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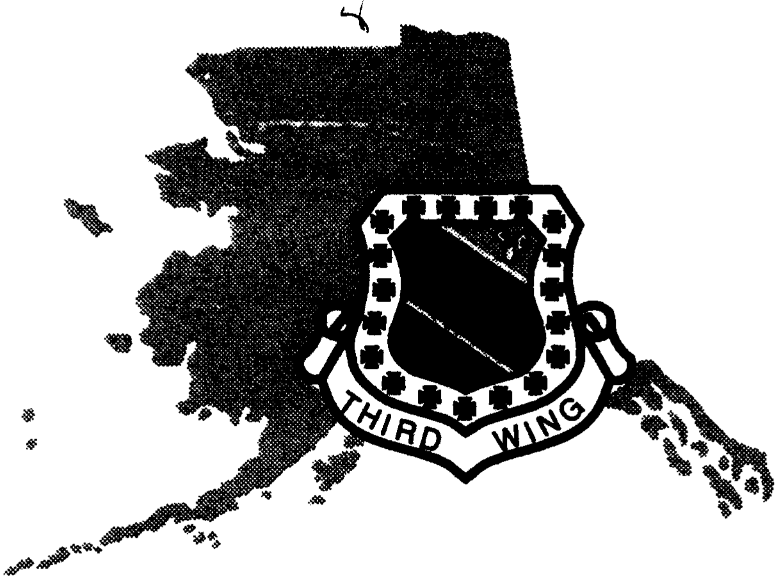

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UNITED STATES AIR FORCE
ELMENDORF AIR FORCE BASE, ALASKA

ENVIRONMENTAL RESTORATION PROGRAM

OPERABLE UNIT 5
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

VOLUME 2 - TEXT AND APPENDICES A - J

FINAL

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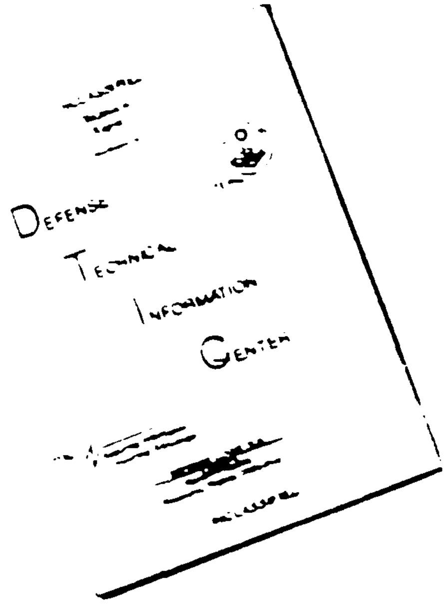

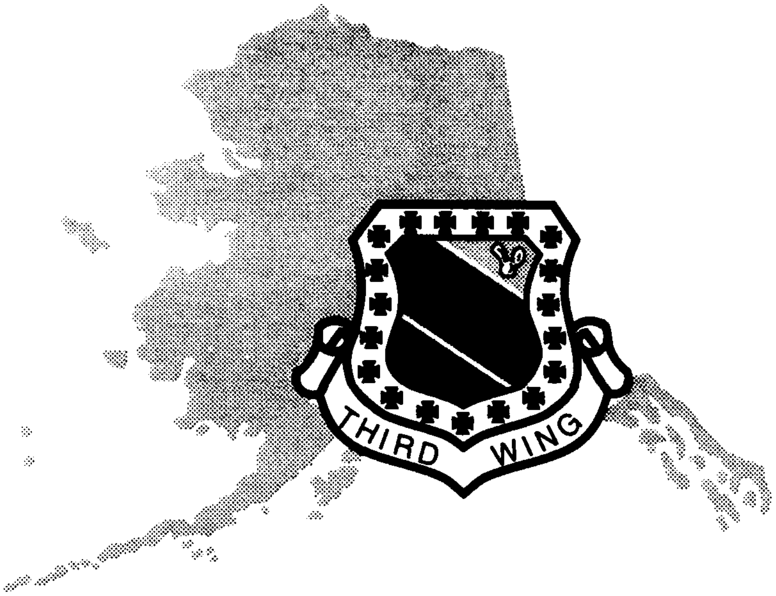

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Radian Corporation
P.O. Box 201088
8501 N. Mopac Boulevard
Austin, Texas, 78759

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13. ABSTRACT (Maximum 200 words)

This Final Report for Operable Unit 5 (OU 5) is provided per the statement of work for the Remedial Investigation/Feasibility Study for (RI/FS) OU 5. The RI portion of the report covers the site background, field investigations, nature and extent of contamination, conceptual model, and baseline risk assessment. The purpose of the RI is to define the contamination at OU 5 and the effects of the contamination on human health and the environment. The FS covers: 1) remedial action objectives, 2) an identification and screening of potentially applicable technologies, 3) a development and screening of alternatives which combine these technologies, and 4) a detailed analysis of the most applicable alternatives. The analysis considers the nine CERCLA evaluation criteria. The alternatives are evaluated according to their combined effectiveness, implementability, and cost scores. Based on the analysis, the most cost-effective alternatives are identified.

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TABLE OF CONTENTS

10.0 DEVELOPMENT AND SCREENING OF MEDIA-SPECIFIC ALTERNATIVES

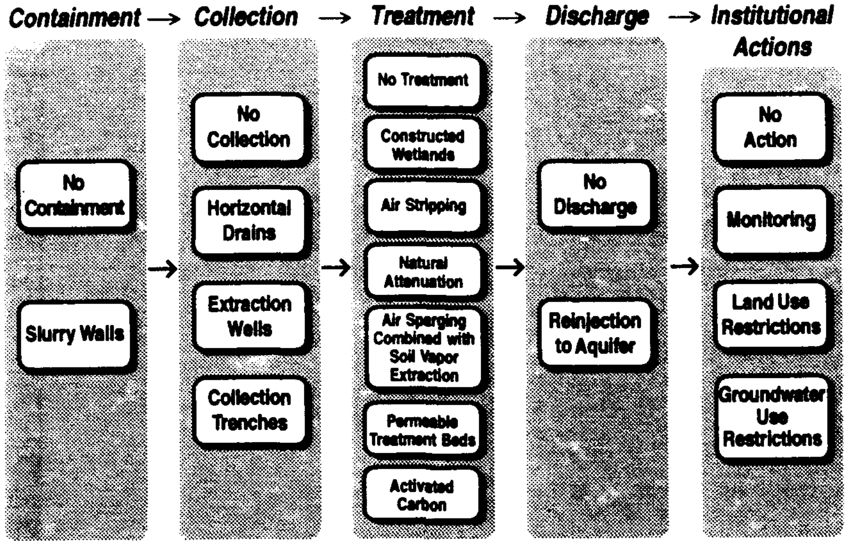
Remedial action alternatives were developed using the potentially acceptable technologies and representative process options identified in Section 9.0. The potential pathways that are addressed in this feasibility study (FS) are as follows:

- Groundwater;
- Seep discharges;
- Soil, and
- Sediment and surface water in the Snowmelt Pond.

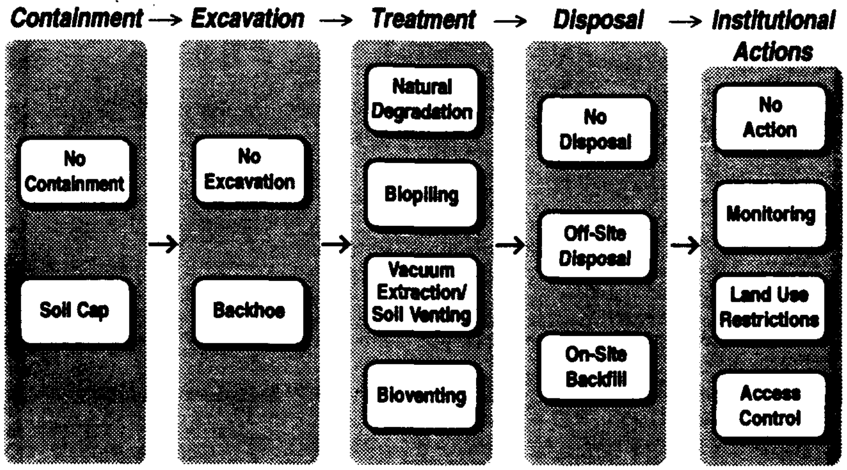
The goal of the FS is to evaluate multi-media alternatives (i.e., grouping of actions that, together, address the three pathways). Even with only a small number of actions that address each pathway, the number of combinations that would address multi-media impacts in different parts of the OU would be very large. Therefore, media-specific alternatives are screened in this section and evaluated in detail in Section 11.0. Multi-media alternativès are developed in the comparative analysis section of Section 11.0. Since the Snowmelt Pond has a presumptive remedy of constructed wetlands, the pond is discussed in detail in Section 11.0.

A building block approach was taken to develop alternatives. Process options were combined into a limited number of alternatives that, based on professional judgement, are most applicable to the setting and contaminants at OU 5. The five basic general response actions for water and soil are shown below, with the process options identified for each action. The alternatives were assembled using different combinations of these process options.

Each alternative was evaluated for effectiveness, implementability, and cost, in a process similar to the evaluation of process options, but evaluating the entire alternative. Alternatives that passed this screening are analyzed in more detail in Section 11.0 (i.e., that analysis evaluates the synergy between the combination of different process options).



Process Options for Water



Process Options for Soil

The definition of each evaluation criterion used in this screening is discussed below.

Effectiveness — The ability of the alternative to protect human health and the environment. "Effectiveness" includes the amount of hazardous material treated and/or destroyed; the amount remaining on site; the degree of expected reduction in mobility, toxicity, or volume of contaminants; the short-term reductions of risk during construction and implementation; and the long-term reduction of risk once the remedial actions are completed. Alternatives that have been shown to achieve remedial action objectives similar to those at Elmendorf AFB are considered effective unless the uncertainty involved calls that effectiveness into question. The judgment of effectiveness is based on literature evaluations of the alternatives at similar sites and on the technical understanding of the type of contamination (chemicals, concentrations, and phase), migration routes, and the geologic/physical setting of OU 5). The alternatives should also protect human health and the environment without compromising the bluff stability and wetlands environment. The alternative should not create a potential environmental impact greater than the potential risks if no action were taken.

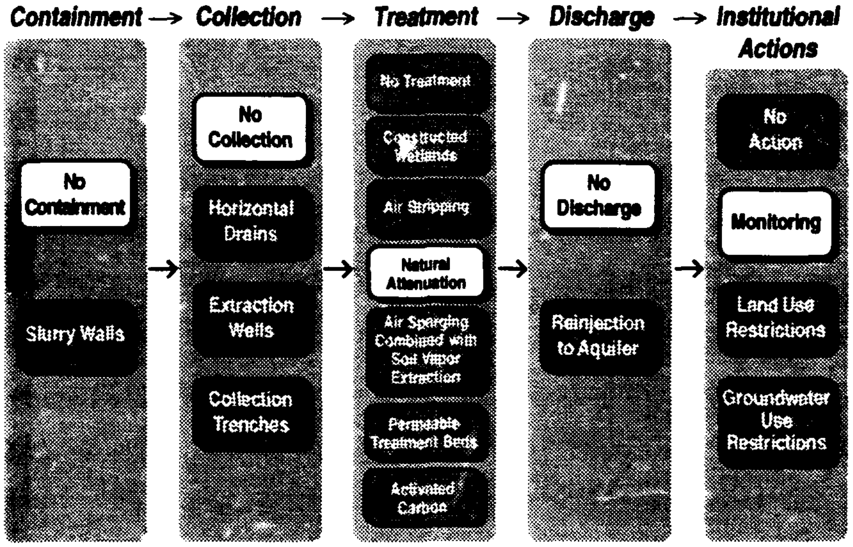
Implementability — The technical and administrative feasibility of the alternative, as well as the availability of the various services and materials that would be required. Technical feasibility generally refers to the ability to construct and reliably operate the process until the remedial goal is achieved. The administrative criteria include the ability to secure necessary approvals from the regulating agencies for construction, operation, and disposal of residuals generated by the alternative. Administrative feasibility also considers the availability of treatment, storage and disposal facilities, technical specialists, and any special equipment that may be required. If an alternative requires significant space, piping, or manpower to implement, its implementability is considered marginal. If significant permitting or waivers from potential ARARs are needed, the implementability is further reduced because of the anticipated difficulty or time required to acquire approvals and obtain waivers. For CERCLA projects, permitting is typically not required as long as substantive requirements are met. The evaluation of implementability is based on the current state of the technology development (obtained from literature sources), and the physical/hydrogeologic setting of OU 5. The most important factors are the groundwater flow direction and rate, the geologic stability of the OU, and the space available to implement an alternative. Of equal importance is the permitting required to dispose of waste generated by an alternative.

Cost — Capital and/or lease costs, miscellaneous costs, and annual operations and maintenance (O&M) costs are considered. These costs are broad, order of magnitude estimates obtained from literature and from experience with similar alternatives. The costs are accurate to within 50% less and 100% more than actual costs and are for comparative purposes only. More detailed costs, based on CORA and RACER computer-based estimates, are provided in the detailed analysis (Section 11.0). Cost details are provided in Appendix T.

10.1 Alternatives for Water

The alternatives for water are described and evaluated below. Rationale for both retaining and dropping alternatives is discussed in Section 10.3.

10.1.1 Natural Attenuation



Natural Attenuation

Description — Natural attenuation would take no action at the site and would leave basewide groundwater, seeps and surface water in their current state. Dilution, adsorption, volatilization, and biological breakdown of the contaminant concentration would occur in seeps, natural wetlands, and in the groundwater. In seeps, volatilization and biological breakdown are the primary mechanisms reducing concentrations of organic contaminants. Natural wetlands possess aerobic, anaerobic, and eutrophication environments capable of breaking down aromatic and chlorinated hydrocarbons, and precipitating metals. This alternative would use natural processes to treat seep water and groundwater discharges to the wetlands. In groundwater, natural attenuation occurs through adsorption, biological breakdown, volatilization, dispersion, and dilution. Natural attenuation would allow these processes to continue. This alternative provides a baseline for comparing other alternatives.

Monitoring would include groundwater, seep water, and the wetlands.

Effectiveness — The effectiveness of the natural attenuation alternative depends on the contaminant removal rate of the physical, chemical, and biological processes that are currently occurring. Breakdown rates depend on the temperature, water and soil chemistry, nutrient supply, flow rate, bacterial colonies/populations, and food supply (contaminant concentrations). The rate is generally faster at high concentrations because increased substrate allows for a higher rate of utilization by organisms. Breakdown rates are slower at low concentration, lower temperatures, and low organic content of the soil can also slow natural attenuation. The rate of natural attenuation cannot be accurately predicted at Elmendorf AFB.

Dispersion may have the greatest effect on the concentrations of COCs in groundwater; however, adsorption (often referred to as retardation) and biological breakdown are important factors. It is very difficult to develop any meaningful estimate of the contribution of each component of natural attenuation to the concentrations of organics currently seen in the groundwater and predicted for the future. For these reasons, natural attenuation is best quantified by evaluating concentrations at source areas and the concentrations of contaminants at downgradient receptors. This approach considers all natural attenuation processes affecting groundwater quality.

For groundwater that is expressed as seeps in OU 5, prior natural attenuation processes may have already occurred within the bluff. Even though natural attenuation likely has occurred to COCs within the bluff, once seeps express themselves into the wetlands as surface water, further degradation is likely since the natural attenuation processes are much different, e.g., effect of plant uptake, more available oxygen, light, etc.

Although natural degradation rates are difficult to predict, recent studies of the Beaver Pond area (see Appendix R) indicate that natural attenuation can be effective in the wetlands environment of OU 5. The Beaver Pond study revealed that the environmental impacts at the pond are minimal and that Ship Creek is not being affected.

The wetland areas in the western half of OU 5 (in the seep areas) are much smaller than Beaver Pond. These other wetland areas may not have the water retention time needed to naturally treat seep water before natural discharge to surface water in drainage ditches occurs. Environmental impacts at the seeps would not be effectively remediated in the short term by this alternative.

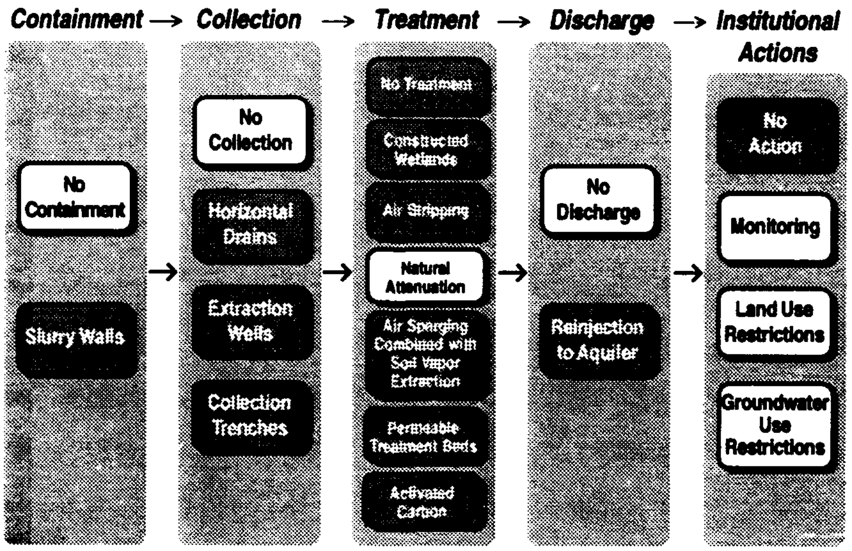
Without combining this alternative with monitoring of groundwater, seeps, and surface water, there would be no measure of the success of the natural processes on the contaminant concentrations. To provide this measure, a monitoring program has been made a part of the natural attenuation alternative. The monitoring would allow for observation of the effectiveness of natural attenuation. If, because of changes in temperature, flow rate, contaminant load, or the other factors described above, the effectiveness is not demonstrated, additional remedial action can be taken.

This alternative would produce no cross-media benefit on soil contamination. Since no access restrictions would be implemented, human and environmental exposures would not be prevented during the time period when contaminant concentrations exceed the clean-up criteria.

Implementability — This alternative is readily implemented. The processes for approving natural attenuation are defined and have been implemented at contaminated sites. For the portion of OU 5 near Beaver Pond, this alternative can be implemented. However, an potential ARAR variance for water quality in the wetland may be needed so it can be used to degrade contaminants.

Cost — The monitoring costs associated with natural attenuation would range from $5,000,000 to $6,000,000 (present value for 30 years of monitoring).

10.1.2 Institutional Action



Institutional Action

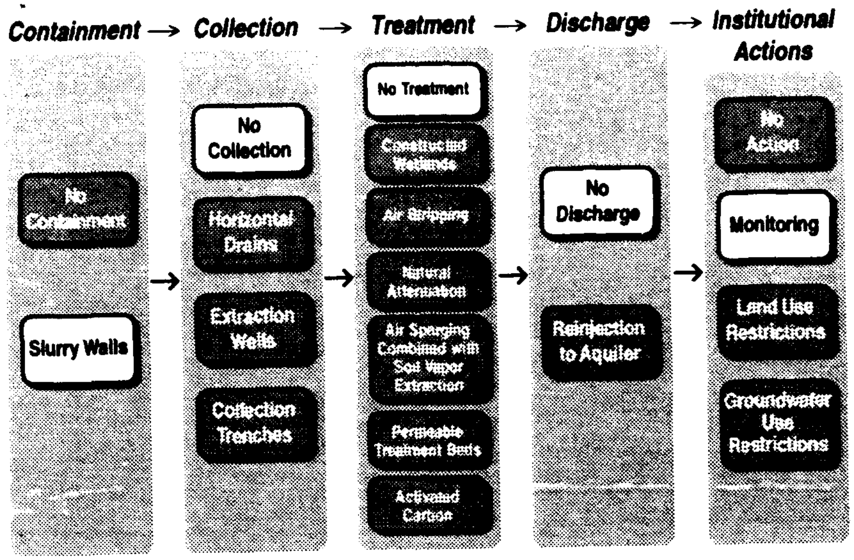
Description — This alternative would implement land use restrictions into the Elmendorf AFB land use plan. City and county land use plans would have to be consulted and potentially, restrictions placed on land not owned by Elmendorf AFB. These restrictions would include prohibiting the extraction and use of groundwater and prohibiting the building of residences in areas affected by contamination. The alternative would include a groundwater and surface water monitoring program. The water samples would be collected periodically and analyzed for the contaminants of concern. Plants and animals would be observed for signs of impact. The data generated would be used to monitor degradation and provide an early indication of possible impact, allowing for a remedial response to mitigate the impact.

Effectiveness — Institutional actions would protect human health and the environment by monitoring the environment and controlling the potential for exposure to contaminated water. The access restrictions would help prevent potential human exposures to contaminated groundwater, seeps, and springs, but they would not reduce exposures to small terrestrial and burrowing animals. The natural contaminant reduction processes present in the no action alternative would continue to operate with implementation of institutional controls. However, the groundwater and surface water monitoring implemented with this alternative would allow tracking of contaminant reduction rates and concentrations.

Implementability — This alternative is implementable and would cause little environmental disruption to the existing ecosystem of the proposed alternatives. The processes for acquiring deed restrictions and restricting groundwater use are defined. Institutional controls have been implemented at contaminated sites.

Cost — The present value of institutional controls, including monitoring, would range from $5,000,000 to $6,500,000. Approximately $100,000 of this cost is for actions such as deed restrictions. The remainder is for monitoring of groundwater, seeps and surface water.

10.1.3 Containment



Containment

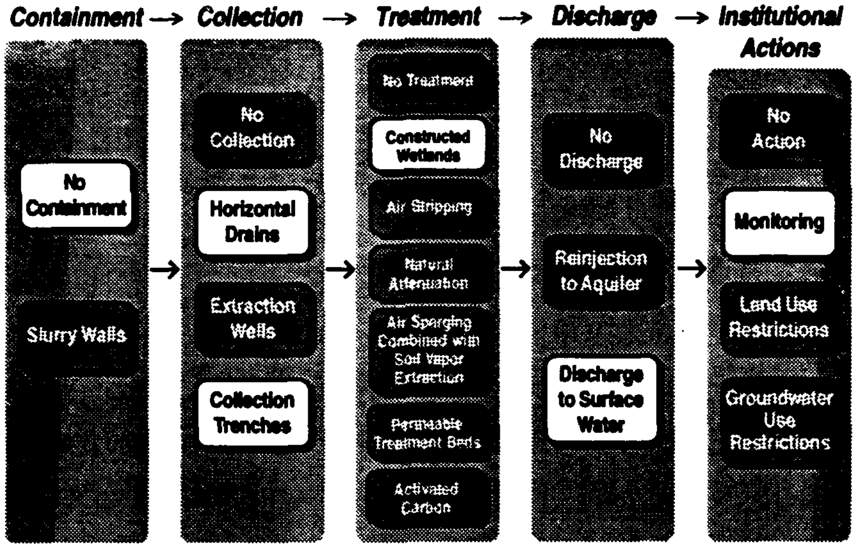
Description — Containment could be partially achieved through the use of a vertical slurry wall barrier that would be keyed into the Bootlegger Cove formation to prevent horizontal migration of contaminated groundwater. The slurry wall would be a mixture of cement and bentonite. Seep water would be contained by installing pavement or Gunite® in the seep areas. The monitoring of groundwater, seeps, and surface water would be needed to document containment of the plume.

Effectiveness — Containment would protect human health and the environment by reducing the migration of contamination. OU 5 is the area of discharge for basewide groundwater. Containing groundwater at the point of discharge is only temporarily effective because groundwater would build up behind the barrier system and eventually bypass the slurry wall. The pavement over the seep areas is also not likely to be effective in the long term since water would eventually bypass the barrier. Constructing the barrier could cause environmental impacts by backing up groundwater and causing flow of impacted water from the bluff at locations that could not be predicted. Wetlands could be dewatered. Also, the increase in the water table could create pond pressures that could affect the stability of the bluff. There would be no cross-media benefit affecting soil contamination.

Implementability — This alternative is not implementable at OU 5. Containing the large amount of groundwater present at OU 5 would be difficult, because of the access difficulties in constructing a slurry wall and the difficulty in containing large volumes of water with these barriers. The railroad, roads, and buildings in the industrial area all make implementing this alternative difficult.

Cost — The cost of this alternative is estimated to be approximately $9,000,000 to $12,000,000. Approximately $4,000,000 is for groundwater, seeps, and surface water monitoring.

10.1.4 Passive Extraction, Treatment Using Constructed Wetlands, and Discharge



Passive Extraction, Treatment Using Constructed Wetlands, and Discharge

Description — Groundwater and seepage water would be extracted using passive horizontal drains and collection trenches installed in areas of identified seeps. All collected water would be directed toward the constructed wetland built at the Snowmelt Pond. Degradation of organic compounds should occur in the aerobic environment near the root zones, and the anaerobic environment in the eutrophication zones of the wetland system. Metals should be precipitated as insoluble salts (typically sulfides) in the eutrophication zones. The effluent would be discharged to the existing drainage ditch leading from the Snowmelt Pond. Monitoring of the wetland would be required to document that clean-up levels are being attained. Ongoing monitoring of groundwater and surface water would be needed to monitor the possible reductions in impact from treating seep water, and to monitor the natural attenuation of these pathways.

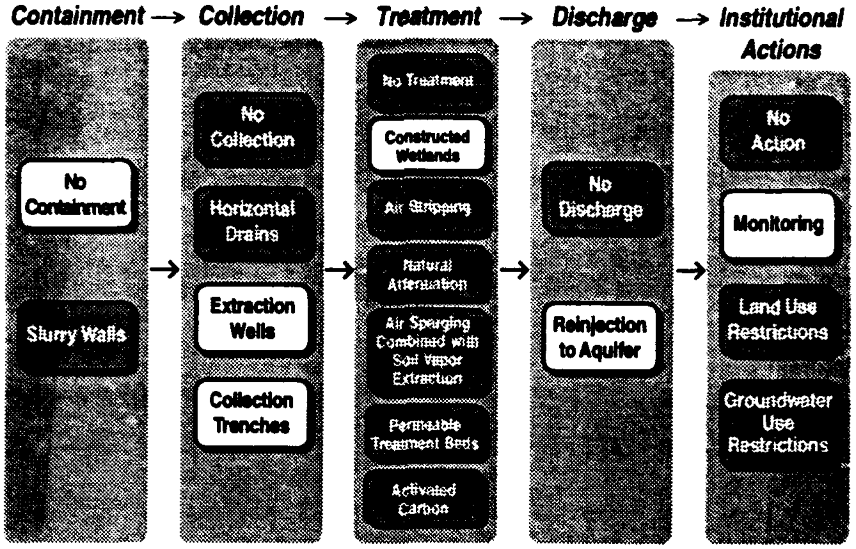
Effectiveness — This alternative protects human health and the environment by eliminating potential for exposures in seep areas, and collects and treats contaminated water from the seeps. Passive extraction of groundwater would only remove water from the top of the aquifer near the water table. Therefore, for the bulk of groundwater flow below the water table this alternative is not effective. However, the alternative would have no negative impact on the environment if implemented and very little impact on bluff stability due to installation of passive drains.

The cold climate may limit the effectiveness of the treatment component of this alternative to the summer months only. Lower temperatures slow biological processes and will slow the degradation rate of organic contaminants. There would be no cross-media benefit affecting soil contamination by implementing this alternative.

Implementability — The alternative is implementable. Passive extraction of groundwater would produce relatively low flows. For the water to be retained in the wetlands system long enough for degradation to occur, 10 to 15 acres of land would be needed. This land would have to be located relatively near the seeps so long pumping distances would not be needed. Since most of the land at the bottom of the bluff south of the seeps is not owned by the Air Force, the constructed wetlands would have to be located on top of the bluff.

Cost — The cost estimates for this alternative range from $6,000,000 to $8,000,000. This includes approximately $4,000,000 for groundwater, seep, and surface water monitoring. This assumes no cost for the land since the Air Force maintains ownership.

10.1.5 Active Extraction, Treatment Using Constructed Wetlands, and Discharge



Active Extraction, Treatment Using Constructed Wetlands, and Discharge

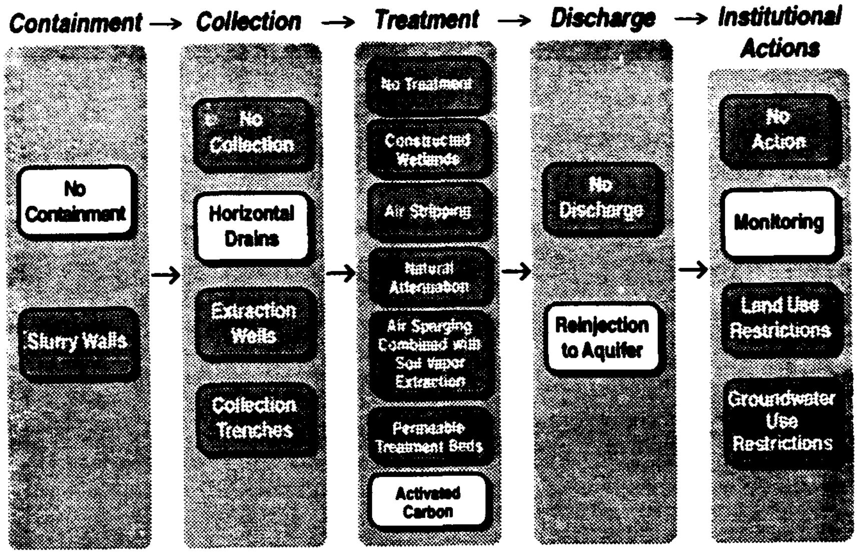
Description — Extraction wells would be installed in areas of identified seeps and in areas where the risk caused by exposure exceeds 1 x 10^{-6}. Collection trenches would be used to supplement the wells in some areas. All collected water would be pumped to the constructed wetlands at the top of the bluff. Degradation of organic compounds should occur in the aerobic environment near the root zones, and the anaerobic environment in the eutrophication zones of the wetland system. Metals should be precipitated as insoluble salts (typically sulfides) in the eutrophication zones. The effluent would be discharged to a reinjection well system in the eastern portion of OU 5. Monitoring of groundwater and surface water would be required to document that clean-up levels are being attained. The only difference between this alternative and the previous one is that substantially more water would be treated.

Effectiveness — This alternative protects human health and the environment by reducing potential for exposures in seep areas, and collects and treats contaminated groundwater. The cold climate may reduce the effectiveness of this alternative in the winter months only because cold ambient temperatures reduce degradation rates. There would be no cross-media benefit affecting soil contamination by implementing this alternative. The pumping would have a very minor impact on the stability of the bluff; however, the hydrology of wetlands could be negatively affected because of the large volumes of groundwater extracted; groundwater that would normally discharge into the Beaver Pond.

Implementability — The alternative is implementable on a small scale (i.e., treating only water from the seeps), but difficult on a large scale because of the extensive land requirements. Pumping groundwater would result in large flows (2,400 to 3,400 gpm). From 100 to 250 acres would be needed to treat this flow. With limited land at the top of the bluff the flow through the wetland would have to be relatively small, making this alternative not implementable for these large flows because of space limitations at the Snowmelt Pond.

Cost — The cost estimates for this alternative range from $15,000,000 to $18,000,000. This cost is for a wetland on top of the bluff since use of the Snowmelt Pond would not be feasible. Monitoring costs of $4,000,000 are included for monitoring of groundwater, seeps, and surface water.

10.1.6 Passive Extraction, Treatment by Activated Carbon and Discharge



Passive Extraction, Treatment by Activated Carbon, and Discharge

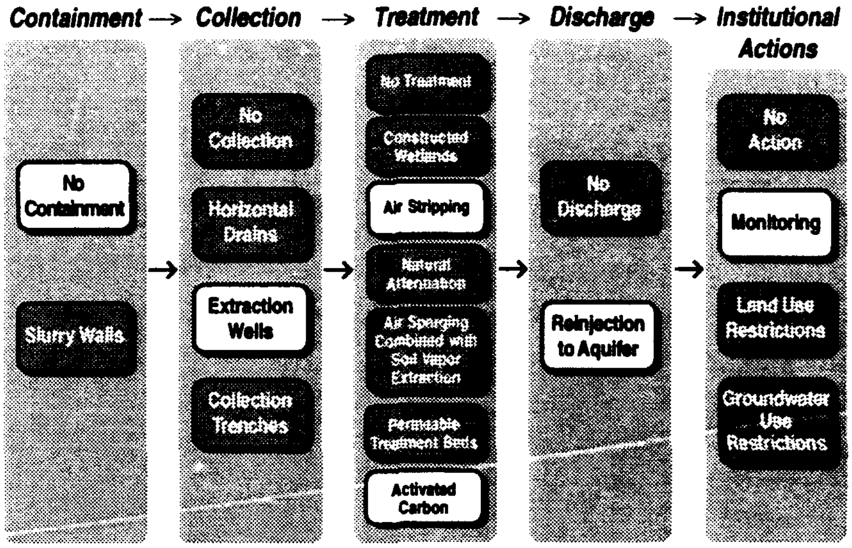
Description — Groundwater and seepage water would be extracted by passive horizontal drains installed in areas of identified seeps. Water would be passively collected and drained to an aqueous activated carbon system at the bottom of the bluff. The activated carbon would remove the contaminants. The water would then be reinjected in the eastern portion of OU 5. Monitoring would be needed for groundwater and treatment effluent to demonstrate that the treatment is effective.

Effectiveness — This alternative protects human health and the environment by reducing the potential for exposure in seep areas by removing and treating contaminated water. Only shallow groundwater near the water table would be removed using horizontal drains. Deeper groundwater would not be captured by a passive system. This alternative would have a very minor, if any, impact on the stability of the bluff and no impact on the hydrology of wetlands.

Implementability — The alternative is implementable; the technology is proven and available. There is sufficient land for this alternative at the bottom of the bluff.

Cost — The cost estimates for this alternative range from $7,000,000 to $8,000,000. The monitoring component for groundwater, seeps, and surface water is estimated to be $4,000,000.

10.1.7 Active Extraction, Treatment Using Air Stripping and Activated Carbon, and Discharge



Active Extraction, Treatment Using Air Stripping and Activated Carbon, and Discharge

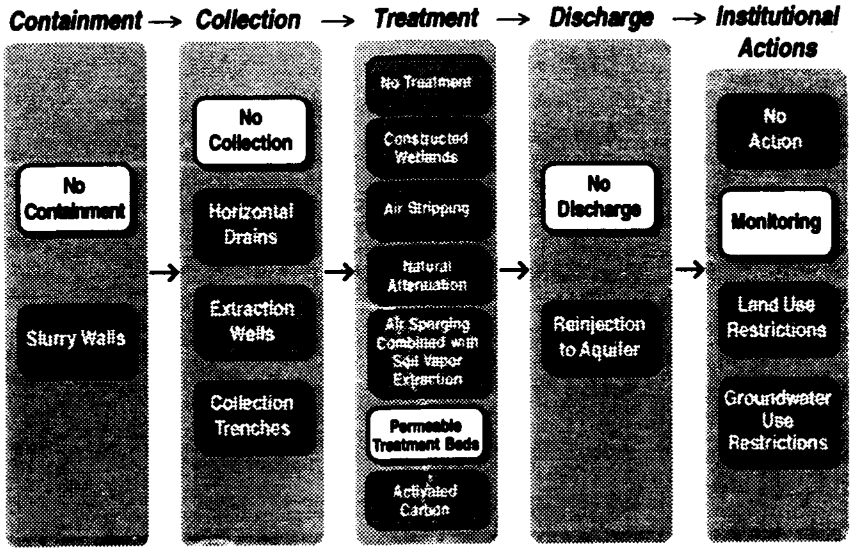
Description — This alternative is applicable to groundwater and seeps. Impacted groundwater would be extracted with wells installed in areas of identified seeps and where cancer risks posed by exposure to groundwater exceed 1 x 10^{-6}. The collected water would be stripped of volatiles with an air stripper, and the effluent would be discharged via a reinjection well system as with previous alternatives. Volatiles from the air stripper would be captured and treated with activated carbon. Monitoring would be needed for groundwater, surface water, effluent from the treatment system, and air to demonstrate that the treatment is effective.

Effectiveness — This alternative protects human health and the environment by reducing the potential for exposure in seep areas by removing and treating contaminated groundwater. A system could be designed to control the migration of impacted groundwater. By controlling the migration, capturing groundwater, and drying up seeps, potential threats to Ship Creek, human receptors, and the environment are eliminated. Implementing this alternative would have an indirect benefit on surface water quality by preventing contaminated groundwater discharge into the surface water systems. However, decreased volume of water flow to the wetlands could upset the ecology of the system. There would be no negative impact on the stability of the bluff.

Implementability — The alternative is implementable; the technology is proven and available. There is sufficient land for this alternative and systems for controlling emissions are available.

Cost — The cost estimates for this alternative range from $25,000,000 to $30,000,000. Monitoring costs of approximately $4,000,000 are included in this estimate.

10.1.8 Permeable Treatment Beds



Permeable Treatment Beds

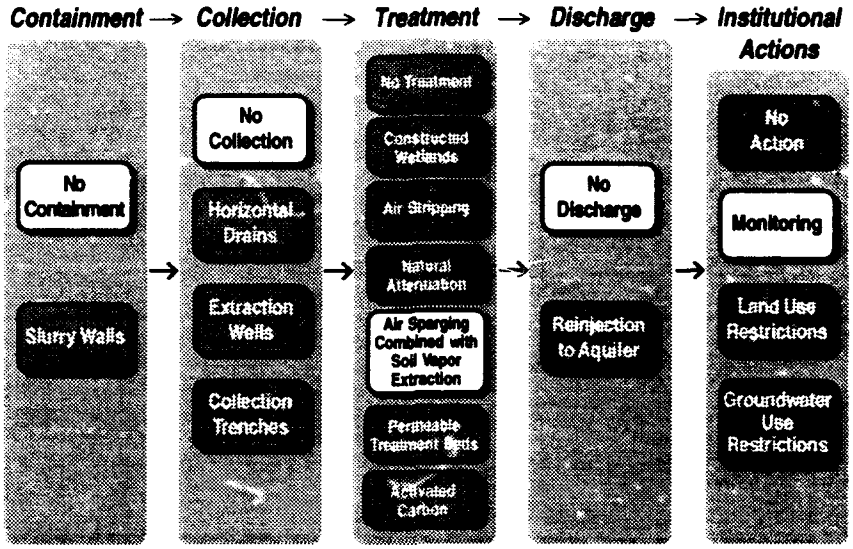
Description — This alternative is applicable to groundwater. Seeps could not be controlled by surface treatment beds, since seeps discharge as surface water. A subsurface flow-through treatment medium would be constructed to treat groundwater in situ. Treatment beds would be installed through a trench excavated into the saturated zone to intercept shallow groundwater. The trench would be backfilled with granular activated carbon (GAC) to just below the water table, and then the backfill completed with clay to the land surface. The GAC would adsorb any dissolved constituents, and the clay layer should effectively filter or block any floating product from flowing past the trench. Once the adsorptive capacity of the bed has been exhausted, the trench could be re-excavated to remove the spent carbon and any accumulated floating product. The spent GAC could be regenerated off-site at a carbon regeneration facility and the desorbed contaminants could be thermally destroyed. The trench could then be re-installed as before with new or regenerated GAC. Monitoring of groundwater on both the upgradient and downgradient side of the trench would be needed to document its effectiveness.

Effectiveness — This alternative would protect human health and the environment by intercepting and treating contaminated groundwater. The potential for affecting Ship Creek would be reduced. Activated carbon would adsorb most contaminants. Regeneration of the carbon would destroy the contaminants. This alternative would have no negative impact on the stability of the bluff, but could negatively affect wildlife habitat and wetlands (see Implementability).

Implementability — Implementing this alternative would be difficult. The need to remove and replace the activated carbon periodically would result in this alternative being implemented more than once over the life of the project. The multiple implementation could result in damage to the ecology. All flora and fauna and related habitats within the area treated would be detrimentally affected. The railroad, Post Road, and industrial buildings would make installation of a continuous trench very difficult. Excavation and reconstruction will also result in a period of time when groundwater would not be treated. The space available for construction is limited due to the railroad tracks in the western and the wetlands in the eastern part of OU 5.

Cost — The estimated cost for this alternative is estimated to range from $10,000,000, to $15,000,000 per implementation, including excavation, carbon, and monitoring costs.

10.1.9 Air Sparging Combined With Soil Vapor Extraction



Air Sparging Combined with Soil Vapor Extraction

Description — This alternative would both volatilize and degrade organic compounds by injecting air into the contaminated groundwater to increase the oxygen content, and thus accelerate the natural degradation processes. Volatized compounds would enter the vadose zone where they would be removed using soil vapor extraction and treated using activated carbon. Aromatic contaminants not volatilized would be broken down by the increase in microbial activity caused by the increased oxygen content of the water. Monitoring of the groundwater, seeps, and surface water would be needed to document the effectiveness of this alternative. Activated carbon would be used to control emissions from the soil vapor extraction wells.

This alternative is generally applicable to groundwater and could have beneficial effects on subsurface soil contamination. Its affect on seeps would be less since the small size of the seeps would make it difficult to accurately target the same area for both seeps and groundwater.

Effectiveness — This alternative would protect human health and the environment by removing volatile contaminants from the groundwater and accelerating the degradation process. The migration of the contaminants remaining in the groundwater is not reduced, so the effectiveness depends upon the distance between the point of sparging and the point of potential exposure. The degradation process would require an unknown period of time and may not be complete by the time impacted water with unstripped contamination reaches potential points of exposure. The lithology of the subsurface would effect system performance as varying migration patterns of air and contaminants in the subsurface could result in uneven performance.

There is a potential for negative influence on surface water quality caused by discharging oxygenated water into the wetlands. The extra oxygen could affect the ecology of the wetland by upsetting the balance between aerobic and anaerobic conditions. This could change the types and population of organisms in the wetlands. There would be no impact on the stability of the bluff.

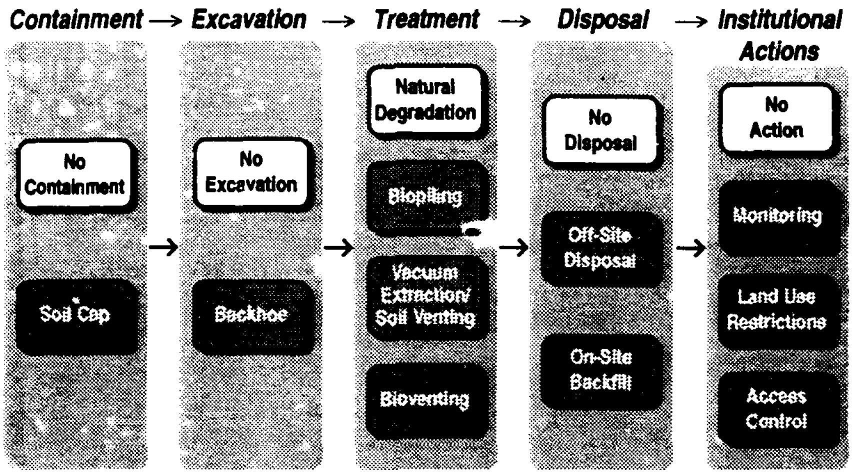
Implementability — This alternative can be implemented. The technology is proven effective in many environments. Sufficient space is available for air sparging wells. Sparging wells and the geologic formation can be fouled by bacterial action and chemical precipitation. This is especially true in waters with high iron content, such as those in OU 5. Fouled wells may have to be abandoned and new wells constructed.

Cost — The cost is estimated to range from $25,000,000 to $30,000,000. The monitoring of groundwater, surface water, and seeps accounts for approximately $4,000,000 of this estimate.

10.2 Remedial Alternatives For Soil

The remedial alternatives for soil are described and evaluated below. Rationale for both retaining and dropping alternatives is discussed in Section 10.3.

10.2.1 Natural Degradation



Natural Degradation

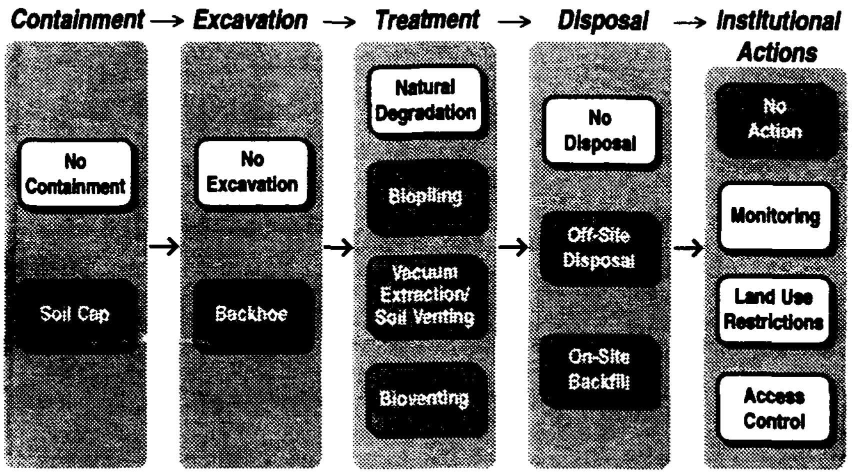
Description — The natural degradation alternative relies upon natural physical, chemical, and biological processes to reduce contaminant concentrations until cleanup levels are met in soil. Aromatic hydrocarbons are a common food source for naturally occurring bacteria. The bacteria break down the organics to carbon dioxide and water. Hydrocarbons also are adsorbed to organic and clay minerals in soil. These natural processes would act slowly, resulting in a remediation time frame whose length is difficult to predict. A site-specific modeling program would be needed to define degradation rates of contaminants and estimate the time required to naturally achieve cleanup levels. An ongoing soil monitoring program, where soil samples are collected periodically, would be required to confirm predicted degradation rates. This alternative provides a baseline for comparing other alternatives.

Effectiveness — Natural degradation does not result in any immediate reduction in risk; however, the risks associated with exposure to soil are low since the contaminated soils are below the surface and not accessible to direct contact. The speed of remediation depends upon many factors, including temperature, nutrient levels, moisture content, oxygen content, and bacterial activity. The breakdown rate is not known. The modeling program could also estimate the reduction in risk over time. There would be no impact on the stability of the bluff; however, wetlands could be affected in the short term by discharges of groundwater flowing through impacted soil.

Implementability — The alternative is implementable. The processes for implementing natural degradation are known and have been used at other waste sites. Public and regulatory acceptance also must be achieved for this alternative to be implementable.

Cost — The monitoring cost (present value based on 30 years of monitoring) associated with this alternative would range from $1,000,000 to $1,500,000.

10.2.2 Institutional Action



Institutional Action

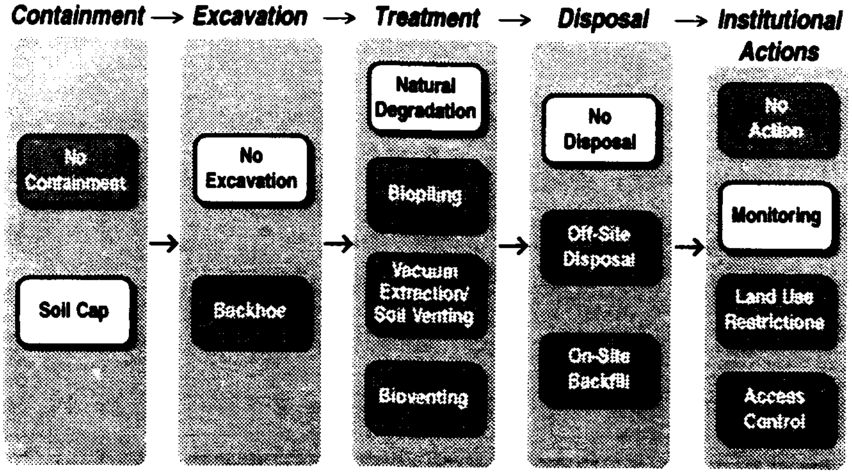
Description — This alternative would involve monitoring soil impacts and would add land use restrictions to the Elmendorf AFB land use plan. The monitoring program would be the same as described under the natural degradation alternative. These restrictions would limit access and prohibit the building of residences and excavations in areas with contamination exceeding cleanup levels. The restrictions would be included on the deed for the property and would be incorporated in the Base Comprehensive Use Plan. The use restriction would be factored into any future decisions to dispose of the property. Monitoring of the soil would be needed to track the natural degradation of the contaminants over time. Any future uses of the impacted areas must be evaluated to make certain that the risk due to these future uses does not exceed acceptable levels.

Effectiveness — This alternative would minimize exposures that could occur from digging in contaminated soil. Risk from exposure to soil would be reduced since the chances for human contact would be reduced. Risks to the environment would not be controlled at seep sites. Animals and vegetation would not be protected by the institutional actions. This alternative is unlikely to affect the stability of the bluff.

Implementability — This alternative is implementable and would cause little environmental disruption to the existing ecosystem of the proposed alternatives. Fences could be easily constructed and maintained without disruption of the environment or operations at Elmendorf AFB. The processes for acquiring deed restrictions and restricting groundwater use are defined. Public and regulatory acceptance would be required for the alternative to be implementable.

Cost — The present value cost would range from $1,000,000 to $1,500,000. This cost includes an estimated cost of $100,000 to implement deed/access restrictions.

10.2.3 Containment



Containment

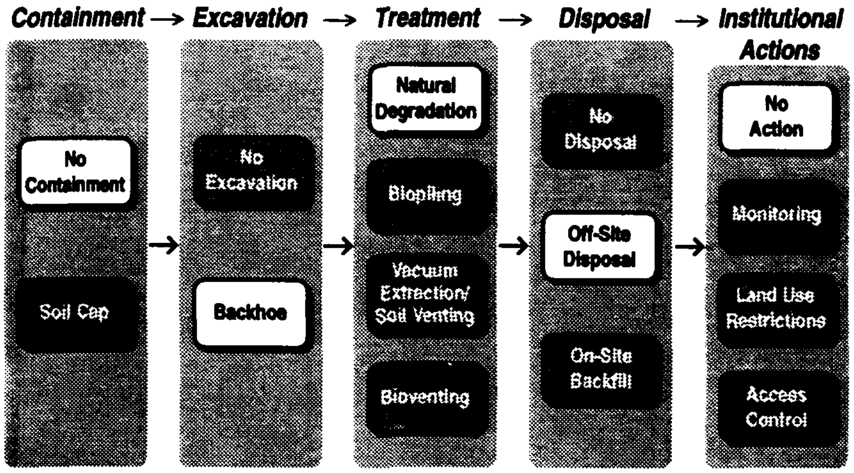
Description — This alternative includes a bentonite and soil cap and sediment control barriers to contain areas of known surface soil contamination. Capping would also be applied to soil contaminated by seeps. A 2-foot thick bentonite and soil cap with a vegetative cover would be constructed over approximately 3.5 acres on top of the bluff. This design should be adequate to prevent dermal contact with contaminated surface soils and infiltration of water through contaminated vadose zone soil. The cap in the seep areas would be small (approximately 0.1 acres each). Silt fences across known drainage ditches would be constructed to prevent contaminated sediments from washing out into surface water. Periodic monitoring of soil pore water, using suction-type lysimeters, would be needed to document the effectiveness of the cap.

Effectiveness — This alternative would be effective in reducing risk from dermal contact with contaminated soil. However, the risk is currently low. There would be a cross-media benefit on groundwater water and, indirectly, on surface water by reducing migration of contaminants through the soil and into groundwater. Reducing the contaminant load on groundwater will indirectly benefit surface water at the point of discharge. Caps in seep areas would not be effective, even with the attempt at water extraction, because of hydraulic pressure that would build up behind the cap and either rupture the cap or eventually cause water to bypass the cap and contaminate other areas, including surface water and wetlands. Back pressures caused by a cap could lead to instability of the bluff.

Implementability — Capping has limited implementability. The topography of the bluff would not allow for construction of a stable cap, so any capping would be limited to the flat areas at the top of the bluff. The area that would be capped is small, so the loss of use of the capped area should not have an impact on operations at Elmendorf AFB. Public and regulatory acceptance must also be achieved for this alternative to be implementable. The technology is proven and available.

Cost — The cost is estimated to range from $1,000,000 to $2,000,000.

10.2.4 Excavation and Disposal



Excavation and Disposal

Description — This alternative would be applied only in the areas where soil contamination exceeds clean up levels for total fuel hydrocarbons (TFH). Natural degradation would continue to be applied to soils with less than the TFH clean-up levels. A backhoe or front-end loader would be used to excavate overburden with contamination below clean-up levels. Approximately a 4 foot x 10 foot x 10 foot portion of soil would be excavated for disposal (1,500 cubic yards) in each of the two areas being evaluated in this FS (3,000 cubic yards total). These contaminated soil areas are at depths of approximately 10-12 feet in the western area and 0-2 feet in the central area. The soil would be temporarily placed on plastic, and samples would be collected to determine the concentration of TFH in the excavated soil. These data would be used to obtain authorization to dispose of the soil at an industrial landfill. Samples also would be collected of the sidewall and bottom soil in the excavation to confirm that the soil with a TFH concentration greater than clean-up levels was removed. The depth of the contamination will depend upon the depth of contamination and the technical ability to excavate. The sidewalls would have to be laid back to permit safe entry into the excavation. Roads, utilities, and buildings would limit the size of the excavation, since they could interfere with the excavation residuals. The excavated soil would be transported to an off-site permitted industrial waste landfill. Clean fill would be imported to the site and the excavation backfilled.

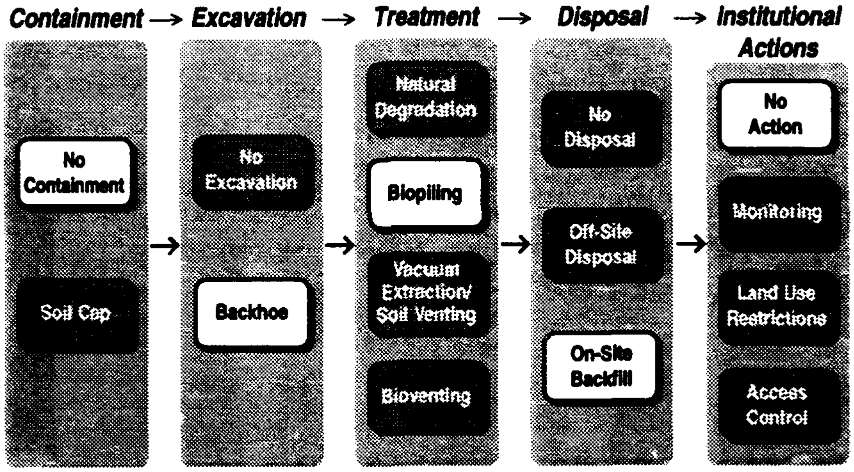
Effectiveness — The potential for dermal exposure to contaminated soil is eliminated, and the alternative is permanent. There would be a limited cross-media benefit on groundwater by the removal of near-surface soil with the highest contaminant concentrations. The Air Force would maintain environmental liability after disposal of the soil, since treatment would not have occurred, even if the soil is disposed at a permitted facility. If the facility became a CERCLA site, the Air Force could become a responsible party. This alternative could affect the stability of the bluff if deep excavations were made. Shoring can minimize this impact. No threat to wetlands or other ecological receptors is expected by implementing this alternative.

Implementability — The alternative may not be implementable. Air Force policy is to not select excavation and off-site disposal as the preferred alternative for CERCLA soils. The excavation techniques are available and proven. However, this alternative is limited only to shallow soil (generally less than 10-15 feet). Deeper soil could only be safely obtained by shoring excavations or using caisson excavation methods.

Disposal of contaminated soil may be difficult. If the soil is hazardous, an out-of-state RCRA landfill would have to be used, and transport of the soil would be difficult. The waste characterization (hazardous/nonhazardous) would have to be determined during a pilot excavation. All current data indicate that the soil would not be hazardous. Public and regulatory acceptance would also be required for this alterative to be implementable.

Cost — Assuming an industrial waste landfill could be used, the cost for this alternative would range from $800,000 to $1,200,000.

10.2.5 Excavation, Biopiling, and Backfill



Excavation, Biopiling, and Backfill

Description — A backhoe or front-end loader would be used to excavate soil from the areas of OU 5 where soil contamination exceeds clean-up levels for TFH. The volume of soil to be treated is estimated to be 3,000 cubic yards. The excavated soil would be stockpiled and transferred to the Elmendorf AFB biopile cell for treatment. The existing biopiling area is located at the eastern end of Elmendorf AFB. Clean fill from on base would be used as backfill in excavated areas. Degradation in the biopile occurs because oxidation of the soil stimulates microbial activity, which breaks down the contaminants into carbon dioxide and water. Some volatilization also occurs.

Soil in the biopile would be monitored for temperature, soil pH, nutrient, and contaminant concentrations. Operations would be adjusted for climate to maintain optimal degradation. Soil samples would be collected from sampling points in the center of the biopile and analyzed to determine that the contaminated soil had been treated to acceptable levels.

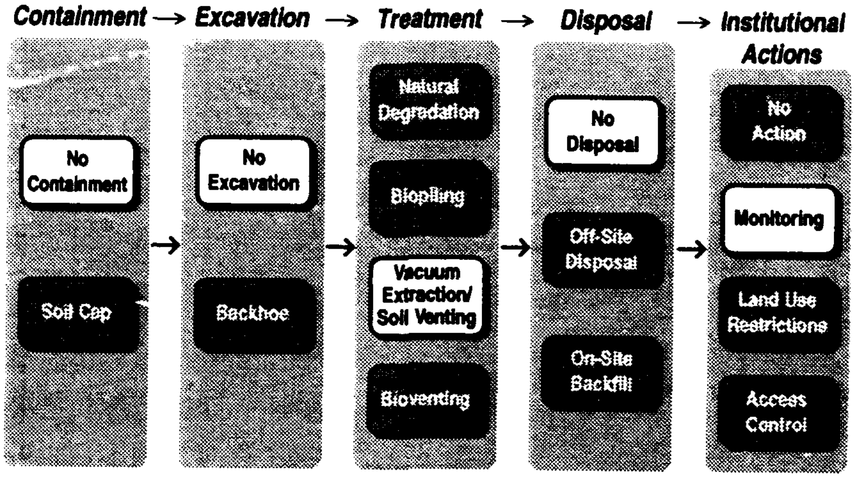
When cleanup objectives are met, the treated soil would be used on-base as fill.

Effectiveness — The potential for dermal exposure to contaminated soil is eliminated. There may be a limited cross-media benefit on groundwater by the removal of near-surface soil with the highest contaminant concentrations. The effectiveness may be slowed in the winter when degradation rates decrease. The bacterial activity is most effective in warm ambient temperatures. As with the excavation and disposal alternative, this alternative is limited only to shallow soil. Deeper soil could only safely be excavated by shoring excavations or using caisson excavation methods. This alternative creates the same potential impacts to bluff stability and wetlands as the excavation and disposal alternative.

Implementability — The alternative can be implemented but may be restricted to the summer months because of the cold winter climate. The excavation and biopiling techniques are available and a treatability study at Elmendorf AFB is ongoing. Excavation in the western area may be difficult since the depths of contamination (10-12 feet) approach the 15 foot depth limit for excavation without complex methods. The biopiling could be coordinated with the existing biopiling study. The land commitment for the duration of treatment would not affect operations at Elmendorf AFB. Public and regulatory acceptance are required for this alternate to be implemented. Contaminated soil on the side of the bluff in the western portion of the OU will be difficult to reach.

Cost — The estimated cost range for this alternative is $150,000 to $300,000. This includes $30,000 for sampling of soil to document remediation of the soil. Also included is excavation and transport to the biopile and backfill (costing in the range of $15 to $20/cy [$45,000 to $60,000]). The remaining cost is for the biopiling effort.

10.2.6 Soil Vapor Extraction/Soil Venting



Soil Vapor Extraction/Soil Venting

Description — Soil vapor extraction (SVE) wells would be installed in the vadose zone and screened in a narrow interval below the soil contamination. The wells would be connected to a vacuum blower via a common header so that a negative pressure would induce air flow through the contaminated soil into the SVE wells. Volatile compounds would partition into the vapor phase where they could be collected by the wells. Activated carbon would be used to adsorb the contaminants from the vapor phase. Periodic regeneration of the carbon would destroy the contaminants. Vapor vacuum monitoring wells would be used to document the radius of influence of the SVE wells. The concentration of organic vapor in the extraction and monitoring wells would be measured periodically to document vapor extraction rates. Soil borings would be drilled to sample the affected soil to confirm that cleanup levels have been achieved.

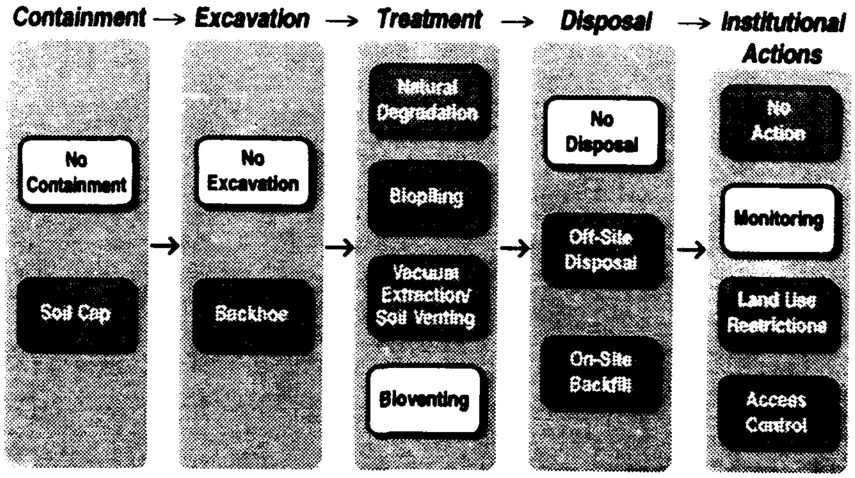
Effectiveness — This alternative protects human health and the environment by reducing the volatile contaminant concentrations in soil. There is a cross-media benefit on groundwater by the reduction of contaminants in the soil. Also some induced volatilization from the groundwater could occur as a result of the reduced pressure in the vadose zone.

Soil vapor extraction would not be highly effective on the low volatility contaminants such as diesel and jet fuel. Since these compounds have low volatility, the relative vapor phase equilibrium concentration between the vapor and adsorbed/liquid phase is low. Also, SVE wells would not be highly effective near the bluff face because the vacuum would be lost as fresh air was drawn in through the bluff, thereby reducing the vacuum induced in the vadose zone. The radius of influence (and thus the effectiveness) of the wells will depend upon the permeability of the formation. Radius of influence also affects the number of wells needed to be effective. The formation is predominantly sand and gravel so the effectiveness of each well to extract soil vapor is expected to be high. However, heterogeneity in the lithology and channeling of air could cause this alternative to be less effective in some areas. This alternative would not affect the stability of the bluff or affect wetlands.

Implementability — This alternative can be implemented. There is sufficient land available to install the wells, header system, and treatment systems. The SVE technology is proven and is available; soil vapor treatment with activated carbon is proven and available. Approvals from regulatory agencies would be needed to discharge treated offgas.

Cost — The estimated cost range would be $1,000,000 to $2,000,000.

10.2.7 Bioventing



Bioventing

Description — Bioventing treats organic contaminants by oxygenating the vadose zone, increasing microbial activity and increasing microbial breakdown of the contaminants. Air injection wells would be installed in areas where concentrations of soil contaminants exceed clean-up levels for TFH. The wells would be screened in the vadose zone in a narrow interval within and below the soil contamination. A blower would be connected to the wells via a common header so that a positive pressure would induce air flow into the contaminated soil. The increased amount of oxygen available in the vadose zone would enhance the aerobic biodegradation of organic contaminants by indigenous microorganisms. In addition to oxygen, macronutrients such as nitrogen and phosphorus, in an atomized phase, could be added to stimulate microbial population growth and contaminant destruction. Soil sampling would be needed to document that cleanup levels were being achieved.

Effectiveness — This alternative protects human health and the environment by reducing the contaminant concentrations in soil. It is effective on aromatic compounds and TFH, but is less effective on chlorinated compounds that break down faster in anaerobic environments. There is a cross-media benefit on groundwater and, indirectly, on surface water, by the reduction of the contaminant concentration in the soil. The effectiveness would depend upon the ambient temperature, moisture content, natural microbial populations, and the permeability of the soil. Bioventing tests in arctic climates have shown that ambient temperatures would be increased by the heat of compression of the inlet air. Bioventing can dry the formation reducing the effectiveness; however, moisture could be added to the inlet air to counteract this negative effect. Effectiveness would also be negatively affected by heterogeneity in lithology and channeling effects. This alternative would not affect the stability of the bluff or wetlands.

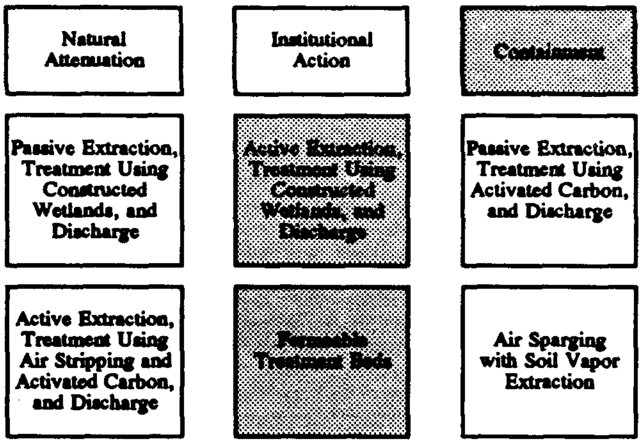
Implementability — This alternative can be implemented. The technology is available, and the space needed for bioventing wells is available. However, the rate of breakdown caused by bioventing in cold climates is not fully documented. Bioventing tests are being currently performed at Elmendorf AFB. The results of these tests will demonstrate the effectiveness of bioventing in cold climates and will provide the data needed. Because the soil in the bluff is composed mostly of interbedded sands and gravel with some thin, discontinuous silty zones, the vapors should travel well through the media.

Cost — The estimated cost range would be $150,000 to $300,000.

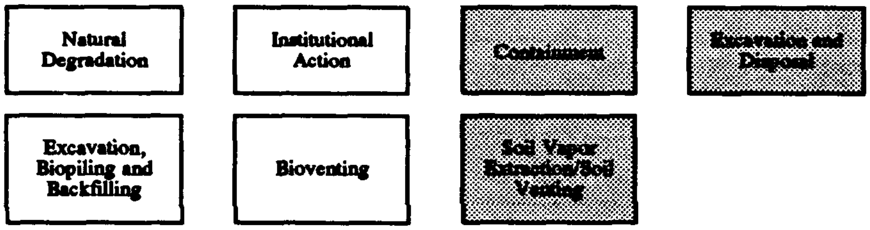
10.3 Alternatives Recommended for Detailed Analysis

Based on the evaluation of alternatives for water and soil, the more promising alternatives were selected for detailed analysis (Section 11). The alternatives selected are shown unshaded below.

Selected Remedial Alternatives for Water



Selected Remedial Alternatives for Soil



The next four subsections (Section 10.3.1 through 10.3.4) discuss the respective rationales for the alternatives that are both retained and eliminated.

10.3.1 Rationale for Retained Water Alternatives

Natural Attenuation

This alternative was retained for both seeps and groundwater as a baseline, for comparison to other alternatives. It is applicable to all areas of OU 5, but is more effective for the main body of groundwater not being expressed as seeps. Natural attenuation can be combined with other alternatives to form cost-effective multi-media alternatives for the different impacted areas of OU 5.

Institutional Action

Institutional action can help prevent exposure for both seeps and groundwater by limiting access to pathways. The monitoring aspects of institutional actions should be combined with any alternative that achieves cleanup levels over a period of time to document the effectiveness of each remedial action.

Passive Extraction With Constructed Wetland Treatment

This alternative was kept for the seeps, but eliminated for groundwater. The alternative can reduce exposures from the seeps and treat contaminants at reasonable costs. Snowmelt Pond would be converted into a constructed wetlands under the presumptive remedy for PCB and sheen contamination. The passive nature of both the extraction and treatment system is beneficial in that the chance of process upsets due to equipment failure is minimized. However, treatment of all groundwater by this method is not practical because the size of the constructed wetlands required to provide adequate retention time for the extremely large volumes of groundwater that would be extracted would not be implementable.

Passive Extraction With Activated Carbon Treatment

This alternative was kept for the seeps, but eliminated for groundwater. Activated carbon is a well-demonstrated technology that can successfully reduce contaminant levels to below clean-up levels. Exposures during both extraction and treatment would be minimal, and contaminants would be removed by the carbon for eventual destruction off site when the carbon is regenerated. The technology can be carried out on minimal space and would be relatively easy to operate. However, treatment of all groundwater by this method is not possible because passive extraction methods cannot remove water below the surface.

Active Extraction With Air Stripping and Activated Carbon Treatment

This alternative was kept for both seeps and groundwater because it involves a well-understood treatment technology that can effectively treat the contaminants of concern. The active extraction, while adding cost, has the added advantage over passive extraction of increasing the amount of contaminated water that can be treated. Contaminants are treated by the carbon and eventually destroyed during carbon regeneration. Chances for exposures are minimal during operation.

Air Sparging With Soil Vapor Extraction

This alternative was kept for the groundwater, but not for the seeps. Air sparging can effectively remove contaminants from the groundwater and treat them with carbon. The technology can also enhance biodegradation and limit plume migration. Both air sparging and soil vapor extraction are well understood technologies and would minimize exposures during treatment. However, this alternative is ineffective on seeps since this water is already at the surface.

10.3.2 Rationale for Eliminated Water Alternatives

Containment

Containment was eliminated because of the difficulty of containing all affected groundwater over the long term. This alternative is only effective in the short-term in preventing exposure by groundwater capture. In the long term, groundwater would bypass any containment structure. Basewide groundwater discharges to OU 5 would eventually overcome any attempt at containment. The environmental costs in the form of damage to the wetlands and bluffs could outweigh the environmental benefits.

Active Extraction With Constructed Wetlands Treatment

Active extraction was eliminated because of the difficulty in implementing a high flow constructed wetlands. The 100 to 250 acres required to construct a high flow wetlands could affect base operations. Also, the wetland would be more complex, require more operations and maintenance, and would produce more water than a smaller scale system.

Permeable Treatment Beds

Because of the need to periodically replace the treatment medium in a permeable, in-situ treatment system, this alternative was eliminated from further consideration. Periodic replacement of the medium would repeatedly disrupt the land, potentially causing slope stability problems in an area where there is little access for the construction equipment (between the bluff and the railroad tracks). The lack of available land owned by the Air Force also makes this alternative undesirable.

The period of treatment would be open-ended because of the potentially large volume of water that flows through OU 5. The number of replacement episodes cannot be predicted because the contaminant load that will pass through the treatment bed at any location can not be predicted. Breakthrough could happen in some areas of the bed and not at others. This would require either partial replacement or a wider trench with more carbon where contaminant loads may be higher. The difficulty in ensuring equal effectiveness across the bed makes this alternative undesirable.

10.3.3 Rationale for Retained Soil Alternatives

Natural Degradation

Natural degradation processes are effective on the type of contaminants found in the soil, i.e., fuel hydrocarbons. While degradation rates must be established by modeling and monitoring programs, and eventual achievement of cleanup levels is not guaranteed, the alternative has the advantage of not exposing surface receptors to contaminated soils and treating soil in place.

Institutional Action

Institutional actions would help reduce exposures to people by reducing potential present and future exposure to impacted soil. This alternative would not be highly effective on protecting the environment because animals and vegetation are not protected. However, institutional controls can be combined with other actions to form multi-media alternatives that would be effective in some areas of OU 5.

Excavation and Treatment With Biopiling

Biopiling is being tested in a treatability study at Elmendorf AFB. The technology is proven in other climates, and the treatability study will define the treatment period needed to achieve cleanup objectives for the contaminants in the soil. Biopiling permanently destroys contaminants, and minimal chances of exposures during treatment are expected. Excavation depths (10-12 feet in the western area and 0-2 feet in the central area) should be shallow enough for excavation to be employed without the use of complex methods required for depths exceeding 15 feet.

Bioventing

Bioventing has been demonstrated to achieve cleanup levels for similar contaminants at other sites. Permanent destruction of contaminants is achieved and minimum chances of exposure during treatment are expected. Sufficient space exists at OU 5 to implement the alternative and vendors are available to supply the needed equipment.

10.3.4 Rationale for Eliminated Soil Alternatives

Containment

Capping would be effective on a small scale at the top of the bluff. However, caps could not be constructed on the face of the bluff because of slope stability problems and the hydraulic buildup that would occur under the cap. The greatest potential for exposure to contaminated soil is near seeps on the bluff, where a cap would be least effective. Therefore, this alternative was eliminated in favor of the in-situ alternatives and ex-situ treatment.

Soil Vapor Extraction and Soil Venting

This alternative was eliminated because soil vapor extraction is not as effective on contaminants which have low volatility. Contaminants at OU 5 such as diesel and jet fuel have low vapor phase equilibrium concentrations which do not allow for effective removal under a vacuum. In addition, much of the vacuum induced by the blower equipment could be lost in the area of the bluff as fresh air from alongside the bluff could be drawn into the extraction zone.

Excavation and Disposal

This alternative was eliminated because it is in conflict with Air Force policy that off-site disposal of excavated CERCLA soils is not a preferred remediation technology.

Additionally, this alternative merely moves the contaminants from Elmendorf AFB to a landfill, which forces the base to maintain liability and does not achieve the remedial action objective of treating contaminants, where possible.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES (CONTINUED)

LIST OF TABLES

11.0 DETAILED ANALYSIS OF REMEDIAL ACTION ALTERNATIVES

The objective of the detailed analysis is to identify the best possible remedial alternatives for the Elmendorf OU 5 site using Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedial action alternative evaluation criteria. The comparative analysis evaluates the alternatives according to their cost effectiveness. An alternative is selected in the Record of Decision (ROD) after agency and community acceptance are evaluated.

To complete the detailed analysis, several important technical assumptions had to be made; these assumptions are discussed in Section 11.1. Three potential pathways had to be evaluated at OU 5: seeps, the main body of groundwater, and soil. Even with a small number of media-based alternatives, the number of plausible multi-media alternatives is large. The technical approach taken to streamline the analysis, and still evaluate a large number of multi-media alternatives according to the nine CERCLA criteria, is discussed in Section 11.2. The body of the detailed analysis is provided in Section 11.3.

Section 11.5 provides a comparative analysis of multi-media alternatives; this analysis relies on the detailed single-media analysis in Section 11.3. These subjective analyses separate the better alternative combinations from those that are likely to be less successful using the CERCLA criteria. However, the results of the comparisons are limited by the analysis's assumptions discussed in Section 11.1, the subjective nature of the analyses, and other factors discussed in Section 11.5. A precise, objective ranking of multi-media alternatives cannot be determined from the analyses. The "best" alternative may be one that does not receive the highest score when the input from regulatory agencies and the public are incorporated into the selection process.

Since some of the assumptions made in the detailed analysis could affect the effectiveness, implementability, and cost of the alternatives, a sensitivity analysis that varied several parameters was performed (Section 11.4). This analysis identified those evaluation criteria that will be most affected for each alternative by changes in the assumed quantities of water and soil potentially requiring remediation, or the level or type of contamination present, and the use of different human health risk objectives.

11.1 Assumptions

Throughout the detailed analysis, it was necessary to make several assumptions about the effects of future contamination on response action, the time it will take to remediate contamination, and the discharge of treated water. The fundamental assumptions that shaped the approach to this analysis are discussed below.

11.1.1 Presence of Upgradient Groundwater Impacts/Affected Media

Investigations of upgradient groundwater contaminant sources and levels of contamination are still ongoing. Therefore, the assumption was made that future or continued upgradient contaminant discharge at OU 5 will occur in the same locations where current groundwater impacts are found and at the concentrations currently found. It was also assumed that the chemicals of concern (COCs) would not change and that there would be no phase change (no soil gas, volatilization/air emissions, free product, or surface water requiring remediation).

11.1.2 Upgradient Response Actions

It was assumed that any upgradient response actions in other OUs would have a beneficial affect on remediation at OU 5. However, the cost reduction that would be associated with any upgradient remedial actions cannot be estimated at this time and was not included in alternative cost estimates. The primary benefit of those actions would be to shorten the time required to achieve remedial action objectives.

11.1.3 Remediation Timeframe/Short-Term Effectiveness

An assumption was made about the estimation of remediation times and the evaluation of an alternative's potential for complying with the chemical-specific ARARs. The assumption has three component factors. First, CERCLA maximum allowable period for remediation of groundwater (30 years) was used because the period of remediation for groundwater cannot be determined as part of this effort. Groundwater from throughout most of Elmendorf AFB will be remediated at OU 5, and the total mass of contaminants to be removed and their rate of migration to OU 5 are not known at this time. For soil, estimates of the time to achieve remediation were made based on the volume or contaminant load.

The second component factor concerns short-term effectiveness. The short-term effectiveness of an alternative depends upon several factors, the three most important of which are as follows:

- The alternative does not create a secondary hazard during implementation;
- An environmental benefit and a reduction in risk are realized during implementation; and
- The remedial action objectives are achieved quickly.

The speed at which remedial action objectives are attained depends upon the mass of contamination to be removed. Since basewide groundwater is to be managed at OU 5, the timeframe for groundwater remediation is assumed to be 30 years. Given a 30-year window for remediation, all groundwater alternatives would receive a low ranking for short-term effectiveness, when timeframe alone is considered. Because the timeframe is equal for all groundwater alternatives, it was not considered in the detailed analysis. The other two factors of short-term effectiveness are the differentiating factors.

Depending on findings and selected remediation strategies at OU 5 and upgradient operable units, groundwater remediation may be achieved in less than 30 years. A cost sensitivity analysis of shorter remediation timeframes is discussed in Section 11.4.

The third component factor relates to the timeframe in which potential exposures are possible. Remedial response actions that require a long time to achieve remedial action objectives are generally considered to have less short-term effectiveness than alternatives that achieve objectives quickly. This is because the period of potential exposure to humans and the environment is longer with alternatives that require more time. This negative aspect can be offset if the alternative eliminates the exposure potential during remediation.

11.1.4 Discharge of Treated Water

The discharge options for treated water include discharge to Ship Creek, discharge to wetlands, and reinjection. The alternatives involving extraction assumed discharge of groundwater via reinjection. This process option was selected as being representative in lieu of site-specific treatability studies that could show direct discharge is possible to surface water bodies. In actuality, the appropriate discharge method is often dictated by the effectiveness of the treatment and the ability to obtain permits. Reinjection is also preferable to discharge to surface water because several of the key remedial action objectives stress the importance of protecting the water quality of the wetlands areas and Ship Creek. Some discharge of treated water to the beaver pond may be beneficial, to maintain a constant water level.

Treatability studies would be needed to determine achievable cleanup levels for each alternative. If it were determined that an on-site treatment system could be designed to reduce contaminant concentrations to levels allowing direct discharge to Ship Creek or the wetlands, then the costs for alternatives with a discharge component would be reduced.

11.1.5 Presumptive Remedy for Snowmelt Pond

As discussed in Section 9.0, converting Snowmelt Pond into a constructed wetland is the presumptive remedy for sediment contamination and surface sheens. The presumptive remedy is considered an element of every multi-media alternative, not just the one involving constructed wetlands. Its cost are included in the total costs that appear in Section 11.5.

11.2 Technical Approach for Detailed Analysis

The first part of this section describes the approach taken to develop and evaluate multi-media alternatives for OU 5. The criteria and the numerical weighting system used to evaluate the alternatives is discussed in the second part of the section.

11.2.1 Development and Analysis of Multi-Media Alternatives

The six water and four soil remedial action alternatives selected for detailed analysis are shown on Table 11-1. However, any remedial action alternative evaluated in the Feasibility Study (FS) must address all of the contamination in the operable unit. In the case of OU 5, that means developing multi-media alternatives that each address the main body of impacted groundwater, seeps, and soil. Seeps include the discharges of impacted groundwater along the bluff. Small surface water channels and ditches along the bluff are not considered as part of the seeps because, if the seeps are remediated, there will be no impact to these face features. As conditions exist now, the main body of groundwater refers to the groundwater flowing under OU 5 that does not discharge as seeps. This includes all groundwater that discharges into the wetlands and Ship Creek. Even with only a few remedial alternatives for each medium, the potential plausible combinations of multi-media alternatives is very large. Examples of two assembled multi-media alternatives are:

Table 11-1

Media-Specific and Applicable Pathway Remedial Action Alternatives for OU 5

WATER TREATMENT ALTERNATIVES		Groundwater	Seeps
Alternative #1 —	Natural Attenuation	✓	✓
Alternative #2 —	Institutional Controls	✓	
Alternative #3 —	Passive Extraction with Constructed Wetlands Treatment		✓
Alternative #4 —	Passive Extraction with Carbon Treatment		✓
Alternative #5 —	Air Sparging with Soil Vapor Extraction	✓	✓
Alternative #6 —	Active Extraction with Air Stripping and Carbon Treatment	✓	✓

SOIL TREATMENT ALTERNATIVES	
Alternative #7 —	Natural Degradation
Alternative #8 —	Institutional Controls
Alternative #9 —	Excavation, Biopiling and Backfilling
Alternative #10 —	Bioventing

Multi-Media Alternative #1

MEDIUM	ALTERNATIVE
Groundwater	Natural attenuation combined with institutional controls
Seeps	Passive extraction with activated carbon treatment
Soil	Natural degradation combined with institutional controls

Multi-Media Alternative #2

MEDIUM	ALTERNATIVE
Groundwater	Natural attenuation combined with institutional controls
Seeps	Passive extraction with activated carbon treatment
Soil	Bioventing

As can be seen, the differences between alternatives can be subtle and descriptions of the multi-media alternatives would be very repetitive. It is important to evaluate all realistic combinations of the 10 media-specific alternatives for different areas within OU 5. To reduce the number of repetitive alternative descriptions, an approach was developed where the media-based alternatives were evaluated individually according to the nine CERCLA criteria using a numerical scoring system. Multi-media alternatives were then developed; the multi-media scores for each CERCLA criterion were calculated from the individual component scores for a total comparative score.

Each media-specific alternative was first individually subjected to detailed analysis before plausible multi-media combinations were defined and analyzed. The protection provided to human health and the environment, compliance with the remedial action objectives and potential ARARs, the effectiveness, and the implementability of each media-specific alternative were evaluated in detail. This way, only 10 alternative descriptions were needed. Multi-media alternatives were then developed. The scores for each CERCLA criterion for each component of the alternative was averaged, for a total comparative score. The relative synergy achieved by different combinations of seep, groundwater, and soil alternatives is not accounted for by averaging the individual component scores. However, synergistic affects are expected to be minimal because the primary contaminants vary between media, e.g., groundwater with VOCs, soil with relatively nonvolatile total fuel hydrocarbons (TFH). For example, a combined multi-media alternative might be:

- Passive extraction and activated carbon treatment for seeps;
- Bioventing for soil; and
- Natural attenuation with institutional controls for groundwater.

If the long-term effectiveness scores for these components are 4, 5, and 3 the average score for the long-term effectiveness of this multi-media alternative would be 4 (12 ÷ 3). The average scores for the multi-media alternatives are evaluated in the comparative analysis section of this report. This approach streamlines the detailed analysis effort by not creating repetitive analyses for similar combinations of alternatives.

11.2.2 Evaluation Criteria and Scoring System

Criteria

The evaluation criteria used in the detailed analysis are divided into three categories: threshold factors, balancing factors, and modifying considerations. Threshold factors are those conditions that must be met for the alternative to be viable and relate directly to statutory findings that will be made in the Record of Decision (ROD); these criteria must be met. Balancing factors are the conditions that are the primary basis for comparing alternatives; these criteria relate the alternative to the site-specific conditions. Modifying considerations factor in agency and community concerns: an alternative could be effective and technically implementable, but not viable based on these considerations. The nine evaluation criteria used in the detailed analyses, and brief definitions of each are shown on Table 11-2. The detailed evaluations focus on the threshold and balancing factors. Cost depends upon the assembly of media-specific alternatives; therefore, cost is evaluated in the comparative analysis portion of the detailed analysis, where multi-media alternatives are

Table 11-2

Remedial Alternative Evaluation Criteria

Criterion Type	Evaluation Criterion	Definition
Threshold Factors	Protective of human health and the environment[a]	Protection of both human health and the environment is achieved through the elimination, reduction, or control of contaminated media. All migration pathways must be addressed.
	Compliance with appropriate ARARs[a]	Complies with applicable or relevant and appropriate requirements of RCRA, CWA, SDWA, TSCA, state and local regulations and codes, and TBCs.
Balancing Factors	Long-term effectiveness and permanence[a]	Protects human health and the environment after the remedial objectives have been met.
	Reduction in toxicity, mobility, and volume through treatment[a]	Treats the media and reduces the toxicity, mobility, and/or volume of the contaminated media.
	Short-term effectiveness[a]	Protects human health and the environment during construction and implementation. Degree of threat and the time period to achieve remedial action objectives are also considered.
	Implementability	There are no administrative barriers (no permits, zoning limitations). The availability of materials and personnel, site features such as available space and topography, and impacts upon on-going operations are considered. The technical status of alternatives is also considered; theoretical technologies with only limited bench-scale evaluation are considered less implementable than fully proven processes.
	Cost	Costs include design, construction, start-up, monitoring, and maintenance. Accuracy to within -30% and +50%.
Modifying Considerations	State acceptance	The state's (or other regulatory agency's) preference among or concern about alternatives.
	Community acceptance	The community's apparent preferences among or concerns about alternatives.

[a] Effectiveness criteria used to determine the effectiveness-to-cost quotient.

developed and compared. Costs are calculated to an accuracy of -30% to +50%. Modifying considerations (agency and community acceptance) will be evaluated in the Proposed Plan.

Scoring System

To measure the degree that the alternatives fulfill each evaluation criterion, a relative numerical rating system was used (see Table 11-3). The numerical values reflect the relative completeness that a criterion is fulfilled by the alternative. As shown, the rating can be one of three possibilities: the criterion is fully met, partially met, or is not met. Table 11-3 describes subjective factors used to evaluate how well the evaluation criteria are met by the alternatives. The number assigned (5, 3, or 0) does not necessarily reflect the degree of meeting the criterion. For example, an alternative which scores a "3" on "implementability" is not necessarily 60% as implementable as an alternative that scores a "5." However, the assigning of these numerical rankings can serve to provide a preliminary ranking of sites that can be used in the comparative analysis. It is difficult to always fully meet a criterion. For the cost criterion, one of four scores was selected, depending on the total present worth of costs associated with the alternative. The selection of an alternative in the ROD is based on an evaluation of the trade-offs between the costs, benefits, and impacts of any remedial response. The scoring system is designed to numerically represent the trade-offs between the different alternatives. Another assumption is that this rating system assumes that each of the CERCLA criteria are equally important, since each are numerically weighted the same. Again, this is not always representative in that certain criteria can have more importance, depending on circumstances. For example, threshold factors must be achieved and therefore might be seen as more important than a balancing factor, such as implementability, that might be of less importance. This scoring system was selected as a reasonable compromise to reflect the inclusion of all applicable CERCLA criteria.

Table 11-3

Remedial Alternative Evaluation Criteria Rating System

Evaluation Criterion	Condition	Value
Protective of Human Health and the Environment	Is protective	5
	Potentially or contingent protection	3
	Is not protective	0
Compliance with appropriate ARARs	Complies with appropriate ARARs	5
	Complies with most appropriate ARARs or waivers needed	3
	Does not comply	0
Long-Term Effectiveness and Permanence	Once cleanup is completed, there is no recurrence potential	5
	Contaminants transferred, future re-release possible	3
	Contaminants not removed or destroyed	0
Reduction in Toxicity, Mobility, and Volume through Treatment	Eliminates toxicity, mobility, and volume	5
	Reduces toxicity, mobility, and volume	3
	No reduction or no treatment	0
Short-Term Effectiveness	Short-term environmental improvement protects human health and the environment. Minimal risks created by implementation	5
	Limited short-term improvement in environment. Limited risks created by implementation of alternative	3
	No short-term environment improvement. Risks created by implementation	0
Implementability	Alternative proven, all materials and personnel available, permitting available or in place, little effect on operations in OU 5 or surrounding area	5
	Alternative requires significant space, some action-specific ARAR compliance issues, some effect on operations in OU 5 or surrounding area, or slope stability may limit application.	3
	Uncertain permitting, major impact on operations in OU 5 or surrounding area	0
Cost	<$1.5 million	5
	$1.5 to 5 million	3
	$5 to 10 million	1
	>$10 million	-1
State Acceptance[a]	To be determined	NA
Community Acceptance[a]	To be determined	NA

[a] These final two criteria are typically evaluated following comment on the RI/FS report and the proposed plan. They will be addressed when the Record of Decision (ROD) is prepared.

11.3 Detailed Evaluation

11.3.1 Detailed Assessment of Remedial Alternatives for Water

Alternative #1 — Natural Attenuation

For the natural attenuation alternative, the water medium was divided into the seeps along the bluff north of Ship Creek (seeps) and the bulk of the groundwater above the Bootlegger Cove formation (groundwater). The effectiveness of this alternative depends on whether seeps or groundwater are being evaluated.

Description — Natural attenuation uses natural processes to treat contaminant concentrations to cleanup levels. Schematic representations of this alternative in elevation and plan view are shown on Figures 11-1 and 11-2. Natural attenuation would occur in wetland areas, within the groundwater body, and as seeps are exposed to the atmosphere. Wetlands commonly are anaerobic with aerobic environments in the root zone. In wetlands, natural attenuation consists of volatilization and the indigenous breaking down of contaminants by microbial species and common chemical mechanisms. Adsorption of fuel hydrocarbons, halogenated solvents, and metals also occurs. Filtration, dispersion, and dilution also are important mechanisms of natural attenuation in wetland environments.

In groundwater, the primary natural attenuation processes are adsorption/ retardation, dispersion, microbial breakdown, dilution, and volatilization. This option would continue to use these processes for groundwater. Organic constituents have been shown to naturally attenuate in groundwater. Factors affecting the rate of natural attenuation include the groundwater discharge/recharge balance, flow rate, temperature, areas of recharge, the mineralogy of the soil (silt and clay soil having greater adsorption and retardation effects), the concentration of the contaminants, and the type of contaminants. Metals and aromatic hydrocarbons tend to adsorb relatively quickly, and aromatics are typically broken down by microbial action relatively fast. Chlorinated organics are more mobile and adsorb to a lesser

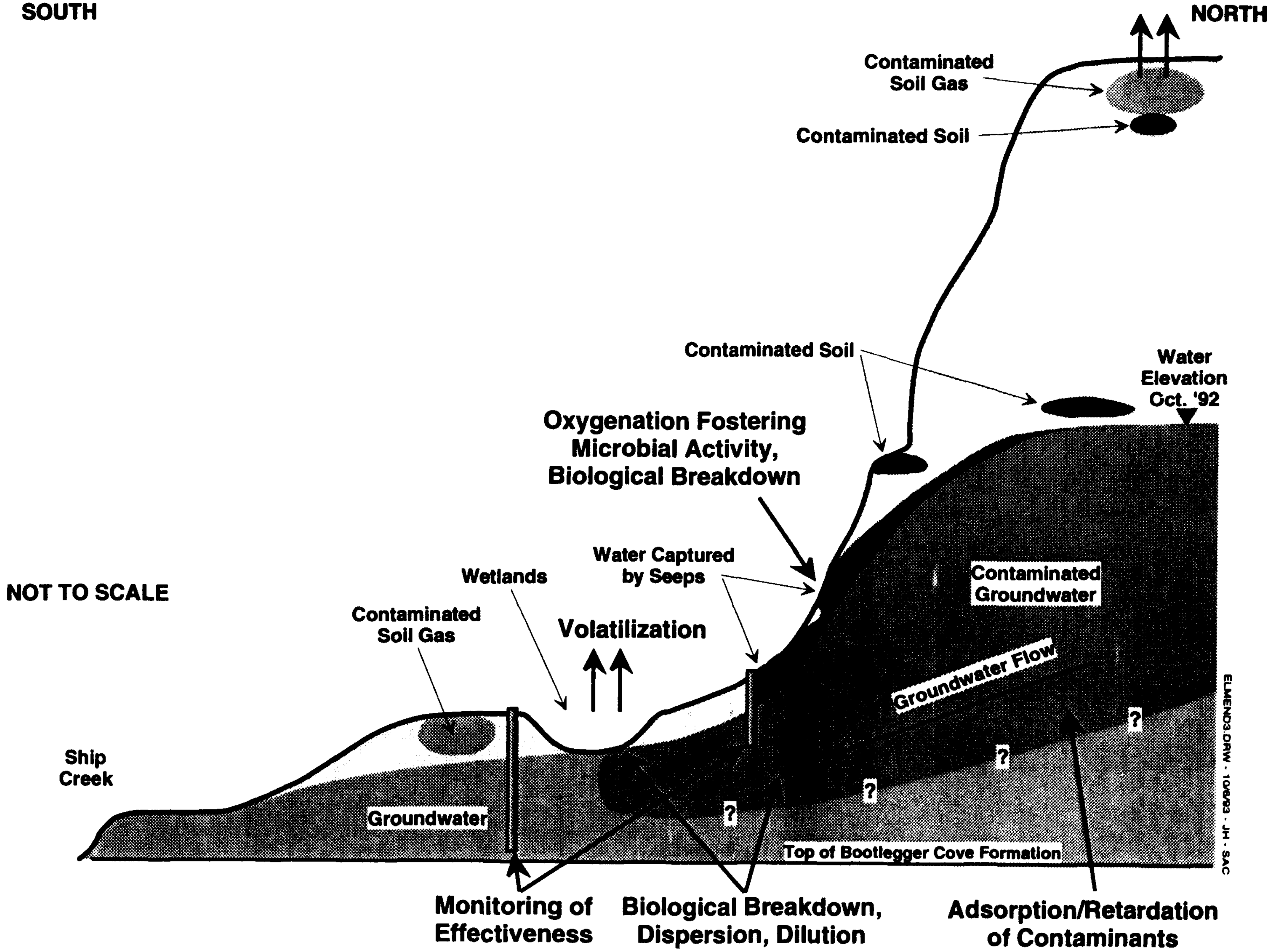


Figure 11-1. Natural Attenuation Alternative (Elevation View)

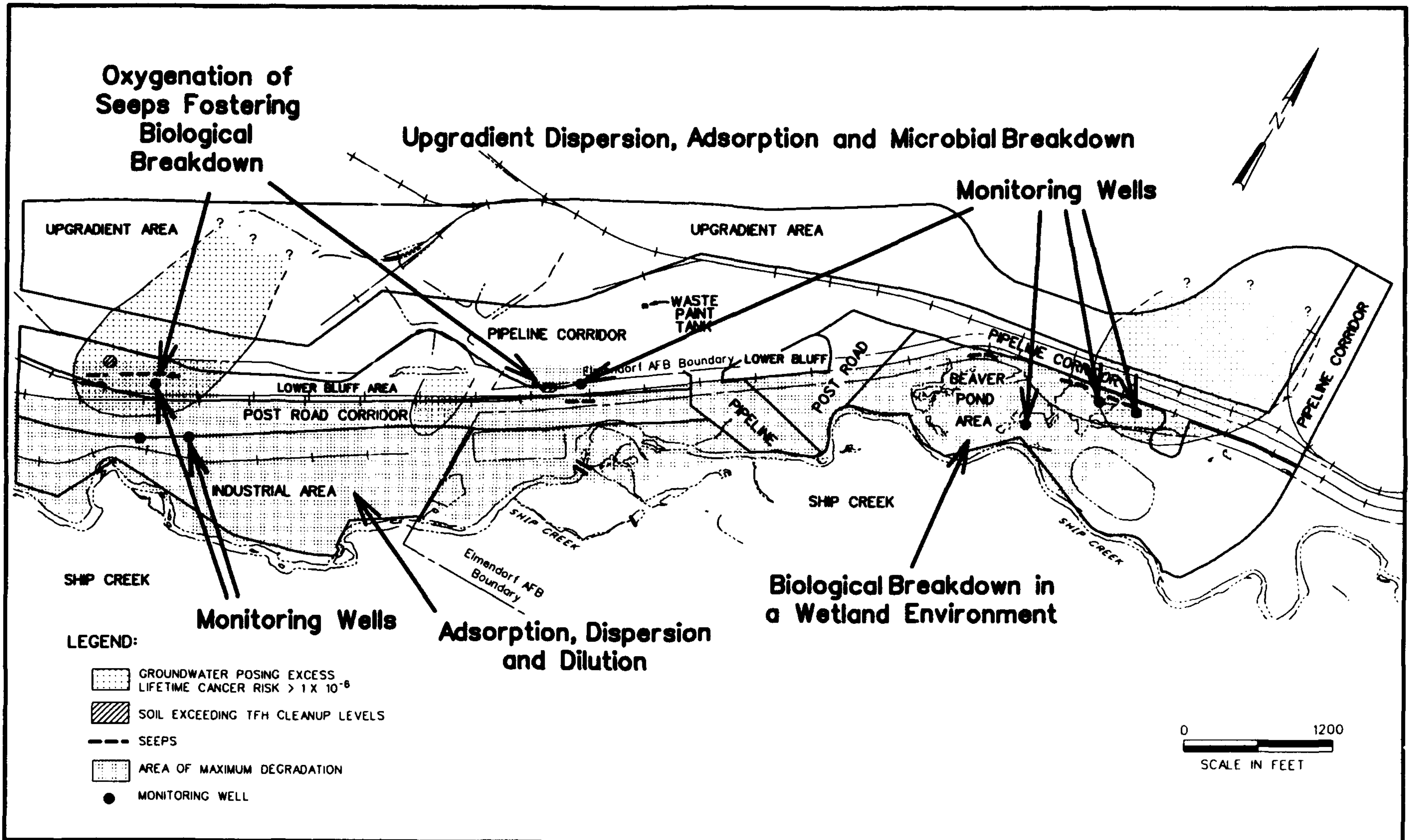


Figure 11-2. Natural Attenuation Alternative

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degree. They also are broken down biologically at a slower rate than aromatic hydrocarbons.

Natural attenuation processes in seeps include volatilization, oxidation, and microbial breakdown. Groundwater discharging as seeps becomes oxygenated when exposed to the atmosphere. The microbial activity would increase degradation of the aromatic hydrocarbons. Exposure to the atmosphere and sunlight would increase the volatilization of aromatic and halogenated hydrocarbons.

The effectiveness of natural attenuation would be monitored by collecting and analyzing samples of groundwater and seep water on a regular basis. Monitoring may include sampling the outfalls from the wetlands into Ship Creek, and continued evaluation of stressed vegetation and monitoring of terrestrial and aquatic wildlife.

Effectiveness

CERCLA CRITERIA SCORING RESULTS
NATURAL ATTENUATION

Criterion	Seeps	Groundwater
Protection of Human Health and the Environment	0	3
Compliance with appropriate ARARs	3	3
Long-Term Effectiveness and Permanence	3	3
Reduction in Toxicity, Mobility, and Volume through Treatment	0	0
Short-Term Effectiveness	0	3
Implementability	5	5

Protection of Human Health and the Environment. This alternative is considered partially protective of human health and the environment. While there is no current threat and natural attenuation to date has been effective, the potential exists for impacts to occur if current conditions change. If groundwater use changed or there were an unattenuated discharge to a human receptor pathway, this alternative could not be adjusted to provide protection of human health and the environment under the changing conditions. Currently, there is no potential for human exposure to groundwater because all known wells in the upper aquifer have been capped. Animal and plant life are not currently exposed to groundwater. The monitoring will provide a mechanism to ensure that action can be taken before potential impacts to human health and the environment occur from changes in conditions.

For seeps, natural attenuation does not reduce the risk to environmental receptors (there are no known current human receptors). Vegetation is stressed and the potential for impact to surface and aquatic animals exist from the seeps. Natural attenuation of the seeps, once the water is discharged, will not protect environmental receptors. Since this is the "no action" alternative, no comparison between the health and environmental risks is necessary if no action were taken and no potential impacts were caused by response actions.

Compliance with Appropriate ARARs. This alternative does not presently comply with potential contaminant-specific ARARs, including Maximum Contaminant Levels (MCLs) (for benzene and TCE) and the Alaska Surface Water Quality Standard of no visible oil sheens. Potential action-specific ARARs are not applicable since no action is taken. The potential location-specific ARAR for wetlands is not achieved since contaminated groundwater naturally discharges into Beaver Pond. However, current chemical analysis of outflow from the wetlands indicate that water quality standards are being met, so this potential location-specific ARAR is partially met. In the long term, contaminant concentrations should decline and, potentially, MCLs or other potential water quality standard ARARs could be achieved. Modelling of the breakdown rate, taking into account site-specific and upgradient conditions, would be needed to determine if potential ARARs could be achieved in the 30-year time period for remediation.

It may be necessary to obtain a waiver from the National Primary Drinking Water Regulations and the Alaska State Drinking Water Standards to permit natural attenuation of the groundwater to continue.

Long-Term Effectiveness and Permanence. This alternative is considered to be partially effective in the long term given the uncertainty of achieving cleanup levels. For groundwater, indigenous aerobic and anaerobic organisms usually break down organic species and naturally occurring geochemical reactions typically degrade organic constituents. The time required to attenuate contaminant concentrations naturally and to achieve final concentrations are not known (for the 30-year period). The monitoring component of the alternative is designed to determine the effectiveness. The monitoring would provide a measure of protection of human health and the environment, allowing action to be taken if conditions change or if cleanup levels are not being achieved.

Reduction in Toxicity, Mobility, and Volume Through Treatment. There is no active treatment performed; therefore, according to the CERCLA guidance, the toxicity, mobility, and volume of organic contamination in groundwater and seepage are not reduced.

Short-Term Effectiveness. This alternative would be effective for groundwater in the short term if the following conditions remain:

- No use of the shallow aquifer;
- No increase in migration rate; and
- No significant increase in contaminant concentrations.

Because of the conditional nature of the effectiveness a score of partially effective was assigned.

For seeps, this alternative is not effective in the short term since there is no action taken to restore stressed vegetation and restrict access and contact with contamination by humans and animals.

Implementability. This alternative is implementable for both seeps and groundwater and will not affect operations at Elmendorf AFB. However, administrative implementability may be complicated by the need to obtain potential ARAR waivers.

Alternative #2 — Institutional Controls

This alternative involves access controls in the areas where groundwater discharges (the Beaver Pond) and in the seep areas, and groundwater use restrictions.

Description — Access restrictions could include fences with notices posted indicating potentially hazardous contaminants. Deed restrictions may include prohibition of the use of shallow groundwater for domestic purposes (drinking, bathing, cooking etc.) and restrictions on the use of the land. Restrictions on the use of groundwater will eliminate one potential pathway of potential exposure. Restrictions on land use would be needed to ensure that exposure to groundwater did not occur during excavation or construction projects. Construction projects could require dewatering local areas within the lower bluff area. Disposal of the discharged water would have to be controlled so inadvertent discharge to surface water or ditches did not occur.

The monitoring of water and seeps would be performed as part of this alternative. An elevation and plan schematic of this alternative is shown on Figures 11-3 and 11-4.

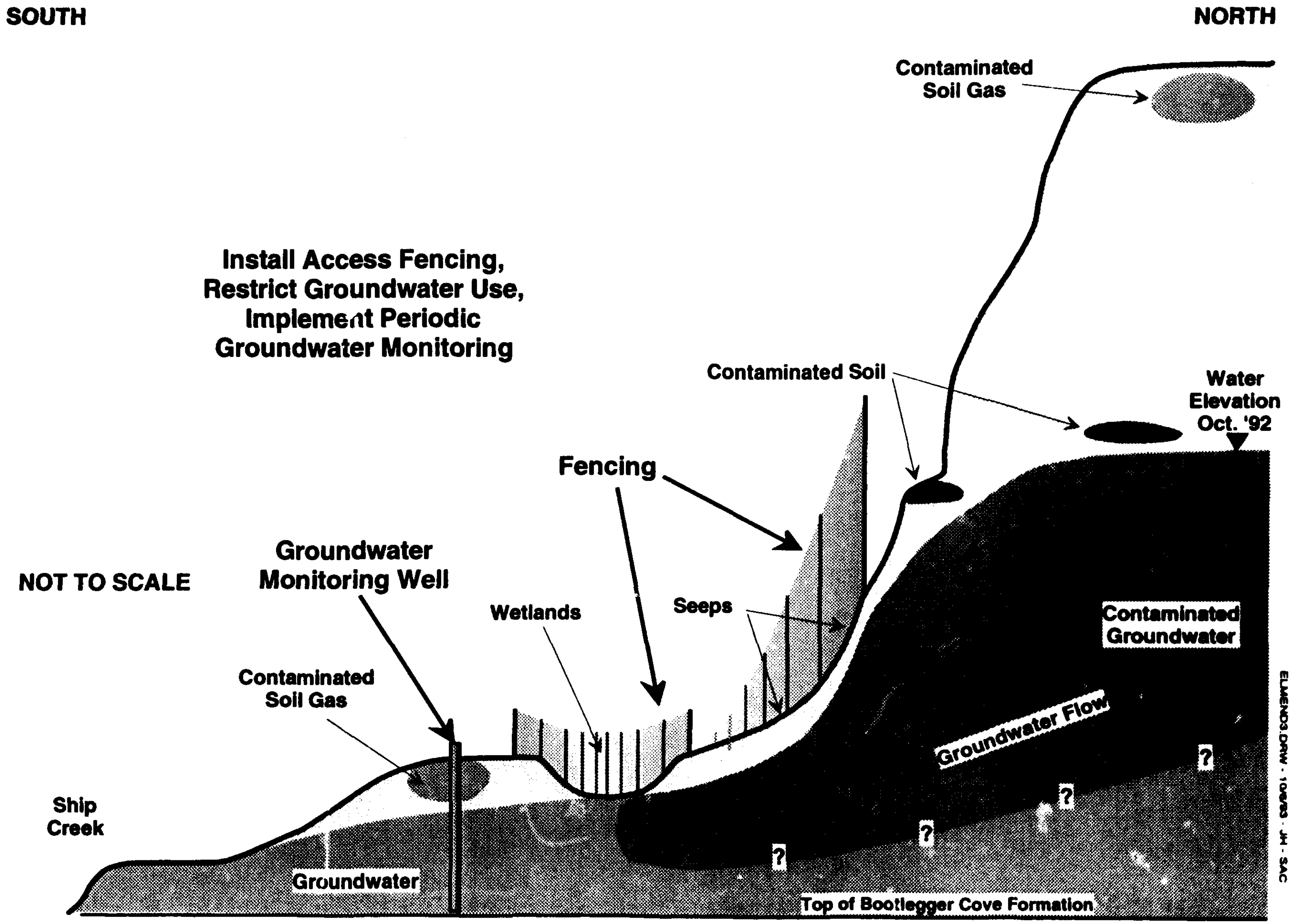

Figure 11-3. Institutional Control Alternative (Elevation View)

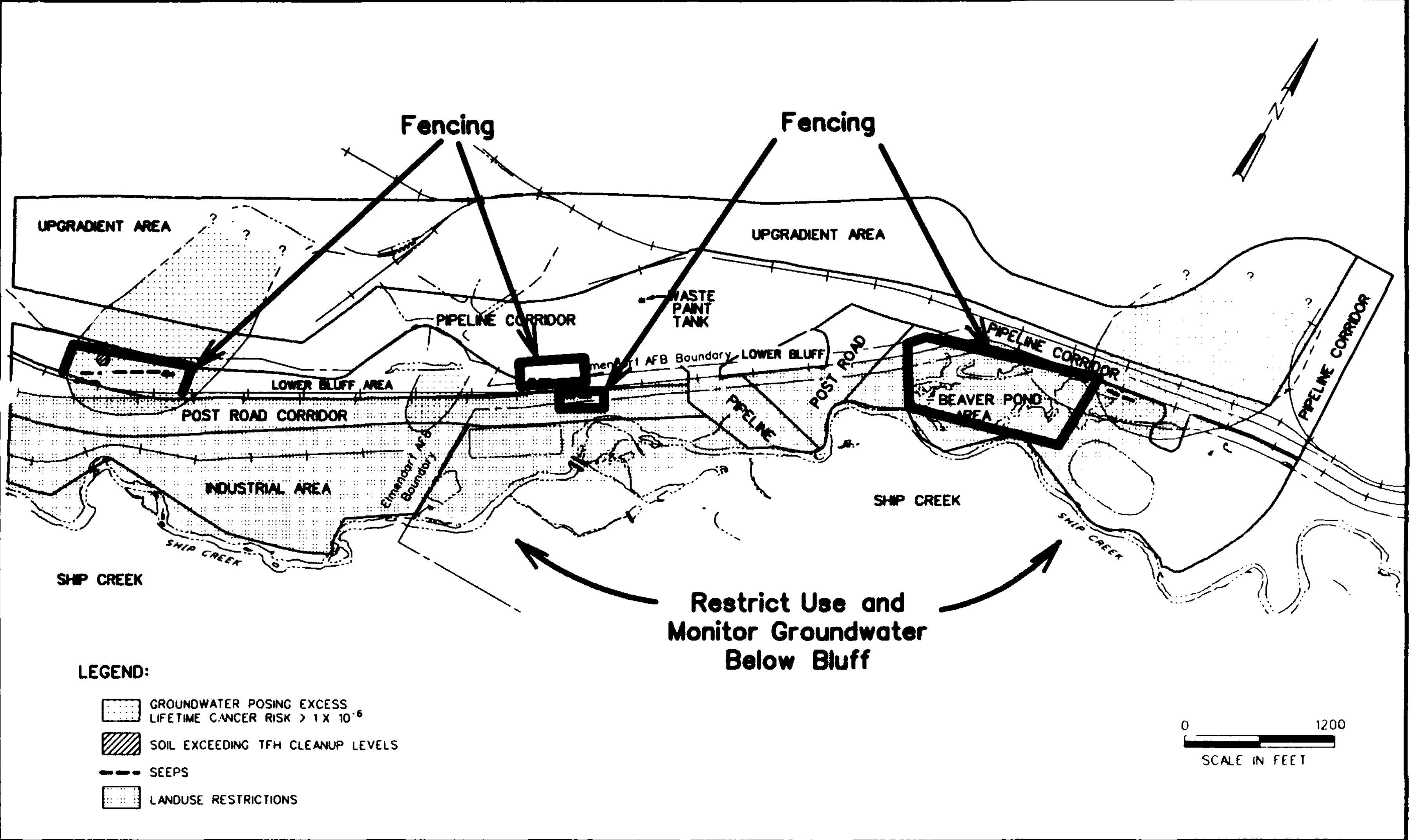

Figure 11-4. Institutional Control Alternative

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Effectiveness

CERCLA CRITERIA SCORING RESULTS
INSTITUTIONAL CONTROLS

Criterion	Groundwater
Protection of Human Health and the Environment	3
Compliance with appropriate ARARs	5
Long-Term Effectiveness and Permanence	3
Reduction in Toxicity, Mobility, and Volume through Treatment	0
Short-Term Effectiveness	3
Implementability	5

Protection of Human Health and the Environment. This alternative was considered partially protective of human health and the environment because of the potential for environmental impact. The environment is not fully protected because institutional controls will not prevent the stressed vegetation in the seep areas (there are no known current human receptors). Also, access restriction would not prevent small terrestrial animals and birds from coming in contact with the seep water. However, this alternative is protective of human health because potential exposure pathways are removed and monitored.

This alternative will not prevent exposures to groundwater; animal and plant life are not currently exposed to groundwater. Overall, the risk to human health is small because major exposure is unlikely. This alternative achieves minor reductions in human health risk while potentially restricting access of some wildlife to wetlands habitat. Bluff stability is unlikely to be compromised by this alternative.

Compliance with Appropriate ARARs. By removing groundwater as a potential drinking water supply, this alternative will comply with water quality potential ARARs. Potential action-specific ARARs protecting workers during construction of fences would apply.

Long-Term Effectiveness and Permanence. This alternative was given a score of partially effective for this criterion because of the conditional nature of the effectiveness. If conditions remain constant, the institutional controls will be effective in the long term for protecting human health. Since the Air Force is a branch of the federal government, the permanence of maintaining institutional controls is assumed (compared to a relatively small commercial operation that may move or go out of business). Institutional controls are not effective in the long term for the environment since the environment has been affected in the seep areas, and little environmental protection is provided by institutional controls in these areas.

Reduction in Toxicity, Mobility, and Volume Through Treatment. There is no active treatment performed; therefore, according to the CERCLA guidance, the toxicity, mobility, and volume of organic contamination in groundwater and seepage are not reduced.

Short-Term Effectiveness. This alternative was given a score of being partially effective for this criterion. The short-term effectiveness analysis is similar to the long term analysis. This alternative is effective in the short term since institutional controls remove the groundwater from the exposure pathways, thereby protecting human health. However, little environmental protection is provided.

Implementability. Institutional controls can be easily implemented at OU 5. There are no current uses of shallow groundwater so implementing groundwater use restrictions would not require finding alternative water sources. Deed restrictions can be prepared and enforced. If Elmendorf AFB were to close, Air Force policy requires that seconded parcels be remediated to cleanup levels appropriate for intended future use. Any deed restrictions would be considered when planning reuse of the parcels.

Implementing access controls would not be significantly affected by topography or physical access to the seep or Beaver Pond area. There are no known mission-related obstacles related to restricting access to these areas.

Alternative #3 — Passive Extraction with Constructed Wetlands

This alternative would consist of eliminating the seeps by intercepting the groundwater before it emerges on the face of the bluff and treating the diverted flow in a constructed wetland. Constructed wetlands use the same mechanisms as natural wetlands to reduce contamination. The difference is the parameters affecting treatment can be more effectively controlled within a constructed wetland. This alternative is only applicable to seeps since passive extraction would capture a much smaller percentage of the overall groundwater flow. The bulk of the groundwater would continue to be affected by natural attenuation (Alternative #1).

Description — Water would be collected in horizontal drains installed in the face of the bluff and pumped into the constructed wetland. Schematics of the alternative in elevation and plan view are provided on Figures 11-5 and 11-6. Wetlands are commonly anaerobic environments with an aerobic environment near the root zone. The constructed wetland would contain both anaerobic and aerobic zones to mimic the natural wetland environment. The constructed wetland may have to be covered with netting to prevent wildlife from entering. The Snowmelt Pond area is proposed as the location for the constructed wetlands. A detailed analysis of the wetland treatment portion of this alternative is provided in Section 11.3.3.

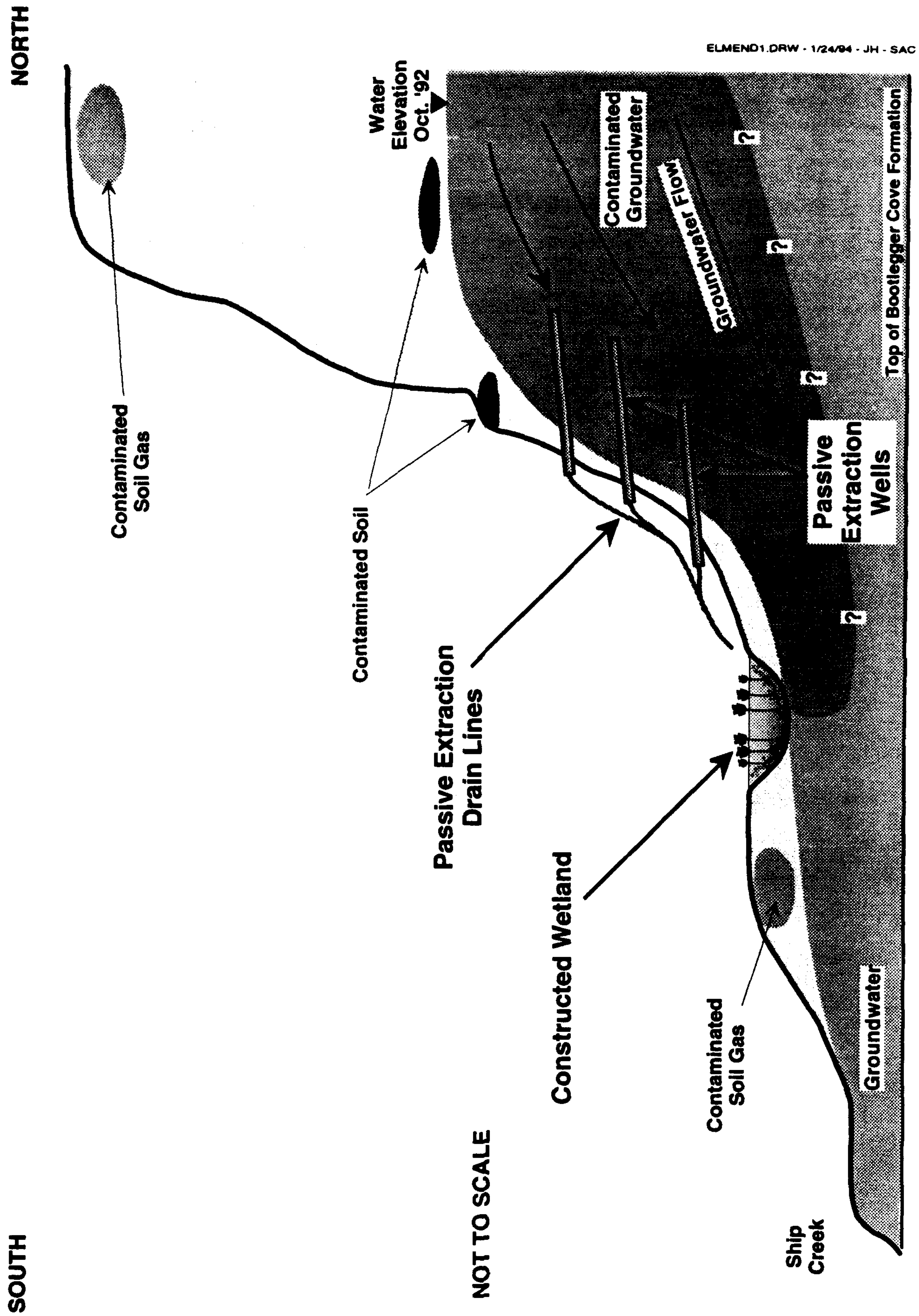

Figure 11-5. Passive Extraction with Constructed Wetland Treatment Alternative (Elevation View)

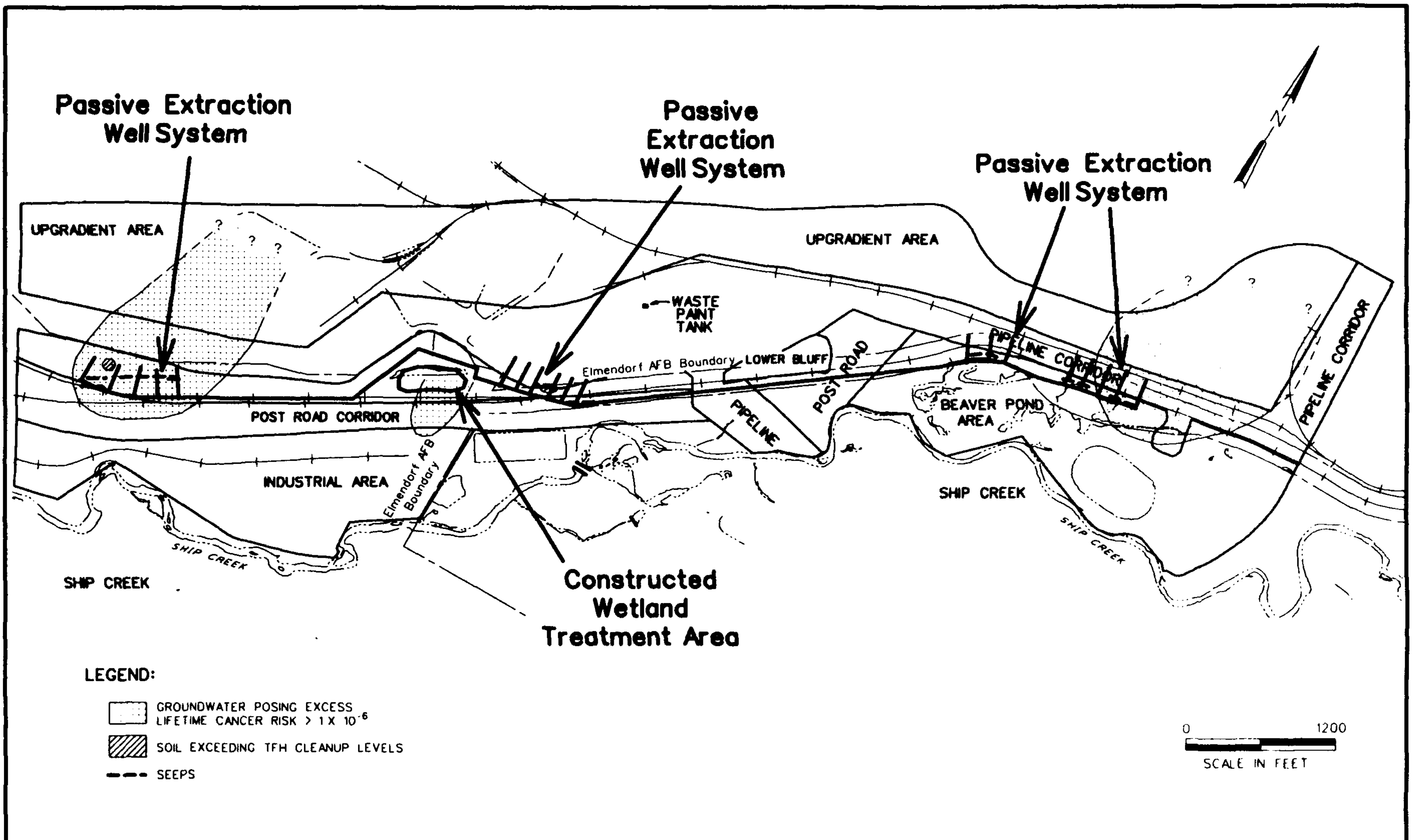

Figure 11-6. Passive Extraction with Constructed Wetland Treatment Alternative

Effectiveness

CERCLA CRITERIA SCORING RESULTS
PASSIVE EXTRACTION WITH CONSTRUCTED WETLANDS TREATMENT

Criterion	Seeps
Protection of Human Health and the Environment	5
Compliance with appropriate ARARs	5
Long-Term Effectiveness and Permanence	5
Reduction in Toxicity, Mobility, and Volume through Treatment	5
Short-Term Effectiveness	5
Implementability	3

Protection of Human Health and the Environment. This alternative is protective of human health and the environment by eliminating the seeps, thereby eliminating the potential for human, animal, and plant exposure. The installation of the drains would eliminate the exposure routes for the seeps to animal and plant receptors.

The bulk of the groundwater would continue to be affected by natural attenuation. Groundwater, which would not be treated, is not currently a route for exposure to plants, animals, or human receptors. The system can be installed without damaging the wetland environment and with only minor damage to the bluff stability. However, damage to bluff stability is more than offset by the overall risk reduction resulting from this alternative.

Compliance with Appropriate ARARs. This alternative complies with potential chemical- and location-specific ARARs for the seepage. Potential action-specific ARARs may result in the need for a permit or approval for discharge from the wetlands, depending upon the attainable cleanup levels. An NPDES permit or waivers may be needed, depending on the level of residual contaminants in the effluent. Currently, it is assumed that waivers will not be needed and approvals can be obtained. This assumption is based on the low concentrations of COCs expected in the treated effluent. A treatability study would be needed to confirm this assumption. Potential action-specific ARARs designed to protect workers drilling the extraction wells and operating the wetland would have to be complied with. Some volatilization of organics would occur, and they would enter the atmosphere. Volatile loading would be very small, so emissions should be low. A treatability study would be needed to see if potential air quality ARARs apply.

Long-Term Effectiveness and Permanence. This approach would reduce contaminant levels in the seepage. Once all contamination is removed, seepage concerns should be permanently eliminated. The time required for treatment cannot be determined, but was assumed to be 30 years. When the treatment is complete, there would be no threat to either human health or the environment from the seeps.

Reduction in Toxicity, Mobility, and Volume Through Treatment. For seeps, the toxicity and volume of contamination are reduced by treatment in the constructed wetland. There is no active treatment of the groundwater, so there is no reduction in these parameters.

Short-Term Effectiveness. This alternative is effective in the short term. All seeping groundwater would be collected, removing any short-term exposure concerns. To document the effectiveness of the treatment system, monitoring of the effluent would be performed.

Emissions to the air are expected to be small, posing little risk to workers near the wetland or pedestrians. A treatability study would be necessary to confirm this assumption.

The potential occupational exposure to workers constructing the wells in the seep area is expected to be small. Risks can be managed by taking appropriate health and safety measures.

Implementability. Though this alternative is implementable, treatability tests would be required to determine biological and physical requirements and the effects of winter climate. However, in the eastern area, it would be difficult to install passive extraction systems because the pond is located close to the bluff. Access for equipment will also be limited. This difficulty in the eastern area will be considered when evaluating preferred multimedia alternatives for that area.

Alternative #4 — Passive Extraction with Activated Carbon Treatment

This alternative uses passive horizontal drains and pumps the extracted water to an activated carbon treatment system. Effluent from the treatment facility would be reinjected into the shallow aquifer upgradient from Ship Creek. The fuel hydrocarbons or VOCs are adsorbed onto the carbon and destroyed during regeneration of the carbon. Schematics of this alternative in elevation and plan view are shown on Figures 11-7 and 11-8. This alternative will not affect the bulk of the groundwater flow, which will continue to be affected by natural attenuation.

Description — Passive drains would be installed into the bluff where there are seeps. The seep water would be drained by gravity from the bluff into a flow control holding tank. A particulate filter would prevent sediment accumulation in the tank. The water would be treated using aqueous-phase carbon adsorption. A single treatment system was used as the basis for evaluation of this alternative (see Figure 11-8). The effluent would be discharged to a flow control tank and into a reinjection system. In general, iron and manganese concentrations are low and unlikely to cause significant fouling of the carbon system. However, if periodic monitoring of the treatment system suggests metals would reduce the efficiency of the carbon system, some method of pretreatment could be considered, depending on the additional costs versus higher carbon replacement rates. The determining variable is the average concentration of iron and manganese in the seep water before carbon treatment. The extraction wells would be monitored to determine the extent of mineral precipitation in the extraction system.

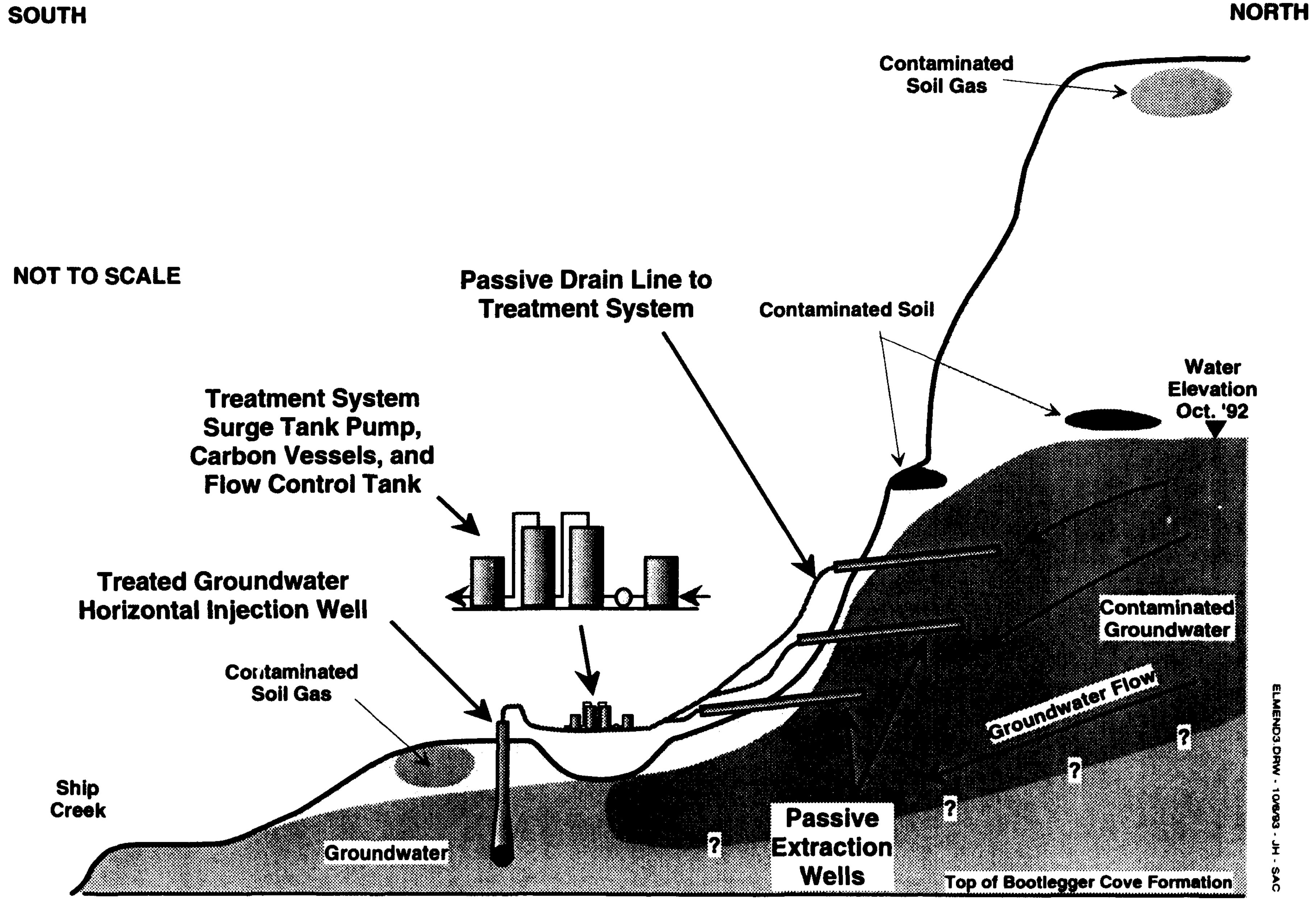

Figure 11-7. Passive Extraction with Carbon Treatment Alternative (Elevation View)

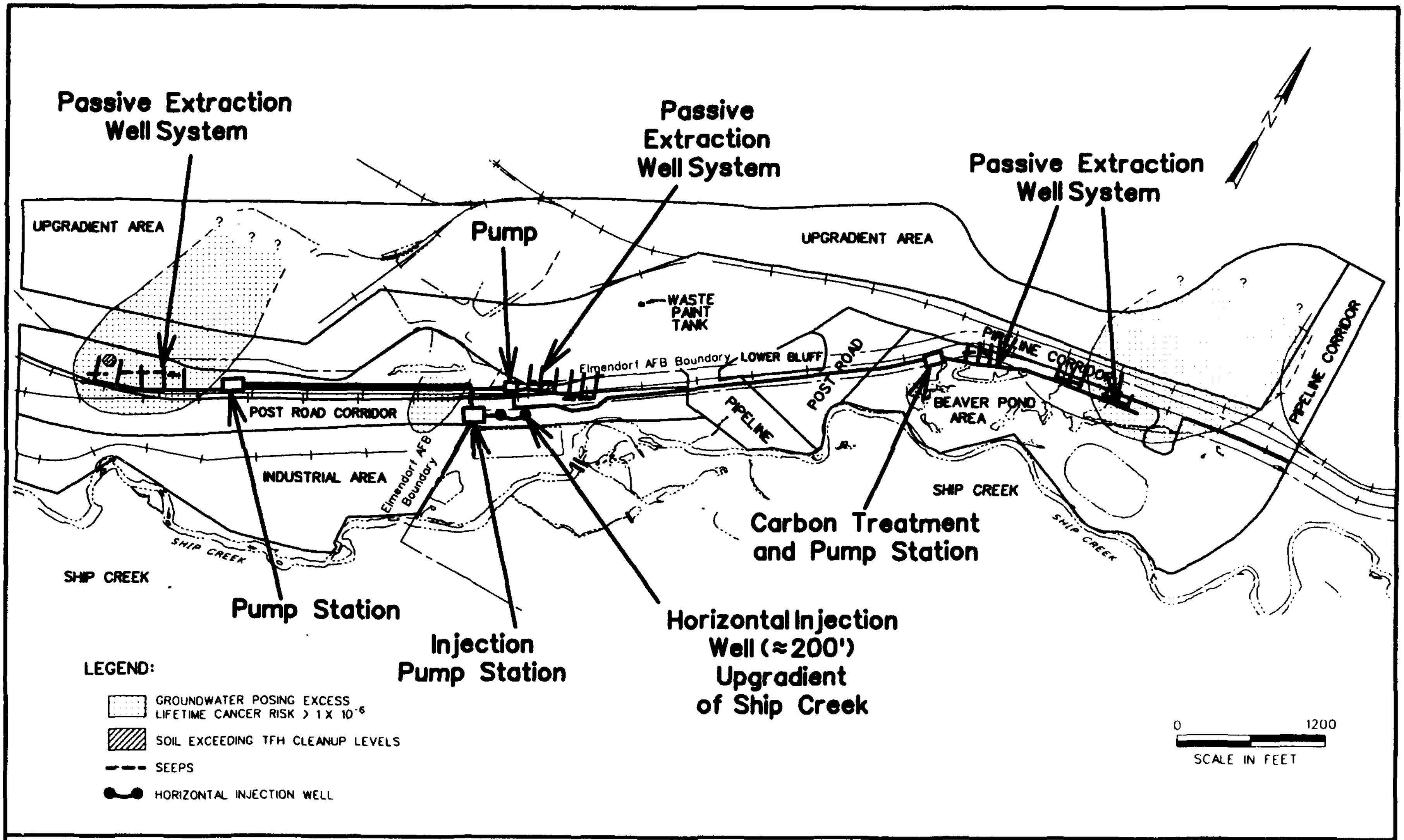

Figure 11-8. Passive Extraction with Activated Carbon Treatment Alternative

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Effectiveness

CERCLA CRITERIA SCORING RESULTS
PASSIVE EXTRACTION WITH CARBON TREATMENT

Criterion	Seeps
Protection of Human Health and the Environment	5
Compliance with appropriate ARARs	5
Long-Term Effectiveness and Permanence	5
Reduction in Toxicity, Mobility, and Volume through Treatment	5
Short-Term Effectiveness	5
Implementability	5

Protection of Human Health and the Environment. This alternative is protective because it eliminates potential exposure to contamination. The installation of the drains and treatment system would eliminate the exposure routes for the seeps to animal and plant receptors. The seepage would be fully contained until contamination is removed. There would be no exposures to either humans or wildlife. The bulk of the groundwater would continue to be affected by natural attenuation; however, there is currently not an exposure pathway for groundwater to human, plant, or animal receptors. Installing the passive extraction wells could cause some slope instability. Overall, the risk to human health and the environment from seeps would be eliminated with minor, if any, damage to the environment.

Compliance with Appropriate ARARs. This alternative complies with potential ARARs for the seeps. Treatment with activated carbon can remove all the contaminants detected in OU 5 groundwater to levels below those listed in the National and Alaska State Drinking Water Standards. Compliance with potential ARARs for effluent disposal will be dependent on locating suitable reinjection well sites. Carbon regeneration facilities are not available in the Anchorage area. Therefore, spent carbon would be transported out of state for regeneration. Analysis of the spent carbon would be required before shipment to determine manifest requirements.

Long-Term Effectiveness and Permanence. This alternative is effective for seeps because contaminants are removed and destroyed. The timeframe for remediation cannot be determined, but is assumed to be 30 years. Once remediation goals are achieved there would be no threat to human health and the environment from seeps.

Reduction in Toxicity, Mobility, and Volume Through Treatment. The activated carbon treatment will reduce the toxicity, mobility, and volume of contaminant concentrations in seeps, by adsorption onto activated carbon. Contaminants would later be destroyed by thermal regeneration of the carbon.

Short-Term Effectiveness. This alternative is effective in the short term. All seeping groundwater would be collected, removing any short-term exposure concerns. To document the effectiveness of the treatment system, monitoring of the effluent would be performed.

Operation of the treatment system should pose little risk to human health and the environment. The treatment system should have no by-product that could affect people or wildlife. The potential occupational exposure to workers installing the drains and treatment system is expected to be small. Risks can be managed by taking appropriate health and safety measures.

During operation, the carbon would have to be changed out approximately once a year. The facility would be taken off line for no more than eight hours during changeout, so there would be little down time.

Implementability. Activated carbon treatment of seepage is both technically and administratively feasible. The system would have to be designed to handle seasonal variation in flows as well as winter conditions. Activated carbon has been used extensively in similar applications and has achieved the necessary cleanup levels. The treatment system would require little space (approximately 400 square feet, depending upon flow and contaminant loading). The small land commitment should not interfere with operations at Elmendorf AFB. If care is taken when installing the extraction wells, slope stability will not be compromised. However, in the eastern area installation of passive extraction systems may be difficult in that area as discussed under Alternative #3.

Alternative #5 — Air Sparging and Soil Vapor Extraction (SVE)

In this alternative, compressed air would be injected into the subsurface to strip contaminants from soil and groundwater. The resulting vapor would be extracted and treated prior to discharge to the atmosphere. When air is injected below the surface of contaminated groundwater (air sparging), it strips VOCs from the water and the adsorbed contaminants from the soil by volatilization. The volatilized compounds are carried up into the unsaturated soil where they can be captured by soil vapor extraction. In addition, the air supplies oxygen to indigenous microbes in the saturated and vadose zones, resulting in increased biological degradation of groundwater and soil contaminants. From the injection point the air tends to move upward and outward, and influences a large area. The combination of SVE and air sparging can provide several advantages over air sparging or SVE alone, including the ability to act as a barrier to limit plume migration, enhanced biodegradation, better control of air flow through the soil resulting in more concentrated offgas for treatment, and reduced remediation time.

Description — At OU 5 several air sparging and SVE wells would be installed in the areas where the excess cancer risk from exposure to groundwater is greater than 1×10^{-6}. The wells would be horizontal to maximize their effectiveness. Horizontal wells have been shown to be more effective than vertical wells because of the greater screen surface area per horizontal well and the resulting influence in the subsurface soils and groundwater. A schematic of the alternative in elevation and plan view is shown on Figures 11-9 and 11-10.

