



PERIODIC REVIEW

**Kent Highlands Landfill
Facility Site ID#: 2042**

**23076 Military Road South,
Kent, Washington 98032**

Northwest Region Office

TOXICS CLEANUP PROGRAM

June 2009

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1.0 INTRODUCTION

This document is a review by the Washington State Department of Ecology (Ecology) of post-cleanup site conditions and monitoring data at the Kent Highlands Landfill (Site or Kent Highlands). The Site was placed on the Federal National Priorities List (NPL) on August 30, 1990 for cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLA sites are known as Superfund sites. The Washington State Department of Ecology (Ecology) is the lead agency for cleanup of Kent Highlands as stipulated by an agreement with Region 10 of the Environmental Protection Agency (EPA). Accordingly, cleanup at this Site was implemented under the Model Toxics Control Act (MTCA) regulations, Chapter 173-340 Washington Administrative Code (WAC)

The purpose of this third periodic review is to determine whether the cleanup remedy at the City of Seattle's Kent Highlands Landfill Superfund Site (Kent Highlands) continues to be protective of human health and the environment. This periodic review is the latest in an ongoing series, the last of which was completed in 2003 (the second periodic review). This periodic review focuses on three areas: (1) activities undertaken by the City of Seattle in response to the previous periodic review (see Section 2.2), (2) three specific questions and answers required by EPA (see Section 3.1), and (3) a protectiveness statement (see Section 4.0).

Cleanup activities at this Site were conducted under a Consent Order between Ecology and the City of Seattle, as executed on May 26, 1987. The cleanup actions were necessary because of high concentrations of landfill decomposition gas, and leachate with high specific conductance, high chemical oxygen demand, and high concentrations of ammonia and iron. Major metals detected were iron, zinc, and manganese. Volatile organic compounds detected were primarily ketones, aromatic hydrocarbons, and chlorinated hydrocarbons. The primary semivolatile organic compounds were low molecular weight polycyclic aromatic hydrocarbons, alkyl phenols, benzoic acid, and chlorinated benzene. The presence of the volatile and semivolatile organic compounds was consistent with the disposal of household products in the landfill. Contaminants remaining at the Site exceed MTCA cleanup levels. The MTCA cleanup levels for soil are established under WAC 173-340-740. The MTCA cleanup levels for groundwater are established under WAC 173-340-720.

WAC 173-340-420 (2) requires that Ecology conduct a periodic review of a site every five years under the following conditions:

- (a) Whenever the department conducts a cleanup action
- (b) Whenever the department approves a cleanup action under an order, agreed order or consent decree
- (c) Or, as resources permit, whenever the department issues a no further action opinion;
- (d) and one of the following conditions exists:
 - 1. Institutional controls or financial assurance are required as part of the cleanup
 - 2. Where the cleanup level is based on a practical quantitation limit
 - 3. Where, in the department's judgment, modifications to the default equations or assumptions using site-specific information would significantly increase the concentration of hazardous substances remaining at the site after cleanup or the

uncertainty in the ecological evaluation or the reliability of the cleanup action is such that additional review is necessary to assure long-term protection of human health and the environment.

When evaluating whether human health and the environment are being protected, the factors the department shall consider include [WAC 173-340-420(4)]:

- (a) The effectiveness of ongoing or completed cleanup actions, including the effectiveness of engineered controls and institutional controls in limiting exposure to hazardous substances remaining at the site;
- (b) New scientific information for individual hazardous substances or mixtures present at the site;
- (c) New applicable state and federal laws for hazardous substances present at the Site;
- (d) Current and projected site use;
- (e) Availability and practicability of higher preference technologies; and
- (f) The availability of improved analytical techniques to evaluate compliance with cleanup levels.

The department shall publish a notice of all periodic reviews in the site register and provide an opportunity for public comment.

2.0 SUMMARY OF SITE CONDITIONS

2.1 History of Landfilling and Contamination

The Site is situated on the eastern flank of the Des Moines upland, where it adjoins the Green River valley. The landfill occupies a former natural ravine that extended about 2,500 feet from near the top of the upland down to the valley floor. The current fill surface slopes downward from a top elevation of 260 feet MSL to a base elevation of 35 feet MSL at the eastern toe of the landfill.

The Seattle Solid Waste Utility started landfilling operations at the Site in 1968. The landfill received mostly municipal garbage until 1983. After 1983 the landfill also took in industrial wastes and construction debris. Disposal operations ceased on December 31, 1986. The City of Seattle was in the process of completing a closure plan at that time.

The Landfill has been subject to federal, state, and local agency regulation since its inception. It initially operated under a "Nonconforming Permit" from the Seattle-King County Department of Public Health, and Ecology imposed leachate collection and treatment requirements in 1974. No specific regulatory actions were taken with regard to landfill gas in the early years, although there were complaints of odors coming from the landfill. Gas migration was first measured directly in 1984 in gas probes installed west of the landfill. A gas monitoring program was finally initiated in 1988 at the request of the Washington State Department of Health.

Ecology conducted a Potential Hazardous Waste Site Preliminary Assessment in 1984. Based on this assessment, the Site was proposed for listing as a Superfund site. The EPA performed a preliminary assessment under its hazard ranking system, and performed a subsequent evaluation in 1990. The site was placed on the NPL on August 30, 1990, because of the presence of an unknown quantity of hazardous waste at the site. Recognizing their responsibility to conduct the investigations necessary to close the landfill, the City of Seattle entered into a Consent Order with Ecology that called for the City to conduct a remedial response program in a manner consistent with the National Contingency Plan, beginning with a remedial investigation.

The remedial investigation found that offsite gas migration had occurred, primarily on the north and west sides of the landfill. Gas migration toward the south was prevented by subsurface hydrogeologic conditions. Gas migration to the east was prevented by a shallow water table. Air dispersion modeling indicated that estimated concentrations of trace gas compounds at the landfill boundaries did not exceed Acceptable Source Impact Levels. The remedial investigation found that about 35% of the leachate within the landfill was not collected in the leachate collection system and migrated downward into the ground water and thence eastward to the Green River. The leachate had high specific conductance, high chemical oxygen demand, high concentrations of ammonia and iron, a neutral pH, and low concentrations of sulfate and trace metals. Major metals detected were iron, zinc, and manganese. Volatile organic compounds detected were primarily ketones, aromatic hydrocarbons, and chlorinated hydrocarbons. The primary semivolatile organic compounds were low molecular weight polycyclic aromatic hydrocarbons, alkyl phenols, benzoic acid, and chlorinated benzene. The remedial investigation

report concluded that the presence of the volatile and semivolatile organic compounds was consistent with the disposal of household products in the landfill.

