# VAL MORITZ VILLAGE

## FEASIBILITY REPORT ON INDIVIDUAL ONSITE WASTEWATER SYSTEMS FOR FILING 2, BLOCK 7

**Prepared by:**
**Shannon Engineering, Inc.**

# FEASIBILITY REPORT
# ON
# INDIVIDUAL ONSITE WASTEWATER SYSTEMS
# FOR
# VAL MORITZ VILLAGE
# FILING 2, BLOCK 7

## SCOPE

The homeowner's association of Val Moritz Village in Grand County, Colorado has investigated possible alternatives for handling the anticipated wastewater of individual homes on the 147 lots in the subdivision. Each lot is approximately 1 acre in size. The small size of the lots, high clay content soils, and some high groundwater situations complicate the use of individual wastewater systems in this subdivision. Consequently, the conventional individual onsite wastewater system (OWS) will not work here. A centralized community sewer system was explored, and although not impractical, it would be quite expensive and probably require adjudicating water issues. The traditional approach in dealing with these conditions by utilizing individual mound systems would work in many cases, but the slope of some lots, the area required for a mound, the negative aesthetic impacts, and the costs of imported materials make the mound an undesirable solution to the challenge at hand. Relatively recently however, advanced treatment and shallow dispersal technologies have become available that are affordable, reliable, and approved for use for individual homes. These treatment techniques sufficiently clean septic tank effluent to allow application at very shallow soil depths and into higher clay content soils exhibiting slow percolation rates.

The homeowner's association desires an engineering review of each lot in sufficient detail to determine the feasibility of employing advanced treatment technologies to provide individual onsite wastewater systems. It is understood that further detailed OWS designs will be required to complete the process for each lot prior to obtaining a building permit. Without specific details on the configuration of each house, it would be premature to design an OWS for a particular lot. Additionally, during the build-out of the subdivision, advanced treatment OWS technologies may improve; which might render early designs obsolete. Since each lot will have its own well, it is crucial that the placement of wells and OWS components be addressed from a multi-lot perspective. Otherwise, some lot owners may find that their neighbors have rendered a particular lot "un-build-able" due to setback conflicts.

## GENERAL FINDINGS AND COMMENTS

In our investigation of the 11 lots in Block 2 of Filing 7 of the Val Moritz Subdivision we found no compelling reasons to preclude the use of onsite wastewater systems for each lot. These systems will require advanced treatment of the septic tank



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effluent and application to the soil at shallow depths. Proper planning and the judicious location of each OWS will allow each lot to have individual wells and proper setbacks from the OWS components. Advanced treatment, though more expensive than conventional wastewater systems, will be more environmentally sound. In considering the subdivision as a whole, advanced treatment will reduce the levels of nitrogen introduced into the soils, and, in the long run, reduce the risks of well water contamination.

It is prudent that the homeowner's association adopted covenants that will reduce the potential wastewater loading for the entire subdivision by establishing a limit on the maximum number of bedrooms per lot. The principle at work: the lower the wastewater loading, the lower the risks of contamination. Since the number of bedrooms is the main indicator of potential wastewater flows, limiting the number of bedrooms will therefore limit the overall wastewater loading.

## ADVANCED SEPTIC TANK EFFLUENT TREATMENT

As mentioned above, the site conditions at Val Moritz Village preclude the use of conventional onsite wastewater systems that employ only a septic tank and drain field. Development of the lots in this subdivision will take several years, and the OWS technology will improve over time. However, there are existing, economically viable systems for the advanced treatment of residential septic tank effluent that will allow application to an onsite drain field. There are several manufactures of these types of systems. We have had good success with the AdvanTex recirculating non-woven textile media filter system provided by Orenco Systems, Inc. (OSI). Several of these systems have been installed in Grand County, and the Board of Health has approved them for use on sites with difficult soil conditions. Appendix A outlines the advantages of this system. Although Aerobic Treatment Units are now approved for residential use in Grand County and may be somewhat less expensive than the AdvanTex system, we believe that the cost differences are outweighed by the long term operating advantages of the AdvanTex system. Appendix B provides comments on why the AdvanTex system is more desirable than some of the other types of treatment approaches that have historically been employed. As technology improves, we may find that other advanced treatment systems will prove to be superior to the AdvanTex system; however, our assertion that the residential wastewater for the lots in Val Moritz Village can be feasibly managed onsite is based upon achieving or surpassing the level of treatment provided by the OSI AdvanTex system. As a minimum, "advanced treatment" as used in this report means producing wastewater that exceeds the NSF secondary effluent standards and achieves a 50 to 70% reduction in nitrogen in the septic tank effluent stream.

## SOIL ABSORPTION AND DISPERSAL

The fundamental issue confronting the lot owners of Val Moritz Village is how to return their well water to the ground after it has been used for household needs. The soil in this subdivision is generally not receptive to typical septic tank effluent (STE). The organic materials and suspended solids in STE readily create an environment that clogs the



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minute pores in clay soils. By "cleaning up" the STE through advanced treatment, the same soil will accept the wastewater over years of service. Therefore, the first important factor is to apply only effluent that is sufficiently free of organics and suspended solids.