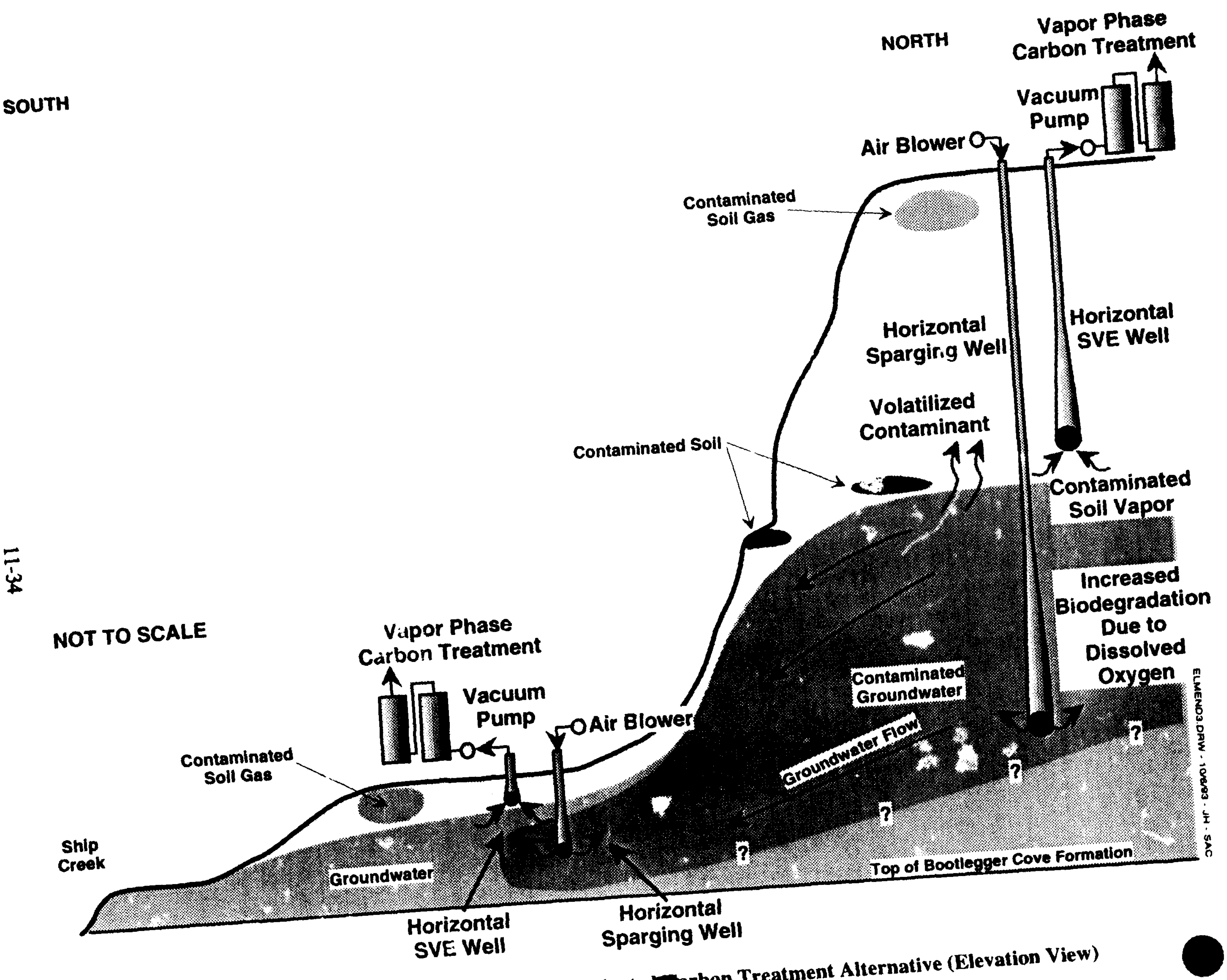

Figure 11-9. Air Sparging with SVE and Activate[illegible]arbon Treatment Alternative (Elevation View)

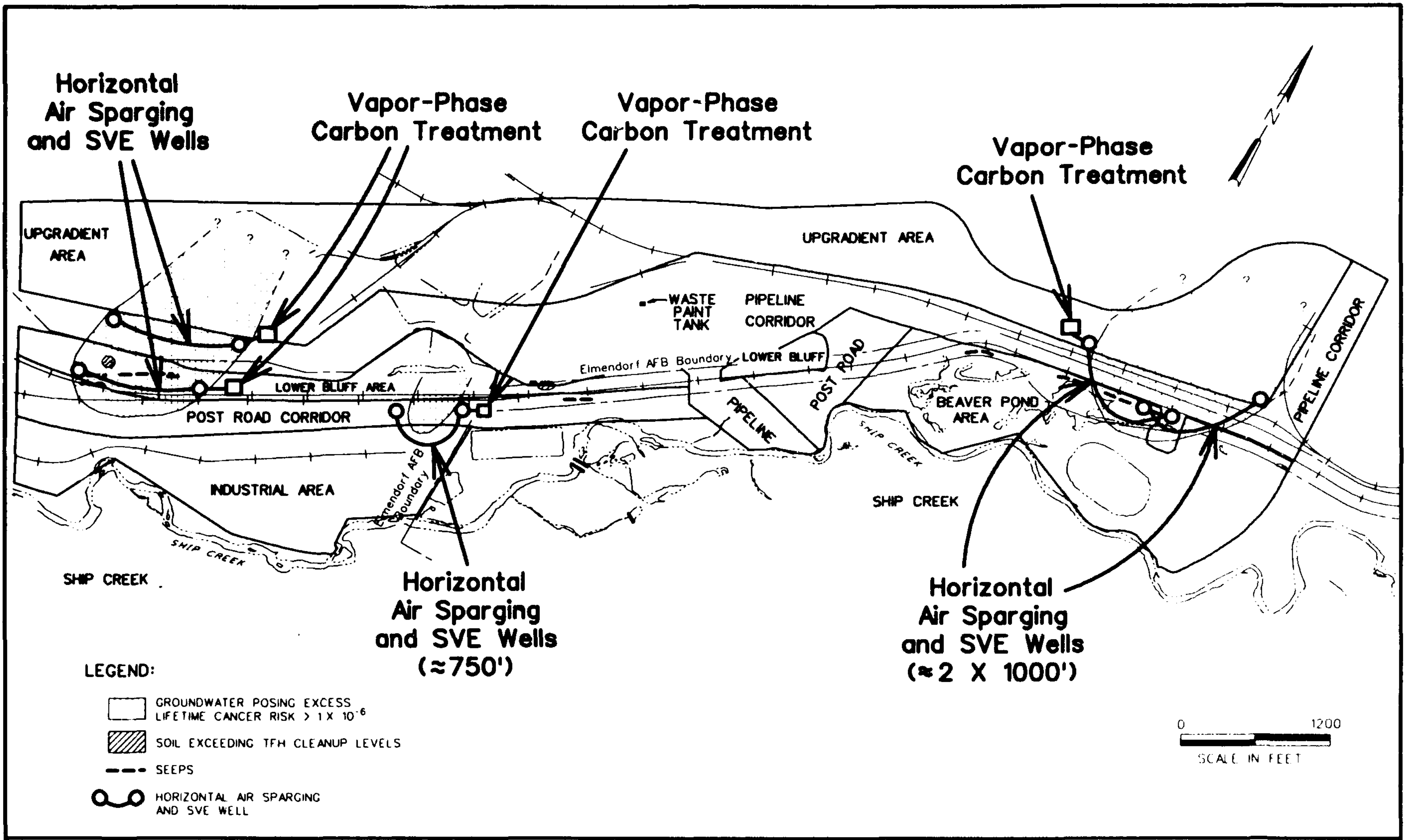

Figure 11-10. Air Sparging with SVE and Activated Carbon Treatment Alternative

ELM5 ALTASVE6 VRL SAC [illegible] 94

The sparging wells would be connected to a blower, capable of injecting air into the aquifer. The SVE wells would be connected to a vacuum pump that discharges vapor to activated carbon canisters to remove contaminants prior to discharge to the atmosphere. Pilot testing would be needed to determine design flows, determine radius of influence, and to size carbon canisters.

Effectiveness

CERCLA CRITERIA SCORING RESULTS
AIR SPARGING WITH SOIL VAPOR EXTRACTION

Criterion	Groundwater	Seeps
Protection of Human Health and the Environment	5	5
Compliance with appropriate ARARs	5	5
Long-Term Effectiveness and Permanence	5	5
Reduction in Toxicity, Mobility, and Volume	5	5
Short-Term Effectiveness	3	3
Implementability	3	3

Protection of Human Health and the Environment. This alternative is protective of both human health and the environment for all groundwater. Stripping volatiles would remove both aromatic and chlorinated compounds from the shallow groundwater, including water that is discharged as seepage along the bluff. Therefore, clean water would be discharged in the seeps, which would protect the plants and animals that are exposed to these seeps.

Groundwater deeper in the shallow aquifer would also be treated; however, groundwater is currently not a pathway for human, plant, or animal contact. The units can be installed in a variety of sites below the bluff with a minimum disruption of the environment. They can be installed above the bluff without compromising slope stability.

Overall, there is little potential for additional damage to the environment that would offset this alternative's risk reduction.

Compliance with Appropriate ARARs. Air sparging in conjunction with soil vapor extraction and activated carbon treatment would be in compliance with potential ARARs. Air sparging in conjunction with soil vapor extraction has been proven effective in the removal of volatile organics from groundwater and enhancing biodegradation of fuel hydrocarbons and VOCs, thus complying with potential chemical-specific ARARs. Potential action-specific ARARs include control of air emissions and waste disposal. Potential ARARs for air emissions would be met by activated carbon treatment of extracted vapor. Carbon regeneration off site would require a manifest.

Long-Term Effectiveness and Permanence. This alternative would be effective in treating the groundwater over the long term. Contaminants would be removed from the groundwater and soil, and then would be destroyed during regeneration of the activated carbon. The timeframe for remediation is not known, but is assumed to be 30 years.

Reduction in Toxicity, Mobility, and Volume Through Treatment. Reduction in the toxicity, mobility, and volume of contaminants in the groundwater would be achieved. This alternative would also aid in reducing VOC and fuel hydrocarbon contamination in the vadose zone through increased biodegradation and soil vapor extraction.

Short-Term Effectiveness. This alternative would be effective in the short term for treating groundwater in the upper bluff area. The effectiveness of SVE may be limited in the lower bluff area. The shallow groundwater (<10 feet) could result in breakthrough of the vacuum from the land surface, requiring a large number of closely spaced vapor extraction wells. Incomplete capture of contaminants stripped from the groundwater could result in a short-term increase in fugitive VOC emissions.

Problems with preferential air pathways, biofouling of wells, and mineral precipitation have been encountered during sparging tests at other sites both in Alaska and the continental United States. Preferential air pathways could lessen the effectiveness of this alternative by allowing the possibility that groundwater might pass by the sparging well untreated or contaminated air may not be captured by the SVE extraction well(s). Both biofouling and mineral precipitation could lead to inefficient system operation, which would also lessen the effectiveness of this alternative. Efficient system operation is dependent on the performance of routine maintenance of the air sparging, soil vapor extraction, and carbon treatment systems, including regeneration of the carbon. Periodic monitoring of the groundwater and carbon treatment system effluent would be necessary to determine system efficiency and effectiveness.

Oxygenation of groundwater could affect biosystems in wetland areas that receive groundwater discharge. The effect an increase in oxygen would have on the current habitat balance in the wetland is not known. Increased oxygen in the water could shift the wetland environment away from an anaerobic environment towards an increased aerobic environment. Relatively small increases in oxygen could influence the wetland by creating more plant/animal diversity that could increase the effectiveness of the systems that naturally attenuate groundwater impacts in area of the wetland. If there were large changes in the nutrient balance, excessive plant growth could occur, potentially impacting the environment.

Implementability. This alternative can be easily implemented in the upper bluff area at OU 5. Because the soil in the bluff is composed mostly of interbedded sands and gravel with some thin, discontinuous silty zones, the vapors should travel well through the media. The alluvial deposits should serve as an adequate medium for this alternative. In the lower bluff area, the implementability is reduced because some of the land is not owned by the Air Force and barriers to siting wells. Constructing the additional wells would be affected by existing buildings, roads, utilities, and wetlands in the lower bluff area. Also, because of potential vacuum breakthrough, SVE well placement would need to be evaluated to assure capture of sparged vapors.

More than one system would be needed for OU 5 to reduce the amount of piping that would be required. Additional equipment or chemical additives may be necessary to ensure that biofouling or mineral precipitation does not occur. A treatability study is recommended before implementation to determine viability of this technology and if the increased oxygen content in the groundwater due to air sparging would have an adverse effect on down gradient ecology.

Alternative #6 — Active Extraction with Air Stripping and Carbon Treatment

This alternative would involve installation of groundwater extraction wells and construction of an air stripper with activated carbon treating the off gases. Figures 11-11 and 11-12 show a schematic of this alternative in elevation and plan view.

Description — The evaluation of this alternative is based on three extraction and treatment systems. Three systems are considered because the groundwater plume areas where the contaminant concentrations pose an excess lifetime cancer risk of greater than 1×10^{-6} are located in three areas approximately 2,500 feet apart. Five wells with a combined flow of 400 to 1,000 gallons per minute (gpm) are estimated to be needed in the western portion of the OU. Four wells with a combined flow of 1,900 to 2,300 gpm would be needed in the eastern portion of the OU. Three additional extraction wells with a combined flow of 80 to 100 gpm and a low flow (50 to 100 gpm) extraction system would be located in the center of OU 5 (Figure 11-12). The low flow extraction system would be located near seeps that are not associated with a groundwater impact with an excess cancer risk of 1×10^{-6}. These flow rates have been assumed (based on preliminary calculations) to capture the entire leading edge of the plumes and to drain the seeps. Contaminated groundwater which has already passed the bluff area would not be captured in this alternative.

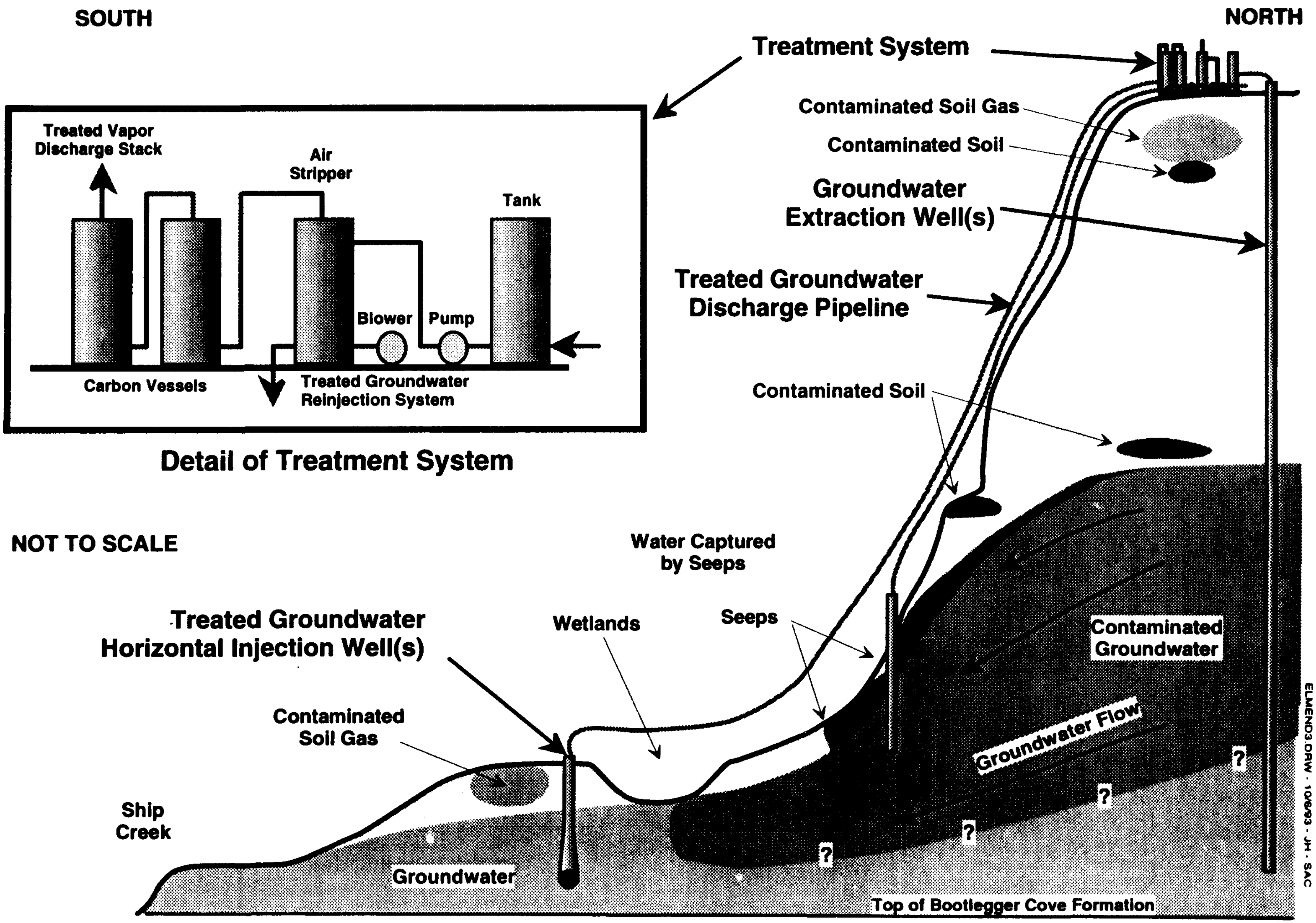

Figure 11-11. Active Extraction, Air Stripping, and Activated Carbon Treatment Alternative (Elevation View)

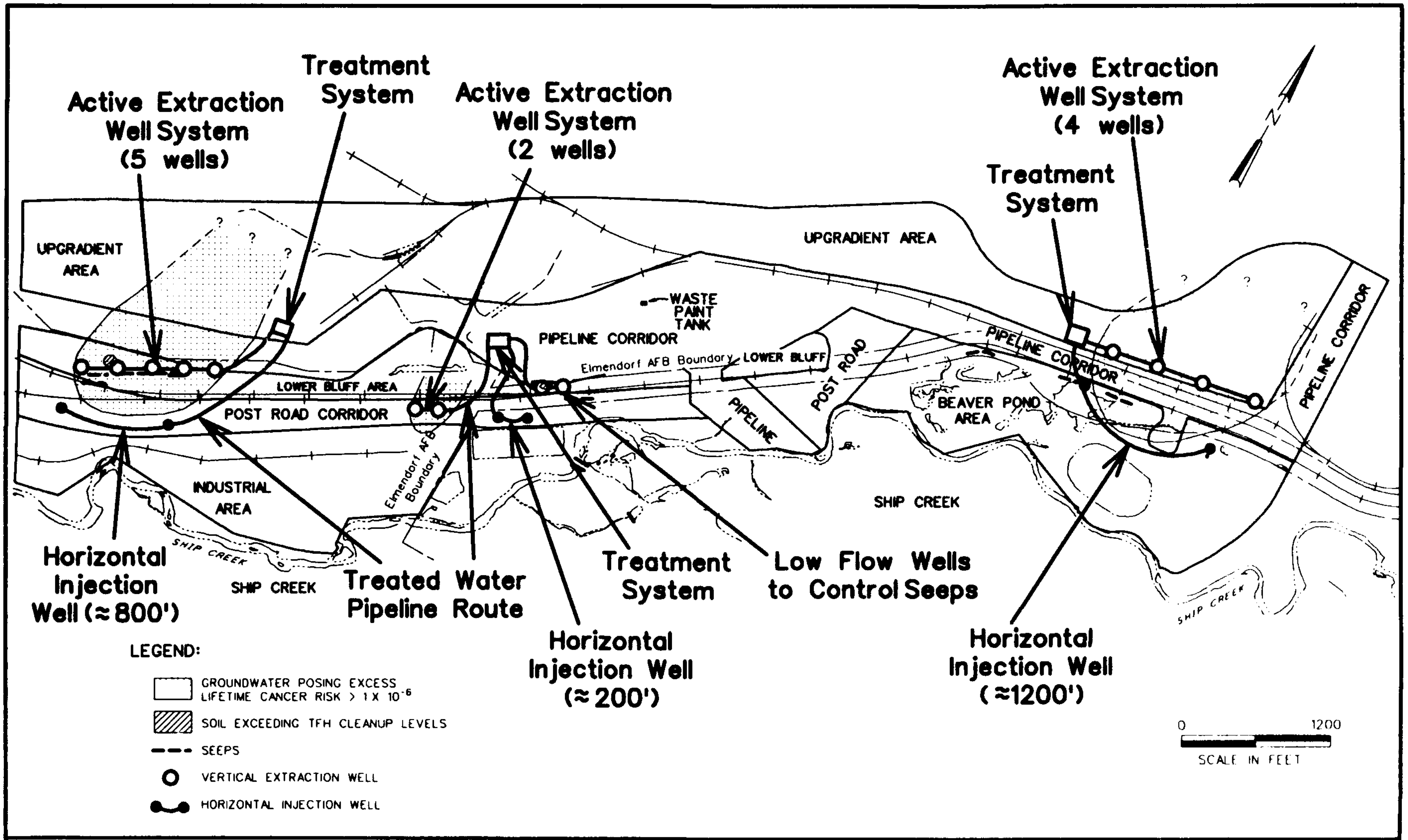

Figure 11-12. Active Extraction, Air Stripping, and Activated Carbon Treatment Alternative

ELM5 ALTXAS6 VRL SAC 2/02/94

In each of the plume areas, groundwater would be pumped from the wells and fed, through a header system, to a flow control holding tank. From the tank the water would be pumped through an air stripper. Volatiles would be stripped from groundwater and the effluent would be discharged to horizontal reinjection wells located at the base of the bluff. Because the groundwater is shallow in the reinjection area (< 10 feet), there is little vadose zone storage capacity. Therefore, horizontal reinjection wells are best suited for this alternative. A hydrogeologic model would be needed to locate reinjection wells followed by close flow monitoring to ensure that there is no adverse effect.

Offgases from the stripper would be treated with activated carbon. At least two canisters would be used so one could be changed out without shutting down the system.

Effectiveness

CERCLA CRITERIA SCORING RESULTS
ACTIVE EXTRACTION WITH AIR STRIPPING AND CARBON TREATMENT

Criterion	Groundwater	Seeps
Protection of Human Health and the Environment	3	3
Compliance with appropriate ARARs	5	5
Long-Term Effectiveness and Permanence	5	5
Reduction in Toxicity, Mobility, and Volume	5	5
Short-Term Effectiveness	3	3
Implementability	3	3

Protection of Human Health and the Environment. This alternative protects human health and the environment from exposure to groundwater impacts. Migration of the plumes is stopped, preventing additional groundwater impact in the lower bluff area (the cancer risk in the lower bluff area is currently less that 1 x 10^{-6}). The seeps would be stopped, depressing the groundwater below their exit points to the surface. Removal of the seeps would protect receptors.

In the eastern portion of OU 5, the removal of the seeps and possible local lowering of the water table could upset the hydrology of the wetlands environment. In the west and central portions of OU 5, the effect of drying up the seeps would be small because there are fewer wetlands environments. Water for the wetlands in OU 5 comes from a combination of precipitation, runoff, seeps, and groundwater. Compared to the "no action" alternative, this alternative imposes significant environmental costs to achieve risk reduction in some portions of OU 5.

Compliance with Appropriate ARARs. This alternative meets potential chemical-specific ARARs. Potential action-specific ARARs affect air emissions and the discharge of treated water. The alternative complies with potential emission-related ARARs by treating the offgases. Compliance with potential ARARs for reinjection is dependent on the treatment system efficiency and identification of an appropriate reinjection site. A treatability study would be needed to determine organic concentrations in the effluent. Groundwater modelling would be needed to locate the reinjection sites.

Long-Term Effectiveness and Permanence. Groundwater extraction and treatment is an effective long-term solution to groundwater contamination. The timeframe for treatment is not known. It was assumed to be 30 years. Once cleanup levels have been achieved at OU 5 and upgradient, the remediation is permanent. Contaminants are destroyed when the carbon is regenerated. This alternative will not produce toxic by-products.

Reduction in Toxicity, Mobility, and Volume Through Treatment. Reduction in the toxicity, mobility, and volume of contaminants in the groundwater would be achieved with this alternative. The contaminants would be removed from the groundwater through the air stripper and carbon adsorption units and destroyed during carbon regeneration.

Short-Term Effectiveness. This type of system would be effective in the short term. Efficient operation is dependent on the performance of routine maintenance, including the regeneration of the activated carbon. Monitoring of the groundwater would be necessary to determine the systems efficiency and effectiveness.

Possible adverse effects on the natural ecology may result downstream from the reinjection wells due to increased oxygen content in the water. The Beaver Pond is fed by water from Ship Creek and groundwater. Extracting up to 2,300 gallons per minute upgradient from the Beaver Pond area could affect the water balance in the pond. However, this balance would be restored by the reinjection of treated water. Additionally, the treated water would be oxygenated. As with the other alternatives that potentially aerate the groundwater, reinjection may alter the natural ecology where groundwater discharges into wetlands. Modelling would be needed to determine if the water balance in the wetlands is adversely affected.

Implementability. This alternative can be implemented. The technology is proven for the contaminants found in the groundwater at OU 5 and the necessary equipment is readily available. The pipes leading from the seeps in the center of OU 5 to the treatment system at the top of the bluff would be required. This is also true for the pipes leading from the air stripper to the reinjection system. The slopes of the bluff have shown signs of failure in the past, and are considered unstable. Slope failure in the future could sever pipes. Special engineering would be needed to ensure system shutdown in the event of a pipeline failure.

The implementability score was reduced because reinjection of 2,500 to 3,500 gpm into the aquifer in the lower bluff area would be difficult. The shallow aquifer allows for little vadose zone storage capacity. Therefore, reinjection would have to be done over a wide area to accommodate the flow. Constructing such a large injection system would be complicated by roads, utilities, and buildings. Also, the current and future use of the land may be limited, because of the reinjection system. Nothing could be constructed that would interfere with the flow (large buildings requiring deep foundations etc.).

11.3.2 Detailed Assessment of Soil Remedial Alternatives

Alternative #7 — Natural Degradation

Description — This alternative provides a baseline for comparing other alternatives. Natural degradation relies upon natural physical, chemical, and biological processes to reduce contaminant concentrations to cleanup levels. The remediation time is not known. A site-specific modeling program would be needed to define degradation rates and estimate the time required to achieve cleanup levels. Monitoring of the soil, vegetation, and animals affected by contamination of soil in the seep areas would be part of this alternative. A schematic of this alternative in elevation and plan view is shown on Figures 11-13 and 11-14.

Effectiveness

CERCLA CRITERIA SCORING RESULTS
NATURAL DEGRADATION

Criterion	Soil
Protection of Human Health and the Environment	3
Compliance with appropriate ARARs	3
Long-Term Effectiveness and Permanence	5
Reduction in Toxicity, Mobility, and Volume through Treatment	0
Short-Term Effectiveness	0
Implementability	5

Protection of Human Health and the Environment. This alternative is considered to be partially protective of human health and the environment. Currently, there are no known human impacts from soil contamination, so this alternative is protective of human health in the short-term. For most of OU 5, natural degradation is also protective of the environment; however, surface contamination is present in two isolated areas in the seep zones. It is thought that the contamination is from the seeps. In these areas, vegetation is

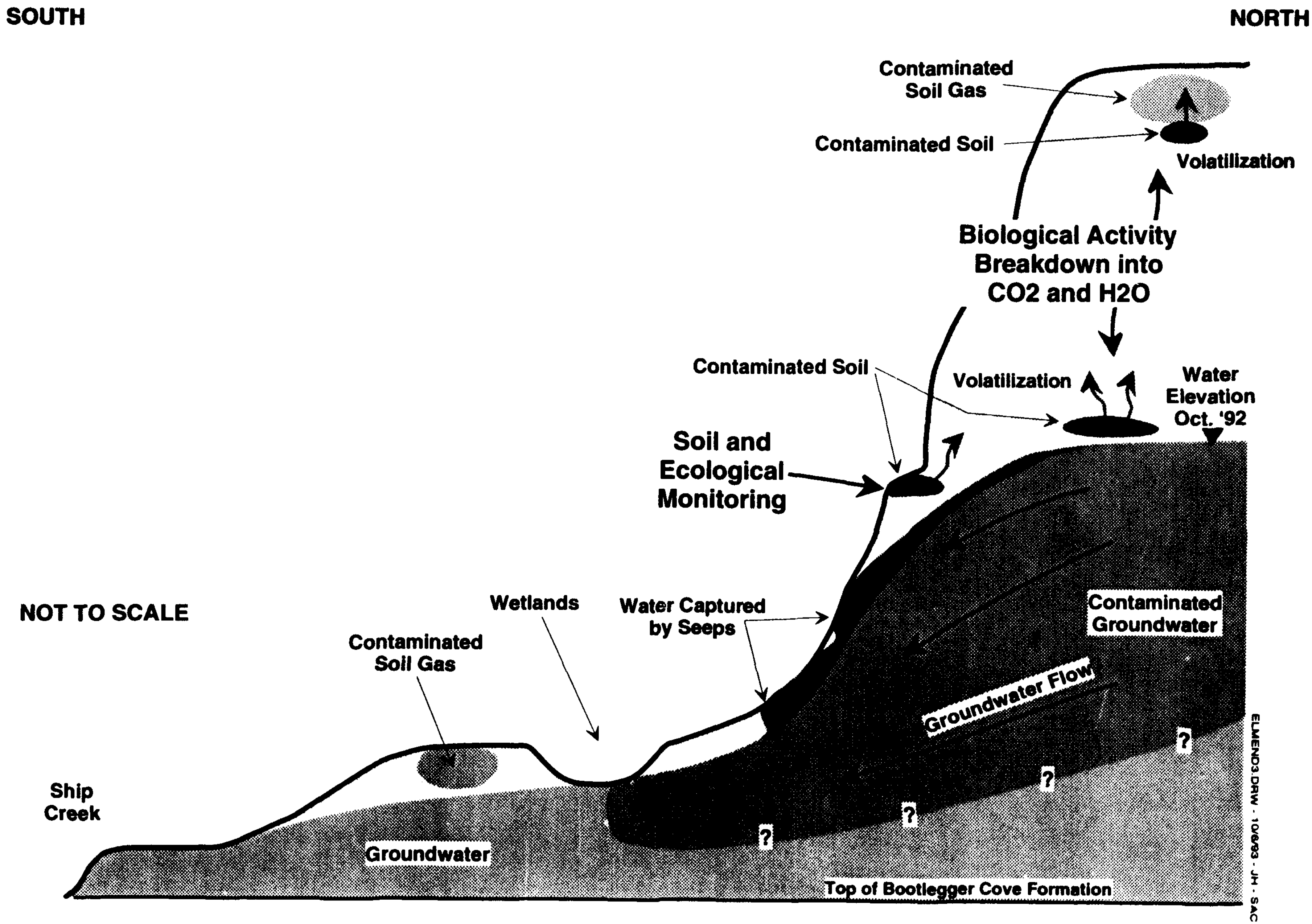

Figure 11-13. Natural Degradation of Contamination in Soil (Elevation View)

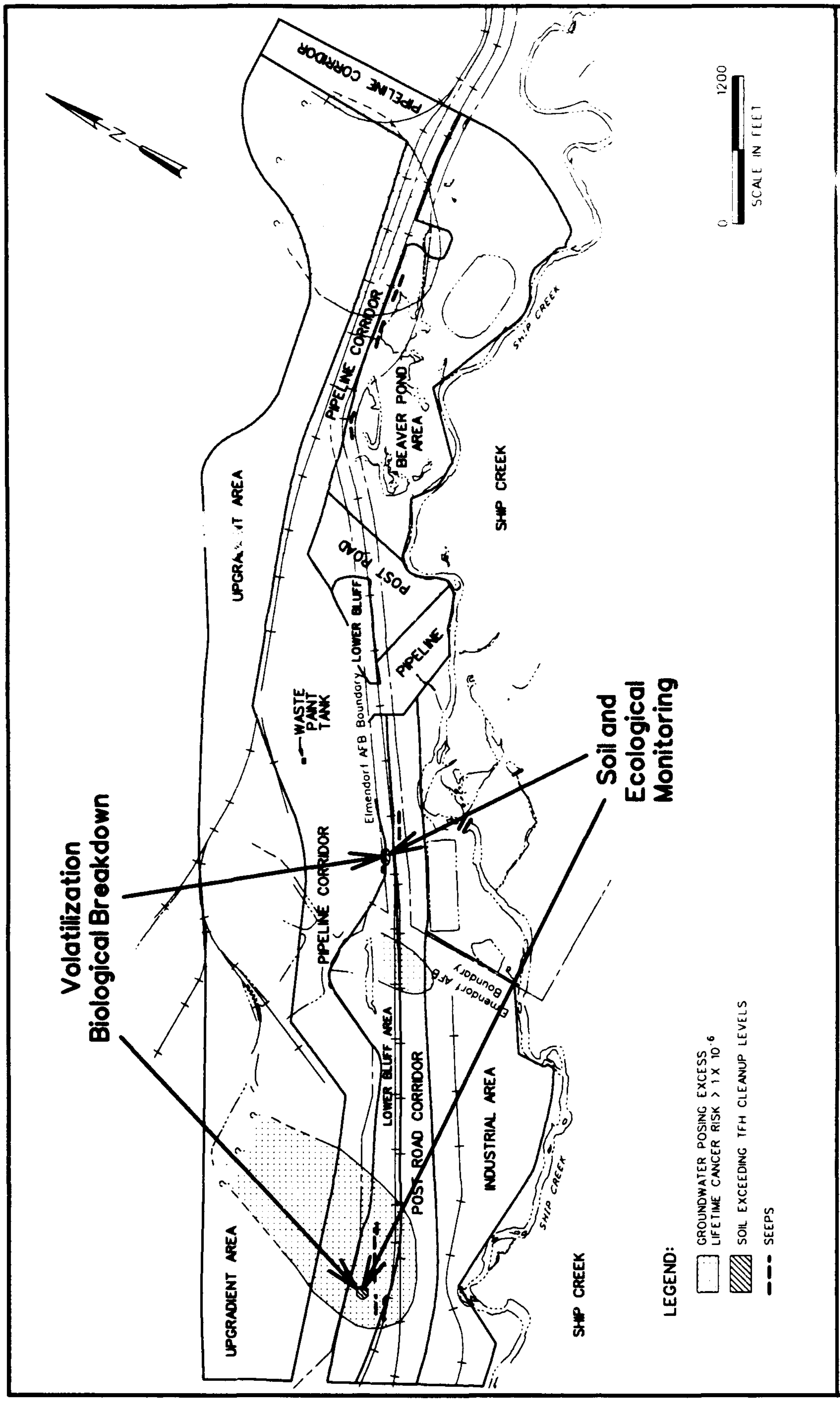

Figure 11-14. Natural Degradation of Contamination in Soil

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stressed and human and animal exposure to soil contamination is possible. Natural degradation may ultimately provide protection to receptors, but only if the degradation processes can be proven to be effective. Since this is the no action alternative, no comparison between the health and environmental risks is necessary if no action were taken and no potential impacts were caused by response actions.

Compliance with Appropriate ARARs. This alternative may not comply with potential ARARs if soil cleanup levels cannot be achieved. Also, soil contamination could contribute to groundwater contamination. While the contaminants of concern from the sites with OU 5 (mainly diesel and jet fuel) are known to degrade naturally over time; the achievable cleanup levels via natural degradation are not known. Monitoring of the soil in the seep areas would help establish a degradation rate and achievable cleanup levels could be estimated.

Long-Term Effectiveness and Permanence. This alternative may be effective in the long term. Natural degradation processes are known to effectively reduce fuel hydrocarbon contamination over time; however, the length of time required to comply with potential ARARs has not been determined. Eventually, the contaminants would break down and the remediation would be permanent.

Reduction in Toxicity, Mobility, and Volume through Treatment. This alternative does not achieve any reduction in toxicity, mobility, and volume through treatment. However, some reduction in toxicity and volume through natural biological degradation is provided. CERCLA does not consider natural reduction to fulfill this criterion.

Short-Term Effectiveness. This alternative is not effective in the short term. The exposure of vegetation and animals to the contaminated soil in the seep areas would continue in the short term. Although no additional risk of exposure will occur as a result of implementation, the contaminated soil near the water table could serve as a source of groundwater contamination.

Implementability. This alternative is implementable. The processes for implementing natural degradation are known and have been used at other sites. A waiver of some potential ARARs may be required for implementation. The implementability may be complicated by the need to acquire waivers and may negatively affect the implementability of this alternative.

Alternative #8 — Institutional Controls

Institutional controls including fencing, administrative, limiting access, and deed restrictions would be implemented.

Description — Cyclone fencing, a minimum of 6 feet high with locked gates, would be installed around areas with contaminated surface soils. Signs would be posted to alert personnel of threats to their health and safety and to the environment. In addition, administrative controls would limit access to these sites to authorized personnel only. Deed restrictions would limit future development including excavation and earthwork. A schematic of this alternative is shown on Figures 11-15 and 11-16.

Effectiveness

CERCLA CRITERIA SCORING RESULTS
INSTITUTIONAL CONTROLS

Criterion	Soil
Protection of Human Health and the Environment	3
Compliance with appropriate ARARs	3
Long-Term Effectiveness and Permanence	5
Reduction in Toxicity, Mobility, and Volume through Treatment	0
Short-Term Effectiveness	3
Implementability	3

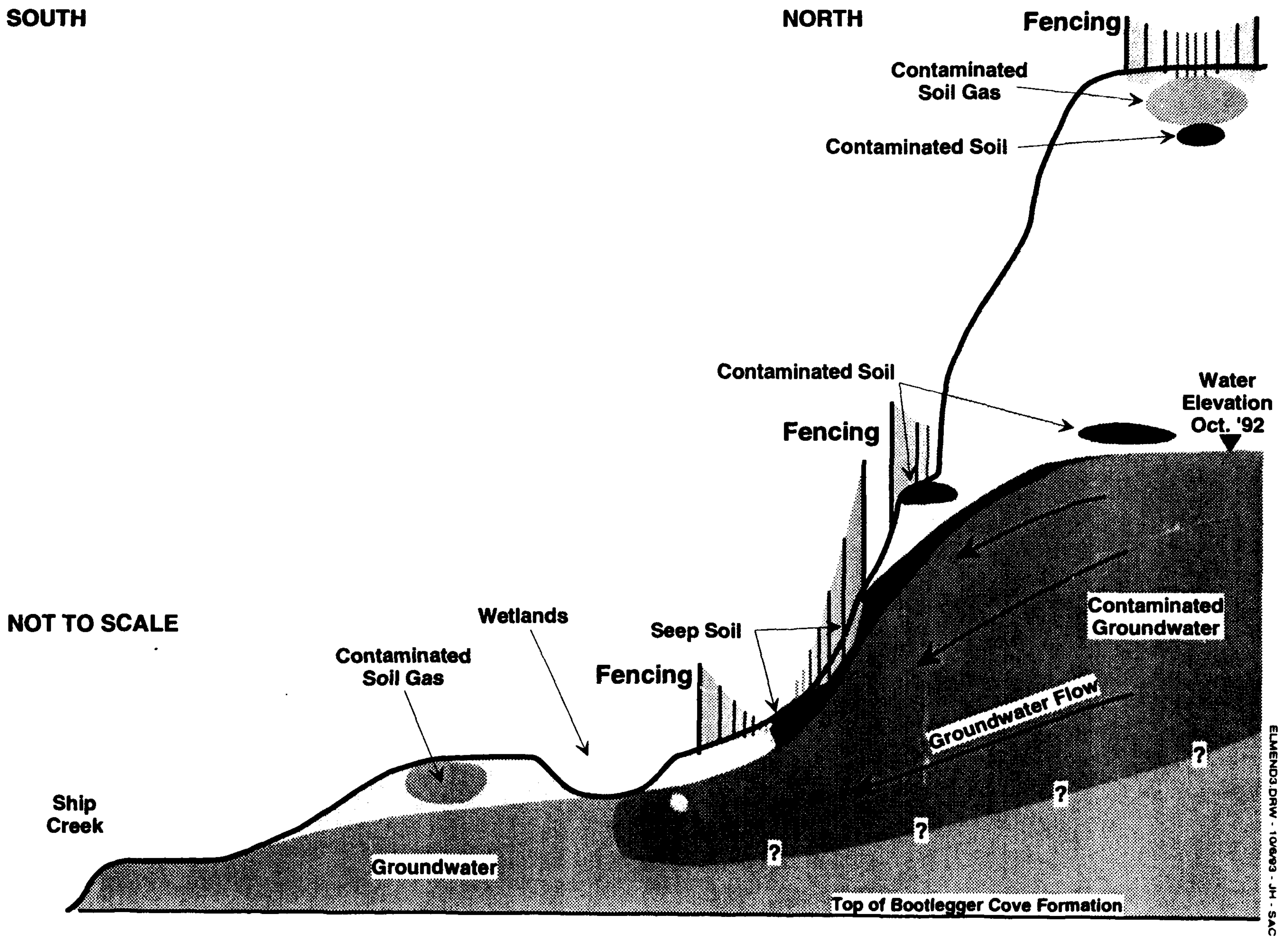

Figure 11-15. Institutional Controls Alternative (Elevation View)

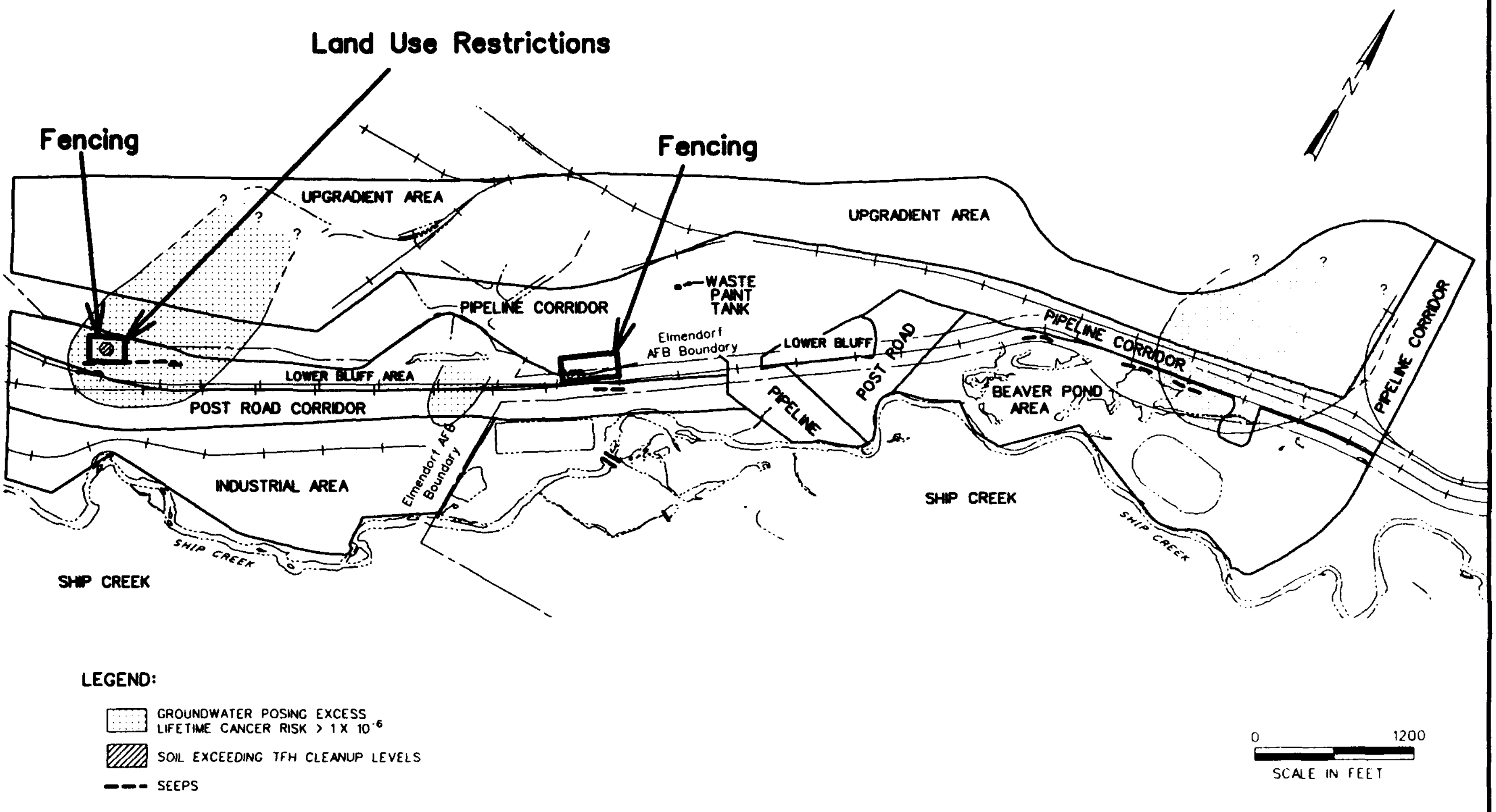

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Figure 11-16. Institutional Controls

Protection of Human Health and the Environment. Because of the potential for environmental impact this alternative was considered partially protective of human health and the environment. This alternative is partially protective of human health because direct potential exposure pathways are removed and monitored. However, migration of contaminants to groundwater may occur, which could impact human and environmental pathways. Additionally, the environment is not fully protected because institutional controls will not prevent the stressed vegetation in the seep areas. Also, access restriction would not prevent small terrestrial animals and birds from coming in contact with soil in the seep areas. The only potential environmental damage associated with this alternative would be minor potential for slope stability problems when fencing is installed on the bluff face. Overall, risk reduction is achieved with little offsetting impacts on the environment.

Compliance with Appropriate ARARs. This alternative may not comply with soils clean-up levels for hydrocarbons. The only potential action-related ARAR would be worker health and safety for the construction of the fences.

Long-Term Effectiveness and Permanence. The long-term effectiveness of institutional controls depends upon conditions not changing. If conditions do not change, the institutional controls will be effective in the long term for protecting human health. Since the Air Force is a branch of the federal government, the permanence of maintaining institutional controls is assumed (compared to a relatively small commercial operation that may move or go out of business). Institutional controls are not effective in the long term for the environment since vegetation and animal impacts from exposure to soil in the seep areas is not eliminated by institutional controls. Because of the conditional nature of the effectiveness, this alternative was given a score of being partially effective for this criterion.

Reduction in Toxicity, Mobility, and Volume Through Treatment. There is no active treatment performed; therefore, by the CERCLA guidance, the toxicity, mobility, and volume of organic contamination in soil is not reduced.

Short-Term Effectiveness. This alternative was given a score of being partially effective for this criterion. The analysis of short-term effectiveness is similar to the long-term analysis. This alternative is effective in the short term since institutional controls remove pathways thereby protecting human health. However, little environmental protection is provided.

Implementability. Institutional controls can be easily implemented at OU 5, but only if the base maintains control over land use. Contaminated soil is close to base property boundaries. Implementation of off-base institutional controls will require coordination with private parties and legal issues could be involved. Although this requirement could be met, it reduces the implementability of this alternative. If Elmendorf AFB were to close, Air Force policy requires that parcels that are to be sold or otherwise divided be remediated to cleanup levels appropriate for intended future use. Any deed restrictions would be considered when planning reuse of the parcels.

Implementing access controls would not be significantly affected by topography. There are no known mission related obstacles related to restricting access to these areas.

Alternative #9 — Excavation, Biopiling, and Backfilling

This alternative would be applied to areas where contamination in shallow soils exceeded clean-up levels for hydrocarbons. This alternative would not be applicable to soils that could not be easily excavated, i.e., below depths of 10–12 feet. This is not a problem for the presently identified soil area in the central area, which is very close to the surface, but may be a problem in the soil identified in the western area, which, at 10–12 feet below the surface, may be difficult to excavate. A schematic of this alternative in elevation and plan view is shown on Figure 11-17 and 11-18.

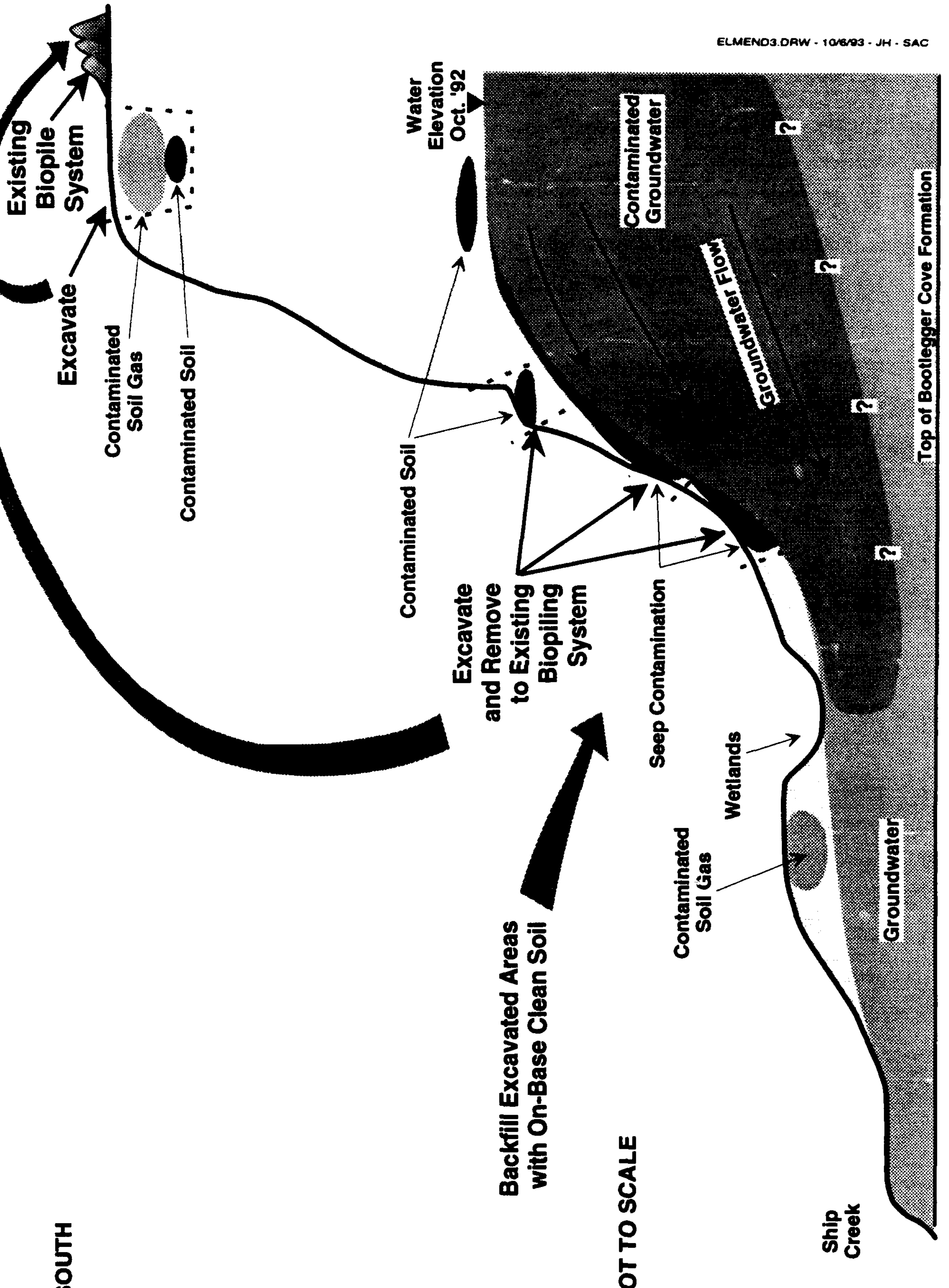

Figure 11-17. Excavation, Biopiling, Backfill Alternative (Elevation View)

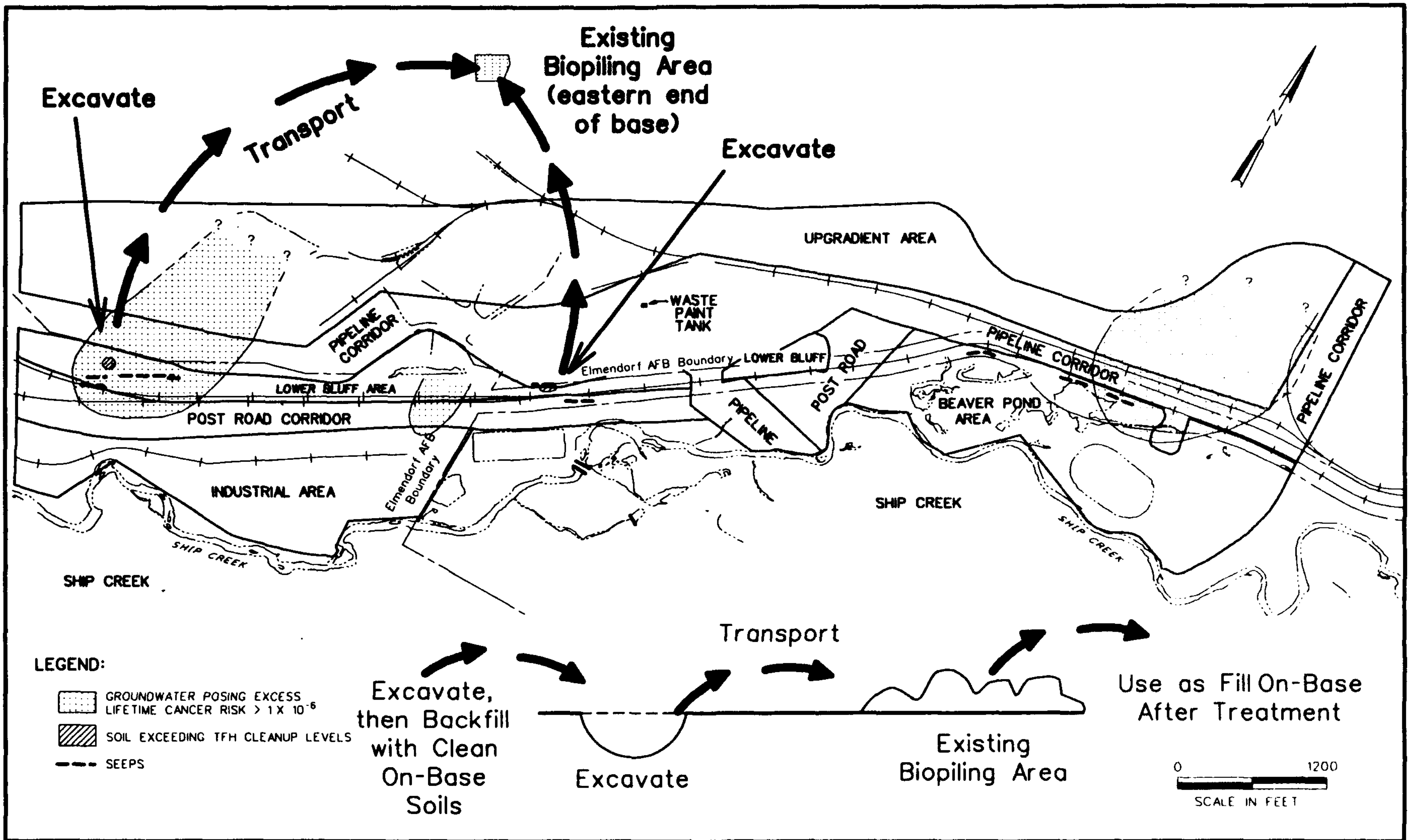

Figure 11-18. Excavation, Biopiling, Backfill

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Description — A backhoe, front-end loader, or other equipment would be used to excavate soils. Each of the two soil volumes to be remediated are estimated to have dimensions of 100 feet by 100 feet by 4 feet deep, for a volume of 1,500 cubic yards each. The excavated areas would be backfilled with treated soil or available clean soil from on base. The excavated soil would be transported to an existing biopiling area at the eastern end of Elmendorf AFB. A new biopiling system would be constructed, consisting of two lifts of 4 feet each, over a 100-square-foot area. Each lift would have piping to supply air and any required nutrients. The soil would be stockpiled until it can be transferred to the treatment cells. Degradation of contaminants would be monitored to document the breakdown rate and confirm that clean-up levels are being met. Monitored parameters would include temperature, soil, pH, nutrients, and contaminant concentrations. The treated soil would be used on base for fill after clean-up levels are achieved.

Effectiveness

CERCLA CRITERIA SCORING RESULTS
EXCAVATION, BIOPILING, AND BACKFILLING

Criterion	Soil
Protection of Human Health and the Environment	3
Compliance with appropriate ARARs	3
Long-Term Effectiveness and Permanence	5
Reduction in Toxicity, Mobility, and Volume through Treatment	3
Short-Term Effectiveness	3
Implementability	3

Protection of Human Health and the Environment. This alternative is partially protective of the human health and the environment for shallow soil. This alternative will reduce surface contamination to less than the remedial action objectives and the risk of exposure to contaminated soil where surface contamination is present. However, this alternative does not address contaminated soil near the water table which will remain and continue to pose a risk to downgradient environmental receptors via groundwater flow and seeps. Removal of these deep soils may be difficult because of the need to excavate on the bluff in the western area, which may require expensive shoring to prevent slope failure. Small land animals and birds could be exposed to contamination in the soil. Furthermore, the risk of slope stability problems while excavating along the bluff face may be greater than the risks associated with the "no action" alternative.

Compliance with Appropriate ARARs. This alternative has been given a score of partially compliant. It will likely comply with clean-up levels for hydrocarbons for the soil excavated for treatment. The only potential action-specific ARARs are for worker protection and air emissions. Worker protection can be provided by accepted health and safety practices. Air emissions are expected to be low because the principal contaminants, diesel and jet fuel, are not highly volatile. The rate of treatment can be varied to minimize volatilization, so potential air-related ARARs are complied with.

Long-Term Effectiveness and Permanence. This alternative is considered effective and permanent in the long term for the soils that are excavated and treated because contaminants are destroyed. For the deep contamination near the seeps, the potential exists for media cross contamination between the soil and groundwater. Therefore, to be effective in the long term, this alternative will have to be combined with a seep remediation alternative. While this alternative is not effective in the long term, the potential impacts are considered to be low. In the long term, the contaminants should degrade naturally; however, the time required to meet cleanup goals is not known.

Reduction in Toxicity, Mobility, and Volume Through Treatment. This alternative reduces the toxicity, mobility, and volume of contaminants through treatment for the excavated soil. In this alternative, un-excavated soils are not affected by this treatment. However, natural degradation should reduce the toxicity and volume of the unexcavated contamination.

Short-Term Effectiveness. This alternative is partially effective in the short-term. Technologies for safely excavating and handling hydrocarbon contaminated soils are well established and result in minimal exposure risk during implementation. Potential impacts for the biopiling can be managed by using liners and controlling emissions and surface water drainage from the pile. The alternative would only be at maximum effectiveness in the summer months. Cold temperatures will reduce the effectiveness in the winter by reducing the biological activity.

Excavation of the shallow soil is quick so the potential window for exposure is very short. The alternative does not address contaminated soil near the water table, which will continue to serve as a source of groundwater contamination in the short term.

Implementability. This alternative is partially implementable. The excavation and soil handling techniques required are available and proven. The land commitment is small and should not affect base operations. Processes for implementing biopiling of contaminated soil are known and have been used at Elmendorf AFB and other sites. However, the alternative would be limited to shallow soils, and slope stability concerns in the vicinity of the bluff may reduce the overall quantity of soil which can be excavated. In addition, the treatment would be limited to the summer months because of the cold winter climate, which would increase the implementation period. Care must be taken when excavating soils near the groundwater table since excavation could cause releases to the groundwater. A waiver of some potential ARARs may be required for those soils which remain in place.

Alternative #10 — Bioventing

Description — Bioventing adds oxygen to the soil pore space, enhancing the growth of natural microbial populations and increasing the breakdown rate of organic contaminants. Air injection wells would be installed in areas where concentration of soil contaminants are above clean-up levels. The wells would be screened in the vadose zone in a narrow interval below the soil contamination. A blower would be connected to the wells via a common header so that a positive pressure would induce air flow into the contaminated soil. The increased amount of oxygen available in the vadose zone would enhance the aerobic biodegradation of organic contaminants by indigenous microorganisms. In addition to oxygen, macronutrients, such as nitrogen and phosphorus, could be added in an atomized phase to stimulate population growth and contaminant destruction or nutrients and water could be added at the surface and allowed to percolate down to the contaminated soil. Soil sampling would be needed to document that cleanup levels were being achieved. Schematics of this alternative in elevation and plan view are shown in Figures 11-19 and 11-20.

Effectiveness

CERCLA CRITERIA SCORING RESULTS
BIOVENTING

Criterion	Soil
Protection of Human Health and the Environment	5
Compliance with appropriate ARARs	5
Long-Term Effectiveness and Permanence	5
Reduction in Toxicity, Mobility, and Volume through Treatment	5
Short-Term Effectiveness	3
Implementability	3

Protection of Human Health and the Environment. The alternative is protective of human health and the environment by reducing the contaminant concentrations in both surface and deep soils. By treating surface soil, the potential exposures to animals, plants, and humans through direct contact are eliminated. Vegetation and animal impacts from soil in the seep areas would be eliminated. Deep soil would be treated, eliminating the potential for future migration of VOCs to the groundwater and the seeps. These seeps could impact receptors, such as plants and small animals. Short-term effectiveness may be limited until the system can be properly adjusted for the climate and media. This alternative

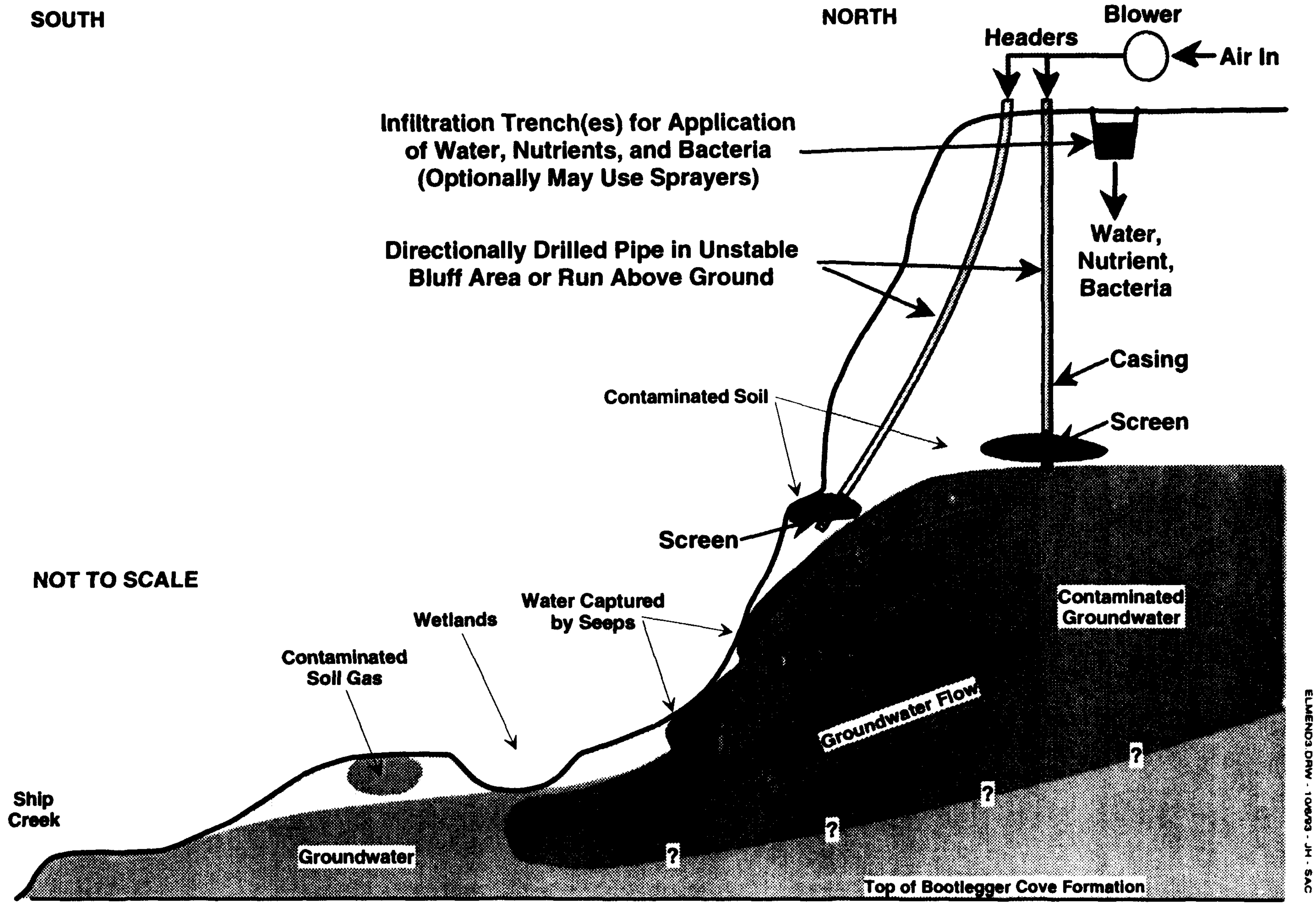

Figure 11-19. Soil Bioventing Alternative (Elevation View)

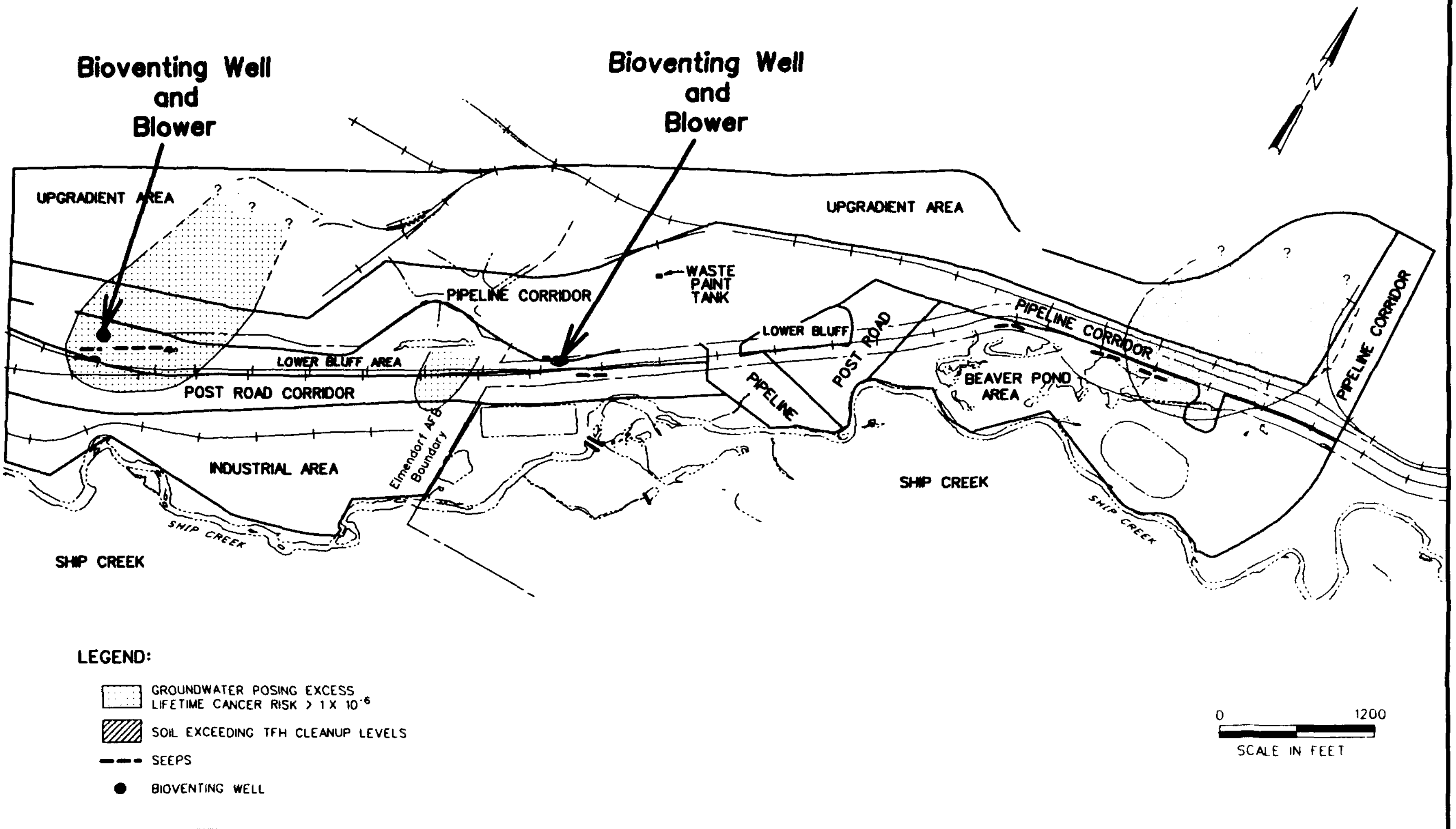

Figure 11-20. Soil Bioventing Alternative

ELM5 ALTBIO6 VRL SAC 02/2/94

achieves major risk reduction when compared to the "no action" alternative without adding major risk of slope instability and damage to the wetlands.

Compliance with Appropriate ARARs. This alternative will comply with potential contaminant-specific ARARs for soil and protect groundwater where soil contamination is present. The only potential action-specitic ARARs would affect workers installing the bioventing wells. Accepted health and safety practices can be followed to comply with this potential action-specific ARAR.

Long-Term Effectiveness and Permanence. Bioventing has been shown to reduce contaminants to clean-up levels. The remediation is permanent.

Reduction in Toxicity, Mobility, and Volume Through Treatment. This alternative will reduce the toxicity, mobility, and volume through treatment. The technology reduces the toxicity and volume of contamination by enhancing the biodegradation of the contaminants by aerobic soil microorganisms. With proper implementation of this alternative, the mobility of contaminants will also be reduced. However, while the byproducts of microbial degradation may be more mobile than the original hydrocarbons; their toxicity will be reduced and should not represent a risk to human health or the environment.

Short-Term Effectiveness. This alternative was considered partially effective. Bioventing will not result in an adverse short-term impact because the technology will not result in increased emissions of contaminated dust, fugitive volatile emissions, and transfer of contaminants to the groundwater. There will be very limited exposure to construction workers during well installation.

However, in the short term, the contaminants break down effectiveness is not fully demonstrated for cold climates. The effectiveness depends upon the temperature and site-specific conditions such as microbial population, moisture content, and available nutrients. Field tests of bioventing have been done in Alaska, and the technology looks promising. The heat of compression of the inlet air does help offset the cold ambient temperatures in the soil. Treatability tests are being done at Elmendorf AFB to determine the effectiveness of this technology. The data generated will help determine if this alternative will be effective at OU 5.

Implementability. This technology can be implemented. The procedures for implementing bioventing are known and the technology has been implemented at other sites. There is sufficient space available to implement the technology and equipment is available from several vendors. Inlet air heating may be required to sustain bioventing during winter months. The air should travel well through the soil to the contaminants because the bluff is composed mostly of gravels and embedded sands. Implementation may not be possible for some soils below the water table without first dewatering those zones. This alternative can be implemented without endangering slope stability because the wells would be placed at the top of the bluff.

11.3.3 Constructed Wetland at Snowmelt Pond

Description — This alternative would isolate PCB sediment from potential receptors by adding a layer of gravel across the bottom of the pond. The water level would be controlled to allow growth of wetland vegetation across the whole Snowmelt Pond area. The wetland would be channelized to ensure retention time and to allow for monitoring effectiveness across the wetland.

The location for the proposed wetland system includes Snowmelt Pond and the adjoining marsh area. The seeps would be intercepted and contained at their point of occurrence by a passive collection system and conveyed to the inlet of the treatment system. A wetland treatment system will use physical, chemical, and biological mechanisms to degrade hydrocarbons dissolved in the seep flow.

The wetland would be used to treat seep water collected in the passive extraction alternative. An inlet would be constructed somewhere along the bluff. The inlet would also be of wetland-type construction with gravel and wetland vegetation. Cascades and pools may be needed to increase treatment and retention time. Discharge from the wetland would enter existing drainage ditches.

The constructed wetland is a single presumptive remedy for PCBs in the Snowmelt Pond and would clearly be effective in isolating the sediment. However, the wetland is also to be used to possibly treat seep water. The treatment of seep water by a wetland is not fully proven for this application in the Anchorage climate; therefore, an evaluation of its technical effectiveness was done. The Snowmelt Pond area is appropriate for a constructed wetland due its location, site hydrology, and proven ability to support aquatic plants and a wetland environment. The location of the proposed wetland system includes roughly 1.5 acres of open water and 1 acre of marsh, and is relatively secluded from other Base activities. This would allow the wetland system to develop and treat water without being disturbed or interfering with other land uses. The site is close to many of the contaminated seeps, which allows conveyance of seep water to the treatment system. The low-lying site and existing open water appear to indicate a high water table that is capable of maintaining hydric soils and moist conditions necessary for wetland development. The existing topography and availability of a receiving stream make the discharge of treated effluent possible. The emergent vegetation suggests the presence of sufficient soil nutrients and climate conditions to support aquatic plants that are typical to a wetland environment.

Wetlands often act as sediment sinks. Wetland plants tend to filter out sediment, and the relatively low flow velocities through wetlands allow suspended particles to settle out. As new sediments are deposited, they will bury and stabilize the existing contamination. Additionally, aquatic plants often have an extensive root system that can also stabilize the sediments.

Aerobic and anaerobic zones exist in wetland soils, providing areas for the potential degradation of hydrocarbon-contaminated sediments. The rhizomes, or roots, of wetland plants transmit oxygen to the root tips. This oxygen can be used by aerobic bacteria for degradational processes. Anaerobic zones create reducing conditions that have a tendency to facilitate sorption reactions and thus stabilize contaminants. Additionally, anaerobic bacteria are capable of hydrocarbon degradation.

The analysis of constructed wetland treatment capacity is based on work performed by Gelb, 1992. Gelb studied an overland flow and wetland system used for the treatment of oilfield-produced water. The overland flow component consisted of a treatment cell 50 feet wide by 100 feet long, excavated to a 3% grade, covered with 1 to 3 inches of gravel, and included four 12-inch high cascades. The wetland component followed the overland flow cell and covered approximately 0.75 acres. Flow channels were approximately 35 feet wide and included sedges, rushes, and cattails.

Gelb examined the removal of many produced water compounds. Those examined in this report include BTEX and total phenolics. Influent flow rates to the overland flow/wetland system ranged from 29 to 232 GPM. Influent concentrations averaged 28.5 μg/L benzene, 48.2 μg/L toluene, 17.5 μg/L ethylbenzene, 36.0 μg/L xylenes, and 0.131 mg/L total phenolics. Gelb observed 68 to 100% removal of all BTEX compounds in the overland flow cell and 100% BTEX removal in the wetland.

Total phenolics concentrations were measured through the system to model the removal of more persistent hydrocarbons. Zero to 15% of the total phenolics were removed in the overland flow cell and 9 to 100% were removed in the wetland. The average removal through the wetland was 40% and the average wetland influent concentration was 0.079 mg/L. Phenolics mass removal through the wetland ranged from 6.4 to 47.7 g/day.

Gelb developed a treatment system design method based on the results of his study. The method determines the system area required for a desired contaminant concentration reduction, given a flow rate and influent contaminant concentration. The design method includes a procedure for total phenolics treatment, and is used here to conservatively model BTEX and TCE removal from seep flows. No design method was available for BTEX compounds.

The following assumptions were used to perform design calculations and estimate the effectiveness of the system:

- A single wetland component was selected as the system type;
- The area available for the system is 2 acres or 87,120 ft^2;
- The influent flow rates considered are 10, 50, and 100 GPM; and
- The contaminant concentrations considered are 0.01, 0.1, and 1.0 mg/L.

The design method was applied in two ways. First, the area required for 100% contaminant removal at the three flow rates specified was determined. The second approach predicted the percent contaminant removed when the treatment system area was conservatively estimated to be 2 acres. The first application of the design method yielded a required system area of 1.6 acres at an influent flow rate of 10 GPM, 7.7 acres at 50 GPM, and 15.7 acres at 100 GPM. The areas calculated were the same for all three influent concentrations examined. The results of the second design approach, assuming a 2-acre system, indicate 90% contaminant removal at 10 GPM, 40% removal at 50 GPM, and 28% removal at 100 GPM.

These results indicate that substantial contaminant removal can result from a constructed wetland of modest size. Since the design method was performed for total phenolics, the results should be viewed as conservative for less persistent hydrocarbons. As explained by Gelb, treatment of BTEX compounds using a system designed with total phenolics data would result in substantially greater contaminant removal. Also, the design evaluated here considered only wetland treatment. Gelb observed greater contaminant removal when both overland flow and wetland treatment components were applied together.

Many system features and configurations may be used to enhance treatment system performance. Systems can be designed with open water surface flow, subsurface flow, or a combination of both. The particular strategy used will depend on whether aerobic or anaerobic reactions will facilitate the greatest contaminant removal.

Flow conditions through the system can be manipulated by the excavation of the site. Excavated baffles and wide channels cause flow to move in a sinuous pattern at low velocity, thus increasing hydraulic residence time. Narrow, rock-lined channels cause high flow velocities and turbulent mixing for gas transfer and contaminant stripping.

An overland flow component can be included to increase the dissolved oxygen content of the water or air strip volatile contaminants. The overland flow might take place upstream of the wetland to potentially remove toxic compounds, in the middle of the wetland to boost depleted dissolved oxygen levels, or prior to discharge to polish the effluent.

Soil amendments can be added at the time of construction to supplement deficient nutrients or encourage particular chemical reactions. Native plant species, appropriate for the regional climate and providing the best treatment environment, should be used to establish the wetland vegetation. Beaver Pond and the marsh area at Snowmelt Pond may be potential sources for acclimated transplants.

Based on site conditions and expected treatment performance, a constructed wetland is a feasible alternative for the treatment of hydrocarbon contamination present in the groundwater seeps of OU 5 and would be effective if the flow were limited. The exact flow and the number of seeps that could be effectively treated could only be estimated based on a treatability study.

Further evaluation of the seeps and the Snowmelt Pond site are recommended to better understand the application of this treatment method. The flow rates and contaminant concentrations of the seeps must be identified. Potential climate effects on a constructed wetland could be monitored at Beaver Pond. The particular plant species and microbes best suited for this application should be determined. Regulatory concerns and applicable permitting requirements for this site should be investigated. Additional work should be performed to evaluate the feasibility of intercepting and transporting seep flow to the treatment system.

Effectiveness

CERCLA CRITERIA SCORING RESULTS
CONSTRUCTED WETLANDS AT SNOWMELT POND

Criterion	Soil
Protection of Human Health and the Environment	5
Compliance with appropriate ARARs	5
Long-Term Effectiveness and Permanence	3
Reduction in Toxicity, Mobility, and Volume through Treatment	3
Short-Term Effectiveness	3
Implementability	5

Protection of Human Health and the Environment. This alternative would be protective of human health and the environment. Seep water would be collected, thus reducing the potential for ecological impacts, and PCBs are isolated, which reduces the potential for exposure. Implementing this alternative would not impact the bluff stability. Some natural wetland in Snowmelt Pond would be dedicated to treat seep water. Fencing and netting may be needed to keep animals out of the wetland's treatment area.

Compliance with Appropriate ARARs. This alternative will comply with potential contaminant and action-specific ARARs. An NPDES permit to discharge water from the wetland may be needed.

Long-Term Effectiveness and Permanence. For seep water, this alternative would be effective. However, the PCBs would be degraded very slowly by this alternative. The alternative would only be effective if the sediments always remained covered.

Reduction in Toxicity, Mobility, and Volume Through Treatment. This alternative would not actively treat the PCBs. However, the sheens would be actively treated in the wetland.

Short-Term Effectiveness. The treatment rates would be slower in the winter; otherwise, this alternative would be effective in the short term. There would be no secondary impacts from implementing this alternative.

Implementability. The only difficulty in implementation is that the Snowmelt Pond is not on Air Force property. An agreement will have to be reached with the railroad to allow access to construct and operate the wetland.

The site proposed is suitable for a constructed wetland. The land is available, is near the contaminated seeps and a receiving stream, and should remain undisturbed by other land use activities. The hydrologic setting appears to support hydric soil conditions and aquatic vegetation. Beaver Pond and the Snowmelt Pond marsh area provide two potential areas for vegetation transplants. The reported success of the ecosystem at Beaver Pond indicates that a wetland environment can survive and prosper in this climate and geographical location.

11.4 Sensitivity Analysis

The scores for the evaluation criteria assigned to each remedial action alternative are based on assumptions regarding the volume of contaminated soil and water to be managed, the anticipated type and concentration of contaminants to be controlled or treated, and the length of time required to implement the alternatives. The actual circumstances of the remediation can only be determined after treatability studies and pilot systems are constructed. The ranking of alternatives could change depending upon how sensitive the alternative is to changes in the assumptions made. This sensitivity analysis identifies how the effectiveness, implementability, and cost of each alternative is affected by the following changes:

- 50% increase in volume of soil or water to be treated;
- Order of magnitude increase in TFH concentrations in the soil or water;
- Order of magnitude increase in the concentration of chlorinated compounds in the water;
- Change the significant risk level from 10^{-6} to 10^{-5};
- Change the significant risk level from 10^{-6} to 10^{-4};
- Change the time required to implement the alternative from 30 years to 5 years; and
- Change the time required to implement the alternative from 30 years to 10 years.

The sensitivity of the alternatives to these factors is shown on Table 11-4. A discussion of the sensitivity is provided below.

Table 11-4

Sensitivity Analysis of Remedial Action Alternatives (By Medium)

Alternative	50% Increase in Extraction/Volume			Order of Magnitude Increase in TPH Concentrations			Order of Magnitude Increase in Concentration of Chlorinated Compounds		
	Effectiveness	Implementability	Cost	Effectiveness	Implementability	Cost	Effectiveness	Implementability	Cost
WATER									
Natural Attenuation	No change	No change	No change	Reduced effectiveness	No change	No change	Reduced effectiveness	No change	No change
Institutional Controls	No change	No change	No change	No change	No change	No change	No change	No change	No change
Passive Extraction Constructed Wetland Treatment	No change	Reduced implementability	13% cost increase	Reduced effectiveness	Reduced implementability	59% cost increase	No longer effective	Reduced implementability	NA
Passive Extraction Activated Carbon Treatment	No change	No change	21% cost increase	No change	No change	241% cost increase	No change	No change	44.6% cost increase
Active Extraction, Air Stripping, Activated Carbon Treatment	No change	Reduced implementability	40% cost increase	No change	No change	429% cost increase	No change	No change	25% cost increase
Air Sparging and SVE/Activated Carbon	No change	No change	38% cost increase	Reduced effectiveness	No change	329% cost increase	No change	No change	19% cost increase
SOIL									
Natural Degradation	No change	No change	No change	Reduced Effectiveness	No change	No change	NA	NA	NA
Institutional Controls	No change	No change	No change	Reduced Effectiveness	No change	No change	NA	NA	NA
Excavation, Biopiling, Backfill	No change	Reduced implementability	19% cost increase	No change	No change	No change	NA	NA	NA
Bioventing	No change	No change	6% cost increase	No change	No change	No change	NA	NA	NA

Table 11-4

(Continued)

Alternative	Base on 10^{-4} Risk			Base on 10^{-4} Risk		
	Effectiveness	Implementability	Cost	Effectiveness	Implementability	Cost
WATER						
Natural Attenuation	No change	No change	No change	No change	No change	No change
Institutional Controls	No change	No change	No change	No change	No change	No change
Passive Extraction Constructed Wetland Treatment	No change	No change	No change	No change	No change	No change
Passive Extraction Activated Carbon Treatment	No change	No change	No change	No change	No change	No change
Active Extraction, Air Stripping, Activated Carbon Treatment	Reduced effectiveness	Increased implementability	13% cost reduction	Reduced effectiveness	Increased implementability	100% decrease
Air Sparging and SVE/Activated Carbon	Reduced effectiveness	Increased implementability	7% cost reduction	Reduced effectiveness	Increased implementability	100% decrease
SOIL						
Natural Degradation	No change	No change	No change	No change	No change	No change
Institutional Controls	No change	No change	No change	No change	No change	No change
Excavation, Biopiling, Backfill	No change	No change	No change	No change	No change	No change
Bioventing	No change	No change	No change	No change	No change	No change

Table 11-4

(Continued)

Alternative	5-Year Implementation Period			10-Year Implementation Period		
	Effectiveness	Implementability	Cost	Effectiveness	Implementability	Cost
WATER						
Natural Attenuation	No change	No change	68% cost reduction	No change	No change	45% cost reduction
Institutional Controls	No change	No change	63% cost reduction	No change	No change	42% cost reduction
Passive Extraction Constructed Wetland Treatment	No change	No change	51% cost reduction	No change	No change	33% cost reduction
Passive Extraction Activated Carbon Treatment	No change	No change	56% cost reduction	No change	No change	37% cost reduction
Active Extraction, Air Stripping, Activated Carbon Treatment	No change	No change	61% cost reduction	No change	No change	39% cost reduction
Air Sparging and SVE/Activated Carbon	No change	No change	60% cost reduction	No change	No change	39% cost reduction
SOIL						
Natural Degradation	No change	No change	67% cost reduction	No change	No change	43% cost reduction
Institutional Controls	No change	No change	65% cost reduction	No change	No change	42% cost reduction
Excavation, Biopiling, Backfill	No change	No change	49% cost reduction	No change	No change	32% cost reduction
Bioventing	No change	No change	53% cost reduction	No change	No change	36% cost reduction

▨ = Indicates alternative sensitive to the variable.
NA = Not applicable.

11.4.1 Sensitivity to a 50% Increase in Volume to be Treated

An increase in the groundwater and seep extraction rates will affect the treatment and effluent management requirements of alternatives with an extraction component. Generally, the effectiveness of the alternatives are not affected because the treatment technologies can be sized for the increased flow. However, implementability of extraction alternatives is affected because effluent management becomes more difficult with increased flows. The implementability of treatment with constructed wetlands is reduced because approximately 50% more land area would be needed to construct wetlands, and there may already be insufficient land space available for the anticipated flow. The implementability of the active extraction alternative is reduced because of the large volume of water that must be discharged. Reinjection of treated water is also less feasible with larger volumes because the shallow depth to groundwater downgradient of OU 5 provides little storage capacity in the vadose zone. Therefore, reinjection would have to be done over a large area south of OU 5. The adverse environmental impacts on existing wetlands from increased groundwater pumping will be increased because less flow will enter these wetlands.

An increase in the volume of contaminated soil should not affect the effectiveness of the remedial alternatives. An increase in soil volume will generally affect the implementability of the biopiling alternative because more widespread and potentially deeper excavation is required. As shown in Sections 9.0 and 10.0, the implementability of the excavation alternative will be affected by slope stability concerns and the potential that buildings, roads, and utilities will limit the extent of excavations. The implementability of in situ treatment options should not be affected.

Any increase in extraction rate and volume will increase costs for all alternatives other than the natural attenuation/degradation alternatives (it is assured that increased monitoring will not be required). The active extraction and excavation alternatives are most sensitive to volume changes because of the large treatment/disposal component of the alternatives.

11.4.2 Order of Magnitude Increase in TFH Concentrations

Increasing the TFH concentration of the soil or water reduces the effectiveness of the natural attenuation/degradation alternatives and the constructed wetland treatment alternative. The natural processes used by these alternatives will be less likely to reduce contaminant transport to human and environmental receptors. The natural attenuation and degradation processes will also require more time to achieve cleanup objectives; therefore, short-term effectiveness is reduced because the time for potential exposure is increased. The effectiveness of those alternatives that have an active treatment component should not be affected because the treatment systems can be designed for the higher concentrations. The exception is air sparging with SVE, which may not be able to reduce the TFH concentrations to acceptable levels because of the increase in nonvolatile components.

Only the implementability of the constructed wetland treatment alternatives is reduced due to an increase in TFH concentration. More land area would be needed for the constructed wetlands because an increase in the retention time of the water in the wetland system would be required to achieve the cleanup goals.

An increase in TFH concentrations increases the cost of all alternatives except the natural attenuation/degradation alternatives. The cost increase is due either to increased carbon use or longer treatment times required to achieve cleanup levels. The active extraction alternatives are affected the most by an increase in TFH because of the higher extraction and treatment volumes.

11.4.3 Order of Magnitude Increase in the Concentration of Chlorinated Compounds

Chlorinated compounds are not contaminants of concern for the soil and increases in groundwater concentrations should not affect the soil alternatives.

An increase in the concentration of chlorinated compounds in the groundwater or seeps will decrease the effectiveness of the alternatives where biological processes reduce the concentration of the contaminants of concern. Because chlorinated compounds are broken down slowly by biological processes. The constructed wetlands alternative will no longer be effective since these high levels of chlorinated compounds do not allow the treatment biota to survive.

The effectiveness of air sparging alternative will not be affected because these compounds will remain at relatively low concentrations and the physical processes used to remove the compounds from the water will not be rate limited.

The implementability of the constructed wetlands alternative is reduced because larger wetlands would be needed for the increased retention time necessary to break down the higher concentrations of chlorinated compounds. Locating larger wetlands would be difficult since any constructed wetland must not interfere with the operations of the Air Force Base, and there is limited area available near the bluff area.

An increase in the concentration of chlorinated compounds increases the cost of all alternatives except for the natural attenuation alternative. The active extraction and air sparging with SVE alternatives are affected the most because of their high flow rates and the large percentage of the total cost that is represented by carbon costs.

11.4.4 Change Significant Risk Level from 10^{-6} to 10^{-5}

The acceptable CERCLA range of risk is 1 x 10^{-4} to 1 x 10^{-6}. If the less conservative value of 10^{-5} is used instead of 10^{-6}, the volume of groundwater required to be remediated will decrease, since fewer areas have contamination that drive a 10^{-5} risk. Figure 11-21 indicates how the plume would shrink to represent 1 x 10^{-5} risk. The main change is that groundwater in central OU 5 would not be remediated because risk is at an acceptable (1 x 10^{-5}) level. The only remedial alternatives affected are active extraction and air sparging

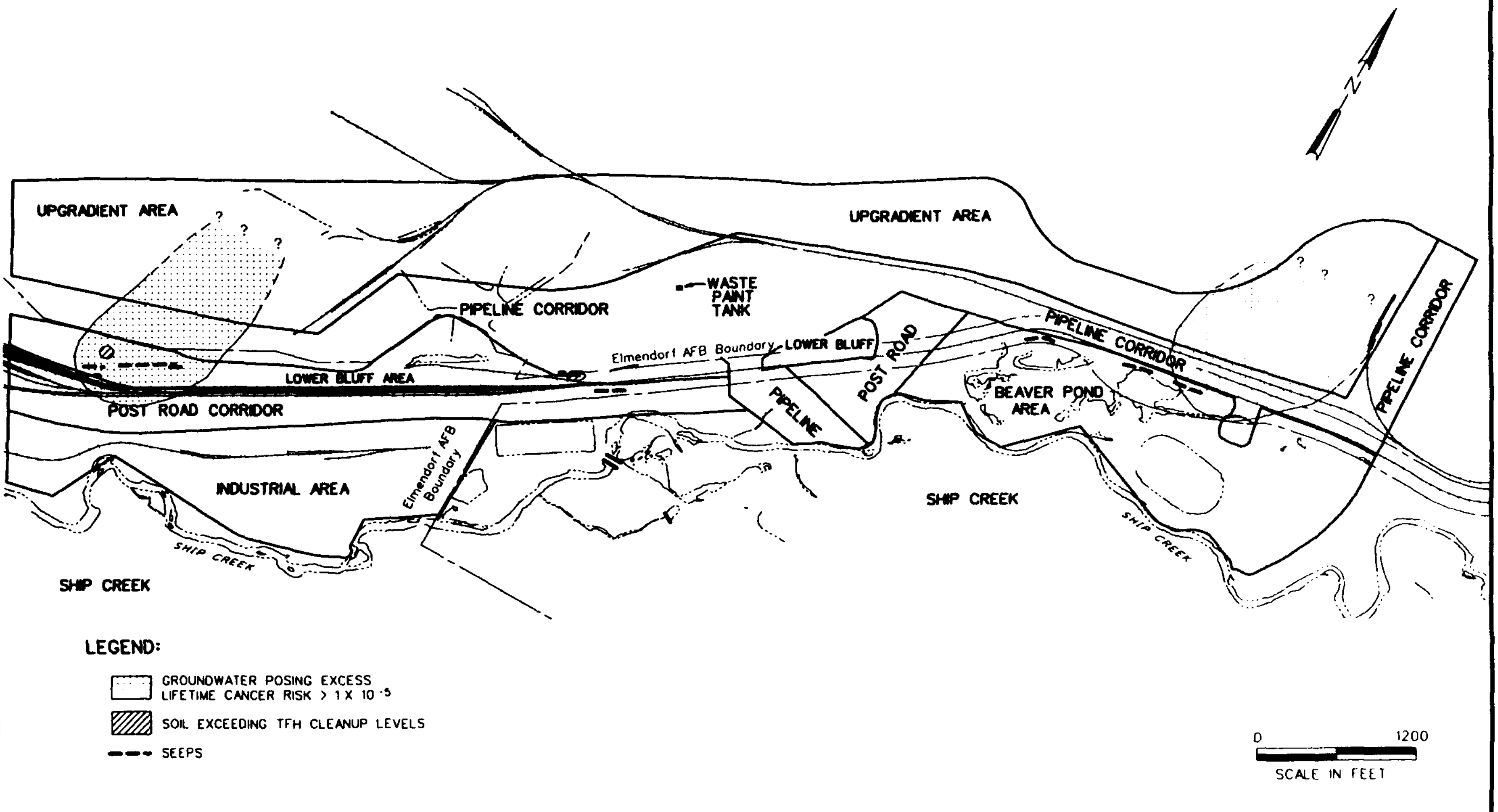

Figure 11-21. Areas Requiring Remediation, Assuming 1 x 10^{-5} Risk

of groundwater. All other alternatives remediate either seeps or soil, neither of which would not be affected by the change from 1 x 10^{-6} to 1 x 10^{-5}. Total air sparging costs for 1 x 10^{-5} would drop 7%. Active extraction costs would drop 13%. The only other change would be a slight decrease in effectiveness and increase in implementability, since the remediation would be a smaller system that would have less effect.

11.4.5 Change Significant Risk Level from 1 x 10^{-6} to 10^{-4}

The change here has the same effect as 1 x 10^{-5} except that in this case no groundwater would require treatment, since no area of groundwater drives a 1 x 10^{-4} risk. This would eliminate all costs of treating groundwater under the air sparging and active extraction alternative. Seeps would still have to be treated since these seeps cause ecological risks (e.g., visible sheens) that would not be affected by this change in health risk.

11.4.6 Change Implementation Time From 30 to 5 Years

In the alternatives analysis, it was generally assumed that a 30-year period would be required to achieve remediation objectives when implementation of each alternative began. Thirty years is commonly used in feasibility studies to compare alternatives. The actual time to achieve clean-up levels can vary, depending on the success of the treatment method employed. This analysis assumed that all remedial objectives can be achieved in five years. This assumes that no additional COCs in groundwater upgradient from OU 5 require treatment after the five-year period. This analysis also assumes no further need to monitor soil and groundwater after the five years. The analysis concluded a cost reduction of 49 to 68% for the alternatives. The savings is from reduced long-term monitoring costs. Also, alternatives with expensive O&M (active extraction) also have larger cost savings. Low monitoring and O&M alternatives have smaller cost savings.

11.4.7 Change Implementation Time From 30 to 10 Years

This analysis is the same as above except that 10 years instead of 5 years is selected for the treatment period. The cost reductions range from 32 to 45%. The relationship to monitoring and O&M are the same as above.

11.5 Comparative Analysis

The comparative analysis was performed in a three-step process:

- To help address the affected areas of impact at OU 5, the OU was divided into three geographic areas;
- The multi-media alternatives were developed for each area; and
- The multi-alternatives were evaluated and compared to each other using the CERCLA criteria.

While most multi-media alternatives are applicable to all three areas, some alternatives are not applicable to specific areas; and the cost for each alternative varies by area. Brief descriptions of the geographic areas are provided below.

11.5.1 Geographic Areas of OU 5

Evaluating the effectiveness, implementability, and cost of remedial alternatives depends upon the type and the physical setting of the contaminated media (soil, groundwater, or seeps) within the different geographic areas of OU 5. The OU can be roughly divided into three geographic areas, labeled Western, Central, and Eastern, as shown on Figure 11-22. Each of these areas are discussed below. While each of the geographic areas had soil, groundwater, and seep water to be remediated, the volumes and locations of the contaminated media are different within each area.

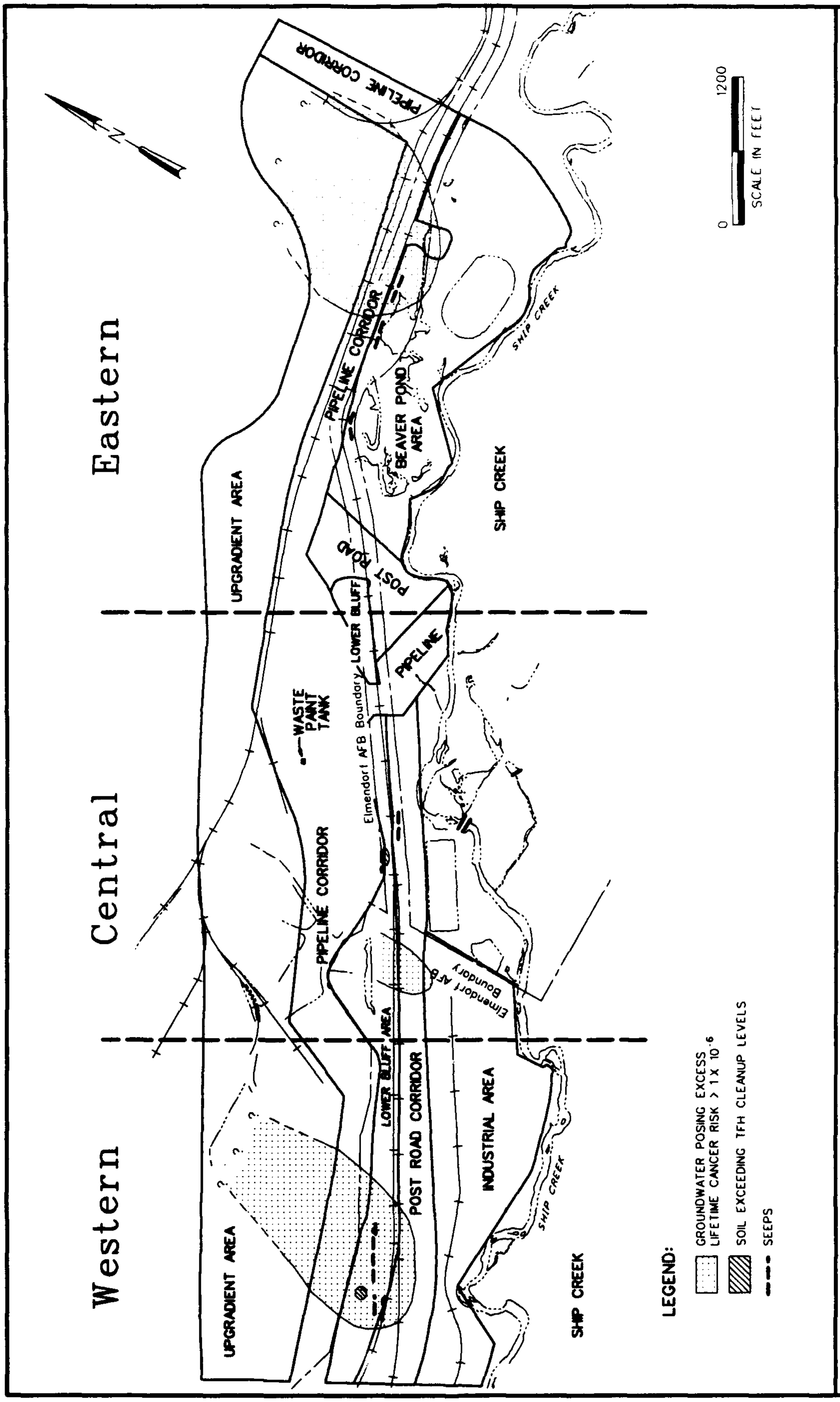

Figure 11-22. Geographical Areas of OU 5

ELM5 OU5RSK6 VRL SAC 03/02/94

Western Area

The physical aspects of the Western Area include a steep bluff leading to a flat area just north of a railroad. The bluff shows signs of slope failure in the past. The industrial area is located immediately to the south of the railroad tracks. Ship Creek is located over 600 feet south of this area.

Groundwater impacts in this area result in an excess lifetime cancer risk of greater than 1 x 10^{-6} with the plume estimated to exceed 1,000 feet in width. There is also an area where hydrocarbons exceed soil clean-up levels, and where there are numerous seeps along the face of the bluff. Soil contamination exists at the 10- to 12-foot depth below the surface. The soil and groundwater contamination are collocated within the Western Area.

Central Area

Central OU 5 has features similar to the Western Area: a steep bluff with railroad tracks at the toe of the slope. The bluff shows signs of slope failure in the past. A snowmelt water retention pond is located in this area. Ship Creek is located approximately 250 feet south of the central part of the Central Area.

There are some seeps along the face of the bluff in the central part of this area (see Figure 11-22). A relatively small area of TFH contamination is found near the seeps. There are also two groundwater contaminant plumes with excess lifetime cancer risk greater than 1 x 10^{-6} within the Central Area. The groundwater contaminant plumes are relatively narrow compared to the Western Area and appear physically separated from the areas of soil contamination.

Eastern Area

Eastern OU 5 includes the beaver pond. The bluff in this area is more gently sloping than in the other areas. The area at the toe of the bluff is a wetland consisting of cascading ponds in the beaver pond area. Ship Creek is located approximately 50 feet south of the beaver pond.

In the Eastern Area, there are no areas where the TFH contamination in soil exceeds soil clean-up levels. Northeast of the beaver pond is an area where the groundwater contamination results in an excess lifetime cancer risk of greater than 1 x 10^{-6}. The plume is estimated to be in excess ot 1,000 feet in width. There are also seeps at three locations along the bluff.

11.5.2 Multi-Media Alternatives Development

The water and soil alternatives have been combined into multi-media alternatives as shown in Table 11-5. This table was developed taking into consideration which individual alternatives would be applicable for each geographic area.

Western Area

All multi-media combinations, except one, are applicable to the Western Area, which has contaminant concerns for seeps, groundwater, and soil (10-to 12-foot depth). Air Sparging with Soil Vapor Extraction and Bioventing are not combined in the Western Area because the soil and groundwater contamination are collocated in this area. Air sparging provides the moisture and oxygen required by bioventing without additional cost or facilities, and vapor extraction will remove volatile contaminants from the soil before significant biological degradation can occur.

Table 11-5

Multi-Media Alternatives

Water Alternatives		Soil Alternatives				
Seeps	Groundwater	No Action	Natural Degradation	Natural Degradation with Institutional Controls	Excavation, Biopiling, and Backfilling	Bioventing
Natural Attenuation	Natural Attenuation	E	Baseline W,C	W,C	W,C	W,C
	Natural Attenuation with Institutional Controls	E	W,C	W,C	W,C	W,C
Passive Extraction with Wetlands Treatment	Natural Attenuation	E	W,C	W,C	W,C	W,C
	Natural Attenuation with Institutional Controls	E	W,C	W,C	W,C	W,C
Passive Extraction, Activated Carbon Treatment	Natural Attenuation	E	W,C	W,C	W,C	W,C
	Natural Attenuation with Institutional Controls	E	W,C	W,C	W,C	W,C
Air Sparging with Soil Vapor Extraction and Activated Carbon Treatment		E	W,C	W,C	W,C	C
Extraction with Air Stripping and Activated Carbon Treatment		E	W,C	W,C	W,C	W,C

W = Western Area
C = Central Area
E = Eastern Area

Central Area

All multi-media combinations are applicable to the Central Area, which has contamination concerns for seeps, groundwater, and shallow soil (< 10 feet BGS).

Eastern Area

Soil contamination was not identified as a contaminant concern in the Eastern Area; therefore, soil treatment alternatives are not applicable to this area.

11.5.3 Comparative Analysis

A comparative analysis of the media-specific alternatives is shown in Table 11-6. The relative numerical values for each of the first six criteria are shown; the seventh criterion, cost, expressed in millions of dollars, is shown separately for each geographic area. The numerical values were developed in Sections 11.3 which discussed the strengths and weaknesses of each alternative for remediation of water and soil.

Table 11-7 shows the comparison of all possible combinations of multi-media alternatives for each geographic area. As shown, the alternatives for seeps and groundwater apply to all three areas of OU 5. The soil alternatives only apply to the western and central areas. However, for comparative purposes, the analysis was performed for the eastern area using "no action" for the soils. The relative numerical values given for each of the seven criteria (except cost) are an average of the media-specific alternative values which have been combined. For instance, in Table 11-7, the score for protection of human health and the environment for the natural attenuation/degradation for seeps, groundwater, and soil (2) is an average of the seep (0), groundwater (3) and soil (3) scores. For costs, the total cost of the multi-media alternative was used to determine the ranking. The absolute value of cost (to within $100,000) is shown next to each cost score.

Table 11-6

Comparative Analysis for Media-Specific Remedial Alternatives

	Effectiveness Criteria						Cost ($ Millions)		
Remedial Alternative	Protection of Human Health and the Environment	Compliance with ARARs	Long-term Effectiveness and Permanence	Reduction in Toxicity, Mobility, and Volume through Treatment	Short-term Effectiveness	Implementability	Western Area	Central Area	Eastern Area
Groundwater, Seeps, Surface Water Alternatives									
Natural Attenuation									
— Seeps	0	3	3	0	0	5	$0.5	$0.5	$0.5
— Groundwater	3	3	3	0	3	5	$1.4	$1.4	$1.4
Natural Attenuation with Institutional Controls for Groundwater	3	5	3	0	3	5	$1.5	$1.5	$1.5
Passive Extraction with Constructed Wetlands	5	5	5	5	5	3	$0.7	$0.7	$0.7
Passive Extraction and Treatment Using Activated Carbon Treatment	5	5	5	5	5	5	$0.9	$0.9	$0.9
Air Sparging with Soil Vapor Extraction/Activated Carbon Treatment	5	5	5	5	3	3	$10.4	$5.4	$7.4
Extraction/Air Stripping/Activated Carbon Treatment	3	5	5	5	3	3	$8.7	$3.9	$14.4
Soil Alternatives									
Natural Degradation	3	3	5	0	0	5	$0.9	$0.3	NA
Natural Degradation with Institutional Controls	3	3	5	0	3	3	$0.9	$0.3	NA
Excavation/Biopiling/Backfilling	3	3	5	3	3	3	$1.1	$0.5	NA
Bioventing	5	5	5	5	3	3	$1.1	$0.5	NA

Notes: Criteria for Agency and Community Acceptance have not been evaluated at this time. These criteria will be evaluated in the Record of Decision.

Key: Criteria Except Cost

5 = Meets or exceeds definition/intent of criteria.
3 = Partially meets definition/intent of criteria.
0 = Does not meet definition/intent of criteria.

Table 11-7

Comparative Analysis for Multi-Media Remedial Alternatives

Remedial Alternative			Effectiveness Criteria					Implementability	Cost		Total Score	Effectiveness to Cost Quotient
Seeps	Groundwater	Soil	Protection of Human Health and the Environment	Compliance with ARARs	Long-term Effectiveness and Permanence	Reduction in Toxicity, Mobility, and Volume through Treatment	Short-term Effectiveness		Score	$ (Millions)		
Nat Att	Nat Att	Nat Deg (W+C)	2	3	3.7	0	1	5	W = 3	2.8	17.7	3.5
		No Action (E)	1.5	3	3	0	1.5	5	C = 3	2.2	17.7	4.4
									E = 3	1.9	17.0	4.7
Nat Att	Nat Att	Nat Deg, Inst Cont	2	3	3.7	0	2	4.3	W = 3	2.8	18.0	3.8
									C = 3	2.2	18.0	4.9
									E = NA			
Nat Att	Nat Att	Biopiling	2	3	3.7	1	2	4.3	W = 3	3.0	19.0	3.9
									C = 3	2.4	19.0	4.9
									E = NA			
Nat Att	Nat Att	Bioventing	2.7	3.7	3.7	1.7	2	4.3	W = 3	3.0	21.1	4.6
									C = 3	2.4	21.1	5.8
									E = NA			
Nat Att	Nat Att	Nat Deg (W+C)	2	3.7	3.7	0	1	5	W = 3	2.9	18.4	3.6
	Inst Cont	No Action (E)	1.5	4	3	0	1.5	5	C = 3	2.3	18.4	4.5
									E = 3	2.0	18.0	5.0
Nat Att	Nat Att Inst Cont	Nat Deg Inst Cont	2	3.7	3.7	0	2	4.3	W = 3	2.9	18.7	3.9
									C = 3	2.3	18.7	5.0
									E = NA			
Nat Att	Nat Att Inst Cont	Biopiling	2	3.7	3.7	1	2	4.3	W = 3	3.1	19.7	4.0
									C = 3	2.5	19.7	5.0
									E = NA			
Nat Att	Nat Att Inst Cont	Bioventing	2.7	4.3	3.7	1.7	2	4.3	W = 3	3.1	21.7	4.6
									C = 3	2.5	21.7	5.8
									E = NA			

Table 11-7

(Continued)

Remedial Alternative			Effectiveness Criteria						Cost			
Seeps	Groundwater	Soil	Protection of Human Health and the Environment	Compliance with ARARs	Long-term Effectiveness and Permanence	Reduction in Toxicity, Mobility, and Volume through Treatment	Short-term Effectiveness	Implementability	Score	$ (Millions)	Total Score	Effectiveness to Cost Quotient
Pass Extrac Const Wets	Nat Att	Nat Deg (W+C) No Action (E)	3.7 4	3.7 4	4.3 4	1.7 2.5	2.7 4	5 5	W = 3 C = 3 E = 3	3.0 2.4 2.1	24.1 24.1 26.5	5.4 6.7 8.8
Pass Extrac Const Wets	Nat Att	Nat Deg (W+C) No Action (E) Inst Cont	3.7	3.7	4.3	1.7	3.7	3.7	W = 3 C = 3 E = NA	3.0 2.4	23.8 23.8	5.7 7.1
Pass Extrac Const Wets	Nat Att	Biopiling	3.7	3.7	4.3	2.7	3.7	3.7	W = 3 C = 3 E = NA	3.2 2.6	24.8 24.8	5.7 7.0
Pass Extrac Const Wets	Nat Att	Bioventing	4.3	4.3	4.3	3.3	3.7	3.7	W = 3 C = 3 E = NA	3.2 2.6	26.6 26.6	6.2 7.7
Pass Extrac Const Wets	Nat Att Inst Cont	Nat Deg (W+C) No Action (E)	3.7 4	4.3 5	4.3 4	1.7 2.5	2.7 4	4.3 4	W = 3 C = 3 E = 3	3.1 2.5 2.2	24.0 24.0 26.5	5.4 6.7 8.9
Pass Extrac Const Wets	Nat Att Inst Cont	Nat Deg (W+C) No Action (E) Inst Cont	3.7	4.3	4.3	1.7	3.7	3.7	W = 3 C = 3 E = NA	3.1 2.5	24.4 24.4	5.7 7.1
Pass Extrac Const Wets	Nat Att Inst Cont	Biopiling	3.7	4.3	4.3	2.7	3.7	3.7	W = 3 C = 3 E = NA	3.3 2.7	25.4 25.4	5.7 6.9
Pass Extrac Const Wets	Nat Att Inst Cont	Bioventing	4.3	5	4.3	3.3	3.7	3.7	W = 3 C = 3 E = NA	3.3 2.7	27.3 27.3	6.3 7.6

Table 11-7

(Continued)

Remedial Alternative			Effectiveness Criteria					Implementability	Cost		Total Score	Effectiveness to Cost Quotient
Seeps	Groundwater	Soil	Protection of Human Health and the Environment	Compliance with ARARs	Long-term Effectiveness and Permanence	Reduction in Toxicity, Mobility, and Volume through Treatment	Short-term Effectiveness		Score	$ (Millions)		
Pass Extrac Activ Carb	Nat Att	Nat Deg (W+C) No Action (E)	3.7 4	3.7 4	4.3 4	1.7 2.5	2.7 4	5 5	W = 3 C = 3 E = 3	3.2 2.6 2.3	24.1 24.1 26.5	5.0 6.2 8.0
Pass Extrac Activ Carb	Nat Att	Nat Deg (W+C) No Action (E) Inst Cont	3.7	3.7	4.3	1.7	3.7	4.3	W = 3 C = 3 E = NA	3.2 2.6	24.4 24.4	5.3 6.6
Pass Extrac Activ Carb	Nat Att	Biopiling	3.7	3.7	4.3	2.7	3.7	4.3	W = 3 C = 3 E = NA	3.4 2.8	25.4 25.4	5.3 6.5
Pass Extrac Activ Carb	Nat Att	Bioventing	4.3	4.3	4.3	3.3	3.7	4.3	W = 3 C = 3 E = NA	3.4 2.8	27.2 27.2	5.9 7.1
Pass Extrac Activ Carb	Nat Att Inst Cont	Nat Deg (W+C) No Action (E)	3.7 4	4.3 5	4.3 4	1.7 2.5	2.7 4	5 5	W = 3 C = 3 E = 3	3.3 2.7 2.4	24.7 24.7 27.5	5.1 6.2 8.1
Pass Extrac Activ Carb	Nat Att Inst Cont	Nat Deg (W+C) No Action (E) Inst Cont	3.7	4.3	4.3	1.7	3.7	4.3	W = 3 C = 3 E = NA	3.3 2.7	25.0 25.0	5.4 6.6
Pass Extrac Activ Carb	Nat Att Inst Cont	Biopiling	3.7	4.3	4.3	2.7	3.7	4.3	W = 3 C = 3 E = NA	3.5 2.9	26.0 26.1	5.3 6.4
Pass Extrac Activ Carb	Nat Att Inst Cont	Bioventing	4.3	5	4.3	3.3	3.7	4.3	W = 3 C = 3 E = NA	3.5 2.9	27.9 27.9	5.9 7.1
Air Sparg Soil Vap Ext	Activ Carb Trt	Nat Deg (W+C) No Action (E)	4.3 5	4.3 5	5 5	3.3 5	2 3	3.7 3	W = -1 C = 1 E = 1	11.3 5.7 7.4	21.6 23.6 27.0	1.7 3.3 3.1

Table 11-7

(Continued)

Remedial Alternative			Effectiveness Criteria					Implementability	Cost		Total Score	Effectiveness to Cost Quotient
Seeps	Groundwater	Soil	Protection of Human Health and the Environment	Compliance with ARARs	Long-term Effectiveness and Permanence	Reduction in Toxicity, Mobility, and Volume through Treatment	Short-term Effectiveness		Score	$ (Millions)		
Air Sparg Soil Vap Ext	Activ Carb Trt	Nat Deg (W+C) No Action (E) Inst Cont	4.3	4.3	5	3.3	3	3	W = -1 C = 1 E = NA	11.3 5.7	21.9 23.9	1.8 3.5
Air Sparg Soil Vap Ext	Activ Carb Trt	Biopiling	4.3	4.3	5	4.3	3	3	W = -1 C = 1 E = NA	11.5 5.9	22.9 24.9	1.8 3.5
Air Sparg Soil Vap Ext	Activ Carb Trt	Bioventing	5	5	5	5	3	3	W = NA C = 1 E = NA	NA 5.9	NA 27.0	NA 3.9
Extract Air Strip Activ Carb	Extract Air Strip Activ Carb	Nat Deg (W+C) No Action (E)	3 3	4.3 5	5 5	3.3 5	2 3	3.7 3	W = 1 C = 3 E = -1	9.6 4.2 14.4	22.3 24.3 23.0	1.8 4.2 1.5
Extract Air Strip Activ Carb	Extract Air Strip Activ Carb	Nat Deg (W+C) No Action (E) Inst Cont	3	4.3	4.3	3.3	3	3	W = 1 C = 3 E = NA	9.6 4.2	21.9 23.9	1.9 4.3
Extract Air Strip Activ Carb	Extract Air Strip Activ Carb	Biopiling	3	4.3	5	4.3	3	3	W = 1 C = 3 E = NA	9.8 4.4	23.6 25.6	2.0 4.5
Extract Air Strip Activ Carb	Extract Air Strip Activ Carb	Bioventing	3.7	5	5	5	3	3	W = 1 C = 3 E = NA	9.8 4.4	25.7 27.7	2.2 4.9

Notes:
1) Criteria for Agency and Community Acceptance have not been evaluated at this time. These criteria will be evaluated in the Record of Decision.
2) The total score is the sum of the seven effectiveness, implementability and cost scores.
3) The Effectiveness/Cost Quotient provides an indication of the benefit provided in relation to the cost of each alternative. The effectiveness numerator is the sum of the five effectiveness scores. The cost denominator is the total estimated cost of each alternative, in $ million.
4) The four top scores for effectiveness/cost quotient, for each area, have been highlighted along with the corresponding remedial alternative.

Table 11-7

(Continued)

Key:

<u>Criteria Except Cost</u>
5 = Meets or exceeds definition/intent of criteria.
1-4 = Partially meets definition/intent of criteria.
0 = Doses do not meet definition/intent of criteria.

<u>Cost</u>
5 = <$1.5 million
3 = $1.5 to 5 million
1 = $5 to 10 million
-1 = >$10 million

W = Western Area
C = Central Area
E = Eastern Area
Nat Att = Natural Attenuation
Nat Deg = Natural Degradation
Inst Cont = Institutional Controls
Pass Ext = Passive Extraction
Const Wets = Constructed Wetlands
Activ Carb = Activated Carbon
Air Sparg = Air Sparging
Soil Vap Ext = Soil Vapor Extraction
Air Strip = Air Stripping
Extract = Extraction
NA = Not Applicable

To aid in comparing alternatives, Table 11-7 also includes the total score and effectiveness to cost quotients for each multimedia alternative. The total score is the sum of the seven criteria scores. The effectiveness-to-cost quotient is the sum of the five effectiveness criteria divided by the total cost (in million dollars). The higher the cost quotient, the more cost effective the alternative. To assist in identifying preferred alternatives, effectiveness-to-cost quotients provide a qualitative comparison of the ability of the alternative to provide remediation versus the cost required to achieve the remedial goals. Although Protectiveness of Human Health and the Environment is a summary of long-term effectiveness, short-term effectiveness, and compliance with ARARs, it is used as a separate factor to emphasize the importance of the three individual factors. The EPA CERCLA Manual indicates that all nine criteria should be separately evaluated.

The multi-media alternatives (Table 11-7) are typically grouped into sets of four alternatives to aid in review of the information presented. Each grouping has a consistent set of seep and groundwater alternatives; only the soil alternative varies within the group.

11.5.4 Limitations of Comparative Analysis

The comparative analysis is limited by several assumptions. First, it assumes that all three pathways are of equal importance. Similarly, it assigns equal importance to each CERCLA criteria over another rather than trying to rank one above another. The analysis also does not quantify synergistic effects between combinations of soil, seep, and groundwater alternatives. Finally, the comparative analysis relies on the five subjective, not objective, scores for the balancing factors for each media-specific alternative.

The best overall remedial approach for OU 5 may not necessarily include the "best" or highest scoring remedial alternative for all three geographical areas. Ultimately, the Air Force, regulatory agencies, and the community must determine which alternative, or set of alternatives, is most desirable based on effectiveness, implementability, acceptability, and cost.

11.5.5 Conclusion of Comparative Analysis

Below is provided a summary discussion of how each of the various alternatives rate for criteria, as well as for the "total score" and "effectiveness to cost quotients."

Protection of Human Health and the Environment. An important consideration for this criterion is that there are no current receptors exposed to groundwater. Notwithstanding this current setting, protection of human health and the environment scores are higher for alternatives that actively treat the water. Alternatives that do not provide for treatment of either seeps or groundwater score lowest because they do not provide protection from contact with seep contamination and because of the potential for discharge of contaminants from both seeps and groundwater to natural wetlands and Ship Creek. The use of institutional controls does not provide additional protection of human health and the environment. The use of passive extraction to collect seep water for treatment improves protection, although the method of treatment, wetlands versus activated carbon, does not effect protectiveness. Active groundwater treatment alternatives (i.e., air sparging with soil vapor extraction and extraction with air stripping) provide the highest levels of protection because they provide protection through interception and treatment of contaminants in both the seeps and groundwater. Similarly, the use of bioventing to treat all soil improves protection over the use of natural degradation or biopiling alternatives because bioventing should reduce contamination in all soil (both shallow and deep) to levels considered protective.

Compliance with Appropriate ARARs. Potential ARARs scores are higher for alternatives that either actively treat groundwater (and therefore seeps) or which provide institutional controls that limit use of groundwater. Alternatives that actively treat the groundwater, such as air sparging or extraction with air stripping, or that provide passive extraction of seeps and institutional controls to limit use of the groundwater, provide the highest level of compliance with potential ARARs. Some level of compliance with potential ARARs is achieved for those alternatives that treat seeps (e.g., passive extraction) but do not provide institutional controls for groundwater; these alternatives will reduce contaminant levels in seeps to acceptable levels. Similarly, those alternatives that do not treat seeps, but which provide institutional controls for groundwater, provide some level of compliance with potential ARARs because they limit use of the groundwater. Bioventing of soil improves compliance with potential ARARs for all alternatives because it should reduce contaminants in all soil to acceptable levels.

Long-Term Effectiveness and Permanence. These scores are all relatively similar, since all alternatives should be substantially effective in the long term. None of the alternatives is expected to produce toxic by-products, assuming carbon treatment alternatives use thermal regeneration to destroy contaminants collected by the carbon. Alternatives relying solely on natural attenuation and degradation processes may be the least effective because there may be insufficient residence time to successfully degrade the contaminants before discharge to natural wetlands and Ship Creek. The highest level of long-term effectiveness and permanence is achieved by those alternatives that actively extract and treat both groundwater and seeps.

Reduction in Toxicity, Mobility, and Volume through Treatment. Those alternatives that provide for active treatment of the groundwater and soil provide the greatest reductions in toxicity, mobility, and volume because all contaminant sources are treated; these alternatives will by their nature also treat the seeps. Those alternatives that only provide for treatment of seeps and soil are less effective at reducing the toxicity, mobility, and volume of the contaminants because contaminants in the groundwater are not actively treated. Alternatives that treat only seeps or soil, but not both, provide little reduction; while alternatives that rely on natural attenuation and degradation for all media, by definition, provide no reduction through treatment.

Short-Term Effectiveness. Short-term effectiveness is primarily affected by whether water treatment is provided. Those alternatives that treat either the seeps or groundwater are effective in the short term because they will immediately begin to reduce the potential for contact with contaminated water. Providing either institutional controls or treatment for soil increases the short-term effectiveness. Alternatives that rely solely on natural attenuation and degradation for the water and soil are the least effective in the short-term because the potential for contact with contaminated media will remain.

Implementability. All alternatives should be implementable. Some reduction in implementability may occur for biopiling, bioventing, and wetlands treatment alternatives because the cold climate may reduce the ability to implement these alternatives during winter months. Alternatives that actively treat the groundwater may be difficult to implement due to reinjection system limitations.

Cost. Cost estimates are primarily affected by selection of water treatment alternative. Soil alternative treatment costs are negligible, compared to soil monitoring costs, since volumes are small. Alternatives that rely on natural attenuation for the seeps and groundwater are the least expensive; they are estimated from $2.8 to $3.0 million in the Western Area, and from $1.9 to $2.4 million in the Central and Eastern Areas. The use of passive extraction and activated carbon to treat seeps is estimated to increase costs by approximately $0.4 million over the baseline cost in all areas; the additional costs are for construction of the extraction system and carbon usage. The use of passive extraction and constructed wetlands to treat seeps is estimated to increase costs by approximately $0.2 million over the baseline cost in all areas; the additional costs are for construction of the extraction system and wetlands. This alternative has a major benefit in that the constructed wetlands already planned as the presumptive remedy for the Snowmelt Pond also serves as the remedy for treating all water from seeps. Since the Snowmelt Pond-constructed wetlands are included as a cost in every alternative, this greatly reduces overall costs for the constructed wetlands alternative. Alternatives that actively treat all groundwater are substantially more expensive, especially in the Western and Eastern Areas, because of the larger volumes of water handled. Active extraction with air stripping and carbon treatment is estimated to increase costs over the baseline by $6.8 million in the Western Area, $12.5 million in the Eastern Area, and $2.0 million in the Central Area. Air sparging with soil vapor extraction and activated carbon treatment is estimated to increase costs over the baseline by $8.5 million in the Western Area, $3.5 million in the Central Area, and $5.5 million in the Eastern Area. The use of biopiling and bioventing to treat surface soil increases cost only slightly (<$200,000) over the baseline of $2.8 million in the Western Area and $2.2 million in the Central Area.

Total Score. Total scores are primarily affected by the level of treatment provided and cost. Alternatives providing treatment of seeps and/or groundwater score higher than those which use natural attenuation; however, the higher cost of actively treating all groundwater tends to off-set the increased effectiveness of these alternatives. The use of bioventing to treat all soil also increases the total score substantially over natural degradation or biopiling alternatives because of increased effectiveness. The use of institutional controls for groundwater and soil, as well as biopiling of soil, provide only a marginal increase in total score.

Cost-Effectiveness. The effectiveness-to-cost quotients are primarily affected by increased effectiveness for treatment of seeps over natural attenuation, the difference in cost between activated carbon (cheaper) and constructed wetlands (more expensive) for treatment of seeps, and high costs for active treatment of groundwater; soil alternatives have less effect on the overall effectiveness-to-cost quotient. The highest quotients in all three areas of OU 5 are for alternatives that treat seeps using activated carbon. The increased effectiveness of treating seeps, using constructed wetlands over the use of natural attenuation, is partially offset by the increased cost. The high cost for active groundwater treatment alternatives in the Western and Eastern Areas, where there are large groundwater contaminant plumes, reduces the cost effectiveness of these alternatives when compared with all other alternatives. The Central Area has smaller groundwater plumes which require less cost to treat, resulting in active treatment being more cost effective than natural attenuation, but less cost effective than passive extraction of seeps. When selecting preferred alternatives, consideration should be given to including institutional controls. For groundwater, the use of institutional controls when selecting natural attenuation of the groundwater increases the cost effectiveness of all alternatives using natural attenuation or passive extraction of seeps. However, it is difficult to fully evaluate the cost for institutional controls. Currently the water is not used; providing a replacement water source should a future user arise could increase costs.

As with water alternatives, the use of institutional controls for soil provides an increase in the effectiveness-to-cost quotient because of the low estimated cost. The use of bioventing and biopiling appears to have a positive effect on the effectiveness-to-cost quotient since only a small area of soil contamination requires remediation.

Summary

While the purpose of this FS is not to recommend the "best" remedial alternative, an analysis of effectiveness/cost quotient can give an indication of the most promising alternatives. Below are indicated the four alternatives that scored highest for each area, with their attendant effectiveness/cost quotients.

Western Area

Effectiveness/Cost Quotient

1) 6.3 Passive extraction with constructed wetlands for seeps/natural attenuation with institutional controls for groundwater/bioventing for soils.

2) 6.2 Passive extraction with constructed wetlands for seeps/natural attenuation for groundwater/bioventing for soils.

3) 5.9 Passive extraction with activated carbon for seeps/natural attenuation with institutional controls for groundwater/bioventing for soils.

5.9 Passive extraction/activated carbon treatment for seeps, natural attenuation with institutional controls for groundwater, and bioventing for soil.

Central Area

Effectiveness/Cost Quotient

1) 7.7 Passive extraction with constructed wetlands for seeps/natural attenuation for groundwater/bioventing for soils.

2) 7.6 Passive extraction with constructed wetlands for seeps/natural attenuation with institutional controls for groundwater/bioventing for soils.

3) 7.1 Four multimedia options tied, all of which include passive extraction with either constructed wetlands or activated carbon.

Eastern Area

Effectiveness/Cost Quotient

1) 8.9 Passive extraction with constructed wetlands for seeps/natural attenuation with institutional controls for groundwater.

2) 8.8 Passive extraction with constructed wetlands for seeps/natural attenuation for groundwater.

3) 8.1 Passive extraction with activated carbon for seeps/natural attenuation with institutional controls for groundwater.

4) 8.0 Passive extraction with activated carbon for seeps/natural attenuation for groundwater.

In all three areas, the alternative using passive extraction of seeps with treatment by constructed wetlands scored highest. Constructed wetlands scored highest because the sunk cost of the presumptive remedy for the Snowmelt Pond (also a constructed wetlands), which is included as an element of each alternative, does not have to be included twice in this alternative. The use of institutional controls or natural attenuation for the groundwater and bioventing for the soil is also frequently indicated as a component of these higher ranking alternatives. These consistent approaches result because the current threats to human health and the environment are limited in OU 5 and because of assumptions used in the analysis of alternatives. Both groundwater and soil are not considered significant threats to human health because the groundwater is not currently used and because there is limited potential for contact with contaminated soil on base. In addition, the soil contamination is primarily a concern for groundwater contamination rather than a toxic threat to humans. Therefore, it is assumed that using institutional controls to prevent future uses of the groundwater and soil will provide the necessary protection and compliance with potential ARARs for these pathways. On the other hand, seeps pose a potential threat to vegetation on the bluffs, the wetlands south of OU 5, and serves as a potential pathway for human contact. This results in the selection of alternatives which treat seeps in order to be effective solutions.

Treatment of soil by either bioventing or biopiling (which scored just behind bioventing) is indicated as preferable to natural degradation or institutional controls for the Western and Central Areas. The relatively small volumes of soil make treatment costs low, compared to the high costs of on-going monitoring. The soil in the Central Area is likely more effectively treated by biopiling, since it is very close to the surface and easily excavated. The soil in the Western Area is deeper (10 to 12 feet deep) and may be more effectively biovented. A depth of 10–12 feet is borderline for easy excavation, especially in a bluff area. This may make excavation of the Western Area soils for biopiling difficult to implement.

Natural attenuation of seeps in the eastern area is preferable over constructed wetlands alternatives because of the demonstrated natural attenuation ability of the Beaver Pond. Also, though passive extraction is an implementable option in OU 5, it would be less implementable in the eastern area because of the close proximity of the Beaver Pond to the bluff. The scoring approach was based on applying the alternatives across the entire OU, so this localized difficulty of implementing passive extraction in the Beaver Pond is not totally reflected in the effectiveness to cost quotient.

As stated earlier, the evaluation of alternatives by using effectiveness/cost quotients cannot be relied on to select the "best" alternative due to the numerous assumptions made (e.g., assigning equal weight to each criteria). However, it can provide a useful cut of the more preferable alternatives. The remainder of the CERCLA process (i.e., Proposed Plan, agency/public input, and Record of Decision) will determine the preferred alternative.

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Appendix A

LABORATORY RESULTS ON POTABLE WATER SUPPLY FOR EQUIPMENT DECONTAMINATION

ROY F. WESTON INC.

INORGANICS DATA SUMMARY REPORT 08/21/92

CLIENT: ELMENDORF AFB OU1
WORK ORDER: 0000-00-00-0000

WESTON BATCH #: 92085517

SAMPLE	SITE ID	ANALYTE	RESULT	UNITS	REPORTING LIMIT
-001	HYDRANT#1	Silver, Total	0.010 u	MG/L	0.010
		Aluminum, Total	0.28	MG/L	0.20
		Arsenic, Total	0.30 u	MG/L	0.30
		Barium, Total	0.10 u	MG/L	0.10
		Beryllium, Total	0.0050 u	MG/L	0.0050
		Calcium, Total	19.6	MG/L	1.0
		Cadmium, Total	0.0050 u	MG/L	0.0050
		Cobalt, Total	0.050 u	MG/L	0.050
		Chromium, Total	0.010 u	MG/L	0.010
		Copper, Total	0.050 u	MG/L	0.050
		Iron, Total	0.28	MG/L	0.050
		Mercury, Total	0.0010 u	MG/L	0.0010
		Potassium, Total	5.0 u	MG/L	5.0
		Magnesium, Total	2.5	MG/L	1.0
		Manganese, Total	0.015 u	MG/L	0.015
		Molybdenum, Total	0.10 u	MG/L	0.10
		Sodium, Total	3.0	MG/L	1.0
		Nickel, Total	0.040 u	MG/L	0.040
		Lead, Total	0.050 u	MG/L	0.050
		Antimony, Total	0.060 u	MG/L	0.060
		Selenium, Total	0.10 u	MG/L	0.10
		Thallium, Total	0.10 u	MG/L	0.10
		Vanadium, Total	0.050 u	MG/L	0.050
		Zinc, Total	0.066	MG/L	0.020

Note: Laboratory results for potable water supply used for equipment decontamination. HYDRANT #1 is the Elmendorf AFB fire hydrant located at intersection of Cedar and Prune Sts. Sampling was performed by Jacobs Engineering in August, 1992.

ROY F. WESTON INC.

INORGANICS DATA SUMMARY REPORT 08/21/92

CLIENT: ELMENDORF AFB OU1
WORK ORDER: 0000-00-00-0000

WESTON BATCH #: 9208S517

SAMPLE	SITE ID	ANALYTE	RESULT		UNITS	REPORTING LIMIT
-001	HYDRANT#1	Petroleum Hydrocarbons	1.1	u	MG/L	1.1

RFW[illegible]tch Number: 9208S517 Semivolat[illegible]s by GC/MS, HSL List Client: ELMENDORF[illegible] OU1 Report Date: [illegible]/92 13:00 Work Order: 0000-00-00-0000 Page: 1a

	Cust ID:	HYDRANT#1		SBLK		SBLK BS	
Sample Information	RFW#:	001		92SE1009-MB1		92SE1009-MB1	
	Matrix:	WATER		WATER		WATER	
	D.F.:	1.00		1.00		1.00	
	Units:	ug/L		ug/L		ug/L	
	Nitrobenzene-d5	77	%	70	%	66	%
Surrogate	2-Fluorobiphenyl	69	%	65	%	65	%
Recovery	Terphenyl-d14	78	%	78	%	79	%
	Phenol-d5	40	%	59	%	31	%
	2-Fluorophenol	52	%	52	%	56	%
	2,4,6-Tribromophenol	66	%	55	%	61	%
			fl		fl		fl
Phenol		10	U	10	U	49	%
bis(2-Chloroethyl)ether		10	U	10	U	10	U
2-Chlorophenol		10	U	10	U	55	%
1,3-Dichlorobenzene		10	U	10	U	10	U
1,4-Dichlorobenzene		10	U	10	U	64	%
Benzyl alcohol		10	U	10	U	10	U
1,2-Dichlorobenzene		10	U	10	U	10	U
2-Methylphenol		10	U	10	U	10	U
bis(2-Chloroisopropyl)ether		10	U	10	U	10	U
4-Methylphenol		10	U	10	U	10	U
N-Nitroso-di-n-propylamine		10	U	10	U	61	%
Hexachloroethane		10	U	10	U	10	U
Nitrobenzene		10	U	10	U	10	U
Isophorone		10	U	10	U	10	U
2-Nitrophenol		10	U	10	U	10	U
2,4-Dimethylphenol		10	U	10	U	10	U
Benzoic acid		50	U	50	U	50	U
bis(2-Chloroethoxy)methane		10	U	10	U	10	U
2,4-Dichlorophenol		10	U	10	U	10	U
1,2,4-Trichlorobenzene		10	U	10	U	69	%
Naphthalene		10	U	10	U	10	U
4-Chloroaniline		10	U	10	U	10	U
Hexachlorobutadiene		10	U	10	U	10	U
4-Chloro-3-methylphenol		10	U	10	U	57	%
2-Methylnaphthalene		10	U	10	U	10	U
Hexachlorocyclopentadiene		10	U	10	U	10	U

*= Outside of Advisory limits.

RFW#:	001		92SE10 -MB1		92SE1009-MB1	
2,4,6-Trichlorophenol	10	U	10	U	10	U
2,4,5-Trichlorophenol	50	U	50	U	50	U
2-Chloronaphthalene	10	U	10	U	10	U
2-Nitroaniline	50	U	50	U	50	U
Dimethylphthalate	10	U	10	U	10	U
Acenaphthylene	10	U	10	U	10	U
2,6-Dinitrotoluene	10	U	10	U	10	U
3-Nitroaniline	50	U	50	U	50	U
Acenaphthene	10	U	10	U	64	%
2,4-Dinitrophenol	50	U	50	U	50	U
4-Nitrophenol	50	U	50	U	53	%
Dibenzofuran	10	U	10	U	10	U
2,4-Dinitrotoluene	10	U	10	U	54	%
Diethylphthalate	10	U	10	U	10	U
4-Chlorophenyl-phenylether	10	U	10	U	10	U
Fluorene	10	U	10	U	10	U
4-Nitroaniline	50	U	50	U	50	U
4,6-Dinitro-2-methylphenol	50	U	50	U	50	U
N-Nitrosodiphenylamine (1)	10	U	10	U	10	U
4-Bromophenyl-phenylether	10	U	10	U	10	U
Hexachlorobenzene	10	U	10	U	10	U
Pentachlorophenol	50	U	50	U	61	%
Phenanthrene	10	U	10	U	10	U
Anthracene	10	U	10	U	10	U
Di-n-butylphthalate	10	U	10	U	10	U
Fluoranthene	10	U	10	U	10	U
Pyrene	10	U	10	U	75	%
Butylbenzylphthalate	10	U	10	U	10	U
3,3'-Dichlorobenzidine	20	U	20	U	20	U
Benzo(a)anthracene	10	U	10	U	10	U
Chrysene	10	U	10	U	10	U
bis(2-Ethylhexyl)phthalate	10	U	10	U	10	U
Di-n-octylphthalate	10	U	10	U	10	U
Benzo(b)fluoranthene	10	U	10	U	10	U
Benzo(k)fluoranthene	10	U	10	U	10	U
Benzo(a)pyrene	10	U	10	U	10	U
Indeno(1,2,3-cd)pyrene	10	U	10	U	10	U
Dibenz(a,h)anthracene	10	U	10	U	10	U
Benzo(g,h,i)perylene	10	U	10	U	10	U

(1) - Cannot be separated from Diphenylamine. *= Outside of Advisory limits.

RFW Batch Number: 92085517 Client: ELMENDORF AFB OU1 Work Order: 0000-00-00-0000 Page: 1b

Cust ID:	HYDRANT#1	BASE TRIP#1	BASE TRIP#1	BASE TRIP#1	VBLKA177	VBLKA177 BS
RFW#:	001	004	004 MS	004 MSD	92SMA177-MB2	92SMA177-MB2
Toluene	5 U	5 U	93 %	101 %	5 U	95 %
Chlorobenzene	5 U	5 U	102 %	113 %	5 U	105 %
Ethylbenzene	5 U	5 U	5 U	5 U	5 U	5 U
Styrene	5 U	5 U	5 U	5 U	5 U	5 U
Xylene (total)	5 U	5 U	5 U	5 U	5 U	5 U

*= Outside of Advisory limits.