Contamination was found in the Sand Aquifer and in the Recent Alluvium Aquifer. Leachate in the landfill discharges primarily to the Sand Aquifer, which in turn discharges to the Recent Alluvium Aquifer. The Recent Alluvium Aquifer is in hydraulic connection with the Green River. Surface water in Midway Creek was found to be degraded by the landfill; no effects of the landfill on the water quality of the Green River were observed. Based on the results of the remedial investigation and further work, ground water monitoring at the site is being done for field parameters, conventional chemical parameters, dissolved metals, volatile organic compounds, herbicides, and pesticides.

2.2 Landfill Closure and Post-Closure Care

Proposed remedies were evaluated in the *Closure Action Report* (Seattle, 1992) and the remedy to be implemented selected in the *Cleanup Action Plan* (Ecology, 1993). The remedy selected consisted of the following components (see Ecology, 1993, p. 8 ff.):

- Access Controls – a 6-foot-high chain link fence provides primary access control.
- Site Grading – The site was graded to achieve adequate drainage slopes.
- Landfill Cover – A geomembrane cover was placed on top of the existing cap, with a prepared soil base. A drainage layer was placed on top of the geomembrane to direct water away from the landfill. Topsoil was placed as the final layer and vegetated.
- Surface Water – A surface water conveyance system was installed, consisting of a perimeter ditch system with runoff control berms and ditches used to intercept sheet flow runoff on the landfill itself and divert it to the perimeter system. Storm water detention facilities were upgraded.
- Leachate Collection System – The existing leachate collection system was completely rebuilt during remedial construction. A subcover seep collection system was constructed as part of the final system design. Much of the water intercepted by the existing leachate collection system was ground water from a series of springs on the north slope of the ravine in which the landfill was built. Although the cleanup action plan concluded that construction of a separate spring drain treatment and discharge system would not be cost-effective, the two were later separated.
- Landfill Gas – The gas collection system was upgraded and connected to a thermal incinerator which uses enclosed flares. The initial upgrade of the gas collection system was completed as part of the remedial construction. Subsequent monitoring data indicated exceedances of compliance standards at the property boundary at the southeast corner of the landfill. The gas collection system was extended farther into this area in 2000, bringing the landfill into compliance.

2003 Second Periodic Review

A number of interrelated issues were raised in the Second Periodic Review (the second review). Because the solution to these issues required additional action on the part of Seattle, a

protectiveness determination could not be made at that time. The additional actions were completed over the next several years, and were summarized in an October 2007 report (the Second Review response). The primary issues raised in the second review were as follows:

- Vinyl chloride and manganese concentrations in ground water consistently exceeded applicable standards in compliance wells at the downgradient edge of the property. The focus was on KMW-17 and KMW-10A, both in the Recent Alluvium Aquifer.
- Ammonia concentrations were too high and oxygen concentrations were too low relative to surface water quality standards in the water discharging from the stormwater pond into the Green River.
- Settlement of the landfill surface had not been measured since 1996 and there was concern about the continuing stability of the steep eastern face of the landfill.

Ecology and Seattle negotiated the scope of the additional investigations necessary to address the three issues over a several year period, and the final scope was established in the August 2006, Kent Highlands Landfill Work Plan, prepared by Floyd Snider. Following is a summary of the key investigation/evaluation elements for each of the three issues:

Issue 1: Vinyl chloride and manganese in ground water

- Evaluate whether leachate is backing up in the landfill because of a change in the Spring Drain outlet elevation, and whether such a backup, if present, could be contributing to the observed ground water contamination. A hydraulic analysis was conducted to evaluate this potential.
- Evaluate whether the leachate collection system had developed leaks and was contributing to the observed contamination. This evaluation consisted of a television inspection of all accessible leachate lines. One pipe joint was noted as being offset; this joint was replaced.
- Evaluate whether leachate was building up near the toe of the landfill, indicating blockage of the leachate collection system, and thus contributing to the observed contamination. This potential was evaluated by directly measuring leachate elevations within refuse near the toe of the landfill.
- Reevaluate the eastern property boundary for Kent Highlands to determine whether it should remain at the west edge of Fraeger Road or be moved to the west edge of the Green River. Moving the property boundary would have the potential effect of moving the ground water point of compliance further downgradient, thus potentially allowing for additional vinyl chloride degradation in ground water. A property survey analysis was completed by the City of Seattle to address this issue.
- Investigate the concentrations of vinyl chloride in ground water downgradient of the compliance wells to determine whether the concentrations are below the cleanup level at the point of discharge into the Green River. This investigation included installing a new downgradient well (KMW-17Z) and modeling vinyl chloride transport in ground water.
- Reevaluate the human health and aesthetic basis for manganese cleanup levels, and propose a revised compliance approach.

Issue 2: Ammonia Too High, Oxygen Too Low in Stormwater Discharge to Green River

- Increase elevation of the stormwater pond outfall to increase residence time within the pond and allow for additional ammonia treatment.
- Install a second aerator in the stormwater pond to increase dissolved oxygen concentrations.
- Conduct intensive discharge quality monitoring for a year to determine the impact of the increased retention time and second aerator on ammonia and oxygen concentrations in the discharge.
- Recalculate chronic ammonia discharge limits based on Ecology's 2007 revised calculation tool.
- Move the location where compliance samples are taken from the pond outfall to the point of discharge into the Green River. Although this action was not part of the 2006 work plan, it had been implemented in 2004 to evaluate whether additional aeration/ammonia reduction would occur in the outfall pipe.

Issue 3: Landfill Settlement and Slope Stability

- Prepare an updated elevation contour map of the landfill in 2005. Comparison of this map with one prepared in 1996 allowed quantification of the differential settlement that has occurred in the 10 years since remedial action was completed. The comparison also provided direct evidence as to whether the toe of the landfill had steepened or otherwise showed signs of instability.
- Measure leachate levels in the landfill to evaluate whether they were rising and potentially destabilizing the toe.

Second Periodic Review Discussion and Ecology Response

Issue 1 - Vinyl Chloride and Manganese in Ground Water

Vinyl Chloride: The vinyl chloride investigations first looked at the regulatory value (i.e., cleanup level). As noted in the second review response, a regulatory value was not originally established for vinyl chloride because it was undetectable in ground water with the analytical methods then available. As the analytical method changed, so did the detection limits. The current detection limit is 0.02 ug/L, which is below current MTCA Method A, B and C cleanup levels, respectively .200, .029, and .290 ug/L. The cleanup level or regulatory value for vinyl chloride was set in the second review as 0.029, the Method B value. Seattle is now proposing that the regulatory value be set at the Method C value of 0.29 ug/L. Ecology concurs with the use of Method C, based on the criteria outlined in WAC 173-340-700 (c). These criteria include a possible inability to achieve Method A or B values, and a total carcinogenic risk for the site of less than 10^{-5} . However, Method C requires the selected cleanup level be at least as stringent as concentrations established under applicable state and federal laws (ARARs). The most stringent of these is a .025 ug/L criterion for surface water under the Clean Water Act for protection of human health (drinking water and eating fish). Because protection of surface water is considered the highest beneficial use for ground water at Kent Highlands, the ground water regulatory value for vinyl chloride must be revised downward from the current .029 regulatory value to the most stringent ARAR at .025 ug/L.