The second important factor is the use of shallow drain fields or drip irrigation to disperse the treated effluent back into the soil. A shallow drain field consists of a series of trenches approximately 1 ft. wide and 1 ft. deep with void space created by inverted sections of 12" diameter irrigation pipe cut in half. In this void space or chamber there are distribution lateral pipes of 1" to 1.5" diameter with orifices for dispersing the effluent evenly along the length of each trench. Typically we are designing these systems with 100 to 150 ft. of trench per bedroom. The length and layout of the trenches will depend upon the soil and the size of the home at that particular lot. Drip irrigation dispersal systems employ a bed of tubes with emitters that distribute the treated effluent directly into the soil over a relatively large area. On most lots, we have found that the upper soil horizon will readily accept the treated effluent. By applying the treated effluent in the upper soil horizon we gain several main advantages over applying directly into the soil horizons with high clay content.

1. The use of trenches or drip irrigation spreads the effluent over a much larger area than would a conventional infiltration bed.
2. The treated effluent will be polished further by the natural processes that occur as it flows through the upper soil horizon.
3. The treated effluent will spread out in the upper soil horizon before reaching the clay soil horizon. This effectively increases the area to which it is applied and lowers the application rate to the clay soil horizon.
4. The natural interface between the upper and clay soil horizons is not disturbed. Root penetrations and irregularities in this interface will greatly facilitate the movement of the effluent into the clay soil.
5. Vegetation rooted in the upper soil horizon will draw some of the moisture away from the clay soils below.
6. Shallow trenches are narrow and can be installed using smaller equipment. This results in less tree removal and less general disturbance to the lot.
7. Shallow drain fields are more economical to construct than deeper ones.
8. Advanced treatment coupled with shallow drain fields will allow for adequate separation in the case of higher groundwater.

The principal concern that we hear regarding shallow drain fields or drip irrigation systems is the fear of freezing. These systems are designed to drain at the end of each dosing cycle and have been used in climates that have more severe freezing problems than Grand County. In addition to shallow systems that have been functioning properly here for several winters, they have been successfully used in Alaska, Minnesota and Wisconsin.

The third important factor is pressure micro dosing. Pressure dosing extends the life of the drain field by spreading out the organic loading over the entire filed. By applying small doses, saturated soil conditions are avoided. This enhances the further treatment of the effluent and increases the acceptance of the moisture into the clay soil



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horizon. It improves adsorption of phosphates by minimizing saturated flow and channeling in the soil pores.

This Feasibility Report addresses the 11 lots in Block 2 of Filing 7. Attached is soil profile information and upper soil horizon percolation or infiltration testing data. These indicate that it is feasible to apply AdvanTex filtrate, or wastewater cleaned to the same or better quality, in a shallow drain field or drip irrigation system. We have concern for those few areas where the upper more permeable soil horizons are less than 1'-4" in total depth. Particular care will be required on all lots during the installation of the shallow drain fields to insure that the bottoms of the trenches do not dive into the extremely low permeability soil horizon. If the more permeable upper soil horizon should prove to be too shallow in spots, the trenches will need to be kept in the permeable horizon and imported fill added over the trenches to provide proper top cover.

One other challenge presented itself on some lots in the subdivision. There was high groundwater. This would have been a problem if conventional OWS approaches were being seriously considered. The level of treatment provided by the AdvanTex or equivalent systems will allow for the application of the treated effluent at sufficiently shallow depths to provide adequate separation from observed groundwater levels.

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APPENDIX A: Orenco Systems, Inc AdvanTex System

A specific example of the type of advanced effluent treatment that is available today is the Orenco Systems, Inc. AdvanTex system. The AdvanTex system passed the National Sanitation Foundation ANSI/NSF Standard 40, Class 1 tests for treatment of residential wastewater. These systems are also approved for advanced treatment of septic tank effluent by the Grand County Board of Health.

The following table indicates the properties of residential wastewater and treated effluent from the proposed OSI AdvanTex system. It also gives figures for the requirements under Article IX of the Colorado ISDS regulations for dispersal of effluent in various ways.

As can be seen from these figures on the table below, the effluent from the AdvanTex system would be "clean" enough to dispose of on the surface if human contact were restricted and certainly sufficient to disperse in a sub-surface manner even where the soil is unsuitable for normal soil absorption bed.

| | Typical Screened Septic Tank Residential Wastewater | Surface Disposal Where Human Contact Is Possible - Article IX | Surface Disposal Protected From Human Contact - Article IX | Sub-surface Disposal In Unsuitable Soils - Article IX | OSI AdvanTex System Effluent |
|---|---|---|---|---|---|
| $BOD_5$ mg/l | 130 | <20 | <20 | <60 | ≤5 |
| TSS mg/l | 30 | <40 | <40 | <40 | ≤5 |
| Tot. N mg/l | 65 | | | | ≤32* |
| Coliform cts/100ml | $10^6$ | <25 | <500 | | ≈1000 |
| Oil & Grease mg/l | 20 | | | | <10 |

* The amount of nitrogen removal may be limited by the alkalinity of the water source.

Table A-1 - Effluent Characteristics

It is documented in the literature that residential wastewater that has been treated in the OSI AdvanTex - AX system is relatively "clean." It surpasses secondary treatment criteria. However, the AdvanTex system will not remove sufficient fecal coliform to allow for discharge directly into streams or to the surface unprotected. This system will utilize



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shallow trenches or drip irrigation techniques for a sub-surface soil absorption field to remove the coliform still remaining in the filtrate effluent. Additionally, the level of nitrogen in the treated effluent is substantially reduced. The use of the AdvanTex units is expected to result in a substantial reduction in the total nitrogen in the wastewater stream of the subdivision. This is a definite environmental benefit.