Roy F. Weston, Inc. Stockton Laboratory
Volatiles by GC/MS, HSL List
Report Date: 08/21/9.
RFW Batch Number: 9208S517 Client: ELMENDORF AFB OU1 Work Order: 0000-00-00-0000 Pa

	Cust ID:	HYDRANT#1		BASE TRIP#1		BASE TRIP#1		BASE TRIP#1		VBLKA177		VBLKA17	
Sample	RFW#:	001		004		004 MS		004 MSD		92SMA177-MB2		92SMA177-MB2	
Information	Matrix:	WATER		WATER		WATER		WATER		WATER		WATER	
	D.F.:	1.00		1.00		1.00		1.00		1.00		1.00	
	Units:	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
	Toluene-d8	111	%	100	%	103	%	109	%	102	%	102	%
Surrogate	Bromofluorobenzene	106	%	102	%	101	%	103	%	103	%	102	%
Recovery	1,2-Dichloroethane-d4	112	%	115	%	108	%	112	%	101	%	102	%
			fl		fl		fl		fl		fl		fl
Chloromethane		10	U	10	U	10	U	10	U	10	U	10	U
Bromomethane		10	U	10	U	10	U	10	U	10	U	10	U
Vinyl Chloride		10	U	10	U	10	U	10	U	10	U	10	U
Chloroethane		10	U	10	U	10	U	10	U	10	U	10	U
Methylene Chloride		5	U	5	U	17	B	19	B	3	J	17	B
Acetone		10	U	10	U	10	U	10	U	10	U	10	U
Carbon Disulfide		5	U	5	U	5	U	5	U	5	U	5	U
1,1-Dichloroethene		5	U	5	U	103	%	112	%	5	U	106	%
1,1-Dichloroethane		5	U	5	U	5	U	5	U	5	U	5	U
2-Chloroethylvinylether		10	U	10	U	10	U	10	U	10	U	10	U
Chloroform		20		5	U	5	U	5	U	5	U	5	U
1,2-Dichloroethane		5	U	5	U	5	U	5	U	5	U	5	U
2-Butanone		10	U	10	U	10	U	10	U	10	U	10	U
1,1,1-Trichloroethane		5	U	5	U	5	U	5	U	5	U	5	U
Carbon Tetrachloride		5	U	5	U	5	U	5	U	5	U	5	U
Vinyl Acetate		10	U	10	U	10	U	10	U	10	U	10	U
Bromodichloromethane		5	U	5	U	5	U	5	U	5	U	5	U
1,2-Dichloropropane		5	U	5	U	5	U	5	U	5	U	5	U
cis-1,3-Dichloropropene		5	U	5	U	5	U	5	U	5	U	5	U
Trichloroethene		5	U	14		77	%	75	%	5	U	100	%
Dibromochloromethane		5	U	5	U	5	U	5	U	5	U	5	U
1,1,2-Trichloroethane		5	U	5	U	5	U	5	U	5	U	5	U
Benzene		5	U	5	U	91	%	90	%	5	U	91	%
trans-1,3-Dichloropropene		5	U	5	U	5	U	5	U	5	U	5	U
Bromoform		5	U	5	U	5	U	5	U	5	U	5	U
4-Methyl-2-pentanone		10	U	10	U	10	U	10	U	10	U	10	U
2-Hexanone		10	U	10	U	10	U	10	U	10	U	10	U
Tetrachloroethene		5	U	5	U	5	U	5	U	5	U	5	U
1,1,2,2-Tetrachloroethane		5	U	5	U	5	U	5	U	5	U	5	U

*= Outside of Advisory limits.

Appendix B

SOIL BORING LOGS

CH2M HILL

PROJECT NUMBER	BORING NUMBER
ANC31026.H3.60	OU5SB-18 SHEET 1 OF 2

SOIL BORING LOG

PROJECT Elmendorf AFB - OU5 **LOCATION** S.E. Corner of Corps Building/EAFB

ELEVATION ______ **DRILLING CONTRACTOR** Denali

DRILLING METHOD AND EQUIPMENT HSA, B61 Mobile Drill Rig, 4.25" ID Augers

WATER LEVELS 34.2' on 8/12/92 **START** 8/12/92 0815 **FINISH** 8/12/92 1600 **LOGGER** Rob Crotty

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	5.0	1-GRAB	NA	NA	ORGANIC MATERIAL, (PT), to 2.0', SILT, (ML), light brown, dry, soft to firm, no dry strength, non plastic; ocassionally organics including rootlets, debris-filled cavities.	Note: No product odor from 0 to 35'. Strong product odor at 35'. HNu=190 ppm Cuttings collected and inspected from flights from 0 to 5'.
5.0	7.0	2-SH	2.0	7-24-14-23 (38)	From 5.0 to 11.1' POORLY GRADED GRAVEL WITH SAND, (GP), brown, dry becoming moist at 3.2', medium dense, subrounded gravel to 3" diameter with fine to medium subangular sand, trace nonplastic silt and occasional subrounded cobble and occasional organic layers to 1".	
	10.0					
10.0	12.0	3-SH	1.8	34-26-20-22 (46)	From 11.1 to 16.0' POORLY GRADED SAND, (SP), brown, moist, medium dense, fine to coarse subangular sand with trace nonplastic silt.	5SB18-10A is field duplicate of 5SB18-10.
	15.0					
15.0	17.0	4-SH	2.0	14-46-55-72 (101)	From 16.0' POORLY GRADED GRAVEL WITH SAND, (GP), brown, moist, very dense, subrounded gravel to 2" diameter, fine to medium subangular sand with trace non plastic silt, occasional coal seams to 2" thick.	Increasing gravel fraction.
	20.0					
20.0	22.0	5-SH	2.0	10-25-35-40 (60)	POORLY GRADED GRAVEL WITH SAND, (GP), same as above.	
	25.0					
25.0	27.0	6-SH	2.0	23-44-63-69 (107)	POORLY GRADED GRAVEL WITH SAND, (GP), same as above.	
	30.0					

CH2M HILL

PROJECT NUMBER	BORING NUMBER
ANC31026.H3.60	OU5SB-18

SHEET 2 OF 2

SOIL BORING LOG

PROJECT Elmendorf AFB - OU5 LOCATION S.E. Corner of Corps Building/EAFB

ELEVATION ______ DRILLING CONTRACTOR Denali

DRILLING METHOD AND EQUIPMENT HSA, B61 Mobile Drill Rig, 4.25" ID Augers

WATER LEVELS 34.2' on 8/12/92 START 8/12/92 0815 FINISH 8/12/92 1600 LOGGER Rob Crotty

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"-6 (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 31.5	7-SH	1.5	62-90-100/6"	<u>POORLY GRADED GRAVEL WITH SAND</u> (GP), same as above with occasional subround cobble to 4" diameter.	Split-spoon refusal encountered at 31.5', augered through it.
					Becomes wet at 34.2'	Freewater encountered at 34.2'
35.0	35.0 37.0	8-SH	2.0	32-53-43-33 (96)	<u>POORLY GRADED GRAVEL WITH SAND</u> (GP), same as above, gray, wet, hydrocarbon stain and sheen on gravel	Strong odor from 35.0' to 37.0'. HNu reads 190 ppm.
					END OF BORING AT 36.0'	Boring sealed using cement/bentonite grout mixed at a ratio of 0.5gal H20/1lb. cement/.05lb. bentonite.
					SH=2.5" sampler.	ORS oil/water interface probe used....no free product.
40.0						
45.0						
50.0						
55.0						

PROJECT NUMBER	BORING NUMBER
ANC31026.H3.60	OU5SB-19 SHEET 1 OF 2

SOIL BORING LOG

PROJECT Elmendorf AFB - OU5 LOCATION EAFB
ELEVATION DRILLING CONTRACTOR Denali
DRILLING METHOD AND EQUIPMENT HSA, B61 Mobile Drill Rig, 4.25" ID Augers
WATER LEVELS 39.0 ' on 8/10/92 START 8/10/92 1015 FINISH 8/11/92 1815 LOGGER Rob Crotty

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	2.5	1-SS	2.4	12-17-24-41 (41)	ORGANIC MATERIAL, (PT), to 0.1' From 0.1 to 2.0' SANDY SILT, (ML), light brown, dry, dense, nonplastic silt with very fine to medium sand; trace organics including rootlets and cavities throughout.	HNu background=2 ppm Note: No product odor, HNu=1ppm, LEL=0%
5.0	5.0	2-SH	2.5	24-67-73-65 (140)	From 2.0 to 7.0' SILTY GRAVEL WITH SAND, (GM), light brown, dry becoming moist, dense to very dense; subrounded gravel to 2.0" diameter with nonplastic silt and very fine to medium subangular sand; trace organics including rootlets and cavities from 2.0 to 3.5 ft.	Increasing gravel fraction in cuttings. Note: Additional 0.5' material collected in sampler after driving and counting required 2.0 ft. therefore, each sampler is driven 2.5'.
	7.5	3-SH	2.4	6-29-37-51 (66)	From 7.0' to 12.5' POORLY GRADED GRAVEL WITH SAND, (GP), brown, moist dense; subround gravel to 3.0" diameter with fine to coarse subangular sand and trace nonplastic silt.	Slight weathered hydrocarbon odor from 7.3 to 15.0'. HNu reads 12.0 ppm.
10.0	10.0	4-SH	2.5	15-27-35-40 (62)	POORLY GRADED GRAVEL WITH SAND, (GP), same as above.	
	12.5	5-SH	2.5	4-36-89-100 (125)	POORLY GRADED GRAVEL WITH SAND, (GP), same as above.	Chemical analysis sample 5SB19-10 taken from 10.0'-12.5' in 5-SH.
	13.0	6-SH	0.5	100/6"	From 12.5 to 13.0' POORLY GRADED GRAVEL WITH SAND, (GP), same as above with occasional subround cobble to 4" diameter.	Sampler refusal at 6" interval from 12.5 to 15.0. HNu reads 3.0 ppm at 12.5' to 15.0'.
15.0	15.0					
	17.5	7-SH	0.7	6-14-50-100 (64)	From 15.0' to 17.5' POORLY GRADED GRAVEL WITH SAND, (GP), same as above	HNu reads 20.0 ppm at 15.0' to 17.0'
20.0	20.0				No sample taken in 17.5' to 20.0' interval.	Poor recovery from 15.0 to 17.5. Chasing a large cobble that is affecting recovery; therefore, 1. drill to 20.0' and begin drive, 2. Log cuttings from 17.5 to 20.0'.
	22.5	8-SH	2.5	17-59-62-51 (121)	From 20.0' to 25.5' POORLY GRADED SAND WITH GRAVEL, (SP), brown, moist, very dense, medium to coarse subangular sand with subrounded gravel to 2" diameter, 1" coal lens at 21.2'.	
25.0	25.0	9-SH	2.5	16-29-31-50 (60)		
	27.5	10-SH	2.5	7-25-36-39 (61)	From 25.5' to 41.0 WELL GRADED SAND, (SW), brown, moist, medium dense, medium subangular sand with occasional subrounded gravel to 0.2" diameter and 1-2" coal lens.	
	30.0	11-SH	2.5	23-36-33-56 (69)		HNu reads 42.0 ppm at 27.5'to 30 0' Note. "Hit" could be due to coal.

CH2M HILL

PROJECT NUMBER ANC31026.H3.60

BORING NUMBER OU5SB-19

SHEET 2 OF 2

SOIL BORING LOG

PROJECT Elmendorf AFB - OU5 **LOCATION** EAFB

ELEVATION ________ **DRILLING CONTRACTOR** Denali

DRILLING METHOD AND EQUIPMENT HSA, B61 Mobile Drill Rig, 4.25" ID Augers

WATER LEVELS 39.0 ' on 8/10/92 **START** 8/10/92 1015 **FINISH** 8/11/92 1815 **LOGGER** Rob Crotty

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 32.5	12-SH	2.5	6-16-32-50 (48)	WELL GRADED SAND, (SW), same as above.	
	35.0	13-SH	2.5	12-13-32-56 (45)	WELL GRADED SAND, (SW), same as above.	
35.0	37.5	14-SH	2.5	12-16-16-22 (32)	WELL GRADED SAND, (SW), same as above.	Note: Change to 300 lb. hammer drive SH sampler at 35.0'.
	40.0	15-SH	2.5	10-12-12-20 (24)	WELL GRADED SAND, (SW), same as above, becomes wet at 39.0'.	Free water encountered at 39.0
40.0	42.5	16-SH	2.5	7-10-11-17 (21)	From 41.0' to 45.0' POORLY GRADED SAND WITH GRAVEL, (SP), brown, wet, medium dense, medium to coarse subround sand with subangular gravel to 0.4" diameter, occasional fractured coal particles throughout.	
	45.0	17-SH	2.5	13-26-27-39 (53)		Potable water added to HSA center rod annulus to counteract heave for 17-SH.
45.0	47.5	18-SH	2.5	6-13-24-32 (37)	From 45.0' to 51.5' POORLY GRADED SAND WITH GRAVEL, (SP), brown, wet, medium dense, medium to coarse subangular sand with trace subround gravel to 0.3" diameter, occasional subangular coal particles throughout.	Again, potable water added to HSA/center rod annulus to counter heave in 18-SH.
	50.0	19-SH	2.5	16-20-37-30 (57)		
50.0	52.5	20-SH	2.5	8-10-12-16 (22)	From 51.5' to 52.5' SILTY CLAY, (CL/ML), olive gray, dry to wet, fat clay with slightly plastic silt, thixotropic.	Bootlegger cove formation. Sample 5SB19-52 collected 51.5 to 52.5'.
					END OF BORING AT 52.5'	End of boring at 52.5' Grouted back 8/12/92.
55.0						

CH2M HILL

PROJECT NUMBER	BORING NUMBER
ANC31026.H3.60	OU5SB-20 SHEET 1 OF 2

SOIL BORING LOG

PROJECT Elmendorf AFB - OU5 LOCATION Operable Unit 5 EAFB

ELEVATION ______ DRILLING CONTRACTOR Denali

DRILLING METHOD AND EQUIPMENT HSA, B61 Mobile Drill Rig.4.25" ID Augers

WATER LEVELS 35.2 ' on 8/6/92 START 8/6/92 0956 FINISH 8/6/92 1750 LOGGER Rob Crotty

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	2.0	1-SS		4-6-18-26 (24)	ORGANIC MATERIAL AND PEAT, (PT), to 0.4'. From 0.4' to 20.0' SILT, (ML), light brownish buff, dry, medium stiff, nonplastic.	HNu background = 2ppm
5.0	5.0					Drilling action becomes harder. Gravel in cuttings.
	7.0	2-SS		24-24-36-17 (60)	From 5.0' to 7.0' SILTY GRAVEL WITH SAND, (GM), dark brown, moist, medium dense to dense, subround gravel to 3.0" diameter with medium to coarse subangular sand, trace nonplastic silt.	
10.0	10.0					
	12.0	3-SH	0	10-15-16-17 (31)	From 10.0' to 12.0' POORLY GRADED GRAVEL WITH SAND, (GP), dark brown, moist, medium dense to dense, subround gravel to 3.0" diameter with medium to coarse subangular sand, trace nonplastic silt.	
	13.0	4-SH	1.0	20-26-107/0"	From 12.0' to 13.0' POORLY GRADED GRAVEL WITH SAND, (GP), same as above.	OVM reads 5.0 ppm at 12.0' to 14.0'.
15.0	15.0					
	17.0	5-SH		36-24-27-28 (51)	From 15.0' to 17.0' POORLY GRADED GRAVEL WITH SAND, (GP), same as above.	
20.0	20.0					
	22.0	6-SH	2.0	4-47-49-54 (96)	From 20.0' to 21.0' POORLY GRADED SAND, (GP), same as above. From 21.0' to 22.0' POORLY GRADED SAND, (SP), brown, moist, very dense, medium to coarse subsubangular sand with occasional subangular gravel to 0.4" diameter. Coal seam from 20.5' to 20.8'.	HNu = 1 ppm at 1130 OVM reads 2.0 ppm at 20.0' to 22.0'
25.0	25.0					
	27.0	7-SH		20-70-77-84 (147)	From 25.0' to 27.0' POORLY GRADED SAND, (SP), same as above.	OVM reads 2.0 ppm at 25.0' to 27.0'
	29.0	8-SH		72-89-77-80 (166)	From 27.5' to 29.0' POORLY GRADED SAND WITH GRAVEL, (SP), brown, moist, dense becoming very dense, medium to coarse subround sand with subround gravel to 2" diameter, coal seam at 28.7' to 29.0'.	

CH2M HILL

PROJECT NUMBER	BORING NUMBER
ANC31026.H3.60	OU5SB-20 SHEET 2 OF 2

SOIL BORING LOG

PROJECT Elmendorf AFB - OU5 LOCATION Operable Unit 5 EAFB

ELEVATION ______ DRILLING CONTRACTOR Denali

DRILLING METHOD AND EQUIPMENT HSA, B61 Mobile Drill Rig.4.25" ID Augers

WATER LEVELS 35.2' on 8/6/92 START 8/6/92 0956 FINISH 8/6/92 1750 LOGGER Rob Crotty

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
35.0	35.0					
		9-SH	2.0	35-40-50-57 (90)	From 35.0' to 37.0' <u>POORLY GRADED SAND WITH GRAVEL</u>, (SP), same as above, becomes wet at 35.2'.	Freewater encountered at 35.2'.
	37.0				END OF BORING AT 37.0'	Boring Grouted
40.0						
45.0						
50.0						
55.0						

PROJECT NUMBER ANC31026.H3.60

BORING NUMBER OU5SB-21

SHEET 1 OF 2

SOIL BORING LOG

PROJECT Elmendorf AFB - OU5

LOCATION SW of EAFB Power Plant

ELEVATION

DRILLING CONTRACTOR Denali

DRILLING METHOD AND EQUIPMENT HSA, B61 Mobile Drill Rig, 4.25" ID Augers

WATER LEVELS 33.8 ' on 8/12/92

START 8/12/92 1700

FINISH 8/13/92 1705

LOGGER Rob Crotty

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	2.5	1-SH	1.9	12-23-30-32 (53)	ORGANIC MATERIAL, (PT), to 0.2'. From 0.2 to 8.2 POORLY GRADED GRAVEL WITH SAND, (GP), brown, moist, medium dense, subrounded gravel to 2" diameter with fine to medium subangular sand and trace nonplastic silt.	Additional 0.5' collected in drive after driving and counting blows for 2.0'. Each sampler contains a 2.5 foot drive.
5.0	5.0	2-SH	1.8	48-32-34-30 (66)		
	7.5	3-SH	1.6	39-22-22-18 (44)		OVM reads 3.0 ppm at 5.0' to 7.5'
10.0	10.0	4-SH	2.0	8-15-16-20 (31)	From 8.2' to 11.0' POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM), brown, moist, medium dense, subrounded gravel to 3" diameter with fine to medium subangular sand and nonplastic silt.	OVM reads 10.0 ppm at 7.5' to 10.0'
	12.5	5-SH	2.0	11-12-11-10 (23)	From 11.0' to 16.0' SILT WITH GRAVEL, (ML), brown, dry to moist, very stiff, low to no dry strength, nonplastic, occasional subangular gravel to 0.1" diameter, loess.	
15.0	15.0	6-SH	2.0	3-8-9-0 (17)		OVM reads 30.0 ppm at 12.5' to 15.0'
	17.5	7-SH	0.7	6-8-10-12 (18)	From 16.0' to 18.0' SILTY GRAVEL, (GM), brown, moist, subround gravel to 0.5" diameter with low dry strength, nonplastic silt.	OVM reads 3.0 ppm at 15.0' to 17.5'
20.0	20.0	8-SH	2.0	12-22-26-21 (49)	From 18.0' to 25.5' POORLY GRADED GRAVEL WITH SAND, (GP), brown, moist, medium dense, subangular to round gravel to 2" diameter with medium subangular sand and trace nonplastic silt, occasional coal seam to 2" thick.	
	22.5	9-SH	1.5	17-28-33-40 (61)		OVM reads 7.0 ppmat 20.0' to 22.5' Note: High OVM reading at 20.0 ' to 22.5' possibly due to coal.
25.0	25.0	10-SH	1.3	33-32-53-43 (85)		
	27.5	11-SH	2.0	12-26-50-52 (76)	From 25.5' to 30.5' POORLY GRADED SAND, (SP), light brown, moist, dense, uniform medium subangular sand, occasional coal lens to 0.5" thick.	
	30.0	12-SH	2.0	11-35-52-56 (87)		

CH2M HILL

PROJECT NUMBER ANC31026.H3.60

BORING NUMBER OU5SB-21

SHEET 2 OF 2

SOIL BORING LOG

PROJECT Elmendorf AFB - OU5

LOCATION SW of EAFB Power Plant

ELEVATION

DRILLING CONTRACTOR Denali

DRILLING METHOD AND EQUIPMENT HSA, B61 Mobile Drill Rig, 4.25" ID Augers

WATER LEVELS 33.8 ' on 8/12/92

START 8/12/92 1700

FINISH 8/13/92 1705

LOGGER Rob Crotty

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 32.5	13-SH	2.0	12-35-50-57 (85)	From 30.5'to 33.8' Interlayered POORLY GRADED SAND WITH GRAVEL (SP), brown, moist, very dense, uniform medium subangular sand, gravel is subround to 2" diameter.	
	35.0	14-SH	2.0	15-23-30-31 (53)	From 33.8' to 36.3' POORLY GRADED SAND WITH GRAVEL (SP) same as above, except becomes wet at 33.8'.	OVM reads 4.0 ppm at 32.5' to 35.0'. Freewater encountered at 33.8'.
35.0	37.5	15-SH	2.0	30-25-30-40 (55)	From 36.3' to 46.0' POORLY GRADED SAND (SP), brown, wet, dense, medium to coarse subangular sand	
	40.0	16-SH	2.0	43-31-50-51 (81)		
40.0	42.5	17-SH	2.0	23-30-33-35 (63)		OVM reads 9.0 ppm at 40.0' to 42.5'.
	45.0	18-SH	2.0	3-38-30-47 (68)		OVM reads 10.0 ppm at 42.5' to 45.0'.
45.0	46.0	19-SH	1.0	24-100/6"		
	47.5				From 47.5' to 48.0' POORLY GRADED SAND (SP) same as above.	Split-spoon sampler refusal at 46.0'. OVM reads 3.0 ppm at 45.0' to 46.0'. Bootlegger cove formation. *No free product encountered.*
	50.0	20-SH	2.0	26-40-55-100 (95)	From 48.0' to 50.0' SILTY CLAY (CL), olive gray, moist to wet, hard.	
50.0					END OF BORING AT 50'	
55.0						

CHM HILL

PROJECT NUMBER	BORING NUMBER
ANC31026.H3.60	OU5SB-22 SHEET 1 OF 1

SOIL BORING LOG

PROJECT ELMENDORF AFB IRP OU5 **LOCATION** ANCHORAGE, ALASKA

ELEVATION -- **DRILLING CONTRACTOR** DENALI DRILLING

DRILLING METHOD AND EQUIPMENT MOBILE DRILL B-61, TRUCK MOUNT, 4.25-INCH ID AUGER

WATER LEVELS 31.5 ft bgs. on 8/28/92 **START** 8/28/92 **FINISH** 8/28/92 **LOGGER** D. KUNKEL

DEPTH BELOW SURFACE (FT)	SAMPLE			BLOWCOUNT	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
5.0	5.0 7.0	SB22-5	1.2	19-32-18-25	From 5.0 to 7.0 ft. POORLY GRADED SAND WITH GRAVEL (SP) poorly-graded sand with gravel, gray-brown, dry, dense, fine to medium sand with subangular to subrounded gravel, and minor amounts of non-plastic silt. Some cobble fragments.	
10.0	10.0 12.0	SB22-1	1.3	12-17-17-18	From 10.0 to 12.0 ft. POORLY GRADED SAND WITH GRAVEL (SP) As above.	
15.0	15.0 17.0	SB22-1	1.1	10-18-28-29	From 15.0 to 17.0 ft. POORLY GRADED SAND WITH GRAVEL (SP) As above.	
20.0	20.0 22.0	SB22-2	1.3	12-25-20-33	From 20.0 to 22.0 ft. POORLY GRADED SAND WITH GRAVEL (SP) As above.	
25.0	25.0 27.0	SB22-2	1.3	15-26-31-35	From 25.0 to 27.0 ft. POORLY GRADED SAND WITH GRAVEL (SP) As above.	
30.0	30.0 32.0	SB22-3	1.3	10-25-28-23	From 30.0 to 32.0 ft. POORLY GRADED SAND WITH GRAVEL (SP) As above. Free water encountered at 31.5 ft. bgs. No discernible floating product.	
35.0	35.0 37.0	SB22-3	1.4	12-19-21-20	From 35.0 to 37.0 ft. POORLY GRADED SAND WITH GRAVEL (SP) As above.	
					END OF BORING AT 37.0 FT. BGS	

CH2M HILL

PROJECT NUMBER	BORING NUMBER
ANC31026.H3.60	OU5SB-23

SHEET 1 OF 2

SOIL BORING LOG

PROJECT Elmendorf AFB - OU5 LOCATION Operable Unit 5 EAFB

ELEVATION DRILLING CONTRACTOR Denali

DRILLING METHOD AND EQUIPMENT HSA B61 Mobile Drill Rig, 4.25" ID Augers

WATER LEVELS 40.5 on 8/18/92 START 8/18/92 1035 FINISH 8/21/92 1432 LOGGER Rob Crotty

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	0.3				From 0.0' to 0.3' ORGANIC MATERIAL, (PT) From 0.3 to 2.5' SILT, (ML), brown, dry to moist, firm, nonplastic with trace very fine sand, organics, rootlets and cavities throughout.	*Surface sample S5B23-0 taken from Sample 1-SH from 0 to 0.5'. *Additional 0.5 material collected in each drive, therefore total drive is 2.5'. Silt appears to be loess, eolian deposition.
	2.5	1-Sh	2.0			
	5.0				From 5.0' to 7.0' POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM), light brown to brown, dry becoming moist at 3.0', subround gravel to 3" diameter with very fine to medium subangular sand and nonplastic silt, trace organics.	
5.0	7.0	2-SH	2.0	45-26-37-38 (63)		
	9.5	3-SH		10-11-29-40 (40)	From 7.0 to 14.0' Interbedded POORLY GRADED SAND, (SP) and POORLY GRADED SAND WITH GRAVEL, (SP), brown, moist, medium dense, sand layers consist of uniform coarse subround sand, gravelly sand layers consist of medium to coarse sand with subround gravel to 1" diameter, sand and gravelly sand beds range to 1' in thickness.	
	10.0					
10.0	12.5	4-SH	2.0	12-30-39-45 (69)		S5B23-10 collected from 10.0' to 12.5'.
	15.0	5-SH	2.0	27-40-45-68 (85)	From 14.0 to 20.0' POORLY GRADED GRAVEL WITH SAND, (GP), brown, moist, dense, subround gravel to 2-inch diameter with medium to coarse subround sand, occasional coal seam to 3".	
15.0	17.5	6-SH	2.0	62-60-60-30 (120)		
	20.0	7-SH	2.0	4-17-21-30 (35)		
20.0	22.5	8-SH	2.0	13-37-67-100 (104)	From 20.0 to 32.0 Interbedded POORLY GRADED SAND, (SP), and POORLY GRADED GRAVEL WITH SAND, (GP), brown, moist, medium dense, fine to coarse grained sand in beds 2' thick, subround gravel with medium to coarse subangular sand in beds to 1'thick. Occasional cobbles to 4" diameter with occasional coal seams to 2".	
	25.0	9-SH	2.0	22-33-44-38 (77)		
25.0	27.5	10-SH	2.1	21-49-99-90 (148)		S5B23-25 collected from 25.0 to 27.5'.
	30.0	11-SH	2.0	16-49-79-72 (128)	Interbedded POORLY GRADED SAND, (SP), and POORLY GRADED GRAVEL WITH SAND, (GP), same as the above, dense.	

CHM HILL

PROJECT NUMBER	BORING NUMBER
ANC31026.H3.60	OU5SB-23 SHEET 2 OF 2

SOIL BORING LOG

PROJECT Elmendorf AFB - OU5 LOCATION Operable Unit 5 EAFB

ELEVATION ______ DRILLING CONTRACTOR Denali

DRILLING METHOD AND EQUIPMENT HSA B61 Mobile Drill Rig. 4.25" ID Augers

WATER LEVELS 40.5 on 8/18/92 START 8/18/92 1035 FINISH 8/21/92 1432 LOGGER Rob Crotty

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 32.5	12-SH	2.0	16-40-45-60 (85)		
35.0	35.0	13-SH	2.0	20-21-48-59 (69)	From 32.0 to 40.5' POORLY GRADED SAND, (SP), brown, moist, medium dense, uniform medium subangular sand, occasional subround gravel lenses and coal lenses to 3".	
	37.5	14-SH	2.0	12-27-77-58 (64)		
40.0	40.0	15-SH	2.0	26-31-41-67 (72)		Free water encountered at 40.5' at 1655 on 8/18/92.
	42.5	16-SH	2.0	33-41-42-34 (83)	POORLY GRADED SAND, (SP), same as above, wet at 40.5'.	
45.0	45.0	17-SH	2.0	9-22-22-29 (44)	From 42.5 to 47.5' POORLY GRADED GRAVEL WITH SAND, (GP), brown, moist, medium dense, medium to coarse grained sand with subround gravel to 3" diameter with occasional coal seams to 1".	HNu= 39 ppm at 42.5 to 45.0' End drilling on 8/18/92 Begin at 42.5 on 8/21/92. Change to 300lb. hammer at 42.5'.
	47.5	18-SH	2.0	9-22-33-41 (55)		HNu= 32 ppm at 45.0' to 47.5' HNu background for 8/21/92 is 0 ppm.
50.0	50.0	19-SH	2.0	12-22-32-35 (54)	From 47.5 to 57.8' POORLY GRADED SAND, (SP), brown, wet, dense, medium to coarse subangular sand, occasional gravel lenses to 0.4' with occasional coal lenses to 2".	
	52.5	20-SH	2.0	7-7-15-20 (22)		
55.0	55.0	21-SH	2.0	12-27-37-33 (64)		
	57.5	22-SH	2.0	23-50-60-43 (110)		
	60.0	23-SH	2.0	7-7-10-17 (17)	From 57.8 to 60.0' SILTY CLAY, (CL), olive gray, moist, stiff, thixotropic. END OF BORING AT 60.0'	End of boring at 60.0' Bootlegger cove formation. No floating product

CH2M HILL

PROJECT NUMBER ANC31026.H3.60

BORING NUMBER OU5SB-24

SHEET 1 OF 2

SOIL BORING LOG

PROJECT Elmendorf AFB - OU5 **LOCATION** Operable Unit 5 EAFB

ELEVATION ________ **DRILLING CONTRACTOR** Denali

DRILLING METHOD AND EQUIPMENT HSA B61 Mobile Drill Rig, 4.25" ID Augers

WATER LEVELS 29.1 on 8/23/92 **START** 8/23/92 1050 **FINISH** 8/23/92 1230 **LOGGER** Rob Crotty

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	0.3	1-GRAB	NA		From 0.0' to 0.3' ORGANIC MATERIAL, (PT)	HNu background <1.0 ppm on August 23, 1992 at OU5SB-24.
	5.0				From 0.3 to 5.0' POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM), brown, moist, loose becoming medium dense, subround gravel to 2" diameter with nonplastic silt and fine to medium sand, trace organics from 0.2 to 4.0'.	Soil description based on soil cuttings and drilling action from 1.5 to 5.0'.
5.0	9.0	2-SH	2.0	6-8-12-18 (20)	From 5.0 to 9.0' POORLY GRADED GRAVEL WITH SAND, (GP), brown, moist, loose, subround gravel to 1" diameter with medium subangular sand, trace silt and occasional coal lens to 3".	Soil description based on soil cuttings and drilling action from 7.0 to 10.0'. decreasing gravel fraction, increasing drilling rate.
10.0	12.0	3-SH	2.0	6-12-16-15 (28)	From 9.0 to 12.0' POORLY GRADED SAND, (SP), brown, medium dense, medium to coarse subround gravel to 1" diameter trace nonplastic silt and occasional coal lenses.	
	15.0					Soil description based on soil cuttings and drilling action from 12.0 to 15.0'.
15.0	17.0	4-SH	2.0	6-18-12-20 (30)	From 15.0' to 17.0' POORLY GRADED SAND, (SP), same as above.	
	20.0					Soil description based on soil cuttings and drilling action from 17.0'to 20.0'
20.0	22.0	5-SH	1.8	9-12-20-22 (32)	From 20.0' to 22.0' POORLY GRADED SAND, (SP), same as above.	
	25.0					Soil description based on soil cuttings and on drilling action from 22.0' to 25.0'. Increase in gravel fraction at 24.0'. Decrease in drilling rate.
25.0	27.0	6-SH	2.0	8-18-19-20 (37)	From 25.0' to 27.0' POORLY GRADED GRAVEL WITH SAND (GP), brown, moist, medium dense, subround gravel to 2" diameter with medium to coarse subangular sand, trace nonplastic silt and occasional coal lens.	
	30.0					Soil description based on drilling actio from 24.0 to 30.0'. Freewater encountered at 29.1' at 1220 on 23 August, 1992.

CH2M HILL

PROJECT NUMBER	BORING NUMBER
ANC31026.H3.60	OU5SB-24 SHEET 2 OF 2

SOIL BORING LOG

PROJECT Elmendorf AFB - OU5 **LOCATION** Operable Unit 5 EAFB

ELEVATION **DRILLING CONTRACTOR** Denali

DRILLING METHOD AND EQUIPMENT HSA B61 Mobile Drill Rig, 4.25" ID Augers

WATER LEVELS 29.1 on 8/23/92 **START** 8/23/92 1050 **FINISH** 8/23/92 1230 **LOGGER** Rob Crotty

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 32.0	7-SH	2.0	9-16-18-36 (34)	POORLY GRADED GRAVEL WITH SAND, (GP), same as above, wet.	
					END OF BORING AT 32.0'	No discernible floating product.
35.0						
40.0						
45.0						
50.0						
55.0						

CH2M HILL

PROJECT NUMBER	BORING NUMBER
ANC31026.H3.60	OU5SB-25 SHEET 1 OF 1

SOIL BORING LOG

PROJECT Elmendorf AFB - OU5 LOCATION 5SB25

ELEVATION ____ DRILLING CONTRACTOR Denali

DRILLING METHOD AND EQUIPMENT HSA B61 Mobile Drill Rig, 4.25" ID Augers

WATER LEVELS 8.6' BGS on 8/18/92 START 8/18/92 0800 FINISH 8/18/92 0920 LOGGER Rob Crotty

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	0.4				ORGANIC MATERIAL AND PEAT (PT), to 0.4'.	Logged by cuttings and drilling action to 5.0'.
	1.5				From 0.4' to 1.5' SILT (ML), brown, dry, becoming moist, stiff, nonplastic with trace very fine grained sand, rootlets and cavities throughout, occasional subangular gravel to 0.5" diameter.	loess Silt deposit possibly of eolian origin, loess
	4.7				From 1.5' to 4.7' POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM), light brown, moist, medium dense, subangular gravel to 1.0" diameter with nonplastic silt and very fine to medium subangular sand, trace organics.	
5.0	7.0	1-SH	2.0	98-36-23-39 (59)	From 4.7' to 7.0' POORLY GRADED GRAVEL WITH SAND (GP), brown, moist, medium dense, subround gravel to 3" diameter with fine to medium subangular sand, trace silt and organics with occasional subround cobble to 5" diameter.	Free water encountered at 8.6' at 0850.
	10.0					
10.0	12.0	2-SH	1.5	32-30-31-40 (61)	From 10.0 to 12.0 POORLY GRADED GRAVEL WITH SAND (GP), same as above, except becomes wet at 8.6'.	
					END OF BORING AT 12.0'.	No discernible floating product.
15.0						
20.0						
25.0						

CH2M HILL

PROJECT NUMBER	BORING NUMBER
ANC31026.H3.60	OU5SB-26 SHEET 1 OF 1

SOIL BORING LOG

PROJECT Elmendorf AFB - OU5 LOCATION OU5

ELEVATION DRILLING CONTRACTOR Denali

DRILLING METHOD AND EQUIPMENT HSA B61 Mobile Drill Rig, 4.25" ID Augers

WATER LEVELS Not encountered START 8/28/92 0940 FINISH 8/28/92 1315 LOGGER Rob Crotty

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	0.2	GRAB			ORGANIC MATERIAL, (PT), to 0.2'. SILTY GRAVEL, (GM), light brown, dry becoming moist at 1.3', loose, subround gravel to 3" diameter with nonplastic silt, trace organics throughout. From 2.5' SILT WITH GRAVEL, (ML), brown, moist, loose, nonplastic loess with subround gravel to 1" diameter.	OVM BG: 1 ppm Note 1: Soil description derived from drilling action and soil cuttings (from 0.65').
5.0	5.0 7.0	2-SH	1.0	5-7-9-13 (16)	From 5.5' to 7.0' ORGANIC SILT WITH GRAVEL, (OL), dark brown, moist, firm, low plasticity with subround gravel to 1" diameter.	
						Same as Note 1 applies from 7'.0 to 10'.
10.0	10.0 12.0	3-SH		10-15-10-13 (25)	From 10.0' to 12.0' POORLY GRADED GRAVEL WITH SAND, (GP), brown, moist , medium dense, subround gravel to 3" diameter with medium to coarse subangular sand, occasional cobble to 4" diameter.	Note 1 applies from 12 to 15'.
15.0	15.0 17.0	4-SH		4-15-21-20 (36)	From 15.0' to 17.0' POORLY GRADED SAND WITH GRAVEL, (SP), brown, moist, medium dense, medium to coarse grained sand with subround gravel to 3" diameter, occasional subround cobble to 4" diameter, occasional coal lenses.	Note 1 applies from 17 to 20'.
20.0	20.0 22.0	5-SH		6-12-13-16 (25)	From 20.0 to 22.0 POORLY GRADED SAND, (SP), dark mottled brown becoming olive gray at 21.5', moist, medium dense, medium to coarse grained sand with occasional coal lens and occasional subround gravel.	Weathered hydrocarbon odor. OVM reads 57 ppm from 20.0' to 22.0'. Note 1 applies from 22.0 to 25.0' Weathered hydrocarbon sheen and odor from 23'.
25.0	25.0 27.0	6-SH		Not recorded	From 25.0' to 27.0' POORLY GRADED SAND, (SP), same as above.	Weathered hydrocarbon odor from 25.0' to 27.0'. OVM malfunction so no reading taken. Sheen on gravel fraction and on sampler.
					END OF BORING AT 27.0'	No discernible floating product, but sheen present in sample at 25.0'.

CH2M HILL

PROJECT NUMBER ANC31026.H3.60

BORING NUMBER OU5SB-27

SHEET 1 OF 2

SOIL BORING LOG

PROJECT Elmendorf AFB - OU5

LOCATION OU5

ELEVATION

DRILLING CONTRACTOR Denali

DRILLING METHOD AND EQUIPMENT HSA B61 Mobile Drill Rig, 4.25" ID Augers

WATER LEVELS 26.4' BGS on 8/27/92

START 8/27/92 0830

FINISH 8/27/92 1020

LOGGER Rob Crotty

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	1.0	1-GRAB			ORGANIC MATERIAL (PT)	OVM background: 0.0 ppm
	5.0				From 1.0' to 6.0' ORGANIC SILT (OL), dark brown, dry becoming moist at 2.5', low plasticity, organics include twigs, rootlets and decayed matter.	Note 1: Soil description based on drilling action and soil cuttings from 0 to 5.0'.
5.0	7.0	2-SH	1.2	5-6-12-15 (18)	From 6.0' to 7.0' POORLY GRADED GRAVEL WITH SAND AND SILT (GP-GM), brown, moist, medium dense, subround gravel to 2" diameter with fine to coarse grained sand and nonplastic silt, trace organics.	Note 1 applies from 7.0 to 10.0'.
	10.0					
10.0	12.0	3-SH	1.1	9-17-15-16 (32)	From 10.5' to 12.0' POORLY GRADED GRAVEL WITH SAND (GP), brown, moist, medium dense, subround gravel to 2" diameter with medium to coarse grained subangular sand, trace silt.	Note 2 applies from 12.0 to 15.0'.
	15.0					
15.0	17.0	4-SH	2.0	20-22-21-30 (43)	From 15.0' to 17.0' POORLY GRADED GRAVEL WITH SAND (GP), same as above.	Note 1 applies from 17.0 to 20.0'
	20.0					
20.0	22.0	5-SH	2.0	10-20-20-25 (40)	From 20.0' to 22.0' POORLY GRADED GRAVEL WITH SAND (GP), same as above.	Note 1 applies from 22.0 to 25.0'.
	25.0					
25.0	27.0	6-SH	2.0	9-20-25-40 (45)	From 25.0' to 27.0' POORLY GRADED GRAVEL WITH SAND (GP), same as above except becomes wet at 26.4'.	Sample 5SB27-25A is a duplicate of 5SB27-25. Freewater encountered at 26.4'. Note 1 applies from 27.0 to 30.0'
	30.0					

CH2M HILL

PROJECT NUMBER	BORING NUMBER
ANC31026.H3.60	OU5SB-27 SHEET 2 OF 2

SOIL BORING LOG

PROJECT Elmendorf AFB - OU5 **LOCATION** OU5

ELEVATION ________ **DRILLING CONTRACTOR** Denali

DRILLING METHOD AND EQUIPMENT HSA B61 Mobile Drill Rig, 4.25" ID Augers

WATER LEVELS 26.4' BGS on 8/27/92 **START** 8/27/92 0830 **FINISH** 8/27/92 1020 **LOGGER** Rob Crotty

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 32.0	7-SH		18-15-17-25 (32)	From 30.0' to 32.0' <u>POORLY GRADED SAND</u>, (SP), brown, wet, medium dense, medium to coarse grained subangular sand.	5SB27-30 collected at 30.0 to 32.0'.
					END OF BORING AT 32.0 FEET.	Note 2: Original 5SB27 abandoned after hitting abandoned paper sheathed copper wire telephone cable at 4.2'. Boring moved. No discernible floating product.
35.0						
40.0						
45.0						
50.0						
55.0						

PROJECT NUMBER	BORING NUMBER
ANC31026.H3.60	OU5SB-28 SHEET 1 OF 3

SOIL BORING LOG

PROJECT Elmendorf AFB - OU5 LOCATION OU5

ELEVATION ______ DRILLING CONTRACTOR Denali

DRILLING METHOD AND EQUIPMENT HSA B61 Mobile Drill Rig, 4.25" ID Augers

WATER LEVELS 36.5' BGS on 8/24/92 START 8/24/92 1035 FINISH 8/25/92 1601 LOGGER Rob Crotty

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6" -6" -6" -6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	2.5	1-SH	2.0	7-9-7-10 (16)	ORGANIC MATERIAL, (PT) to 0.3'. From 0.3' to 1.5' SILT WITH SAND AND GRAVEL, (ML), light brown, dry, medium dense, nonplastic silt with fine to medium plastic and subround gravel to 2" diameter, organics throughout.	HNu background is <1 ppm.
5.0	5.0	2-SH	2.0	7-7-20-15 (27)	From 1.5 to 27.5 POORLY GRADED GRAVEL WITH SAND, (GP), moist, medium dense, subround gravel to 2" diameter with fine to coarse grained sand, trace nonplastic silt.	Additional 0.5 material collected in sampler by advancing additional 0.5', therefore each drive is 2.5'.
	7.5	3-SH	2.0	6-9-15-17 (24)		
10.0	10.0	4-SH	1.0	7-9-18-20 (27)		
	12.5	5-SH	2.0	6-18-21-22 (39)		5SB28-0 collected from 0 to 0.5' for chemical analysis 5SB28-10 collected from 10.0 to 12.5 feet for chemical analysis.
15.0	15.0	6-SH	2.0	12-21-43-49 (64)		
	17.5	7-SH	2.0	6-12-18-21 (30)	From 17.0' to 27.5' POORLY GRADED GRAVEL WITH SAND, (GP), same as above except occasional subround cobble to 4" diameter.	
20.0	20.0	8-SH	2.0	7-20-43-41 (63)		
	22.5	9-SH	2.0	12-28-25-26 (53)		
25.0	25.0	10-SH	1.0	9-13-21-23 (34)		
	27.5	11-SH	2.0	13-23-28-43 (51)		5SB28-25 collected from 25.0 to 27.5' for chemical analysis
	30.0	12-SH	2.0	11-19-20-22 (39)	From 27.5 to 30.0 POORLY GRADED SAND, (SP), brown, moist, medium dense, fine to medium subangular sand, some subround gravel with occasional cobble.	

CH2M HILL

PROJECT NUMBER ANC31026.H3.60
BORING NUMBER OU5SB-28
SHEET 2 OF 3

SOIL BORING LOG

PROJECT Elmendorf AFB - OU5
LOCATION OU5
ELEVATION
DRILLING CONTRACTOR Denali
DRILLING METHOD AND EQUIPMENT HSA B61 Mobile Drill Rig, 4.25" ID Augers
WATER LEVELS 36.5' BGS on 8/24/92
START 8/24/92 1035
FINISH 8/25/92 1601
LOGGER Rob Crotty

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 32.5	13-SH	2.0	23-30-70-38 (100)	From 30.0' to 32.5' <u>POORLY GRADED SAND</u>, (SP), same as above, except dense.	
35.0	32.5 35.0	14-SH	2.0	7-32-43-37 (75)	From 32.5' to 35.0' <u>POORLY GRADED SAND</u>, (SP), same as above, except occasional coal lens to 1" thick.	Increasing gravel fraction.
	35.0 37.5	15-SH	2.0	2-13-33-22 (46)	From 35.0 to 40.2 <u>POORLY GRADED SAND</u>, (SP), same as above, except wet at 36.4'.	Decreasing gravel fraction. Free water encountered at 36.5'.
40.0	37.5 40.0	16-SH	2.0	6-15-18-22 (33)		5SB28-38 collected for chemical analysis from 37.5 to 40.0'.
	40.0 42.5	17-SH	2.0	5-13-22-35 (35)	From 40.2' to 60.0 <u>POORLY GRADED SAND WITH GRAVEL</u>, (SP), brown, wet, medium dense, medium to coarse grained subangular sand with subround gravel to 2" diameter, occasional coal lenses to 1".	End drilling at 40.0' for 8/24/92. Begin drilling at 40.0' on 8/25/92.
45.0	42.5 45.0	18-SH	2.0	20-22-25-32 (47)		
	45.0 47.5	19-SH	2.0	22-26-32-38 (58)		
50.0	47.5 50.0	20-SH	2.0	6-25-35-16 (60)		
	50.0 52.5	21-SH	2.0	20-15-33-50 (48)		
55.0	52.5 55.0	22-SH	2.0	16-24-56-70 (80)		
	55.0 57.5	23-SH	2.0	9-22-38-56 (60)		
	57.5 60.0	24-SH	2.0	32-35-33-65 (68)		

CHM HILL

PROJECT NUMBER
ANC31026.H3.60

BORING NUMBER
OU5SB-28

SHEET 3 OF 3

SOIL BORING LOG

PROJECT Elmendorf AFB - OU5

LOCATION OU5

ELEVATION

DRILLING CONTRACTOR Denali

DRILLING METHOD AND EQUIPMENT HSA B61 Mobile Drill Rig, 4.25" ID Augers

WATER LEVELS 36.5' BGS on 8/24/92

START 8/24/92 1035

FINISH 8/25/92 1601

LOGGER Rob Crotty

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	60.0 62.5	25-SH	2.0	14-22-70-77 (92)	From 60.0 to 67.5 POORLY GRADED SAND (SP), brown, wet, dense to very dense, uniform medium subangular sand, occasional subround gravel in 4" layers along with coal in 1" lenses.	
	65.0	26-SH	2.0	9-13-22-48 (35)		
65.0	67.5	27-SH	2.0	30-32-30-70 (62)		
	70.0					Description from 67.5 to 70.0' based on drilling action.
70.0	72.5	28-SH	2.0	9-20-22-32 (42)	From 70.0' to 72.5' POORLY GRADED SAND (SP), same as above.	
	75.0					Description from 72.5 to 75.0' based on drilling action.
75.0	77.5	29-SH	2.0	9-23-23-30 (46)	From 75.0' to 76.5' POORLY GRADED SAND (SP), same as above. From 76.0' to 77.0' CLAY (CL), olive gray, moist, stiff, lean, occasional SILTY SAND (SM), lens to 1".	Bootlegger cove formation. No discernible floating product.
80.0					END OF BORING AT 79.5 FEET	
85.0						

PROJECT NUMBER	BORING NUMBER
ANC31026.H3.60	OU5SB-29 SHEET 1 OF 1

SOIL BORING LOG

PROJECT Elmendorf AFB - OU5 LOCATION OU5

ELEVATION ______ DRILLING CONTRACTOR Denali

DRILLING METHOD AND EQUIPMENT HSA B61 Mobile Drill Rig, 4.25" ID Augers

WATER LEVELS 3.91' BGS on 8/7/92 START 8/7/92 0817 FINISH 8/7/92 LOGGER Rob Crotty

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	0.6	1-SH	1.0	8-13-77-17 (30)	From 0.0' to 0.6' ORGANIC MATERIAL AND PEAT (PT) to 0.3' grading into SILTY SAND (SM), dark brown, moist, rootlets and organic debris, very fine to medium sand with nonplastic silt to 0.6.	HNu background=1 ppm.
	2.0					
	4.0	2-SH	0.2	8-11-7-7 (18)		Poor recovery.
5.0	6.0	3-SH	.04	8-9-10-7 (19)	From 0.6' to 4.0' At 0.6' becomes SILTY GRAVEL WITH SAND (GM), dark brown becoming brown, moist, loose, subround gravel to 1.5" diameter with very fine to medium sand and nonplastic silt. Occasional subround cobbles to 3" diameter.	Free water encountered at 3.91' at 0920 Free water at 3.11' at 0920
	10.0				From 4.0' to 6.0' SILTY GRAVEL WITH SAND (GM), same as above except becomes wet, trace of silty clay.	Additional drive at 4-6' required to collect enough material for representative sampling. Slight hydrocarbon odor at 4.0 to 6.0'. HNu reads 4.0pm.
10.0	12.0	4-SH	0.8	4-3-7-7 (10)	From 10.0' to 12.0' SILTY GRAVEL WITH SAND (GM), same as above except slight sheen in gravel fraction.	Heave occurring in hole. Strong hydrocarbon at 10.0' to 12.0'. HNu reads 50 ppm.
	15.0					
15.0	17.0	5-SH	0.4	5-7-8-7 (15)	From 15.0' to 17.0' SILTY GRAVEL WITH SAND (GM), same as above.	Strong hydrocarbon odor at 15.0' to 17.0'. HNu reads 600 ppm.
	20.0					"Sleeved" SH in plastic bag to avoid contamination when sampling below the water table.
20.0	22.0	6-SH				
					END OF BORING AT 22.0'	Note at 1200: Boring and site currently shut down. Sample 6-SH from 20.0' to 22.0' not taken. See field log notebook SB002.
25.0						

Appendix C

MONITORING WELL BORING AND CONSTRUCTION LOG

PROJECT NUMBER	BORING NUMBER
ANC31026.H3.60	OU5MW-01 SHEET 1 OF 1

WELL COMPLETION LOG

PROJECT ELMENDORF AFB IRP OU5 **LOCATION** ANCHORAGE, ALASKA

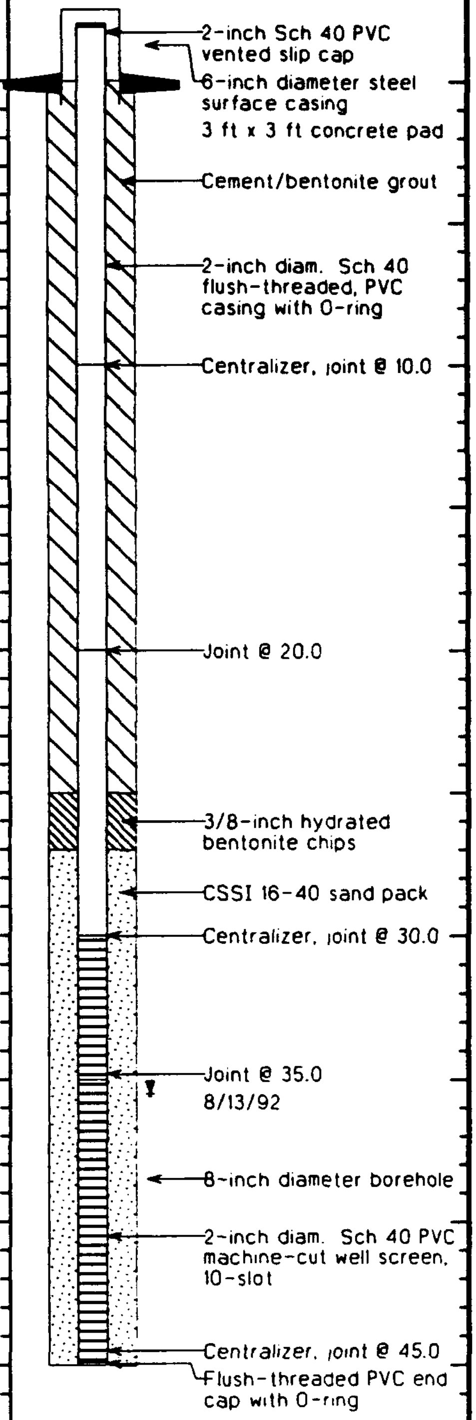
ELEVATION -- **DRILLING CONTRACTOR** DENALI DRILLING

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER, MOBILE DRILL B-61, TRUCK MOUNT

WATER LEVELS 35.5 ft. bgs **START** 8-13-92 **FINISH** 8-13-92 **LOGGER** D. KUNKEL

DEPTH BELOW SURFACE (FT)	SAMPLE			BLOW COUNTS	SOIL DESCRIPTION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT.)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
5.0	5.0 7.0	B01-5	1.2	7-18-27 (45)	From 5.0 to 6.0 ft SILT WITH GRAVEL, (ML) tan to yellowish brown, dry, hard, powdery silt with subangular to subrounded gravel, up to 2.5 inches in diameter. From 6.0 to 7.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) brown to dark brown, moist, dense, well-graded brown sand with subangular to subrounded gravel, 2-inch diameter maximum, minor amounts of brown non-plastic silt.
10.0	10.0 12.0	B01-10	1.3	7-22-26-32 (48)	From 10.0 to 12.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) As above.
15.0	15.0 17.0	B01-15	1.7	9-12-21-25 (33)	From 15.0 to 17.0 ft POORLY-GRADED SAND WITH GRAVEL, (SP) Brown, moist to wet, dense, fine to medium-grained sand with subangular to subrounded gravel and non-plastic silt.
20.0	20.0 22.0	B01-20	1.8	7-13-27-26 (40)	From 21.0 to 22.0 ft POORLY-GRADED SAND, (SP) rust-brown, moist, dense, medium-grained sand with subangular to subrounded gravel up to 3/4 inches in diameter, trace of brown to rust-brown silt.
25.0	25.0 27.0	B01-25	1.7	13-17-24-33 (41)	From 27.0 to 27.0 ft POORLY-GRADED SAND, (SP) As above.
30.0	30.0 32.0	B01-30	1.7	12-18-22-32 (40)	From 30.0 to 32.0 ft POORLY-GRADED SAND, (SP) As above.
35.0	35.0 37.0	B01-35	1.8	10-16-28-32 (44)	From 35.0 to 37.0 ft POORLY-GRADED SAND, (SP) As above. Free water encountered at 35.5 ft. bgs. No discernible free product.
40.0	40.0 42.0	B01-40	2.0	45-22-28-29 (50)	From 40.0 to 42.0 ft POORLY-GRADED SAND, (SP) As above.
45.0					End of boring at 45 ft. bgs.

WELL COMPLETION DIAGRAM



CH2M HILL

PROJECT NUMBER ANC31026.H3.60

BORING NUMBER OU5MW-02 **SHEET** 1 **OF** 1

WELL COMPLETION LOG

PROJECT ELMENDORF AFB IRP OU5 **LOCATION** ANCHORAGE, ALASKA

ELEVATION --

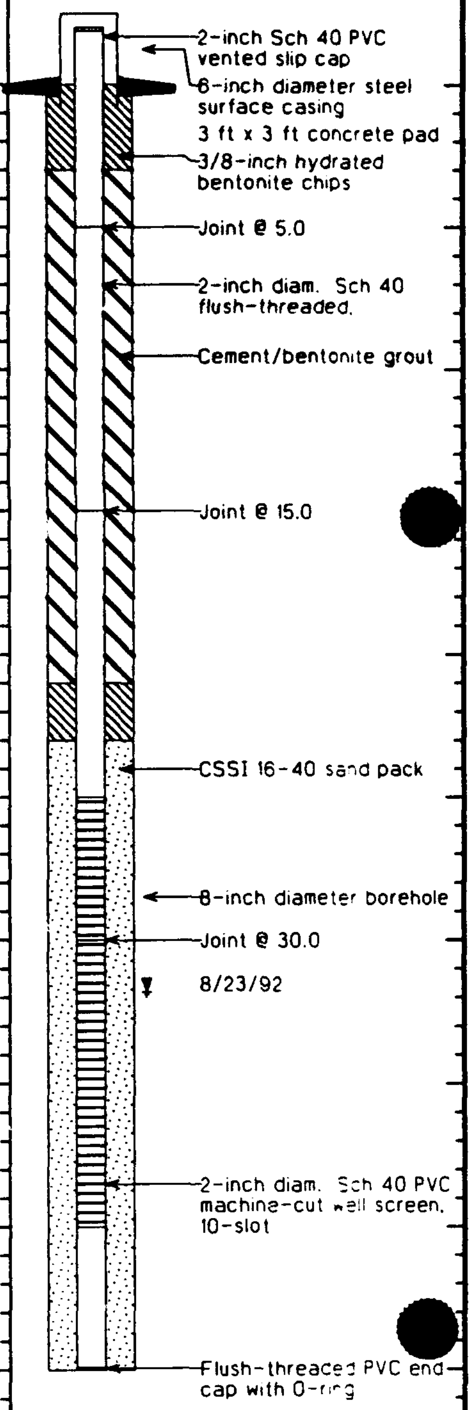
DRILLING CONTRACTOR DENALI DRILLING

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER, MOBILE DRILL B-61, TRUCK MOUNT

WATER LEVELS 31.5 ft. bgs **START** 8-23-92 **FINISH** 8-23-92 **LOGGER** D. KUNKEL

DEPTH BELOW SURFACE (FT)	SAMPLE			BLOW COUNTS	SOIL DESCRIPTION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT.)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
5.0	5.0 7.0	B02-5	1.2	12-14-10-12 (24)	From 0 to 21.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) brown, moist, medium dense, well-graded sand with subrounded gravel up to 3-inches in diameter in sampler, non-plastic silt.
10.0	10.0 12.0	B02-10	1.0	12-26-31-42 (57)	From 10.0 to 12.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) As above.
15.0	15.0 17.0	B02-15	1.2	10-44-50/4" (95)	From 15.0 to 17.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) As above.
20.0	20.0 22.0	B02-20	1.3	13-32-35-50 (67)	From 20.0 to 22.0 ft POORLY-GRADED SAND WITH GRAVEL, (SP) brown to rust brown, moist, very dense, medium and fine sand, subrounded gravel, and brown non-plastic silt.
25.0	25.0 27.0	B02-25	1.3	3-16-20-50/5" (36)	From 25.0 to 27.0 ft POORLY-GRADED SAND WITH GRAVEL, (SP) As above, some charcoal.
30.0	30.0 32.0	B02-30	1.4	18-32-31-25 (63)	From 30.0 to 32.0 ft POORLY-GRADED SAND WITH GRAVEL, (SP) As above, charcoal in 3-inch layer. Free water encountered at 31.8 ft. bgs. No discernible free product.
	32.5 34.5	B02-33	1.3	14-30--30-26 (60)	32.5-34.5 ft POORLY-GRADED SAND WITH GRAVEL, (SP) As above.
35.0					
	37.5 39.5	B02-38	1.3	23-35-38-41 (73)	
40.0					
45.0					End of boring at 45 ft. bgs.

WELL COMPLETION DIAGRAM



CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ANC31026.H3.60	OU5MW-03	SHEET 1 OF 1

WELL COMPLETION LOG

PROJECT ELMENDORF AFB IRP OU5 **LOCATION** ANCHORAGE, ALASKA

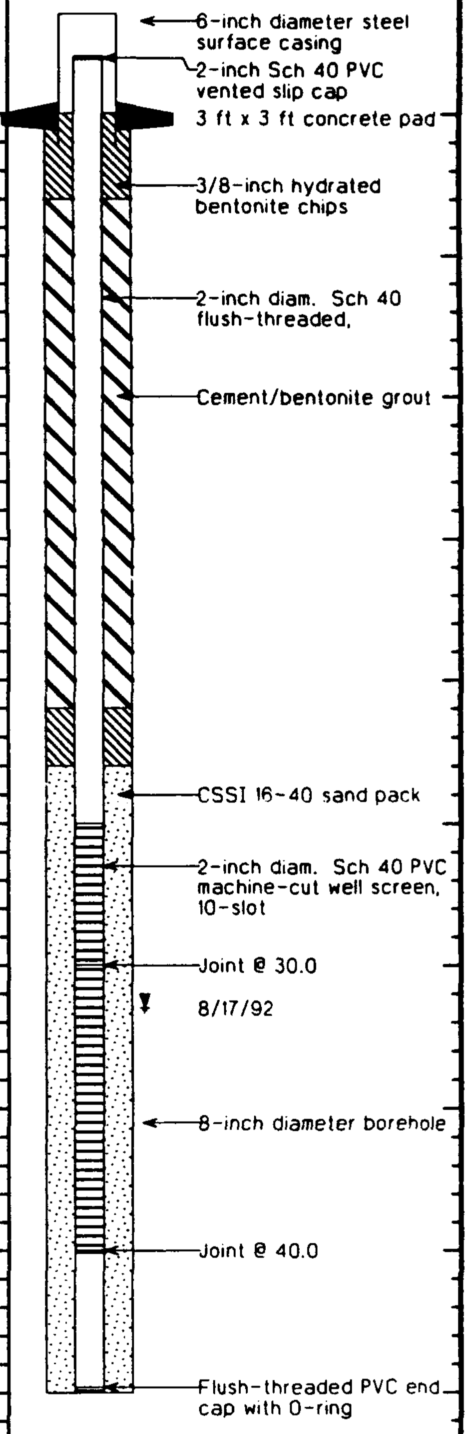
ELEVATION -- **DRILLING CONTRACTOR** DENALI DRILLING

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER, MOBILE DRILL B-61, TRUCK MOUNT

WATER LEVELS 31.5 ft. bgs **START** 8-17-92 **FINISH** 8-17-92 **LOGGER** D. KUNKEL

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT.)	BLOW COUNTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
5.0	5.0 7.0	B03-5	1.3	16-22-25-24 (47)	From 5.0-7.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) brown to rusty-brown, dry to moist, dense, fine to coarse-grained sand with subangular to subrounded gravel up to 2.5 inches in diameter and rusty-brown silt, silt occurs as slightly plastic clumps.
10.0	10.0 12.0	B03-10	1.5	6-8-15-22 (23)	From 10.0 to 12.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) brown to tan-brown, moist, medium dense, well-graded sand with subangular to subrounded gravel, and minor amounts of silt. A 4-inch layer of charcoal at 10.5 bgs.
15.0	15.0 17.0	B03-15	1.3	6-21-23-25 (44)	From 15.0 to 17.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) As above.
20.0	20.0 22.0	B03-20	1.5	10-23-24-27 (47)	From 20.0 to 22.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) As above.
25.0	25.0 27.0	B03-25	1.5	20-27-28-42 (55)	From 25.0 to 27.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) As above.
30.0	30.0 32.0	B03-30	1.3	12-35-32-22 (67)	From 30.0 to 32.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) As above. Free water encountered at 31.5 ft. bgs. No discernible free product.
35.0	35.0 37.0	B03-35	1.7	13-17-23-26 (40)	From 35.0 to 37.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) gray to gray-brown, wet, dense, well-graded sand with gravel, subangular to subrounded, some cobbles, gray silt.
40.0	40.0 42.0	B03-40	1.5	10-36-24-25 (60)	From 40.0 to 42.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) As above.
45.0					End of boring at 45 ft. bgs.

WELL COMPLETION DIAGRAM



CH2M HILL

PROJECT NUMBER ANC31026.H3.60

BORING NUMBER OU5MW-04 **SHEET** 1 **OF** 1

WELL COMPLETION LOG

PROJECT ELMENDORF AFB IRP OU5 **LOCATION** ANCHORAGE, ALASKA

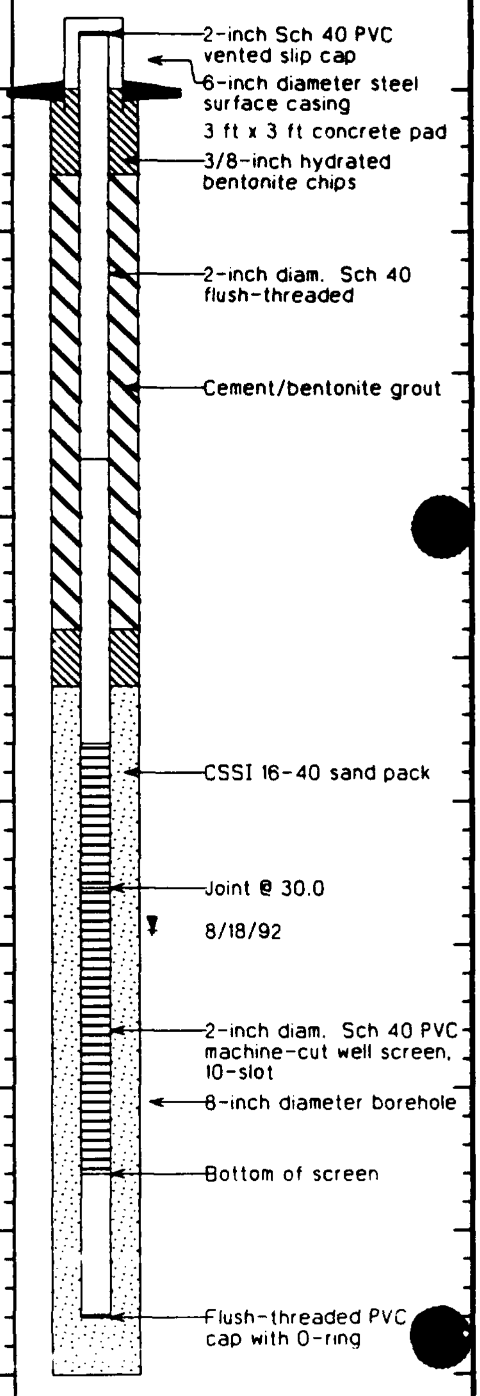
ELEVATION -- **DRILLING CONTRACTOR** DENALI DRILLING

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER, MOBILE DRILL B-61, TRUCK MOUNT

WATER LEVELS 29.5 ft. bgs **START** 8-18-92 **FINISH** 8-18-92 **LOGGER** D. KUNKEL

DEPTH BELOW SURFACE (FT)	SAMPLE			BLOW COUNTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT.)		SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
5.0	5.0 7.0	B04-5	0.7	9-5-2-2 (7)	From 5.0 to 6.0 ft POORLY GRADED SAND WITH GRAVEL (SP) brown, dry to moist, loose. From 6.0 to 7.0 SILT WITH GRAVEL (ML) moist, soft, orange-brown to rust-brown. Silt is plastic.
10.0	10.0 12.0	B04-10	1.5	9-23-27-31 (50)	From 10.0 to 12.0 ft WELL-GRADED SAND WITH GRAVEL (SW) some rust-brown layers, dry to moist, dense, well-graded sand with well-graded subangular to subrounded gravel and non-plastic brown to rust-brown silt.
15.0	15.0 17.0	B04-15	1.5	4-14-18-19 (32)	From 15.0 to 17.0 ft WELL-GRADED SAND WITH GRAVEL (SW) As above.
20.0	20.0 22.0	B04-20	1.5	11-19-28-34 (47)	From 20.0 to 22.0 ft WELL-GRADED SAND WITH GRAVEL (SW) As above.
25.0	25.0 27.0	B04-25	1.3	13-29-38-40 (67)	From 25.0 to 27.0 ft POORLY-GRADED SAND WITH GRAVEL (SP) brown, wet, very dense, fine to medium sand with subrounded gravel up to 1-inch in diameter, minor amounts of silt.
30.0	30.0 32.0	B04-30	1.4	44-21-23-21 (44)	Free water encountered at 29.5 bgs. No discernible free product. From 30.0 to 32.0 ft WELL-GRADED GRAVEL WITH SAND (GW) brown, wet, dense, subangular to subrounded gravel, well-graded sand and brown, non-plastic silt.
35.0	35.0 37.0	B04-35	1.3	10-29-19-23 (48)	From 35.0 to 37.0 ft WELL-GRADED GRAVEL WITH SAND (GW) brown, wet, very dense, decreasing gravel at 37 ft bgs, sand content increasing, heaving formation.
40.0	40.0 42.0	B04-40	1.3	8-24-33-24 (57)	
45.0					End of boring at 45 ft. bgs.

WELL COMPLETION DIAGRAM



CH2M HILL

PROJECT NUMBER ANC31026.H3.60

BORING NUMBER OU5MW-05 **SHEET** 1 **OF** 1

WELL COMPLETION LOG

PROJECT ELMENDORF AFB IRP OU5 **LOCATION** ANCHORAGE, ALASKA

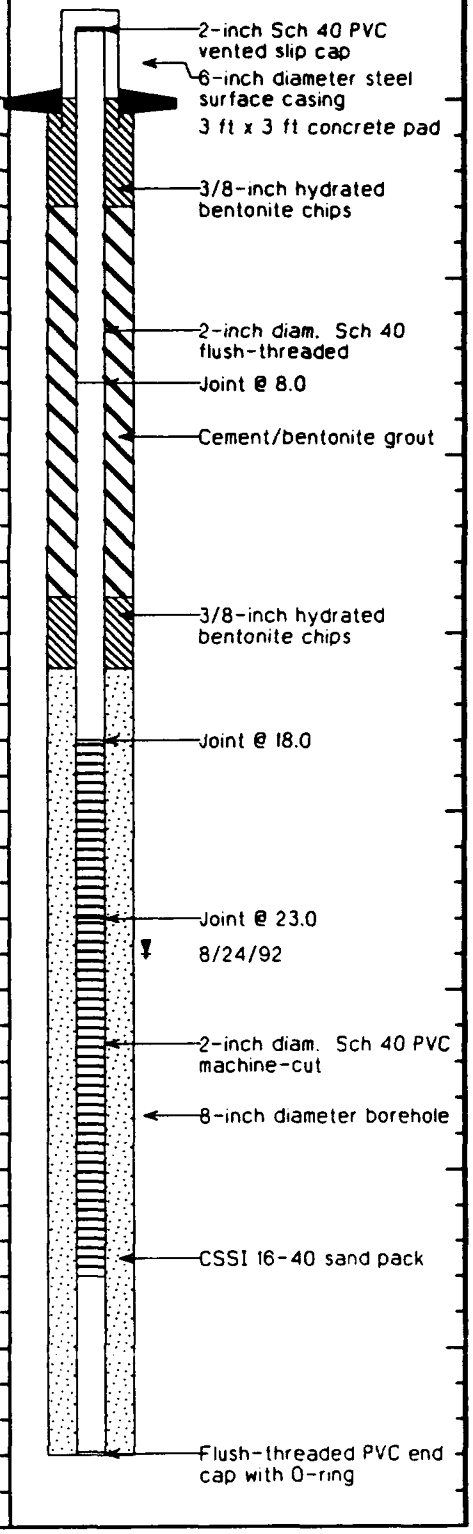
ELEVATION -- **DRILLING CONTRACTOR** DENALI DRILLING

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER, MOBILE DRILL B-61, TRUCK MOUNT

WATER LEVELS 24.0 ft. bgs **START** 8-24-92 **FINISH** 8-24-92 **LOGGER** D. KUNKEL

DEPTH BELOW SURFACE (FT)	SAMPLE			BLOW COUNTS	SOIL DESCRIPTION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT.)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
5.0	5.0 7.0	B05-5	0.7	5-3-2-3 (5)	From 5.0 to 7.0 ft WELL-GRADED GRAVEL WITH SAND, (GW) grey-brown, dry to moist, loose, well-graded subrounded to subangular gravel, up to 3-inches in diameter with well-graded sand, minor amounts of brown silt.
10.0	10.0 12.0	B05-10	1.0	3-6-10-15 (16)	From 10.0 to 12.0 ft WELL-GRADED GRAVEL WITH SAND, (GW) As above. Medium dense.
15.0	15.0 17.0	B05-15	1.0	10-30-27-34 (57)	From 15.0 to 17.0 ft WELL-GRADED GRAVEL WITH SAND, (GW) As above. Increased gravel fraction, very dense.
20.0	20.0 22.0	B05-20	1.3	10-23-33-30 (56)	From 20.0 to 22.0 ft WELL-GRADED GRAVEL WITH SAND, (GW) As above.
					Free water encountered at 24.0 ft bgs. No discernible free product.
25.0	25.0 27.0	B05-25	1.3	9-16-24-29 (40)	From 25.0 to 27.0 ft WELL-GRADED GRAVEL WITH SAND, (GW) As above. Wet, dense.
30.0	30.0 32.0	B05-30	1.3	9-17-25-25 (42)	From 30.0 to 32.0 ft WELL-GRADED GRAVEL WITH SAND, (GW) As above.
35.0	35.0 37.0	B05-35	1.3	10-28-28-21 (56)	From 35.0 to 37.0 ft WELL-GRADED GRAVEL WITH SAND, (GW) As above. Very dense.
					End of boring at 38 ft. bgs.

WELL COMPLETION DIAGRAM



CH2M HILL

PROJECT NUMBER ANC31026.H3.60

BORING NUMBER OU5MW-06 SHEET 1 OF 1

WELL COMPLETION LOG

PROJECT ELMENDORF AFB IRP OU5 LOCATION ANCHORAGE, ALASKA

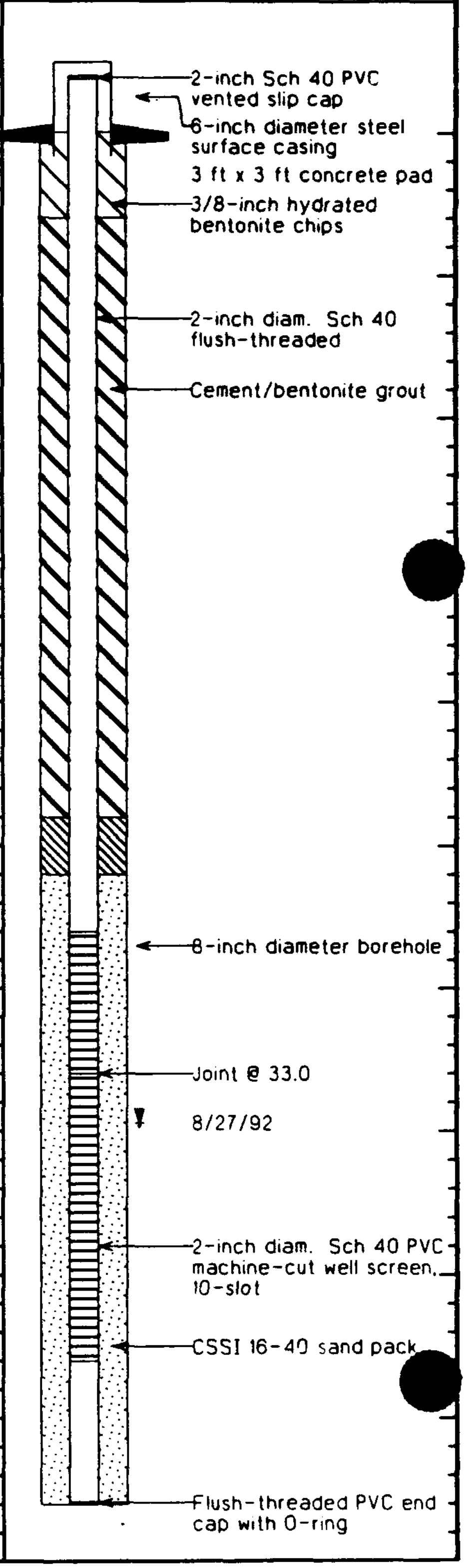
ELEVATION -- DRILLING CONTRACTOR DENALI DRILLING

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER, MOBILE DRILL B-61, TRUCK MOUNT

WATER LEVELS 34.7 ft. bgs START 8-27-92 FINISH 8-27-92 LOGGER D. KUNKEL

DEPTH BELOW SURFACE (FT)	SAMPLE			BLOW COUNTS	SOIL DESCRIPTION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT.)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
					From 0.0 to 7.0 ft POORLY-GRADED SAND WITH GRAVEL, (SP) brown to rust-brown, dry, medium, dense, fine to medium sand with subangular to subrounded gravel up to 3-inches in diameter. Minor amounts of non-plastic brown silt.
5.0	5.0 7.0	B06-5	1.3	10-17-22-22 (29)	
10.0	10.0 12.0	B06-10	1.3	10-20-26-46 (46)	From 10.0 to 12.0 ft POORLY-GRADED SAND WITH GRAVEL, (SP) As above.
15.0	15.0 17.0	B06-15	1.3	14-28-23-25 (51)	From 15.0 to 17.0 ft POORLY-GRADED SAND WITH GRAVEL, (SP) As above with pieces of charcoal.
20.0	20.0 22.0	B06-20	1.3	10-16-21-25 (37)	From 20.0 to 25.0 ft WELL-GRADED SAND WITH SILT AND GRAVEL, (SW-SM), brown to gray brown, well-graded sand with subangular to subrounded gravel and brown non-plastic silt.
25.0	25.0 26.5	B06-25	0.7	10-24-70/5" (94)	From 25.0 to 26.5 ft WELL-GRADED SAND WITH SILT AND GRAVEL, (SW-SM), dark brown, wet, very dense, well-graded sand with subangular to subrounded gravel, some cobbles, dark brown non-plastic silt.
30.0	30.0 32.0	B06-30	1.2	10-22-25-28 (47)	From 30.0 to 32.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) gray-brown, some rusty-brown areas, moist, dense, well-graded sand with subrounded gravel, minor amounts of non-plastic silt.
35.0	35.0 37.0	B06-35	1.0	13-25-27-24 (52)	Free water encountered at 34.0 ft bgs. No discernible free product. From 35.0 to 37.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) As above.
40.0	40.0 42.0	B06-40	1.3	16-26-19-21 (45)	From 40.0 to 42.0 ft WELL-GRADED SAND WITH SILT AND GRAVEL, (SW-SM) dark brown, wet, dense, well-graded sand with subrounded gravel, up to 2-inches in diameter and dark brown silt, cohesive when silty, sandy portions are looser.
45.0					
					End of boring at 48 ft. bgs.

WELL COMPLETION DIAGRAM



PROJECT NUMBER ANC31026.H3.60

BORING NUMBER OU5MW-07 **SHEET** 1 **OF** 1

WELL COMPLETION LOG

PROJECT ELMENDORF AFB IRP OU5 **LOCATION** ANCHORAGE, ALASKA

ELEVATION -- **DRILLING CONTRACTOR** DENALI DRILLING

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER, MOBILE DRILL B-61, TRUCK MOUNT

WATER LEVELS 35.5 ft. bgs **START** 8-26-92 **FINISH** 8-26-92 **LOGGER** D. KUNKEL

DEPTH BELOW SURFACE (FT)	SAMPLE			BLOW COUNTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT.)	6"-6"-6"-6" (N)
5.0	5.0 7.0	B07-5	1.3	13-13-16-21 (29)
10.0	10.0 12.0	B07-10	1.3	10-14-25-27 (39)
15.0	15.0 17.0	B07-15	1.2	3-14-18-12 (14)
20.0	20.0 22.0	B07-20	1.3	6-1-8-16-23 (15)
25.0	25.0 27.0	B07-25	1.5	12-34-36-38 (70)
30.0	30.0 32.0	B07-30	1.5	10-23-29-25 (52)
35.0	35.0 37.0	B07-35	1.3	10-24-33-28 (57)
40.0	40.0 42.0	B07-40	1.3	15-17-33-40 (50)
45.0				
50.0				

SOIL DESCRIPTION

SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY

From 1.5-11.0 ft POORLY-GRADED SAND WITH GRAVEL, (SP) brown to gray-brown, moist, medium dense, fine to medium sand with subangular to subrounded gravel, up to 3-inches in diameter, some brown, non-plastic silt.

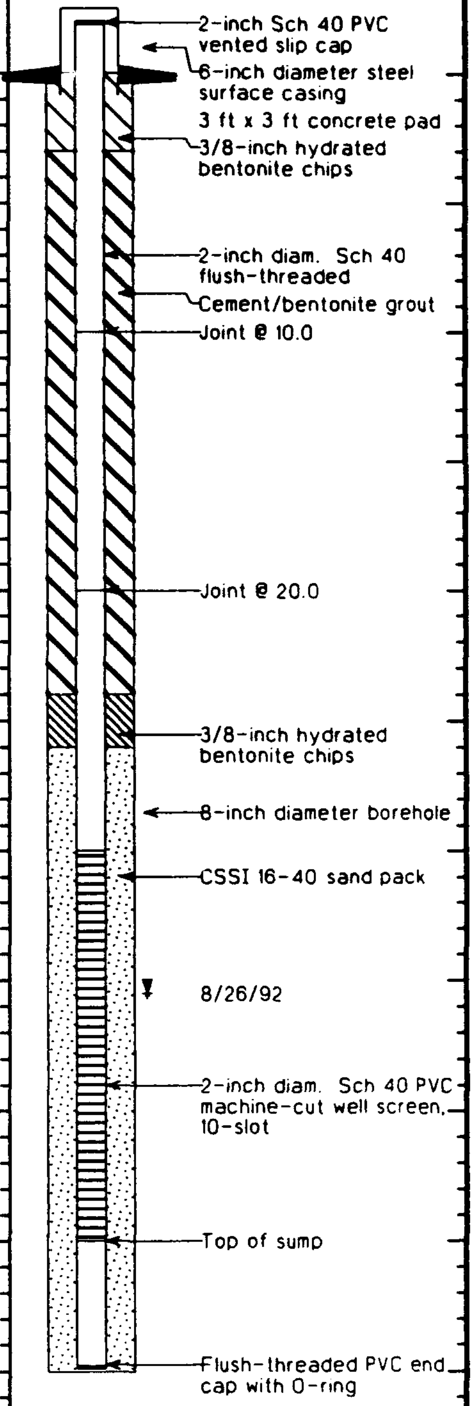
From 11.0-30.0 ft POORLY-GRADED SAND WITH GRAVEL, (SP) gray to rust-brown, moist to wet, dense, fine to medium sand with subangular to subrounded gravel, some brown non-plastic silt.

From 30.0 to 50.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) rust-brown, wet, very dense, well-graded sand with subangular gravel, some cobbles, some brown, non-plastic silt, some denser lenses of increased silt content.

Free water encountered at 35.5 ft. bgs. No discernible free product.

End of boring at 50 ft. bgs.

WELL COMPLETION DIAGRAM



CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ANC31026.H3.60	OU5MW-03	SHEET 1 OF 1

WELL COMPLETION LOG

PROJECT ELMENDORF AFB IRP OU5 **LOCATION** ANCHORAGE, ALASKA

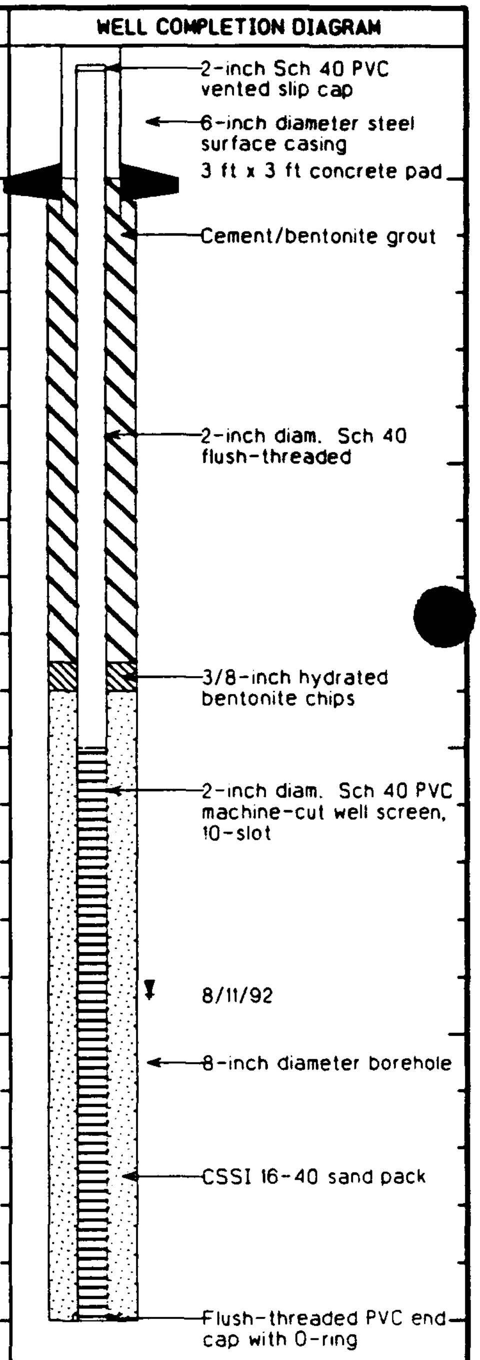
ELEVATION -- **DRILLING CONTRACTOR** DENALI DRILLING

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER, MOBILE DRILL B-61, TRUCK MOUNT

WATER LEVELS Approx. 10 ft. bgs **START** 8-11-92 **FINISH** 8-11-92 **LOGGER** D. KUNKEL

DEPTH BELOW SURFACE (FT)	SAMPLE			BLOW COUNTS	SOIL DESCRIPTION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT.)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
	3.0				From 0.0 to 3.0 ft WELL-GRADED GRAVEL WITH SILT AND SAND, (GW-GM) dark brown, dry to moist, loose, well-graded subrounded to subangular gravel up to 8-inches in diameter with well-graded sand and brown, non-plastic silt. Very difficult drilling due to cobbles.
	5.0				
5.0	7.0	B08-5	0.9	8-13-12-9 (25)	From 5.0 to 7.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) brown, moist to wet, medium dense, well-graded sand with subrounded to rounded gravel up to 4-inches in diameter, minor amounts of brown, non-plastic silt.
	10.0				
10.0	12.0	B08-10	1.3	4-10-16-24 (26)	From 10.0 to 12.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) brown, wet, medium dense, well-graded sand with subrounded to rounded gravel up to 4-inches in diameter, minor amounts of brown, non-plastic silt.
	14.0				
15.0	16.0	B08-14	1.4	7-12-16-20 (28)	From 14.0 to 16.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) brown, wet, medium dense, well-graded sand with subrounded to rounded gravel up to 4-inches in diameter, minor amounts of brown, non-plastic silt. Free water encountered at 14.3 ft. bgs.
	20.0				
20.0	22.0	B08-20	1.4	9-15-18-28 (33)	
					End of boring at 22 ft. bgs.

WELL COMPLETION DIAGRAM



CH2M HILL

PROJECT NUMBER ANC31026.H3.60

BORING NUMBER OU5MW-09

SHEET 1 **OF** 1

WELL COMPLETION LOG

PROJECT ELMENDORF AFB IRP **LOCATION** ANCHORAGE, ALASKA

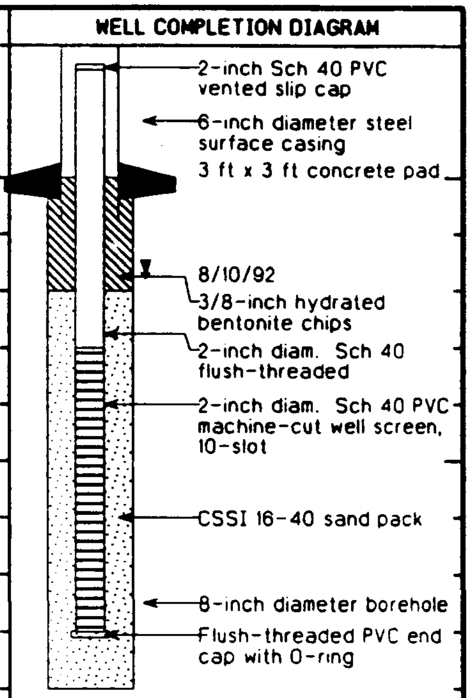
ELEVATION -- **DRILLING CONTRACTOR** DENALI DRILLING

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER, MOBILE DRILL B-61, TRUCK MOUNT

WATER LEVELS 1.7 ft. bgs 8/10/92 **START** 8-10-92 **FINISH** 8-10-92 **LOGGER** D. KUNKEL

DEPTH BELOW SURFACE (FT)	SAMPLE			BLOW COUNTS	SOIL DESCRIPTION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT.)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
					Free water encountered at 1.7 ft. bgs.
	2.5				From 2.5 to 5.5 ft WELL-GRADED SAND WITH GRAVEL (SW) brown, wet, loose, fine to coarse sand with subrounded to rounded gravel up to 1.5-inches in diameter, minor amounts of brown silt.
		B09-3	0.9	5-5-4-4 (9)	
5.0	5.5				
	7.5				From 7.5 to 9.5 ft WELL-GRADED SAND WITH GRAVEL (SW) brown, wet, dense, fine to coarse sand with subrounded to rounded gravel up to 1.5-inches in diameter, minor amounts of brown silt.
		B09-8	1.0	18-16-18-16 (34)	
	9.5				End of boring at 9.5 ft. bgs.
10.0					
15.0					
20.0					

WELL COMPLETION DIAGRAM



CH2M HILL

PROJECT NUMBER ANC31026.H3.60

BORING NUMBER OU5MW-10

SHEET 1 **OF** 1

WELL COMPLETION LOG

PROJECT ELMENDORF AFB IRP **LOCATION** ANCHORAGE, ALASKA

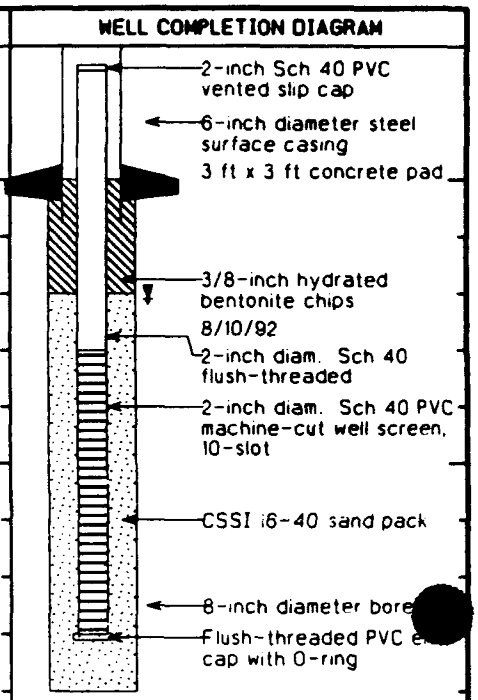
ELEVATION -- **DRILLING CONTRACTOR** DENALI DRILLING

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER, MOBILE DRILL B-61, TRUCK MOUNT

WATER LEVELS 2.0 ft bgs 8/10/92 **START** 8-10-92 **FINISH** 8-10-92 **LOGGER** D. KUNKEL

DEPTH BELOW SURFACE (FT)	SAMPLE			BLOW COUNTS	SOIL DESCRIPTION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT.)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
	0.5				From 0.0 to 0.5 ft TOPSOIL, brown, moist, loose, some fine gravel. Free water encountered at 2.0 ft. bgs. No discernible free product.
5.0	5.0 7.0	B10-5	1.0	6-6-5-5 (11)	From 5.0 to 7.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) brown to gray brown, moist, wet at 2 ft bgs, medium dense, fine to coarse sand with subrounded to rounded gravel up to 2.5-inches in diameter, some brown silt.
10.0	9.0 11.0	B10-9	0.6	7-6-5-5 (11)	From 9.0 to 11.0 ft WELL-GRADED SAND WITH GRAVEL (SW) grayish brown, wet, medium dense, fine to coarse sand with rounded gravel up to 2.5-inches in diameter, some brown silt washed out of sampler. End of boring at 11.0 ft. bgs.
15.0					
20.0					

WELL COMPLETION DIAGRAM



CH2M HILL

PROJECT NUMBER	BORING NUMBER
ANC31026.H3.60	OU5MW-11 SHEET 1 OF 1

WELL COMPLETION LOG

PROJECT ELMENDORF AFB IRP OU5 **LOCATION** ANCHORAGE, ALASKA

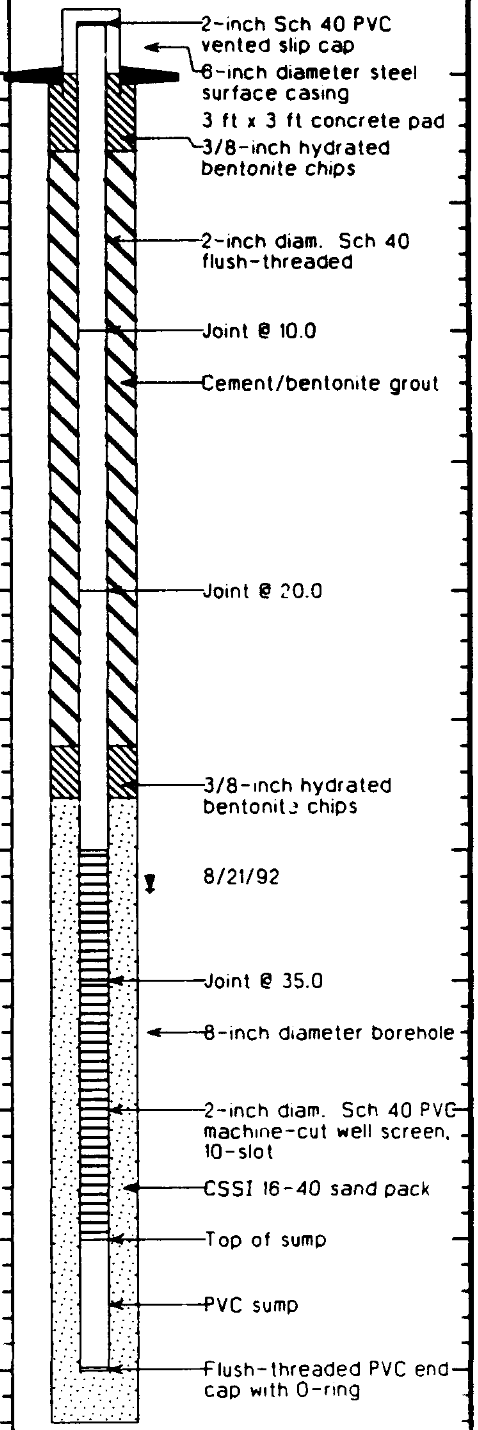
ELEVATION -- **DRILLING CONTRACTOR** DENALI DRILLING

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER, MOBILE DRILL B-61, TRUCK MOUNT

WATER LEVELS 36.5 ft. bgs **START** 8-21-92 **FINISH** 8-21-92 **LOGGER** D. KUNKEL

DEPTH BELOW SURFACE (FT)	SAMPLE			BLOW COUNTS	SOIL DESCRIPTION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT.)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
5.0	5.0 7.0	B11-5	1.4	33-13-15-17 (28)	From 5.0 to 7.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) brown to rusty-brown, dry to moist, medium dense, fine to coarse sand with subangular to subrounded gravel up to 2.5-inches in diameter and rusty-brown silt. Silt occurs as slightly plastic clumps.
10.0	10.0 12.0	B11-10	1.2	20-17-16-18 (33)	From 10.0 to 12.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) As above.
15.0	15.0 17.0	B11-15	1.2	17-14-18-18 (32)	From 15.0 to 17.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) As above
20.0	20.0 22.0	B11-20	1.3	5-12-18-19 (30)	From 20.0 to 22.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) As above.
25.0	25.0 27.0	B11-25	1.3	12-16-18-21 (34)	From 25.0 to 27.0 ft WELL-GRADED SAND WTIH GRAVEL, (SW) As above. Wet at 31.5 ft. bgs.
30.0	30.0 32.0	B11-30	1.3	12-29-34-29 (63)	Free water encountered at 31.5 ft. bgs. No discernible free product.
35.0	35.0 37.0	B11-35	1.3	18-13-20-19 (43)	From 35.0 to 37.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) As above.
40.0	40.0 42.0	B11-40	1.3	18-20-18-17 (38)	From 40.0 to 42.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) As above.
45.0					
50.0					
					End of boring at 52 ft. bgs.

WELL COMPLETION DIAGRAM



CH2M HILL

PROJECT NUMBER ANC31026.H3.60

BORING NUMBER OU5MW-12 **SHEET** 1 **OF** 1

WELL COMPLETION LOG

PROJECT ELMENDORF AFB IRP **LOCATION** ANCHORAGE, ALASKA

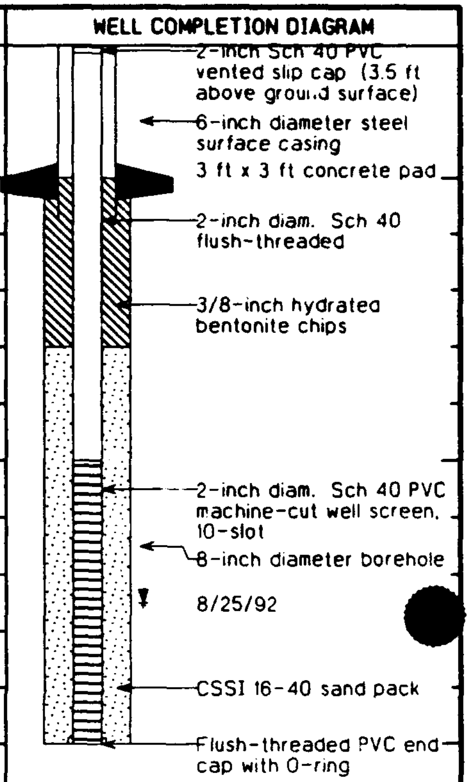
ELEVATION -- **DRILLING CONTRACTOR** DENALI DRILLING

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER, MOBILE DRILL B-61, TRUCK MOUNT

WATER LEVELS -- **START** 8-25-92 **FINISH** 8-25-92 **LOGGER** D. KUNKEL

DEPTH BELOW SURFACE (FT)	SAMPLE			BLOW COUNTS	SOIL DESCRIPTION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT.)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
	2.5				From 0.0 to 7.0 ft POORLY-GRADED SAND WITH GRAVEL, (SP) brown, moist, fine to medium sand, subangular and subrounded gravel to 3 inches in diameter and trace silt.
	4.5	B12-3	1.2	11-15-19-21 (34)	
5.0	5.0				
	7.0	B12-5	1.1	11-11-14-18 (25)	
	7.50				
	9.50	B12-8	1.1	11-19-19-16 (38)	Free water encountered at 7.5 ft. bgs. No discernible free product. From 7.0 to 9.5 ft WELL-GRADED GRAVEL WITH SAND, (GW) gray-brown, wet, loose, subrounded gravel, some fine to coarse sand and trace silt.
10.0	10.0				
	12.0	B12-10	0.5	10-10-10-9 (20)	
					End of boring at 12 ft.
15.0					
20.0					

WELL COMPLETION DIAGRAM



PROJECT NUMBER	BORING NUMBER
ANC31026.H3.60	OU5MW-13 SHEET 1 OF 1

WELL COMPLETION LOG

PROJECT ELMENDORF AFB IRP OU5 **LOCATION** ANCHORAGE, ALASKA

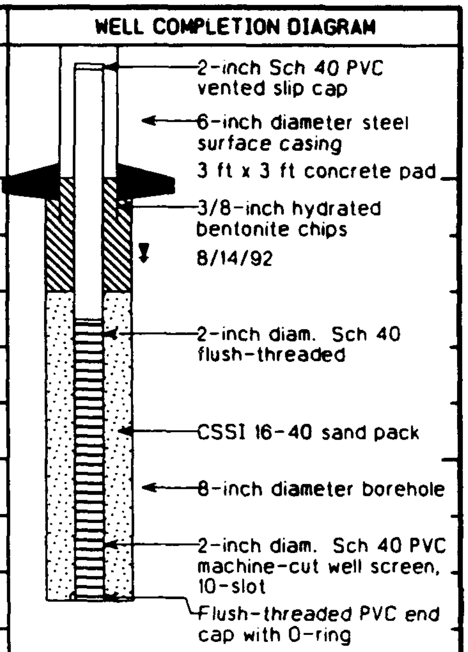
ELEVATION -- **DRILLING CONTRACTOR** DENALI DRILLING

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER, MOBILE DRILL B-61, TRUCK MOUNT

WATER LEVELS 1.4 ft. bgs 8/14/92 **START** 8-14-92 **FINISH** 8-14-92 **LOGGER** D. KUNKEL

DEPTH BELOW SURFACE (FT)	SAMPLE			BLOW COUNTS	SOIL DESCRIPTION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT.)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
	2.5				From 0.0 to 0.5 ft TOPSOIL, (ML) soft, brown non-plastic silt, moist soft, fine to medium sand with trace subrounded gravel. Free water encountered at 1.4 ft. bgs.
	2.5 4.5	B13-3	1.0	2-6-6-10 (12)	From 2.5 to 4.5 ft SILTY CLAYEY GRAVEL WITH SAND, (GC-GM) blue-gray to brownish gray, wet, medium dense subangular and subrounded gravel, with fine to coarse sand, some gray plastic silt and clay.
5.0					
	7.5 9.5	B13-8	1.3	5-6-6-6 (12)	From 7.5 to 9.5 ft LEAN CLAY, (CL) blue-gray, moist to wet, medium dense bootlegger cove formation, clay with some silt, plastic, product odor.
10.0					End of boring at 9.5 ft. bgs.
15.0					
20.0					

WELL COMPLETION DIAGRAM



CH2M HILL

PROJECT NUMBER ANC31026.H3.60

BORING NUMBER OU5MW-14 **SHEET** 1 **OF** 1

WELL COMPLETION LOG

PROJECT ELMENDORF AFB IRP OU5 **LOCATION** ANCHORAGE, ALASKA

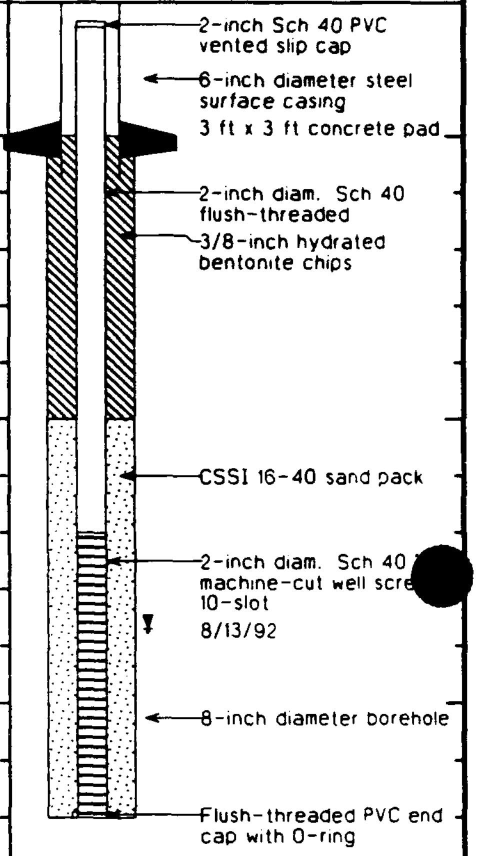
ELEVATION -- **DRILLING CONTRACTOR** DENALI DRILLING

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER, MOBILE DRILL B-61, TRUCK MOUNT

WATER LEVELS 8.7 ft bgs 8/13/92 **START** 8-13-92 **FINISH** 8-13-92 **LOGGER** D. KUNKEL

DEPTH BELOW SURFACE (FT)	SAMPLE			BLOW COUNTS	SOIL DESCRIPTION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT.)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
	1.0				From 0.0 to 1.0 ft TOPSOIL (ML) brown, dry to moist, loose, sandy silt, brown, non-plastic silt with fine sand.
5.0	5.0 7.0	B14-5	1.3	9-10-12-15 (22)	From 5.0 to 7.0 ft WELL-GRADED GRAVEL WITH SAND (GW) light brown, moist, medium dense, subrounded to rounded gravel, well-graded sand and some brown, non-plastic silt with gravel up to 1.5-inches in diameter.
	7.5 9.5	B14-8	0.8	9-12-17-23 (29)	From 7.5 to 9.5 ft WELL-GRADED GRAVEL WITH SAND (GW) light brown, moist to wet, medium dense subrounded to rounded gravel up to 1.5-inches in diameter, with well-graded sand and some brown, non-plastic silt. Free water encountered at 8.7 ft. bgs.
10.0	10.0 12.0	B14-10	1.1	5-9-10-18 (19)	From 10.0 to 12.0 ft WELL-GRADED GRAVEL WITH SAND (GW) light brown, wet, medium dense subrounded to rounded gravel up to 1.5-inches in diameter, with well-graded sand and some brown, non-plastic silt. End of boring at 12.0 ft. bgs.
15.0					
20.0					

WELL COMPLETION DIAGRAM



CH2M HILL

PROJECT NUMBER	BORING NUMBER
ANC31026.H3.60	OU5MW-15

SHEET 1 OF 1

WELL COMPLETION LOG

PROJECT ELMENDORF AFB IRP **LOCATION** ANCHORAGE, ALASKA

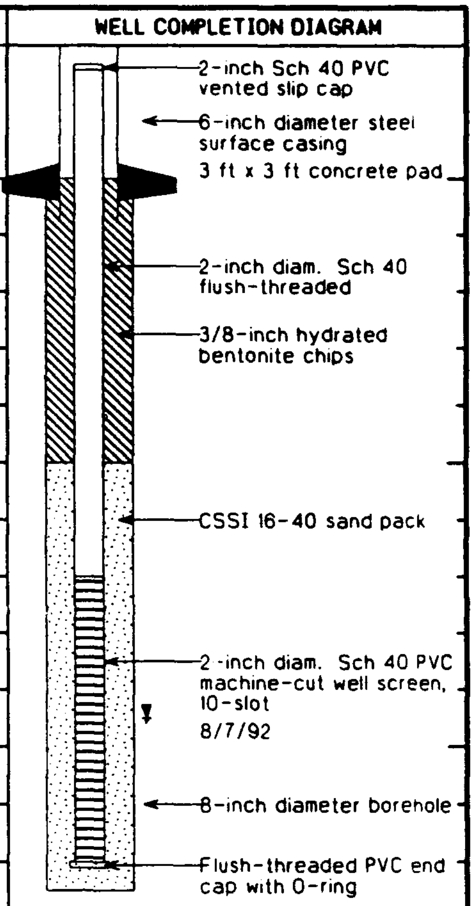
ELEVATION -- **DRILLING CONTRACTOR** DENALI DRILLING

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER, MOBILE DRILL B-61, TRUCK MOUNT

WATER LEVELS 9.5 ft bgs 8/7/92 **START** 8-7-92 **FINISH** 8-7-92 **LOGGER** D. KUNKEL

DEPTH BELOW SURFACE (FT)	SAMPLE			BLOW COUNTS	SOIL DESCRIPTION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT.)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
5.0	5.5				
	7.5	B15-5	1.2	1-1-1-1 (2)	From 5.5 to 7.5 ft SILTY CLAY (CL-ML) mottled gray-rust silty clay, moist, very soft gray clay with fine silt. Slightly plastic in some portions, most portions crumbly when manipulated. Increasing plasticity with moisture content.
	9.5	B15-7	1.2	4-5-6-10 (11)	From 7.5 to 9.5 ft WELL-GRADED SAND WITH GRAVEL (SW) blue-gray, moist, wet at 9 ft bgs, medium dense, fine to coarse sand with subrounded gravel up to 3-inches in diameter, minor amounts of silt.
10.0					Free water encountered at 9.5 ft bgs. Product sheen detected on water.
	12.5				
	14.5	B15-12	1.2	8-10-20-28 (30)	From 12.5 to 14.5 ft WELL-GRADED GRAVEL WITH SILT AND SAND (GW-GM) tan-brown, wet, medium dense gravel up to 3-inches in diameter with fine to coarse sand, minor amounts of light brown silt. Sheen on water, petroleum odor in sampler.
15.0					
20.0					

WELL COMPLETION DIAGRAM



PROJECT NUMBER ANC31026.H3.60

BORING NUMBER OU5MW-16 **SHEET** 1 **OF** 1

WELL COMPLETION LOG

PROJECT ELMENDORF AFB IRP OU5 **LOCATION** ANCHORAGE, ALASKA

ELEVATION -- **DRILLING CONTRACTOR** DENALI DRILLING

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER, MOBILE DRILL B-61, TRUCK MOUNT

WATER LEVELS Approx. 10 ft. bgs **START** 8-6-92 **FINISH** 8-7-92 **LOGGER** D. KUNKEL

DEPTH BELOW SURFACE (FT)	SAMPLE			BLOW COUNTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT.)	6"-6"-6"-6" (N)
	2.5 4.5	B16-2.5	1.0	3-2-1-1 (3)
5.0	5.0 7.0	B16-5	1.1	2-5-7-8 (12)
	7.5 9.5	B16-7.5	1.1	6-9-10-15 (19)
10.0	10.0 12.0	B16-10	0.9	16-18-25-20 (43)
15.0	15.0 17.0	B16-15	2.0	1-2-3-3 (5)
20.0				

SOIL DESCRIPTION

SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY

2.5-4.0 ft SILTY SAND WITH GRAVEL, (SM) brown, moist, loose, approx. 60-65% fine to medium grained sand, 20-25% subrounded to rounded gravel, up to 1.5 inches in diameter, up to 15% non-plastic silt, few chunks of gray clay in 2.5-4.0 ft interval.

4.0-4.5 ft PEAT, (PT) brown, moist, soft, dark reddish brown, some product odor.

5.0-5.5 ft PEAT, (PT) brown, moist, soft, dark reddish brown, some product odor.

5.5-7.0 ft GRAVELLY LEAN CLAY WITH SAND, (CL) light grayish-brown, moist, somewhat dense and cohesive, approx. 50-60% lean clay, 25% subrounded to rounded gravel, up to 15% silt and fine sand. Poorly graded.

7.5-9.5 ft WELL-GRADED SAND WITH GRAVEL, (SW) gray to blue-gray, moist, loose, mostly non-plastic silt, approx. 55-65% fine to medium grained sand, 30% subrounded gravel up to 2 inches in diameter, up to 5% fine sand.

Hit groundwater at 10 ft. bgs.

10.0-12.0 ft WELL-GRADED GRAVEL WITH SILT AND SAND, (GW-GM) gray to blue-gray, approx. 50-55% well-graded gravel, subangular to subrounded, 30% fine to coarse-grained sand, up to 15% silt, wet, loose.

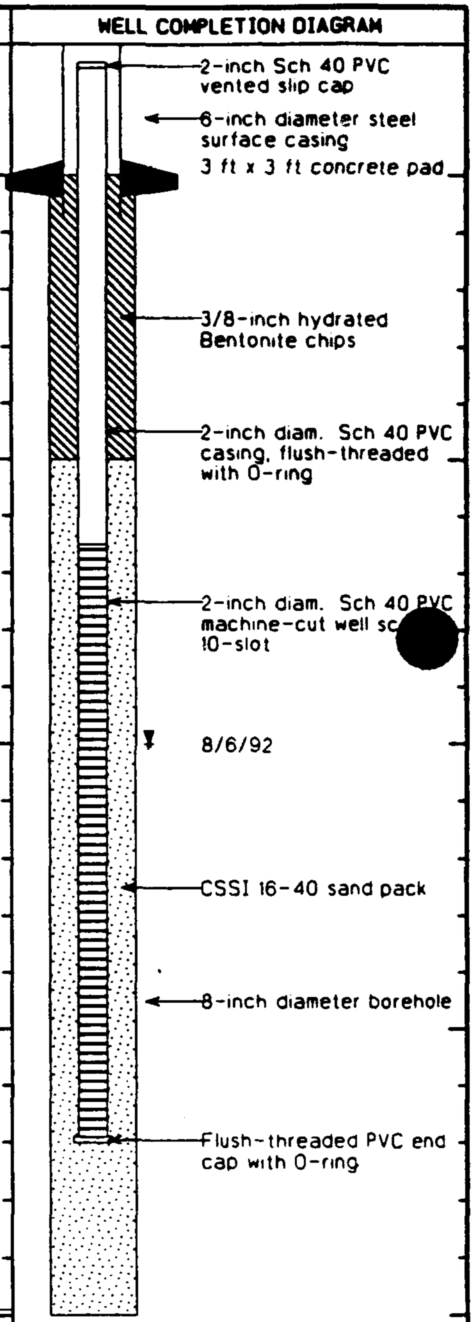
15.0-17.0 ft LEAN CLAY, (CL) blue-gray, moist, wet, elastic, dense, sticky clay, up to 75% lean clay, approx. 5% fine sand in the upper 5 inches of the sampler.

End of sampling at 17 ft. bgs.

End of boring at 20 ft. bgs.

Note: OU5MW-16 was abandoned and backfilled on 8/25/92 due to insufficient yield.

WELL COMPLETION DIAGRAM



CH2M HILL

PROJECT NUMBER	BORING NUMBER
ANC31026.H3.60	OU5MW-16A SHEET 1 OF 1

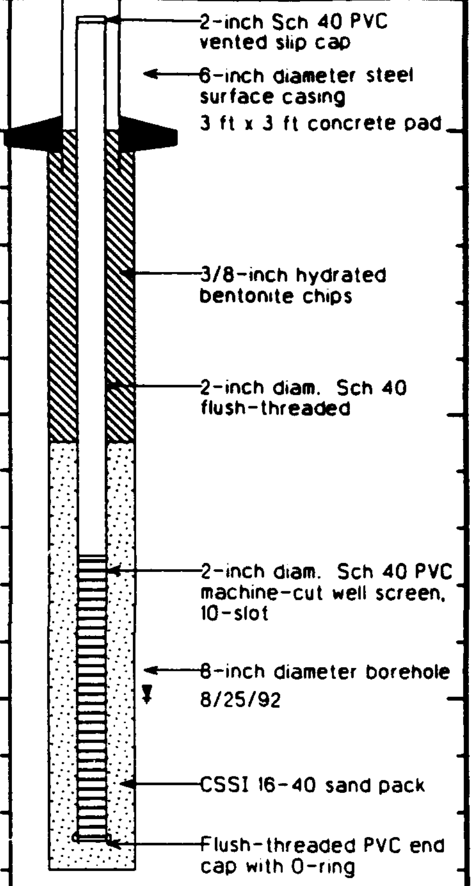
WELL COMPLETION LOG

PROJECT ELMENDORF AFB IRP OU5 **LOCATION** ANCHORAGE, ALASKA

ELEVATION -- **DRILLING CONTRACTOR** DENALI DRILLING

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER, MOBILE DRILL B-61, TRUCK MOUNT

WATER LEVELS Approx. 10 ft. bgs **START** 8-25-92 **FINISH** 8-26-92 **LOGGER** D. KUNKEL

DEPTH BELOW SURFACE (FT)	SAMPLE			BLOW COUNTS	SOIL DESCRIPTION	WELL COMPLETION DIAGRAM
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT.)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	
					From 2.5 to 4.0 ft SILTY SAND WITH GRAVEL, (SM) brown, moist, very loose, fine to medium sand with subrounded to rounded gravel, up to 1.5 inches in diameter, and non-plastic silt, few chunks of gray clay in 2.5-4.0 ft interval.	
5.0					From 4.0 to 4.5 ft PEAT, (PT) brown, moist, very soft, dark reddish brown, some product odor. From 5.0 to 5.5 ft PEAT, (PT) brown, moist, soft, dark reddish brown, some product odor. From 5.5 to 7.0 ft GRAVELLY LEAN CLAY WITH SAND, (CL) light grayish-brown, moist, medium dense and cohesive lean clay with subrounded to rounded gravel, silt and fine sand. Poorly graded.	
10.0					From 7.5 to 9.5 ft WELL-GRADED SAND WITH GRAVEL, (SW) gray to blue-gray, moist, very stiff, mostly non-plastic silt with fine to medium sand, and subrounded gravel up to 2-inches in diameter. Free water encountered at 10 ft. bgs. From 10.0 to 12.0 ft WELL-GRADED GRAVEL WITH SILT AND SAND, (GW-GM) gray to blue-gray, wet, dense, well-graded subangular to subrounded gravel with fine to coarse sand and silt. End of boring at 13 ft. bgs.	
15.0					Note: Soil description is taken from log for OU5MW-16, which was drilled approximately 10 ft. from OU5MW-16A.	
20.0						

CH2M HILL

PROJECT NUMBER ANC31026.H3.60

BORING NUMBER OU5MW-17 **SHEET** 1 **OF** 1

WELL COMPLETION LOG

PROJECT ELMENDORF AFB IRP OU5 **LOCATION** ANCHORAGE, ALASKA

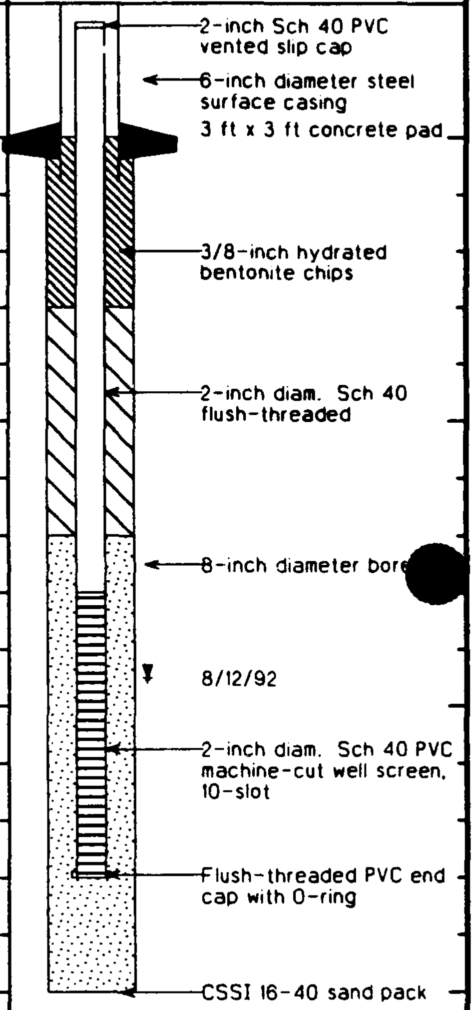
ELEVATION -- **DRILLING CONTRACTOR** DENALI DRILLING

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER, MOBILE DRILL B-61, TRUCK MOUNT

WATER LEVELS 9.5 ft. bgs 8/12/92 **START** 8-12-92 **FINISH** 8-12-92 **LOGGER** D. KUNKEL

DEPTH BELOW SURFACE (FT)	SAMPLE			BLOW COUNTS	SOIL DESCRIPTION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT.)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
	1.0				From 0.0 to 1.0 ft TOPSOIL, (ML) brown, moist, loose, some large gravel, mostly silt and fine sand.
5.0	5.0 7.0	B17-5	1.7	11-12-18-23 (30)	From 5.0 to 7.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) rust-brown, moist, medium dense. A few small, wet, thin silty zones. Well-graded sand with fine to medium gravel, minor amounts of silt.
	7.5 9.0	B17-8	1.3	4-7-20-15 (27)	7.5-9.0 ft WELL-GRADED SAND WITH GRAVEL, (SW) rust-brown, moist, medium dense. A few small, wet, thin silty zones. Fine to coarse sand with fine to medium gravel, some silt.
10.0	9.5 11.0	B17-9.5	1.2	7-8-6-5 (14)	Free water encountered at 9.5 ft. bgs. No discernible free product. From 9.0 to 11.0 ft SILTY SAND, (SM) light brown, fine sand with brown, non-plastic silt, trace of clay, dense, somewhat sticky.
15.0	14.5 16.5	B17-15	2.0	1-1-2-2 (3)	From 14.0 to 16.0 ft LEAN CLAY, (CL) blue-gray, 100% clay, bootlegger cove formation, plastic, sticky. End of boring at 15 ft. bgs. End of sampling at 16.5 ft. bgs.
20.0					

WELL COMPLETION DIAGRAM



CH2M HILL

PROJECT NUMBER ANC31026.H3.60

BORING NUMBER OU5MW-30

SHEET 1 **OF** 1

WELL COMPLETION LOG

PROJECT ELMENDORF AFB IRP **LOCATION** ANCHORAGE, ALASKA

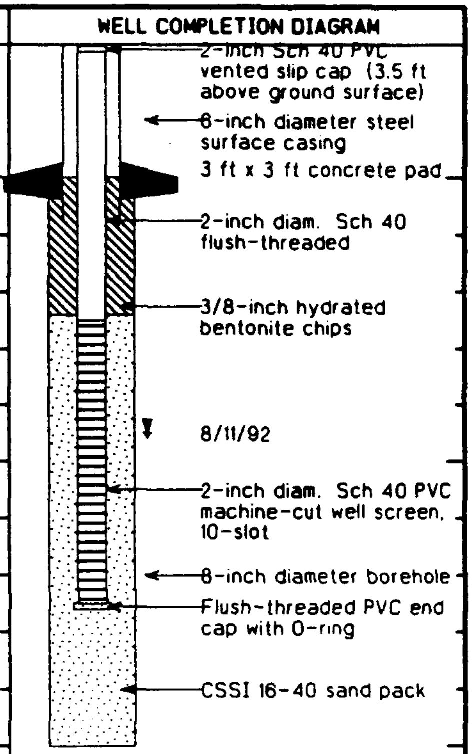
ELEVATION -- **DRILLING CONTRACTOR** DENALI DRILLING

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER, MOBILE DRILL B-61, TRUCK MOUNT

WATER LEVELS -- **START** 8-11-92 **FINISH** 8-11-92 **LOGGER**

DEPTH BELOW SURFACE (FT)	SAMPLE			BLOW COUNTS	SOIL DESCRIPTION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT.)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
					From 0.0 to 0.5 ft TOPSOIL, brown, moist, organic rich, mostly silt, some fine sand.
	2.0	B030-0	0.7	4-15-24-24 (39)	From 0.5 to 2.0 ft WELL-GRADED GRAVEL WITH SILT (GW-GM) brown fill material, moist, dense, looks like pit run, cobbles up to 1 ft in diameter in a silt matrix, well-graded gravel, difficult drilling due to cobbles.
5.0	5.0				Free water encountered at 4.5 ft. bgs. No discernible free product.
	7.0	B030-5	1.0	5-8-10-12 (18)	From 5.0 to 7.0 ft WELL-GRADED GRAVEL WITH SILT (GW-GM) brown fill material, wet, medium dense, loose like pit run, cobbles up to 1 ft in diameter in a silt matrix, well-graded gravel, difficult drilling due to cobbles.
10.0	10.0				From 10.0 to 12.0 ft WELL-GRADED SAND WITH GRAVEL (SW) brown, wet, medium dense, fine to coarse sand with subrounded gravel up to 15-inches in diameter, minor amounts of non-plastic silt. No cobbles.
	12.0	B030-1	1.2	7-11-19-39 (30)	
					End of boring at 12.0 ft. bgs.
15.0					
20.0					

WELL COMPLETION DIAGRAM



CH2M HILL

PROJECT NUMBER ANC31026.H3.60

BORING NUMBER OU5MW-31 **SHEET** 1 **OF** 1

WELL COMPLETION LOG

PROJECT ELMENDORF AFB IRP **LOCATION** ANCHORAGE, ALASKA

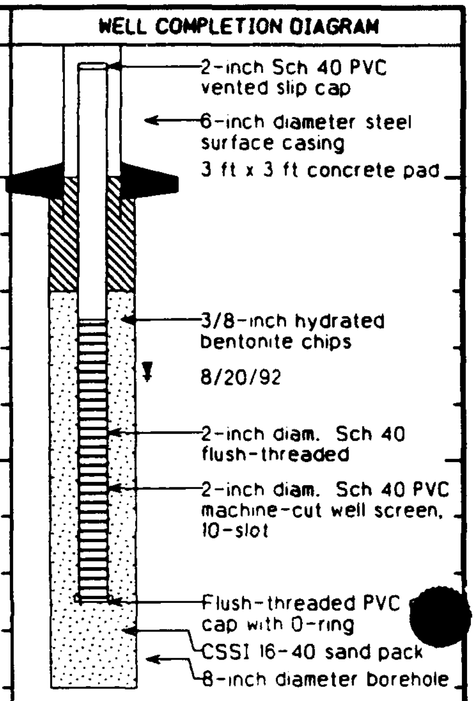
ELEVATION -- **DRILLING CONTRACTOR** DENALI DRILLING

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER, MOBILE DRILL B-61, TRUCK MOUNT

WATER LEVELS 3.5 ft. bgs **START** 8-20-92 **FINISH** 8-20-92 **LOGGER** D. KUNKEL

DEPTH BELOW SURFACE (FT)	SAMPLE			BLOW COUNTS	SOIL DESCRIPTION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT.)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
	2.5				
	4.5	B31-3	1.1	3-2-4-7 (6)	From 2.5 to 3.0 ft SILT WITH SAND, (ML) brown to dark brown, moist, firm, non-plastic silt with subangular gravel and well-graded sand
5.0	7.5				From 3.0 to 4.5 ft WELL-GRADED GRAVEL WITH SAND, (GW) brown, wet, loose, well-graded gravel up to 3-inches in diameter with well-graded sand and non-plastic silt. Free water encountered at 3.5 ft. bgs. No discernible free product.
	9.5	B31-8	1.3	7-7-8-16 (15)	From 7.5 to 9.5 ft WELL-GRADED GRAVEL WITH SAND, (GW) As above.
10.0	11.5	B31-11	1.0	8-5-7-12 (12)	From 9.5 to 11.5 ft WELL-GRADED GRAVEL WITH SAND, (GW) As above.
					End of boring at 11.5 ft. bgs.
15.0					
20.0					

WELL COMPLETION DIAGRAM



Appendix D

WELL PURGING AND DEVELOPMENT FIELD DATA SHEETS

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER OU5 MW1 FIELD TEAM (INITIALS) S Repko

SITE Elmendorf AFB JOB NUMBER ANC31026.H3.60

FIELD CONDITIONS Cool (50°) overcast, raining

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			
CONDUCTIVITY METER	See page 1		
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION

PURGE INFORMATION

DATE 25-26 Aug 92 START TIME 25 Aug 92 17:30 END TIME 26 Aug 09:30

INITIAL DEPTH TO WATER 37.22 TOC WELL DEPTH 46.9 TOC EST. WELLBORE VOL. 9.7

FINAL DEPTH TO WATER 37.23 TOTAL VOL. PURGED 440 gal DISCHARGE RATE 5.5 gpm

METHOD pumped PUMP DEPTH 4^{ss} 37.22 to 46.9' TOC

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0	11.4°C	6.82	600	muddy brown
55 gallons	10.9	6.69	525	Turbid brown
220 gallons	11.4	6.82	550	Slightly Turbid brown
420 "	10.4	6.72	550	Clear Colorless

SAMPLING INFORMATION

DATE 26 Aug 92 START TIME 09:30 END TIME 10:00

METHOD grunfos ~~red-e~~ ready flow pump

INITIAL DEPTH TO WATER 37.23' DEPTH TO WATER AFTER SAMPLING 37.23'

(43)

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER MW-1 FIELD TEAM (INITIALS) BT,JG

SITE Elmendorf AFB IRP JOB NUMBER ANC31026.H3.60

FIELD CONDITIONS Rain, 50°F

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION 230A	HAZCO 1875	10.0, 4.0, 7.0 @ 13°C
CONDUCTIVITY METER	YSI 33	HAZCO 2170	780 umhos 7500 umhos @14°C
THERMOMETER			
WATER LEVEL INDICATOR Oil/Water Interface	ORS	HAZCO 1792	
BAILER/PUMP			

DECONTAMINATION Steam Clean, Liquinox WASH, Tap Rinse, DI Rinse

PURGE INFORMATION / Developement

DATE 8/~~25~~ 26/92 START TIME ____ END TIME ____

INITIAL DEPTH TO WATER 36.86' WELL DEPTH 46.5' BTOC EST. WELLBORE VOL. ____

FINAL DEPTH TO WATER ____ TOTAL VOL. PURGED ____ DISCHARGE RATE ____

METHOD Watera, Footvalve, Surgeblock HDPE Tube PUMP DEPTH ____

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
8 GAL				

Developed By Denali & Susan Repco/CHm Hill

SAMPLING INFORMATION

DATE 8/26/92 START TIME 1500 END TIME ____

METHOD Watera, HDPE Tube, Volatile Sample Tube

INITIAL DEPTH TO WATER ____ DEPTH TO WATER AFTER SAMPLING ____

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER SMW01 FIELD TEAM (INITIALS) KBL/RC

SITE ____ JOB NUMBER ____

FIELD CONDITIONS OVERCAST, 0°F, WINDS CALM

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION 250A	2882	4 3pt calibration on log
CONDUCTIVITY METER	YSI 33	1820	See calibration log
THERMOMETER	ORION 250A	2882	See calibration log
WATER LEVEL INDICATOR	SLOPE 51453	19566	✓d water bath
BAILER/PUMP	GRUNDFOS MP1	056208	

DECONTAMINATION STEAM CLEAN - ALCONOX - TAP - DI RINSE FOR PUMP. ALL OTHERS FOLLOW OUS MANAGEMENT PLAN

PURGE INFORMATION

DATE 12/16/92 START TIME 1530 END TIME ____

INITIAL DEPTH TO WATER 36.73* WELL DEPTH 46.65* EST. WELLBORE VOL. ____

FINAL DEPTH TO WATER ____ TOTAL VOL. PURGED ____ DISCHARGE RATE ~3 gpm

METHOD GRUNFOS VARIABLE FLOW PUMP DEPTH ____

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
<1 gal	8.1°C	~~10.2~~ 6.8	500 mhos	Slightly cloudy
5 gal	8.6°C	6.8	400 mhos	clean
15 gal	7.0°C	6.8	400 mhos	clean
30 gal	7.0°C	6.8	400 mhos	clean

* Measured from Top of Casing

SAMPLING INFORMATION

DATE 16-DEC-92 START TIME 1630 END TIME 1633

METHOD GRUNFOS Variable Flow and field filter for dissolved

INITIAL DEPTH TO WATER 36.73* DEPTH TO WATER AFTER SAMPLING 37*

69

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER MW-02 FIELD TEAM (INITIALS) JG

SITE ELMENDORF AFB OU5 JOB NUMBER ANC 3102 6. H3.60

FIELD CONDITIONS CLOUDY 55°

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION 230 A	HAZCO# 2017	SEE CALIBRATION LOG
CONDUCTIVITY METER	YSI/SCT	HAZco# 2170	" " "
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION STEAM CLEAN, LIQUINOX H2O, TAP H2O, DI H2O RINSE

PURGE INFORMATION

DATE 3 SEPT 92 START TIME 1535 END TIME

INITIAL DEPTH TO WATER 33.25' WELL DEPTH 46.35 EST. WELLBORE VOL.

FINAL DEPTH TO WATER TOTAL VOL. PURGED DISCHARGE RATE

METHOD GRUNDFOS REDI FLO 2 PUMP DEPTH 40'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
185 GAL	10.7 °C	7.19	430	DARK BROWN/MUDDY
230 GAL	10.7 °C	7.13	420	BROWN/TURBID
275 GAL	10.6 °C	7.01	420	LIGHT BROWN/TURBID

SAMPLING INFORMATION

DATE 3 Sept 92 START TIME 14:00 END TIME 14:20

METHOD bailed w/ 2" ~~Stainless~~ Stainless steel

INITIAL DEPTH TO WATER 33.26' below PVC DEPTH TO WATER AFTER SAMPLING 33.26'

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER SMW02 FIELD TEAM (INITIALS) RC/KBL

SITE ______ JOB NUMBER ANC31026 H360

FIELD CONDITIONS Snowing, ~0-10°F with 5 knot wind N-S.

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION 250A	2882	See cal logs
CONDUCTIVITY METER	YSI 33	1820	↓
THERMOMETER	ORION 250A	2882	
WATER LEVEL INDICATOR	SLOPE 51453	19566	
BAILER/PUMP	GRUNDFOS MP1	256208	

DECONTAMINATION Same as SMW01

PURGE INFORMATION

DATE 17-DEC-92 START TIME 1426 END TIME 1445

INITIAL DEPTH TO WATER 32.94* WELL DEPTH 46.40* EST. WELLBORE VOL. 9.3

FINAL DEPTH TO WATER 33.0 TOTAL VOL. PURGED 30 gal DISCHARGE RATE ~2 gpm

METHOD GRUNFOS MP1 PUMP DEPTH 34.5*

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
<1 gal	6.8°C	6.98	300 mhos	slightly cloudy
13 gal	8.9°C	6.91	300 mhos	clear
20 gal	8.9°C	6.93	300 mhos	clear
30 gal	8.9°C	6.93	300 mhos	clear

* TOP OF CASING

SAMPLING INFORMATION

DATE 17-DEC-92 START TIME 1445 END TIME 1450

METHOD GRUNDFOS w/ field filter where applicable

INITIAL DEPTH TO WATER 32.94 DEPTH TO WATER AFTER SAMPLING 33.0

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER 5MW3 FIELD TEAM (INITIALS) SR

SITE Elmendorf AFB OU5 JOB NUMBER ANC31026.H360

FIELD CONDITIONS Cool, overcast

FIELD MEASUREMENT/ COLLECTION EQUIP.

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			
CONDUCTIVITY METER			
THERMOMETER	See page 1		
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION

See Page 1

PURGE INFORMATION

DATE 27 Aug 92 START TIME 26 Aug 92 11:30 END TIME 27 Aug 92 12:30

INITIAL DEPTH TO WATER 34.2 below steel WELL DEPTH 47.3 EST. WELLBORE VOL 15.3

FINAL DEPTH TO WATER 34.2 TOTAL VOL. PURGED 825 gal DISCHARGE RATE 9 gpm

METHOD pumped PUMP DEPTH 40'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 gallons	7.5°C	7.20	420	muddy
165 "	8.1°C	7.03	420	Turbid
300 gallons	9.2°C	6.86	440	Turbid
715	8.5°C	6.93	425	Slightly Turbid
825	8.5°C	7.0	450	Clear Colorless

SAMPLING INFORMATION

DATE 27 Aug 92 START TIME END TIME

METHOD Well sampled using 2" Stainless Steel bailer

INITIAL DEPTH TO WATER 34.0 DEPTH TO WATER AFTER SAMPLING 34.0

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER MW.3 FIELD TEAM (INITIALS) BT, JG

SITE Elmendorf AFB IRP JOB NUMBER ANC31026.H3.60

FIELD CONDITIONS Overcast, 58°F

FIELD MEASUREMENT/ COLLECTION EQUIP.

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			
CONDUCTIVITY METER	Refer TO Page #51		
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION

PURGE INFORMATION / Developement

DATE START TIME END TIME

INITIAL DEPTH TO WATER WELL DEPTH 46.64' BTOC EST. WELLBORE VOL.

FINAL DEPTH TO WATER TOTAL VOL. PURGED DISCHARGE RATE

METHOD PUMP DEPTH

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
Susan	Repko/CH2M Hill			
Denali	Drilling	Developed	8/27/92	

SAMPLING INFORMATION

DATE 8/27/92 START TIME 1545 END TIME

METHOD SS Bailer

INITIAL DEPTH TO WATER 33.38' BTOC DEPTH TO WATER AFTER SAMPLING

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER 5MW4 FIELD TEAM (INITIALS) SR

SITE Elmendorf AFB JOB NUMBER ANC31026.H3.60

FIELD CONDITIONS Cool, overcast

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			
CONDUCTIVITY METER			
THERMOMETER	see page 1		
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION

see page 1

PURGE INFORMATION

DATE 28 Aug 92 START TIME 14:20 END TIME 18:00

INITIAL DEPTH TO WATER 33.08 TOC (steel) WELL DEPTH 45.30 EST. WELLBORE VOL 12.22

FINAL DEPTH TO WATER 33.08 TOTAL VOL. PURGED 715gal DISCHARGE RATE 9gpm

METHOD Submersible pump PUMP DEPTH 40 feet

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0	9.9°C	7.03	410	muddy
110	8.4°C	7.00	385	Turbid
165	8.7°C	6.99	390	Turbid
230	8.7°C	7.04	360	Slightly Turbid
715	8.5°C	6.94	380	Clear Colorless

SAMPLING INFORMATION

DATE 28 Aug 92 START TIME 18:35 END TIME 18:45

METHOD 2" Stainless Steel Bailer

INITIAL DEPTH TO WATER 33.08 DEPTH TO WATER AFTER SAMPLING 33.08

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER 5MW5 FIELD TEAM (INITIALS) S Repko

SITE Elmendorf AFB JOB NUMBER ANC31026 H3.6

FIELD CONDITIONS Cool, Cloudy, overcast.

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			
CONDUCTIVITY METER		1	
THERMOMETER	see page		
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION see page 1

PURGE INFORMATION

DATE 30 Aug 92 START TIME 16:00 END TIME 31 Aug 10:30

INITIAL DEPTH TO WATER 38.34 WELL DEPTH 52.38 EST. WELLBORE VOL.