The vinyl chloride investigations next looked at possible changes in source areas or contributions from the landfill. These included factors such as increased bypass of the leachate collection system or increased leakage from the collection system. Leachate levels do appear to have increased within the landfill, but there is no indication that this has a bearing on vinyl chloride leaching into ground water. The only change was the recognition that leakage from the former North Pond may be playing a larger role than previously thought. This feature is no longer a pond, but is like a french drain that partially intercepts ground water seepage from slopes adjoining the landfill. During periods of high ground water, some of the water captured in piping within the North Pond discharges to the leachate system. Otherwise it does not. Seattle has suggested the possibility that trace levels of vinyl chloride may be passing through the North Pond area and bypassing the leachate collection system. If true, this could be the source of the low vinyl chloride concentrations being detected in downgradient wells. Seattle has proposed additional investigations to evaluate vinyl chloride in this area. Ecology supports these additional investigations. However it should be noted that the North Pond cannot be the only factor, given that vinyl chloride has been detected at low concentrations in a number of wells across the base of the landfill as illustrated by monitoring data from the fourth quarter of 2007:

Recent Alluvium Aquifer

Well Number	Vinyl Chloride (ug/L)
10A (compliance well)	.068
15A (background well)	ND
16A	ND
17 (compliance well)	.75
17Z	.65
19A (compliance well)	ND

Sand Aquifer

Well Number	Vinyl Chloride (ug/L)
8A	ND
12A	.31
13 (background well)	ND
16B	.032
18A	.057

ND indicates no detection at .02 detection limit

The vinyl chloride investigations then examined the potential for further degradation of vinyl chloride in ground water between the compliance wells and the point of discharge into the Green River. This analysis was contingent on redefining the eastern property boundary (a conditional point of compliance) and moving it from along Fraeger Road to the western edge of the Green River. Seattle concluded the property line change was warranted and submitted a brief outlining the basis for their conclusion. Ecology acknowledges the move may be warranted, but has not yet completed its analysis of the brief. Seattle's analysis of vinyl chloride degradation downgradient of the existing compliance wells focused on KMW-17, which historically has had the highest vinyl chloride concentrations. This analysis had two parts, an empirical demonstration and a predictive model.

The first part included installation of a new ground water monitoring well at a location expected to be directly downgradient of KMW-17. The new well, KMW-17Z, was located about 150 feet closer to the Green River, and about 75 feet from the river. Vinyl chloride concentrations in the new well are generally lower than at KMW-17 indicating degradation is continuing to occur. Vinyl chloride concentrations discharging into the Green River should therefore be less than those measured at KMW-17. Seattle has requested replacing KMW-17 as the compliance monitoring point with the new well. Ecology agrees with this request provided one of the following occurs: (1) Ecology concurs with moving the property boundary to the edge of the Green River, or (2) If Ecology does not agree with moving the property boundary, then the current property owner agrees in writing to allow a conditional point of compliance to be established on their property at rivers edge (WAC 173-340-720 (d)(ii)).

The second part of the downgradient evaluation consisted of ground water modeling. The purpose of the modeling was to predict vinyl chloride concentrations at the discharge point into the Green River based on the data at KMW-17 and -17Z, and to estimate a concentration at these wells that would meet the regulatory value at the point of ground water discharge into the Green River. The latter value is a remediation level under MTCA. The data and assumptions used in the modeling were reasonable, but unfortunately showed that vinyl chloride is above the 0.025 ug/L cleanup level at the point of discharge into the river. Ecology accepts the modeling but does not accept the proposed remediation levels for KMW-17 and KMW-17Z because they are based on a higher 0.25 ug/L regulatory value. Seattle also proposed modifying the procedure for determining vinyl chloride compliance to be in accord with MTCA, WAC 173-340-720 (9)(c)(iii)(A). This subsection requires compliance for carcinogenic compounds be determined through calculation of the true mean concentration. Ecology accepts the proposal, while noting that the provisions of -720(9)(e) must also be met. Also, the true mean must be a running average reflecting the previous four quarters of data. The running averages must themselves meet cleanup levels for at least two years (a total of 8 running averages) in order for the landfill to be considered in compliance.

Manganese: Seattle approached this issue first with a discussion of the compliance evaluation process, and second, with a re-evaluation of the current regulatory value established in the Second Review as .05 mg/L. The compliance evaluation process, established in the 1996 *Kent Highlands Landfill Groundwater Compliance Monitoring Plan*, calls for control charts with three components – regulatory value, control limit, and tolerance limit. Control charts were therefore established for manganese at all compliance wells, except KMW-19A, which had excessive scatter in the data. Ecology has determined that compliance for this well will be established by reference to the regulatory value alone. This has created the highly contradictory situation whereby all of the compliance wells, except KMW-19A, are “in compliance”, even though all exceed the regulatory value for manganese. In very broad terms, the monitoring data shows background wells meeting the regulatory value at around .05 mg/L or less, with concentrations in the Sand Aquifer much higher at around 2 mg/L and in the Recent Alluvium Aquifer lower at around 1 mg/L. For comparison, manganese concentrations in leachate are between 2.5 and 3.0 mg/L. Seattle has proposed that the regulatory value be increased from .05 mg/L, the current Federal secondary drinking water standard, to 2.2 mg/L, the current Method B cleanup level under MTCA. Ecology cannot accept the proposed change because the 0.05 mg/L value has

been adopted as a primary drinking water standard or maximum contaminant limit (MCL) by Washington under WAC 246-290-310. MTCA does not allow this ARAR to be ignored or adjusted downward, even though it is based on aesthetics, not human health risk.

Issue 2 - Ammonia Too High, Oxygen Too Low in Stormwater Discharge to Green River

Storm water discharge to the Green River had been out of compliance for ammonia and dissolved oxygen prior to 2003, and the second review requested this situation be corrected. Seattle has taken a number of steps since then to address the issue. The most recent data from 2007 shows the discharge to be in compliance. The specific steps and improvements made by Seattle are described in the following paragraphs.

Improvements were made to the stormwater pond. The improvements included increasing the elevation of the pond outfall, thus providing for an additional 30 hours of residence and treatment time. Raising the outfall also broadened the area where storm water treatment could occur. A second aerator was also added to the pond to increase dissolved oxygen concentrations. The combination of these two changes resulted in a dramatic lowering of ammonia concentrations at the pond outfall and an increase in dissolved oxygen levels.

The compliance point for oxygen in the storm water discharge was also changed in 2004 from the pond outfall to the actual point of discharge into the Green River. Seattle had requested this change because they suspected additional aeration was occurring within the corrugated discharge pipe. Subsequent monitoring over a several year period showed them to be correct, suggesting that the discharge had always been in compliance at the point of discharge into Green River. Seattle has now requested the point of compliance be moved back to the pond outfall for safety reasons. Ecology approves the requested change.

