.arizona.edu/pubs/general/resrpt2003/article11_2003.html

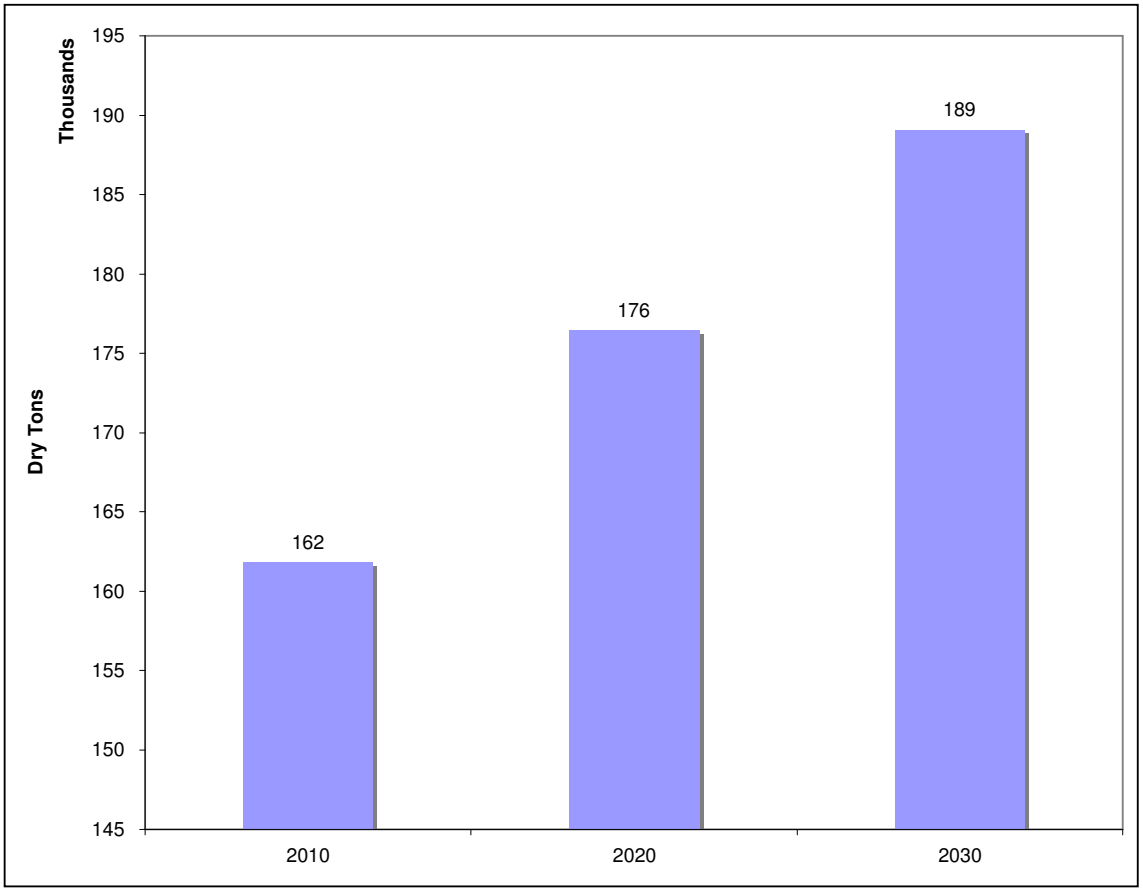
operations and at farms where biosolids have been applied show no differences in the incidence of health problems from farms where no biosolids were applied.[5]

[5] For a review of studies, see California State Water Resources Control Board, "Final Environmental Impact Report Covering General Waste Discharge Requirements for Biosolids Land Application." June 30, 2000. Chapter 5: Public Health.

2. Biosolids Production in the Bay Area

As of 2007, the Bay Area currently generated about 158,000 dry tons of biosolids annually. Because biosolids production largely depends on regional population, the amount of biosolids generated in the Bay Area is expected to increase as the region's population continues to grow. As shown in Figure 2, Bay Area biosolids generation is expected to reach 176,000 dry tons by 2020, and 189,000 dry tons by 2030.[6]

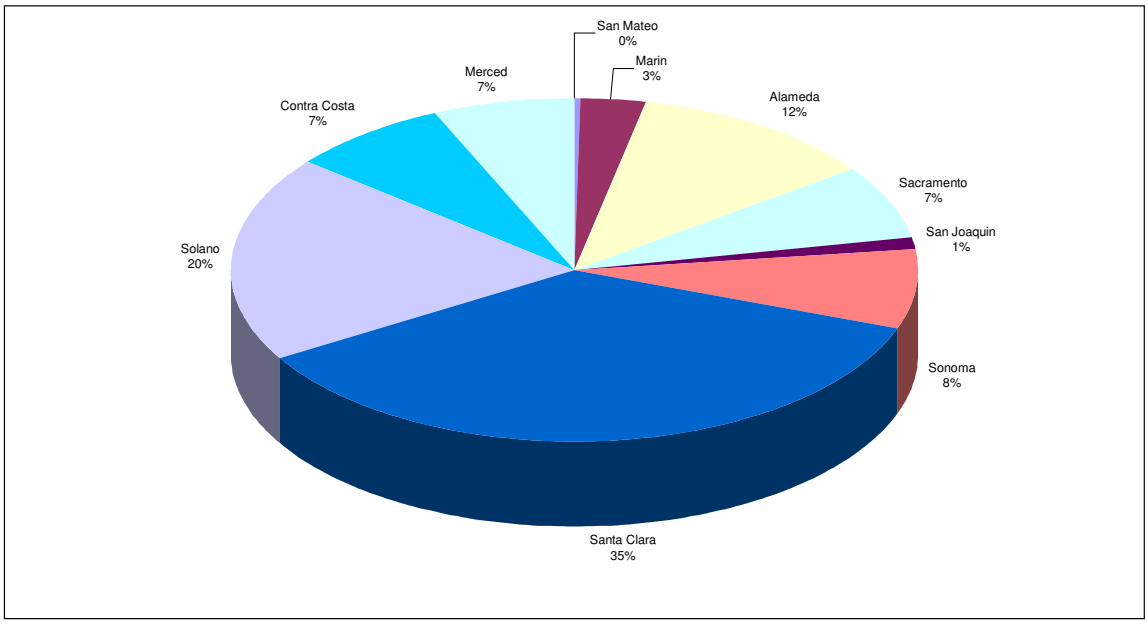
Figure 2. Projected Bay Area Biosolids Production



Reuse of biosolids occurs throughout the Bay Area. Figure 3 shows the destination counties for the Bay Area's biosolids in 2007. Santa Clara County and Solano County receive the bulk of the region's biosolids, most of which are used in landfill applications, such as Alternative Daily Cover (ADC). The rest of the Bay Area's biosolids are broadly distributed throughout the region.

[6] In fact, biosolids production in the Bay Area is expected to increase somewhat faster than population because treatment in the parts of the Bay Area where the most growth is expected (e.g. San Jose and Santa Clara) requires nitrification of ammonia and filtration, which has been shown to result in higher production rates of biosolids.