OSI's system was selected because of their history of providing high quality systems for over 20 years. There are over 200 AdvanTex based onsite wastewater systems that have already been installed in Colorado and thousands more around the country. The ability of SCG Enterprises, Inc. of Conifer, Colorado to provide remote monitoring of the pump controls and tank high-level indicators gives confidence that we will have warning if the wastewater flows exceed design limits. Periodic onsite monitoring of the effluent quality by SCG's approved service provider for Grand County will give confidence that the system is performing properly.



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APPENDIX B: Onsite Wastewater Treatment Alternatives

Several alternatives for treatment were considered. Recirculating media filter technology is proven and has been used for decades. The OSI AdvanTex units are modular, facilitating installation flexibility. With these units, the quality of the media textile is controlled in the factory, and it may be easily cleaned as needed or replaced if it becomes necessary. They have passed NSF testing and are approved for use by the Colorado Department of Public Health and Environment and by the Grand County Board of Health.

The practicality of using a "package treatment plant" for clusters of homes was also considered. This type of OWS is relatively expensive for this level of wastewater flow. These systems typically require frequent monitoring by specially trained operators and often require attention to the many mechanical components. Seasonal shutdown/startup may also prove problematic.

The use of a recirculating or single pass sand filter to accomplish the pretreatment of the effluent was considered. The variability of the media, its cost, installation challenges, and the difficulty of replacing media when needed again directed us toward the textile media system.

Mound systems constructed from imported materials could also be employed for these lots. The mound systems have the same disadvantages as sand filters, but with increased difficulty of installation, and they tend to be unsightly.

Therefore, the AdvanTex approach has several advantages.

1. The treatment units are modular and compact requiring only a small footprint for installation. Disruption of the rest of the lot is kept to a minimum. The light weight units are easy to transport and install on difficult-to-access sites.
2. The quality of the filtration media is assured in the AdvanTex systems. Sand media of proper quality is difficult to find, expensive to haul, and requires skilled placement by the installing contractor in order to function properly.
3. Once installed, sand media can be serviced only by replacement. This is difficult and costly. The non-woven textile media in the AdvanTex modules can be easily removed for cleaning or replacement should it become necessary.
4. Sand filters and mounds are constructed onsite with locally available materials. The effectiveness of the treatment is greatly influenced by the knowledge and ability of the installing contractor. AdvanTex units are factory assembled and then installed by authorized service providers.

Peat is sometimes employed as a packed bed filter media. There are units commercially available that make use of this technology. However, there appears to be no particular



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advantage, either economically or technologically, to using the peat filter units. Grand County has not been regularly approving peat systems as they have with the AdvanTex units, and there is no mechanism in place for ongoing maintenance agreements on these units. Grand County has not been regularly approving peat systems as they have with the AdvanTex units.

Another advanced treatment system that is available, but we believe to be inferior to the use on non-woven textile packed bed technology, is the aerobic treatment unit (ATU). The ATU works by using blowers to diffuse air in the septic tank to create an environment conducive to aerobic bacteriological processes. This enhances the level of treatment of the sewage. These units are sometimes less expensive than the AdvanTex units. However, field studies have indicated a problem with the reliability of the blowers, and therefore the reliability of the treatment process. There is a greater likelihood of suspended solids being discharged into the drainfield when the ATU is first started and each time the system is awakened from a period of non-use. The energy necessary to operate the blower is more than that required for the AdvanTex pumps. Also the blower wears out much more rapidly than the pumps, and periodic replacement costs can offset any initial installation savings. ATU's are now approved for use in Grand County and are an option for Val Moritz property owners. The dispersal field would typically be either shallow trenches or drip irrigation as with the AdvanTex systems.



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# Val Moritz Village, Filing 2, Block 7

| Lot | Avg. Perc. (min./in.) | cm of fall in Perc. Hole #1 | cm of fall in Perc. Hole #2 | cm of fall in Perc. Hole #3 | Time | Avg. Depth |
|---|---|---|---|---|---|---|
| 1 | | 1.4 | 1.6 | 1.6 | 10 | 13 |
| | 17 | 18 | 16 | 16 | | |
| 2 | | 1.0 | 0.8 | 1.9 | 10 | 14 |
| | 24 | 25 | 32 | 13 | | |
| 3 | | 0.4 | 0.3 | 0.6 | 10 | 15 |
| | 64 | 64 | 85 | 42 | | |
| 4 | | 0.9 | 0.9 | 0.5 | 10 | 16 |
| | 36 | 28 | 28 | 51 | | |
| 5 | | 0.7 | 1.0 | 0.9 | 10 | 16 |
| | 30 | 36 | 25 | 28 | | |
| 6 | | 1.0 | 0.8 | 1.3 | 10 | 14 |
| | 26 | 25 | 32 | 20 | | |
| 7 | | 0.8 | 0.8 | 0.6 | 10 | 13 |
| | 35 | 32 | 32 | 42 | | |
| 8 | | 0.7 | 0.8 | 0.9 | 10 | 15 |
| | 32 | 36 | 32 | 28 | | |
| 9 | | 0.9 | 1.5 | 0.8 | 10 | 15 |
| | 26 | 28 | 17 | 32 | | |
| 10 | | 0.7 | 1.2 | 1.1 | 10 | 14 |
| | 27 | 36 | 21 | 23 | | |
| 11 | | 1.5 | 0.9 | 0.9 | 10 | 13 |
| | 24 | 17 | 28 | 28 | | |