Seattle also recalculated the ammonia discharge limits based on Ecology's 2007 revised calculation tool. The limits increased slightly for both the summer (1.2 to 1.9 mg-N/L) and winter (1.9 to 2.2 mg-N/L) criteria.

Issue 3 - Landfill Settlement and Slope Stability

Seattle prepared an updated elevation contour map of the landfill in 2005 for comparison with one prepared in 1996. The comparison showed between 0 and 4 feet of differential settlement over most of the landfill, with up to 8 feet near the central portion where the refuse is thickest. Seattle determined the settlement has not adversely impacted storm water drainage or other landfill systems, and it is not yet necessary to regrade the surface of the landfill. A regrade may become necessary as the landfill continues to settle.

Future settlement monitoring will take place as established in the 2006 Revised Work Plan. Specifically, an aerial photographic survey will be completed every 10 years, and then replaced with a ground-based survey at some indeterminate time in the future as the end of post-closure care approaches. As described in the Revised Work Plan, permanent monuments will be installed on the surface of the landfill 10 years prior to the end of post-closure care, and will be surveyed every two years thereafter. The purpose of this end-phase monitoring is to demonstrate landfill settlement is no longer occurring.

Seattle also evaluated the stability of the steep eastern slope of the landfill. The last time this issue had been evaluated was in 1991 as part of a geotechnical analysis. The current analysis consisted of checking whether the slope has steepened over time and whether fluid levels have risen within the landfill sufficient to destabilize the slope. Neither are occurring. Comparison of topographic data from 1991, 1995, and 2005 showed no significant change in the slope. Fluid measurements (2005 – 2007) obtained at four locations within the landfill showed the levels have increased since last measured in 1991, but are still below the elevation used in the stability analysis. While the analysis suggests conditions continue to be stable, the increased water levels are a potential concern. Ecology therefore requests fluid level monitoring be added to the ground water monitoring program, and that a stability analysis be conducted every five years coincident with Ecology's periodic reviews.

2.3 Sample Results

Please see the above "Discussion and Ecology Response".

2.4 Cleanup Levels

There is some discussion of cleanup levels included in the above "Discussion and Ecology Response".

2.5 Restrictive Covenant

The April 1993 Cleanup Action Plan for the Site was approved by Ecology in the form of a Declarative Statement, signed by Ching-Pi Wang, Project Manager and Michael Gallagher, Section Head Northwest Region Toxics Cleanup Program. The Declarative Statement stated in part "...it is determined by Ecology that the selected cleanup actions are protective of human health and the environment, attain Federal and State requirements which are applicable or relevant and appropriate,... and provide for compliance monitoring....Furthermore is is Ecology's opinion that the selected cleanup actions are consistent with the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR Part 300)...."

A Restrictive Covenant was subsequently placed on the City-owned property on March 14, 2002 to ensure the continued integrity of the cleanup action. The Restrictive Covenant explicitly defines the cleanup action as the "work done to clean up the property, described in the Cleanup Action Plan for Kent Highlands Landfill dated April 19, 1993". A second covenant on City of Kent owned property was recorded in 2003. The following limitations in both covenants were imposed:

Section 1. Any activity on the Site that may interfere with the Cleanup Action is prohibited. Any activity on the Site that may result in the release of a hazardous substance that was contained as part of the Cleanup Action is prohibited. Any activity on the Site that may result in endangerment to human health or the environment by hazardous substances contained on site or by gas generated by and emitted from the Site is prohibited.

Section 2. Except for groundwater monitoring, no groundwater may be taken for any purpose from any well on the Site without Department of Ecology ("Ecology") approval.

Section 3. The owner of the Site must give written notice to Ecology, or to its successor agency, of the owner's intent to convey any fee interest in the Site. Seattle and all subsequent owners shall provide for the continued operation, maintenance and monitoring of the Cleanup Action.

Section 4. The owner must notify and obtain approval from Ecology, or from its successor agency, prior to any use of the Site that is inconsistent with the terms of this Restrictive Covenant. Ecology or its successor agency may approve such a use only after public notice and comment.

Section 5. The owner shall restrict leases to uses and activities consistent with this Restrictive Covenant and notify all lessees of the restrictions on the use of the property.

Section 6. The owner shall allow authorized representatives of Ecology, or its successor agency, the right to enter the Site at reasonable times and with reasonable prior notice for the purpose of evaluating compliance with the Cleanup Action Plan and to inspect records that are related to the Cleanup Action.

Section 7. The owner of the Site reserves the right under WAC 173-340-720 and WAC 173-340-440 (1991 ed.), to record an instrument which provides that this Restrictive Covenant shall no longer limit use of the Site or be of any further force or effect. However, such an instrument may be recorded only with the consent of Ecology, or its successor agency. Ecology or a successor agency may consent to the recording of such an instrument only after public notice and comment.

The Restrictive Covenants are available as Appendix 6.3.

3.0 PERIODIC REVIEW

3.1 Effectiveness of completed cleanup actions

The Restrictive Covenant for the Site was recorded and is in place. This Restrictive Covenant prohibits activities that will result in the release of contaminants at the Site without Ecology's approval, and prohibits any use of the property that is inconsistent with the Covenant. This Restrictive Covenant serves to ensure the long term integrity of the remedy.

Based upon the site visit conducted on June 17, 2009, the remedy at the Site continues to eliminate exposure to contaminated soils by ingestion and contact, and surfacewater and groundwater is adequately protected. The landfill cover and all controls appear in satisfactory condition and no repair, maintenance, or contingency requirements have been altered. The Site is not operating as a landfill. A photo log is available as Appendix 6.4.

Soils with various landfill related contaminants with concentrations higher than MTCA cleanup levels are still present at the Site. However, the remedy prevents human exposure to this contamination by ingestion and direct contact with soils. The Restrictive Covenant for the property will ensure that the contamination remaining is contained and controlled.

EPA Question A: Is the remedy functioning as intended by the decision documents?

Yes, the remedy is functioning largely as intended:

- Landfill gas is under control;
- Storm water runoff is being handled appropriately, and its discharge to the Green River meets surface water quality standards;
- The refuse has been encapsulated and is not accessible to the public or to sensitive species;
- Access to the landfill is controlled and restricted;
- The leachate collection and discharge system is operating effectively;
- Ground water impacts have been largely eliminated, except for manganese and vinyl chloride.

EPA Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?

The Consent Order governing cleanup at this site was amended in 1996. The amendment provides that the site is being cleaned up pursuant to the Water Pollution Control Act [Ch. 90.48 RCW] and the Model Toxics Control Act [Ch. 70.105D RCW], as well as all other applicable state and federal laws. The exposure assumptions and remedial action objectives used at the time of remedy selection have not been reviewed with respect to the Model Toxics Control Act for this periodic review. However, cleanup levels have been evaluated with respect to MTCA with the following resulting changes:

- The vinyl chloride MTCA cleanup level has decreased from the 0.029 set in the second periodic review to 0.025 µg/L, a Federal chronic water quality criterion for fresh water, Clean Water Act;

- The manganese cleanup level had been set at 747 ug/L in the second periodic review, but has been reduced to 0.050 mg/L, a secondary Maximum Contaminant Limit under state law, WAC 246-290-310.