Figure 3. County Destination of Bay Area Biosolids, 2007



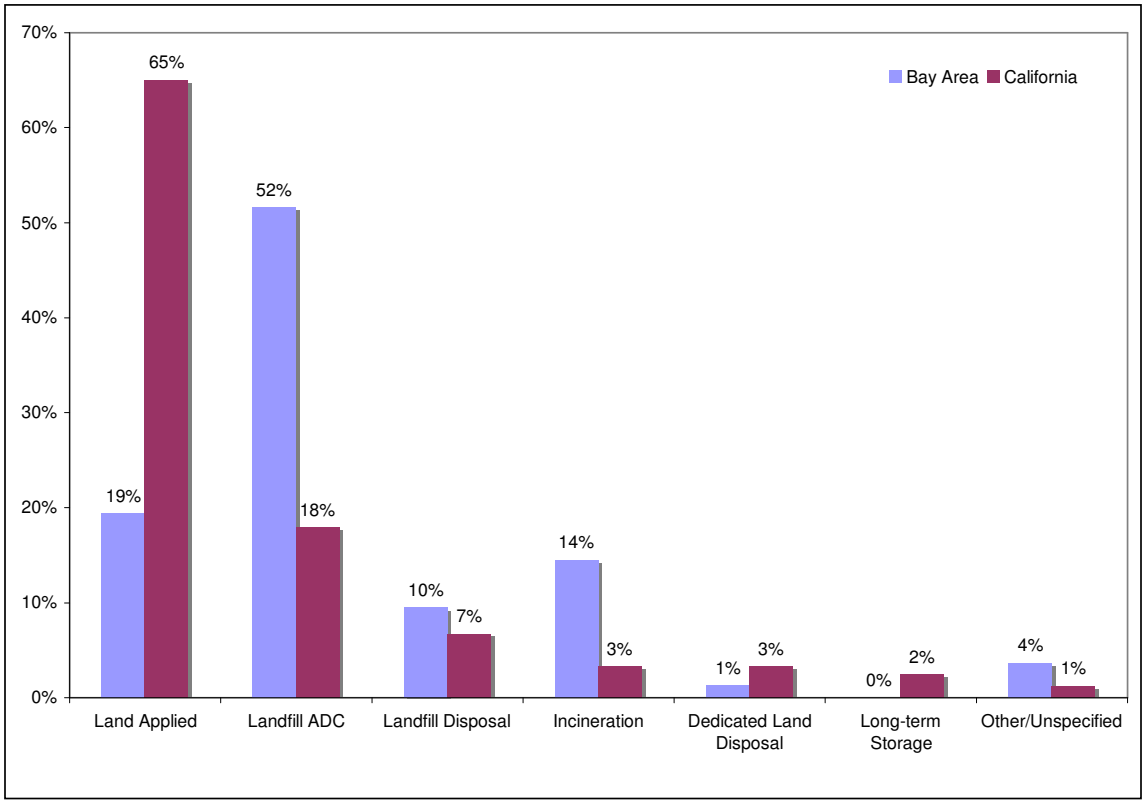
2.1. The Bay Area's Biosolids Management Portfolio

Management of biosolids in the Bay Area is different in several ways from statewide patterns. These differences are illustrated in Figure 4. In the Bay Area, the predominant management method is landfill alternative daily cover (ADC). Over half of the Bay Area's biosolids are used as landfill ADC. For California as a whole, land application rather than landfill ADC is the predominant management method. Statewide, about two-thirds of all biosolids are managed through land application, compared to about 19% in the Bay Area. Use of incineration is another significant difference between the Bay Area and the State as a whole. The Bay Area incinerates about 14% of its biosolids compared to 3% for all of California. AB 939, the Integrated Waste Management Act of 1989, which established landfill diversion mandates for California cities and counties, has been an important driver for the Bay Area's current biosolids management policies. Less than 3% of the Bay Area's biosolids are now disposed of in landfills. Over 80% are beneficially reused as landfill ADC or recycled through land application.

Several factors explain the differences in biosolids management between the Bay Area and other parts of California. Most biosolids in Southern California, where the majority of California's population resides, are managed through land application because of its low cost relative to other management options, and because of access to large swaths of farmable area within reasonable distances from the region's treatment plants. Southern California landfills are also more restrictive in accepting biosolids, which is another reason why this part of the state relies much more on land application. Reliance on land application also has led to more composting in Southern California, in response to local land use ordinances restricting land application to Class A biosolids in some areas. The wet winter months in Northern California also limit land application as an option for the Bay Area during half of the year, which is another reason why use of biosolids for ADC is more prevalent in the Bay Area. Most treatment plants in California

do not incinerate biosolids. Only two in Northern California do, both of which are located in the Bay Area.

Figure 4. Biosolids Management: Bay Area and California



Effective management of the Bay Area's biosolids will continue to require a mix of management options. No single management option will work for all Bay Area wastewater agencies. For example, while land application is generally considered the lowest cost and best available management option for Class B biosolids, Northern California's relatively wet winters and the Bay Area's distance from arable farmland limit field application opportunities. The rainy season can also impact the ability of landfills to dispose of or reuse biosolids. Thus, during wet weather a combination of management approaches is needed.

Additionally, the Bay Area's heavy reliance on landfill reuse and disposal may not be sustainable. A 2004 study prepared for BACWA concluded that insufficient capacity at landfills within 200 miles of San Francisco would require continuation and expansion of land application programs as well as development of regional or individual agency Class A management programs. Without alternatives to landfill disposal and reuse, Bay Area wastewater agencies will face growing competition for limited landfill capacity, higher costs, and longer hauling distances.

A more detailed description of the three most commonly applied biosolids management practices in the Bay Area – (1) landfill ADC and beneficial reuse, (2) land application, and (3) incineration (also called thermal oxidation) -- follows.

2.2. Landfill ADC and Beneficial Reuse

Most landfills that accept biosolids use some or all of the biosolids they receive as ADC, non-soil material applied at the end of each operating day to provide vector control and other benefits. Like land application, ADC constitutes beneficial reuse of biosolids and results in diversion credits for the source agency. According to Title 27 § 20690, only 25 percent of a landfill's daily cover can comprise biosolids. Depending on the amount of daily cover they use, some facilities cannot use all of the biosolids they receive as ADC. Landfills with insufficient soil also beneficially use biosolids for soil substitute as an alternative to importing soil to the site.

Landfill ADC and beneficial reuse opportunities in the Bay Area are limited. While there are 31 sites within 200 miles of San Francisco permitted by the Integrated Waste Management Board to receive biosolids, only 18 actually accept biosolids, and half of these accept in-county material only. Of the nine landfills who accept out of county biosolids, only five currently accept biosolids for reuse, and only three -- Potrero Hills, Vasco Road, and Hay Road -- routinely accept biosolids in significant quantities for ADC.

Landfills accepting Bay Area biosolids had capacity during wet weather of about 720 wet tons/day and during dry weather about 1,250 wet tons/day, according to data compiled by BACWA in 2005. Current production of biosolids in the Bay Area averages about 2,150 wet tons/day, which is about 70% greater than the 2005 dry weather capacity identified by BACWA.

2.3. Land Application of Class B Biosolids

EPA defines land application as the "application of biosolids to land to either condition the soil or to fertilize crops or other vegetation grown in the soil." Land application is the primary way biosolids are recycled in California. Land application is generally viewed by wastewater agencies, regulatory bodies, and farmers as the highest and best use for Class B biosolids.

Land application of biosolids provides the most direct way to recycle biosolids and return nutrients to the soil. Land application is a relatively inexpensive option and capital investments are generally lower than other biosolids management technologies. Land application also directly benefits the agricultural sector by lowering farm production costs and increasing crop yields. According to USEPA, a properly managed biosolids land application program is preferable to the use of conventional fertilizers.[7] Compared to conventional fertilizers:

- Biosolids are a recycled product, which do not deplete non-renewable resources such as phosphorous.
- The nutrients in biosolids are released more slowly than nutrients in chemical fertilizers.
- Land application of biosolids requires setbacks from water resources and is subject to more stringent soil conservation and erosion control practices, nutrient management, and record keeping and reporting requirements than application of chemical fertilizers.
- The organic matter in biosolids improves soil properties for optimum plant growth, including tilth, friability, fertility, and water holding capacity.

[7] USEPA, "Biosolids Technology Fact Sheet: Land Application of Biosolids," EPA 832-F-00-064, September 2000.

- Biosolids reduce demand for energy intensive inorganic fertilizer, which reduces climate change impacts.

Land application of biosolids is regulated by the Part 503 Rule. Biosolids applied to the land must meet risk-based pollutant limits. Application is also subject to operational standards to control pathogens and vectors (e.g. flies, mosquitoes, and other potential disease-carrying organisms). Under the Part 503 Rule, general requirements and management practices must be met for all but EQ biosolids. These requirements and management practices govern where, when, and how Class B and A biosolids can be applied to land for recycling. The Part 503 Rule groups land application requirements into four options for meeting pollutant limits and pathogen and vector attraction reduction standards. Through a combination of pollutant limits and management practices, each option is designed to be equally protective of public health and the environment.

Even with the Part 503 Rule safeguards, land application of Class B biosolids remains controversial and is increasingly subject to local land use ordinances limiting its application. Problems with odor, proximity to residential areas, and worry about the potential for transmission of pathogens are the primary causes for public concern. Problems with odor can be addressed with biosolids stabilization processes, which, according to USEPA, usually result in an operation that is less offensive than manure application.[8] Of more concern to the public are potential impacts to human health and the environment. While the previously discussed NRC study concluded there was no scientific evidence that the Part 503 Rule has failed to protect human health, it also identified significant data gaps and the need for more epidemiological studies. Thus, concerns about the potential for health impacts persist.