FINAL DEPTH TO WATER 38.3 TOTAL VOL. PURGED 660 DISCHARGE RATE 9gpm

METHOD pumped PUMP DEPTH 40'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0	8.8°C	7.00	385	muddy
80	9.9°C	7.04	380	Turbid
220	9.0°C	6.98	400	Turbid
440	9.8°C	6.98	375	Slightly Turbid
660	8.2°C	6.6	420	Clear Colorless

SAMPLING INFORMATION

DATE 31 Aug 92 START TIME 12:50 END TIME 13:15

METHOD bailed w/ 2" Stainless steel bailer

INITIAL DEPTH TO WATER 25.54' below PVC DEPTH TO WATER AFTER SAMPLING 25.54'

(67)

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER MW-06 FIELD TEAM (INITIALS) JG

SITE ELMENDORF AFB OU5 JOB NUMBER ANC 31026.43.60

FIELD CONDITIONS CLEAR 55°

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION 230 A	HAZCO# 2017	SEE CALIBRATION LOG
CONDUCTIVITY METER	431/SCT	HAZCO# 2170	" " "
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION STEAM CLEAN, LIQUINOX W/TAP H2O, TAP H2O, DI H2O RINSE

PURGE INFORMATION

DATE ~~2 SEPT 92~~ [illegible] 2SEPT92 1SEPT - 2SEPT 92 START TIME ~~1535~~ [illegible] 2SEPT92 1600 1SEPT 92 END TIME 2SEPT 92 1415

INITIAL DEPTH TO WATER ~~39.25~~ 35.83' [illegible] 2SEPT92 WELL DEPTH ~~46.35~~ 50.05' [illegible] 2SEPT92 EST. WELLBORE VOL

FINAL DEPTH TO WATER 35.83 TOTAL VOL. PURGED 880 DISCHARGE RATE

METHOD GRUNDFOS REDI FLO 2" PUMP DEPTH 48'

VOLUME PURGED GAL.	TEMPERATURE °C	pH	CONDUCTIVITY	APPEARANCE
~~105~~ 330 GAL.	7.6 °C	6.97	310	CLOUDY/BROWN
~~330~~ 495 "	7.7 °C	6.79	300	" "
~~440~~ 605 "	7.6 °C	6.84	300	" "
~~550~~ 715 "	7.6 °C	6.80	300	TAN/TURBID
~~715~~ 880 GAL	7.7 °C	6.88	310	LIGHT TAN/SLIGHT TURBID

2SEPT92

SAMPLING INFORMATION

DATE 3 Sept 92 START TIME 12:00 END TIME 12:20

METHOD bailed

INITIAL DEPTH TO WATER 35.80 DEPTH TO WATER AFTER SAMPLING 35.80

65

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER 5MW 7-40 FIELD TEAM (INITIALS) JG, SR

SITE ELMENDORF AFB IRP OU5 JOB NUMBER ANC 30036.H3.60

FIELD CONDITIONS RAIN 55°

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION 250 A	CH2MHill 2682	SEE CALIBRATION LOG
CONDUCTIVITY METER	YSI/SCT	Harco # 2170	" "
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION Steam Clean, Liquinox, tap rinse, DI Rinse

PURGE INFORMATION /DEVELOPEMENT

DATE 1SEPT 92 START TIME 31 AUG 92 1215 END TIME 1355 1SEPT92

INITIAL DEPTH TO WATER 34.50' WELL DEPTH 51.92' EST. WELLBORE VOL. ______

FINAL DEPTH TO WATER 34.50 TOTAL VOL. PURGED 825 DISCHARGE RATE 3GPM

METHOD 2" VARIABLE SPEED SUBMERSABLE PUMP DEPTH 45'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
~~445~~ 550 GAL	6.4 °C	6.93	330	TURBID, BROWN/TAN
715	6.6	6.82	330	TURBID, LIGHT TAN
770	7.2	6.91	330	TURBID(SLIGHTLY), LIGHT TAN
825	6.5	6.81	330	CLEAR

SAMPLING INFORMATION

DATE 1SEPT 92 START TIME 1645 END TIME 1730

METHOD SS BAILER

INITIAL DEPTH TO WATER 34.50' DEPTH TO WATER AFTER SAMPLING 34.50

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER MW-8 FIELD TEAM (INITIALS) BT, JG

SITE Elmendorf AFB IRP JOB NUMBER ANC31026-44360

FIELD CONDITIONS Rain, Cool, 46°F

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			
CONDUCTIVITY METER			
THERMOMETER	Refer To	Page # 43	
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION

PURGE INFORMATION / Developement

DATE 8/25/92 START TIME 1000 END TIME 1300

INITIAL DEPTH TO WATER 16.22' WELL DEPTH 21.94' BTOC EST. WELLBORE VOL 7.37 gal

FINAL DEPTH TO WATER 16.23' TOTAL VOL. PURGED 165 gal DISCHARGE RATE

METHOD Waterra, HDPE Tube, Foot Valve / Surge Block PUMP DEPTH 15'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	9.5°c	6.02	~~440x1~~ 448x1	Orangish
55	8.2°c	6.42	375x1	"
110	8.5°c	6.45	375x1	Slight Turbid / orange
140	8.5°c	6.44	380x1	Cloudy
160	8.7°c	6.58	375x1	Slightly Cloudy
after sample	9.6°C	6.46	380x1	Clear

SAMPLING INFORMATION

DATE 8/25/92 START TIME 1315 END TIME 1330

METHOD Waterra, HDPE Tube, Volatile Sample Tube

INITIAL DEPTH TO WATER DEPTH TO WATER AFTER SAMPLING

(51)

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER MW-09 FIELD TEAM (INITIALS) BT, JG

SITE Elmendorf AFB IRP JOB NUMBER Anc31026.HL60

FIELD CONDITIONS Overcast, 50°F

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	Orion 230A	HAZCO 2017	4.0, 7.01, 10.21 @ 13°C
CONDUCTIVITY METER	YSI 33	HAZCO 2170	750u/1000 @14°C 7500uf[illegible]
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION Steam Clean, Liquinox WASH, TaP Rinse, DI WATER Rinse

PURGE INFORMATION / Developement

DATE 8/27/92 START TIME 1110 END TIME 1300

INITIAL DEPTH TO WATER 3.74' WELL DEPTH 10.32 BTOC EST. WELLBORE VOL 5.95gal

FINAL DEPTH TO WATER 3.75' TOTAL VOL. PURGED ______ DISCHARGE RATE ______

METHOD Watera Surge Block Parastoltic Pump PUMP DEPTH ______

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	9.5°C	7.20	478x1	muddy/silty Brown
55 GAL	9.1°C	7.13	460x1	Turbid
110 GAL	9.5°C	7.22	440x1	Semi-Turbid
165 GAL	9.4°C	7.24	440x1	Cloudy
220 GAL	9.1°C	7.17	435x1	Semi/Cloudy
After Sample	9.5°C	6.94	440x1	Clear

SAMPLING INFORMATION

DATE 8/27/92 START TIME 1315 END TIME 1330

METHOD Paeastoltic Pump

INITIAL DEPTH TO WATER ______ DEPTH TO WATER AFTER SAMPLING ______

(39)

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER MW10 FIELD TEAM (INITIALS) BI, JG

SITE Elmendorf AFB IRP JOB NUMBER ANC31026.H3.60

FIELD CONDITIONS Overcast, 55°F

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	Orion	HAZCO 1875	10.12, 4.0, 7.01 @ %
CONDUCTIVITY METER	YSI 33	HAZCO 2170	990 w/1000 umhos 9900 w/10,000 @ 15°C
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION Steam Clean, Liquinox Wash, Tap Rinse DI Water Rinse

PURGE INFORMATION / Developement

DATE 8/24/92 START TIME 10:15 END TIME 1250

INITIAL DEPTH TO WATER 2.96' WELL DEPTH 10.30' EST. WELLBORE VOL 6.67

FINAL DEPTH TO WATER 2.92' TOTAL VOL. PURGED 225 gal DISCHARGE RATE

METHOD Waterra, HDPE Tube, Foot valve, Surge block PUMP DEPTH 7'

	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
-	0 GAL	12.5°C	6.23	445x1	Cloudy
SAP	55 GAL	10.2°C	6.91	440x1	Turbid, Sandy - Dark
SAP	110 GAL	10.0°C	7.18	435x1	Cloudy
P	165 GAL	10.9°C	7.38	440x1	Cloudy
P	200 GAL	10.2°C	6.91	435x1	Semi Cloudy
P	220 GAL	10.4°C	6.92	430x1	Semi/Clear
	After sample	10.2°C	7.38	440x1	" "

SAMPLING INFORMATION

DATE 8/24/92 START TIME 1300 END TIME 1315

METHOD Waterra, HDPE Tubing Volatile Sample Tube

INITIAL DEPTH TO WATER DEPTH TO WATER AFTER SAMPLING

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER 5MW 11 FIELD TEAM (INITIALS) S Repko

SITE Elmendorf AFB JOB NUMBER ANC31026.H3.6C

FIELD CONDITIONS Cool, overcast

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			
CONDUCTIVITY METER	see page 1		
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION

page 1

PURGE INFORMATION

DATE 28 Aug 92 START TIME 09:30 END TIME 13:15

INITIAL DEPTH TO WATER 38.24 below PVC WELL DEPTH 52.32 EST. WELLBORE VOL 14.0gal

FINAL DEPTH TO WATER 38.3 TOTAL VOL. PURGED 460 DISCHARGE RATE 9gpm

METHOD Submersible pump PUMP DEPTH 40'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
60gal ~~0~~ +.1R	9.9°C	7.04	380	Turbid
220	9.0°C	6.98	400	Turbid
330	10.3°C	6.97	385	wtr Slightly Turbid
460	9.8°C	6.98	375	clear Colorless

SAMPLING INFORMATION

DATE 28 Aug 92 START TIME 16:55 END TIME 17:15

METHOD bailed w/ 2" Stainless steel bailer

INITIAL DEPTH TO WATER 38.3 DEPTH TO WATER AFTER SAMPLING 38.3

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER MW12 FIELD TEAM (INITIALS) BT, SG

SITE Elmendorf AFB IRP JOB NUMBER ANC31026.HS.60

FIELD CONDITIONS PartLY Sunny 58°F

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			
CONDUCTIVITY METER	Refer To	Page #	55
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION

PURGE INFORMATION / Developement

DATE 8/28/92 START TIME 1510 END TIME 1725

INITIAL DEPTH TO WATER 8.39' BTOC WELL DEPTH 11.68' BTOC EST. WELLBORE VOL 2.99 gal

FINAL DEPTH TO WATER 8.24' TOTAL VOL. PURGED 165 gal DISCHARGE RATE

METHOD Watera Tube, Surge Block, Peristaltic Pump PUMP DEPTH 10'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	15.3°C	7.26	485x1	muddy
55	14.3°C	7.15	450x1	semi/Cloudy/Turbid
110	14.7°C	7.08	450x1	Cloudy
165	14.9°C	7.18	460x1	Clear
after Sample	14.5°C	7.11	480x1	suspended particles / Clear

SAMPLING INFORMATION

DATE 8/28/92 START TIME 1720 END TIME 1730

METHOD Watera Tube, Volatile Sample tube

INITIAL DEPTH TO WATER DEPTH TO WATER AFTER SAMPLING 8.24'

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER MW 13 FIELD TEAM (INITIALS) BT, JG

SITE Elmendorf AFB IRP JOB NUMBER ANC31026.H3.60

FIELD CONDITIONS Overcast, Drizzle, 50°F

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION 230A	1875 HAZCO	10.02, 4.0, 7.0 @ 14.9°C
CONDUCTIVITY METER	YSI 33	2170 HAZCO	990 w/1000 9000 w/10000 @ 14.9°C
THERMOMETER			
WATER LEVEL INDICATOR → Oil/Water Interface	ORS	1792 HAZCO	
BAILER/PUMP			

DECONTAMINATION Steam Clean, Liquinox Wash, Tap Rinse DI Rinse

PURGE INFORMATION/DEVELOPEMENT

DATE 8/23/92 START TIME 0940 END TIME 1330

INITIAL DEPTH TO WATER 3.62' WELL DEPTH 7.5' EST. WELLBORE VOL 4.62gal

FINAL DEPTH TO WATER 3.59' TOTAL VOL. PURGED 220gal DISCHARGE RATE

METHOD Watera, HDPE Tube PUMP DEPTH 2.5' → 7.5' BGS

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	11.6°C	6.83	478X1	Turbid/Sheen/ODOR
55	9.5°C	7.15	450x1	" " "
110	9.3°C	7.21	475X1	Semi-Turbid/ODOR
180	9.4°C	7.19	450x1	" " "
200	9.4°C	6.60	440X1	Semi/Clear/ODOR
220 ↓	9.4°C	6.55	440X1	Semi/Clear/ODOR

SAMPLING INFORMATION

DATE 8/23/92 START TIME 1400 END TIME 1415

METHOD Watera, HDPE Tube, Volatile Sample Tube

INITIAL DEPTH TO WATER DEPTH TO WATER AFTER SAMPLING

(49)

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER MW13 FIELD TEAM (INITIALS) BJ, JG

SITE Elmendorf AFB JOB NUMBER ANC31026H360

FIELD CONDITIONS Overcast, 50°F

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORion 230A	MAZCO 1875	7.02, 4.00 @ 15°C
CONDUCTIVITY METER			
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

Refer To Page# 43

DECONTAMINATION

PURGE INFORMATION

DATE 8/26/92 START TIME 1745 END TIME 1805

INITIAL DEPTH TO WATER 3.56' WELL DEPTH 7.5' EST. WELLBORE VOL 5.58 gal

FINAL DEPTH TO WATER ______ TOTAL VOL. PURGED 17.0 DISCHARGE RATE ______

METHOD SS Bailer PUMP DEPTH ______

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 Gal	11.3	5.96	470	Clear, Sheen
5.58 Gal	10.0	6.06	450	Slightly turbid, Sheen
11.0 Gal	9.5	6.16	450	Cloudy, Sheen
16.5	9.3	6.24	445	" "
Post Sample	9.4	6.30	450	" "

SAMPLING INFORMATION

DATE 8/26/92 START TIME 1800 END TIME 1810

METHOD SS Bailer

INITIAL DEPTH TO WATER ______ DEPTH TO WATER AFTER SAMPLING ______

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER OU5 MW14 FIELD TEAM (INITIALS) S Repko

SITE Elmendorf AFB JOB NUMBER ANC 31026.H3.

FIELD CONDITIONS Cool (~50°F), Overcast, raining (light to moderate)

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER		2882	
CONDUCTIVITY METER		1820	
THERMOMETER		2882	
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION Wash with alconox and tap water rinse with Tap water then HPLC (organic-free) deionized water

PURGE INFORMATION

DATE 23 Aug 92 START TIME ____ END TIME ____

INITIAL DEPTH TO WATER 10.88 WELL DEPTH 15.20 EST. WELLBORE VOL 5.3 gal

FINAL DEPTH TO WATER 10. TOTAL VOL. PURGED ____ DISCHARGE RATE ~1 gpm

METHOD bailed PUMP DEPTH ____

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE

SAMPLING INFORMATION

DATE ____ START TIME ____ END TIME ____

METHOD ____

INITIAL DEPTH TO WATER ____ DEPTH TO WATER AFTER SAMPLING ____

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER OBS MW-14 FIELD TEAM (INITIALS) SR

SITE Elmendorf JOB NUMBER

FIELD CONDITIONS Sunny Cool.

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	Orion	2882	See Calibration
CONDUCTIVITY METER	YSI #33	1820	Log book
THERMOMETER	Orion	2882	↓
WATER LEVEL INDICATOR			
BAILER/PUMP	Stainless Steel grundfos variable flow		

DECONTAMINATION Wash with Alconox and DI water

rinse with organic free DI water

PURGE INFORMATION

DATE 25 Aug 92 START TIME 23 Aug 92 09:30 END TIME 15:30

INITIAL DEPTH TO WATER 10.88 below Steel Casing WELL DEPTH 15.20 EST. WELLBORE VOL 5.3

FINAL DEPTH TO WATER ______ TOTAL VOL. PURGED ______ DISCHARGE RATE ~10gpm

METHOD pumped PUMP DEPTH 15.0 below TOC

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
5.5	11.8	6.84	370	colorless, slightly Cloudy
11.0	11.7	6.91	395	"
16.0	11.7	6.90	390	"

SAMPLING INFORMATION

DATE 25 Aug 92 START TIME 16:00 END TIME 16:30

METHOD stainless steel bailer

INITIAL DEPTH TO WATER ______ DEPTH TO WATER AFTER SAMPLING ______

(71)

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER MW15 FIELD TEAM (INITIALS) BT, WW

SITE Elmendorf OU5 JOB NUMBER ANC 31026.H3.60

FIELD CONDITIONS 50°F, Overcast

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	Orion Model 250A	S/N 002151	Cal to 4.0 and 7.0
CONDUCTIVITY METER	YSI Model 33	S/N J8016848	
THERMOMETER			
WATER LEVEL INDICATOR	Slope Model 51453	S/N 19566 [illegible]	
BAILER/PUMP			

DECONTAMINATION Alconox, potable water rinse, DI water rinse

PURGE INFORMATION

DATE 9/16/92 START TIME 1540 END TIME

INITIAL DEPTH TO WATER 10.17' BTOC WELL DEPTH 14.35' BTOC EST. WELLBORE VOL 3 gal

FINAL DEPTH TO WATER TOTAL VOL. PURGED 9 gall DISCHARGE RATE

METHOD 3'SS Bailer PUMP DEPTH NA.

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	9.7°C	7.41	340 µmhos/cm	Cloudy
3 gal	9.4°C	7.41	375 µmhos/cm	Cloudy
6	8.9°C	7.42	347 µmhos/cm	partly cloudy
9	8.9°C	7.50	350 µmhos/cm	partly cloudy

SAMPLING INFORMATION

DATE 9/16/92 START TIME 16¹⁵ END TIME 17⁰⁰

METHOD 3'SS Bailer

INITIAL DEPTH TO WATER 10.17 BTOC DEPTH TO WATER AFTER SAMPLING 10.17 BTOC

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER 5MW15 FIELD TEAM (INITIALS) KBL/RC

SITE EAFB OU5 JOB NUMBER AUC 3/026.H3.00

FIELD CONDITIONS OVERCAST, 12°F, CALM WINDS, SNOWING

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION 250A	2882	See Cal logs
CONDUCTIVITY METER	YSI 33	1820	↓
THERMOMETER	ORION 250A	2882	
WATER LEVEL INDICATOR	Slope H1543	19566	
BAILER/PUMP	GRUNDFOS MP1	056208	

DECONTAMINATION Same As 5MW02

PURGE INFORMATION

DATE 18-DEC-92 START TIME 1310 END TIME 1320

INITIAL DEPTH TO WATER 9.57 WELL DEPTH 14.45 EST. WELLBORE VOL 2gal

FINAL DEPTH TO WATER 9.56 TOTAL VOL. PURGED 16gal DISCHARGE RATE 8gpm

METHOD GRUNDFOS Pump PUMP DEPTH 12.0'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
1 GAl	1.6°C	7.20	290µmhos	ClEAR
7 GAl	1.9	7.15	312	" "
10 GAl	1.8	7.15	320	" "
13 GAl	1.8	7.17	320	" "
16 Gal	1.8	7.16	318	" "

SAMPLING INFORMATION

DATE 18-Dec-92 START TIME 1345 END TIME 1350

METHOD GRUNFOS MP1

INITIAL DEPTH TO WATER 9.57 DEPTH TO WATER AFTER SAMPLING 9.56

59

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER MW 16A FIELD TEAM (INITIALS) BJ, JG

SITE Elmendorf AFB IRP OU5 JOB NUMBER AK31026.43.60

FIELD CONDITIONS Overcast, 45°F

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION 230A	HAZCO 2017	4.0, 7.05, 10.0 @ 11.6°C
CONDUCTIVITY METER	YSI 33	HAZCO 2170	790 w/1000 7000 w/10,000 @ 12°C
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION Steam Clean, Liquinox WASH, Tap Rinse, DI WASH

PURGE INFORMATION

DATE 8/31/92 START TIME 0900 END TIME 1150

INITIAL DEPTH TO WATER 11.60' BTOC WELL DEPTH 15.30' BTOC EST. WELLBORE VOL 3.37 gal

FINAL DEPTH TO WATER 11.60' TOTAL VOL. PURGED 100 gal DISCHARGE RATE

METHOD Waterra Tube, Surge Block, Peristaltic Pump, Tygon Tube PUMP DEPTH 14'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE	
0 GAL	12.2°C	6.36	490x1	Silty, Grey	ODOR
50 GAL	11.9°C	6.82	450x1	Clear	↓
~~40~~75 GAL	11.8°C	7.03	448x1	Cloudy	
95 GAL	11.7°C	7.06	448x1	Clear	
100 after Sample	11.7°C	7.44	440x1	Cloudy	↓

SAMPLING INFORMATION

DATE 8/31/92 START TIME 1200 END TIME 1210

METHOD Waterra HDPE Tubing Volatile Sample Tube

INITIAL DEPTH TO WATER DEPTH TO WATER AFTER SAMPLING 11.60

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER SMW16A FIELD TEAM (INITIALS) RC/KBL

SITE OU5 JOB NUMBER 403102GH360

FIELD CONDITIONS SNOWING, ~5°F

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION 250A	2882	see cal logs
CONDUCTIVITY METER	YSI 33	1820	
THERMOMETER	ORION 250A	2882	
WATER LEVEL INDICATOR	SLOPE 41543	19366	
BAILER/PUMP	GRUNDFOS MP1	056208	

DECONTAMINATION Same as SMW02

PURGE INFORMATION

DATE START TIME END TIME

INITIAL DEPTH TO WATER 10.83 WELL DEPTH 15.25 EST. WELLBORE VOL. 2gal

FINAL DEPTH TO WATER TOTAL VOL. PURGED DISCHARGE RATE

METHOD PUMP DEPTH

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
<2gal	5.4	7.2	400 mhos	slightly cloudy
5gal	5.6	7.03	390 mhos	slightly cloudy
8gal	5.4	7.04	400 mhos	slightly cloudy
10gal	5.4	7.03	395 mhos	slightly cloudy
15gal	5.4	7.03	395 mhos	slightly cloudy

SAMPLING INFORMATION

DATE 18-Dec-92 START TIME 1450 END TIME 1450

METHOD GRundfos MP1

INITIAL DEPTH TO WATER 10.83 DEPTH TO WATER AFTER SAMPLING 10.8

(37)

GROUNDWATER SAMPLING FIELD DATA SHEET

WELL NUMBER MW 17 FIELD TEAM (INITIALS) BJ, JG

SITE Elmendorf AFB IRP JOB NUMBER ANC31026.H360

FIELD CONDITIONS Rain, 55°F

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORion 230A	Hazco 1875	10.12, 7.01, 4.00 @ 19.9°C
CONDUCTIVITY METER	YSI 33	HAZCO 2170	300 w/1000 umhos 7000 w/10000 @ 19.9°C.
THERMOMETER			
WATER LEVEL INDICATOR Oil/WateR Interface	ORS	HAZCO 1792	
BAILER/PUMP			

DECONTAMINATION

Steam Clean, Liquinox WASH, Tap Rinse, DI Rinse

PURGE INFORMATION

DATE 8/21/92 START TIME 1000 END TIME 1010

INITIAL DEPTH TO WATER 12.10 WELL DEPTH ~~15.00'~~ 13.0' @ 8/21/92 EST. WELLBORE VOL 3.37 gal

FINAL DEPTH TO WATER ____ TOTAL VOL. PURGED ____ DISCHARGE RATE ____

METHOD Watera, HDPE Tubing PUMP DEPTH 14.5'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	9.3°C	6.05	81x10	Cloudy / Grout Color
3.4	8.2°C	6.09	78x10	" "
6.8	7.6°C	6.25	78x10	" "
10.2	7.9°C	6.28	78x10	" "
after Sample	7.8°C	6.61	78x10	" "

SAMPLING INFORMATION

DATE 8/21/92 START TIME 1015 END TIME 1020

METHOD WATERA, HDPE Tube, Volatile Sample Tube

INITIAL DEPTH TO WATER ____ DEPTH TO WATER AFTER SAMPLING ____

(41)

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER MW 30 FIELD TEAM (INITIALS) BT, JG

SITE Elmendorf AFB IRP JOB NUMBER ANC31026.H3.60

FIELD CONDITIONS Overcast 52°F

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			10.1, 7.0/7.0 @ 12°C
CONDUCTIVITY METER	Refer to Page #43		750 w/1000 7500 w/10,000 @ 14°C
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION

PURGE INFORMATION /Developement

DATE 8/25/92 / 8/26/92 START TIME 8/25 1459 / 8/26 0945 END TIME 8/25 1630/1300

INITIAL DEPTH TO WATER 5.69' WELL DEPTH 10.32' BTOC EST. WELLBORE VOL. 6.58 gal

FINAL DEPTH TO WATER 5.66' TOTAL VOL. PURGED 111 GAL DISCHARGE RATE

METHOD Waterra, HDPE Tube, Foot Valve, Surge Block PUMP DEPTH 7'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
20 GAL	14.1°C	6.69	430x1	Brownish Cloudy
8/26 6 GAL	12.2°C	7.12	500x1	Turbid/muddy Brown silty
14 GAL	12.0°C	7.30	425x1	" "
55 GAL	12.0°C	7.33	420x1	Slight Turbid/Sandy
16 GAL	12.4°C	7.43	430x1	Cloudy-Slightly
After Sample	13.0°C	7.38	425x1	" "

SAMPLING INFORMATION

DATE ~~8/25/92~~ 8/26/92 START TIME 1330 END TIME

METHOD Waterra, HDPE Tube, Volatile Sample Tube

INITIAL DEPTH TO WATER DEPTH TO WATER AFTER SAMPLING

(55)

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER MW 31 FIELD TEAM (INITIALS) BT, SG

SITE Elmendorf AFB IRP JOB NUMBER ANC31026.H360

FIELD CONDITIONS Overcast 52°F

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION 230A	HAZCO 2017	4.00, 7.0, 10.01 14.2°C
CONDUCTIVITY METER	YSI 33	HAZCO 2170	780 w/1000 @ 14.2° 7500 w/10,000
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION Steam Clean, Liquinox WASH, Tap Rinse, DI Rinse

PURGE INFORMATION / Developement

DATE 8/28/92 START TIME 1130 END TIME 1315

INITIAL DEPTH TO WATER 4.40' BTOC WELL DEPTH 9.74' BTOC EST. WELLBORE VOL 4.86 gal

FINAL DEPTH TO WATER 4.38' TOTAL VOL. PURGED 150 gal DISCHARGE RATE

METHOD Waterra Tube, Surge Block, Parastoltic Pump PUMP DEPTH 7'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	13.3°C	7.04	330x1	SILTY/BROWN
55	9.8°C	7.11	285x1	Turbid/Brown
110	9.8°C	7.22	290x1	semi/Turbid
150	9.5°C	7.27	290x1	Clear
after Sample	10.3°C	7.21	290x1	Cloudy

SAMPLING INFORMATION

DATE 8/28/92 START TIME 1330 END TIME 1325

METHOD Waterra HDPE Tube, Volatile Sample Tube

INITIAL DEPTH TO WATER DEPTH TO WATER AFTER SAMPLING 4.38'

①

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER SPI-0[illegible] FIELD TEAM (INITIALS) BT, JG

SITE EAFB OU5 JOB NUMBER ANC31026.H3.60

FIELD CONDITIONS Overcast 60°F

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION SA 230A	1875 Hazco	10.02, 4.00, 7.04 at 17.6°C
CONDUCTIVITY METER	YSI 33	2170 Hazco	840 w 1000 mho 8400 w 10,000 @18°C
THERMOMETER			
WATER LEVEL INDICATOR/ Oil water Interface probe	ORS	1792 Hazco	
BAILER/PUMP			

DECONTAMINATION

Steam Clean

PURGE INFORMATION

DATE 8/10/92 START TIME 11:15 END TIME 1200

INITIAL DEPTH TO WATER 8.32 WELL DEPTH 20.0' EST. WELLBORE VOL 13.85 gal

FINAL DEPTH TO WATER — TOTAL VOL. PURGED 43 gal DISCHARGE RATE —

METHOD Waterra & HDPE Tubing PUMP DEPTH 14.0'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE		
0 Gal	10.9°C	6.22	450x1	Cloudy	sheen	odor
13.85 ↓	9.3°C	6.19	410x1	"	"	"
27.70	8.7°C	6.29	402x1	"	"	"
41.55	9.0°C	6.39	409x1	"	"	"
After Sample	9.8°C	6.47		"	"	"

SAMPLING INFORMATION

DATE 8/10/92 START TIME 1200 END TIME 1220

METHOD Watera Pump w/ HDPE Tubing & Volatile Sample Tubes

INITIAL DEPTH TO WATER — DEPTH TO WATER AFTER SAMPLING —

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER SP1-01 FIELD TEAM (INITIALS) KBL

SITE EAFB OU-5 JOB NUMBER

FIELD CONDITIONS OVERCAST, -2°F, WINDS CALM

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION 250A	2882	See Cal logs
CONDUCTIVITY METER	YSI 33	1820	
THERMOMETER	ORION 250A	2882	
WATER LEVEL INDICATOR	Slope 41543	19366	
BAILER/PUMP	Grundfos MP-1	056208	

DECONTAMINATION SAME AS SMW02

PURGE INFORMATION

DATE 12/21/92 START TIME 1150 END TIME 1155

INITIAL DEPTH TO WATER 8.36 WELL DEPTH 23.16 EST. WELLBORE VOL 6 gal

FINAL DEPTH TO WATER 9.33 TOTAL VOL. PURGED 37 DISCHARGE RATE 3 gpm

METHOD Grundfos Pump PUMP DEPTH 19.56*

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
<1 gal	5.8°C	6.52	400 mhos	slightly cloudy
8 gal	5.0°C	6.65	400 mhos	
15 gal	4.9°C	6.73	400 mhos	
18 gal	3.6°C	6.86	400 mhos	
25 gal	3.6°C	6.73	400 mhos	

* TOP of CASING

36 gal 4.6°C 6.92 400 mhos Slightly cloudy

SAMPLING INFORMATION

DATE 20-DEC-92 START TIME 1150 END TIME 1155

METHOD GRUNDFOS MP1

INITIAL DEPTH TO WATER 8.36 DEPTH TO WATER AFTER SAMPLING 9.38

33 gal 4.6°C 6.94 400 mhos slightly cloudy

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER SP1-02 FIELD TEAM (INITIALS) RC/KBL

SITE EAFB OU5 JOB NUMBER

FIELD CONDITIONS SNOWING, ca 10°F, 5 Knot wind N-S

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION 250A	2882	see cal logs
CONDUCTIVITY METER	YSI 33	1820	↓
THERMOMETER	ORION 250A	288L	
WATER LEVEL INDICATOR	SLOPE 41543	19566	
BAILER/PUMP	Soc LOI GRUNDFOS MP1 17 DEC 92	056208	

DECONTAMINATION SAME AS SMW02

PURGE INFORMATION

DATE 12/17/92 START TIME 1540 END TIME 1600

INITIAL DEPTH TO WATER 35.05* WELL DEPTH 49.75* EST. WELLBORE VOL 5.5

FINAL DEPTH TO WATER 35.5* TOTAL VOL. PURGED 25g DISCHARGE RATE ~2gpm

METHOD GRUNDFOS MP1 PUMP DEPTH 36.5 feet*

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
<1gal	3.7°C	7.11	310 mhos	Cloudy
14gal	5.6°C	7.07	220 mhos	very slightly cloudy to clear
20gal	5.5°C	7.12	220 mhos	clear
22gal	5.7°C	7.11	320 mhos	clear
25gal	5.7°C	7.11	320 mhos	clear

* TOP OF CASING

SAMPLING INFORMATION

DATE 17-DEC-92 START TIME 1600 END TIME 1605

METHOD GRUNDFOS VARIABLE & FIELD FILTERS WHERE APPLICABLE

INITIAL DEPTH TO WATER 35.05 DEPTH TO WATER AFTER SAMPLING 35.5

③

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER SP1-02 FIELD TEAM (INITIALS) BT, JG

SITE EAFB OU5 JOB NUMBER ANC31026.H3.60

FIELD CONDITIONS Overcast 60°F

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			
CONDUCTIVITY METER	Refer To Page #1		
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION

PURGE INFORMATION

DATE 8/10/92 START TIME 1500 END TIME 1600

INITIAL DEPTH TO WATER 34.62 WELL DEPTH 50' EST. WELLBORE VOL 17.36 gal

FINAL DEPTH TO WATER / TOTAL VOL. PURGED 58 gal DISCHARGE RATE /

METHOD WATERRA & HDPE Tubing PUMP DEPTH 43'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	10.4°C	6.74	459x1	Turbid
17.36	10.1°C	6.79	422x1	Turbid
34.72	9.9°C	6.83	432x1	Turbid
52.08	9.3°C	6.85	432x1	Turbid
after Sample	10.7°C	6.86	4.42x1	Turbid

SAMPLING INFORMATION

DATE 8/10/92 START TIME 1600 END TIME 1630

METHOD Waterra, HDPE Tubing & Volatile Sample Tubing

INITIAL DEPTH TO WATER / DEPTH TO WATER AFTER SAMPLING /

⑤

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER SP2/6-01 FIELD TEAM (INITIALS) BT, JG

SITE EAFB OU5 JOB NUMBER ANC31026.H3.60

FIELD CONDITIONS OVERCAST, 58°C

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION 230A	HAZCO 1875	10.10, 4.0, 7.0 @17°C
CONDUCTIVITY METER	YSI 33	HAZCO 2170	800 w/8000 umhos @17°C 8,000 w/10,000 umhos
THERMOMETER			
WATER LEVEL INDICATOR Oil/WATER Interface	ORS	HAZCO 1792	
BAILER/PUMP			

DECONTAMINATION Steam Clean, Liquinox WASH, Tap Rinse, DI WATER Rinse

PURGE INFORMATION

DATE 8/12/92 START TIME 1015 END TIME 1115

INITIAL DEPTH TO WATER 40.21' WELL DEPTH 45' BGS EST. WELLBORE VOL. 6.44 gal

FINAL DEPTH TO WATER / TOTAL VOL. PURGED 21.0' DISCHARGE RATE /

METHOD WATERRA + HDPE Tubing PUMP DEPTH 43'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	8.4 °C	6.20	417X1	muddy (Turbid)
6.44	11.1°C	6.56	422X1	Cloudy/Brownish
12.88	8.3°C	6.68	398X1	Slightly Cloudy
19.32	9.1°C	6.74	405X1	" "
after Sample	9.3°C	6.70	410X1	Slightly Cloudy

SAMPLING INFORMATION

DATE 8/12/92 START TIME 1115 END TIME 1150

METHOD WATERRA, HDPE Tubing, Volatile Sample Tube

INITIAL DEPTH TO WATER / DEPTH TO WATER AFTER SAMPLING /

(7)

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER SP2/6-02 FIELD TEAM (INITIALS) BT, JG

SITE EAFB OUS JOB NUMBER ANC 31026.H3.60

FIELD CONDITIONS Overcast, 60°F

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			
CONDUCTIVITY METER	Refer to Page #5		
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION

PURGE INFORMATION

DATE 8/11/92 START TIME 1400 END TIME 1445

INITIAL DEPTH TO WATER 31.97 WELL DEPTH 45' EST. WELLBORE VOL. 9.71

FINAL DEPTH TO WATER ______ TOTAL VOL. PURGED ______ DISCHARGE RATE ______

METHOD Waterra + HDPE Tubing PUMP DEPTH ______

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	12.3°C	7.04	410X1	Turbid
9.7	8.7°C	6.99	392x1	"
19.4	9.0°C	6.95	398X1	"
29.1	9.2°C	7.03	400X1	"
after Sample	11.4°C	7.00	425X1	"

SAMPLING INFORMATION

DATE 8/11/92 START TIME 1450 END TIME 1500

METHOD Waterra, HDPE Tubing, Volatile Sampling Tube

INITIAL DEPTH TO WATER ______ DEPTH TO WATER AFTER SAMPLING ______

(21)

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER SP2/6-03 FIELD TEAM (INITIALS) BT, JG

SITE EAFB OU5 JOB NUMBER ANC31026.H3.60

FIELD CONDITIONS Sunny 62°F

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			
CONDUCTIVITY METER	Refer TO Page # 17		
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION

PURGE INFORMATION

DATE 8/13/92 START TIME 1530 END TIME 1625

INITIAL DEPTH TO WATER 37.23' WELL DEPTH 50' EST. WELLBORE VOL 13.79

FINAL DEPTH TO WATER ____ TOTAL VOL. PURGED ____ DISCHARGE RATE ____

METHOD WATERA, HDPE Tube PUMP DEPTH 43'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	13.5°C	6.58	153 x 10	Orange & Muddy
13.79 GAL	9.2°C	6.77	68 X 10	Sandy/muddy
27.58 GAL	9.0°C	6.84	90 X 10	" "
41.37 GAL	8.5°C	6.87	70 X 10	Greyish/Brown Turbidity
55.0 GAL	9.3°C	7.18	70 X 10	" " "
60.0 GAL	8.5°C	7.18	80 X 10	" " "
after Sample	8.8°C	7.09	110 X 10	" " "

SAMPLING INFORMATION

DATE 8/13/92 START TIME 1630 END TIME 1635

METHOD Watera, HDPE Tubing, Volatile Sample Tubes

INITIAL DEPTH TO WATER ____ DEPTH TO WATER AFTER SAMPLING ____

(19)

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER SP2/6-04 FIELD TEAM (INITIALS) BT, JG

SITE EAFB OU5 JOB NUMBER AMC31026 H360

FIELD CONDITIONS Sunny 60°F

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			
CONDUCTIVITY METER	Refer	To	
THERMOMETER		Page	
WATER LEVEL INDICATOR		#17	
BAILER/PUMP			

DECONTAMINATION

PURGE INFORMATION

DATE 8/13/92 START TIME 1330 END TIME 1410

INITIAL DEPTH TO WATER 37.90 WELL DEPTH 50' EST. WELLBORE VOL ~~6.67~~ 8/13/92 13.27

FINAL DEPTH TO WATER ___ TOTAL VOL. PURGED 42 gal DISCHARGE RATE —

METHOD Waterra, HDPE Tubing PUMP DEPTH ~~38~~ 8/13/92 44'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	10.2°C	6.63	380X1	Orangish/Brown
~~18.79~~ 13.27	7.9°C	6.78	365X1	Brownish/Turbid
~~37.58~~ 26.54	8.4°C	6.62	350X1	Greyish/Turbid
~~56.37~~ 39.81	7.5°C	6.58	355X1	" "
after Sample	7.5°C	6.38	355X1	Cloudy

8/13/92

SAMPLING INFORMATION

DATE 8/13/92 START TIME 1420 END TIME 1425

METHOD WATERRA, HDPE Tubing, Volatile Sample Tube

INITIAL DEPTH TO WATER — DEPTH TO WATER AFTER SAMPLING —

⑬

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER SP2/6-05 FIELD TEAM (INITIALS) BT, JG

SITE EAFB OU5 JOB NUMBER AM 31026 H360

FIELD CONDITIONS Overcast, Rain, 58°F

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORion 230A	HAZCO 1875	10.10, 4.0, 7.0 @ 17.3°C
CONDUCTIVITY METER	YSI 33	HAZCO 2170	850 w/1000 umhos [illegible] 8000 w/10,000 umhos
THERMOMETER			
WATER LEVEL INDICATOR/ Oil/water Interface	ORS	HAZCO 1792	
BAILER/PUMP			

DECONTAMINATION Steam Clean, Liquinox WASH, Tap Rinse DI WATER Rinse

PURGE INFORMATION

DATE 8/12/92 START TIME 1020 END TIME 1115

INITIAL DEPTH TO WATER 32.16' WELL DEPTH 46' EST. WELLBORE VOL. 15.07

FINAL DEPTH TO WATER — TOTAL VOL. PURGED 48gal DISCHARGE RATE —

METHOD WATERA, HDPE Tubing PUMP DEPTH 40'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	8.4°C	6.24	422x1	Muddy, Sheen, ODOR
15.7	7.6°C	6.37	395 x1	Muddy, Sheen, Odor
31.4	7.3°C	6.58	395 x1	Cloudy, Sheen, Odor
46.1	7.4°C	6.66	390x1	Cloudy, ODOR, Grayish
after Sample	8.4°C	6.74	398x1	" , " , "

SAMPLING INFORMATION

DATE 8/12/92 START TIME 1120 END TIME 1125

METHOD Waterra, HDPE Tubing, VOLATILE Sample Tubes

INITIAL DEPTH TO WATER — DEPTH TO WATER AFTER SAMPLING —

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER W-16 FIELD TEAM (INITIALS) BT, JG

SITE OUS EAFB JOB NUMBER ANC31026H3.60

FIELD CONDITIONS Rain, Overcast, 60°F

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			
CONDUCTIVITY METER			
THERMOMETER	Refer To		
WATER LEVEL INDICATOR		Page #	13
BAILER/PUMP			

DECONTAMINATION

PURGE INFORMATION

DATE 8/12/92 START TIME 1515 END TIME 1640

INITIAL DEPTH TO WATER 31.63' WELL DEPTH 56' EST. WELLBORE VOL 23.4

FINAL DEPTH TO WATER — TOTAL VOL. PURGED 72gal DISCHARGE RATE

METHOD WATERA, HDPE Tubing PUMP DEPTH 46'

VOLUME PURGED	TEMPERATURE °C	pH	CONDUCTIVITY	APPEARANCE
0 GAL	10.8°c	6.77	420x1	Cloudy, Floaters
23.4	8.9°C.	6.94	390x1	Silty/Greyish
46.9	8.0°c	6.99	385x1	Silty/Grey
70.2	8.2°c	7.02	392X1	" / "
after sample	8.9°C	7.11	390x1	Greyish/Cloudy

SAMPLING INFORMATION

DATE 8/12/92 START TIME 1650 END TIME 1700

METHOD Watera, HDPE Tubing, Volatile Sample Tube

INITIAL DEPTH TO WATER DEPTH TO WATER AFTER SAMPLING —

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER GW-6A FIELD TEAM (INITIALS) BT, JG

SITE EAFB OU5 JOB NUMBER Ane 31026.H3.60

FIELD CONDITIONS Sunny 60°F

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION 230A	Hazco 1875	10.12, 4.0, 7.02 @15.3°C
CONDUCTIVITY METER	YSI 33	Hazco 2170	800 w/1000umhos @15.3°C 8000 w/10,000 umhos
THERMOMETER			
WATER LEVEL INDICATOR OIL/WATER Interface	OKS	1792 Hazco	
BAILER/PUMP			

DECONTAMINATION Steam Clean, Liquinox WASH, Tap Rinse, DI Rinse

PURGE INFORMATION

DATE 8/13/92 START TIME 1120 END TIME 1155

INITIAL DEPTH TO WATER 31.23 WELL DEPTH 40' EST. WELLBORE VOL.

FINAL DEPTH TO WATER — TOTAL VOL. PURGED 30 gal DISCHARGE RATE

METHOD WATERRA, HDPE Tubing PUMP DEPTH 38'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	10.7°C	6.42	430×1	Brown, Muddy, Sheen, Odor
9.69	8.2°C	6.58	392×1	Brown, Muddy, Sheen, Odor
19.38	8.1°C	6.66	395×1	" " " "
28.17	7.6°C	6.69	390×1	" " " "
After Sample	7.9°C	6.73	390×1	" " " "

SAMPLING INFORMATION

DATE 8/13/92 START TIME 1200 END TIME 1215

METHOD Waterra, HDPE Tubing, Volatile Sampling Tube

INITIAL DEPTH TO WATER DEPTH TO WATER AFTER SAMPLING

21

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER SP4-01 FIELD TEAM (INITIALS) BT, JG

SITE Elmendorf AFB IRP JOB NUMBER ANC 31026-H3.60

FIELD CONDITIONS Dusty (ASH) Overcast, Calm, 55°F

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION 230A	HAZCO 1875	10.13, 4.0, 7.0 @ 14.8°C
CONDUCTIVITY METER	YSI 33	HAZCO 2170	990 w/1000 µmhos 9900/w/10,000 @ 14.8°C
THERMOMETER			
WATER LEVEL INDICATOR / OIL/WATER Interface	ORS	HAZCO 1792	
BAILER/PUMP			

DECONTAMINATION Steam Clean, Liquinox Wash, Tap Rinse DI WATER Rinse

PURGE INFORMATION

DATE 8/20/92 START TIME 0945 END TIME 1045

INITIAL DEPTH TO WATER 5.39' WELL DEPTH 24' EST. WELLBORE VOL 19.27ga

FINAL DEPTH TO WATER ______ TOTAL VOL. PURGED 59gal DISCHARGE RATE ______

METHOD Waterra, HDPE Tubing PUMP DEPTH 18'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	9.2°C	5.88	315X1	Clear
19.27	7.6°C	6.02	290X1	Brownish/Cloudy
38.54	7.7°C	6.34	290X1	" "
57.81	8.4°C	6.45	295X1	" "
after Sample	8.1°C	6.74	295X1	" "

SAMPLING INFORMATION

DATE 8/20/92 START TIME 1045 END TIME 1050

METHOD Waterra, HDPE Tubing, Volatile Sampling Tube

INITIAL DEPTH TO WATER ______ DEPTH TO WATER AFTER SAMPLING ______

Q 8/17/92

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER SP4/M-03 FIELD TEAM (INITIALS) BT, JG

SITE E.AFB OU5 JOB NUMBER ANC 31.X.H3.CC

FIELD CONDITIONS

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION 230A	HAZCO 1875	10.14, 4.0, 6.95 @ 12.4°C
CONDUCTIVITY METER	YSI 33	HAZCO 2178	750 = 1000 umhos 750 = 1000 @ 12.5°C.
THERMOMETER			
WATER LEVEL INDICATOR / oil/water Interface	ORS	HAZCO 1792	
BAILER/PUMP			

DECONTAMINATION Steam Clean, Liquinox wash, Tap Rinse DI Water Rinse

PURGE INFORMATION

DATE 8/17/92 START TIME 0915 END TIME 0945

INITIAL DEPTH TO WATER 5.80' WELL DEPTH 34' EST. WELLBORE VOL 19.27 gal

FINAL DEPTH TO WATER ______ TOTAL VOL. PURGED 58 gal DISCHARGE RATE —

METHOD WATERRA, HDPE Tube PUMP DEPTH 15'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	9.3°C	6.64	265x1	Clear
19.27	6.1°C	6.51	248x1	Brownish/Turbid
38.54	6.5°C	6.67	240x1	" / semi-Turbid
57.81	6.4°C	6.72	240x1	" / "
After Sample	6.5°C	6.90	245x1	" / "

SAMPLING INFORMATION

DATE 8/ /92 START TIME 1000 END TIME 1005

METHOD WATERRA, HDPE Tube, Volatile Sample Tube

INITIAL DEPTH TO WATER — DEPTH TO WATER AFTER SAMPLING —

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER SP4-03 FIELD TEAM (INITIALS) BT, JG

SITE Elmendorf AFB IRP JOB NUMBER Anc31026.H360

FIELD CONDITIONS Overcast, 58°F

FIELD MEASUREMENT/ COLLECTION EQUIP.

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			
CONDUCTIVITY METER			
THERMOMETER	Refer To	Page #39	
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION

PURGE INFORMATION

DATE 8/24/92 START TIME 1530 END TIME 1625

INITIAL DEPTH TO WATER 39.38' WELL DEPTH 55' EST. WELLBORE VOL 16.56

FINAL DEPTH TO WATER ______ TOTAL VOL. PURGED 50' DISCHARGE RATE 1gpm

METHOD Watera, HDPE Tube PUMP DEPTH 50'

VOLUME PURGED		TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0	GAL	12.1°C	7.51	375x1	Clear/suspended Blue mat.
16.56	GAL	7.5°C	7.51	350x1	Brown murky/Turbid
33	"	7.4°C	7.34	360	medium brown cloudy
50	"	7.4°C	7.23	350	medium to dark brown Turbid

SAMPLING INFORMATION

DATE 8/24/92 START TIME 1630 END TIME 1645

METHOD Watera, HDPE Tube, Foot Valve, Valatile Smple Tube

INITIAL DEPTH TO WATER ______ DEPTH TO WATER AFTER SAMPLING ______

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER GW4A FIELD TEAM (INITIALS) BT, RC

SITE Elmendorf AFB JOB NUMBER ANC31026.H3.60

FIELD CONDITIONS Rain, 45°F, Breezy

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			
CONDUCTIVITY METER	Refer to Page 73		
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION

PURGE INFORMATION

DATE 9/17/~~88~~92 START TIME 1645 END TIME 1710

INITIAL DEPTH TO WATER 4.11 * WELL DEPTH 12.25 EST. WELLBORE VOL. ~~[illegible]~~ 6 gal

FINAL DEPTH TO WATER ______ TOTAL VOL. PURGED 19 GAL DISCHARGE RATE ______

METHOD 3'SS Bailer PUMP DEPTH ______

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	6.9° C	7.06	210 umho	CLOUDY/ODOR w/SHEEN
6.2	6.9°C	7.07	210 umho	same
12.4	6.7°C	7.11	220 umho	same
18.6	6.2°C	7.20	220 umho	same

* MEASURED INCLUDING STICKUP

SAMPLING INFORMATION

DATE 9/17/~~88~~92 START TIME 1715 END TIME 1725

METHOD 3'SS Bailer

INITIAL DEPTH TO WATER ______ DEPTH TO WATER AFTER SAMPLING ______

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER W-14 FIELD TEAM (INITIALS) BT, WW

SITE Elmendorf AFB IRP OU5 JOB NUMBER ANC31026.H360

FIELD CONDITIONS Raining, upper 40's

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION 250A	2882	4.00, 7.01, 10.0 @ 21.5°C
CONDUCTIVITY METER	YSI 33	1668	960 w/1000 umhos @ 21.5°C
THERMOMETER			
WATER LEVEL INDICATOR	Solinst	CH2M Hill No. 1673	NA
BAILER/PUMP			

DECONTAMINATION Liquinox, Tap, Distilled Rinse Twice

PURGE INFORMATION

DATE 9/18/92 START TIME 0930 END TIME 1015

INITIAL DEPTH TO WATER 3.25 BTOC WELL DEPTH 23.0' BTOC EST. WELLBORE VOL 14.5 GAL

FINAL DEPTH TO WATER ______ TOTAL VOL. PURGED 44 gal DISCHARGE RATE NA

METHOD HDPE Tube, Foot Valve PUMP DEPTH ~~NA~~ approx 10' BTOC

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	6.4°C	~~6.44~~ 7.01	215X1	Clear
14.5	5.1°C	7.61	210x1	dirty (dark brown)
29.0	5.2°C	7.59	222X1	Turbid, Brown
43.5	5.1°C	7.61	[illegible]03x1	Turbid, Light brown

SAMPLING INFORMATION

DATE 9/18/92 START TIME 1020 END TIME 1040

METHOD 3' SS Bailer

INITIAL DEPTH TO WATER 3.25' BTOC DEPTH TO WATER AFTER SAMPLING 3.25 BTOC

(31)

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER NS3-02 FIELD TEAM (INITIALS) BT, JG

SITE Elmendorf AFB IRP JOB NUMBER ANC31026.H360

FIELD CONDITIONS ashy, overcast, 55°F

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			
CONDUCTIVITY METER	Refer To	Page # 29	
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION

PURGE INFORMATION

DATE 8/20/92 START TIME 1230 END TIME 1300

INITIAL DEPTH TO WATER 5.24' WELL DEPTH 24' EST. WELLBORE VOL 19.5gal

FINAL DEPTH TO WATER ____ TOTAL VOL. PURGED 59gal DISCHARGE RATE ____

METHOD Watera, HDPE Tubing PUMP DEPTH 15'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	10.5°C	6.74	287X1	Cloudy / Sandy
19.5	8.8°C	6.71	275X1	Turbid / Brownish
39.0	8.4°C	6.74	275X1	" "
57.5	8.4	6.84	275X1	" "
After Sample	9.3°C	6.78	280X1	" "

SAMPLING INFORMATION

DATE 8/20/92 START TIME 1300 END TIME 1310

METHOD watera, HDPE Tubing, Volatile Sample Tube

INITIAL DEPTH TO WATER ____ DEPTH TO WATER AFTER SAMPLING ____

(33)

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER NS3-03 FIELD TEAM (INITIALS) BT, JG

SITE Elmendorf AFB IRP JOB NUMBER ANC31026.1H800

FIELD CONDITIONS Partly Cloudy, Ashy, 60°F

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			
CONDUCTIVITY METER	Refer To Page # 29		
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION

PURGE INFORMATION

DATE 8/20/92 START TIME 1510 END TIME 1530

INITIAL DEPTH TO WATER 4.02' WELL DEPTH 14' EST. WELLBORE VOL 11.8gal

FINAL DEPTH TO WATER ______ TOTAL VOL. PURGED 40gal DISCHARGE RATE ______

METHOD Watera, HDPE Tubing PUMP DEPTH 10'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	10.2°C	6.81	460x1	Muddy/Turbid/Brownish
11.8	9.3°C	6.86	435x1	" " "
23.6	9.4°C	6.91	435x1	" " "
35.4	9.1°C	6.91	435x1	Slightly Turbid / Brownish
after Sample	9.5°C	7.16	438x1	Slightly Cloudy

SAMPLING INFORMATION

DATE 8/20/92 START TIME 1530 END TIME 154

METHOD Watera, HDPE Tubing, Volatile Sample Tube

INITIAL DEPTH TO WATER ______ DEPTH TO WATER AFTER SAMPLING ______

㉓

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER NS3-06 FIELD TEAM (INITIALS) BT, JG

SITE EAFB OU5 JOB NUMBER ANC31026.H3.60

FIELD CONDITIONS OVERCAST, 48°F

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION 230A	HAZCO 1875	10.12, 4.0, 7.01 @ 15.3°C
CONDUCTIVITY METER	YSI 33	HAZCO 2170	800 w/1000 umhos 7900 w/10,000 @ 15.3°C
THERMOMETER			
WATER LEVEL INDICATOR Oil/Water Interface	ORS	HAZCO 1792	
BAILER/PUMP			

DECONTAMINATION Steam Clean, Liquinox WASH, Tap Rinse DI Rinse

PURGE INFORMATION

DATE 8/14/92 START TIME 0840 END TIME 1015

INITIAL DEPTH TO WATER 28.01' WELL DEPTH 48' EST. WELLBORE VOL 17.63 gal

FINAL DEPTH TO WATER — TOTAL VOL. PURGED 54 GAL DISCHARGE RATE —

METHOD 2" SS Bailer PUMP DEPTH 3'

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
0 GAL	7.5°C	6.07	480 x 1	MUDDY
17.63	7.6°C	6.39	475 x 1	MUDDY
35.26	7.7°C	6.62	480 x 1	MUDDY
52.89	8.1°C	6.71	485 x 1	MUDDY
After Sample	8.4°C	6.78	500 x 1	"

SAMPLING INFORMATION

DATE 8/14/92 START TIME 1030 END TIME 1040

METHOD SS Bailer

INITIAL DEPTH TO WATER DEPTH TO WATER AFTER SAMPLING

(6)

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER 5WS01 FIELD TEAM (INITIALS) WWW MLP

SITE I.G.M. 2433 Post Road JOB NUMBER ANC 31026.413.60

FIELD CONDITIONS Well water sampling at sink in Bathroom

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			
CONDUCTIVITY METER			
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

9-1-92

DECONTAMINATION Bottles filled directly from faucet.

PURGE INFORMATION

DATE 9-1-92 START TIME 09 35 END TIME 0940

INITIAL DEPTH TO WATER NA WELL DEPTH NA EST. WELLBORE VOL NA

FINAL DEPTH TO WATER NA TOTAL VOL. PURGED ____ DISCHARGE RATE 1 gallon/10 sec.

METHOD open cold water faucet full. measured discharge rate with 1 gallon bucket PUMP DEPTH unknown

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE

1 SEPT 92

SAMPLING INFORMATION

DATE 1 SEPT 92 START TIME 09 35 END TIME 09 55

METHOD direct fill into sample conta er

INITIAL DEPTH TO WATER NA DEPTH TO WATER AFTER SAMPLING NA

63

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER 5WS02 FIELD TEAM (INITIALS) WWW, MLP

SITE INLET COMPANY JOB NUMBER ANC 31026.143.60

FIELD CONDITIONS Filled directly from faucet in bathroom

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			
CONDUCTIVITY METER			
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

SSS 1 SEPT 92

DECONTAMINATION Bottles filled directly from faucet

PURGE INFORMATION

DATE 1 SEPT 92 START TIME 1025 END TIME 10^{33}

INITIAL DEPTH TO WATER N/A WELL DEPTH unknown ~~NA~~ WW 1 SEPT 92 EST. WELLBORE VOL. ____

FINAL DEPTH TO WATER NA TOTAL VOL. PURGED ____ DISCHARGE RATE 1 gallon/22 sec

METHOD open cold water full in bathroom sink PUMP DEPTH unknown

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
				Clear

SSS 1 SEPT 92

SAMPLING INFORMATION

DATE 1 SEPT 92 START TIME 10^{33} END TIME ____

METHOD directly filled bottles from bathroom sink

INITIAL DEPTH TO WATER NA DEPTH TO WATER AFTER SAMPLING NA

75

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER 3W2 FIELD TEAM (INITIALS) BT, RC

SITE Elmendorf AFB JOB NUMBER ANC31026.H360

FIELD CONDITIONS Rain, 45°F, Volcanic ash

FIELD MEASUREMENT/ COLLECTION EQUIP.	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER			
CONDUCTIVITY METER	Refer To	Page # 73	
THERMOMETER			
WATER LEVEL INDICATOR			
BAILER/PUMP			

DECONTAMINATION

PURGE INFORMATION / START up

DATE 9/17/92 START TIME 1545 END TIME 1600

INITIAL DEPTH TO WATER ? WELL DEPTH 800'? EST. WELLBORE VOL. ?

FINAL DEPTH TO WATER TOTAL VOL. PURGED 12,000 DISCHARGE RATE 800gpm

METHOD Turbine Pump PUMP DEPTH

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
12,000 gAL	5.1°C	8.01	130 umho	Clear

SAMPLING INFORMATION

DATE 9/17/92 START TIME 1605 END TIME

METHOD Spigot & Tygon Tube

INITIAL DEPTH TO WATER DEPTH TO WATER AFTER SAMPLING

GROUNDWATER SAMPLING
FIELD DATA SHEET

WELL NUMBER BW-52 FIELD TEAM (INITIALS) BT, RC

SITE Elmendorf AFB JOB NUMBER ANC31026.H3.60

FIELD CONDITIONS Rain, 45°F, Volcanic ASH

FIELD MEASUREMENT/ COLLECTION EQUIP.

	MAKE/MODEL	SERIAL/ID NO.	CALIBRATION/ COMMENTS
pH METER	ORION 250A	002151	4.00 ~~and~~ 7.02 @ 17.9°C
CONDUCTIVITY METER	YSI Model 33	K8010848	900 w/1000 umhos @ 18°C
THERMOMETER			
WATER LEVEL INDICATOR	Slope Model 5143	19566	
BAILER/PUMP			

DECONTAMINATION

Liquinox, Tap, DI Rinse Twice

PURGE INFORMATION

Runs on Demand

DATE 9/17/92 START TIME 1445 END TIME 1500

INITIAL DEPTH TO WATER ______ WELL DEPTH ______ EST. WELLBORE VOL 100 gal

FINAL DEPTH TO WATER ______ TOTAL VOL. PURGED 150 gal DISCHARGE RATE 10 GPM

METHOD Spigot @ ~~Tygon Tube~~, Hose PUMP DEPTH ______

VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	APPEARANCE
100 GAL	5.8°C	8.29	168x1	Clear

SAMPLING INFORMATION

DATE 9/17/92 START TIME 1515 END TIME ______

METHOD Spigot & Tygon Tubing

INITIAL DEPTH TO WATER ______ DEPTH TO WATER AFTER SAMPLING ______

Appendix E

WATER LEVEL MONITORING DATA

Groundwater Elevations and Estimated Hydraulic Conductivities

Station	Date	Time	Depth to Water (ft)	Top of PVC Casing Elevation (ft)	Groundwater Elevation (ft)	Top of Steel Casing Elevation (ft)	Ground Surface Elevation (ft)	Estimated Hydraulic Conductivity (ft/min)	Estimated Hydraulic Conductivit (cm/sec)
GW 4A	8/5/92	1510	6.6	134.79	128.19	135.32	132.9		
GW 4A	8/27/92	1842	6.46	134.79	128.33	135.32	132.9		
GW 4A	9/25/92	1500	4	134.79	130.79	135.32	132.9		
GW 4A	10/29/92	1059	3.935	134.79	130.855	135.32	132.9		
GW 6A	8/5/92	1410	31.2	137.62	106.42	137.74	135.6		
GW 6A	8/27/92	1720	31.26	137.62	106.36	137.74	135.6		
GW 6A	9/25/92	1602	31.06	137.62	106.56	137.74	135.6		
GW 6A	8/5/92	1610	31.075	137.62	106.545	137.74	135.6		
NS3-02	8/5/92	1800	5.02	117.98	112.96	118.44	115.3		
NS3-02	8/27/92	1625	5.21	117.98	112.77	118.44	115.3		
NS3-02	9/25/92	1506	5.33	117.98	112.65	118.44	115.3		
NS3-02	10/29/92	1310	5.47	117.98	112.51	118.44	115.3		
NS3-03	8/5/92	1450	3.82	109.13	105.31	109.17	106.2		
NS3-03	8/28/92	845	3.97	109.13	105.16	109.17	106.2		
NS3-03	9/25/92	1512	4.01	109.13	105.12	109.17	106.2		
NS3-03	10/30/92	1109	4.14	109.13	104.99	109.17	106.2		
NS3-06	8/6/92	800	27.92	NS		146.84	152		
NS3-06	8/28/92	815	28.02	NS		146.84	152		
NS3-06	9/25/92	1530	27.9	NS		146.84	152		
NS3-06	10/30/92	NM	NM	NM		146.84	152		
OU5MW-01	8/27/92	1735	36.5	136.41	99.91	136.82	134.1	0.05	0.025
OU5MW-01	9/25/92	1536	36.77	136.41	99.64	136.82	134.1		
OU5MW-01	10/28/92	1523	36.89	136.41	99.52	136.82	134.1		
OU5MW-02	8/28/92	900	33.36	140.95	107.59	141.67	139.2		
OU5MW-02	9/25/92	1610	33.06	140.95	107.89	141.67	139.2		
OU5MW-02	10/28/92	1203	33.165	140.95	107.785	141.67	139.2		
OU5MW-03	8/27/92	1720	33.33	147.58	114.25	148.11	145.7	0.032	0.016
OU5MW-03	9/25/92	1612	33.02	147.58	114.56	148.11	145.7		
OU5MW-03	10/28/92	1337	33.07	147.58	114.51	148.11	145.7		
OU4MW-04	8/28/92	905	32.38	157.09	124.71	157.46	154.8		
OU4MW-04	9/25/92	1621	32.51	157.09	124.58	157.46	154.8		
OU4MW-04	10/28/92	1457	32.51	157.09	124.58	157.46	154.8		

Groundwater Elevations and Estimated Hydraulic Conductivities

OU5MW-05	9/25/92	1624	25.3	157.29	131.99	157.82	155.3	0.037	0.019
OU5MW-05	10/30/92	1225	25.335	157.29	131.955	157.82	155.3		
OU5MW-06	8/28/92	920	35.86	173.99	138.13	174.54	172.4		
OU5MW-06	9/25/92	1521	35.73	173.99	138.26	174.54	172.4		
OU5MW-06	10/30/92	1325	35.81	173.99	138.18	174.54	172.4		
OU5MW-07	8/28/92	915	34.19	179.42	145.23	179.97	177.4		
OU5MW-07	9/25/92	1515	34.08	179.42	145.34	179.97	177.4		
OU5MW-07	10/30/92	1405	34.25	179.42	145.17	179.97	177.4		
OU5MW-08	8/27/92	1631	16.16	153.5	137.34	153.88	151.1	0.045	0.023
OU5MW-08	9/25/92	1455	16.1	153.5	137.4	153.88	151.1		
OU5MW-08	10/29/92	947	16.14	153.5	137.36	153.88	151.1		
OU5MW-09	8/27/92	1520	3.74	113.02	109.28	113.62	111		
OU5MW-09	9/25/92	1510	3.81	113.02	109.21	113.62	111		
OU5MW-09	10/29/92	1330	3.92	113.02	109.1	113.62	111		
OU5MW-10	8/27/92	1445	2.89	105.25	102.36	106.08	103.5	0.068	0.035
OU5MW-10	9/25/92	1450	2.97	105.25	102.28	106.08	103.5		
OU5MW-10	10/29/92	1349	3.05	105.25	102.2	106.08	103.5		
OU5MW-11	8/28/92	935	38.24	152.95	114.71	153.5	151.9		
OU5MW-11	9/25/92	1617	37.99	152.95	114.96	153.5	151.9		
OU5MW-11	10/28/92	1415	38.01	152.95	114.94	153.5	151.9		
OU5MW-12	8/27/92	1623	8.4	96.01	87.61	96.89	94.1	0.076	0.039
OU5MW-12	9/25/92	1445	7.94	96.01	88.07	96.89	94.1		
OU5MW-12	10/28/92	1504	8.49	96.01	87.52	96.89	94.1		
OU5MW-13	8/27/92	1619	3.68	90.81	87.13	91.39	88.6	0.062	0.032
OU5MW-13	9/25/92	1437	3.61	90.81	87.2	91.39	88.6		
OU5MW-13	10/28/92	1514	4.38	90.81	86.43	91.39	88.6		
OU5MW-14	8/27/92	1615	10.28	84.97	74.69	85.52	83	0.258	0.131
OU5MW-14	9/25/92	1435	10.2	84.97	74.77	85.52	83		
OU5MW-14	10/28/92	1529	10.11	84.97	74.86	85.52	83		
OU5MW-15	8/27/92	1603	10.4	81.56	71.16	82	79.6	0.042	0.021
OU5MW-15	9/25/92	1425	10.07	81.56	71.49	82	79.6		
OU5MW-15	10/29/92	1620	9.87	81.56	71.69	82	79.6		
OU5MW-16	8/27/92	1558	11.64	77.29	65.65	77.98	75.4	0.005	0.003

Groundwater Elevations and Estimated Hydraulic Conductivities

OU5MW-16	9/25/92	1427	11.25	77.29	66.04	77.98	75.4		
OU5MW-16	10/29/92	1613	10.8	77.29	66.49	77.98	75.4		
OU5MW-17	8/27/92	1610	11.98	65.99	54.01	66.38	63.1		
OU5MW-17	9/25/92	1430	11.56	65.99	54.43	66.38	63.1		
OU5MW-17	10/29/92	1600	11.7	65.99	54.29	66.38	63.1		
OU5MW-30	8/27/92	1530	5.71	117.29	111.58	117.6	114.7		
OU5MW-30	9/25/92	1508	5.75	117.29	111.54	117.6	114.7		
OU5MW-30	10/29/92	1320	5.74	117.29	111.55	117.6	114.7		
OU5MW-31	8/27/92	1535	4.39	125.16	120.77	125.73	123.5	0.022	0.011
OU5MW-31	9/25/92	1504	4.44	125.16	120.72	125.73	123.5		
OU5MW-31	10/29/92	1420	4.45	125.16	120.71	125.73	123.5		
SP1-01	8/5/92	1325	8.22	97.91	89.69	98.2	94.8		
SP1-01	8/27/92	1645	8.59	97.91	89.32	98.2	94.8		
SP1-01	9/25/92	1552	8.47	97.91	89.44	98.2	94.8		
SP1-01	10/28/92	1110	8.405	97.91	89.505	98.2	94.8		
SP1-02	8/5/92	1335	34.56	135.55	100.99	135.9	132.5		
SP1-02	8/27/92	1655	35.66	135.55	99.89	135.9	132.5		
SP1-02	9/25/92	1555	35.14	135.55	100.41	135.9	132.5		
SP1-02	10/28/92	1015	35.75	135.55	99.8	135.9	132.5		
SP2/6-01	8/5/92	1405	40.17	152.75	112.58	153.05	150.4		
SP2/6-01	8/27/92	1700	40.28	152.75	112.47	153.05	150.4		
SP2/6-01	9/25/92	1615	40.01	152.75	112.74	153.05	150.4		
SP2/6-01	10/28/92	1433	40.04	152.75	112.71	153.05	150.4		
SP2/6-02	8/5/92	1420	31.92	144.19	112.27	144.31	141.3		
SP2/6-02	8/27/92	1740	32.02	144.19	112.17	144.31	141.3		
SP2/6-02	9/25/92	1607	31.78	144.19	112.41	144.31	141.3		
SP2/6-02	10/30/92	1023	31.81	144.19	112.38	144.31	141.3		
SP2/6-03	8/5/92	1440	37.2	141.63	104.43	141.85	139.1		
SP2/6-03	8/27/92	1730	37.54	141.63	104.09	141.85	139.1		
SP2/6-03	9/25/92	1605	37.08	141.63	104.55	141.85	139.1		
SP2/6-03	10/30/92	1053	37.08	141.63	104.55	141.85	139.1		
SP2/6-04	8/5/92	1415	37.85	140.44	102.59	140.49	137.9		
SP2/6-04	8/27/92	1725	37.83	140.44	102.61	140.49	137.9		
SP2/6-04	9/25/92	1603	37.82	140.44	102.62	140.49	137.9		
SP2/6-04	10/28/92	1038	37.8	140.44	102.64	140.49	137.9		

Groundwater Elevations and Estimated Hydraulic Conductivities

SP2/6-05	8/5/92	1350	32.14	135.81	103.67	136.03	133.1
SP2/6-05	8/27/92	1710	32.12	135.81	103.69	136.03	133.1
SP2/6-05	9/25/92	1558	32.02	135.81	103.79	136.03	133.1
SP2/6-05	10/28/92	1553	29.995	135.81	105.815	136.03	133.1
SP4-02	8/5/92	1530	5.84	128.13	122.29	128.45	125.3
SP4-02	9/25/92	1503	5.8	128.13	122.33	128.45	125.3
SP4-02	10/28/92	1210	5.8	128.13	122.33	128.45	125.3
SP4/11-01	8/5/92	1505	5.45	134.3	128.85	134.58	131.3
SP4/11-01	8/27/92	1634	5.34	134.3	128.96	134.58	131.3
SP4/11-01	9/25/92	1502	5.28	134.3	129.02	134.58	131.3
SP4/11-01	10/28/92	1144	5.245	134.3	129.055	134.58	131.3
SP4/11-03	8/5/92	1545	39.4	171.06	131.66	171.65	168.5
SP4/11-03	8/27/92	825	39.38	171.06	131.68	171.65	168.5
SP4/11-03	9/25/92	1525	39.27	171.06	131.79	171.65	168.5
SP4/11-03	10/28/92	1304	39.295	171.06	131.765	171.65	168.5
W-14	8/5/92	1520	3.52	135.16	131.64	135.35	133.7
W-14	8/27/92	1640	3.38	135.16	131.78	135.35	133.7
W-14	9/25/92	1457	3.19	135.16	131.97	135.35	133.7
W-14	10/29/92	1107	3.09	135.16	132.07	135.35	133.7
W-16	8/5/92	1358	31.6	138.18	106.58	138.48	137
W-16	8/27/92	1715	31.64	138.18	106.54	138.48	137
W-16	9/25/92	1600	31.45	138.18	106.73	138.48	137
W-16	10/30/92	1004	31.47	138.18	106.71	138.48	137
OU5GW-25	8/6/92	1515	4	114.2	110.2	117.05	
OU5GW-25	9/23/92	1630	3.86	114.2	110.34	117.05	
OU5GW-25	10/29/92	1408	3.865	114.2	110.335	117.05	
OU5GW-27	8/6/92	1215	4.39	130.9	126.51	133.71	
OU5GW-27	8/27/92	1740	4.1	130.9	126.8	133.71	
OU5GW-27	9/23/92	1506	3.88	130.9	127.02	133.71	
OU5GW-27	10/29/92	1034	3.77	130.9	127.13	133.71	
OU5GW-28	8/6/92	1145	4.48	133	128.52	136.54	
OU5GW-28	8/27/92	1746	4.36	133	128.64	136.54	
OU5GW-28	9/23/92	1502	3.75	133	129.25	136.54	
OU5GW-28	10/29/92	1013	4.265	133	128.735	136.54	
OU5GW-29	8/6/92	1220	6.49	123.54	117.05	127.12	
OU5GW-29	9/23/92	1513	4.79	123.54	118.75	127.12	

Groundwater Elevations and Estimated Hydraulic Conductivities

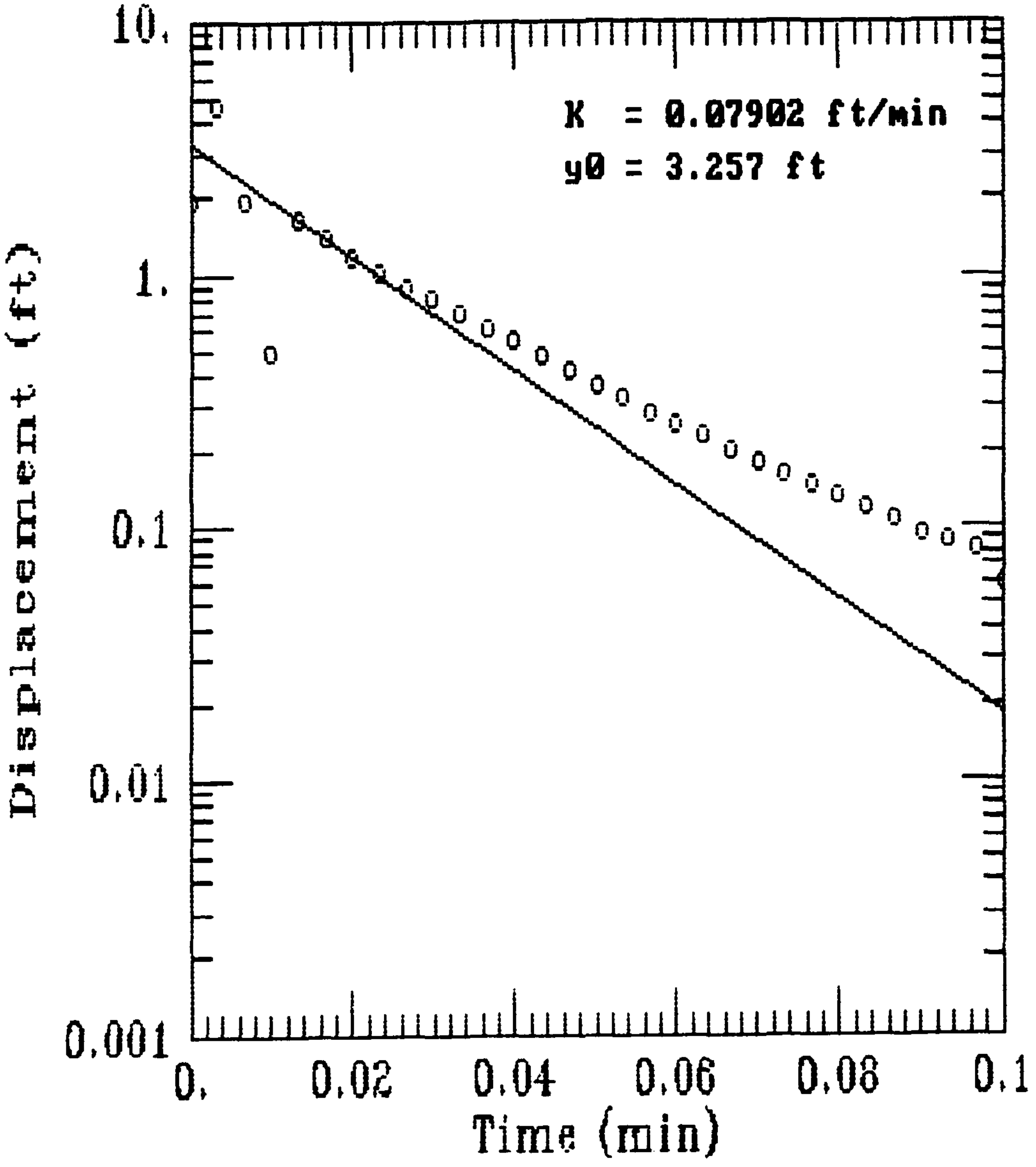
OU5GW-29	10/30/92	1248	4.61	123.54	118.93	127.12
OU5GW-34	8/6/92	1525	3.64	98.8	95.16	102.53
OU5GW-34	8/27/92	1637	3.78	98.8	95.02	102.53
OU5GW-34	9/23/92	1542	3.7	98.8	95.1	102.53
OU5GW-34	10/29/92	1428	4.86	98.8	93.94	102.53
OU5GW-40	8/6/92	1155	4.44	134.6	130.16	138.01
OU5GW-40	8/27/92	1800	4.3	134.6	130.3	138.01
OU5GW-40	9/25/92	1417	4.14	134.6	130.46	138.01
OU5GW-40	10/29/92	1003	4.18	134.6	130.42	138.01
OU5GW-41	8/6/92	1140	5.72	129	123.28	132.96
OU5GW-41	9/25/92	1424	5.85	129	123.15	132.96
OU5GW-41	10/29/92	933	5.81	129	123.19	132.96
OU5GW-42	8/6/92	1135	3.37	123.7	120.33	126.26
OU5GW-42	9/25/92	1436	3.85	123.7	119.85	126.26
OU5GW-42	10/29/92	911	4.015	123.7	119.685	126.26
OU5GW-44	8/6/92	1128	3.59	121.3	117.71	124.86
OU5GW-44	9/25/92	1431	4	121.3	117.3	124.86
OU5GW-44	10/29/92	903	4.135	121.3	117.165	124.86
OU5GW-46	8/6/92	NA	1.93	99.1	97.17	101.83
OU5GW-46	8/27/92	1649	1.92	99.1	97.18	101.83
OU5GW-46	9/23/92	1545	1.85	99.1	97.25	101.83
OU5GW-46	10/29/92	1436	1.805	99.1	97.295	101.83
OU5GW-50	8/6/92	1506	3.79	112.9	109.11	116.14
OU5GW-50	9/25/92	1650	3.75	112.9	109.15	116.14
OU5GW-50	10/30/92	1205	3.715	112.9	109.185	116.14
OU5GW-51	8/6/92	1150	5.52	93	87.48	96.74
OU5GW-51	8/27/92	1655	5.46	93	87.54	96.74
OU5GW-51	9/25/92	1358	5.3	93	87.7	96.74
OU5GW-51	10/29/92	1454	5.395	93	87.605	96.74
OU5GW-55	8/6/92	1615	3.7	54.6	50.9	58.2
OU5GW-55	8/28/92	957	4.06	54.6	50.54	58.2
OU5GW-55	9/24/92	1633	4.1	54.6	50.5	58.2
OU5GW-55	10/30/92	1128	4.325	54.6	50.275	58.2
OU5GW-58	8/28/92	953	3	55.1	52.1	58.61
OU5GW-58	9/24/92	1643	2.9	55.1	52.2	58.61

Groundwater Elevations and Estimated Hydraulic Conductivities

OU5GW-58	10/30/92	1135	2.89	55.1	52.21	58.61
OU5GW-63	8/6/92	1420	3.47	129.8	126.33	133
OU5GW-63	9/23/92	1420	3.44	129.8	126.36	133
OU5GW-63	10/29/92	1135	2.41	129.8	127.39	133
OU5SL-07	8/6/92	1650	4.36	80.7	76.34	84.77
OU5SL-07	9/25/92	1533	4.35	80.7	76.35	84.77
OU5SL-07	10/29/92	1629	4.25	80.7	76.45	84.77
OU5SL-10	9/25/92	1505	2	93.6	91.6	96.78
OU5SL-10	10/28/92	1535	2.66	93.6	90.94	96.78
OU5SL-12	8/6/92	1540		3.35	3.35	107.04
OU5SL-12	8/27/92	1703		4.02	4.02	107.04
OU5SL-12	9/23/92	1600		3.95	3.95	107.04
OU5SL-12	10/29/92	1448		3.9	3.9	107.04
OU5SL-18	8/6/92	1455	3.66	107.3	103.64	110.78
OU5SL-18	8/27/92	1631	3.7	107.3	103.6	110.78
OU5SL-18	9/23/92	1620	3.44	107.3	103.86	110.78
OU5SL-18	10/29/92	1400	3.465	107.3	103.835	110.78
OU5SL-20	9/23/92	1650	4.4	110.4	106	114.87
OU5SL-20	10/30/92	1155 ICE		110.4		114.87
OU5SL-22	8/6/92	1440	4.73	129.9	125.17	134.29
OU5SL-22	9/23/92	1425	4.65	129.9	125.25	134.29
OU5SL-22	10/29/92	1150	4.635	129.9	125.265	134.29
OU5SL-23	8/6/92	1415	4.27	132.1	127.83	136.4
OU5SL-23	9/23/92	1415	4.08	132.1	128.02	136.4
OU5SL-23	10/29/92	1123	4.09	132.1	128.01	136.4
OU5SL-25	8/6/92	1515	4	105.7	101.7	109.21
OU5SL-25	9/23/92	1630	3.86	105.7	101.84	109.21
OU5SL-25	10/29/92	1408	3.865	105.7	101.835	109.21
BW-40	NM	NM	NM	171.6	0	173.86
BW-50	NM	NM	NM	200.2	0	200.43
BW-52	NM	NM	NM	106.1		108.01

Groundwater Elevations and Estimated Hydraulic Conductivities

NS = Not Surveyed
NM = Not Measured
NA = Not Available
* These samples are labeled SP4-01 on the data sheets.



EAFB - Monitoring Well 10, Test 1

[illegible]
(SLUG-OUT)

```
        SE1000C
  Environmental Logger
     09/02 07:36

  Unit# 00856  Test 2

Setups:         INPUT  1
------------    ---------
Type            Level (F)
Mode            TOC
I.D.            00000

Reference         0.000
Linearity         0.000
Scale factor     10.010
Offset           -0.130
Delay mSEC       50.000

Step 0  09/01 14:48:48

Elapsed Time    INPUT  1
------------    ---------
   0.0000          0.022
   0.0033          0.066
   0.0066          0.018
   0.0100          0.022
   0.0133          0.025
   0.0166          0.025
   0.0200          0.022
   0.0233          0.047
   0.0266          0.018
   0.0300          1.539
   0.0333          4.080
   0.0366          0.632
   0.0400          1.508
   0.0433          1.492
   0.0466          1.297
   0.0500          1.152
   0.0533          1.010
   0.0566          0.891
   0.0600          0.784
   0.0633          0.692
   0.0666          0.610
   0.0700          0.541
   0.0733          0.481
   0.0766          0.425
   0.0800          0.377
   0.0833          0.340
   0.0866          0.302
   0.0900          0.270
   0.0933          0.242
   0.0966          0.220
   0.1000          0.198
   0.1033          0.179
   0.1066          0.163
   0.1100          0.151
   0.1133          0.135
   0.1166          0.125
   0.1200          0.116
```

MW10 1st TEST
(SLUGOUT)

```
       SE1000C
 Environmental Logger
     09/02 07:33

Unit# 00856  Test 1

Setups:           INPUT  1
------------     ---------
Type              Level (F)
Mode              TOC
I.D.              00000

Reference            0.000
Linearity            0.000
Scale factor        10.010
Offset              -0.130
Delay mSEC          50.000

Step 0  09/01 14:41:05

Elapsed Time     INPUT  1
------------     ---------
   0.0000          0.040
   0.0033          0.040
   0.0066          0.040
   0.0100          0.040
   0.0133          0.040
   0.0166          0.040
   0.0200          0.040
   0.0233          0.040
   0.0266          0.040
   0.0300          0.040
   0.0333          0.040
   0.0366          0.044
   0.0400          0.040
   0.0433          0.044
   0.0466          0.015
   0.0500          4.631
   0.0533          2.021
   0.0566          0.532
   0.0600          1.678
   0.0633          1.423
   0.0666          1.218
   0.0700          1.070
   0.0733          0.941
   0.0766          0.831
   0.0800          0.733
   0.0833          0.651
   0.0866          0.579
   0.0900          0.513
   0.0933          0.456
   0.0966          0.406
   0.1000          0.365
   0.1033          0.327
   0.1066          0.295
   0.1100          0.267
   0.1133          0.242
   0.1166          0.220
   0.1200          0.204
```

0.1233	0.185
0.1266	0.173
0.1300	0.160
0.1333	0.148
0.1366	0.135
0.1400	0.129
0.1433	0.122
0.1466	0.100
0.1500	0.094
0.1533	0.081
0.1566	0.081
0.1600	0.072
0.1633	0.075
0.1666	0.059
0.1700	0.063
0.1733	0.063
0.1766	0.063
0.1800	0.066
0.1833	0.063
0.1866	0.053
0.1900	0.075
0.1933	0.063
0.1966	0.066
0.2000	0.059
0.2033	0.056
0.2066	0.059
0.2100	0.059
0.2133	0.063
0.2166	0.056
0.2200	0.063
0.2233	0.063
0.2266	0.056
0.2300	0.056
0.2333	0.053
0.2366	0.072
0.2400	0.047
0.2433	0.059
0.2466	0.063
0.2500	0.059
0.2533	0.047
0.2566	0.056
0.2600	0.069
0.2633	0.056
0.2666	0.050
0.2700	0.053
0.2733	0.047
0.2766	0.050
0.2800	0.059
0.2833	0.047
0.2866	0.056
0.2900	0.040
0.2933	0.050
0.2966	0.059
0.3000	0.047
0.3033	0.059
0.3066	0.056
0.3100	0.053
0.3133	0.050
0.3166	0.053
0.3200	0.053

0.3233	0.053
0.3266	0.059
0.3300	0.050
0.3333	0.059
0.3500	0.059
0.3666	0.066
0.3833	0.085
0.4000	0.063
0.4166	0.053
0.4333	0.053
0.4500	0.050
0.4666	0.050
0.4833	0.037
0.5000	0.056
0.5166	0.050
0.5333	0.050
0.5500	0.050
0.5666	0.047
0.5833	0.050
0.6000	0.047
0.6166	0.047
0.6333	0.050
0.6500	0.047
0.6666	0.047
0.6833	0.047
0.7000	0.047
0.7166	0.047
0.7333	0.047
0.7500	0.044
0.7666	0.047
0.7833	0.047
0.8000	0.047
0.8166	0.047
0.8333	0.037
0.8500	0.075
0.8666	0.053
0.8833	0.050
0.9000	0.047
0.9166	0.047
0.9333	0.047
0.9500	0.047
0.9666	0.047
0.9833	0.047
1.0000	0.047
1.2000	0.044
1.4000	0.044
1.6000	0.044

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                          A Q T E S O L V   R E S U L T S
                                    Version  1.10

09/24/92                                                                  15:07:2

==================================================================================
                                  TEST DESCRIPTION

Data set........... 0901n-1.in
Data set title..... EAFB - Monitoring Well 10, Test 1

Knowns and Constants:
   No. of data points.................. 126
   Radius of well casing............... 0.08333
   Radius of well...................... 0.3333
   Aquifer saturated thickness......... 7.4
   Well screen length.................. 5
   Static height of water in well...... 7.4
   Log(Re/Rw).......................... 2.199
   A, B, C.............................  0.000,  0.000,  1.498

==================================================================================
                                 ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)

==================================================================================
                           RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =    5.2445E-003
   y0 =    1.6970E-155

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

TYPE CURVE DATA

     K  = 7.90226E-002
     y0 = 3.25741E+000

   Time      Drawdown      Time      Drawdown      Time      Drawdown
 ----------  ----------  ----------  ----------  ----------  ----------
 0.000E+000  3.257E+000  1.000E-001  1.844E-002
```

Hydraulic Conductivity Estimates
Based on Slug Test Data

Well No.	Aquifer Type	Geometric Mean	K (feet/min)		K (cm/sec)		Calculated	Curve
			Curve	Corrected	Curve	Corrected	Yo (feet)	Yo (feet)
MW14	Well graded gravel w/sand		2.8E-01	1.5E+00	1.4E-01	7.8E-01	1.3	8.8
			2.0E-01	1.1E+00	1.0E-01	5.6E-01		0.2
			2.9E-01	1.6E+00	1.5E-01	8.0E-01		14.4
			2.8E-01	1.5E+00	1.4E-01	7.7E-01	0.9	8.9
			2.4E-01	1.3E+00	1.2E-01	6.6E-01		2.6
		Mean	2.6E-01	1.4E+00	1.3E-01	7.1E-01		
MW12	Well graded gravel w/sand		7.6E-02	4.1E-01	3.9E-02	2.1E-01	0.6	1.9
			7.6E-02	4.1E-01	3.9E-02	2.1E-01		2.0
		Mean	7.6E-02	4.1E-01	3.9E-02	2.1E-01		
MW10	Well graded sand w/gravel		7.9E-02	#N/A	4.0E-02	#N/A	3.3	3.4
			5.8E-02	#N/A	3.0E-02	#N/A		2.7
		Mean	6.8E-02	#N/A	3.5E-02	#N/A		
MW13	Clayey gravel w/sand & clay		6.2E-02	#N/A	3.2E-02	#N/A	1.7	2.7
			6.2E-02	#N/A	3.2E-02	#N/A		3.0
		Mean	6.2E-02	#N/A	3.2E-02	#N/A		
MW1	Poorly graded sand w/gravel		4.9E-02	2.6E-01	2.5E-02	1.4E-01	2.0	6.3
			5.1E-02	2.8E-01	2.6E-02	1.4E-01		9.5
		Mean	5.0E-02	2.7E-01	2.5E-02	1.4E-01		
MW8	Well graded gravel w/sand		4.6E-02	2.5E-01	2.3E-02	1.2E-01	1.2	3.7
			4.4E-02	2.4E-01	2.2E-02	1.2E-01		1.8
		Mean	4.5E-02	2.4E-01	2.2E-02	1.2E-01		

MW15	Well graded gravel w/sand		4.5E-02	2.4E-01	2.3E-02	1.2E-01	0.1	2.0
			3.9E-02	2.1E-01	2.0E-02	1.1E-01		1.5
		Mean	4.2E-02	2.3E-01	2.1E-02	1.2E-01		
MW5	Well graded gravel w/sand		3.7E-02	2.0E-01	1.9E-02	1.0E-01	2.7	9.7
			3.8E-02	2.1E-01	1.9E-02	1.0E-01		8.2
		Mean	3.7E-02	2.0E-01	1.9E-02	1.0E-01		
MW3	Poorly graded sand & gravelly sand		3.3E-02	1.8E-01	1.7E-02	9.2E-02	5.6	7.1
			3.2E-02	1.7E-01	1.6E-02	8.6E-02		9.7
		Mean	3.2E-02	1.8E-01	1.6E-02	8.9E-02		
MW31	Well graded gravel w/sand		2.2E-02	#N/A	1.1E-02	#N/A	1.1	2.2
			2.2E-02	#N/A	1.1E-02	#N/A		2.0
		Mean	2.2E-02	#N/A	1.1E-02	#N/A		
MW16	Well graded sand w/gravel & well graded gravel w/silt & sand		5.0E-03	2.7E-02	3.0E-03	1.6E-02	0.7	1.3
			5.0E-03	2.7E-02	3.0E-03	1.6E-02		1.2
		Mean	5.0E-03	2.7E-02	3.0E-03	1.6E-02		

Note 1: Corrected K values account for effective contribution from gravel pack (see text).

TECHNICAL MEMORANDUM

PREPARED FOR: Mike Singer

PREPARED BY: Kirk Creswick

DATE: September 29, 1992

SUBJECT: Elmendorf Air Force Base Slug Testing

PROJECT: ANC31026.H4.10

This memorandum presents results from analysis of slug test data collected from Elmendorf Air Force Base, Alaska, during the 1st and 2nd of September, 1991.

The aquifer is a shallow unconfined glacio-fluvial aquifer consisting of mixtures of gravels and sands with occasional silts and clays.

The data are a record of the rising head after the removal of solid slug. Two slug sizes were used for the testing: a 1.5-inch-diameter, 10-foot-long slug, and a 1-inch-diameter, 10.6-foot-long slug. Both slugs produced good results. The slug was partially submerged in the majority of the tests.

Data were analyzed using the AQTESOLV algorithm for the Bouwer and Rice (1976) solution for unconfined aquifers. This method proved appropriate for the data and produced consistent results with excellent repeatability.

Water levels in nine of the tested wells intersected the well screen during the tests, requiring that a correction factor be applied to the well casing radius to account for the thickness and porosity of the gravel pack (Bouwer and Rice, 1976). The following formula is used to calculate the corrected well casing radius:

$$r_{corr} = [(1-n)r^2_c + nr^2_w]0.5$$

Where:

r_{corr} = corrected casing radius, in feet
n = porosity of gravel pack
r_c = measured casing radius, in feet
r_w = radius of borehole, in feet

The tested wells have a casing radius of 1 inch (0.083 feet), a borehole radius of 4 inches (0.333 feet), and an assumed gravel pack porosity of 30 percent. These measurements resulted in a computed value for r_{corr} of 2.3 inches (0.192 feet).

The hydraulic conductivities were first computed using the actual casing diameter of 1 inch. For the affected wells, a correction factor based on the value for r_{corr} was then applied to the hydraulic conductivity value. The hydraulic conductivity value computed using the Bouwer and Rice (1979) solution is directly proportional to the square of the r_c. The correction factor (cf) was computed as follows:

$$cf = r^2_{corr} / r^2_c$$

For the affected wells, the computed correction factor was 5.3. The corrected hydraulic conductivity was computed by multiplying the computed value by 5.3. The corrected values are shown in the table below.

As described by Bouwer (1989), the drawdown data generally exhibit characteristic curves with a distinctive straight-line segment. On some plots (for example, Well 16, test 8), a minor amount of deviation occurs. The plotted lines were fitted visually; deviations within the range of data observed on the plots do not result in significant variations in estimated hydraulic conductivity. For some tests (for example, Well 14, test 12), the water levels changed quickly after the removal of the slug. For these tests, only the first few data points were used for the analyses. However, even for these wells the results exhibited good repeatability between tests.

Resulting hydraulic conductivities in the wells ranged from 1.6 ft/min (0.8 cm/s) to 0.027 ft/min (0.016 cm/s). The geometric mean of the test results was 0.4 ft/min (0.2 cm/sec). These values are appropriate for sand and gravel aquifers and represent highly conductive materials. K values of individual tests at any particular well were very similar (see table).

Initial drawdown values, y_o computed by the algorithm were consistently higher than values calculated for displacement by the slug. This is likely due to the very fast response of the aquifer. The first second or two of data often show erratic readings which are caused by the shock of the slug removal. The data being fitted consists of the first 6 to 12 seconds of the record. This means that slug removal is slightly less than instantaneous and thereby causes an offset in the time axis which in turn causes the y intercept to be higher. However, after the initial noise has dissipated, the first good data have y values reasonably close to y_o and therefor provide for a valid solution. The effective radius of these tests appears to be about 1.2 to 3.7 feet from the center of the well.

Overall, the resulting K values appear to be good and consistent indicators of the hydraulic conductivities of these aquifer materials.

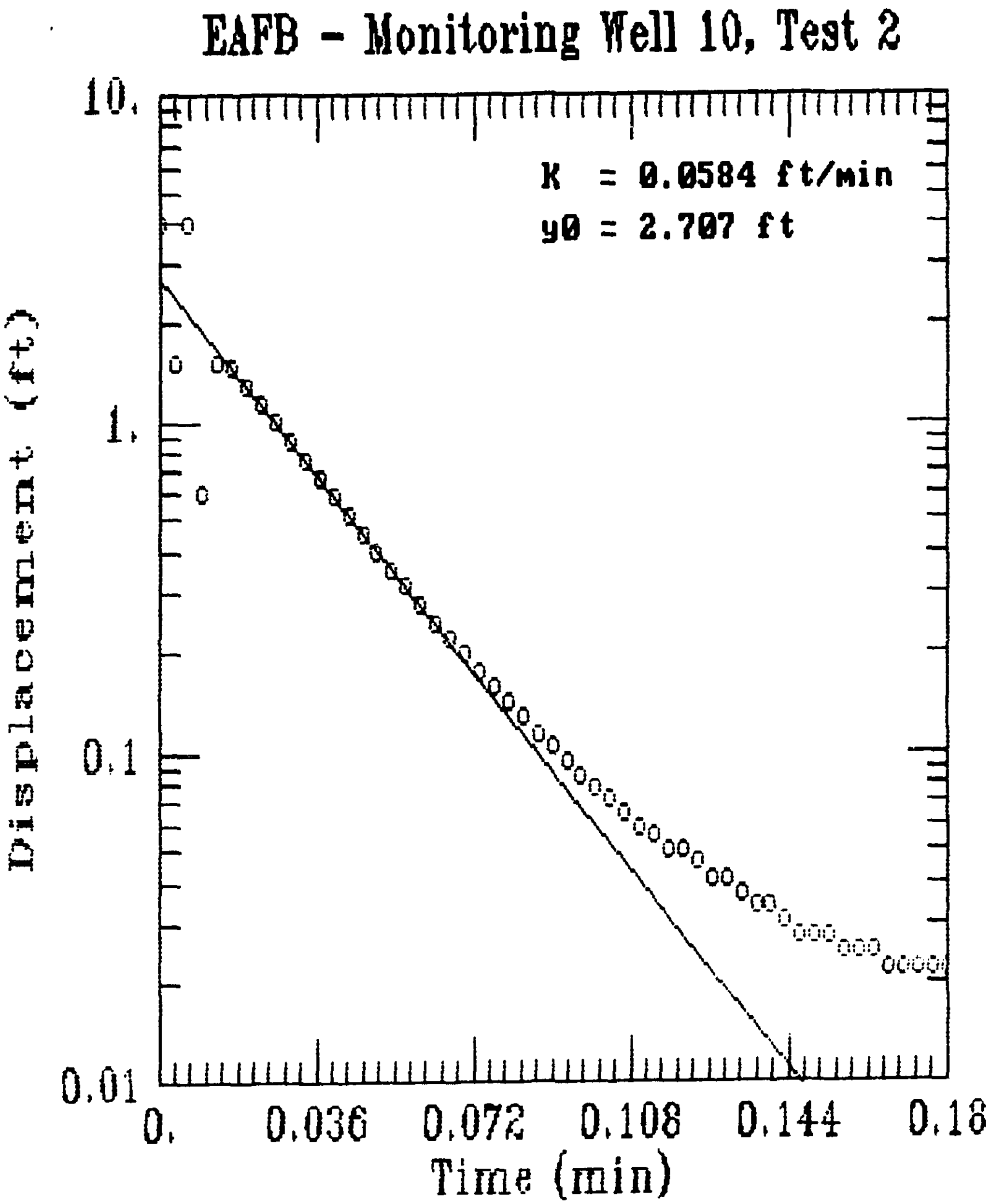
Appendix F

SLUG TEST DATA

0.1233	0.107
0.1266	0.100
0.1300	0.094
0.1333	0.088
0.1366	0.081
0.1400	0.078
0.1433	0.072
0.1466	0.072
0.1500	0.069
0.1533	0.063
0.1566	0.063
0.1600	0.059
0.1633	0.056
0.1666	0.056
0.1700	0.053
0.1733	0.050
0.1766	0.050
0.1800	0.050
0.1833	0.047
0.1866	0.047
0.1900	0.047
0.1933	0.044
0.1966	0.044
0.2000	0.044
0.2033	0.044
0.2066	0.044
0.2100	0.040
0.2133	0.040
0.2166	0.040
0.2200	0.040
0.2233	0.037
0.2266	0.040
0.2300	0.037
0.2333	0.037
0.2366	0.037
0.2400	0.037
0.2433	0.040
0.2466	0.034
0.2500	0.037
0.2533	0.034
0.2566	0.037
0.2600	0.037
0.2633	0.034
0.2666	0.034
0.2700	0.034
0.2733	0.034
0.2766	0.034
0.2800	0.034
0.2833	0.034
0.2866	0.034
0.2900	0.034
0.2933	0.034
0.2966	0.034
0.3000	0.034
0.3033	0.034
0.3066	0.034
0.3100	0.034
0.3133	0.031
0.3166	0.034
0.3200	0.034

0.3233	0.031
0.3266	0.034
0.3300	0.031
0.3333	0.031
0.3500	0.031
0.3666	0.031
0.3833	0.031
0.4000	0.028
0.4166	0.031
0.4333	0.028
0.4500	0.028
0.4666	0.028
0.4833	0.028
0.5000	0.028
0.5166	0.028
0.5333	0.028
0.5500	0.028
0.5666	0.028
0.5833	0.028
0.6000	0.028
0.6166	0.028
0.6333	0.025
0.6500	0.025
0.6666	0.025
0.6833	0.025
0.7000	0.025
0.7166	0.025
0.7333	0.025
0.7500	0.025
0.7666	0.025
0.7833	0.025
0.8000	0.025
0.8166	0.025
0.8333	0.025
0.8500	0.025
0.8666	0.025
0.8833	0.025
0.9000	0.025
0.9166	0.025
0.9333	0.025
0.9500	0.025
0.9666	0.025
0.9833	0.022
1.0000	0.025
1.2000	0.022
1.4000	0.018
1.6000	0.022
1.8000	0.022
2.0000	0.022
2.2000	0.025
2.4000	0.022
2.6000	0.022
2.8000	0.022

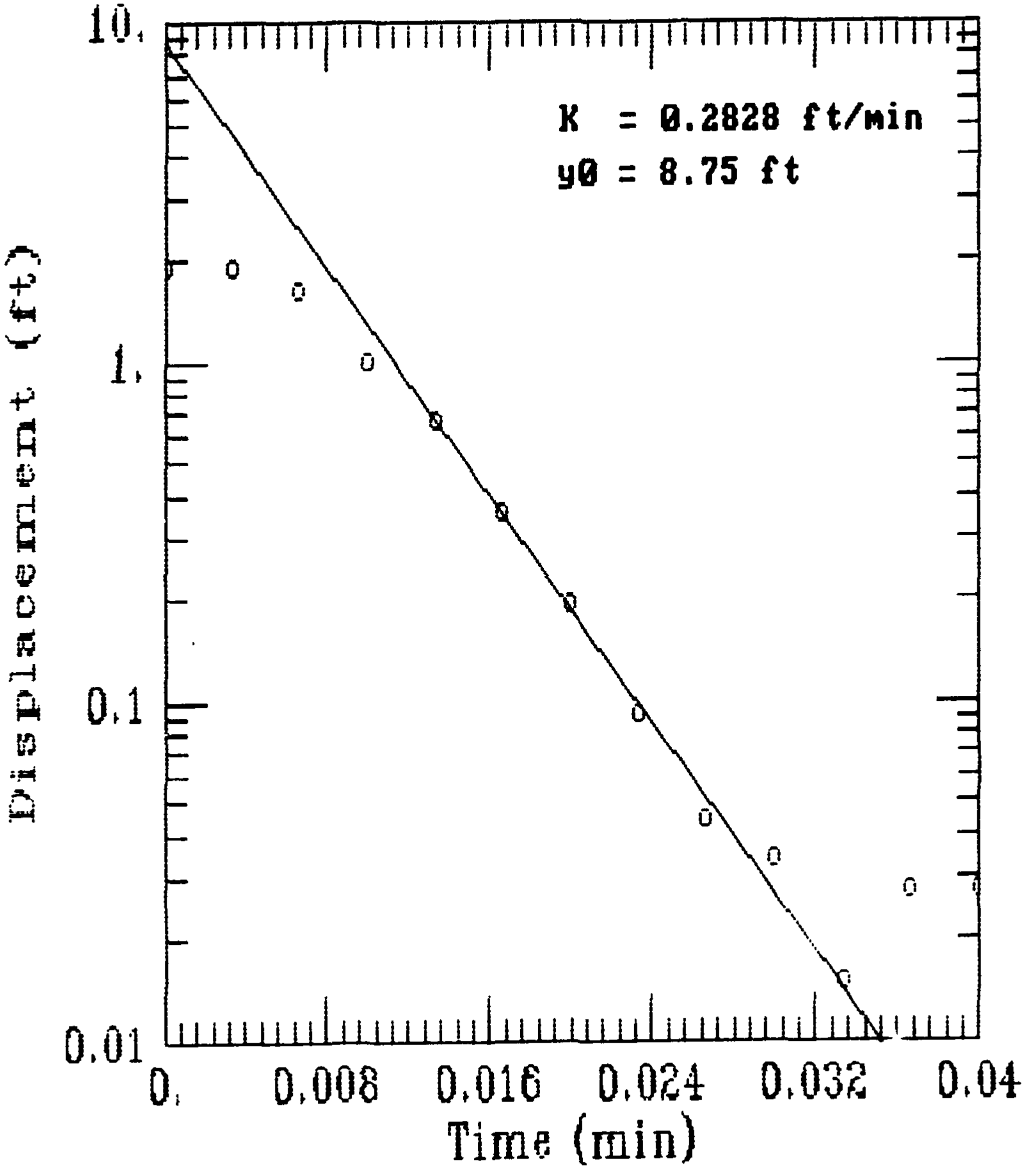
```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                        A Q T E S O L V   R E S U L T S
                                  Version 1.10

09/24/92                                                                        15:43:23

================================================================================
                                TEST DESCRIPTION

Data set........... 0901n-2.in
Data set title..... EAFB - Monitoring Well 10, Test 2

Knowns and Constants:
   No. of data points................... 132
   Radius of well casing............... 0.08333
   Radius of well...................... 0.3333
   Aquifer saturated thickness......... 7.4
   Well screen length.................. 5
   Static height of water in well...... 7.4
   Log(Re/Rw).......................... 2.199
   A, B, C.............................  0.000,  0.000,  1.498

================================================================================
                                ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)

================================================================================
                        RESULTS FROM VISUAL CURVght of water in well...... 7.4
   Log(Re/Rw).......................... 2.199
   A, B, C.............................  0.000,  0.000,  1.498

================================================================================
                                ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)

==============================================
```



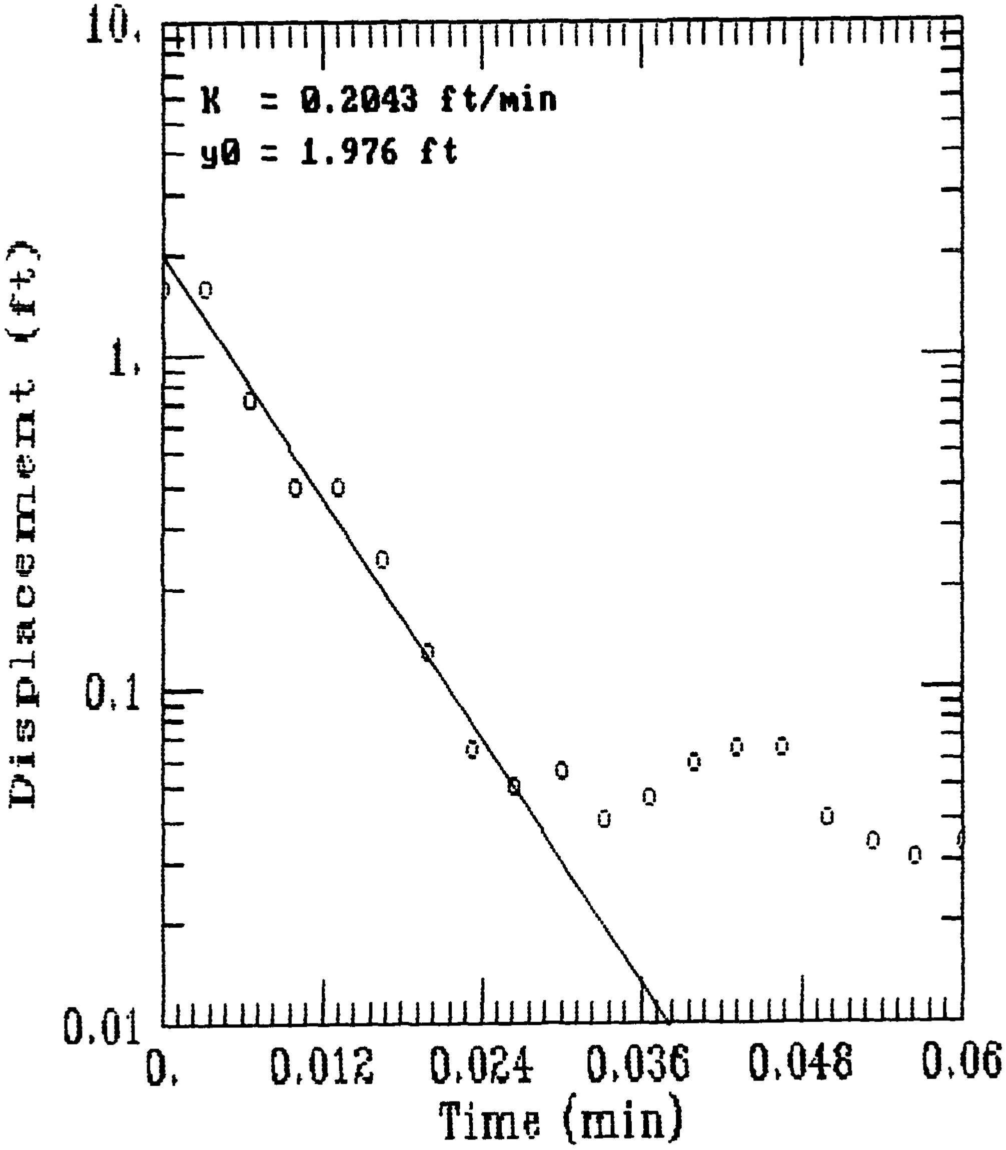
EAFB - Monitoring Well 10, Test 2

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                         A Q T E S O L V   R E S U L T S
                                  Version 1.10

09/25/92                                                                 09:56:31

=================================================================================
                                TEST DESCRIPTION

Data set........... mw14t3.in
Data set title..... EAFB - Monitoring Well 14, Test 3

Knowns and Constants:
   No. of data points.................. 95
   Radius of well casing............... 0.08333
   Radius of well...................... 0.3333
   Aquifer saturated thickness......... 4.44
   Well screen length.................. 4.44
   Static height of water in well...... 4.44
   Log(Re/Rw).......................... 1.877
   A, B, C.............................  0.000,  0.000,  1.436

=================================================================================
                               ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)

=================================================================================
                         RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

          Estimate
   K  =   2.8279E-001
   y0 =   2.3474E-022


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>


TYPE CURVE DATA

     K  = 2.82790E-001
     y0 = 8.74994E+000

   Time      Drawdown      Time      Drawdown      Time      Drawdown
----------  ----------  ----------  ----------  ----------  ----------
0.000E+000  8.750E+000  4.000E-002  3.946E-003
```

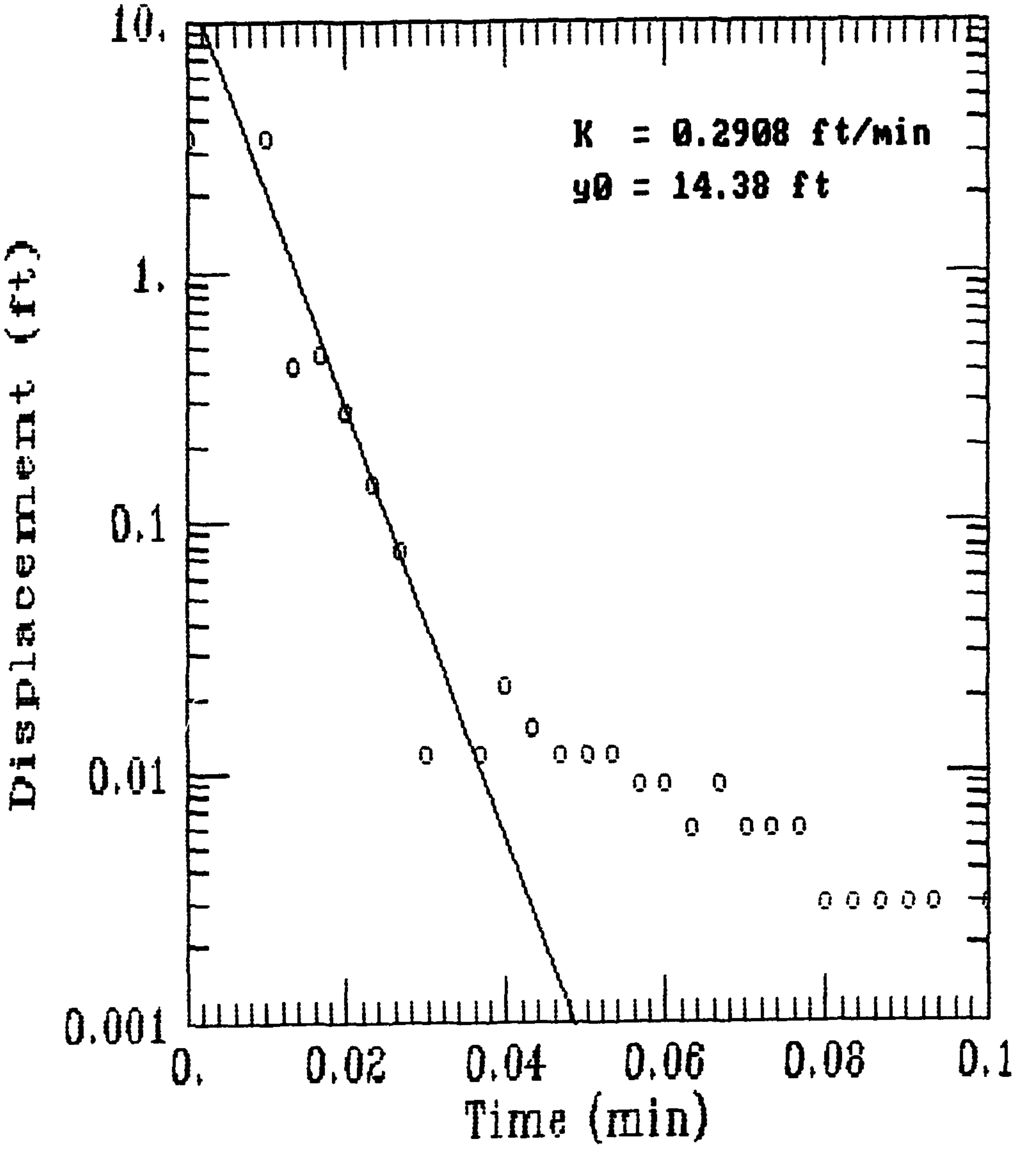
EAFB - Monitoring Well 14, Test 3



EAFB - Monitoring Well 14, Test 4



EAFB - Monitoring Well 14, Test 5



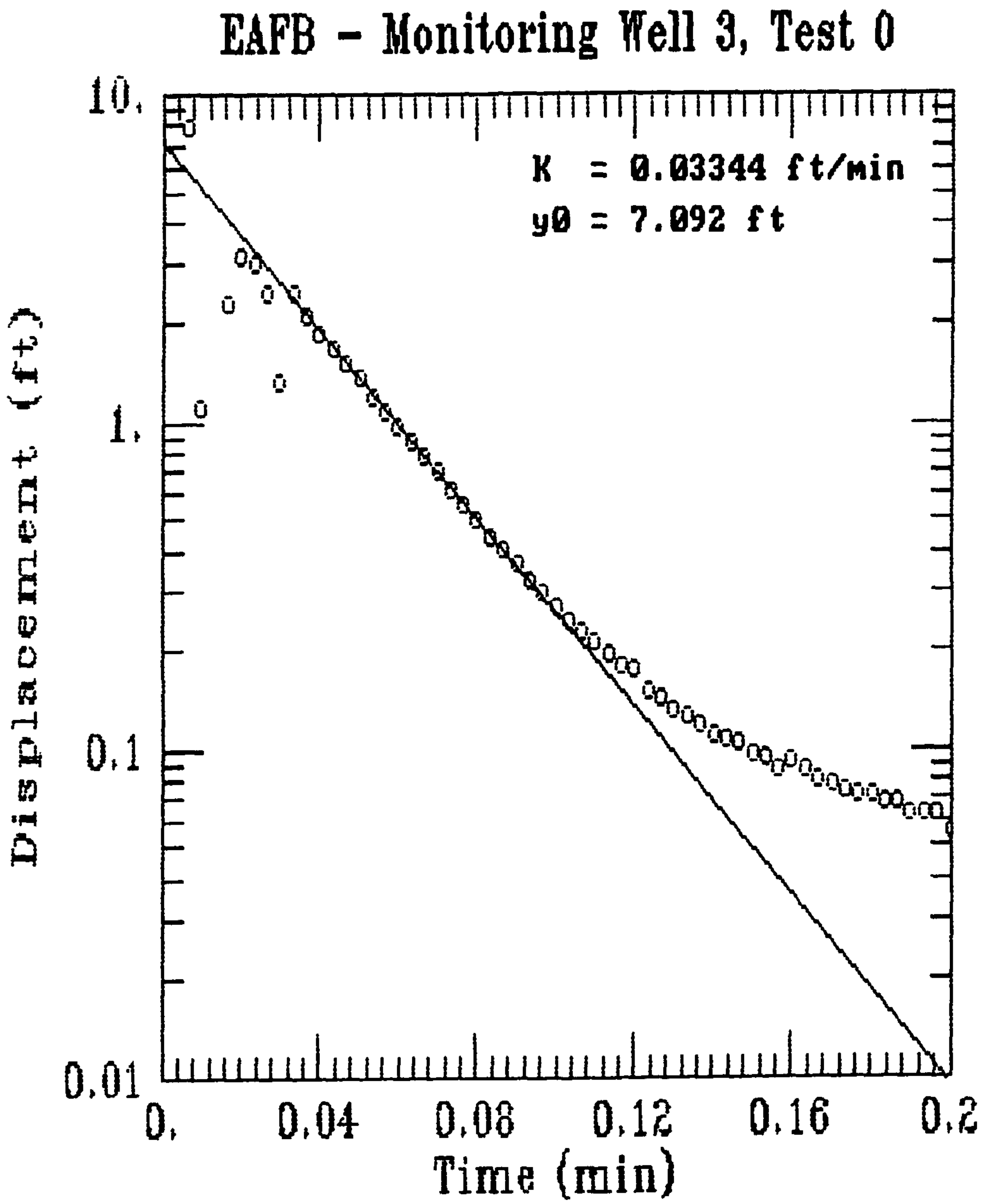
MWE 3 12' 1281

```
      SE1000C
 Environmental Logger
    09/02 10:28

 nit# 00856  Test 0

Setups:         INPUT  1
------------    ---------
Type            Level (F)
Mode            TOC
I.D.            00000

Reference         0.000
Linearity         0.000
Scale factor     10.010
Offset           -0.130
Delay mSEC       50.000

Step 0  09/02 10:01:29

Elapsed Time   INPUT  1
------------   ---------
   0.0000         0.006
   0.0033         0.003
   0.0066         0.006
   0.0100         0.006
   0.0133         0.012
   0.0166        14.002
   0.0200         7.884
   0.0233         1.092
   0.0266        -1.020
   0.0300         2.263
   0.0333         3.161
   0.0366         2.991
   0.0400         2.456
   0.0433         1.325
   0.0466         2.446
   0.0500         2.081
   0.0533         1.864
   0.0566         1.687
   0.0600         1.517
   0.0633         1.350
   0.0666         1.190
   0.0700         1.086
   0.0733         0.963
   0.0766         0.872
   0.0800         0.777
   0.0833         0.702
   0.0866         0.626
   0.0900         0.560
   0.0933         0.503
   0.0966         0.450
   0.1000         0.409
   0.1033         0.368
   0.1066         0.330
   0.1100         0.302
   0.1133         0.273
   0.1166         0.248
   0.1200         0.226
```

0.1233	0.211
0.1266	0.192
0.1300	0.179
0.1333	0.173
0.1366	0.151
0.1400	0.141
0.1433	0.132
0.1466	0.125
0.1500	0.119
0.1533	0.110
0.1566	0.107
0.1600	0.103
0.1633	0.097
0.1666	0.094
0.1700	0.088
0.1733	0.091
0.1766	0.088
0.1800	0.081
0.1833	0.078
0.1866	0.075
0.1900	0.072
0.1933	0.072
0.1966	0.069
0.2000	0.069
0.2033	0.063
0.2066	0.063
0.2100	0.063
0.2133	0.056
0.2166	0.053
0.2200	0.056
0.2233	0.056
0.2266	0.056
0.2300	0.053
0.2333	0.050
0.2366	0.050
0.2400	0.050
0.2433	0.050
0.2466	0.059
0.2500	0.047
0.2533	0.047
0.2566	0.050
0.2600	0.047
0.2633	0.047
0.2666	0.050
0.2700	0.047
0.2733	0.047
0.2766	0.050
0.2800	0.040
0.2833	0.044
0.2866	0.040
0.2900	0.040
0.2933	0.040
0.2966	0.040
0.3000	0.040
0.3033	0.040
0.3066	0.037
0.3100	0.040
0.3133	0.037
0.3166	0.040
0.3200	0.037

0.3233	0.040
0.3266	0.037
0.3300	0.037
0.3333	0.037
0.3500	0.034
0.3666	0.037
0.3833	0.034
0.4000	0.034
0.4166	0.034
0.4333	0.034
0.4500	0.034
0.4666	0.034
0.4833	0.034
0.5000	0.031
0.5166	0.031
0.5333	0.031
0.5500	0.031
0.5666	0.031
0.5833	0.031
0.6000	0.028
0.6166	0.028
0.6333	0.028
0.6500	0.028
0.6666	0.028
0.6833	0.028
0.7000	0.037
0.7166	0.040
0.7333	0.040
0.7500	0.028
0.7666	0.037
0.7833	0.031
0.8000	0.031
0.8166	0.031
0.8333	0.034
0.8500	0.031
0.8666	0.040
0.8833	0.034
0.9000	0.031
0.9166	0.031
0.9333	0.031
0.9500	0.031
0.9666	0.028
0.9833	0.034
1.0000	0.034
1.2000	0.031

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                       A Q T E S O L V   R E S U L T S
                                  Version 1.10

09/28/92                                                                15:35:43

================================================================================
                               TEST DESCRIPTION

Data set........... mw3t0.in
Data set title..... EAFB - Monitoring Well 3, Test 0

Knowns and Constants:
   No. of data points.................. 136
   Radius of well casing............... 0.08333
   Radius of well...................... 0.3333
   Aquifer saturated thickness......... 8.3
   Well screen length.................. 8.3
   Static height of water in well...... 8.3
   Log(Re/Rw).......................... 2.41
   A, B, C.............................  0.000,  0.000,  1.810

================================================================================
                               ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)


================================================================================
                       RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   1.0645E-001
   y0 =   3.7552E+232


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>


TYPE CURVE DATA

     K  = 3.34412E-002
     y0 = 7.09170E+000

   Time       Drawdown       Time      Drawdown       Time      Drawdown
----------  ----------  ----------  ----------  ----------  ----------
0.000E+000  7.092E+000  2.000E-001  9.338E-003
```

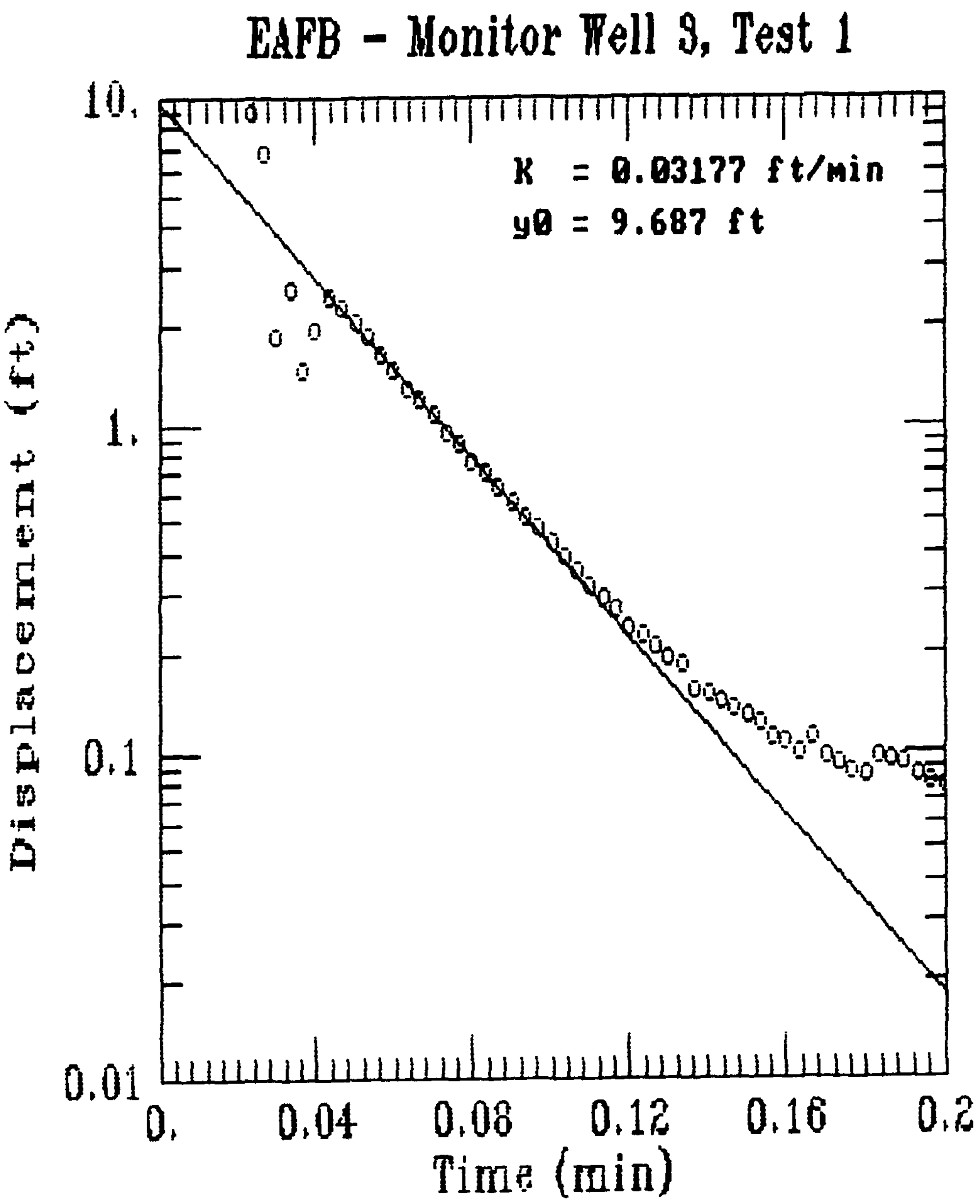

EAFB - Monitoring Well 3, Test 0
K = 0.03344 ft/min
y0 = 7.092 ft
Displacement (ft)
10.
1.
0.1
0.01
Time (min)
0.
0.04
0.08
0.12
0.16
0.2

```
        SE1000C
  Environmental Logger
     09/03 09:26

  Unit# 00856  Test 1

Setups:          INPUT  1
------------     ---------
Type             Level (F)
Mode             TOC
I.D.             00000

Reference          0.000
Linearity          0.000
Scale factor      10.010
Offset            -0.130
Delay mSEC        50.000

Step 0  09/02 10:08:30

Elapsed Time     INPUT  1
------------     ---------
   0.0000          0.003
   0.0033          0.003
   0.0066          0.003
   0.0100          0.003
   0.0133          0.003
   0.0166          0.000
   0.0200         12.195
   0.0233          9.033
   0.0266          6.738
   0.0300          1.848
   0.0333          2.575
   0.0366          1.451
   0.0400          1.923
   0.0433          2.437
   0.0466          2.279
   0.0500          2.056
   0.0533          1.854
   0.0566          1.640
   0.0600          1.448
   0.0633          1.275
   0.0666          1.177
   0.0700          1.061
   0.0733          0.950
   0.0766          0.865
   0.0800          0.758
   0.0833          0.714
   0.0866          0.639
   0.0900          0.579
   0.0933          0.525
   0.0966          0.475
   0.1000          0.431
   0.1033          0.390
   0.1066          0.355
   0.1100          0.321
   0.1133          0.296
   0.1166          0.274
   0.1200          0.236
```

0.1233	0.226
0.1266	0.211
0.1300	0.195
0.1333	0.185
0.1366	0.154
0.1400	0.148
0.1433	0.141
0.1466	0.135
0.1500	0.129
0.1533	0.122
0.1566	0.110
0.1600	0.107
0.1633	0.100
0.1666	0.110
0.1700	0.097
0.1733	0.091
0.1766	0.088
0.1800	0.085
0.1833	0.097
0.1866	0.094
0.1900	0.091
0.1933	0.085
0.1966	0.081
0.2000	0.078
0.2033	0.078
0.2066	0.072
0.2100	0.069
0.2133	0.072
0.2166	0.063
0.2200	0.066
0.2233	0.063
0.2266	0.059
0.2300	0.056
0.2333	0.056
0.2366	0.050
0.2400	0.050
0.2433	0.050
0.2466	0.047
0.2500	0.047
0.2533	0.047
0.2566	0.047
0.2600	0.047
0.2633	0.047
0.2666	0.047
0.2700	0.050
0.2733	0.059
0.2766	0.056
0.2800	0.056
0.2833	0.056
0.2866	0.056
0.2900	0.056
0.2933	0.056
0.2966	0.053
0.3000	0.056
0.3033	0.053
0.3066	0.053
0.3100	0.053
0.3133	0.053
0.3166	0.053
0.3200	0.053

0.3233	0.053
0.3266	0.053
0.3300	0.050
0.3333	0.053
0.3500	0.050
0.3666	0.047
0.3833	0.047
0.4000	0.050
0.4166	0.047
0.4333	0.047
0.4500	0.044
0.4666	0.044
0.4833	0.044
0.5000	0.044
0.5166	0.044
0.5333	0.041
0.5500	0.044
0.5666	0.044
0.5833	0.044
0.6000	0.044
0.6166	0.041
0.6333	0.044
0.6500	0.044
0.6666	0.044
0.6833	0.044
0.7000	0.041
0.7166	0.050
0.7333	0.041
0.7500	0.041
0.7666	0.041
0.7833	0.041
0.8000	0.041
0.8166	0.041
0.8333	0.041
0.8500	0.041
0.8666	0.041
0.8833	0.041
0.9000	0.041
0.9166	0.041
0.9333	0.041
0.9500	0.041
0.9666	0.041
0.9833	0.031
1.0000	0.034

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                        A Q T E S O L V   R E S U L T S
                                  Version 1.10

09/28/92                                                                  16:05:16

================================================================================
                                TEST DESCRIPTION

Data set....... ... a:\mw3t1.in
Data set title..... EAFB - Monitor Well 3, Test 1

Knowns and Constants:
   No. of data points.................. 139
   Radius of well casing............... 0.08333
   Radius of well...................... 0.3333
   Aquifer saturated thickness......... 8.3
   Well screen length.................. 8.3
   Static height of water in well...... 8.3
   Log(Re/Rw).......................... 2.41
   A, B, C.............................  0.000,  0.000,  1.810

================================================================================
                                ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)

================================================================================
                         RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

             Estimate
   K  =    1.5349E-002
   y0 =    .ºÄ&E+Î06


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>


TYPE CURVE DATA

     K  = 3.14906E-002
     y0 = 9.57249E+000

    Time        Drawdown        Time        Drawdown        Time        Drawdown
 ----------    ----------    ----------    ----------    ----------    ----------
 0.000E+000    9.572E+000    2.000E-001    1.856E-002
```


EAFB - Monitor Well 9, Test 1
K = 0.03177 ft/min
y0 = 9.687 ft
Displacement (ft)
10.
1.
0.1
0.01
0.
0.04
0.08
0.12
0.16
0.2
Time (min)

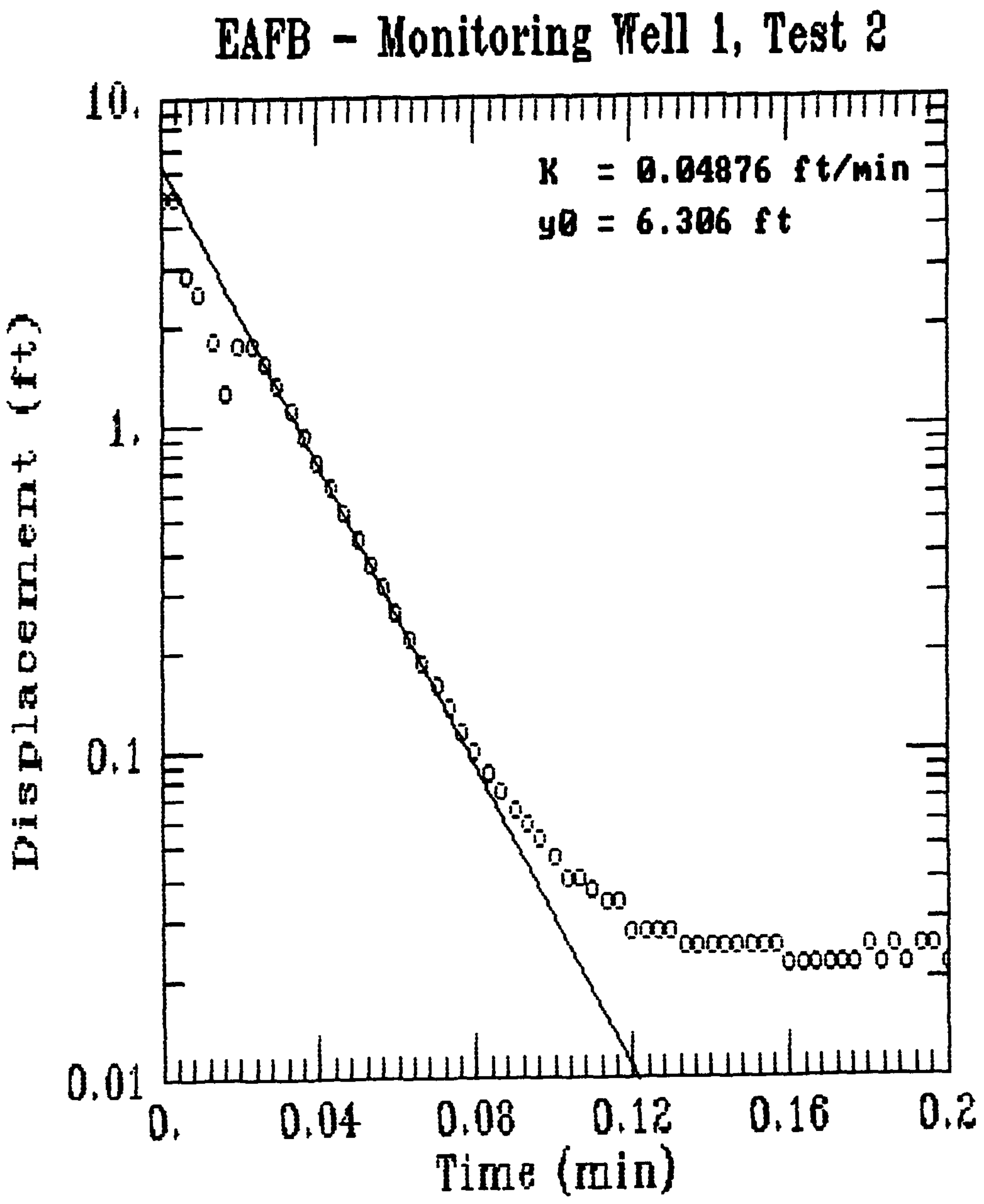
MW1 12 1281

```
        SE1000C
  Environmental Logger
      09/02 11:42

Unit# 00856  Test 2

Setups:          INPUT  1
------------     ---------
Type             Level (F)
Mode             TOC
I.D.             00000

Reference          0.000
Linearity          0.000
Scale factor      10.010
Offset            -0.130
Delay mSEC        50.000

Step 0  09/02 11:21:14

Elapsed Time     INPUT  1
------------     ---------
   0.0000          0.028
   0.0033          0.062
   0.0066         -0.037
   0.0100          0.018
   0.0133          5.000
   0.0166          2.881
   0.0200          2.547
   0.0233          1.804
   0.0266          1.262
   0.0300          1.763
   0.0333          1.772
   0.0366          1.542
   0.0400          1.313
   0.0433          1.111
   0.0466          0.925
   0.0500          0.774
   0.0533          0.645
   0.0566          0.538
   0.0600          0.450
   0.0633          0.374
   0.0666          0.314
   0.0700          0.264
   0.0733          0.220
   0.0766          0.185
   0.0800          0.157
   0.0833          0.135
   0.0866          0.113
   0.0900          0.100
   0.0933          0.085
   0.0966          0.075
   0.1000          0.066
   0.1033          0.059
   0.1066          0.053
   0.1100          0.047
   0.1133          0.040
   0.1166          0.040
   0.1200          0.037
```

0.1233	0.034
0.1266	0.034
0.1300	0.028
0.1333	0.028
0.1366	0.028
0.1400	0.028
0.1433	0.025
0.1466	0.025
0.1500	0.025
0.1533	0.025
0.1566	0.025
0.1600	0.025
0.1633	0.025
0.1666	0.025
0.1700	0.022
0.1733	0.022
0.1766	0.022
0.1800	0.022
0.1833	0.022
0.1866	0.022
0.1900	0.025
0.1933	0.022
0.1966	0.025
0.2000	0.022
0.2033	0.025
0.2066	0.025
0.2100	0.022
0.2133	0.025
0.2166	0.022
0.2200	0.025
0.2233	0.022
0.2266	0.025
0.2300	0.022
0.2333	0.025
0.2366	0.025
0.2400	0.022
0.2433	0.025
0.2466	0.025
0.2500	0.025
0.2533	0.025
0.2566	0.025
0.2600	0.025
0.2633	0.025
0.2666	0.025
0.2700	0.025
0.2733	0.025
0.2766	0.025
0.2800	0.025
0.2833	0.025
0.2866	0.025
0.2900	0.025
0.2933	0.025
0.2966	0.025
0.3000	0.025
0.3033	0.025
0.3066	0.025
0.3100	0.025
0.3133	0.028
0.3166	0.025
0.3200	0.025

0.3233	0.022
0.3266	0.025
0.3300	0.025
0.3333	0.025
0.3500	0.025
0.3666	0.022
0.3833	0.025
0.4000	0.025
0.4166	0.025
0.4333	0.025
0.4500	0.025
0.4666	0.022
0.4833	0.022
0.5000	0.022
0.5166	0.022
0.5333	0.022
0.5500	0.022
0.5666	0.022
0.5833	0.022
0.6000	0.022
0.6166	0.022
0.6333	0.022
0.6500	0.022
0.6666	0.022
0.6833	0.022
0.7000	0.022
0.7166	0.025
0.7333	0.022
0.7500	0.028

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                          A Q T E S O L V   R E S U L T S
                                   Version 1.10

09/25/92                                                                13:56:25

================================================================================
                                TEST DESCRIPTION

Data set........... a:\mw1t2.in
Data set title..... EAFB - Monitoring Well 1, Test 2

Knowns and Constants:
   No. of data points................... 122
   Radius of well casing............... 0.08333
   Radius of well...................... 0.3333
   Aquifer saturated thickness......... 9.6
   Well screen length.................. 9.6
   Static height of water in well...... 9.6
   Log(Re/Rw).......................... 2.536
   A, B, C.............................  0.000,  0.000,  1.931

================================================================================
                               ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)

================================================================================
                        RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

              Estimate
   K  =   4.8760E-002
   y0 =   5.2140E-303

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

TYPE CURVE DATA

     K  = 4.87601E-002
     y0 = 6.30642E+000

   Time       Drawdown      Time      Drawdown      Time      Drawdown
 ----------  ----------  ----------  ----------  ----------  ----------
 0.000E+000  6.306E+000  2.000E-001  1.519E-004
```


EAFB - Monitoring Well 1, Test 2
K = 0.04876 ft/min
y0 = 6.306 ft
Displacement (ft)
10.
1.
0.1
0.01
0.
0.04
0.08
0.12
0.16
0.2
Time (min)

[illegible]

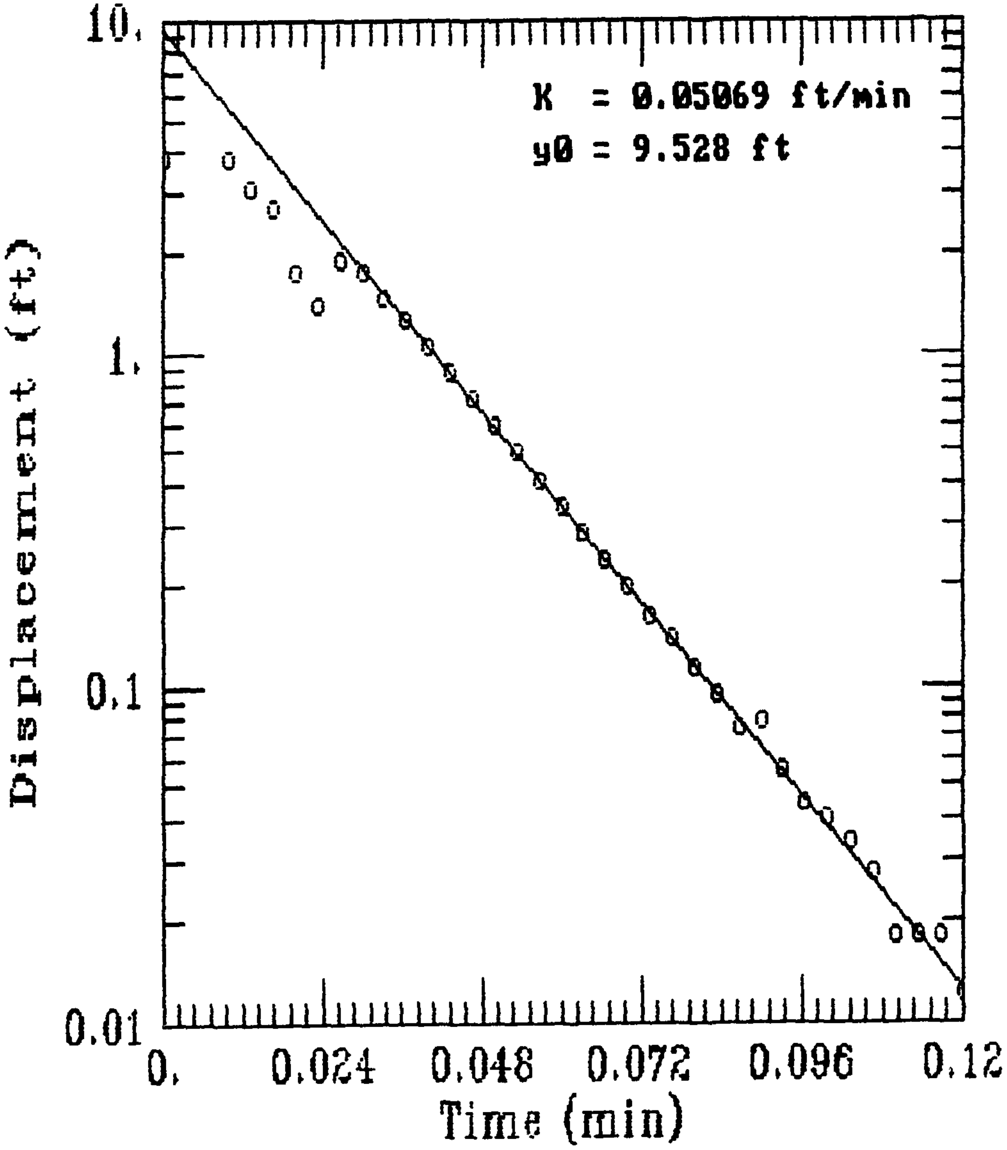
```
         SE1000C
   Environmental Logger
       09/02 11:46