EPA Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Not at this time.

3.2 New scientific information for individual hazardous substances for mixtures present at the Site

There is no new scientific information for the contaminants related to the Site.

3.3 New applicable state and federal laws for hazardous substances present at the Site

The cleanup at the site was governed by Chapter 173-340 WAC and all other applicable, relevant, and appropriate requirements. As cleanup standards change requirements at the Site are adjusted accordingly.

3.4 Current and projected site use

The site is currently a closed landfill. There have been no changes in current or projected future Site or resource uses.

3.5 Availability and practicability of higher preference technologies

The remedy implemented included containment of hazardous substances, and it continues to be protective of human health and the environment. While higher preference cleanup technologies may be available, they are still not practicable at this Site.

3.6 Availability of improved analytical techniques to evaluate compliance with cleanup levels

The analytical methods used at the time of the remedial action were capable of detection below selected site cleanup levels except for vinyl chloride, but the detection limit for vinyl chloride has been improved and the cleanup level was changed in the second periodic review to reflect the lower detection limit. The presence of improved analytical techniques would not affect decisions or recommendations made for the site.

4.0 CONCLUSIONS

The following conclusions can be made as a result of this periodic review:

- The cleanup actions completed at the Site appear to be protective of human health and the environment, except as noted below;
- Soils cleanup levels have not been met at the standard point of compliance for the Site; however, the cleanup action has been determined to comply with cleanup standards since the long-term integrity of the containment system is ensured, and the requirements for containment technologies are being met;
- The Restrictive Covenant for the property is in place and continues to be effective in protecting public health and the environment from exposure to hazardous substances and protecting the integrity of the cleanup action.

The remedy at the Kent Highlands Landfill can be considered protective of human health and the environment with respect to refuse encapsulation, landfill gas control, surface water quality maintenance, leachate capture, and ground water quality protection, except for vinyl chloride and manganese which continue to exceed regulatory values in ground water. The vinyl chloride exceedences theoretically pose a risk to those who might use the Green River for consumption of both water and organisms (fish). Manganese does not present a human health or ecological risk at the concentrations present in ground water at Kent Highlands, but could cause aesthetic problems such as staining of porcelain fixtures. Essentially, the bulk of the environmental threats posed by the landfill has been and is continuing to be controlled.

Based on this periodic review, the Department of Ecology has determined that the requirements of the Restrictive Covenant continue to be met. No additional cleanup actions are required by the property owner. It is the property owner's responsibility to continue to inspect and manage the site to assure that the integrity of the remedy is maintained.

4.1 Next Review

The next review for the site will be scheduled five years from the date of this periodic review. In the event that additional cleanup actions or institutional controls are required, the next periodic review will be scheduled five years from the completion of those activities.

5.0 REFERENCES

Documents which include detailed information on landfill conditions and cleanup activities include:

- *Final Remedial Investigation Report for the Kent Highlands Landfill*, Seattle, 1991;
- *Closure Action Report for the Kent Highlands Landfill*, Seattle, 1992;
- *Cleanup Action Plan*, Ecology, 1993;
- *Waste Discharge Permit 7115 for City of Seattle, Public Utilities – Kent Highlands Landfill*, King County, 1999;
- *Kent Highlands Spring Drain Separation Technical Memorandum*, CH2MHill, 1995;
- *Ground water Compliance Monitoring Plan for the Kent Highlands Landfill*, Seattle, 1996;
- Ecology, 2002 and 2003, Restrictive Covenants.

Activities or Reports Prepared Since 2003 Second Periodic Review

- *Kent Highlands Landfill Groundwater Monitoring 2007 Annual Report*, June 2008, prepared by Parametrix;
- *Second Periodic Review Response*, October 2007, prepared by Floyd Snider;
- *Kent Highlands Landfill Groundwater Monitoring 2006 Annual Report*, August 2007, prepared by Parametrix;
- Memorandum prepared by City of Seattle Assistant City Attorney Marya J. Silvernale outlining basis for revising eastern boundary of the Kent Highlands Landfill Site, May 2007;
- *A Reuse Planning Report, Kent Highlands & Midway Landfills*, February 2007, prepared by E² Inc. for City of Seattle, and EPA Region 10;
- Pumps replaced in nine ground water monitoring wells, 2007. Replacement pumps obtained from Midway landfill monitoring wells;
- Leachate elevation monitoring in landfill completed as part of slope stability evaluation, 2007 – 2005;
- Gas probes abandoned along new 228th Street extension, replacement probes constructed, 2007 – 2005;
- New ground water monitoring well KMW-17Z installed in Recent Alluvium Aquifer, 2006;
- Leachate collection system inspected with closed circuit television and collection pipes repaired, 2006;
- Kent Highlands re-surveyed and new topographic map prepared, 2005 (last surveyed in 1996);
- *Kent Highlands Landfill Groundwater Monitoring Annual Report for 2005*, April 2006, prepared by Parametrix;
- *Kent Highlands Landfill Groundwater Monitoring Report for 2004*, August 2005, prepared by Parametrix.