Some Bay Area wastewater agencies are addressing community concerns about land application of biosolids through implementation of a Voluntary Environmental Management System (EMS), being developed for biosolids by the National Biosolids Partnership (NBP).[9] The EMS is a tool that biosolids producers and appliers are using both to demonstrate to their communities that biosolids products meet market and regulatory standards and to explain how they are working to further improve their practices. Through the EMS process wastewater agencies are involving their communities in defining improved performance. In this way, EMS is being used to demonstrate to a sometimes skeptical public that responsible biosolids management is real, not merely promises and rhetoric.

While land application currently represents a small share of biosolids reuse in the Bay Area, the region's wastewater agencies view it as a key component in their overall biosolids management strategy. Working with local governments and communities to maintain and expand land application of the Bay Area's biosolids is a priority for these agencies.

2.4. Thermal Oxidation

Thermal oxidation, or incineration, is the firing of biosolids at high temperatures in an enclosed device. Central Contra Costa Sanitary District and the City of Palo Alto, which account for about 15% of the Bay Area's biosolids production, use thermal oxidation to manage their biosolids.

[8] Ibid.
[9] Currently, East Bay Municipal Utility District is fully certified and San Francisco Public Utilities Commission and the City of Santa Rosa are in the process of obtaining certification.

Thermal oxidation systems generally consist of a furnace and one or more air pollution control devices. Thermal oxidation may also involve energy recovery systems. Auxiliary fuel is often used to enhance the burning of biosolids, but state-of-the-art systems are designed to recover energy in excess of what is needed for the oxidation process. Wastewater solids normally have a bioenergy value of 10,000 to 12,000 BTUs per pound of volatile solids.[10] Improvements in mechanical dewatering and exhaust heat recovery devices have made autogenous combustion (combustion without supplemental fuel) possible. Such systems can become net energy exporters. Recovered energy from thermal oxidation can supplant other facility energy needs.

Thermal oxidation as a biosolids management option for the Bay Area has both advantages and disadvantages. In terms of disadvantages, thermal oxidation has high initial capital costs compared to other management options. Permitting thermal oxidation facilities is also more complex than permitting for other biosolids management options. Because the incineration process concentrates metals in the ash, the Part 503 Rule includes specific pollutant limits for biosolids that will be managed through thermal oxidation. Negative public perceptions of thermal oxidation can also make this management strategy more difficult to implement than other options.

In terms of advantages, thermal oxidation is cost competitive to other options for medium to large-scale, continuously operated facilities, particularly when they are designed to produce recoverable energy. Emissions from thermal oxidation have been shown to be less than from drying and composting when transportation emissions are taken into account.[11] Ash from thermal oxidation is pathogen free, inert, and may be suitable for beneficial uses, such as land application, landfill cover, or brick and cement production. Thermal oxidation is under the control of the agency or agencies responsible for management of biosolids and can operate continuously in all weather conditions. Lastly, thermal oxidation has much smaller land and transportation requirements compared to other biosolids management options.[12]

As will be discussed in Section 5, because of these advantages Bay Area wastewater agencies are investigating the feasibility of a regional fluidized bed oxidation facility with energy recovery as a long-term management option for the region's biosolids.

[10] Water Environment Federation, "Thermal Oxidation of Sewage Solids," White Paper, April 2002.
[11] Ibid.
[12] According to Heitz, et. al. (1996), one truckload of ash is equivalent to three truckloads of dried biosolids product, ten to twelve truckloads of dewatered cake, and sixteen truckloads of composted material.

3. Challenges to Bay Area Biosolids Management

The Bay Area faces a number of challenges when it comes to biosolids management. These include a growing number of regulatory restrictions on landfilling and land application, rising costs, land use and air quality conflicts in urbanizing areas, management of greenhouse gases, and control of emerging contaminants. Overarching each of these issues is the challenge of addressing the public's perceptions about biosolids.

3.1. Regulatory and Land Use Trends

Options for managing the Bay Area's biosolids have been narrowing in recent years. Two trends in particular have the potential to impact the Bay Area's ability to manage its biosolids. First, legislation and regulatory action seeking to restrict or prohibit the reuse of biosolids in landfills has increased in recent years. Second, restrictions and prohibitions on land application of Class B biosolids threaten to shut the door to this key management option for the Bay Area.

As previously described in this paper, landfill ADC is an important beneficial reuse of Bay Area biosolids. Historically, Bay Area wastewater agencies have relied on landfill ADC to manage up to two-thirds of the region's biosolids. Recent legislative proposals and regulatory actions may significantly limit this management option in the future. Two examples of recent initiatives impacting the use of biosolids as landfill ADC include the following:

- AB 2640. This proposed legislation would impose state tipping fees on all green material sent to landfills to discourage its use for ADC. The legislative intent is to sharply reduce the use of green material for ADC and instead direct it into composting channels. Because the general practice is to mix biosolids with green material for ADC, restricting the use of green material for ADC will also impact the use of biosolids for ADC, thus limiting one of the Bay Area's primary options for managing its biosolids.
- San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) Rule 4565. This rule, adopted in March of 2007, is aimed at reducing emissions of volatile organic compounds (VOC) from landfill facilities. The rule prohibits the use of biosolids as ADC unless the receiving facility (1) obtains an Authority to Construct authorizing such cover, which would necessitate the facility comply with applicable BACT requirements for VOCs, or (2) implements an alternative mitigation measure that demonstrates at least a 10% reduction in VOC emissions. Rather than comply with either alternative, landfill facilities subject to this rule are expected to simply stop accepting biosolids for use as ADC.

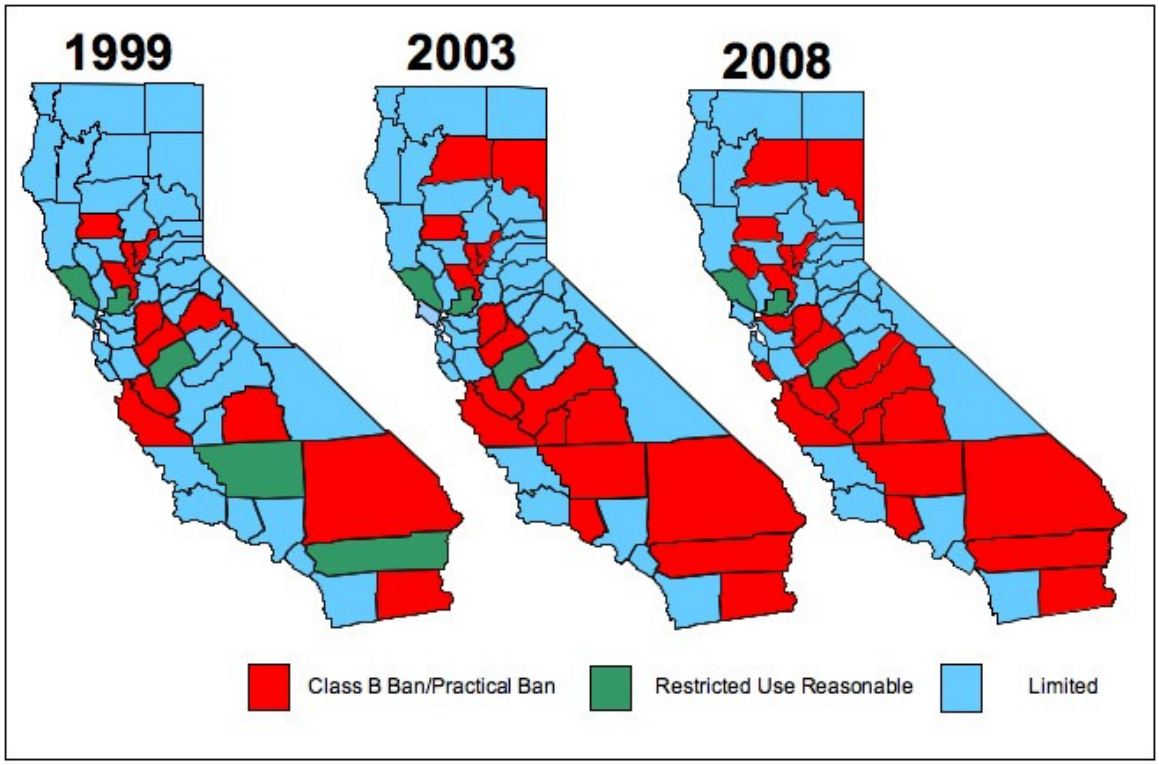
The upshot of these types of legislative and regulatory actions is that there are fewer and fewer landfills serving the Bay Area that accept biosolids, either for disposal or for use as ADC. As previously discussed, out of the 31 landfill sites serving the Bay Area permitted for biosolids, there are now only five that actually will accept them for reuse.