# SOIL PROFILE INFORMATION

**Val Moritz Village**
**Filing 2, Block 7, Lot 1**

**Profile Hole Observed: 9/24/2006**

| U.S.D.A. SOIL CLASSIFICATION METHOD | | | | | |
|---|---|---|---|---|---|
| | | DEPTH | 0'-0" - 0'-2" | 0'-2" - 1'-4" | 1'-4" - 7'-0" |
| | | | Topsoil | | |
| **TEXTURE** | | | Loam & Pine Duff | Sandy Clay | Sandy Clay |
| **ROCK FRAGMENTS** | **% Rock** | | < 10% | < 10% | < 10% |
| | **Size** | | | | |
| | **Shape** | | | | |
| **SOIL STRUCTURE** | **Degree** | | Compound | Compound | Compound |
| | **Shape** | | Sub-Angular | Sub-Angular Blocky | Sub-Angular Blocky |
| | **Grade** | | Weak | Moderate to Strong | Strong |
| | **Size** | | Fine | Fine | Fine |
| **CONSISTENCE** | **Wet** | | | | |
| | | **Stickiness** | Not Sticky | Sticky | Sticky |
| | | **Plasticity** | Not Plastic | Plastic | Plastic |
| | **Moist** | | Friable | Friable | Friable |
| | **Dry** | | | | |
| | | **Consistence** | Weak | Medium | Medium to Hard |
| | | **Cementation** | None | None | None |
| **COLOR** | **Munsell** | | 10 YR 5/2 | 7.5 YR 6/2 to 7.5 YR 5/4 | 7.5 YR 4/4 |
| | **Description** | | Grayish Brown | Pinkish Gray to Brown | Brown |
| | **Mottling** | | None | None | None |
| **OBSERVED MOISTURE** | | | None | None | None |

According to the U.S.D.A. S.C.S. Grand County Soil Survey - This area is likely to be: Cimarron Loam

GROUND COVER: Aspen, pine, grasses, shrubs, forbs.

SLOPE: 7% at a bearing of 0°

PERCOLATION RATE: 17 min./in. Avg Depth (in.) 13

NOTES: Profile hole is on the property line with lots 1, 2, 10, 11.

# SOIL PROFILE INFORMATION

**Val Moritz Village**
**Filing 2, Block 7, Lot 2**

**Profile Hole Observed: 9/24/2006**

| U.S.D.A. SOIL CLASSIFICATION METHOD | | | | | |
|---|---|---|---|---|---|
| | | DEPTH | 0'-0" - 0'-2" | 0'-2" - 1'-4" | 1'-4" - 7'-0" |
| | | | Topsoil | | |
| **TEXTURE** | | | Loam & Pine Duff | Sandy Clay | Sandy Clay |
| **ROCK FRAGMENTS** | **% Rock** | | < 10% | < 10% | < 10% |
| | **Size** | | | | |
| | **Shape** | | | | |
| **SOIL STRUCTURE** | **Degree** | | Compound | Compound | Compound |
| | **Shape** | | Sub-Angular | Sub-Angular Blocky | Sub-Angular Blocky |
| | **Grade** | | Weak | Moderate to Strong | Strong |
| | **Size** | | Fine | Fine | Fine |
| **CONSISTENCE** | **Wet** | | | | |
| | | **Stickiness** | Not Sticky | Sticky | Sticky |
| | | **Plasticity** | Not Plastic | Plastic | Plastic |
| | **Moist** | | Friable | Friable | Friable |
| | **Dry** | | | | |
| | | **Consistence** | Weak | Medium | Medium to Hard |
| | | **Cementation** | None | None | None |
| **COLOR** | **Munsell** | | 10 YR 5/2 | 7.5 YR 6/2 to 7.5 YR 5/4 | 7.5 YR 4/4 |
| | **Description** | | Grayish Brown | Pinkish Gray to Brown | Brown |
| | **Mottling** | | None | None | None |
| **OBSERVED MOISTURE** | | | None | None | None |

According to the U.S.D.A. S.C.S. Grand County Soil Survey - This area is likely to be: Cimarron Loam

GROUND COVER: Aspen, pine, grasses, shrubs, forbs.

SLOPE: 4% at a bearing of 35°

PERCOLATION RATE: 24 min./in. Avg Depth (in.) 14

NOTES: Profile hole is on the property line with lots 1, 2, 10, 11.

# SOIL PROFILE INFORMATION

**Val Moritz Village**
**Filing 2, Block 7, Lot 3**

**Profile Hole Observed: 9/24/2006**

| U.S.D.A. SOIL CLASSIFICATION METHOD | | | | | |
|---|---|---|---|---|---|
| | | DEPTH | 0'-0" - 0'-2" | 0'-2" - 1'-4" | 1'-4" - 7'-0" |
| | | | Topsoil | | |
| **TEXTURE** | | | Loam & Pine Duff | Sandy Clay | Sandy Clay |
| **ROCK FRAGMENTS** | **% Rock** | | < 10% | < 10% | < 10% |
| | **Size** | | | | |
| | **Shape** | | | | |
| **SOIL STRUCTURE** | **Degree** | | Compound | Compound | Compound |
| | **Shape** | | Sub-Angular | Sub-Angular Blocky | Sub-Angular Blocky |
| | **Grade** | | Weak | Moderate to Strong | Strong |
| | **Size** | | Fine | Fine | Fine |
| **CONSISTENCE** | **Wet** | | | | |
| | | **Stickiness** | Not Sticky | Sticky | Sticky |
| | | **Plasticity** | Not Plastic | Plastic | Plastic |
| | **Moist** | | Friable | Friable | Friable |
| | **Dry** | | | | |
| | | **Consistence** | Weak | Medium | Medium to Hard |
| | | **Cementation** | None | None | None |
| **COLOR** | **Munsell** | | 10 YR 5/2 | 7.5 YR 6/2 to 7.5 YR 5/4 | 7.5 YR 4/4 |
| | **Description** | | Grayish Brown | Pinkish Gray to Brown | Brown |
| | **Mottling** | | None | None | None |
| **OBSERVED MOISTURE** | | | None | None | None |

According to the U.S.D.A. S.C.S. Grand County Soil Survey - This area is likely to be: Cimarron Loam

GROUND COVER: Aspen, pine, grasses, shrubs, forbs.