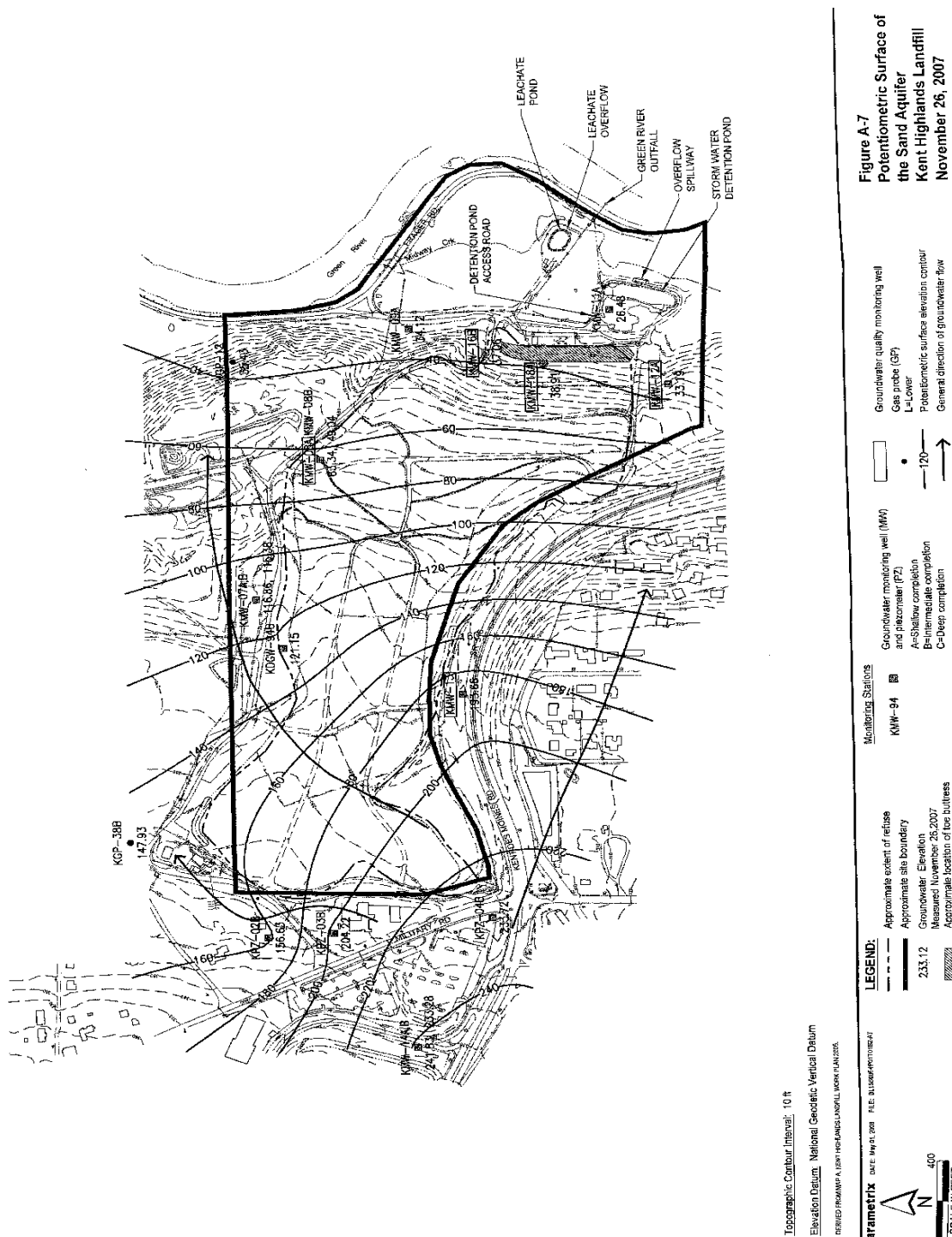
These documents as well as the complete file for the landfill may be reviewed at Central Records, Washington State Department of Ecology, Northwest Regional Office 3190 160th Avenue SE, Bellevue, WA (Call 425-649-7000 to make an appointment for record review).

Also, please note the Ecology June, 2009 Site Visit.

6.0 APPENDICES

[illegible]

6.2 Site Plan



6.3 Environmental Covenant

Kent Highh Islandfill/SITB.7

CONFORMED COPY

Return Address:

City of Seattle SPU/Real Prop - SWU
710 Second Avenue 10th Floor
Seattle, WA 98104

20020314002279
SEATTLE PUBLIC RCOVE 145.00
PAGE 001 OF 138
03/14/2002 15:29
KING COUNTY, WA

Document Title(s) (or transactions contained therein): 1. Restrictive Covenant
Reference Number(s) of Documents assigned or released: (on page ___ of document(s))
Grantor(s) (Last name first, then first name and initials) 1. The City of Seattle
Grantee(s) (Last name first, then first name and initials) 1. Washington State Department of Ecology
Legal Description (Abbreviated: i.e. lot, block, plat or section, township, range) Portion of Enos Cooper Donation Claim No. 38 in Section 15, Township 22 North, Range 4 East, W.M. Additional legal is on page <u>4</u> of document
Assessor's Property Tax Parcel/Account Number Tax Parcel/Account Number 000200-0005-03
The Auditor/Recorder will rely on the information provided on the form. The staff will not read the document to verify the accuracy or completeness of the indexing information provided herein.

RECEIVED

MAY 20 2003

DEPT OF ECOLOGY

RESTRICTIVE COVENANT KENT HIGHLANDS LANDFILL

The property that is the subject of this Restrictive Covenant has been the subject of remedial action under Chapter 70.105D RCW. The work done to clean up the property (hereinafter the "Cleanup Action") is described in the Cleanup Action Plan for Kent Highlands Landfill dated April 19, 1993. This Restrictive Covenant is required by WAC 173-340-440 to assure the continued integrity of the Cleanup Action.

The undersigned, City of Seattle ("Seattle"), is the fee owner of real property in King County (legal description attached), hereinafter referred to as the "Site." For the purposes of this Restrictive Covenant, the Site refers to the Seattle-owned portions of the former Kent Highlands Landfill, located Northeast of the intersection of State Route 516 (AKA Kent-DesMoines Road) and Military Road in Kent, Washington. Seattle makes the following declaration as to limitations, restrictions, and uses as to which the Site may be put, and specifies that such declarations shall constitute covenants running with the land, as provided by law, and shall be binding on all parties and all persons claiming under them.

Section 1. Any activity on the Site that may interfere with the Cleanup Action is prohibited. Any activity on the Site that may result in the release of a hazardous substance that was contained as part of the Cleanup Action is prohibited. Any activity on the Site that may result in endangerment to human health or the environment by hazardous substances contained on site or by gas generated by and emitted from the Site is prohibited.

Section 2. Except for groundwater monitoring, no groundwater may be taken for any purpose from any well on the Site without Department of Ecology ("Ecology") approval.

Section 3. The owner of the Site must give written notice to Ecology, or to its successor agency, of the owner's intent to convey any fee interest in the Site. Seattle and all subsequent owners shall provide for the continued operation, maintenance and monitoring of the Cleanup Action.

Section 4. The owner must notify and obtain approval from Ecology, or from its successor agency, prior to any use of the Site that is inconsistent with the terms of this Restrictive Covenant. Ecology or its successor agency may approve such a use only after public notice and comment.

Section 5. The owner shall restrict leases to uses and activities consistent with this Restrictive Covenant and notify all lessees of the restrictions on the use of the property.

Section 6. The owner shall allow authorized representatives of Ecology, or its successor agency, the right to enter the Site at reasonable times and with reasonable prior notice for the purpose of evaluating compliance with the Cleanup Action Plan and to inspect records that are related to the Cleanup Action.

Section 7. The owner of the Site reserves the right under WAC 173-340-720 and WAC 173-340-440 (1991 ed.), to record an instrument which provides that this Restrictive Covenant shall no longer limit use of the Site or be of any further force or effect. However, such an instrument may be recorded only with the consent of Ecology, or its successor agency. Ecology or a successor agency may consent to the recording of such an instrument only after public notice and comment.

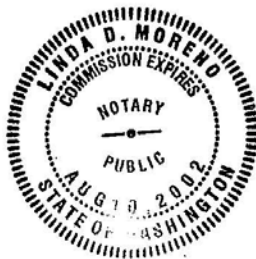
DATED this 14th day of March, 2002.