  Unit# 00856  Test 3

Setups:          INPUT  1
------------     ---------
Type             Level (F)
Mode             TOC
I.D.             00000

Reference           0.000
Linearity           0.000
Scale factor       10.010
Offset             -0.130
Delay mSEC         50.000

Step 0  09/02 11:25:14

Elapsed Time     INPUT  1
------------     ---------
   0.0000           0.031
   0.0033           0.018
   0.0066          -0.031
   0.0100          -0.091
   0.0133           3.772
   0.0166           3.082
   0.0200           2.701
   0.0233           1.772
   0.0266           1.394
   0.0300           1.882
   0.0333           1.753
   0.0366           1.473
   0.0400           1.262
   0.0433           1.057
   0.0466           0.878
   0.0500           0.733
   0.0533           0.610
   0.0566           0.510
   0.0600           0.415
   0.0633           0.346
   0.0666           0.286
   0.0700           0.236
   0.0733           0.198
   0.0766           0.163
   0.0800           0.138
   0.0833           0.113
   0.0866           0.094
   0.0900           0.075
   0.0933           0.078
   0.0966           0.056
   0.1000           0.044
   0.1033           0.040
   0.1066           0.034
   0.1100           0.028
   0.1133           0.018
   0.1166           0.018
   0.1200           0.018
```

0.1233	0.012
0.1266	0.012
0.1300	0.009
0.1333	0.009
0.1366	0.009
0.1400	0.009
0.1433	0.009
0.1466	0.006
0.1500	0.009
0.1533	0.003
0.1566	0.006
0.1600	0.006
0.1633	0.009
0.1666	0.009
0.1700	0.006
0.1733	0.000
0.1766	0.006
0.1800	0.006
0.1833	0.006
0.1866	0.006
0.1900	0.006
0.1933	0.009
0.1966	0.006
0.2000	0.006
0.2033	0.003
0.2066	0.006
0.2100	0.006
0.2133	0.006
0.2166	0.006
0.2200	0.006
0.2233	0.006
0.2266	0.006
0.2300	0.006
0.2333	0.006
0.2366	0.006
0.2400	0.006
0.2433	0.006
0.2466	0.006
0.2500	0.006
0.2533	0.006
0.2566	0.006
0.2600	0.006
0.2633	0.006
0.2666	0.006
0.2700	0.006
0.2733	0.006
0.2766	0.006
0.2800	0.006
0.2833	0.006
0.2866	0.006
0.2900	0.006
0.2933	0.006
0.2966	0.006
0.3000	0.006
0.3033	0.006
0.3066	0.006
0.3100	0.006
0.3133	0.003
0.3166	0.006
0.3200	0.003

0.3233	0.006
0.3266	0.003
0.3300	0.003
0.3333	0.006
0.3500	0.003
0.3666	0.003
0.3833	0.003
0.4000	0.003
0.4166	0.003
0.4333	0.006
0.4500	0.003
0.4666	0.003
0.4833	0.003
0.5000	0.003
0.5166	0.000
0.5333	0.000
0.5500	0.003
0.5666	0.003
0.5833	0.003
0.6000	0.003
0.6166	0.003
0.6333	0.003
0.6500	0.003
0.6666	0.003
0.6833	0.003
0.7000	0.003
0.7166	0.003
0.7333	0.003
0.7500	0.003
0.7666	0.003
0.7833	0.003
0.8000	0.003
0.8166	0.003
0.8333	0.000
0.8500	0.003
0.8666	0.000
0.8833	0.003
0.9000	0.000
0.9166	0.000
0.9333	0.000
0.9500	0.000
0.9666	0.003

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                    A Q T E S O L V   R E S U L T S
                              Version  1.10

09/25/92                                                               14:07:19

================================================================================
                              TEST DESCRIPTION

Data set........... a:\mw1t3.in
Data set title..... EAFB - Monitoring Well 1, Test 3

Knowns and Constants:
   No. of data points.................. 126
   Radius of well casing............... 0.08333
   Radius of well...................... 0.3333
   Aquifer saturated thickness......... 9.6
   Well screen length.................. 9.6
   Static height of water in well...... 9.6
   Log(Re/Rw).......................... 2.536
   A, B, C.............................  0.000,  0.000,  1.931

================================================================================
                              ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)

================================================================================
                      RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

            Estimate
   K  =   4.0944E-002
   y0 =   5.2140E-303


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>


TYPE CURVE DATA

     K  = 5.06885E-002
     y0 = 9.52796E+000

   Time       Drawdown       Time       Drawdown       Time       Drawdown
 ----------  ----------   ----------  ----------   ----------  ----------
 0.000E+000  9.528E+000   1.200E-001  1.255E-002
```

EAFB - Monitoring Well 1, Test 3



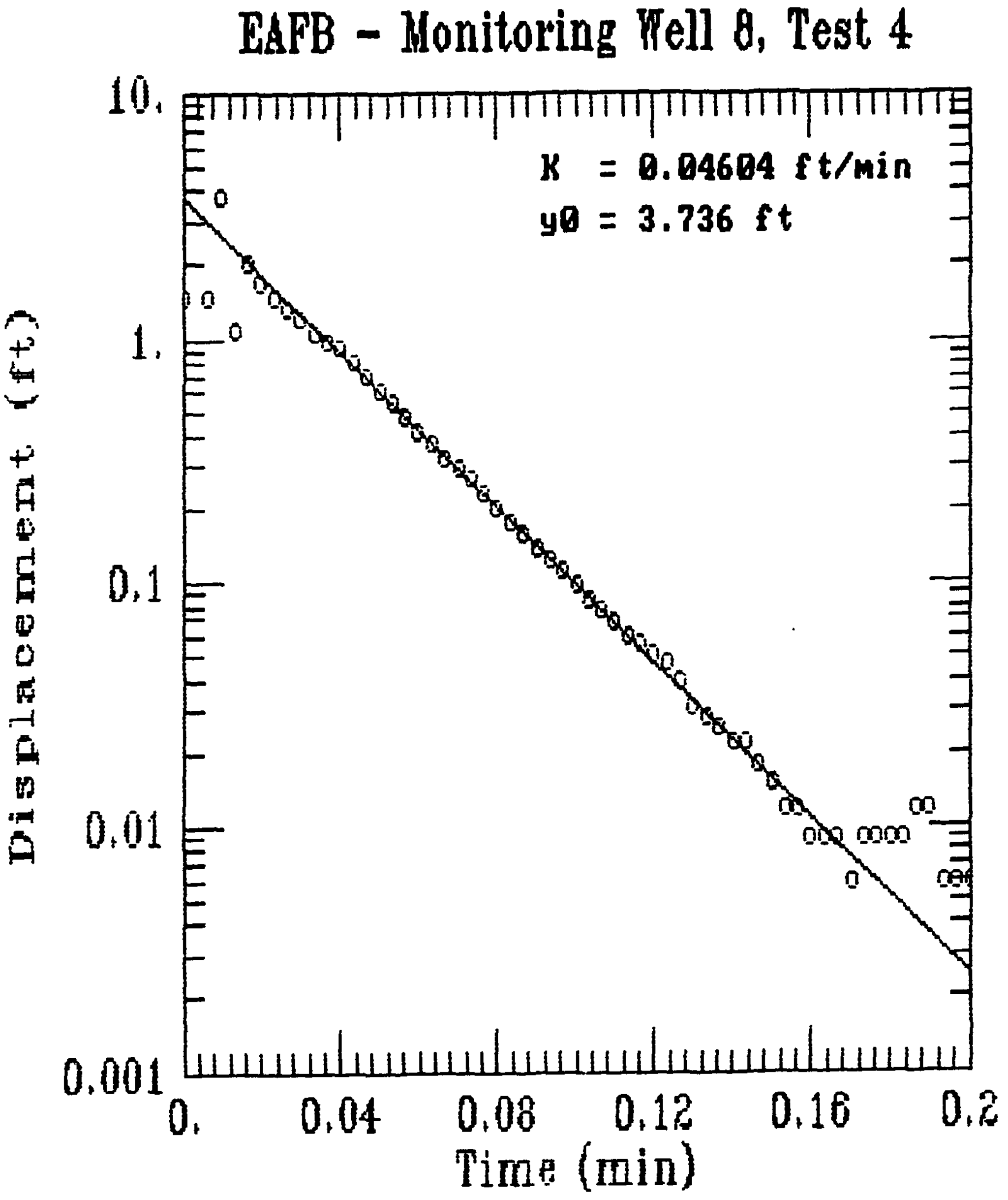
MWO 1- 120

```
          SE1000C
   Environmental Logger
       09/02 13:52

Unit# 00856   Test 4

Setups:          INPUT  1
------------     ---------
Type             Level (F)
Mode             TOC
I.D.             00000

Reference           0.000
Linearity           0.000
Scale factor       10.010
Offset             -0.130
Delay mSEC         50.000

Step 0   09/02 12:50:11

Elapsed Time     INPUT  1
------------     ---------
   0.0000           0.000
   0.0033          -0.012
   0.0066           1.511
   0.0100           3.806
   0.0133           1.086
   0.0166           2.008
   0.0200           1.687
   0.0233           1.467
   0.0266           1.335
   0.0300           1.212
   0.0333           1.057
   0.0366           0.982
   0.0400           0.922
   0.0433           0.793
   0.0466           0.689
   0.0500           0.613
   0.0533           0.544
   0.0566           0.472
   0.0600           0.418
   0.0633           0.371
   0.0666           0.330
   0.0700           0.295
   0.0733           0.264
   0.0766           0.229
   0.0800           0.201
   0.0833           0.176
   0.0866           0.157
   0.0900           0.138
   0.0933           0.122
   0.0966           0.110
   0.1000           0.097
   0.1033           0.085
   0.1066           0.075
   0.1100           0.069
   0.1133           0.059
   0.1166           0.056
   0.1200           0.050
```

0.1233	0.047
0.1266	0.040
0.1300	0.031
0.1333	0.028
0.1366	0.025
0.1400	0.022
0.1433	0.022
0.1466	0.018
0.1500	0.015
0.1533	0.012
0.1566	0.012
0.1600	0.009
0.1633	0.009
0.1666	0.009
0.1700	0.006
0.1733	0.009
0.1766	0.009
0.1800	0.009
0.1833	0.009
0.1866	0.012
0.1900	0.012
0.1933	0.006
0.1966	0.006
0.2000	0.006
0.2033	0.003
0.2066	0.006
0.2100	0.009
0.2133	0.012
0.2166	0.009
0.2200	0.009
0.2233	0.015
0.2266	0.015
0.2300	0.012
0.2333	0.012
0.2366	0.012
0.2400	0.012
0.2433	0.012
0.2466	0.012
0.2500	0.012
0.2533	0.012
0.2566	0.009
0.2600	0.012
0.2633	0.009
0.2666	0.012
0.2700	0.012
0.2733	0.009
0.2766	0.009
0.2800	0.009
0.2833	0.012
0.2866	0.009
0.2900	0.009
0.2933	0.009
0.2966	0.009
0.3000	0.006
0.3033	0.006
0.3066	0.006
0.3100	0.006
0.3133	0.009
0.3166	0.009
0.3200	0.009

0.3233	0.003
0.3266	0.003
0.3300	0.003
0.3333	0.003
0.3500	0.000
0.3666	0.003
0.3833	0.003
0.4000	0.000
0.4166	0.000
0.4333	0.000
0.4500	0.000
0.4666	0.003
0.4833	0.003
0.5000	0.000
0.5166	0.000
0.5333	0.000
0.5500	0.000
0.5666	0.000
0.5833	0.000
0.6000	0.000
0.6166	0.000
0.6333	-0.006
0.6500	-0.006
0.6666	-0.018
0.6833	0.000
0.7000	0.015
0.7166	0.018
0.7333	0.015
0.7500	0.015
0.7666	0.015
0.7833	0.015
0.8000	0.015
0.8166	0.015
0.8333	0.015
0.8500	0.015
0.8666	0.015
0.8833	0.015
0.9000	0.015
0.9166	0.015
0.9333	0.015
0.9500	0.015
0.9666	0.018
0.9833	0.015
1.0000	0.015
1.2000	0.012
1.4000	-0.006
1.6000	0.012

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                      A Q T E S O L V    R E S U L T S
                                Version  1.10

09/25/92                                                                14:21:49

================================================================================
                              TEST DESCRIPTION

Data set........... a:\mw8t4.in
Data set title..... EAFB - Monitoring Well 8, Test 4

Knowns and Constants:
   No. of data points.................. 124
   Radius of well casing............... 0.08333
   Radius of well...................... 0.3333
   Aquifer saturated thickness......... 5.77
   Well screen length.................. 5.77
   Static height of water in well...... 5.77
   Log(Re/Rw).......................... 2.097
   A, B, C.............................  0.000,  0.000,  1.576

================================================================================
                              ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)

================================================================================
                      RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   3.2469E-003
   y0 =   5.2140E-303


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>


TYPE CURVE DATA

     K  = 4.60367E-002
     y0 = 3.73594E+000

   Time       Drawdown      Time       Drawdown      Time       Drawdown
----------   ----------  ----------   ----------  ----------   ----------
0.000E+000   3.736E+000  2.000E-001   2.534E-003
```



EAFB - Monitoring Well 8, Test 4

MW8 CNT YEN

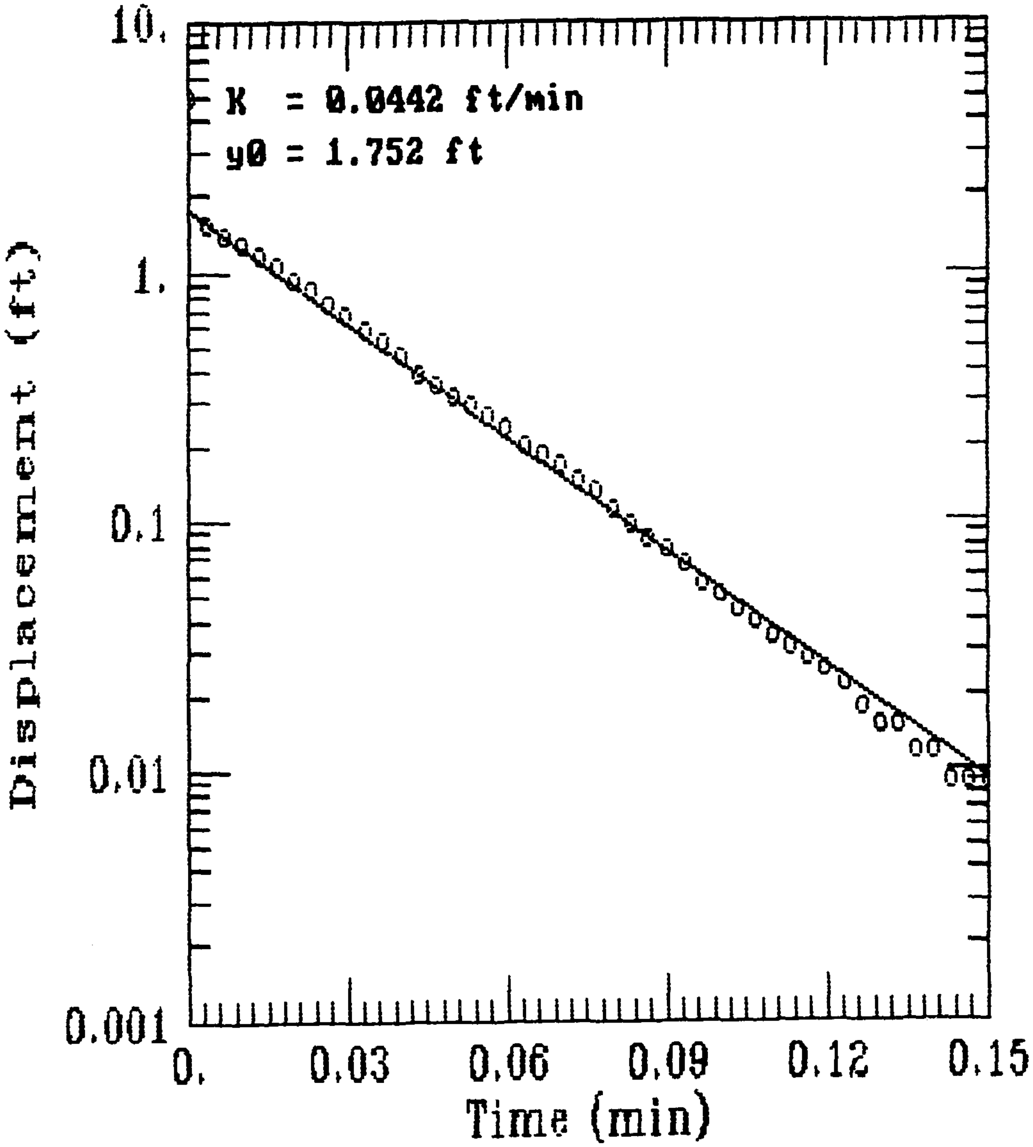
```
          SE1000C
   Environmental Logger
       09/02 13:57

  Unit# 00856  Test 5

Setups:         INPUT  1
------------    ---------
Type            Level (F)
Mode            TOC
I.D.            00000

Reference          0.000
Linearity          0.000
Scale factor      10.010
Offset            -0.130
Delay mSEC        50.000

Step 0  09/02 12:55:50

Elapsed Time    INPUT  1
------------    ---------
   0.0000         -0.006
   0.0033          0.034
   0.0066          0.031
   0.0100          0.566
   0.0133          5.003
   0.0166         -0.349
   0.0200          1.974
   0.0233          1.539
   0.0266          1.394
   0.0300          1.294
   0.0333          1.155
   0.0366          1.045
   0.0400          0.932
   0.0433          0.853
   0.0466          0.733
   0.0500          0.673
   0.0533          0.591
   0.0566          0.522
   0.0600          0.453
   0.0633          0.393
   0.0666          0.352
   0.0700          0.318
   0.0733          0.289
   0.0766          0.261
   0.0800          0.236
   0.0833          0.204
   0.0866          0.188
   0.0900          0.166
   0.0933          0.148
   0.0966          0.132
   0.1000          0.110
   0.1033          0.097
   0.1066          0.085
   0.1100          0.075
   0.1133          0.066
   0.1166          0.056
   0.1200          0.050
```

0.1233	0.044
0.1266	0.040
0.1300	0.034
0.1333	0.031
0.1366	0.028
0.1400	0.025
0.1433	0.022
0.1466	0.018
0.1500	0.015
0.1533	0.015
0.1566	0.012
0.1600	0.012
0.1633	0.009
0.1666	0.009
0.1700	0.009
0.1733	0.006
0.1766	0.006
0.1800	0.006
0.1833	0.003
0.1866	0.003
0.1900	0.003
0.1933	0.003
0.1966	0.003
0.2000	0.003
0.2033	0.000
0.2066	0.000
0.2100	0.000
0.2133	-0.003
0.2166	0.000
0.2200	-0.003
0.2233	-0.003
0.2266	-0.006
0.2300	0.000
0.2333	0.000
0.2366	0.003
0.2400	0.000
0.2433	0.003
0.2466	0.003
0.2500	0.000
0.2533	0.000
0.2566	0.000
0.2600	0.000
0.2633	0.000
0.2666	0.000
0.2700	0.000
0.2733	0.000
0.2766	0.000
0.2800	0.000
0.2833	0.000
0.2866	0.000
0.2900	0.003
0.2933	0.000
0.2966	0.000
0.3000	0.003
0.3033	0.003
0.3066	0.000
0.3100	0.000
0.3133	0.000
0.3166	0.000
0.3200	0.003

0.3233	0.000
0.3266	0.000
0.3300	0.000
0.3333	0.000
0.3500	0.003
0.3666	0.003
0.3833	-0.003
0.4000	-0.003
0.4166	0.003
0.4333	0.003
0.4500	0.003
0.4666	0.003
0.4833	0.000
0.5000	0.003
0.5166	0.003

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                      A Q T E S O L V   R E S U L T S
                               Version  1.10

09/25/92                                                                14:39:47

================================================================================
                                TEST DESCRIPTION

Data set........... a:\mw8t5.in
Data set title..... EAFB - Monitoring Well 8, Test 5

Knowns and Constants:
   No. of data points.................. 69
   Radius of well casing............... 0.08333
   Radius of well...................... 0.3333
   Aquifer saturated thickness......... 5.77
   Well screen length.................. 5.77
   Static height of water in well...... 5.77
   Log(Re/Rw).......................... 2.097
   A, B, C.............................  0.000,  0.000,  1.576

================================================================================
                                ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)

================================================================================
                        RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   4.4200E-002
   y0 =   0.0000E+000


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>


TYPE CURVE DATA

     K  = 4.42004E-002
     y0 = 1.75198E+000

   Time       Drawdown       Time       Drawdown       Time       Drawdown
----------  ----------    ----------  ----------    ----------  ----------
0.000E+000  1.752E+000    1.500E-001  9.160E-003
```

EAFB - Monitoring Well 8, Test 5



MW 51 [illegible]

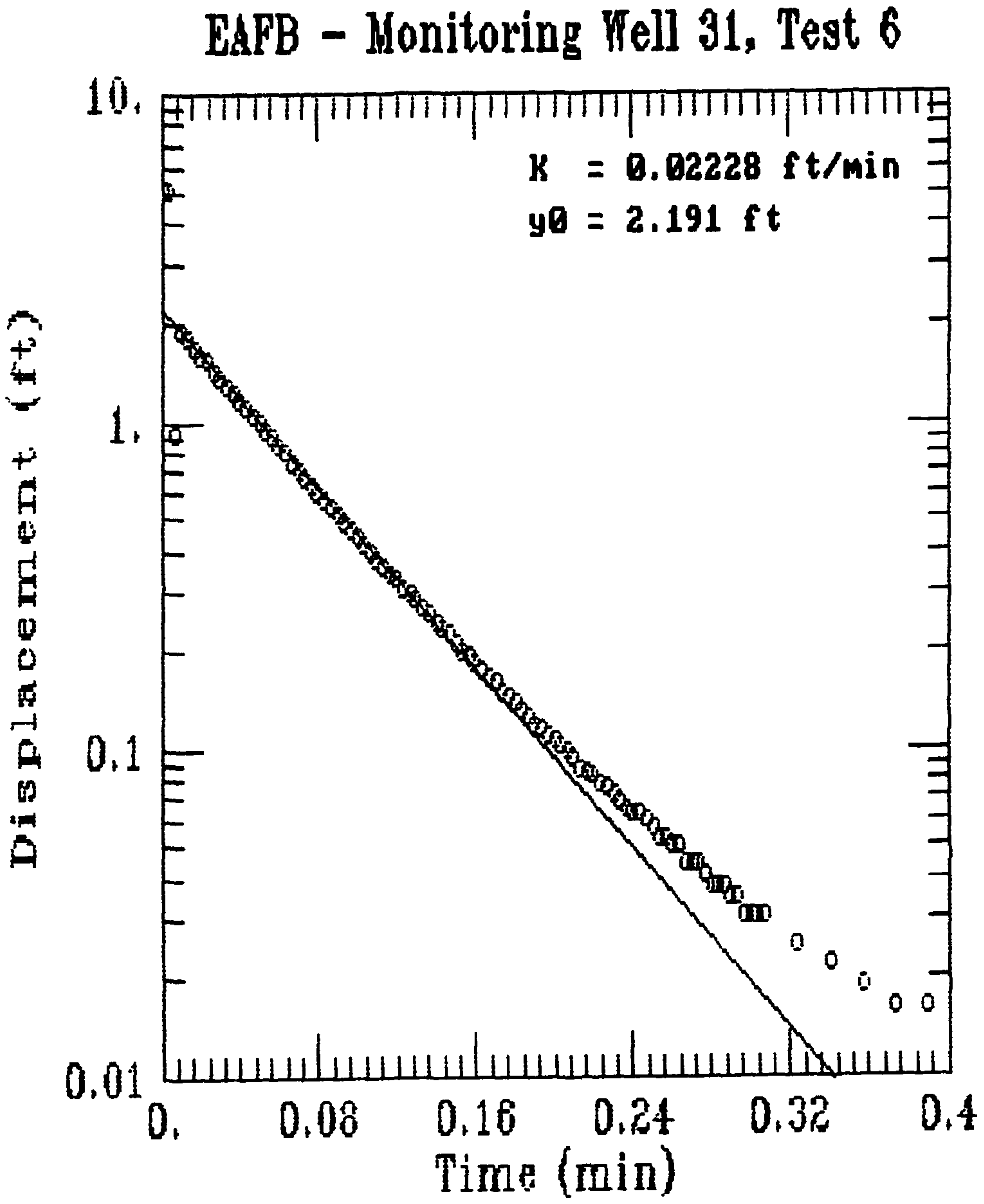
```
        SE1000C
  Environmental Logger
      09/02 14:00

  nit# 00856  Test 6

Setups:          INPUT  1
------------     ---------
Type             Level (F)
Mode             TOC
I.D.             00000

Reference           0.000
Linearity           0.000
Scale factor       10.010
Offset             -0.130
Delay mSEC         50.000

Step 0  09/02 13:23:23

Elapsed Time     INPUT  1
------------     ---------
   0.0000           0.012
   0.0033           0.009
   0.0066           0.012
   0.0100           0.012
   0.0133           0.009
   0.0166           0.012
   0.0200           0.012
   0.0233           0.006
   0.0266           0.103
   0.0300           5.119
   0.0333           0.919
   0.0366           1.898
   0.0400           1.826
   0.0433           1.694
   0.0466           1.605
   0.0500           1.546
   0.0533           1.435
   0.0566           1.376
   0.0600           1.303
   0.0633           1.234
   0.0666           1.171
   0.0700           1.111
   0.0733           1.051
   0.0766           0.998
   0.0800           0.947
   0.0833           0.897
   0.0866           0.853
   0.0900           0.806
   0.0933           0.765
   0.0966           0.727
   0.1000           0.689
   0.1033           0.654
   0.1066           0.623
   0.1100           0.591
   0.1133           0.560
   0.1166           0.532
   0.1200           0.503
```

0.1233	0.481
0.1266	0.456
0.1300	0.434
0.1333	0.412
0.1366	0.393
0.1400	0.371
0.1433	0.355
0.1466	0.340
0.1500	0.321
0.1533	0.308
0.1566	0.292
0.1600	0.280
0.1633	0.267
0.1666	0.255
0.1700	0.242
0.1733	0.233
0.1766	0.220
0.1800	0.210
0.1833	0.201
0.1866	0.192
0.1900	0.185
0.1933	0.176
0.1966	0.170
0.2000	0.160
0.2033	0.154
0.2066	0.147
0.2100	0.141
0.2133	0.135
0.2166	0.129
0.2200	0.125
0.2233	0.119
0.2266	0.116
0.2300	0.110
0.2333	0.107
0.2366	0.103
0.2400	0.097
0.2433	0.094
0.2466	0.091
0.2500	0.088
0.2533	0.085
0.2566	0.081
0.2600	0.078
0.2633	0.075
0.2666	0.072
0.2700	0.072
0.2733	0.069
0.2766	0.066
0.2800	0.062
0.2833	0.062
0.2866	0.059
0.2900	0.059
0.2933	0.053
0.2966	0.053
0.3000	0.053
0.3033	0.050
0.3066	0.047
0.3100	0.047
0.3133	0.047
0.3166	0.044
0.3200	0.044

0.3233	0.040
0.3266	0.040
0.3300	0.040
0.3333	0.040
0.3500	0.034
0.3666	0.031
0.3833	0.028
0.4000	0.025
0.4166	0.025
0.4333	0.022
0.4500	0.018
0.4666	0.018
0.4833	0.015
0.5000	0.018
0.5166	0.018
0.5333	0.018
0.5500	0.015
0.5666	0.015
0.5833	0.015
0.6000	0.015
0.6166	0.015
0.6333	0.015
0.6500	0.015
0.6666	0.015
0.6833	0.015
0.7000	0.015
0.7166	0.015
0.7333	0.015
0.7500	0.015
0.7666	0.015
0.7833	0.015
0.8000	0.015
0.8166	0.015
0.8333	0.015
0.8500	0.015
0.8666	0.015
0.8833	0.015
0.9000	0.015
0.9166	0.015
0.9333	0.015
0.9500	0.015
0.9666	0.015
0.9833	0.012
1.0000	0.012

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                          A Q T E S O L V   R E S U L T S
                                   Version  1.10

09/25/92                                                                15:05:42

================================================================================
                                TEST DESCRIPTION

Data set........... a:\mw31t6.in
Data set title..... EAFB - Monitoring Well 31, Test 6

Knowns and Constants:
   No. of data points.................. 132
   Radius of well casing............... 0.08333
   Radius of well...................... 0.3333
   Aquifer saturated thickness......... 5.42
   Well screen length.................. 5
   Static height of water in well...... 5.42
   Log(Re/Rw).......................... 2.023
   A, B, C.............................  0.000,  0.000,  1.498

================================================================================
                               ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)

================================================================================
                        RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   2.2983E-002
   y0 =   0.0000E+000


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>


TYPE CURVE DATA

     K  = 2.29830E-002
     y0 = 2.27856E+000

   Time       Drawdown       Time       Drawdown       Time       Drawdown
----------  ----------  ----------  ----------  ----------  ----------
0.000E+000  2.279E+000  4.000E-001  3.278E-003


TYPE CURVE DATA

     K  = 2.22808E-002
     y0 = 2.19072E+000
```

```
   Time        Drawdown        Time        Drawdown        Time        Drawdown
----------    ----------    ----------    ----------    ----------    ----------
0.000E+000    2.191E+000    4.000E-001    3.849E-003
```


EAFB - Monitoring Well 31, Test 6
K = 0.02228 ft/min
y0 = 2.191 ft
Displacement (ft)
10.
1.
0.1
0.01
0.
0.08
0.16
0.24
0.32
0.4
Time (min)

MW 31 2ND TEST

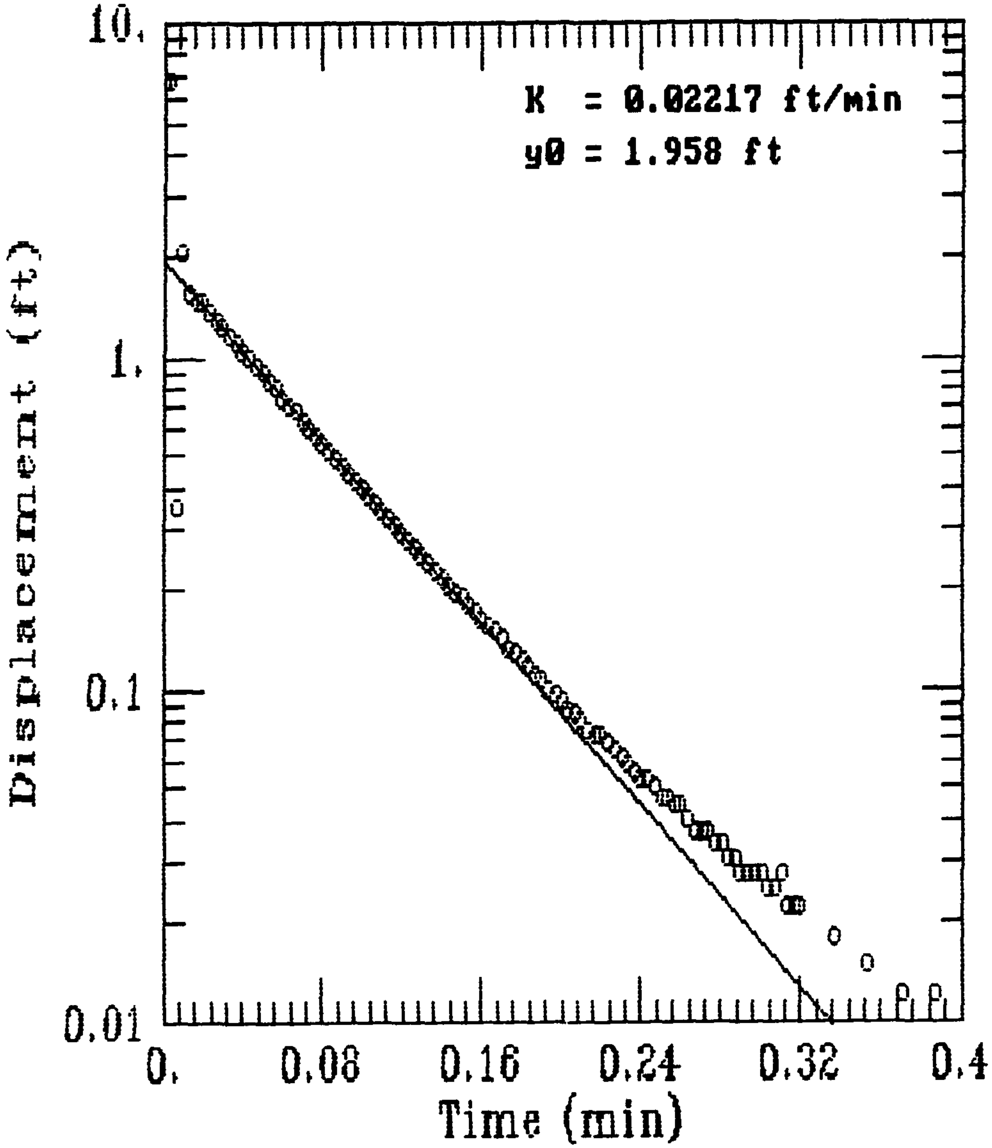
```
        SE1000C
  Environmental Logger
      09/02 14:02

 Unit# 00856  Test 7

Setups:         INPUT  1
------------    ---------
Type            Level (F)
Mode            TOC
I.D.            00000

Reference          0.000
Linearity          0.000
Scale factor      10.010
Offset            -0.130
Delay mSEC        50.000

Step 0  09/02 13:28:51

Elapsed Time    INPUT  1
------------    ---------
   0.0000          -0.012
   0.0033          -0.015
   0.0066          -0.018
   0.0100          -0.015
   0.0133          -0.166
   0.0166           6.769
   0.0200           0.355
   0.0233           2.071
   0.0266           1.549
   0.0300           1.476
   0.0333           1.457
   0.0366           1.372
   0.0400           1.300
   0.0433           1.212
   0.0466           1.171
   0.0500           1.111
   0.0533           1.051
   0.0566           0.998
   0.0600           0.938
   0.0633           0.887
   0.0666           0.850
   0.0700           0.802
   0.0733           0.749
   0.0766           0.714
   0.0800           0.692
   0.0833           0.645
   0.0866           0.610
   0.0900           0.579
   0.0933           0.547
   0.0966           0.519
   0.1000           0.491
   0.1033           0.466
   0.1066           0.443
   0.1100           0.418
   0.1133           0.399
   0.1166           0.381
   0.1200           0.358
```

0.1233	0.340
0.1266	0.324
0.1300	0.308
0.1333	0.292
0.1366	0.280
0.1400	0.264
0.1433	0.251
0.1466	0.239
0.1500	0.229
0.1533	0.217
0.1566	0.204
0.1600	0.195
0.1633	0.188
0.1666	0.179
0.1700	0.170
0.1733	0.160
0.1766	0.154
0.1800	0.148
0.1833	0.141
0.1866	0.132
0.1900	0.129
0.1933	0.122
0.1966	0.116
0.2000	0.110
0.2033	0.107
0.2066	0.100
0.2100	0.097
0.2133	0.091
0.2166	0.088
0.2200	0.085
0.2233	0.081
0.2266	0.075
0.2300	0.072
0.2333	0.072
0.2366	0.069
0.2400	0.066
0.2433	0.062
0.2466	0.059
0.2500	0.056
0.2533	0.053
0.2566	0.053
0.2600	0.050
0.2633	0.047
0.2666	0.047
0.2700	0.044
0.2733	0.044
0.2766	0.040
0.2800	0.037
0.2833	0.037
0.2866	0.037
0.2900	0.034
0.2933	0.034
0.2966	0.031
0.3000	0.031
0.3033	0.028
0.3066	0.028
0.3100	0.028
0.3133	0.028
0.3166	0.025
0.3200	0.025

0.3233	0.028
0.3266	0.022
0.3300	0.022
0.3333	0.022
0.3500	0.018
0.3666	0.015
0.3833	0.012
0.4000	0.012
0.4166	0.009
0.4333	0.009
0.4500	0.009
0.4666	0.009
0.4833	0.006
0.5000	0.006
0.5166	0.006
0.5333	0.006
0.5500	0.006
0.5666	0.006
0.5833	0.006
0.6000	0.003
0.6166	0.006
0.6333	0.003
0.6500	0.003
0.6666	0.003
0.6833	0.003
0.7000	0.006
0.7166	0.003
0.7333	0.003
0.7500	0.003
0.7666	0.003
0.7833	0.003
0.8000	0.003
0.8166	0.003
0.8333	0.006
0.8500	0.003
0.8666	0.003
0.8833	0.003
0.9000	0.003
0.9166	0.003
0.9333	0.003
0.9500	0.003
0.9666	0.003
0.9833	0.003
1.0000	0.003
1.2000	0.000
1.4000	-0.003
1.6000	-0.006

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                        A Q T E S O L V    R E S U L T S
                                  Version  1.10

09/25/92                                                                15:20:24

================================================================================
                                TEST DESCRIPTION

Data set........... a:\mw31t7.in
Data set title..... EAFB - Monitoring Well 31, Test 7

Knowns and Constants:
   No. of data points.................. 136
   Radius of well casing............... 0.08333
   Radius of well...................... 0.3333
   Aquifer saturated thickness......... 5.42
   Well screen length.................. 5
   Static height of water in well...... 5.42
   Log(Re/Rw).......................... 2.023
   A, B, C.............................  0.000,  0.000,  1.498

================================================================================
                                ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)

================================================================================
                       RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

              Estimate
   K  =    9.9244E-003
   y0 =    0.0000E+000


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>


TYPE CURVE DATA

     K  = 2.21737E-002
     y0 = 1.95754E+000

   Time      Drawdown      Time      Drawdown      Time      Drawdown
----------  ----------  ----------  ----------  ----------  ----------
0.000E+000  1.958E+000  4.000E-001  3.546E-003
```

EAFB - Monitoring Well 31, Test 7



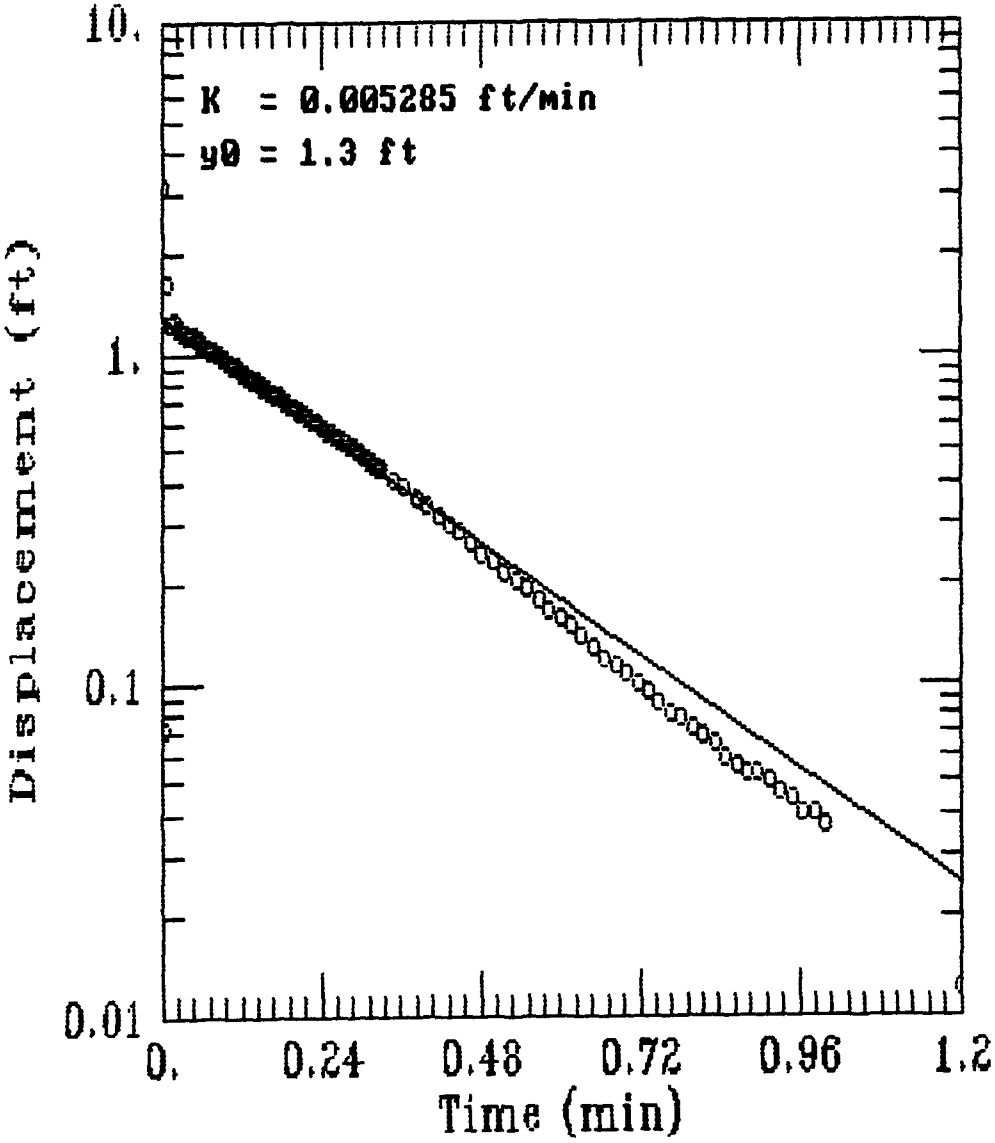
MW16 1st [illegible]

```
         SE1000C
  Environmental Logger
      09/02 18:49

  Unit# 00856  Test 8

Setups:         INPUT  1
------------    ---------
Type            Level (F)
Mode            TOC
I.D.            00000

Reference          0.000
Linearity          0.000
Scale factor      10.010
Offset            -0.130
Delay mSEC        50.000

Step 0  09/02 14:57:32

Elapsed Time    INPUT  1
------------    ---------
   0.0000         -0.056
   0.0033          3.167
   0.0066          0.072
   0.0100          1.605
   0.0133          1.228
   0.0166          1.212
   0.0200          1.240
   0.0233          1.202
   0.0266          1.190
   0.0300          1.180
   0.0333          1.168
   0.0366          1.155
   0.0400          1.136
   0.0433          1.136
   0.0466          1.124
   0.0500          1.130
   0.0533          1.095
   0.0566          1.089
   0.0600          1.073
   0.0633          1.064
   0.0666          1.051
   0.0700          1.042
   0.0733          1.029
   0.0766          1.017
   0.0800          1.007
   0.0833          0.991
   0.0866          0.988
   0.0900          0.976
   0.0933          0.969
   0.0966          0.957
   0.1000          0.947
   0.1033          0.938
   0.1066          0.928
   0.1100          0.919
   0.1133          0.910
   0.1166          0.900
   0.1200          0.894
```

0.1233	0.869
0.1266	0.865
0.1300	0.856
0.1333	0.847
0.1366	0.837
0.1400	0.828
0.1433	0.821
0.1466	0.812
0.1500	0.802
0.1533	0.793
0.1566	0.787
0.1600	0.777
0.1633	0.771
0.1666	0.762
0.1700	0.752
0.1733	0.746
0.1766	0.739
0.1800	0.730
0.1833	0.724
0.1866	0.714
0.1900	0.708
0.1933	0.699
0.1966	0.692
0.2000	0.686
0.2033	0.677
0.2066	0.670
0.2100	0.664
0.2133	0.654
0.2166	0.648
0.2200	0.642
0.2233	0.636
0.2266	0.629
0.2300	0.623
0.2333	0.617
0.2366	0.610
0.2400	0.601
0.2433	0.598
0.2466	0.591
0.2500	0.582
0.2533	0.576
0.2566	0.569
0.2600	0.563
0.2633	0.560
0.2666	0.554
0.2700	0.547
0.2733	0.541
0.2766	0.535
0.2800	0.529
0.2833	0.522
0.2866	0.516
0.2900	0.513
0.2933	0.506
0.2966	0.500
0.3000	0.494
0.3033	0.488
0.3066	0.481
0.3100	0.478
0.3133	0.472
0.3166	0.466
0.3200	0.459

0.3233	0.456
0.3266	0.450
0.3300	0.447
0.3333	0.440
0.3500	0.412
0.3666	0.390
0.3833	0.365
0.4000	0.343
0.4166	0.321
0.4333	0.302
0.4500	0.283
0.4666	0.264
0.4833	0.245
0.5000	0.233
0.5166	0.217
0.5333	0.204
0.5500	0.192
0.5666	0.179
0.5833	0.166
0.6000	0.157
0.6166	0.148
0.6333	0.138
0.6500	0.129
0.6666	0.119
0.6833	0.113
0.7000	0.107
0.7166	0.100
0.7333	0.094
0.7500	0.088
0.7666	0.081
0.7833	0.078
0.8000	0.072
0.8166	0.069
0.8333	0.066
0.8500	0.059
0.8666	0.056
0.8833	0.053
0.9000	0.053
0.9166	0.050
0.9333	0.047
0.9500	0.044
0.9666	0.040
0.9833	0.040
1.0000	0.037
1.2000	0.012
1.4000	0.000
1.6000	-0.006
1.8000	-0.009
2.0000	-0.012
2.2000	-0.015
2.4000	-0.018

EAFB - Monitoring Well 16, Test 8



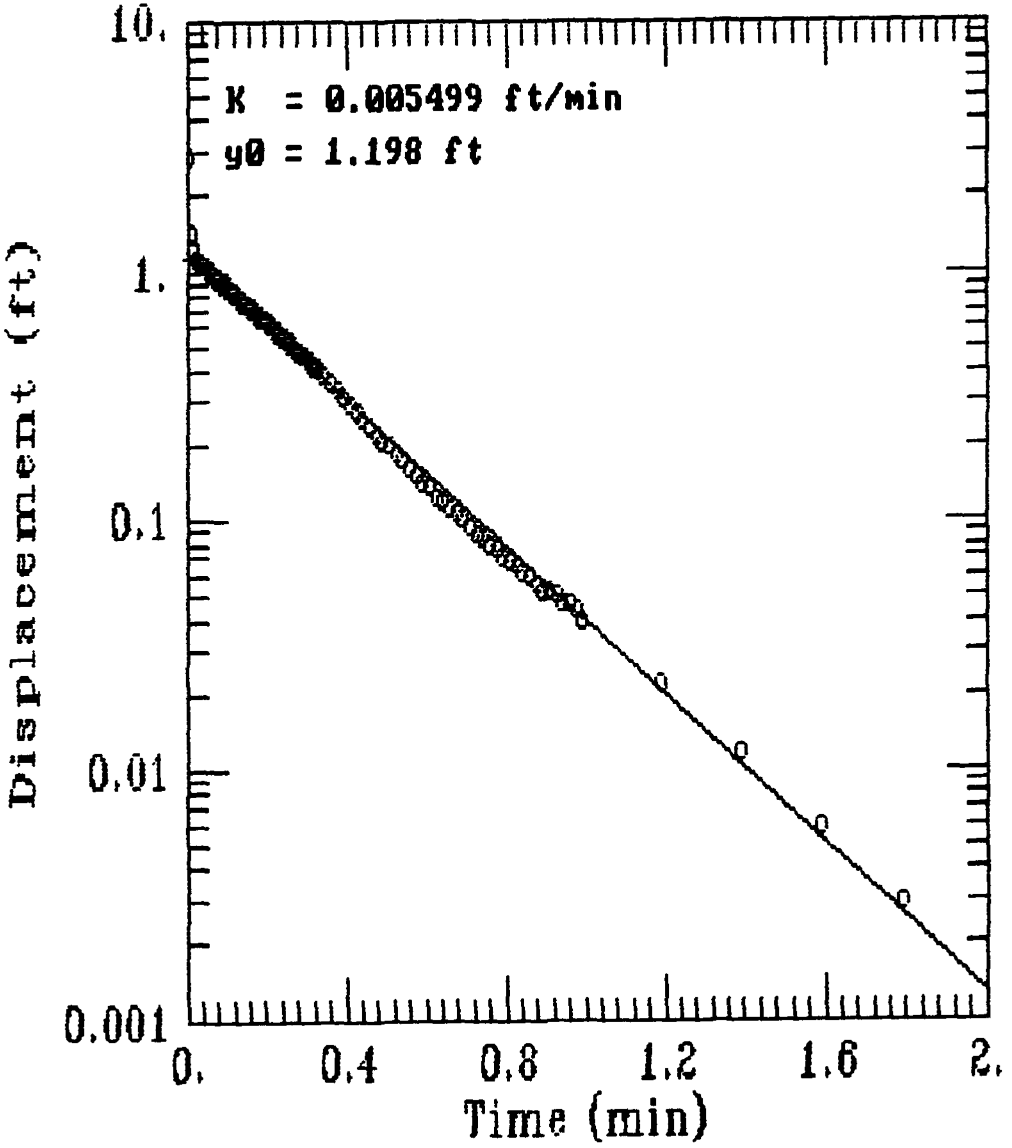
MW16 [illegible] TEST

```
        SE1000C
  Environmental Logger
      09/02 18:52

  Unit# 00856  Test 9

Setups:          INPUT  1
-------------    ---------
Type             Level (F)
Mode             TOC
I.D.             00000

Reference          0.000
Linearity          0.000
Scale factor      10.010
Offset            -0.130
Delay mSEC        50.000

Step 0  09/02 15:05:40

Elapsed Time     INPUT  1
-------------    ---------
    0.0000         0.000
    0.0033        -0.006
    0.0066         0.003
    0.0100         2.833
    0.0133        -1.791
    0.0166         1.416
    0.0200         1.259
    0.0233         1.190
    0.0266         1.146
    0.0300         1.124
    0.0333         1.108
    0.0366         1.105
    0.0400         1.089
    0.0433         1.080
    0.0466         1.061
    0.0500         1.051
    0.0533         1.039
    0.0566         1.029
    0.0600         1.017
    0.0633         1.007
    0.0666         0.995
    0.0700         0.982
    0.0733         0.973
    0.0766         0.963
    0.0800         0.950
    0.0833         0.941
    0.0866         0.928
    0.0900         0.919
    0.0933         0.910
    0.0966         0.900
    0.1000         0.891
    0.1033         0.881
    0.1066         0.872
    0.1100         0.862
    0.1133         0.853
    0.1166         0.843
    0.1200         0.834
```

0.1233	0.828
0.1266	0.818
0.1300	0.806
0.1333	0.796
0.1366	0.790
0.1400	0.784
0.1433	0.774
0.1466	0.768
0.1500	0.758
0.1533	0.749
0.1566	0.743
0.1600	0.733
0.1633	0.727
0.1666	0.717
0.1700	0.708
0.1733	0.702
0.1766	0.692
0.1800	0.689
0.1833	0.680
0.1866	0.673
0.1900	0.667
0.1933	0.658
0.1966	0.651
0.2000	0.642
0.2033	0.639
0.2066	0.629
0.2100	0.623
0.2133	0.617
0.2166	0.610
0.2200	0.601
0.2233	0.598
0.2266	0.588
0.2300	0.582
0.2333	0.576
0.2366	0.569
0.2400	0.563
0.2433	0.557
0.2466	0.551
0.2500	0.544
0.2533	0.538
0.2566	0.532
0.2600	0.529
0.2633	0.519
0.2666	0.513
0.2700	0.510
0.2733	0.503
0.2766	0.497
0.2800	0.491
0.2833	0.484
0.2866	0.481
0.2900	0.475
0.2933	0.469
0.2966	0.466
0.3000	0.459
0.3033	0.453
0.3066	0.450
0.3100	0.443
0.3133	0.437
0.3166	0.431
0.3200	0.428

0.3233	0.421
0.3266	0.418
0.3300	0.412
0.3333	0.409
0.3500	0.384
0.3666	0.358
0.3833	0.333
0.4000	0.314
0.4166	0.292
0.4333	0.273
0.4500	0.258
0.4666	0.242
0.4833	0.223
0.5000	0.210
0.5166	0.198
0.5333	0.185
0.5500	0.173
0.5666	0.163
0.5833	0.151
0.6000	0.144
0.6166	0.135
0.6333	0.125
0.6500	0.119
0.6666	0.113
0.6833	0.107
0.7000	0.100
0.7166	0.094
0.7333	0.088
0.7500	0.085
0.7666	0.078
0.7833	0.075
0.8000	0.072
0.8166	0.069
0.8333	0.066
0.8500	0.062
0.8666	0.059
0.8833	0.056
0.9000	0.053
0.9166	0.053
0.9333	0.050
0.9500	0.047
0.9666	0.047
0.9833	0.044
1.0000	0.040
1.2000	0.022
1.4000	0.012
1.6000	0.006
1.8000	0.003
2.0000	0.000
2.2000	0.000
2.4000	-0.003
2.6000	-0.003
2.8000	-0.003
3.0000	-0.006
3.2000	-0.006
3.4000	-0.009
3.6000	-0.006
3.8000	-0.006

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                      A Q T E S O L V    R E S U L T S
                               Version  1.10

09/25/92                                                                 16:24:39

===================================================================================
                              TEST DESCRIPTION

Data set........... a:\mw16t9.in
Data set title..... EAFB - Monitoring Well 16, Test 9

Knowns and Constants:
   No. of data points................... 141
   Radius of well casing................ 0.08333
   Radius of well....................... 0.3333
   Aquifer saturated thickness.......... 3.76
   Well screen length................... 3.76
   Static height of water in well....... 3.76
   Log(Re/Rw)........................... 1.744
   A, B, C..............................  0.000,  0.000,  1.348

===================================================================================
                             ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)

===================================================================================
                      RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

              Estimate
   K  =    6.2772E-003
   y0 =   -5.5992E-282


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>


TYPE CURVE DATA

     K  = 5.49911E-003
     y0 = 1.19822E+000

   Time        Drawdown        Time        Drawdown        Time        Drawdown
----------   ----------    ----------   ----------    ----------   ----------
0.000E+000   1.198E+000    2.000E+000   1.295E-003
```



EAFB - Monitoring Well 16, Test 9

```
MW15 TEST1
        SE1000C
  Environmental Logger
      09/02 18:34

 nit# 00856  Test 10

Setups:           INPUT  1
------------      ---------
Type              Level (F)
Mode              TOC
I.D.              00000

Reference            0.000
Linearity            0.000
Scale factor        10.010
Offset              -0.130
Delay mSEC          50.000

Step 0  09/02 15:27:52

Elapsed Time      INPUT  1
------------      ---------
     0.0000          -0.072
     0.0033          -0.025
     0.0066           2.912
     0.0100           0.330
     0.0133           1.505
     0.0166           1.193
     0.0200           1.183
     0.0233           0.979
     0.0266           0.850
     0.0300           0.834
     0.0333           0.758
     0.0366           0.654
     0.0400           0.604
     0.0433           0.569
     0.0466           0.506
     0.0500           0.450
     0.0533           0.412
     0.0566           0.355
     0.0600           0.333
     0.0633           0.295
     0.0666           0.267
     0.0700           0.270
     0.0733           0.210
     0.0766           0.195
     0.0800           0.179
     0.0833           0.163
     0.0866           0.154
     0.0900           0.135
     0.0933           0.122
     0.0966           0.110
     0.1000           0.100
     0.1033           0.091
     0.1066           0.085
     0.1100           0.081
     0.1133           0.075
     0.1166           0.066
     0.1200           0.059
```

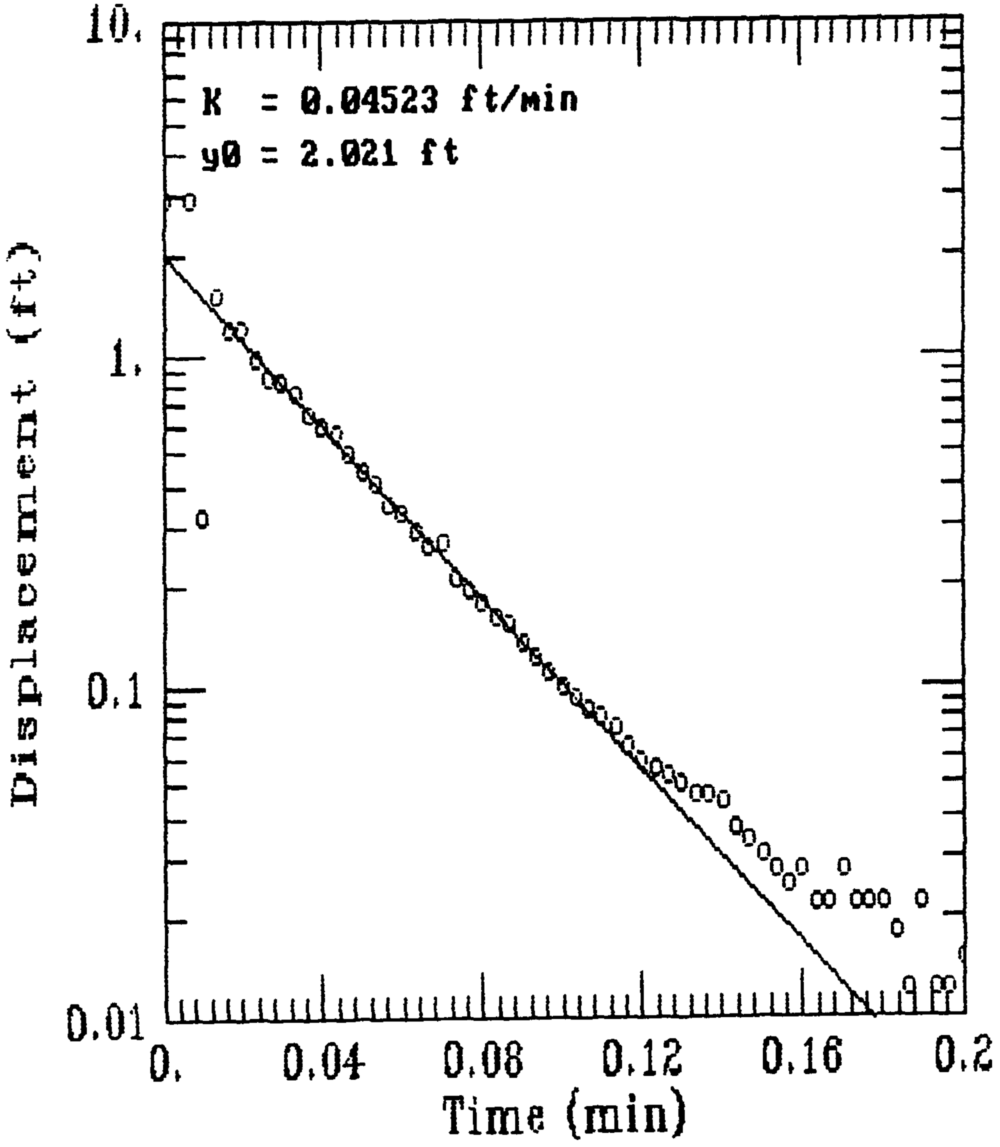
0.1233	0.056
0.1266	0.053
0.1300	0.050
0.1333	0.047
0.1366	0.047
0.1400	0.044
0.1433	0.037
0.1466	0.034
0.1500	0.031
0.1533	0.028
0.1566	0.025
0.1600	0.028
0.1633	0.022
0.1666	0.022
0.1700	0.028
0.1733	0.022
0.1766	0.022
0.1800	0.022
0.1833	0.018
0.1866	0.012
0.1900	0.022
0.1933	0.012
0.1966	0.012
0.2000	0.015
0.2033	0.018
0.2066	0.015
0.2100	0.015
0.2133	0.009
0.2166	0.012
0.2200	0.006
0.2233	0.009
0.2266	0.009
0.2300	0.009
0.2333	0.009
0.2366	0.009
0.2400	0.006
0.2433	0.003
0.2466	0.006
0.2500	0.009
0.2533	0.009
0.2566	0.009
0.2600	0.009
0.2633	0.009
0.2666	0.006
0.2700	0.006
0.2733	0.009
0.2766	0.003
0.2800	0.006
0.2833	0.006
0.2866	0.003
0.2900	0.006
0.2933	0.003
0.2966	0.006
0.3000	0.006
0.3033	0.003
0.3066	0.006
0.3100	0.003
0.3133	0.003
0.3166	0.006
0.3200	0.006

0.3233	0.006
0.3266	0.000
0.3300	-0.003
0.3333	0.003
0.3500	0.003
0.3666	0.003
0.3833	0.000
0.4000	0.003
0.4166	0.003
0.4333	0.003
0.4500	0.000
0.4666	0.000
0.4833	-0.003
0.5000	0.000
0.5166	0.003
0.5333	0.000
0.5500	0.003
0.5666	0.000
0.5833	0.003
0.6000	-0.003
0.6166	0.000
0.6333	0.003
0.6500	0.000
0.6666	0.000
0.6833	-0.003
0.7000	0.000
0.7166	-0.003
0.7333	-0.003
0.7500	0.000
0.7666	-0.003
0.7833	0.000
0.8000	-0.003
0.8166	-0.003
0.8333	-0.003
0.8500	0.003
0.8666	0.000
0.8833	0.000
0.9000	-0.003
0.9166	0.000
0.9333	-0.009
0.9500	0.000
0.9666	0.000
0.9833	-0.003
1.0000	-0.009
1.2000	-0.003
1.4000	0.003
1.6000	-0.012

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                       A Q T E S O L V    R E S U L T S
                                  Version  1.10

09/28/92                                                                09:18:22

================================================================================
                               TEST DESCRIPTION

Data set........... a:\mw15t10.in
Data set title..... EAFB - Monitoring Well 15, Test 10

Knowns and Constants:
   No. of data points.................. 108
   Radius of well casing............... 0.08333
   Radius of well...................... 0.3333
   Aquifer saturated thickness......... 4.22
   Well screen length.................. 4.22
   Static height of water in well...... 4.22
   Log(Re/Rw).......................... 1.836
   A, B, C.............................  0.000,  0.000,  1.409

================================================================================
                                ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)

================================================================================
                       RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   6.3189E-002
   y0 =   7.7468E-304


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>


TYPE CURVE DATA

     K  = 6.31889E-002
     y0 = 2.61070E+000

   Time       Drawdown       Time       Drawdown       Time       Drawdown
----------  ----------  ----------  ----------  ----------  ----------
0.000E+000  2.611E+000  2.000E-001  6.077E-004


TYPE CURVE DATA

     K  = 4.52290E-002
     y0 = 2.02127E+000
```

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	2.021E+000	2.000E-001	5.072E-003		

EAFB - Monitoring Well 15, Test 10



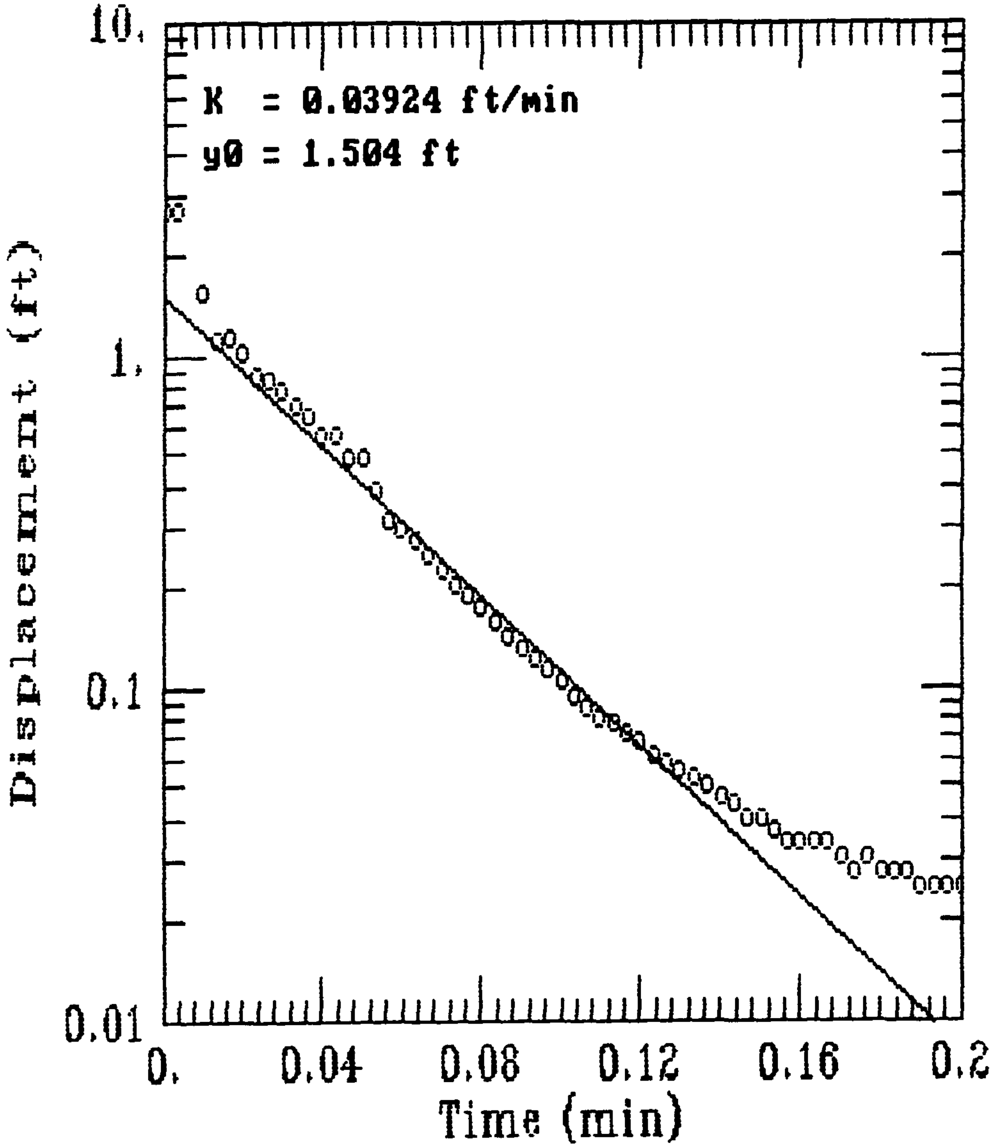
```
MW15 TEST2
        SE1000C
  Environmental Logger
      09/02 18:55

 Unit# 00856  Test 11

Setups:         INPUT  1
------------    ---------
Type            Level (F)
Mode            TOC
I.D.            00000

Reference          0.000
Linearity          0.000
Scale factor      10.010
Offset            -0.130
Delay mSEC        50.000

Step 0  09/02 15:32:43

Elapsed Time    INPUT  1
------------    ---------
   0.0000         -0.003
   0.0033         -0.003
   0.0066         -0.003
   0.0100          0.135
   0.0133          2.707
   0.0166         -1.057
   0.0200          1.524
   0.0233          1.114
   0.0266          1.117
   0.0300          1.007
   0.0333          0.869
   0.0366          0.856
   0.0400          0.780
   0.0433          0.717
   0.0466          0.648
   0.0500          0.579
   0.0533          0.569
   0.0566          0.494
   0.0600          0.494
   0.0633          0.393
   0.0666          0.314
   0.0700          0.302
   0.0733          0.280
   0.0766          0.251
   0.0800          0.229
   0.0833          0.207
   0.0866          0.188
   0.0900          0.173
   0.0933          0.157
   0.0966          0.144
   0.1000          0.132
   0.1033          0.122
   0.1066          0.113
   0.1100          0.103
   0.1133          0.094
   0.1166          0.088
   0.1200          0.081
```

0.1233	0.078
0.1266	0.072
0.1300	0.069
0.1333	0.062
0.1366	0.059
0.1400	0.056
0.1433	0.053
0.1466	0.050
0.1500	0.047
0.1533	0.044
0.1566	0.040
0.1600	0.040
0.1633	0.037
0.1666	0.034
0.1700	0.034
0.1733	0.034
0.1766	0.034
0.1800	0.031
0.1833	0.028
0.1866	0.031
0.1900	0.028
0.1933	0.028
0.1966	0.028
0.2000	0.025
0.2033	0.025
0.2066	0.025
0.2100	0.025
0.2133	0.025
0.2166	0.025
0.2200	0.022
0.2233	0.022
0.2266	0.022
0.2300	0.022
0.2333	0.022
0.2366	0.022
0.2400	0.022
0.2433	0.018
0.2466	0.018
0.2500	0.018
0.2533	0.018
0.2566	0.018
0.2600	0.018
0.2633	0.018
0.2666	0.015
0.2700	0.018
0.2733	0.018
0.2766	0.018
0.2800	0.015
0.2833	0.015
0.2866	0.015
0.2900	0.015
0.2933	0.015
0.2966	0.015
0.3000	0.015
0.3033	0.015
0.3066	0.015
0.3100	0.015
0.3133	0.015
0.3166	0.015
0.3200	0.015

0.3233	0.012
0.3266	0.015
0.3300	0.015
0.3333	0.012
0.3500	0.012
0.3666	0.012
0.3833	0.012
0.4000	0.012
0.4166	0.009
0.4333	0.012
0.4500	0.012
0.4666	0.012
0.4833	0.012
0.5000	0.009
0.5166	0.009
0.5333	0.012
0.5500	0.009
0.5666	0.009
0.5833	0.009
0.6000	0.009
0.6166	0.009
0.6333	0.009
0.6500	0.009
0.6666	0.009
0.6833	0.009
0.7000	0.009
0.7166	0.009
0.7333	0.009
0.7500	0.009
0.7666	0.009
0.7833	0.009
0.8000	0.009
0.8166	0.009
0.8333	0.009
0.8500	0.009
0.8666	0.009
0.8833	0.009
0.9000	0.009
0.9166	0.009
0.9333	0.009
0.9500	0.006
0.9666	0.009
0.9833	0.009
1.0000	0.012
1.2000	0.006
1.4000	0.006
1.6000	0.003
1.8000	0.006
2.0000	0.003

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                        A Q T E S O L V   R E S U L T S
                                  Version 1.10

09/28/92                                                                  09:38:32

==================================================================================
                                TEST DESCRIPTION

Data set........... mw15t11.in
Data set title..... EAFB - Monitoring Well 15, Test 11

Knowns and Constants:
   No. of data points................. 141
   Radius of well casing.............. 0.08333
   Radius of well..................... 0.3333
   Aquifer saturated thickness........ 4.22
   Well screen length................. 4.22
   Static height of water in well..... 4.22
   Log(Re/Rw)......................... 1.836
   A, B, C............................  0.000,  0.000,  1.409

==================================================================================
                                ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)

==================================================================================
                        RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   3.9245E-002
   y0 =   6.6365E+265


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>


TYPE CURVE DATA

     K  = 3.92448E-002
     y0 = 1.50384E+000

   Time      Drawdown       Time      Drawdown       Time      Drawdown
 ----------  ----------  ----------  ----------  ----------  ----------
 0.000E+000  1.504E+000  2.000E-001  8.333E-003
```

EAFB - Monitoring Well 15, Test 11

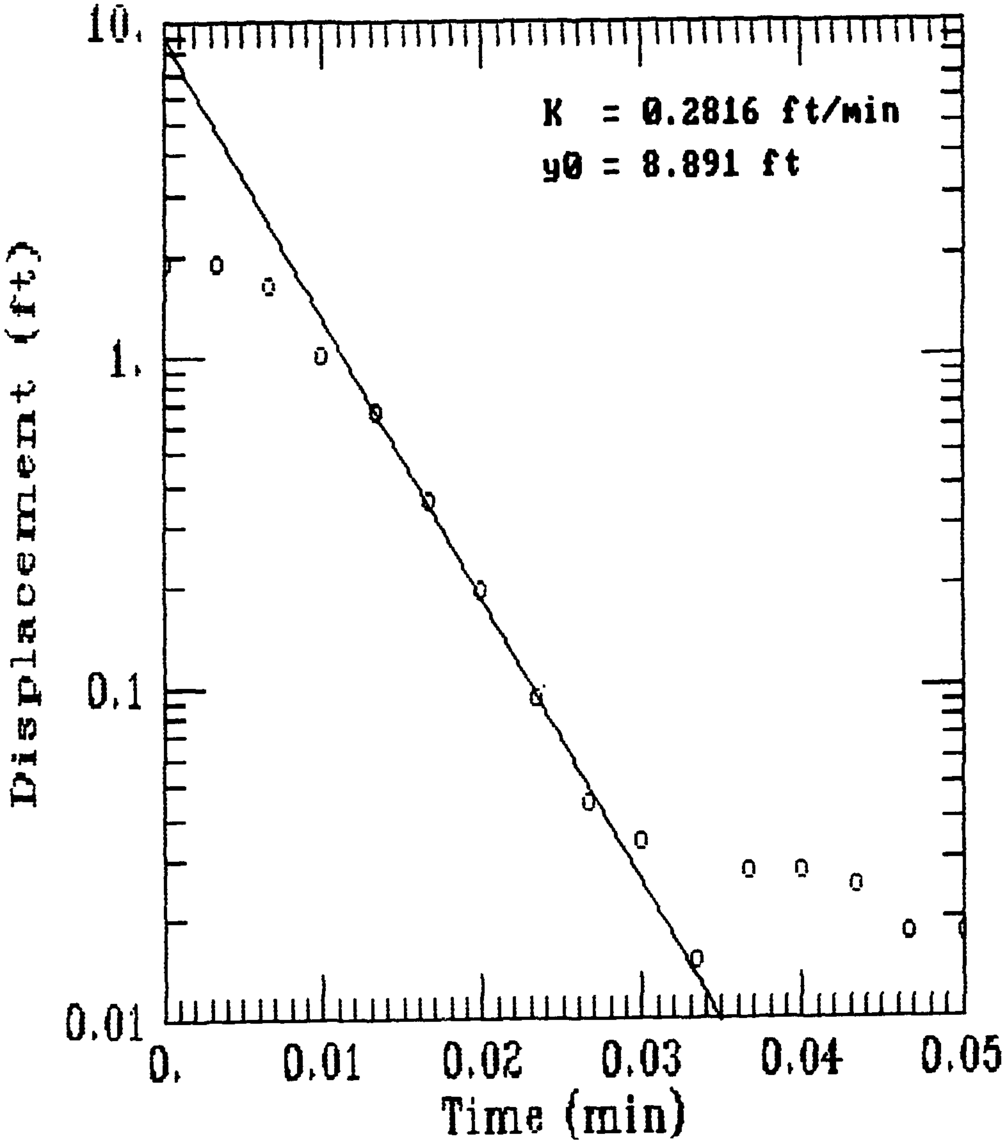


```
MW14 TEST 1
        SE1000C
  Environmental Logger
     09/03 07:28

  Unit# 00856  Test 12

Setups:          INPUT  1
------------     ---------
Type             Level (F)
Mode             TOC
I.D.             00000

Reference           0.000
Linearity           0.000
Scale factor       10.010
Offset             -0.130
Delay mSEC         50.000

Step 0  09/02 16:05:31

Elapsed Time     INPUT  1
------------     ---------
   0.0000          -0.006
   0.0033           1.908
   0.0066           1.643
   0.0100           0.991
   0.0133           0.673
   0.0166           0.362
   0.0200           0.192
   0.0233           0.091
   0.0266           0.044
   0.0300           0.034
   0.0333           0.015
   0.0366           0.028
   0.0400           0.028
   0.0433           0.025
   0.0466           0.018
   0.0500           0.018
   0.0533           0.015
   0.0566           0.018
   0.0600           0.012
   0.0633           0.015
   0.0666           0.015
   0.0700           0.012
   0.0733           0.015
   0.0766           0.012
   0.0800           0.012
   0.0833           0.012
   0.0866           0.012
   0.0900           0.009
   0.0933           0.012
   0.0966           0.012
   0.1000           0.012
   0.1033           0.009
   0.1066           0.009
   0.1100           0.009
   0.1133           0.009
   0.1166           0.009
   0.1200           0.009
```

0.1233	0.009
0.1266	0.009
0.1300	0.006
0.1333	0.006
0.1366	0.006
0.1400	0.006
0.1433	0.006
0.1466	0.006
0.1500	0.006
0.1533	0.006
0.1566	0.006
0.1600	0.006
0.1633	0.006
0.1666	0.006
0.1700	0.006
0.1733	0.006
0.1766	0.006
0.1800	0.003
0.1833	0.003
0.1866	0.006
0.1900	0.003
0.1933	0.003
0.1966	0.003
0.2000	0.003
0.2033	0.003
0.2066	0.003
0.2100	0.003
0.2133	0.003
0.2166	0.003
0.2200	0.003
0.2233	0.003
0.2266	0.003
0.2300	0.003
0.2333	0.003
0.2366	0.006
0.2400	0.003
0.2433	0.003
0.2466	0.003
0.2500	0.003
0.2533	0.000
0.2566	0.003
0.2600	0.003
0.2633	0.003
0.2666	0.003
0.2700	0.003
0.2733	0.003
0.2766	0.003
0.2800	0.003
0.2833	0.003
0.2866	0.003
0.2900	0.003
0.2933	0.003
0.2966	0.003
0.3000	0.000
0.3033	0.000
0.3066	0.003
0.3100	0.003
0.3133	0.000
0.3166	0.003
0.3200	0.003

0.3233	0.003
0.3266	0.003
0.3300	0.000
0.3333	0.003
0.3500	0.000
0.3666	0.000
0.3833	0.000
0.4000	-0.003
0.4166	-0.003
0.4333	0.000
0.4500	0.000
0.4666	-0.003
0.4833	-0.003
0.5000	0.000
0.5166	0.000
0.5333	0.000
0.5500	-0.003
0.5666	0.000
0.5833	-0.003
0.6000	-0.003
0.6166	0.000
0.6333	-0.003
0.6500	-0.003
0.6666	-0.003
0.6833	-0.003
0.7000	0.000
0.7166	0.000
0.7333	-0.003
0.7500	0.000
0.7666	0.000
0.7833	-0.003
0.8000	-0.003
0.8166	-0.006
0.8333	-0.003
0.8500	-0.003
0.8666	-0.006
0.8833	-0.003
0.9000	-0.006
0.9166	-0.003
0.9333	-0.003
0.9500	-0.003
0.9666	-0.003
0.9833	-0.003
1.0000	-0.003

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                      A Q T E S O L V   R E S U L T S
                                Version 1.10

09/28/92                                                                  09:52:13

==================================================================================
                               TEST DESCRIPTION

Data set........... a:\mw14t12.in
Data set title..... EAFB - Monitoring Well 14, Test 12

Knowns and Constants:
   No. of data points.................. 95
   Radius of well casing............... 0.08333
   Radius of well...................... 0.3333
   Aquifer saturated thickness......... 4.6
   Well screen length.................. 4.6
   Static height of water in well...... 4.6
   Log(Re/Rw).......................... 1.907
   A, B, C.............................  0.000,  0.000,  1.454

==================================================================================
                               ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)

==================================================================================
                        RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   2.8162E-001
   y0 =   6.6365E+265


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>


TYPE CURVE DATA

     K  = 2.81619E-001
     y0 = 8.89135E+000

   Time      Drawdown       Time      Drawdown       Time      Drawdown
---------- ----------   ---------- ----------   ---------- ----------
0.000E+000 8.891E+000   5.000E-002 5.009E-004
```



EAFB - Monitoring Well 14, Test 12

K = 0.2816 ft/min
y0 = 8.891 ft

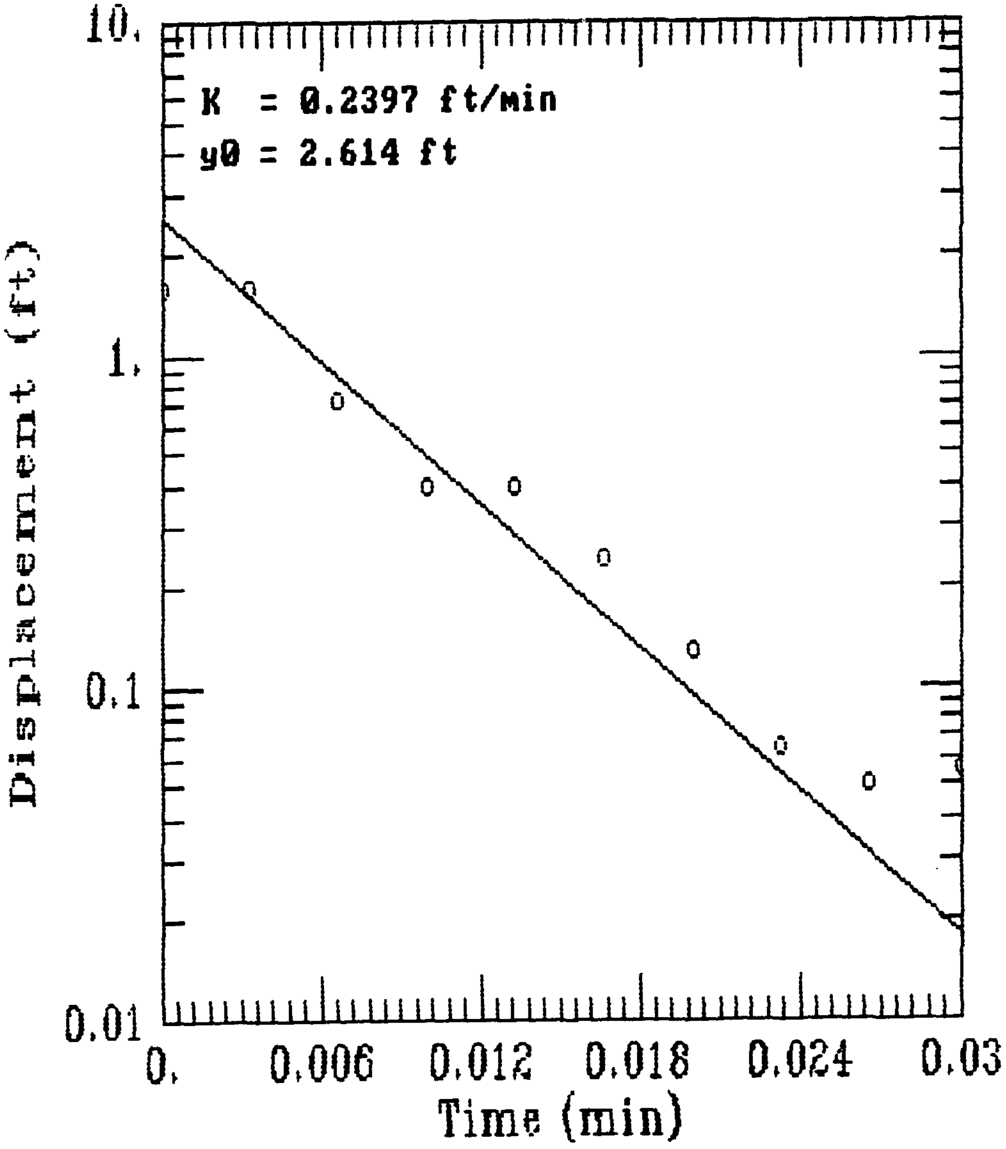
```
MW 14 TEST2
        SE1000C
  Environmental Logger
      09/03 07:31

 nit# 00856  Test 13

Setups:         INPUT  1
------------    ---------
Type            Level (F)
Mode            TOC
I.D.            00000

Reference          0.000
Linearity          0.000
Scale factor      10.010
Offset            -0.130
Delay mSEC        50.000

Step 0   09/02 16:11:14

Elapsed Time    INPUT  1
------------    ---------
   0.0000          0.059
   0.0033          1.564
   0.0066          0.727
   0.0100          0.406
   0.0133          0.406
   0.0166          0.245
   0.0200          0.129
   0.0233          0.066
   0.0266          0.050
   0.0300          0.056
   0.0333          0.040
   0.0366          0.047
   0.0400          0.059
   0.0433          0.066
   0.0466          0.066
   0.0500          0.040
   0.0533          0.034
   0.0566          0.031
   0.0600          0.034
   0.0633          0.031
   0.0666          0.031
   0.0700          0.031
   0.0733          0.031
   0.0766          0.028
   0.0800          0.028
   0.0833          0.028
   0.0866          0.028
   0.0900          0.028
   0.0933          0.028
   0.0966          0.028
   0.1000          0.028
   0.1033          0.025
   0.1066          0.025
   0.1100          0.025
   0.1133          0.025
   0.1166          0.025
   0.1200          0.025
```

0.1233	0.025
0.1266	0.025
0.1300	0.025
0.1333	0.022
0.1366	0.022
0.1400	0.025
0.1433	0.022
0.1466	0.022
0.1500	0.022
0.1533	0.022
0.1566	0.022
0.1600	0.022
0.1633	0.022
0.1666	0.022
0.1700	0.022
0.1733	0.022
0.1766	0.022
0.1800	0.022
0.1833	0.022
0.1866	0.022
0.1900	0.018
0.1933	0.022
0.1966	0.022
0.2000	0.018
0.2033	0.018
0.2066	0.018
0.2100	0.018
0.2133	0.018
0.2166	0.018
0.2200	0.018
0.2233	0.018
0.2266	0.018
0.2300	0.018
0.2333	0.018
0.2366	0.018
0.2400	0.018
0.2433	0.018
0.2466	0.018
0.2500	0.018
0.2533	0.015
0.2566	0.018
0.2600	0.018
0.2633	0.015
0.2666	0.015
0.2700	0.018
0.2733	0.018
0.2766	0.015
0.2800	0.018
0.2833	0.018
0.2866	0.018
0.2900	0.018
0.2933	0.018
0.2966	0.015
0.3000	0.015
0.3033	0.015
0.3066	0.015
0.3100	0.015
0.3133	0.015
0.3166	0.015
0.3200	0.015

0.3233	0.015
0.3266	0.015
0.3300	0.015
0.3333	0.015
0.3500	0.015
0.3666	0.015
0.3833	0.015
0.4000	0.015
0.4166	0.015
0.4333	0.015
0.4500	0.012
0.4666	0.012
0.4833	0.015
0.5000	0.015
0.5166	0.012
0.5333	0.012
0.5500	0.012
0.5666	0.012
0.5833	0.012
0.6000	0.012
0.6166	0.012
0.6333	0.012
0.6500	0.012
0.6666	0.012
0.6833	0.012
0.7000	0.012
0.7166	0.012
0.7333	0.012
0.7500	0.009
0.7666	0.012
0.7833	0.009
0.8000	0.009
0.8166	0.012
0.8333	0.012
0.8500	0.009
0.8666	0.012
0.8833	0.012
0.9000	0.003
0.9166	0.012
0.9333	0.009
0.9500	0.012
0.9666	0.012
0.9833	0.009
1.0000	0.009

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                        A Q T E S O L V   R E S U L T S
                                 Version  1.10

09/28/92                                                                 10:04:19

=================================================================================
                                TEST DESCRIPTION

Data set........... a:\mw14t13.in
Data set title..... EAFB - Monitoring Well 14, Test 13

Knowns and Constants:
   No. of data points................... 140
   Radius of well casing................ 0.08333
   Radius of well....................... 0.3333
   Aquifer saturated thickness.......... 4.6
   Well screen length................... 4.6
   Static height of water in well...... 4.6
   Log(Re/Rw)........................... 1.907
   A, B, C..............................  0.000,   0.000,   1.454

=================================================================================
                                ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)

=================================================================================
                        RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

              Estimate
   K  =    2.3967E-001
   y0 =    6.6365E+265

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

TYPE CURVE DATA

     K  = 2.39667E-001
     y0 = 2.61401E+000

   Time       Drawdown       Time       Drawdown       Time       Drawdown
----------   ----------   ----------   ----------   ----------   ----------
0.000E+000   2.614E+000   3.000E-002   1.768E-002
```

EAFB - Monitoring Well 14, Test 13



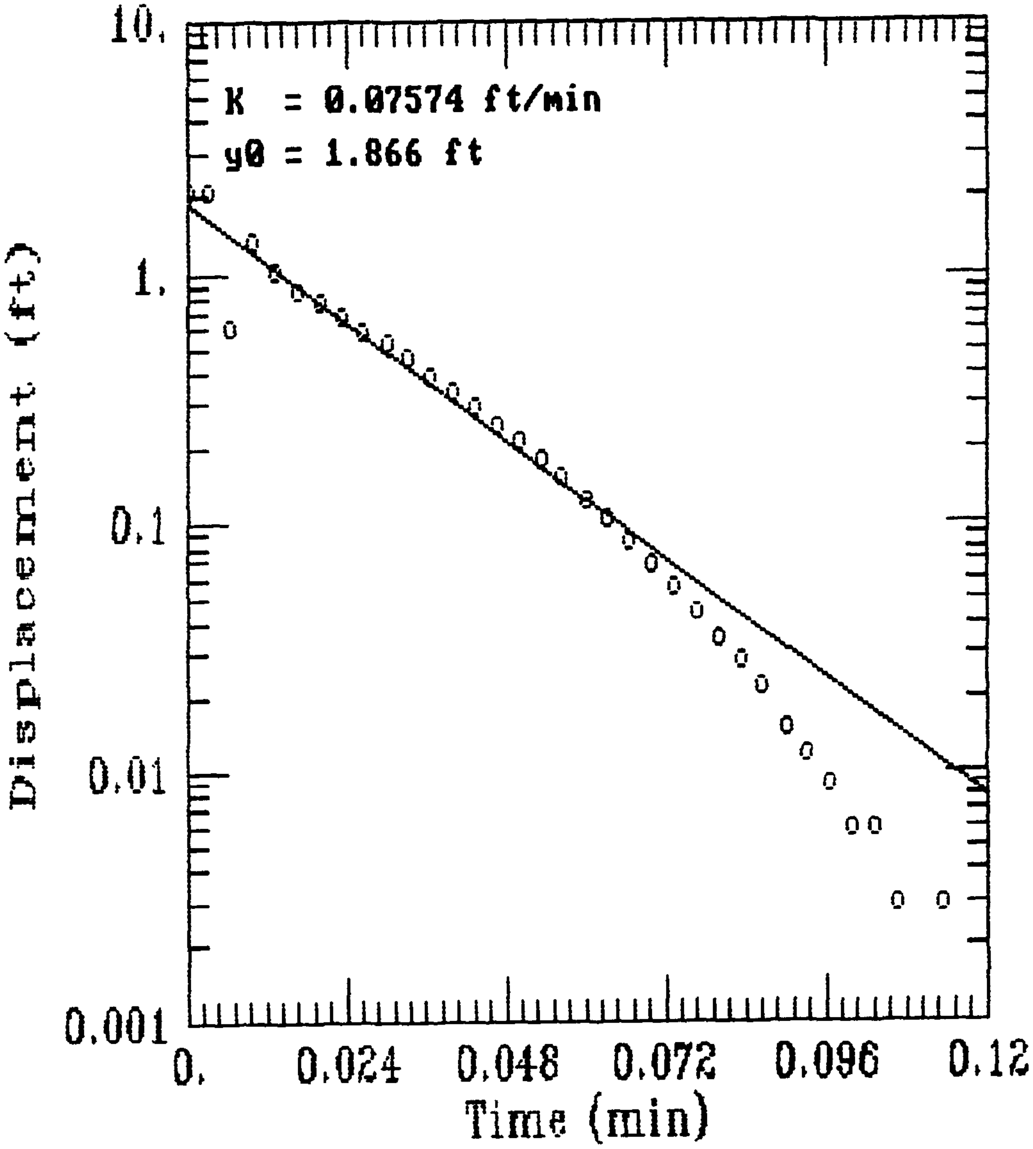
```
MW 12 TEST1
        SE1000C
  Environmental Logger
      09/03 07:37

  Unit# 00856  Test 14

Setups:         INPUT  1
------------    ---------
Type            Level (F)
Mode            TOC
I.D.            00000

Reference          0.000
Linearity          0.000
Scale factor      10.010
Offset            -0.130
Delay mSEC        50.000

Step 0  09/02 16:27:47

Elapsed Time    INPUT  1
------------    ---------
   0.0000         -0.025
   0.0033          2.122
   0.0066          0.601
   0.0100          1.335
   0.0133          1.023
   0.0166          0.859
   0.0200          0.774
   0.0233          0.661
   0.0266          0.576
   0.0300          0.519
   0.0333          0.453
   0.0366          0.393
   0.0400          0.340
   0.0433          0.292
   0.0466          0.248
   0.0500          0.214
   0.0533          0.179
   0.0566          0.151
   0.0600          0.125
   0.0633          0.103
   0.0666          0.085
   0.0700          0.069
   0.0733          0.056
   0.0766          0.044
   0.0800          0.034
   0.0833          0.028
   0.0866          0.022
   0.0900          0.015
   0.0933          0.012
   0.0966          0.009
   0.1000          0.006
   0.1033          0.006
   0.1066          0.003
   0.1100          0.000
   0.1133          0.003
   0.1166          0.000
   0.1200          0.000
```

0.1233	0.000
0.1266	0.000
0.1300	-0.003
0.1333	-0.003
0.1366	-0.003
0.1400	-0.003
0.1433	-0.003
0.1466	-0.003
0.1500	-0.003
0.1533	-0.003
0.1566	-0.003
0.1600	-0.003
0.1633	-0.003
0.1666	-0.006
0.1700	-0.006
0.1733	-0.006
0.1766	-0.006
0.1800	-0.006
0.1833	-0.006
0.1866	-0.006
0.1900	-0.006
0.1933	-0.006
0.1966	-0.006
0.2000	-0.006
0.2033	-0.006
0.2066	-0.006
0.2100	-0.006
0.2133	-0.006
0.2166	-0.006
0.2200	-0.006
0.2233	-0.006
0.2266	-0.006
0.2300	-0.006
0.2333	-0.006
0.2366	-0.006
0.2400	-0.006
0.2433	-0.006
0.2466	-0.006
0.2500	-0.006
0.2533	-0.006
0.2566	-0.009
0.2600	-0.006
0.2633	-0.006
0.2666	-0.006
0.2700	-0.006
0.2733	-0.006
0.2766	-0.006
0.2800	-0.006
0.2833	-0.009
0.2866	-0.006
0.2900	-0.006
0.2933	-0.006
0.2966	-0.009
0.3000	-0.006
0.3033	-0.009
0.3066	-0.006
0.3100	-0.009
0.3133	-0.006
0.3166	-0.009
0.3200	-0.009

0.3233	-0.006
0.3266	-0.009
0.3300	-0.009
0.3333	-0.006
0.3500	-0.006
0.3666	-0.009
0.3833	-0.009
0.4000	-0.009
0.4166	-0.009
0.4333	-0.009
0.4500	-0.009
0.4666	-0.009
0.4833	-0.009
0.5000	-0.009
0.5166	-0.009
0.5333	-0.009
0.5500	-0.009
0.5666	-0.009
0.5833	-0.009
0.6000	-0.009
0.6166	-0.009
0.6333	-0.012
0.6500	-0.009
0.6666	-0.009
0.6833	-0.009
0.7000	-0.009
0.7166	-0.009
0.7333	-0.009
0.7500	-0.009
0.7666	-0.009
0.7833	-0.009
0.8000	-0.009
0.8166	-0.009
0.8333	-0.009
0.8500	-0.009
0.8666	-0.009
0.8833	-0.009
0.9000	-0.012
0.9166	-0.012
0.9333	-0.009
0.9500	-0.009
0.9666	-0.012
0.9833	-0.012
1.0000	-0.012

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                      A Q T E S O L V    R E S U L T S
                               Version  1.10

09/28/92                                                               10:19:08

================================================================================
                              TEST DESCRIPTION

Data set........... a:\mw12t14.in
Data set title..... EAFB - Monitoring Well 12, Test 14

Knowns and Constants:
   No. of data points.................. 33
   Radius of well casing............... 0.08333
   Radius of well...................... 0.3333
   Aquifer saturated thickness......... 3.5
   Well screen length.................. 3.5
   Static height of water in well...... 3.5
   Log(Re/Rw).......................... 1.688
   A, B, C.............................  0.000,  0.000,  1.309

================================================================================
                              ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)

================================================================================
                       RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   7.5740E-002
   y0 =   6.6365E+265


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>


TYPE CURVE DATA

     K  = 7.57398E-002
     y0 = 1.86601E+000

    Time       Drawdown       Time       Drawdown       Time       Drawdown
 ----------   ----------   ----------   ----------   ----------   ----------
 0.000E+000   1.866E+000   1.200E-001   8.193E-003
```

EAFB - Monitoring Well 12, Test 14



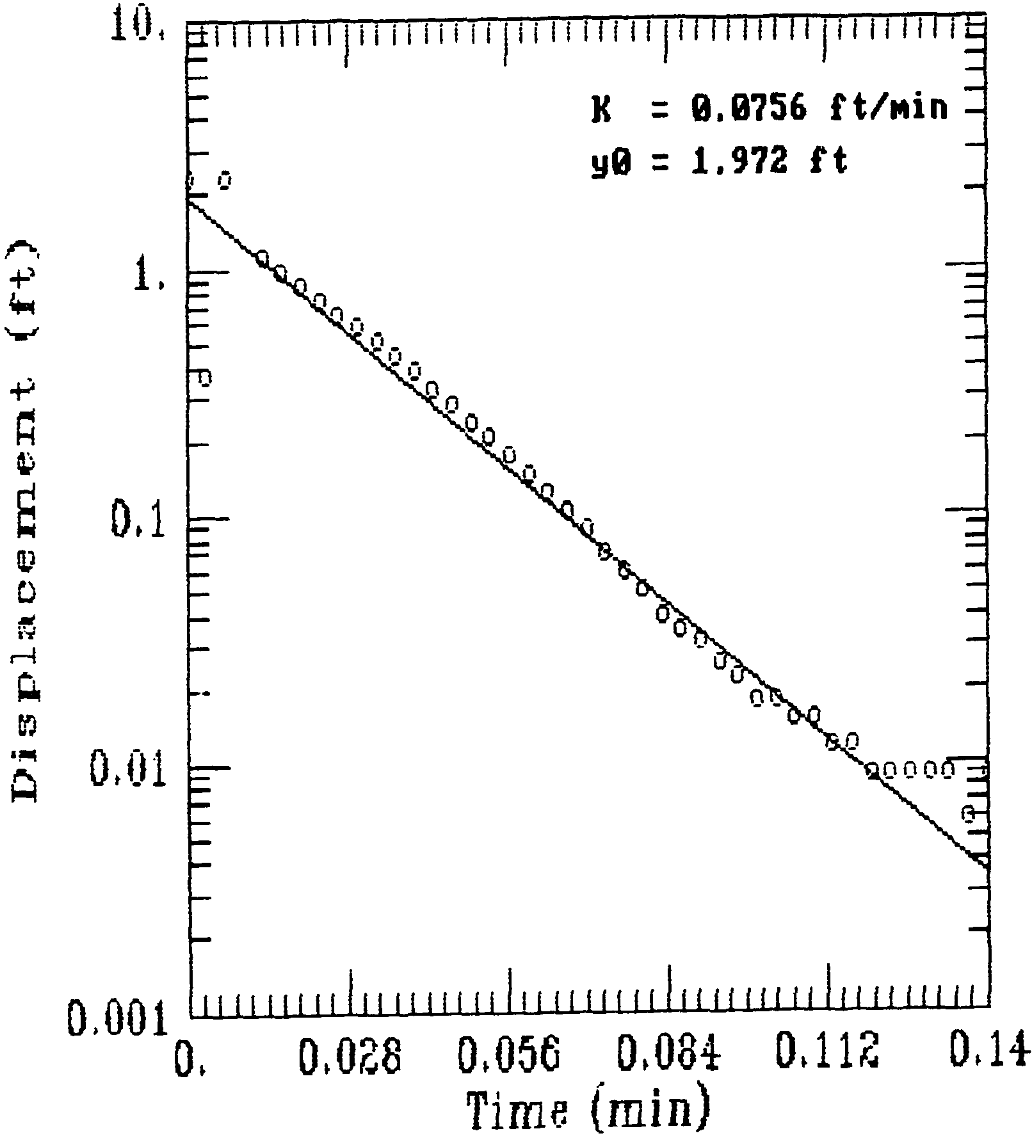
```
MW12 TEST2
        SE1000C
  Environmental Logger
      09/03 07:47

  nit# 00856  Test 15

Setups:          INPUT  1
------------     ---------
Type             Level (F)
Mode             TOC
I.D.             00000

Reference          0.000
Linearity          0.000
Scale factor      10.010
Offset            -0.130
Delay mSEC        50.000

Step 0   09/02 16:33:03

Elapsed Time     INPUT  1
------------     ---------
   0.0000          -0.012
   0.0033           0.377
   0.0066           2.333
   0.0100          -0.163
   0.0133           1.136
   0.0166           0.969
   0.0200           0.850
   0.0233           0.746
   0.0266           0.654
   0.0300           0.576
   0.0333           0.516
   0.0366           0.437
   0.0400           0.384
   0.0433           0.327
   0.0466           0.286
   0.0500           0.242
   0.0533           0.207
   0.0566           0.173
   0.0600           0.147
   0.0633           0.122
   0.0666           0.103
   0.0700           0.088
   0.0733           0.072
   0.0766           0.059
   0.0800           0.050
   0.0833           0.040
   0.0866           0.034
   0.0900           0.031
   0.0933           0.025
   0.0966           0.022
   0.1000           0.018
   0.1033           0.018
   0.1066           0.015
   0.1100           0.015
   0.1133           0.012
   0.1166           0.012
   0.1200           0.009
```

0.1233	0.009
0.1266	0.009
0.1300	0.009
0.1333	0.009
0.1366	0.006
0.1400	0.009
0.1433	0.009
0.1466	0.009
0.1500	0.006
0.1533	0.006
0.1566	0.006
0.1600	0.006
0.1633	0.006
0.1666	0.006
0.1700	0.006
0.1733	0.003
0.1766	0.006
0.1800	0.006
0.1833	0.003
0.1866	0.006
0.1900	0.006
0.1933	0.003
0.1966	0.003
0.2000	0.003
0.2033	0.006
0.2066	0.003
0.2100	0.003
0.2133	0.003
0.2166	0.003
0.2200	0.003
0.2233	0.003
0.2266	0.003
0.2300	0.003
0.2333	0.006
0.2366	0.003
0.2400	0.003
0.2433	0.003
0.2466	0.003
0.2500	0.003
0.2533	0.003
0.2566	0.003
0.2600	0.003
0.2633	0.003
0.2666	0.003
0.2700	0.003
0.2733	0.003
0.2766	0.003
0.2800	0.000
0.2833	0.000
0.2866	0.003
0.2900	0.003
0.2933	0.003
0.2966	0.003
0.3000	0.003
0.3033	0.003
0.3066	0.003
0.3100	0.003
0.3133	0.003
0.3166	0.003
0.3200	0.000

0.3233	0.000
0.3266	0.000
0.3300	0.003
0.3333	0.003
0.3500	0.003
0.3666	0.000
0.3833	0.000
0.4000	0.003
0.4166	0.000
0.4333	0.000
0.4500	0.000
0.4666	0.000
0.4833	0.000
0.5000	0.000
0.5166	0.000
0.5333	0.000
0.5500	0.000
0.5666	0.000
0.5833	0.000
0.6000	0.000
0.6166	0.000
0.6333	0.000
0.6500	0.000
0.6666	0.000
0.6833	0.000
0.7000	0.000
0.7166	0.000
0.7333	0.000
0.7500	0.000
0.7666	0.000
0.7833	0.000
0.8000	0.000
0.8166	0.000
0.8333	0.000
0.8500	0.000
0.8666	0.000
0.8833	0.000
0.9000	0.000
0.9166	0.000
0.9333	0.000
0.9500	0.000
0.9666	0.000
0.9833	0.000
1.0000	0.000
1.2000	-0.003

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                          A Q T E S O L V   R E S U L T S
                                  Version  1.10

09/28/92                                                                  10:27:49

==================================================================================
                                  TEST DESCRIPTION

Data set........... a:\mw12t15.in
Data set title..... EAFB - Monitoring Well 12, Test 15

Knowns and Constants:
   No. of data points.................. 96
   Radius of well casing............... 0.08333
   Radius of well...................... 0.3333
   Aquifer saturated thickness......... 3.5
   Well screen length.................. 3.5
   Static height of water in well...... 3.5
   Log(Re/Rw).......................... 1.688
   A, B, C.............................  0.000,  0.000,  1.309

==================================================================================
                                 ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)

==================================================================================
                          RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

              Estimate
   K  =    7.5600E-002
   y0 =    6.6365E+265

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

TYPE CURVE DATA

     K  = 7.55995E-002
     y0 = 1.97242E+000

   Time       Drawdown       Time       Drawdown       Time       Drawdown
----------   ----------   ----------   ----------   ----------   ----------
0.000E+000   1.972E+000   1.400E-001   3.546E-003
```

EAFB - Monitoring Well 12, Test 15



MW 5 1 TEST

15

= 0902-16.DAT

```
       SE1000C
 Environmental Logger
     09/03 07:51

 Unit# 00856  Test 16

Setups:        INPUT  1
------------   ---------
Type           Level (F)
Mode           TOC
I.D.           00000

Reference        0.000
Linearity        0.000
Scale factor    10.010
Offset          -0.130
Delay mSEC      50.000

Step 0  09/02 17:08:01

Elapsed Time   INPUT  1
------------   ---------
   0.0000         0.018
   0.0033         6.911
   0.0066         4.823
   0.0100         5.324
   0.0133         2.566
   0.0166         2.651
   0.0200         1.536
   0.0233         1.586
   0.0266         1.268
   0.0300         1.731
   0.0333         1.662
   0.0366         1.432
   0.0400         1.146
   0.0433         0.976
   0.0466         0.831
   0.0500         0.686
   0.0533         0.582
   0.0566         0.484
   0.0600         0.402
   0.0633         0.336
   0.0666         0.286
   0.0700         0.239
   0.0733         0.201
   0.0766         0.173
   0.0800         0.141
   0.0833         0.119
   0.0866         0.103
   0.0900         0.085
   0.0933         0.078
   0.0966         0.069
   0.1000         0.066
   0.1033         0.059
   0.1066         0.056
   0.1100         0.056
   0.1133         0.047
   0.1166         0.044
   0.1200         0.040
```

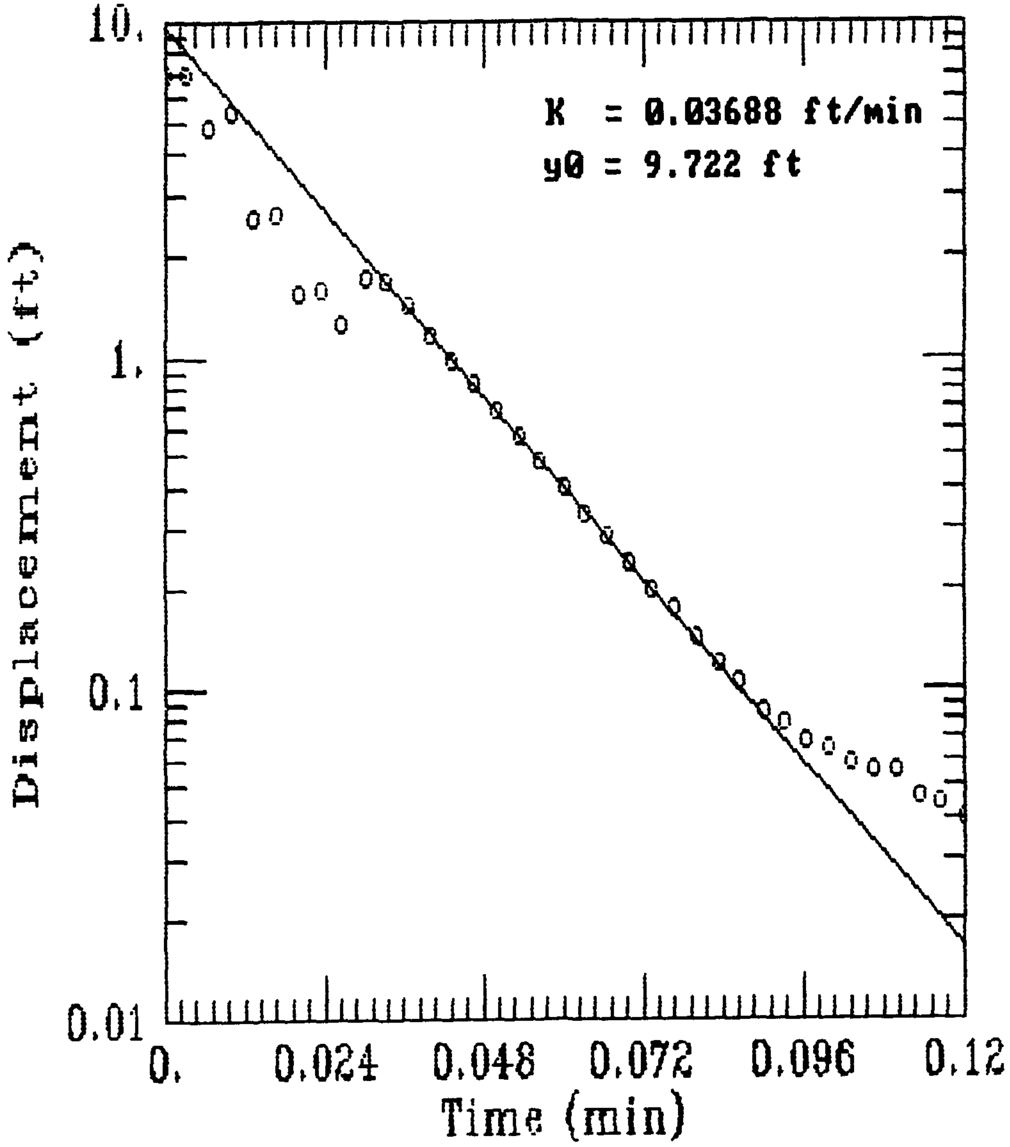
0.1233	0.040
0.1266	0.040
0.1300	0.037
0.1333	0.034
0.1366	0.037
0.1400	0.034
0.1433	0.031
0.1466	0.031
0.1500	0.034
0.1533	0.031
0.1566	0.031
0.1600	0.031
0.1633	0.031
0.1666	0.025
0.1700	0.031
0.1733	0.031
0.1766	0.031
0.1800	0.031
0.1833	0.028
0.1866	0.028
0.1900	0.028
0.1933	0.028
0.1966	0.028
0.2000	0.031
0.2033	0.031
0.2066	0.031
0.2100	0.028
0.2133	0.028
0.2166	0.031
0.2200	0.031
0.2233	0.028
0.2266	0.031
0.2300	0.031
0.2333	0.031
0.2366	0.031
0.2400	0.031
0.2433	0.031
0.2466	0.031
0.2500	0.031
0.2533	0.031
0.2566	0.031
0.2600	0.031
0.2633	0.031
0.2666	0.031
0.2700	0.031
0.2733	0.031
0.2766	0.034
0.2800	0.031
0.2833	0.031
0.2866	0.031
0.2900	0.031
0.2933	0.031
0.2966	0.031
0.3000	0.031
0.3033	0.031
0.3066	0.031
0.3100	0.031
0.3133	0.028
0.3166	0.031
0.3200	0.031

```
  0.3233          0.031
  0.3266          0.031
  0.3300          0.031
  0.3333          0.031
  0.3500          0.031
  0.3666          0.028
  0.3833          0.031
  0.4000          0.031
  0.4166          0.031
  0.4333          0.028
  0.4500          0.028
  0.4666          0.028
  0.4833          0.031
  0.5000          0.031
  0.5166          0.031
  0.5333          0.031
  0.5500          0.031
  0.5666          0.028
  0.5833          0.031
  0.6000          0.028
  0.6166          0.031
  0.6333          0.031
  0.6500          0.031
  0.6666          0.031
  0.6833          0.031
  0.7000          0.031
  0.7166          0.031
  0.7333          0.031
  0.7500          0.031
  0.7666          0.028
  0.7833          0.028
  0.8000          0.031
  0.8166          0.031
  0.8333          0.031
  0.8500          0.034
  0.8666          0.028
  0.8833          0.028
  0.9000          0.028
  0.9166          0.028
  0.9333          0.034
  0.9500          0.028
  0.9666          0.031
  0.9833          0.028
  1.0000          0.028
  1.2000          0.028
  1.4000          0.028
  1.6000          0.028
  1.8000          0.028
  2.0000          0.028
  2.2000          0.028
  2.4000          0.028
  2.6000          0.028
  2.8000          0.028
  3.0000          0.025
  3.2000          0.028
;µ;¶;¾;−;¼;½;ª;º;«;■;»;±; ;<
```

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                         A Q T E S O L V   R E S U L T S
                                  Version  1.10

09/28/92                                                                10:40:07

================================================================================
                                TEST DESCRIPTION

Data set........... a:\mw5t16.in
Data set title..... EAFB - Monitoring Well 5, Test 16

Knowns and Constants:
   No. of data points.................. 151
   Radius of well casing............... 0.08333
   Radius of well...................... 0.3333
   Aquifer saturated thickness......... 14.35
   Well screen length.................. 14.35
   Static height of water in well...... 14.35
   Log(Re/Rw).......................... 2.873
   A, B, C.............................  0.000,  0.000,  2.400

================================================================================
                                ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)

================================================================================
                         RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   4.0123E-002
   y0 =   6.6365E+265


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>


TYPE CURVE DATA

     K  = 3.68784E-002
     y0 = 9.72246E+000

   Time      Drawdown      Time      Drawdown      Time      Drawdown
----------  ----------  ----------  ----------  ----------  ----------
0.000E+000  9.722E+000  1.200E-001  1.670E-002


  PE CURVE DATA

     K  = 3.68784E-002
     y0 = 9.72246E+000
```

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	9.722E+000	1.200E-001	1.670E-002		

EAFB - Monitoring Well 5, Test 16



MW 3 2MW 1359

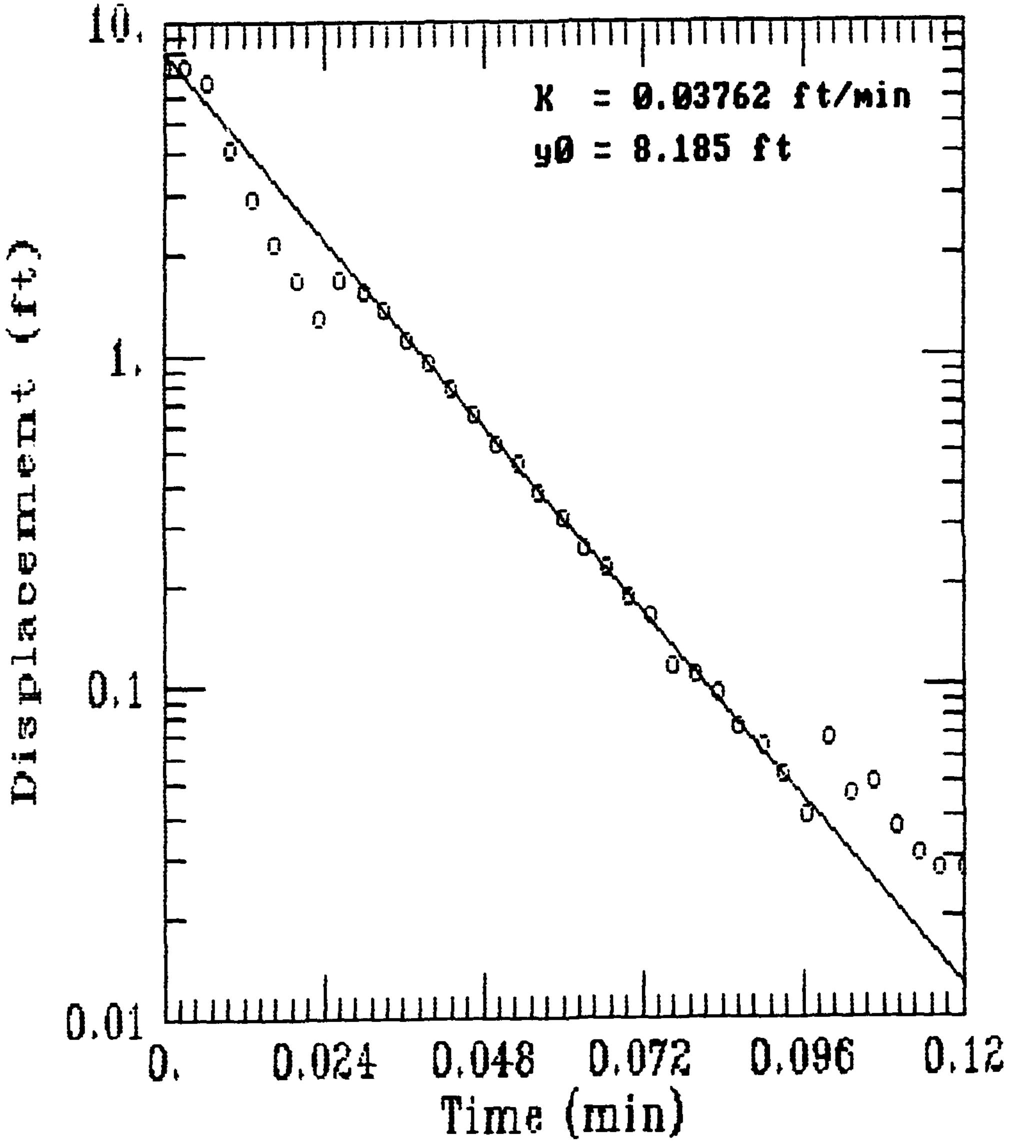
```
        SE1000C
  Environmental Logger
      09/03 07:54

  Unit# 00856   Test 17

Setups:           INPUT  1
------------      ---------
Type              Level (F)
Mode              TOC
I.D.              00000

Reference            0.000
Linearity            0.000
Scale factor        10.010
Offset              -0.130
Delay mSEC          50.000

Step 0   09/02 17:17:31

Elapsed Time      INPUT  1
------------      ---------
   0.0000            3.586
   0.0033            7.311
   0.0066            6.612
   0.0100            4.143
   0.0133            2.972
   0.0166            2.175
   0.0200            1.687
   0.0233            1.294
   0.0266            1.665
   0.0300            1.536
   0.0333            1.338
   0.0366            1.098
   0.0400            0.938
   0.0433            0.796
   0.0466            0.661
   0.0500            0.532
   0.0533            0.469
   0.0566            0.377
   0.0600            0.318
   0.0633            0.258
   0.0666            0.229
   0.0700            0.182
   0.0733            0.160
   0.0766            0.113
   0.0800            0.107
   0.0833            0.094
   0.0866            0.075
   0.0900            0.066
   0.0933            0.053
   0.0966            0.040
   0.1000            0.069
   0.1033            0.047
   0.1066            0.050
   0.1100            0.037
   0.1133            0.031
   0.1166            0.028
   0.1200            0.028
```

0.1233	0.025
0.1266	0.022
0.1300	0.018
0.1333	0.015
0.1366	0.022
0.1400	0.018
0.1433	0.031
0.1466	0.031
0.1500	0.018
0.1533	0.022
0.1566	0.025
0.1600	0.018
0.1633	0.018
0.1666	0.018
0.1700	0.018
0.1733	0.015
0.1766	0.018
0.1800	0.018
0.1833	0.018
0.1866	0.018
0.1900	0.018
0.1933	0.018
0.1966	0.015
0.2000	0.015
0.2033	0.015
0.2066	0.015
0.2100	0.015
0.2133	0.015
0.2166	0.015
0.2200	0.015
0.2233	0.012
0.2266	0.012
0.2300	0.012
0.2333	0.015
0.2366	0.015
0.2400	0.015
0.2433	0.015
0.2466	0.015
0.2500	0.012
0.2533	0.015
0.2566	0.015
0.2600	0.015
0.2633	0.015
0.2666	0.015
0.2700	0.015
0.2733	0.015
0.2766	0.015
0.2800	0.015
0.2833	0.015
0.2866	0.015
0.2900	0.012
0.2933	0.012
0.2966	0.012
0.3000	0.015
0.3033	0.012
0.3066	0.012
0.3100	0.012
0.3133	0.012
0.3166	0.012
0.3200	0.012

0.3233	0.012
0.3266	0.012
0.3300	0.012
0.3333	0.015
0.3500	0.012
0.3666	0.015
0.3833	0.012
0.4000	0.012
0.4166	0.012
0.4333	0.006
0.4500	0.012
0.4666	0.015
0.4833	0.012
0.5000	0.012
0.5166	0.012
0.5333	0.012
0.5500	0.012
0.5666	0.012
0.5833	0.012
0.6000	0.012
0.6166	0.012
0.6333	0.012
0.6500	0.012
0.6666	0.015
0.6833	0.012
0.7000	0.012
0.7166	0.012
0.7333	0.012
0.7500	0.012
0.7666	0.012
0.7833	0.012
0.8000	0.012
0.8166	0.012
0.8333	0.012
0.8500	0.012
0.8666	0.012
0.8833	0.012
0.9000	0.012
0.9166	0.012
0.9333	0.015
0.9500	0.012
0.9666	0.012
0.9833	0.012
1.0000	0.012
1.2000	0.015
1.4000	0.015
1.6000	0.015
1.8000	0.015
2.0000	-0.006
2.2000	0.015
2.4000	0.015
2.6000	0.015
2.8000	0.015
3.0000	0.015
3.2000	0.015
3.4000	0.015
3.6000	0.012
3.8000	0.003
4.0000	0.003

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                         A Q T E S O L V   R E S U L T S
                                  Version 1.10

09/28/92                                                                 11:05:39

=================================================================================
                                TEST DESCRIPTION

Data set........... mw5t17.in
Data set title..... EAFB - Monitoring Well 5, Test 17

Knowns and Constants:
   No. of data points.................. 154
   Radius of well casing............... 0.08333
   Radius of well...................... 0.3333
   Aquifer saturated thickness......... 14.35
   Well screen length.................. 14.35
   Static height of water in well...... 14.35
   Log(Re/Rw).......................... 2.873
   A, B, C.............................  0.000,  0.000,  2.400

=================================================================================
                                ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)

=================================================================================
                         RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

             Estimate
   K  =    6.3745E-002
   y0 =    0.0000E+000


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>


TYPE CURVE DATA

     K  = 3.76168E-002
     y0 = 8.18465E+000

   Time       Drawdown        Time       Drawdown        Time       Drawdown
----------   ----------   ----------   ----------   ----------   ----------
0.000E+000   8.185E+000   1.200E-001   1.237E-002
```

EAFB - Monitoring Well 5, Test 17



MW15 1~ 1284

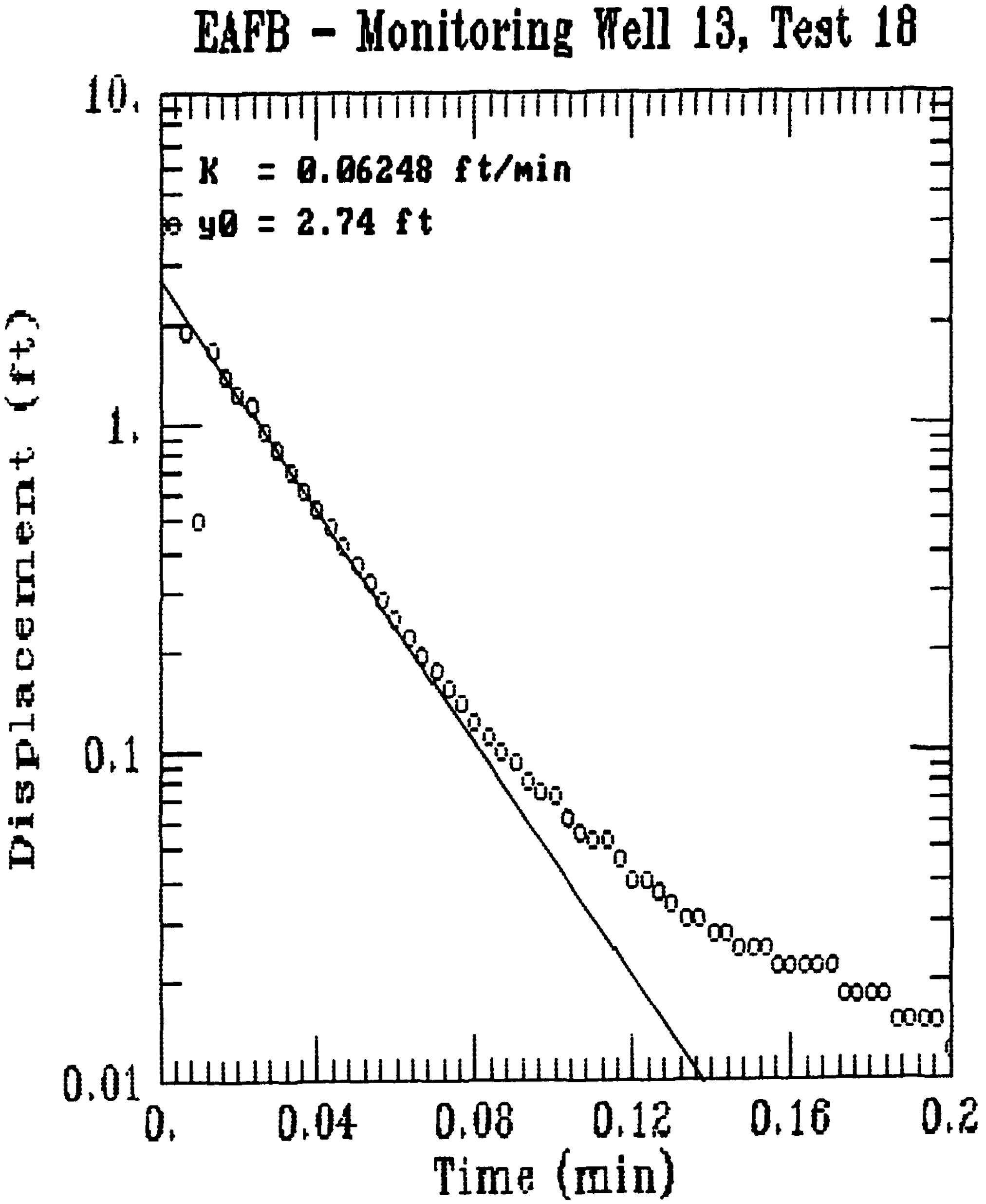
```
       SE1000C
 Environmental Logger
     09/03 07:59

Unit# 00856  Test 18

Setups:         INPUT  1
------------    ---------
Type            Level (F)
Mode            TOC
I.D.            00000

Reference         0.000
Linearity         0.000
Scale factor     10.010
Offset           -0.130
Delay mSEC       50.000

Step 0  09/02 17:57:23

Elapsed Time    INPUT  1
------------    ---------
   0.0000          1.111
   0.0033          3.976
   0.0066          1.901
   0.0100          0.503
   0.0133          1.684
   0.0166          1.379
   0.0200          1.237
   0.0233          1.130
   0.0266          0.941
   0.0300          0.821
   0.0333          0.717
   0.0366          0.629
   0.0400          0.551
   0.0433          0.481
   0.0466          0.421
   0.0500          0.371
   0.0533          0.324
   0.0566          0.286
   0.0600          0.251
   0.0633          0.223
   0.0666          0.195
   0.0700          0.173
   0.0733          0.154
   0.0766          0.138
   0.0800          0.122
   0.0833          0.110
   0.0866          0.100
   0.0900          0.091
   0.0933          0.081
   0.0966          0.075
   0.1000          0.072
   0.1033          0.062
   0.1066          0.056
   0.1100          0.053
   0.1133          0.053
   0.1166          0.047
   0.1200          0.040
```

0.1233	0.040
0.1266	0.037
0.1300	0.034
0.1333	0.031
0.1366	0.031
0.1400	0.028
0.1433	0.028
0.1466	0.025
0.1500	0.025
0.1533	0.025
0.1566	0.022
0.1600	0.022
0.1633	0.022
0.1666	0.022
0.1700	0.022
0.1733	0.018
0.1766	0.018
0.1800	0.018
0.1833	0.018
0.1866	0.015
0.1900	0.015
0.1933	0.015
0.1966	0.015
0.2000	0.012
0.2033	0.012
0.2066	0.012
0.2100	0.012
0.2133	0.012
0.2166	0.012
0.2200	0.012
0.2233	0.012
0.2266	0.012
0.2300	0.012
0.2333	0.009
0.2366	0.009
0.2400	0.012
0.2433	0.009
0.2466	0.009
0.2500	0.009
0.2533	0.009
0.2566	0.009
0.2600	0.009
0.2633	0.009
0.2666	0.009
0.2700	0.009
0.2733	0.009
0.2766	0.009
0.2800	0.009
0.2833	0.006
0.2866	0.006
0.2900	0.006
0.2933	0.006
0.2966	0.006
0.3000	0.006
0.3033	0.006
0.3066	0.006
0.3100	0.006
0.3133	0.006
0.3166	0.006
0.3200	0.006

0.3233	0.006
0.3266	0.006
0.3300	0.006
0.3333	0.006
0.3500	0.006
0.3666	0.003
0.3833	0.003
0.4000	0.003
0.4166	0.006
0.4333	0.003
0.4500	0.003
0.4666	0.000
0.4833	0.003
0.5000	0.003
0.5166	0.003
0.5333	0.003
0.5500	0.003
0.5666	0.003
0.5833	0.003
0.6000	0.000
0.6166	0.000
0.6333	0.003
0.6500	0.000
0.6666	0.003
0.6833	0.000
0.7000	0.000
0.7166	0.000
0.7333	0.000
0.7500	0.000
0.7666	0.000
0.7833	0.000
0.8000	0.000
0.8166	0.000
0.8333	0.000
0.8500	0.003
0.8666	0.000
0.8833	0.000
0.9000	0.000
0.9166	0.000
0.9333	0.000
0.9500	0.000
0.9666	0.000
0.9833	0.000
1.0000	0.003
1.2000	-0.003
1.4000	-0.003

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                         A Q T E S O L V   R E S U L T S
                                  Version 1.10

09/28/92                                                                11:16:54

================================================================================
                                TEST DESCRIPTION

Data set........... a:\mw13t18.in
Data set title..... EAFB - Monitoring Well 13, Test 18

Knowns and Constants:
   No. of data points.................. 118
   Radius of well casing............... 0.08333
   Radius of well...................... 0.3333
   Aquifer saturated thickness......... 7.36
   Well screen length.................. 5
   Static height of water in well...... 7.36
   Log(Re/Rw).......................... 2.196
   A, B, C.............................  0.000,  0.000,  1.498

================================================================================
                                ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)


================================================================================
                        RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

            Estimate
   K  =   7.6591E-002
   y0 =   0.0000E+000


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>


TYPE CURVE DATA

     K  = 6.60952E-002
     y0 = 2.98187E+000

   Time      Drawdown       Time      Drawdown       Time      Drawdown
----------  ----------  ----------  ----------  ----------  ----------
0.000E+000  2.982E+000  2.000E-001  5.131E-004


TYPE CURVE DATA

     K  = 6.24777E-002
     y0 = 2.74037E+000
```

```
   Time        Drawdown        Time        Drawdown        Time        Drawdown
----------   ----------   ----------   ----------   ----------   ----------
0.000E+000   2.740E+000   2.000E-001   7.577E-004
```


EAFB - Monitoring Well 13, Test 18
K = 0.06248 ft/min
y0 = 2.74 ft
Displacement (ft)
10.
1.
0.1
0.01
0.
0.04
0.08
0.12
0.16
0.2
Time (min)

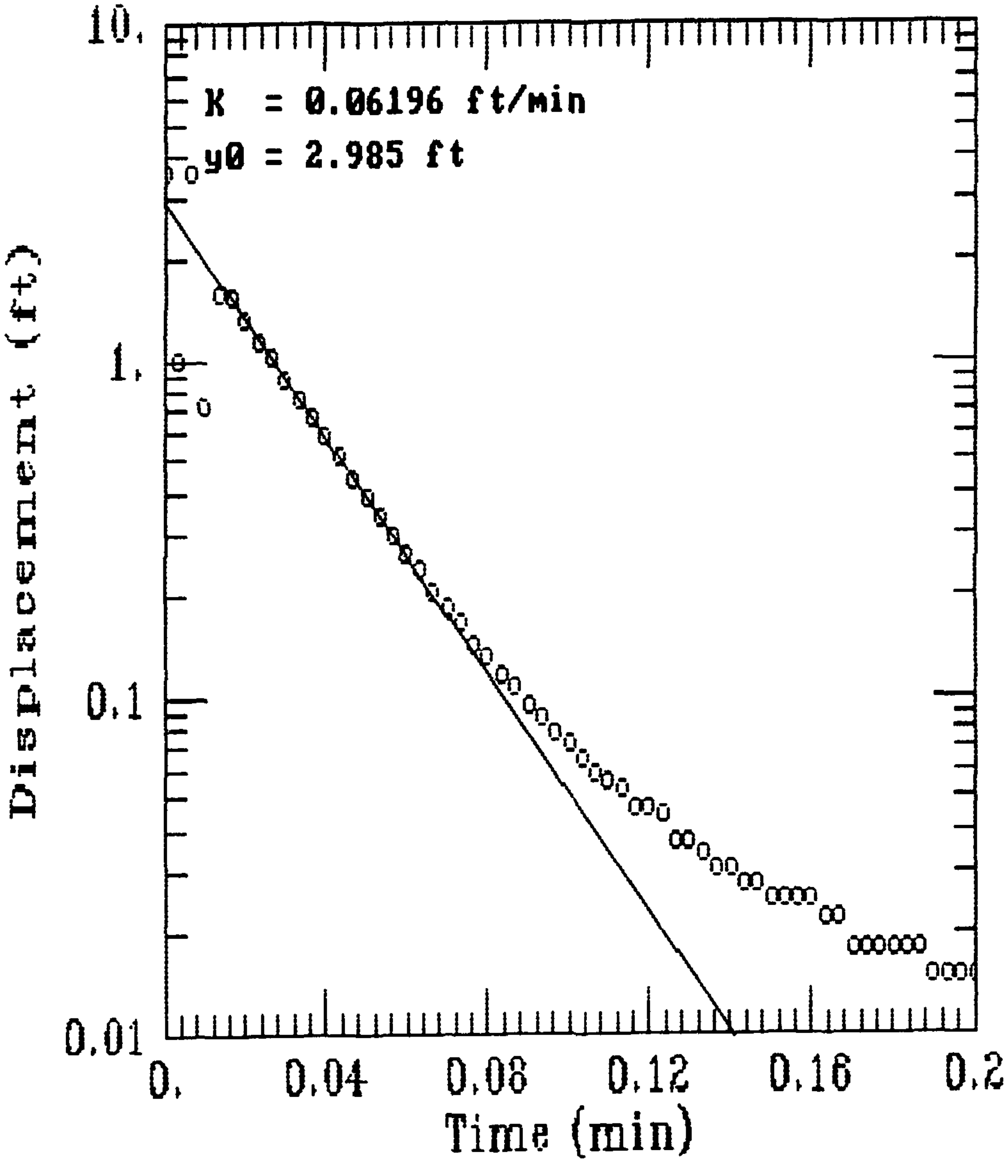
```
       SE1000C
  Environmental Logger
     09/03 08:02

Unit# 00856  Test 19

Setups:         INPUT  1
------------    ---------
Type            Level (F)
Mode            TOC
I.D.            00000

Reference          0.000
Linearity          0.000
Scale factor      10.010
Offset            -0.130
Delay mSEC        50.000

Step 0  09/02 18:03:55

Elapsed Time    INPUT  1
------------    ---------
   0.0000         -0.006
   0.0033          0.982
   0.0066          3.662
   0.0100          0.721
   0.0133          1.599
   0.0166          1.530
   0.0200          1.328
   0.0233          1.130
   0.0266          1.007
   0.0300          0.881
   0.0333          0.768
   0.0366          0.673
   0.0400          0.588
   0.0433          0.516
   0.0466          0.450
   0.0500          0.393
   0.0533          0.346
   0.0566          0.305
   0.0600          0.267
   0.0633          0.236
   0.0666          0.204
   0.0700          0.182
   0.0733          0.166
   0.0766          0.144
   0.0800          0.132
   0.0833          0.116
   0.0866          0.107
   0.0900          0.094
   0.0933          0.088
   0.0966          0.078
   0.1000          0.072
   0.1033          0.066
   0.1066          0.059
   0.1100          0.056
   0.1133          0.053
   0.1166          0.047
   0.1200          0.047
```

0.1233	0.044
0.1266	0.037
0.1300	0.037
0.1333	0.034
0.1366	0.031
0.1400	0.031
0.1433	0.028
0.1466	0.028
0.1500	0.025
0.1533	0.025
0.1566	0.025
0.1600	0.025
0.1633	0.022
0.1666	0.022
0.1700	0.018
0.1733	0.018
0.1766	0.018
0.1800	0.018
0.1833	0.018
0.1866	0.018
0.1900	0.015
0.1933	0.015
0.1966	0.015
0.2000	0.015
0.2033	0.015
0.2066	0.015
0.2100	0.015
0.2133	0.012
0.2166	0.012
0.2200	0.012
0.2233	0.012
0.2266	0.009
0.2300	0.012
0.2333	0.012
0.2366	0.012
0.2400	0.012
0.2433	0.009
0.2466	0.009
0.2500	0.012
0.2533	0.009
0.2566	0.009
0.2600	0.009
0.2633	0.009
0.2666	0.009
0.2700	0.009
0.2733	0.009
0.2766	0.006
0.2800	0.009
0.2833	0.006
0.2866	0.006
0.2900	0.006
0.2933	0.006
0.2966	0.006
0.3000	0.006
0.3033	0.006
0.3066	0.006
0.3100	0.009
0.3133	0.006
0.3166	0.006
0.3200	0.006

0.3233	0.006
0.3266	0.006
0.3300	0.006
0.3333	0.006
0.3500	0.006
0.3666	0.006
0.3833	0.006
0.4000	0.003
0.4166	0.003
0.4333	0.003
0.4500	0.003
0.4666	0.003
0.4833	0.003
0.5000	0.003
0.5166	0.003
0.5333	0.003
0.5500	0.003
0.5666	0.003
0.5833	0.003
0.6000	0.003
0.6166	0.000
0.6333	0.000
0.6500	0.003
0.6666	0.003
0.6833	0.000
0.7000	0.000
0.7166	0.000
0.7333	0.000
0.7500	0.000
0.7666	0.000
0.7833	0.003
0.8000	0.000
0.8166	0.000
0.8333	0.000
0.8500	0.000
0.8666	0.000
0.8833	0.000
0.9000	0.003
0.9166	0.000
0.9333	0.000
0.9500	0.000
0.9666	0.000
0.9833	0.000
1.0000	0.000