At the same time options for reusing biosolids in landfills are narrowing, local land use ordinances are making it increasingly difficult to use land application to manage the Bay Area's Class B biosolids. As Figure 5 shows, more and more counties in California are prohibiting or restricting the use of Class B biosolids in land application. The number of California counties with bans on Class B biosolids land application nearly doubled

between 1999 and 2008. Twenty-one of California's 58 counties now have restrictions on land application of Class B biosolids. Others may follow suit. Solano County, for instance, which currently receives about 20% of the region's biosolids (of which about 6% are land applied), amended its land application ordinance in 2007 to require by 2012 that any agency that land applies Class B biosolids in Solano County must also divert a portion of their biosolids to a Class A or biosolids-to-energy process.

Bay Area wastewater agencies commissioned a study of interim biosolids management options available to the region prior to completion of a regional biosolids processing facility or implementation of some other regional solution.[13] Results were not encouraging. While options for additional land application were identified, they mostly involved longer hauling distances (e.g. Nevada) and higher costs. In the case of landfill disposal and reuse, the study identified only three landfills with potential to expand their take of Class B biosolids.

Figure 5. County Land Use Restrictions Impacting Biosolids Land Application in California



3.2. Escalating Costs of Biosolids Management

Regulatory and land use trends are driving up the costs of biosolids management for the Bay Area. Increasing restrictions on land application and narrowing opportunities to beneficially reuse biosolids in landfills are making it necessary for wastewater agencies to find new outlets for the region's biosolids. In most cases, this involves greater

[13] Carollo Engineers, "Bay Area Regional Solids Processing Facility: Phase III – Facilities Plan and Environmental Documentation. Technical Memorandum No. 1 Interim Biosolids Management Alternatives." March 2007.

transportation distance and tipping fees. For example, Bay Area wastewater agencies are now looking at land application opportunities as far away as Nevada.[14]

Higher tipping fees and greater transportation distances also threaten to increase the cost of using biosolids as landfill ADC. The Bay Area study of biosolids management alternatives referred to in the previous section estimated landfill ADC costs per wet ton of biosolids that were 50% to 200% higher than what many Bay Area agencies currently pay.[15] A 2005 study of landfill capacity by the Bay Area Clean Water Agencies (BACWA) determined:

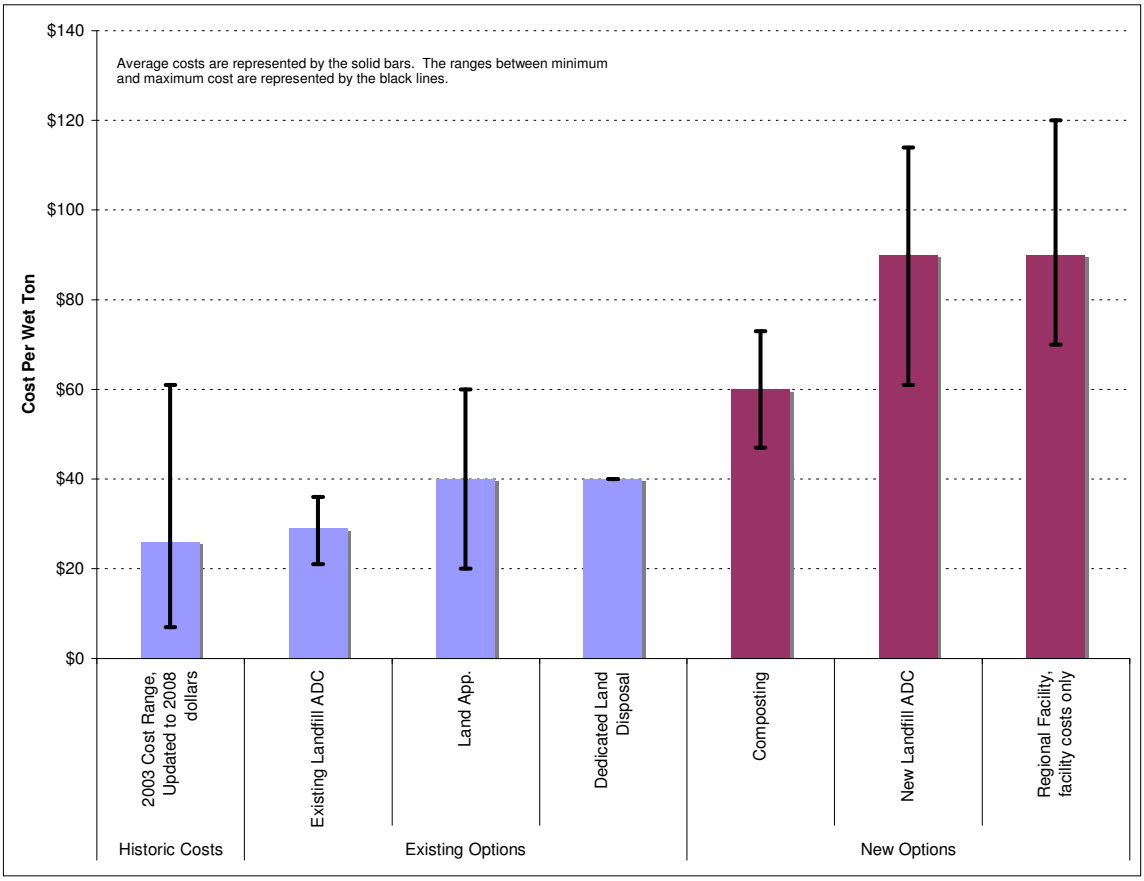
> *From these estimates, it appears that there is not sufficient capacity to dispose/reuse the biosolids from the BACWA agencies within a 200 mile radius of San Francisco and that both ensuring the continuation of land application programs and the development of either individual or regional Class A alternatives is critical to providing reliable reuse/disposal options for the region's facilities. As landfill sites close or further restrict the acceptance of biosolids, agencies could find themselves competing for scarce resources which would result in both high tipping prices and possibly longer hauling distances. Both options will increase the cost to POTWs for responsibly reusing this resource.*[16]

Realizing the prognosis, Bay Area wastewater agencies are looking into alternatives to land application and landfill reuse of biosolids. One option is a regional processing facility to convert biosolids into energy. As will be discussed in a later section of this paper, such a facility has promise as a long-term, sustainable management alternative for the region. However, it also may entail substantially higher costs than current management options. Planning level analysis puts the costs of a regional processing facility designed to convert biosolids to energy at between $70 and $120 per wet ton just for the facility. In addition to facility costs, there would be costs for pre-processing and transportation, which would vary by wastewater agency.[17]

As shown in Figure 6, biosolids management costs are on an upward trajectory. This is significant, since by some estimates biosolids management can account for up to half the overall costs of wastewater treatment.[18] Bay Area wastewater agencies are managing these cost pressures by working to maintain all of the options available to them for handling the region's biosolids. This diversity is needed so that wastewater agencies can adjust their management emphasis in response to changing costs, thereby protecting their ratepayers from sharp cost increases.

[14] Ibid.
[15] Ibid. Current costs for Bay Area agencies range between $30 and $40 per wet ton. Landfill ADC costs at three landfill sites with potential to expand their use of biosolids ranged between $61 and $114 per wet ton.
[16] Bay Area Clean Water Agencies. "BACWA Survey of the Capacity of Local Landfills to Accept Biosolids." December 27, 2005.
[17] Carollo Engineers, "Bay Area Regional Solids Processing Facility: Phase III – Facilities Plan and Environmental Documentation. Technical Memorandum No. 2 Fluid Bed Reactor Analyis." February 2008.
[18] Forbes, R., Z. Erdal, and P. Burrowes, "Biosolids Master Planning From A Greenhouse Gas Perspective: How Difference Options Affect the Carbon Footprint." Residuals and Biosolids 2008.

Figure 6. Bay Area Biosolids Management Costs



3.3. Urbanization

Urbanization within and adjacent to the Bay Area is making biosolids management more challenging. Urbanization is impacting both the ability to site and permit new landfills and the ability to land apply biosolids. Ideally, both landfill and land application sites would be located away from population centers. As the region continues to add population, such sites are becoming increasingly difficult to locate within a reasonable distance from the Bay Area's wastewater facilities.

According to the Greenbelt Alliance, there are over 400,000 acres of greenbelt land in the Bay Area at risk of development.[19] About one-third of this at-risk acreage could be lost to urbanization by 2015, while the other two-thirds could be developed by 2030. A second land use trend noted by Greenbelt Alliance is land parcelization, which creates the potential for thousands of new houses in what are now the Bay Area's remaining rural areas. Solano and Sonoma counties, where biosolids are currently land applied, are two Bay Area counties where the Greenbelt Alliance says these trends are most pronounced.