Chuck Clarke
The City of Seattle
Chuck Clarke, Director, Seattle Public Utilities

STATE OF WASHINGTON)
)SS.
COUNTY OF KING)

I certify that I know or have satisfactory evidence that Chuck Clarke signed this instrument, on oath stated that he was authorized to execute the instrument and acknowledged it as the Director of Seattle Public Utilities of the City of Seattle to be the free and voluntary act of the City of Seattle for the uses and purposes mentioned in the instrument.

Dated: March 14, 2002



Linda D. Moreno
NOTARY PUBLIC in and for the
State of Washington,
My appointment expires 8-10-02

- All of Parcel, tax lot number 000200-0005-03. Said parcel described as:
That portion of the west 400 feet of the north 1436 feet of the south 1944 feet of the Enos Cooper Donation Claim Number 38 lying north of the Kent-Des Moines right-of-way north boundary line, and being more particularly described as Follows:

Beginning at the center of Section 15, T22N, R4E. Thence eastward along a line parallel to the south boundary of said Enos Cooper Claim to a point on the west boundary of said claim; Thence southward along the west boundary of said Enos Cooper Claim 500 feet to the true point of beginning;
thence north $88^{\circ}45'52''$ east 400 feet;
thence south 220 feet along a line parallel to the west boundary line of said Enos Cooper Claim;
thence south $36^{\circ}00'$ west a distance of about 330 feet to the north boundary of the SR-516 right-of-way;
thence northwestward along said north right-of-way line to the west boundary line of said Enos Cooper Claim;
thence north along the west boundary line of Said Enos Cooper Claim to the true point of beginning.

36

City of Kent
Attn. Property Management
220 - 4th Avenue South
Kent, Washington 98032



20030711003046
PACIFIC NW TIT COV 157 00
PAGE 001 OF 139
07/11/2003 15:08
KING COUNTY, WA

Reference Number of Related Document. N/A

Grantor(s) City of Kent

Grantee(s) The Public

139/157 PNWT
W 6175

Abbreviated Legal Description. A ptn of Enos Cooper Donation Claim, SE 1/4, Sec 15,
T22N, R4E, W M, King County

Additional Legal Description is contained in Exhibit "A" of Document

Assessor's Property Tax Parcel or Account No.. 152204-9022

PROJECT NAME Kent Highlands Landfill

139/157 PNWT
W 6175
157 00
PAGE 001 OF 139
07/11/2003 15:08
KING COUNTY, WA

RESTRICTIVE COVENANT KENT HIGHLANDS LANDFILL

The property that is the subject of this Restrictive Covenant has been the subject of remedial action under Chapter 70.105D RCW. This Restrictive Covenant is required by WAC 173-340-440 to assure the continued integrity of the Cleanup Action.

The undersigned, City of Kent, ("Kent"), is the fee owner of real property in King County (legal description attached as Exhibit "A"), hereinafter referred to as the "Site". For the purposes of this Restrictive Covenant, the Site refers to the Kent-owned portions

KENT HIGHLANDS LANDFILL RESTRICTIVE COVENANT

(July 1, 2003)

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JUL 30 2003
DEPT OF ECOLOGY

of the former Kent Highlands Landfill, located Northeast of the intersection of State Route 516 (aka Kent-DesMoines Road) and Military Road in Kent, Washington. The work done to clean up the property (hereinafter the "Cleanup Action") is described in the Cleanup Action Plan for Kent Highlands Landfill dated April 19, 1993 (attached as Exhibit "B").

Kent makes the following declaration as to limitations, restrictions, and uses as to which the Site may be put, and specifies that such declarations shall constitute covenants running with the land, as provided by law, and shall be binding on all parties and all persons claiming under them.

SECTION 1. Any activity on the Site that may interfere with the Cleanup Action is prohibited. Any activity on the Site that may result in the release of a hazardous substance that was contained as part of the Cleanup Action is prohibited. Any activity on the Site that may result in endangerment to human health or the environment by hazardous substances contained or by gas generated by and emitted from the Site is prohibited.

SECTION 2. Except for groundwater monitoring, no groundwater may be taken for any purpose from any well on the Site without Department of Ecology ("Ecology") approval.

SECTION 3. The owner of the Site must give written notice to Ecology, or to its successor agency, of the owner's intent to convey any fee interest in the Site. Kent and all subsequent owners shall provide for the continued operation, maintenance, and monitoring of the Cleanup Action.

SECTION 4. The owner must notify and obtain approval from Ecology, or from its successor agency, prior to any use of the Site that is inconsistent with the terms of this Restrictive Covenant. Ecology or its successor agency may approve such a use only after public notice and comment.

SECTION 5. The owner shall restrict leases to uses and activities consistent with this Restrictive Covenant and notify all lessees of the restrictions on the use of the property.

SECTION 6. The owner shall allow authorized representatives of Ecology, or its successor agency, the right to enter the Site at reasonable times and with reasonable prior notice for the purpose of evaluating compliance with the Cleanup Action Plan and to inspect records that are related to the Cleanup Action.

SECTION 7. The owner of the Site reserves the right under WAC 173-340-720 and WAC 173-340-440 (1991 ed.), to record an instrument which provides that this Restrictive Covenant shall no longer limit use of the Site or be of any further force or effect. However, such an instrument may be recorded only with the consent of Ecology, or its successor agency. Ecology or a successor agency may consent to the recording of such an instrument only after public notice and comment.

DATED this 8th day of July, 2003.

CITY OF KENT:

By Jim White

Its Mayor

DATE: 7-8-03

STATE OF WASHINGTON)

: ss.

COUNTY OF KING)

I hereby certify that on the 8th day of July, 2003, I know or have satisfactory evidence that **JIM WHITE** is the person who appeared before me, and said person acknowledged that he signed this instrument, on oath stated that he is authorized to execute the instrument on behalf of the **CITY OF KENT** as its Mayor, and such execution to be the free and voluntary act of such party for the uses and purposes mentioned in the foregoing instrument.

-Notary Seal Must Appear Within This Box-

IN WITNESS WHEREOF, I have hereunto set my hand and official seal the day and year first above written.