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                         A Q T E S O L V   R E S U L T S
                                  Version  1.10

09/28/92                                                                  11:40:21

==================================================================================
                                TEST DESCRIPTION

Data set........... a:\mw18t19.in
Data set title..... EAFB - Monitoring Well 13, Test 19

Knowns and Constants:
   No. of data points.................. 120
   Radius of well casing............... 0.08333
   Radius of well...................... 0.3333
   Aquifer saturated thickness......... 7.36
   Well screen length.................. 5
   Static height of water in well...... 7.36
   Log(Re/Rw).......................... 2.196
   A, B, C.............................  0.000,  0.000,  1.498

==================================================================================
                               ANALYTICAL METHOD

Bouwer and Rice (unconfined aquifer slug test)


==================================================================================
                         RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =    6.3222E-002
   y0 =    0.0000E+000


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>


TYPE CURVE DATA

     K  = 6.19572E-002
     y0 = 2.98538E+000

   Time       Drawdown       Time       Drawdown       Time       Drawdown
----------   ----------   ----------   ----------   ----------   ----------
0.000E+000   2.985E+000   2.000E-001   8.838E-004
```

EAFB - Monitoring Well 13, Test 19



Appendix G

CIVIL SURVEYING DATA

Elmendorf AFB - Operable Unit 5 - Monitoring Wells

Designation		Northing	Easting	Top of Steel Casing (cap removed)	Top of PVC Casing (cap removed)	Ground Surface next to Well
GW 4A	ft	2644454.49	1674775.40	135.32	134.79	132.9
GW 4A	m	806031.341	510472.562	41.246	41.084	40.51
GW 6A	ft	2642648.49	1670730.39	137.74	137.62	135.6
GW 6A	m	805480.871	509239.641	41.983	41.947	41.33
NS3-02	ft	2643600.36	1673577.61	118.44	117.98	115.3
NS3-02	m	805771.001	510107.476	36.101	35.960	35.14
NS3-03	ft	2643144.74	1672285.55	109.17	109.13	106.2
NS3-03	m	805632.128	509713.655	33.275	33.263	32.37
NS3-06	ft	2644144.97	1672841.54	146.84		146.8
NS3-06	m	805936.999	509883.121	44.757		44.74
OU5MW-01	ft	2641440.14	1667083.49	136.82	136.41	134.1
OU5MW-01	m	805112.565	508128.064	41.703	41.578	40.87
OU5MW-02	ft	2642493.14	1668573.89	141.67	140.95	139.2
OU5MW-02	m	805433.520	508582.339	43.181	42.962	42.43
OU5MW-03	ft	2643187.22	1669747.10	148.11	147.58	145.7
OU5MW-03	m	805645.076	508939.934	45.144	44.982	44.41
OU4MW-04	ft	2644187.86	1671146.14	157.46	157.09	154.8
OU4MW-04	m	805950.072	509366.362	47.994	47.881	47.18
OU5MW-05	ft	2644958.94	1672552.29	157.82	157.29	155.3
OU4MW-05	m	806185.097	509794.958	48.104	47.942	47.34
OU5MW-06	ft	2645199.58	1674566.13	174.54	173.99	172.4
OU5MW-06	m	806258.445	510408.777	53.200	53.032	52.55
OU5MW-07	ft	2645421.29	1675634.89	179.97	179.42	177.4
OU5MW-07	m	806326.022	510734.536	54.855	54.687	54.07
OU5MW-08	ft	2644734.62	1675474.37	153.88	153.50	151.1
OU5MW-08	m	806116.724	510685.609	46.903	46.787	46.06
OU5MW-09	ft	2643498.85	1672675.46	113.62	113.02	111.0
OU5MW-09	m	805740.061	509832.500	34.631	34.449	33.83
OU5MW-10	ft	2642902.03	1672025.94	106.08	105.25	103.5
OU5MW-10	m	805558.150	509634.526	32.333	32.080	31.55
OU5MW-11	ft	2643322.68	1670837.17	153.50	152.95	151.9
OU5MW-11	m	805686.364	509272.188	46.787	46.619	46.30
OU5MW-12	ft	2641969.40	1670451.81	96.89	96.01	94.1
OU5MW-12	m	805273.884	509154.730	29.532	29.264	28.68
OU5MW-13	ft	2641783.28	1669909.23	91.39	90.81	88.6
OU5MW-13	m	805217.154	508989.351	27.856	27.679	27.01

DOWL Engineers - Revised, December 15, 1992

Elmendorf AFB - Operable Unit 5 - Monitoring Wells

Designation		Northing	Easting	Top of Steel Casing (cap removed)	Top of PVC Casing (cap removed)	Ground Surface next to Well
OU5MW-14	ft	2641283.98	1669070.86	85.52	84.97	83.0
OU5MW-14	m	805064.967	508733.816	26.067	25.899	25.30
OU5MW-15	ft	2640954.48	1668159.38	82.00	81.56	79.6
OU5MW-15	m	804964.535	508455.996	24.994	24.860	24.26
OU5MW-16	ft	2640657.86	1667569.69	77.98	77.29	75.4
OU5MW-16	m	804874.125	508276.258	23.768	23.558	22.98
OU5MW-17	ft	2640111.83	1666837.83	66.38	65.99	63.1
OU5MW-17	m	804707.695	508053.187	20.233	20.114	19.23
OU5MW-30	ft	2643719.87	1673208.63	117.60	117.29	114.7
OU5MW-30	m	805807.428	509995.010	35.845	35.750	34.96
OU5MW-31	ft	2644051.90	1674322.56	125.73	125.16	123.5
OU5MW-31	m	805908.631	510334.537	38.323	38.149	37.64
SP1-01	ft	2640815.84	1667437.25	98.20	97.91	94.8
SP1-01	m	804922.278	508235.890	29.931	29.843	28.89
SP1-02	ft	2641264.68	1668249.57	135.90	135.55	132.5
SP1-02	m	805059.085	508483.486	41.422	41.316	40.39
SP2/6-01	ft	2643026.15	1670418.50	153.05	152.75	150.4
SP2/6-01	m	805595.982	509144.577	46.650	46.558	45.84
SP2/6-02	ft	2643046.73	1670706.58	144.31	144.19	141.3
SP2/6-02	m	805602.255	509232.384	43.986	43.949	43.07
SP2/6-03	ft	2642951.72	1671070.88	141.85	141.63	139.1
SP2/6-03	m	805573.295	509343.423	43.236	43.169	42.40
SP2/6-04	ft	2642799.59	1670895.12	140.49	140.44	137.9
SP2/6-04	m	805526.926	509289.851	42.821	42.806	42.03
SP2/6-05	ft	2642393.82	1670442.28	136.03	135.81	133.1
SP2/6-05	m	805403.247	509151.825	41.462	41.395	40.57
SP4-02	ft	2644118.12	1674413.02	128.45	128.13	125.3
SP4-02	m	805928.815	510362.109	39.152	39.054	38.19
SP4/11-01	ft	2644372.91	1674636.15	134.58	134.30	131.3
SP4/11-01	m	806006.475	510430.119	41.020	40.935	40.02
SP4/11-03	ft	2644727.92	1674238.07	171.65	171.06	168.5
SP4/11-03	m	806114.682	510308.784	52.319	52.139	51.36
W-14	ft	2644578.29	1675043.47	135.35	135.16	133.7
W-14	m	806069.075	510554.271	41.255	41.197	40.75
W-16	ft	2642644.26	1670567.61	138.48	138.18	137.0
W-16	m	805479.581	509190.026	42.209	42.117	41.76

DOWL Engineers - Revised, December 15, 1992

Elmendorf AFB - Operable Unit 5 - Piezometers

Designation		Northing	Easting	Top of Steel Pipe (cap removed)	Ground Surface
OU5GW-25	ft	2643635.94	1673456.25	117.05	114.2
OU5GW-25	m	805781.846	510070.486	35.677	34.81
OU5GW-27	ft	2644303.85	1674882.70	133.71	130.9
OU5GW-27	m	805985.425	510505.268	40.755	39.90
OU5GW-28	ft	2644379.37	1675291.12	136.54	133.0
OU5GW-28	m	806008.444	510629.755	41.617	40.54
OU5GW-29	ft	2644121.22	1674165.03	127.12	123.54
OU5GW-29	m	805929.760	510286.521	38.746	37.66
OU5GW-34	ft	2642593.39	1671126.84	102.53	98.8
OU5GW-34	m	805464.076	509360.479	31.251	30.11
OU5GW-40	ft	2644431.24	1675424.27	138.01	134.6
OU5GW-40	m	806024.253	510670.339	42.066	41.03
OU5GW-41	ft	2643660.91	1675645.34	132.96	129.0
OU5GW-41	m	805789.456	510737.720	40.526	39.32
OU5GW-42	ft	2643676.09	1675132.72	126.26	123.7
OU5GW-42	m	805794.084	510581.475	38.484	37.70
OU5GW-44	ft	2643775.97	1674666.37	124.86	121.3
OU5GW-44	m	805824.528	510439.330	38.057	36.97
OU5GW-46	ft	2642275.23	1670616.14	101.83	99.1
OU5GW-46	m	805367.101	509204.818	31.038	30.21
OU5GW-50	ft	2643474.43	1671992.91	116.14	112.9
OU5GW-50	m	805732.616	509624.458	35.399	34.41
OU5GW-51	ft	2642037.23	1670309.83	96.74	93.0
OU5GW-51	m	805294.558	509111.454	29.486	28.35
OU5GW-55	ft	2640021.46	1667822.47	58.20	54.6
OU5GW-55	m	804680.151	508353.306	17.739	16.64
OU5GW-58	ft	2640171.51	1668016.26	58.67	55.1
OU5GW-58	m	804725.884	508412.373	17.882	16.79
OU5GW-63	ft	2644562.42	1674467.19	133.00	129.8
OU5GW-63	m	806064.237	510378.620	40.538	39.56
OU5SL-07	ft	2641199.85	1668391.08	84.77	80.7
OU5SL-07	m	805039.323	508526.617	25.838	24.59
OU5SL-10	ft	2641653.82	1669256.27	96.78	93.6
OU5SL-10	m	805177.694	508790.328	29.499	28.53
OU5SL-12	ft	2642359.48	1670514.23	107.04	103.1
OU5SL-12	m	805392.782	509173.757	32.626	31.42

DOWL Engineers - Revised, December 15, 1992

Elmendorf AFB - Operable Unit 5 - Piezometers

Designation		Northing	Easting	Top of Steel Pipe (cap removed)	Ground Surface
OU5SL-18	ft	2643014.36	1671648.26	110.78	107.3
OU5SL-18	m	805592.389	509519.409	33.766	32.71
OU5SL-20	ft	2643425.54	1672211.50	114.87	110.4
OU5SL-20	m	805717.717	509691.083	35.012	33.65
OU5SL-22	ft	2644571.92	1674234.19	134.29	129.9
OU5SL-22	m	806067.135	510307.603	40.932	39.59
OU5SL-23	ft	2644634.05	1674661.20	136.40	132.1
OU5SL-23	m	806086.069	510437.753	41.575	40.26
OU5SL-25	ft	2642987.35	1671468.82	109.21	105.7
OU5SL-25	m	805584.155	509464.714	33.287	32.22

Elmendorf AFB - Operable Unit 5 - Soil Borings

Designation		Northing	Easting	Ground Surface	References
OU5SB-18	ft	2,641,072.74	1,667,584.32	133.0	S87°E, 47.8-Duplex Nail in Power Pole
OU5SB-18	m	805,000.582	508,280.716	40.54	N25°W, 52.2-Duplex Nail in 5" Aspen
					N80°W, 98.3-Duplex Nail in Power Pole
OU5SB-19	ft	2,640,845.87	1,666,934.38	131.0	N80°W, 76.9-Duplex Nail in Power Pole
OU5SB-19	m	804,931.430	508,082.615	39.93	S40°E, 41.7-Duplex Nail in Power Pole
					N25°E, 74.0-Duplex Nail in Power Pole
OU5SB-20	ft	2,640,961.98	1,667,210.23	131.7	S22°W, 114.7-Duplex Nail in 8" Aspen
OU5SB-20	m	804,966.823	508,166.695	40.14	N72°W, 50.6-Duplex Nail in 6" Birch
					N54°E, 87.5-Duplex Nail in Power Pole
OU5SB-21	ft	2,641,498.02	1,668,728.49	133.5	S23°W, 30.0-Duplex Nail in 12" Cottonwood
OU5SB-21	m	805,130.207	508,629.460	40.68	S57°E, 18.5-Duplex Nail in 6" Aspen
					N77°W, 75.1-Duplex Nail in Power Pole
OU5SB-22	ft	2,642,501.39	1,669,897.62	138.4	S48°W, 69.5-Duplex Nail in Wood Sign Post
OU5SB-22	m	805,436.035	508,985.812	42.18	N74°W, 37.7-Speed Limit Sign Post
					N44°E, 24.0-Duplex Nail in 3" Aspen
OU5SB-23	ft	2,642,590.12	1,670,419.70	147.1	S62°E, 59.7-Duplex Nail in Power Pole
OU5SB-23	m	805,463.078	509,144.942	44.84	N64°E, 44.2-Duplex Nail in Wood Service Pole
					w/climbing arms
					N26°W, 29.6-Duplex Nail in Southeast corner of
					Building #22-007
OU5SB-24	ft	2,643,055.28	1,670,720.22	141.1	S66°W, 16.6-Center of MW SP2/6-02
OU5SB-24	m	805,604.859	509,236.540	43.01	N70°W, 18.8-Duplex Nail in 3" Aspen
					N72°E, 87.5-Southwest corner of Quanset Hut
OU5SB-25	ft	2,643,696.35	1,672,308.11	121.9	S30°W, 44.0-Duplex Nail in 8" Aspen
OU5SB-25	m	805,800.259	509,720.531	37.16	S26°E, 82.5-Duplex Nail in Power Pole
					S70°E, 44.0-Duplex Nail in 8" Aspen
OU5SB-26	ft	2,644,420.58	1,672,587.92	147.9	S36°E, 68.5-Metal Light Pole
OU5SB-26	m	806,021.005	509,805.819	45.08	N20°W, 24.0-Centerline of Manhole Cover
					N44°E, 78.5-RR X-ing Sign Post
OU5SB-27	ft	2,644,526.12	1,672,976.71	152.0	S18°E, 148.2-Totem Pole
OU5SB-27	m	806,053.173	509,924.320	46.33	S70°W, 51.5-Northeast corner of Concrete Structure
					for Steam Pipes
					N10°W, 22.3-Flagged RR Spike inside of S. Rail
OU5SB-27A	ft	2,644,519.25	1,673,109.92	161.2	North, 57.0-Flagged RR Spike inside of S. Rail
OU5SB-27A	m	806,051.078	509,964.925	49.13	West, 182.6-Northeast corner of Concrete Steam Vaul
					S36°W, 153.3-Totem Pole
OU5SB-28	ft	2,644,649.57	1,673,626.25	163.4	S24°W, 50.5-Duplex Nail in 5" Aspen
OU5SB-28	m	806,090.802	510,122.301	49.80	S12°E, 29.7-Duplex Nail in 2" Aspen
					East, 66.0-4" BC Mon. "TTAN-7"
					N12°W, 20.3-Flagged RR Spike inside of S. Rail
OU5SB-29	ft	2,640,824.12	1,667,448.99	95.3	S16°E, 43.3-Duplex Nail in 8" Cottonwood
OU5SB-29	m	804,924.800	508,239.468	29.05	S53°W, 13.5-Center MW SP1-01
					N20°E, 32.2-Duplex Nail in 6" Cottonwood

Elmendorf AFB - Operable Unit 5 - Water Supply Wells

Designation		Northing	Easting	Top of Flange	Ground Surface	
BW-40	ft	2,646,694.13	1,673,691.11	173.86	171.6	
BW-40	m	806,713.985	510,142.070	52.993	52.30	
BW-50	ft	2,642,551.36	1,680,511.10	200.43	200.2	*
BW-50	m	805,451.264	512,220.807	61.091	61.02	
BW-52	ft	2,642,921.89	1,672,341.57	108.01	106.1	
BW-52	m	805,564.204	509,730.729	32.922	32.34	
		*Finish Floor Next to Casing at BW-50				

DOWL Engineers - November 3, 1992

Elmendorf AFB - Operable Unit 5 - Stream Gauges

Designation		Northing	Easting	Top of Steel Rod
Gauging Station at	ft	2,644,191.91	1,679,417.31	175.89
Davis Highway	m	805,951.306	511,887.421	53.611
Gauging Station Dam	ft	2,642,020.14	1,671,096.71	98.70
	m	805,289.349	509,351.295	30.084

DOWL Engineers - November 3, 1992

Beaver Ponds

Water surface levels were taken at two locations on October 28, 1992.

9:50 AM Surface of pond just east of OU5SL-10 = 87.50 feet (26.670 meters)
Project Book 4, Page 6

12:40 PM Surface of pond 100' west of NS3-02 = 113.42 feet (34.570 meters)
Project Book 4, Page 7

Appendix H

DATA VALIDATION

Review of QA/QC Data For Close Support Laboratory Analyses at Elmendorf AFB OU 5

Review of QA/QC Data For Offsite Laboratory Analyses at Elmendorf AFB OU 5

Field Duplicate Results

Data Validation Summaries

REVIEW OF QA/QC DATA FOR OFFSITE LABORATORY ANALYSES AT ELMENDORF AFB OU 5

REVIEW OF QA/QC DATA FOR CLOSE SUPPORT LABORATORY ANALYSES AT ELMENDORF AFB OU 5

MEMORANDUM CH2M HILL

TO: Win Westervelt/ANC

COPIES: Susan Schrader/ANC

FROM: Donna Morgans/CVO

DATE: November 24, 1992

SUBJECT: Review of Quality Assurance/Quality Control (QA/QC) Data for Close Support Laboratory Analyses at Elmendorf Air Force Base (AFB), Operable Unit 5

PROJECT: ANC31026.H3.80

Summary

Overall, the data have met the acceptance criteria as outlined in the Elmendorf AFB Operable Unit 5 (OU-5) Remedial Investigation (RI) Work Plan and are usable for the purposes outlined in the context of the data quality objectives. Minor nonconformances with project data quality objectives or QA/QC criteria are thoroughly discussed, identified, and qualified in this report. The following is a brief summary of the overall quality of the sample results.

The majority of the JP-4/diesel range organics (DRO), gasoline range organics (GRO), and volatile organic compound (VOC) results met all QA/QC criteria for the selected QC parameters. Some minor deviations from the QA/QC criteria were observed as follows:

- 5SB04-25 exceeded the GRO analysis holding time and was qualified as an estimate and flagged with a "J" for positive results, or a "UJ" for nondetected results.
- Twenty-four different samples had compounds qualified as estimates and flagged with a "J" because continuing calibration verification did not meet QC acceptance criteria.
- Six JP-4/DRO results and one GRO result were qualified as estimates and flagged with a "J" because surrogate spike recoveries did not meet QC acceptance criteria.
- 1,1,1-Trichloroethane, trichloroethene, and tetrachloroethene did not meet the completeness objective of 80 percent usable data based on

meeting precision and accuracy criteria. However, all qualified data are considered usable for the purposes outlined in the RI work plan.

- Overall, the completeness criterion of 80 percent was met by all data.

Introduction

A review has been conducted on data submitted for the Close Support Laboratory (CSL) for the OU-5 Remedial Investigation (RI) at Elmendorf Air Force Base, Alaska. This report summarizes the results of the review of QA/QC data associated with the analysis of JP-4 (jet fuel), DRO, GRO, and nine VOCs. The following VOCs were analyzed by gas chromatography (GC) using a hall electrolytic conductivity detector (ECD): trans-1,2 dichloroethene, 1,1,1-trichloroethane, trichloroethene, tetrachloroethene. The following VOCs were analyzed by GC using a photoionization detector (PID): benzene, toluene, ethylbenzene, and meta, para, and ortho-xylenes. Soil and water samples were collected between August 6 and August 28, 1992. The intent of this review is to assess the appropriate use or "usability" of the analytical data for RI purposes based on the QA/QC data collected by the laboratory.

The usability review focuses on criteria for the following QA/QC parameters and their overall effect on the data.

- Holding times
- Calibration Verification Checks
- Method blanks
- Surrogate spikes
- Matrix spike/matrix spike duplicates
- Field QA/QC (Field blanks and duplicates)

Soil samples were collected from 31 different soil borings from OU-5 and from one soil boring from OU-7. Laboratory QA/QC data were evaluated from analyses associated with this investigation and include the following:

- Seventy-eight soil samples were analyzed for nine halogenated VOCs according to EPA Modified Methods 8010/8020 and gasoline range organics (GRO) according to the State of Alaska Department of Environmental Conservation (ADEC) Modified Method 8015.

- Seventy-eight soil samples were analyzed for JP-4 and DRO according to the ADEC Modified Method 8100.
- Twelve water blanks were analyzed for nine halogenated VOCs according to EPA Modified Methods 8010/8020 and GRO according to the ADEC Modified Method 8015.
- Four water blanks were analyzed for JP-4 and DRO according to the ADEC Modified Method 8100.

All analyses were performed by the Close Support Laboratory (CSL) in the CH2M HILL Applied Science and Technology Laboratory in Corvallis, Oregon.

Soil and water samples were analyzed for VOCs using methods and QA/QC criteria procedures derived from the U.S. EPA SW-846 *Test Methods for Evaluating Solid Waste*, September 1986, Third Edition. Soil and water samples were analyzed for GRO and JP-4/DRO using methods and QA/QC procedures derived from the State of Alaska Department of Environmental Conservation.

A data package similar to that of the EPA Contract Laboratory Program (CLP) was generated for each batch of samples submitted to the CSL. These data packages consisted of modified Forms 1 through 8 derived from the current version of the CLP Statement of Work for Organics Analysis. Two data packages (approximately 20 percent) were reviewed following the *U.S. EPA Functional Guidelines for Evaluating Organics Analyses*, where possible, reviewing all QA/QC data and validating all of the raw data. Because the completeness criteria of 80 percent was met, the remaining data packages were reviewed for all QA/QC data, but validating only 5 percent of the raw data.

Holding Times

Except for two soil samples, all samples were analyzed between one and seven days after collection. Soil samples 5SB22-30 and 5SB04-25 were analyzed for VOCs and GRO 14 and 17 days after collection, respectively. Except for 5SB04-25, all samples were analyzed within their 14-day holding time requirement.

5SB04-25 was qualified as an estimate and flagged with a "J" for positive results, or a "UJ" for nondetected results.

Continuing Calibration Verification

Continuing calibration verification standards monitor instrument performance and reference values used for quantitation of sample concentrations.

Calibration verification checks were required to be performed for each analytical method on a daily basis. Calibrations were verified by analyzing a mid-level concentration standard. Calibration verification results should be within ± 25 percent of the initial calibration concentration to meet QC acceptance criteria.

For JP-4/DRO analyses, a continuing calibration was performed on a daily basis. All continuing calibrations were performed using a 200 mg/l standard. All calibration verification results met QC acceptance criteria.

For VOC/GRO analyses, a continuing calibration was performed on a daily basis. All continuing calibrations were performed using a 20 μg/l standard. Except for samples analyzed on August 14, 20, and 27, 1992, all calibration verifications met QC acceptance criteria. Except for trans-1,2-dichloroethene (t-1,2-DCE), all VOC compounds exceeded the QC acceptance criteria on August 14, 1992. Except for benzene, toluene, ethylbenzene, and xylenes (BTEX), all compounds met QC acceptance criteria on August 20, 1992. Except for t-1,2-DCE, 1,1,1-trichloroethane (1,1,1-TCA), trichloroethene (TCE), and tetrachloroethene, all compounds met QC acceptance criteria on August 27, 1992. All samples associated with continuing calibrations that did not meet QC acceptance criteria were qualified as estimates and flagged with a "J" for positive results. Nondetect results were not qualified. The following six samples analyzed on August 14 had all VOC results, except t-1,2-DCE, qualified as estimates:

- 5SB08-14
- 5SB08-20B
- 5SB08-20B TB-01
- 5SB08-20C
- 5SB30-1
- 5SB30-5

The following eight samples analyzed on August 20 had BTEX qualified as estimates:

- 5SB03-10
- 5SB03-25
- 5SB03-30

- 5SB03-30D
- 5SB13-3
- 7SB01-10
- 7SB01-25
- 7SB01-40

The following 18 samples analyzed on August 27 had t-1,2-DCA, 1,1,1-TCA, TCE, and tetrachloroethene qualified as estimates:

- 5SB02-10
- 5SB02-25
- 5SB02-33
- 5SB05-10
- 5SB11-10
- 5SB11-25
- 5SB11-35
- 5SB11-35D
- 5SB05-25
- 5SB05-25D
- 5SB23-0
- 5SB23-58
- 5SB24-25
- 5SB24-30
- 5SB28-0
- 5SB28-10
- 5SB28-25
- 5SB28-38

Standard Reference Material

In addition to calibration verification checks, an standard reference material (SRM) standard was analyzed for each method. The SRM was analyzed once at the beginning of the RI to verify that instruments were correctly identifying and quantifying target compounds. Recoveries for all SRMs should be between 70 and 130 percent to meet QC acceptance criteria. All SRM recoveries met QC acceptance criteria.

Blanks

Blanks monitor potential laboratory contamination that may result in reporting false positive sample results.

Method blanks were required to be performed for each analytical method on a daily basis. A method blank verifies the analytical system is free of contamination under conditions of the analysis. Except for one VOC method blank, all method blanks were free from contamination, therefore meeting QC acceptance criteria. The method blank analyzed on August 16, 1992, contained 1.6 μg/l of tetrachloroethene. However, sample qualification was not required because tetrachloroethene was not detected in any of the samples associated with this blank.

Sensitivity

Sensitivity criteria monitor achievement of detection limits.

The detection limit achieved for JP-4/DRO analyses was 5 mg/l for waters and 50 mg/kg for soils. The detection limit achieved for VOC analyses was 1 μg/l for waters and 0.05 mg/kg for soils. The detection limits achieved for GRO analyses was 1.0 mg/l for waters and 50 mg/kg for soils. Therefore, all method detection limits met QC acceptance criteria. All soil sample results were reported on an "as received" basis.

All soil samples analyzed for JP-4/DRO achieved the target detection limits. Except for four soil samples analyzed for VOCs/GRO, all soil samples achieved the target detection limits. Soil sample 5SB15-07 required a 2-fold dilution, 5SB18-35 required a 10-fold dilution, 5SB29-10 required a 20-fold dilution, and 5SB01-40 required a 40-fold dilution to bring high concentrations of target compounds into the linear range of the instrument. All results and detection limits were correctly multiplied by the dilution factor.

Surrogate Spike Recovery

Surrogate spike recovery criteria monitor instrument performance and matrix effects on accuracy measurements. For JP4/DRO and GRO analyses, surrogate spike recovery should fall within the QC control limits of 50 to 150 percent for accuracy to meet QC acceptance criteria. For halogenated VOC analyses, surrogate spike recovery should fall within the QC control limits of 60 to 140 percent for accuracy to meet QC acceptance criteria.

Samples analyzed for JP-4/DRO were spiked with o-terphenyl as a surrogate spike compound. Samples analyzed for VOC compounds detected by the ECD were spiked with 1,2-dichloroethane-d4 (1,2-DCA). Samples analyzed for VOC compounds detected by the PID were spiked with trifluorotoluene. Samples analyzed for GRO were spiked with 4-bromofluorobenzene. Samples submitted between August 6 and 13, 1992, for GRO analyses were not spiked with the GRO surrogate compound because this analysis was not originally requested on the chain of custody.

Except for six JP-4/DRO surrogate recoveries, all surrogate spike recoveries for JP-4/DRO analyses met QC acceptance criteria. The following samples (surrogate recoveries) exceeded the QC acceptance limits. These were qualified as estimates and flagged with a "J" for positive results.

- 5SB09-3 (41%)
- 5SB10-5 (44%)
- 5SB12-8C (154%)
- 5SB19-0 (40%)
- 5SB23-25 (226%)
- 5SB25-05 (44%)

Except for one GRO surrogate recovery, all surrogate spike recoveries for GRO analyses met QC acceptance criteria. The surrogate recovery for 7SB01-40 (0%) was below the QC acceptance limit. 7SB01-40 was qualified as estimate and flagged with a "J" for positive results.

Precision and Accuracy

Precision criteria monitor analytical reproducibility as determined by duplicate analyses and accuracy criteria monitor agreement with "true values" as determined by analytical spike recovery.

Matrix Spike/Matrix Spike Duplicates

For JP4/DRO analyses, matrix spike recoveries should fall within the QC control limits of 60 to 120 percent for accuracy and ± 50 relative percent difference (RPD) for precision to meet QC acceptance criteria. For GRO analyses, matrix spike recoveries should fall within the QC control units of 50 to 100 percent for accuracy and ± 50 RPD for precision to meet QC acceptance criteria. For VOC analyses, matrix spike recoveries should fall within the QC control limits of 60 to 140 percent for accuracy and ± 20 RPD for precision to meet QC acceptance criteria. A matrix spike/matrix spike duplicate (MS/MSD) should be analyzed at a 5 percent frequency, or once per batch, whichever is more frequent to meet QC acceptance criteria.

One water (25 percent frequency) and nine soil (12 percent frequency) MS/MSDs were performed with the JP-4/DRO analyses. Frequency QC acceptance criteria for analysis of MS/MSDs were met for both matrices.

Except for recoveries from one soil MS/MSD, all water and soil MS/MSDs met QC acceptance criteria for accuracy and precision. For soil sample 5SB21-10, the MS/MSD spike recoveries for JP-4 were 41 percent and 60 percent, respectively. No samples were qualified as a result of low spike recoveries. Low recoveries can mostly likely be attributed to interferences from the sample matrix.

Two GRO (2.5 percent frequency) and nine VOC (12 percent frequency) MS/MSDs were performed with soil analyses. Except for GRO analyses, frequency criteria for analysis of MS/MSDs were met for soils. Additional water samples were not submitted to perform MS/MSDs.

Except for recoveries from one soil MS/MSD, all soil MS/MSDs met QC acceptance criteria for accuracy and precision. For soil sample 5SB26-25, the MS/MSD spike recoveries for t-1,2-DCE were 35 percent and 49 percent, respectively and the RPD for the same compound was 33 percent. For the same sample, MS/MSD recoveries for m,p-xylenes were 175 percent and 168 percent recovery, respectively. No samples were qualified as a result of matrix spike recoveries or RPDs outside QC acceptance criteria. Recoveries outside QC acceptance criteria can mostly likely be attributed to interferences within the sample matrix.

Field QA/QC

Rinsate, Field, and Travel Blanks

Rinsate blanks monitor for potential contamination from inadequate decontamination procedures between sample grabs or from other sample handling procedures. Field blanks are used primarily to indicate if contamination has occurred as a result of ambient air conditions. Travel blanks are useful in determining possible contamination occurring during packaging, shipping, and handling. However, rinsate, field, and travel blanks are not totally representative of field conditions, since laboratory contamination can be introduced as well.

A total of four rinsate blanks (5 percent frequency), four field blanks (5 percent frequency), and 16 travel blanks, were submitted as blind samples to the CSL. Field and rinsate blanks were submitted at the minimum frequency of five percent to meet QC acceptance criteria. A travel blank was submitted with every container containing VOC samples. Except for one travel blank, all travel blanks were analyzed for VOCs and GRO only. Travel blank (5SB08-20D) was analyzed for JP-4, DRO, GRO, and VOCs. Except for one field blank, all field blanks were analyzed for VOCs and GRO only. Field blank (5SB08-20B) was analyzed for JP-4, DRO, GRO, and VOCs. All rinsate blanks were analyzed for JP-4, DRO, GRO, and VOCs.

All rinsate, field, and travel blanks met frequency criteria and were free from contamination. Therefore, decontamination procedures, ambient air, or shipping and handling procedures did not attribute to concentrations detected in field samples.

Field Duplicates

Field duplicates are another measure of reproducibility by duplicate analysis. There are no generally accepted QC acceptance criteria or control limits for RPD of field duplicates; therefore, laboratory duplicate criteria were applied. Project QA goals allow control limits of ± 100 percent RPD with the provisional control limit of plus or minus the CRDL when concentrations are less than five times the method detection limit. Qualifiers are not assigned when field duplicate results do not meet QC acceptance criteria.

A total of four soil samples were submitted as blind field duplicates (5.1 percent frequency). Soil samples 5SB07-25, 5SB18-10, 5SB26-10, and 5SB27-25A were submitted in duplicate. No target compounds were detected in any of the field duplicates. Therefore, field duplicates could not be evaluated for sampling and analytical precision.

Completeness

Completeness is defined as the percentage of measurements made that are judged to be valid or useable compared to the expected total amount of measurements. The overall completeness objective or QC acceptance criteria was set at 80 percent for this RI.

Except for 1,1,1-TCA, TCE, and tetrachloroethene, the completeness objective was met for all compounds based on precision and accuracy. The completeness for 1,1,1-TCA, TCE, and tetrachloroethene was 77 percent; this was slightly lower than the objective because sample results were qualified as estimates.

As noted, certain continuing calibration verifications or surrogate spike recoveries did not meet the completeness QC acceptance criteria. However, these data are considered usable for purposes outlined in the RI work plan.

TO: Win Westervelt/CH2M HILL/ANC

COPY: Susan Schrader/CH2M HILL/ANC

FROM: Donna Morgans/CH2M HILL/CVO

DATE: February 11, 1993

SUBJECT: Review of Quality Assurance/Quality Control (QA/QC) Data for Elmendorf Air Force Base (AFB) Operable Unit 5 (OU-5) Groundwater and Flyash Sample Analyses

PROJECT: ANC31026.H3.80

Summary

Overall, the data have met the acceptance criteria as outlined in the Elmendorf AFB OU-5 Quality Assurance Project Plan and are usable for the purposes outlined in the context of the data quality objectives. Minor nonconformances of the data are thoroughly discussed, identified, and qualified in this memorandum. The following is a brief summary of the overall quality of the sample results.

The majority of metal results met all QA/QC criteria for the selected QC parameters and the completeness criterion of 80 percent was met by all data. Some minor deviations from the QA/QC criteria were observed as follows:

- One iron and eight zinc results were qualified as nondetects and flagged with a "U" because of preparation blank contamination.
- Two iron, one lead, seven selenium, and three zinc results were qualified as nondetects and flagged with a "U" because of rinsate blank contamination.
- Five arsenic results were qualified as biased high and flagged with a "K" because analytical spike recoveries were above QC acceptance criteria.
- Six selenium results were qualified as biased low and flagged with a "L" because analytical spike recoveries were below QC acceptance criteria.
- Seventeen barium, three copper, and three zinc results were qualified as estimates and flagged with a "J" because ICP serial dilutions did not meet QC acceptance criteria.

Introduction

A review has been conducted on data submitted for groundwater samples collected for the OU-5 remedial investigation (RI) at Elmendorf AFB, Alaska. This report summarizes the results of the QA/QC data associated with the analysis of total, soluble, and Extraction Procedure for Toxicity (EPTOX) metal analyses performed on samples collected between December 16 and 21, 1992. The intent of this review is to assess the appropriate use or "usability" of the analytical data for remediation purposes based on the QA/QC data submitted by the laboratory.

The usability review focuses on criteria for the following QA/QC parameters and their overall effect on the data.

- Holding times
- Initial and continuing calibrations
- Preparation blanks
- Interference check sample
- Laboratory control sample
- Duplicate sample analysis
- Matrix spike sample analysis
- Furnace atomic absorption QC
- ICP Serial dilution

Seven groundwater samples collected from MW01-37, 5MW01-37A (field duplicate), 5MW02-33, 5MW15-10, 5MW16-11, SP101-9, and SP102-36 and three rinsate blanks collected from 5FA01-02C, 5MW02-33C, and 5MW02-33CS were analyzed for total and/or soluble metals. Two flyash samples collected from 5FA01-02 and 5FA02-02 were analyzed for total and EPTOX metals. Laboratory QA/QC data were evaluated from analyses associated with this RI. The following summarizes the number of samples analyzed and the analytical methods:

- Fourteen groundwater and two rinsate blank samples were analyzed for 23 total and soluble target analyte list (TAL) metals by Inductively Coupled Plasma (ICP) Method, graphite furnace atomic absorption (GFAA), or cold vapor atomic absorption (EPA Methods 6010/7000 series)

- Two flyash and one rinsate blank sample were analyzed for 23 total TAL metals by ICP, GFAA, or CVAA (EPA Methods 6010/7000 series)

- Two fly ash samples were EPTOX extracted using deionized water as the extraction solution according to EPA Method 1310 and analyzed for 23 metals by ICP, GFAA, and CVAA (EPA Method 6010/7471)

All analyses were performed by the CH2M HILL Quality Analytical Laboratory in Redding, California.

Groundwater samples analyzed for metals were analyzed in accordance with, and QA/QC criteria were taken from, the U.S. EPA *Test Methods for Evaluating Solid Waste*, September 1986, Third Edition.

A CLP-like data package was provided with each batch of samples submitted to the laboratory for analysis. Data packages for all analyses included Forms 1 through 14 from the Contract Laboratory Program (CLP) Statement of Work for Inorganics Analysis and all raw data. All samples were reviewed according to the *U.S. EPA Functional Guidelines for Evaluating Inorganic Analyses* and all raw data were validated. The completeness criterion of 80 percent was met by all data.

Holding Times

Holding time criteria monitor sample integrity that may be compromised over time.

Except for mercury, all metals have a holding time requirement of 6 months. Mercury has a holding time requirement of 28 days.

All samples were analyzed within the required holding times. Therefore, holding time QC acceptance criteria were met for all samples.

Initial and Continuing Calibrations

An initial calibration should be performed on a daily basis and continuing calibrations should be performed at a frequency of 10 percent. Initial and continuing calibration recoveries should be within the control limits of 90 to 110 percent recovery.

Each instrument was calibrated at the correct frequency and with the proper number of blanks and standards for each element. All initial and continuing calibration recoveries met QC acceptance criteria.

Preparation Blanks

Blank criteria monitor sample contamination through carry-over and instrument sensitivity.

Preparation blanks should be performed at a five percent frequency or once per batch, whichever is more frequent. Blanks should be contamination-free to meet QC acceptance criteria.

Preparation blanks contained concentrations of barium, calcium, iron, selenium, sodium, thallium, or zinc below the contract required detection limit (CRDL).

According to the CLP functional guidelines, when a preparation blank contains an analyte from the target analyte list (TAL), positive results should not be reported unless the concentration found in the sample exceeds five times the concentration found in the blank. Sample results with concentrations of contaminants greater than five times the concentration detected in the preparation blank were considered positive hits. Sample concentrations less than five times the contaminant concentration were considered nondetected results and a "U" qualifier was assigned.

Except for one iron and eight zinc results, groundwater and flyash samples did not require qualification due to preparation blank contamination. The following sample results were qualified as nondetects and flagged with a "U":

Iron results for:

- 5MW02-33S (5.1 U)

Zinc results for:

- 5MW01-37 (6.6 U)
- 5MW01-37A (6.7 U)

- 5MW01-37S (9.7 U)
- 5MW02-33 (14.4 U)
- 5MW02-33S (12.7 U)
- 5MW16-11 (9.7 U)
- SP102-36 (13.1 U)
- SP102-36S (10.7 U)

Interference Check Sample

Interference check samples monitor the laboratory's interelement and background correction factors.

An inference check sample should be analyzed at the beginning and end of each analytical batch and check sample recoveries should be within the control limits of 80 to 120 percent.

All interference check samples met frequency and recovery QC acceptance criteria.

Laboratory Control Sample

Laboratory control samples (LCSs) monitor the laboratory's overall performance including sample preparation when analyzing a standard from an independent source.

An LCS should be analyzed with each analytical batch and recoveries should be within the control limits of 80 to 120 percent.

All LCSs met frequency and recovery QC acceptance criteria.

Duplicate Sample Analysis

Precision criteria monitor analytical reproducibility.

A duplicate sample should be analyzed with each analytical batch and relative percent difference (RPD) results should be within the control limits of ±20 or within the provisional criteria of plus or minus the CRDL when the sample concentration is less than five times the CRDL to meet precision criteria.

All laboratory duplicates met frequency and precision QC acceptance criteria.

Matrix Spike Sample Analysis

Accuracy criteria monitor agreement with "true values" as determined by matrix spike recovery.

A matrix spike sample should be analyzed with each analytical batch and recoveries should be within the control limits of 75 to 125 percent recovery.

All matrix spike recoveries met frequency and accuracy QC acceptance criteria.

Furnace Atomic Absorption QC

Analytical spikes monitor the accuracy of individual analyses based on the bias contributed by the instrument and the digested sample matrix.

Analytical spikes should be analyzed with every sample requiring graphite furnace atomic absorption (GFAA) analysis and recoveries should be within the QC control limits of 85 to 115 percent.

According to the CLP functional guidelines, sample results associated with each analytical spike recoveries below the QC control limits should be qualified as biased low and flagged with an "L" for positive results, a "UL" for nondetected results. Analytical spike recoveries above the QC control limits should be qualified as biased high and flagged with a "K" for positive results.

Except for five arsenic and six selenium analytical spike recoveries, all analytical spike recoveries met QC acceptance criteria. The following arsenic results were qualified as biased high and flagged with a "K":

- 5MW15-10
- 5MW16-11
- 5MW16-11S
- SP101-9
- SP102-36

The following selenium results were qualified as biased low and flagged with an "L":

- 5MW01-37A
- 5MW02-33S
- 5MW15-10S
- 5MW16-11S
- SP101-9
- SP102-36

ICP Serial Dilution

ICP serial dilution analyses determine if significant physical or chemical interferences exist due to the sample matrix.

One ICP serial dilution should be analyzed with each analytical batch and percent difference results should be within the control limits of ±10 percent.

Except for one barium, one copper, and one zinc percent difference result, all ICP serial dilution results met the QC acceptance criteria. According to CLP functional guidelines, all samples analyzed with the ICP serial dilution outside the QC acceptance limits were qualified as estimates and flagged with a "J" for positive results, a "UJ" for nondetected results.

Barium results for the following 17 samples were qualified as estimates and flagged with a "J":

- 5FA01-2C
- 5MW01-37
- 5MW01-37A
- 5MW01-37AS
- 5MW01-37S
- 5MW02-33
- 5MW02-33C
- 5MW02-33CS
- 5MW02-33S
- 5MW15-10
- 5MW15-10S
- 5MW16-11
- 5MW16-11S
- SP101-9
- SP101-9S
- SP102-36
- SP102-36S

Copper and zinc results for the following samples were qualified as estimates and flagged with a "J":

- 5FA01-02
- 5FA02-02
- 5FA02-02A

Completeness

Completeness is defined as the percentage of measurements made that are judged to be valid compared to the expected total amount of measurements. The overall completeness objective for acceptable analytical data was set at 80 percent based on precision and accuracy.

All metals met the completeness objective based on precision and accuracy.

Field QA/QC

Rinsate Blanks

Rinsate blanks monitor for potential contamination from inadequate decontamination procedures between sample grabs or from other sample handling procedures. However, rinsate blanks are not totally representative of field conditions, since laboratory contamination can be introduced as well. Rinsate blanks should be collected at a frequency of five percent.

Three rinsate blanks were submitted as a blind samples. Two rinsate blanks (5MW02-33C and 5FA01-02C) were analyzed for total metals (16 percent frequency) and one rinsate blank (5MW02-33CS) was analyzed for soluble metals (14 percent frequency), therefore meeting frequency QC acceptance criteria.

Calcium (104 μg/l), iron (2.7 μg/l), selenium (1.7 μg/l), sodium (42.9 μg/l), and zinc (3.8 μg/l) were detected in 5MW02-33C; calcium (148 μg/l), iron (12.0 μg/l), lead (1.3 μg/l), manganese (1.0 μg/l), selenium (1.8 μg/l), sodium (48.2 μg/l), and zinc (4.4 μg/l) were detected in 5FA01-02C; and calcium (111 μg/l), iron (13.9 μg/l), sodium (54.8 μg/l), and zinc (4.4 μg/l) were detected in 5MW02-33C. Except for two iron, one lead, seven selenium, and three zinc results, groundwater and flyash samples did not require qualification due to rinsate blank contamination. The following metal results were qualified as nondetects and flagged with a "U" as a result of rinsate blank contamination.

Iron results for:

- 5MW01-37AS (14.2 U)
- 5MW15-10S (20.9 U)

Lead results for:

- SP101-9 (3.2 U)

Selenium results for:

- 5MW01-37A (0.64 U)
- 5MW02-33 (0.64 U)
- 5MW15-10 (1.0 U)
- 5MW16-11 (0.93 U)
- SP101-9 (0.68 U)
- SP101-9S (1.1 U)
- SP102-36 (2.0 U)

Zinc results for:

- 5MW15-10S (21.3 U)
- 5MW16-11S (16.7 U)
- SP101-9S (11.7 U)

Field Duplicates

Field duplicate results are used to determine the precision of field sampling and laboratory techniques.

Project QA control limits for field duplicates allow ±100 RPD for water samples with the provisional control limit of plus or minus the CRDL when concentrations are less than five times the CRDL. Qualifiers are not assigned when field duplicate results do not meet QC acceptance criteria. Field duplicates should be collected at a minimum frequency of five percent.

One groundwater (5MW01-37) (7.1 percent frequency) was collected as a blind duplicate and analyzed for total and soluble metals. One fly ash sample (5FA02-02A) (50 percent frequency) was collected as a blind field duplicate and analyzed for total metals. Therefore, frequency QC acceptance criteria was met for field duplicate analysis. Tables 1 through 3 show field duplicate RPD results for metal analyses. Field duplicate results are summarized below.

- Table 1 summarizes the hits for the groundwater sample field duplicates collected at 5MW01-37 that were analyzed for total metals. Ten metals were detected in one or both samples analyzed. RPDs for metals detected in both samples ranged between 0.6 and 42.0 percent, therefore field duplicate QC acceptance criteria was met by all metals detected in both samples. Lead was detected in only one sample, therefore an RPD could not be calculated.

- Table 2 summarizes the hits for groundwater sample field duplicates collected at 5MW01-37S that were analyzed for soluble metals. Twelve metals were detected in one or both samples analyzed. RPDs for metals detected in both samples ranged between 0.9 and 73.9 percent, therefore field duplicate QC acceptance criteria was met by all metals detected in both samples. Lead, nickel, selenium, and zinc were detected in only one sample, therefore RPDs could not be calculated.

- Table 3 summarizes the hits for flyash sample field duplicates collected at 5FA02-02 that were analyzed for total metals. Twenty metals were detected in one or both samples analyzed. RPDs for metals detected in both samples ranged between zero and 57.8 percent, therefore field duplicate QC acceptance criteria was met by all metals detected in both samples. Mercury was detected in only one sample, therefore an RPD could not be calculated.

Total and Soluble Metals

5MW01-37, 5MW01-37A (field duplicate), 5MW02-33, 5MW02-33C (rinsate blank), 5MW15-10, 5MW16-11, SP101-9, and SP102-36 were analyzed for total and soluble metals. Groundwater samples analyzed for total metals were preserved with nitric acid upon collection. Groundwater samples analyzed for soluble metals were filtered upon collection with a 0.45μ filter and then preserved with nitric acid. Soluble metal concentrations should be less than or equal to total metal concentrations.

In all cases, aluminum concentrations showed a significant reduction in concentration as a result of sample filtration; therefore indicating that aluminum was primarily associated with sample particulate. The remaining metals detected in each sample showed a small concentration reduction or no concentration change as a result of sample filtration; therefore indicating that these metals are primarily dissolved in both sample fractions. Tables 4 through 11 show total and soluble metal concentration percent differences. The following paragraphs discuss each metal and concentrations trends as a result of sample filtration.

Aluminum was detected in 5MW02-33, 5MW16-11, SP101-9, and SP102-36 and each sample showed a significant concentration reduction as a result of filtration.

Calcium and sodium were detected in all samples analyzed. Except for equipment blanks, barium, magnesium, manganese, and potassium were detected in all samples analyzed. Each of these metals showed a small concentration reduction or no concentration change as a result of filtration.

Except for equipment blanks, copper was detected in all samples analyzed. For 5MW01-37, 5MW01-37A, 5MW02-33, 5MW15-10, and SP102-36 there was a small concentration reduction or no concentration change as a result of filtration. Copper was not detected in the soluble fraction of 5MW16-11 and SP101-9.

Except for equipment blanks, vanadium was detected in all samples analyzed. There was a significant concentration reduction following filtration for SP101-9. For 5MW01-37, 5MW01-37A, 5MW02-33, 5MW15-10, 5MW16-11, and SP102-36 there was a small concentration reduction or no concentration change as a result of filtration.

Iron was detected in all samples analyzed. There was a significant concentration reduction of iron following filtration for SP102-36. Iron was detected in 5MW02-33C, 5MW16-11, and SP101-9, however there was only a small concentration reduction or no concentration change as a result of filtration. Iron was not detected in the soluble fraction of 5MW01-37, 5MW01-37A, 5MW02-33, and 5MW15-10.

Arsenic was detected in five samples analyzed. Arsenic was detected in 5MW15-10, 5MW16-11, and SP101-9, however there was only a small concentration reduction or no concentration change as a result of filtration. Arsenic was not detected in the soluble fraction of 5MW02-33 and SP102-36.

Selenium was detected in five samples analyzed. Selenium was detected in 5MW16-11, however there was no concentration change as a result of filtration. Selenium was only detected the soluble fraction of 5MW01-37A, 5MW02-33, and 5MW15-10 and was not detected in the soluble fraction of 5MW02-33C.

Lead was detected in three samples analyzed. Lead was not detected in the soluble fraction of 5MW01-37 and SP102-36 and was only detected in the soluble fraction of 5MW01-37A.

Nickel was detected in three samples analyzed. Nickel was not detected in the soluble fraction of SP101-9 and SP102-36 and nickel was only detected in the soluble fraction of 5MW01-37A.

Zinc was detected in three samples analyzed. Zinc was detected in 5MW02-33C , however there was no concentration change as a result of filtration. Zinc was not detected in the soluble fraction of 5MW15-10 and SP101-9 and zinc was only detected in the soluble fraction of 5MW01-37A.

Thallium was detected in two samples analyzed. Thallium was only detected in the soluble fraction of 5MW15-10 and was not detected in the soluble fraction of 5MW02-33.

Chromium was detected in SP101-9 only and was not detected in the soluble fraction.

TABLE 1
ELMENDORF AFB OPERABLE UNIT 5
SAMPLE AND DUPLICATE SAMPLE RESULTS FOR TOTAL METALS
UNITS = ug/l
ANC31026.H3.80

Field Sample ID 5MW01-37 (Total Metals)

Analyte	Sample Results	C	Q	Duplicate Sample Results	C	Q	Relative % Difference
Aluminum, Al	31.0	U		31.0	U		N/C
Antimony, Sb	12.1	U		12.1	U		N/C
Arsenic, As	0.70	U		0.70	U		N/C
Barium, Ba	15.2	B	EJ	14.8	B	EJ	2.67
Beryllium, Be	0.50	U		0.50	U		N/C
Cadmium, Cd	1.2	U		1.2	U		N/C
Calcium, Ca	90,100			87,300			3.16
Chromium, Cr	3.7	U		3.7	U		N/C
Cobalt, Co	5.8	U		5.8	U		N/C
Copper, Cu	3.7	B		3.3	B		11.4
Iron, Fe	41.5	B		27.1	B		42.0
Lead, Pb	0.90	B		0.60	U		N/C
Magnesium, Mg	24,100			23,500			2.52
Manganese, Mn	329			321			2.46
Mercury, Hg	0.10	U		0.10	U		N/C
Nickel, Ni	7.7	U		7.7	U		N/C
Potassium, K	1,800	B		1,790	B		0.56
Selenium, Se	0.50	U		0.64	U	WL	N/C
Silver, Ag	2.1	U		2.1	U		N/C
Sodium, Na	11,500			11,400			0.87
Thallium, Tl	0.70	U		0.70	U		N/C
Vanadium, Vn	1.9	B		2.7	B		-34.8
Zinc, Zn	6.6	U		6.7	U		N/C

C (Concentration) Qualifier
"B" = Analyte concentration is between the instrument detection limit (IDL) and the method detection limit.
"U" = Analyte not detected.

Q Laboratory Qualifier
"E" = Analyte is estimated because of interference.
"W" = Analytical spike recovery was outside QC control limits.

Q Data Validation Qualifier
"J" = Analyte concentrations is considered estimate because a direction of bias could not be determined.
"K" = Analyte concentrations is biased high, the expected concentration is expected to be lower.
"L" = Analyte concentrations is biased low, the expected concentration is expected to be higher.

Relative % Difference
N/C = Not calculable

TABLE 2
ELMENDORF AFB OPERABLE UNIT 5
SAMPLE AND DUPLICATE SAMPLE RESULTS FOR SOLUBLE METALS
UNITS = ug/l
ANC31026.H3.80

Field Sample ID 5MW01-37S (Soluble Metals)

Analyte	Sample Results	C	Q	Duplicate Sample Results	C	Q	Relative % Difference
Aluminum, Al	31.0	U		31.0	U		N/C
Antimony, Sb	12.1	U		12.1	U		N/C
Arsenic, As	0.70	U		0.70	U		N/C
Barium, Ba	14.6	B	EJ	15.1	B	EJ	-3.37
Beryllium, Be	0.50	U		0.50	U		N/C
Cadmium, Cd	1.2	U		1.2	U		N/C
Calcium, Ca	87,200			89,000			-2.04
Chromium, Cr	3.7	U		3.7	U		N/C
Cobalt, Co	5.8	U		5.8	U		N/C
Copper, Cu	2.9	B		6.3	B		-73.9
Iron, Fe	2.3	U		14.2	U		N/C
Lead, Pb	0.60	U		0.80	B		N/C
Magnesium, Mg	23,400			23,800			-1.69
Manganese, Mn	317			323			-1.88
Mercury, Hg	0.10	U		0.10	U		N/C
Nickel, Ni	7.7	U		9.4	B		N/C
Potassium, K	1,790	B		2,040	B		-13.05
Selenium, Se	0.50	U		0.68	B		N/C
Silver, Ag	2.1	U		2.1	U		N/C
Sodium, Na	11,400			11,500			-0.87
Thallium, Tl	0.70	U		0.70	U		N/C
Vanadium, Vn	2.3	B		3.0	B		-26.4
Zinc, Zn	9.7	U		24.5			N/C

C (Concentration) Qualifier
"B" = Analyte concentration is between the instrument detection limit (IDL) and the method detection limit.
"U" = Analyte not detected.

Q Laboratory Qualifier
"E" = Analyte is estimated because of interference.
"W" = Analytical spike recovery was outside QC control limits.

Q Data Validation Qualifier
"J" = Analyte concentrations is considered estimate because a direction of bias could not be determined.
"K" = Analyte concentrations is biased high, the expected concentration is expected to be lower.
"L" = Analyte concentrations is biased low, the expected concentration is expected to be higher.

Relative % Difference
N/C = Not calculable

TABLE 3
ELMENDORF AFB OPERABLE UNIT 5
SAMPLE AND DUPLICATE SAMPLE RESULTS FOR TOTAL METALS
UNITS = mg/kg
ANC31026.H3.80

Field Sample ID 5FA02-02

Analyte	Sample Results	C	Q	Duplicate Sample Results	C	Q	Relative % Difference
Aluminum, Al	6,770			6,900			-1.90
Antimony, Sb	3.6	U		3.6	U		N/C
Arsenic, As	3.5			4.0			-13.3
Barium, Ba	1,600			1,300			20.7
Beryllium, Be	0.58	B		0.32	B		57.8
Cadmium, Cd	1.1	B		0.68	B		47.2
Calcium, Ca	5,090			5,610			-9.72
Chromium, Cr	9.8			12.0			-20.2
Cobalt, Co	10.4	B		9.8	B		5.94
Copper, Cu	19.9		EJ	23.0		EJ	-14.5
Iron, Fe	5,360			6,660			-21.6
Lead, Pb	10.1			13.5			-28.8
Magnesium, Mg	1,280	B		1,530			-17.8
Manganese, Mn	63.4			91.4			-36.2
Mercury, Hg	0.05	B		0.04	U		N/C
Nickel, Ni	22.2			20.4			8.45
Potassium, K	876	B		838	B		4.43
Selenium, Se	0.15	U		0.15	U		N/C
Silver, Ag	0.62	U		0.62	U		N/C
Sodium, Na	531	B		526	B		0.95
Thallium, Tl	0.21	B		0.21	B		0.00
Vanadium, Vn	79.9			71.1			11.7
Zinc, Zn	22.1		EJ	27.4		EJ	-21.4

C (Concentration) Qualifier

"B" = Analyte concentration is between the instrument detection limit (IDL) and the method detection limit.

"U" = Analyte not detected.

Q Laboratory Qualifier

"E" = Analyte is estimated because of interference.

"W" = Analytical spike recovery was outside QC control limits.

Q Data Validation Qualifier

"J" = Analyte concentrations is considered estimate because a direction of bias could not be determined.

"K" = Analyte concentrations is biased high, the expected concentration is expected to be lower.

"L" = Analyte concentrations is biased low, the expected concentration is expected to be higher.

Relative % Difference

N/C = Not calculable

TABLE 4
ELMENDORF AFB OPERABLE UNIT 5
TOTAL AND SOLUBLE METAL RESULTS
UNITS = ug/l
ANC31026.H3.80

Field Sample ID 5MW01-37

Analyte	Total Metals	C	Q	Soluble Metals	C	Q	% Difference
Aluminum, Al	31.0	U		31.0	U		N/C
Antimony, Sb	12.1	U		12.1	U		N/C
Arsenic, As	0.70	U		0.70	U		N/C
Barium, Ba	15.2	B	EJ	14.6	B	EJ	-3.95
Beryllium, Be	0.50	U		0.50	U		N/C
Cadmium, Cd	1.2	U		1.2	U		N/C
Calcium, Ca	90,100			87,200			-3.22
Chromium, Cr	3.7	U		3.7	U		N/C
Cobalt, Co	5.8	U		5.8	U		N/C
Copper, Cu	3.7	B		2.9	B		-21.6
Iron, Fe	41.5	B		2.3	U		N/C
Lead, Pb	0.90	B		0.60	U		N/C
Magnesium, Mg	24,100			23,400			-2.90
Manganese, Mn	329			317			-3.65
Mercury, Hg	0.10	U		0.10	U		N/C
Nickel, Ni	7.7	U		7.7	U		N/C
Potassium, K	1,800	B		1,790	B		-0.56
Selenium, Se	0.50	U		0.50	U		N/C
Silver, Ag	2.1	U		2.1	U		N/C
Sodium, Na	11,500			11,400			-0.87
Thallium, Tl	0.70	U		0.70	U		N/C
Vanadium, Vn	1.9	B		2.3	B		21.1
Zinc, Zn	6.6	U		9.7	U		N/C

C (Concentration) Qualifier

"B" = Analyte concentration is between the instrument detection limit (IDL) and the method detection limit.

"U" = Analyte not detected.

Q Laboratory Qualifier

"E" = Analyte is estimated because of interference.

"W" = Analytical spike recovery was outside QC control limits.

Q Data Validation Qualifier

"J" = Analyte concentrations is considered estimate because a direction of bias could not be determined.

"K" = Analyte concentrations is biased high, the expected concentration is expected to be lower.

"L" = Analyte concentrations is biased low, the expected concentration is expected to be higher.

% Difference

N/C = Not calculable

TABLE 5
ELMENDORF AFB OPERABLE UNIT 5
TOTAL AND SOLUBLE METAL RESULTS
UNITS = ug/l
ANC31026.H3.80

Field Sample ID 5MW01-37A

Analyte	Total Metals	C	Q	Soluble Metals	C	Q	% Difference
Aluminum, Al	31.0	U		31.0	U		N/C
Antimony, Sb	12.1	U		12.1	U		N/C
Arsenic, As	0.70	U		0.70	U		N/C
Barium, Ba	14.8	B	EJ	15.1	B	EJ	2.03
Beryllium, Be	0.50	U		0.50	U		N/C
Cadmium, Cd	1.2	U		1.2	U		N/C
Calcium, Ca	87,300			89,000			1.95
Chromium, Cr	3.7	U		3.7	U		N/C
Cobalt, Co	5.8	U		5.8	U		N/C
Copper, Cu	3.3	B		6.3	B		90.9
Iron, Fe	27.1	B		14.2	U		N/C
Lead, Pb	0.60	U		0.80	B		N/C
Magnesium, Mg	23,500			23,800			1.28
Manganese, Mn	321			323			0.62
Mercury, Hg	0.10	U		0.10	U		N/C
Nickel, Ni	7.7	U		9.4	B		N/C
Potassium, K	1,790	B		2,040	B		14.0
Selenium, Se	0.64	U	WL	0.68	B		N/C
Silver, Ag	2.1	U		2.1	U		N/C
Sodium, Na	11,400			11,500			0.88
Thallium, Tl	0.70	U		0.70	U		N/C
Vanadium, Vn	2.7	B		3.0	B		11.1
Zinc, Zn	6.7	U		24.5			N/C

C (Concentration) Qualifier
"B" = Analyte concentration is between the instrument detection limit (IDL) and the method detection limit.
"U" = Analyte not detected.

Q Laboratory Qualifier
"E" = Analyte is estimated because of interference.
"W" = Analytical spike recovery was outside QC control limits.

Q Data Validation Qualifier
"J" = Analyte concentrations is considered estimate because a direction of bias could not be determined.
"K" = Analyte concentrations is biased high, the expected concentration is expected to be lower.
"L" = Analyte concentrations is biased low, the expected concentration is expected to be higher.

% Difference
N/C = Not calculable

TABLE 6
EILMENDORF AFB OPERABLE UNIT 5
TOTAL AND SOLUBLE METAL RESULTS
UNITS - ug/l
ANC31026.H3.80

Field Sample ID 5MW02-33

Analyte	Total Metals	C	Q	Soluble Metals	C	Q	% Difference
Aluminum, Al	58.1	B		31.0	U		N/C
Antimony, Sb	14.4	B		12.1	U		N/C
Arsenic, As	1.8	B		0.70	U		N/C
Barium, Ba	16.3	B	EJ	15.2	B	EJ	-6.75
Beryllium, Be	0.50	U		0.50	U		N/C
Cadmium, Cd	1.2	U		1.2	U		N/C
Calcium, Ca	84,400			83,300			-1.30
Chromium, Cr	3.7	U		3.7	U		N/C
Cobalt, Co	5.8	U		5.8	U		N/C
Copper, Cu	2.7	B		1.1	B		-59.3
Iron, Fe	184			5.1	U		N/C
Lead, Pb	0.60	U		0.60	U		N/C
Magnesium, Mg	14,600			14,400			-1.37
Manganese, Mn	27.1			3.9	B		-85.6
Mercury, Hg	0.10	U		0.10	U		N/C
Nickel, Ni	7.7	U		7.7	U		N/C
Potassium, K	1,430	B		1,520	B		6.29
Selenium, Se	0.64	U		1.9	B		N/C
Silver, Ag	2.1	U		2.1	U		N/C
Sodium, Na	7,820			7,900			1.02
Thallium, Tl	1.2	B		0.70	U		N/C
Vanadium, Vn	3.0	B		1.9	B		-36.7
Zinc, Zn	14.4	U		12.7	U		N/C

C (Concentration) Qualifier
"B" = Analyte concentration is between the instrument detection limit (IDL) and the method detection limit.
"U" = Analyte not detected.

Q Laboratory Qualifier
"E" = Analyte is estimated because of interference.
"W" = Analytical spike recovery was outside QC control limits.

Q Data Validation Qualifier
"J" = Analyte concentrations is considered estimate because a direction of bias could not be determined.
"K" = Analyte concentrations is biased high, the expected concentration is expected to be lower.
"L" = Analyte concentrations is biased low, the expected concentration is expected to be higher.

% Difference
N/C = Not calculable

TABLE 7
ELMENDORF AFB OPERABLE UNIT 5
TOTAL AND SOLUBLE METAL RESULTS
UNITS = ug/l
ANC31026.H3.80

Field Sample ID 5MW02-33C							
Analyte	**Total Metals**	**C**	**Q**	**Soluble Metals**	**C**	**Q**	**% Difference**
Aluminum, Al	31.0	U		31.0	U		N/C
Antimony, Sb	12.1	U		12.1	U		N/C
Arsenic, As	0.70	U		0.70	U		N/C
Barium, Ba	0.10	U	EJ	0.10	U	EJ	N/C
Beryllium, Be	0.50	U		0.50	U		N/C
Cadmium, Cd	1.2	U		1.2	U		N/C
Calcium, Ca	104	B		111	B		6.73
Chromium, Cr	3.7	U		3.7	U		N/C
Cobalt, Co	5.8	U		5.8	U		N/C
Copper, Cu	0.90	U		0.90	U		N/C
Iron, Fe	2.7	B		13.9	B		414.81
Lead, Pb	0.60	U		0.60	U		N/C
Magnesium, Mg	14.3	U		14.3	U		N/C
Manganese, Mn	0.80	U		0.80	U		N/C
Mercury, Hg	0.10	U		0.10	U		N/C
Nickel, Ni	7.7	U		7.7	U		N/C
Potassium, K	191	U		191	U		N/C
Selenium, Se	1.7	B		0.50	U		N/C
Silver, Ag	2.1	U		2.1	U		N/C
Sodium, Na	42.9	B		54.8	B		27.74
Thallium, Tl	0.70	U		0.70	U		N/C
Vanadium, Vn	1.9	U		1.9	U		N/C
Zinc, Zn	3.8	B		4.4	B		15.79

C (Concentration) Qualifier
"B" = Analyte concentration is between the instrument detection limit (IDL) and the method detection limit.
"U" = Analyte not detected.

Q Laboratory Qualifier
"E" = Analyte is estimated because of interference.
"W" = Analytical spike recovery was outside QC control limits.

Q Data Validation Qualifier
"J" = Analyte concentrations is considered estimate because a direction of bias could not be determined.
"K" = Analyte concentrations is biased high, the expected concentration is expected to be lower.
"L" = Analyte concentrations is biased low, the expected concentration is expected to be higher.

% Difference
N/C = Not calculable

TABLE 8
ELMENDORF AFB OPERABLE UNIT 5
TOTAL AND SOLUBLE METAL RESULTS
UNITS = ug/l
ANC31026.H3.80

Field Sample ID 5MW15-10

Analyte	Total Metals	C	Q	Soluble Metals	C	Q	% Difference
Aluminum, Al	31.0	U		31.0	U		N/C
Antimony, Sb	12.1	U		12.1	U		N/C
Arsenic, As	0.80	B	WK	0.90	B		12.5
Barium, Ba	16.8	B	EJ	16.5	B	EJ	-1.79
Beryllium, Be	0.50	U		0.50	U		N/C
Cadmium, Cd	1.2	U		1.2	U		N/C
Calcium, Ca	86,600			88,900			2.66
Chromium, Cr	3.7	U		3.7	U		N/C
Cobalt, Co	5.8	U		5.8	U		N/C
Copper, Cu	2.5	B		2.3	B		-8.00
Iron, Fe	57.0	B		20.9	U		N/C
Lead, Pb	0.60	U		0.60	U		N/C
Magnesium, Mg	14,400			14,300			-0.69
Manganese, Mn	99.0			94.1			-4.95
Mercury, Hg	0.10	U		0.10	U		N/C
Nickel, Ni	7.7	U		7.7	U		N/C
Potassium, K	1,090	B		1,130	B		3.67
Selenium, Se	1.0	U		2.2	B	WL	N/C
Silver, Ag	2.1	U		2.1	U		N/C
Sodium, Na	6,970			7,020			0.72
Thallium, Tl	0.70	U		0.70	B		N/C
Vanadium, Vn	3.4	B		4.1	B		20.6
Zinc, Zn	32.8			21.3	U		N/C

C (Concentration) Qualifier
"B" = Analyte concentration is between the instrument detection limit (IDL) and the method detection limit.
"U" = Analyte not detected.

Q Laboratory Qualifier
"E" = Analyte is estimated because of interference.
"W" = Analytical spike recovery was outside QC control limits.

Q Data Validation Qualifier
"J" = Analyte concentrations is considered estimate because a direction of bias could not be determined.
"K" = Analyte concentrations is biased high, the expected concentration is expected to be lower.
"L" = Analyte concentrations is biased low, the expected concentration is expected to be higher.

% Difference
N/C = Not calculable

TABLE 9
ELMENDORF AFB OPERABLE UNIT 5
TOTAL AND SOLUBLE METAL RESULTS
UNITS = ug/l
ANC31026.H3.80

Field Sample ID 5MW16-11

Analyte	Total Metals	C	Q	Soluble Metals	C	Q	% Difference
Aluminum, Al	392			67.8	B		-82.7
Antimony, Sb	12.1	U		12.1	U		N/C
Arsenic, As	2.2	B	WK	3.0	B	WK	36.4
Barium, Ba	116	B	EJ	103	B	EJ	-11.2
Beryllium, Be	0.50	U		0.50	U		N/C
Cadmium, Cd	1.2	U		1.2	U		N/C
Calcium, Ca	93,700			94,700			1.07
Chromium, Cr	3.7	U		3.7	U		N/C
Cobalt, Co	5.8	U		5.8	U		N/C
Copper, Cu	1.7	B		0.90	U		N/C
Iron, Fe	6,160			5,230			-15.1
Lead, Pb	0.60	U		0.60	U		N/C
Magnesium, Mg	20,000			18,800			-6.00
Manganese, Mn	1,940			1,630			-16.0
Mercury, Hg	0.10	U		0.10	U		N/C
Nickel, Ni	7.7	U		7.7	U		N/C
Potassium, K	2,130	B		1,960	B		-7.98
Selenium, Se	0.93	B		2.5	B		169
Silver, Ag	2.1	U		2.1	U		N/C
Sodium, Na	10,000			9,570			-4.30
Thallium, Tl	0.70	U		0.70	U		N/C
Vanadium, Vn	6.9	B		5.0	B		-27.5
Zinc, Zn	9.7	U		16.7	U		N/C

C (Concentration) Qualifier
"B" = Analyte concentration is between the instrument detection limit (IDL) and the method detection limit.
"U" = Analyte not detected.

Q Laboratory Qualifier
"E" = Analyte is estimated because of interference.
"W" = Analytical spike recovery was outside QC control limits.

Q Data Validation Qualifier
"J" = Analyte concentrations is considered estimate because a direction of bias could not be determined.
"K" = Analyte concentrations is biased high, the expected concentration is expected to be lower.
"L" = Analyte concentrations is biased low, the expected concentration is expected to be higher.

% Difference
N/C = Not calculable

TABLE 10
ELMENDORF AFB OPERABLE UNIT 5
TOTAL AND SOLUBLE METAL RESULTS
UNITS = ug/l
ANC31026.H3.80

Field Sample ID SP101-9

Analyte	Total Metals	C	Q	Soluble Metals	C	Q	% Difference
Aluminum, Al	7,840			43.9	B		-99.44
Antimony, Sb	12.1	U		12.1	U		N/C
Arsenic, As	5.4	B	WK	3.2	B	WK	-40.74
Barium, Ba	110	B	EJ	61.6	B	EJ	-44.00
Beryllium, Be	0.50	U		0.50	U		N/C
Cadmium, Cd	1.2	U		1.2	U		N/C
Calcium, Ca	77,600			77,800			0.26
Chromium, Cr	12.5			3.7	U		N/C
Cobalt, Co	5.8	U		5.8	U		N/C
Copper, Cu	9.9	B		0.90	U		N/C
Iron, Fe	19,300	B		12,600			-34.72
Lead, Pb	3.20	U		0.60	U		N/C
Magnesium, Mg	20,200			18,300			-9.41
Manganese, Mn	4,440			4280			-3.60
Mercury, Hg	0.10	U		0.10	U		N/C
Nickel, Ni	20.8	B		7.7	U		N/C
Potassium, K	2,150	B		2,070	B		-3.72
Selenium, Se	0.68	U	W	1.1	U		N/C
Silver, Ag	2.1	U		2.1	U		N/C
Sodium, Na	6,900			6,790			-1.59
Thallium, Tl	0.70	U		0.70	U		N/C
Vanadium, Vn	18.7	B		3.0	B		-84.0
Zinc, Zn	34.1			11.7	U		N/C

C (Concentration) Qualifier
"B" = Analyte concentration is between the instrument detection limit (IDL) and the method detection limit.
"U" = Analyte not detected.

Q Laboratory Qualifier
"E" = Analyte is estimated because of interference.
"W" = Analytical spike recovery was outside QC control limits.

Q Data Validation Qualifier
"J" = Analyte concentrations is considered estimate because a direction of bias could not be determined.
"K" = Analyte concentrations is biased high, the expected concentration is expected to be lower.
"L" = Analyte concentrations is biased low, the expected concentration is expected to be higher.

% Difference
N/C = Not calculable

TABLE 11
ELMENDORF AFB OPERABLE UNIT 5
TOTAL AND SOLUBLE METAL RESULTS
UNITS = ug/l
ANC31026.H3.80

Field Sample ID SP102-36

Analyte	Total Metals	C	Q	Soluble Metals	C	Q	% Difference
Aluminum, Al	1,090			31.0	U		N/C
Antimony, Sb	12.1	U		12.1	U		N/C
Arsenic, As	1.7	B	WK	0.70	U	W	N/C
Barium, Ba	25.9	B	EJ	18.9	B	EJ	-27.0
Beryllium, Be	0.50	U		0.50	U		N/C
Cadmium, Cd	1.2	U		1.2	U		N/C
Calcium, Ca	87,500			84,800			-3.09
Chromium, Cr	3.7	U		3.7	U		N/C
Cobalt, Co	5.8	U		5.8	U		N/C
Copper, Cu	5.9	B		2.3	B		-61.0
Iron, Fe	1,840			78.3	B		-95.7
Lead, Pb	0.70	B		0.60	U		N/C
Magnesium, Mg	19,000			18,300			-3.68
Manganese, Mn	1,450			1,380			-4.83
Mercury, Hg	0.10	U		0.10	U		N/C
Nickel, Ni	11.5	B		7.7	U		N/C
Potassium, K	1,330	B		1,350	B		1.50
Selenium, Se	2.0	U	WL	0.50	U		N/C
Silver, Ag	2.1	U		2.1	U		N/C
Sodium, Na	6,980			7,120			2.01
Thallium, Tl	0.70	U		0.70	U		N/C
Vanadium, Vn	6.1	B		2.3	B		-62.3
Zinc, Zn	13.1	U		10.7	U		N/C

C (Concentration) Qualifier
"B" = Analyte concentration is between the instrument detection limit (IDL) and the method detection limit.
"U" = Analyte not detected.

Q Laboratory Qualifier
"E" = Analyte is estimated because of interference.
"W" = Analytical spike recovery was outside QC control limits.

Q Data Validation Qualifier
"J" = Analyte concentrations is considered estimate because a direction of bias could not be determined.
"K" = Analyte concentrations is biased high, the expected concentration is expected to be lower.
"L" = Analyte concentrations is biased low, the expected concentration is expected to be higher.

% Difference
N/C = Not calculable

MEMORANDUM

CH2M HILL

TO: Win Westervelt/CH2M HILL/ANC

COPIES: Artemis Antipas/CH2M HILL/SEA
Susan Schrader/CH2M HILL/ANC

FROM: Page Birmingham/CH2M HILL/CVO
Donna Morgans/CH2M HILL/CVO

DATE: November 23, 1992

SUBJECT: Review of Quality Assurance/Quality Control (QA/QC) Data for Offsite Laboratory Analyses at Elmendorf Air Force Base (AFB), Operable Unit 5 (OU-5)

PROJECT: ANC31026.H3.80

A data review has been conducted on data submitted for groundwater, surface water, sediment, and soil samples collected for the Operable Unit five (OU-5) remedial investigation at Elmendorf Air Force Base, Alaska. Samples for this field program were collected between May 28 and September 18, 1992.

Approximately 10 to 20 percent of the organic, inorganic, and conventional analyses were reviewed following the U.S. EPA Functional Guidelines for Evaluating Organics and Inorganics Analyses, where possible, reviewing all quality assurance/quality control (QA/QC) data and validating all of the raw data.

QA/QC data from groundwater, surface water, soil, sediment, travel blanks, rinsate blanks, and field blanks were reviewed. The following table lists the type of analyses performed, together with the respective number and type of sample for each analysis.

Number of Samples	VOC Analysis EPA Method 8010	Number of Samples	Purgeable VOC Analysis EPA Method 524.2
7	Groundwater samples	6	Groundwater samples
9	Soil samples		
2	Field blanks		
2	Rinsate blanks		
6	Travel blanks		
Number of Samples	Semivolatile Analysis EPA Method 8270	Number of Samples	PCB Analysis EPA Method 8080
9	Groundwater samples	4	Soil Samples
11	Soil samples		
2	Rinsate blanks		
Number of Samples	TMBE/BTEX/Gas Analysis EPA Modified Method 8015/8020/ADEC AK 101	Number of Samples	TFH Gasoline Analysis EPA Modified Method 8015/ ADEC AK 102
9	Groundwater samples	3	Groundwater Samples
7	Soil samples		
1	Field blanks		
1	Rinsate blanks		
5	Travel blanks		
Number of Samples	TFH Diesel and JP-4 Analysis EPA Modified Method 8015	Number of Samples	Total Metals Analysis EPA Method 6010/7000 Series
9	Groundwater samples	12	Groundwater samples
8	Soil samples	10	Soil samples
1	Rinsate blanks	2	Rinsate blanks
Number of Samples	Alkalinity Analysis EPA Method 310.1	Number of Samples	Anion Analysis[a] EPA Method 300.0 and 310.1
2	Groundwater samples	3	Groundwater samples
1	Rinsate blank		
Number of Samples	TOC Analysis EPA Method 9060		
3	Soil samples		

[a] Anion analyses include carbonate, bicarbonate, chloride, nitrate, and sulfate.

Overall, the data have met the acceptance criteria as outlined in the Elmendorf AFB OU-5 Quality Assurance Project Plan (QAPP) and have also met the QC acceptance criteria as outlined in the U.S. EPA Functional Guidelines for Evaluating

Organics and Inorganics Analyses. All data are considered usable for the purposes outlined in the context of the data quality objectives.

The following summarizes the overall results of the data review for each organic analytical method and each QC parameter evaluated.

Organic Analyses

Holding Times

For Method 8270 analyses, except for 5SE09RX, 5SE09ARX, and 5SE10RX, all samples were analyzed within their respective holding time requirements. Sample results for 5SE09RX, 5SE09ARX, and 5SE10RX were qualified as estimates and flagged with a "J" for positive results, or a "UJ" for nondetected results.

GC/MS Tuning

For Methods 524.2 and 8270 analyses, a GC/MS tune was reported for each 12-hour tuning period and ion abundances met QC acceptance criteria.

Initial Calibration

For each analytical method, all target compounds met initial calibration QC acceptance criteria.

Continuing Calibration

Except for several Method 8010 and Method 8270 target compounds, all target compound calibration curves met continuing calibration QC acceptance criteria.

Where continuing calibrations exceeded QC acceptance criteria, no target compounds were detected in the samples. Therefore, no samples were qualified as a result of continuing calibrations.

Blanks

Except for the analyses listed below, all method, travel, field, and rinsate blanks were contamination-free. Samples containing contaminants were qualified as nondetects and flagged with a "U".

Method 8010 analyses:

- Tetrachloroethene result for OU5SE-08 (1,400U)

Method 524.2 analyses:

- Methylene chloride results for 5SW01 (1.4U), 5SW01A (1.6U), and 5SW02 (1.1U)

Method 8270 analyses:

- N-nitrosodiphenylamine results for OU5SW-07 (10U), OU5SW-08 (10U), and OU5SE-07 (540U)
- Diethylphthalate result for 5WS02 (10U)
- Di-n-butylphthalate results for 5SE09RX (420UJ) and 5SE09ARX (420UJ)

System Monitoring Compounds

Except for the analyses listed below, all surrogate spike recoveries met QC acceptance criteria. Analyses not meeting QC acceptance criteria were qualified as estimates and flagged with a "J" for positive results, or a "UJ" for nondetected results.

- Method 8010 (OU5SE-07)
- Method 8080 (5SE05, 5SE04, and 5SE04A)
- Method 8015/8020 (BTEX/TFH gasoline) (5MW5-30)
- Method 8015 (TFH diesel/JP-4) (5SE10, 5SW11, and 5SE11)

Matrix Spike/Matrix Spike Duplicates

Except for several matrix spike recoveries and relative percent difference results, all MS/MSDs met QC acceptance criteria. Samples are not qualified on the basis of MS/MSD results.

Internal Standards

All area counts and retention times met QC acceptance criteria.

Target Compound Identification

For Method 8010 analyses, except for OU5SW-07D, all compounds detected in samples were verified by a second column confirmation analysis. The tetrachloroethene result for OU5SW-07D was qualified as an estimate and flagged with a "J".

Compound Quantitation and Reported Detection Limits

The samples listed below required dilution to bring high concentrations of target compounds into the linear range of the instrument. The following samples required dilution and detection limits were increased. Except for VOC, BTEX/TFH gasoline, and TFH diesel/JP-4 results for 5SE09, 5SE09A, and 5SE10, all soil results were correctly adjusted for percent moisture.

Method 8270 analyses:

- OU5SE-08 (20-fold dilution)

Method 8080 analyses:

- OU5SE-07 (2-fold dilution)

Method 8015/8020 (BTEX/TFH gasoline) analyses:

- OU5SE-08 (5-fold dilution)

Method 8015 (JP-4) analyses:

- OU5SE-07 (2-fold dilution)

Method 8015 (TFH diesel) analyses:

- OU5SE-07 (5-fold dilution)
- OU5SE-08 (5-fold dilution)
- 5SE09A (detection limit raised from 1 μg/kg to 3 μg/kg)

Original TFH gasoline analyses were performed by all laboratories according to modified EPA method 8015/8020. Following sample analysis and reporting, it was noticed that the TFH gasoline analyses should have been performed according to method AK 101. The two analytical methods differ based on the type of calibration standard used. Method 8015/8020 uses a 5-point calibration using a commercially prepared gasoline standard; the ADEC AK 101 method uses a 5-point calibration using a 10-component mix standard. The overall effect is that a larger retention time window was used that covered the major range of gasoline peaks.

Sample results were then recalculated using a newly established retention time window. Recalculation only affects sample results reported above the detection limit. Only results reported by CH2M HILL were recalculated. It is considered that the technique used for recalculating the TFH gasoline results is highly reliable; therefore, sample qualification was not required. The following 13 samples analyzed by CH2M HILL required TFH gasoline recalculation, and amended results were reported by the laboratory:

- OU5SW-05
- OU5SW-08
- OU5SE-04
- OU5SE-05
- OU5SE-06
- OU5SE-08
- OU5SB11-10
- 5SB29-04
- SP10114
- SP01118
- GW-6A38
- OU5-MW13S
- 5MW3-40

TFH gasoline results reported by the ENSECO laboratory did not require qualification because there was no TFH gasoline reported above the detection limit. TFH gasoline results reported by Superior Analytical could not be recalculated; therefore, the following sample results, which were reported above the detection limit, were qualified as estimates and flagged with a "J":

- SL04S12A
- SL04S12AA
- SL04S12A
- SL16S12N
- SL16S24N

Original TFH diesel analyses were performed by all laboratories according to modified EPA method 8015. Following sample analysis and reporting, it was noticed that the TFH diesel analyses should have been performed according to ADEC method AK 102. The two analytical methods differ based on the type of calibration standard used. Method 8015 uses a 5-point calibration using a commercially prepared gasoline standard; the ADEC AK 102 method uses a 5-point calibration using a 10-component mix standard. The overall effect of using method 8015 instead of the ADEC method is that significant peaks were present outside the retention time window used in the original analysis, but within the ADEC-defined retention time window.

TFH diesel results reported by CH2M HILL, ENSECO, and Superior Analytical could not be recalculated because the chromatographic peaks of the commercial diesel standard did not match the peaks of the 10-component mix standard; consequently, a new retention time window could not be established. Because the ADEC-defined retention time window is larger than the original retention time window, it is expected that the TFH diesel results are biased low. The following samples analyzed by the CH2M HILL laboratory are considered biased low and flagged with a "J":

- OU5SE-04
- OU5SE-06
- OU5SE-08
- GW-6A38
- SP2/60540
- 5SB29-0
- SP10114
- 5SB29-04
- 5MW09-7
- 5MW4-35
- 5SE-05

The following samples analyzed by the ENSECO laboratory are considered biased low and flagged with a "J":

- 5SE-09A
- 5SE-11

The following samples analyzed by Superior Analytical are considered biased low and flagged with an "L":

- SL04S12A
- SL04S12AA
- SL04S12N

- SL04S12NA
- SL04S12ND
- SL04S12A
- SL04S12N
- SL20S24A
- SL19S12A
- SL29S12N
- SL16S12N
- SL16S24N
- SL19S12N

Tentative Identified Compounds (TICs)

All sample TICs met QC acceptance criteria. Samples OU5SE-07, OU5SE-08, 5SB19-10, 5SB19-52, 5SB01-10, 5SB21-10, 5SB21-25, 5SB21-48, 5WS01, 5WS01A, 5WS02, 5MW16A-14, 5MW5-30, 5SE09ARX, 5SE09RX, and 5SE10RX each contained TICs that were detected in the method blank as well as the sample; these TIC results were rejected and flagged with an "R". All TICs detected are considered estimate concentrations and flagged with a "JN".

System Performance

Chromatograms and instrument performance for each sample analysis were considered acceptable.

Inorganic and Conventional Parameter Analyses

The following summarizes the overall results of the data review for each inorganic analytical method and each QC parameter evaluated. All sample results were qualified in accordance with the criteria outlined in the functional guidelines.

Holding Times

For metals and conventional parameters, all samples were analyzed within their respective holding time requirements. Therefore, all samples met holding time QC acceptance criteria.

Calibration Check

All initial and continuing calibrations met QC acceptance criteria.

Blanks

Except for three aluminum, two iron, three mercury, five potassium, four selenium, and two zinc results, samples did not require qualification as a result of blank contamination. The following sample results were qualified as nondetects and flagged with a "U" as a result of preparation blank contamination.

Aluminum results:

- 5SW03 (67.4U)
- 5SW02 (109U)
- 5SW03A (59.8U)

Iron results:

- 5SW03A-S (10.7U)
- 5SW03-S (12.6U)

Mercury results:

- 5SB21-10 (0.09U)
- 5SB21-25 (0.07U)
- 5SB21-48 (0.08U)

Potassium results:

- 5SW03-S (571U)
- 5SW03 (47.0U)
- 5SW03A (509U)
- 5SW02 (376U)
- 5SW03A-S (454U)

Selenium results:

- OU5SE-07 (0.22U)
- OU5SE-08 (0.25U)
- 5SW03 (0.78U)
- 5SW02 (0.69U)

Zinc results:

- 5SW03-S (12.4U)
- 5SW03A-S (4.6U)

ICP Interference Check Samples

All ICP interference check sample recoveries met QC acceptance criteria.

Laboratory Control Samples (LCS)

All LCS recoveries met QC acceptance criteria.

Laboratory Duplicates

All duplicate results met QC acceptance criteria.

Matrix Spikes

Except for one lead and two manganese matrix spike recoveries, all matrix spike recoveries met QC acceptance criteria. The lead results for OU5SE-07 and OU5SE-08 and the manganese results for 5SB01-25, 5SB21-10, 5SB21-25, 5SB21-35, and 5SB21-48 were qualified as biased low and flagged with an "L". The manganese results for OU5SE-07 and OU5SE-08 were qualified as biased high and flagged with a "K".

Analytical Spike Recoveries

Except for four selenium and three thallium analytical spike recoveries, all analytical spike recoveries met QC acceptance criteria. The selenium results for 5SB21-10, 5SB21-25, 5SB21-35, and 5SB21-48 and the thallium results for OU5SE-07, OU5SE-08, and 5SB21-48 were qualified as biased low and flagged with an "L".

ICP Serial Dilution

Except for three barium, one calcium, and two zinc, all serial dilutions met QC acceptance criteria. The following sample results not meeting QC acceptance criteria were qualified as estimates and flagged with a "J" for positive results.

Barium results:

- OU5SW-07
- OU5SW-07S
- OU5SW-08
- OU5SW-08C
- OU5SW-08S
- 5SB12-8C
- 5SW03
- 5SW03-S
- 5SW03A
- 5SW03A-S
- 5SW02

Calcium results:

- OU5SE-07
- OU5SE-08

Zinc results:

- OU5SE-07
- OU5SE-08
- 5SB01-25
- 5SB21-10
- 5SB21-25
- 5SB21-35
- 5SB21-48

Sample Result Verification

All sample results and detection limits were calculated correctly. All soil results were correctly adjusted for percent moisture.

The attached sections provide complete validation results on a batch basis, for each medium.

FIELD DUPLICATE RESULTS

Field Duplicate Results

Seven water samples (12 percent frequency) and six soil samples (9 percent frequency) were collected and analyzed as blind field duplicates. Project quality assurance (QA) control limits for field duplicates allow ±100 relative percent difference (RPD) for water and soil samples with the provisional control limit of plus or minus the contract-required detection limit (CRDL) when concentrations are less than five times the CRDL. There are no specific review criteria used to compare field sample result comparability. Field duplicate results are used to determine the precision of field sampling and laboratory techniques. Qualifiers are not assigned when field duplicate results do not meet QC acceptance criteria.

Field duplicates 5SW03, 5WS01, 5SE03, 5SE04, and 5SB29-0 were analyzed for the full suite of analytical parameters. 5MW7-40, 5MW6-35, and 5SE09 were analyzed for organic parameters. NS30215 was analyzed for BTEX, TFH gasoline, TFH diesel, and JP-4. 5GW4A-5 was analyzed for semivolatile organic compounds. SL04S12A and SL04S12N were analyzed for metals and conventional parameters. Tables 1 through 11 show field duplicate RPD results for organic, metal, and conventional parameters that were detected in one or both of the samples analyzed.

Field duplicate results for samples collected are summarized below.

- Table 1 summarizes the hits for the surface water sample field duplicates collected at 5SW03. Twelve total metals, eight dissolved metals, and alkalinity were detected in one or both samples. RPDs for metals detected in both samples ranged between 0.5 and 128 percent. Except for alkalinity and manganese, all metals met the project quality control (QC) acceptance criteria of ±100 RPD for field precision. The manganese RPD met the provisional QC acceptance criteria of plus or minus the CRDL. The RPD for alkalinity was 130 percent, which exceeded the QC acceptance criteria. All total metals concentrations were greater than dissolved metals concentrations.

- Table 2 summarizes the hits for the surface water sample field duplicates collected at 5SW03. Seven total metals, seven dissolved metals, and alkalinity were detected in one or both samples. RPDs for metals detected in both samples and alkalinity ranged between 0.7 and 11.6 percent; therefore, all parameters detected met the project QC acceptance criteria of ±100 RPD for field precision. All total metals concentrations were the same or slightly greater than dissolved metals concentrations.

- Table 3 summarizes the hits for the groundwater sample field duplicates collected at 5WS01. Five total metals, alkalinity, bicarbonate, carbonate, chloride, and sulfate were detected in one or both samples. RPDs for metals and conventional parameters detected in both samples ranged between zero and 10.9 percent; therefore, all parameters detected met the project QC acceptance criteria of ±100 RPD for field precision.

- Table 4 summarizes the hits for the soil sample field duplicates collected at SE03. Bis(2-ethylhexyl)phthalate and 20 total metals were detected in one or both samples. RPDs for metals detected in both samples ranged between 0.7 and 28.9 percent; therefore, all parameters detected met the project QC acceptance criteria of ±100 RPD for field precision. Bis(2-ethylhexyl)phthalate was detected in only one sample; therefore, RPD could not calculated.

- Table 5 summarizes the hits for the soil sample field duplicates collected at 5SE04. Bis(2-ethylhexyl)phthalate and 19 total metals were detected in one or both samples. RPDs for metals detected in both samples ranged between zero and 36.2 percent; therefore, all parameters detected met the project QC acceptance criteria of ±100 RPD for field precision.

- Table 6 summarizes the hits for the soil sample field duplicates collected at 5SB29-0. Nineteen semivolatile organic compounds, TFH diesel, and 20 total metals were detected in one or both samples. RPDs for semivolatiles and metals detected in both samples ranged between 4.6 and 182 percent. Except for bis(2-ethylhexyl)phthalate, all semivolatiles (phenanthrene, fluoranthene, and pyrene) detected exceeded the project QC acceptance criteria of ±100 RPD for field precision. Except for lead, all metals detected met the QC acceptance criteria for ±100 percent for field precision. TFH diesel was detected in only one sample; therefore, an RPD could not be calculated.

- Table 7 summarizes the hits for the groundwater sample field duplicates collected at 5MW7-40. Trichloroethene and 1,1,2,2-tetrachloroethane were detected in both samples. RPDs for these VOCs ranged between 2.5 and 14.3 percent; therefore, both VOCs detected met the project QC acceptance criteria of ±100 RPD for field precision.

- Table 8 summarizes the hits for the groundwater sample field duplicates collected at 5MW6-35. Trichloroethene, toluene, ethylbenzene, total xylenes, and bis(2-ethylhexyl)phthalate were detected in one or both samples. RPDs for these parameters ranged between 3.3 and 25.0 percent; therefore, all parameters detected met the project QC acceptance criteria of ±100 RPD for field precision.

- Table 9 summarizes the hits for the soil sample field duplicates collected at SL04S12A. Eighteen total metals, three water soluble metals, four ammonium acetate extractable metals, phosphate, TKN, conductivity, and TOC were detected in one or both samples. RPDs for all parameters detected in both samples ranged between zero and 40 percent; therefore, all parameters detected met the project QC acceptance criteria of ±100 RPD for field precision.

- Table 10 summarizes the hits for the soil sample field duplicates collected at SL04S12N. Seventeen total metals, three water soluble metals, four ammonium acetate extractable metals, phosphate, TKN, conductivity, and TOC were detected in one or both samples. RPDs for all parameters detected in both samples ranged between zero and 78.9 percent; therefore, all parameters detected met the project QC acceptance criteria of ±100 RPD for field precision.

- Table 11 summarizes the hits for the soil sample field duplicates collected at 5SE09. Phenol and JP-4 were detected in one or both samples. The RPD for phenol was 32.3 percent; therefore, all parameters detected met the project QC acceptance criteria of ±100 RPD for field precision. JP-4 was detected in only one sample; therefore, an RPD could not be calculated.

TABLE 1. Field Duplicate Results for 5SW03 on 30 May 92

Compounds	Sample Result (µg/l)	Duplicate Result (µg/l)	Relative Percent Difference
Total Metals			
Aluminum	315	557	55.5
Arsenic	0.70	0.80	13.3
Barium	16.2	13.0	21.9
Calcium	27,400	18,300	39.8
Copper	1.4	1.6	13.3
Iron	562	835	39.1
Lead	0.70	0.60 U	N/C
Magnesium	4,010	2,920	31.5
Manganese	189	90.1	70.6
Potassium	559	468	17.7
Sodium	2,170	2,160	0.46
Vanadium	2.0	2.8	33.3
Dissolved Metals			
Barium	4.0	3.8	5.1
Calcium	14,500	19,300	28.4
Iron	26.4	54.3	69.1
Magnesium	2,250	2,890	24.9
Manganese	16.2	73.9	128
Potassium	391	285	31.4
Sodium	1,580	2,180	31.9
Vanadium	1.3	1.3 U	N/C
Akalinity (mg/l)	138	40	110

N/C = Not Calculable
U = Nondetected result

TABLE 2. Field Duplicate Results for 5SW03 on 27 Aug 92			
Compounds	**Sample Result (μg/l)**	**Duplicate Result (μg/l)**	**Relative Percent Difference**
Total Metals			
Barium	9.0	9.3	3.3
Calcium	24,400	24,700	1.2
Copper	1.0U	130	N/C
Magnesium	3,600	3,660	1.7
Manganese	47.9	48.2	0.62
Sodium	2,360	2,390	1.3
Zinc	2.2U	79.9	N/C
Dissolved Metals			
Barium	8.8	8.8	0.0
Calcium	24,600	24,400	0.82
Copper	1.7	0.90U	N/C
Magnesium	3,640	3,620	0.55
Manganese	44.1	43.8	0.68
Sodium	2,650	2,360	11.6
Akalinity (mg/l)	60	57	5.1

N/C = Not Calculable
U = Nondetected result

TABLE 3. Field Duplicate Results for 5WS01 on 1 Sep 92			
Compounds	**Sample Result (μg/l)**	**Duplicate Result (μg/l)**	**Relative Percent Difference**
Total Metals			
Calcium	10,500	10,400	0.96
Iron	118	129	8.9
Magnesium	6,330	6,300	0.48
Potassium	1,990	1,800	10.0
Sodium	41,900	41,600	0.72
Conventional Parameters (mg/l)			
Alkalinity	141	127	10.4
Bicarbonate	165	148	10.9
Carbonate	3.6	3.6	0.0
Cloride	3.63	3.64	0.28
Sulfate	13.7	13.7	0.0

N/C = Not Calculable
U = Nondetected result

TABLE 4. Field Duplicate Results for 5SE03 on 30 May 92

Compounds	Sample Result (µg/kg)	Duplicate Result (µg/kg)	Relative Percent Difference
Semivolatile Organic Compounds			
bis(2-Ethylhexyl)phthalate	57	520U	N/C
Total Metals (mg/kg)			
Aluminum	18,000	16,500	8.7
Arsenic	5.6	5.8	1.8
Barium	90.3	80.4	11.6
Beryllium	0.73	0.64	13.1
Cadmium	1.8	1.9	5.4
Calcium	7,510	5,930	23.5
Chromium	40	38.2	4.6
Cobalt	13.3	11.8	12.0
Copper	29.4	27.7	6.0
Iron	33,100	32,400	2.1
Lead	5.8	6.1	5.0
Magnesium	10,100	10,200	1.0
Manganese	787	710	10.3
Nickel	40.9	40.6	0.74
Potassium	1,080	808	28.9
Selenium	0.22	0.12 U	N/C
Silver	0.84	1.6	62.3
Sodium	433	364	17.3
Vanadium	70.5	60.5	15.3
Zinc	79.1	76.3	3.6

N/C = Not Calculable
U = Nondetected result

TABLE 5. Field Duplicate Results for 5SE04 on 29 Aug 92

Compounds	Sample Result (µg/kg)	Duplicate Result (µg/kg)	Relative Percent Difference
Semivolatile Organic Compounds			
Bis(2-ethylhexyl)phthalate	1,300U	210	N/C
Total Metals (mg/kg)			
Aluminum	9,580	13,400	33.2
Arsenic	38.1	29.4	25.8
Barium	441	366	18.6
Cadmium	1.7	2.4	34.1
Calcium	12,000	12,000	0.0
Chromium	23.5	28.6	19.6
Cobalt	23.7	22.4	5.6
Copper	26.3	27.6	4.8
Iron	69,300	67,200	3.1
Lead	24.5	22.9	6.8
Magnesium	5,390	7,050	26.7
Manganese	37,900	29,300	25.6
Mercury	0.11U	0.10	N/C
Nickel	71.5	61.5	15.0
Potassium	634	914	36.2
Silver	5.6	4.7	17.5
Sodium	609	521	15.6
Vanadium	39.5	54.5	31.9
Zinc	108	102	5.7

N/C = Not Calculable
U = Nondetected result

TABLE 6. Field Duplicate Results for 5SB29-0 on 4 Sep 92

Compounds	Sample Result (μg/kg)	Duplicate Result (μg/kg)	Relative Percent Difference
Semivolatile Organic Compounds			
Napthalene	380U	110	N/C
2-Methylnaphthalene	380U	50	N/C
Acenaphthene	380U	120	N/C
Dibenzofuran	380U	93	N/C
Fluorene	380U	140	N/C
Phenanthrene	39	830	182
Anthracene	380U	150	N/C
Carbazole	380U	83	N/C
Fluoranthene	63	840	172
Pyrene	67	820	170
Benzo(a)anthracene	380U	350	N/C
Chrysene	380U	410	N/C
Bis(2-ethylhexyl)phthalate	49	39	22.7
Benzo(b)fluoranthene	380U	260	N/C
Benzo(k)fluoranthene	43	310	151
Benzo(a)pyrene	380U	330	N/C
Ideno(1,2,3-cd)pyrene	380U	160	N/C
Dibenz(a,h)anthracene	380U	40	N/C
Benzo(g,h,i)perylene	380U	330	N/C
TFH Diesel (mg/kg)	6.1	4.6U	N/C
Metals (mg/kg)			
Aluminum	16,000	9,360	52.4
Arsenic	6.3	5.2	19.1
Barium	125	283	77.5
Cadmium	1.5	1.3	14.3
Calcium	6,770	4,850	33.0
Chromium	29.0	23.4	21.4
Cobalt	11.6	7.3	45.5
Copper	33.3	22.3	39.6
Iron	30,900	17,300	56.4
Lead	23.9	193	156
Magnesium	9,080	5,340	51.9
Manganese	612	400	41.9
mercury	0.05	0.06	18.2
Nickel	31.2	24.9	22.5
Potassium	662	468	34.3
Selenium	0.11U	0.16	N/C
Silver	0.60	0.48U	N/C
Sodium	259	22	15.4
Vanadium	83.3	37.2	76.5
Zinc	63.5	66.5	4.6

N/C = Not Calculable
U = Nondetected result

TABLE 7. Field Duplicate Results for 5MW7-40 on 1 Sep 92

Compounds	Sample Result ($\mu g/l$)	Duplicate Result ($\mu g/l$)	Relative Percent Difference
VOCs			
Trichloroethene	13	15	14.3
1,1,2,2-tetrachloroethane	8.0	8.2	2.5

N/C = Not Calculable
U = Nondetected result

TABLE 8. Field Duplicate Results for 5MW6-35 on 3 Sep 92

Compounds	Sample Result ($\mu g/l$)	Duplicate Result ($\mu g/l$)	Relative Percent Difference
Purgeable VOCs			
Trichloroethene	52	54	3.8
Toluene	1.4	1.2	15.4
Ethylbenzene	0.67	0.60	11.0
Total Xylenes	2.7	2.1	25.0
Semivolatile Organic Compounds			
Bis(2-ethylhexyl)phthalate	10U	1	N/C
TFH gasoline (mg/l)	92	89	3.3

N/C = Not Calculable
U = Nondetected result

TABLE 9. Field Duplicate Results for SL04S12A on 4 Sep 92

Compounds	Sample Result (mg/kg)	Duplicate Result (mg/kg)	Relative Percent Difference
Ethylbenzene	200	390	64.4
Total Xylenes	3,100	8,400	92.2
TFH Gasoline	310	670	73.5
TFH Diesel	83	151	58.1
Metals			
Aluminum	14,000	11,800	17.1
Arsenic	7.4	8.1	9.0
Barium	75.6	89.9	17.3
Cadmium	1.5	1.5	0.0
Calcium	5,400	5,760	6.5
Chromium	24.9	22.0	12.4
Cobalt	9.8	9.4	4.2
Copper	21.7	21.3	1.9
Iron	29,300	27,900	4.9
Lead	23.0	27.3	17.1
Magnesium	6,840	5,550	20.8
Manganese	2,240	3,190	35.0
Mercury	0.09	0.06	40.0
Nickel	25.7	24.9	3.2
Potassium	536	361	39.0
Silver	0.76	0.68	11.1
Vanadium	44.8	38.0	16.4
Zinc	53.9	49.4	8.7
Water Soluble Metals (meq/100g)			
Calcium	0.28	0.26	7.4
Magnesium	0.12	0.11	8.7
Sodium	0.06	0.05	18.2
Ammonium Acetate Extractable Metals (meq/100g)			
Calcium	10.3	8.9	14.6
Magnesium	1.42	1.21	16.0
Potassium	0.14	0.12	15.4
Sodium	0.27	0.24	11.8
Conventional Parameters			
Electrical conductivity (mmhos/cm)	0.73	0.65	11.6
Phosphate	16	17	6.1
Total kjeidahl nitrogen	1,900	1,770	7.1
Ammonia	9.04	11.8	26.5
Total organic carbon	35,300	44,100	22.2

N/C = Not Calculable
U = Nondetected result

TABLE 10. Field Duplicate Results for SL04S12N on 4 Sep 92			
Compounds	**Sample Result (mg/kg)**	**Duplicate Result (mg/kg)**	**Relative Percent Difference**
TFH Diesel	10	9	10.5
Metals			
Aluminum	18,400	16,700	9.7
Barium	87.1	84.2	3.4
Cadmium	1.6	1.5	6.5
Calcium	6,800	4,420	42.4
Chromium	35.4	31.9	10.4
Cobalt	12.5	10.8	14.6
Copper	26.6	24.1	9.9
Iron	27,900	26,300	5.9
Lead	10.2	8.0	24.2
Magnesium	8,850	8,200	7.6
Manganese	444	430	3.2
Mercury	0.04	0.05	22.2
Nickel	34.1	35.5	4.0
Potassium	720	565	24.1
Silver	0.49	0.70	35.3
Vanadium	66.4	55.4	18.1
Zinc	56.9	54.6	4.1
Water Soluble Metals (meq/100g)			
Calcium	0.04	0.04	0.0
Magnesium	0.02	0.02	0.0
Sodium	0.02	0.02	0.0
Ammonium Extractable Metals (meq/100g)			
Calcium	2.5	2.7	7.7
Magnesium	0.61	0.66	7.9
Potassium	0.12	0.13	0.1
Sodium	0.17	0.17	0.0
Conventional Parameters			
Electrical conductivity (mmhos/cm)	0.24	0.28	15.4
Phosphate	7.6	3.3	78.9
Total kjeidahl nitrogen	857	829	3.3
Ammonia	6.62	5.63	16.2
Total organic carbon	14,400	15,400	6.7

N/C = Not Calculable
U = Nondetected result

TABLE 11. Field Duplicate Results for 5SE09 on 3 Sep 92			
Compounds	**Sample Result (μg/kg)**	**Duplicate Result (μg/kg)**	**Relative Percent Difference**
Semivolatile Organic Compounds			
Phenol	52	72	32.3
JP-4 (mg/kg)	1.0U	1.1	N/C

DATA VALIDATION SUMMARIES

Volatile Organic Compounds
(EPA Method 8010)
Surface Water/Sediment
Batch 33061

Surface water and sediment samples 5SE07, 5SW07, 5SW07D, 5SE08, 5SE08C, and 5SW08 were validated from analytical batch 33061, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All samples were analyzed within 14 days, therefore all samples met holding time QC acceptance criteria.

III. Initial Calibration

Five-point calibration curves were generated for all target compounds. The correlation determination factor (R^2) for this calibration curve was within the QC control limit of 0.9025. Therefore, the target compound calibration curve met initial calibration QC acceptance criteria.

IV. Continuing Calibration

Except for several target compounds, the percent difference for all compounds were within the QC control limits of 20 percent or the method specified limit, thereby meeting continuing calibration QC acceptance criteria. Target compounds that did not meet QC acceptance criteria are listed in Table 1.

Where continuing calibrations exceeded QC acceptance criteria, no target compounds were detected in the samples. Therefore, no samples were qualified as a result of continuing calibrations.

V. Blanks

Except for chloroform and tetrachloroethene, the method, travel, and rinsate blanks associated with this analytical batch were free of contaminants, thereby meeting QC acceptance criteria. Chloroform was detected in rinsate blank, 5SE08C, at a concentration of 52 μg/L. No samples were qualified as a result of chloroform contamination. Tetrachloroethene was detected in travel blank, 5SW07D, at a concentration of 6.2 μg/L. The tetrachloroethene result for 5SE08 (1,400 U) was qualified as a nondetect and flagged with a "U."

Table 1

Compound	Percent Difference
Continuing Calibration (6/16/92 1345 GC-2 HECD)	
chloromethane	-75.21
Continuing Calibration (6/17/92 1605 GC-2 HECD)	
chloromethane	-85.86
Continuing Calibration (6/18/92 0638 GC-1 HECD)	
tetrachlorothene	+25.47
chloroethane	+26.01
methylene chloride	+25.36
chloroform	+31.76
1,1,1-trichloroethane	+31.35
1,2-dichloropropane	+26.09
bromodichloromethane	-32.95
1,1,2-trichloroethane	+22.18
Continuing Calibration (6/18/92 1346 GC-1 HECD)	
bromodichloromethane	-41.22
Continuing Calibration (6/18/92 0918 GC-2 HECD)	
chloromethane	-85.78
1,1-dichloroethene	+23.66
tetrachloroethene	+32.31

VI. System Monitoring Compounds (Surrogates)

Except for 5SE07, all surrogate spike recoveries were within QC control limits of 60 to 130 percent for water samples and 80 to 130 percent for sediment samples, thereby meeting QC acceptance criteria. Because holding times were exceeded, this sample was not reanalyzed to verify the surrogate recovery. Therefore, all results for 5SE07 were qualified as estimates and flagged with a "J" for positive results, a "UJ" for nondetected results.

XI. Target Compound Identification

Except for compounds detected in 5SW07D, all compounds detected in samples were verified with a second column confirmation analysis. Therefore, target compound identification QC acceptance criteria were met for the majority of samples. Target compounds were reported only when retention times were within their specified windows. For 5SW07D, tetrachloroethene was qualified as an estimate and flagged with a "J."

XII. Compound Quantitation and Reported Detection Limits

All sample results were calculated correctly, thereby meeting compound quantitation acceptance criteria. All sample results and detection limits were reported correctly and all results were correctly adjusted for percent moisture and dilution factors. Sample 5SE08 required a 500-fold dilution and sample 5SE08C required a 10-fold dilution to bring high concentrations of target compounds into the linear range of the instrument.

XV. System Performance

Chromatograms from each sample analysis and instrument performance were considered acceptable.

Semivolatile Organic Compounds
(EPA Method 8270)
Surface Water/Sediment
Batch 33061

Surface water and sediment samples 5SW07, 5SE07, 5SW08, 5SE08, 5SE08C, 5SW07 MS/MSD, and 5SE07 MS/MSD were validated from analytical batch 33061, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All water samples were extracted within 7 days; all sediment samples were extracted within 14 days. All samples were analyzed within 40 days. Therefore, all samples met extraction and analysis holding time QC acceptance criteria.

II. GC/MS Tuning

GC/MS tuning was performed for every 12-hour period. Each GC/MS tune met ion abundance QC acceptance criteria.

III. Initial Calibration

All initial calibration average relative response factors (RRFs) and percent relative standard deviations (RSDs) met QC acceptance criteria. Therefore, all initial calibration met QC acceptance criteria.

IV. Continuing Calibration

Except for several target compounds, all continuing calibration RRFs and percent differences met continuing calibration QC acceptance criteria. Compounds that did not meet QC acceptance criteria are listed in Table 2.

According to the CLP functional guidelines, all compounds with continuing calibration percentage differences greater than 25 percent should be qualified as estimates and positive results flagged with a "J." Compounds that exceeded calibration criteria were not detected in any of the samples analyzed; therefore, no samples were qualified.

Table 2

Compound	Percent Difference
Continuing Calibration (7/4/92 1239)	
4-chloroaniline	+37.8
3-nitroaniline	+52.1
2,4-dinitrophenol	+46.9
4-nitrophenol	+39.3
4-nitroaniline	+51.2
hexachlorobenzene	-30.7
pyrene	-39.3
di-n-octylphthalate	-34.0
benzo(k)fluoranthene	-28.2
Continuing Calibration (7/8/92 1054)	
4-chloroaniline	+49.9
3-nitroaniline	+42.1
2,4-dinitrophenol	+52.6
4-nitroaniline	+42.0
4,6-dinitro-2-methylphenol	+36.2
Continuing Calibration (7/12/92 1109)	
3-nitroaniline	-51.4
4-nitrophenol	-29.7
Carbazole	-26.1
Di-n-octyphthalate	-30.4
2,4,6-tribromophenol	-28.2
Continuing Calibration (7/13/92 0626)	
2,4-dichlorophenol	+29.9
4-chloroaniline	+32.8
4-methylnaplthalene	+28.5
3-nitroaniline	+26.1
2,4-dinitrophenol	+28.5
4-nitrophenol	+41.0
pentachlorophenol	+37.8
3,3'-dichlorobenzidine	+33.2

V. Blanks

Except for n-nitrosodiphenylamine, the method and rinsate blanks associated with this analytical batch were contamination free. N-nitrosodiphenylamine was detected in two method blanks and one rinsate blank associated with these samples. N-nitrosodiphenylamine was detected in SBLKW (June 11) at a concentration of 2 μg/L; SBLKS (June 13) at a concentration of 71 μg/kg; and rinsate blank (5SE08C) at a concentration of 2 μg/L. N-nitrosodiphenylamine results for the following samples were qualified as nondetected and flagged with "U":

- 5SW07 (10U)
- 5SW08 (10U)
- 5SE07 (540U)

VI. System Monitoring Compounds (Surrogates)

Except for 5SE06 and 5SW02, all surrogate spike recoveries were within the CLP QC control limits, thereby meeting QC acceptance criteria. Sample 5SE06 contained 2,4,6-tribromophenol above QC control limits and 5SW02 contained 1,2-dichlorobenzene-d4 above QC control limits. According to the CLP functional guidelines, samples are qualified when two or more surrogate spike recoveries are outside QC control limits. Therefore, no sample results were qualified.

VII. Matrix Spike/Matrix Spike Duplicate

All MS/MSD recoveries were within the CLP QC control limits, thereby meeting QC acceptance criteria for accuracy. Except for one RPD, all RPDs were within the CLP QC control limits, thereby meeting QC acceptance criteria for precision. For 5SE07 MS/MSD, the acenaphthene RPD (24 percent) was outside the RPD control limit of 19 percent. According to the CLP functional guidelines, samples are not qualified on the basis of MS/MSD results.

X. Internal Standards

All area counts and retention times were within the CLP QC control limits. Therefore, all samples met QC acceptance criteria for internal standards.

XI. Target Compound Identification

All target compound RRTs were within 0.06 units of the standard RRT. All target compound mass spectra matched standard mass spectra and met QC acceptance criteria. Therefore, all samples met target compound identification QC acceptance criteria.

XII. Compound Quantitation and Reported Detection Limits

All sample results were calculated using the correct internal standard, quantitation ion, and relative response factor. Therefore, all samples met compound quantitation QC acceptance criteria. All sample results and detection limits were correctly adjusted for percent moisture and dilution factors. Sample 5SE08 required a 20-fold dilution to bring high concentrations of target compounds into the linear range of the instrument.

XIII. Tentatively Identified Compounds (TICs)

All sample TICs met QC acceptance criteria. A library search was conducted for each sample results reported on Form I. Sample mass spectra for each TIC identified matched standard mass spectra. When sample mass spectra did not match standard mass spectra, the TIC was designated as an "unknown." Samples 5SE07 and 5SE08 contained three TICs that were also detected in the method blanks; these TICs were rejected and flagged with an "R." All TICs detected are considered estimated concentrations and flagged with a "JN."

XV. System Performance

Chromatograms and mass spectra from each sample analysis and instrument performance were considered acceptable.

Polychlorinated Biphenyls
(EPA Method 8080)
Sediment Samples
Batch 33061

Sediment sample 5SE07 was validated from analytical batch 33061, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

This sample was extracted within 14 days and analyzed within 40 days, thereby meeting extraction and analysis holding time QC acceptance criteria.

III. Initial Calibration

All percent RSDs were within the QC control limits of ±30 percent, thereby meeting initial calibration QC acceptance criteria.

IV. Continuing Calibration

All percent differences were within the control limit of ±15 percent, thereby meeting continuing calibration QC acceptance criteria.

V. Blanks

The method blank associated with this analytical batch was free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

All samples were spiked with tetrachloro-m-xylene and decachlorobiphenyl as surrogate compounds prior to analysis. All surrogate spike recoveries were within QC control limits of 60 to 150 percent, thereby meeting QC acceptance criteria.

XI. Target Compound Identification

The presence of Aroclor 1260 was verified by a second column confirmation analysis and by comparing the sample chromatogram with a standard chromatogram of Aroclor 1260. Therefore, this sample met target compound identification QC acceptance criteria.

XII. Compound Quantitation and Reported Detection Limits

Sample results were calculated correctly, thereby meeting compound quantitation acceptance criteria. All sample results and detection limits were reported correctly and correctly adjusted for percent moisture and dilution factors. Sample 5SE07 required a 2-fold dilution to bring high concentrations of target compounds into the linear range of the instrument.

XV. System Performance

Chromatograms from each sample analysis and instrument performance were considered acceptable.

BTEX and TFH Gasoline
(EPA Modified Method 8015/8020/ADEC AK 101)
Surface Water/Sediment
Batch 33061

Surface water and sediment samples 5SE07, 5SW07, 5SW07D, 5SE08, 5SE08C, and 5SW08 were validated from analytical batch 33061, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All water samples were analyzed within 14 days. All sediment samples were extracted and analyzed within 14 days. Therefore, all samples met holding time QC acceptance criteria.

III. Initial Calibration

All percent RSDs were within the control limit of ±30 percent, thereby meeting initial calibration QC acceptance criteria.

IV. Continuing Calibration

All percent differences were within the QC control limit of ±15 percent, thereby meeting continuing calibration QC acceptance criteria.

V. Blanks

The method, rinsate, and travel blanks associated with this analytical batch were free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

All surrogate spike recoveries were within QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

XI. Target Compound Identification