[19] Greenbelt Alliance. "At Risk: The Bay Area Greenbelt, 2006 Edition."

3.4. Air Quality Restrictions

Another challenge for agencies managing the Bay Area's biosolids is the maze of air quality restrictions and regulations that must be navigated. Biosolids treatment, processing, handling, and transporting must conform to a broad array of air emission requirements. An analysis of regulatory feasibility for a regional biosolids-to-energy facility, for example, identified 23 applicable air quality and emission requirements.[20] While this analysis concluded that such a facility could meet all applicable requirements, the CIWMB is less sanguine about management options involving thermal oxidation. On its website, CIWMB states: "[d]ue to existing and increasing air quality regulations, permitting of additional [thermal oxidation] facilities is not considered likely and thus incineration is not considered a widespread management option."[21]

Air quality restrictions are impacting other management options, as well. For example, SJVUAPCD's adoption of Rule 4565 in 2007, introduced in the previous section, provides a case in point. This rule regulates not only landfill VOCs, but also VOCs generated by composting and land application. In the case of land application and landfill management of biosolids, air quality impacts are caused primarily by the vehicles and equipment used to transport and spread biosolids, rather than the biosolids themselves.[22] It is important for policy makers to understand that policies and regulations that push Bay Area biosolids further and further from their source of origin can worsen these transportation-related air quality impacts.

3.5. Greenhouse Gases

All wastewater treatment and biosolids management processes release gases associated with global warming -- primarily carbon dioxide and methane. The California Global Warming Solutions Act of 2006 (AB 32) established a comprehensive, multi-year program to reduce greenhouse gas emissions in California to 1990 levels by 2020. Compliance with AB 32 requirements is expected to have far ranging impacts on California's water and wastewater sectors, including the management of biosolids. AB 32 requirements ultimately may favor certain biosolids management practices over others.

To understand how AB 32 requirements may encourage some biosolids management practices over others, it is necessary to draw a distinction between anthropogenic and biogenic emissions. Anthropogenic emissions are man-made. These emissions, such as those created by burning fossil fuels, add new carbon dioxide and other greenhouse gases to the atmosphere. Biogenic emissions, on the other hand, merely recycle the carbon dioxide that is already in the atmosphere. Biogenic emissions are carbon-neutral whereas anthropogenic emissions are not. Carbon dioxide emissions from wastewater aeration tanks and offgasing from biosolids piles or composting are considered biogenic, as are carbon dioxide emissions from successfully captured and combusted digester and landfill gas. Releases of methane or nitrous oxide, on the other hand, are not biogenic. Whether a biosolids management option results primarily in the release of anthropogenic or biogenic emissions will affect how it is viewed by AB 32 requirements.

[20] CH2MHill, "Bay Area Regional Solids Processing Facility – Regulatory Feasibility Technical Memorandum." February 8, 2008.
[21] http://www.ciwmb.ca.gov/Organics/Biosolids/
[22] California State Water Resources Control Board, "Final Environmental Impact Report Covering General Waste Discharge Requirements for Biosolids Land Application." June 30, 2000.

It is tempting to make simple comparative statements regarding the greenhouse gas impacts of one biosolids management option over another. Generally, such statements are inaccurate and may even mislead. Biosolids management options from the standpoint of their impact on greenhouse gas emissions depend on numerous region- and project-specific factors. In a review of how alternative management options impact greenhouse gas emissions, Forbes, et al. (2008) concluded:

> *It would be misleading to assume that some management alternatives are generically better than others from a carbon footprint perspective. Much depends on site- specific factors, such as distances to land application sites and landfills, methods of land application, availability and use of digester gas, viability of methane recovery from landfills, efficiency of incineration and use of the heat generated, and other issues. It is clear that minimizing fossil fuel use through increased process efficiencies and better energy recovery is a major factor in reducing carbon footprint. Biosolids management alternatives with lower total energy consumption are generally more likely to have lower carbon footprints.*

The biosolids management options being pursued by Bay Area wastewater agencies all have potential greenhouse gas benefits as well as costs. For example:

- Land application of biosolids compared to use of inorganic fertilizers can help reduce greenhouse gas emissions by avoiding the use of fossil fuels needed for the production of inorganic fertilizer and avoiding the production of unused methane in landfills, though whether or to what extent benefits are realized depends on transportation distances.
- Management options, such as a regional biosolids-to-energy facility, that convert biosolids to fuel for energy generation can displace demand for fossil fuels, thereby reducing anthropogenic greenhouse gas emissions, but may also release methane to the atmosphere.
- Landfill disposal of biosolids in the absence of landfill gas capture and combustion increases anthropogenic greenhouse gas emissions. With landfill gas capture and combustion, however, this management option provides a source of bioenergy that reduces regional dependence on fossil fuels.

3.6. Emerging Contaminants

Organic compounds from personal care products, pharmaceuticals, and industrial processes are part of a growing list of trace constituents being detected in some treated wastewater. A growing source of public concern about biosolids is the possibility these compounds will also be present in biosolids in concentrations sufficient to constitute measurable risk to public health. Concerns are highest for nonvolatile or semivolatile organic compounds, since volatile compounds tend to rapidly biodegrade during treatment or incorporation into the soil.

The presence of trace amounts of emerging contaminants is not unique to biosolids. On the contrary, they are ubiquitous to most water supply and wastewater sources.[23] For example, all of the substances presently identified as hormone disruptors are now widely

[23] The recycled water industry, for example, is confronting similar public concerns.

distributed throughout the environment.[24] Generally, they have been detected in concentrations deemed too low to pose a public health risk, though it is important to stress that actual effects on health from environmental levels of these compounds is still an area of controversy and direct links have yet to be established between chemicals and human health effects.[25]

The potential presence of dioxins is also frequently cited by opponents of biosolids land application. Following a five-year study, EPA in 2003 made a final decision not to regulate dioxins in land-applied biosolids, concluding that dioxins from biosolids do not pose a significant risk to human health or the environment and that the risk for those that apply biosolids on their land and then consume the produce was very low.[26] The risk for the general population was even lower. In addition, the 2001 National Sewage Sludge Survey found that the presence of dioxins in biosolids is insignificant.[27]

In California, state regulations require testing of biosolids for PCBs and semivolatile organic compounds, even though the Part 503 Rule does not establish standards for synthetic organic compounds contents. In this area, California requirements for land application of biosolids exceed those set by the EPA.

3.7. Public Perception

Overarching each of the challenges discussed in this section are the publics' perceptions about biosolids. These perceptions impact to some degree all of the biosolids management options the Bay Area currently relies upon. Increasing the publics' awareness of and knowledge about biosolids management issues in the Bay Area is one of the most important tasks confronting biosolids management agencies. Without informed public discussion, the region is unlikely to implement optimal management policies. Instead, a more likely outcome is policy aimed at placating negative public perceptions about biosolids.

Public concerns about biosolids are wide-ranging. Table 1 lists common public perceptions about biosolids along with the actual evidence.

Table 1. Public Perceptions and Available Evidence About Biosolids

Public Perception	Available Evidence
1. *Land application of biosolids is a public health risk because it exposes people to dangerous pathogens and other contaminants found in municipal sewage.*	Following an 18-month long investigation, the National Research Council (NRC - 2002) concluded there was "no documented scientific evidence that the Part 503 rule has failed to protect public health." An earlier NRC report concluded that the use of biosolids "in the production of crops for human consumption when practiced in accordance with existing federal guidelines and regulations, presents negligible risk to the consumer, to crop production and to the environment." (NRC – 1996) The Solano County Grand Jury found "[t]hat there is no evidence that

[24] California State Water Resources Control Board, "Final Environmental Impact Report Covering General Waste Discharge Requirements for Biosolids Land Application, Chapter 5 Public Health." June 30, 2000.
[25] Ibid.
[26] http://www.epa.gov/waterscience/biosolids/
[27] Ibid.

	the spreading of biosolids under the conditions set by the County is unsafe or hazardous to health."[28]
2. *Land application and landfilling of biosolids results in the airborne transmission of pathogens.*	SWRCB's "Final Environmental Impact Report Covering General Waste Discharge Requirements for Biosolids Land Application" found no reported cases of air-borne transmission of disease in California as it relates to biosolids management. Studies by University of Arizona scientists have concluded the risk of airborne transmission of pathogens from biosolids land application is negligible.[29, 30]
3. *Land application and landfilling of biosolids contaminate surface water and groundwater.*	Potential adverse impacts to surface water and groundwater quality were examined by the SWRCB's "Final Environmental Impact Report Covering General Waste Discharge Requirements for Biosolids Land Application." The report found that biosolids land application practices consistent with Water Quality Order No 2004-0012-DWQ would result in less than significant impacts to water quality.
4. *Thermal oxidation of biosolids increases greenhouse gas emissions and releases toxics into the air.*	Studies indicate thermal oxidation of biosolids when coupled with energy recovery has the potential to reduce total greenhouse gas emissions by displacing demand for fossil fuels. A recent engineering analysis of a Bay Area biosolids-to-energy regional facility concluded that all air quality requirements could be satisfied without the use of Toxic Best Available Control Technology (TBACT).