Janice D. Banister
JANICE D. BANISTER
NOTARY PUBLIC, in and for the State of Washington
residing at Trent
My appointment expires 12-19-04

APPROVED AS TO FORM:

Kent City Attorney
Kent City Attorney

P:\Civil-FILES OpenFiles 0722 RestrictiveCovenant.doc

KENT HIGHLANDS LANDFILL RESTRICTIVE COVENANT

(July 1, 2003)

EXHIBIT "A"

THAT PORTION OF THE ENOS COOPER DONATION CLAIM LYING WITHIN THE SOUTHEAST QUARTER OF SECTION 15, TOWNSHIP 22 NORTH, RANGE 4 EAST, W.M., KING COUNTY, WASHINGTON, DEFINED AS FOLLOWS:

BEGINNING AT A POINT OF INTERSECTION WITH THE CENTERLINE OF KENT-DES MOINES HIGHWAY AND THE SOUTH LINE OF THE NORTH HALF OF SAID SUBDIVISION;

THENCE SOUTHEASTERLY ALONG SAID CENTERLINE A DISTANCE OF 135.48 FEET;

THENCE NORTH 62°30'00" EAST 30 FEET TO THE TRUE POINT OF BEGINNING;

THENCE CONTINUING NORTH 62°30'00" EAST 525 FEET;

THENCE NORTHWESTERLY ON A CURVE TO THE LEFT AND RUNNING PARALLEL WITH THE PROPOSED NORTHEASTERLY MARGIN OF STATE ROUTE 516 (AS SHOWN ON THAT CERTAIN MAP DATED MAY 8, 1969, SHEET 2 OF 11 SHEETS, JUNCTION STATE ROUTE 5 TO JUNCTION STATE ROUTE 167 MILEPOST 2.21 TO MILEPOST 4.83) TO THE WEST LINE OF SAID DONATION CLAIM;

THENCE SOUTH ALONG THE WEST LINE OF SAID DONATION CLAIM TO THE CENTERLINE OF SAID HIGHWAY;

THENCE SOUTHEASTERLY TO A POINT WHICH BEARS SOUTH 62°30'00" WEST FROM THE TRUE POINT OF BEGINNING;

THENCE NORTH 62°30'00" EAST 30 FEET TO THE TRUE POINT OF BEGINNING.

EXCEPT THAT PORTION DEFINED AS FOLLOWS:
BEGINNING AT A POINT OF INTERSECTION OF THE WEST LINE OF THE COOPER DONATION CLAIM WITH THE NORTH MARGIN OF SSH 5A (KENT-DES MOINES HIGHWAY) BEING THE TRUE POINT OF BEGINNING OF EXCEPTION HEREIN DESCRIBED;

THENCE NORTH ALONG SAID DONATION CLAIM LINE 450 FEET;

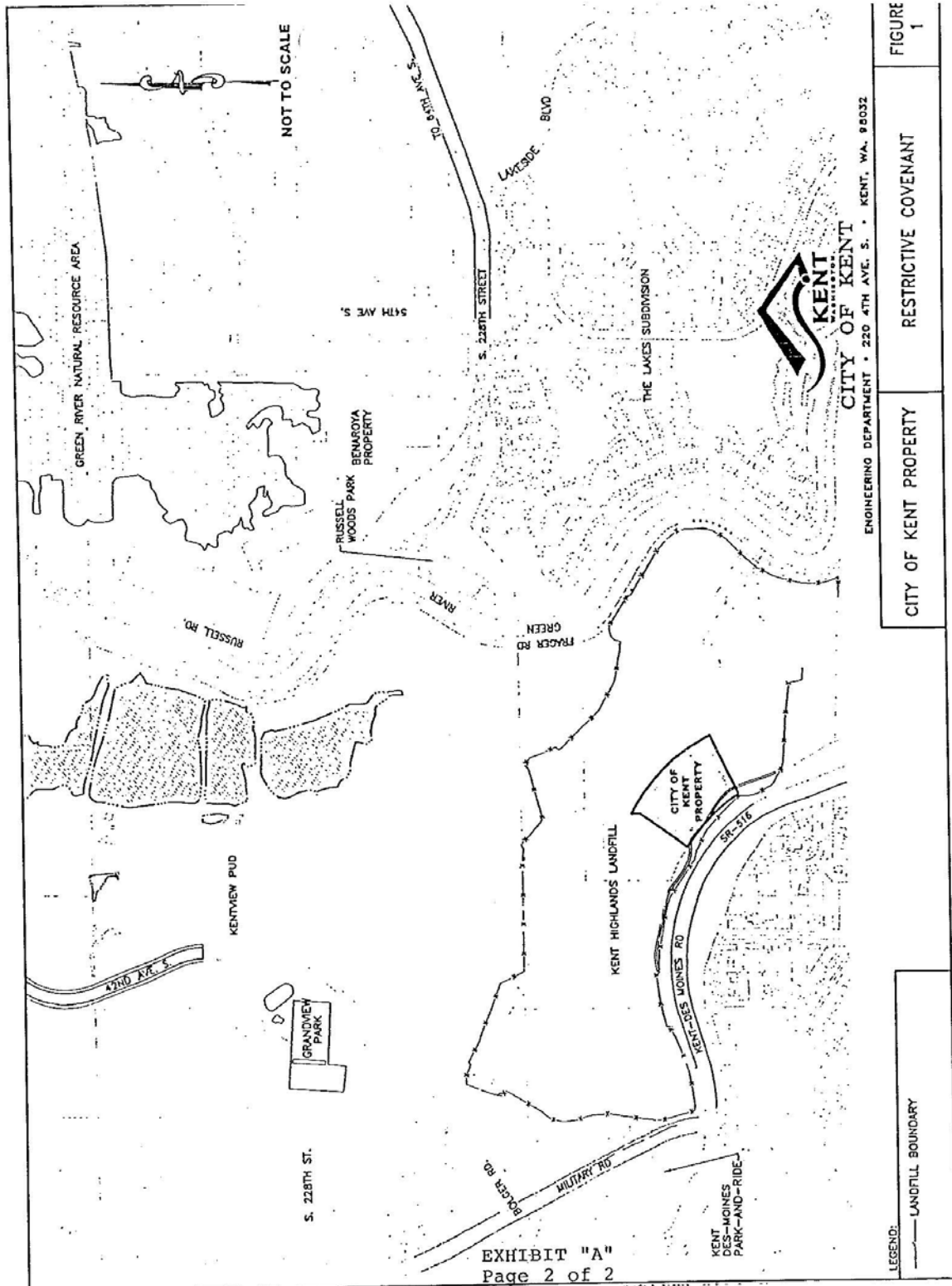
THENCE EAST AT RIGHT ANGLES TO SAID DONATION CLAIM LINE 400 FEET;

THENCE SOUTH PARALLEL WITH THE WEST LINE OF SAID DONATION CLAIM LINE 220 FEET;

THENCE SOUTH 36° WEST 440 FEET MORE OR LESS TO NORTHERLY MARGIN OF SSH 5A;

THENCE NORTHWESTERLY ALONG THE NORTHERLY MARGIN OF SSH 5A TO THE TRUE POINT OF BEGINNING OF EXCEPTION HEREIN DESCRIBED.

AND ALSO EXCEPT THAT PORTION LYING SOUTHERLY OF SAID NORTHEASTERLY MARGIN OF SAID STATE ROUTE 516.



6.4 Photo log

Photo 1: Sign at Entrance - from the across Military Road



Photo 2: Gas Control Facility - from the south



Photo 3: Gas Control Facility Equipment and Building - near the entrance



Photo 4: Typical Drainage ditch and East Face – looking approximately southwest



Photo 5: Input w/ New Aerator at Stormwater Treatment Pond Obscured by Vegetation



Photo 6: Stormwater Treatment Pond – Improved Discharge Structure, Aerator



Photo 7: New Leachate Pump Station



Photo 8: Leachate Pond – looking east