For BTEX analyses, compounds detected were verified by a second column confirmation analysis. Therefore, BTEX analyses met target compound identification QC acceptance criteria. TFH gasoline analyses do not require second column confirmation.

XII. Compound Quantitation and Reported Detection Limits

Sample results were calculated correctly, thereby meeting compound quantitation acceptance criteria. All sample results and detection limits were reported correctly and all results were correctly adjusted for percent moisture and dilution factors. Sample 5SE08 required a 5-fold dilution to bring high concentrations of target compounds into the linear range of the instrument.

All TFH gasoline analyses were calculated incorrectly because Method 8015/8020 was used instead of ADEC Method AK 101. the retention time window and type of calibration standard used for Method 8015/8020 differed when compared to the ADEC method. The retention time window was larger for the EPA method and included the major range of gasoline peaks when compared to the ADEC standards. A new retention time window was established that included peaks similar to standards used for both methods. TFH-gasoline recalculations affected results reported above the detection limit only. Only OU5SE-08 was recalculated from this analytical batch using the new retention time window. No sample results required qualification based on recalculation.

XV. System Performance

Chromatograms from each sample analysis and instrument performance were considered acceptable.

TFH Diesel and JP-4
(EPA Modified Method 8015/ADEC Method AK 102)
Surface Water/Sediment
Batch 33061

Surface water and sediment samples 5SE07, 5SW07, 5SE08, 5SW08, 5SW08C, 5SE07 MS/MSD, and 5SW07 MS/MSD were validated from analytical batch 33061, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All samples were extracted and analyzed within 14 days. Therefore, all samples met holding time QC acceptance criteria.

III. Initial Calibration

All percent RSDs were within the QC control limit of ±30 percent, thereby meeting initial calibration QC acceptance criteria.

IV. Continuing Calibration

All percent differences were within the QC control limit of ±15 percent, thereby meeting continuing calibration QC acceptance criteria.

V. Blanks

The method and travel blanks associated with this analytical batch were free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

All surrogate spike recoveries were within QC control limits of 50 to 150 percent, thereby meeting QC acceptance criteria.

VII. Matrix Spike/Matrix Spike Duplicates

For JP-4 analyses, MS/MSD recoveries and RPD for sediment analyses could not be determined because spiking compounds were diluted from the matrix. MS/MSD recoveries for water analysis of JP-4 were below the QC acceptance criteria of 60 to 120 percent recovery. The RPD for water analysis of JP-4 met the QC acceptance criteria of ±20 RPD.

For diesel analyses, MS/MSD recovery for sediment analyses met the QC acceptance criteria of 60 to 120 percent. The RPD for sediment analyses exceeded the QC acceptance criteria of ±20 RPD. The MS/MSD recoveries for water analysis of diesel was below the QC acceptance criteria of 60 to 120 percent recovery. The RPD for water analyses of diesel exceeded the QC acceptance criteria of ±20 RPD.

According to the CLP functional guidelines, samples are not qualified on the basis of MS/MSD results, therefore no samples were qualified.

XI. Target Compound Identification

Target compounds were reported when retention times were within the specified windows and when chromatograms matched standard fingerprint pattern associated with diesel or JP-4. Therefore, all JP-4 analyses met target compound identification QC acceptance criteria.

All TFH diesel analyses were calculated incorrectly because Method 8015 was used instead of ADEC Method AK 102. The retention time window and type of calibration standards used differed when compared to the ADEC method. TFH diesel results could not be recalculated because the chromatographic peaks from Method 8015 and the ADEC method did not match; consequently, a new retention time window could not be established. Because the ADEC-defined retention time window is larger than the original retention time, it is expected that TFH diesel results are biased low. This only affects results reported above the detection limit. Therefore, OU5SE-08 was qualified as biased low and flagged with a "J".

XII. Compound Quantitation and Reported Detection Limits

Sample results were calculated correctly, thereby meeting compound quantitation acceptance criteria. All sample results and detection limits were reported correctly and all results were correctly adjusted for percent moisture and dilution factors. Diesel results for samples 5SE07 and 5SE08 required a 5-fold dilution and JP-4 results for sample 5SE07 required a 2-fold dilution to bring high concentrations of target compounds into the linear range of the instrument.

XV. System Performance

Chromatograms for each sample analysis and instrument performance were considered acceptable.

Metals
(EPA Methods 6010 and 7000 Series)
Surface Water/Sediment
Batch 33061

Surface water and sediment samples 5SE07, 5SW07, 5SW07S, 5SE08, 5SW08, 5SW08C, and 5SW08S were validated from analytical batch 33061, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Inorganic Analyses.

I. Holding Times

Mercury analyses were performed within 28 days and all other metals were performed within 6 months. Therefore, all samples met holding time QC acceptance criteria.

II. Calibration Check

Each instrument was calibrated at the correct frequency and with the proper number of blanks and standards for each element. All initial and continuing calibration recoveries were within QC control limits of 90 to 110 percent. Therefore, all calibrations met QC acceptance criteria.

III. Preparation and Rinsate Blanks

Twelve different elements were detected in the preparation blank. However, blank contaminant concentrations were below the contract required detection limit (CRDL).

Seven different elements were detected in the rinsate blank associated with these samples. However, contaminant concentrations were below CRDL.

Except for two selenium results, no samples required qualification as a result of blank contamination. The following selenium results were qualified as nondetected and flagged with a "U" as a result of preparation blank contamination:

- 5SE07 (0.22U)
- 5SE08 (0.25U)

IV. ICP Interference Check Samples

All ICP interference check sample recoveries were within QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

V. Laboratory Control Sample (LCS)

All LCS recoveries were within QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

VI. Duplicates

All duplicate results were within the QC control limits of ±20 RPD for water samples and ±35 RPD for sediment samples, thereby meeting QC acceptance criteria.

VII. Matrix Spike Sample Analysis

For water samples, matrix spike recoveries were within the QC control limits of 75 to 125 percent, thereby meeting QC acceptance criteria. For sediment samples, except for lead and manganese, all matrix spike recoveries were within the QC control limits of 75 to 125 percent, thereby meeting QC acceptance criteria. The matrix spike recovery for lead (54.0 percent) was below the QC control limits, therefore lead results were qualified as biased low and flagged with an "L":

- 5SE07 (10.8L)
- 5SE08 (22.9L)

The matrix spike recovery for manganese (154.5 percent) was above the QC control limits, therefore manganese results were qualified as biased high and flagged with a "K":

- 5SE07 (905K)
- 5SE08 (650K)

VIII. Furnace Atomic Absorption QC (Analytical Spikes)

Except for two thallium spike recoveries, all furnace analytical spike recoveries were within the QC control limits of 85 to 115 percent, thereby meeting QC acceptance criteria. Thallium analytical spike recoveries for 5SE07 (81.4 percent) and 5SE08 (83.5 percent) were below QC acceptance criteria. Thallium results for 5SE07 (0.26BL) and 5SE08 (0.23UL) were qualified as biased low and flagged with an "L" for detected results, a "UL" for nondetected results.

IX. ICP Serial Dilution

For water analyses, except for barium, all serial dilutions met QC acceptance criteria. The following barium results were qualified as estimates and flagged with a "J" for positive results:

- 5SW07 (200BJ)
- 5SW07S (160BJ)
- 5SW08 (123BJ)
- 5SW08C (0.65BJ)
- 5SW08S (28.0BJ)

For sediment analyses, except for calcium and zinc, all serial dilutions met the QC acceptance criteria of ±10 percent difference. The following calcium results were qualified as estimates and flagged with a "J" for positive results:

- 5SE07 (6340J)
- 5SE08 (5140J)

The following zinc results were qualified as estimates and flagged with a "J":

- 5SE07 (36.8J)
- 5SE08 (77.2J)

X. Sample Result Verification

All sample results were calculated correctly, thereby meeting compound quantitation acceptance criteria. All sample results and detection limits were correctly adjusted for percent moisture.

General Chemistry-Alkalinity
(EPA Method 310.1)
Surface Water/Sediment
Batch 33061

Surface water samples 5SW07, 5SW08, and sediment sample 5SE08C were validated from analytical batch 33061, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Inorganic Analyses.

I. Holding Times

All samples were analyzed within 14 days, therefore all samples met holding time QC acceptance criteria.

II. Initial and Continuing Calibration

All initial and continuing calibration recoveries were within QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

V. Laboratory Control Sample

LCS results were within QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

VI. Duplicates

All duplicate results were within the QC control limits of ±20 RPD, thereby meeting QC acceptance criteria.

Semivolatile Organic Compounds
(EPA Method 8270)
Soil and Groundwater
Batch 33605

Soil and water samples 5SB19-52, 5SB19-10, and 5SB08-20C were validated from analytical batch 33605, following the criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All water samples were extracted within 7 days; all soil samples were extracted within 14 days. All samples were analyzed within 40 days. Therefore, all samples met extraction and analysis holding time QC acceptance criteria.

II. GC/MS Tuning

GC/MS tuning was performed for every 12-hour period. Each GC/MS tune met ion abundance QC acceptance criteria.

III. Initial Calibration

All initial calibration average relative response factors (RRFs) and percent relative standard deviations (RSDs) met QC acceptance criteria. Therefore, all initial calibration met QC acceptance criteria.

IV. Continuing Calibration

Except for several target compounds, all continuing calibration RRFs and percent differences met continuing calibration QC acceptance criteria. Compounds that did not meet QC acceptance criteria are listed in Table 3.

Table 3

Compound	Percent Difference
Continuing Calibration (8/21/92 1534)	
naphthalene	-30.8
hexachlorocyclopentadiene	-39.3
acenaphthylene	-25.1
3-nitroaniline	-54.5
4-nitrophenol	-43.1
pentachlorophenol	+36.0
3,3^1-dichlorobenzidine	-44.4
Continuing Calibration (8/24/92 1432)	
hexachlorobutadiene	-37.5
hexachlorocyclopentadiene	-42.1
4-chlorophenyl-phenylether	-32.2

According to the CLP functional guidelines, all compounds with continuing calibration percentage differences greater than 25 percent should be qualified as estimates and positive results flagged with a "J." Compounds that exceeded calibration criteria were not detected in any of the samples analyzed, therefore no samples were qualified.

V. Blanks

All method and rinsate blanks associated with these samples were free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

All surrogate spike recoveries were within the CLP QC control limits, thereby meeting QC acceptance criteria.

X. Internal Standards

All area counts and retention times were within the CLP QC control limits. Therefore, all samples met QC acceptance criteria for internal standards.

XI. Target Compound Identification

All target compound relative retention times (RRTs) were within 0.06 units of the standard RRT. All target compound mass spectra matched standard mass spectra and met QC acceptance criteria. Therefore, all samples met target compound identification QC acceptance criteria.

XII. Compound Quantitation and Reported Detection Limits

All sample results were calculated using the correct internal standard, quantitation ion, and relative response factor. Therefore, all samples met compound quantitation QC acceptance criteria. All sample results and detection limits were reported correctly and all results were correctly adjusted for percent moisture.

XIII. Tentatively Identified Compounds (TICs)

All sample TICs met QC acceptance criteria. A library search was conducted for each sample result reported on Form I. Sample spectra for each TIC identified matched standard mass spectra. When sample mass spectra did not match standard mass spectra, the TIC was designated as an "unknown." Samples 5SB19-10 and 5SB19-52 contained TICs that were also detected in the method blanks; these TICs were rejected and flagged with an "R." All TICs detected are considered estimated concentrations and flagged with a "JN."

XV. System Performance

Chromatograms and mass spectra from each sample analysis and instrument performance were considered acceptable.

Volatile Organic Compounds
(EPA Method 8010)
Soil
Batch 33632

Soil samples 5SB01-10, 5SB01-45D, 5SB21-10, 5SB21-25, 5SB21-48, and 5SB21-25 MS/MSD were validated from analytical batch 33632, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All samples were analyzed within 14 days, therefore all samples met holding time QC acceptance criteria.

III. Initial Calibration

All percent relative standard deviations (RSDs) were within the QC control limits of ±30 percent, thereby meeting initial calibration QC acceptance criteria.

IV. Continuing Calibration

Except for several target compounds, the continuing calibration concentration for all compounds were within the method specified QC control limits, thereby meeting continuing calibration QC acceptance criteria. Target compounds that did not meet QC acceptance criteria are listed in Table 4.

Table 4

Compound	Concentration	QC Control Limits
Continuing Calibration (8/26/92 0951)		
chloromethane	7.8	11.9-28.1
Continuing Calibration (8/26/92 2048)		
chloromethane	6.8	11.9-28.1
Continuing Calibration (8/27/92 0815)		
chloromethane	6.6	11.9-28.1
dichloromethane	15.4	15.5-24.5
bromoform	13.3	14.7-25.3

Where continuing calibrations exceeded QC acceptance criteria, no target compounds were detected in the samples. Therefore, no samples were qualified as a result of continuing calibrations.

V. Blanks

The method blank associated with this analytical batch was free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

All surrogate spike recoveries were within QC control limits of 80 to 130, thereby meeting QC acceptance criteria.

VII. Matrix Spike/Matrix Spike Duplicate

All MS/MSD recoveries were within the method specified QC control limits, thereby meeting QC acceptance criteria for accuracy. Except for one RPD, all RPDs were within the QC control limits of ±30, thereby meeting QC acceptance criteria for precision. The RPD for 1,1,2,2-tetrachlorethane (31.9 percent) was outside the control limit of 30 percent. According to the CLP functions guidelines, samples are not qualified on the basis of MS/MSD results; therefore, no sample results were qualified.

XI. Target Compound Identification

No target compounds were detected above the method detection limit (MDL).

XII. Compound Quantitation and Reported Detection Limits

No target compounds were detected above the MDL. All detection limits were reported correctly and all results were correctly adjusted for percent moisture.

XV. System Performance

Chromatograms from each sample analysis and instrument performance were considered acceptable.

Semivolatile Organic Compounds
(EPA Method 8270)
Soil
Batch 33632

Soil samples 5SB01-10, 5SB21-10, 5SB21-25, 5SB21-48, and 5SB21-25 MS/MSD were validated from analytical batch 33632, following the criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All samples were extracted within 14 days and analyzed within 40 days. Therefore, all samples met extraction and analysis holding time QC acceptance criteria.

II. GC/MS Tuning

GC/MS tuning was performed for every 12-hour period. Each GC/MS tune met ion abundance QC acceptance criteria.

III. Initial Calibration

All initial calibration average relative response factors (RRFs) and percent relative standard deviations (RSDs) met QC acceptance criteria. Therefore, all initial calibration met QC acceptance criteria.

IV. Continuing Calibration

Except for several target compounds, all continuing calibration RRFs and percent differences met continuing calibration QC acceptance criteria. Compounds that did not meet QC acceptance criteria are listed in Table 5.

According to the CLP functional guidelines, all compounds with continuing calibration percentage differences greater than 25 percent should be qualified as estimates and positive results flagged with a "J." Compounds that exceeded calibration criteria were not detected in any of the samples analyzed, therefore no samples were qualified.

V. Blanks

The method blank associated with this analytical batch was free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

All surrogate spike recoveries were within the CLP QC control limits, thereby meeting QC acceptance criteria.

Table 5

Compound	Percent Difference
Continuing Calibration (8/29/92 0809)	
napthalene	-29.1
acenaphthylene	-25.7
Continuing Calibration (8/31/92 1649)	
4-chloroaniline	+40.2
3-nitroaniline	+42.8
2,4-dinitrophenol	+41.4
4-nitroaniline	+27.6
4,6-dinitro-2-methylphenol	+27.2
3,3'-dichlorobenzidine	+25.9
Continuing Calibration (9/1/92 0459)	
4-chloroaniline	+49.1
3-nitroaniline	+56.9
2,4-dinitrophenol	+30.2
4-nitroaniline	+27.6

VII. Matrix Spike/Matrix Spike Duplicates

All MS/MSD recoveries and RPDs were within the CLP QC control limits, thereby meeting QC acceptance criteria for both accuracy and precision.

X. Internal Standards

All area counts and retention times were within the CLP QC control limits. Therefore, all samples met QC acceptance criteria for internal standards.

XI. Target Compound Identification

All target compound relative retention times (RRTs) were within 0.06 units of the standard RRT. All target compound mass spectra matched standard mass spectra and met QC acceptance criteria. Therefore, all samples met target compound identification QC acceptance criteria.

XII. Compound Quantitation and Reported Detection Limits

All sample results were calculated using the correct internal standard, quantitation ion, and relative response factor. Therefore, all samples met compound quantitation QC acceptance criteria. All sample results and detection limits were reported correctly and all results were correctly adjusted for percent moisture.

XIII. Tentatively Identified Compounds (TICs)

All sample TICs met QC acceptance criteria. A library search was conducted for each sample result reported on Form I. Sample spectra for each TIC identified matched standard mass spectra. When sample mass spectra did not match standard mass spectra, the TIC was designated as an "unknown." Samples 5SB01-10, 5SB21-10, 5SB21-25, and 5SB21-48 contained TICs that were also detected in the method blank; these TICs were rejected and flagged with an "R." All TICs detected are considered estimated concentrations and flagged with a "JN."

XV. System Performance

Chromatograms and mass spectra from each sample analysis and instrument performance were considered acceptable.

TBME, BTEX, and TFH Gasoline
(EPA Modified Method 8015/8020/ADEC Method AK 101)
Soil
Batch 33632

Soil samples 5SB01-10, 5SB21-10, 5SB21-25, 5SB21-48, and 5SB21-25 MS/MSD were validated from analytical batch 33632, following the criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All soil samples were extracted and analyzed within 14 days. Therefore, all samples met holding time QC acceptance criteria.

III. Initial Calibration

All percent RSDs were within the control limit of ±30 percent, thereby meeting initial calibration QC acceptance criteria.

IV. Continuing Calibration

All percent differences were within the QC control limits of ±15 percent, thereby meeting continuing calibration QC acceptance criteria.

V. Blanks

The method blank associated with this analytical batch was free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

All surrogate spike recoveries were within the QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

VII. Matrix Spike/Matrix Spike Duplicates

All MS/MSD recoveries were within the QC control limits of 80 to 120 percent and RPDs were within QC control limits of ±20, thereby meeting QC acceptance criteria for both accuracy and precision.

XI. Target Compound Identification

No target compounds were detected above the reporting limits.

XII. Compound Quantitation and Reported Detection Limits

No target compounds were detected above the reporting limits. All detection limits were reported correctly and all results were correctly adjusted for percent moisture.

All TFH gasoline analyses were calculated incorrectly because Method 8015/8020 was used instead of ADEC Method AK 101. The retention time windows and type of calibration standard used for Method 8015/8020 differed when compared to the ADEC method. The retention time window was larger for the EPA method and included the major range of gasoline peaks when compared to the ADEC standards. A new retention time window was established that included peaks similar to standards used for both methods. TFH-gasoline recalculations affected results reported above the detection limit only; therefore, no sample results were recalculated from this analytical batch.

XV. System Performance

Chromatograms for each sample analysis and instrument performance were considered acceptable.

TFH Diesel and JP-4
(EPA Modified Method 8015/ADEC Method AK 102)
Soil
Batch 33632

Soil samples 5SB01-10, 5SB21-10, 5SB21-25, 5SB21-48, and 5SB21-25 MS/MSD were validated from analytical batch 33632, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All samples were extracted and analyzed within 14 days. Therefore, all samples met holding time QC acceptance criteria.

III. Initial Calibration

All percent RSDs were within the QC control limits of ±30 percent, thereby meeting initial calibration QC acceptance criteria.

IV. Continuing Calibration

All percent differences were within the QC control limits of ±15 percent, thereby meeting continuing calibration QC acceptance criteria.

V. Blanks

The method blank associated with this analytical batch was free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

All surrogate spike recoveries were within the QC control limits of 50 to 150 percent, thereby meeting QC acceptance criteria.

VII. Matrix Spike/Matrix Spike Duplicates

The MS/MSD recoveries were within the QC control limits of 60 to 120 percent and RPDs were within the QC control limits of ±20, thereby meeting QC acceptance criteria for both accuracy and precision.

XI. Target Compound Identification

No target compounds were detected above the reporting limits.

XII. Compound Quantitation and Reported Detection Limits

No target compounds were detected above the reporting limits. All detection limits were reported correctly and all results were correctly adjusted for percent moisture.

All TFH diesel analyses were calculated incorrectly because Method 8015 was used instead of ADEC Method AK 102. The retention time windows and type of calibration standards used differed when compared to the ADEC method. TFH diesel results could not be recalculated because the chromatographic peaks from Method 8015 and the ADEC method did not match. Consequently, a new retention time window could not be established. Because the ADEC-defined retention time window is larger than the original retention time, it is expected that TFH diesel results are biased low. This only affects results reported above the detection limit; therefore, no sample results from this analytical batch were qualified.

XV. System Performance

Chromatograms for each sample analysis and, therefore, instrument performance were considered acceptable.

Metals
(EPA Methods 6010 and 7000 Series)
Soil
Batch 33632

Soil samples 5SB01-25, 5SB21-10, 5SB21-25, 5SB21-35, and 5SB21-48 were validated from analytical batch 33632, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Inorganic Analyses.

I. Holding Times

Mercury analyses were performed within 28 days and all other metals were performed within 6 months. Therefore, all samples met holding time QC acceptance criteria.

II. Calibration Check

Each instrument was calibrated at the correct frequency and with the proper number of blanks and standards for each element. All initial and continuing calibration recoveries were within QC control limits of 90 to 110 percent. Therefore, all calibrations met QC acceptance criteria.

III. Preparation Blanks

Seven different elements were detected in the preparation blank. However, blank contaminant concentrations were below the contract required detection limit (CRDL).

Except for three mercury results, no samples required qualification as a result of blank contamination. The following mercury results were qualified as nondetected and flagged with a "U":

- 5SB21-10 (0.09U)
- 5SB21-25 (0.07U)
- 5SB21-48 (0.08U)

IV. ICP Interference Check Samples

All ICP interference check sample recoveries were within QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

V. Laboratory Control Sample (LCS)

All LCS recoveries were within QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

VI. Duplicates

All duplicate results were within the QC control limits of ±35 RPD for soil samples, thereby meeting QC acceptance criteria.

VII. Matrix Spike Sample Analysis

Except for manganese, all matrix spike recoveries were within QC control limits of 75 to 125 percent, thereby meeting QC acceptance criteria.

The matrix spike recovery for manganese (68.0 percent) was below the QC control limits, therefore the sample results were qualified as biased low and flagged with an "L":

5SB01-25	(410L)
5SB21-10	(551L)
5SB21-25	(413L)
5SB21-35	(490L)
5SB21-48	(658L)

VIII. Furnace Atomic Absorption QC (Analytical Spikes)

Except for four selenium spike recoveries and one thallium spike recovery, all furnace analytical spike recoveries were within QC control limits of 85 to 115 percent, thereby meeting QC acceptance criteria. Selenium and thallium analytical spikes were below QC acceptance criteria, therefore, sample results were qualified as biased low and flagged with an "L" for positive results, a "UL" for nondetected results:

5SB21-10	selenium	(0.11UL)
5SB21-25	selenium	(0.15BL)
5SB21-35	selenium	(0.11UL)
5SB21-48	selenium	(0.24BL)
5SB21-48	thallium	(0.17UL)

IX. ICP Serial Dilution

Except for zinc, all serial dilutions met the QC acceptance criteria of ±10 percent difference. The following zinc results were qualified as estimates and flagged with a "J" for positive results:

5SB01-25	(47.1J)
5SB21-10	(62.9J)
5SB21-25	(48.8J)
5SB21-35	(45.3J)
5SB21-48	(81.3J)

X. Sample Result Verification

All sample results were calculated correctly, thereby meeting compound quantitation acceptance criteria. All sample results and detection limits were correctly adjusted for percent moisture.

General Chemistry Total Organic Carbon
(EPA Method 415.1)
Soil
Batch 33632

Soil samples 5SB01-5, 5SB01-15, and 5SB21-28 were validated from analytical batch 33632, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Inorganic Analyses.

I. Holding Times

All samples were analyzed within 28 days, therefore meeting holding time QC acceptance criteria.

II. Initial and Continuing Calibration

All initial and continuing calibration recoveries were within QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

III. Blanks

Method blanks were free of contamination, thereby meeting QC acceptance criteria.

V. Laboratory Control Sample

All LCS results were within QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

VI. Duplicates

All duplicate results were within the QC control limits of ±20, thereby meeting QC acceptance criteria.

VII. Matrix Spike Sample Analysis

All matrix spike recoveries were within QC control limits of 75 to 125 percent, thereby meeting QC acceptance criteria.

Volatile Organic Compounds
(EPA Method 8010)
Soil
Batch 33744

Soil samples 5SB12-8D, 5SB16-0B, and 5SB12-8C were validated from analytical batch 33744, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All samples were analyzed within 14 days, therefore all samples met holding time QC acceptance criteria.

III. Initial Calibration

All percent relative standard deviations (RPDs) were within the QC control limits of ±30 percent, thereby meeting initial calibration QC acceptance criteria.

IV. Continuing Calibration

Except for several target compounds, the continuing calibration concentration for all compounds were within the method specified QC control limits, thereby meeting continuing calibration QC acceptance criteria. Compounds that did not meet QC acceptance criteria are listed in Table 6.

Table 6

Compound	Concentration	QC Control Limits
Continuing Calibration (9/2/92 0913)		
dichlorodifluoromethane	3.7	15.0-25.0
chloromethane	6.0	11.9-28.1
vinyl chloride	12.1	13.7-26.3
bromoform	10.6	14.7-25.3
Continuing Calibration (9/3/92 0118)		
dichlorodifluoromethane	4.0	15.0-25.0
chloromethane	5.1	11.9-28.1
chloromethane	15.1	15.4-24.6
bromoform	13.8	14.7-25.3

Where continuing calibrations exceeded QC acceptance criteria, no target compounds were detected in the samples. Therefore, no samples were qualified as a result of continuing calibrations.

V. Blanks

All method, travel, rinsate, and field banks associated with this analytical batch were free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

All surrogate spike recoveries for these samples were within QC control limits, thereby meeting QC acceptance criteria.

XI. Target Compound Identification

No target compounds were detected above the method detection limit (MDL).

XII. Compound Quantitation and Reported Detection Limits

No target compounds were detected above the MDL. All detection limits were reported correctly and all results were correctly adjusted for percent moisture.

XV. System Performance

Chromatograms from each sample analysis and instrument performance were considered acceptable.

Metals
(EPA Methods 6010 and 7000)
Groundwater
Batch 33744

Water sample 5SB12-8C was validated from analytical batch 33744, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Inorganic Analyses.

I. Holding Times

Mercury analyses were performed within 28 days and all other metals were performed within 6 months. Therefore, the sample met holding time QC acceptance criteria.

II. Calibration Check

Each instrument was calibrated at the correct frequency and with the proper number of blanks and standards for each element. All initial and continuing calibration recoveries were within QC control limits of 90 to 110 percent. Therefore, all calibrations met QC acceptance criteria.

III. Preparation and Rinsate Blanks

Eleven different elements were detected in the preparation blank. However, blank contaminant concentrations were below the contract required detection limit (CRDL).

Seven different elements were detected in the rinsate blank. However, contaminant concentrations were below the CRDL. No samples required qualification as a result of blank contamination.

IV. ICP Interference Check Samples

All ICP interference check sample recoveries were within QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

V. Laboratory Control Sample (LCS)

All LCS recoveries were within the QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

VI. Duplicates

All duplicate results were within the QC control limits of ±20 RPD, thereby meeting QC acceptance criteria.

VII. Matrix Spike Sample Analysis

All matrix spike recoveries were within the QC control limits of 75 to 125 percent, thereby meeting QC acceptance criteria.

VIII. Furnace Atomic Absorption QC (Analytical Spikes)

All furnace analytical spike recoveries were within the QC control limits of 85 to 115 percent, thereby meeting QC acceptance criteria.

IX. ICP Serial Dilution

Except for barium, all serial dilutions met the QC acceptance criteria of ±10 percent difference. For sample 5SB12-8C the barium result was qualified as an estimate and flagged with a "UJ" for the nondetected result.

X. Sample Result Verification

All sample results were calculated correctly, thereby meeting compound quantitation acceptance criteria.

TBME, BTEX, and TFH Gasoline
(EPA Modified Method 8015/8020/ADEC Method AK 101)
Groundwater
Batch 33756

Water samples 5SW03, 5SW03A, 5SW02D, 5SW02, and 5SW02 MS/MSD were validated from analytical batch 33756, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All samples were analyzed within 14 days. Therefore, all samples met holding time QC acceptance criteria.

III. Initial Calibration

All percent RSDs were within the control limit of ±30 percent, thereby meeting initial calibration QC acceptance criteria.

IV. Continuing Calibration

All percent differences were within the QC control limit of ±15 percent, thereby meeting continuing calibration QC acceptance criteria.

V. Blanks

The method and travel blank associated with this analytical batch were free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

All surrogate spike recoveries were within QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

VII. Matrix Spike/Matrix Spike Duplicates

All MS/MSD recoveries were within the QC control limits of 80 to 120 percent and RPDs were within QC control limits of ±20, thereby meeting QC acceptance criteria for both accuracy and precision.

XI. Target Compound Identification

No target compounds were detected above the reporting limits.

XII. Compound Quantitation and Reported Detection Limits

No target compounds were detected above the reporting limits. All detection limits were reported correctly.

All TFH gasoline analyses were calculated incorrectly because Method 8015/8020 was used instead of ADEC Method AK 101. The retention time windows and type of calibration standard used for Method 8015/8020 differed when compared to the ADEC method. The retention time window was larger for the EPA method and included the major range of gasoline peaks when compared to the ADEC standards. A new retention time window was established that included peaks similar to standards used for both methods. TFH-gasoline recalculations affected results reported above the detection limit only; therefore, no sample results were recalculated from this analytical batch.

XV. System Performance

Chromatograms from each sample analysis and instrument performance were considered acceptable.

Metals
(EPA Methods 6010 and 7000 Series)
Surface Water
Batch 33756

Water samples 5SW02, 5SW02-S, 5SW03, 5SW03-S, 5SW03A, and 5SW03A-S were validated from analytical batch 33756, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Inorganic Analyses.

I. Holding Times

Mercury analyses were performed within 28 days and all other metals were performed within 6 months. Therefore, all samples met holding time QC acceptance criteria.

II. Calibration Check

Each instrument was calibrated at the correct frequency and with the proper number of blanks and standards for each element. All initial and continuing calibration recoveries were within the QC control limits of 90 to 110 percent. Therefore, all calibrations met QC acceptance criteria.

III. Preparation Blanks

Eleven different elements were detected in the preparation blank. However, blank contaminant concentrations were below the contract required detection limit (CRDL).

Except for three aluminum, two iron, five potassium, two selenium, and two zinc results, no samples required qualification as a result of blank contamination.

The following aluminum results were qualified as nondetected and flagged with a "U":

- 5SW03 (67.4U)
- 5SW02 (109U)
- 5SW03A (59.8U)

The following iron results were qualified as nondetected and flagged with a "U":

- 5SW03A-S (10.7U)
- 5SW03-S (12.6U)

The following potassium results were qualified as nondetected and flagged with a "U":

- 5SW03-S (571U)
- 5SW03 (47.0U)
- 5SW03A (509U)
- 5SW02 (376U)
- 5SW03A-S (454U)

The following selenium results were qualified as nondetected and flagged with a "U":

- 5SW03 (0.78U)
- 5SW02 (0.69U)

The following zinc results were qualified as nondetected and flagged with a "U":

- 5SW03-S (12.4U)
- 5SW03A-S (4.6U)

IV. ICP Interference Check Samples

All ICP interferences check sample recoveries were within QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

V. Laboratory Control Sample (LCS)

All LCS recoveries were within QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

VI. Duplicates

All duplicate results were within the QC control limits of ±20 RPD, thereby meeting QC acceptance criteria.

VII. Matrix Spike Sample Analysis

All matrix spike recoveries were within the QC control limits of 75 to 125 percent, thereby meeting QC acceptance criteria.

VIII. Furnace Atomic Absorption QC (Analytical Spikes)

All furnace analytical spike recoveries were within the QC control limits of 85 to 115 percent, thereby meeting QC acceptance criteria.

IX. ICP Serial Dilution

Except for barium, all serial dilutions met the QC acceptance criteria of ±10 percent difference. The following barium results were qualified as estimates and flagged with a "J" for positive results:

5SW03	(9.0BJ)
5SW03-S	(8.8BJ)
5SW03A	(9.3BJ)
5SW03A-S	(8.8BJ)
5SW02	(9.5BJ)

X. Sample Result Verification

All sample results were calculated correctly, thereby meeting compound quantitation acceptance criteria.

Polychlorinated Biphenyls
(EPA Method 8080)
Sediment
Batch 33781

Sediment samples 5SE05, 5SE04, 5SE04A, and 5SE05 MS/MSD were validated from analytical batch 33781, using the criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All samples were extracted within 14 days and analyzed within 40 days, thereby meeting extraction and analysis holding time QC acceptance criteria.

III. Initial Calibration

All percent RSDs were within the QC control limits of ±30 percent, thereby meeting initial calibration QC acceptance criteria.

IV. Continuing Calibration

All percent differences were within the control limit of ±15 percent, thereby meeting continuing calibration QC acceptance criteria.

V. Blanks

The method blank associated with this analytical batch was free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

All samples were spiked with tetrachloro-m-xylene and decachlorobiphenyl as surrogate compounds prior to analysis. All tetrachloro-m-xylene surrogate spike recoveries were within QC control limits of 60 to 150 percent, thereby meeting QC acceptance criteria. All decachlorobiphenyl surrogate spike recoveries were below the QC control limits. Therefore, all sample results were qualified as estimates and flagged with a "J" for positive results, a "UJ" for nondetected results.

VII. Matrix Spike/Matrix Spike Duplicates

All matrix spike recoveries were within the QC control limits of 50 to 150 and RPDs were within QC control limits of ±20, thereby meeting QC acceptance criteria for both accuracy and precision.

XI. Target Compound Identification

No target compounds were detected above the reporting limits.

XII. Compound Quantitation and Reported Detection Limits

No target compounds were detected above the reporting limits. Detection limits were reported correctly and all results were correctly adjusted for percent moisture.

XV. System Performance

Chromatograms from each sample analysis and instrument performance were considered acceptable.

Volatile Organic Compounds
(EPA Method 8010)
Groundwater
Batch 33799

Water samples 5MW5-30, 5MW5030D, 5MW16A-14, 5MW16A-14D, and 5CF02 were validated from analytical batch 33799, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All samples were analyzed within 14 days, therefore all samples met holding time QC acceptance criteria.

III. Initial Calibration

All percent relative standard deviations (RPDs) were within the QC control limits of ±30 percent, thereby meeting initial calibration QC acceptance criteria.

IV. Continuing Calibration

Except for dichlorodifluoromethane, the continuing calibration concentration for all compounds were within the method specified QC control limits, thereby meeting continuing calibration QC acceptance criteria. For the continuing calibration performed on September 14, the dichlorodifluoromethane continuing concentration was 9.16; below the method specified limits of 15.0 to 25.0. Dichlorodifluoromethane was not detected in any of the samples. Therefore, no samples were qualified as a result of continuing calibration criterias.

V. Blanks

The method and travel blanks associated with this analytical batch were free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

All surrogate spike recoveries were within QC control limits of 80 to 130, thereby meeting QC acceptance criteria.

XI. Target Compound Identification

No target compounds were detected above the method detection level (MDL).

XII. Compound Quantitation and Reported Detection Limits

No target compounds were detected above the MDL. All detection limits were reported correctly.

XV. System Performance

Chromatograms from each sample analysis and instrument performance were considered acceptable.

Purgeable Volatile Organic Compounds
(EPA Method 524.2)
Groundwater
Batch 33799

Water samples 5WS01, 5WS01A, 5WS02, 5WS01B, 5WS01D, 5WS02D, and 5WS02 MS/MSD were validated from analytical batch 33799, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All samples were analyzed within 14 days, therefore all samples met holding time QC acceptance criteria.

II. GC/MS Tuning

GC/MS tuning was performed for every 12-hour period. Each GC/MS tune met ion abundance QC acceptance criteria.

III. Initial Calibration

All average relative response factors (RRFs) met QC acceptance criteria. Except for methylene chloride, the percent relative standard deviations (RSDs) were within the QC control limits of ±30 percent, thereby meeting initial calibration QC acceptance criteria. Methylene chloride had a RSD of 60.3 percent.

According to the CLP functional guidelines, all compounds with RSDs greater than 30 percent should be qualified as estimates and positive results flagged with a "J." Methylene chloride was not detected in these samples, therefore qualification was not required.

IV. Continuing Calibration

All continuing calibration RRFs met QC acceptance criteria. Except for methylene chloride, all percent differences were within the QC control limits of ±15 percent, thereby meeting continuing calibration QC acceptance criteria. Methylene chloride had a percent difference of 54.4 percent. According to the CLP functional guidelines, all compounds with continuing calibration percent differences greater than 25 percent should be qualified as estimates and positive results flagged with a "J." Methylene chloride was not detected in these samples, therefore qualification was not required.

V. Blanks

Methylene chloride was detected in the method blank associated with this analytical batch. Methylene chloride was detected in SBLKW (September 11), at a concentration of 1.2 μg/L. Methylene chloride results for the following samples were qualified as nondetected and flagged with a "U":

- 5WS01 (1.4U)
- 5WS01A (1.6U)
- 5WS02 (1.1U)

VI. System Monitoring Compounds (Surrogates)

All surrogate spike recoveries for these samples were within QC control limits of 70 to 130 percent, thereby meeting QC acceptance criteria.

VII. Matrix Spike/Matrix Spike Duplicates

MS/MSD recoveries were within the QC control limits of 60 to 140 percent and relative percent differences (RPDs) were within the QC control limits of ±20, thereby meeting QC acceptance criteria for both accuracy and precision.

X. Internal Standards

All area counts and retention times were within the method specified QC control limits. Therefore, all samples met QC acceptance criteria for internal standards.

XI. Target Compound Identification

All target compound relative retention times (RRTs) were within 0.06 RRT units of the standard RRT. All target compound mass spectra matched standard mass spectra and met QC acceptance criteria. Therefore, all samples met target compound identification QC acceptance criteria.

XII. Compound Quantitation and Reported Detection Limits

All sample results were correctly calculated, thereby meeting compound quantitation acceptance criteria. All detection limits were reported correctly.

XV. System Performance

Chromatograms and mass spectra from each sample analysis and instrument performance were considered acceptable.

Semivolatile Organic Compounds
(EPA Method 8270)
Groundwater
Batch 33799

Water samples 5MW5-30, 5MW16A-14, 5WS01, 5WS01A, 5WS02, and 5WS02 MS/MSD were validated from analytical batch 33799, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All water samples were extracted within 7 days and analyzed within 40 days. Therefore, all samples met extraction and analysis holding time QC acceptance criteria.

II. GC/MS Tuning

GC/MS tuning was performed for every 12-hour period. Each GC/MS tune met ion abundance QC acceptance criteria.

III. Initial Calibration

All initial calibration average RRFs and percent RSDs met QC acceptance criteria. Therefore, all initial calibration met QC acceptance criteria.

IV. Continuing Calibration

Except for several target compounds, all continuing calibration RRFs and percent differences met continuing calibration QC acceptance criteria. The compounds that did not meet QC acceptance criteria are listed in Table 7.

Table 7

Compound	Percent Difference
Continuing Calibration (9/14/92 1009)	
4-chloroaniline	+41.6
hexachlorobutadiene	-26.9
hexachlorocyclopentadiene	-28.4
bis (2-ethylhexyl) phthalate	-29.9
Continuing Calibration (9/15/92 1529)	
4-chloroaniline	+55.7
3-nitroaniline	+31.2
4-nitroaniline	+43.9

According to the CLP functional guidelines, all compounds with continuing calibration percentage differences greater than 25 percent should be qualified as estimates and positive results flagged with a "J." Compounds that exceeded calibration criteria were not detected in any of the samples analyzed, therefore no samples were qualified.

V. Blanks

Except for diethylphthalate, the method blank associated with this analytical batch was contamination free. Diethylphthalate was detected in method blank SBLKW1 (September 5) at a concentration of 2 μg/L. The diethylphthalate result for 5WS02 (10 U) was qualified as nondetected and flagged with a "U."

VI. System Monitoring Compounds (Surrogates)

All surrogate spike recoveries were within the CLP QC control limits, thereby meeting QC acceptance criteria.

VII. Matrix Spike/Matrix Spike Duplicate

All MS/MSD recoveries and RPDs were within the CLP QC control limits, thereby meeting QC acceptance criteria for both accuracy and precision.

X. Internal Standards

All area counts and retention times were within the CLP QC control limits. Therefore, all samples met QC acceptance criteria for internal standards.

XI. Target Compound Identification

All target compound RRTs were within 0.06 units of the standard RRT. All target compound mass spectra matched standard mass spectra and met QC acceptance criteria. Therefore, all samples met target compound identification QC acceptance criteria.

XII. Compound Quantitation and Reported Detection Limits

All sample results were calculated using the correct internal standard, quantitation ion, and relative response factor. Therefore, all samples met compound quantitation QC acceptance criteria. All detection limits were reported correctly.

XIII. Tentatively Identified Compounds (TICs)

All sample TICs met QC acceptance criteria. A library search was conducted for each sample result reported on Form I. Sample mass spectra for each TIC identified matched standard mass spectra. When sample mass spectra did not match standard mass spectra, the TIC was designated as an "unknown." Samples 5WS02, 5WS01, 5WS01A, 5MW16A-14, and 5MW5-30 contained TICs that were also detected in the method blanks; these TICs were rejected and flagged with an "R." All TICs detected are considered estimated concentrations and flagged with a "JN."

XV. System Performance

Chromatograms and mass spectra from each sample analysis and instrument performance were considered acceptable.

TBME, BTEX, and TFH Gasoline
(EPA Modified Method 8015/8020/ADEC Method AK 101)
Groundwater
Batch 33799

Water samples 5MW5-30, 5MW5-30D, 5MW16A-14, 5MW16A-14D, and 5CF02 were validated from analytical batch 33799, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All samples were analyzed within 14 days. Therefore, all samples met holding time QC acceptance criteria.

III. Initial Calibration

All percent RSDs were within the control limit of ±30 percent, thereby meeting initial calibration QC acceptance criteria.

IV. Continuing Calibration

All percent differences were within the QC control limit of ±15 percent, thereby meeting continuing calibration QC acceptance criteria.

V. Blanks

The method and travel blank associated with this analytical batch were free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

Except for 5MW5-30, all surrogate spike recoveries were within QC control limits of 80 to 120 percent. Therefore, the majority surrogate spike recoveries met QC acceptance criteria. All results for 5MW5-30 were qualified as estimates and flagged with a "J" for positive results, a "UJ" for nondetected results.

XI. Target Compound Identification

For BTEX analyses, compounds detected were verified by a second column confirmation analysis. Therefore, BTEX analyses met target compound identification QC acceptance criteria. TBME and TFH gasoline analyses do not require second column confirmation.

XII. Compound Quantitation and Reported Detection Limits

Sample results were correctly calculated, thereby meeting compound quantitation acceptance criteria. All detection limits were reported correctly.

All TFH gasoline analyses were calculated incorrectly because Method 8015/8020 was used instead of ADEC Method AK 101. The retention time windows and type of calibration standard used for Method 8015/8020 differed when compared to the ADEC method. The retention time window was larger for the EPA method and included the major range of gasoline peaks when compared to the ADEC standards. A new retention time window was established that included peaks similar to standards used for both methods. TFH-gasoline recalculations affected results reported above the detection limit only; therefore, no sample results were recalculated from this analytical batch.

XV. System Performance

Chromatograms from each sample analysis and instrument performance were considered acceptable.

TFH Gasoline
(EPA Modified Method 8015/ADEC Method AK 102)
Groundwater
Batch 33799

Water samples 5WS01, 5WS01A, 5WS02, and 5WS02 MS/MSD were validated from analytical batch 33799, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All samples were analyzed within 14 days. Therefore, all samples met holding time QC acceptance criteria.

III. Initial Calibration

All percent RSDs were within the control limit of ±30 percent, thereby meeting initial calibration QC acceptance criteria.

IV. Continuing Calibration

All percent differences were within the QC control limit of ±15 percent, thereby meeting continuing calibration QC acceptance criteria.

V. Blanks

The method blanks associated with these analytical batches were free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

All surrogate spike recoveries were within QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

VII. Matrix Spike/Matrix Spike Duplicates

The MS/MSD recoveries were within the QC control limits of 80 to 120 percent and RPD were within the QC control limits of ±20, thereby meeting QC acceptance criteria for both accuracy and precision.

XI. Target Compound Identification

No target compounds were detected above the reporting limits.

XII. Compound Quantitation and Reported Detection Limits

No target compounds were detected above reporting limits. Detection limits were reported correctly.

All TFH gasoline analyses were calculated incorrectly because Method 8015/8020 was used instead of ADEC Method AK 101. The retention time windows and type of calibration standard used for Method 8015/8020 differed when compared to the ADEC method. The retention time window was larger for the EPA method and included the major range of gasoline peaks when compared to the ADEC standards. A new retention time window was established that included peaks similar to standards used for both methods. TFH-gasoline recalculations affected results reported above the detection limit only; therefore, no sample results were recalculated from this analytical batch.

XV. System Performance

Chromatograms from each sample analysis and instrument performance were considered acceptable.

TFH Diesel and JP-4
(EPA Modified Method 8015/ADEC Method AK 102)
Groundwater
Batch 33799

Water samples 5MW5-30, 5MW16A-14, 5WS01, 5WS01A, 5WS02, and 5WS02 MS/MSD were validated from analytical batch 33799, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All samples were extracted and analyzed within 14 days. Therefore, all samples met holding time QC acceptance criteria.

III. Initial Calibration

All percent RSDs were within the QC control limit of ±30 percent, thereby meeting initial calibration QC acceptance criteria.

IV. Continuing Calibration

All percent differences were within the QC control limit of ±15 percent, thereby meeting continuing calibration QC acceptance criteria.

V. Blanks

The method blank associated with this analytical batch was free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

All surrogate spike recoveries were within QC control limits of 50 to 150 percent, thereby meeting QC acceptance criteria.

VII. Matrix Spike/Matrix Spike Duplicates

For JP-4 analyses, MS/MSD recoveries were below the QC acceptance criteria of 60 to 120 percent. The RPD for this analysis met the QC acceptance criteria of ±20 RPD. According to the functional guidelines, samples are not qualified on the basis of MS/MSD results. For diesel analyses, MS/MSD recoveries were within the QC control limits of 60 to 120 percent and RPDs were within the QC control limits of ±20, thereby meeting QC acceptance criteria.

XI. Target Compound Identification

No target compounds were detected above the reporting limit.

XII. Compound Quantitation and Reported Detection Limits

No target compounds were detected above the reporting limit. Detection limits were reported correctly.

All TFH diesel analyses were calculated incorrectly because Method 8015 was used instead of ADEC Method AK 102. The retention time windows and type of calibration standards used differed when compared to the ADEC method. TFH diesel results could not be recalculated because the chromatographic peaks from Method 8015 and the ADEC method did not match. Consequently, a new retention time window could not be established. Because the ADEC-defined retention time window is larger than the original retention time, it is expected that TFH diesel results are biased low. This only affects results reported above the detection limit; therefore, no sample results from this analytical batch were qualified.

XV. System Performance

Chromatograms for each sample analysis and instrument performance were considered acceptable.

Cations
(EPA Methods 6010 and 7000)
Groundwater
Batch 33799

Water samples 5WS01, 5WS01A, and 5WS02 were validated from analytical batch 33799, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Inorganic Analyses.

All samples were analyzed for the following cations by Inductively Coupled Plasma (ICP) method; calcium, iron, magnesium, potassium, and sodium.

I. Holding Times

All metal analyses were analyzed within 6 months. Therefore, all samples met holding time QC acceptance criteria.

II. Calibration Check

Each instrument was calibrated at the correct frequency and with the proper number of blanks and standards for each element. All initial and continuing calibration recoveries were within QC control limits of 90 to 110 percent. Therefore, all calibrations met QC acceptance criteria.

III. Preparation Blanks

Two different elements were detected in at least one of the preparation blanks. However, blank contaminant concentrations were below the CRDL.

No samples required qualification as a result of blank contamination.

IV. ICP Interference Check Samples

All ICP interference check sample recoveries were within the QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

V. Laboratory Control Sample (LCS)

All LCS recoveries were within QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

VI. Duplicates

All duplicate results were within the QC control limits of ±20 RPD, thereby meeting QC acceptance criteria.

VII. Matrix Spike Sample Analysis

All matrix spike recoveries were within the QC control limits of 75 to 125 percent, thereby meeting QC acceptance criteria.

IX. ICP Serial Dilution

All serial dilutions met the QC control acceptance criteria of ±10 percent difference.

X. Sample Result Verification

All sample results were calculated correctly, thereby meeting compound quantitation acceptance criteria.

General Chemistry-Conventional Parameters
(EPA Method 310.1/300.0)
Groundwater
Batch 33799

Water samples 5WS01, 5WS01A, and 5WS02 were validated from analytical batch 33799, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Inorganic Analyses.

All samples were analyzed for alkalinity, bicarbonate, carbonate, chloride, nitrate, and sulfate.

I. Holding Times

All nitrate analyses were performed within 2 days; all alkalinity, bicarbonate, and carbonate analyses were performed within 14 days, and all chloride and sulfate analyses were performed within 28 days, therefore all samples met holding time QC acceptance criteria.

II. Initial and Continuing Calibration

All initial and continuing calibration recoveries were within QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

III. Blanks

Methods blanks were free of contamination, thereby meeting QC acceptance criteria.

V. Laboratory Control Sample

All LCS recoveries were within QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

VI. Duplicates

All duplicate results were within the QC control limits of ±20 RPD, thereby meeting QC acceptance criteria.

VIII. Matrix Spike Recovery

Chloride, nitrate, and sulfate matrix spike recoveries were within QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria. Matrix spikes are not performed with alkalinity, bicarbonate, and carbonate analyses.

Volatile Organic Compounds
(EPA Method 8010)
Surface Water/Sediment
Batch 33862

Surface water and sediment samples 5SW09B, 5SW09, 5SW09D, 5SW10, 5SE09, 59SE09A, 5SE10, 5SW10 MS/MSD, and 5SE10 MS/MSD were validated from analytical batch 33862, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All samples were analyzed within 14 days, therefore all samples met holding time QC acceptance criteria.

III. Initial Calibration

All percent relative standard errors (RSEs) were within the QC control limits of ±30 percent, thereby meeting initial calibration QC acceptance criteria.

IV. Continuing Calibration

Except for several target compounds, the percent *difference* for all compounds were within the QC control limits of ±15 percent, thereby meeting continuing calibration QC acceptance criteria. Target compounds that did not meet QC acceptance criteria are listed in Table 8.

Where continuing calibrations exceeded QC acceptance criteria, no target compounds were detected in the samples. Therefore, no samples were qualified as a result of continuing calibrations.

V. Blanks

The method and travel blanks associated with this analytical batch were free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

All surrogate spike recoveries were within QC control limits of 60 to 130 percent, thereby meeting QC acceptance criteria.

VII. Matrix Spike/Matrix Spike Duplicates

All MS/MSD recoveries were within the method specified QC control limits and relative percent differences (RPDs) were within the QC control limits of ±20, thereby meeting QC acceptance criteria for both accuracy and precision.

Table 8

Compound	Percent Difference
Continuing Calibration (9/15/92 FA RTX-1)	
chloromethane	34.6
vinyl chloride	22.2
1,1-dichloroethene	19.4
tetrachloroethene	22.8
Continuing Calibration (9/16/92 GC3A RTX-1)	
chloromethane	31.4
vinyl chloride	24.4
bromomethane	17.0
chloroethane	19.7
1,1-dichloroethene	17.5
chlorobenzene	18.0
Continuing Calibration (9/16/92 GC3C RESTEK 502.2)	
bromomethane/chloromethane	23.0
1,1-dichloroethene	29.8
methylene chloride	38.5
trans-1,2-dichloroethene	21.1
1,1-dichlorethane	23.1
cis-1,2-dichloroethene	20.4
chloroform	21.4
1,2-dichloroethane	23.7
carbon tetrachloride	19.6
1,2-dichloropropene	17.1
bromodichloromethane	18.5
trichloroethene	17.8
cis-1,3-dichloropropene	19.7
1,1,2-trichloroethane	18.7
dibromochloromethane	22.9
1,2-dibromoethane	26.9
bromoform	20.7
1,1,2,2-tetrachloroethene	15.7

XI. Target Compound Identification

Compounds detected in samples were verified by a second column confirmation analysis, thereby meeting target compound identification QC acceptance criteria.

XII. Compound Quantitation and Reported Detection Limits

All sample results were calculated correctly, thereby meeting compound quantitation acceptance criteria. For water samples, all detection limits were reported correctly. For soil samples, detection limits and results were reported without adjustment for percent moisture.

XV. System Performance

Chromatograms from each sample analysis and instrument performance were considered acceptable.

Semivolatile Organic Compounds
(EPA Method 8270)
Surface Water/Sediment
Batch 33862

Surface water and sediment samples 5SW09, 5SW10, 5SE09RX, 5SE09ARX, 5SE10R, 5SW10 MS/MSD, and 5SE10RX MS/MSD were validated from analytical batch 33862, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All water samples were extracted within 7 days and analyzed within 40 days. Therefore, all water samples met extraction and analysis holding time QC acceptance criteria. All soil samples exceeded the 14-day extraction holding time requirement and were analyzed within 40 days. Therefore, all soil sample results were qualified as estimates and flagged with a "J" for positive results, a "UJ" for nondetected results.

II. GC/MS Tuning

GC/MS tuning was performed for every 12-hour period. Each GC/MS tune met ion abundance QC acceptance criteria.

III. Initial Calibration

Except for 2,4-dinitrophenol, all initial calibration average relative response factors (RRFs) and percent relative standard deviations (RSDs) met QC acceptance criteria. Therefore, the majority of initial calibration results met QC acceptance criteria. The percent RSD for 2,4-dinitrophenol was 31.6, which was outside the QC control limit of ±30 percent RSD. 2,4-Dinitrophenol was not detected in any of the samples analyzed, therefore no samples were qualified.

IV. Continuing Calibration

Except for several target compounds, all continuing calibration RRFs and percent differences met continuing calibration QC acceptance criteria. The compounds that did not meet QC acceptance criteria are listed in Table 9.

Where continuing calibrations exceeded QC acceptance criteria, no target compounds were detected in the samples. Therefore, no samples were qualified as a result of continuing calibrations.

Table 9

Compound	Percent Difference
Continuing Calibration (10/5/92 948)	
2,4-dinitrophenol	72.9
4-nitroaniline	43.4
4,6-dinitro-2-methylphenol	26.4
Continuing Calibration (10/5/92 1005)	
nitrobenzene	36.7
isophorone	31.0
bis (2-chloroethoxy)methane	25.4
4-chloro-3-methylphenol	31.4
4-nitroaniline	37.5
Continuing Calibration (10/22/92 2121)	
3,3'-dichlorobenzedine	+27.2

V. Blanks

Except for di-n-buytlphthalate, method blanks associated with this analytical batch were contamination free. Di-n-buytlphthalate was detected in SBLK4RX (October 19) at a concentraion of 39 µg/kg. Di-n-buytlphthalate results for 5SE09RX (420UJ) and 5SE09ARX (420UJ) were qualified as nondetected and flagged with a "U" as a result of method blank contamination.

VI. System Monitoring Compounds (Surrogates)

All surrogate spike recoveries were within the CLP QC control limits, thereby meeting QC acceptance criteria.

VII. Matrix Spike/Matrix Spike Duplicate

Except for two MSD recoveries and nine RSDs, all MS/MSD recoveries and RPDs were within the CLP QC control limits, thereby meeting QC acceptance criteria for both accuracy and precision. According to the CLP functional guidelines, samples are not qualified on the basis of MS/MSD results, therefore no sample results were qualified.

X. Internal Standards

All area counts and retention times were within the CLP QC control limits. Therefore, all samples met QC acceptance criteria for internal standards. Sample retention times were not reported by the laboratory on computer printouts. Therefore, it was not possible to verify if retention times were reported correctly.

XI. Target Compound Identification

All target compound relative retention times (RRTs) were within 0.06 units of the standard RRT. All target compound mass spectra matched standard mass spectra. Therefore, all samples met target compound identification QC acceptance criteria.

XII. Compound Quantitation and Reported Detection Limits

All sample results were calculated using the correct internal standard, quantitation ion, and RRF. Therefore, all samples met compound quantitation QC acceptance criteria. For water samples, all detection limits were reported correctly. For soil samples, all detection limits were correctly adjusted for percent moisture.

XIII. Tentatively Identified Compounds (TICs)

All sample TICs met QC acceptance criteria. A library search was conducted for each sample result reported on Form I. Sample mass spectra for each TIC identified matched standard mass spectra. When sample mass spectra did not match standard mass spectra, the TIC was designated as an "unknown." Samples 5SE09ARX, 5SE09RX, and 5SE10RX contained TICs that were also detected in the method blanks; these TICs were rejected and flagged with an "R." All TICs detected are considered estimated concentrations and flagged with a "JN."

XV. System Performance

Chromatograms and mass spectra from each sample analysis and instrument performance were considered acceptable.

BTEX and TFH Gasoline
(EPA Modified Method 8015/8020/ADEC Method AK 101)
Surface Water/Sediment
Batch 33862

Surface water and sediment samples 5SW09B, 5SW09, 5SW09D, 5SW10, 5SE09, 5SE09A, 5SE10, 5SW10 MS/MSD, and 5SE10 MS/MSD were validated from analytical batch 33862, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All water samples were analyzed within 14 days. All soil samples were extracted and analyzed within 14 days. Therefore, all samples met holding time QC acceptance criteria.

III. Initial Calibration

For TFH gasoline analyses, all percent RSDs were within the QC control limit of ±30 percent. For BTEX analyses, percent RSEs were within the QC control limits of ±30 percent. Therefore, all compounds met initial calibration QC acceptance criteria.

IV. Continuing Calibration

All percent differences were within the QC control limit of ±15 percent, thereby meeting continuing calibration QC acceptance criteria.

V. Blanks

The method and travel blank associated with this analytical batch were free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

All surrogate spike recoveries were within QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

VII. Matrix Spike/Matrix Spike Duplicates

All MS/MSD recoveries were within the QC control limits of 60 to 120 percent and all RPDs were within the QC control limits of ±20, thereby meeting QC acceptance criteria for both accuracy and precision.

XI. Target Compound Identification

No target compounds were detected above the reporting limits.

XII. Compound Quantitation and Reported Detection Limits

No target compounds were detected above the reporting limits. For water samples, detection limits were reported correctly. For soil samples, detection limits and results were reported without adjustment for percent moisture.

All TFH gasoline analyses were calculated incorrectly because Method 8015/8020 was used instead of ADEC Method AK 101. The retention time windows and type of calibration standard used for Method 8015/8020 differed when compared to the ADEC method. The retention time window was larger for the EPA method and included the major range of gasoline peaks when compared to the ADEC standards. A new retention time window was established that included peaks similar to standards used for both methods. TFH-gasoline recalculations affected results reported above the detection limit only; therefore, no sample results were recalculated from this analytical batch.

XV. System Performance

Chromatograms from each sample analysis and instrument performance were considered acceptable.

TFH Diesel and JP-4
(EPA Modified Method 8015/ADEC Method AK 102)
Surface Water/Sediment
Batch 33862

Surface water and sediment samples 5SW09, 5SW10, 5SE09, 5SE09A, 5SW10 MS/MSD, and 5SE10 MS/MSD were validated from analytical batch 33862, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All samples were extracted and analyzed within 14 days. Therefore, all samples met holding time QC acceptance criteria.

III. Initial Calibration

All percent RSEs were within the QC control limit of ±30 percent, thereby meeting initial calibration QC acceptance criteria.

IV. Continuing Calibration

All continuing calibration compound recoveries were within the QC control limit of 85 to 115 percent, thereby meeting continuing calibration QC acceptance criteria.

V. Blanks

The method blank associated with this analytical batch was free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

Except for 5SE10 (48 percent), 5SW11 (209 percent), and 5SE11 (38 percent), all surrogate spike recoveries were within the QC control limits of 50 to 150 percent. Therefore, the majority of surrogate spike recoveries met QC acceptance criteria.

Sample results were qualified as estimates and flagged with a "J" for positive results, a "UJ" for nondetected results.

VII. Matrix Spike/Matrix Spike Duplicates

All MS/MSD recoveries were within the QC control limit of 60 to 120 percent and all RPDs were within the QC control limit of ±20, thereby meeting QC acceptance criteria for both accuracy and precision.

XI. Target Compound Identification

Target compounds were reported when retention times were within the specified windows and when the chromatograms matched standard fingerprint pattern associated with diesel or JP-4. Therefore, all samples met target compound identification QC acceptance criteria.

All TFH diesel analyses were calculated incorrectly because Method 8015 was used instead of ADEC Method AK 102. The retention time windows and type of calibration standards used differed when compared to the ADEC method. TFH diesel results could not be recalculated because the chromatographic peaks from Method 8015 and the ADEC method did not match. Consequently, a new retention time window could not be established. Because the ADEC-defined retention time window is larger than the original retention time, it is expected that TFH diesel results are biased low. This only affects results reported above the detection limit. Therefore, OU5SE-09A was qualified as biased low and flagged with a "J".

XII. Compound Quantitation and Reported Detection Limits

Sample results were calculated correctly, thereby meeting compound quantitation acceptance criteria. For soil samples, detection limits and results were reported without adjustment for percent moisture. For 5SE09A, the detection limit for TFH diesel was raised from 1 µg/kg to 3 µg/kg. Due to the presence of JP-4 and unknown hydrocarbons in the sample, it was not possible to confidently identify peaks found in the diesel range, therefore the TFH diesel detection limit was raised.

XV. System Performance

Chromatograms for each sample analysis and instrument performance were considered acceptable.

Metals
(EPA Methods 6010 and 200.7)
Soil
Batch 33822

Soil samples SL19HA, SL19HN, and SL20FA were validated from analytical batch 33822, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Inorganic Analyses. Samples were analyzed for 17 metals by ICP.

I. Holding Times

All metals were analyzed within 6 months. Therefore, all samples met holding time QC acceptance criteria.

II. Calibration Check

Each instrument was calibrated at the correct frequency and with the proper number of blanks and standards for each element. All initial and continuing calibration recoveries were within QC control limits of 90 to 110 percent. Therefore, all calibrations met QC acceptance criteria.

III. Preparation Blanks

Three different elements were detected in the preparation blank. No samples required qualification as a result of blank contamination.

IV. ICP Interference Check Samples

All ICP interference check samples recoveries were within QC control limits of 80 to 120 percent, thereby meeting QC acceptance criteria.

V. Laboratory Control Sample (LCS)

All LCS results were within QC control limits, thereby meeting QC acceptance criteria.

VI. Duplicates

All duplicate results were within the QC control limit of ±35 RPD, thereby meeting QC acceptance criteria.

VII. Matrix Spike Sample Analysis

Post-digestion matrix spikes were performed instead of predigestion matrix spikes. All post-digestion matrix spike recoveries were within the QC control limits of 75 to 125 percent, thereby meeting QC acceptance criteria.

IX. ICP Serial Dilution

A serial dilutions was not performed with this analytical batch.

X. Sample Result Verification

All sample results were calculated correctly, thereby meeting compound quantitation acceptance criteria. All sample results and detection limits were correctly adjusted for percent moisture.

Volatile Organic Compounds
(EPA Method 8010)
Soil
Batch 55500

Water and soil samples SL04S12ND, SL04S12A, SL04S12AA, and SL04S12N were validated from analytical batch 55500, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All samples were analyzed within 14 days, therefore all samples met holding time QC acceptance criteria.

III. Initial Calibration

All percent relative standard deviations (RSDs) were within the QC control limits of ±30 percent, thereby meeting initial calibration QC acceptance criteria.

IV. Continuing Calibration

The continuing calibration concentration for all compounds were within the method specified QC control limits, thereby meeting continuing calibration QC acceptance criteria.

V. Blanks

The method blank associated with this analytical batch was free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

All surrogate spike recoveries were within QC control limits of 71 to 121 for water samples and 52 to 129 for soil samples, thereby meeting QC acceptance criteria.

VII. Matrix Spike/Matrix Spike Duplicate

All MS/MSD recoveries and RPDs were within the method specified QC control limits, thereby meeting QC acceptance criteria for both accuracy and precision.

XI. Target Compound Identification

No target compounds were detected above the method detection limit (MDL).

XII. Compound Quantitation and Reported Detection Limits

No target compounds were detected above the MDL. All detection limits were reported correctly and all results were correctly adjusted for percent moisture.

XV. System Performance

Chromatograms from each sample analysis and instrument performance were considered acceptable.

BTEX and TFH Gasoline
(EPA Modified Method 8015/8020/ADEC AK 101)
Soil
Batch 55500

Soil samples SL04S12A, SL04S12AA, and SL04S12N were validated from analytical batch 55500, following the criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All soil samples were extracted and analyzed within 14 days. Therefore, all samples met holding time QC acceptance criteria.

III. Initial Calibration

All percent RSDs were within the control limit of ±30 percent, thereby meeting initial calibration QC acceptance criteria.

IV. Continuing Calibration

All percent differences were within the QC control limits of ±15 percent, thereby meeting continuing calibration QC acceptance criteria.

V. Blanks

The method blank associated with this analytical batch was free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

All surrogate spike recoveries were within the QC control limits of 50 to 120 percent, thereby meeting QC acceptance criteria.

VII. Matrix Spike/Matrix Spike Duplicates

All MS/MSD recoveries and RPDs were within the method specified QC control limits, thereby meeting QC acceptance criteria for both accuracy and precision.

XI. Target Compound Identification

Target compounds were reported only when retention times were within their specified windows. Therefore, target compound identification QC acceptance criteria were met for all samples.

XII. Compound Quantitation and Reported Detection Limits

All sample results were calculated correctly, thereby meeting compound quantitation acceptance criteria. All sample results and detection limits were reported correctly and all results were correctly adjusted for percent moisture. Samples SL04S12A and SL04S12AA required a medium-level (tenfold dilution) analysis to bring high concentrations of target compounds into the linear range of the instrument.

All TFH gasoline analyses were calculated incorrectly because Method 8015/8020 was used instead of ADEC Method AK 101. The retention time windows and type of calibration standard used for method 8015/8020 differed when compared to the ADEC method. The retention time window was larger for the EPA method and included the major range of gasoline peaks when compared to the ADEC standards. A new retention time window could not be established for samples analyzed by Superior Analytical, and results reported above the detection limit could not be recalculated. Therefore, TFH-gasoline results for SL04S12A and SL04S12AA are considered estimates and flagged with a "J".

XV. System Performance

Chromatograms for each sample analysis and instrument performance were considered acceptable.

TFH Diesel and JP-4
(EPA Modified Method 8015/ADEC Method AK 102)
Soil
Batch 55500

Water and soil samples SL04S12ND, SL04S12A, SL04S12AA, SL04S12N, and SL04S12NA were validated from analytical batch 55500, following criteria outlined in the U.S. EPA Functional Guidelines for Evaluating Organic Analyses.

I. Holding Times

All samples were extracted and analyzed within 14 days. Therefore, all samples met holding time QC acceptance criteria.

III. Initial Calibration

All percent RSDs were within the QC control limits of ±30 percent, thereby meeting initial calibration QC acceptance criteria.

IV. Continuing Calibration

All percent differences were within the QC control limits of ±15 percent, thereby meeting continuing calibration QC acceptance criteria.

V. Blanks

The method blank associated with this analytical batch was free of contaminants, thereby meeting QC acceptance criteria.

VI. System Monitoring Compounds (Surrogates)

All surrogate spike recoveries were within the QC control limits of 50 to 120 percent, thereby meeting QC acceptance criteria.

VII. Matrix Spike/Matrix Spike Duplicates

The MS/MSD recoveries were within the QC control limits of 61 to 145 percent and RPDs were within the QC control limits of ±14, thereby meeting QC acceptance criteria for both accuracy and precision.

XI. Target Compound Identification

Target compounds were reported only when retention times were within their specified windows. JP-4 results for samples SL04S12A, SL04S12AA, and SL04S12N were flagged with an "X" because sample JP-4 chromatograms did not match standard JP-4 chromatograms. JP-4 results for these samples were qualified as non-detects and the original "X" qualifier was replaced with a "J".

XII. Compound Quantitation and Reported Detection Limits

All sample results were calculated correctly, thereby meeting compound quantitation acceptance criteria. All sample results were reported correctly and all results were correctly adjusted for percent moisture. Detection limits were raised for samples SL04S12A (108-fold), SL04S12AA (143-fold), and SL04S12N (4-fold) due to the presence of interferents in the samples.

All TFH gasoline analyses were calculated incorrectly because Method 8015 was used instead of ADEC Method AK 102. The retention time windows and type of calibration standards used differed when compared to the ADEC method. TFH diesel results could not be recalculated because the chromatographic peaks from Method 8015 and the ADEC method did not match. Consequently, a new retention time window could not be established. Because the ADEC-defined retention time window is larger than the original retention time, it is expected that TFH diesel results are biased low. This only affects results reported above the detection limit. Therefore, SL04S12A, SL04S12AA, SL04S12N, SL04S12NA, and SL04S12ND were qualified as biased low and flagged with an "L".

XV. System Performance

Chromatograms for each sample analysis and instrument performance were considered acceptable.

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Appendix J

AQUATIC SURVEY DATA

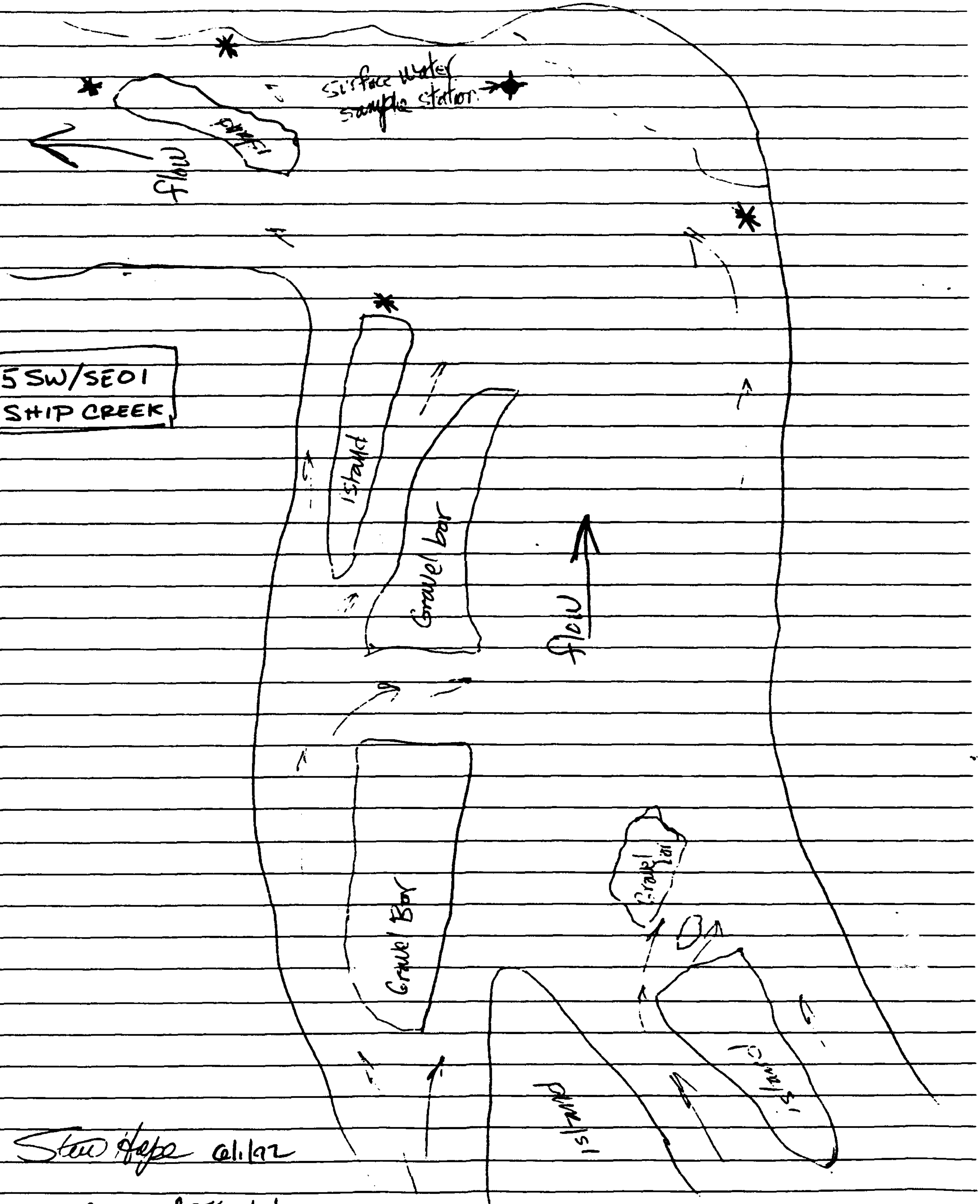
Maps of Sampling Locations
Field Survey Data
Quantitative Results For Macroinvertebrate Surveys
Rapid Bioassessment Protocol 1 Data—Spring 1992
Rapid Bioassessment Protocol 1 Data—Late Summer 1992

MAPS OF SAMPLING LOCATIONS

- Appra. 1000 ft. upstream of Ft. Richardson - EAFB boundary

* = Sediment sample sites
✦ = SW sample site

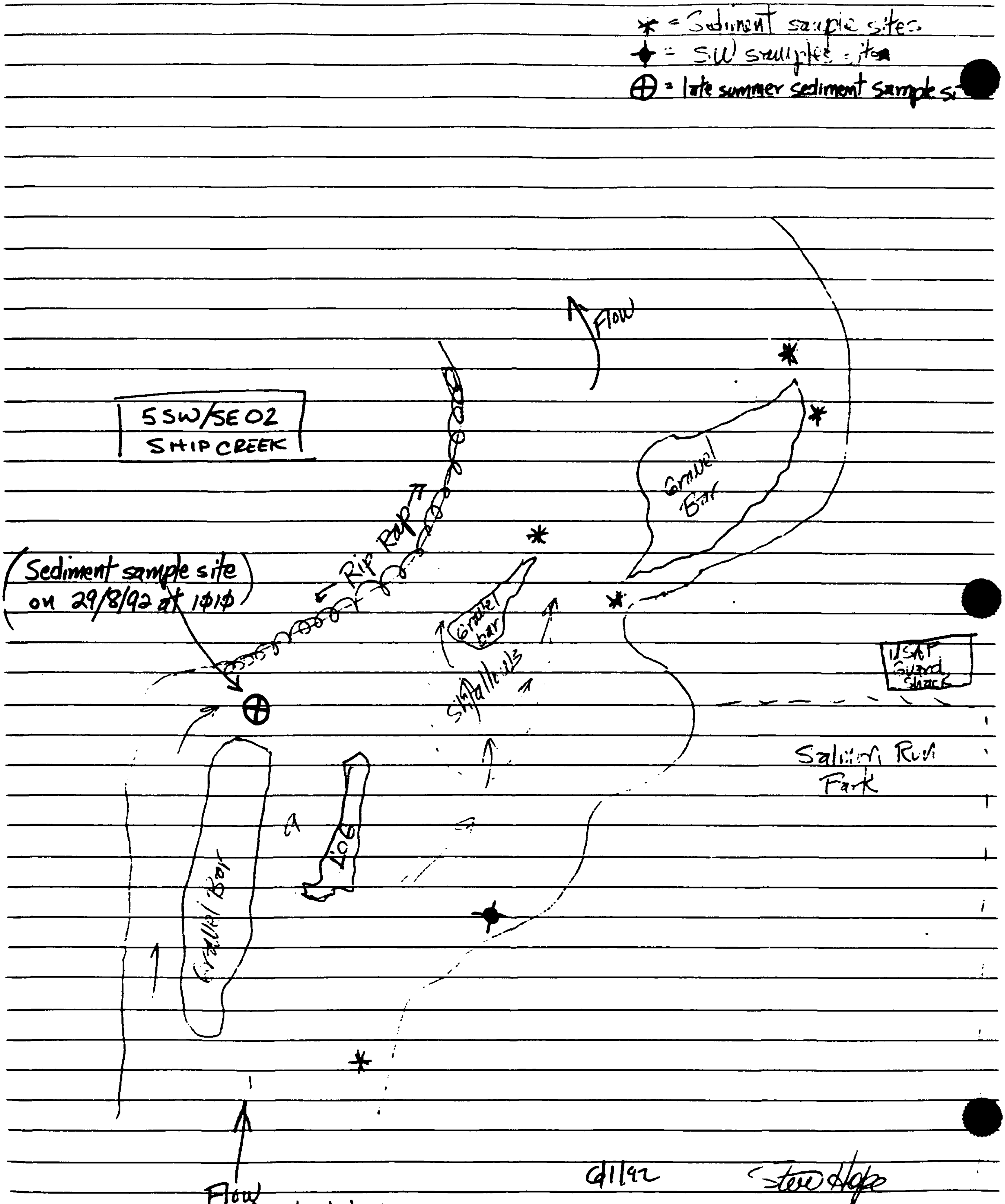
Elmendorf OU5



Steve Hope 6/1/92

QC check JCK 8/4/92

Elmendorf OU5

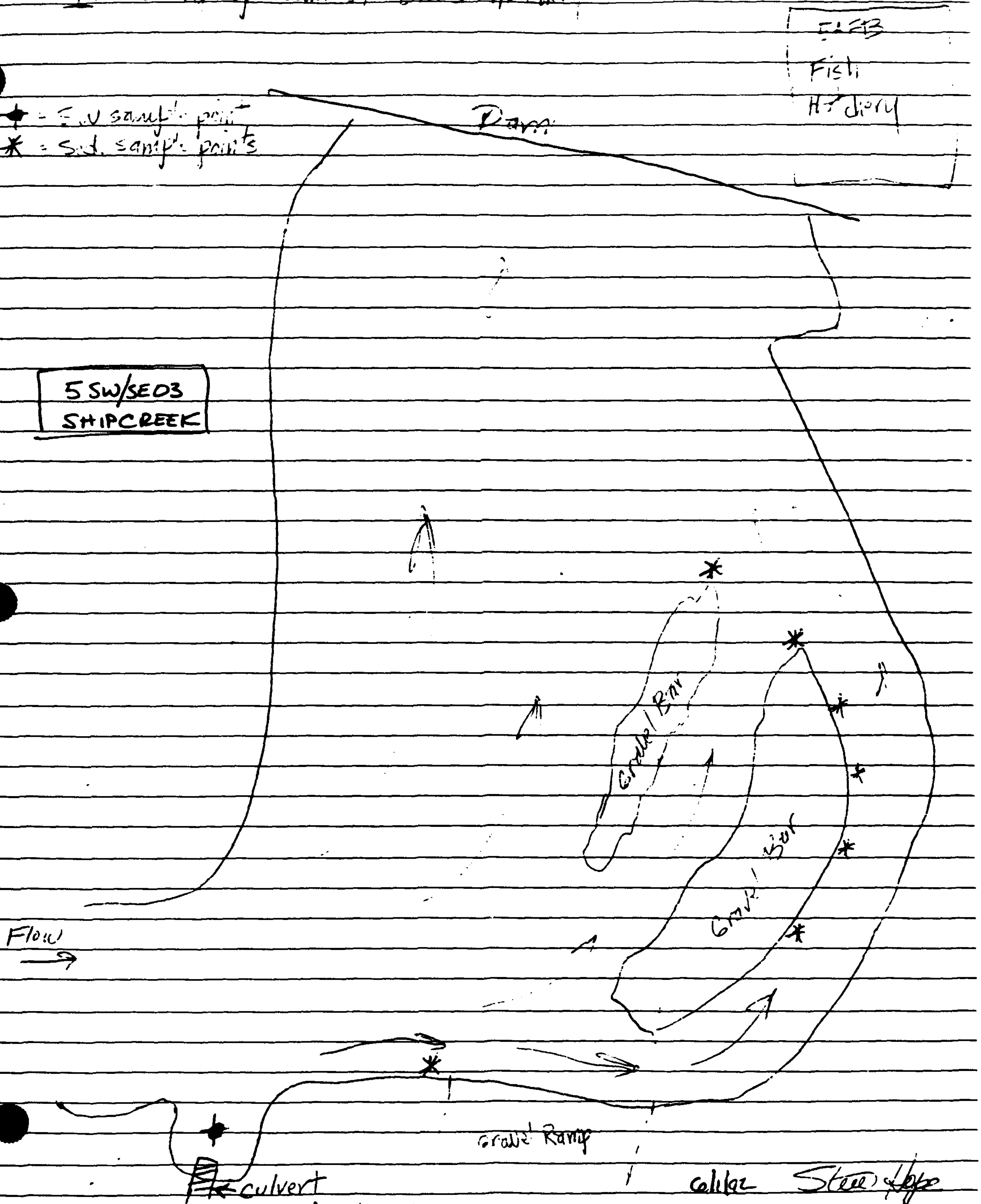


9/1/92 Steve Hope

QC check NCK 8/4/92

Elmendorf OU5

- Immediately upstream of EAFB Hatchery



6/1/92 Steve Hope

QC check DCK 8/4/92

ANL 31026.H2.20 Map of 5SW-SE04 (Southern end of Beaver Pond) 6/3/92

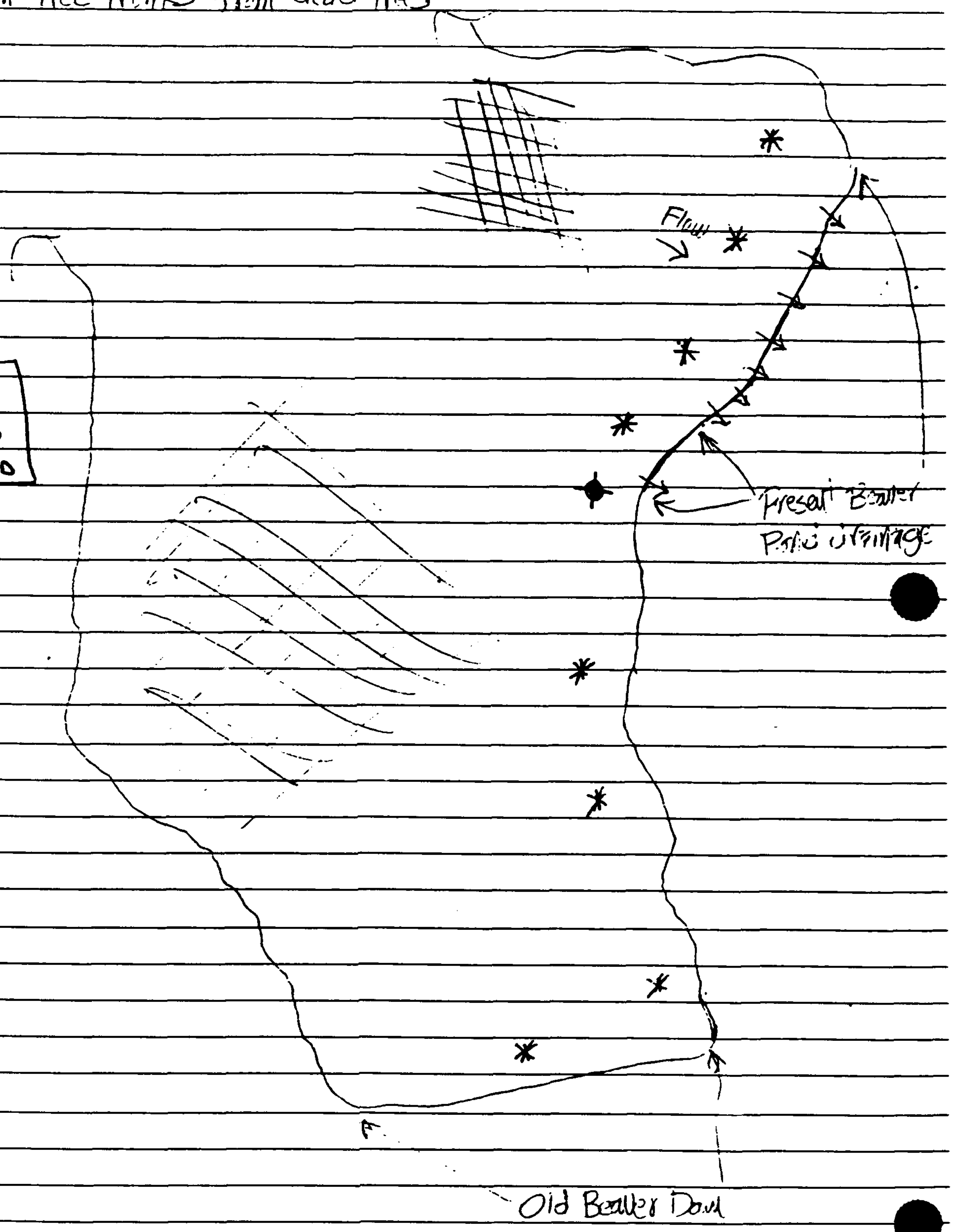
pg 21

● = SW sample point

✱ = Sediment sample point

= Remnant tree trunks from dead trees

5SW/SE04
SOUTHERN END
OF BEAVER POND

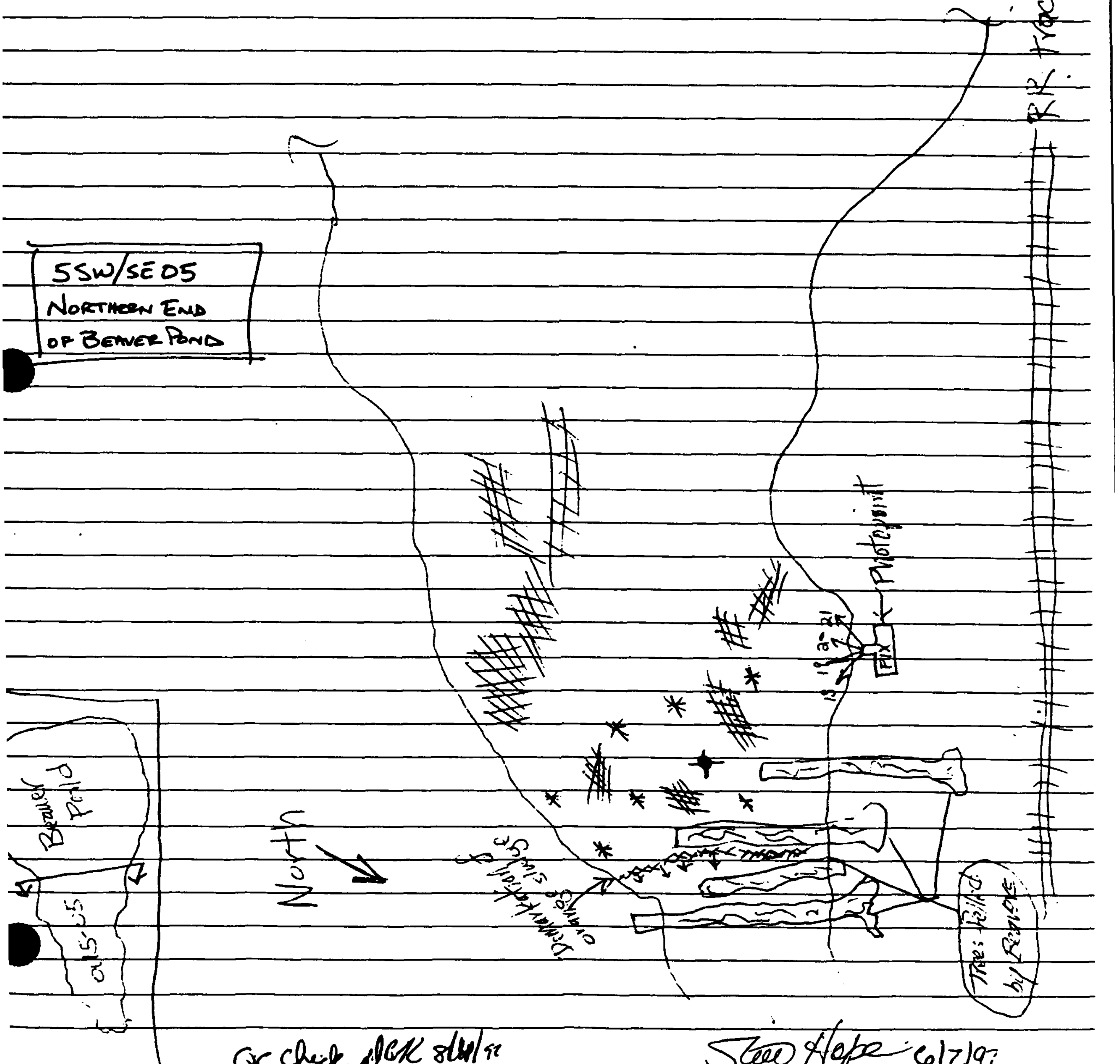


6/3/92 Steve Hope

QC check DCK 8/4/92

✦ = SW sample point
* = Sediment sample point

\# = Prominent tree trunks from dead trees (1 to 6" diameters)



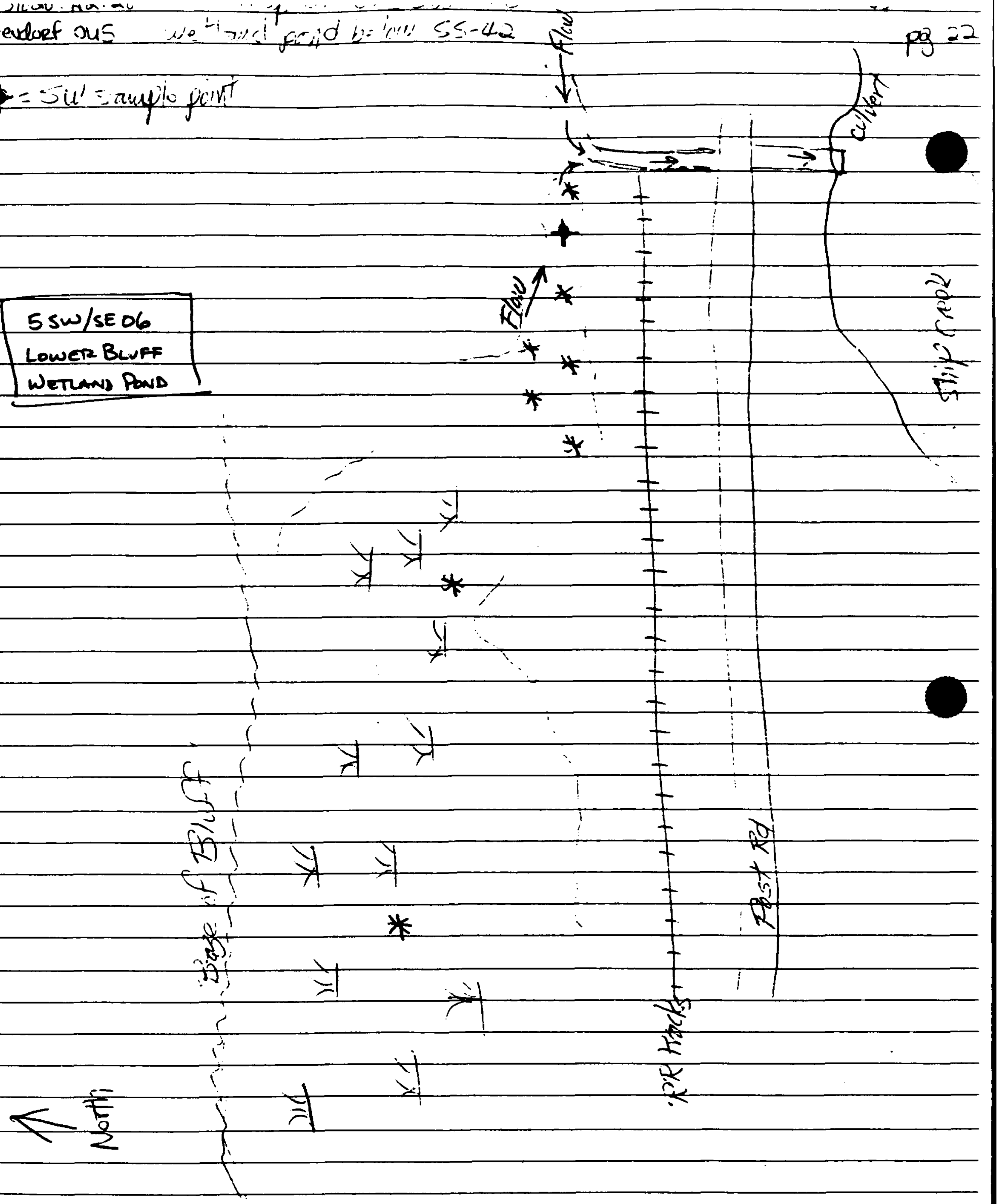
QC Check DGK 8/11/92

Steve Hope 6/2/92

Elmendorf OU5 wetland pond below SS-42 pg 22

◆ = SW sample point

5SW/SE06
LOWER BLUFF
WETLAND POND



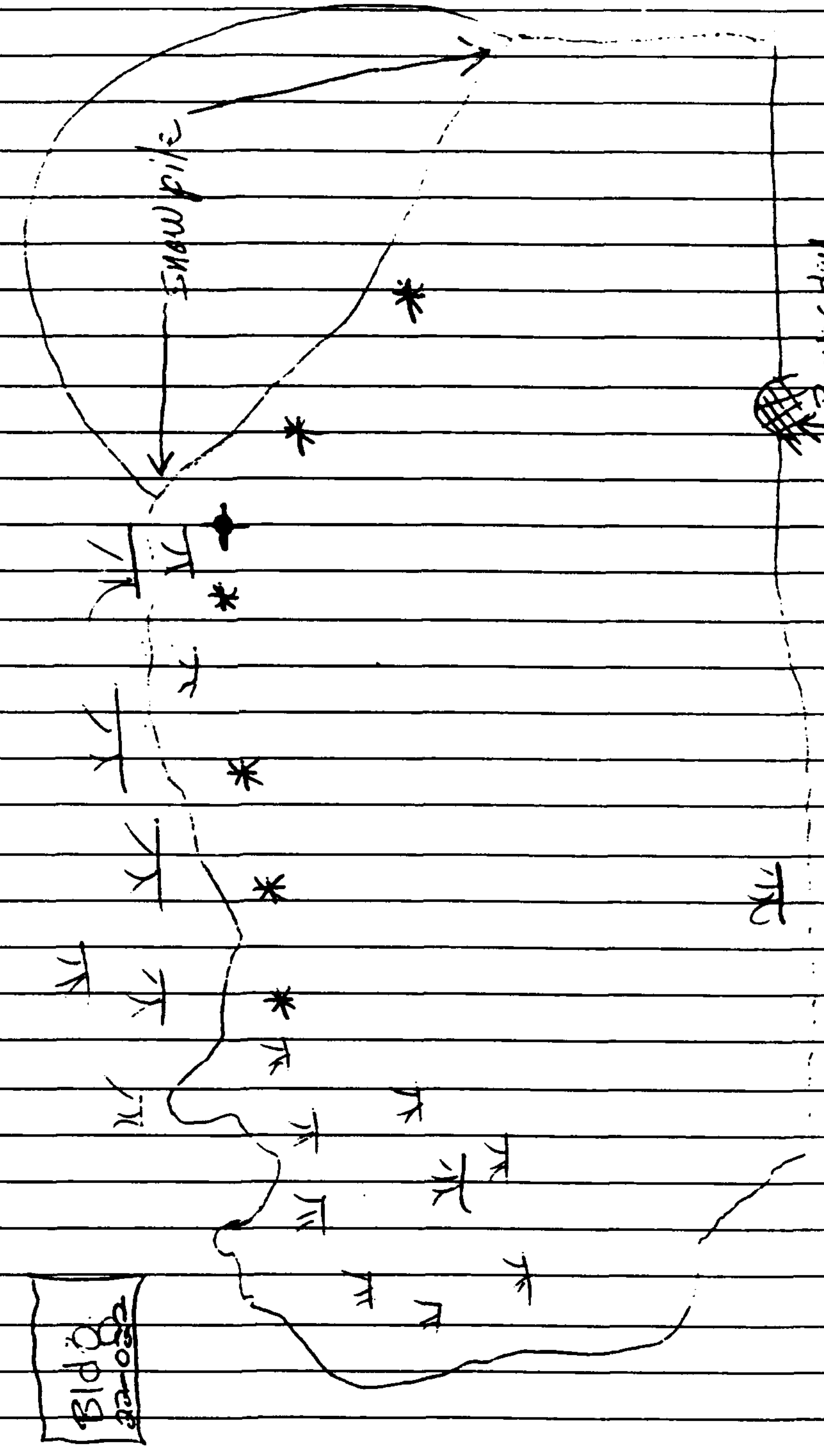
Steve Hopo 6/3/97

QC check DCK 8/4/92

Old Beaver Pond below ST-38 & Snow disposal pile

✦ = SW sample point
✱ - Sediment sample points

5SW/SE07
LOWER BLUFF
BEAVER POND/SNOW
DISPOSAL AREA

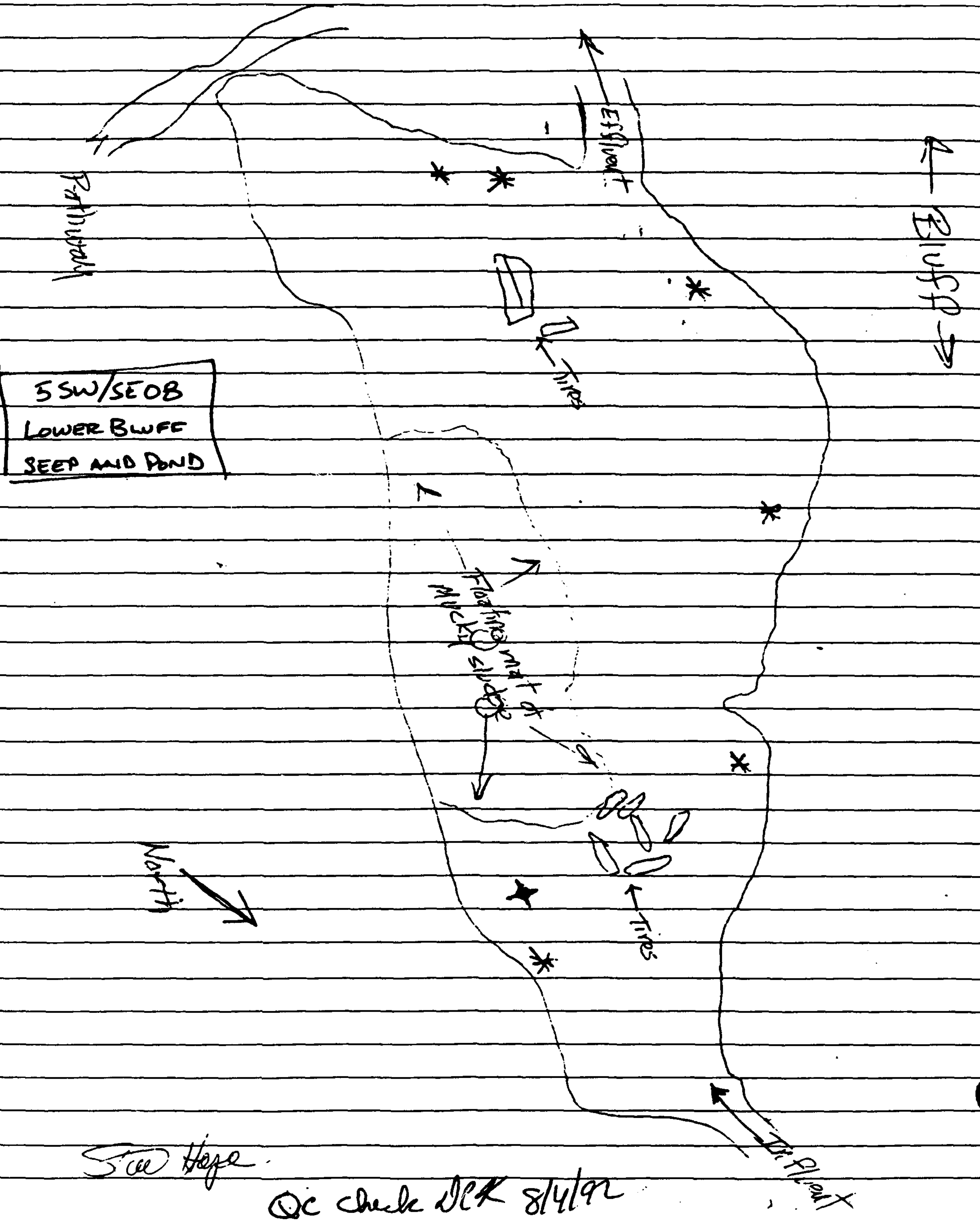


6/3/92 Steve Hope

QC check NCK 8/4/92

UC31026.H2.20 Map of [illegible]
(Find below ST-37 and adjacent to seep SL-C5) Pg 24

Elmendorf OU5
✚ = SW sample point
✱ = Sediment sample points

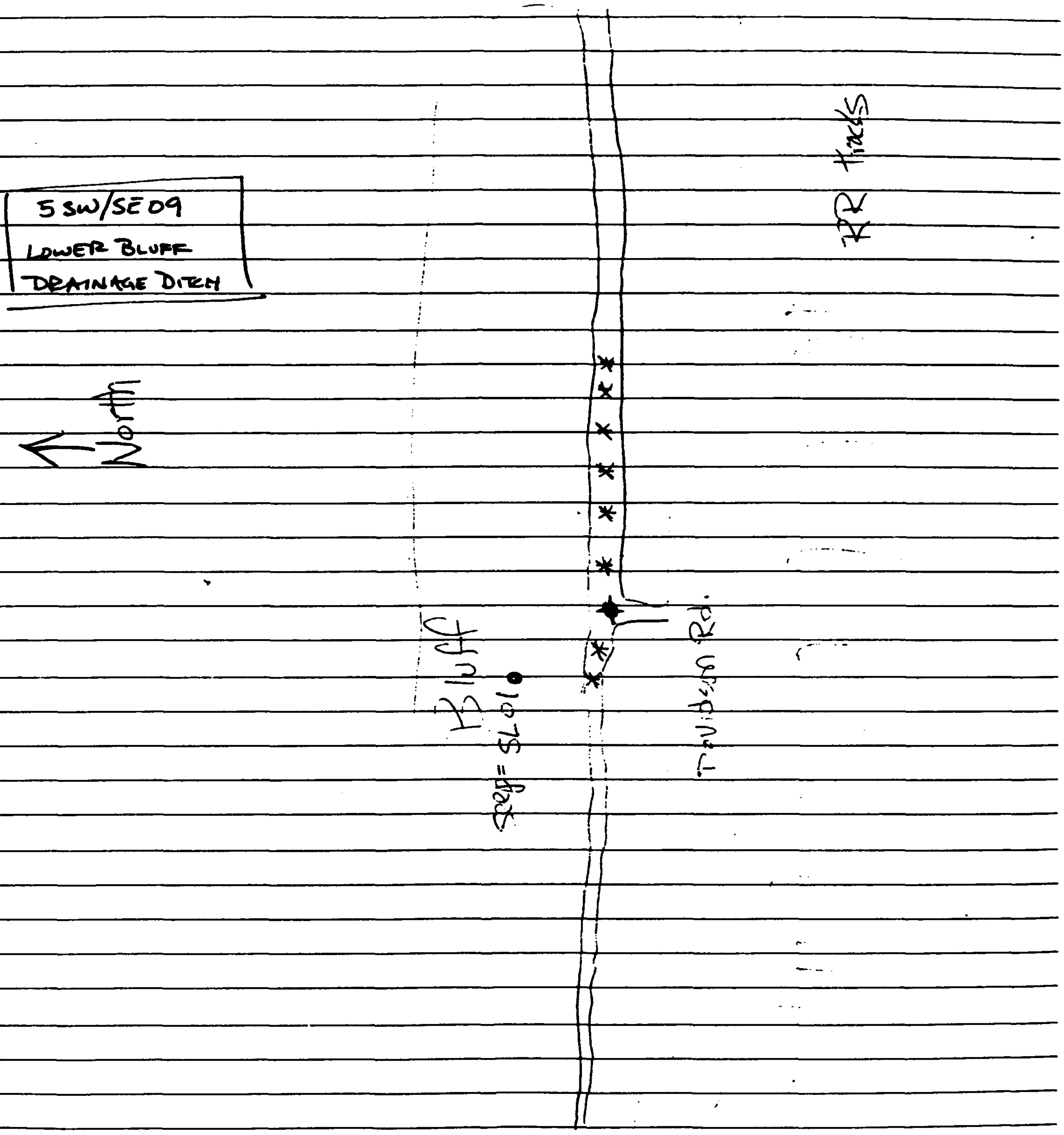


Sue Hope

QC check DCK 8/4/92

ANC 31626.02.20 Map of OU5-09T (Toxicity test sample station pg 25
Elmendorf OU5

✦ = SW sample point
✱ = Sed " points



QC check DCK. 8/4/92

FIELD SURVEY DATA

TABLE J.1. Physical Measurements Observed in Ship Creek-1992 (Spring and Fall)

	Stations				
	5 MI01	5 MI02	5 MI03	5 MI11	5 MI12
Riparian Zone/Water					
Predominant Surrounding Land Use	Forest/Wetland	Commercial	Commercial	Industrial	Commercial
High Water Mark (m)	0.5-1	0.5-1	0.5-1	1	0.5-1
Canopy Cover	Open	Open	Open	Open	
River Width (m)	39	30	25	10	23
River Depth (m)	0.5 (avg)	0.5 (avg)	0.5 (avg)	0.5 (avg)	0.5 (avg)
Undercut Banks	Present	Present	Present	Present	Present
Sediment/Substrate					
Sediment Odors	Normal	Normal	Normal	Normal	Normal
Sediment Oils	Absent	Absent	Absent	Absent	Absent
Sediment Deposits	Some sand	Some sand	Some sand	Some sand	Some sand
Inorganic Substrate Components (%)					
Cobble	10	5	10	10	70
Gravel	80	80	80	80	25
Sand	<10	<15	<10	10	5
Silt	<1	<1	<1	0	0
Organic Substrate Components (%)					
Detritus (CPOM)	>90	100	100	100	100
Muck-Mud (FPOM)	<10	0	0	0	0

TABLE J.2. Water Quality Measurements (In Situ) Taken In Ship Creek-1992

Station	Sampling Period	DO (mg/L)	Temp (°C)	Cond (umhos/cm)	pH
5 MI01	Spring	12.8	5.6	58	6.4
	Fall	11.1	8.5	89	7.4
5 MI02	Spring	12.8	7.3	70	6.6
	Fall	10.2	10.0	109	7.1
5 MI03	Spring	12.8	7.2	99	6.7
	Fall	8.7	8.7	110	7.1
5 MI11	Spring	NS	NS	NS	NS
	Fall	8.9	9.0	390	7.7
5 MI12	Spring	NS	NS	NS	NS
	Fall	11.1	8.3	101	7.3

TABLE J.3. Habitat Assessment, Ship Creek-Station 5 MI01

Habitat Parameter	Category							
	Excellent		Good		Fair		Poor	
	S	(F)	S	(F)	S	(F)	S	(F)
Substrate								
Bottom substrate/available cover		(18)	15					
Embeddedness		(18)	15					
Flow/velocity	20	(18)						
Channel Morophology								
Channel alteration	14	(12)						
Bottom scouring and deposition			10	(10)				
Pool/riffle, run/bend ratio	12	(15)						
Bank Structure								
Bank stability		(9)	8					
Bank vegetation	9	(10)						
Streamside cover			8			(5)		
Column totals	55	(100)	56	(10)				

Total Score 111 (115)

S = Spring
(F) = Fall

TABLE J.3. (Cont'd)
Habitat Assessment, Ship Creek-Station 5 MI02

Habitat Parameter	Category							
	Excellent		Good		Fair		Poor	
	S	(F)	S	(F)	S	(F)	S	(F)
Substrate								
Bottom substrate/available cover	18	(16)						
Embeddedness			13	(13)				
Flow/velocity	17	(15)						
Channel Morophology								
Channel alteration	13	(13)						
Bottom scouring and deposition		(13)	9					
Pool/riffle, run/bend ratio			10	(11)				
Bank Structure								
Bank stability			7	(8)				
Bank vegetation			7	(8)				
Streamside cover			7			(5)		
Column totals	48	(57)	53	(40)		(5)		

Total Score 101 (102)

S = Spring
(F) = Fall

TABLE J.3. (Cont'd)
Habitat Assessment, Ship Creek-Station 5 MI03

Habitat Parameter	Category							
	Excellent		Good		Fair		Poor	
	S	(F)	S	(F)	S	(F)	S	(F)
Substrate								
Bottom substrate/available cover	16			(15)				
Embeddedness	16			(15)				
Flow/velocity	18	(16)						
Channel Morophology								
Channel alteration	13	(13)						
Bottom scouring and deposition			8	(11)				
Pool/riffle, run/bend ratio			9	(10)				
Bank Structure								
Bank stability				(8)	5			
Bank vegetation			8	(8)				
Streamside cover			8			(4)		
Column totals	63	(29)	33	(67)	5	(4)		

Total Score 101 (100)

S = Spring
(F) = Fall

TABLE J.3. (Cont'd)
Habitat Assessment, Ship Creek-Station 5 MI11

Habitat Parameter	Category							
	Excellent		Good		Fair		Poor	
	S	(F)	S	(F)	S	(F)	S	(F)
Substrate								
Bottom substrate/available cover				(11)				
Embeddedness						(10)		
Flow/velocity						(10)		
Channel Morophology								
Channel alteration						(7)		
Bottom scouring and deposition				(11)				
Pool/riffle, run/bend ratio				(10)				
Bank Structure								
Bank stability						(5)		
Bank vegetation						(5)		
Streamside cover						(5)		
Column totals				(32)		(42)		

Total Score (74)

S = Spring (no assessment)
(F) = Fall

TABLE J.3. (Cont'd)
Habitat Assessment, Ship Creek-Station 5 MI12

Habitat Parameter	Category							
	Excellent		Good		Fair		Poor	
	S	(F)	S	(F)	S	(F)	S	(F)
Substrate								
Bottom substrate/available cover				(15)				
Embeddedness				(15)				
Flow/velocity		(15)						
Channel Morophology								
Channel alteration		(14)						
Bottom scouring and deposition				(11)				
Pool/riffle, run/bend ratio				(11)				
Bank Structure								
Bank stability				(8)				
Bank vegetation		(9)						
Streamside cover				(6)				
Column totals		(38)		(66)				

Total Score (104) S = Spring (no assessment)
(F) = Fall

TABLE J.4. Physical Characteristics, Beaver Pond-1992

	Stations	
	5 MI04	**5 MI05**
Riparian Zone/Water		
Predominant Surrounding Land Uses	Commercial[1]	Commercial[1]
Dam Present (Beaver)	Yes	Yes
Canopy Cover	Open	Open
Sediment/Substrate		
Sediment Odors	Normal	Petroleum
Sediment Oils	Slight	Moderate
Sediment Deposits	None	Detritus/sand
Inorganic Substrate Components (%)		
Gravel	20	
Sand	50	10
Silt	20	90
Clay	10	
Organic Substrate Components (%)		
Detritus (CPOM)[2]	20	80
Muck-Mud (FPOM)[3]	80	20

[1] Railroad grade to the north; golf course to the south

[2] Coarse particulate organic matter

[3] Fine particulate organic matter

TABLE J.5. Physical Characteristics, Seeps and Pools-1992

	Stations		
	5 MI06	**5 MI07**	**5 MI08**
Riparian Zone / Water			
Predominant Surrounding Land Uses	Commercial[1]	Commercial[1]	Commercial[1]
Canopy Cover	Shaded	Open	Shaded
Sediment / Substrate			
Sediment Odors	Petroleum	None	Petroleum
Sediment Oils	None	None	None
Sediment Deposits	Iron bacteria	None	Detritus
Inorganic Substrate Components (%)[2]			
Gravel		10	
Sand	10	80	
Silt	80	10	90
Clay	10		10
Organic Substrate Components (%)[2]			
Detritus (CPOM)[2]	80	10	90
Muck-Mud (FPOM)[3]	20	90[3]	10

[1] Alaskan Railroad tracks and yard to south of these sites; Air Force to the north

[2] Qualitative assessment

[3] Very little organic material present; that present was FPOM

TABLE J.6. Water Quality Measurements and Qualitative Assessments Seeps and Pools—1992

Parameters	Sampling Period	Stations		
		5 MI06	5 MI07	5 MI08
D.O. (mg/L)	Spring	4.5	9.6	2.8
Temperature (°C)	Spring	10.0	14.0	12.5
Conductivity (umhoes/cm)	Spring	382	425	435
pH	Spring	6.9	7.1	7.0
Water odors		Petroleum	None	Petroleum
Water surface oils		Sheen	None	None

QUANTITATIVE RESULTS FOR MACROINVERTEBRATE SURVEYS

1. Aquatic Benthic Macroinvertebrates from Station 1, Elmendorf Air Force

5/28/92

SPECIES	STA 1 REP1	STA 1 REP2	STA 1 REP3	STA 1 TOTAL
NEMATODA				
ANNELIDA				
Oligochaeta				
Lumbriculidae	4		1	5
Kincaidiana hexatheca				
Lumbriculus sp.				
Niadidae				
Nais sp.	2	18	21	41
Nais communis				
Nais cf.simplex				
Pristinella sp.				
Slavina appendiculata				
Stylaria lacustris				
Tubificidae w.h.c.				
Tubificidae w.o.h.c.				
Limnodrilus sp.				
Limnodrilus cf. hoffmeisteri				
Rhyacodrilus montana				
PLATYHELMINTHES				
Turbellaria				
Tricladida				
ARTHOPODA				
Arachnoidea				
Hydracarina				
Crustacea				
Amphipoda				
Talitridae				
Hyalella azteca				
Cladocera				
Daphnidae				
Daphnia cf. pulex				
Copepoda				
Cyclopoida				
Ostracoda				
Insecta				
Ephemeroptera				
Baetidae				
Baetis sp.	1	2	1	4
Ephemerellidae				
Drunella doddsi	1		1	2
Ephemerella inermis				
Heptageniidae				
Cinygmula sp.			1	1
Epeorus sp.	4	1		5
Stenonema sp.				

SPECIES	STA 1 REP1	STA 1 REP2	STA 1 REP3	STA 1 TOTAL
Plecoptera				
Choroperlidae				
Suwallia sp.	3		3	6
Nemouridae				
Zapada sp.				
Perlodidae				
Isoperla sp.				
Heteroptera				
Corixidae				
Arctocorisa sp.				
Corisella sp.				
Trichoptera				
Glossosomatidae				
Glossosoma sp.				
Hydropsychidae				
Cheumatopsyche sp.				
Limnephilidae				
Ecclisomyia sp.				
Nemotaulius hostilis				
Rhyacophilidae				
Rhyacophila sp.			1	1
Diptera				
Ceratopogonidae				
Bezzia/Palpomyia sp. gp.	1			1
Chironomidae	8	11		19
Brillia sp.				
Cardiocladius sp.				
Chaetocladius sp.				
Chironominae A				
Chironomus sp.				
Cricotopus sp.	5	8	1	14
Diamesa sp.		1	4	5
Dicrotendipes sp.				
Diplocladius cultriger				
Eukiefferiella sp.				
Eukiefferiella cf. claripennis sp.gp.				
Eukiefferiella gracei sp.gp.	1	2	2	5
Glyptotendipes sp.				
Orthocladiinae A				
Orthocladiinae B				
Orthocladius sp.	2	3		5
Pagastia sp.	2			2
Pagastiella sp.				
Paramerina sp.				
Paracladopelma sp.				
Parakiefferiella bathophila				
Paratanytarsus sp.				
Phaenopsectra sp.				
Polypedilum sp.				
Polypedilum cf. convictum				
Potthastia sp.				
Procladius sp.				
Prodiamesa sp.				

SPECIES	STA 1 REP1	STA 1 REP2	STA 1 REP3	STA 1 TOTAL
Psectrocladius sp.				
Psectrotanypus sp.				
Rheocricotopus sp.				
Rheotanytarsus sp.				
Synorthocladius semivirens				
Tanypus sp.				
Tanytarsus sp.				
Tvetenia bavarica sp.gp.	1			1
Empididae				
Chelifera sp.				
Muscidae				
Limnophora sp.				
Psychodidae				
Pericoma sp.				
Simuliidae				
Cnephia sp.			1	1
Tipulidae				
Dicranota sp.				
Ormosia sp.				
Coleoptera				
Dytiscidae				
Acililus sp.				
Dytiscus sp.				
MOLLUSCA				
Gastropoda				
Planorbidae			1	1
Gyraulus (Torquis) sp.				
Pelecypoda				
Sphaeriidae				
Pisidium milium				
TOTAL NUMBER OF ORGANISMS	35	46	38	119
TOTAL NUMBER OF SPECIES	13	8	12	18

Table 2. Aquatic Benthic Macroinvertebrates from Station 1, Elmendorf Air Force Base, 9/01/92.

SPECIES	STA 1 REP1	STA 1 REP2	STA 1 REP3	STA 1 TOTAL
NEMATODA				
ANNELIDA				
Oligochaeta				
Lumbriculidae	18	1	7	26
Kincaidiana hexatheca	1			1
Lumbriculus sp.				
Niadidae				
Nais sp.	2	2		4
Nais communis				
Nais cf.simplex				
Pristinella sp.				
Slavina appendiculata				
Stylaria lacustris				
Tubificidae w.h.c.				
Tubificidae w.o.h.c.	1		2	3
Limnodrilus sp.				
Limnodrilus cf. hoffmeisteri				
Rhyacodrilus montana				
PLATYHELMINTHES				
Turbellaria				
Tricladida			1	1
ARTHOPODA				
Arachnoidea				
Hydracarina	1	1	1	3
Crustacea				
Amphipoda				
Talitridae				
Hyalella azteca				
Cladocera				
Daphnidae				
Daphnia cf. pulex				
Copepoda				
Cyclopoida				
Ostracoda				
Insecta				
Ephemeroptera				
Baetidae				
Baetis sp.			3	3
Ephemerellidae				
Drunella doddsi	99	69	34	202
Ephemerella inermis			6	6
Heptageniidae				
Cinygmula sp.	13	9	6	28
Epeorus sp.	42	23	26	91
Stenonema sp.				
Plecoptera				
Choroperlidae				
Suwallia sp.				

Table 2. Aquatic Benthic Macroinvertebrates from Station 1, Elmendorf Air Force Base, 9/01/92.

Nemouridae				
Zapada sp.				
Perlodidae				
Isoperla sp.			1	1
Heteroptera				
Corixidae				
Arctocorisa sp.				
Corisella sp.				
Trichoptera				
Glossosomatidae				
Glossosoma sp.	21	12	23	56
Hydropsychidae				
Cheumatopsyche sp.	1			1
Limnephilidae				
Ecclisomyia sp.	1			1
Nemotaulius hostilis				
Rhyacophilidae				
Rhyacophila sp.				
Diptera				
Ceratopogonidae				
Bezzia/Palpomyia sp. gp.	1			1
Chironomidae	3	1		4
Brillia sp.				
Cardiocladius sp.	1			1
Chaetocladius sp.				
Chironominae A				
Chironomus sp.				
Cricotopus sp.				
Diamesa sp.				
Dicrotendipes sp.				
Diplocladius cultriger				
Eukiefferiella sp.	1			1
Eukiefferiella cf. claripennis sp.gp.				
Eukiefferiella gracei sp.gp.				
Glyptotendipes sp.				
Orthocladiinae A				
Orthocladiinae B				
Orthocladius sp.				
Pagastia sp.	2		5	7
Pagastiella sp.				
Paramerina sp.				
Paracladopelma sp.				
Parakiefferiella bathophila				
Paratanytarsus sp.				
Phaenopsectra sp.				
Polypedilum sp.				
Polypedilum cf. convictum				
Potthastia sp.				
Procladius sp.				
Prodiamesa sp.				
Psectrocladius sp.				
Psectrotanypus sp.				
Rheocricotopus sp.				
Rheotanytarsus sp.				
Synorthocladius semivirens				

Table 2. Aquatic Benthic Macroinvertebrates from Station 1, Elmendorf Air Force Base, 9/01/92.

Tanypus sp.				
Tanytarsus sp.				
Tvetenia bavarica sp.gp.				
Empididae				
Chelifera sp.			1	1
Muscidae		1		1
Limnophora sp.				
Psychodidae				
Pericoma sp.				
Simuliidae				
Cnephia sp.	4	1	3	8
Tipulidae				
Dicranota sp.				
Ormosia sp.				
Coleoptera				
Dytiscidae				
Acililus sp.				
Dytiscus sp.				
MOLLUSCA				
Gastropoda				
Planorbidae				
Gyraulus (Torquis) sp.				
Pelecypoda				
Sphaeriidae				
Pisidium milium				
TOTAL NUMBER OF ORGANISMS	212	120	119	451
TOTAL NUMBER OF SPECIES	17	10	14	23

Table 3. Aquatic Benthic Macroinvertebrates from Station 2, Elmendorf Air Force Base, 5/29/92.

SPECIES	STA 2 REP1	STA 2 REP2	STA 2 REP3	STA 2 TOTAL
NEMATODA				
ANNELIDA				
Oligochaeta				
Lumbriculidae	1	10	4	15
Kincaidiana hexatheca				
Lumbriculus sp.				
Niadidae				
Nais sp.	2	23	22	47
Nais communis				
Nais cf.simplex				
Pristinella sp.				
Slavina appendiculata				
Stylaria lacustris				
Tubificidae w.h.c.				
Tubificidae w.o.h.c.				
Limnodrilus sp.				
Limnodrilus cf. hoffmeisteri				
Rhyacodrilus montana				
PLATYHELMINTHES				
Turbellaria				
Tricladida				
ARTHOPODA				
Arachnoidea				
Hydracarina			2	2
Crustacea				
Amphipoda				
Talitridae				
Hyalella azteca				
Cladocera				
Daphnidae				
Daphnia cf. pulex				
Copepoda				
Cyclopoida				
Ostracoda				
Insecta				
Ephemeroptera				
Baetidae				
Baetis sp.		3	7	10
Ephemerellidae				
Drunella doddsi	1		5	6
Ephemerella inermis				
Heptageniidae				
Cinygmula sp.			2	2
Epeorus sp.		2		2
Stenonema sp.				
Plecoptera				
Choroperlidae				
Suwallia sp.			1	1

Table 3. Aquatic Benthic Macroinvertebrates from Station 2, Elmendorf Air Force Base, 5/29/92.

Nemouridae				
Zapada sp.				
Perlodidae				
Isoperla sp.				
Heteroptera				
Corixidae				
Arctocorisa sp.				
Corisella sp.				
Trichoptera				
Glossosomatidae				
Glossosoma sp.				
Hydropsychidae				
Cheumatopsyche sp.				
Limnephilidae				
Ecclisomyia sp.				
Nemotaulius hostilis				
Rhyacophilidae				
Rhyacophila sp.				
Diptera				
Ceratopogonidae				
Bezzia/Palpomyia sp. gp.		2		2
Chironomidae	5	4	10	19
Brillia sp.	1			1
Cardiocladius sp.				
Chaetocladius sp.				
Chironominae A				
Chironomus sp.				
Cricotopus sp.	1	5	7	13
Diamesa sp.		2	7	9
Dicrotendipes sp.				
Diplocladius cultriger				
Eukiefferiella sp.				
Eukiefferiella cf. claripennis sp.gp.				
Eukiefferiella gracei sp.gp.	2	5	22	29
Glyptotendipes sp.				
Orthocladiinae A				
Orthocladiinae B				
Orthocladius sp.			2	2
Pagastia sp.			1	1
Pagastiella sp.				
Paramerina sp.				
Paracladopelma sp.				
Parakiefferiella bathophila				
Paratanytarsus sp.				
Phaenopsectra sp.	1			1
Polypedilum sp.				
Polypedilum cf. convictum				
Potthastia sp.				
Procladius sp.				
Prodiamesa sp.				
Psectrocladius sp.				
Psectrotanypus sp.				
Rheocricotopus sp.				
Rheotanytarsus sp.				
Synorthocladius semivirens			1	1

Table 3. Aquatic Benthic Macroinvertebrates from Station 2, Elmendorf Air Force Base, 5/29/92.

Tanypus sp.				
Tanytarsus sp.				
Tvetenia bavarica sp.gp.		5	1	6
Empididae				
Chelifera sp.		3		3
Muscidae				
Limnophora sp.				
Psychodidae				
Pericoma sp.				
Simuliidae				
Cnephia sp.			1	1
Tipulidae				
Dicranota sp.	2		1	3
Ormosia sp.				
Coleoptera				
Dytiscidae				
Acililus sp.				
Dytiscus sp.				
MOLLUSCA				
Gastropoda				
Planorbidae				
Gyraulus (Torquis) sp.				
Pelecypoda				
Sphaeriidae				
Pisidium milium				
TOTAL NUMBER OF ORGANISMS	16	64	96	176
TOTAL NUMBER OF SPECIES	9	11	17	22

Table 4. Aquatic Benthic Macroinvertebrates from Station 2, Elmendorf Air Force Base, 9/01/92.

SPECIES	STA 2 REP1	STA 2 REP2	STA 2 REP3	STA 2 TOTAL
NEMATODA				
ANNELIDA				
Oligochaeta				
Lumbriculidae				
Kincaidiana hexatheca				
Lumbriculus sp.				
Niadidae				
Nais sp.	24	16		40
Nais communis				
Nais cf.simplex				
Pristinella sp.	1			1
Slavina appendiculata				
Stylaria lacustris				
Tubificidae w.h.c.				
Tubificidae w.o.h.c.		2		2
Limnodrilus sp.				
Limnodrilus cf. hoffmeisteri				
Rhyacodrilus montana				
PLATYHELMINTHES				
Turbellaria				
Tricladida				
ARTHOPODA				
Arachnoidea				
Hydracarina				
Crustacea				
Amphipoda				
Talitridae				
Hyalella azteca				
Cladocera				
Daphnidae				
Daphnia cf. pulex				
Copepoda				
Cyclopoida				
Ostracoda				
Insecta				
Ephemeroptera				
Baetidae				
Baetis sp.				
Ephemerellidae				
Drunella doddsi	35	27	13	75
Ephemerella inermis				
Heptageniidae				
Cinygmula sp.				
Epeorus sp.	5	5	1	11
Stenonema sp.				
Plecoptera				
Choroperlidae				
Suwallia sp.				

Table 4. Aquatic Benthic Macroinvertebrates from Station 2, Elmendorf Air Force Base, 9/01/92.

Nemouridae				
Zapada sp.	2	1		3
Perlodidae				
Isoperla sp.				
Heteroptera				
Corixidae				
Arctocorisa sp.				
Corisella sp.				
Trichoptera				
Glossosomatidae				
Glossosoma sp.	45	37	37	119
Hydropsychidae				
Cheumatopsyche sp.				
Limnephilidae				
Ecclisomyia sp.	3			3
Nemotaulius hostilis				
Rhyacophilidae				
Rhyacophila sp.				
Diptera				
Ceratopogonidae				
Bezzia/Palpomyia sp. gp.				
Chironomidae	2	6	3	11
Brillia sp.				
Cardiocladius sp.				
Chaetocladius sp.				
Chironominae A				
Chironomus sp.				
Cricotopus sp.	5	18		23
Diamesa sp.				
Dicrotendipes sp.				
Diplocladius cultriger				
Eukiefferiella sp.				
Eukiefferiella cf. claripennis sp.gp.				
Eukiefferiella gracei sp.gp.		4	1	5
Glyptotendipes sp.				
Orthocladiinae A				
Orthocladiinae B				
Orthocladius sp.				
Pagastia sp.	8	3		11
Pagastiella sp.				
Paramerina sp.				
Paracladopelma sp.				
Parakiefferiella bathophila				
Paratanytarsus sp.				
Phaenopsectra sp.				
Polypedilum sp.				
Polypedilum cf. convictum				
Potthastia sp.		1		1
Procladius sp.				
Prodiamesa sp.				
Psectrocladius sp.				
Psectrotanypus sp.				
Rheocricotopus sp.				
Rheotanytarsus sp.				
Synorthocladius semivirens				

Table 4. Aquatic Benthic Macroinvertebrates from Station 2, Elmendorf Air Force Base, 9/01/92.

Tanypus sp.				
Tanytarsus sp.				
Tvetenia bavarica sp.gp.				
Empididae				
Chelifera sp.				
Muscidae				
Limnophora sp.				
Psychodidae				
Pericoma sp.				
Simuliidae			1	1
Cnephia sp.		1		1
Tipulidae				
Dicranota sp.	2			2
Ormosia sp.				
Coleoptera				
Dytiscidae				
Acililus sp.				
Dytiscus sp.				
MOLLUSCA				
Gastropoda				
Planorbidae				
Gyraulus (Torquis) sp.				
Pelecypoda				
Sphaeriidae				
Pisidium milium				
TOTAL NUMBER OF ORGANISMS	132	121	56	309
TOTAL NUMBER OF SPECIES	11	12	6	16

Table 5. Aquatic Benthic Macroinvertebrates from Station 3, Elmendorf Air Force Base, 5/30/92.

SPECIES	STA 3	STA 3	STA 3	STA 3
	REP1	REP2	REP3	TOTAL
NEMATODA				
ANNELIDA				
Oligochaeta				
Lumbriculidae	8	9	11	28
Kincaidiana hexatheca				
Lumbriculus sp.				
Niadidae				
Nais sp.	50	25	35	110
Nais communis				
Nais cf.simplex				
Pristinella sp.				
Slavina appendiculata				
Stylaria lacustris				
Tubificidae w.h.c.			1	1
Tubificidae w.o.h.c.				
Limnodrilus sp.				
Limnodrilus cf. hoffmeisteri				
Rhyacodrilus montana				
PLATYHELMINTHES				
Turbellaria				
Tricladida				
ARTHOPODA				
Arachnoidea				
Hydracarina				
Crustacea				
Amphipoda				
Talitridae				
Hyalella azteca				
Cladocera				
Daphnidae				
Daphnia cf. pulex				
Copepoda				
Cyclopoida				
Ostracoda				
Insecta				
Ephemeroptera				
Baetidae				
Baetis sp.	5		2	7
Ephemerellidae				
Drunella doddsi	1		3	4
Ephemerella inermis				
Heptageniidae				
Cinygmula sp.				
Epeorus sp.				
Stenonema sp.				
Plecoptera				
Choroperlidae				
Suwallia sp.			4	4

Table 5. Aquatic Benthic Macroinvertebrates from Station 3, Elmendorf Air Force Base, 5/30/92.

Nemouridae				
Zapada sp.	1			1
Perlodidae				
Isoperla sp.			1	1
Heteroptera				
Corixidae				
Arctocorisa sp.				
Corisella sp.				
Trichoptera				
Glossosomatidae				
Glossosoma sp.				
Hydropsychidae				
Cheumatopsyche sp.				
Limnephilidae				
Ecclisomyia sp.				
Nemotaulius hostilis				
Rhyacophilidae				
Rhyacophila sp.				
Diptera				
Ceratopogonidae				
Bezzia/Palpomyia sp. gp.			3	3
Chironomidae	11	3	12	26
Brillia sp.				
Cardiocladius sp.				
Chaetocladius sp.				
Chironominae A				
Chironomus sp.				
Cricotopus sp.	9	5	38	52
Diamesa sp.	5	4	12	21
Dicrotendipes sp.				
Diplocladius cultriger				
Eukiefferiella sp.				
Eukiefferiella cf. claripennis sp.gp.				
Eukiefferiella gracei sp.gp.	23		13	36
Glyptotendipes sp.				
Orthocladiinae A				
Orthocladiinae B				
Orthocladius sp.		5	4	9
Pagastia sp.	3			3
Pagastiella sp.				
Paramerina sp.				
Paracladopelma sp.				
Parakiefferiella bathophila				
Paratanytarsus sp.				
Phaenopsectra sp.				
Polypedilum sp.				
Polypedilum cf. convictum				
Potthastia sp.				
Procladius sp.				
Prodiamesa sp.				
Psectrocladius sp.				
Psectrotanypus sp.				
Rheocricotopus sp.		1		1
Rheotanytarsus sp.				
Synorthocladius semivirens				

Table 5. Aquatic Benthic Macroinvertebrates from Station 3, Elmendorf Air Force Base, 5/30/92.

Tanypus sp.				
Tanytarsus sp.	1		1	2
Tvetenia bavarica sp.gp.	4	2	16	22
Empididae				
Chelifera sp.			6	6
Muscidae				
Limnophora sp.				
Psychodidae				
Pericoma sp.	1			1
Simuliidae				
Cnephia sp.	3			3
Tipulidae				
Dicranota sp.	1	3	1	5
Ormosia sp.				
Coleoptera				
Dytiscidae				
Acililus sp.				
Dytiscus sp.				
MOLLUSCA				
Gastropoda				
Planorbidae				
Gyraulus (Torquis) sp.				
Pelecypoda				
Sphaeriidae				
Pisidium milium				
TOTAL NUMBER OF ORGANISMS	126	57	163	346
TOTAL NUMBER OF SPECIES	15	9	17	22

Table 6. Aquatic Benthic Macroinvertebrates from Station 3, Elmendorf Air Force Base, 8/30/92.

SPECIES	STA 3 REP1	STA 3 REP2	STA 3 REP3	STA 3 TOTAL
NEMATODA				
ANNELIDA				
Oligochaeta				
Lumbriculidae		3		3
Kincaidiana hexatheca				
Lumbriculus sp.				
Niadidae				
Nais sp.	2	10	26	38
Nais communis				
Nais cf.simplex				
Pristinella sp.				
Slavina appendiculata				
Stylaria lacustris				
Tubificidae w.h.c.				
Tubificidae w.o.h.c.				
Limnodrilus sp.				
Limnodrilus cf. hoffmeisteri				
Rhyacodrilus montana				
PLATYHELMINTHES				
Turbellaria				
Tricladida				
ARTHOPODA				
Arachnoidea				
Hydracarina				
Crustacea				
Amphipoda				
Talitridae				
Hyalella azteca				
Cladocera				
Daphnidae				
Daphnia cf. pulex				
Copepoda				
Cyclopoida				
Ostracoda				
Insecta				
Ephemeroptera				
Baetidae				
Baetis sp.			1	1
Ephemerellidae				
Drunella doddsi	15	33	33	81
Ephemerella inermis				
Heptageniidae				
Cinygmula sp.				
Epeorus sp.	8	8	1	17
Stenonema sp.				
Plecoptera				
Choroperlidae				
Suwallia sp.				

Table 6. Aquatic Benthic Macroinvertebrates from Station 3, Elmendorf Air Force Base, 8/30/92.

Nemouridae				
Zapada sp.		1		1
Perlodidae				
Isoperla sp.				
Heteroptera				
Corixidae				
Arctocorisa sp.				
Corisella sp.				
Trichoptera				
Glossosomatidae				
Glossosoma sp.	12	28	14	54
Hydropsychidae				
Cheumatopsyche sp.				
Limnephilidae				
Ecclisomyia sp.			1	1
Nemotaulius hostilis				
Rhyacophilidae				
Rhyacophila sp.				
Diptera				
Ceratopogonidae				
Bezzia/Palpomyia sp. gp.				
Chironomidae	8	5	5	18
Brillia sp.				
Cardiocladius sp.				
Chaetocladius sp.				
Chironominae A				
Chironomus sp.				
Cricotopus sp.	7	11		18
Diamesa sp.				
Dicrotendipes sp.				
Diplocladius cultriger				
Eukiefferiella sp.				
Eukiefferiella cf. claripennis sp.gp.				
Eukiefferiella gracei sp.gp.	10	37	42	89
Glyptotendipes sp.				
Orthocladiinae A				
Orthocladiinae B				
Orthocladius sp.	2		56	58
Pagastia sp.	1	4	8	13
Pagastiella sp.				
Paramerina sp.				
Paracladopelma sp.				
Parakiefferiella bathophila				
Paratanytarsus sp.				
Phaenopsectra sp.				
Polypedilum sp.				
Polypedilum cf. convictum				
Potthastia sp.				
Procladius sp.				
Prodiamesa sp.				
Psectrocladius sp.				
Psectrotanypus sp.				
Rheocricotopus sp.				