Historically, land application of biosolids has generated the most public controversy. Public concerns about health risks and environmental impacts of land application are currently driving land use regulations and prohibitions in California. In 2006, for example, Kern County voters overwhelmingly approved a measure banning the land application of both Class A and Class B biosolids in unincorporated parts of Kern County. Similar public concerns led Kings County to adopt an ordinance restricting biosolids land application to Class A/EQ compost. These land use restrictions gained widespread public support despite the fact that there was at the time of their passage no documented scientific evidence that land application of Class B biosolids when conducted according to the prescribed regulations had resulted in any adverse human health impacts or posed a significant risk to the environment. In these cases, public perceptions of risk and concerns about safety trumped objective research findings.

The continuation of the widespread use of biosolids as a soil amendment will require public education and a concerted effort by regulators and biosolids managers to show the public that their concerns are being addressed and that biosolids management is conducted according to the prescribed regulations. Approaches for doing this are discussed in the next section of this paper.

[28] Solano County Grand Jury. "Biosolids: 2003-2004 Grand Jury Report."
[29] Brooks, J.P., B.D. Tanner, C.P. Gerba, C.N. Haas, and I.L. Pepper. 2004. Estimation of Bioaerosol Risk of Infection to Residents Adjacent to a Land Applied Biosolids Site Using an Empirically Derived Transport Model. J. Appl. Microbiol. 98:397–405.
[30] Brooks, J.P., B.D. Tanner, K.L. Josephson, C.P. Gerba, C.N .Haas, and I.L. Pepper. 2005. A National Study on the Residential Impact of Biological Aerosols from the Land Application of Biosolids. J. Appl. Microbiol. 99:310–322.

4. Addressing Public Concerns about Biosolids

Not only must Bay Area wastewater agencies ensure that management of biosolids is fully compliant with all applicable federal, State, and local regulations, they also must be sure their management programs are responsive to issues of concern to stakeholders and the public. This section describes policies and public processes Bay Area wastewater agencies are following to meet both these objectives.

4.1. The National EMS Initiative

In 1997, the Association of Metropolitan Sewerage Agencies, EPA, and the Water Environment Federation formed the National Biosolids Partnership (NBP) to cooperatively promote environmentally sound and publicly acceptable biosolids management. The NBP immediately set to work developing a national model for an Environmental Management System (EMS) for biosolids. An EMS is a set of standard procedures and steps that biosolids managers can use to ensure the environmental integrity of their biosolids program, improve the effectiveness of their operations, meet regulatory requirements, and address issues of concern to stakeholders and the public. Wastewater agencies can use the national EMS model to craft an EMS for biosolids suitable to their program objectives and local circumstances.

Three elements are common to all EMS programs based on the national model:

- Compliance with all applicable regulations as a baseline;
- A standardized set of actions for developing the EMS; and
- A system for verifying performance through internal or external audits.

At a minimum, a facility EMS must include the following actions:

- Follow the NBP's Code of Good Practice;
- Establish clear objectives for its EMS;
- Implement best management practices that meet these objectives;
- Measure the effectiveness of the EMS at all critical control points;
- Conduct internal audits to ensure EMS objectives are being met;
- Correct all deficiencies identified by the audit process;
- Establish management feedback; and
- Implement a communications program with the community and stakeholders.

Certification of a facility EMS by the NBP is a rigorous process, requiring a significant commitment of resources by the agency seeking certification. In order to be certified by the NBP, the agency must meet five separate requirements, including successfully completing a fully independent audit of its EMS and having this audit verified by an NBP accredited auditing company. In 2006, EBMUD became the thirteenth wastewater agency in nation to be certified by the NBP. SFPUC is currently in the process of developing a facility EMS and obtaining NBP certification.

4.2. Public Outreach and Stakeholder Involvement

Providing objective information about biosolids to the public and involving stakeholders in the development and implementation of biosolids management programs are viewed

by Bay Area wastewater agencies as essential management practices. Public acceptance of biosolids management practices is dependent on public confidence that they do not pose substantial risks to public health or the environment. While there is substantial, scientifically supported evidence that biosolids management practices are safe, the public can be skeptical.

Research into public acceptance of recycled water use provides insight into some key determinants of how the public is likely to view alternative biosolids management practices. This research has shown that public acceptance increases when:[31]

- The degree of human contact is minimal;
- Protection of public health is clear;
- Protection of the environment is a benefit of reuse;
- Promotion of resource sustainability is a benefit of reuse;
- The community has high awareness of waste management issues;
- The perception of the quality of the biosolids products is high; and
- Confidence in local management of public utilities and technologies is high.

Communicating objective information to the public and involving stakeholders is a key part of the NBP's national model for a biosolids EMS. In order to comply with the national model, a facility EMS must provide meaningful opportunities for interested parties to express their views and perspectives regarding current and proposed biosolids management practices, including concerns about environmental impacts, biosolids program performance, and potential areas of improvement. It must also establish and maintain a proactive communications program to provide on-going information about its biosolids management program and its EMS to interested parties, as well as procedures for receiving and responding to requests for information or complaints.

The approach embedded in the national EMS model, and followed by Bay Area wastewater agencies, conforms to basic community value-based decision-making principles, including:

- Involving the public in all phases of project planning, including developing and selecting alternatives;
- Listening and responding to public concerns with respect and incorporating community values into the decision criteria;
- Acknowledging and validating fears and concerns and addressing them with accurate information and, if necessary, changes in project design.
- Disseminating adequate and understandable information about the proposed project and its role in regional wastewater management to a broad array of public forums;
- Explaining how the project contributes to fundamental community needs or desires, such as sustainable resource use, prevention of water pollution, environmental protection and enhancement, reduced dependence on fossil fuels, and promotion of local agriculture; and

[31] Ibid. Page 1-2.

- Incorporating concepts of environmental justice, fairness, and equity into the decision-making process.

Changes to Solano County's biosolids land use regulations provide an informative case study of how public outreach and involvement can increase public awareness and support. In response to public pressure to ban land application of biosolids in Solano County, the Board of Supervisors initiated a deliberative process to review existing regulations and consider whether changes were needed. In 2003, amended regulations were, according to a report by the Solano County Grand Jury, "passed after a significant amount of study and input from concerned citizens; local government officials; county environmental, health and agricultural officials; growers and ranchers; applicators and biosolids generators; and experts from USEPA, California RWQCBs, and University of California. Public comment was heard during regular Board of Supervisors meetings, special Board of Supervisors meetings … and numerous stakeholder meetings." In short, all stakeholders in the outcome were provided the opportunity to participate in shaping it. The outcome did not result in the ban initially sought by opponents of Class B land application. Instead, existing regulations were amended to provide additional protection of land and water resources, more monitoring, reporting, and public notification, and procedures for registering complaints about proposed biosolids applications.

Following a detailed review of the amended regulations and the process leading to their adoption, the Solano County Grand Jury officially found that the "County has developed adequate regulations and monitoring procedures to maintain safety for residents near biosolids sites." It further found that "[c]itizens' committees have taken an active role in helping to develop regulations that address their concerns about possible negative effects of biosolids applications in the county."

5. Sustainable Solutions for the Bay Area's Biosolids

Traditional management of biosolids focused on disposal. Dumping biosolids at sea was the primary disposal method until banned by the Ocean Dumping Ban Act of 1988. Landfill disposal then became a prominent method, until this too was proven unsustainable. Today, Bay Area wastewater agencies are focused on developing sustainable management strategies for the region's biosolids. This section describes how the Bay Area's biosolids management programs are helping to meet landfill diversion goals for the region, supporting sustainable agriculture, and promoting the development of bioenergy. It also discusses ways in which biosolids could be transformed into marketable commodities.