SLOPE: 7% at a bearing of 0°

PERCOLATION RATE: 64 min./in. Avg Depth (in.) 15

NOTES: This Profile hole is on the property line with lots 3 and 9.

# SOIL PROFILE INFORMATION

**Val Moritz Village**
**Filing 2, Block 7, Lot 4**

**Profile Hole Observed: 9/24/2006**

| U.S.D.A. SOIL CLASSIFICATION METHOD | | | | | |
|---|---|---|---|---|---|
| | | DEPTH | 0'-0" - 0'-2" | 0'-2" - 1'-4" | 1'-4" - 7'-0" |
| | | | Topsoil | | |
| **TEXTURE** | | | Loam & Pine Duff | Sandy Clay | Sandy Clay |
| **ROCK FRAGMENTS** | **% Rock** | | < 10% | < 10% | < 10% |
| | **Size** | | | | |
| | **Shape** | | | | |
| **SOIL STRUCTURE** | **Degree** | | Compound | Compound | Compound |
| | **Shape** | | Sub-Angular | Sub-Angular Blocky | Sub-Angular Blocky |
| | **Grade** | | Weak | Moderate to Strong | Strong |
| | **Size** | | Fine | Fine | Fine |
| **CONSISTENCE** | **Wet** | | | | |
| | | **Stickiness** | Not Sticky | Sticky | Sticky |
| | | **Plasticity** | Not Plastic | Plastic | Plastic |
| | **Moist** | | Friable | Friable | Friable |
| | **Dry** | | | | |
| | | **Consistence** | Weak | Medium | Medium to Hard |
| | | **Cementation** | None | None | None |
| **COLOR** | **Munsell** | | 10 YR 5/2 | 7.5 YR 6/2 to 7.5 YR 5/4 | 7.5 YR 4/4 |
| | **Description** | | Grayish Brown | Pinkish Gray to Brown | Brown |
| | **Mottling** | | None | None | None |
| **OBSERVED MOISTURE** | | | None | None | None |

According to the U.S.D.A. S.C.S. Grand County Soil Survey - This area is likely to be: Cimarron Loam

GROUND COVER: Pine, aspen, grasses, forbs, shrubs.

SLOPE: 7% at a bearing of 0°

PERCOLATION RATE: 36 min./in. Avg Depth (in.) 16

NOTES: This profile hole is on the property line with lots 4 &5.

# SOIL PROFILE INFORMATION

**Val Moritz Village**
**Filing 2, Block 7, Lot 5**

**Profile Hole Observed: 9/24/2006**

| U.S.D.A. SOIL CLASSIFICATION METHOD | | | | | |
|---|---|---|---|---|---|
| | | DEPTH | 0'-0" - 0'-2" | 0'-2" - 1'-4" | 1'-4" - 7'-0" |
| | | | Topsoil | | |
| **TEXTURE** | | | Loam & Pine Duff | Sandy Clay | Sandy Clay |
| **ROCK FRAGMENTS** | **% Rock** | | < 10% | < 10% | < 10% |
| | **Size** | | | | |
| | **Shape** | | | | |
| **SOIL STRUCTURE** | **Degree** | | Compound | Compound | Compound |
| | **Shape** | | Sub-Angular | Sub-Angular Blocky | Sub-Angular Blocky |
| | **Grade** | | Weak | Moderate to Strong | Strong |
| | **Size** | | Fine | Fine | Fine |
| **CONSISTENCE** | **Wet** | | | | |
| | | **Stickiness** | Not Sticky | Sticky | Sticky |
| | | **Plasticity** | Not Plastic | Plastic | Plastic |
| | **Moist** | | Friable | Friable | Friable |
| | **Dry** | | | | |
| | | **Consistence** | Weak | Medium | Medium to Hard |
| | | **Cementation** | None | None | None |
| **COLOR** | **Munsell** | | 10 YR 5/2 | 7.5 YR 6/2 to 7.5 YR 5/4 | 7.5 YR 4/4 |
| | **Description** | | Grayish Brown | Pinkish Gray to Brown | Brown |
| | **Mottling** | | None | None | None |
| **OBSERVED MOISTURE** | | | None | None | None |

According to the U.S.D.A. S.C.S. Grand County Soil Survey - This area is likely to be: Cimarron Loam

GROUND COVER: Aspen, pine, grasses, forbs, shrubs.

SLOPE: 10% at a bearing of 0°

PERCOLATION RATE: 30 min./in. Avg Depth (in.) 16

NOTES: This profile hole is on the property line of lots 6 &7.