Rheotanytarsus sp.				
Synorthocladius semivirens				

Table 6. Aquatic Benthic Macroinvertebrates from Station 3, Elmendorf Air Force Base, 8/30/92.

Tanypus sp.				
Tanytarsus sp.				
Tvetenia bavarica sp.gp.				
Empididae				
Chelifera sp.				
Muscidae				
Limnophora sp.				
Psychodidae				
Pericoma sp.				
Simuliidae				
Cnephia sp.	4	2	5	11
Tipulidae				
Dicranota sp.				
Ormosia sp.				
Coleoptera				
Dytiscidae				
Acililus sp.				
Dytiscus sp.				
MOLLUSCA				
Gastropoda				
Planorbidae				
Gyraulus (Torquis) sp.				
Pelecypoda				
Sphaeriidae				
Pisidium milium				
TOTAL NUMBER OF ORGANISMS	69	142	192	403
TOTAL NUMBER OF SPECIES	10	11	11	14

Table 7. Aquatic Benthic Macroinvertebrates from Station 11, Elmendorf Air Force Base, 9/04/92.

SPECIES	STA 11	STA 11	STA 11	STA 11
	REP1	REP2	REP3	TOTAL
NEMATODA				
ANNELIDA				
Oligochaeta				
Lumbriculidae	3	3		6
Kincaidiana hexatheca				
Lumbriculus sp.				
Niadidae				
Nais sp.	51	25		76
Nais communis				
Nais cf.simplex				
Pristinella sp.				
Slavina appendiculata				
Stylaria lacustris				
Tubificidae w.h.c.				
Tubificidae w.o.h.c.		3	22	25
Limnodrilus sp.		1	6	7
Limnodrilus cf. hoffmeisteri				
Rhyacodrilus montana				
PLATYHELMINTHES				
Turbellaria				
Tricladida				
ARTHOPODA				
Arachnoidea				
Hydracarina		2		2
Crustacea				
Amphipoda				
Talitridae				
Hyalella azteca				
Cladocera				
Daphnidae				
Daphnia cf. pulex				
Copepoda				
Cyclopoida				
Ostracoda				
Insecta				
Ephemeroptera				
Baetidae				
Baetis sp.				
Ephemerellidae				
Drunella doddsi		3	1	4
Ephemerella inermis		1		1
Heptageniidae				
Cinygmula sp.				
Epeorus sp.				
Stenonema sp.				
Plecoptera				
Choroperlidae				
Suwallia sp.				

Table 7. Aquatic Benthic Macroinvertebrates from Station 11, Elmendorf Air Force Base, 9/04/92.

Nemouridae				
Zapada sp.		1		1
Perlodidae				
Isoperla sp.				
Heteroptera				
Corixidae				
Arctocorisa sp.				
Corisella sp.				
Trichoptera				
Glossosomatidae				
Glossosoma sp.		26		26
Hydropsychidae				
Cheumatopsyche sp.				
Limnephilidae				
Ecclisomyia sp.		2		2
Nemotaulius hostilis	1			1
Rhyacophilidae				
Rhyacophila sp.				
Diptera				
Ceratopogonidae				
Bezzia/Palpomyia sp. gp.				
Chironomidae	7	4		11
Brillia sp.	2			2
Cardiocladius sp.				
Chaetocladius sp.				
Chironominae A				
Chironomus sp.				
Cricotopus sp.	19			19
Diamesa sp.				
Dicrotendipes sp.				
Diplocladius cultriger				
Eukiefferiella sp.				
Eukiefferiella cf. claripennis sp.gp.	6			6
Eukiefferiella gracei sp.gp.		19		19
Glyptotendipes sp.				
Orthocladiinae A				
Orthocladiinae B				
Orthocladius sp.		24	4	28
Pagastia sp.		5	1	6
Pagastiella sp.				
Paramerina sp.				
Paracladopelma sp.				
Parakiefferiella bathophila				
Paratanytarsus sp.				
Phaenopsectra sp.				
Polypedilum sp.				
Polypedilum cf. convictum				
Potthastia sp.				
Procladius sp.				
Prodiamesa sp.				
Psectrocladius sp.				
Psectrotanypus sp.				
Rheocricotopus sp.				
Rheotanytarsus sp.				
Synorthocladius semivirens				

Table 7. Aquatic Benthic Macroinvertebrates from Station 11, Elmendorf Air Force Base, 9/04/92.

Tanypus sp.				
Tanytarsus sp.				
Tvetenia bavarica sp.gp.				
Empididae				
Chelifera sp.				
Muscidae				
Limnophora sp.		3		3
Psychodidae				
Pericoma sp.				
Simuliidae				
Cnephia sp.				
Tipulidae				
Dicranota sp.				
Ormosia sp.	1	4		5
Coleoptera				
Dytiscidae				
Acililus sp.				
Dytiscus sp.				
MOLLUSCA				
Gastropoda				
Planorbidae				
Gyraulus (Torquis) sp.				
Pelecypoda				
Sphaeriidae				
Pisidium milium				
TOTAL NUMBER OF ORGANISMS	90	126	34	250
TOTAL NUMBER OF SPECIES	8	16	5	20

Table 8. Aquatic Benthic Macroinvertebrates from Station 12, Elmendorf Air Force Base, 9/05/92.

SPECIES	STA 12 REP1	STA 12 REP2	STA 12 REP3	STA 12 TOTAL
NEMATODA	1			1
ANNELIDA				
Oligochaeta				
Lumbriculidae	15	3		18
Kincaidiana hexatheca				
Lumbriculus sp.				
Niadidae				
Nais sp.	5			5
Nais communis				
Nais cf.simplex				
Pristinella sp.				
Slavina appendiculata				
Stylaria lacustris				
Tubificidae w.h.c.				
Tubificidae w.o.h.c.				
Limnodrilus sp.				
Limnodrilus cf. hoffmeisteri				
Rhyacodrilus montana				
PLATYHELMINTHES				
Turbellaria				
Tricladida				
ARTHOPODA				
Arachnoidea				
Hydracarina				
Crustacea				
Amphipoda				
Talitridae				
Hyalella azteca				
Cladocera				
Daphnidae				
Daphnia cf. pulex				
Copepoda				
Cyclopoida				
Ostracoda				
Insecta				
Ephemeroptera				
Baetidae				
Baetis sp.				
Ephemerellidae				
Drunella doddsi	12	6	4	22
Ephemerella inermis				
Heptageniidae				
Cinygmula sp.				
Epeorus sp.	2	6	1	9
Stenonema sp.				
Plecoptera				
Choroperlidae				
Suwallia sp.				

Table 8. Aquatic Benthic Macroinvertebrates from Station 12, Elmendorf Air Force Base, 9/05/92.

Nemouridae				
Zapada sp.				
Perlodidae				
Isoperla sp.				
Heteroptera				
Corixidae				
Arctocorisa sp.				
Corisella sp.				
Trichoptera				
Glossosomatidae				
Glossosoma sp.	1	47	8	56
Hydropsychidae				
Cheumatopsyche sp.				
Limnephilidae			1	1
Ecclisomyia sp.			1	1
Nemotaulius hostilis				
Rhyacophilidae				
Rhyacophila sp.				
Diptera				
Ceratopogonidae				
Bezzia/Palpomyia sp. gp.				
Chironomidae	6		1	7
Brillia sp.				
Cardiocladius sp.	7			7
Chaetocladius sp.				
Chironominae A				
Chironomus sp.				
Cricotopus sp.	18		1	19
Diamesa sp.				
Dicrotendipes sp.				
Diplocladius cultriger				
Eukiefferiella sp.				
Eukiefferiella cf. claripennis sp.gp.				
Eukiefferiella gracei sp.gp.			1	1
Glyptotendipes sp.				
Orthocladiinae A				
Orthocladiinae B				
Orthocladius sp.				
Pagastia sp.		1	1	2
Pagastiella sp.				
Paramerina sp.				
Paracladopelma sp.				
Parakiefferiella bathophila				
Paratanytarsus sp.				
Phaenopsectra sp.				
Polypedilum sp.				
Polypedilum cf. convictum				
Potthastia sp.				
Procladius sp.				
Prodiamesa sp.				
Psectrocladius sp.				
Psectrotanypus sp.				
Rheocricotopus sp.				
Rheotanytarsus sp.				
Synorthocladius semivirens				

Table 8. Aquatic Benthic Macroinvertebrates from Station 12, Elmendorf Air Force Base, 9/05/92.

Tanypus sp.				
Tanytarsus sp.				
Tvetenia bavarica sp.gp.	1			1
Empididae				
Chelifera sp.				
Muscidae				
Limnophora sp.				
Psychodidae				
Pericoma sp.				
Simuliidae				
Cnephia sp.	1	2	2	5
Tipulidae				
Dicranota sp.				
Ormosia sp.				
Coleoptera				
Dytiscidae				
Acililus sp.				
Dytiscus sp.				
MOLLUSCA				
Gastropoda				
Planorbidae				
Gyraulus (Torquis) sp.				
Pelecypoda				
Sphaeriidae				
Pisidium milium				
TOTAL NUMBER OF ORGANISMS	69	65	21	155
TOTAL NUMBER OF SPECIES	11	6	10	15

Table 9. Aquatic Benthic Macroinvertebrates from Station 4, Elmendorf Air Force Base, 6/03/92.

SPECIES	STA 4	STA 4	STA 4	STA 4
	REP1	REP2	REP3	TOTAL
NEMATODA				
ANNELIDA				
Oligochaeta				
Lumbriculidae			44	44
Kincaidiana hexatheca			13	13
Lumbriculus sp.	1	3		4
Niadidae			8	8
Nais sp.		1		1
Nais communis			12	12
Nais cf.simplex				
Pristinella sp.				
Slavina appendiculata			4	4
Stylaria lacustris			4	4
Tubificidae w.h.c.				
Tubificidae w.o.h.c.			4	4
Limnodrilus sp.				
Limnodrilus cf. hoffmeisteri	1			1
Rhyacodrilus montana	7	1		8
PLATYHELMINTHES				
Turbellaria				
Tricladida				
ARTHOPODA				
Arachnoidea				
Hydracarina				
Crustacea				
Amphipoda				
Talitridae				
Hyalella azteca			1	1
Cladocera				
Daphnidae				
Daphnia cf. pulex				
Copepoda				
Cyclopoida				
Ostracoda				
Insecta				
Ephemeroptera				
Baetidae				
Baetis sp.				
Ephemerellidae				
Drunella doddsi				
Ephemerella inermis				
Heptageniidae				
Cinygmula sp.				
Epeorus sp.				
Stenonema sp.		1		1
Plecoptera				
Choroperlidae				
Suwallia sp.				

Table 9. Aquatic Benthic Macroinvertebrates from Station 4, Elmendorf Air Force Base, 6/03/92.

Nemouridae				
Zapada sp.				
Perlodidae				
Isoperla sp.				
Heteroptera				
Corixidae				
Arctocorisa sp.				
Corisella sp.				
Trichoptera				
Glossosomatidae				
Glossosoma sp.				
Hydropsychidae				
Cheumatopsyche sp.				
Limnephilidae				
Ecclisomyia sp.				
Nemotaulius hostilis				
Rhyacophilidae				
Rhyacophila sp.				
Diptera				
Ceratopogonidae				
Bezzia/Palpomyia sp. gp.	1		1	2
Chironomidae		9	36	45
B[illegible]lia sp.				
Cardiocladius sp.				
Chaetocladius sp.				
Chironominae A				
Chironomus sp.				
Cricotopus sp.			59	59
Diamesa sp.				
Dicrotendipes sp.				
Diplocladius cultriger				
Eukiefferiella sp.				
Eukiefferiella				
cf. claripennis sp.gp.				
Eukiefferiella gracei sp.gp.				
Glyptotendipes sp.				
Orthocladiinae A				
Orthocladiinae B				
Orthocladius sp.				
Pagastia sp.				
Pagastiella sp.				
Paramerina sp.				
Paracladopelma sp.			5	5
Parakiefferiella bathophila				
Paratanytarsus sp.			39	39
Phaenopsectra sp.				
Polypedilum sp.				
Polypedilum cf. convictum			5	5
Potthastia sp.				
Procladius sp.	1	23	20	44
Prodiamesa sp.				
Psectrocladius sp.		8	25	33
Psectrotanypus sp.				
Rheocricotopus sp.				
Rheotanytarsus sp.		4		4
Synorthocladius semivirens				

Table 9. Aquatic Benthic Macroinvertebrates from Station 4, Elmendorf Air Force Base, 6/03/92.

Tanypus sp.				
Tanytarsus sp.	40	333	356	729
Tvetenia bavarica sp.gp.				
Empididae				
Chelifera sp.				
Muscidae				
Limnophora sp.				
Psychodidae				
Pericoma sp.				
Simuliidae				
Cnephia sp.				
Tipulidae				
Dicranota sp.				
Ormosia sp.				
Coleoptera				
Dytiscidae				
Acililus sp.				
Dytiscus sp.				
MOLLUSCA				
Gastropoda				
Planorbidae				
Gyraulus (Torquis) sp.			4	4
Pelecypoda				
Sphaeriidae				
Pisidium milium	1	2	3	6
TOTAL NUMBER OF ORGANISMS	52	385	643	1080
TOTAL NUMBER OF SPECIES	7	10	19	25

Table 10. Aquatic Benthic Macroinvertebrates from Station 4, Duplicate Samples, Elmendorf Air Force Base, 6/03/92.

SPECIES	STA 4D REP4	STA 4D REP5	STA 4D REP6	STA 4D TOTAL
NEMATODA				
ANNELIDA				
Oligochaeta				
Lumbriculidae				
Kincaidiana hexatheca	1		2	3
Lumbriculus sp.	11		2	13
Niadidae				
Nais sp.		1		1
Nais communis				
Nais cf.simplex	3			3
Pristinella sp.				
Slavina appendiculata				
Stylaria lacustris				
Tubificidae w.h.c.		1	4	5
Tubificidae w.o.h.c.		2	5	7
Limnodrilus sp.				
Limnodrilus cf. hoffmeisteri				
Rhyacodrilus montana				
PLATYHELMINTHES				
Turbellaria				
Tricladida				
ARTHOPODA				
Arachnoidea				
Hydracarina				
Crustacea				
Amphipoda				
Talitridae				
Hyalella azteca	4			4
Cladocera				
Daphnidae				
Daphnia cf. pulex				
Copepoda				
Cyclopoida	4			4
Ostracoda				
Insecta				
Ephemeroptera				
Baetidae				
Baetis sp.				
Ephemerellidae				
Drunella doddsi				
Ephemerella inermis				
Heptageniidae				
Cinygmula sp.				
Epeorus sp.				
Stenonema sp.				
Plecoptera				
Choroperlidae				
Suwallia sp.				

Table 10. Aquatic Benthic Macroinvertebrates from Station 4, Duplicate Samples, Elmendorf Air Force Base, 6/03/92.

Nemouridae				
Zapada sp.				
Perlodidae				
Isoperla sp.				
Heteroptera				
Corixidae	3			3
Arctocorisa sp.				
Corisella sp.	1			1
Trichoptera				
Glossosomatidae				
Glossosoma sp.				
Hydropsychidae				
Cheumatopsyche sp.				
Limnephilidae				
Ecclisomyia sp.				
Nemotaulius hostilis				
Rhyacophilidae				
Rhyacophila sp.				
Diptera				
Ceratopogonidae				
Bezzia/Palpomyia sp. gp.	8	5	1	14
Chironomidae	37	10		47
Brillia sp.				
Cardiocladius sp.				
Chaetocladius sp.	5			5
Chironominae A				
Chironomus sp.				
Cricotopus sp.				
Diamesa sp.				
Dicrotendipes sp.				
Diplocladius cultriger	2			2
Eukiefferiella sp.				
Eukiefferiella cf. claripennis sp.gp.				
Eukiefferiella gracei sp.gp.				
Glyptotendipes sp.				
Orthocladiinae A				
Orthocladiinae B				
Orthocladius sp.				
Pagastia sp.				
Pagastiella sp.	2			2
Paramerina sp.				
Paracladopelma sp.	2			2
Parakiefferiella bathophila				
Paratanytarsus sp.				
Phaenopsectra sp.				
Polypedilum sp.				
Polypedilum cf. convictum				
Potthastia sp.				
Procladius sp.	7	21		28
Prodiamesa sp.				
Psectrocladius sp.	17	7		24
Psectrotanypus sp.		3		3
Rheocricotopus sp.				
Rheotanytarsus sp.	21			21
Synorthocladius semivirens				

Table 10. Aquatic Benthic Macroinvertebrates from Station 4, Duplicate Samples, Elmendorf Air Force Base, 6/03/92.

Tanypus sp.				
Tanytarsus sp.	172	317	5	494
Tvetenia bavarica sp.gp.				
Empididae				
Chelifera sp.				
Muscidae				
Limnophora sp.				
Psychodidae				
Pericoma sp.				
Simuliidae				
Cnephia sp.				
Tipulidae				
Dicranota sp.				
Ormosia sp.				
Coleoptera				
Dytiscidae				
Acililus sp.	1			1
Dytiscus sp.				
MOLLUSCA				
Gastropoda				
Planorbidae				
Gyraulus (Torquis) sp.				
Pelecypoda				
Sphaeriidae				
Pisidium milium				
TOTAL NUMBER OF ORGANISMS	301	367	19	687
TOTAL NUMBER OF SPECIES	18	9	6	22

Table 11. Aquatic Benthic Macroinvertebrates from Station 4, Elmendorf Air Force Base, 8/31/92.

SPECIES	STA 4 REP1	STA 4 REP2	STA 4 REP3	STA 4 TOTAL
NEMATODA				
ANNELIDA				
Oligochaeta				
Lumbriculidae	117	3		120
Kincaidiana hexatheca		5	2	7
Lumbriculus sp.			5	5
Niadidae				
Nais sp.			10	10
Nais communis				
Nais cf.simplex				
Pristinella sp.			7	7
Slavina appendiculata				
Stylaria lacustris				
Tubificidae w.h.c.			7	7
Tubificidae w.o.h.c.				
Limnodrilus sp.				
Limnodrilus cf. hoffmeisteri				
Rhyacodrilus montana				
PLATYHELMINTHES				
Turbellaria				
Tricladida				
ARTHOPODA				
Arachnoidea				
Hydracarina		1	1	2
Crustacea				
Amphipoda				
Talitridae				
Hyalella azteca	14		1	15
Cladocera				
Daphnidae				
Daphnia cf. pulex			3	3
Copepoda				
Cyclopoida				
Ostracoda			1	1
Insecta				
Ephemeroptera				
Baetidae				
Baetis sp.	1			1
Ephemerellidae				
Drunella doddsi				
Ephemerella inermis				
Heptageniidae				
Cinygmula sp.				
Epeorus sp.				
Stenonema sp.				
Plecoptera				
Choroperlidae				
Suwallia sp.				

Table 11. Aquatic Benthic Macroinvertebrates from Station 4, Elmendorf Air Force Base, 8/31/92.

Nemouridae				
Zapada sp.				
Perlodidae				
Isoperla sp.				
Heteroptera				
Corixidae				
Arctocorisa sp.				
Corisella sp.				
Trichoptera				
Glossosomatidae				
Glossosoma sp.				
Hydropsychidae				
Cheumatopsyche sp.				
Limnephilidae				
Ecclisomyia sp.				
Nemotaulius hostilis				
Rhyacophilidae				
Rhyacophila sp.				
Diptera				
Ceratopogonidae				
Bezzia/Palpomyia sp. gp.	2	1	2	5
Chironomidae	5	3	1	9
Brillia sp.				
Cardiocladius sp.				
Chaetocladius sp.				
Chironominae A				
Chironomus sp.				
Cricotopus sp.			1	1
Diamesa sp.				
Dicrotendipes sp.		11		11
Diplocladius cultriger				
Eukiefferiella sp.				
Eukiefferiella				
cf. claripennis sp.gp.				
Eukiefferiella gracei sp.gp.				
Glyptotendipes sp.	1			1
Orthocladiinae A				
Orthocladiinae B				
Orthocladius sp.				
Pagastia sp.				
Pagastiella sp.				
Paramerina sp.				
Paracladopelma sp.				
Parakiefferiella bathophila				
Paratanytarsus sp.				
Phaenopsectra sp.				
Polypedilum sp.				
Polypedilum cf. convictum				
Potthastia sp.	3	35		38
Procladius sp.	23		6	29
Prodiamesa sp.				
Psectrocladius sp.	1	3	7	11
Psectrotanypus sp.				
Rheocricotopus sp.				
Rheotanytarsus sp.		3		3
Synorthocladius semivirens				

Table 11. Aquatic Benthic Macroinvertebrates from Station 4, Elmendorf Air Force Base, 8/31/92.

Tanypus sp.				
Tanytarsus sp.	13	216	6	235
Tvetenia bavarica sp.gp.				
Empididae				
Chelifera sp.			1	1
Muscidae				
Limnophora sp.				
Psychodidae				
Pericoma sp.				
Simuliidae				
Cnephia sp.				
Tipulidae				
Dicranota sp.				
Ormosia sp.				
Coleoptera				
Dytiscidae				
Acilius sp.				
Dytiscus sp.				
MOLLUSCA				
Gastropoda				
Planorbidae				
Gyraulus (Torquis) sp.				
Pelecypoda				
Sphaeriidae				
Pisidium milium		20		20
TOTAL NUMBER OF ORGANISMS	180	301	61	542
TOTAL NUMBER OF SPECIES	10	11	16	23

Table 12. Aquatic Benthic Macroinvertebrates from Station 5, Elmendorf Air Force Base, 6/02/92.

SPECIES	STA 5 REP1	STA 5 REP2	STA 5 REP3	STA 5 TOTAL
NEMATODA	1			1
ANNELIDA				
Oligochaeta				
Lumbriculidae			1	1
Kincaidiana hexatheca				
Lumbriculus sp.				
Niadidae				
Nais sp.				
Nais communis				
Nais cf.simplex				
Pristinella sp.				
Slavina appendiculata				
Stylaria lacustris				
Tubificidae w.h.c.				
Tubificidae w.o.h.c.				
Limnodrilus sp.				
Limnodrilus cf. hoffmeisteri				
Rhyacodrilus montana				
PLATYHELMINTHES				
Turbellaria				
Tricladida				
ARTHOPODA				
Arachnoidea				
Hydracarina				
Crustacea				
Amphipoda				
Talitridae				
Hyalella azteca				
Cladocera				
Daphnidae				
Daphnia cf. pulex	11	1		12
Copepoda				
Cyclopoida				
Ostracoda				
Insecta				
Ephemeroptera				
Baetidae				
Baetis sp.				
Ephemerellidae				
Drunella doddsi				
Ephemerella inermis				
Heptageniidae				
Cinygmula sp.				
Epeorus sp.				
Stenonema sp.				
Plecoptera				
Choroperlidae				
Suwallia sp.				

Table 12. Aquatic Benthic Macroinvertebrates from Station 5, Elmendorf Air Force Base, 6/02/92.

Nemouridae				
Zapada sp.				
Perlodidae				
Isoperla sp.				
Heteroptera				
Corixidae				
Arctocorisa sp.	1			1
Corisella sp.				
Trichoptera				
Glossosomatidae				
Glossosoma sp.				
Hydropsychidae				
Cheumatopsyche sp.				
Limnephilidae				
Ecclisomyia sp.				
Nemotaulius hostilis				
Rhyacophilidae				
Rhyacophila sp.				
Diptera				
Ceratopogonidae				
Bezzia/Palpomyia sp. gp.				
Chironomidae	3	1	2	6
Brillia sp.				
Cardiocladius sp.				
Chaetocladius sp.				
Chironominae A				
Chironomus sp.			3	3
Cricotopus sp.				
Diamesa sp.				
Dicrotendipes sp.				
Diplocladius cultriger				
Eukiefferiella sp.				
Eukiefferiella				
cf. claripennis sp.gp.				
Eukiefferiella gracei sp.gp.				
Glyptotendipes sp.	1		2	3
Orthocladiinae A				
Orthocladiinae B				
Orthocladius sp.				
Pagastia sp.				
Pagastiella sp.				
Paramerina sp.				
Paracladopelma sp.				
Parakiefferiella bathophila			2	2
Paratanytarsus sp.			10	10
Phaenopsectra sp.		1	2	3
Polypedilum sp.				
Polypedilum cf. convictum				
Potthastia sp.				
Procladius sp.			3	3
Prodiamesa sp.				
Psectrocladius sp.		2		2
Psectrotanypus sp.				
Rheocricotopus sp.				
Rheotanytarsus sp.		2	13	15
Synorthocladius semivirens				

Table 12. Aquatic Benthic Macroinvertebrates from Station 5, Elmendorf Air Force Base, 6/02/92.

Tanypus sp.				
Tanytarsus sp.	5	11	132	148
Tvetenia bavarica sp.gp.				
Empididae				
Chelifera sp.				
Muscidae				
Limnophora sp.				
Psychodidae				
Pericoma sp.				
Simuliidae				
Cnephia sp.				
Tipulidae				
Dicranota sp.				
Ormosia sp.				
Coleoptera				
Dytiscidae				
Acililus sp.				
Dytiscus sp.	1	1		2
MOLLUSCA				
Gastropoda				
Planorbidae				
Gyraulus (Torquis) sp.				
Pelecypoda				
Sphaeriidae				
Pisidium milium				
TOTAL NUMBER OF ORGANISMS	23	19	170	212
TOTAL NUMBER OF SPECIES	7	7	10	15

Table 13. Aquatic Benthic Macroinvertebrates from Station 5, Elmendorf Air Force Base, 8/31/92.

SPECIES	STA 5 REP1	STA 5 REP2	STA 5 REP3	STA 5 TOTAL
NEMATODA				
ANNELIDA				
Oligochaeta				
Lumbriculidae	4			4
Kincaidiana hexatheca				
Lumbriculus sp.				
Niadidae				
Nais sp.	4		8	12
Nais communis				
Nais cf.simplex				
Pristinella sp.		1		1
Slavina appendiculata				
Stylaria lacustris				
Tubificidae w.h.c.				
Tubificidae w.o.h.c.				
Limnodrilus sp.				
Limnodrilus cf. hoffmeisteri				
Rhyacodrilus montana				
PLATYHELMINTHES				
Turbellaria				
Tricladida				
ARTHOPODA				
Arachnoidea				
Hydracarina				
Crustacea				
Amphipoda				
Talitridae				
Hyalella azteca				
Cladocera				
Daphnidae				
Daphnia cf. pulex	1	3		4
Copepoda				
Cyclopoida				
Ostracoda	1	1		2
Insecta				
Ephemeroptera				
Baetidae				
Baetis sp.				
Ephemerellidae				
Drunella doddsi				
Ephemerella inermis				
Heptageniidae				
Cinygmula sp.				
Epeorus sp.				
Stenonema sp.				
Plecoptera				
Choroperlidae				
Suwallia sp.				

Table 13. Aquatic Benthic Macroinvertebrates from Station 5, Elmendorf Air Force Base, 8/31/92.

Nemouridae				
Zapada sp.				
Perlodidae				
Isoperla sp.				
Heteroptera				
Corixidae				
Arctocorisa sp.				
Corisella sp.				
Trichoptera				
Glossosomatidae				
Glossosoma sp.				
Hydropsychidae				
Cheumatopsyche sp.				
Limnephilidae				
Ecclisomyia sp.				
Nemotaulius hostilis				
Rhyacophilidae				
Rhyacophila sp.				
Diptera				
Ceratopogonidae				
Bezzia/Palpomyia sp. gp.				
Chironomidae			1	1
Brillia sp.				
Cardiocladius sp.				
Chaetocladius sp.				
Chironominae A				
Chironomus sp.	1		5	6
Cricotopus sp.			1	1
Diamesa sp.				
Dicrotendipes sp.	2			2
Diplocladius cultriger	1			1
Eukiefferiella sp.				
Eukiefferiella cf. claripennis sp.gp.				
Eukiefferiella gracei sp.gp.				
Glyptotendipes sp.				
Orthocladiinae A				
Orthocladiinae B				
Orthocladius sp.				
Pagastia sp.				
Pagastiella sp.				
Paramerina sp.			1	1
Paracladopelma sp.				
Parakiefferiella bathophila				
Paratanytarsus sp.				
Phaenopsectra sp.	12	27	7	46
Polypedilum sp.				
Polypedilum cf. convictum				
Potthastia sp.				
Procladius sp.	22	15	3	40
Prodiamesa sp.				
Psectrocladius sp.				
Psectrotanypus sp.	52	34	31	117
Rheocricotopus sp.				
Rheotanytarsus sp.		1	6	7
Synorthocladius semivirens				

Table 13. Aquatic Benthic Macroinvertebrates from Station 5, Elmendorf Air Force Base, 8/31/92.

Tanypus sp.		5		5
Tanytarsus sp.	7	12	13	32
Tvetenia bavarica sp.gp.				
Empididae				
Chelifera sp.				
Muscidae				
Limnophora sp.				
Psychodidae				
Pericoma sp.				
Simuliidae				
Cnephia sp.				
Tipulidae				
Dicranota sp.				
Ormosia sp.				
Coleoptera				
Dytiscidae				
Acililus sp.				
Dytiscus sp.				
MOLLUSCA				
Gastropoda				
Planorbidae				
Gyraulus (Torquis) sp.				
Pelecypoda				
Sphaeriidae				
Pisidium milium				
TOTAL NUMBER OF ORGANISMS	107	99	76	282
TOTAL NUMBER OF SPECIES	11	9	10	17

Table 14. Aquatic Benthic Macroinvertebrates from Station 6, Elmendorf Air Force Base, 6/03/92.

SPECIES	STA 6	STA 6	STA 6	STA 6
	REP1	REP2	REP3	TOTAL
NEMATODA				
ANNELIDA				
Oligochaeta				
Lumbriculidae		25	31	56
Kincaidiana hexatheca	2	10	10	22
Lumbriculus sp.				
Niadidae				
Nais sp.				
Nais communis				
Nais cf.simplex				
Pristinella sp.				
Slavina appendiculata				
Stylaria lacustris				
Tubificidae w.h.c.	1	5		6
Tubificidae w.o.h.c.	1	2	31	34
Limnodrilus sp.		5	135	140
Limnodrilus cf. hoffmeisteri				
Rhyacodrilus montana				
PLATYHELMINTHES				
Turbellaria				
Tricladida				
ARTHOPODA				
Arachnoidea				
Hydracarina				
Crustacea				
Amphipoda				
Talitridae				
Hyalella azteca				
Cladocera				
Daphnidae				
Daphnia cf. pulex				
Copepoda				
Cyclopoida				
Ostracoda				
Insecta				
Ephemeroptera				
Baetidae				
Baetis sp.				
Ephemerellidae				
Drunella doddsi				
Ephemerella inermis				
Heptageniidae				
Cinygmula sp.				
Epeorus sp.				
Stenonema sp.				
Plecoptera				
Choroperlidae				
Suwallia sp.				

Table 14. Aquatic Benthic Macroinvertebrates from Station 6, Elmendorf Air Force Base, 6/03/92.

Nemouridae				
Zapada sp.				
Perlodidae				
Isoperla sp.				
Heteroptera				
Corixidae				
Arctocorisa sp.				
Corisella sp.				
Trichoptera				
Glossosomatidae				
Glossosoma sp.				
Hydropsychidae				
Cheumatopsyche sp.				
Limnephilidae				
Ecclisomyia sp.				
Nemotaulius hostilis				
Rhyacophilidae				
Rhyacophila sp.				
Diptera				
Ceratopogonidae				
Bezzia/Palpomyia sp. gp.			4	4
Chironomidae			1	1
Brillia sp.				
Cardiocladius sp.				
Chaetocladius sp.	1	1	61	63
Chironominae A	1	1		2
Chironomus sp.	8		12	20
Cricotopus sp.	2		6	8
Diamesa sp.				
Dicrotendipes sp.				
Diplocladius cultriger				
Eukiefferiella sp.				
Eukiefferiella cf. claripennis sp.gp.				
Eukiefferiella gracei sp.gp.				
Glyptotendipes sp.				
Orthocladiinae A	10			10
Orthocladiinae B	1	1		2
Orthocladius sp.	2		37	39
Pagastia sp.	1			1
Pagastiella sp.				
Paramerina sp.	4	4		8
Paracladopelma sp.				
Parakiefferiella bathophila				
Paratanytarsus sp.				
Phaenopsectra sp.	65	2	485	552
Polypedilum sp.		1		1
Polypedilum cf. convictum				
Potthastia sp.				
Procladius sp.				
Prodiamesa sp.	1			1
Psectrocladius sp.			12	12
Psectrotanypus sp.				
Rheocricotopus sp.				
Rheotanytarsus sp.				
Synorthocladius semivirens				

Table 14. Aquatic Benthic Macroinvertebrates from Station 6, Elmendorf Air Force Base, 6/03/92.

Tanypus sp.				
Tanytarsus sp.		5		5
Tvetenia bavarica sp.gp.				
Empididae				
Chelifera sp.				
Muscidae				
Limnophora sp.				
Psychodidae				
Pericoma sp.				
Simuliidae				
Cnephia sp.				
Tipulidae				
Dicranota sp.				
Ormosia sp.				
Coleoptera				
Dytiscidae			1	1
Acililus sp.				
Dytiscus sp.				
MOLLUSCA				
Gastropoda				
Planorbidae				
Gyraulus (Torquis) sp.				
Pelecypoda				
Sphaeriidae				
Pisidium milium				
TOTAL NUMBER OF ORGANISMS	100	62	826	988
TOTAL NUMBER OF SPECIES	14	12	13	22

Table 15. Percent Similarity between invertebrate communities within each habitat -1992.

	Ship Creek							
	5MI01-M	5MI01-S	5MI02-M	5MI02-S	5MI03-M	5MI03-S	5MI11-S	5MI12-S
5MI01-M		15.6	67.4	31.1	72.8	34.5	55.3	31.3
5MI01-S	15.6		16.1	44.8	11.8	43	19.7	43.5
5MI02-M	67.4	16.1		30.9	77.2	42.7	53.2	30.6
5MI02-S	31.1	44.8	30.9		28.8	60.2	42.5	71
5MI03-M	72.8	11.8	77.2	28.8		35.5	58.8	32.3
5MI03-S	34.5	43	42.7	60.2	35.5		52.7	49.6
5MI11-S	55.3	19.7	53.2	42.5	58.8	52.7		32.2
5MI12-S	31.3	43.5	30.6	71	32.3	49.6	32.2	

	Beaver Pond/Wetland Pond				
	5MI04-J	5MI04-A	5MI05-J	5MI05-A	5MI006-J
5MI04-J		82.3	77.1	18	8.5
5MI04-A	82.3		78.5	19.1	6.9
5MI05-J	77.1	78.5		20.3	4.9
5MI05-A	18	19.1	20.3		21.1
5MI06-J	8.5	6.9	4.9	21.1	

Percent Similarity = SUM of (lowest percentage for each taxa)

Within each community taxa abundance is tabulated as a percentage.
For each taxa, the lowest percentage between any two communities
is summed to calculate the Percent Similarity

M = May, S = September, J = June, A = August

RAPID BIOASSESSMENT PROTOCOL 1 DATA—SPRING 1992

~~SE-001~~-[illegible] M.M.
1800 HRS
052892

Document #1-MI

Mike [illegible]

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE/WATER

Predominant Surrounding Land Use:

[✓ Forest] Field/Pasture Agricultural Residential Commercial Industrial Other Military

High Water Mark 1 (m) Velocity ≥1 cfs Dam Present: Yes ___ No X Channelized: Yes ___ No X

Canopy Cover: [✓ Open] Partly Open Partly Shaded Shaded

SEDIMENT/SUBSTRATE:

Sediment Odors: [✓ Normal] Sewage Petroleum Chemical Anaerobic None Other ___

Sediment Oils: [✓ Absent] Slight Moderate Profuse

Sediment Deposits: Sludge Sawdust Paper Fiber Sand Relict Shells None Other ___

Are the undersides of stones which are not deeply embedded black? Yes ___ No X

Inorganic Substrate Components

Substrate Type	Diameter	Percent Composition in Sampling Area
Bedrock		
Boulder	>256mm (10 in.)	
[✓ Cobble]	64-256mm (2.5-10 in.)	~~40~~ 20 m.m
[✓ Gravel]	2-64mm (0.1-2.5 in.)	~~20~~ 40 m.m
[✓ Sand]	0.06-2.00mm (gritty)	40
Silt	0.004-.06mm	
Clay	<0.004mm (slick)	

Organic Substrate Components

Substrate Type	Characteristic	Percent Composition in Sampling Area
Detritus	Sticks, Wood, Coarse Plant Materials (CPOM)	90
Muck-Mud	Black, Very Fine Organic (FPOM)	10
Marl	Grey, Shell Fragments	

WATER QUALITY

Stream Type: [✓ Coldwater] Warmwater

Water Odors: [✓ Normal] Sewage Petroleum Chemical None Other ___

Water Surface Oils: Slick Sheen Globs Flecks [✓ None]

Turbidity: Clear [✓ Slightly Turbid] Turbid Opaque Water Color ___

Some sediment transport (fine) in water column causing a slight turbidity

Water Temp. - 6.9°C
Cond. - 58 umhos
D.O. - 11.7 mg/L
pH - 5.8
Water Chem In Situ 052892

New Meters
Ph : 6.36 (Temp 5.6°c)
D.O : 12.80
Cond : 58 umhos
Water Chem ~~06~~ 0192

Depth of River ~~averages~~ - few inches in riffle areas to 3 ft in cut bank and chute areas

Figure 5.1-1. Physical Characterization/Water Quality Field Data Sheet for use with all Rapid Bioassessment Protocols.

MI = Macroinvertebrates

Width - Approx 50 to 60 ft

ATLR28/066.51

~~SE-001~~ 045-MI-01
1300 HRS
052892
M.M.

Page 2 of 2

Document # 2-MI

HABITAT ASSESSMENT FIELD DATA SHEET

Habitat Parameter	Category Excellent	 Good	 Fair	 Poor
1. *Bottom substrate/ available cover[a]	Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16-20	30-50% rubble, gravel or other stable habitat. Adequate habitat. 11-[✓ 15]	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness[b]	Gravel, cobble, and boulder particles are between 0 and 25 % surrounded by fine sediment 16-20	Gravel, cobble, and boulder particles are between 25 and 50 % surrounded by fine sediment 11-[✓ 15]	Gravel, cobble, and boulder particles are between 50 and 75 % surrounded by fine sediment 6-10	Gravel, cobble, and boulder particles are over 75 % surrounded by fine sediment 0-5
3. ≤0.15 cms (5cfs) = *Flow[a] at rep. low flow	Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 10-20	0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.03 cms (.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 6-10	<0.01 cms (.5 cfs) <0.03 cms (1 cfs) 0-5
or >0.15 cms (5cfs) = Velocity/depth	Slow (<0.3 m/s), deep (>0.5 m); slow, shallow (<0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. 16-[✓ 20]	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles/runs receive lower score). 6-10	Dominated by one velocity/depth category (usually pool). 0-5
4. * Channel alteration[a]	Little or no enlargement of islands or point bars, and/or no channelization. 14 12-15	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 4-7	Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or extensive channelization. 0-3
5. Bottom scouring and deposition[a]	Less than 5% of the bottom affected by scouring and deposition. 12-15	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 10 8-11	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 4-7	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3

(a) From Ball 1982.
(b) From Platts et al. 1983.
Note: * = Habitat parameters not currently incorporated into BIOS

Habitat Assessment Field Data Sheet for use with all Rapid Bioassessment Protocols.

HABITAT ASSESSMENT FIELD DATA SHEET (cont.)

Habitat Parameter	Category			
	Excellent	Good	Fair	Poor
6. Pool/riffle, run/bend ratio(a) (distance between riffles divided by stream width)	5-7. Variety of habitat. Deep riffles and pools. 12-15	7-15. Adequate depth in pools and riffles. Bends provide habitat. 8-11	15-25. Occasional riffle or bend. Bottom contours provide some habitat. 4-7	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 0-3
7. Bank stability(a)	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. Little potential for future problem. 9-10	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods. 6-8	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow. 3-5	Unstable. Many eroded areas. Side slopes >60% common. "Raw" areas frequent along straight sections and bends. 0-2
8. Bank vegetative stability(b)	Over 80% of the streambank surfaces covered by vegetation or boulders and cobble. 9-10	50-79% of the streambank surfaces covered by vegetation, gravel or larger material. 6-8	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. 3-5	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. 0-2
9. Streamside cover(b)	Dominant vegetation is shrub. 9-10	Dominant vegetation is of tree form. 6-8	Dominant vegetation is grass or forbes. 3-5	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 0-2
Column Totals	55	56	___	___

Score 111

(Cont.).

Page 1 of 1

~~SL-001~~ OU5-MI-01
1300 Hrs
052892
Mike Mischel

M.M.

Document #3-MI

Rapid Bioassessment Protocol I

Biosurvey Field Data Sheet

RELATIVE ABUNDANCE OF AQUATIC BIOTA

Periphyton	[✓ 0]	1	2	3	4	Slimes	[✓ 0]	1	2	3	4
Filamentous Algae	[✓ 0]	1	2	3	4	Macroinvertebrates	0	1	2	[✓ 3]	4
Macrophytes	0	[✓ 1]	2	3	4	Fish	0	1	2	3	4

0 = Absent/Not Observed   1 = Rare   2 = Common   3 = Abundant   4 = Dominant

MACROBENTHOS QUALITATIVE SAMPLE LIST (Indicate Relative Abundance R = Rare, C = Common, A = Abundant, D = Dominant)

Porifera	R	Anisoptera	R	Chironomidae	A
Hydrozoa	R	Zygoptera	R	Plecoptera	A
Platyhelminthes	R	Hemiptera	R	Ephemeroptera	A
Turbellaria	R	Coleoptera	R	Trichoptera	R
Hirudinea	R	Lepidoptera	R	Other	
Oligochaeta	R	Sialidae	R		
Isopoda	R	Corydalidae	R		
Amphipoda	R	Tipulidae	R		
Decapoda	R	Empididae	R		
Gastropoda	R	Simuliidae	R		
Bivalvia	R	Tabanidae	R		
		Culicidae	C		

Rare < 3   Common 3–9   Abundant > 10   Dominant > 50 (Estimate)

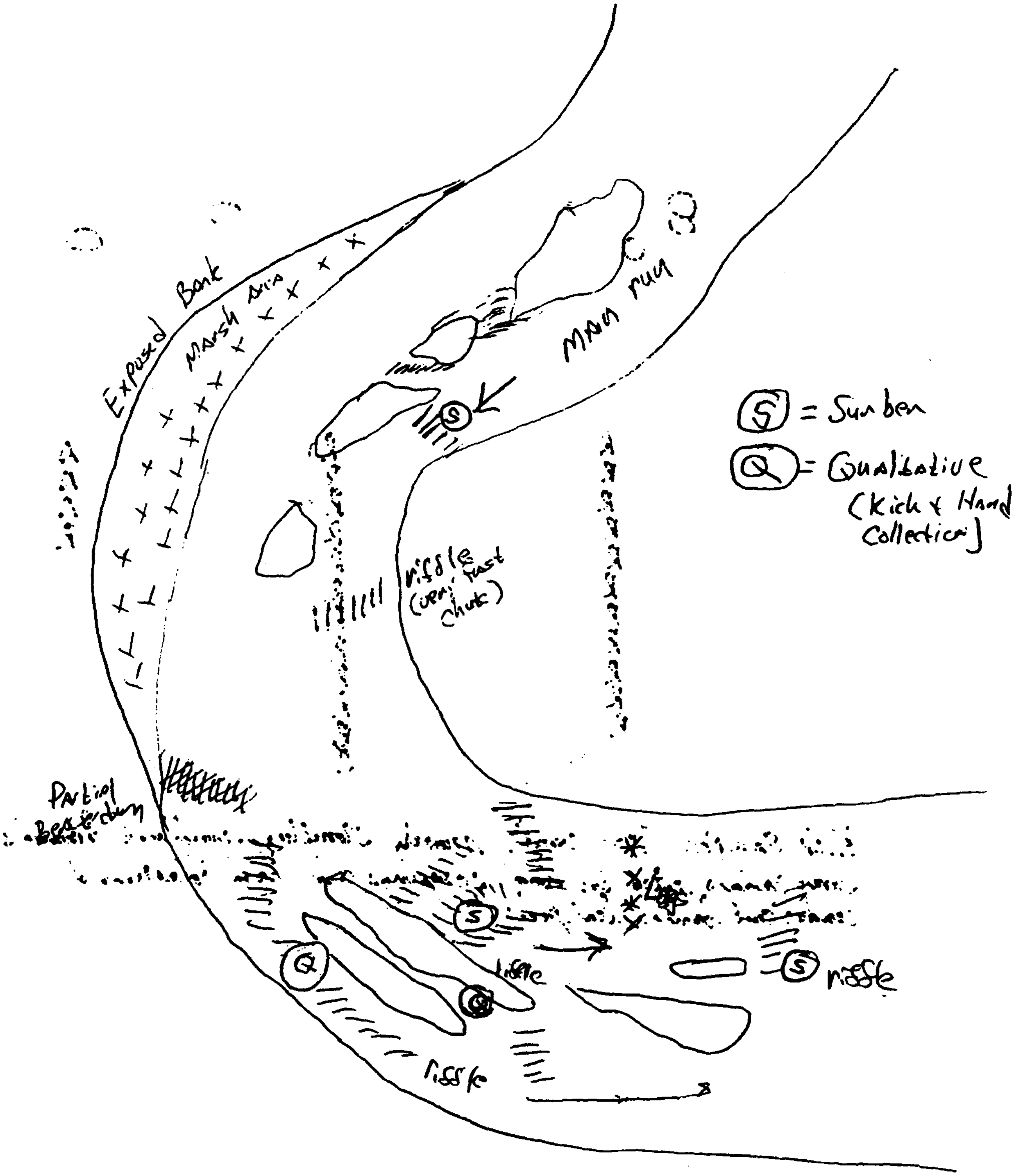
Observations

Kick Samples (100 count) mostly stoneflies, mayflies + chironomids. Some caddis noted in wood scrapings and hand collection of undercut banks, leaf packs

Map (over)

Biosurvey Field Data Sheet for use with Rapid Bioassessment Protocol I.

OUS-MI-01



Exposed Bank
Marsh Area
Main run
riffle (very fast chute)
Partial Beaver dam
Logs
S
Q
riffle
riffle
riffle
S = Surber
Q = Qualitative (Kick & Hand Collection)

Page 1 of 1

~~SC-001~~ OU5-MT-01

Document # 4-MI

1300 HRS

M.M.

052892

Mike Mischel

IMPAIRMENT ASSESSMENT SHEET

1. Detection of impairment: Impairment detected (Complete items 2-6) [✓ No impairment detected (Stop here)]

2. Biological impairment indicator:

Benthic macroinvertebrates
- ___ absence of EPT taxa
- ___ dominance of tolerant groups
- ___ low benthic abundance
- ___ low taxa richness
- ___ other

Other aquatic communities
- ___ Periphyton
  - ___ filamentous
  - ___ other
- ___ Macrophytes
- ___ Slimes
- ___ Fish

3. Brief description of problem: ______________________

Year and date of previous surveys: ______________________

Survey data available in: ______________________

4. Cause: (indicate major cause) organic enrichment toxicants flow

habitat limitations other ____________

5. Estimated areal extent of problem (m^2) and length of stream reach affected (m), where applicable: ______________________

6. Suspected source(s) of problem:

- ___ point source discharge (name, type of facility, location)
- ___ construction site runoff
- ___ combined sewer outfall
- ___ silviculture runoff
- ___ animal feedlot
- ___ agricultural runoff
- ___ urban runoff
- ___ ground water
- ___ other
- ___ unknown

Briefly explain:

Impairment Assessment Sheet for use with macroinvertebrate Rapid Bioassessment Protocols.

045-MI-02
052992

Document #5-MI

PHYSICAL CHARACTERIZATION/WATER QUALITY
FIELD DATA SHEET

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE/WATER

Predominant Surrounding Land Use:

Forest Field/Pasture Agricultural Residential ✱ Commercial Industrial Other Golf Course

High Water Mark ≥1 ~~ft~~ m.n. (m) Velocity ≥1 fps (1.5) Dam Present: Yes ___ No ___ Channelized: Yes X No ___ Some areas above Sample area

Canopy Cover: [✓ Open] Partly Open Partly Shaded Shaded

SEDIMENT/SUBSTRATE:

Sediment Odors: Normal Sewage Petroleum Chemical Anaerobic [✓ None] Other ______

Sediment Oils: [✓ Absent] Slight Moderate Profuse

Sediment Deposits: Sludge Sawdust Paper Fiber Sand Relict Shells None. Other ______

Are the undersides of stones which are not deeply embedded black? ✱ Yes X No ___ Some stones that were deeply embedded

Inorganic Substrate Components

Substrate Type	Diameter	Percent Composition in Sampling Area
Bedrock		
Boulder	>256mm (10 in.)	
Cobble	64-256mm (2.5-10 in.)	5%
Gravel	2-64mm (0.1-2.5 in.)	70%
Sand	0.06-2.00mm (gritty)	25%
Silt	0.004-.06mm	5%
Clay	<0.004mm (slick)	

Organic Substrate Components

Substrate Type	Characteristic	Percent Composition in Sampling Area
Detritus	Sticks, Wood, Coarse Plant Materials (CPOM)	5%
Muck-Mud	Black, Very Fine Organic (FPOM)	95%
Marl	Grey, Shell Fragments	0

WATER QUALITY

Stream Type: [✓ Coldwater] Warmwater

Water Odors: Normal Sewage Petroleum Chemical [✓ None] Other ______

Water Surface Oils: Slick Sheen Globs Flecks [✓ None]

Turbidity: Clear [✓ Slightly Turbid] Turbid Opaque Water Color ______

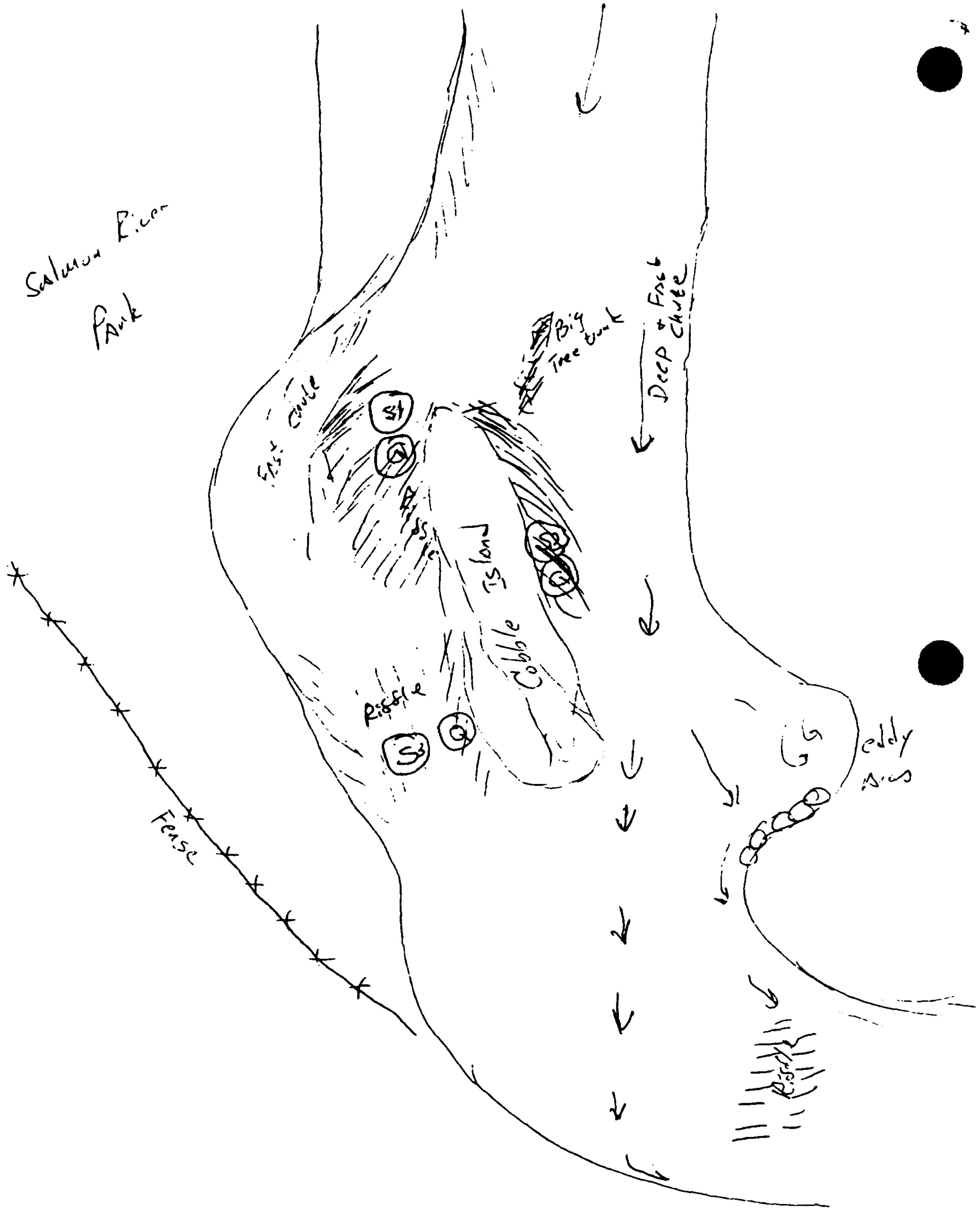
MI - Macroinvertebrate Sample
* Golf Course upstream.
Input from Beaver pond (system) about 0.6 tenths mile
Creek width in Sampling area 25 to 30 ft. ave., Sample station length 75 yds.
Ph = 6.57 (7.3°C)
Cond = 70 umhos 7.1°C
D.O. = 12.8 mg/L
} sample In situ on 060192
MAP OF Input. Sample locations)
(over)

Figure 5.1-1. Physical Characterization/Water Quality Field Data Sheet for use with all Rapid Bioassessment Protocols.

ATLR28/066.51

045-MI-02-S

OU5-MI-02


Salmon River Park
Big Tree trunk
Deep + Fast Chute
1st cable
S4
Q
Riffle
Island
Cobble
Q
Q
Riffle
S3
Q
Fense
eddy area
Riffle

05 29 92
OUS-MI-02

Page 1 of 2
Document # 6-MI
Mike Misch

HABITAT ASSESSMENT FIELD DATA SHEET

Habitat Parameter	Category Excellent	 Good	 Fair	 Poor
1. *Bottom substrate/available cover[a]	Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16-20 18	30-50% rubble, gravel or other stable habitat. Adequate habitat. 11-15	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness[b]	Gravel, cobble, and boulder particles are between 0 and 25 % surrounded by fine sediment 16-20	Gravel, cobble, and boulder particles are between 25 and 50 % surrounded by fine sediment 11-15 13	Gravel, cobble, and boulder particles are between 50 and 75 % surrounded by fine sediment 6-10	Gravel, cobble, and boulder particles are over 75 % surrounded by fine sediment 0-5
3. ≤0.15 cms (5cfs) → *Flow[a] at rep. low flow	[✓ Cold] >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 10-20 17	0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.03 cms (.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 6-10	<0.01 cms (.5 cfs) <0.03 cms (1 cfs) 0-5
or >0.15 cms (5cfs) → Velocity/depth	Slow (<0.3 m/s), deep (>0.5 m); slow, shallow (<0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. 16-20	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles/runs receive lower score). 6-10	Dominated by one velocity/depth category (usually pool). 0-5
4. * Channel alteration[a]	Little or no enlargement of islands or point bars, and/or no channelization. 12-15 13	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 4-7	Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or extensive channelization. 0-3
5. Bottom scouring and deposition[a]	Less than 5% of the bottom affected by scouring and deposition. 12-15	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8-11 9	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 4-7	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3

(a) From Ball 1982.
(b) From Platts et al. 1983.
Note: * = Habitat parameters not currently incorporated into BIOS

Habitat Assessment Field Data Sheet for use with all Rapid Bioassessment Protocols.

052992
045-MI-02

Page 2 of 2
Document # 6-MI

HABITAT ASSESSMENT FIELD DATA SHEET (cont.)

	Category			
Habitat Parameter	Excellent	Good	Fair	Poor
6. Pool/riffle, run/bend ratio(a) (distance between riffles divided by stream width)	5-7. Variety of habitat. Deep riffles and pools. 12-15	7-15. Adequate depth in pools and riffles. Bends provide habitat. 10 8-11	15-25. Occassional riffle or bend. Bottom contours provide some habitat. 4-7	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 0-3
7. Bank stability(a)	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. Little potential for future problem. 9-10	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods. 7 6-8	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow. 3-5	Unstable. Many eroded areas. Side slopes >60% common. "Raw" areas frequent along straight sections and bends. 0-2
8. Bank vegetative stability(b)	Over 80% of the streambank surfaces covered by vegetation or boulders and cobble. 9-10	50-79% of the streambank surfaces covered by vegetation, gravel or larger material. 7 6-8	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. 3-5	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. 0-2
9. Streamside cover(b)	Dominant vegetation is shrub. 9-10	Dominant vegetation is of tree form. 7 6-8	Dominant vegetation is grass or forbes. 3-5	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 0-2
Column Totals	48	53	0	0

Score 101

(Cont.).

OUS-MI-02
1500 HRS
052992

Document # ~~8~~ 7-MI
M.M. 052992

Rapid Bioassessment Protocol I

Biosurvey Field Data Sheet

RELATIVE ABUNDANCE OF AQUATIC BIOTA

Periphyton	[✓ 0]	1	2	3	4	**Slimes**	[✓ 0]	1	2	3	4
Filamentous Algae	0	[✓ 1]	2	3	4	**Macroinvertebrates**	0	1	2	[✓ 3]	4
Macrophytes	[✓ 0]	1	2	3	4	**Fish**	0	[✓ 1] x	2	3	4

0 = Absent/Not Observed 1 = Rare 2 = Common 3 = Abundant 4 = Dominant

MACROBENTHOS QUALITATIVE SAMPLE LIST (Indicate Relative Abundance R = Rare, C = Common, A = Abundant, D = Dominant)

Porifera	R	Anisoptera	R	Chironomidae	A
Hydrozoa	R	Zygoptera	R	Plecoptera	C
Platyhelminthes	R	Hemiptera	R	Ephemeroptera	C
Turbellaria	R	Coleoptera	R	Trichoptera	R
Hirudinea	R	Lepidoptera	R	Other	
Oligochaeta	R	Sialidae	R		
Isopoda	R	Corydalidae	R		
Amphipoda	R	Tipulidae	C		
Decapoda	R	Empididae	R		
Gastropoda	R	Simuliidae	R		
Bivalvia	R	Tabanidae	R		
		Culicidae	R		

Rare < 3 Common 3–9 Abundant > 10 Dominant > 50 (Estimate)

Observations

Tipulidae, several genera of mayflies (Baetis, Leptophlebiids,
, stoneflies (several Filipalpia)
x Sculpins

Biosurvey Field Data Sheet for use with Rapid Bioassessment Protocol I.

052992

Page 1 of 1

Document # 8-MI

Mike Miackul

IMPAIRMENT ASSESSMENT SHEET

1. Detection of impairment: Impairment detected (Complete items 2-6) [✓ No impairment detected (Stop here)]

2. Biological impairment indicator:

Benthic macroinvertebrates
- ____ absence of EPT taxa
- ____ dominance of tolerant groups
- ____ low benthic abundance
- ____ low taxa richness
- ____ other

Other aquatic communities
- ____ Periphyton
  - ____ filamentous
  - ____ other
- ____ Macrophytes
- ____ Slimes
- ____ Fish

3. Brief description of problem: ____________________

Year and date of previous surveys: ____________________

Survey data available in: ____________________

4. Cause: (indicate major cause) organic enrichment toxicants flow habitat limitations other ____________

5. Estimated areal extent of problem (m^2) and length of stream reach affected (m), where applicable: ____________________

6. Suspected source(s) of problem:

- ____ point source discharge (name, type of facility, location)
- ____ construction site runoff
- ____ combined sewer outfall
- ____ silviculture runoff
- ____ animal feedlot
- ____ agricultural runoff
- ____ urban runoff
- ____ ground water
- ____ other
- ____ unknown

Briefly explain:

Impairment Assessment Sheet for use with macroinvertebrate Rapid Bioassessment Protocols.

063092
OU5-03

Document #9 - MI

~~Page 1 of 1~~

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE/WATER

Predominant Surrounding Land Use:

Forest Field/Pasture Agricultural Residential * [✓ Commercial] Industrial Other ______

High Water Mark .5 (m) Velocity >2 fps ** Dam Present: Yes X No ___ Channelized: Yes ___ No X

Canopy Cover: [✓ Open] Partly Open Partly Shaded Shaded

SEDIMENT/SUBSTRATE:

Sediment Odors: Normal Sewage Petroleum Chemical Anaerobic [✓ None] Other ______

Sediment Oils: [✓ Absent] Slight Moderate Profuse

Sediment Deposits: Sludge Sawdust Paper Fiber Sand Relict Shells Other Some Silt

Are the undersides of stones which are not deeply embedded black? Yes ___ No X

Inorganic Substrate Components			Organic Substrate Components		
Substrate Type	Diameter	Percent Composition in Sampling Area	Substrate Type	Characteristic	Percent Composition in Sampling Area
Bedrock			Detritus	Sticks, Wood, Coarse Plant Materials (CPOM)	5%
Boulder	>256mm (10 in.)				
Cobble	64-256mm (2.5-10 in.)	5%			
Gravel	2-64mm (0.1-2.5 in.)	70%	Muck-Mud	Black, Very Fine Organic (FPOM)	90%
Sand	0.06-2.00mm (gritty)	20%			
Silt	0.004-.06mm	5%	Marl	Grey, Shell Fragments	0
Clay	<0.004mm (slick)				

WATER QUALITY

Stream Type: [✓ Coldwater] Warmwater

Water Odors: Normal Sewage Petroleum Chemical [✓ None] Other ______

Water Surface Oils: Slick Sheen Globs Flecks [✓ None]

Turbidity: Clear [✓ Slightly Turbid] Turbid Opaque Water Color ______

* Sample area just below input culvert from seep and drainage in vicinity of OU5-SL-16 downstream of Salmon Run Park & Fish Hatchery of ADFG adjacent to site, above Dam.

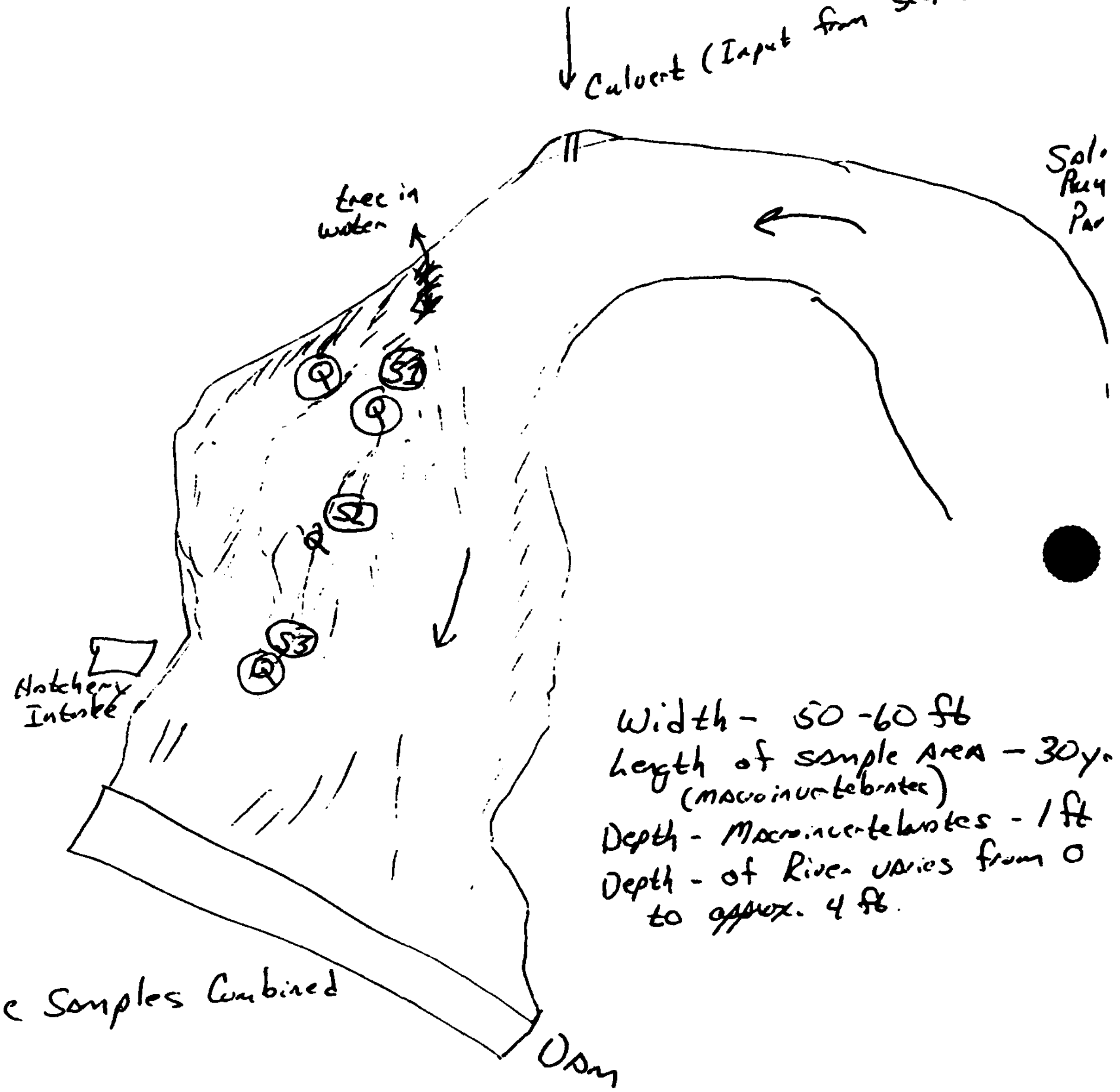
** Above Dam

Ph : 6.72 (7.2 °c)
Cond = 99 μmhos/cm²
D.O. : 12.8 mg/L

Measured on 060192 In Situ

Map of Invert Sites

Figure 5.1-1. Physical Characterization/Water Quality Field Data Sheet for use with all Rapid Bioassessment Protocols.



Width - 50-60 ft
Length of sample Area - 30 y.
(macroinvertebrates)
Depth - Macroinvertebrates - 1 ft
Depth - of River varies from 0
to approx. 4 ft.

All Qualitative Samples Combined

053092
OU5-03

Document # 10-MI

Page 1 of 2

HABITAT ASSESSMENT FIELD DATA SHEET

Habitat Parameter	Category Excellent	 Good	 Fair	 Poor
1. *Bottom substrate/available cover[a]	Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16 16-20	30-50% rubble, gravel or other stable habitat. Adequate habitat. 11-15	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness[b]	Gravel, cobble, and boulder particles are between 0 and 25 % surrounded by fine sediment 16 16-20	Gravel, cobble, and boulder particles are between 25 and 50 % surrounded by fine sediment 11-15	Gravel, cobble, and boulder particles are between 50 and 75 % surrounded by fine sediment 6-10	Gravel, cobble, and boulder particles are over 75 % surrounded by fine sediment 0-5
3. ≤0.15 cms (5cfs) → *Flow[a] at rep. low flow	Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 10-20 18	0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.03 cms (.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 6-10	<0.01 cms (.5 cfs) <0.03 cms (1 cfs) 0-5
or >0.15 cms (5cfs) → Velocity/depth	Slow (<0.3 m/s), deep (>0.5 m); slow, shallow (<0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. 16-20	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles/runs receive lower score). 6-10	Dominated by one velocity/depth category (usually pool). 0-5
4. * Channel alteration[a]	Little or no enlargement of islands or point bars, and/or no channelization. 13 12-15	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 4-7	Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or extensive channelization. 0-3
5. Bottom scouring and deposition[a]	Less than 5% of the bottom affected by scouring and deposition. 12-15	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8 8-11	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 4-7	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3

(a) From Ball 1982.
(b) From Platts et al. 1983.
Note: * = Habitat parameters not currently incorporated into BIOS

Habitat Assessment Field Data Sheet for use with all Rapid Bioassessment Protocols.

HABITAT ASSESSMENT FIELD DATA SHEET (cont.)

Habitat Parameter	Category			
	Excellent	Good	Fair	Poor
6. Pool/riffle, run/bend ratio[(a)] (distance between riffles divided by stream width)	5-7. Variety of habitat. Deep riffles and pools. 12-15	7-15. Adequate depth in pools and riffles. Bends provide habitat. 9 8-11	15-25. Occassional riffle or bend. Bottom contours provide some habitat. 4-7	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 0-3
7. Bank stability[(a)]	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. Little potential for future problem. 9-10	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods. 6-8	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow. 5 3-5	Unstable. Many eroded areas. Side slopes >60% common. "Raw" areas frequent along straight sections and bends. 0-2
8. Bank vegetative stability[(b)]	Over 80% of the streambank surfaces covered by vegetation or boulders and cobble. 9-10	50-79% of the streambank surfaces covered by vegetation, gravel or larger material. 8 6-8	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. 3-5	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. 0-2
9. Streamside cover[(b)]	Dominant vegetation is shrub. 9-10	Dominant vegetation is of tree form. 8 6-8	Dominant vegetation is grass or forbes. 3-5	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 0-2
Column Totals	63	33	5	—

Score 63/101

(Cont.).

053092
045-MI-03-Q
Document # 11-MI

Rapid Bioassessment Protocol I

Biosurvey Field Data Sheet

RELATIVE ABUNDANCE OF AQUATIC BIOTA

Periphyton	0	[✓ 1]	2	3	4	**Slimes**	[✓ 0]	1	2	3	4
Filamentous Algae	0	[✓ 1]	2	3	4	**Macroinvertebrates**	0	1	2	[✓ 3]	4
Macrophytes	[✓ 0]	1	2	3	4	**Fish**	0	1	2	3	4

0 = Absent/Not Observed **1 = Rare** **2 = Common** **3 = Abundant** **4 = Dominant**

MACROBENTHOS QUALITATIVE SAMPLE LIST (Indicate Relative Abundance R = Rare, C = Common, A = Abundant, D = Dominant)

Porifera	R	**Anisoptera**	R	**Chironomidae**	D
Hydrozoa	R	**Zygoptera**	R	**Plecoptera**	C
Platyhelminthes	R	**Hemiptera**	R	**Ephemeroptera**	A
Turbellaria	R	**Coleoptera**	R	**Trichoptera**	R
Hirudinea	R	**Lepidoptera**	R	**Other** Acaria	R
Oligochaeta	R	**Sialidae**	R		
Isopoda	R	**Corydalidae**	R		
Amphipoda	R	**Tipulidae**	C		
Decapoda	R	**Empididae**	R		
Gastropoda	R	**Simuliidae** Noted	R		
Bivalvia		**Tabanidae**	R		
		Culicidae			

Rare < 3 **Common 3–9** **Abundant > 10** **Dominant > 50 (Estimate)**

Observations

Ephemeroptera dominated by Baetis
Many different chironomids which dominated sample
Dipterans (other than chironomids) prevalent
Very small stoneflies

Biosurvey Field Data Sheet for use with Rapid Bioassessment Protocol I.

Page 1 of

053092
045-03

Document # 12-MI Mike Mischel

IMPAIRMENT ASSESSMENT SHEET

1. Detection of impairment: Impairment detected (Complete items 2-6) [✓ No impairment detected (Stop here)]

2. Biological impairment indicator:

Benthic macroinvertebrates
- ____ absence of EPT taxa
- ____ dominance of tolerant groups
- ____ low benthic abundance
- ____ low taxa richness
- ____ other

Other aquatic communities
- ____ Periphyton
  - ____ filamentous
  - ____ other
- ____ Macrophytes
- ____ Slimes
- ____ Fish

3. Brief description of problem: ____________________
Year and date of previous surveys: ____________________
Survey data available in: ____________________

4. Cause: (indicate major cause) organic enrichment toxicants flow
habitat limitations other ____________

5. Estimated areal extent of problem (m^2) and length of stream reach affected (m), where applicable: ____________________

6. Suspected source(s) of problem:

- ____ point source discharge (name, type of facility, location)
- ____ construction site runoff
- ____ combined sewer outfall
- ____ silviculture runoff
- ____ animal feedlot
- ____ agricultural runoff
- ____ urban runoff
- ____ ground water
- ____ other
- ____ unknown

Briefly explain:

Impairment Assessment Sheet for use with macroinvertebrate Rapid Bioassessment Protocols.

06 03 92
OU5-MI-04

Document #13-MI

Mike Mi[illegible]

Qualitative Assessment
Beaver Pond Station #2
Start 10:28 END: 11:05

* Rapid Bioassessment ~~Protocol I~~

Biosurvey Field Data Sheet

RELATIVE ABUNDANCE OF AQUATIC BIOTA

Periphyton	0	[✓ 1]	2	3	4	**Slimes**	0	[✓ 1]	2	3	4
Filamentous Algae	[✓ 0]	1	2	3	4	**Macroinvertebrates**	0	1	2	[✓ 3]	4
Macrophytes	[✓ 0]	1	2	3	4	**Fish**	0	1	2	3	4

0 = Absent/Not Observed **1 = Rare** **2 = Common** **3 = Abundant** **4 = Dominant**

MACROBENTHOS QUALITATIVE SAMPLE LIST (Indicate Relative Abundance R = Rare, C = Common, A = Abundant, D = Dominant)

Porifera	0	**Anisoptera**	0	**Chironomidae**	D
Hydrozoa	0	**Zygoptera**	0	**Plecoptera**	0
Platyhelminthes	0	**Hemiptera**	C	**Ephemeroptera**	0
Turbellaria	0	**Coleoptera**	0	**Trichoptera**	0
Hirudinea	0	**Lepidoptera**	0	**Other**	
Oligochaeta	C	**Sialidae**	0		
Isopoda	0	**Corydalidae**	0		
Amphipoda	A	**Tipulidae**	0		
Decapoda	0	**Empididae**	0		
Gastropoda	0	**Simuliidae**	0		
Bivalvia	0	**Tabanidae**	0		
		Culicidae	C		

Rare < 3 **Common 3–9** **Abundant > 10** **Dominant > 50 (Estimate)**

Observations

Ph = 7.06
DO = 10.3
Cond = 290
Temp = 11.0°C
In Situ (10:28 hrs)

Chironomids ~~the~~ the most dominant organisms. Oligochaets present, Scuds, Water boatman, zooplankton in water column (Daphnids, cyclops) Dragonfly nymph I ated (Damsel stocking)

Sample site A (P1 + P4) Hard bottom very mud clay, slippery!
Sample site B (P2 + P5) More silt, less clay, and coarse sand, gravel under silt.
Sample site C (P3 + P6) Fine silt 1 to 2" covering sand, gravel. Freshwater sponges on tree stumps.

Biosurvey Field Data Sheet for use with Rapid Bioassessment ~~Protocol I~~

Qualitative samples were obtained by running a dip net through water column, and kick net skimmed across surface of sediments on bottom.

Map Over

* No RBP for Ponds

P1-3 = Regular Sample
P4-6 = QA/QC Sample
Q = Qualitative Sample

06 0292

045-MI-05Q

Document # 14-MI

Beaver Pond : Station 1

Rapid Bioassessment *

~~Rapid Bioassessment Protocol I~~

Biosurvey Field Data Sheet

RELATIVE ABUNDANCE OF AQUATIC BIOTA

Periphyton	[✓ 0]	1	2	3	4	**Slimes**	0	1	[✓ 2]	3	4
Filamentous Algae	[✓ 0]	1	2	3	4	**Macroinvertebrates**	0	1	2	[✓ 3]	4
Macrophytes	[✓ 0]	1	2	3	4	**Fish**	[✓ 0]	1	2	3	4

0 = Absent/Not Observed **1 = Rare** **2 = Common** **3 = Abundant** **4 = Dominant**

MACROBENTHOS QUALITATIVE SAMPLE LIST (Indicate Relative Abundance R = Rare, C = Common, A = Abundant, D = Dominant)

Porifera	R	**Anisoptera**	None	**Chironomidae**	D
Hydrozoa	None	**Zygoptera**	None	**Plecoptera**	R
Platyhelminthes	None	**Hemiptera**	C	**Ephemeroptera**	R
Turbellaria	None	**Coleoptera**	None	**Trichoptera**	R
Hirudinea	None	**Lepidoptera**	None	***Other**	Inwater column
Oligochaeta	R ?	**Sialidae**	None	Daphnia sp.	
Isopoda	None	**Corydalidae**	None	Scuds along surface bottom	
Amphipoda	A	**Tipulidae**	None		
Decapoda	None	**Empididae**	None		
Gastropoda	None	**Simuliidae**	None		
Bivalvia	None	**Tabanidae**	None		
		Culicidae	C		

Rare < 3 **Common 3-9** **Abundant > 10** **Dominant > 50 (Estimate)**

Observations : Qualitative Collection Scuds and Daphnia in the water column dominated the invertebrates. Scuds and midges were abundant near the surface sediments. Other organisms present were water mites (Acarali), mosquito larvae (culicidae), water boatmen (Hemyptera), Cyclops, Bryozoans, Mayfly.

Note: The bottom material was light sediment over gravel except near the input area of the diesel fuel spill. This area had a lite sediment over crust then a black sludge material.

Map of Sample area (OVER)

Biosurvey Field Data Sheet fo~~r use with Rapid Bioassessment Protocol I~~**.** Beaver Pond

pH 6.85
D.O. 3.70
Cond. 320 In Site Water Chem.
Temp. 9.0 °C

* No RBP for Ponds

⁙ Iron bacteria
Oil Scum

P: Ponars

Q: Qualitative Collection
  a) dip net in water column
  b) Kicknet along the surface of the bottom

D.T. Dead Tree

C6 0392
QUS-MI-06

Document # 15-MI

Qualitative Assessment
Ponding Area Below ST 36
Start 1500 END 1730

*Rapid Bioassessment ~~Protocol I~~

Biosurvey Field Data Sheet

RELATIVE ABUNDANCE OF AQUATIC BIOTA

Periphyton	[✓ 0]	1	2	3	4	**Slimes**	0	1	2	3	[✓ 4]
Filamentous Algae	[✓ 0]	1	2	3	4	**Macroinvertebrates**	0	1	[✓ 2]	3	4
Macrophytes	[✓ 0]	1	2	3	4	**Fish**	[✓ 0]	1	2	3	4

0 = Absent/Not Observed **1 = Rare** **2 = Common** **3 = Abundant** **4 = Dominant**

MACROBENTHOS QUALITATIVE SAMPLE LIST (Indicate Relative Abundance R = Rare, C = Common, A = Abundant, D = Dominant)

Porifera	0	**Anisoptera**	0	**Chironomidae**	D
Hydrozoa	0	**Zygoptera**	0	**Plecoptera**	0
Platyhelminthes	0	**Hemiptera**	0	**Ephemeroptera**	0
Turbellaria	0	**Coleoptera**	0	**Trichoptera**	R C
Hirudinea	0	**Lepidoptera**	0	**Other** Zooplanktons (Many	
Oligochaeta	C ?	**Sialidae**	0	could be Cyclops)	
Isopoda	0	**Corydalidae**	0		
Amphipoda	0	**Tipulidae**	0		
Decapoda	0	**Empididae**	0		
Gastropoda	0	**Simuliidae**	0		
Bivalvia	0	**Tabanidae**	0		
		Culicidae	C		

Rare < 3 **Common 3–9** **Abundant > 10** **Dominant > 50 (Estimate)**

Observations

Qualitative sample dominated by Chironomidae. One trichopteran (case builder, Limnephilid or Leptocerid). Many small zooplankters (not Daphnids) probably cyclops (copepods)

Water chem
ph = 6.86
D.O. = 4.5 mg/L
Cond. = 382 µmhos/cm²
Water temp. = 10.0°C

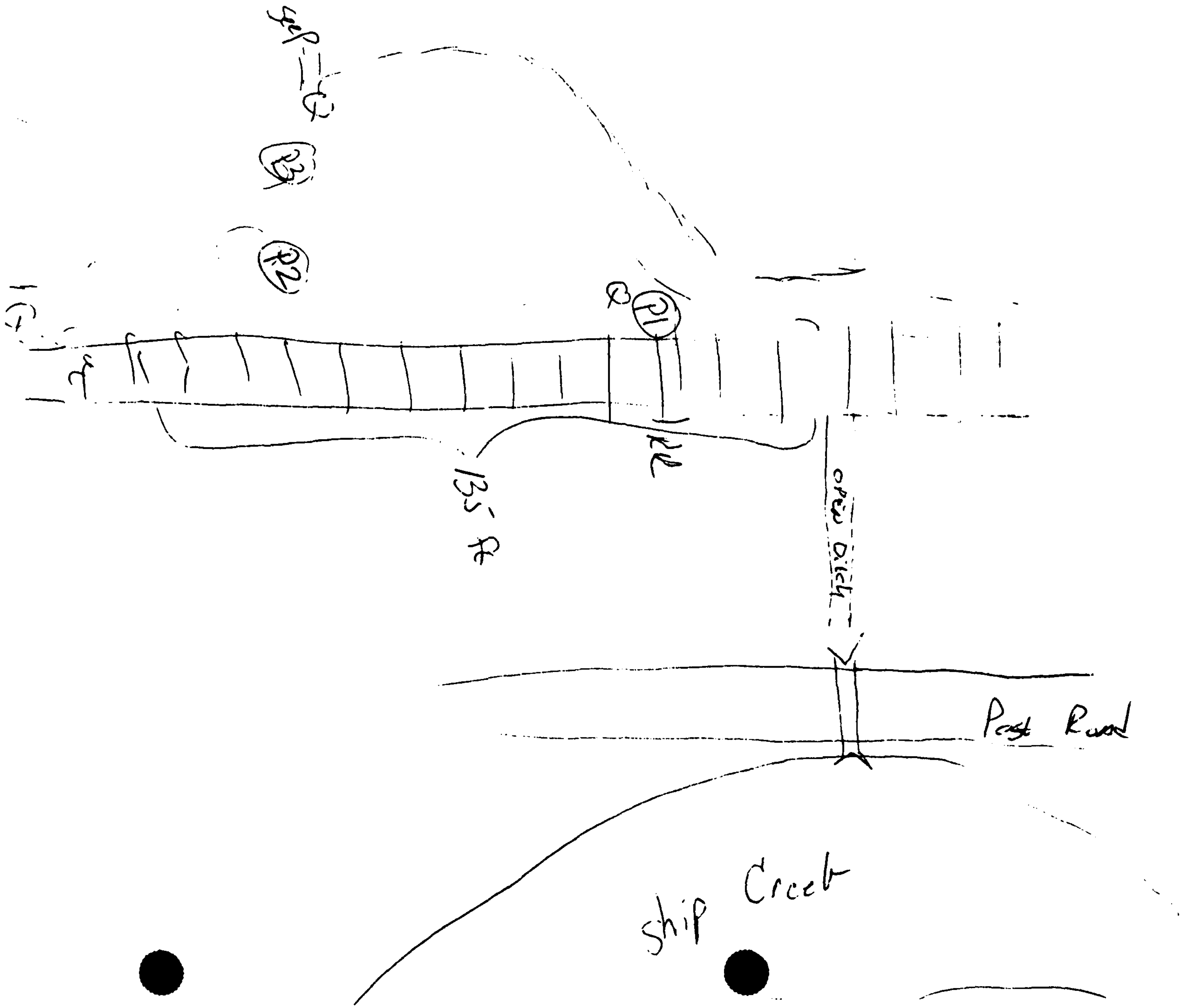
Quantitative samples
P1 - Smelled (very strong) of diesel fuel
P2 } odor not as strong
P3

A lot of iron bacteria in the sample area and petroleum sheen

Biosurvey Field Data Sheet for use with Rapid Bioassessment Protocol I.

* No RBP for Ponds

Map (OVER)



45
87

060492

OU5-MI-07-Q

Document #16-MI

** Snow Melt Pond
Qualitative

**

Rapid Bioassessment ~~Protocol I~~

Biosurvey Field Data Sheet

RELATIVE ABUNDANCE OF AQUATIC BIOTA

Periphyton	0	1	2	3	4	Slimes	0	1	2	3	4
Filamentous Algae	0	1	2	3	4	Macroinvertebrates	0	1	2	3	4
Macrophytes	0	1	2	3	4	Fish	0	1	2	3	4

0 = Absent/Not Observed 1 = Rare 2 = Common 3 = Abundant 4 = Dominant

MACROBENTHOS QUALITATIVE SAMPLE LIST (indicate Relative Abundance R = Rare, C = Common, A = Abundant, D = Dominant)

Porifera	Anisoptera	Chironomidae
Hydrozoa	Zygoptera	Plecoptera
Platyhelminthes	Hemiptera	Ephemeroptera
Turbellaria	Coleoptera	Trichoptera
Hirudinea	Lepidoptera	Other
Oligochaeta	Sialidae	
Isopoda	Corydalidae	
Amphipoda	Tipulidae	
Decapoda	Empididae	
Gastropoda	Simuliidae	
Bivalvia	Tabanidae	
	Culicidae	

Rare < 3 Common 3–9 Abundant > 10 Dominant > 50 (Estimate)

Observations:
Sample taken for macroinvertebrates was preserved, but not field picked. Daphnia present in water column, midges and mosquito larvae present in bottom surface sediment. Sediment composed of coarse sand and gravel material with a fine silt layer over the top. No odors noted in sediment.

* No RBP for Snow Melt Pond

Biosurvey Field Data Sheet for use with Rapid Bioassessment Protocol I.

06.04.92
C45-MI-08-Q

Document # 17-MI

** Pond located at
SL005

Rapid Bioassessment * ~~Protocol I~~

Biosurvey Field Data Sheet

RELATIVE ABUNDANCE OF AQUATIC BIOTA

Periphyton	0	1	2	3	4	Slimes	0	1	2	3	4
Filamentous Algae	0	1	2	3	4	Macroinvertebrates	0	1	2	3	4
Macrophytes	0	1	2	3	4	Fish	0	1	2	3	4

0 = Absent/Not Observed 1 = Rare 2 = Common 3 = Abundant 4 = Dominant

MACROBENTHOS QUALITATIVE SAMPLE LIST (Indicate Relative Abundance R = Rare, C = Common, A = Abundant, D = Dominant)

Porifera	Anisoptera	Chironomidae
Hydrozoa	Zygoptera	Plecoptera
Platyhelminthes	Hemiptera	Ephemeroptera
Turbellaria	Coleoptera	Trichoptera
Hirudinea	Lepidoptera	Other
Oligochaeta	Sialidae	
Isopoda	Corydalidae	
Amphipoda	Tipulidae	
Decapoda	Empididae	
Gastropoda	Simuliidae	
Bivalvia	Tabanidae	
	Culicidae	

Rare < 3 Common 3–9 Abundant > 10 Dominant > 50 (Estimate)

Observations: Sample of surface water dominated by Daphnia and Culicides. Grabbed leaf pack and bottom sediment but did not observe anything. Preserved sample in formaldehyde. Water and bottom material smelled of fuel oil. Bottom ~~Daphnids, Culicids~~ sediment overlain ~~with~~ 1 ft. of leaves + twigs.

* No RBP for Ponds

Biosurvey Field Data Sheet for use with Rapid Bioassessment Protocol I.

RAPID BIOASSESSMENT PROTOCOL 1 DATA— LATE SUMMER 1992

RAPID BIOASSESS   ; PROTOCOL

Biosurvey Field Data Sheet

Date 9-1-92
Time 1135
Project # ADC 31026. H2.20

Location Ship Creek
Sample # S-M1-01-Q
Biologist/Asst. M. Mischuk / S. Hope

Relative Abundance of Aquatic Biota

Periphyton	[✓ 0]	1	2	3	4	Slimes	[✓ 0]	1	2	3	4
Filamentous Algae	[✓ 0]	1	2	3	4	Macroinvertebrates	0	1	2	3	[✓ 4]
Macrophytes	[✓ 0]	1	2	3	4	Fish	[✓ 0]	1	2	3	4

0 = Absent/Not Observed   1 = Rare   2 = Common   3 = Abundant   4 = Dominant

MACROBENTHOS QUALITATIVE SAMPLE LIST(Indicate Relative Abundance R = Rare, C = Common, A = Abundant, D = Dominant)

Porifera	R	Anisoptera	R	Chironomidae	C
Hydrozoa	R	Zygoptera	R	Plecoptera	C
Platyhelminthes	R	Hemiptera	R	Ephemeroptera	D
Turbellaria	R	Coleoptera	R	Trichoptera	C
Hirudinea	R	Lepidoptera	R	Other	
Oligochaeta	R	Sialidae	R		
Isopoda	R	Corydalidae	R		
Amphipoda	R	Tipulidae	R		
Decopoda	R	Empididae	R		
Gastropoda	R	Simuliidae	C		
Bivalvia	R	Tabanidae	R		
		Culicidae	C		

Rare < 3   Common 3 - 9   Abundant > 10   Dominant > 50 (Estimate)

Observations:
Dominant organisms present in qual. samples (Kick net collection) was mayflies (Ephemerelids, Heptageniids, Plecoptera present, Simulids, Trichoptera (Limnephilids, Brachycentrids), A few chironomids

Document #1

RAPID BIOASSESS. PROTOCOL

Biosurvey Field Data Sheet

Date 9-1-92
Time 1556
Project # AWC 31026. H2. 20

Location Ship Creek
Sample # S-MI-02-Q
Biologist/Asst. M. Mischuk / S. Hope

Relative Abundance of Aquatic Biota

Periphyton 0 [✓ 1] 2 3 4
Filamentous Algae [✓ 0] 1 2 3 4
Macrophytes [✓ 0] 1 2 3 4

Slimes [✓ 0] 1 2 3 4
Macroinvertebrates 0 1 2 3 [✓ 4]
Fish [✓ 0] 1 2 3 4

0 = Absent/Not Observed 1 = Rare 2 = Common 3 = Abundant 4 = Dominant

MACROBENTHOS QUALITATIVE SAMPLE LIST(Indicate Relative Abundance R = Rare, C = Common, A = Abundant, D = Dominant)

Porifera	R	Anisoptera	R	Chironomidae	A
Hydrozoa	R	Zygoptera	R	Plecoptera	R
Platyhelminthes	R	Hemiptera	R	Ephemeroptera	D
Turbellaria	R	Coleoptera	R	Trichoptera	A
Hirudinea	R	Lepidoptera	R	Other	
Oligochaeta	R	Sialidae	R		
Isopoda	R	Corydalidae	R		
Amphipoda	R	Tipulidae	R		
Decopoda	R	Empididae	R		
Gastropoda	R	Simuliidae	R		
Bivalvia	R	Tabanidae	R		
		Culicidae	R		

Rare < 3 Common 3 - 9 Abundant > 10 Dominant > 50 (Estimate)

Observations
Ephemeroptera dominant (Ephemerellidae, Ephemeridae), Chironomidae prevalent, more so than S-MI-01, Caddisfly represented Leptoceridae and possibly Glossosomatids + Limnephilids), Stoneflies also present

D[illegible]ent #2

RAPID BIOASSESS… …PROTOCOL

Biosurvey Field Data Sheet

Date 8-30-92
Time 1448
Project # AWC 31026. 42.20

Location Ship Creek
Sample # 5-MI-03-Q
Biologist/Asst. M. Mischuk / S. Hupe

Relative Abundance of Aquatic Biota

Periphyton 0 [✓ 1] 2 3 4

Filamentous Algae 0 [✓ 1] 2 3 4
Some Bryophytes

Macrophytes [✓ 0] 1 2 3 4

Slimes [✓ 0] 1 2 3 4

Macroinvertebrates 0 1 2 3 [✓ 4]

Fish 0 [✓ 1] 2 3 4

0 = Absent/Not Observed 1 = Rare 2 = Common 3 = Abundant 4 = Dominant

MACROBENTHOS QUALITATIVE SAMPLE LIST (Indicate Relative Abundance R = Rare, C = Common, A = Abundant, D = Dominant)

Porifera	R	Anisoptera	R	Chironomidae	D
Hydrozoa	R	Zygoptera	R	Plecoptera	R
Platyhelminthes	R	Hemiptera	R	Ephemeroptera	D
Turbellaria	R	Coleoptera	R	Trichoptera	A
Hirudinea	R	Lepidoptera	R	Other	
Oligochaeta	R	Sialidae	R		
Isopoda	R	Corydalidae	R		
Amphipoda	R	Tipulidae	R		
Decopoda	R	Empididae	C		
Gastropoda	R	Simuliidae	R		
Bivalvia	R	Tabanidae	R		
		Culicidae	C		

Rare < 3 Common 3 - 9 Abundant > 10 Dominant > 50 (Estimate)

Observations:
Chironomidae very abundant, mostly small, probably orthoclads. Many Ephemeroptera either Heptagenoids/Ephemerellids. Some water mites noted. Trichopterans - probably Brachycentrus.

Document # 3

RAPID BIOASSESS. PROTOCOL

Biosurvey Field Data Sheet

Date 8-31-92
Time 1700
Project # ANC 31026.H2.20

Location Beaver Pond
Sample # 5-MI-04 Q
Biologist/Asst. M. Mischuk / S. Hope

Relative Abundance of Aquatic Biota

Periphyton	[✓ 0]	1	2	3	4	Slimes	0	[✓ 1]	2	3	4
Filamentous Algae	[✓ 0]	1	2	3	4	Macroinvertebrates	0	1	2	3	[✓ 4]
Macrophytes	[✓ 0]	1	2	3	4	Fish	[✓ 0]	1	2	3	4

0 = Absent/Not Observed 1 = Rare 2 = Common 3 = Abundant 4 = Dominant

MACROBENTHOS QUALITATIVE SAMPLE LIST(Indicate Relative Abundance R = Rare, C = Common, A = Abundant, D = Dominant)

Porifera	R	Anisoptera	R	Chironomidae	D
Hydrozoa	R	Zygoptera	C	Plecoptera	R
Platyhelminthes	R	Hemiptera	R	Ephemeroptera	R
Turbellaria	R	Coleoptera	R	Trichoptera	R
Hirudinea	R	Lepidoptera	R	Other	
Oligochaeta	C	Sialidae	R		
Isopoda	R	Corydalidae	R		
Amphipoda	C	Tipulidae	R		
Decopoda	R	Empididae	R		
Gastropoda	R	Simuliidae	R		
Bivalvia	R	Tabanidae	R		
		Culicidae	R		

Rare < 3 Common 3 - 9 Abundant > 10 Dominant > 50 (Estimate)

Observations :

Qual. samples dominated by Chironomids, oligochaetes common particularly tubificids, Scuds, daphnids, dragonflies, watermites present. Preserved samples as 5-MI-04-Q (Picked) & (unpicked

ment #4

RAPID BIOASSESS. PROTOCOL

Biosurvey Field Data Sheet

Date 8-31-92
Time 13Ø6
Project # ANC 31Ø26. H2. 2Ø

Location Beaver Pond
Sample # 5-MI-05-Q
Biologist/Asst. M. Mischuk/ S. Hupe

Relative Abundance of Aquatic Biota

Periphyton	[✓ 0]	1	2	3	4	* Slimes	0	1	[✓ 2]	3	4
Filamentous Algae	[✓ 0]	1	2	3	4	Macroinvertebrates	0	1	2	[✓ 3]	4
Macrophytes	[✓ 0]	1	2	3	4	Fish	[✓ 0]	1	2	3	4

0 = Absent/Not Observed 1 = Rare 2 = Common 3 = Abundant 4 = Dominant

MACROBENTHOS QUALITATIVE SAMPLE LIST(Indicate Relative Abundance R = Rare, C = Common, A = Abundant, D = Dominant)

Porifera	R	Anisoptera	R	Chironomidae	A
Hydrozoa	R	Zygoptera	R	Plecoptera	R
Platyhelminthes	R	Hemiptera	R	Ephemeroptera	R
Turbellaria	R	Coleoptera	R	Trichoptera	R
Hirudinea	R ~~C~~	Lepidoptera	R	Other	
Oligochaeta	C	Sialidae	R		
Isopoda	R	Corydalidae	R		
Amphipoda	R	Tipulidae	R		
Decopoda	R	Empididae	R		
Gastropoda	R	Simuliidae	R		
Bivalvia	R	Tabanidae	R		
		Culicidae	R		

Rare < 3 Common 3 - 9 Abundant > 10 Dominant > 50 (Estimate)

Observations
* Oily filmon water surface, Iron bacterial growth present where seeps entering the Pond
Chironomidae most prevalent in qual. sample picked 32 organisms after 30min. Hydracarina present, oligochaetes, Daphnia also noted in sample, probably associated with water column above sediment surface.
Quantitative samples numbered #'s 5-MI-Ø5-P1, P2, P3

Document # 5

RAPID BIOASSESS. PROTOCOL

Biosurvey Field Data Sheet

Date 9-4-92
Time 1530 Completed
Project # ANC 31026. H2.20

Location Ship Creek
Sample # S-MI-11-Q
Biologist/Asst. M. Mischuk/S. Hope

Relative Abundance of Aquatic Biota

Periphyton	[✓ 0]	1	2	3	4
Filamentous Algae	[✓ 0]	1	2	3	4
Macrophytes	[✓ 0]	1	2	3	4
Slimes	[✓ 0]	1	2	3	4
Macroinvertebrates	0	1	2	[✓ 3]	4
Fish	0	[✓ 1] 2 Sculpins	2	3	4

0 = Absent/Not Observed 1 = Rare 2 = Common 3 = Abundant 4 = Dominant

MACROBENTHOS QUALITATIVE SAMPLE LIST(Indicate Relative Abundance R = Rare, C = Common, A = Abundant, D = Dominant)

Porifera	R	Anisoptera	R	Chironomidae	A
Hydrozoa	R	Zygoptera	R	Plecoptera	R
Platyhelminthes	R	Hemiptera	R	Ephemeroptera	C
Turbellaria	R	Coleoptera	R	Trichoptera	C
Hirudinea	R	Lepidoptera	R	Other	
Oligochaeta	A	Sialidae	R		
Isopoda	R	Corydalidae	R		
Amphipoda	R	Tipulidae	R		
Decopoda	R	Empididae	C		
Gastropoda	R	Simuliidae	R		
Bivalvia	R	Tabanidae	R		
		Culicidae	R		

Rare < 3 Common 3 - 9 Abundant > 10 Dominant > 50 (Estimate)

Observations :
Oligochaetes the most dominant group (Tubificidae), followed by chironomidae (Cricotopus sp.?), sand case building caddisflies, Ephemeroptera (Heptageniids, Ephemerellids), Leech, hydracarina. Samples were collected in stream going from storm drain to Ship Creek and along a tree trunk that diverted the SD water from main channel.

D ment #6

RAPID BIOASSESS. ; PROTOCOL

Biosurvey Field Data Sheet

Date 9-5-92
Time 1107
Project # ANC 31026. H2.20

Location Ship Creek
Sample # S-MI-12-Q
Biologist/Asst. M. Mischuk / S. Hope

Relative Abundance of Aquatic Biota

Periphyton 0 1 [✓ 2] 3 4
Filamentous Algae [✓ 0] 1 2 3 4
Macrophytes [✓ 0] 1 2 3 4

Slimes [✓ 0] 1 2 3 4
Macroinvertebrates 0 1 2 [✓ 3] 4
Fish 0 [✓ 1] 2 3 4

0 = Absent/Not Observed 1 = Rare 2 = Common 3 = Abundant 4 = Dominant

MACROBENTHOS QUALITATIVE SAMPLE LIST(Indicate Relative Abundance R = Rare, C = Common, A = Abundant, D = Dominant)

Porifera	R	Anisoptera	R	Chironomidae	A
Hydrozoa	R	Zygoptera	R	Plecoptera	C
Platyhelminthes	R	Hemiptera	R	Ephemeroptera	D
Turbellaria	R	Coleoptera	R	Trichoptera	A
Hirudinea	R	Lepidoptera	R	Other	
Oligochaeta	C	Sialidae	R		
Isopoda	R	Corydalidae	R		
Amphipoda	R	Tipulidae	R		
Decopoda	R	Empididae	C		
Gastropoda	R	Simuliidae	R		
Bivalvia	R	Tabanidae	R		
		Culicidae	R		

Rare < 3 Common 3 - 9 Abundant > 10 Dominant > 50 (Estimate)

Observations

Ephemeroptera very abundant (Heptageniidae, Baetidae, Ephemerellidae), Plecoptera present (Filipalpians), Tricloptera abundant (Brachycentrids, Leptocerids?,) Chironomidae (Cricotopus sp. small, and larger forms), + Oligochaetes (Tubificids). Kicknet samples were taken from Riffle (S1) and Run/Riffle (S2, S3) areas.

Document #7

~~Page 1 of~~

Document # 8

9-1-92
M. Mischuk / S. Hupe

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET

ADC 31026.H2.20
5-MJ-01
1255 Hrs

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE/WATER

Predominant Surrounding Land Use: AFB + Army Base

[✓ Forest] Field/Pasture Agricultural Residential [✓ Commercial] Industrial Other ____________

High Water Mark 2 (~~m~~ ft) Velocity 5.2 ft/sec Dam Present: Yes ___ No X Channelized: Yes ___ No X

Canopy Cover: [✓ Open] Partly Open Partly Shaded Shaded

SEDIMENT/SUBSTRATE:

Sediment Odors: [✓ Normal] Sewage Petroleum Chemical Anaerobic None Other ____________

Sediment Oils: [✓ Absent] Slight Moderate Profuse

Sediment Deposits: Sludge Sawdust Paper Fiber Sand Relict Shells Other None - some sand at end of gravel bars

Are the undersides of stones which are not deeply embedded black? Yes ___ No X

Inorganic Substrate Components			Organic Substrate Components		
Substrate Type	Diameter	Percent Composition in Sampling Area	Substrate Type	Characteristic	Percent Composition in Sampling Area
Bedrock			Detritus	Sticks, Wood, Coarse Plant Materials (CPOM)	Mostly Inorganic
Boulder	>256mm (10 in.)				
Cobble	64-256mm (2.5-10 in.)	10%			
Gravel	2-64mm (0.1-2.5 in.)	80%	Muck-Mud	Black, Very Fine Organic (FPOM)	< 10%
Sand	0.06-2.00mm (gritty)	10%			
Silt	0.004-.06mm		Marl	Grey, Shell Fragments	
Clay	<0.004mm (slick)				

WATER QUALITY

Stream Type: [✓ Coldwater] Warmwater

Water Odors: [✓ Normal] Sewage Petroleum Chemical None Other ____________

Water Surface Oils: Slick Sheen Globs Flecks [✓ None]

Turbidity: [✓ Clear] Slightly Turbid Turbid Opaque Water Color ____________

Many riffle & pool areas. Riffles very shallow 1 to 2" of water, pools 4-6' deep in places. Chutes 2 to 3' in depth

High water mark at 2 ft above surface of water

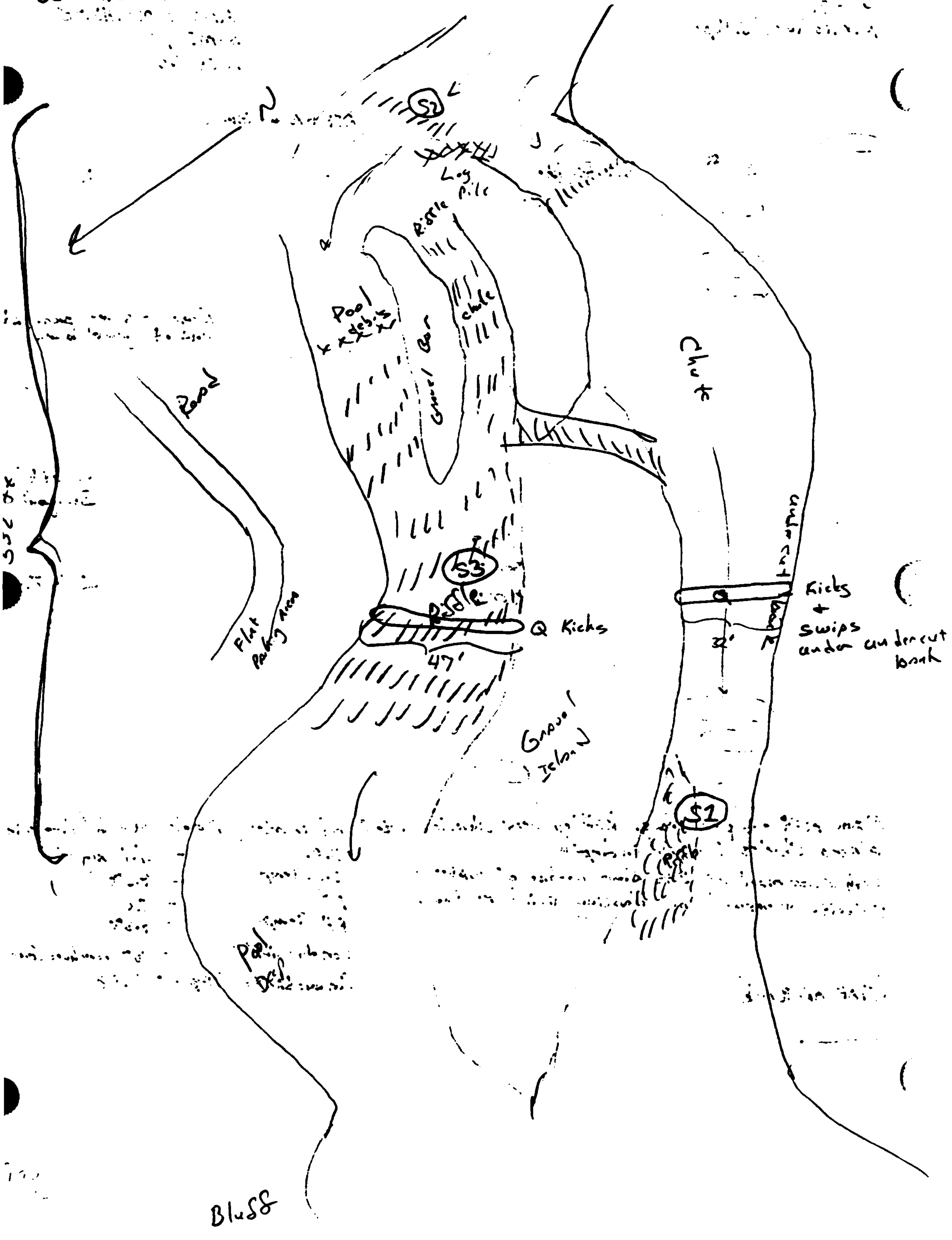
Velocity measured by floating stick method

D.O. - 11.1 mg/L
D.O. Temp - 8.6°C
pH - 7.4
pH Temp. - 8.3°C
Conductivity - 87 µmhos/cm
Conductivity Temp. - 8.5°C

(MAP ON BACK)

~~Figure 5.1-1.~~ Physical Characterization/Water Quality Field Data Sheet for use with all Rapid Bioassessment Protocols.

Document #9


N
S2
Log Pile
Riffle
Pool
x debris x
Gravel Bar
chute
Chute
Road
Flat Parking Area
undercut bank
S3
Riffle
Q Kicks
47'
Kicks + swips under undercut bank
32'
Gravel Island
S1
Riffle
Pool Debris
Bluff

~~Page 1 of 4~~

Document # 10

9-92
1700
ANC 31026.H2.20

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET

Ship Creek
5-MI-02
M. Mischuk / S. Hope

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE/WATER

Predominant Surrounding Land Use:

Forest Field/Pasture Agricultural Residential [✓ Commercial] Golf Course Industrial Other ______

High Water Mark 2 ft. (m) Velocity 7.7 fps * Dam Present: Yes X Downstream No ___ Channelized: Yes ___ No X

Canopy Cover: [✓ Open] Partly Open Partly Shaded Shaded

SEDIMENT/SUBSTRATE:

Sediment Odors: [✓ Normal] Sewage Petroleum Chemical Anaerobic None Other ______

Sediment Oils: [✓ Absent] Slight Moderate Profuse

Sediment Deposits: Sludge Sawdust Paper Fiber Sand Relict Shells Other fine sand opposite cut Bank and at end of gravel bars

Are the undersides of stones which are not deeply embedded black? Yes ___ No X

Inorganic Substrate Components		
Substrate Type	**Diameter**	**Percent Composition in Sampling Area**
Bedrock		
Boulder	>256mm (10 in.)	
Cobble	64-256mm (2.5-10 in.)	
Gravel	2-64mm (0.1-2.5 in.)	90%
Sand	0.06-2.00mm (gritty)	5%
Silt	0.004-.06mm	< 5%
Clay	<0.004mm (slick)	

Organic Substrate Components		
Substrate Type	**Characteristic**	**Percent Composition in Sampling Area**
Detritus	Sticks, Wood, Coarse Plant Materials (CPOM)	100% (Very little present)
Muck-Mud	Black, Very Fine Organic (FPOM)	None
Marl	Grey, Shell Fragments	None

WATER QUALITY

Stream Type: [✓ Coldwater] Warmwater

Water Odors: [✓ Normal] Sewage Petroleum Chemical None Other ______

Water Surface Oils: Slick Sheen Globs Flecks [✓ None]

Turbidity: [✓ Clear] Slightly Turbid Turbid Opaque Water Color ______

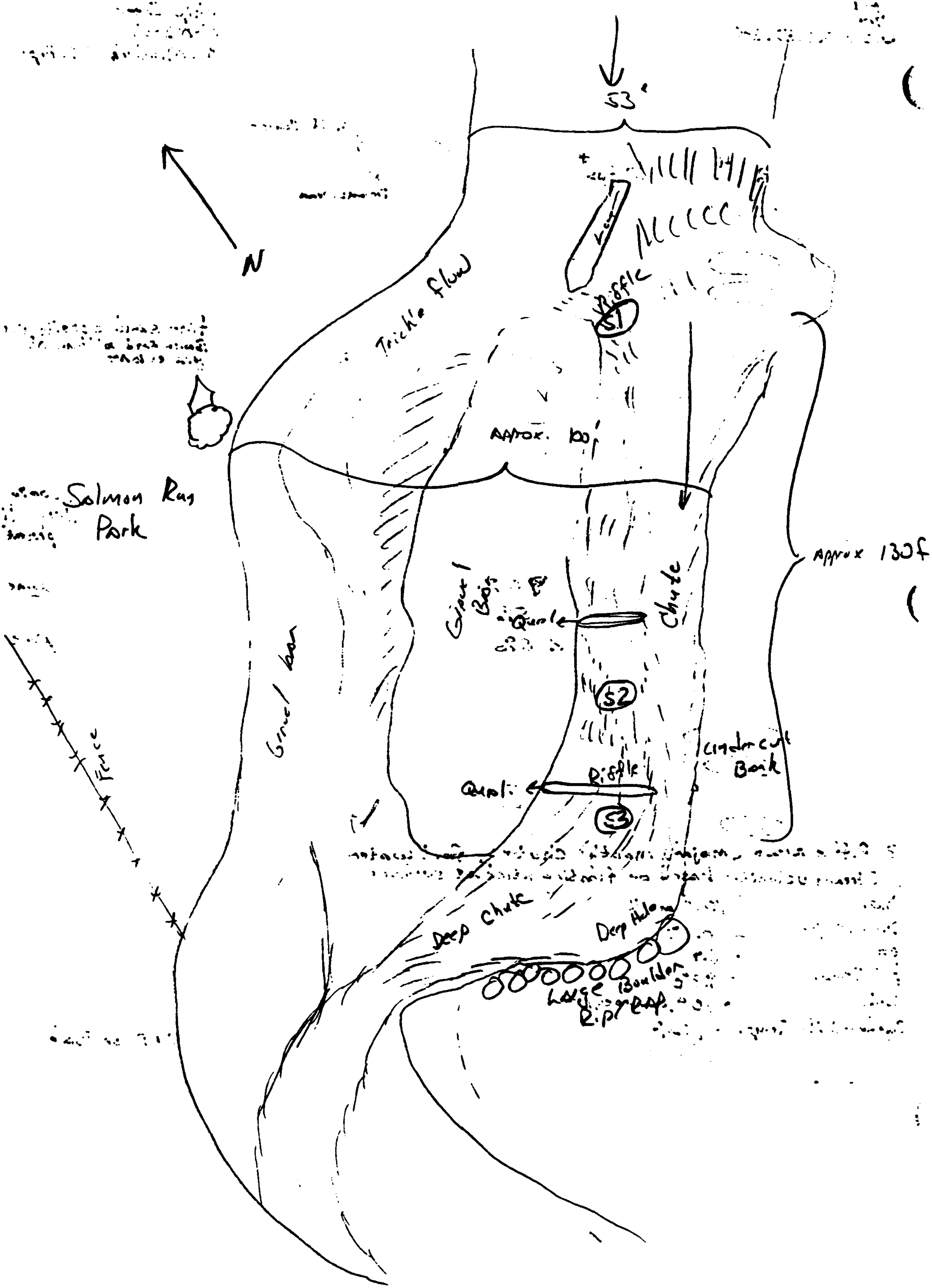
2 Riffle areas (major) mostly chutes, fast water
* Stream velocity based on floating stick at surface
D.O. - 10.2 mg/L
D.O. Temp. - 10.0 °C
pH - 6.9
pH Temp. - 9.9°c
Cond. - 109 µmhoes/cm
Conductivity/Temp. - 10.0°C

(Map on Back)

~~Figure 5.1-1:~~ Physical Characterization/Water Quality Field Data Sheet for use with all Rapid Bioassessment Protocols.

ATLR28/066.51

Document # 11


53'
N
Riffle
Trickle flow
S1
Approx. 100'
Salmon Run Park
Approx 130f
Gravel Bar
Qual
Chute
Gravel bar
S2
Fence
Undercut Bank
Riffle
Qual.
S3
Deep Chute
Deep Hole
Large Boulder Rip rap

~~Page 1 of 1~~

Document #12

8-30-92 / 1500

ANC 31026. H2.20

PHYSICAL CHARACTERIZATION/WATER QUALITY
FIELD DATA SHEET

Ship Creek

5-MI-03

M. Mischuk / S. Hope

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE/WATER

Predominant Surrounding Land Use: Downstream of Golf Course, Salmon Run Park, Adjacent to fish hatchery

Forest Field/Pasture Agricultural Residential [✓ Commercial] Industrial Other ______

High Water Mark ____(m) Velocity ______ Dam Present: Yes X No ___ downstream of sample area Channelized: Yes ___ No X

Canopy Cover: Open Partly Open Partly Shaded Shaded

SEDIMENT/SUBSTRATE:

Sediment Odors: [✓ Normal] Sewage Petroleum Chemical Anaerobic None Other ______

Sediment Oils: [✓ Absent] Slight Moderate Profuse

Sediment Deposits: Sludge Sawdust Paper Fiber Sand Relict Shells [✓ None] Other ______

Are the undersides of stones which are not deeply embedded black? Yes ___ No X

Inorganic Substrate Components			Organic Substrate Components		
Substrate Type	Diameter	Percent Composition in Sampling Area	Substrate Type	Characteristic	Percent Composition in Sampling Area
Bedrock			Detritus	Sticks, Wood, Coarse Plant Materials (CPOM)	100% (Very little actually Present)
Boulder	>256mm (10 in.)				
Cobble	64-256mm (2.5-10 in.)	10%			
Gravel	2-64mm (0.1-2.5 in.)	80%	Muck-Mud	Black, Very Fine Organic (FPOM)	None
Sand	0.06-2.00mm (gritty)	10%			
Silt	0.004-.06mm		Marl	Grey, Shell Fragments	None
Clay	<0.004mm (slick)				

WATER QUALITY

Stream Type: [✓ Coldwater] Warmwater

Water Odors: [✓ Normal] Sewage Petroleum Chemical None Other ______

Water Surface Oils: Slick Sheen Globs Flecks [✓ None]

Turbidity: [✓ Clear Slightly Turbid] Turbid Opaque Water Color ______

D.O. - 8.7 mg/L

D.O. Temp. - 9.5°C

Conductivity - 110 μmhos/cm

Conductivity Temp. - 9.0 °C

pH - 7.1

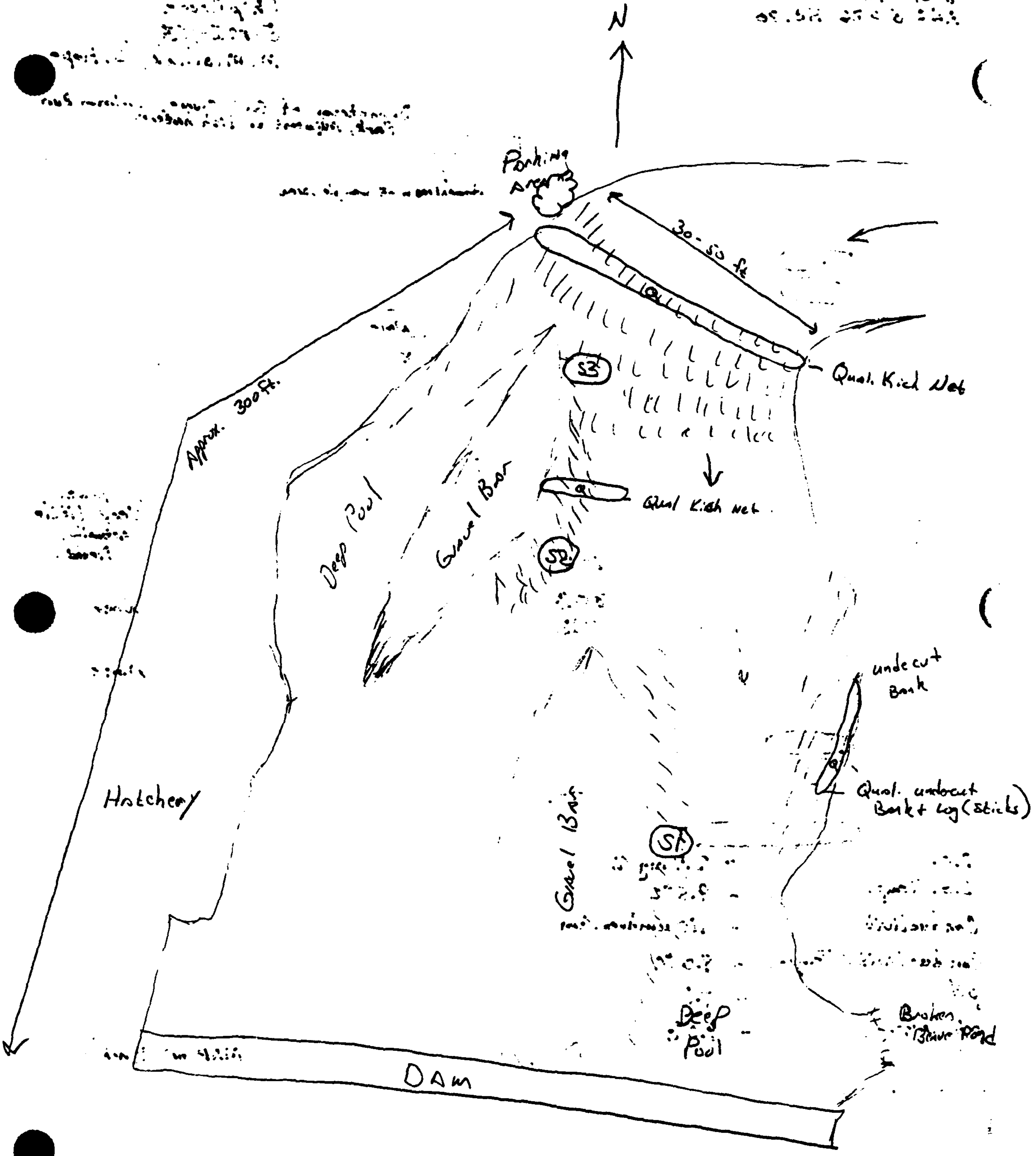
pH Temp. - 9.0°C

(MAP on Back)

~~Figure 5.1-1~~. Physical Characterization/Water Quality Field Data Sheet for use with all Rapid Bioassessment Protocols.

ATLR28/066.51

Document #13


N
Parking Area
30-50 ft
Approx. 300 ft.
Qual. Kick Net
S3
Deep Pool
Gravel Bar
Qual Kick Net
S2
undecut Bank
Qual. undercut Bank + Log (sticks)
Hatchery
Gravel Bar
S1
Deep Pool
Broken Beaver Pond
DAM

Document # 14

8-31-92
1530

Beaver Pond
ANC 31026.112.20
5-MI-04

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE/WATER

Predominant Surrounding Land Use:

Forest Field/Pasture Agricultural Residential [✓ Commercial] Industrial Other ______

High Water Mark N/A (m) Velocity N/A Dam Present: Yes X Beaver No ___ Channelized: Yes ___ No ___

Canopy Cover: [✓ Open] Partly Open Partly Shaded Shaded

SEDIMENT/SUBSTRATE:

Sediment Odors: [✓ Normal] Sewage Petroleum Chemical Anaerobic None Other ______

Sediment Oils: Absent [✓ Slight] Moderate Profuse

Sediment Deposits: Sludge Sawdust Paper Fiber Sand Relict Shells Other ______

Are the undersides of stones which are not deeply embedded black? N/A Yes ___ No ___

Inorganic Substrate Components

Substrate Type	Diameter	Percent Composition in Sampling Area
Bedrock		
Boulder	>256mm (10 in.)	
Cobble	64-256mm (2.5-10 in.)	
Gravel	2-64mm (0.1-2.5 in.)	20%
Sand	0.06-2.00mm (gritty)	50%
Silt	0.004-.06mm	20%
Clay	<0.004mm (slick)	10%

Organic Substrate Components

Substrate Type	Characteristic	Percent Composition in Sampling Area
Detritus	Sticks, Wood, Coarse Plant Materials (CPOM)	20%
Muck-Mud	Black, Very Fine Organic (FPOM)	80%
Marl	Grey, Shell Fragments	

WATER QUALITY

~~Stream~~ Pond Type: [✓ Coldwater] Warmwater

Water Odors: [✓ Normal] Sewage Petroleum Chemical None Other ______

Water Surface Oils: Slick Sheen Globs Flecks [✓ None]

Turbidity: [✓ Clear Slightly Turbid] Turbid Opaque Water Color ______

D.O. - 8.2 mg/L
D.O. Temp - 10.2 °C
Cond. - 289 µmhos/cm
Cond. Temp. - 10.1 °C
pH - 7.09
pH Temp. - 10.2°C

(MAP on Back)

~~Figure 5.1-1.~~ Physical Characterization/Water Quality Field Data Sheet for use with all Rapid Bioassessment Protocols.

Document # 15

Beaver Pond West End

~~Page 1 of 1~~

Document #16

8-31-92
13∅6

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET

Beaver Pond
AOC 81∅26. H2. 2∅
5-MI-∅5

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE/WATER

Predominant Surrounding Land Use:

[✓ Forest] Field/Pasture Agricultural Residential [✓ Commercial] Industrial Other ______

High Water Mark N/A (m) Velocity N/A Dam Present: Yes X Beaver No ___ Channelized: Yes ___ No X

Canopy Cover: [✓ Open] Partly Open Partly Shaded Shaded

SEDIMENT/SUBSTRATE:

Sediment Odors: Normal Sewage [✓ Petroleum] Chemical Anaerobic None Other ______

Sediment Oils: Absent Slight [✓ Moderate] Profuse

Sediment Deposits: [✓ Sludge] Sawdust Paper Fiber [✓ Sand] Relict Shells Other Vegitable detritus, leaves, sticks

Are the undersides of stones which are not deeply embedded black? N/A Yes ___ No ___

Inorganic Substrate Components			Organic Substrate Components		
Substrate Type	Diameter	Percent Composition in Sampling Area	Substrate Type	Characteristic	Percent Composition in Sampling Area
Bedrock			[✓ Detritus]	Sticks, Wood, Coarse Plant Materials (CPOM)	80%
Boulder	>256mm (10 in.)				
Cobble	64-256mm (2.5-10 in.)				
Gravel	2-64mm (0.1-2.5 in.)		[✓ Muck-Mud]	Black, Very Fine Organic (FPOM)	20% ~~10%~~ m.m.
Sand	0.06-2.00mm (gritty)	10%			
Silt	0.004-.06mm	90%	Marl	Grey, Shell Fragments	
Clay	<0.004mm (slick)				

WATER QUALITY

~~Stream~~ Pond Type: [✓ Coldwater] Warmwater

Water Odors: Normal Sewage [✓ Petroleum] Chemical None Other ______

Water Surface Oils: Slick [✓ Sheen] Globs Flecks None

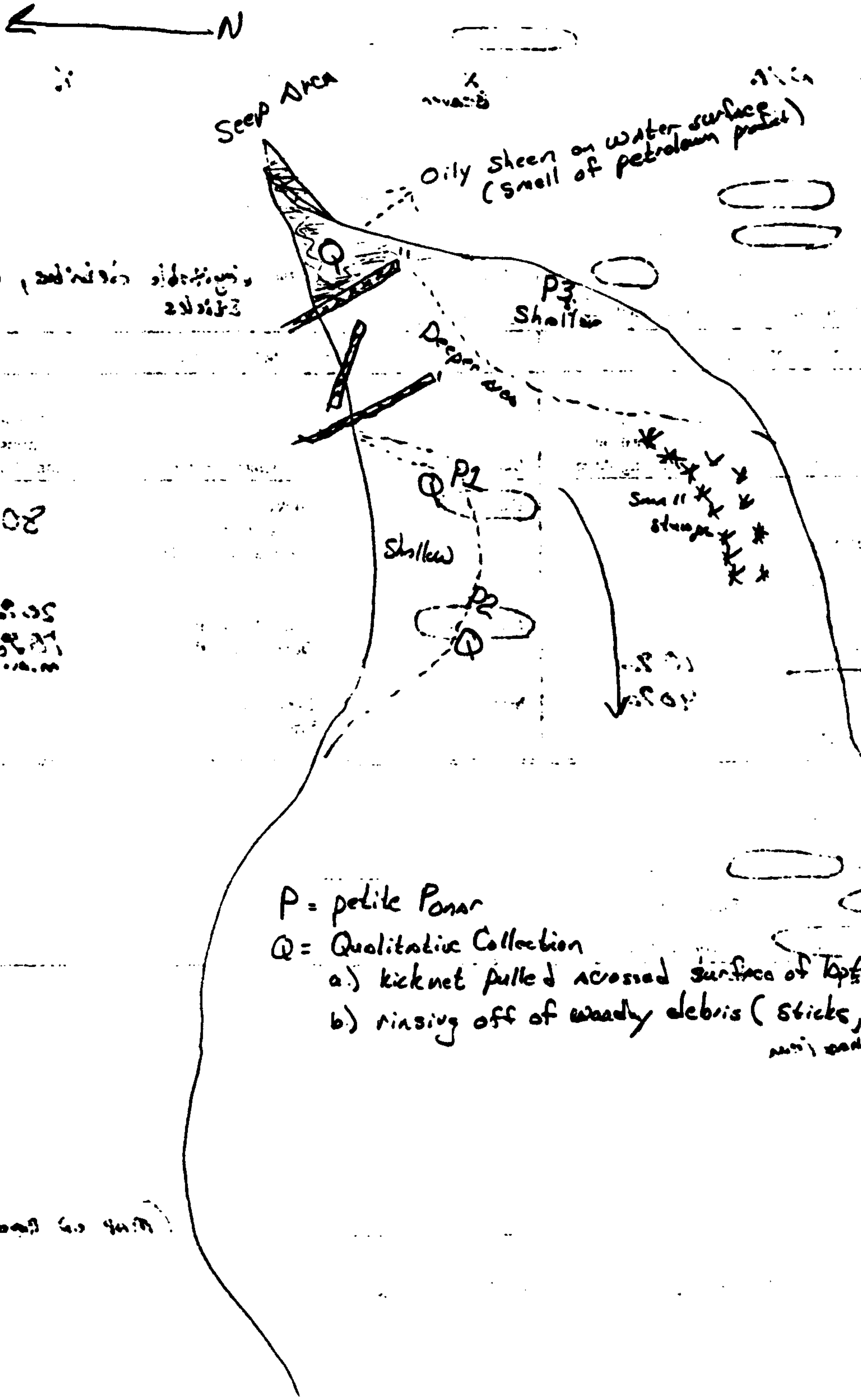
Turbidity: [✓ Clear — Slightly Turbid] Turbid Opaque Water Color ______

D.O. - 6.3 ppm
D.O. Temp. - 10.1 °c
Cond. - 310 umhos/cm
Cond. Temp. - 10.1 °c
pH - 7.3
PH Temp - 9.8 °c

(Map on Back)

~~Figure 5.1-1.~~ Physical Characterization/Water Quality Field Data Sheet for use with all Rapid Bioassessment Protocols.

Document # 17



P = petite Ponar

Q = Qualitative Collection

a.) kicknet pulled acrossed surface of bottom sediments

b.) rinsing off of woody debris (sticks, branches, logs in pond).

Document # 18

9-4-92
AOC 31026.H2.20

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET

Ship Creek 1530
6-MI-11-Q
M. Mischuk / S. Hype

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE/WATER

Predominant Surrounding Land Use: Creek runs along junkyard

Forest Field/Pasture Agricultural Residential Commercial [✓ Industrial] Other ____

High Water Mark 3 ft. (m) **Velocity** 4.3 fps stick method main flow **Dam Present:** Yes ___ No X **Channelized:** Yes ___ No X

Canopy Cover: [✓ Open] Partly Open Partly Shaded Shaded

SEDIMENT/SUBSTRATE:

Sediment Odors: [✓ Normal] Sewage Petroleum Chemical Anaerobic None Other ____

Sediment Oils: [✓ Absent] Slight Moderate Profuse

Sediment Deposits: Sludge Sawdust Paper Fiber [✓ Sand] Relict Shells Other ____

Are the undersides of stones which are not deeply embedded black? Yes ___ No ___ not observed

Inorganic Substrate Components

Substrate Type	Diameter	Percent Composition in Sampling Area
Bedrock		
Boulder	>256mm (10 in.)	
Cobble	64-256mm (2.5-10 in.)	10%
Gravel	2-64mm (0.1-2.5 in.)	80%
Sand	0.06-2.00mm (gritty)	10%
Silt	0.004-.06mm	
Clay	<0.004mm (slick)	

Organic Substrate Components

Substrate Type	Characteristic	Percent Composition in Sampling Area
Detritus	Sticks, Wood, Coarse Plant Materials (CPOM)	very little
Muck-Mud	Black, Very Fine Organic (FPOM)	None
Marl	Grey, Shell Fragments	None

WATER QUALITY

Stream Type: [✓ Coldwater] Warmwater

Water Odors: Normal Sewage Petroleum Chemical [✓ None] Other ____

Water Surface Oils: Slick Sheen Globs Flecks None None noted at time of sampling

Turbidity: [✓ Clear] Slightly Turbid Turbid Opaque Water Color ____

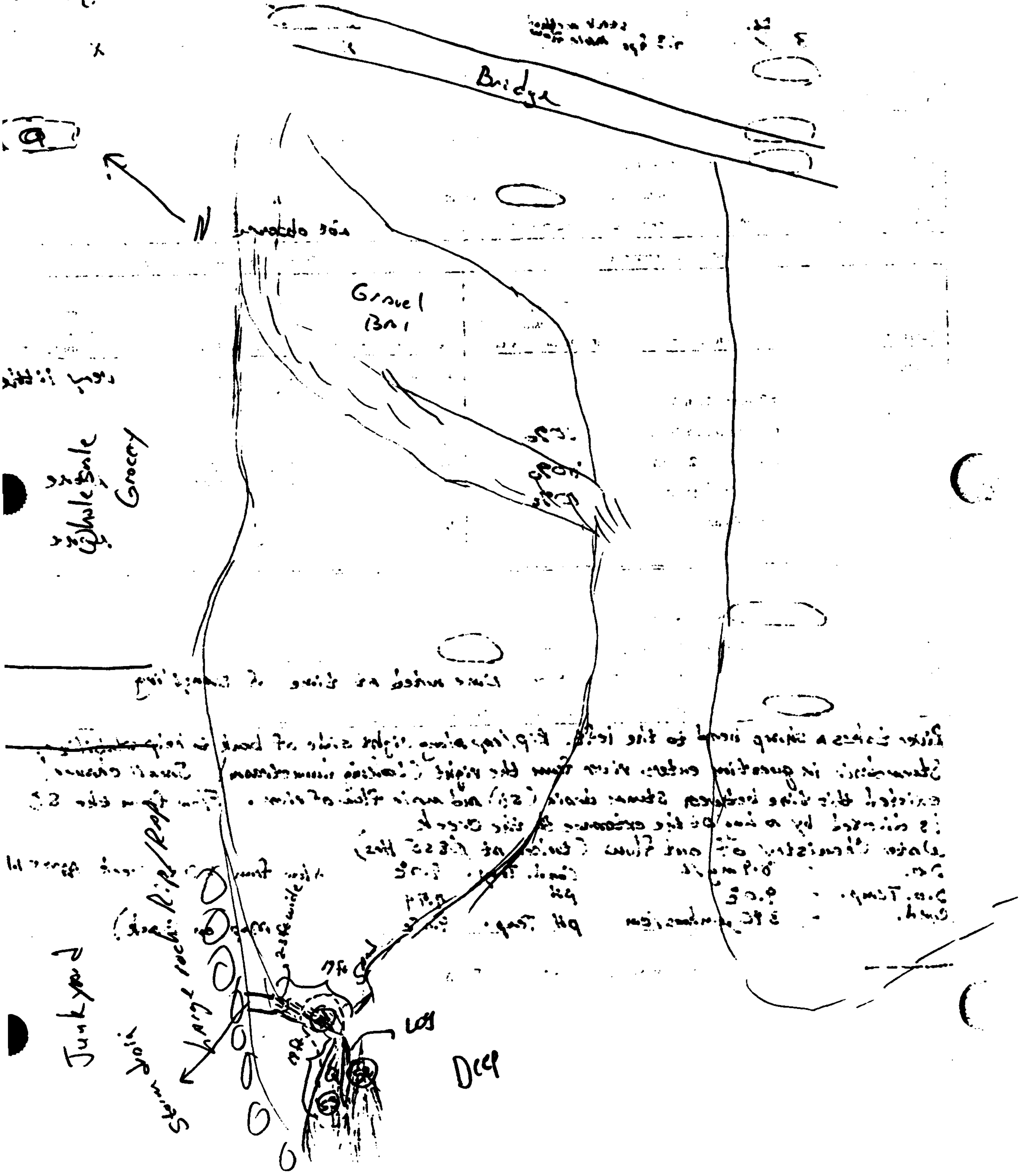
River takes a sharp bend to the left. Rip/rap along right side of bank to help stabilize. Stormdrain in question enters river from the right (Looking downstream). Small channel existed this time between storm drain (SD) and main flow of river. Flow from the SD is diverted by a log at the entrance to the creek.

Water Chemistry of outflow (taken at 0855 Hrs)

D.O. - 8.9 mg/L Cond. Temp. 9.0°C flow from SD to creek approx 1.1 fps
D.O. Temp. - 9.0°C pH 7.79
Cond. - 390 umhos/cm pH Temp. 9.0°C (Map on Back)

~~Figure 5.1-1~~. Physical Characterization/Water Quality Field Data Sheet for use with all Rapid Bioassessment Protocols.

Document #19


Bridge
N
Gravel Bar
Wholesale Grocery
Large rocks Rip/Rap
2-3 ft wide
7 ft
Junkyard
Storm drain
LOS
Deep

M. M.

Document # 20

9-5-92 / 1130
AUC 31026.H2.20

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET

Ship Creek
5-MI-12
M. Mischuk / S. Hope

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE/WATER

Predominant Surrounding Land Use: Adjacent to whole produce place Junkyard below sample area

Forest Field/Pasture Agricultural Residential [✓ Commercial] [✓ Industrial] Other ____

High Water Mark 2 ~~(m)~~ ft Velocity >4.0 fps Dam Present: Yes X No ___ Channelized: Yes ___ No X

Canopy Cover: [✓ Open] Partly Open Partly Shaded Shaded

SEDIMENT/SUBSTRATE:

Sediment Odors: [✓ Normal] Sewage Petroleum Chemical Anaerobic None Other ____

Sediment Oils: [✓ Absent] Slight Moderate Profuse

Sediment Deposits: Sludge Sawdust Paper Fiber [✓ Sand] Some sand areas Relict Shells Other ____

Are the undersides of stones which are not deeply embedded black? Yes ___ No X

Inorganic Substrate Components

Substrate Type	Diameter	Percent Composition in Sampling Area
Bedrock		
Boulder	>256mm (10 in.)	
Cobble	64-256mm (2.5-10 in.)	70%
Gravel	2-64mm (0.1-2.5 in.)	25%
Sand	0.06-2.00mm (gritty)	5%
Silt	0.004-.06mm	
Clay	<0.004mm (slick)	

Organic Substrate Components

Substrate Type	Characteristic	Percent Composition in Sampling Area
Detritus	Sticks, Wood, Coarse Plant Materials (CPOM)	100% (still very little present)
Muck-Mud	Black, Very Fine Organic (FPOM)	None
Marl	Grey, Shell Fragments	None

WATER QUALITY

Stream Type: [✓ Coldwater] Warmwater

Water Odors: Normal Sewage Petroleum Chemical [✓ None] Other ____

Water Surface Oils: Slick Sheen Globs Flecks [✓ None]

Turbidity: [✓ Clear] Slightly Turbid Turbid Opaque Water Color ____

Sample area just downstream of bridge and outfall area of State fish hatchery. In situ water quality measurements

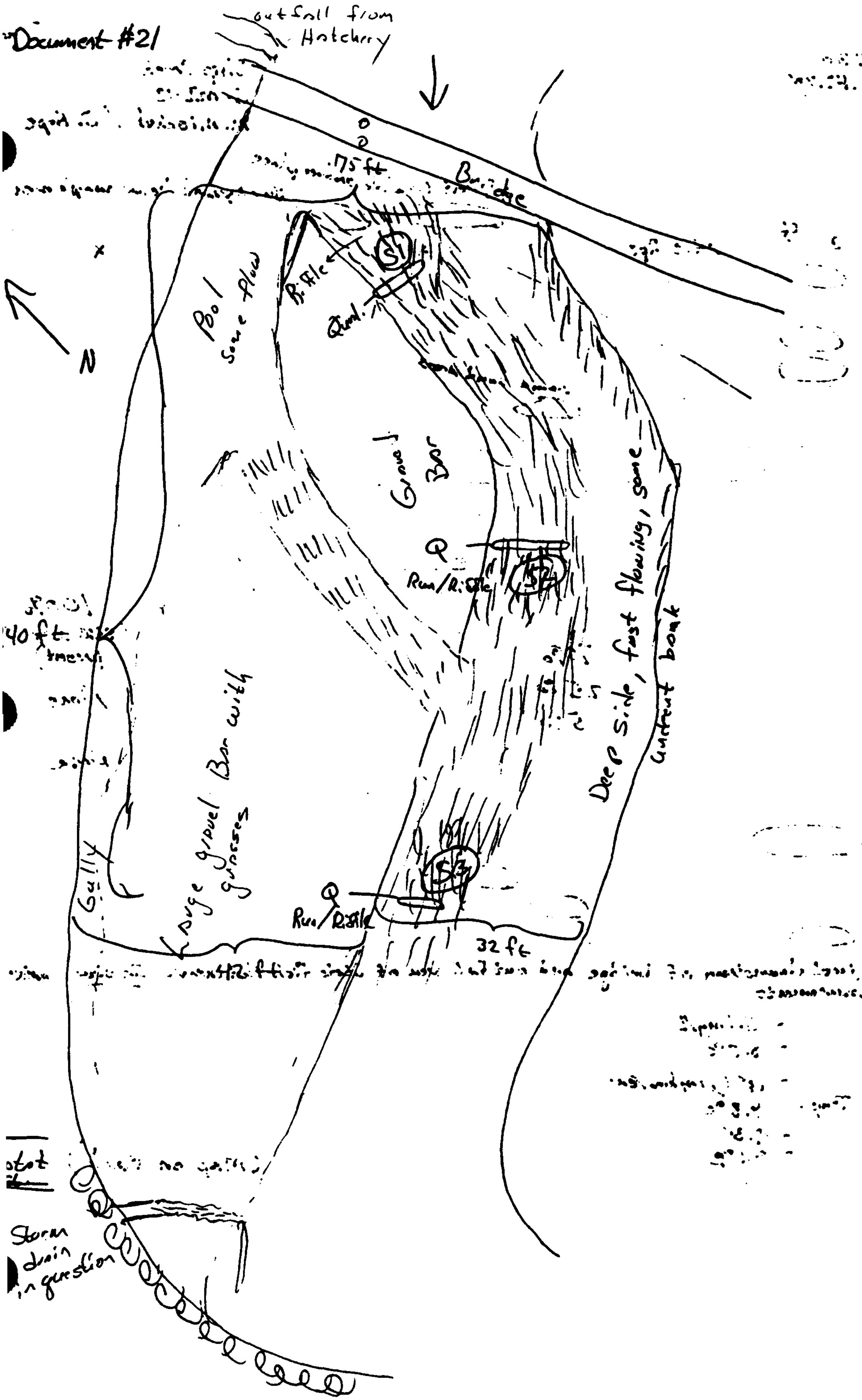
D.O. - 11.1 mg/l
D.O. Temp. - 8.5°C
Conductivity - 101 µmhos/cm
Conductivity Temp. - 8.8°C
pH - 7.34
pH Temp. - 8.1°C

(Map on Back)

~~Figure 5.1-1.~~ Physical Characterization/Water Quality Field Data Sheet for use with all Rapid Bioassessment Protocols.

ATLR28/066.51

Document #21


outfall from Hatchery
175 ft
Bridge
S1
Riffle
Qind.
Pool some flow
x
N
Gravel Bar
Q
Run/Riffle
S2
40 ft
Deep side, fast flowing, some undercut bank
Large gravel Bar with grasses
Gully
Q
S3
Run/Riffle
32 ft
Storm drain in question

9-1-92
M. Mischuk / S. Hope

Elmendorf AFB

1255 HRS.
AWC 31026.H2.20
5-MI-01

HABITAT ASSESSMENT FIELD DATA SHEET

Habitat Parameter	Category			
	Excellent	Good	Fair	Poor
1. *Bottom substrate/ available cover(a)	Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 18 16-20	30-50% rubble, gravel or other stable habitat. Adequate habitat. 11-15	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness(b)	Gravel, cobble, and boulder particles are between 0 and 25 % surrounded by fine sediment 18 16-20	Gravel, cobble, and boulder particles are between 25 and 50 % surrounded by fine sediment 11-15	Gravel, cobble, and boulder particles are between 50 and 75 % surrounded by fine sediment 6-10	Gravel, cobble, and boulder particles are over 75 % surrounded by fine sediment 0-5
3. ≤0.15 cms (5cfs) → *Flow(a) at rep. low flow	Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 18 10-20	0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.03 cms (.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 6-10	<0.01 cms (.5 cfs) <0.03 cms (1 cfs) 0-5
or >0.15 cms (5cfs) → Velocity/depth	Slow (<0.3 m/s), deep (>0.5 m); slow, shallow (<0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. 16-20	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles/runs receive lower score). 6-10	Dominated by one velocity/depth category (usually pool). 0-5
4. * Channel alteration(a)	Little or no enlargement of islands or point bars, and/or no channelization. 12 12-15	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 4-7	Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or extensive channelization. 0-3
5. Bottom scouring and deposition(a)	Less than 5% of the bottom affected by scouring and deposition. 12-15	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 10 8-11	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 4-7	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3

(a) From Ball 1982.
(b) From Platts et al. 1983.
Note: * = Habitat parameters not currently incorporated into BIOS

Page 1 of 2

Document # 22

Habitat Assessment Field Data Sheet for use with all Rapid Bioassessment Protocols.

HABITAT ASSESSMENT FIELD DATA SHEET (cont.)

Habitat Parameter	Category			
	Excellent	Good	Fair	Poor
6. Pool/riffle, run/bend ratio[a] (distance between riffles divided by stream width)	5-7. Variety of habitat. Deep riffles and pools. 15 12-15	7-15. Adequate depth in pools and riffles. Bends provide habitat. 8-11	15-25. Occassional riffle or bend. Bottom contours provide some habitat. 4-7	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 0-3
7. Bank stability[a]	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. Little potential for future problem. 9 9-10	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods. 6-8	Moderat , unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow. 3-5	Unstable. Many eroded areas. Side slopes >60% common. "Raw" areas frequent along straight sections and bends. 0-2
8. Bank vegetative stability[b]	Over 80% of the streambank surfaces covered by vegetation or boulders and cobble. 10 9-10	50-79% of the streambank surfaces covered by vegetation, gravel or larger material. 6-8	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. 3-5	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. 0-2
9. Streamside cover[b]	Dominant vegetation is shrub. 9-10	Dominant vegetation is of tree form. 6-8	Dominant vegetation is grass or forbes. 5 3-5	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 0-2
Column Totals	100	10	5	—

Score 115

Document # 22
(Cont.).

Page 2 of 2

Elmendorf AFB OU5
ANC 31026.H2.20

9-1-92
M. Mischuk / S. Hope

S-MI-02
1700 hrs

HABITAT ASSESSMENT FIELD DATA SHEET

Habitat Parameter	Category Excellent	Good	Fair	Poor
1. *Bottom substrate/ available cover[a]	Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16 16-20	30-50% rubble, gravel or other stable habitat. Adequate habitat. 11-15	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness[b]	Gravel, cobble, and boulder particles are between 0 and 25 % surrounded by fine sediment 16-20	Gravel, cobble, and boulder particles are between 25 and 50 % surrounded by fine sediment 13 11-15	Gravel, cobble, and boulder particles are between 50 and 75 % surrounded by fine sediment 6-10	Gravel, cobble, and boulder particles are over 75 % surrounded by fine sediment 0-5
3. ≤0.15 cms (5cfs) → *Flow[a] at rep. low flow	Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 13 10-20	0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.03 cms (.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 6-10	<0.01 cms (.5 cfs) <0.03 cms (1 cfs) 0-5
or >0.15 cms (5cfs) → Velocity/depth	Slow (<0.3 m/s), deep (>0.5 m); slow, shallow (<0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. 16-20	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles/runs receive lower score). 6-10	Dominated by one velocity/depth category (usually pool). 0-5
4. * Channel alteration[a]	Little or no enlargement of islands or point bars, and/or no channelization. 13 12-15	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 4-7	Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or extensive channelization. 0-3
5. Bottom scouring and deposition[a]	Less than 5% of the bottom affected by scouring and deposition. 13 12-15	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8-11	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 4-7	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3

(a) From Ball 1982.
(b) From Platts et al. 1983.
Note: * = Habitat parameters not currently incorporated into BIOS

Document #23

Page 1 of 2

Habitat Assessment Field Data Sheet for use with all Rapid Bioassessment Protocols.

HABITAT ASSESSMENT FIELD DATA SHEET (cont.)

Habitat Parameter	Category Excellent	 Good	 Fair	 Poor
6. Pool/riffle, run/bend ratio[a] (distance between riffles divided by stream width)	5-7. Variety of habitat. Deep riffles and pools. 12-15	7-15. Adequate depth in pools and riffles. Bends provide habitat. 11 8-11	15-25. Occassional riffle or bend. Bottom contours provide some habitat. 4-7	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 0-3
7. Bank stability[a]	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. Little potential for future problem. 9-10	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods. 8 6-8	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow. 3-5	Unstable. Many eroded areas. Side slopes >60% common. "Raw" areas frequent along straight sections and bends. 0-2
8. Bank vegetative stability[b]	Over 80% of the streambank surfaces covered by vegetation or boulders and cobble. 9-10	50-79% of the streambank surfaces covered by vegetation, gravel or larger material. 8 6-8	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. 3-5	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. 0-2
9. Streamside cover[b]	Dominant vegetation is shrub. 9-10	Dominant vegetation is of tree form. 6-8	Dominant vegetation is grass or forbes. 5 3-5	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 0-2
Column Totals	57	40	5	0

Score 102

Document # 23
(Cont.)

Page 2 of 2

8-30-92/1000 hrs
ANC 31026.H2.20

Ship Creek
5-MI-03

M. Mischuk/
S. Hupe

HABITAT ASSESSMENT FIELD DATA SHEET

Habitat Parameter	Category Excellent	 Good	 Fair	 Poor
1. *Bottom substrate/ available cover[a]	Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16-20	30-50% rubble, gravel or other stable habitat. Adequate habitat. 15 11-15	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness[b]	Gravel, cobble, and boulder particles are between 0 and 25 % surrounded by fine sediment 16-20	Gravel, cobble, and boulder particles are between 25 and 50 % surrounded by fine sediment 15 11-15	Gravel, cobble, and boulder particles are between 50 and 75 % surrounded by fine sediment 6-10	Gravel, cobble, and boulder particles are over 75 % surrounded by fine sediment 0-5
3. ≤0.15 cms (5cfs) → *Flow at rep. low flow[a]	Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 10-20	0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.03 cms (.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 6-10	<0.01 cms (.5 cfs) <0.03 cms (1 cfs) 0-5
or >0.15 cms (5cfs) → Velocity/depth	Slow (<0.3 m/s), deep (>0.5 m); slow, shallow (<0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. 16 16-20	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles/runs receive lower score). 6-10	Dominated by one velocity/depth category (usually pool). 0-5
4. * Channel alteration[a]	Little or no enlargement of islands or point bars, and/or no channelization. 13 12-15	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 4-7	Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or extensive channelization. 0-3
5. Bottom scouring and deposition[a]	Less than 5% of the bottom affected by scouring and deposition. 12-15	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 11 8-11	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 4-7	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3

(a) From Ball 1982.
(b) From Platts et al. 1983.
Note: * = Habitat parameters not currently incorporated into BIOS

Document #24

Page 1 of 2

Habitat Assessment Field Data Sheet for use with all Rapid Bioassessment Protocols.

HABITAT ASSESSMENT FIELD DATA SHEET (cont.)

Habitat Parameter	Category Excellent	 Good	 Fair	 Poor
6. Pool/riffle, run/bend ratio[a] (distance between riffles divided by stream width)	5-7. Variety of habitat. Deep riffles and pools. 12-15	7-15. Adequate depth in pools and riffles. Bends provide habitat. 10 8-11	15-25. Occassional riffle or bend. Bottom contours provide some habitat. 4-7	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 0-3
7. Bank stability[a]	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. Little potential for future problem. 9-10	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods. 8 6-8	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow. 3-5	Unstable. Many eroded areas. Side slopes >60% common. "Raw" areas frequent along straight sections and bends. 0-2
8. Bank vegetative stability[b]	Over 80% of the streambank surfaces covered by vegetation or boulders and cobble. 9-10	50-79% of the streambank surfaces covered by vegetation, gravel or larger material. 8 6-8	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. 3-5	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. 0-2
9. Streamside cover[b]	Dominant vegetation is shrub. 9-10	Dominant vegetation is of tree form. 6-8	Dominant vegetation is grass or forbes. 4 3-5	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 0-2
Column Totals	29	67	4	0

Score 100

Document # 29
(Cont.).

Page 2 of 2

9-4-92
AWC 31026.H2.20

Elmendorf AFB OU5

1530
Ship Creek
5-MI-11-Q
M. Mischuk / S. Hope

HABITAT ASSESSMENT FIELD DATA SHEET

Habitat Parameter	Category			
	Excellent	Good	Fair	Poor
1. *Bottom substrate/ available cover[a]	Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16-20	30-50% rubble, gravel or other stable habitat. Adequate habitat. 11 11-15	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness[b]	Gravel, cobble, and boulder particles are between 0 and 25 % surrounded by fine sediment 16-20	Gravel, cobble, and boulder particles are between 25 and 50 % surrounded by fine sediment 11-15	Gravel, cobble, and boulder particles are between 50 and 75 % surrounded by fine sediment 10 6-10	Gravel, cobble, and boulder particles are over 75 % surrounded by fine sediment 0-5
3. ≤0.15 cms (5cfs) → *Flow at rep. low flow[a]	Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 10-20	0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.03 cms (.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 6-10	<0.01 cms (.5 cfs) <0.03 cms (1 cfs) 0-5
or >0.15 cms (5cfs) → Velocity/depth	Slow (<0.3 m/s), deep (>0.5 m); slow, shallow (<0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. 16-20	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles/runs receive lower score). 10 6-10	Dominated by one velocity/depth category (usually pool). 0-5
4. * Channel alteration[a]	Little or no enlargement of islands or point bars, and/or no channelization. 12-15	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 7 4-7	Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or extensive channelization. 0-3
5. Bottom scouring and deposition[a]	Less than 5% of the bottom affected by scouring and deposition. 12-15	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 11 8-11	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 4-7	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3

(a) From Ball 1982.
(b) From Platts et al. 1983.
Note: * = Habitat parameters not currently incorporated into BIOS

Document # 25

Page 1 of 2

Habitat Assessment Field Data Sheet for use with all Rapid Bioassessment Protocols.

HABITAT ASSESSMENT FIELD DATA SHEET (cont.)

Habitat Parameter	Category Excellent	Good	Fair	Poor
6. Pool/riffle, run/bend ratio(a) (distance between riffles divided by stream width)	5-7. Variety of habitat. Deep riffles and pools. 12-15	7-15. Adequate depth in pools and riffles. Bends provide habitat. 10 8-11	15-25. Occassional riffle or bend. Bottom contours provide some habitat. 4-7	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 0-3
7. Bank stability(a)	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. Little potential for future problem. 9-10	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods. 6-8	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow. Rip/Rap 5 3-5	Unstable. Many eroded areas. Side slopes >60% common. "Raw" areas frequent along straight sections and bends. 0-2
8. Bank vegetative stability(b)	Over 80% of the streambank surfaces covered by vegetation or boulders and cobble. 9-10	50-79% of the streambank surfaces covered by vegetation, gravel or larger material. 6-8	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. 5 3-5	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. 0-2
9. Streamside cover(b)	Dominant vegetation is shrub. 9-10	Dominant vegetation is of tree form. 6-8	Dominant vegetation is grass or forbes. 5 3-5	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 0-2
Column Totals	0	32	42	0

Score 74

Document #25
(Cont.).

Page 2 of 2

4-5-92 / 1130
AWC 31026.H2.20

Elmendorf AFB OU5

Ship Creek
S-MI-12
M. Miachuk / S. Hope

HABITAT ASSESSMENT FIELD DATA SHEET

	Category			
Habitat Parameter	Excellent	Good	Fair	Poor
1. *Bottom substrate/ available cover[a]	Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16-20	30-50% rubble, gravel or other stable habitat. Adequate habitat. 15 11-15	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness[b]	Gravel, cobble, and boulder particles are between 0 and 25 % surrounded by fine sediment 16-20	Gravel, cobble, and boulder particles are between 25 and 50 % surrounded by fine sediment 15 11-15	Gravel, cobble, and boulder particles are between 50 and 75 % surrounded by fine sediment 6-10	Gravel, cobble, and boulder particles are over 75 % surrounded by fine sediment 0-5
3. ≤0.15 cms (5cfs) → *Flow at rep. low flow[a]	Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 10-20 15	0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.03 cms (.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 6-10	<0.01 cms (.5 cfs) <0.03 cms (1 cfs) 0-5
or >0.15 cms (5cfs) → Velocity/depth	Slow (<0.3 m/s), deep (>0.5 m); slow, shallow (<0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. 16-20	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles/runs receive lower score). 6-10	Dominated by one velocity/depth category (usually pool). 0-5
4. * Channel alteration[a]	Little or no enlargement of islands or point bars, and/or no channelization. 14 12-15	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 4-7	Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or extensive channelization. 0-3
5. Bottom scouring and deposition[a]	Less than 5% of the bottom affected by scouring and deposition. 12-15	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 11 8-11	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 4-7	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3

(a) From Ball 1982.
(b) From Platts et al. 1983.
Note: * = Habitat parameters not currently incorporated into BIOS

Document #26

Page 2 of 2

Habitat Assessment Field Data Sheet for use with all Rapid Bioassessment Protocols.

HABITAT ASSESSMENT FIELD DATA SHEET (cont.)

Habitat Parameter	Category			
	Excellent	Good	Fair	Poor
6. Pool/riffle, run/bend ratio[a] (distance between riffles divided by stream width)	5-7. Variety of habitat. Deep riffles and pools. 12-15	7-15. Adequate depth in pools and riffles. Bends provide habitat. 11 8-11	15-25. Occassional riffle or bend. Bottom contours provide some habitat. 4-7	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 0-3
7. Bank stability[a]	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. Little potential for future problem. 9-10	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods. 8 6-8	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow. 3-5	Unstable. Many eroded areas. Side slopes >60% common. "Raw" areas frequent along straight sections and bends. 0-2
8. Bank vegetative stability[b]	Over 80% of the streambank surfaces covered by vegetation or boulders and cobble. 9 9-10	50-79% of the streambank surfaces covered by vegetation, gravel or larger material. 6-8	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. 3-5	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. 0-2
9. Streamside cover[b]	Dominant vegetation is shrub. 9-10	Dominant vegetation is of tree form. 6-8	Dominant vegetation is grass or forbes. 5 3-5	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 0-2
Column Totals	38	60	5	0

Score 103

Document # 26
(Cont.).

Page 2 of 2

Document #27

9-1-92
M. Mischuk / S. Hope
AWC 31026.H2.20
5-MI-01

Elmendorf AFB
1255 Hrs

IMPAIRMENT ASSESSMENT SHEET

1. Detection of impairment: Impairment detected (Complete items 2-6) [✓ No impairment detected (Stop here)]

2. Biological impairment indicator:

Benthic macroinvertebrates
- ____ absence of EPT taxa
- ____ dominance of tolerant groups
- ____ low benthic abundance
- ____ low taxa richness
- ____ other

Other aquatic communities
- ____ Periphyton
  - ____ filamentous
  - ____ other
- ____ Macrophytes
- ____ Slimes
- ____ Fish

3. Brief description of problem: ____
Year and date of previous surveys: ____
Survey data available in: ____

4. Cause: (indicate major cause) organic enrichment toxicants flow
habitat limitations other ____

5. Estimated areal extent of problem (m^2) and length of stream reach affected (m), where applicable: ____

6. Suspected source(s) of problem:

- ____ point source discharge (name, type of facility, location)
- ____ construction site runoff
- ____ combined sewer outfall
- ____ silviculture runoff
- ____ animal feedlot
- ____ agricultural runoff
- ____ urban runoff
- ____ ground water
- ____ other
- ____ unknown

Briefly explain:

Impairment Assessment Sheet for use with macroinvertebrate Rapid Bioassessment Protocols.

Document A 28
Elmendorf AFB
AWC 31[illegible]2C.H2.20
9-1-92 / 1700 hrs
6-MI-02
M. Mischuk/S. Hope

IMPAIRMENT ASSESSMENT SHEET

1. Detection of impairment: Impairment detected (Complete items 2-6) [✓ No impairment detected (Stop here)]

2. Biological impairment indicator:

Benthic macroinvertebrates	Other aquatic communities
____ absence of EPT taxa	____ Periphyton
____ dominance of tolerant groups	____ filamentous
____ low benthic abundance	____ other
____ low taxa richness	____ Macrophytes
____ other	____ Slimes
	____ Fish

3. Brief description of problem: ____________________
   Year and date of previous surveys: ____________________
   Survey data available in: ____________________

4. Cause: (indicate major cause) organic enrichment toxicants flow
   habitat limitations other ____________

5. Estimated areal extent of problem (m^2) and length of stream reach affected (m), where applicable: ____________________

6. Suspected source(s) of problem:

   ____ point source discharge (name, type of facility, location)
   ____ construction site runoff
   ____ combined sewer outfall
   ____ silviculture runoff
   ____ animal feedlot
   ____ agricultural runoff
   ____ urban runoff
   ____ ground water
   ____ other
   ____ unknown

Briefly explain:

Impairment Assessment Sheet for use with macroinvertebrate Rapid Bioassessment Protocols.

Document #29
8-30-92/1530 Hrs
ANC 31026.H2-20
Ship Creek

5-MI-03
M. Mischuk/
S. Hope

IMPAIRMENT ASSESSMENT SHEET

1. Detection of impairment: Impairment detected (Complete items 2-6) [✓ No impairment detected] (Stop here)

2. Biological impairment indicator:

Benthic macroinvertebrates
- ___ absence of EPT taxa
- ___ dominance of tolerant groups
- ___ low benthic abundance
- ___ low taxa richness
- ___ other

Other aquatic communities
- ___ Periphyton
  - ___ filamentous
  - ___ other
- ___ Macrophytes
- ___ Slimes
- ___ Fish

3. Brief description of problem: ____________________
Year and date of previous surveys: ____________________
Survey data available in: ____________________

4. Cause: (indicate major cause) organic enrichment toxicants flow
habitat limitations other ____________

5. Estimated areal extent of problem (m^2) and length of stream reach affected (m), where applicable: ____________________

6. Suspected source(s) of problem:

- ___ point source discharge (name, type of facility, location)
- ___ construction site runoff
- ___ combined sewer outfall
- ___ silviculture runoff
- ___ animal feedlot
- ___ agricultural runoff
- ___ urban runoff
- ___ ground water
- ___ other
- ___ unknown

Briefly explain:

Impairment Assessment Sheet for use with macroinvertebrate Rapid Bioassessment Protocols.

Document # 30

9-4-92
ANC 31026.H2.20
Elmendorf AFB OU5
Ship Creek

5-MI-11-Q
M. Mischuk / S. Hype

IMPAIRMENT ASSESSMENT SHEET

1. Detection of impairment: Impairment detected (Complete items 2-6) No impairment detected (Stop here)

2. Biological impairment indicator:

Benthic macroinvertebrates
- ☐ absence of EPT taxa
- ☒ dominance of tolerant groups
- ☐ low benthic abundance
- ☐ low taxa richness
- ☐ other

Other aquatic communities
- ☐ Periphyton
  - ☐ filamentous
  - ☐ other
- ☐ Macrophytes
- ☐ Slimes
- ☐ Fish

3. Brief description of problem: Increased # of Tubificid worms
Year and date of previous surveys:
Survey data available in:

4. Cause: (indicate major cause) organic enrichment toxicants flow
habitat limitations other Could be several of the above

5. Estimated areal extent of problem (m^2) and length of stream reach affected (m), where applicable: 40 m^2

6. Suspected source(s) of problem:

- ☐ point source discharge (name, type of facility, location)
- ☐ construction site runoff
- ☐ combined sewer outfall
- ☐ silviculture runoff
- ☐ animal feedlot
- ☐ agricultural runoff
- ☐ urban runoff
- ☐ ground water
- ☐ other
- ☒ unknown

Briefly explain:
Water flow Storm drain originates from bluff Area (ST39, 38, moves through RR Area then into open ditch down Yakutat St., into drain pipe under junk yard and into Creek.

Impairment Assessment Sheet for use with macroinvertebrate Rapid Bioassessment Protocols.

Document #31
9-5-92 / 1150
AWC 31026. H2.20
Ship Creek

5-MI-12
M. Mischel/
S. Hope

IMPAIRMENT ASSESSMENT SHEET

1. Detection of impairment: Impairment detected (Complete items 2-6) [✓ No impairment detected] (Stop here)

2. Biological impairment indicator:

Benthic macroinvertebrates
- ____ absence of EPT taxa
- ____ dominance of tolerant groups
- ____ low benthic abundance
- ____ low taxa richness
- ____ other

Other aquatic communities
- ____ Periphyton
  - ____ filamentous
  - ____ other
- ____ Macrophytes
- ____ Slimes
- ____ Fish

3. Brief description of problem: ____________________

Year and date of previous surveys: ____________________

Survey data available in: ____________________

4. Cause: (indicate major cause) organic enrichment toxicants flow

habitat limitations other ____________

5. Estimated areal extent of problem (m^2) and length of stream reach affected (m), where applicable: ____________________

6. Suspected source(s) of problem:

- ____ point source discharge (name, type of facility, location)
- ____ construction site runoff
- ____ combined sewer outfall
- ____ silviculture runoff
- ____ animal feedlot
- ____ agricultural runoff
- ____ urban runoff
- ____ ground water
- ____ other
- ____ unknown

Briefly explain:

Impairment Assessment Sheet for use with macroinvertebrate Rapid Bioassessment Protocols.