5.1. Meeting AB 939 Goals

Reuse of Bay Area biosolids through land application, landfill ADC, energy production, and recycling into compost is helping the Bay Area meet landfill diversion goals established by the California Integrated Waste Management Act (AB 939) of 1989. Under AB 939, municipalities and counties were required to divert from landfills up to 50 percent of their solid waste by 2000. Legislative objectives of AB 939 included decreasing reliance on landfill disposal, preventing waste generation, reusing products and packaging as much as possible, and recycling and composting whenever possible.

The Bay Area's primary biosolids management approaches – landfill ADC, land application, and waste-to-energy – help to reduce reliance on landfill disposal of a major regional waste product. Such diversion is required under Public Resources Code Section 41000 et seq., which mandates the use of source reduction, source separation, diversion, recycling, reuse, composting, and co-composting of solid waste to the maximum extent feasible to conserve water, energy, and other natural resources and to protect the environment. In the Bay Area, less than 10% of biosolids are now disposed of in landfills. Over 80% are beneficially reused as landfill ADC or recycled through land application (see Figure 4).

Bay Area wastewater agencies are continuing to expand beneficial reuse of biosolids by investing in new technology, upgrading treatment facilities, and expanding composting. For example, multiple Bay Area agencies have contracted with Synagro, Inc., to convert a portion of their biosolids to Class A compost.

5.2. Sustainable Land Use Practices

Recent research published in the Journal of Environmental Quality concluded that long-term land application of Class B biosolids is sustainable.[32] The study showed over a 20-year application period enhanced soil microbial activity, no adverse toxicity effects on the soil microbial community, increased soil macronutrients, and low soil metal and salt concentrations. The SWRCB's "Final Environmental Impact Report Covering General Waste Discharge Requirements for Biosolids Land Application" states that "[a] long-term, well-managed program of biosolids application would normally be expected to improve soil productivity, both over the short term and over the long term." As an additional safeguard against long-term impacts to land productivity, Water Quality Order No 2004-0012-DWQ requires submittal of soil and site information to RWQCB staff so they can

[32] Pepper, I., H. Zerzghi, J. Brooks, and C. Gerba. "Sustainability of Land Application of Class B Biosolids." Journal of Environmental Quality, 37:S-58-S-67 (2008).

determine whether soils would be degraded and/or land productivity would be reduced as a result of biosolids application.

5.3. Supporting Local Agriculture

Agriculture in the Bay Area has come under increasing financial and land use pressures in recent years. The amount of arable farmland has steadily declined and the difficulty in making farming financially viable has grown. At the same time, Bay Area communities are seeking ways to increase the availability of and access to locally grown foods and agricultural products.

Biosolids provide a renewable, nutrient rich source of fertilizer and soil conditioner that can be managed in ways that benefit local agriculture. Land application of biosolids provides benefits to Bay Area agriculture by improving soil productivity, reducing dependence on inorganic fertilizers, and lowering production costs. In its review of Solano County land application regulations, the Solano County Grand Jury highlighted both the importance of agriculture to the region's economy and the economic benefits of land application of biosolids accruing to the county's farm sector. In its report, the Grand Jury wrote:

> *Agriculture is an important element of Solano County's economic health, with approximately 400 full-time farming operations. Approximately 65% of the acreage in Solano County is farm land… Biosolids allow the grower to avoid the use of chemical fertilizers and increase the productivity of grassland in Solano County which has marginal value for other crops. Biosolids application has been shown to increase yields of hay approximately 4-fold over untreated, undisked fields, which in one example corresponded to about $400 per acre. Costs of biosolids application are borne by the utility/sanitary district with no additional cost to the farmer. Equivalent chemical fertilizer costs would be approximately $55-60/acre, which includes the application and disking costs.*[33]

5.4. Converting Biosolids to Energy

As discussed in Section 2, biosolids are a source of renewable bioenergy. Latent energy in biosolids can be harnessed indirectly via the capture and combustion of methane or directly via combustion of the biosolids themselves. With a bioenergy value of 10,000 to 12,000 BTUs per pound of volatile solids, biosolids are a significant potential source of bioenergy for the region.

Most Bay Area wastewater agencies already capture a portion of this energy through anaerobic digestion. For example, EBMUD's Main Wastewater Treatment Plant captures methane gas produced during anaerobic digestion of biosolids and uses it to generate power. In recent years, energy production has averaged approximately 4 megawatts, enough energy to meet up to 90% of plant energy demand.[34]

Improvements in mechanical dewatering and exhaust heat recovery devices have made autogenous combustion (combustion without supplemental fuel) possible. Such systems can become net energy exporters. Bay Area wastewater agencies are now exploring the feasibility of a regional B2E facility capable of providing 100% beneficial use of the region's biosolids. Air quality/permitting analysis and cost analysis have been

[33] Solano County Grand Jury. "Biosolids: 2003-2004 Grand Jury Report."
[34] http://ebmud.com/wastewater/biosolids/eMS/2007_ebmud_biosolids_performance_report.pdf

completed for the facility, as have program level cost estimates. These initial investigations have concluded that:

- The proposed facility could be air quality permitted at the four locations and the two processing volumes investigated
- The proposed facility would require Best Available Control Technology (BACT) under the Bay Area Air Quality Management District's permitting program, but would not require Toxic Best Available Control Technology (TBACT).
- The greenhouse gas (GHG) emissions of the proposed facility would be much lower than GHG emissions from a regional thermal dryer facility, somewhat lower than GHG emissions from a regional composting facility, but somewhat higher than GHG emissions from landfill ADC and land application management of biosolids.
- The facility may generate renewable energy credits (RECs), though there is some ambiguity in CPUC code as to whether biosolids meet the State's requirements.
- The facility would have capital costs ranging from $45 to $90 per wet ton, based on the nature of the biosolids, haul costs, facility size and potential state and federal grant funds.

5.5. Turning Biosolids into Commodities

Other options for sustainable reuse of biosolids involve transforming biosolids into one or more marketable commodities. Examples include bulk and packaged compost, pelletized fertilizer, and inputs into the production of cement, bricks and glass. For example:

- **Composting**: Composted biosolids are a marketable product that can be used by farmers, park departments, golf courses, and home gardeners. There are currently several composting operations in California. Many Bay Area wastewater agencies are working with Synagro, Inc., to convert a portion of their biosolids into Class A compost. Synagro compost is marketed under the trade name AllGro.
- **Pelletization**: This process creates a Class A/EQ biosolids pellet used as a fertilizer and soil conditioner. Pelletized biosolids contain approximately 2% to 4% nitrogen and 3% to 4% phosphorous. There are several commercial producers providing both bulk and bagged products. For example, Synagro, Inc., markets pelletized biosolids under the trade name Granulite.
- **Cement, Bricks, and Glass**: In 2006, the Cement Industry Environmental Consortium (CIEC), the Air and Waste Management Association, and the Mohave Valley Air Quality Management District co-sponsored a conference on biosolids utilization in the cement industry. The purpose of the conference was to share information on the potential for using biosolids as an alternative fuel source in cement kilns. Biosolids have also been used for nitrogen oxides control in cement manufacturing, and research into using biosolids as a component of brick manufacture is underway, including a pilot project as part of Australia's Smart Water Fund program. By converting biosolids into a glass-like aggregate through vitrification, the inorganic minerals in biosolids

can be used beneficially in products that include glass aggregate (which can be used in lightweight concrete or as an industrial abrasive) and pozzolan, which can be used in sandblasting grit, abrasives, roofing shingle granules, and cement additive. Ash from thermal oxidation of biosolids can be used to manufacture cement.

6. Supporting Biosolids Reuse in the Bay Area

A long-term, sustainable solution for managing and reusing the Bay Area's biosolids requires a coordinated, comprehensive management approach. Generation, treatment, and reuse of biosolids are fundamentally regional issues that are best addressed through regional initiatives. Biosolids disposal and reuse decisions frequently involve disparate localities and communities spanning multiple political jurisdictions. Biosolids management is seldom just a local issue; it is regional in nature. Additionally, several of the more promising opportunities for reusing biosolids, such as B2E, composting, and pelletization, can only be realized through regional approaches that harness the economies of scale associated with these technologies. This is also true for marketing new products and providing information to the public. Regional coordination and action will also facilitate State and federal partnerships needed to advance the state-of-the-art of biosolids management in the Bay Area.