# SOIL PROFILE INFORMATION

**Val Moritz Village**
**Filing 2, Block 7, Lot 6**

**Profile Hole Observed: 9/24/2006**

| U.S.D.A. SOIL CLASSIFICATION METHOD | | | | | |
|---|---|---|---|---|---|
| | | DEPTH | 0'-0" - 0'-4" | 0'-4" - 4'-4" | 4'-4" - 7'-0" |
| | | | Topsoil | | |
| **TEXTURE** | | | Loam | Sandy Clay Loam & Sandy Clay | Clay |
| **ROCK FRAGMENTS** | **% Rock** | | < 10% | < 15% | < 10% |
| | **Size** | | | To 4" | |
| | **Shape** | | | Sub-Angular | |
| **SOIL STRUCTURE** | **Degree** | | Compound | Compound | Compound |
| | **Shape** | | Sub-Angular | Sub-Angular | Sub-Angular Blocky |
| | **Grade** | | Moderate | Moderate | Moderate |
| | **Size** | | Fine | Fine | Fine - Medium |
| **CONSISTENCE** | **Wet** | | | | |
| | | **Stickiness** | Not Sticky | Slightly Sticky | Sticky |
| | | **Plasticity** | Not Plastic | Slightly Plastic | Plastic |
| | **Moist** | | Friable | Friable | Friable |
| | **Dry** | | | | |
| | | **Consistence** | Moderate | Firm | Firm to Hard |
| | | **Cementation** | None | None | None |
| **COLOR** | **Munsell** | | 10 YR 3/2 | 10 YR 4/4 | 10 YR 5/1 |
| | **Description** | | Very Dark Gray Brown | Dark Yellowish Brown | Gray |
| | **Mottling** | | None | None | None |
| **OBSERVED MOISTURE** | | | None | None | Moist |

*According to the U.S.D.A. S.C.S. Grand County Soil Survey - This area is likely to be: Cimmaron Loam*

GROUND COVER: Aspen, shrubs, forbs, grass.

SLOPE: 10% at a bearing of 330°

PERCOLATION RATE: 26 min./in. Avg. Depth (in.): 14

NOTES: This is on the property line between lots 6 & 7.

# SOIL PROFILE INFORMATION

**Val Moritz Village**
**Filing 2, Block 7, Lot 7**

**Profile Hole Observed: 9/24/2006**

| U.S.D.A. SOIL CLASSIFICATION METHOD | | | | | |
|---|---|---|---|---|---|
| | | DEPTH | 0'-0" - 0'-4" | 0'-4" - 4'-4" | 4'-4" - 7'-0" |
| | | | Topsoil | | |
| **TEXTURE** | | | Loam | Sandy Clay Loam & Sandy Clay | Clay |
| **ROCK FRAGMENTS** | **% Rock** | | < 10% | < 15% | < 10% |
| | **Size** | | | To 4" | |
| | **Shape** | | | Sub-Angular | |
| **SOIL STRUCTURE** | **Degree** | | Compound | Compound | Compound |
| | **Shape** | | Sub-Angular | Sub-Angular | Sub-Angular Blocky |
| | **Grade** | | Moderate | Moderate | Moderate |
| | **Size** | | Fine | Fine | Fine - Medium |
| **CONSISTENCE** | **Wet** | | | | |
| | | **Stickiness** | Not Sticky | Slightly Sticky | Sticky |
| | | **Plasticity** | Not Plastic | Slightly Plastic | Plastic |
| | **Moist** | | Friable | Friable | Friable |
| | **Dry** | | | | |
| | | **Consistence** | Moderate | Firm | Firm to Hard |
| | | **Cementation** | None | None | None |
| **COLOR** | **Munsell** | | 10 YR 3/2 | 10 YR 4/4 | 10 YR 5/1 |
| | **Description** | | Very Dark Gray Brown | Dark Yellowish Brown | Gray |
| | **Mottling** | | None | None | None |
| **OBSERVED MOISTURE** | | | None | None | Moist |

According to the U.S.D.A. S.C.S. Grand County Soil Survey - This area is likely to be: Cimmaron Loam

GROUND COVER: Aspen, shrubs, forbs, grass.

SLOPE: 10% at a bearing of 330°

PERCOLATION RATE: 35 min./in. Avg. Depth (in.): 13

NOTES: This is on the property line between lots 6 & 7.

# SOIL PROFILE INFORMATION

**Val Moritz Village**
**Filing 2, Block 7, Lot 8**

**Profile Hole Observed: 9/24/2006**

| U.S.D.A. SOIL CLASSIFICATION METHOD | | | | | |
|---|---|---|---|---|---|
| | | DEPTH | 0'-0" - 0'-2" | 0'-2" - 1'-4" | 1'-4" - 7'-0" |
| | | | Topsoil | | |
| **TEXTURE** | | | Loam & Pine Duff | Sandy Clay | Sandy Clay |
| **ROCK FRAGMENTS** | **% Rock** | | < 10% | < 10% | < 10% |
| | **Size** | | | | |
| | **Shape** | | | | |
| **SOIL STRUCTURE** | **Degree** | | Compound | Compound | Compound |
| | **Shape** | | Sub-Angular | Sub-Angular Blocky | Sub-Angular Blocky |
| | **Grade** | | Weak | Moderate to Strong | Strong |
| | **Size** | | Fine | Fine | Fine |
| **CONSISTENCE** | **Wet** | | | | |
| | | **Stickiness** | Not Sticky | Sticky | Sticky |
| | | **Plasticity** | Not Plastic | Plastic | Plastic |
| | **Moist** | | Friable | Friable | Friable |
| | **Dry** | | | | |
| | | **Consistence** | Weak | Medium | Medium to Hard |
| | | **Cementation** | None | None | None |
| **COLOR** | **Munsell** | | 10 YR 5/2 | 7.5 YR 6/2 to 7.5 YR 5/4 | 7.5 YR 4/4 |
| | **Description** | | Grayish Brown | Pinkish Gray to Brown | Brown |
| | **Mottling** | | None | None | None |
| **OBSERVED MOISTURE** | | | None | None | None |

According to the U.S.D.A. S.C.S. Grand County Soil Survey - This area is likely to be: Cimarron Loam

GROUND COVER: Aspen, pine, grasses, shrubs, forbs.