6.1. Regional Coordination Initiatives

Given the potentially substantial benefits and synergies associated with developing regional solutions to biosolids management, Bay Area Clean Water Agencies formed the Biosolids Committee to develop economical, diversified, reliable, and sustainable regional biosolids management strategies. Through the Biosolids Committee, Bay Area wastewater agencies have been evaluating the feasibility of a regional biosolids processing facility. Two initial feasibility studies for interest in and potential siting of a regional processing facility resulted in the seven Bay Area agencies executing a Joint Exercise of Powers Agreement (JEPA) in 2006 to further evaluate a regional facility. The JEPA provides the framework for managing and paying for the planning studies and environmental documentation. The JEPA is currently in the process of being amended and re-executed with 17 Bay Area agency members. JEPA members will begin work on detailed planning and environmental review in 2009.

The initial planning-level work has identified a number of potential benefits of a regional processing facility, including:

- More robust and diversified options for managing the Bay Area's biosolids;
- Greater regional control over biosolids management and reuse decisions;
- Advancing the state-of-the-art in sustainable resource management and bioenergy production in the Bay Area;
- Harnessing economies of scale and reducing technology redundancy among agencies; and
- Better opportunities to form State and federal partnerships and cost-sharing agreements.

6.2. State and Federal Partnership Opportunities

Biosolids management is an issue that concerns every municipality, whether in the Bay Area, elsewhere in California, or across the nation. In this respect, biosolids management is an issue of State and national importance. In addition to regulatory responsibilities, the State and federal governments have an obligation to pursue policies and partnerships that facilitate regional approaches to biosolids management. A number

of State and federal funding initiatives already exist in this regard, but other initiatives are warranted. This section briefly reviews existing State and federal financial assistance programs that could potentially benefit regional solutions to biosolids management and then discusses additional policy options that should be considered.

6.2.1. Federal Programs Potentially Supporting Biosolids-to-Energy

Several existing federal programs could support conversion of Bay Area biosolids to energy. These include the following:

- **The Biomass Research and Development Act of 2000**. This Act calls for the creation of a national strategy for bioenergy through research, development, and private sector incentives. National goals for 2030 established under the Act include doubling the biomass share of electricity and heat used by utilities and industry, a fivefold expansion of bioproducts production and use, and a 650% increase in the use of biofuels for transportation. Under the Act, biomass includes any organic matter available on a renewable or recurring basis, including dedicated energy crops, agricultural food and feed residues, animal wastes, municipal wastes, and other waste materials.
- **Executive Order 13134**. This order was intended to further promote creation and early adoption of technologies needed to make bioenergy cost effective by supporting research, development, and private sector incentives. Under this order, the federal government is to prepare annually a strategic plan outlining national goals in the development and use of bioenergy and how these goals can best be achieved through federal programs and integrated planning. More specifically, the plans must include: (1) priorities for research, development, demonstration, and other investments in biobased products and bioenergy; and (2) policies to encourage the adoption and use of biobased products and bioenergy and recommended legislation for modifying these policies or creating new policies if needed.
- **The Renewable Energy Production Incentive Program**. This program was created by the Energy Policy Act of 1992, and amended in 2005, to provide financial incentives for renewable energy electricity produced and sold by qualified renewable energy generation facilities. The program is managed by the U.S. Department of Energy (DOE) and provides financial incentive payments for electricity generated and sold by new qualifying renewable energy generation facilities. Qualifying facilities are eligible for annual incentive payments of 1.5 cents per kilowatt-hour (1993 dollars and indexed for inflation) for the first 10-year period of their operation, subject to the availability of annual appropriations in each Federal fiscal year of operation. The 2005 amendments included use of landfill gas for electricity production.
- **The Climate Change Technology Program (CCTP) Strategic Plan**: Through the CCTP, the DOE has $3 billion available in federal funding for climate technology research, development, demonstration, and deployment to reduce greenhouse gas emissions while increasing economic growth.
- **Clean Renewable Energy Bonds**: This bond program was authorized through the Energy Policy Act of 2005. The program allows local governments to obtain interest free financing by granting investors tax credits

in place of interest payments. In total $750 million is available to governments for the 2008 fiscal year.

6.2.2. State Programs Potentially Supporting Biosolids Management

As with the federal government, several existing State programs potentially offer support for regional biosolids management initiatives. These include:

- **Renewable Portfolio Standard**: Established in 2002 under SB 1078 and accelerated in 2006 under SB 107, California's Renewables Portfolio Standard (RPS) is one of the most ambitious renewable energy standards in the country. The RPS program requires electric corporations to increase procurement from eligible renewable energy resources by at least 1% of their retail sales annually, until they reach 20% by 2010. Biosolids-to-energy can qualify as an RPS electricity source.
- **New Renewable Energy Program (NRFP)**: The NRFP provides grant funding in the form of production incentives generate. To qualify for funding, applicants must show that their proposed renewable facility meets a number of requirements as specified in Public Utilities Code section 383.5(d), as amended by Public Resources Code section 25743.
- **Self Generation Incentive Program**: In September 2000, AB 970 was approved, which called for the creation of more energy supply and demand programs. As a result, in March 2001, the CPUC issued a decision creating the Self-Generation Incentive Program (SGIP) for energy utilities to offer financial incentives to their customers who install certain types of distributed generation facilities to meet all or a portion of their energy needs. In late 2003, AB 1685 extended the SGIP through 2007. Then, in late 2006, AB 2778 extended the SGIP again through 2011.
- **Public Interest Energy Research (PIER) Program**: The PIER program supports public interest energy research, development, and demonstration. RD&D activities include providing contracts and grants for research and development of energy technologies and related scientific activities. The RD&D Division administers a total of $83.5 million in public interest energy research funds annually - $62.5 million for electricity and $21 million for natural gas.
- **California Energy Commission Energy Efficiency Financing Program**: This program provides low-interest financing for schools, hospitals and local governments through low-interest loans for feasibility studies and the installation of energy-saving measures. Eligible projects include renewable energy projects and cogeneration.
- **California Infrastructure Development Bank:** This program offers state revolving funds for infrastructure projects including biosolids processing facilities. Loans are fixed rate at 67 percent of the market rate for "A" rated tax-exempt security. Sewage collection and treatment and solid waste collection and disposal facilities are eligible to receive loans up to $10 million.

6.2.3. Potential New Biosolids Policies

New policy options that would promote long-term, sustainable management of biosolids include:

State Support for Biosolids Composting: More stringent air emission standards are a barrier to expanding biosolids composting. Compliance technologies are frequently cost-prohibitive. To promote the composting of biosolids, the State could provide production or tax incentives to the composting industry to partially offset initial capital costs and stimulate expansion. Possible incentives suggested by the California Research Bureau included: (1) low interest loans to meet emission standards, (2) tax credits for composting companies, and (3) regional tipping fees dedicated to expansion of composting facilities.

State Support for Product Development and Creation of New Markets: There are a number of policies that could promote innovative uses of biosolids and expand markets for these products, such as:

- Requiring the use of biosolids-derived products such as cement, bricks, and other construction materials in public construction;
- Establishing statewide policies on biosolids to promote biosolids-to-energy or other products;
- Providing incentives for wastewater treatment facilities to convert biosolids to energy by expediting and reducing the cost of utility interconnection, eliminating economic penalties, including standby charges, removing size limitations for net metering, and allowing water and wastewater utilities to self generate and provide power within their own systems;
- Amending Diversion Credits policies by awarding higher credit to projects that transform biosolids to energy or other useful products;
- Directing State funds and leveraging federal funds for research, development, and demonstration projects for alternative uses and markets for biosolids (e.g. expanding funding eligibility under the Emerging Renewables Program to include biosolids-to-energy projects);
- Providing private sector grants and tax credits for the creation of new technologies supporting alternative applications of biosolids, such as biosolids-based fuel production, power generation, materials production, and commercial product development; and
- Consolidating and rationalizing existing regulatory and permitting requirements to facilitate development and installation of new biosolids conversion technologies.

6.3. Looking Forward

Bay Area biosolids management is at a crossroads. While the region has made great strides in beneficially using it biosolids, its traditional management approaches are confronting a number of challenges. Opportunities to beneficially use biosolids for landfill ADC are narrowing and local land use and air quality regulations are impacting the ability to use biosolids in land application. Meanwhile, the region's population – and hence its production of biosolids -- continues to increase. These trends are causing

biosolids management costs to escalate. Responding to these management challenges, Bay Area wastewater agencies are working to develop new outlets and sustainable uses for the region's biosolids. These efforts include potential development of a regional biosolids processing or bioenergy facility; development of commercial products and markets for biosolids; and continuation of beneficial land application and ADC uses. Successfully transitioning to the next generation of biosolids management practices will require a range of public policies, including creating incentives for B2E and other biosolids products, removing regulatory barriers to biosolids energy conversion, and promoting private sector investment in biosolids technologies and markets.