SLOPE: 5% at a bearing of 0°

PERCOLATION RATE: 32 min./in. Avg. Depth (in.): 15

NOTES:

# SOIL PROFILE INFORMATION

**Val Moritz Village**
**Filing 2, Block 7, Lot 9**

**Profile Hole Observed: 9/24/2006**

| U.S.D.A. SOIL CLASSIFICATION METHOD | | | | | |
|---|---|---|---|---|---|
| | | DEPTH | 0'-0" - 0'-2" | 0'-2" - 1'-4" | 1'-4" - 7'-0" |
| | | | Topsoil | | |
| **TEXTURE** | | | Loam & Pine Duff | Sandy Clay | Sandy Clay |
| **ROCK FRAGMENTS** | **% Rock** | | < 10% | < 10% | < 10% |
| | **Size** | | | | |
| | **Shape** | | | | |
| **SOIL STRUCTURE** | **Degree** | | Compound | Compound | Compound |
| | **Shape** | | Sub-Angular | Sub-Angular Blocky | Sub-Angular Blocky |
| | **Grade** | | Weak | Moderate to Strong | Strong |
| | **Size** | | Fine | Fine | Fine |
| **CONSISTENCE** | **Wet** | | | | |
| | | **Stickiness** | Not Sticky | Sticky | Sticky |
| | | **Plasticity** | Not Plastic | Plastic | Plastic |
| | **Moist** | | Friable | Friable | Friable |
| | **Dry** | | | | |
| | | **Consistence** | Weak | Medium | Medium to Hard |
| | | **Cementation** | None | None | None |
| **COLOR** | **Munsell** | | 10 YR 5/2 | 7.5 YR 6/2 to 7.5 YR 5/4 | 7.5 YR 4/4 |
| | **Description** | | Grayish Brown | Pinkish Gray to Brown | Brown |
| | **Mottling** | | None | None | None |
| **OBSERVED MOISTURE** | | | None | None | None |

According to the U.S.D.A. S.C.S. Grand County Soil Survey - This area is likely to be: Cimarron Loam

GROUND COVER: Aspen, grasses, forbs, sagebrush, rabbit brush, potentella.

SLOPE: 15% at a bearing of 0°

PERCOLATION RATE: 26 min./in. Avg. Depth (in.): 15

NOTES: This Profile hole is on the property line with lots 3 and 9.

# SOIL PROFILE INFORMATION

**Val Moritz Village**
**Filing 2, Block 7, Lot 10**

**Profile Hole Observed:** 9/24/2006

| U.S.D.A. SOIL CLASSIFICATION METHOD | | | | | |
|---|---|---|---|---|---|
| | | DEPTH | 0'-0" - 0'-2" | 0'-2" - 1'-4" | 1'-4" - 7'-0" |
| | | | Topsoil | | |
| **TEXTURE** | | | Loam & Pine Duff | Sandy Clay | Sandy Clay |
| **ROCK FRAGMENTS** | **% Rock** | | < 10% | < 10% | < 10% |
| | **Size** | | | | |
| | **Shape** | | | | |
| **SOIL STRUCTURE** | **Degree** | | Compound | Compound | Compound |
| | **Shape** | | Sub-Angular | Sub-Angular Blocky | Sub-Angular Blocky |
| | **Grade** | | Weak | Moderate to Strong | Strong |
| | **Size** | | Fine | Fine | Fine |
| **CONSISTENCE** | **Wet** | | | | |
| | | **Stickiness** | Not Sticky | Sticky | Sticky |
| | | **Plasticity** | Not Plastic | Plastic | Plastic |
| | **Moist** | | Friable | Friable | Friable |
| | **Dry** | | | | |
| | | **Consistence** | Weak | Medium | Medium to Hard |
| | | **Cementation** | None | None | None |
| **COLOR** | **Munsell** | | 10 YR 5/2 | 7.5 YR 6/2 to 7.5 YR 5/4 | 7.5 YR 4/4 |
| | **Description** | | Grayish Brown | Pinkish Gray to Brown | Brown |
| | **Mottling** | | None | None | None |
| ***OBSERVED MOISTURE*** | | | *None* | None | None |

According to the U.S.D.A. S.C.S. Grand County Soil Survey - This area is likely to be: Cimarron Loam

GROUND COVER: Aspen, pine, grasses, shrubs, forbs.

SLOPE: 4% at a bearing of 35°

PERCOLATION RATE: *27 min./in.* *Avg. Depth (in.):* 14

NOTES: Profile hole is on the property line with lots 1, 2, 10, 11.

# SOIL PROFILE INFORMATION

**Val Moritz Village**
**Filing 2, Block 7, Lot 11**

**Profile Hole Observed: 9/24/2006**

| U.S.D.A. SOIL CLASSIFICATION METHOD | | | | | |
|---|---|---|---|---|---|
| | | DEPTH | 0'-0" - 0'-2" | 0'-2" - 1'-4" | 1'-4" - 7'-0" |
| | | | Topsoil | | |
| **TEXTURE** | | | Loam & Pine Duff | Sandy Clay | Sandy Clay |
| **ROCK FRAGMENTS** | **% Rock** | | < 10% | < 10% | < 10% |
| | **Size** | | | | |
| | **Shape** | | | | |
| **SOIL STRUCTURE** | **Degree** | | Compound | Compound | Compound |
| | **Shape** | | Sub-Angular | Sub-Angular Blocky | Sub-Angular Blocky |
| | **Grade** | | Weak | Moderate to Strong | Strong |
| | **Size** | | Fine | Fine | Fine |
| **CONSISTENCE** | **Wet** | | | | |
| | | **Stickiness** | Not Sticky | Sticky | Sticky |
| | | **Plasticity** | Not Plastic | Plastic | Plastic |
| | **Moist** | | Friable | Friable | Friable |
| | **Dry** | | | | |
| | | **Consistence** | Weak | Medium | Medium to Hard |
| | | **Cementation** | None | None | None |
| **COLOR** | **Munsell** | | 10 YR 5/2 | 7.5 YR 6/2 to 7.5 YR 5/4 | 7.5 YR 4/4 |
| | **Description** | | Grayish Brown | Pinkish Gray to Brown | Brown |
| | **Mottling** | | None | None | None |
| **OBSERVED MOISTURE** | | | None | None | None |

According to the U.S.D.A. S.C.S. Grand County Soil Survey - This area is likely to be: Cimarron Loam

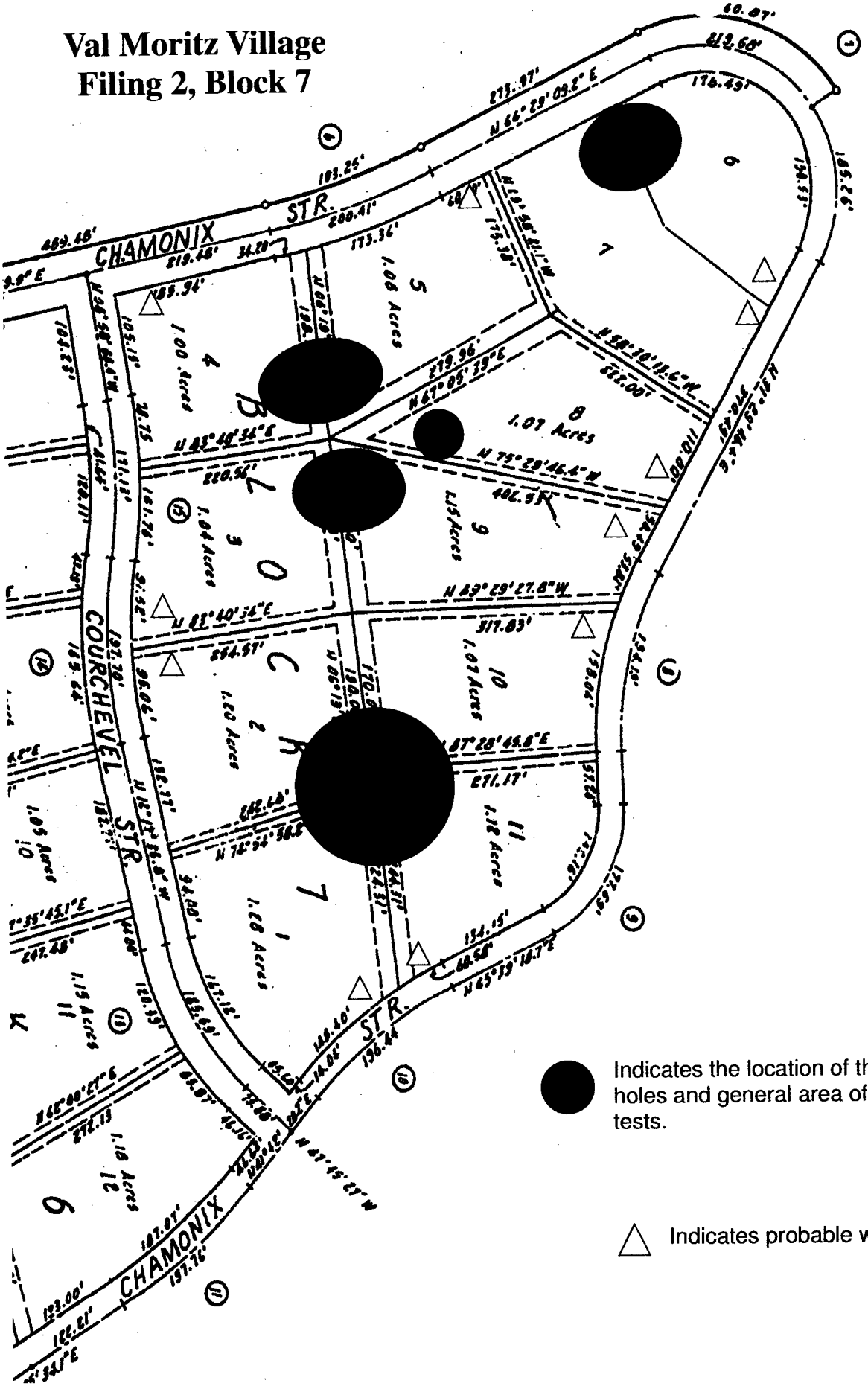
GROUND COVER: Aspen, pine, grasses, shrubs, forbs.

SLOPE: 4% at a bearing of 35°

PERCOLATION RATE: 24 min./in. Avg. Depth (in.): 13

NOTES: Profile hole is on the property line with lots 1, 2, 10, 11.

# Val Moritz Village
# Filing 2, Block 7




Indicates the location of the soil profile holes and general area of percolation tests.

△ Indicates probable well locations.